# A66 Northern Trans-Pennine Project
TR010062

# 3.4 Environmental Statement
# Appendix 14.2 Flood Risk Assessment and Outline Drainage Strategy

**APFP Regulations 5(2)(e)**

**Planning Act 2008**

**Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009**

**Volume 3**

June 2022

Infrastructure Planning

Planning Act 2008

**The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009**

# A66 Northern Trans-Pennine Project Development Consent Order 202x

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# 3.4 ENVIRONMENTAL STATEMENT APPENDIX 14.2 FLOOD RISK ASSESSMENT AND OUTLINE DRAINAGE STRATEGY

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|---|---|
| **Regulation Number:** | Regulation 5(2)(e) |
| **Planning Inspectorate Scheme Reference** | TR010062 |
| **Application Document Reference** | 3.4 |
| **Author:** | A66 Northern Trans-Pennine Project Team, National Highways |

| **Version** | **Date** | **Status of Version** |
|---|---|---|
| Rev 1 | 13/06/22 | DCO Application |

## CONTENTS

# 14.2 Flood Risk Assessment and Outline Drainage Strategy

## 14.2.1 Introduction

14.2.1.1 The Flood Risk Assessment (FRA) and outline drainage strategy has been developed to support Chapter 14 Road drainage and the water environment of the Environmental Statement (ES) (Application Document 3.2) for the Project. The Project is described in Chapter 2: the Project (Application Document 3.2).

14.2.1.2 This report describes the baseline environment, the existing flood risk and drainage arrangements on a scheme-by-scheme basis and the proposed drainage design principles and parameters for the Project.

14.2.1.3 The FRA sections of this document are required to identify the sources of flood risk to and from the Project. An FRA is required in England for:

- any development or change of use in Flood Zones 2 or 3, as identified from the Environment Agency flood maps,
- any development more than 1 hectare (ha) in size in Flood Zone 1
- any development in Flood Zone 1 which may be susceptible to flooding from sources other than rivers and the sea or subject to critical drainage problems

14.2.1.4 A review of the Environment Agency *Flood Maps* (Environment Agency, 2019)[1] indicates that the majority of schemes within the Project are within Flood Zone 1; however, as some areas of schemes are within Flood Zones 2 or 3 and the overall Project is greater than 1ha and therefore a FRA is required in accordance with the current legislation.

14.2.1.5 The Environmental Management Plan (EMP) (Application Document 2.7) includes details of measures to protect the water environment during construction of the scheme and so construction issues are not considered in this report.

14.2.1.6 This report has been completed in accordance with the *Design Manual from Roads and Bridges (*DMRB) *LA 113 Road drainage and the water environment* (*DMRB LA 113*) (Highways England, 2020)[2] and the following DMRB Standards:

- *DMRB CD 521 - Hydraulic design of road edge surface water channels and outlets (DMRB CD 521)* (Highways England, 2021a)[3]
- *DMRB CD 524 - Edge of pavement details (DMRB CD 524)* (Highways England, 2021b)[4]

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[1] Environment Agency (2019) Flood Map for Planning.

[2] Highways England (2020a) Design Manual for Roads and Bridges LA 113 Road drainage and the water environment. Version 1.

[3] Highways England (2021a) Design Manual for Roads and Bridges CD 521 Hydraulic design of road edge surface water channels and outlets

[4] Highways England (2021b) Design Manual for Roads and Bridges CD 524 Edge of pavement details

- *DMRB CD 526 - Spacing of road gullies (DMRB CD 526)* (Highways England, 2020b)[5]
- *DMRB CD 501 - Design of highway drainage systems (DMRB CD 501)* (Highways England 2020c)[6]
- *DMRB CD 529 - Design of outfall and culvert details (DMRB CD 529)* (Highways England, 2021c)[7]

14.2.1.7 Further information to support and inform the assessment, including existing and proposed drainage plans, catchment representations, calculations, MicroDrainage model outputs and hydraulic modelling reports are located in the following annexes to this appendix:

- Annex A: Proposed drainage layouts
- Annex B: Calculations
- Annex C: Existing catchment plans
- Annex D: Proposed catchment plans
- Annex E: Annex E: Hydraulic modelling reports.

## Legislation and policy framework

### *Flood Risk Regulations 2009*

14.2.1.8 The Flood Risk Regulations 2009 require the assessment and management of flood risk in England and Wales. The regulations designate a Lead Local Flood Authority (LLFA) and impose duties on the Environment Agency and LLFAs to prepare a number of documents including:

- Preliminary Flood Risk Assessments
- Flood risk and flood hazard maps
- Flood risk management plans.

### *Flood and Water Management Act 2010*

14.2.1.9 The Flood and Water Management Act gives the Environment Agency a strategic overview of the management of flood and coastal erosion risk in England. In accordance with the Government’s Response to the Pitt Review, it also gives upper tier local authorities in England responsibility for preparing and putting in place strategies for managing flood risk from groundwater, surface water and ordinary watercourses in their areas.

14.2.1.10 It provides for better, more comprehensive management of flood risk for people, homes and businesses, helps safeguard community groups from unaffordable rises in surface water drainage charges and protects water supplies to the consumer.

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[5] Highways England (2020b) Design Manual for Roads and Bridges CD 526 Spacing of road gullies

[6] Highways England (2020c) Design Manual for Roads and Bridges CG 501 Design of highway drainage systems

[7] Highways England (2021c) Design Manual for Roads and Bridges CD 529 Design of outfall and culvert details

### *National Policy Statement for National Networks*

14.2.1.11 *National Policy Statement for National Networks (NPSNN)* (Department for Transport, 2014)[8] paragraph reference 5.90 to 5.115 sets out how flood risk impacts should be considered. A *NPSNN* compliant FRA should include the following.

14.2.1.12 Consideration of the risks of all forms of flooding arising from the Project (including adjacent parts of the United Kingdom), in addition to the risks of flooding to the Project, and demonstrate how these risks will be managed and, where relevant, mitigated, so that the development remains safe throughout its lifetime.

14.2.1.13 The impacts of climate change should be taken into account, clearly stating the development lifetime over which the assessment has been made.

14.2.1.14 Consideration of the vulnerability of those using the infrastructure including arrangements for safe access and exit.

14.2.1.15 Inclusion of an assessment of the remaining (known as ‘residual’) risk after risk reduction measures have been taken into account and demonstrate that this is acceptable for the Project.

14.2.1.16 Consideration of whether there is a need to remain operational during a worst-case flood event of the development’s lifetime.

14.2.1.17 Evidence for the Secretary of State to apply the Sequential Test and Exception Test, as appropriate.

### *National Planning Policy Framework*

14.2.1.18 The Department for Communities and Local Government (DCLG) published the *National Planning Policy Framework (NPPF)* (Ministry of Housing, Communities & Local Government, 2021)[9] on the 27 March 2012. This was a wholesale reform of the planning system and replaced all existing Planning Policy Guidance (PPG) and Statements (PPS) to make the planning system less complex and more accessible. It transfers more responsibility onto individual planning authorities and states that there should normally be a practice in favour of ‘sustainable development’. The *NPPF* has subsequently been updated by the Ministry of Housing, Communities and Local Government (MHCLG) in July 2018 and again in February 2019.

14.2.1.19 The aim of the *NPPF*, particularly relating to flooding, is to ensure that flood risk is considered at all stages in the planning process, to avoid inappropriate development in areas at risk of flooding and to direct development away from areas at highest risk. It does this by formulating a risk-based approach towards flooding to be adopted at all levels of planning.

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[8] Department for Transport (2014) *National policy statement for national networks.*

[9] Ministry of Housing, Communities & Local Government (2021) National Planning Policy Framework.

14.2.1.20 In April 2015 changes to the *NPPF* saw the LLFA made a statutory planning consultee for development and flood risk issues except those concerning Main Rivers. Responsibility for the latter still resides with the Environment Agency. Furthermore, the Local Planning Authority (LPA), through the planning system, were given the role of ensuring sustainable drainage is incorporated into schemes.

## Guidance

14.2.1.21 The following guidance, where relevant, has been used to inform scheme assessments:

- Cumbria County Council *Development Design Guide* (Cumbria County Council, 2017)[10]
- Durham County Council *Sustainable Drainage System Adoption Guide 2016* (Durham County Council, 2016)[11]
- North Yorkshire County Council *SuDS Design Guidance* (North Yorkshire County Council, 2018)[12]
- Construction Industry Research and Information Association (CIRIA) *The SuDS Manual (C753)* (Construction Industry Research and Information Association, 2015)[13]
- DMRB guidance outlined in Section 14.2.1: Introduction.

## Consultation

14.2.1.22 There are several key local stakeholders and/or approving authorities associated with the development of the Project, including the Environment Agency, LLFAs (Cumbria County Council, North Yorkshire County Council and Durham County Council) and Natural England.

14.2.1.23 Consultation with these stakeholders is recorded in the respective Statement of Common Ground. A summary of the stakeholder consultations undertaken is presented in the following sections.

### *Environment Agency*

14.2.1.24 Multiple meetings with the Environment Agency have taken place since February 2021. Feedback includes the following points:

- Environment Agency stated that the proposed FRA to be submitted with the application should also provide the evidence for the Secretary of State to apply the Sequential Test and Exception Test, as appropriate.
- Based on recent events it is likely that Kirkby Thore can be at risk of flooding from the River Eden and Trout Beck either independently or in combination.

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[10] Cumbria County Council (2017) Cumbria Development Design Guide.

[11] Durham County Council (2016) Sustainable Drainage System Adoption Guide 2016.

[12] North Yorkshire County Council (2018) SuDS Design Guidance. Revision 4.

[13] Construction Industry Research and Information Association (2015) The SuDS Manual (C753)

- The EA's Climate Change Allowances for rainfall are expected to change in Cumbria following the preliminary design development, but prior to DCO submission. It has been agreed with the EA that the guidance will be considered post-submission by way of a sensitivity test that will report the implications of the new guidance on the assessments undertaken to date, this is to minimise delays to DCO submission. The results of the sensitivity tests are included in this FRA for the schemes located in Cumbria.
- Warcop is at risk of flooding from both Lowgill Beck and Crooks Beck / Moor Beck. The Environment Agency modelling report and S19 report produced by the Environment Agency and Cumbria County Council (Environment Agency and Cumbria County Council, 2016)[14] following Storm Desmond refer to an extensive flood history.
- It is recommended that dedicated sediment traps and settlement attenuation ponds should be designed into the scheme, and where these are unlikely to be effective, treatment systems such as lamella tanks and chemical dosing should be costed into the scheme.
- Based on the proposed location of the sustainable drainage system (SuDS) attenuation pond to the east of Carleton Hall and to the north of the River Eamont, we would advise that further consideration be given to possible river erosion issues as the use of any revetment to protect the asset in the future would be undesirable in the Special Area of Conservation (SAC) river.
- Further geomorphological and / or geotechnical assessment is required to confirm that the location of the SuDS attenuation ponds will not pose a risk to the River Eden SAC.

### *Natural England*

14.2.1.25 Multiple meetings with Natural England have taken place since February 2021. Feedback includes the following points:

- Natural England requested that A66 improvements should be designed to ensure that no watercourses are lost
- At Kempley Bank the construction site is in the floodplain, as is the settlement attenuation pond. Consideration needs to be given to creating these above the floodplain.
- Natural England requested the crossing of Trout Beck should ensure the proposals by Eden Rivers Trust for the Sleastonhow River Restoration can be accommodated.

### *Cumbria County Council LLFA*

14.2.1.26 Multiple meetings with Cumbria County Council (CCC) have taken place since October 2020. Feedback includes the following points:

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[14] Environment Agency & Cumbria County Council (2016) Flood Incident Investigation Report: Warcop, Flood Event 5th December 2015 (Draft).

- CCC have requested National Highways to seek opportunities for partnership working at Warcop to manage local drainage/flooding issues.
- CCC would prefer to see combined Local Authority and National Highways attenuation ponds in the majority of cases which would be a departure from National Highways standard.
- CCC confirmed QBAR[15] run off rates to be used in greenfield areas.

### *Durham County Council LLFA*

14.2.1.27 Multiple meetings with Durham County Council (DCC) have taken place since September 2020. Feedback includes the following points:

- DCC confirmed mean annual flood discharge (QBAR) run off rates to be used in greenfield areas. 50mm/hr rainfall intensity rates to be used for brownfield areas.
- DCC requested erosion mitigation is considered where high discharge rates are present.

### *North Yorkshire County Council LLFA*

14.2.1.28 Multiple meetings with North Yorkshire County Council (NYCC) have taken place since February 2021. Feedback from discussions within meetings includes the following points:

- Concern about the scale and frequency of drainage detention attenuation ponds with the Stephen Bank to Carkin Moor scheme. There is a request to reduce the scale and frequency of these elements of the scheme and for sensitive design to protect local character and setting.
- The Layton attenuation ponds are 400m south of mainline A66. Request to combine them into one attenuation pond and move them closer to the mainline.
- Concerns about existing highway flooding on the section of A66 to be de-trunked, when responsibility for this may pass to North Yorkshire County Council.

## Data sources

14.2.1.29 The following data sources have been used to inform the scheme assessments:

- Environment Agency *Flood Map*
- Environment Agency guidance (Environment Agency, 2021a)[16]
- Scheme specific baseline flood modelling of relevant Main Rivers, ordinary watercourses and culverts (detailed following scheme sections)
- Topographical surveys

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[15] QBAR, or the mean annual flood, is the value of the average annual flood event recorded in a river.

[16] Environment Agency (2021a) Flood risk assessments: climate change allowances.

- LLFA Consultation
- *Highways Agency Drainage Data Management System (HADDMS)* (Highways England, 2021d)[17]

14.2.1.30 Groundwater context is provided in Appendix 14.6 Hydrogeological Impact Assessment.

14.2.1.31 Baseline flood risk from rivers and sea using Environment Agency data is shown on ES Figure 14.2: Existing Flood Risk (Application Document 3.3).

14.2.1.32 Flood risk during the operational phase of the Project, based on fluvial modelling for the Project and Environment Agency data is shown on ES Figure 14.7: Operational Flood Risk (Application Document 3.3).

14.2.1.33 Details of modelling are further described in Annex D: Hydraulic Modelling Report.

### Surveys

14.2.1.34 Watercourse and culverts surveys were undertaken to inform the baseline watercourse and culvert hydraulic modelling. Details on modelling are further described in Annex E: Hydraulic modelling reports.

14.2.1.35 Site visits were undertaken in September 2021, where the scheme design teams met with local landowners to discuss existing drainage and flooding issues.

### General Introduction

14.2.1.36 This document provides an outline of the drainage strategy developed for the Project. A mix of both new and existing outfalls are proposed within the design and no infiltration to ground has been considered in the proposals to date. The drainage design has been developed to ensure the quality of surface water, as demonstrated in Appendix 14.3 Water Quality Assessment (Application Document 3.4), to mitigate the impact from accidental spillages from the highway, as demonstrated in Appendix 14.5 Spillage Risk Assessment (Application Document 3.4) and to mitigate any potential impacts as a result of increased impermeable area upon flood risk outside of the Order Limits. Specific details for each scheme are considered in the relevant sections.

## 14.2.2 M6 Junction 40 to Kemplay Bank

### Introduction

14.2.2.1 This section of the document details the proposed design for this scheme, the M6 Junction 40 and the carriageway to Kemplay Bank respectively. The M6 Junction 40 to Kemplay Bank scheme is located

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[17] Highways England (2021d) Highways Agency Drainage Data Management System

at the most westerly point of the Project. The scheme is situated adjacent to the urban fringes of Penrith and runs from Junction 40 of the M6 to Kemplay Bank Roundabout. The location of the scheme is shown on ES Figure 14.1: Surface Water Features (Application Document 3.3).

14.2.2.2 The drainage for this scheme has been designed in accordance with the Standards for Highways Design Manual for Roads and Bridges and in accordance with relevant Local Authority design standards as detailed in Section 14.2.1: Introduction.

## Baseline conditions

### *Surface watercourses*

14.2.2.3 Watercourses within the study area drain into the River Eamont via a number of tributaries.

14.2.2.4 Most of the watercourses in the study area drain from agricultural lands north and west of Penrith and flow through urban landscapes with modification such as culverts in place. Exceptions are the River Eamont, that drains from Ullswater situated south-west of the study area, and the River Lowther which drains from the south-west of Shap.

14.2.2.5 The watercourses designated as Main Rivers by the Environment Agency within the study area include the River Lowther and River Eamont. Table 1: Watercourses within M6 Junction 40 to Kemplay Bank study area gives a brief description of the watercourses within the study area (from west to east) and they are displayed on ES Figure 14.1: Surface Water Features (Application Document 3.3).

Table 1: Watercourses within M6 Junction 40 to Kemplay Bank study area

| Watercourse | Description |
|---|---|
| Carlsike Beck | Flows south into the River Eamont, crossed by the existing A66/A592 roundabout, in the west of the study area. |
| Myers Beck | Flows east into Dog Beck, crossed by the existing M6, and then culverted under the railway and housing within Penrith, in the north-west of the study area. |
| Dog Beck | Flows east into Thacka Beck, culverted through Penrith beneath Victoria Road, in the north of the study area. |
| Thacka Beck | Flows south into the River Eamont, through Penrith and is crossed by the existing A66 and then culverted beneath Carlton Hall, in the centre of the study area |
| Unnamed Tributary of River Eamont 3.2 | Flows east into the River Eamont, straightened channel through Frenchfield sports centre, in the east of the study area |
| River Eamont | Flows east, crossed by the existing M6, and flows parallel, to the south of the existing A66. Joins the River Lowther to the east of the study area, then joins the River Eden approximately 7km further downstream. |

| | |
|---|---|
| River Lowther | Flows east, located parallel, to the south of the River Eamont. Joins the River Eamont at Brougham Castle 250m upstream of the existing A66 crossing. |

### *Topography*

14.2.2.6 Levels generally fall north to south along the proposed route, towards the River Eamont. Carriageway drainage catchments are determined by undulating topography across the whole scheme. See ES Figure 14.2: Existing Flood Risk (Application Document 3.3) for contours.

### *Geology and soils*

14.2.2.7 A complete description of the geological and soils context is provided in ES Chapter 9: Geology and Soils (Application Document 3.2) and ES Appendix 14.6: Hydrogeological Impact Assessment (Application Document 3.4).

## Existing drainage

### *Background*

14.2.2.8 The existing drainage network has been assessed using information from *HADDMS*, existing drainage drawings and site surveys. Whilst site visits have been undertaken to clarify existing drainage where possible, no intrusive drainage surveys have been undertaken at this stage of design. Where the proposed drainage interfaces with the existing, CCTV surveys shall be undertaken prior to commencement of detailed design. Due to the limited information available, the existing catchments have been assessed using the Wallingford Surface Water Storage Volume Estimation Tool to determine QBAR. The maximum discharge from the outfalls in the proposed drainage design has been limited to QBAR.

### *Description of existing drainage*

14.2.2.9 Existing drainage comprises a mixture of gullies, combine kerb drains, filter drains, and over the edge drainage, either onto adjacent land or into roadside ditches.

14.2.2.10 Positive drainage systems outfall into local watercourses at strategic locations.

14.2.2.11 Highway drainage on the western side of M6 Junction 40 drains to an outfall discharging to the River Eamont south of Skirsgill Business Park.

14.2.2.12 To the east of M6 Junction 40 to Kemplay Bank Roundabout, the highway drainage collects flow from the A592, from the Haweswater roundabout to the junction of the A66, and the A66 between M6 Junction 40 and the Kemplay Bank Roundabout. This drainage outfalls to the River Eamont to the south of Skirsgill Lane. The Kemplay Bank Roundabout and the carriageway to the Carlton Avenue underpass drains to Thacka Beck. The carriageway to the east of the Carlton Avenue underpass drains to an outfall to the River Eamont.

### *Assessment of catchment areas and existing runoff rates*

14.2.2.13 The following information has been considered in the assessment of catchment areas and to calculate existing runoff rates:

- Catchment areas associated with the works have developed using both existing and proposed drainage catchments
- Existing catchment areas considered in this section therefore relate to areas beneath the proposed alignment.
- Existing catchments beneath the proposed alignment have been used to calculate restricted flow rates that will be applied to new outfalls from the proposed drainage system.
- The proposed vertical alignment has been considered, and new outfall locations determined.
- Existing topography has also been considered to ensure that only area beneath the proposed alignment that currently drains towards a proposed outfall location is included in the restricted flow rate calculations.

14.2.2.14 This approach ensures that flows to individual watercourses are not increased over the baseline conditions.

14.2.2.15 A summary of the existing catchments include (see Annex C):

- Catchment S01-01 relates to the drainage from the west of the roundabout, which discharges to the River Eamont south of Skirsgill Business Park.
- Catchment S02-01 relates to the drainage from the southern section of the A592 and the A66 west of Kemplay Bank Roundabout, the Kemplay underpass and carriageway to the Carlton Avenue underpass.
- Catchment S02-02 relates to the carriageway discharge to the east of the Carlton Avenue underpass which drains to an outfall to the River Eamont.

14.2.2.16 The "*Greenfield runoff rate estimation"* tool developed by HR Wallingford (HR Wallingford, 2022a)[18] has been used to assess existing "greenfield" runoff rates. The QBAR greenfield runoff rate of 5.27 l/s/ha has been allowed for runoff from greenfield/undeveloped areas.

14.2.2.17 Brownfield run-off rates were calculated in line with the recommendations of CIRIA's The SuDS Manual (C753). These are specifically equated to existing hardstanding areas such as footways, carriageways, traffic islands and central reservations. The QBAR brownfield runoff rate has been estimated using a Standard Percentage Runoff (SPR) of 0.53 for runoff from brownfield/developed areas.

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[18] HR Wallingford (2022) Greenfield runoff rate estimation.

14.2.2.18 Table 2: M6 Junction 40 to Kemplay Bank existing drainage catchments summary shows existing catchments that drain to each of the proposed outfalls.

Table 2: M6 Junction 40 to Kemplay Bank existing drainage catchments summary

| **Catchment** | **Existing Greenfield Area (ha)** | **Existing Brownfield Area (ha)** | **Existing Greenfield Flow Rate (l/s)** | **Existing Brownfield Flow Rate (l/s)** | **Restricted Flow Rate Applied to Outfall (l/s)** |
|---|---|---|---|---|---|
| S01-01 | 0.292 | 0.051 | 2.04 | 0.46 | 2.50 |
| S02-01 | 2.713 | 3.550 | 18.49 | 31.41 | 49.90 |
| S02-02 | 0.025 | 1.145 | 0.16 | 9.35 | 9.51 |

### *Hydraulic modelling of existing highway surface water drainage networks*

14.2.2.19 The extent of existing drainage networks has been assessed using topographic surveys, site surveys and *HADDMS* data.

14.2.2.20 No hydraulic modelling of the existing drainage networks has been undertaken due to the limitations of available information.

## Proposed drainage

### *Collection system design*

14.2.2.21 A number of surface water collections systems will be utilised.

#### National Highways A66 Collection System

- Primary surface water collection system will be road edge concrete surface water channels.
- Laybys and refuge areas will be drained using either concrete surface water channels or gullies.
- Bridge Deck Drainage units will be used to drain surface water on bridge sections.
- Filter drains will be used where required, including highway verges where the verge is contained by earthworks and cuttings/embankments.
- Open ditches and/or filter drains will be used to intercept and convey overland flow from areas outside of the highway corridor.

#### Local Authority Roads Collection System

- Primary surface water collection system will be gullies.
- Filter drains will be used where required, including highway verges where the verge is contained by earthworks and cuttings/embankments.
- Open ditches and/or filter drains will be used to intercept and convey overland flow from areas outside of the highway corridor.

14.2.2.22 For the National Highways route, the primary drainage collection system will consist of concrete surface water channels. For the scheme, surface water channels will be placed on the road edge adjacent to the hard strip and will drain surface water from the A66 carriageway, verges, embankments, and the central reserve.

14.2.2.23 The design of the surface water channels is in accordance with *DMRB CD 521*. The proposed vertical and horizontal highways alignment has been assessed using the process outlined in Section 4 Design Process of *DMRB CD 521*.

14.2.2.24 The position of surface water channels in relation to the pavement edge shall follow the guidance provided in *DMRB CD 524*.

14.2.2.25 Where gullies are used, gully spacing will be determined as part of detailed design in accordance with *DMRB CD 526*.

14.2.2.26 Combined kerb and drainage systems will be designed in accordance with *DMRB CG 501*.

14.2.2.27 A simple assessment of the minimum required discharge capacity of the combined kerb and drainage systems is based on the Rational Method Equation Q = 2.78 CiA, where:

- 'Q' is the design peak rate of runoff (l/s)
- 'C' is a non-dimensional runoff coefficient (taken as 1.0)
- 'i' is the design rainfall intensity (mm/hr)
- 'A' is the total catchment area (ha)
- Note: 2.78 is a conversion factor to address the rainfall units being in mm/hr

### *Pollution controls*

14.2.2.28 In accordance with *DMRB CG 501*, the selection of pollution control measures has been determined by the following process:

- Complete assessment in accordance with *DMRB LA 113*
- If mitigation is required, identify viable options/combinations of measures, taking account of:
  - Road drainage hierarchy
  - Site constraints
  - Storm flow and flood risk requirements
  - Climate change allowances
  - Road geometry
- Review short list of options against construction and maintenance requirements
- Confirming the measures fulfil water quality.

14.2.2.29 The pollution control measures vary for each proposed outfall, and include a combination of the following measures:

- Wet attenuation ponds with sediment forebays
- Vortex grit separators
- Vegetated ditches

14.2.2.30 Highways England Water Risk Assessment Tool (HEWRAT) Assessments have been undertaken to ensure sufficient mitigation measures have been incorporated at each outfall. Details of the

HEWRAT assessment are provided in ES Appendix 14.3: Water Quality Assessment (Application Document 3.4).

14.2.2.31 Table 3: M6 Junction 40 to Kemplay Road pollution control mitigation measures outlines the pollution control mitigation measures included at each proposed outfall.

Table 3: M6 Junction 40 to Kemplay Road pollution control mitigation measures

| Catchment | Attenuation pond | Grit Separator | Vegetated Ditch |
|---|---|---|---|
| S01-01 | Y | N | Y |
| S02-01 | Y | N | Y |
| S02-02 | Y | N | Y |

### *Climate change*

14.2.2.32 In accordance with *DMRB CG 501*, a 20% increase to peak rainfall intensity shall be considered the minimum accommodated within the drainage design in order to account for potential climate change.

14.2.2.33 Environment Agency guidance[19] for allowances that should be made for climate change has been followed. Climate change allowances relating to increased peak rainfall intensity are outlined in Table 4: Peak rainfall intensity allowance in small and urban catchments - M6 Junction 40 to Kemplay Bank.

Table 4: Peak rainfall intensity allowance in small and urban catchments - M6 Junction 40 to Kemplay Bank

| Applies across all of England | Total potential change anticipated for the '2020s' (2015 to 2039) | Total potential change anticipated for the '2050s' (2040 to 2069) | Total potential change anticipated for the '2080s' (2070 to 2115) |
|---|---|---|---|
| Upper end | 10% | 20% | 40% |
| Central | 5% | 10% | 20% |

14.2.2.34 The guidance states that both the central and upper end allowances should be assessed to understand the range of impact.

14.2.2.35 Environment Agency have advised that there is a proposed increase in allowances for climate change within the Cumbria region. Accordingly, a 50% climate change allowance has been included as a sensitivity check.

### *Surface water storage*

14.2.2.36 The proposals lead to an increase in impermeable area draining to local watercourses.

14.2.2.37 In accordance with *DMRB CG 501*, the proposed drainage design will ensure that there is no increase in runoff rates as a result of the proposals. To achieve this, existing runoff rates have been assessed (Section 0), and flow control devices incorporated into the drainage

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[19] Environment Agency (2021a). Flood risk assessments: climate change allowances. s

systems. Storage for surplus flows has been provided using attenuation ponds.

14.2.2.38 The proposed drainage design makes an allowance for potential climate change. A 40% increase to rainfall intensity has been included when considering surface water storage, and attenuation ponds designed to ensure no flooding occurs during the critical 1 in 100-year storm.

### *Hydraulic modelling of proposed highway surface water drainage networks*

14.2.2.39 The proposed main carrier drainage network and surface water storage has been modelled using MicroDrainage software.

14.2.2.40 Flood Studies Report (FSR) rainfall data has been used, with global variables (M560, r) to suit the site location.

14.2.2.41 The equivalent impermeable area draining to proposed networks has been obtained by applying the following factors to the measured contributing areas: -

- Paved surfaces - 1.00
- Verges contained by embankments/cutting slopes - 0.5
- Embankments/Cutting Slopes - 0.25
- Attenuation pond surfaces - 1.00.

14.2.2.42 Networks have been established to suit proposed vertical alignments and potential outfall locations.

14.2.2.43 HydroBrake flow controls have been incorporated downstream of attenuation ponds, with flow rates restricted to those detailed in Table 2: M6 Junction 40 to Kemplay Bank existing drainage catchments summary.

14.2.2.44 Table 5: M6 Junction 40 to Kemplay Road proposed catchments table below, is a summary of proposed total catchment area size, percentage of impermeable area within each catchment and the volume of attenuation required to achieve the peak permitted discharge rate calculated for the corresponding existing catchment (see above). This is to ensure the proposed discharge rates are no greater than existing.

14.2.2.45

Table 5: M6 Junction 40 to Kemplay Road proposed catchments

| Catchment | Drained Embankment Area (ha) | Drained Verge Area (ha) | Drained Highway Area (ha) | Volume of storage provided[a] ($m^3$) | Peak Permitted Flow Rate[b] (l/s) |
|---|---|---|---|---|---|
| S01-01 | 0 | 0.051 | 0.292 | 210 | 2.50 |
| S02-01 | 1.060 | 0.297 | 6.263 | 4744 | 49.90 |
| S02-02 | 0.111 | 0.208 | 1.170 | 955 | 9.51 |

a - Volume provided in design from normal water level to 300mm below road level, as per guidance provided in The SuDS Manual (CIRIA C753).

b - 1 in 100-year storm plus 40% climate change

### *Exceedance flood routing*

14.2.2.46 All drainage attenuation ponds are designed for a 1 in 100-year storm with a 40% climate change allowance (Upper end). All drainage attenuation ponds in this scheme are located on the downstream side of the scheme so that any exceedance flow from the drainage attenuation ponds will be to the downstream watercourse away from the carriageway and any residential properties.

### *Existing watercourses*

14.2.2.47 In accordance with *DMRB CG 501* and *DMRB LA 113* the proposed highways and drainage design where possible limit impact on Environment Agency Main Rivers and ordinary watercourses. Where a watercourse has been disrupted by the proposed highways alignment a proposed culvert has been sized appropriately to allow the flow from the watercourse to be uninterrupted.

14.2.2.48 During detailed design the following will be required:

- All new culverts will be designed in accordance with *DMRB CD 529* details and in consultation with relevant stakeholders (e.g. LLFA or EA).
- All culverts with a diameter of 900mm and above will require structural design.
- It is the design intention to maintain existing outfalls on existing watercourses and to not increase the discharge rate of these outfalls.
- Where new outfalls are required the individual outfall details will be designed in accordance with DMRB CD 529 and in consultation with relevant stakeholders (e.g. LLFA or EA).

### *Land drainage and overland flow*

14.2.2.49 Where land outside of the highway corridor falls towards the highway, cut-off drainage has been provided as part of the design. Cut-off drainage will intercept and convey overland flow around the highway corridor, so that this flow does not enter the highway drainage system or cause flooding issues on the proposed highway.

14.2.2.50 Cut-off drainage comprises open ditches and/or filter drains, with culverts provided to cross the highway corridor where necessary.

14.2.2.51 Cut-off drainage will intercept and convey overland flow around the highway corridor, so that this flow does not enter the highway drainage system or cause flooding issues on the proposed highway.

## Flood Risk Assessment

### *Data collection*

14.2.2.52 The risk of flooding to the development has been assessed on readily available information, published on the Environment Agency website.

14.2.2.53 In addition to readily available information, JBA has undertaken baseline hydraulic modelling of existing watercourse/culvert crossings. This modelling establishes flooding in the vicinity of the existing A66.

### *Flood risk vulnerability classification*

14.2.2.54 Guidance for flood risk vulnerability for new development sites is set out in the Government planning portal for flood risk and coastal change. Table 6: Flood risk vulnerability classification is used as a guide to help determine if new development sites should or should not be permitted, based upon the vulnerability classifications set out on the planning portal.

14.2.2.55 In accordance with *DMRB LA 113*, NI/1.7, the development is classified as "Essential Infrastructure". The development is therefore permitted providing it is located within Flood Zones 1 or 2, with the exception test required if located in Flood Zones 3a or 3b.

Table 6: Flood risk vulnerability classification

| **Flood Zones** | **Flood risk vulnerability classification** | | | | |
|---|---|---|---|---|---|
| | **Essential Infrastructure** | **Highly Vulnerable** | **More Vulnerable** | **Less Vulnerable** | **Water Compatible** |
| Zone 1 | Y | Y | Y | Y | Y |
| Zone 2 | Y | Exception Test required | Y | Y | Y |
| Zone 3a | Exception Test required | N | Exception Test required | Y | Y |
| Zone 3b | Exception Test required | N | N | N | Y |

Y = Development is appropriate

N = Development should not be permitted

### *Sequential Test*

14.2.2.56 As part of a Flood Risk Assessment a Sequential Test is required when the proposed development is located within Flood Zone 2 or 3. The Sequential Test compares the proposed site with other available sites to find out which has the lowest flood risk.

14.2.2.57 The design team considered alternative alignments which would still meet the project requirements.

14.2.2.58 A full extensive write up of this review can be seen in Project Development Overview Report (Application Document 4.1).

14.2.2.59 This review identifies the proposed route is the most favourable with the least environmental impacts, impacts on landowners, buildability and design safety, whilst maintaining project design principles.

14.2.2.60 In respect of the Sequential Test for this scheme, the majority of the development is in Flood Zone 1 and at low risk of fluvial flooding, with the exception of drainage attenuation pond S02-02 which is located in Flood Zone 2 and at medium risk of fluvial flooding. However, flood risk must be considered from all potential sources. The scheme is shown to be at low risk of surface water and groundwater flooding. However, in the scenario when there is flooding from rivers, the mapping indicates that the scheme to the east of the Carleton Underpass is within the maximum extent of flooding from reservoirs.

### *Exception Test*

14.2.2.61 The proposed scheme is located within Flood Zone 1 and Flood Zone 2. In accordance with Table 2 of the Flood Risk and Coastal Change guidance, the proposed alignment has been assessed as being Essential Infrastructure and is appropriate for these flood zones. However, as the proposed alignment to the east of the Carleton Underpass is identified as being within the maximum extent of flooding from reservoirs, an exception test is required.

14.2.2.62 The 2 parts to the Test require the proposed development to show that it will provide wider sustainability benefits to the community that outweigh flood risk, and that it will be safe for its lifetime, without increasing flood risk elsewhere and where possible reduce flood risk overall.

14.2.2.63 To answer the first part of the assessment, refer to Case for the Project (Application Document 2.2) which highlights the Social, Environmental and Economic benefits for the proposed Nationally Significant Infrastructure Project. Including:

- safety – a consistent standard of dual carriageway, to reduce the number of accidents. Use of the ‘old’ A66 as part of the local road network will provide better, safer routes for cyclists and pedestrians.
- connectivity – improving connectivity for people living and working nearby and creating better facilities for cyclists and pedestrians. Reducing congestion and improving the reliability of people’s journeys between the M6 at Penrith and the A1(M) Scotch Corner and nationwide. It also improves connectivity between the key employment areas of Cumbria, Tees Valley and Tyne and Wear.
- environmental – minimising noise levels for people living and working near the route and reducing the congestion currently occurring in the single carriageway sections. The scheme is also being designed to minimise any potential negative impacts on the natural environment and landscapes of the North Pennines and Lake District.
- economic – improving strategic regional and national connectivity, particularly for hauliers. Heavy goods vehicles account for a

quarter of all traffic on the road and any delays to journeys can have an extremely negative effect on business and commerce, including lost working time and missed shipment slots.

- tourism – improving access to key tourist destinations such as the North Pennines and Lake District.
- community – re-connecting communities and providing better links between settlements along the route as well as improving access to services such as healthcare, employment areas and education.
- capacity – reducing delays and queues during busy periods and improving the performance of key junctions such as the A66/A6 and the M6 junction 40.
- increasing reliability – an improved A66, will lead to less accidents which, in turn, makes the road more reliable. Also, having a dual carriageway provides the option to close lanes where required due to accidents or break downs and keep traffic moving

14.2.2.64 To answer the second part of the Exception test, refer to section Flood Risk Mitigation below which outlines how the scheme proposes to mitigate flooding of the carriageway and downstream of the scheme.

14.2.2.65 The proposed design will be constructed to remain operational and safe in times of flooding from fluvial, surface water and groundwater sources.

14.2.2.66 In respect of the risk associated with flooding from reservoirs, refer to the Flooding from reservoirs section below which details how the management of large raised reservoirs is governed by the Reservoirs Act 1975.

14.2.2.67 The proposed design does not impede existing water flows as cut of ditches intercept overland flows and conveys water in a controlled manor to its existing receiving watercourse.

14.2.2.68 As demonstrated in Case for the Project (Application Document 2.2), the A66 constitutes nationally significant Essential Infrastructure. The improvements proposed for the A66 will provide wider sustainability benefits to the community that outweigh the flood risk posed by the exceptional circumstances which would result in a reservoir breach scenario. The Exception Test would therefore be satisfied by the proposed A66 improvements for M6 junction 40 to Kemplay Bank.

### *Flooding from rivers or the sea*

14.2.2.69 For planning purposes, the Environment Agency has defined flood zones for the UK. The flood zones do not consider sources of flooding other than fluvial (flooding from rivers and seas), and do not take account of climate change. The zones are defined as follows, and are presented on ES Figure 14.2: Existing Flood Risk (Application Document 3.3):

- Flood Zone 1: land having less than 0.1% annual probability of river or sea flooding

- Flood Zone 2: land having between 0.1% and 1% annual probability of flooding from rivers or between 0.1% and 0.5% annual probability of flooding from the sea
- Flood Zone 3a: greater than 1% annual probability of flooding from rivers or greater than 0.5% annual probability of flooding from the sea
- Flood Zone 3b: land where water has to flow or be stored in times of flood known as the functional floodplain

14.2.2.70 In addition, the Environment Agency has defined the following risk categories for fluvial flooding:

- High risk means the annual probability of flooding is greater than 3.3%
- Medium risk means the annual probability of flooding is between 1% and 3.3%
- Low risk means the annual probability of flooding is between 0.1% and 1%
- Very low risk means the annual probability of flooding is less than 0.1%

14.2.2.71 Baseline flood risk from rivers and sea using Environment Agency and the JBA baseline hydraulic modelling of existing watercourse/culvert crossings, overlaid onto the proposed scheme route alignment is shown on ES Figure 14.2: Existing Flood Risk (Application Document 3.3).

14.2.2.72 The EA has produced flood maps indicate the risk of flooding from rivers and the sea. However, as the nearest coastline is c.45km away and the low point of the M6 junction 40 to Kemplay Bank scheme is above 119mAOD, the scheme is not at risk of coastal flooding

14.2.2.73 The existing A66 within the study area does not have a flood risk greater than Fluvial Flood Zone 1. Environment Agency mapping shows areas within Fluvial Flood Zone 2 and 3 which are associated with:

- Dog Beck and Myers Beck to the north-west of the study area, within the Penrith Industrial Estate
- Thacka Beck to the north-east of the study area.
- *Unnamed Tributary of River Eamont 3.2 within the Frenchfield sports fields* in *the east of the study area*
- The River Eamont in the south of the study area from Red Hills to Eamont Bridge.

14.2.2.74 Baseline fluvial modelling undertaken for the scheme has highlighted an increased flood risk extent at Eamont Bridge for the 1 in 100-year fluvial event with a 94% climate change allowance and a slightly reduced extent associated with Dog Beck when compared to the Environment Agency *Flood Map for Planning*. This area is south of the proposed dual carriageway and does require further modelling or mitigation.

### *Surface water flooding*

14.2.2.75 The Environment Agency has defined the following risk categories for surface water flooding, these are presented on ES Figure 14.2: Existing Flood Risk (Application Document 3.3) where present:

- High risk means the annual probability of flooding is greater than 3.3%
- Medium risk means the annual probability of flooding is between 1% and 3.3%
- Low risk means the annual probability of flooding is between 0.1% and 1%
- Very low risk means the annual probability of flooding is less than 0.1%.

14.2.2.76 The surface water flood map indicates that much of the scheme is at very low risk from surface water flooding, with some low to high-risk areas located to the north of the existing A66 between M6 Junction 40 and Kemplay Bank Roundabout.

14.2.2.77 There are areas of 'High' surface water flood risk associated with Dog Beck, Myers Beck and Thacka Beck within Penrith, in the north-east of the study area located within industrial estates, along residential roads, the A6 road through the town centre, the existing A66, adjacent parkland to Thacka Beck and a small area of the A686.

14.2.2.78 In the north of the study area, adjacent to the existing A66, Wetheriggs Country Park has areas of 'High' surface water flood risk and this also impacts on Clifford Road. Parkland in the east of the study area. Frenchfield has areas of 'High' flood risk that continue north towards the existing A686 and Charleton residential areas.

14.2.2.79 Small sections of 'High' surface water flood risk are displayed adjacent to the River Eamont at Skirsgill and Eamont Park. This is likely to be a result of localised depressions in the topography and may be influenced by the watercourse. Areas of 'High' surface water flood risk within the Brougham area in the south of the study area impact agricultural and recreational land uses.

14.2.2.80 Cut-off drainage has been provided where land outside of the highway corridor falls towards the highway. The cut-off drainage will intercept and convey surface water flows around the highway.

### *Historic flooding*

14.2.2.81 Environment Agency data show historic flooding events associated with Thacka Beck within Penrith in 2002 and 2005. Historic flooding associated with the River Eamont has also occurred south of the existing A66 around the area of Skirsgill in 1995, 1997, 2005 and 2015. A further area of flooding occurred in 2005 associated with the River Eamont and River Lowther in the east of the study area, around Brougham.

### *Existing highway drainage flooding*

14.2.2.82 HADDMS identifies a number of locations along the existing A66 for this scheme that are, or have previously been subject to flooding.

14.2.2.83 There are four closed/historic events and there are no open events recorded.

14.2.2.84 The closed/historic events relate to blockages of kerb drains and gullies.

### *Groundwater flooding*

14.2.2.85 The scheme is susceptible to groundwater flooding in accordance with the Groundwater Flooding Susceptibility map in Environmental Statement Figure 14.8. A complete description of the groundwater context is provided in the Environmental Statement Appendix 14.6 Hydrogeological Impact Assessment.

1.1.1 Where the scheme is at or above existing ground level the risk of groundwater flooding is considered to be low because the proposed drainage systems will reduce the ground water levels in the vicinity of the scheme to below the formation level of the road.

14.2.2.86 There are a number of areas across the scheme where the route is in cutting. A sub surface filter drainage system will be provided to these areas, or the area will be lined, should high groundwater be assessed as a risk during detailed design.

### *Flooding from reservoirs*

14.2.2.87 The Environment Agency *Flood Map* indicates that the M6 Junction 40 to Kemplay Bank scheme is outside of the maximum extent of flooding from reservoirs when river levels are normal, with the exception of drainage attenuation pond S02-02. However, when there is also flooding from rivers the mapping indicates that the areas of the scheme to the east of Carleton Underpass are within the maximum extent of flooding from reservoirs.

14.2.2.88 The management of large, raised reservoirs (capable of holding 10,000m$^3$ of water above natural ground level) is governed by the Reservoirs Act 1975. The Reservoirs Act identifies that the reservoir undertaker is responsible for ensuring the structural integrity of the reservoir and needs to ensure that panel engineers are appointed to complete the necessary monitoring and inspection of the reservoir. Where necessary the panel engineer will undertake the design/supervision of repair works to existing reservoirs.

14.2.2.89 Although the consequence of a reservoir failure is potentially very significant, the controls and management procedures of the Reservoirs Act 1975, enforced by the Environment Agency, mean that the probability of a catastrophic breach is highly unlikely.

14.2.2.90 Annually there are a number of incidents which require the emergency drawdown of reservoirs to enable further inspection or remedial works to be undertaken. However, since the introduction of reservoir legislation in the 1920’s there has been no loss of life as a result of reservoir failure in the UK.

14.2.2.91 Reservoir flood mapping allows a better understanding of potential areas at risk in supporting emergency planning. National Highways work with Environment Agency, Cumbria County Council, Cumbria Constabulary and other statutory bodies to develop and implement local emergency plans for all eventualities.

### *Flooding from other Artificial waterbodies*

14.2.2.92 The scheme is not at risk of flooding from other artificial waterbodies. This has been assessed based on the scale of the other artificial waterbodies in relation to the local topography and carriageway elevation.

### *Coastal flooding*

14.2.2.93 The Environment Agency *Flood Map* indicates that the scheme is outside of the maximum extent of flooding from coastal flooding.

### *Flooding from sewers*

14.2.2.94 There are no reports of flooding from existing public sewers. United Utilities shall be consulted throughout the detailed design process to ensure that any risk identified is managed appropriately.

### *Flood risk mitigation*

14.2.2.95 The detailed design of the proposed highway drainage will be in accordance with current design standards (Design Manual for Roads and Bridges (DMRB) and Manual of Contract Documents for Highway Works (MCHW). By following these design standards, the design of the scheme will have low risk of surface water flooding and low risk from fluvial flooding.

14.2.2.96 Flood risk from groundwater will be mitigated though cut-off drains at all highway earthwork cuttings and embankments.

14.2.2.97 In addition to the above, proposed methods of flood mitigation are outlined in the following sections.

### Attenuation

14.2.2.98 The detailed design of the proposed highway drainage will be in accordance with current design standards specifically the Design Manual for Roads and Bridges (DMRB) and the Manual of Contract Documents for Highway Works (MCHW). By following these design standards, the design of the A66 NTP S0102 M6 junction 40 to Kemplay Bank will have low risk of surface water flooding and low risk from fluvial flooding.

14.2.2.99 The design of the A66 NTP S0102 M6 junction 40 to Kemplay Bank leads to a substantial increase the impermeable area.

14.2.2.100 In Accordance with CG 501, the proposed drainage design will ensure that there is no increase in discharge rates at each outfall. To achieve this, any increase in impermeable area as a result of the proposed alignment will need to be attenuated prior to the outfall, with sufficient storage for a 1 in 100-year event.

14.2.2.101 The Proposed attenuation will also make an allowance for 20% climate change for the total area served the drainage networks. Consideration has also been given to the effects of applying 40% climate change to the hydraulic models. The proposed attenuation volumes have considered the amount of flooding. The proposed attenuation will ensure that the flooded volume is less than existing.

14.2.2.102 Proposed drainage and highway design will ensure safe usage of proposed A66 route and side roads.

### Flow Paths

14.2.2.103 Drainage flow paths during storm events have been considered as part of the design process. The road alignment and drainage collection systems expediate the flow of water from trafficked and hard standing areas to minimise the risk of standing water on the carriageway.

14.2.2.104 For higher rainfall return periods and in the event of drainage blockages, exceedance flow paths shall direct flood water downstream to watercourses.

## Conclusion

### *Summary*

14.2.2.105 The proposed works for the scheme involve improvements to the motorway roundabout, widening the existing dual carriageway between M6 Junction 40 and Kemplay Bank and the construction of a new dual-carriageway underpass below the existing Kemplay Bank Roundabout.

14.2.2.106 The scheme results in an increase in impermeable area being discharged to local watercourses.

14.2.2.107 Existing flow rates have been calculated, and proposed flow rates restricted to ensure that there is no increased flood risk as a result of the scheme.

14.2.2.108 Water quality mitigation measures have been incorporated in the proposals.

14.2.2.109 Surface water run-off will be attenuated within the proposed highway drainage system to mitigate off-site flooding. To mitigate the risk of surface water flooding on the proposed highway sustainable drainage techniques shall be further developed during detailed design.

14.2.2.110 Additional storage is provided within the new drainage system to allow for the anticipated increase in rainfall intensities due to climate change. The attenuation is designed to manage flows to the 1 in 100-

year event plus 40% climate change uplift value. A sensitivity check on the drainage design has also been conducted to include the 1 in 100-year event plus 50% climate change uplift value.

14.2.2.111 The scheme is not considered to be at risk of flooding from the sea and is considered to be at low risk of flooding from rivers, surface water and groundwater. The risk of flooding from reservoirs is managed through the enforcement of the Reservoirs Act 1975 by the Environment Agency.

#### *Residual risks*

14.2.2.112 The key residual risks associated with the drainage / flood risk are as follows:

- Flood events in excess of the design standard – the capacity of the designed drainage system will minimise the impact of exceedance events.
- Blockages in the drainage system – managed through routine and/or reactive maintenance.
- Flooding from reservoirs – reservoir breach is highly unlikely but is addressed by enforcement of the Reservoirs Act 1975 and through flood warning.

## 14.2.3 Penrith to Temple Sowerby

### Introduction

14.2.3.1 This section of the document details the proposed design for the scheme, which runs from Penrith to Temple Sowerby. The location of the scheme is shown on ES Figure 14.1: Surface Water Features (Application Document 3.3).

14.2.3.2 The drainage for this scheme has been designed in accordance with the Standards for Highways Design Manual for Roads and Bridges and in accordance with relevant Local Authority design standards as detailed in Section 14.2.1: Introduction.

### Baseline conditions

#### *Surface watercourses*

14.2.3.3 Watercourses within the study area drain into the River Eden via a number of tributaries. Minor watercourses which are tributaries of these named rivers and the River Eden have also been included in the assessment and grouped where required.

14.2.3.4 All watercourses within the study area flow through agricultural rural landscapes. The River Eamont drains from Ullswater situated southwest of the study area, and the River Lowther which drains from the south-west of Shap, outside of the study area.

14.2.3.5 The watercourses designated as Main Rivers by the Environment Agency within the study area include the River Lowther and River Eamont. Table 7: Watercourses within Penrith to Temple Sowerby study area gives a brief description of the watercourses in the study area (from west to east). ES Figure 14.1: Surface Water Features (Application Document 3.3) displays the watercourses identified in the study area.

Table 7: Watercourses within Penrith to Temple Sowerby study area

| Watercourse | Description |
|---|---|
| River Eamont | Flows east, joined by the River Lowther and crossed by the existing M6 in the west of the study area, flows north-east and joins the River Eden 2.3km directly north of the existing A66. |
| River Lowther | Flows east, located parallel, to the south of the River Eamont. Joins the River Eamont at Brougham Castle 250m upstream of the existing A66 crossing, in the west of the study area. |
| Unnamed Tributary of River Eamont 3.2 | Flows east into the River Eamont, straightened channel through Frenchfield sports centre, in the west of the study area |
| Unnamed Tributary of Light Water 3.1 | Flows north into the Light Water in the west of the study area, crossed by the existing A66. |
| Light Water | Flows north into the Eamont, crossed by the existing A66, and joins the River Eamont 780m downstream of the crossing point, in the western extent of the study area. |
| Unnamed Tributary of River Eamont 3.3 | Flows north into the River Eamont, in close proximity to Whinfell Park, crossed by the existing A66 and joins the River Eamont 350m downstream. |
| Unnamed Tributary of River Eamont 3.4 | Small roadside drain that flows west into Unnamed Tributary of River Eamont 3.3, in the central west of the study area. |
| Unnamed Tributary of River Eamont 3.5 | Flows north into the River Eamont, crossed by the existing A66 in line with the meander in the River Eamont in the centre of the study area. |
| Swine Gill | Flows north into the River Eden, crossed by the existing A66, to the west of Whinfell. Joins the River Eden 1.67km downstream of the crossing point. |
| Unnamed tributary of River Eden 4.5 | Flows north into the River Eden, at existing A66 and B6412 junction in the east of the study area. |
| River Eden | Flows north-west in the far east of the study area. |
| Unnamed Tributary of River Eamont 3.7 | Small watercourse that flows west, redirected via field drains before discharging into the River Eamont. Situated north of the existing A66. |

### *Topography*

14.2.3.6 Levels generally fall south to north along the proposed route, towards the River Eamont. Carriageway drainage catchments are determined by undulating topography across the whole scheme. Along the route of the carriageway, ground levels fall towards the numerous watercourses which are culverted below the A66. See ES Figure 14.2: Existing Flood Risk (Application Document 3.3) for contours.

### *Geology and soils*

14.2.3.7 A complete description of the geological and soils context is provided in ES Chapter 8: Geology and Soils (Application Document 3.2) and ES Appendix 14.6: Hydrogeological Impact Assessment (Application Document 3.4).

## Existing drainage

### *Background*

14.2.3.8 The existing drainage network has been assessed using information from *HADDMS*, existing drainage drawings and site surveys. Whilst site visits have been undertaken to clarify existing drainage where possible, no intrusive drainage surveys have been undertaken at this stage of design. Where the proposed drainage interfaces with the existing, CCTV surveys shall be undertaken prior to commencement of detailed design. Due to the limited information available, the existing catchments have been assessed using the Wallingford Surface Water Storage Volume Estimation Tool to determine QBAR. The maximum discharge from the outfalls in the proposed drainage design has been limited to QBAR.

### *Description of existing drainage*

14.2.3.9 Existing drainage comprises a mixture of gullies, combine kerb drains, filter drains, and over the edge drainage, either onto adjacent land or into roadside ditches.

14.2.3.10 Positive drainage systems outfall into local watercourses at strategic locations.

### *Assessment of catchment areas and existing runoff rates*

14.2.3.11 The following information has been considered in the assessment of catchment areas and to calculate existing runoff rates:

- Catchment areas associated with the works have been measured
- Catchment areas associated with the works have developed using both existing and proposed drainage catchments
- Existing catchment areas considered in this section therefore relate to areas beneath the proposed alignment
- Existing catchments beneath the proposed alignment have been used to calculate restricted flow rates that will be applied to new outfalls from the proposed drainage system
- The proposed vertical alignment has been considered, and new outfall locations determined
- Existing topography has also been considered to ensure that only area beneath the proposed alignment that currently drains towards a proposed outfall location is included in the restricted flow rate calculations

14.2.3.12 This approach ensures that flows to individual watercourses are not increased over the existing scenario.

14.2.3.13 A summary of the existing catchments include (see Annex C):

- Catchment S03-01 relates to the carriageway drainage from Countess Pillar to the Light Water. The network discharges on the left bank of the watercourse downstream of the A66.

- Catchment S03-02 relates to the carriageway drainage from west of Whinfell Park to the Light Water. The network discharges on the right bank of the watercourse downstream of the A66.
- Catchment S03-03 relates to the carriageway drainage from east of Whinfell Park and discharges to an un-named watercourse located to the north of the A66 at Whinfell Park.
- Catchment S03-04 relates to the carriageway drainage midway between Whinfell Park and the Center Parcs Junction. The network discharges to an un-named watercourse located to the north of the A66.
- Catchment S03-05 relates to the drainage of the Center Parcs Junction. The existing drainage network in this area is shown to flow to a drainage ditch located north of the A66. However, as there is no known discharge from this ditch, the proposed drainage network will outfall via the un-named watercourse at Catchment S03-04.
- Catchment S03-06 relates to the drainage from the local road network in the vicinity of the Center Parcs Junction. It will outfall via the un-named watercourse at Catchment S03-04.
- Catchment S03-07 relates to the carriageway drainage from east of the Center Parcs Junction to Swine Gill. The network discharges on the left bank of the watercourse downstream of the A66.

14.2.3.14 The “*Greenfield runoff rate estimation”* tool developed by HR Wallingford has been used to assess existing “greenfield” runoff rates. The QBAR greenfield runoff rate of 5.27 l/s/ha has been allowed for runoff from greenfield/undeveloped areas.

14.2.3.15 Brownfield run-off rates were calculated in line with the recommendations of CIRIA's *The SuDS Manual (C753)*. These are specifically equated to existing hardstanding areas such as footways, carriageways, traffic islands and central reservations. The QBAR brownfield runoff rate has been estimated using a SPR of 0.53% for runoff from brownfield/developed areas.

14.2.3.16 Table 8: Penrith to Temple Sowerby existing drainage catchments summary shows existing catchments that drain to each of the proposed outfalls.

Table 8: Penrith to Temple Sowerby existing drainage catchments summary

| Catchment | Existing Greenfield Area (ha) | Existing Brownfield Area (ha) | Existing Greenfield Flow Rate (l/s) | Existing Brownfield Flow Rate (l/s) | Restricted Flow Rate Applied to Outfall (l/s) |
|---|---|---|---|---|---|
| S03-01 | 0.220 | 1.095 | 1.38 | 8.94 | 10.32 |
| S03-02 | 2.035 | 0.572 | 12.62 | 4.67 | 17.29 |
| S03-03 | 1.382 | 0.869 | 8.47 | 6.91 | 15.38 |
| S03-04 | 1.237 | 0.521 | 7.58 | 4.04 | 11.62 |
| S03-05 | 0 | 0.968 | 0 | 7.31 | 7.31 |
| S03-06 | 0.185 | 0.030 | 0.04 | 0.23 | 0.27 |

| Catchment | Existing Greenfield Area (ha) | Existing Brownfield Area (ha) | Existing Greenfield Flow Rate (l/s) | Existing Brownfield Flow Rate (l/s) | Restricted Flow Rate Applied to Outfall (l/s) |
|---|---|---|---|---|---|
| S03-07 | 2.731 | 1.099 | 0.54 | 8.13 | 8.67 |

a - includes 30% reduction in brownfield flow rates

#### *Hydraulic modelling of existing highway surface water drainage networks*

14.2.3.17 The extent of existing drainage networks has been assessed using topographic surveys, site visits and *HADDMS* data. No hydraulic modelling of the existing drainage networks has been undertaken due to the limitations of available information.

### Proposed drainage

#### *Collection system design*

14.2.3.18 A number of surface water collections systems will be utilised.

#### National Highways A66 Collection System

- Primary surface water collection system will be road edge concrete surface water channels.
- Laybys and refuge areas will be drained using either concrete surface water channels or gullies
- Filter drains will be used where required, including highway verges where the verge is contained by earthworks and cuttings/embankments.
- Open ditches and/or filter drains will be used to intercept and convey overland flow from areas outside of the highway corridor.

#### *Local Authority Roads Collection System*

- Primary surface water collection system will be gullies.
- Filter drains will be used where required, including highway verges where the verge is contained by earthworks and cuttings/embankments.
- Open ditches and/or filter drains will be used to intercept and convey overland flow from areas outside of the highway corridor.

14.2.3.19 For the Project, the primary drainage collection system will consist of concrete surface water channels. For the scheme, surface water channels will be placed on the road edge adjacent to the hard strip and will drain surface water from the scheme carriageway, verges, embankments, and the central reserve.

14.2.3.20 The design of the surface water channels is in accordance with *DMRB CD 521*. The proposed vertical and horizontal highways alignment has been assessed using the process outlined in Section 4 – Design Process of *DMRB CD 521*.

14.2.3.21 The position of surface water channels in relation to the pavement edge shall follow the guidance provided in *DMRB CD 524*.

14.2.3.22 Where gullies are used, gully spacing will be determined as part of detailed design in accordance with *DMRB CD 526*.

14.2.3.23 Combined kerb and drainage systems will be designed in accordance with *DMRB CG 50*1.

14.2.3.24 A simple assessment of the minimum required discharge capacity of the combined kerb and drainage systems is based on the Rational Method Equation Q = 2.78 CiA, where:

- Q is the design peak rate of runoff (l/s)
- C is a non-dimensional runoff coefficient (taken as 1.0)
- i is the design rainfall intensity (mm/hr)
- A is the total catchment area (ha)
- Note: 2.78 is a conversion factor to address the rainfall units being in mm/hr

### *Pollution controls*

14.2.3.25 In accordance with *DMRB CG 501*, the selection of pollution control measures has been determined following the process outlined below:

- Complete assessment in accordance with *DMRB LA 113*
- If mitigation is required, identify viable options/combinations of measures, taking account of:
- Road drainage hierarchy.
- Site constraints.
- Storm flow and flood risk requirements.
- Climate change allowances.
- Road geometry.
- Review short list of options against construction and maintenance requirements.
- Confirming the measures fulfil water quality requirements - these are presented in ES Appendix 14.3: Water Quality Assessment (Application Document 3.4)

14.2.3.26 The pollution control measures vary for each proposed outfall, and include a combination of the following measures:

- Wet attenuation ponds with sediment forebays
- Vortex grit separators
- Vegetated ditches

14.2.3.27 Water quality assessments have been undertaken to ensure sufficient mitigation measures have been incorporated at each outfall. Details of the *HEWRAT* assessment are provided in ES Appendix 14.3: Water Quality Assessment (Application Document 3.4).

14.2.3.28 Table 14-9: Penrith to Temple Sowerby pollution control mitigation measures outlines the pollution control mitigation measures included at each proposed outfall.

Table 14-9: Penrith to Temple Sowerby pollution control mitigation measures

| Catchment | Attenuation pond | Grit Separator | Vegetated Ditch |
|---|---|---|---|
| S03-01 | Y | N | N |
| S03-02 | Y | N | N |
| S03-03 | Y | N | N |
| S03-04 | Y | N | Y |
| S03-05 | Y | Y | Y |
| S03-06 | Y | Y | Y |
| S03-07 | Y | N | N |

### *Climate change*

14.2.3.29 In accordance with *DMRB CG 501*, a 20% increase to peak rainfall intensity shall be considered the minimum accommodated within the drainage design in order to account for potential climate change.

14.2.3.30 *Environment Agency guidance* for allowances that should be made for climate change has been followed. Climate change allowances relating to increased peak rainfall intensity are outlined in Table 10: Peak rainfall intensity allowance in small and urban catchments - Penrith to Temple Sowerby.

Table 10: Peak rainfall intensity allowance in small and urban catchments - Penrith to Temple Sowerby

| Applies across all of England | Total potential change anticipated for the '2020s' (2015 to 2039) | Total potential change anticipated for the '2050s' (2040 to 2069) | Total potential change anticipated for the '2080s' (2070 to 2115) |
|---|---|---|---|
| Upper end | 10% | 20% | 40% |
| Central | 5% | 10% | 20% |

14.2.3.31 Environment Agency guidance is to assess both the central and upper end allowances to understand the range of impact.

14.2.3.32 EA have advised that there is a proposed increase in allowances for climate change within the Cumbria region. Accordingly, a 50% climate change allowance has been included as a sensitivity check.

### *Surface water storage*

14.2.3.33 The proposals lead to an increase in impermeable area draining to local watercourses.

14.2.3.34 In accordance with *DMRB CG 501*, the proposed drainage design will ensure that there is no increase in runoff rates as a result of the proposals. To achieve this, existing runoff rates have been assessed and flow control devices incorporated into the drainage systems. Storage for surplus flows has been provided using attenuation ponds.

14.2.3.35 The detailed design will be based on updated geotechnical information, and at that stage disposal via infiltration will be explored to see if it is a practicable option. If it is not, the regulated hierarchy of discharge will be followed in finalising the drainage design. Also refer to the Karst section regarding dissolution features that are present on this scheme.

14.2.3.36 The proposed drainage design makes an allowance for potential climate change. A 40% increase to rainfall intensity has been included when considering surface water storage, and attenuation ponds designed to ensure no flooding occurs during the critical 1 in 100-year storm.

### *Hydraulic modelling of proposed highway surface water drainage networks*

14.2.3.37 The proposed main carrier drainage network and surface water storage has been modelled using MicroDrainage software.

14.2.3.38 FSR rainfall data has been used, with global variables (M560, r) to suit the site location.

14.2.3.39 The equivalent impermeable area draining to proposed networks has been obtained by applying the following factors to the measured contributing areas: -

- Paved surfaces - 1.00
- Verges contained by embankments/cutting slopes - 0.5
- Embankments/Cutting Slopes - 0.25
- Attenuation pond surfaces - 1.00

14.2.3.40 Networks have been established to suit proposed vertical alignments and potential outfall locations.

14.2.3.41 HydroBrake flow controls have been incorporated downstream of attenuation ponds, with flow rates restricted to those detailed in Table 8: Penrith to Temple Sowerby existing drainage catchments summary.

14.2.3.42 Table 11: Penrith to Temple Sowerby proposed catchments is a summary of proposed total catchment area size, percentage of impermeable area within each catchment and the volume of attenuation required to achieve the peak permitted discharge rate calculated for the corresponding existing catchment (see above). This is to ensure the proposed discharge rates are no greater than existing.

Table 11: Penrith to Temple Sowerby proposed catchments

| Catchment | Drained Embankment Area (ha) | Drained Verge Area (ha) | Drained Highway Area (ha) | Volume of storage provided[a] ($m^3$) | Peak Permitted Flow Rate[b] (l/s) |
|---|---|---|---|---|---|
| S03-01 | 0.767 | 0.261 | 1.315 | 748 | 10.32 |
| S03-02 | 0.251 | 0.542 | 2.607 | 1668 | 17.29 |
| S03-03 | 0.312 | 0.430 | 2.251 | 1446 | 15.38 |
| S03-04 | 0.061 | 0.320 | 1.758 | 1144 | 11.62 |
| S03-05 | 0.391 | 0.160 | 1.082 | 830 | 7.31 |

| Catchment | Drained Embankment Area (ha) | Drained Verge Area (ha) | Drained Highway Area (ha) | Volume of storage provided[a] ($m^3$) | Peak Permitted Flow Rate[b] (l/s) |
|---|---|---|---|---|---|
| S03-06 | 0.613 | 0.073 | 0.215 | 87 | 0.27 |
| S03-07 | 0.814 | 0.823 | 3.830 | 3032 | 8.67 |

a - Volume provided in design from normal water level to 300mm below road level, as per guidance provided in The SuDS Manual (CIRIA C753).

b - 1 in 100-year storm plus 40% climate change

### *Exceedance flood routing*

14.2.3.43 All drainage attenuation ponds are designed for a 1 in 100-year storm with a 40% climate change allowance (Upper end). All drainage attenuation ponds in this scheme are located on the downstream side of the A66 so that any exceedance flow from the drainage attenuation ponds will be to the downstream watercourse away from the carriageway and any residential properties.

### *Existing watercourses*

14.2.3.44 In accordance with *DMRB CG 501* and *DMRB LA 113* the proposed highways and drainage design where possible limit impact on Environment Agency Main Rivers and ordinary watercourses. Where a watercourse has been disrupted by the proposed highways alignment a proposed culvert has been sized appropriately to allow the flow from the watercourse to be uninterrupted. Where existing culverts below the alignment are being extended to facilitate the widening of the carriageway, these will be extended at the same size as the original culvert. This will ensure that the pass forward flow does not increase from the existing scenario and therefore will not exacerbate flood risk downstream.

14.2.3.45 During detailed design the following will be required

- All new culverts will be designed in accordance with DMRB CD 529 details and in consultation with relevant stakeholders (e.g. LLFA or EA).
- All culverts with a diameter of 900mm and above will require structural design
- It is the design intention to maintain existing outfalls on existing watercourses and to not increase the discharge rate of these outfalls.
- Where new outfalls are required the individual outfall details will be designed in accordance with *DMRB CD 529* and in consultation with relevant stakeholders (e.g. LLFA or EA).

### *Land drainage and overland flow*

14.2.3.46 Where land outside of the highway corridor falls towards the highway, cut-off drainage has been provided as part of the design. Cut-off drainage will intercept and convey overland flow around the highway corridor, so that this flow does not enter the highway drainage system or cause flooding issues on the proposed highway.

14.2.3.47 Cut-off drainage comprises open ditches and/or filter drains, with culverts provided to cross the highway corridor where necessary.

## Flood Risk Assessment

### *Data collection*

14.2.3.48 The risk of flooding to the development has been assessed on readily available information, published on the Environment Agency website.

14.2.3.49 In addition to readily available information, JBA has undertaken baseline hydraulic modelling of existing watercourse/culvert crossings. This modelling establishes flooding in the vicinity of the existing A66.

### *Flood risk vulnerability classification*

14.2.3.50 Guidance for flood risk vulnerability for new development sites is set out in the Government planning portal for flood risk and coastal change. Table 6: Flood risk vulnerability classification is used as a guide to help determine if new development sites should or should not be permitted, based upon the vulnerability classifications set out on the planning portal.

14.2.3.51 In accordance with *DMRB LA113*, NI/1.7, the development is classified as *“Essential Infrastructure”.* The development is therefore permitted providing it is located within Flood Zones 1 or 2, with the exception test required if located in Flood Zones 3a or 3b.

### *Sequential Test*

14.2.3.52 As part of a Flood Risk Assessment a sequential test is required when the proposed development is located within Flood Zone 2 or 3. The sequential test compares the proposed site with other available sites to find out which has the lowest flood risk.

14.2.3.53 The design team considered alternative alignments which would still meet the project requirements.

14.2.3.54 A full extensive write up of this review can be seen in Project Development Overview Report (Application Document 4.1)

14.2.3.55 This review identifies the proposed route is the most favourable with the least environmental impacts, impacts on landowners, buildability and design safety, whilst maintaining project design principles.

14.2.3.56 In respect of the Sequential Test for this scheme, the development is in Flood Zone 1 and at low risk of fluvial flooding. However, flood risk must be considered from all potential sources. The scheme is shown to be at low risk of surface water and groundwater flooding. However, the mapping indicates that the scheme to the west of Whinfell Park Cottages is within the maximum extent of flooding from reservoirs.

### *Exception Test*

14.2.3.57 The proposed scheme is located within Flood Zone 1. In accordance with Table 2 of the Flood Risk and Coastal Change guidance, the proposed alignment has been assessed as being Essential Infrastructure and is appropriate for this flood zone. However, as the proposed alignment to the west of Whinfell Park Cottages is identified as being within the maximum extent of flooding from reservoirs, an exception test is required.

14.2.3.58 The 2 parts to the Test require the proposed development to show that it will provide wider sustainability benefits to the community that outweigh flood risk, and that it will be safe for its lifetime, without increasing flood risk elsewhere and where possible reduce flood risk overall.

14.2.3.59 To answer the first part of the assessment, refer to Case for the Project (Application Document 2.2) which highlights the Social, Environmental and Economic benefits for the proposed Nationally Significant Infrastructure Project. Including:

- safety – a consistent standard of dual carriageway, to reduce the number of accidents. Use of the ‘old’ A66 as part of the local road network will provide better, safer routes for cyclists and pedestrians.
- connectivity – improving connectivity for people living and working nearby and creating better facilities for cyclists and pedestrians. Reducing congestion and improving the reliability of people’s journeys between the M6 at Penrith and the A1(M) Scotch Corner and nationwide. It also improves connectivity between the key employment areas of Cumbria, Tees Valley and Tyne and Wear.
- environmental – minimising noise levels for people living and working near the route and reducing the congestion currently occurring in the single carriageway sections. The scheme is also being designed to minimise any potential negative impacts on the natural environment and landscapes of the North Pennines and Lake District.
- economic – improving strategic regional and national connectivity, particularly for hauliers. Heavy goods vehicles account for a quarter of all traffic on the road and any delays to journeys can have an extremely negative effect on business and commerce, including lost working time and missed shipment slots.
- tourism – improving access to key tourist destinations such as the North Pennines and Lake District.
- community – re-connecting communities and providing better links between settlements along the route as well as improving access to services such as healthcare, employment areas and education.
- capacity – reducing delays and queues during busy periods and improving the performance of key junctions such as the A66/A6 and the M6 junction 40.

- increasing reliability – an improved A66, will lead to less accidents which, in turn, makes the road more reliable. Also, having a dual carriageway provides the option to close lanes where required due to accidents or break downs and keep traffic moving

14.2.3.60 To answer the second part of the Exception test, refer to the Flood Risk Mitigation section below which outlines how the scheme proposes to mitigate flooding of the carriageway and downstream of the scheme.

14.2.3.61 The proposed design will be constructed to remain operational and safe in times of flooding from fluvial, surface water and groundwater sources.

14.2.3.62 In respect of the risk associated with flooding from reservoirs, refer to the Flooding from reservoirs section below which details how the management of large raised reservoirs is governed by the Reservoirs Act 1975.

14.2.3.63 The proposed design does not impede existing water flows as cut of ditches intercept overland flows and conveys water in a controlled manor to its existing receiving watercourse.

14.2.3.64 As demonstrated in Case for the Project (Application Document 2.2), A66 constitutes nationally significant Essential Infrastructure. The improvements proposed for the A66 will provide wider sustainability benefits to the community that outweigh the flood risk posed by the exceptional circumstances which would result in a reservoir breach scenario. The Exception Test would therefore be satisfied by the proposed A66 improvements for Penrith to Temple Sowerby.

### *Flooding from rivers or the sea*

14.2.3.65 Baseline flood risk from rivers and sea using Environment Agency data is shown on ES Figure 14.2: Existing Flood Risk (Application Document 3.3).

14.2.3.66 The Environment Agency has produced flood maps indicate the risk of flooding from rivers and the sea. However, as the nearest coastline is c.48km away and the low point of the Penrith to Temple Sowerby scheme is above 113mAOD, the scheme is not at risk of coastal flooding.

14.2.3.67 The Environment Agency flood mapping indicates that the development is in Flood Zone 1 and at low risk of flooding. However, the JBA mapping shows that flooding of the existing carriageway does occur in the vicinity of the Lightwater Cottages as a result of flows backing up in the un-named watercourse at Whinfell Park and flowing overland to the Lightwater. Reprofiling of the farmland between the Whinfell Park watercourse and the Lightwater is proposed to maintain this conveyance route, whilst ensuring that the overland flow does not inundate the carriageway.

### *Surface water flooding*

14.2.3.68 The surface water flood map indicates that much of the route is at very low risk from surface water flooding, with some low to medium risk areas located to the south of the existing A66. The localised surface water flooding of the carriageway in the vicinity of the Light Water has been addressed by existing culvert improvements for the discharge of the Unnamed Tributary of River Eamont 3.3 located west of the Light Water and the conveyance works identified in the previous section.

14.2.3.69 Cut-off drainage has been provided where land outside of the highway corridor falls towards the highway. The cut-off drainage will intercept and convey surface water flows around the highway.

### *Historic flooding*

14.2.3.70 Environment Agency data shows historic flooding events associated with the River Eamont in 2005, 2009 and 2015. Historic flooding associated with the study area is indicated on Environment Agency mapping to be at risk of fluvial flooding (from rivers or the sea).

14.2.3.71 The consultation response received from Cumbria County Council LLFA stated that *"Flooding has been experienced in the vicinity of the Karma Llama Kafé due to a watercourse culvert underneath the A66".* This has been replicated in the additional hydraulic modelling undertaken for the Lightwater.

14.2.3.72 Refer to Flood Risk Mitigation below.

### *Existing highway drainage flooding*

14.2.3.73 HADDMS identifies a number of locations along the existing A66 for this scheme that are, or have previously been subject to flooding.

14.2.3.74 There are 2 closed/historic events and there are no open events recorded.

14.2.3.75 The closed/historic events relate to overland flow from Whinfell Farm in the vicinity of the Lightwater Cottages and a blocked gully.

### *Groundwater flooding*

14.2.3.76 The scheme is susceptible to groundwater flooding in accordance with the Groundwater Flooding Susceptibility map in Environmental Statement Figure 14.8. A complete description of the groundwater context is provided in the Environmental Statement Appendix 14.6 Hydrogeological Impact Assessment.

14.2.3.77 Where the scheme is at or above existing ground level the risk of groundwater flooding is considered to be low because the proposed drainage systems will reduce the ground water levels in the vicinity of the scheme to below the formation level of the road.

14.2.3.78 There are a number of areas across the scheme where the route is in cutting. A sub surface filter drainage system will be provided to these areas, or the area will be lined, should high groundwater be assessed as a risk during detailed design.

### *Flooding from reservoirs*

14.2.3.79 The Environment Agency *Flood Map for Planning* indicates that the scheme to the west of Whinfell Park Cottages is within the maximum extent of flooding from reservoirs.

14.2.3.80 The management of large, raised reservoirs (capable of holding 10,000m$^3$ of water above natural ground level) is governed by the Reservoirs Act 1975. The Act identifies that the reservoir undertaker is responsible for ensuring the structural integrity of the reservoir and needs to ensure that panel engineers are appointed to complete the necessary monitoring and inspection of the reservoir. Where necessary the panel engineer will undertake the design/supervision of repair works to existing reservoirs.

14.2.3.81 Although the consequence of a reservoir failure is potentially very significant, the controls and management procedures of the Reservoirs Act 1975, enforced by the Environment Agency, mean that the probability of a catastrophic breach is highly unlikely.

14.2.3.82 Annually there are a number of incidents which require the emergency drawdown of reservoirs to enable further inspection or remedial works to be undertaken. However, since the introduction of reservoir legislation in the 1920’s there has been no loss of life as a result of reservoir failure in the UK.

14.2.3.83 Reservoir flood mapping allows a better understanding of potential areas at risk in supporting emergency planning. National Highways work with Environment Agency, Cumbria County Council, Cumbria Constabulary and other statutory bodies to develop and implement local emergency plans for all eventualities.

### *Flooding from other Artificial waterbodies*

14.2.3.84 The scheme is not at risk of flooding from other artificial waterbodies. This has been assessed based on the scale of the other artificial waterbodies in relation to the local topography and carriageway elevation.

### *Coastal flooding*

14.2.3.85 The Environment Agency *Flood Map* indicates that the scheme is outside of the maximum extent of flooding from coastal flooding.

### *Flooding from sewers*

14.2.3.86 There are no reports of flooding from existing public sewers. United Utilities shall be consulted throughout the detailed design process to ensure that any risk identified is managed appropriately.

### *Flood risk mitigation*

14.2.3.87 The detailed design of the proposed highway drainage will be in accordance with current design standards specifically the Design Manual for Roads and Bridges (DMRB) and the Manual of Contract Documents for Highway Works (MCHW). By following these design standards, the design of the A66 NTP S03 Penrith to Temple Sowerby will have low risk of surface water flooding and low risk from fluvial flooding.

14.2.3.88 Flood risk from groundwater will be mitigated though cut-off drains at all highway earthwork cuttings and embankments.

14.2.3.89 In addition to the above, proposed methods of flood mitigation are outlined in the following sections.

### Attenuation

14.2.3.90 The detailed design of the proposed highway drainage will be in accordance with current design standards specifically the Design Manual for Roads and Bridges (DMRB) and the Manual of Contract Documents for Highway Works (MCHW). By following these design standards, the design of the A66 NTP S03 Penrith to Temple Sowerby will have low risk of surface water flooding and low risk from fluvial flooding.

14.2.3.91 The design of the A66 NTP S03 Penrith to Temple Sowerby leads to a substantial increase the impermeable area.

14.2.3.92 In Accordance with CG 501, the proposed drainage design will ensure that there is no increase in discharge rates at each outfall. To achieve this, any increase in impermeable area as a result of the proposed alignment will need to be attenuated prior to the outfall, with sufficient storage for a 1 in 100-year event.

14.2.3.93 The Proposed attenuation will also make an allowance for 20% climate change for the total area served the drainage networks. Consideration has also been given to the effects of applying 40% climate change to the hydraulic models. The proposed attenuation volumes have considered the amount of flooding. The proposed attenuation will ensure that the flooded volume is less than existing.

14.2.3.94 Proposed drainage and highway design will ensure safe usage of proposed A66 route and side roads.

### Flow path

14.2.3.95 Drainage flow paths during storm events have been considered as part of the design process. The road alignment and drainage collection systems expediate the flow of water from trafficked and hard standing areas to minimise the risk of standing water on the carriageway.

14.2.3.96 For higher rainfall return periods and in the event of drainage blockages, exceedance flow paths shall direct flood water downstream to watercourses.

### Overland flow compensation

14.2.3.97 The JBA mapping shows that minor flooding of the existing carriageway occurs in the 1 in 100-year plus 94% climate change scenario in the vicinity of the Lightwater Cottages as a result of flows backing up in the un-named watercourse at Whinfell Park and flowing overland to the Lightwater. This flooding of the carriageway does not occur for all modelled flood events up to and including the 1 in 100-year fluvial event with a 47% climate change. Reprofiling of the farmland between the Whinfell Park watercourse and the Lightwater is proposed to maintain this conveyance route, for the 1 in 100-year plus 94% climate change event, whilst ensuring that the overland flow does not inundate the carriageway or exacerbate flood risk further downstream. The initial modelling has shown a reduction of flooding onto the carriageway but further refinement will be required at detailed design to fully resolve this issue. Space has been included within the red line boundary for any future refinement of this design. This issue has been recorded in the Design Decision Register.

## Conclusion

### *Summary*

14.2.3.98 The proposed works at Penrith to Temple Sowerby, involves widening the route to dual carriageway between Penrith and Temple Sowerby. The scheme predominantly follows the existing route, widening the existing carriageway and constructing a second carriageway to the north of the existing route.

14.2.3.99 The scheme results in a significant increase in impermeable area being discharged to local watercourses.

14.2.3.100 Existing flow rates have been calculated, and proposed flow rates restricted to ensure that there is no increased flood risk as a result of the scheme.

14.2.3.101 Water quality mitigation measures have been incorporated in the proposals.

14.2.3.102 A full assessment of the capacity of the receiving drainage system shall be undertaken as part of detailed design. Surface water storage will be required if the existing drainage system does not have the capacity to accept additional flows.

14.2.3.103 The scheme is not considered to be at risk of flooding from the sea and is considered to be at low risk of flooding from rivers, surface water and groundwater. The risk of flooding from reservoirs is managed through the enforcement of the Reservoirs Act 1975 by the Environment Agency.

### *Residual risks*

14.2.3.104 The key residual risks associated with the drainage / flood risk are as follows:

- Flood events in excess of the design standard – the capacity of the designed drainage system will minimise the impact of exceedance events.
- Blockages in the drainage system – managed through routine and/or reactive maintenance.
- Flooding from reservoirs – reservoir breach is highly unlikely but is addressed by enforcement of the Reservoirs Act 1975 and through flood warning.

## 14.2.4 Temple Sowerby to Appleby

### Introduction

14.2.4.1 This section of the document details the proposed design for this scheme, which runs from Temple Sowerby to Appleby close to the villages of Kirkby Thore and Crackenthorpe. The location of the scheme is shown on ES Figure 14.1: Surface Water Features (Application Document 3.3).

14.2.4.2 The drainage for this scheme has been designed in accordance with the Standards for Highways Design Manual for Roads and Bridges and in accordance with relevant Local Authority design standards as detailed in Section 14.2.1: Introduction.

### Baseline conditions

#### *Surface watercourses*

14.2.4.3 Watercourses within the study areas drain into the River Eden via several tributaries.

14.2.4.4 The watercourses in the north and west of the study areas drain from the fells to the north, including Knock Pike and Dufton Pike, and flow through agricultural fields and small villages, including Long Marton. In the south of the study areas the watercourses flow north from the Howgill Fells through largely agricultural land.

14.2.4.5 Both Trout Beck and the River Eden are designated by the Environment Agency as Main Rivers. Table 12: Watercourses within Temple Sowerby to Appleby study area gives a brief description of the watercourses in the study area (from west to east) and they are displayed on ES Figure 14.1: Surface Water Features (Application Document 3.3).

Table 12: Watercourses within Temple Sowerby to Appleby study area

| Watercourse | Description |
|---|---|
| Birk Sike | Flows west into the River Eden via the Crowdundle Beck, parallel to the north of the existing A66 in the north of the study areas. Joins the River Eden to the west of the study areas. |
| River Eden | Flows northwest, parallel to the south of the existing A66. Joined by several tributaries to the south of the study area and joins River Lyvennet in the south-east of the study areas. |
| River Lyvennet | Flows north, joins the River Eden 520m to the south of the existing A66. |

| Watercourse | Description |
|---|---|
| Coat Sike | Flows north, joins the River Eden 1.2kmm to the south of the existing A66, in the south-west of the study area. |
| Unnamed Tributary of Birk Sike 4.2 | Situated north-west of Kirkby Thore, flows north-east through agricultural land into Birke Sike. |
| Unnamed Tributary of Birk Sike 4.3 | Situated north-east of Kirkby Thore, flows northwest through agricultural land into Birk Sike, adjacent to British Gypsum factory. |
| Unnamed Tributary of Trout Beck 4.1 | Situated 440m south of existing A66, flows south-west into the River Eden in west of study areas. |
| Trout Beck | Flows north-west into the River Eden, from Long Marton, crossed by the existing A66 to the south of Kirby Thore. |
| Unnamed Tributary of Keld Sike 4.1 | Partially subterranean artificially straightened field drainage channel situated 200m north of Sleastonhow Lane, to the east of Kirkby Thore. Flows south-east into Keld Sike. |
| Keld Sike (1) | Flows south into Trout Beck where it becomes a straightened channel to the west of Long Marton. |
| Unnamed Tributary of Trout Beck 4.2 | Flows north from Crackenthorpe, parallel to the existing A66. Data received from the Environment Agency indicates a culvert linking this watercourse to the watercourse along the field boundary to the south of Powis House, flowing via another culvert into Trout Beck. |
| Unnamed Tributary of Trout Beck 4.3 | Flows north into Trout Beck, located within the area of low ground adjacent to the Roman Road and flows along Castrigg Lane and past Broad Lea House. |
| Unnamed Tributary of Trout Beck 4.6 | Flows west with areas of artificially straightened channel and into Trout Beck 100m north of the existing A66. |
| Keld Sike (2) | Flows from Castrigg Lane at the railway line north past Broom House Farm and joining Trout Beck 200m to the south of Long Marton, parallel to the north of the Roman Road. |
| Unnamed Tributary of River Eden 4.2 | Situated north-east of Colby Laithes, flows south from existing A66 and into the River Eden |
| Unnamed Tributary of River Eden 4.3 | Situated north-west of Appleby, flows south from existing A66 for 60m into the River Eden. |
| Unnamed Tributary of Birk Sike 4.1 | A stretch of open field drain for approximately 150m before it is culverted again. |
| Unnamed Tributary of River Eden 4.0 | Flows south, in the south of the study area, into the River Eden just south of Skygarth Farm, culverted under the dismantled railway. |
| Colby Beck | Flows north, adjacent to Colby, through some areas of forest before joining the River Eden in the south-east of the study area. |
| Palmer Gill | Flows north with some artificially straightened sections, into the River Eden, in the south of the study area. |
| Sweetmilk Sike | Flows north into the River Eden, in the south of the study area, flows under Sweetmilk Bridge by New Bewley Castle. |
| Teas Sike | Flow north before splitting to feed Sweetmilk Sike, in the south of the study area. |

| Watercourse | Description |
|---|---|
| Unnamed Tributary of River Eden 4.1 | Flows north into the River Eden at Limekiln Hill after an artificially straightened stretch, in the central east of the study area. |
| Unnamed Tributary of Birk Sike 1.1 | Flows south and into Trout Beck, culverted under the railway line and flows into Birk Sike, in the north-west of the study area. |

### *Topography*

14.2.4.6 Levels generally fall north-east to south-west along the scheme towards the River Eden valley. Carriageway drainage catchments are determined by undulating topography across the scheme. See ES Figure 14.2: Existing Flood Risk (Application Document 3.3) for contours.

### *Geology and soils*

14.2.4.7 A complete description of the geological and soils context is provided in ES Chapter 9: Geology and Soils (Application Document 3.2) and ES Appendix 14.6 Hydrogeological Impact Assessment (Application Document 3.4).

14.2.4.8 Existing ground materials are a combination of cohesive and granular tills. Little lithological sequencing between types can be established, particularly over the western (Kirkby Thore Bypass) section, the materials appearing as sheets and lenses of varying lateral and vertical extents overlying Penrith Sandstone at relatively shallow depth. The sandstone often is weathered to appear as Sand and gravelly Sand. To the east of Trout Beck towards Appleby cohesive tills (GT_CO) predominate. Based upon total exploratory depths during the 2021 ground investigation an estimate of proportion can be established. Based on plasticity criteria, the relevant proportions in SHW material classes 2A (wet cohesive) and 2C (stony cohesive) are also indicated.

## Existing drainage

### *Background*

14.2.4.9 The existing drainage models have been produced using HADDAMS data, Existing drainage drawings and using drainage design assumptions. Using this information an existing hydraulic model has been produced using Micro Drainage software.

### *Description of existing drainage*

14.2.4.10 Prior to outline drainage design of the proposed A66 Route and associated side roads an understanding of the existing drainage was required. All existing outfalls needed to be identified to ensure that they can be assessed.

14.2.4.11 The existing drainage networks consists primarily of:

- Carrier Drains
- Filter Drains

- Existing attenuation pond

14.2.4.12 The majority of the existing drainage catchments outfall to an existing watercourse (see Annex C). The exception is existing catchment EX-A, this existing catchment prior to outfall on the River Eden passes through an attenuation pond.

### *Assessment of catchment areas and existing runoff rates*

14.2.4.13 Following review of the received information, seventeen existing drainage catchments have been identified and hydraulic models have been produced. For each of these existing catchments the catchment areas have been calculated and individual catchment outfalls identified see in Table 13: Temple Sowerby to Appleby existing discharge rates.

14.2.4.14 The majority of the existing drainage catchments are not affected by the proposed alignment of the scheme. The catchments affected by the scheme are those located a tie in points of the Temple Sowerby Bypass and of the Appleby Bypass. The proposed highways alignment also impacts the downstream drainage of the Kirkby Thore Highway Drainage Network (Catchment EX-N & O) (see Annex C).

14.2.4.15 An assessment of the impacts of a new cycleway on the A66 existing drainage network was undertaken. And concluded no additional work to the drainage network would be required.

14.2.4.16 In addition, several watercourses are impacted by the proposed works. These impacted watercourses take flows from existing highway drainage catchments, existing cut-off ditches and take flows from scheme catchments.

### *Hydraulic modelling of existing highway surface water drainage networks*

14.2.4.17 Hydraulic models of the existing drainage networks have been created and existing discharge rates calculated. A summary of discharge rates can be seen in Table 13: Temple Sowerby to Appleby existing discharge rates.

Table 13: Temple Sowerby to Appleby existing discharge rates

| Catchment | Drained Area (ha) | Return Period | Discharge Rate (l/s) (Flood) |
|---|---|---|---|
| EX-A | 3.583 | 1 in 1 Year | 94.6 (13.$m^3$) |
| | Note: This catchment contains a HydroBrake which we have no information for. Assumed 90l/s Limit | 1 in 5 Year | 100.4 (129$m^3$) |
| | | 1 in 100 year | 101.1 (634$m^3$) |
| EX-B | 0.937 | 1 in 1 Year | 66.3 |
| | | 1 in 5 Year | 99 |
| | | 1 in 100 year | 118.3 (44$m^3$) |
| EX-C | 0.453 | 1 in 1 Year | 35.9 |

| Catchment | Drained Area (ha) | Return Period | Discharge Rate (l/s) (Flood) |
|---|---|---|---|
| | | 1 in 5 Year | 54.9 |
| | | 1 in 100 year | 89.3 (4m$^3$) |
| EX-D | 0.634 | 1 in 1 Year | 40.2 |
| | | 1 in 5 Year | 51.2 |
| | | 1 in 100 year | 55.9 (44m$^3$) |
| EX-E | 0.111 | 1 in 1 Year | 12.1 |
| | | 1 in 5 Year | 20.2 |
| | | 1 in 100 year | 37.2 |
| EX-F | 0.057 | 1 in 1 Year | 6.4 |
| | | 1 in 5 Year | 10.8 |
| | | 1 in 100 year | 20.3 |
| EX-G | 1.027 | 1 in 1 Year | 45.9 |
| | | 1 in 5 Year | 74.3 (0.3m$^3$) |
| | | 1 in 100 year | 118.2 (19m$^3$) |
| EX-H | 1.345 | 1 in 1 Year | 62.4 |
| | | 1 in 5 Year | 97.3 (5m$^3$) |
| | | 1 in 100 year | 153.4 (60m$^3$) |
| EX-I | 0.685 | 1 in 1 Year | 50.6 |
| | | 1 in 5 Year | 85.1 |
| | | 1 in 100 year | 120.8 (4m$^3$) |
| EX-J | 0.826 | 1 in 1 Year | 64.5 |
| | | 1 in 5 Year | 108.9 |
| | | 1 in 100 year | 182.3 (0.6m$^3$) |
| EX-K | 0.344 | 1 in 1 Year | 31.7 |
| | | 1 in 5 Year | 52 |
| | | 1 in 100 year | 93.3 |
| EX-L | 0.552 | 1 in 1 Year | 51.5 |
| | | 1 in 5 Year | 78.5 |
| | | 1 in 100 year | 125.2 (14m$^3$) |
| EX-M | 2.306 | 1 in 1 Year | 127.1 (0.4m$^3$) |
| | | 1 in 5 Year | 168.7 (21m$^3$) |
| | | 1 in 100 year | 187.9 (234m$^3$) |
| EX-N | 2.227 | 1 in 1 Year | 173.7 |
| | | 1 in 5 Year | 244.3 (8m$^3$) |
| | | 1 in 100 year | 357.7 (150m$^3$) |

Note: Existing catchment IDs only refer to existing catchments and not those proposed as part of the Project

## Proposed drainage

### *Collection system design*

14.2.4.18 A number of surface water collections systems will be utilised.

#### National Highways A66 Collection System

- Primary surface water collection system will be road edge concrete surface water channels.
- Laybys and refuge areas will be drained using either concrete surface water channels or gullies
- Bridge Deck Drainage units will be used to drain surface water on bridge sections.
- Filter drains will be used where required, including highway verges where the verge is contained by earthworks and cuttings/embankments.
- Open ditches and/or filter drains will be used to intercept and convey overland flow from areas outside of the highway corridor.

#### Local Authority Roads Collection System

- Primary surface water collection system will be gullies.
- Filter drains will be used where required, including highway verges where the verge is contained by earthworks and cuttings/embankments.
- Open ditches and/or filter drains will be used to intercept and convey overland flow from areas outside of the highway corridor.

14.2.4.19 For the National Highways route, the primary drainage collection system will consist of concrete surface water channels (SWC). For this scheme SWC will be placed on the road edge adjacent to the hard strip and will drain surface water from the A66 carriageway, verges, embankments, and the central reserve.

14.2.4.20 The design of the surface water channels is in accordance with *DMRB CD 521*. The proposed vertical and horizontal highways alignment has been assessed using the process outlined in Section 4 – Design Process of *DMRB CD 521*.

14.2.4.21 The position of surface water channels in relation to the pavement edge shall follow the guidance provided in *DMRB CD 524*.

14.2.4.22 Where gullies are used, gully spacing will be determined as part of detailed design in accordance with *DMRB CD 526*.

14.2.4.23 Combined kerb and drainage systems will be designed in accordance with *DMRB CG 501*.

14.2.4.24 A simple assessment of the minimum required discharge capacity of the combined kerb and drainage systems is based on the Rational Method Equation $Q = 2.78\ CiA$, where:

- 'Q' is the design peak rate of runoff (l/s)
- 'C' is a non-dimensional runoff coefficient (taken as 1.0)
- 'i' is the design rainfall intensity (mm/hr)

- 'A' is the total catchment area (ha)
- Note: 2.78 is a conversion factor to address the rainfall units being in mm/hr

### *Pollution controls*

14.2.4.25 In accordance with *DMRB CG 501*, the selection of pollution control measures has been determined following the process outlined below:

- Complete assessment in accordance with *DMRB LA 113*
- If mitigation is required, identify viable options/combinations of measures, taking account of
  - Road drainage hierarchy
  - Site constraints
  - Storm flow and flood risk requirements
  - Climate change allowances
  - Road geometry
- Review short list of options against construction and maintenance requirements
- Confirming the measures fulfil water quality requirements - these are presented in ES Appendix 14.3: Water Quality Assessment (Application Document 3.4)

14.2.4.26 The pollution control measures vary for each proposed outfall, and include a combination of the following measures:

- Wet attenuation ponds with sediment forebays
- Vortex grit separators
- Vegetated ditches

14.2.4.27 Water quality assessments have been undertaken to ensure sufficient mitigation measures have been incorporated at each outfall. Details of the HEWRAT assessment are provided in ES Appendix 14.3: Water Quality Assessment (Application Document 3.4).

14.2.4.28 Table 14: Temple Sowerby to Appleby pollution control mitigation measures outlines the pollution control mitigation measures included at each proposed outfall.

Table 14: Temple Sowerby to Appleby pollution control mitigation measures

| Catchment | Attenuation pond | Grit Separator | Vegetated Ditch |
|---|---|---|---|
| S0405-01 | Y | N | Y |
| S0405-02 | N | N | N |
| S0405-03 | N | N | N |
| S0405-04 | Y | N | N |
| S0405-05 | Y | Y | Y |
| S0405-06 | Y | N | N |
| S0405-06b | N | N | N |
| S0405-07 | Y | N | N |
| S0405-08 | Y | N | N |
| S0405-09 | Y | N | Y |

| Catchment | Attenuation pond | Grit Separator | Vegetated Ditch |
|---|---|---|---|
| S0405-010 | Y | N | N |
| S0405-011 | Y | N | N |
| S0405-012 | Y | N | N |
| S0405-012a | N | N | N |
| S0405-012b | N | N | N |
| S0405-013 | Y | N | N |
| S0405-014 | Y | N | N |
| S0405-015 | Y | Y | Y |
| S0405-016 | Y | Y | Y |
| S0405-017 | N | N | N |
| S0405-018 | Y | N | Y |
| S0405-019 | N | N | N |
| S0405-020 | N | N | N |
| S0405-EX-D | N | N | N |

### *Climate change*

14.2.4.29 In accordance with *DMRB CG 501*, a 20% increase to peak rainfall intensity should be considered the minimum accommodated within the drainage design in order to account for potential climate change.

14.2.4.30 The Environment Agency has produced guidance, available on the gov.uk website, relating to allowances that should be made for climate change. Climate change allowances relating to increased peak rainfall intensity are outlined Table 15: Peak rainfall intensity allowance in small and urban catchments - Temple Sowerby to Appleby.

Table 15: Peak rainfall intensity allowance in small and urban catchments - Temple Sowerby to Appleby

| Applies across all of England | Total potential change anticipated for the '2020s' (2015 to 2039) | Total potential change anticipated for the '2050s' (2040 to 2069) | Total potential change anticipated for the '2080s' (2070 to 2115) |
|---|---|---|---|
| Upper end | 10% | 20% | 40% |
| Central | 5% | 10% | 20% |

14.2.4.31 Environment Agency guidance is to assess both the central and upper end allowances to understand the range of impact.

14.2.4.32 EA have advised that there is a proposed increase in allowances for climate change within the Cumbria region. Accordingly, a 50% climate change allowance has been included as a sensitivity check.

### *Surface water storage*

14.2.4.33 The proposals lead to a substantial increase in impermeable area draining to local watercourses.

14.2.4.34 In accordance with *DMRB CG 501*, the proposed drainage design will ensure that there is no increase in runoff rates as a result of the proposals. To achieve this, existing runoff rates have been assessed and flow control devices incorporated into the drainage systems. Storage for surplus flows has generally been provided using attenuation ponds.

14.2.4.35 The detailed design will be based on updated geotechnical information, and at that stage disposal via infiltration will be explored to see if it is a practicable option. If it is not, the regulated hierarchy of discharge will be followed in finalising the drainage design. Also refer to the Karst section regarding dissolution features that are present on this scheme.

14.2.4.36 Detailed design will be base

14.2.4.37 The proposed drainage design makes an allowance for potential climate change. A 40% increase to rainfall intensity has been included when considering surface water storage, and attenuation ponds designed to ensure no flooding occurs during the critical 1 in 100-year storm.

### *Hydraulic modelling of proposed highway surface water drainage networks*

14.2.4.38 The proposed main carrier drainage network and surface water storage has been modelled using MicroDrainage software.

14.2.4.39 FSR rainfall data has been used, with global variables (M560, r) to suit the site location.

14.2.4.40 The equivalent impermeable area draining to proposed networks has been obtained by applying the following factors to the measured contributing areas: -

- Paved surfaces - 1.00
- Verges contained by embankments/cutting slopes - 0.5
- Embankments/Cutting Slopes - 0.25
- Attenuation pond surfaces - 1.00

14.2.4.41 Networks have been established to suit proposed vertical alignments and potential outfall locations.

14.2.4.42 HydroBrake flow controls have been incorporated downstream of attenuation ponds, with flow rates restricted to those detailed in Table 4-2: Temple Sowerby to Appleby existing discharge rates.

14.2.4.43 Table 16: Temple Sowerby to Appleby proposed catchments table below, is a summary of proposed total catchment area size, percentage of impermeable area within each catchment and the volume of attenuation required to achieve the peak permitted discharge rate calculated for the corresponding existing catchment (see above). This is to ensure the proposed discharge rates are no greater than existing.

Table 16: Temple Sowerby to Appleby proposed catchments

| Catchment | Drained Embankment Area (ha) | Drained Verge Area (ha) | Drained Highway Area (ha) | Volume of storage provided[a] (m3) | Peak Permitted Flow Rate[b] (l/s) |
|---|---|---|---|---|---|
| S0405-01 | 0.645 | 1.618 | 1.109 | 1605 | Existing N |
| S0405-02 | 0.350 | 0.060 | 0.483 | 0 | Existing M |
| S0405-03 | 0.303 | 0.029 | 0.087 | 0 | Existing N |
| S0405-04 | 1.274 | 1.061 | 1.148 | 2410 | 22.32 |
| S0405-05 | 0.728 | 0.864 | 1.428 | 3370 | 18.00 |
| S0405-06 | 0.630 | 0.490 | 0.290 | 580 | 7.90 |
| S0405-06b | 0.010 | 0.210 | 0.230 | NA | 94.80 |
| S0405-07 | 0.984 | 1.221 | 1.186 | 2076 | 17.64 |
| S0405-08 | 1.345 | 2.716 | 5.665 | 5339 | 40.80 |
| S0405-09 | 2.323 | 1.705 | 1.841 | 2010 | 35.10 |
| S0405-010 | 0.000 | 0.346 | 0.374 | 500 | 42.10 |
| S0405-011 | 0.000 | 0.149 | 0.202 | 684 | 45.00 |
| S0405-012 | 0.135 | 0.290 | 0.370 | 1500 | 4.70 |
| S0405-012a | 0.000 | 0.175 | 0.146 | 0 | 64.60 |
| S0405-012b | 0.622 | 0.122 | 0.207 | 0 | 48.10 |
| S0405-013 | 3.905 | 2.417 | 2.252 | 4264 | 28.20 |
| S0405-014 | 1.225 | 0.999 | 0.910 | 1441 | 12.25 |
| S0405-015 | 3.509 | 2.601 | 2.556 | 3950 | 40.00 |
| S0405-016 | 0.795 | 1.241 | 1.417 | 2600 | 22.00 |
| S0405-017 | 1.240 | 0.200 | 0.870 | 0 | Existing M |
| S0405-018 | 0.514 | 0.752 | 0.598 | 1945 | 10.00 |
| S0405-019 | 0.729 | 0.000 | 0.259 | 0 | 107.20 |
| S0405-020 | 0.726 | 0.000 | 0.000 | 0 | 75.90 |
| S0405-EX-D | 0.400 | 0.000 | 0.850 | 0 | 166.50 |

a – Volume provided in design from normal water level to 300mm below access track level, as per guidance provided in The SuDS Manual (CIRIA C753).

b – 1 in 100-year storm, 40% climate change.

c – Existing highway realigned with same cross section, new drainage system provided.

d – Peak modelled flow rate from realigned drainage system.

e – Drained area taken from record drawings. All assumed to be 100% impermeable.

### *Exceedance flood routing*

14.2.4.44 All drainage attenuation ponds are designed for a 1 in 100-year storm with a 40% climate change allowance. All attenuation ponds in the Temple Sowerby to Appleby study area are located on the downstream side of the A66 so that any exceedance flow from the drainage attenuation ponds will be to the downstream watercourse away from the carriageway.

14.2.4.45 At detailed design, the highway and drainage designs will consider the overland flow routes of exceedance flows, and where possible provide a route for exceedance flows that minimises the risk of flooding of properties. The routing of exceedance flows will follow the discharge pipe route to receiving waters, where possible.

### *Existing watercourses*

14.2.4.46 In accordance with *DMRB CG 501* and *DMRB LA 113* the proposed highways and drainage design where possible limit impact on Environment Agency Main Rivers and ordinary watercourses. Where a watercourse has been disrupted by the proposed highways alignment a proposed culvert has been sized appropriately to allow the flow from the watercourse to be uninterrupted.

14.2.4.47 During detailed design the following will be required:

- All new culverts will be designed in accordance with DMRB CD 529 details and in consultation with relevant stakeholders (e.g. LLFA or EA).
- All culverts with a diameter of 900mm and above will require structural design
- It is the design intention to maintain existing outfalls on existing watercourse and to not increase the discharge rate of these outfalls (see Table 13: Temple Sowerby to Appleby existing discharge rates)
- Where new outfalls are required the individual outfall details will be designed in accordance with DMRB CD 529 and in consultation with relevant stakeholders (e.g. LLFA or EA).

### *Land drainage and overland flow*

14.2.4.48 Where land outside of the highway corridor falls towards the highway, cut-off drainage has been provided as part of the design. Cut-off drainage will intercept and convey overland flow around the highway corridor, so that this flow does not enter the highway drainage system or cause flooding issues on the proposed highway.

14.2.4.49 Proposed cut-off drainage ditches will be of a minimum depth of 0.75 meters and will outfall to the nearest watercourse (see Annex A).

14.2.4.50 Cut-off drainage will intercept and convey overland flow around the highway corridor, so that this flow does not enter the highway drainage system or cause flooding issues on the proposed highway.

### *Karst Risk*

14.2.4.51 Karst is an area of land formed of rock such as limestone that is worn away by water to make caves and other formations.

14.2.4.52 Karst Risk, is a natural human induced hazard in karst areas, resulting in dissolution of soluble rocks such as limestone, dolomite, and gypsum, potentially resulting in collapse or sink holes.

14.2.4.53 Infiltration systems must not be used close to dissolution features. All ponds and drainage systems to be lined where the karst risk is classed as Medium or High.

14.2.4.54 Maintenance access to all drainage systems shall be provided to allow a suitably experienced and qualified professionals to monitor karst risk regularly.

## Flood Risk Assessment

### *Data collection*

14.2.4.55 The risk of flooding to the development has been assessed on readily available information, published on the Environment Agency website.

14.2.4.56 In addition to readily available information, JBA has undertaken baseline hydraulic modelling of existing watercourse/culvert crossings. This modelling establishes flooding in the vicinity of the existing A66.

### *Flood risk vulnerability classification*

14.2.4.57 Guidance for flood risk vulnerability for new development sites is set out in the Government planning portal for flood risk and coastal change. Table 6: Flood risk vulnerability classification is used as a guide to help determine if new development sites should or should not be permitted, based upon the vulnerability classifications set out on the planning portal.

14.2.4.58 In accordance with *DMRB LA 113*, NI/1.7, the development is classified as “Essential Infrastructure”.  The development is therefore permitted providing it is located within Flood Zones 1 or 2, with the exception test required if located in Flood Zones 3a or 3b.

### *Sequential Test*

14.2.4.59 As part of a Flood Risk Assessment a sequential test is required when the proposed development is located within Flood Zone 2 or 3. The sequential test compares the proposed site with other available sites to find out which has the lowest flood risk.

14.2.4.60 The design team considered alternative alignments which would still meet the Project requirement to dual the A66 from the M6 to the A1(M).

14.2.4.61 As part of this review, a total of 15 principal alternative routes or combination of routes were identified, considering potential environmental impacts, Project design principles, impacts on landowners, buildability, and design safety.

14.2.4.62 A full extensive write up of this review can be seen in Project Development Overview Report (Application Document 4.1).

14.2.4.63 This review identifies the proposed route is the most favourable with the least environmental impacts, impacts on landowners, buildability, design safety, whilst maintaining Project design principles.

### *Exception Test*

14.2.4.64 The proposed scheme is located within flood zone 3. In accordance with Table 2 of the Flood Risk and Coastal Change guidance, the proposed alignment has been assessed as being Essential Infrastructure and therefore the exception test is required.

14.2.4.65 The 2 parts to the test require the proposed development to show that it will provide wider sustainability benefits to the community that outweigh flood risk, and that it will be safe for its lifetime, without increasing flood risk elsewhere and where possible reduce flood risk overall.

14.2.4.66 To answer the first part of the assessment, refer to Case for the Project (Application Document 2.2) which highlights the Social, Environmental and Economic benefits for the proposed Nationally Significant Infrastructure Project. Including:

- safety – a consistent standard of dual carriageway, to reduce the number of accidents. Use of the 'old' A66 as part of the local road network will provide better, safer routes for cyclists and pedestrians.
- connectivity – improving connectivity for people living and working nearby and creating better facilities for cyclists and pedestrians. Reducing congestion and improving the reliability of people's journeys between the M6 at Penrith and the A1(M) Scotch Corner and nationwide. It also improves connectivity between the key employment areas of Cumbria, Tees Valley and Tyne and Wear.
- environmental – minimising noise levels for people living and working near the route and reducing the congestion currently occurring in the single carriageway sections. The scheme is also being designed to minimise any potential negative impacts on the natural environment and landscapes of the North Pennines and Lake District.
- economic – improving strategic regional and national connectivity, particularly for hauliers. Heavy goods vehicles account for a quarter of all traffic on the road and any delays to journeys can have an extremely negative effect on business and commerce, including lost working time and missed shipment slots.
- tourism – improving access to key tourist destinations such as the North Pennines and Lake District.
- community – re-connecting communities and providing better links between settlements along the route as well as improving access to services such as healthcare, employment areas and education.
- capacity – reducing delays and queues during busy periods and improving the performance of key junctions such as the A66/A6 and the M6 junction 40.

- increasing reliability – an improved A66, will lead to less accidents which, in turn, makes the road more reliable. Also, having a dual carriageway provides the option to close lanes where required due to accidents or break downs and keep traffic moving

14.2.4.67 To answer the second part of the Exception test, refer to the Flood Risk Mitigation section below which outlines how the scheme proposes to mitigate flooding of the carriageway and downstream of the scheme.

14.2.4.68 The proposed design will be constructed to remain operational and safe in times of flooding from fluvial, surface water and groundwater sources.

14.2.4.69 The proposed design results in no net loss of flood plain storage as outlined in the Flood Compensatory Storage section below. This has been achieved using level for level compensatory storage for locations where the alignment has been raised outside of the flood level.

14.2.4.70 The design does not impede existing water flows as cut of ditches intercept overland flows and conveys water in a controlled manner to its receiving watercourses.

14.2.4.71 As demonstrated in Case for the Project (Application Document 2.2), the A66 constitutes nationally significant Essential Infrastructure. The improvements proposed for the A66 will provide wider sustainability benefits to the community that outweigh the flood risk posed by the exceptional circumstances which would result in a reservoir breach scenario. The Exception Test would therefore be satisfied by the proposed A66 improvements for Temple Sowerby to Appleby.

### *Flooding from rivers or the sea*

14.2.4.72 Baseline flood risk from rivers and sea using Environment Agency data is shown on ES Figure 14.2: Existing Flood Risk (Application Document 3.3).

14.2.4.73 On review of the Environment Agency *Flood Map for Planning* it is noted that there are areas of the existing A66 that is located within Flood Zone 3. The Flood Zone 3 area for the scheme is located at the proposed viaduct over Trout Beck. Flood Zone 3 is defined as land assessed as having a 1 in 100 or greater annual probability of river flooding (1%), or 1 in 200 or greater annual probability of sea flooding (0.5%) (Land shown in dark blue on ES Figure 14.2: Existing Flood Risk (Application Document 3.3)).

14.2.4.74 There are also areas of the existing A66 and the scheme that are located within Flood Zone 2. Flood Zone 2 is defined as land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding: or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.

14.2.4.75 To aid the design of the alignment and drainage design, baseline flood modelling was undertaken by JBA Consulting. See ES Figure 14.2.

14.2.4.76 This modelling will be used to understand the existing situation, in particular around Trout Beck crossing

14.2.4.77 Once the proposed design was concluded, proposed flood modelling was undertaken by JBA to analyse the impact of the proposed alignments and drainage assets on the flood volumes and locations.

14.2.4.78 Baseline fluvial modelling undertaken for the scheme has highlighted increased flood risk extent around Trout Beck in comparison with the Environment Agency mapping. An additional area of flood risk has been identified associated with Unnamed Tributary of Trout Beck 4.5 and Unnamed Tributary of Trout Beck 4.6, both north and south of the existing A66 respectively.

14.2.4.79 Refer to Flood Risk Mitigations section below.

### *Surface water flooding*

14.2.4.80 On review of the Environment Agency *Flood Map* flood risk from surface water sources, areas of the existing A66, local roads, low points and areas adjacent to watercourses that are at risk of surface water flooding. Surface water flooding (1 in 30 year return period) is shown on ES Figure 14.2: Existing Flood Risk (Application Document 3.3). The scheme will increase surface waterflooding due to cutting off existing flow paths, unless mitigation is included within the proposed drainage and highways design.

14.2.4.81 Cut-off drainage has been provided where land outside of the highway corridor falls towards the highway. The cut-off drainage will intercept and convey surface water flows around the highway.

### *Historic flooding*

14.2.4.82 Environment Agency data show historic flooding events associated with Thacka Beck within Penrith in 2002 and 2005. Historic flooding associated with the River Eamont has also occurred south of the existing A66 around the area of Skirsgill in 1995, 1997, 2005 and 2015. A further area of flooding occurred in 2005 associated with the River Eamont and River Lowther in the east of the study area, around Brougham. These events did not impact the A66 carriageway.

### *Existing highway drainage flooding*

14.2.4.83 HADDMS identifies a number of locations along the existing A66 for this scheme that are, or have previously been subject to flooding.

14.2.4.84 There are 2 closed/historic events and there are no open events recorded.

14.2.4.85 The closed/historic events relate to blockages of kerb drains and gullies.

14.2.4.86 HADDMS also identifies 2 Flooding hotspots as follows; ID 1106, A66 Kirkby Thore, with only 1 recorded flood event in 2018 believed to be as a result of an issue with existing drainage. No further information is available.

14.2.4.87 ID 1107, A66 South of Crackenthorpe, with 2 to 5 recorded flood events since 2020 believed to be as a result of a blockage. No further information is available.

14.2.4.88 From site visits, we have identified one area just off the A66, north of Kirkby Thore Primary School which looks to experience severe flooding. Initial investigations shows an existing ditch which has been piped through which has resulted in overland flows not reaching the pipes system.

### *Groundwater flooding*

14.2.4.89 The scheme is susceptible to groundwater flooding in accordance with the Groundwater Flooding Susceptibility map in Environmental Statement Figure 14.8. A complete description of the groundwater context is provided in the Environmental Statement Appendix 14.6 Hydrogeological Impact Assessment.

14.2.4.90 Where the scheme is at or above existing ground level the risk of groundwater flooding is considered to be low because the proposed drainage systems will reduce the ground water levels in the vicinity of the scheme to below the formation level of the road.

14.2.4.91 There are a number of areas across the scheme where the route is in cutting. A sub surface filter drainage system will be provided to these areas, or the area will be lined, should high groundwater be assessed as a risk during detailed design.

### *Flooding from reservoirs*

14.2.4.92 The Environment Agency *Flood Map* indicates that the scheme is outside of the maximum extent of flooding from reservoirs.

### *Flooding from other Artificial Waterbodies*

14.2.4.93 The scheme is not at risk of flooding from other artificial waterbodies. This has been assessed based on the scale of the other artificial waterbodies in relation to the local topography and carriageway elevation.

### *Coastal flooding*

14.2.4.94 The Environment Agency *Flood Map* indicates that the scheme is outside of the maximum extent of flooding from coastal flooding.

### *Flooding from sewers*

14.2.4.95 There are no reports of flooding from existing public sewers. United Utilities shall be consulted throughout the detailed design process to ensure that any risk identified is managed appropriately.

### *Flood risk mitigation*

14.2.4.96 The detailed design of the proposed highway drainage will be in accordance with current design standards specifically the Design Manual for Roads and Bridges (DMRB) and the Manual of Contract Documents for Highway Works (MCHW). By following these design standards, the design of the A66 NTP S0405 Temple Sowerby to Appleby will have low risk of surface water flooding and low risk from fluvial flooding.

14.2.4.97 Flood risk from groundwater will be mitigated through cut-off drains at all highway earthworks cuttings and embankments.

14.2.4.98 In addition to the above, proposed methods of Flood Mitigation is outlined below.

### Attenuation

14.2.4.99 The detailed design of the proposed highway drainage will be in accordance with current design standards specifically the Design Manual for Roads and Bridges (DMRB) and the Manual of Contract Documents for Highway Works (MCHW). By following these design standards, the design of the A66 NTP S0405 Temple Sowerby to Appleby will have low risk of surface water flooding and low risk from fluvial flooding.

14.2.4.100 The design of the A66 NTP S0405 Temple Sowerby to Appleby leads to a substantial increase the impermeable area.

14.2.4.101 In Accordance with *DMRB CG 501*, the proposed drainage design will ensure that there is no increase in discharge rates at each outfall. To achieve this, any increase in impermeable area as a result of the proposed alignment will need to be attenuated prior to the discharge, with sufficient storage for a 1 in 100 AEP design storm including an increase for current climate change allowances.

14.2.4.102 The detailed design will be based on updated geotechnical information, and at that stage disposal via infiltration will be explored to see if it is a practicable option. If it is not, the regulated hierarchy of discharge will be followed in finalising the drainage design. Also refer to the Karst section regarding dissolution features that are present on this scheme.

14.2.4.103 The proposed attenuation will ensure that the flooded volume is no greater than existing.

### Flow path

14.2.4.104 Drainage flow paths during storm events have been considered as part of the design process. The road alignment and drainage collection systems expediate the flow of water from trafficked and hard standing areas to minimise the risk of standing water on the carriageway.

14.2.4.105 For higher rainfall return periods and in the event of drainage blockages, exceedance flow paths shall direct flood water downstream to watercourses.

### Flood compensatory storage

14.2.4.106 Proposed design includes flood compensation for when the proposed highway design is located within an area identified as a functional flood plain. For these said areas the total flood volume will be provided via flood compensation areas. The flood volume is calculated from using the baseline flood model.

14.2.4.107 Based on the operational flood model, Trout Beck Crossing results in a reduction in functional flood plain of 1760m$^3$. See ES Figure 14.2 : Existing Flood Risk (Application Document 3.3).

14.2.4.108 To offset this, two areas of compensatory storage have been designed into the 3D Model totalling 1761.2m$^3$. This volume is split over two locations on a level for level basis. As the flood water rises, the immediate loss in flood volume from the bridge piers is offset by the proposed compensatory storage. Refer to Annex C.

14.2.4.109 The flood compensation areas shall be refined at detailed design to suit the topography, flood modelling and to blend the storage areas into the existing flood plain landscape. Space has been provided within the Order Limits for this.

## Conclusion

### *Summary*

14.2.4.110 The Environment Agency *Flood Maps* show that areas within the Order Limits are located within Flood Zones 2 and 3. Correspondence with the Environment Agency provided further information about the flood risk in this area. To support the drainage design process additional flood modelling was undertaken to provide an existing flooding baseline.

14.2.4.111 Fluvial modelling has been conducted to determine the potential impacts as a result of the scheme on the flood volumes and locations.

14.2.4.112 Surface water run-off will be attenuated within the proposed highway drainage system to mitigate off-site flooding. To mitigate the risk of surface water flooding on the proposed highway sustainable drainage techniques shall be further developed during detailed design.

14.2.4.113 Additional storage is provided within the new drainage system to allow for the anticipated increase in rainfall intensities due to climate change. The attenuation is designed to manage flows to the 1 in 100-year event plus 20% climate change uplift value. A sensitivity check on the drainage design has also been conducted to include the 1 in – 100-year event plus 40% climate change uplift value.

14.2.4.114 Water quality mitigation measures have been incorporated in the proposals.

14.2.4.115 The scheme is not considered to be at risk of flooding from the sea and is considered to be at low risk of flooding from rivers, surface water and groundwater. The risk of flooding from reservoirs is managed through the enforcement of the Reservoirs Act 1975 by the Environment Agency.

#### *Residual risks*

14.2.4.116 The key residual risks associated with the drainage / flood risk are as follows:

- Flood events in excess of the design standard – the capacity of the designed drainage system will minimise the impact of exceedance events.
- Blockages in the drainage system – managed through routine and/or reactive maintenance.
- Incidents of historic flooding to the existing A66 will be investigated during future design and mitigation incorporated where appropriate.

## 14.2.5 Appleby to Brough

### Introduction

14.2.5.1 This section of the document details the proposed design for this scheme, which runs from Appleby to Brough, and to the north of Warcop. The location of the scheme is shown on ES Figure 14.1: Surface Water Features (Application Document 3.3).

14.2.5.2 The drainage for this scheme has been designed in accordance with the Standards for Highways Design Manual for Roads and Bridges and in accordance with relevant Local Authority design standards as detailed in the introduction.

### Baseline conditions

#### *Surface watercourses*

14.2.5.3 Watercourses within the study areas drain into the River Eden (Main River) via several tributaries.

14.2.5.4 All watercourses in the study area, with the exception of the River Eden, drain from fells to the north of the study area and flow through predominately agricultural land and some small settlements, including Warcop and Sandford.

14.2.5.5 Table 17: Watercourses within Appleby to Brough study area gives a brief description of the surface water receptors within the study area (from west to east) which are also displayed on ES Figure 14.1: Surface Water Features (Application Document 3.4).

Table 17: Watercourses within Appleby to Brough study area

| Watercourse | Description |
|---|---|
| Hilton Beck | Flows south in the north-west of the study area. Discharges into the Coupland Beck. |
| George Gill | Flows west into Coupland Beck, to the south of Brackenber, in the north-west of the study area. |
| Coupland Beck | Flows south into the River Eden, to the south of Coupland in the north-west of the study area and drains George Gill and Hilton Beck. |
| Lycum Beck | Flows south into the George Gill, in the west of the study area. |
| River Eden | Flows northwest, south of the existing A66, Warcop and Sandford in the north-west of the study area. |
| Greenber Sike | Flows north in the south-west of the study area, flowing into the River Eden east of Little Ormside. |
| Helm Beck | Flows north in the south-west of the study area, passing between Great Ormside and Little Ormside and into the River Eden. |
| Unnamed Tributary of Mire Sike 6.1 | Drain flows east from Middle Bank End, before flowing south and into Mire Sike to the south of Far Bank End. |
| Unnamed Tributary of Mire Sike 6.5 | Drainage that flows through Far Bank End farm and discharges into Unnamed Tributary of Mire Sike 6.1 |
| Unnamed Tributary of Mire Sike 6.4 | Flows west parallel to the existing A66 before joining Unnamed Tributary of Mire Sike 6.1 to the north of Far Bank End. |
| Unnamed Tributary of Mire Sike 6.8 | Flows south through Sandford Mire, three small drains discharge into it as it flows through the mire before discharging into Mire Sike. |
| Unnamed Tributary of Mire Sike 6.6 | Field drain that flows east from New Hall farm in the south of the study area and discharges into Unnamed Tributary of Mire Sike 6.8. |
| Unnamed Tributary of Mire Sike 6.12 | Flows south and crosses existing A66 to the west of Dike Nook, in the north-west of the study area. Watercourse flows into Mire Sike. |
| Unnamed Tributary of Mire Sike 6.13 | Flows west through an area of fen and joins Unnamed Tributary of Mire Sike 6.12 in a depression north of the existing A66. |
| Mire Sike | Crossed by the existing A66 to the south of Wheat Sheaf Farm in the centre of the study area. Watercourse flows north-west into the River Eden at the confluence to the west of Far Bank End. |
| Unnamed Tributary of Cringle Beck 6.1 | Flows south from Moor House and Hilton Road, passing adjacent east to Wheat Sheaf Farm, culverted under Eden Valley Railway before discharging into Cringle Beck. |
| Cringle Beck | Flows south then west into Mire Sike, crossing the existing A66 adjacent to the east of Wheat Sheaf Farm in the centre of the study area. It is also culverted under the Eden Valley Railway. |
| Unnamed Tributary of Cringle Beck 6.3 | Flows south and west culverted under the Eden Valley Railway. |
| Hayber Beck | Crossed by the existing A66 and flows south through the centre of the study area, where a weir splits the channel, and Moor Beck continues to the east while Moor Beck (Offtake) continues into the Warcop Training Camp. |

| Watercourse | Description |
|---|---|
| Moor Beck | Flows south-east from Hayber Beck, across open fields with an artificially straightened section and into Crooks Beck, in the centre of the study area. |
| Moor Beck (Offtake) | Flows south from Hayber beck after the split in channel. Artificial channel that supplies the fire ponds within the Warcop Training Camp before being culverted into Crooks Beck. |
| Eastfield Sike | Crossed by the existing A66 and flows south-west through the centre of the study area. Meets Moor Beck at a confluence and becomes Crooks Beck, to the east of Warcop. |
| Crooks Beck | Flows west though Warcop into the River Eden in the centre of the study area. Watercourse drains Hayber Beck, Eastfield Sike and Lowgill Beck. |
| Lowgill Beck | Flows under the existing A66 in the east of the study area. Flows west and drains into Crooks Beck. |
| Unnamed Tributary of Lowgill Beck 6.1 | Unnamed watercourse flows from Bale Hill to under the existing A66 into Lowgill Beck, towards the east of the study area. |
| Woodend Sike | Located in the east of the study area, the watercourse flows south before the confluence with Yosgill Sike (to the north of the existing A66) and becoming Lowgill Beck. |
| Yosgill Sike | Located in the east of the study area, the watercourse flows south before the confluence with Woodend Sike (to the north of the existing A66) and becoming Lowgill Beck. |
| Unnamed Tributary of Lowgill Beck 6.7 | Located in the east of the study area, the watercourse flows south, crossed by the existing A66 before feeding into Unnamed Tributary of Lowgill Beck 6.3. |
| Unnamed Tributary of Lowgill Beck 6.3 | Located in the south-east of the study area, the watercourse flows west and joins the Lowgill Beck just south of Broom Rigg. |
| Swindale Beck | Located in the east of the study area, the watercourse flows south crossed by the existing A66. Joins the River Eden approximately 2.8km downstream. |
| Augill Beck | Located in the east of the study area, the watercourse flows south crossed by the existing A66. Discharges into the Swindale Beck south-west of Brough Primary School. |
| Unnamed Tributary of Mire Sike 6.9 | Flows south-east, artificially straightened through fields, and then flows into Unnamed Tributary of Mire Sike 6.12, 150m north of the existing A66. |
| Unnamed Tributary of Mire Sike 6.10 | Located in south central areas of the study area. Flows west culverted in sections through Sandford Mire, parallel to the railway line, and joins Unnamed Tributary of Mire Sike 6.8 |
| Unnamed Tributary of Lowgill Beck 6.6 | Flows north, in the south-east of the study area, and into Lowgill Beck. |
| Unnamed Tributary of Lowgill Beck 6.5 | Flows south from and Brough Hill and joins Unnamed Tributary of Lowgill Beck 6.1 upstream of the crossing of the existing A66. |
| Unnamed Tributary of Augill Beck 1.1 | Flows south crossed by the existing A66, in the east of the study area, between Swindale Beck and Augill beck before joining Augill Beck downstream of a crossing with the A685. |

| Watercourse | Description |
|---|---|
| Unnamed Tributary of Yosgill Sike 1.1 | Flows west from Helbeck, in the north-east of the study area, and joins Yosgill Sike |
| Unnamed Tributary of Mire Sike 6.15 | Flows west in the central area of the study area, through agricultural fields and into the Mire Sike. |
| Unnamed Tributary of Lowgill Beck 6.8 | Flows north-west, in the south-west of the study area, and into Lowgill Beck upstream of its crossing with the B6259. |

### *Topography*

14.2.5.6 The east end of this section of the scheme is higher than the west end with the scheme undulating throughout its length. The low points are at Newhall Farm underpass and the watercourse crossings of Unnamed Tributary of Mire Sike 6.12, Moor Beck, Unnamed Ttributary of Lowgill Beck 6.1 and Lowgill Beck. The high points are at Wild Boar Hill, Flitholme and Brough slip road. See ES Figure 14.2: Existing Flood Risk (Application Document 3.3) for contours.

14.2.5.7 South of the existing A66, is the broad valley of the River Eden. To the north of the existing A66 are the North Pennines.

### *Geology and soils*

14.2.5.8 A complete description of the geological and soils context is provided in ES Chapter 9: Geology and Soils (Application Document 3.2) and ES Appendix 14.6: Hydrogeological Impact Assessment (Application Document 3.4).

14.2.5.9 The Preliminary Sources Study Report undertaken at the start of the geotechnical investigation confirmed the following for Scheme 06:

- this section traverses predominantly agricultural land with an absence of any particular development beyond the MoD facilities and general rural amenity, with the village of Warcop the only current settlement;
- the existing A66 lies along the original Roman road route;
- the main geotechnical risks to the scheme will arise from the buildings on the MoD training ground and any potential sources of contamination from those training activities such as fuel and munitions storage;
- further constraints arise from the presence of designated sites (SAC) associated with the River Eden, Hellbeck and Swindale Woods and Moor House-Upper Teesdale, Special Protection Area (SPA) of North Pennine Moors and areas of Special Scientific Interest (SSSI) of the River Eden, Appleby Fells and Hellbeck Wood; and
- there is a scheduled monument, Warcop Roman Camp, close to the development route. This is deemed to be of high value and of archaeological interest.

14.2.5.10 The Ground Investigation Report completed upon completion of the fieldwork confirmed the following ground model for Scheme 06 (from the west end):

- Ch.39900m – Ch.41000m. The material profile is expected to comprise topsoil overlying granular glacial till, which is in turn underlain by sand, weathered sandstone, and bedrock. Bedrock is a sequence of Penrith Sandstone and Brockram Conglomerate. Glacial till will be the material at formation level (permeability of the order of 1 x 10-6 m/s).
- CH.41000m to Ch.41750m. The new route is formed in alternate nominal cutting and on nominal embankment. Cohesive glacial till is likely to be the formation material.
- Ch.41750m to Ch.42100m. The cutting runs through the mainline at the new Sandford Junction, which incorporates a new underpass at Ch.41920m. The cutting is likely to be formed in granular glacial till while the foundation level for the underpass may be formed in any of the primary geological units.
- Ch.42100m to Ch.42900m. The route will be formed on low embankment, at which point it diverges to the south, leaving the existing A66. Materials at formation are potentially granular or cohesive till.
- Ch.42900m to Ch.43600m. The off-line section is formed on embankment on a sequence of interbedded cohesive glacial till, granular glacial till, fluvio-glacial deposits, and sand (weathered Penrith Sandstone).
- Ch.43700m to Ch.44700m. The route is formed on new embankment parallel to and adjacent to the existing A66 on its southern boundary. The embankment will be formed on a sequence of interbedded cohesive glacial till, granular glacial till, fluvio-glacial deposits, and sand (weathered Penrith Sandstone).
- Ch.44700m to Ch.45000m. The route will be formed in cutting up to 3m deep in cohesive glacial till.
- Ch.45 000m to Ch.45150m. There is a short section of low embankment on the same cohesive till.
- Ch.45150m to Ch.45600m. The route continues in cutting up to 5m depth. The expected soil profile comprises cohesive and granular glacial till.
- Ch.45600m to Ch.46100m. The route is on embankment. The soil profile comprises mainly granular glacial till, with lenses of sand and cohesive tills.
- Ch.46100m to Ch.46300m. A short section of shallow cutting in predominantly cohesive till, although granular till may also be present.
- Ch.46300m to Ch.46700m. This section is on embankment. The soil profile comprises a mix of interbedded granular and cohesive glacial tills, with lenses of fluvio-glacial till and sand.
- Ch.46700m to Ch.48000m. A significant length of cutting is required. Cohesive glacial till is likely to be present at formation level.

## Existing drainage

### *Background*

14.2.5.11 *HADDAMS* and Local Authority record drawings have been used to determine the form and location of all existing drainage. Whilst site visits have been undertaken to clarify existing drainage where possible, no intrusive drainage surveys have been undertaken at this stage of design. Where proposed drainage interfaces with existing drainage, CCTV surveys shall be undertaken prior to commencement of detailed design.

### *Description of existing drainage*

14.2.5.12 Existing drainage comprises a mixture of gullies, filter drains, and over the edge drainage, either onto adjacent land or into roadside ditches.

14.2.5.13 Positive drainage systems outfall into local watercourses at strategic locations.

### *Assessment of catchment areas and existing runoff rates*

14.2.5.14 The west end of the scheme is online (approximately 3.0km) and the east end is off-line (approximately 5.1km). Where carriageway levels are unaltered the existing drainage system for the de-trunked east end will remain unaltered.

14.2.5.15 Existing catchment areas considered in this section therefore relate to areas beneath the proposed alignment.

14.2.5.16 The proposed vertical alignment has been considered, and new outfall locations determined.

14.2.5.17 Existing topography has also been considered to ensure that only area beneath the proposed alignment that currently drains towards a proposed outfall location is included in the restricted flow rate calculations.

14.2.5.18 This approach ensures that flows to individual watercourses are not increased over the existing scenario.

14.2.5.19 The “Greenfield runoff rate estimation” tool developed by HR Wallingford has been used to assess existing “greenfield” runoff rates. The QBAR greenfield runoff rate of 5.27 l/s/ha has been allowed for runoff from greenfield/undeveloped areas.

14.2.5.20 Brownfield run-off rates have not been determined and conservatively greenfield run-off rates have been used for brownfield areas. The exceptions are catchments S06-01 and S06-02 where the availability of land to locate ponds is limited due to the extents of surface water flooding and environmental mitigation. For these catchments, the brownfield flow rate is based on a unit brownfield run-off rate of 140l/s/ha with a 30% betterment.

14.2.5.21 Table 18: Appleby to Brough existing drainage catchments summary shows existing catchments that drain to each of the proposed outfalls.

Table 18: Appleby to Brough existing drainage catchments summary

| Catchment | Existing Greenfield Area (ha) | Existing Brownfield Area (ha) | Existing Greenfield Flow Rate (l/s) | Existing Brownfield Flow Rate (l/s) | Restricted Flow Rate Applied to Outfall (l/s) |
|---|---|---|---|---|---|
| S06-01 | 3.53 | 0.17 | 9.60 | 16.51 a | 26.11 |
| S06-02 | 2.15 | 1.37 | 15.30 | 134.26 a | 149.56 |
| S06-03 | 3.63 | 0.6 | 23.87 | 3.95 | 27.82 |
| S06-04 | 0.97 | 0.26 | 9.39 | 2.49 | 11.88 |
| S06-05 | 2.34 | 0.048 | 16.98 | 0.35 | 17.33 |
| S06-06 | 0.078 | 0.065 | 1.05 | 0.88 | 1.93 |
| S06-07 | 4.08 | 0.67 | 31.62 | 5.19 | 36.81 |
| S06-08 | 2.59 | 0 | 23.54 | 0 | 23.54 |
| S06-09 | 7.93 | 0.99 | 41.76 | 5.21 | 46.97 |
| S06-10 | 3.10 | 0.57 | 28.02 | 5.15 | 33.17 |
| S06-11 | 1.56 | 0.02 | 15.85 | 0.20 | 16.05 |
| S06-12 | 1.28 | 0.26 | 8.36 | 1.70 | 10.06 |
| S06-13 | 0.89 | 0.05 | 6.28 | 0.35 | 6.63 |
| S06-14 | 6.90 | 0.02 | 50.14 | 0.15 | 50.29 |
| S06-15 | 0.72 | 0 | 7.28 | 0 | 7.28 |
| S06-16 | 0.78 | 0.01 | 4.23 | 0.05 | 4.28 |
| S06-17 | 0.17 | 0.08 | 1.82 | 0.86 | 2.68 |
| S06-18 | 1.36 | 1.50 | 15.01 | 16.55 | 31.57 |
| S06-19 | 2.3 | 0.12 | 14.13 | 0.74 | 14.87 |
| S06-20 | 0.73 | 0.11 | 5.02 | 0.76 | 5.78 |

a –. – Brownfield flow rate base on a factored unit brownfield run-off rate

### *Hydraulic modelling of existing highway surface water drainage networks*

14.2.5.22 As limited information was available for the existing drainage within Scheme 06 no hydraulic modelling of the existing drainage networks was undertaken. Hence brownfield run-off rates have not been determined and conservatively greenfield run-off rates have been used for brownfield areas.

## Proposed drainage

### *Collection system design*

14.2.5.23 A number of surface water collections systems will be utilised.

### *National Highways A66 Collection System*

- Primary surface water collection system will be road edge concrete surface water channels.
- Laybys and refuge areas will be drained using either concrete surface water channels or gullies
- Bridge Deck Drainage units will be used to drain surface water on bridge sections.
- Filter drains will be used where required, including highway verges where the verge is contained by earthworks and cuttings/embankments.
- Open ditches and/or filter drains will be used to intercept and convey overland flow from areas outside of the highway corridor.

### *Local Authority Roads Collection System*

- Primary surface water collection system will be gullies.
- Filter drains will be used where required, including highway verges where the verge is contained by earthworks and cuttings/embankments.
- Open ditches and/or filter drains will be used to intercept and convey overland flow from areas outside of the highway corridor.

14.2.5.24 For the Project, the primary drainage collection system will consist of concrete surface water channels. For this scheme surface water channels will be placed on the road edge adjacent to the hard strip and will drain surface water from the A66 carriageway, verges, embankments, and the central reserve.

14.2.5.25 The design of the surface water channels is in accordance with *DMRB CD 521*. The proposed vertical and horizontal highways alignment has been assessed using the process outlined in Section 4 – Design Process of *DMRB CD 521*.

14.2.5.26 The position of surface water channels in relation to the pavement edge shall follow the guidance provided in *DMRB CD 524*.

14.2.5.27 Where gullies are used, gully spacing will be determined as part of detailed design in accordance with *DMRB CD 526*.

14.2.5.28 Combined kerb and drainage systems will be designed in accordance with *DMRB CG 501*.

14.2.5.29 A simple assessment of the minimum required discharge capacity of the combined kerb and drainage systems is based on the Rational Method Equation $Q = 2.78 CiA$, where:

- 'Q' is the design peak rate of runoff (l/s)
- 'C' is a non-dimensional runoff coefficient (taken as 1.0)
- 'i' is the design rainfall intensity (mm/hr)
- 'A' is the total catchment area (ha)
- Note: 2.78 is a conversion factor to address the rainfall units being in mm/hr

### *Pollution controls*

14.2.5.30 In accordance with *DMRB CG 501*, the selection of pollution control measures has been determined following the process outlined below:

- Complete assessment in accordance with *DMRB LA 113*
- If mitigation is required, identify viable options/combinations of measures, taking account of
  - Road drainage hierarchy
  - Site constraints
  - Storm flow and flood risk requirements
  - Climate change allowances
  - Road geometry
- Review short list of options against construction and maintenance requirements
- Confirming the measures fulfil water quality requirements - these are presented in ES Appendix 14.3: Water Quality Assessment (Application Document 3.4)

14.2.5.31 The pollution control measures vary for each proposed outfall, and include a combination of the following measures:

- Wet attenuation ponds with sediment forebays
- Vortex grit separators
- Vegetated ditches

14.2.5.32 To meet the suspended solids removal requirements, it is envisaged that the permanent water in the ponds shall extend to a depth of 0.7m below the attenuation pond outlet level.

14.2.5.33 The vegetated ditches shall remove both suspended solids and metals (zinc, lead, cadmium, copper). It is envisaged the main channel of the ditch shall be 0.5m wide with a 0.5m wide intermediate grassed bench and an overall maximum depth of 1.5m.

14.2.5.34 Water quality assessments have been undertaken to ensure sufficient mitigation measures have been incorporated at each outfall. Details of the HEWRAT assessment are provided in ES Appendix 14.3: Water Quality Assessment (Application Document 3.4).

14.2.5.35 Table 19: Appleby to Brough pollution control mitigation measures outlines the pollution control mitigation measures included at each proposed outfall.

Table 19: Appleby to Brough pollution control mitigation measures

| Catchment | Attenuation pond | Grit Separator | Vegetated Ditch |
|---|---|---|---|
| S06-01 | Y | Y | Y |
| S06-02 | Y | Y | Y |
| S06-03 | Y | Y | Y |
| S06-04 | Y | N | Y |
| S06-05 | Y | N | Y |
| S06-06 | Y | N | N |

| Catchment | Attenuation pond | Grit Separator | Vegetated Ditch |
|---|---|---|---|
| S06-07 | Y | N | N |
| S06-08 | Y | Y | Y |
| S06-09 | Y | N | N |
| S06-10 | Y | N | Y |
| S06-11 | Y | N | Y |
| S06-12 | Y | N | N |
| S06-13 | Y | N | N |
| S06-14 | Y | N | Y |
| S06-15 | Y | N | N |
| S06-16 | Y | N | N |
| S06-17 | Y | N | Y |
| S06-18 | Y | Y | Y |
| S06-19 | Y | N | N |
| S06-20 | Y | N | N |

### *Climate change*

14.2.5.36 In accordance with *DMRB CG 501*, a 20% increase to peak rainfall intensity should be considered the minimum accommodated within the drainage design in order to account for potential climate change.

14.2.5.37 The Environment Agency has produced guidance, available on the gov.uk website, relating to allowances that should be made for climate change. Climate change allowances relating to increased peak rainfall intensity are outlined in Table 20: Peak rainfall intensity allowance in small and urban catchments - Appleby.

Table 20: Peak rainfall intensity allowance in small and urban catchments - Appleby to Brough

| Applies across all of England | Total potential change anticipated for the '2020s' (2015 to 2039) | Total potential change anticipated for the '2050s' (2040 to 2069) | Total potential change anticipated for the '2080s' (2070 to 2115) |
|---|---|---|---|
| Upper end | 10% | 20% | 40% |
| Central | 5% | 10% | 20% |

14.2.5.38 Environment Agency guidance is to assess both the central and upper end allowances to understand the range of impact.

14.2.5.39 Environment Agency have advised that there is a proposed increase in allowances for climate change within the Cumbria region. Accordingly, a 50% climate change allowance has been included as a sensitivity check.

### *Surface water storage*

14.2.5.40 The proposals lead to a substantial increase in impermeable area draining to local watercourses.

14.2.5.41 In accordance with *DMRB CG 501*, the proposed drainage design will ensure that there is no increase in runoff rates as a result of the proposals. To achieve this, existing runoff rates have been assessed and flow control devices incorporated into the drainage systems. Storage for surplus flows has generally been provided using attenuation ponds.

14.2.5.42 The proposed drainage design makes an allowance for potential climate change. A 40% increase to rainfall intensity has been included when considering surface water storage, and attenuation ponds designed to ensure no flooding occurs during the critical 1 in 100-year storm.

14.2.5.43 Where possible separate ponds have been provided for the main line and local road drainage. The exception to this is Pond 9 (see drawing in Annex C), located at the proposed Warcop junction, which due to flooding constraints attenuates run-off from both the mainline and local road.

14.2.5.44 The Ground Investigation Report completed upon completion of the fieldwork confirmed that for Scheme 06, the proposed attenuation storage ponds are to be constructed within glacial till (either cohesive or granular or a combination of both) and as such the soakaway potential is considered low (granular glacial till) to very low (cohesive glacial till).

14.2.5.45 Infiltration systems must not be used close to dissolution features. All ponds and drainage systems to be lined where the karst risk is classed as Medium or High. Maintenance access to all drainage systems shall be provided to allow suitably experienced and qualified professionals to monitor karst risk regularly.

### *Hydraulic modelling of proposed highway surface water drainage networks*

14.2.5.46 The proposed main carrier drainage network and surface water storage has been modelled using MicroDrainage software.

14.2.5.47 FSR rainfall data has been used, with global variables (M560, r) to suit the site location.

14.2.5.48 The equivalent impermeable area draining to proposed networks has been obtained by applying the following factors to the measured contributing areas: -

- Paved surfaces - 1.00
- Verges contained by embankments/cutting slopes - 0.5
- Embankments/Cutting Slopes - 0.25
- Attenuation pond surfaces - 1.00

14.2.5.49 Networks have been established to suit proposed vertical alignments and potential outfall locations.

14.2.5.50 Vortex flow controls have been incorporated downstream of ponds, with flow rates restricted to those detailed in Table 18: Appleby to Brough existing drainage catchments summary.

14.2.5.51 Table 21: Appleby to Brough proposed catchments table below, is a summary of proposed total catchment area size, percentage of impermeable area within each catchment and the volume of attenuation required to achieve the peak permitted discharge rate calculated for the corresponding existing catchment (see above). This is to ensure the proposed discharge rates are no greater than existing.

Table 21: Appleby to Brough proposed catchments

| Catchment | Drained Embankment Area (ha) | Drained Verge Area (ha) | Drained Highway Area (ha) | Volume of storage provided[a] ($m^3$) | Peak Permitted Flow Rate[b] (l/s) |
|---|---|---|---|---|---|
| S06-01 | 2.18 | 0.33 | 1.08 | 2578 | 26.11[c] |
| S06-02 | 0.76 | 0.72 | 2.16 | 1252 | 149.56[c] |
| S06-03 | 1.51 | 1.03 | 1.64 | 2396 | 27.82 |
| S06-04 | 0.09 | 0.48 | 0.66 | 814 | 11.88 |
| S06-05 | 1.07 | 0.50 | 0.93 | 1314 | 17.33 |
| S06-06 | 0.02 | 0.03 | 0.09 | 83 | 1.93 |
| S06-07 | 2.03 | 1.38 | 2.33 | 3416 | 36.81 |
| S06-08 | 0.21 | 0.49 | 1.81 | 1995 | 23.54 |
| S06-09 | 2.23 | 1.20 | 3.53 | 4631 | 46.97 |
| S06-10 | 0.57 | 0.68 | 2.64 | 2987 | 33.17 |
| S06-11 | 0.38 | 0.52 | 0.98 | 1200 | 16.05 |
| S06-12 | 0.26 | 0.30 | 0.56 | 669 | 10.06 |
| S06-13 | 0.40 | 0.12 | 0.31 | 392 | 6.63 |
| S06-14 | 1.71 | 0.95 | 4.18 | 5059 | 50.29 |
| S06-15 | 0.11 | 0.16 | 0.41 | 437 | 7.28 |
| S06-16 | 0.45 | 0.11 | 0.21 | 380 | 4.28 |
| S06-17 | 0.03 | 0.06 | 0.12 | 125 | 2.68 |
| S06-18 | 0.63 | 0.65 | 2.45 | 2800 | 31.57 |
| S06-19 | 0.52 | 0.46 | 0.85 | 1080 | 14.87 |
| S06-20 | 0.19 | 0.29 | 0.69 | 1091 | 5.78 |

a - Volume provided in design from normal water level to 300mm below access track level, as per guidance provided in The SuDS Manual (CIRIA C753).

b - 1 in 100-year storm, 40% climate change

c - Peak Permitted Flow Rate incorporates a factored brownfield discharge rate

### *Exceedance flood routing*

14.2.5.52 The design will consider the overland flow routes of exceedance flows, and where possible provide a route for exceedance flows that minimises the risk of flooding of properties. The routing of exceedance flows where possible will follow the discharge pipe route to receiving waters.

14.2.5.53 An overland flow analysis (using Microdrainage FloodFlow) for the proposed drainage network was undertaken for the 100-year event plus 40% climate change, with a sensitivity test adding 50%. As anticipated the analyses identified increasing depths of surface water at low spots along the route (Ch. 40400m, Ch.41900m, Ch.42300m, Ch. 46450m and Ch.47600m). In general, the maximum flow depths on the carriageway are, retained within the carriageway limits. Any excess flows down embankments shall be picked up by the cut-off drainage. At the next stage of design consideration shall be given to increasing the number of gully outlets at the low spots. Drainage maintenance regimes should also prioritise the low spots.

### *Existing watercourses*

14.2.5.54 In accordance with *DMRB CG 501* and *DMRB LA 113* the proposed highways and drainage design where possible limit impact on Environment Agency main rivers and ordinary watercourses. Where a watercourse has been disrupted by the proposed highways alignment a proposed culvert has been sized appropriately to allow the flow from the watercourse to be uninterrupted.

14.2.5.55 During detailed design the following will be required:

- All new culverts will be designed in accordance with DMRB CD 529 details and in consultation with relevant stakeholders (e.g. LLFA or EA).
- All culverts with a diameter of 900mm and above will require structural design
- Where new outfalls are required the individual outfall details will be designed in accordance with DMRB CD 529 and in consultation with relevant stakeholders (e.g. LLFA or EA).

14.2.5.56 All new outfalls have been specified as there is insufficient information about the existing outfalls to know whether they are suitable for incorporating into the scheme. Further investigations at the next stage of the design shall determine whether existing outfalls are suitable to be incorporated into the scheme.

### *Land drainage and overland flow*

14.2.5.57 Where land outside of the highway corridor falls towards the highway, cut-off drainage has been provided.

14.2.5.58 Cut-off drainage comprises open ditches and/or filter drains, with culverts provided to cross the highway corridor where necessary.

14.2.5.59 Cut-off drainage will intercept and convey overland flow around the highway corridor, so that this flow does not enter the highway drainage system or cause flooding issues on the proposed highway.

### *Karst Risk*

14.2.5.60 Karst is an area of land formed of rock such as limestone that is worn away by water to make caves and other formations.

14.2.5.61 Karst Risk, is a natural human induced hazard in karst areas, resulting in dissolution of soluble rocks such as limestone, dolomite, and gypsum, potentially resulting in collapse or sink holes.

14.2.5.62 Infiltration systems must not be used close to dissolution features. All ponds and drainage systems to be lined where the karst risk is classed as Medium or High.

14.2.5.63 Maintenance access to all drainage systems shall be provided to allow a suitably experienced and qualified professionals to monitor karst risk regularly.

## Flood Risk Assessment

### *Data collection*

14.2.5.64 The risk of flooding to the development has been assessed on readily available information, published on the Environment Agency website.

14.2.5.65 In addition to readily available information, JBA has undertaken baseline hydraulic modelling of existing watercourse/culvert crossings. This modelling establishes flooding in the vicinity of the existing A66.

### *Flood risk vulnerability classification*

14.2.5.66 Guidance for flood risk vulnerability for new development sites is set out in the Government planning portal for flood risk and coastal change. Table 6: Flood risk vulnerability classification is used as a guide to help determine if new development sites should or should not be permitted, based upon the vulnerability classifications set out on the planning portal.

14.2.5.67 In accordance with *DMRB LA 113*, NI/1.7, the development is classified as “Essential Infrastructure”. The development is therefore permitted providing it is located within Flood Zones 1 or 2, with the exception test required if located in Flood Zones 3a or 3b.

14.2.5.68 A number of watercourse crossings across the scheme are located in Flood Zone 3b, namely Cringle Beck, Moor Beck (Offtake), Moor Beck, Eastfield Sike and Lowgill Beck. Therefore, sequential and exception tests are required for new development at these locations.

14.2.5.69 The aim of the sequential test is to locate, where possible, the proposed development in areas at the lowest risk of flooding, by ensuring that there are no other appropriate and available sites at a lower risk of flooding. If the sequential test demonstrates that it isn’t possible to use an alternative site, then for essential infrastructure in Flood Zone 3b an exception test is required.

### *Sequential test*

14.2.5.70 The route of the A66 between Appleby and Brough is generally located within agricultural land bounded by a Ministry of Defence (MoD) training camp and firing range to the north and follows the southern edge of the North Pennines Area of Outstanding Natural Beauty (AONB) from Moor House Lane all the way to Brough in the east. Following completion of the feasibility study in May 2020 the Preferred Route (the Black Route) was announced. This route marginally encroached into the AONB at the eastern end hence at this preliminary design stage four end-to-end refined plan alignments were considered to balance the impact on the AONB against the impacts that alternative routes outside of the AONB might have on the local environment, property, and communities.

14.2.5.71 The four routes were formed through the combination of three component sections: western, central, and eastern.

14.2.5.72 For the western section there was only the May 2020 Preferred Route (the Black Route) comprising 2.6Km of on-line widening starting from the west (Appleby) end of the scheme. This section is in Flood Zone 1, so the sequential and exceptions tests do not apply.

14.2.5.73 In the central section, which includes the Flood Zone 3b areas at the crossings of Cringle Beck, Hayber Beck, Moor Beck and Eastfield Sike, two routes were considered: the May 2020 Preferred Route (the Black Route) and the Blue Route. From Sandford the Black Route generally follows an alignment to the south of the existing A66. The Blue Route takes the route slightly further north and reduces the impact on the local environment, property, and communities, particularly in the Warcop area. More significantly, with respect to flooding, this route also lowers the new A66 on a smaller embankment closer to existing ground levels approximately 3m high around Warcop (the Black route has an 8m high embankment). The reduced embankment height reduces the width of the road corridor and impact of the proposed development within the Flood Zone 3b areas. The blue route has been selected as the preferred option for the central section at this preliminary design stage and is considered the best option for minimising flood impact. Moving the alignment of the central section north of the existing A66 would further reduce the flood impact but moving the road substantially into the AONB is not considered a viable option.

14.2.5.74 In the eastern section, which includes the Flood Zone 3b area at the crossing of Lowgill Beck, two routes were considered: the May 2020 Preferred Route (the Black Route) and the Orange Route. The Black Route generally follows an alignment to the south of the existing A66. The Orange Route was developed to demonstrate how the AONB could be avoided entirely by running to the south of the existing A66. The black route has been selected as the preferred option for the eastern section at this preliminary design stage and is considered the best option for minimising flood impact. The orange route crosses an additional watercourse and crosses Lowgill Beck further downstream where the Flood Zone is more extensive.

14.2.5.75 A full extensive write up of the review of route options is found in Project Development Overview Report (Application Document 4.1).

### *Exception test*

14.2.5.76 The sequential test shows that the alignment developed at the preliminary design stage is the best viable option for minimising flood impact. As the development is essential infrastructure in Flood Zone 3b then a further test, the exception test is required. The aim of the exception test is to demonstrate:

- how flood risk is to be managed so that flood risk won't be increased elsewhere
- that the sustainability benefits to the community outweigh the flood risk
- the development will be safe for its lifetime

14.2.5.77 Scheme 06 incorporates new road infrastructure in Flood Zone 3b (functional floodplain) and significantly increases the impermeable area being discharged to local watercourses. However, the scheme has been designed to ensure there is no increase in flood risk for the '2080s' design horizon (2070 to 2115). Flood storage lost due to new road infrastructure in the functional floodplain shall be compensated by the construction of new, compensatory storage areas (see 6.4.6). Surface water run-off from the new A66 and local roads shall be attenuated, and proposed flow rates restricted to ensure that there is no increased flood risk as a result of the scheme (see Section 5).

14.2.5.78 To answer the first part of the assessment, refer to Case for the Project (Application Document 2.2) which highlights the Social, Environmental and Economic benefits for the proposed Nationally Significant Infrastructure Project. Including:

- safety – a consistent standard of dual carriageway, to reduce the number of accidents. Use of the 'old' A66 as part of the local road network will provide better, safer routes for cyclists and pedestrians.
- connectivity – improving connectivity for people living and working nearby and creating better facilities for cyclists and pedestrians. Reducing congestion and improving the reliability of people's journeys between the M6 at Penrith and the A1(M) Scotch Corner and nationwide. It also improves connectivity between the key employment areas of Cumbria, Tees Valley and Tyne and Wear.
- environmental – minimising noise levels for people living and working near the route and reducing the congestion currently occurring in the single carriageway sections. The scheme is also being designed to minimise any potential negative impacts on the

natural environment and landscapes of the North Pennines and Lake District.

- economic – improving strategic regional and national connectivity, particularly for hauliers. Heavy goods vehicles account for a quarter of all traffic on the road and any delays to journeys can have an extremely negative effect on business and commerce, including lost working time and missed shipment slots.
- tourism – improving access to key tourist destinations such as the North Pennines and Lake District.
- community – re-connecting communities and providing better links between settlements along the route as well as improving access to services such as healthcare, employment areas and education.
- capacity – reducing delays and queues during busy periods and improving the performance of key junctions such as the A66/A6 and the M6 junction 40.
- increasing reliability – an improved A66, will lead to less accidents which, in turn, makes the road more reliable. Also, having a dual carriageway provides the option to close lanes where required due to accidents or break downs and keep traffic moving.

14.2.5.79 The scheme has been designed to DMRB standards which requires no flooding of the drainage network for the 5-year return period storm plus 20% climate change allowance. In addition, the scheme is designed so that surface water flooding does not extend beyond the highway boundary for the 100-year return period storm plus 50% climate change allowance. The design will consider the overland flow routes of exceedance flows, and where possible provide a route for exceedance flows that minimises the risk of flooding of properties. The routing of exceedance flows where possible will follow the discharge pipe route to receiving waters.

### *Flooding from rivers or the sea*

14.2.5.80 Baseline flood risk from rivers and sea using Environment Agency data is shown on ES Figure 14.2: Existing Flood Risk (Application Document 3.3).

14.2.5.81 Areas of Fluvial Flood Zone 2 and 3 shown within Environment Agency *Flood Map* include areas associated with:

- Coupland Beck and its floodplain in the north-west of the study area
- River Eden and Mire Sike between Warcop and Ormside
- Hayber Beck, the confluence and floodplain of Hayber Beck, Moor Beck and Eastfield Sike in the centre of the study area
- The wide floodplain of Crooks Beck and the lower reaches of Lowgill Beck within Warcop
- Lowgill Beck at Flitholme and Flitholme Bridge
- Lowsgill Beck where it is crossed by the existing A66 which extends to Woodend Sike, upstream of its confluence with Yosgill Sike

- Swindale Beck and Augill beck, through Brough in the east of the study area.

14.2.5.82 Baseline fluvial modelling undertaken for the scheme has highlighted increased flood risk extent associated with Cringle Beck both north and south of the existing A66, and the Lowgill Beck when compared against the Environment Agency flood mapping. Additionally, the Project modelling has refined the flood risk associated with the confluence and floodplain of Hayber Beck, Moor Beck and Eastfield Sike in the centre of the study area. This confirms the anecdotal evidence from consultees that floodwater is stored by the railway line.

14.2.5.83 Refer to Flood Risk Mitigations section below.

14.2.5.84 Table 22: Flood zones and risks of fluvial flooding for Appleby to Brough summarises the flood zones for areas considered to be associated with risk to and from the scheme. The Environment Agency has defined the following risk categories for fluvial flooding:

Table 22: Flood zones and risks of fluvial flooding for Appleby to Brough

| Watercourse | Flood Zone | Risk of fluvial flooding |
|---|---|---|
| Unnamed Tributary of Mire Sike 6.12[a] | 2 | Low risk of flooding |
| Unnamed Tributary of Cringle Beck 6.1 | 3b | High risk local of flooding local to watercourse<br>Medium risk of flooding extending into floodplain |
| Cringle Beck | 3b | High risk local of flooding local to watercourse<br>Medium risk of flooding extending into floodplain |
| Moor Beck (Offtake) | 3b | High risk local of flooding local to watercourse<br>Medium risk of flooding extending into floodplain |
| Moor Beck | 3b | High risk of flooding local to watercourse<br>High/medium risk of flooding extending into floodplain |
| Eastfield Sike | 3b | High risk of flooding local to watercourse<br>High/medium risk of flooding extending into floodplain |
| Unnamed Tributary of Lowgill Beck 6.1 | 2 | Low risk of flooding |
| Lowgill Beck | 3b | High risk of flooding local to watercourse<br>High/medium risk of flooding extending into floodplain |
| Unnamed Tributary of Lowgill Beck 6.3[b] | 1 | Very low risk of flooding |
| Unnamed Tributary of Lowgill Beck 6.7 | 2 | Low risk of flooding |

a - although not identified on the Environment Agency Flood Maps, the baseline modelling has identified fluvial flooding at the crossing of the unnamed tributary of Mire Sike 6.12 (at the proposed Sandford Junction).

b - this watercourse is not crossed by the proposed A66 but runs along the southside of the proposed A66

14.2.5.85 Models for existing flood risk and models incorporating the scheme were developed. The models have enabled the design of the scheme to be tested and subsequently adjusted to ensure that the risk of flooding has not increased as a result of the proposals.

14.2.5.86 Three models were built for the scheme, the largest, Warcop (total reach length: 10.3Km) and two small models: UNN605 (Unnamed tributary of Mire Sike 6.12, total reach length: 0.6Km) and UNN607 (Unnamed tributary of Lowgill Beck 6.7, total reach length 0.7Km).

14.2.5.87 The Warcop model (Plate 1: Scheme model overview) was based on the Environment Agency's existing FM-TUFLOW model for Warcop (2018) updated with additional river channel and structure survey data, 1m resolution LIDAR (2020), MasterMap data, as built drawings of the scheme, HADDMS information and the scheme route alignments.

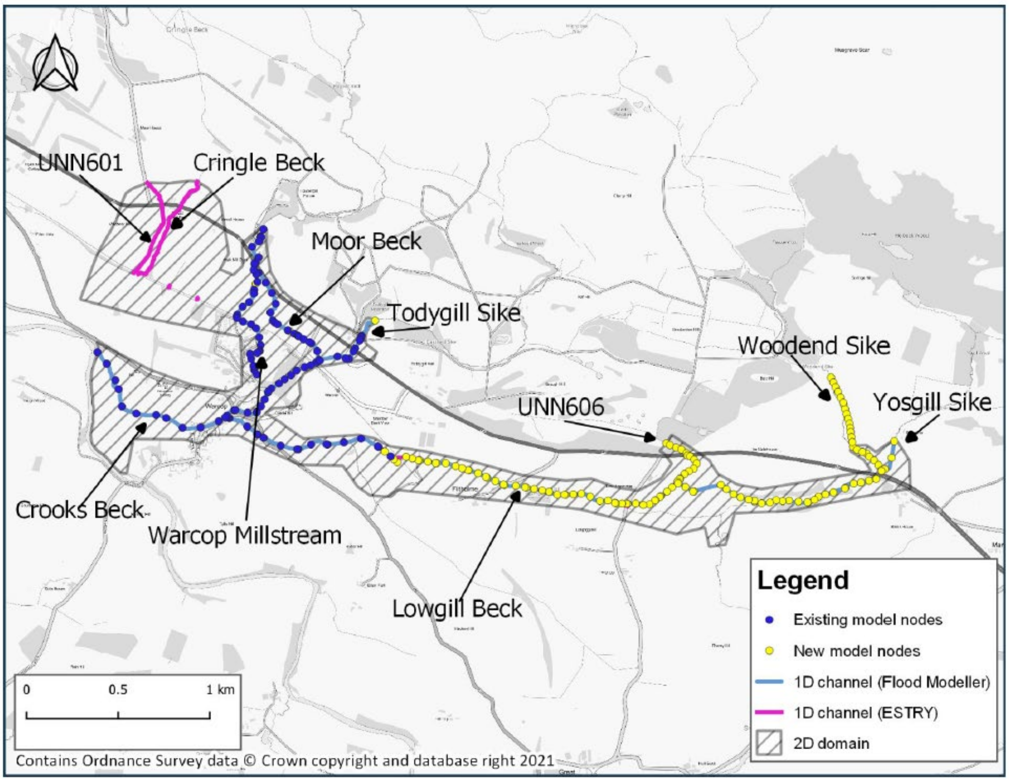

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Plate 1: Scheme model overview

14.2.5.88 Models UNN605 (Plate 2: UNN605 model overview) and UNN607 (Plate 3: UNN607 model overview) were built using river channel and structure survey data, 1m resolution LIDAR (2019), MasterMap data, as built drawings of the A66, *HADDMS* information and proposed scheme alignments

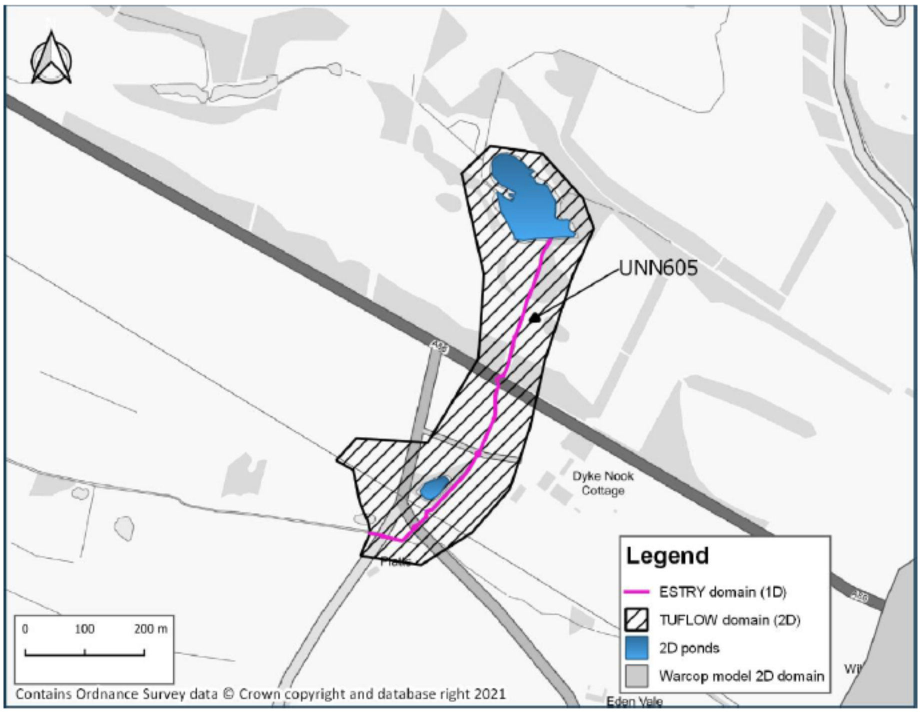


Plate 2: UNN605 model overview

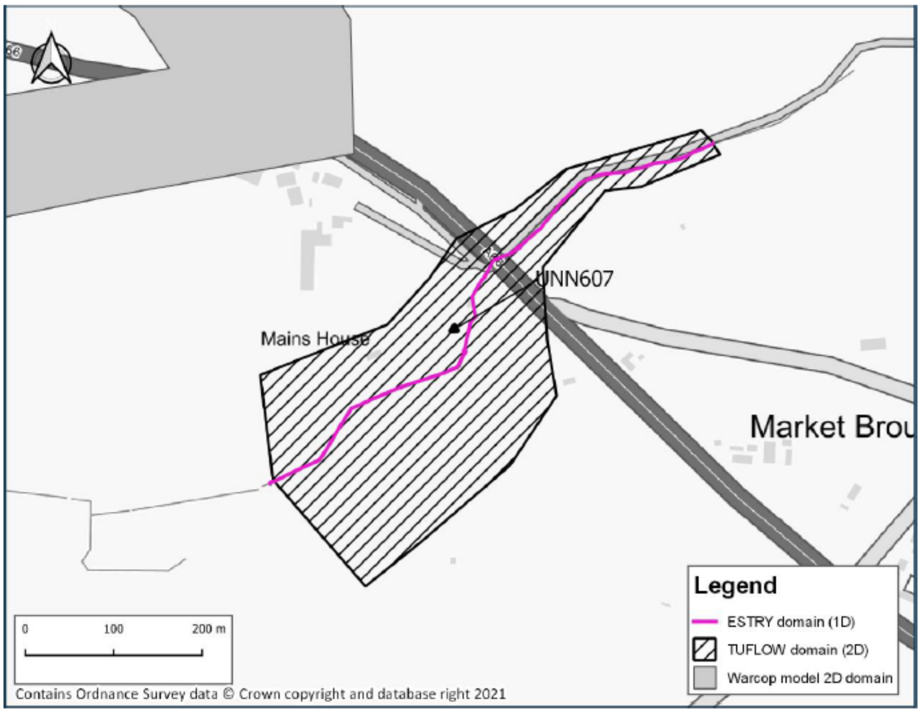


Plate 3: UNN607 model overview

14.2.5.89 Although not identified on the Environment Agency Flood Maps, the baseline modelling identified fluvial flooding at the crossing of the unnamed tributary of Mire Sike 6.12 (at Sandford Junction). The baseline modelling also predicted greater flooding extents at the crossing of Cringle Beck than shown on the Environment Agency Flood Maps ES Figure 14.1: Surface Water Features

### *Surface water flooding*

14.2.5.90 The EA maps for flood risk from surface water for the existing A66 have been reviewed to identify areas with a high risk of surface water flooding.

14.2.5.91 In the northern sections of the study area there are areas of ‘High’ and ‘Medium’ pluvial water flood risk associated with Coupland Beck and its tributaries upstream and adjacent to the existing A66.

14.2.5.92 Downstream of the existing A66 there are areas of ‘High’ and ‘Medium’ pluvial water flood risk associated with small areas of wetland and field drains to the north and east of both Far Bank End and Middle Bank End. Additionally, to the south of the railway line, are areas of ‘Medium’ pluvial water flood risk associated with Sandford Mire and Mire Sike.

14.2.5.93 In the central sections of the study area there are areas of ‘High’ and ‘Medium’ pluvial water flood risk adjacent to Cringle Beck and an extensive area to the east of Cringle Beck’s confluence with Mire Sike. This is considered to be a result of a number of small tributaries and the railway line. There are also large areas to the north, east and south of Warcop, associated with depressions in the land around existing A66 watercourse crossings and the large valley bottom immediately upstream and downstream of the railway embankment, to the north-west and east of Warcop. To the east of Warcop, there are areas of ‘High’ and ‘Medium’ pluvial water flood risk around Eastfield Sike and upstream of the existing A66 crossing at Toddygill Bridge.

14.2.5.94 In the eastern sections of the study area, there are areas of ‘High’ and ‘Medium’ pluvial water flood risk along the extent of Lowgill Beck, with a large area to the north of Flitholme, and areas adjacent to large reaches of Woodend Sike and Yosgill Sike and their confluence north of the existing A66 crossing.

14.2.5.95 Throughout the study area there are areas of ‘High’ and ‘Medium’ pluvial water flood risk associated with the River Eden and its floodplain, including some areas around minor unnamed tributaries.

14.2.5.96 The east of the study area has areas of ‘High’ and ‘Medium’ pluvial water flood risk associated with the Swindale Beck and Augill Beck, affecting sections of the existing A66 junction.

14.2.5.97 Table 23: Surface water flooding locations for Appleby to Brough summarises the surface water flooding locations considered to be associated with risk to and from the scheme, as shown on EA map for flood risk from surface water.

Table 23: Surface water flooding locations for Appleby to Brough

| Location | Risk of surface water flooding |
|---|---|
| Underpass for New Hall Farm | The existing underpass is at a high risk of flooding |
| Crossing Unnamed Tributary of Mire Sike 6.12 | High risk of flooding local to watercourse |
| Crossing Unnamed Tributary of Cringle Beck 6.1 | High risk of flooding local to watercourse<br>Low risk of flooding extending into the floodplain |
| Crossing Cringle Beck | High risk of flooding local to watercourse<br>Low risk of flooding extending into the floodplain |
| Crossing Moor Beck (Offtake) | Low risk of flooding local to watercourse |
| Crossing Moor Beck | High risk of flooding local to watercourse<br>High risk of flooding extending into the floodplain in vicinity of proposed Warcop westbound junction |
| Crossing Eastfield Sike | High risk of flooding local to watercourse<br>High risk of flooding extending into the floodplain |
| Crossing Unnamed Tributary of Lowgill Beck 6.1 | High risk flooding local to watercourse |
| Crossing Lowgill Beck | High risk of flooding local to watercourse |
| Crossing Unnamed Tributary of Lowgill Beck 6.7 | High risk of flooding local to watercourse |

14.2.5.98 The surface water flood maps indicate that much of the existing route is at very low risk from surface water flooding. However, at watercourse crossings, the risk of surface water flooding is high and is coincident with the risk of river flooding.

14.2.5.99 JBA flood modelled water levels in the location of watercourse crossings confirms that the proposed alignment is not at risk of surface water flooding in these locations. In addition, cut-off drainage has been provided where land outside of the highway corridor falls towards the highway. The cut off drainage will intercept and convey surface water flows around the highway.

14.2.5.100 Cut-off drainage has been provided where land outside of the highway corridor falls towards the highway. The cut-off drainage will intercept and convey surface water flows around the highway.

### *Historic flooding*

14.2.5.101 Environment Agency data, including a flood incident investigation report published in 2016[14], show historic flooding events associated with the following events in the study area:

- Coupland Beck at Coupland in 2000, 2002, 2005 and 2015
- The River Eden at Ormside in 2005 and 2015 and Sandford in 2015
- Moor Beck at Warcop in 2015
- Swindale Beck within Brough town centre
- River Eden at Warcop in 2009.

14.2.5.102 The flood incident investigation report[14] highlights that Warcop has reportedly experienced minor flood events approximately six times since 1968, most recently in 2015 as the document reports, and before that in 2009 where the River Eden flooded the southern side of the village.

14.2.5.103 Where there is considered to be an interaction with the scheme, these events have been taken into consideration in the hydraulic modelling, design and proposed flood mitigation measures.

### *Existing highway drainage flooding*

14.2.5.104 HADDMS identifies seven closed and three historic locations along the existing A66 for this scheme that are or have previously been subject to flooding at the following locations:

- 230m east of New Hall Farm underpass, eastbound carriageway: 1nr closed event recorded as low impact resulting from blocked gullies. Incident occurred in December 2012.
- Crossing Unnamed Tributary of Cringle Beck 6.1, westbound carriageway: 2nr closed events. Both events recorded as low impact resulting from the beck flooding and blocked gullies on the carriageway. Incident occurred in January 2013.
- 70m east of Warcop junction, eastbound carriageway: 1nr historic event and three closed events. All four events recorded as low impact resulting from blocked drains and gullies. Incident occurred in May 2012.
- Crossing of Lowgill Beck, eastbound carriageway: two historic events and one closed event. All three events recorded as low impact resulting from either a culvert blockage or blocked gullies due to silt washing off from adjoining field. Incident occurred in January 2005.

### *Groundwater flooding*

14.2.5.105 The scheme is susceptible to groundwater flooding in accordance with the Groundwater Flooding Susceptibility map in Environmental Statement Figure 14.8. A complete description of the groundwater context is provided in the Environmental Statement Appendix 14.6 Hydrogeological Impact Assessment.

14.2.5.106 Where the scheme is at or above existing ground level the risk of groundwater flooding is considered to be low because the proposed drainage systems will reduce the ground water levels in the vicinity of the scheme to below the formation level of the road.

14.2.5.107 There are a number of areas across the scheme where the route is in cutting. A sub surface filter drainage system will be provided to these areas, or the area will be lined, should high groundwater be assessed as a risk during detailed design.

14.2.5.108 Travelling eastbound from the west end the following road lengths are in cutting:

- local roads at the replacement underpass serving New Hall Farm and Far Bank End
- north side of the scheme between the replacement underpass and Sandford junction
- local roads at the Sandford Junction
- north side of the scheme between Sandford Junction and Warcop Junction
- local roads on the north side of Warcop Junction
- both sides of the scheme between Warcop Junction and Langrigg Junction
- local roads at Langrigg Junction
- local road connecting Flitholme and Langrigg
- both sides of the scheme between Langrigg Junction and underpass to the west of West View Farm
- local road connecting Langrigg to the existing A66
- local roads at scheme underpass to the west of West View Farm
- both sides of the scheme between new underpass and the junction at the west end of Brough Bypass
- local roads at the junction at the west end of Brough Bypass

14.2.5.109 The Ground Investigation Report completed upon completion of the fieldwork confirmed that for Scheme 06, the groundwater levels in 23 exploratory sites are generally at depth although at 5 sites locally high or potentially sub-artesian water pressure was encountered including the site at the proposed underbridge at Sandford (crossing of the unnamed tributary of Mire Sike 6.12).

14.2.5.110 There is a risk of encountering perched groundwater when constructing the attenuation ponds. If this water cannot be drained during construction, it is possible that the ponds may have to be lined to prevent groundwater ingress.

### *Flooding from reservoirs*

14.2.5.111 The Environment Agency *Flood Map* indicates that there is a risk of carriageway flooding at the crossing of the Unnamed Tributary of Mire Sike 6.12 in the event of a reservoir breach and when river levels in the Mire Sike are at their normal level. At this location there is also a low risk of fluvial flooding and a high risk of surface water flooding.

14.2.5.112 The management of large, raised reservoirs (capable of holding 10,000m$^3$ of water above natural ground level) is governed by the Reservoirs Act 1975. The Reservoirs Act identifies that the reservoir undertaker is responsible for ensuring the structural integrity of the reservoir and needs to ensure that panel engineers are appointed to complete the necessary monitoring and inspection of the reservoir. Where necessary the panel engineer will undertake the design/supervision of repair works to existing reservoirs.

14.2.5.113 Although the consequence of a reservoir failure is potentially very significant, the controls and management procedures of the

Reservoirs Act 1975, enforced by the Environment Agency, mean that the probability of a catastrophic breach is highly unlikely.

14.2.5.114 Annually there are a number of incidents which require the emergency drawdown of reservoirs to enable further inspection or remedial works to be undertaken. However, since the introduction of reservoir legislation in the 1920’s there has been no loss of life as a result of reservoir failure in the UK.

14.2.5.115 Reservoir flood mapping allows a better understanding of potential areas at risk in supporting emergency planning. National Highways work with Environment Agency, Cumbria County Council, Cumbria Constabulary and other statutory bodies to develop and implement local emergency plans for all eventualities.

### *Flooding from other Artificial waterbodies*

14.2.5.116 The scheme is not at risk of flooding from other artificial waterbodies. This has been assessed based on the scale of the other artificial waterbodies in relation to the local topography and carriageway elevation.

### *Coastal flooding*

14.2.5.117 The Environment Agency *Flood Map* indicates that the scheme is outside of the maximum extent of flooding from coastal flooding.

### *Flooding from sewers*

14.2.5.118 There are no reports of flooding from existing public sewers. United Utilities shall be consulted throughout the detailed design process to ensure that any risk identified is managed appropriately.

### *Flood risk mitigation*

14.2.5.119 The detailed design of the proposed highway drainage will be in accordance with current design standards specifically DMRB and the MCHW. By following these design standards, the design of the scheme will have low risk of surface water flooding and low risk from fluvial flooding.

14.2.5.120 Table 14-24: Flood zones, risks of flooding and flood risk mitigation for Appleby to Brough summarises the flood zones, risks of flooding and flood risk mitigation for the scheme. The following flood risk mitigation measures are in place throughout the complete length of the scheme:

- formation of road above the 100-year plus 94% climate change allowance river level;
- flow control and attenuation storage of stormwater run-off from new roads, verges, and cuttings, and
- cut-off drainage ditches at top of cuttings and at bottom of embankments.

Table 14-24: Flood zones, risks of flooding and flood risk mitigation for Appleby to Brough

| Location | Flood Zone | Risk of river flooding | Risk of surface water flooding | Risk of flooding from reservoir breach | Flood mitigation measures |
|---|---|---|---|---|---|
| Underpass for New Hall Farm | 1 | Very low | High | None | Replacement underpass proposed with drainage connecting to new scheme drainage |
| Crossing of Unnamed Tributary of Mire Sike 6.12 | 2 | Low[a] | High | Yes[b] | Extending existing culvert<br>Level for level flood compensation storage on both sides of watercourse on north side of proposed A66 |
| Crossing of Unnamed Tributary of Cringle Beck 6.1 | 3b | High | High | None | Viaduct crossing both unnamed tributary of Cringle Beck 6.1 and Cringle Beck |
| Crossing of Cringle Beck | 3b | High | High | None | Viaduct crossing both unnamed tributary of Cringle Beck 6.1 and Cringle Beck<br>Flood relief culverts on east side of viaduct<br>Level for level flood compensation storage on east side of watercourse on north side of proposed A66 |
| Crossing of Moor Beck (Offtake) | 3b | High | Low | None | Viaduct crossing both Moor Beck (Offtake) and Moor Beck |
| Crossing of Moor Beck | 3b | High | High | None | Viaduct crossing both Moor Beck (Offtake) and Moor Beck<br>Volume for volume flood compensation[d] storage on both sides of Moor Beck upstream of proposed junction at Warcop |
| Crossing of Eastfield Sike | 3b | High | High | None | Underbridge crossing watercourse<br>Level for level flood compensation storage on east side of watercourse on north side of proposed A66 and volume for volume flood compensation storage on both sides of Moor Beck upstream of proposed junction at Warcop |
| Crossing of Unnamed Tributary of | 2 | Low | High | None | New culvert crossing with watercourse re-alignment below A66 |

| Location | Flood Zone | Risk of river flooding | Risk of surface water flooding | Risk of flooding from reservoir breach | Flood mitigation measures |
|---|---|---|---|---|---|
| Lowgill Beck 6.1 | | | | | |
| Crossing of Lowgill Beck | 3b | High | High | None | Underbridge<br>Level for level flood compensation storage on north side of proposed A66 |
| Crossing of Unnamed Tributary of Lowgill Beck 6.7 | 2 | Low | High | None | Extension[c] of existing 1.05m dia. culvert below A66<br>(Bullistone Bridge Culvert) |

a - although not identified on the Environment Agency Flood Maps, the modelling conducted for the scheme has identified fluvial flooding at the crossing of the Unnamed Tributary of Mire Sike 6.12 (at Sandford Junction)

b - flooding from a reservoir breach is considered a very low risk but nevertheless remains a residual risk

c - this is a proposed departure from CD529i.e., extending an existing culvert by matching the culvert size for a culvert with a diameter less than 1.2m

d - Volume for volume flood compensation provided where there is insufficient space, due to site constraints, to accommodate level for level flood compensation.

14.2.5.121 Flood risk from groundwater will be mitigated through cut-off drains at all highway earthworks cuttings and embankments.

14.2.5.122 In addition to the above, proposed methods of Flood Mitigation is outlined below.

### *Attenuation*

14.2.5.123 The detailed design of the proposed highway drainage will be in accordance with current design standards specifically the Design Manual for Roads and Bridges (DMRB) and the Manual of Contract Documents for Highway Works (MCHW). By following these design standards, the design of the scheme will have low risk of surface water flooding and low risk from fluvial flooding.

14.2.5.124 The design of the A66 NTP S06 Appleby to Brough leads to a substantial increase the impermeable area.

14.2.5.125 In Accordance with CG 501, the proposed drainage design will ensure that there is no increase in discharge rates at each outfall. To achieve this, any increase in impermeable area as a result of the proposed alignment will need to be attenuated prior to the discharge, with sufficient storage for a 1 in 100 AEP design storm including an increase for current climate change allowances.

14.2.5.126 The detailed design will be based on updated geotechnical information, and at that stage disposal via infiltration will be explored to see if it is a practicable option. If it is not, the regulated hierarchy of discharge will be followed in finalising the drainage design. Also refer to the Karst section regarding dissolution features that are present on this scheme.

14.2.5.127 The proposed attenuation will ensure that the flooded volume is no greater than existing.

### *Flow Path*

14.2.5.128 Drainage flow paths during storm events have been considered as part of the design process. The road alignment and drainage collection systems expedite the flow of water from trafficked and hard standing areas to minimise the risk of standing water on the carriageway.

14.2.5.129 For higher rainfall return periods and in the event of drainage blockages, exceedance flow paths shall direct flood water downstream to watercourses.

14.2.5.130 watercourses.

### *Flood Compensatory Storage*

14.2.5.131 Where possible compensatory storage has been provided on a level for level basis to mitigate against the volume of floodplain lost, as a result of the proposed road alignment. Compensatory storage areas have been provided close to the loss areas and are hydraulically connected to the floodplain. Volumes are provided in Table 25: Level for level flood compensation details for Appleby to Brough.

Table 25: Level for level flood compensation details for Appleby to Brough

| Location | Volume provided ($m^3$) |
|---|---|
| Adjacent to Unnamed Tributary of Mire Sike 6.12, north of the proposed crossing at Sandford Junction | 325 |
| Northeast of Cringle Beck viaduct crossing | 2969 |
| Northeast of Warcop Junction adjacent to Eastfield Sike | 843 |
| North of Westview Farm crossing adjacent to Yosgill Sike and Woodend Sike | 1198 |

14.2.5.132 At the proposed Warcop westbound junction, in the vicinity of Moor Beck, it is not possible to provide level for level compensation as the availability of suitable low lying land close to the loss areas is limited. Therefore, it is proposed to provide indirect storage (or volume for volume compensation) that relies on water entering a storage area which then releases water at a slower rate. The indirect storage is located both sides of Moor Beck on the south side of the scheme and to the west of the junction (Plate 4: Proposed volume for volume flood compensation storage adjacent to Moor Beck at Warcop Junction). Locating the storage within the same Water Framework Directive (WFD) waterbody ensures no deterioration or prevention of achieving WFD objectives.

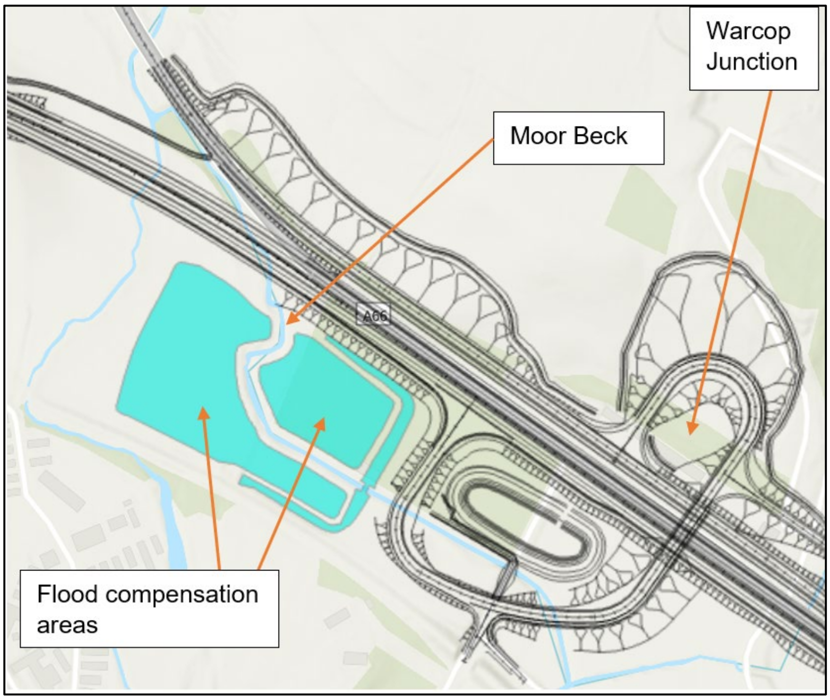


Plate 4: Proposed volume for volume flood compensation storage adjacent to Moor Beck at Warcop Junction

14.2.5.133 The flood modelling undertaken confirms that the proposed storage ensures no increase in flood risk downstream (see flood modelling report in Annex F). At detailed design there is an opportunity to consider further increasing the storage area to reduce the flood risk downstream.

## Conclusion

### *Summary*

14.2.5.134 The Flood Risk Assessment has been undertaken in accordance with NPS, NPPF and Planning Practice Guidance: Flood and Costal Change. These standards will support the scheme development and guide the development of an appropriate drainage design at detailed design.

14.2.5.135 The Environment Agency Flood Maps show that areas within the Order Limits are located within Flood Zones 2 and 3. Correspondence with the Environment Agency provided further information about the flood risk in this area. To support the drainage design process additional flood modelling was undertaken to provide an existing flooding baseline.

14.2.5.136 Fluvial modelling of scheme has been conducted to determine the potential impacts as a result of the scheme and its drainage assets on the flood volumes and locations.

14.2.5.137 Surface water run-off will be attenuated within the proposed highway drainage system to mitigate off-site flooding. To mitigate the risk of surface water flooding on the proposed highway sustainable drainage techniques shall be further developed during detailed design.

14.2.5.138 Additional storage is provided within the new drainage system to allow for the anticipated increase in rainfall intensities due to climate change. The attenuation is designed to manage flows to the 1 in 100-year event plus 20% climate change uplift value. A sensitivity check on the drainage design has also been conducted to include the 1 in-100 year event plus 50% climate change uplift value.

14.2.5.139 Risk to Warcop from existing fluvial flood risk and from the scheme has been modelled and compensatory storage developed to mitigate any downstream risk. This will be further developed at detailed design.

14.2.5.140 Water quality mitigation measures have been incorporated in the proposals.

14.2.5.141 The scheme is not considered to be at risk of flooding from the sea and is considered to be at low risk of flooding from rivers, surface water and groundwater. The risk of flooding from reservoirs is managed through the enforcement of the Reservoirs Act 1975 by the Environment Agency.

### *Residual risks*

14.2.5.142 The key residual risks associated with the drainage / flood risk are as follows:

- Flood events in excess of the design standard – the capacity of the designed drainage system will minimise the impact of exceedance events.

- Blockages in the drainage system – managed through routine and/or reactive maintenance.
- Flooding from reservoirs – reservoir breach is highly unlikely but is addressed by enforcement of the Reservoirs Act 1975 and through flood warning.

## 14.2.6 Bowes Bypass

### Introduction

14.2.6.1 This section of the document details the proposed design for this scheme, that is located at the town of Bowes in Durham. The location of the scheme is shown on ES Figure 14.1: Surface Water Features (Application Document 3.3).

14.2.6.2 The drainage for this scheme has been designed in accordance with the Standards for Highways Design Manual for Roads and Bridges and in accordance with relevant Local Authority design standards as detailed in section 14.2.1.

### Baseline conditions

#### *Surface watercourses*

14.2.6.3 The majority of watercourses within the study area drain into the River Greta via a number of tributaries that converge at a low point to the north-east of the A66 and A67 junction

14.2.6.4 The only watercourse in the study area designated by the Environment Agency as a Main River is the River Greta. This is noted on the Environment Agency website as being in consultation. Table 14-26: Watercourses within the Bowes Bypass study area provides a brief description of the watercourses in the study area (from west to east). ES Figure 14.1: Surface Water Features (Application Document 3.3)displays the watercourses identified in the study area.

Table 14-26: Watercourses within the Bowes Bypass study area

| Watercourse | Description |
|---|---|
| Bessy Sike | Flows east and then north in the north-west of the study area. |
| Unnamed Tributary of River Greta 7.7 | Flows south into the River Greta in the west of the study area. |
| Unnamed Tributary of River Greta 7.1 | Flows south from the existing A66 into the River Greta, south-west of Ivy Hall Farm. |
| Unnamed Tributary of River Greta 7.3 | Flows south, crossed by Clint Lane in the north of the study area. Converges multiple field drains into one culvert which flows under the existing A66 and emerges to the south of the existing A66 at Stone Bridge Farm. Watercourse then flows south into the River Greta. |
| Chert Gill | Flows north into the River Greta in the south of the study area, culverted under Long Close Lane. |
| How Low Gill | Flows north into the River Greta in the south of the study area, culverted at Whorlands. |

| Watercourse | Description |
|---|---|
| Unnamed Tributary of River Greta 7.5 | Flows south from Stone Bridge Farm, in the centre of the study area, and is artificially straightened as it flows into the River Greta. |
| Unnamed Tributary of River Greta 7.6 | Flows east, south of the existing A66, and towards Thackholm with some sections of artificial straightening. Joins the River Greta in the far south-east of the study area, south of Low Broats. |
| River Greta | Flows east, parallel to the south of the existing A66 and Bowes. Flows into the River Tees 9.5km downstream of the study area. |
| Unnamed Tributary of River Greta 7.2 | Flows west, south of the existing A66, in the west of the study area. Flows into the River Greta. |
| Thorsgill Beck | Flows east in the north-west of the study area, discharges into the River Tees approximately 5km downstream of the study area. |
| Huggill Sike | Flows north, over Huggill Force and into the River Greta, in the south-west of the study area. |
| Tom Gill | Flows north and into the River Greta at Tom Gill Plantation, in the south and central area of the study area. |
| Unnamed Tributary of River Greta 7.4 | Flows east, north of and parallel to the existing A66 in the central portion of the study area. It is then culverted under the existing A66 and joins the Unnamed Tributary of River Greta 7.5 |

### *Topography*

14.2.6.5 Levels generally fall north-west to south-east along the proposed route.

14.2.6.6 The topography for the area consists of a steady fall from circa 289mAOD at the west, falling to circa 266mOD to the east. The village of Bowes located to the south is located at a gradual rise culminating at the high point of Bowes Castle, before falling away towards the Greta Burn located to the south by means of a 1:10 slope, prior to an approximately 1:2 embankment to water level. See ES Figure 14.2: Existing Flood Risk (Application Document 3.3) for contours.

14.2.6.7 To the north of the proposed alignment, the land rises at a gradient of circa 20% before plateauing, resulting in a maximum level of circa 338mAOD to the north west.

14.2.6.8 Along the route, levels undulate with a highpoint located at the existing overbridge of the A66 and A67. A low point is located circa 650m west, of the existing, “The Street/A66” junction, prior to rising to a high point of circa 292mAOD located at the access of the existing quarry located on the south side of the carriageway.

### *Geology and soils*

14.2.6.9 A complete description of the geological and topological context is provided in the Environmental Statement Appendix 14.6 Hydrogeological Impact Assessment.

14.2.6.10 Ground conditions within this scheme, Scheme 7, are generally made up of a sequence of thin Topsoil or Made Ground overlying variable thicknesses of predominantly Cohesive Glacial Deposits and mudstone bedrock at depth (ARUP, 2022).

14.2.6.11 Topsoil was recorded as having an average thickness of 0.3m and was described as soft sandy gravelly clay (ARUP, 2022).

14.2.6.12 Made Ground typically comprised of clayey slightly gravelly sand and frequently included rootlets where encountered at ground level (ARUP, 2022).

14.2.6.13 Bedrock was recorded within a number of exploratory holes including historical ones and was encountered at depths ranging between 0.15m bgl (TP BB003) and 17m bgl (BH BB023). Rockhead was shallowest in the area of the A67 underpass, which is anticipated to have been constructed directly onto rock (ARUP, 2022).

## Existing drainage

### *Background*

14.2.6.14 HADDAMS and Local Authority record drawings have been used to determine the form and location of all existing drainage. Whilst site visits have been undertaken to clarify existing drainage where possible, no intrusive drainage surveys have been undertaken at this stage of design. Where proposed drainage interfaces with existing, CCTV surveys shall be undertaken prior to commencement of detailed design.

### *Description of existing drainage*

14.2.6.15 Existing drainage comprises a mixture of gullies, filter drains, and over the edge drainage, either onto adjacent land or into roadside ditches.

14.2.6.16 Positive drainage systems outfall into local watercourses at strategic locations.

14.2.6.17 The existing Bowes Bypass accepts flows from a tributary of the River Greta. This passes through a series of pipes which also collect drainage from the A67 before discharging to the southwest of the junction back into an open drain. This stretch of drainage has been included as an existing culvert in design schedules. This is based on information from As Built records (AOne+, 1981) which are appended to this report.

14.2.6.18 Sections of the existing drainage will be retained along the scheme. Where suitable, existing outfall locations have been retained. In instances that this has not been possible, new outfalls will be provided.

### *Assessment of catchment areas and existing runoff rates*

14.2.6.19 An assessment of the existing catchment areas has been undertaken to inform the calculation of proposed discharged rates and ensure that flows to individual watercourses do not increase above existing rates.

14.2.6.20 Existing catchments and the existing drainage information have been used to calculate restricted flow rates that will be applied to proposed outfalls from the proposed drainage system.

14.2.6.21 This approach ensures that flows to individual watercourses are not increased over the existing scenario. The proposed discharge rates are based upon the new catchment areas. These new catchment areas are then split between existing and new impermeable area. Where the catchment is existing impermeable area and brownfield area, a factor has been applies. Where the area is new impermeable area resulting from the scheme, a greenfield run-off rate estimation has been undertaken. The sum of these two rates then yields the proposed discharge rate for each catchment.

14.2.6.22 The “Greenfield runoff rate estimation” tool from uksuds.com employs the HR Wallingford method (Wallingford, 2021). has been used to assess existing runoff rates. The Qbar greenfield runoff rate of 8.51 l/s/ha and a brownfield rate of 139l/s/ha (i.e. 50mm/hr) have been used. Calculations produced are appended to this report.

14.2.6.23 Table 14-27: Bowes Bypass existing drainage catchments summary shows existing catchments that drain to each of the proposed outfalls.

Table 14-27: Bowes Bypass existing drainage catchments summary

| Catchment | Existing Greenfield Area (ha) | Existing Brownfield Area (ha) | Existing Greenfield Flow Rate (l/s) | Existing Brownfield Flow Rate (l/s) | Restricted Flow Rate Applied to Outfall (l/s) |
|---|---|---|---|---|---|
| S07-01 | 2.08 | 2.52 | 17.68 | 349.96 | 367.65 |
| S07-02 | 3.21 | 0.42 | 27.35 | 58.07 | 85.43 |
| S07-03 | 1.85 | 0.72 | 15.73 | 99.54 | 115.27 |
| S07-04 | 1.27 | 0.38 | 10.81 | 52.25 | 63.06 |
| S07-05 | 0.76 | 0.19 | 6.47 | 26.62 | 33.10 |
| S07-06 | 1.91 | 1.44 | 16.25 | 199.84 | 216.10 |
| S07-07 | 0.94 | 0.10 | 0.80 | 14.34 | 15.14 |

### *Hydraulic Modelling of Existing Highway Surface Water Drainage Networks*

14.2.6.24 Existing drainage networks between the junction at Rokeby and the Barnard Castle Road roundabout are to remain largely in place. The outfall for this drainage will connect into a carrier pipe which will direct flows south of the proposed A66.

14.2.6.25 No hydraulic modelling of existing drainage networks unaffected by the works has been undertaken.

## Proposed drainage

### *Collection system design*

14.2.6.26 A number of surface water collections systems will be utilised.

- National Highways A66 Collection System
    - Primary surface water collection system will be road edge concrete surface water channels.
    - Laybys and refuge areas will be drained using either concrete surface water channels or gullies.
    - Bridge Deck Drainage units will be used to drain surface water on bridge sections.
    - Filter drains will be used where required, including highway verges where the verge is contained by earthworks and cuttings/embankments.
    - Open ditches and/or filter drains will be used to intercept and convey overland flow from areas outside of the highway corridor.
- Local Authority Roads Collection System
    - Primary surface water collection system will be gullies.
    - Filter drains will be used where required, including highway verges where the verge is contained by earthworks and cuttings/embankments.
    - Open ditches and/or filter drains will be used to intercept and convey overland flow from areas outside of the highway corridor.

14.2.6.27 For the Project, the primary drainage collection system will consist of concrete surface water channels. For this scheme surface water channels will be placed on the road edge adjacent to the hard strip and will drain surface water from the A66 carriageway, verges, embankments, and the central reserve.

14.2.6.28 The design of the surface water channels is in accordance with *DMRB CD 521.* The proposed vertical and horizontal highways alignment has been assessed using the process outlined in Section 4 – Design Process of *DMRB CD 521*.

14.2.6.29 The position of surface water channels in relation to the pavement edge shall follow the guidance provided in *DMRB CD 524*.

14.2.6.30 Where gullies are used, gully spacing will be determined as part of detailed design in accordance with *DMRB CD 526*.

14.2.6.31 Combined kerb and drainage systems will be designed in accordance with *DMRB CG 501*.

14.2.6.32 A simple assessment of the minimum required discharge capacity of the combined kerb and drainage systems is based on the Rational Method Equation $Q = 2.78\ CiA$, where:

- 'Q' is the design peak rate of runoff (l/s)
- 'C' is a non-dimensional runoff coefficient (taken as 1.0)
- 'i' is the design rainfall intensity (mm/hr)
- 'A' is the total catchment area (ha)

- Note: 2.78 is a conversion factor to address the rainfall units being in mm/hr

### *Pollution Controls*

14.2.6.33 In accordance with *DMRB CG 501*, the selection of pollution control measures has been determined following the process outlined below:

- Complete assessment in accordance with DMRB LA 113[2]
- If mitigation is required, identify viable options/combinations of measures, taking account of:
- Road drainage hierarchy
- Site constraints
- Storm flow and flood risk requirements
- Climate change allowances
- Road geometry
- Review short list of options against construction and maintenance requirements
- Confirming the measures fulfil water quality requirements - these are presented in ES Appendix 14.3: Water Quality Assessment (Application Document 3.4)

14.2.6.34 The pollution control measures vary for each proposed outfall, and include a combination of the following measures:

- Wet attenuation ponds with sediment forebays
- Vortex grit separators
- Vegetated ditches

14.2.6.35 HEWRAT Assessments have been undertaken to ensure sufficient mitigation measures have been incorporated at each outfall. Details of the Highways England Water Risk Assessment Tool (HEWRAT) are provided in ES Appendix 14.3: Water Quality Assessment (Application Document 3.4).

14.2.6.36 Table 14-28: Bowes Bypass pollution control mitigation measures outlines the pollution control mitigation measures included at each proposed outfall.

Table 14-28: Bowes Bypass pollution control mitigation measures

| Catchment | Attenuation pond | Grit Separator | Vegetated Ditch |
|---|---|---|---|
| S07-01 | Y | N | N |
| S07-02 | Y | N | Y |
| S07-03 | Y | Y | N |
| S07-04 | Y | Y | N |
| S07-05 | Y | N | Y |
| S07-06 | Y | N | Y |
| S07-07 | N | N | Y |

### *Climate change*

14.2.6.37 In accordance with *DMRB CG 501*, a 20% increase to peak rainfall intensity should be considered the minimum accommodated within the drainage design in order to account for potential climate change.

14.2.6.38 Environment Agency guidance[19] for allowances that should be made for climate change has been followed. Climate change allowances relating to increased peak rainfall intensity are outlined in Table 14-29: Peak rainfall intensity allowance in small and urban catchments - Bowes Bypass.

Table 14-29: Peak rainfall intensity allowance in small and urban catchments - Bowes Bypass

| Applies across all of England | Total potential change anticipated for the '2020s' (2015 to 2039) | Total potential change anticipated for the '2050s' (2040 to 2069) | Total potential change anticipated for the '2080s' (2070 to 2115) |
|---|---|---|---|
| Upper end | 10% | 20% | 40% |
| Central | 5% | 10% | 20% |

14.2.6.39 Environment Agency guidance is to assess both the central and upper end allowances to understand the range of impact.

14.2.6.40 In accordance with DCC SuDS guidance, the SuDS have been designed with a consideration for climate change.

14.2.6.41 For the 1, 5, and 100 year storm events, a 40% climate change uplift has been applied. Simulations adhered to the following requirements:

- No surcharging in the 1 year storm event.
- No flooding in the 1 or 5 year storm events.
- Water level in the ponds not to exceed the pond storage layer in the 1 in-100 year + 40% climate change storm event.

### *Surface water storage*

14.2.6.42 The proposals lead to an increase in impermeable area draining to local watercourses.

14.2.6.43 In Accordance with CG 501, the proposed drainage design will ensure that there is no increase in runoff rates as a result of the proposals. To achieve this, existing runoff rates have been assessed and flow control devices incorporated into the drainage systems. Storage for surplus flows has generally been provided using ponds.

14.2.6.44 It has been noted that DCC require that ponds which will fall under their ownership shall have an internal side slope of 1:5. At present, the modelled designs have ponds with an internal side slope of 1:4 with an access track surrounding the perimeter of the pond. Verbal agreement from DCC to remove the access track has been given in order to allow for a slackening of the internal side slopes. This was discussed in a meeting with DCC on the 24th of March 2022 and meeting minutes have been appended to this report.

14.2.6.45 For the proposed drainage design, a climate change allowance of 40% has been applied to design storm events.

### *Hydraulic modelling of proposed highway surface water drainage networks*

14.2.6.46 The proposed main carrier drainage network and surface water storage has been modelled using MicroDrainage software.

14.2.6.47 FSR rainfall data has been used, with global variables (M560, r) to suit the site location.

14.2.6.48 The equivalent impermeable area draining to proposed networks has been obtained by applying the following factors to the measured contributing areas:

- Paved surfaces - 1.00
- Verges contained by embankments/cutting slopes - 0.5
- Embankments/Cutting Slopes - 0.25
- As limited GI information is available at this stage, all attenuation ponds have been assumed to require an impermeable liner. Attenuation pond surfaces – 1.00

14.2.6.49 Networks have been established to suit proposed vertical alignments and potential outfall locations.

14.2.6.50 HydroBrake flow controls have been incorporated downstream of attenuation ponds, with flow rates restricted to those detailed in Table 14-27: Bowes Bypass existing drainage catchments summary.

14.2.6.51 Table 14-30: Bowes Bypass proposed catchments, is a summary of proposed total catchment area size, percentage of impermeable area within each catchment and the volume of attenuation required to achieve the peak permitted discharge rate calculated for the corresponding existing catchment (see above). This is to ensure the proposed discharge rates are no greater than existing.

Table 14-30: Bowes Bypass proposed catchments

| Catchment | Drained Area (ha) | Total Impermeable Area Drained (ha) [a] | Volume of storage provided[b] ($m^3$) | Peak Permitted Flow Rate[c] (l/s) |
|---|---|---|---|---|
| S07-01 | 4.98 | 4.38 | 230 | 367.65 |
| S07-02 | 3.47 | 1.77 | 780 | 85.43 |
| S07-03 | 2.75 | 2.50 | 1445 | 115.27 |
| S07-04 | 2.00 | 1.69 | 585 | 63.06 |
| S07-05 | 0.91 | 0.50 | 590 | 33.10 |
| S07-06 | 3.35 | 3.13 | 1820 | 216.10 |
| S07-07 | 0.2 | 0.19 | N/A | 15.14[d] |

a - Total drained embankment and drained verge. Attenuation pond not included in table, included in calculations.

b - Volume provided in design from normal water level to 300mm freeboard (below road level), as per guidance provided in The SuDS Manual (CIRIA C753).

c - 1 in 100-year storm, 40% climate change.

d - No pond proposed.

### *Exceedance flood routing*

14.2.6.52 The design will consider the overland flow routes of exceedance flows, and where possible, provide a route for exceedance flows that minimises the risk of flooding of properties. The routing of exceedance flows where possible will follow the discharge pipe route to receiving waters.

14.2.6.53 All storage ponds are designed for a 1 in 100 year storm with a 40% climate change allowance with a free board allowance of 300mm to provide a conservative design.

### *Existing watercourses*

14.2.6.54 In accordance with *CG 501* and *DMRB LA 113* the proposed highways and drainage design, where possible, will limit impact on Environment Agency main rivers and ordinary watercourses. Where a watercourse has been disrupted by the proposed highways alignment a proposed culvert has been sized appropriately to allow the flow from the watercourse to be uninterrupted.

14.2.6.55 All new culverts will be designed in accordance with *DMRB CD 529* details and in consultation with relevant stakeholders (e.g. LLFA or EA).

14.2.6.56 Existing culverts which have been extended match the existing culvert dimensions. In two instances within Scheme 07, a relaxation from point 3.4 of *CD 529* is required. This guidance states *“Where a circular culvert is longer than 12 metres it shall be at least 1.2 metres in diameter to facilitate access for maintenance”.*

14.2.6.57 All culverts with a diameter of 900mm and above will require structural design.

14.2.6.58 It is the design intention to maintain existing outfalls on existing watercourse and to not increase the discharge rate of these outfalls (see Existing Hydraulic Modelling Results).

14.2.6.59 Where new outfalls are required the individual outfall details will be designed in accordance with *DMRB CD 529* and in consultation with relevant stakeholders (e.g. LLFA or EA).

14.2.6.60 Erosion/scour protection to be considered at detailed design stage.

14.2.6.61 Following discussions with DCC, DCC would expect a headwall to suit the specific pipe it supports and contain a culvert screen (70 degree angle screen with a minimum of 70mm bar spacing).

14.2.6.62 The outfall for Pond 01 on the scheme, refer to Proposed Drainage Plans appended to this report, is currently proposed to discharge into the River Greta. This would require consultation with the Environment Agency as this is an outfall to a main watercourse. During detailed design, there is scope to investigate the option of discharging to the tributary of the River Greta at the west of Pond 01. This would negate the need for special permission for discharge into the main watercourse and potentially reduce the need for cascade at the outfall.

### *Land drainage and overland flow*

14.2.6.63 Where land outside of the highway corridor falls towards the highway, cut-off drainage has been provided. Filter drains have been used in scenarios that result in deep cut off ditches.

14.2.6.64 Cut-off drainage comprises open ditches and/or filter drains, with culverts/carrier pipes provided to cross the highway corridor where necessary.

14.2.6.65 Cut-off drainage will intercept and convey overland flow around the highway corridor, so that this flow does not enter the highway drainage system or cause flooding issues on the proposed highway.

### *Karst Risk*

14.2.6.66 Karst is an area of land formed of rock such as limestone that is worn away by water to make caves and other formations.

14.2.6.67 Karst Risk, is a natural human induced hazard in karst areas, resulting in dissolution of soluble rocks such as limestone, dolomite, and gypsum, potentially resulting in collapse or sink holes.

14.2.6.68 Infiltration systems must not be used close to dissolution features. All ponds and drainage systems to be lined where the Karst Risk is classed as Medium or High.

14.2.6.69 Maintenance access to all drainage systems shall be provided to allow a suitably experienced and qualified professionals to monitor Karst Risk regularly.

## Flood Risk Assessment

### *Data Collection*

14.2.6.70 The risk of flooding to the development has been assessed on readily available information, published on the Environment Agency website.

14.2.6.71 In addition to readily available information, JBA has undertaken baseline hydraulic modelling of existing watercourse/culvert crossings. This modelling indicates flooding in the vicinity of the existing A66.

14.2.6.72 JBA have also completed hydraulic modelling on the proposed design at where these existing culverts are extended due to widening works in the proposed highway. These results have been appended to this report.

14.2.6.73 The proposed drainage strategy presented in this report has been developed in consultation with DCC. A record of the consultation from December and May 2022 is appended to this report.

### *Flood risk vulnerability classification*

14.2.6.74 Guidance for flood risk vulnerability for new development sites is set out in the Government planning portal for flood risk and coastal change. Table 6: Flood risk vulnerability classification advises whether new development sites should or should not be permitted, based upon the vulnerability classifications set out on the planning portal.

14.2.6.75 In accordance with *DMRB LA 113*, NI/1.7, the development is classified as “Essential Infrastructure”. The development is therefore permitted providing it is located within Flood Zones 1 or 2, with the exception test required if located in Flood Zones 3a or 3b.

### *Sequential Test*

14.2.6.76 As part of a Flood Risk Assessment a sequential test is required when the proposed development is located within Flood Zone 2 or 3. The sequential test compares the proposed site with other available sites to find out which has the lowest flood risk.

14.2.6.77 The design team considered alternative alignments which would still meet the project requirements.

14.2.6.78 As part of this review, a number of principal alternative routes or combination of routes were identified, considering potential environmental impacts, project design principles, impacts on landowners, buildability and design safety.

14.2.6.79 A full extensive write up of this review can be seen in the Project Development Overview Report (Application Document 4.1).

14.2.6.80 This review identifies the proposed route is the most favourable with the least environmental impacts, impacts on landowners, buildability and design safety, whilst maintaining project design principles.

14.2.6.81 In respect of the Sequential Test for this scheme, the development is in Flood Zone 1 and at low risk of fluvial flooding. However, flood risk must be considered from all potential sources. The scheme is shown to be at low risk of surface water flooding. The scheme is outside of the predicted maximum extent of reservoir flooding.

### *Exception Test*

14.2.6.82 The proposed scheme is located within Flood Zone 1. In accordance with Table 2 of the Flood Risk and Coastal Change guidance, the proposed alignment has been assessed as being Essential Infrastructure and is appropriate for this flood zone. An Exception Test is not required as the scheme is located within Flood Zone 1.

### *Flooding from rivers or the sea*

14.2.6.83 Baseline flood risk from rivers and sea using Environment Agency data is shown on ES Figure 14.2: Existing Flood Risk (Application Document 3.3). The Environment Agency data indicates that the scheme is in Flood Zone 1 and at low risk of flooding.

14.2.6.84 The Environment Agency Flood Map indicates that the development is at low risk of flooding from the rivers in the vicinity of the proposed design.

14.2.6.85 The flooded extent shown at the River Greta in the maps are noted as being “Medium Risk,” meaning the annual probability of flooding is between 1% and 3.3%. This does not overlap with the proposed design and is not viewed as a risk to the development.

14.2.6.86 Baseline flood modelling of all watercourse and field drains crossing the existing A66 has been undertaken.

14.2.6.87 JBA climate change uplifts have been applied for the central, higher central and upper end allowances for the Tees Management Catchment using the Environment Agency July 2021 allowances.

14.2.6.88 Watercourses crossing the A66 are summarised below. These are all designated as Ordinary Watercourses:

## *Unnamed Tributary of River Greta 7.3*

14.2.6.89 This watercourse is inputted to the JBA “Armoury Model” as the upstream watercourse. This is located at the east of the site at Stone Bridge Farm.

14.2.6.90 The watercourse passes beneath the existing A66 through a culvert measuring approximately 40m in length.

14.2.6.91 See post development results in Post Development Flood Modelling Results below.

### *Unnamed Tributary of River Greta 7.4*

14.2.6.92 This watercourse is inputted to the JBA “Armoury Model” as the downstream watercourse. This is located at the east of the site at Stone Bridge Farm.

14.2.6.93 The watercourse passes beneath the existing A66 through a culvert measuring approximately 40m in length.

14.2.6.94 In the JBA draft flood model results, flood depths have increased in the proposed scenario at The Street. JBA have stated this is likely due to model instability or as a result of proposed ditch depths to the north of the alignment. Therefore, these ditches in this zone may need to be increased in depth to match existing and provide like for like storage. This will be confirmed at a later design stage.

14.2.6.95 JBA results show peak flows out of the culverted network upstream of this reach have not changed between the baseline and the proposed.

14.2.6.96 Flooding has increased upstream of the catchment, though this closely matches the existing extent of flooding shown by JBA. This is likely caused by the widening works on the mainline. Consequently, an allowance has been made within the red line boundary north of the existing culvert. This is to provide an area for flooding for any flood compensation that may be needed.

14.2.6.97 See post development results in Post Development Flood Modelling Results below.

### *Unnamed Tributary of River Greta 7.5*

14.2.6.98 This watercourse is inputted to the JBA “Bowes Bypass Model”. This is located at the Bowes Bypass.

14.2.6.99 The watercourse passes beneath the existing A66 through a culvert measuring approximately 472m in length.

14.2.6.100 The culverts are made up of a series of pipes, ranging in internal diameters from 450mm to 675mm, and manhole chambers.

14.2.6.101 From As Built information it is understood that a portion of the existing A67 highway drains into this culvert. This area has not been included in the assessment by JBA. In the next design stage a more detailed assessment of this shall be undertaken to understand the cumulative flow through the culvert resulting from the watercourse and surface water from the highway.

14.2.6.102 See post development results in Post Development Flood Modelling Results below.

## Post Development Flood Modelling Results

14.2.6.103 The results from JBA, which are appended to this report, concluded that generally the scheme has a negligible impact on water levels and pass-forward flows within the channel.

14.2.6.104 Peak water level and pass-forward flows downstream of the pipe network in Unnamed Tributary of River Greta slightly increase. This is likely due to flows being attenuated by a proposed drainage ditch north of the existing channel (NGR: 399728, 513533), causing increased flow towards The Street.

14.2.6.105 At Bowes, generally there is low to no impact on flood depths due to the proposal. During the 100-year plus 61% event, there are few isolated locations where an increase in flood risk is predicted.

14.2.6.106 As previously noted, the existing Bowes Bypass culvert accepts flows from a tributary of the River Greta as well as portions of highways drainage according to As-Built records. As part of the proposals, the slip road will be realigned to the north. Highway drainage in the new slip road will not be connected to this existing network, but instead drain to the proposed pond south of Bowes. This will reduce the impermeable area draining into the system and provide betterment.

14.2.6.107 At Stone Bridge Farm, flood depths show a significant increase as a result of impoundment against the embankment in all events. Downstream, there is negligible impact on flood depths.

14.2.6.108 While the mainline of the A66 is widening, showing an impact on the floodplain, this does not take into consideration the reduction of contributing catchment as a result of this widening. The portion of the widened A66 will be drained to an attenuation pond and discharged at an agreed controlled rate.

14.2.6.109 Area has been included within the order limits boundary to accommodate a portion of flooded area north of the areas reviewed by JBA. These areas are pending agreement with local flood authorities based on pre and post development flood extents.

### *Surface water flooding*

14.2.6.110 Surface water risks are apparent at the west of the work near Ivy Hall Farm Campsite, at the Bowes Underpass and at the east of the scheme at Stone Bridge Farm.

14.2.6.111 These risks range from low to high in these locations.

14.2.6.112 Works in the west, north of Ivy Hall Farm, are minimal, with widening into the north occurring. A pond is proposed to collect the existing catchment and proposed widened section of A66 carriageway in this area. This provides a means of storage and controlled release of treated highways surface water.

14.2.6.113 Flooding at the Bowes Bypass is expected to have a level of betterment through removal of a portion of the highways drainage from the culvert which is located beneath the underbridge which is believed to be a contributor to the surface water flooding levels as this currently receives a portion of the existing highway surface water runoff.

14.2.6.114 Highway drainage from the mainline adjacent to Stone Bridge Farm will be collected and treated via ponds. It is believed that this surface water flooding is, for the majority, caused by a lack of capacity within the existing culvert underneath the existing A66 and access road off of The Street. As well as collecting the drainage into the ponds, the proposed design will also restrict the flows to the agreed discharge rate. This restriction and storage should provide a betterment to the flooding experienced at Stone Bridge Farm.

14.2.6.115 Additionally, cut-off drainage is proposed where land outside of the highway corridor falls towards the highway. This cut-off drainage will intercept flows from adjacent natural catchments and convey this water to watercourses via culverts/carrier pipes. Where possible this land drainage will be kept separate from the surface water drainage of the highway.

### *Historic flooding*

14.2.6.116 No historic flood outlines within the study area are shown within Environment Agency data.

### *Existing highway drainage flooding*

14.2.6.117 HADDMS identifies two culverts and four flooding hotspots within the study area. Of the four flooding hotspots one was classed as very high priority (category A status), two as high priority (category B status) and one as moderate priority (category C status). No outfalls or soakaways were identified within the study area on HADDMS.

14.2.6.118 There are several Open cases of flooding which are likely due to gully blockages in a number of locations on the mainline.

14.2.6.119 Other notable open cases of flooding are clustered in an around the Bowes Bypass on the mainline and on the east bound diverge. These are believed to be related to the beck which enters the highways drainage via a headwall. The proposed design separates the highways system from the culverted watercourse system in an effort to reduce flooding in this area as well as provide water quality treatment. The most recent Open report of flooding is from 2020 at the Bowes Bypass. There are currently no Open cases of flooding in the east at Ivy Hall Farm.

14.2.6.120 From landowner accounts, it has been recorded that a combined outfall for the campsite is locates at the upstream of the existing culvert for Bowes Bypass. This shall be investigated further during detailed design. Diverting may would reduce flows to the culvert which would reducing flooding. Furthermore water quality would be improved.

14.2.6.121 HADDMS also illustrates the flood event by severity. No floods recorded in the area of Scheme 07 are recorded as being more severe than “Yellow – 5-6”. This evidence of fair to moderate flooding severity is predominantly grouped at Clint Lane Overbridge. A further two instances of “Yellow” severity of flooding is recorded on the mainline between Clint Lane Overbridge and Bowes Bypass.

### *Groundwater flooding*

14.2.6.122 The scheme is susceptible to groundwater flooding in accordance with the Groundwater Flooding Susceptibility in Environmental Statement Figure 14.8. A complete description of the groundwater context is provided in the Environmental Statement Appendix 14.6 Hydrogeological Impact Assessment.

14.2.6.123 Ground investigation undertaken shows relatively shallow groundwater encountered at location of proposed Lyndale Farm Underpass, Blacklodge Farm Underpass and East Bowes Accommodation bridge. This is according to the Package D Ground Investigation Report

14.2.6.124This report also assesses the risk of Groundwater flooding in its’ Geotechnical Risk Register, the likelihood of groundwater flooding on this scheme has been categorised as “Extremely likely”. This is from estimated as being a result of shallow or perched groundwater, including seepages from granular portions within the Glacial Deposits (ARUP, 2022).

14.2.6.125 There are a number of areas across the scheme where the route is in cutting. A sub surface filter drainage system will be provided to these areas, or the area will be lined, should high groundwater be assessed as a risk during detailed design.

### *Flooding from reservoirs*

14.2.6.126 The Environment Agency *Flood Map* indicates that the scheme is outside of the maximum extent of flooding from reservoirs. Flooding from other artificial waterbodies.

14.2.6.127 The scheme is not at risk of flooding from other artificial waterbodies. This has been assessed based on the scale of the other artificial waterbodies in relation to the local topography and carriageway elevation.

### *Coastal flooding*

14.2.6.128 The Environment Agency *Flood Map* indicates that the scheme is outside of the maximum extent of flooding from coastal flooding.

### *Flooding from sewers*

14.2.6.129 There are no reports of flooding from existing public sewers. Northumbrian Water shall be consulted throughout the detailed design process to ensure that any risk identified is managed appropriately.

### *Flood Mitigation*

14.2.6.130 The detailed design of the proposed highway drainage will be in accordance with current design standards specifically the Design

Manual for Roads and Bridges (DMRB) and the Manual of Contract Documents for Highway Works (MCHW). By following these design standards, the design of the scheme will have low risk of surface water flooding and low risk from fluvial flooding.

14.2.6.131 Measures have been incorporated into the drainage system to mitigate any increase to the risk of flooding as a result of the scheme. Including:

- Cut-off drainage
- Surface water drainage attenuation ponds
- Flow control devices
- Flood risk from groundwater will be mitigated though cut-off drains at all highway earthwork cuttings and embankment.

14.2.6.132 In addition to the above, proposed methods of Flood Mitigation is outlined below.

### *Attenuation*

14.2.6.133 In Accordance with *CG 501*, the proposed drainage design will ensure that there is no increase in discharge rates at each outfall. To achieve this, any increase in impermeable area as a result of the proposed alignment will need to be attenuated prior to the discharge, with sufficient storage for a 1 in 100 AEP design storm including an increase for current climate change allowances.

14.2.6.134 The detailed design will be based on updated geotechnical information, and at that stage disposal via infiltration will be explored to see if it is a practicable option. If it is not, the regulated hierarchy of discharge will be followed in finalising the drainage design. Also refer to the Karst section regarding dissolution features that are present on this scheme.

14.2.6.135 The proposed attenuation will ensure that the flooded volume is no greater than existing.

### *Flow Path*

14.2.6.136 Drainage flow paths during storm events have been considered as part of the design process. The road alignment and drainage collection systems expediate the flow of water from trafficked and hard standing areas to minimise the risk of standing water on the carriageway.

14.2.6.137 For higher rainfall return periods and in the event of drainage blockages, exceedance flow paths shall direct flood water downstream to watercourses.

### *Conclusion*

### *Summary*

14.2.6.138 The scheme results in an increase in impermeable area being discharged to local watercourses. However, existing flow rates have been calculated, and proposed flow rates restricted to ensure that there is no increased flood risk created by the scheme.

14.2.6.139 Water quality mitigation measures have been incorporated in the proposals.

14.2.6.140 A full assessment of the capacity of the receiving drainage system shall be undertaken as part of detailed design. Surface water storage will be required if the existing drainage system does not have the capacity to accept additional flows.

14.2.6.141 The scheme is at low risk of flooding from the sea and reservoirs.

14.2.6.142 Flooding risk from groundwater and surface water is not expected to be made worse by the proposed scheme and mitigation against this is proposed.

14.2.6.143 Based on information from JBA, watercourses are a flood risk to the existing and proposed scheme.

14.2.6.144 JBA flood modelled areas have shown a negligible increase to flooding extents. These extents are shown north of the existing A66 and should not be of risk to properties or any greater risk to the A66. An allowance for flood mitigation has been allowed for in the order limits for review in detailed design.

#### *Residual risks*

14.2.6.145 There are numerous incidents of flooding to the existing A66 based on HADDMS information and JBA modelling. Flooding shall be further investigated during future design stages.

14.2.6.146 Water quality mitigation measures should be revisited as detailed design progresses, to ensure that sufficient mitigation is included.

## 14.2.7 Cross Lanes to Rokeby

### Introduction

14.2.7.1 This section of the document details the proposed design for the scheme, which runs from Cross Lanes to Rokeby. This section of the Project is located north of Tutta Beck. Cross Lanes Farm Barnard Castle Road are at the western and eastern extents respectively. The location of the scheme is shown on ES Figure 14.1: Surface Water Features (Application Document 3.3).

14.2.7.2 The drainage for this scheme has been designed in accordance with the Standards for Highways Design Manual for Roads and Bridges and in accordance with relevant Local Authority design standards as detailed in Section 14.2.1.

## Baseline conditions

### *Surface watercourses*

14.2.7.3 Watercourses within the study area drain into the River Tees via a number of tributaries. None of the watercourses in the study area are designated by the Environment Agency as a Main River.

14.2.7.4 Table 14-31: Watercourses within Cross Lanes to Rokeby study area gives a brief description of the surface watercourses within the study area (from west to east) which are also displayed on ES Figure 14.1: Surface Water Features (Application Document 3.3).

Table 14-31: Watercourses within Cross Lanes to Rokeby study area

| Watercourse | Description |
|---|---|
| Thorsgill Beck | Flows east in the north-west of the study area, discharging into the River Tees. |
| Punder Gill | Flows east parallel to the south of the existing A66, crossed by the Moorhouse Lane in the west of the study area, flowing into Tutta Beck. |
| Unnamed Tributary of Punder Gill 8.1 | Flows east into Punder Gill, crossing the existing A66 in the west of the study area. |
| Unnamed Tributary of Tutta Beck 8.1 | Flows north into Tutta Beck, parallel to Moorhouse Lane in the west of the study area. |
| Tutta Beck | Flows east, parallel to the south of the existing A66. Crossed by the existing A66 and joins the River Greta in the east of the study area. |
| New Cut | Flows south in the south-west of the study area, discharges into the River Greta. |
| Unnamed Tributary of Tutta Beck 8.2 | Flows north along agricultural field boundaries into Tutta Beck, to the west of Birk House, in the east of the study area. |
| Unnamed Tributary of Tutta Beck 8.3 | Flows north into Tutta Beck, to the east of Birk House in the west of the study area. |
| Partridge Gill | Flows east in the south of the study area, flows into the Wellfield Strand at Jack Wood. |
| Wellfield Strand | Flows north in the south of the study area, flows into the Tutta Beck near Ewbank Farm. |
| Manyfold Beck | Flows east into the River Tees, parallel to the north of the existing A66, joins the River Tees on the east of the study area, downstream of the Abbey Road bridge crossing. |
| Unnamed Tributary of Manyfold Beck 8.3 | Flows east into Manyfold Beck from Princess Charlotte Wood, culverted beneath B6277. |
| Unnamed Tributary of Manyfold Beck 8.1 | Flows east into Manyfold Beck from Smithy Cottage, culverted beneath B6277. |
| River Greta | Flows north into the River Tees, crossed by the existing A66 (to the north of Greta Bridge) and joins the River Tees 1.1km downstream, in the east of the study area. |
| River Tees | Flows east from Barnard Castle, to the north of the existing A66, joined by the River Greta to the north-east of the study area. |

| Watercourse | Description |
|---|---|
| Unnamed Tributary of Mannyfold Beck 8.4 | Located in the north-east of the study area. Flows north, straightened, and joins the Manyfold Beck, slightly upstream of its meeting with the River Tees. |
| Unnamed Tributary of River Tees 1.1 | Flows east and then north, along predominantly artificially straightened channels, in the north central portion of the study area. Discharges directly into the River Tees at Abbey Mill House. |

### *Topography*

14.2.7.5 The majority of the catchments fall south towards Tutta Beck.

14.2.7.6 The topography consists of a fall from circa 240mAOD in the west to circa 135mAOD to the east at Greta Bridge. See ES Figure 14.2: Existing Flood Risk (Application Document 3.3) for contours.

14.2.7.7 To the north and south of the existing carriageway, which is situated in both cut and fill along its length, is arable farmland consisting of shallow undulating gradients. These gradients predominantly fall away from the existing carriageway, both to the north and south, to the Manyfold Beck and Greta Burn respectively.

14.2.7.8 Along the route the ground generally falls east, however one low point and high point have been identified. The low point is located 1km east of the Moorhouse Lane and A66 junction, at the double field accesses. The high point is located circa 400m east of the low point, before falling away at a steady gradient to Greta bridge.

### *Geology and soils*

14.2.7.9 A complete description of the geological and soils context is provided in ES Chapter 8 Geology and Soils (Application Document 3.2) and ES Appendix 14.6 Hydrogeological Impact Assessment (Application Document 3.4).

14.2.7.10 Geological mapping indicates ground conditions in the area of Cross Lanes Junction to be consistent with the rest of the scheme 8 area. The superficial geology is shown as Glacial, and bedrock deposits as the Great Limestone Member (Limestone), Alston Group and Four Fathoms Limestone. The majority of the site is believed to comprise of Glacial with Alluvium shown to the south of the site.

## Existing drainage

### *Background*

14.2.7.11 HADDAMS and Local Authority record drawings have been used to determine the form and location of all existing drainage. Whilst site visits have been undertaken to clarify existing drainage where possible, no intrusive drainage surveys have been undertaken at this stage of design. Where proposed drainage interfaces with existing, CCTV surveys shall be undertaken prior to commencement of detailed design.

### *Description of existing drainage*

14.2.7.12 Existing drainage comprises a mixture of gullies, filter drains, and over the edge drainage, either onto adjacent land or into roadside ditches.

14.2.7.13 Positive drainage systems outfall into local watercourses at strategic locations.

14.2.7.14 As built drawings (AOne+, 1981) have been appended to this report.

### *Assessment of catchment areas and existing runoff rates*

14.2.7.15 Due to sections of the scheme being south and north of the existing route of the A66, catchment areas related to these sections relate to areas north or south of the proposed alignment.

14.2.7.16 The following information has been considered in the assessment of catchment areas and to calculate existing runoff rates:

14.2.7.17 Existing catchments beneath the proposed alignment and the existing drainage information have been used to calculate restricted flow rates that will be applied to proposed outfalls from the proposed drainage system.

14.2.7.18 This approach ensures that flows to individual watercourses are not increased over the existing scenario.

14.2.7.19 The proposed discharge rates are based upon the new catchment areas. These new catchment areas are then split between existing and new impermeable area. Where the catchment is existing impermeable area and brownfield area, a factor has been applies. Where the area is new impermeable area resulting from the scheme, a greenfield run-off rate estimation has been undertaken. The sum of these two rates then yields the proposed discharge rate for each catchment.

14.2.7.20 The “Greenfield runoff rate estimation” tool from uksuds.com employs the HR Wallingford method (Wallingford, 2021) has been used to assess existing runoff rates. The Qbar greenfield runoff rate of 5.82 l/s/ha and a brownfield rate of 139l/s/ha (i.e. 50mm/hr) have been used. Calculations produced are appended to this report.

14.2.7.21 Table 14-32: Cross Lanes to Rokeby existing drainage catchments summary shows existing catchments that drain to each of the proposed outfalls.

Table 14-32: Cross Lanes to Rokeby existing drainage catchments summary

| Catchment | Existing Greenfield Area (ha) | Existing Brownfield Area (ha) | Existing Greenfield Flow Rate (l/s) | Existing Brownfield Flow Rate (l/s) | Restricted Flow Rate Applied to Outfall (l/s) |
|---|---|---|---|---|---|
| S08-01 | 1.30 | 0.02 | 7.59 | 2.09 | 9.67 |
| S08-02 | 0.62 | 0.02 | 3.60 | 2.06 | 5.66 |
| S08-03 | 2.35 | 2.81 | 13.69 | 390.91 | 404.60 |

| | | | | | |
|---|---|---|---|---|---|
| S08-04 | 2.11 | 0.52 | 12.27 | 71.85 | 84.12 |
| S08-05 | 6.27 | 0.51 | 36.48 | 71.24 | 107.72 |
| S08-06 | 2.76 | 0.26 | 16.06 | 35.60 | 51.65 |
| S08-07 | 0.10 | 0.00 | 0.61 | 0.00 | 3.50 |
| S08-08 | 0.31 | 0.00 | 1.79 | 0.00 | 3.50 |
| S08-09 | 0.27 | 0.07 | 1.54 | 0.07 | 11.7 |
| S08-10 | 0.24 | 0.49 | 1.42 | 0.49 | 69.42 |

14.2.7.22 Catchment S08-10 has a reduction in the impermeable area and is proposed to drain to the east to the existing highway drainage. This catchment is not proposed to pass through a pond.

#### *Hydraulic modelling of existing highway surface water drainage networks*

14.2.7.23 Existing drainage networks are largely to remain in place. The outfall for these networks will connect into an existing carrier pipe which will direct flows south of the proposed A66. It is anticipated this pipe will need to be replaced, subject to the findings of the drainage survey to be undertaken at the detailed design stage.

14.2.7.24 No hydraulic modelling of existing drainage networks unaffected by the works has been undertaken.

### Proposed drainage

#### *Collection system design*

14.2.7.25 Cross Lanes will have a new junction. The new dualled road at Rokeby sits south of the existing A66 as does the proposed Rokeby junction. This will require completely new drainage with the exception of tie ins.

14.2.7.26 A portion of the existing A66 will be utilised and unaltered. This is west of the proposed Rokeby Junction to the roundabout at Barnard Castle Road. Drainage along this length will be unaltered with the exception of the tie ins to the new works.

14.2.7.27 A number of surface water collections systems will be utilised.

#### *National Highways A66 Collection System*

- Primary surface water collection system will be road edge concrete surface water channels.
- Laybys and refuge areas will be drained using either concrete surface water channels or gullies.
- Bridge Deck Drainage units will be used to drain surface water on bridge sections.
- Filter drains will be used where required, including highway verges where the verge is contained by earthworks and cuttings/embankments.

- Open ditches and/or filter drains will be used to intercept and convey overland flow from areas outside of the highway corridor.

### *Local Authority Roads Collection System*

- Primary surface water collection system will be gullies.
- Filter drains will be used where required, including highway verges where the verge is contained by earthworks and cuttings/embankments.
- Open ditches and/or filter drains will be used to intercept and convey overland flow from areas outside of the highway corridor.

14.2.7.28 For the Project, the primary drainage collection system will consist of concrete surface water channels. For this scheme surface water channels will be placed on the road edge adjacent to the hard strip and will drain surface water from the A66 carriageway, verges, embankments, and the central reserve.

14.2.7.29 The design of the Surface water channels is in accordance with *DMRB CD 521*. The proposed vertical and horizontal highways alignment has been assessed using the process outlined in Section 4 – Design Process of *DMRB CD 521*.

14.2.7.30 The position of surface water channels in relation to the pavement edge shall follow the guidance provided in *DMRB CD 524*.

14.2.7.31 Where gullies are used, gully spacing will be determined as part of detailed design in accordance with *DMRB CD 526*.

14.2.7.32 Combined kerb and drainage systems will be designed in accordance with *DMRB CG 501*.

14.2.7.33 A simple assessment of the minimum required discharge capacity of the combined kerb and drainage systems is based on the Rational Method Equation $Q = 2.78\ CiA$, where:

- 'Q' is the design peak rate of runoff (l/s)
- 'C' is a non-dimensional runoff coefficient (taken as 1.0)
- 'i' is the design rainfall intensity (mm/hr)
- 'A' is the total catchment area (ha)
- Note: 2.78 is a conversion factor to address the rainfall units being in mm/hr

### *Pollution controls*

14.2.7.34 In accordance with *DMRB CG 501*, the selection of pollution control measures has been determined following the process outlined below:

- Complete assessment in accordance with *DMRB LA 113*
- If mitigation is required, identify viable options/combinations of measures, taking account of:
    - Road drainage hierarchy.
    - Site constraints.
    - Storm flow and flood risk requirements.
    - Climate change allowances.

  - Road geometry.
- Review short list of options against construction and maintenance requirements.
- Confirm measures fulfil mitigation requirements identified from the *DMRB LA 113* assessment.

14.2.7.35 The pollution control measures vary for each proposed outfall, and include a combination of the following measures:

- Wet attenuation ponds with sediment forebays
- Vortex grit separators
- Vegetated ditches

14.2.7.36 HEWRAT Assessments have been undertaken to ensure sufficient mitigation measures have been incorporated at each outfall. Details of the HEWRAT are provided in ES Appendix 14.3: Water Quality Assessment (Application Document 3.4).

14.2.7.37 Table 14-33: Cross Lanes to Rokeby pollution control mitigation measures outlines the pollution control mitigation measures included at each proposed outfall.

Table 14-33: Cross Lanes to Rokeby pollution control mitigation measures

| Catchment | Attenuation pond | Grit Separator | Vegetated Ditch |
|---|---|---|---|
| S08-01 | Y | N | N |
| S08-02 | Y | N | Y |
| S08-03 | Y | N | N |
| S08-04 | Y | N | N |
| S08-05 | Y | N | Y |
| S08-06 | Y | N | Y |
| S08-07 | N | N | N |
| S08-08 | N | N | N |
| S08-09 | N | N | N |

### *Climate change*

14.2.7.38 In accordance with *DMRB CG 501*, a 20% increase to peak rainfall intensity should be considered the minimum accommodated within the drainage design in order to account for potential climate change.

14.2.7.39 Environment Agency guidance for allowances that should be made for climate change has been followed. Climate change allowances relating to increased peak rainfall intensity are outlined in Table 14-34: Peak rainfall intensity allowance in small and urban catchments - Cross Lanes to Rokeby.

Table 14-34: Peak rainfall intensity allowance in small and urban catchments - Cross Lanes to Rokeby

| Applies across all of England | Total potential change anticipated for the '2020s' (2015 to 2039) | Total potential change anticipated for the '2050s' (2040 to 2069) | Total potential change anticipated for the '2080s' (2070 to 2115) |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Upper end | 10% | 20% | 40% |
| Central | 5% | 10% | 20% |

14.2.7.40 Environment Agency guidance is to assess both the central and upper end allowances to understand the range of impact.

14.2.7.41 In accordance with DCC SuDS guidance, the SuDS have been designed with a consideration for climate change.

14.2.7.42 For the 1, 5, and 100 year storm events, a 40% climate change uplift has been applied. Simulations adhered to the following requirements:

- No surcharging in the 1 year storm event.
- No flooding in the 1 or 5 year storm events.
- Water level in the ponds not to exceed the pond storage layer in the 1 in-100 year + 40% climate change storm event.

### *Surface water storage*

14.2.7.43 The proposals lead to an increase in impermeable area draining to local watercourses.

14.2.7.44 In Accordance with CG 501, the proposed drainage design will ensure that there is no increase in runoff rates as a result of the proposals. To achieve this, existing runoff rates have been assessed (refer to section 0), and flow control devices incorporated into the drainage systems. Storage for surplus flows has generally been provided using ponds.

14.2.7.45 It has been noted that DCC require that ponds which will fall under their ownership shall have an internal side slope of 1:5. At present, the modelled designs have ponds with an internal side slope of 1:4 with an access track surrounding the perimeter of the pond. Verbal agreement from DCC to remove the access track has been given in order to allow for a slackening of the internal side slopes. This was discussed in a meeting with DCC on the 24th of March 2022 and meeting minutes have been appended to this report.

14.2.7.46 For the proposed drainage design, a climate change allowance of 40% has been applied to design storm events.

### *Hydraulic modelling of proposed highway surface water drainage networks*

14.2.7.47 The proposed main carrier drainage network and surface water storage has been modelled using MicroDrainage software.

14.2.7.48 FSR rainfall data has been used, with global variables (M560, r) to suit the site location.

14.2.7.49 The equivalent impermeable area draining to proposed networks has been obtained by applying the following factors to the measured contributing areas:

- Paved surfaces - 1.00
- Verges contained by embankments/cutting slopes - 0.5

- Embankments/Cutting Slopes - 0.25
- As limited GI information is available at this stage, all attenuation ponds have been assumed to require an impermeable liner. Attenuation pond surfaces – 1.00

14.2.7.50 Networks have been established to suit proposed vertical alignments and potential outfall locations.

14.2.7.51 HydroBrake flow controls have been incorporated downstream of attenuation ponds, with flow rates restricted to those detailed in Table 14-32: Cross Lanes to Rokeby existing drainage catchments summary.

14.2.7.52 Table 14-35: Cross Lanes to Rokeby proposed catchments table below, is a summary of proposed total catchment area size, percentage of impermeable area within each catchment and the volume of attenuation required to achieve the peak permitted discharge rate calculated for the corresponding existing catchment (see above). This is to ensure the proposed discharge rates are no greater than existing.

Table 14-35: Cross Lanes to Rokeby proposed catchments

| Catchment | Drained Area (ha) | Total Impermeable Area Drained (ha)[a] | Volume of storage provided[b] (m3) | Peak Permitted Flow Rate[c] (l/s) |
|---|---|---|---|---|
| S08-01 | 1.32 | 1.04 | 682 | 9.67 |
| S08-02 | 0.63 | 0.49 | 565 | 5.66 |
| S08-03 | 5.16 | 5.77 | 1235 | 404.60 |
| S08-04 | 2.63 | 2.07 | 1245 | 84.12 |
| S08-05 | 6.78 | 5.33 | 2300 | 107.72 |
| S08-06 | 3.02 | 2.59 | 2435 | 51.65 |
| S08-07 | 0.10 | 0.06 | N/A | 3.50[d] |
| S08-08 | 0.31 | 0.24 | N.A | 3.50[d] |
| S08-09 | 0.34 | 0.20 | N/A | 11.79[e] |
| S08-10 | 0.60 | 0.548 | N/A | 69.42[f] |

a – Total drained embankment and drained verge. Pond not included in table, included in calculations.

b – Volume provided in design from normal water level to 300mm below road level, as per guidance provided in The SuDS Manual (CIRIA C753).

c - 1 in 100 year storm, 40% climate change.

d- No pond proposed. Discharge rate calculated rounded to 3.5 l/s to allow for flow control.

e- Connects into the existing sewer which discharges to Tutta Beck according to As Built drawings appended to this report.

f- The impermeable area drained is a reduction, therefore, no storage required.

### *Exceedance flood routing*

14.2.7.53 The design will consider the overland flow routes of exceedance flows, and where possible provide a route for exceedance flows that minimises the risk of flooding of properties. The routing of exceedance flows where possible will follow the discharge pipe route to receiving waters.

14.2.7.54 All storage ponds are designed for a 1 in 100 year storm with a 40% climate change allowance with a free board allowance of 300mm to provide a conservative design.

### *Existing Watercourses*

14.2.7.55 In accordance with CG 501 and LA 113 the proposed highways and drainage design where possible limit impact on Environment Agency main rivers and ordinary watercourses. Where a watercourse has been disrupted by the proposed highways alignment a proposed culvert has been sized appropriately to allow the flow from the watercourse to be uninterrupted.

14.2.7.56 All new culverts will be designed in accordance with DMRB CD 529 details and in consultation with relevant stakeholders (e.g. LLFA or EA).

14.2.7.57 All culverts with a diameter of 900mm and above will require structural design.

14.2.7.58 It is the design intention to maintain existing outfalls into existing watercourses and not to increase the existing discharge rate at these outfalls (see Existing Hydraulic Modelling Results).

14.2.7.59 Where new outfalls are required the individual outfall details will be designed in accordance with DMRB CD 529 and in consultation with relevant stakeholders (e.g. LLFA or EA).

14.2.7.60 Erosion protection to be considered at detailed design stage.

14.2.7.61 DCC would expect a headwall to suit the specific pipe it supports and contain a culvert screen (70 degree angle screen with a minimum of 70mm bar spacing).

14.2.7.62 All proposed outfalls into existing watercourses will be in accordance with the appropriate LLFA and the Environment Agency regulations, and consent obtained at an appropriate point in the design process.

14.2.7.63 It is proposed to divert Tutta Beck to the south of the mainline at the proposed Cross Lanes junction. This is illustrated on the Proposed Drainage Plans which are appended to this report and detailed further in the following text:

### Tutta Beck Diversion

14.2.7.64 Due to constraints imposed by the land topography, road geometry standards and existing road levels, it was not possible to achieve sufficient clearance above Tuta Beck to enable it to be culverted on its existing alignment. Consequently, the proposal is to divert Tutta Beck on a new alignment in this location.

14.2.7.65 The invert levels of the proposed diversion were calculated by following a similar gradient to the existing Tutta Beck.

14.2.7.66 Two proposed culverts over Tutta Beck are required to facilitate the proposed highway. These culverts have a conservative width and are subject to further design. The width is based on the channel dimensions recorded at the closest JBA survey point further downstream.

14.2.7.67 The Q20 values provided by JBA were used to give an approximation of the flood levels in the beck.

14.2.7.68 The review deemed that there is adequate space above the Q20 storm event to facilitate a dry mammal ledge for otters (that is, to accommodate 150 mm above the highest water level and allow for 600 mm headroom) (DMRB, NATURE CONSERVATION ADVICE IN RELATION TO OTTERS HA 81/99 V10, 2001). The parameters of which were specified as being suitable for the 1 in 2 year storm event. This is subject to further design and may result in a separate otter crossing culvert.

14.2.7.69 The culvert locations have been partially driven by the environmental factors, with the aim of providing a culvert with as short a length as possible for benefit to the otters and ecology.

14.2.7.70 Additional benefits are expected from a constructability perspective during phasing for the side roads.

### *Land drainage and overland flow*

14.2.7.71 Where land outside of the highway corridor falls towards the highway, cut-off drainage has been provided.

14.2.7.72 Cut-off drainage comprises open ditches and/or filter drains. Open ditches are used where possible, but where space is limited, or where the ditches become too deep, filter drains are used instead. Culverts/carrier pipes are provided to convey this water across the highway corridor where necessary

14.2.7.73 Cut-off drainage will intercept and convey overland flow around the highway corridor, so that this flow does not enter the highway drainage system or cause flooding issues on the proposed highway.

### *Karst Risk*

14.2.7.74 Karst is an area of land formed of rock such as limestone that is worn away by water to make caves and other formations.

14.2.7.75 Karst Risk, is a natural human induced hazard in karst areas, resulting in dissolution of soluble rocks such as limestone, dolomite, and gypsum, potentially resulting in collapse or sink holes.

14.2.7.76 Infiltration systems must not be used close to dissolution features. All ponds and drainage systems to be lined where the Karst Risk is classed as Medium or High.

14.2.7.77 Maintenance access to all drainage systems shall be provided to allow a suitably experienced and qualified professionals to monitor Karst Risk regularly.

## Flood Risk Assessment

### *Data collection*

14.2.7.78 The risk of flooding to the development has been assessed on readily available information, published on the Environment Agency website.

14.2.7.79 In addition to readily available information, JBA has undertaken baseline hydraulic modelling of existing watercourse/culvert crossings. This modelling establishes flooding in the vicinity of the existing A66.

14.2.7.80 The proposed drainage strategy presented in this report has been developed in consultation with DCC. A record of the consultation from December 2020 and May 2022 is appended to this report.

### *Flood risk vulnerability classification*

14.2.7.81 Guidance for flood risk vulnerability for new development sites is set out in the Government planning portal for flood risk and coastal change. Table 6: Flood risk vulnerability classification is used as a guide to help determine if new development sites should or should not be permitted, based upon the vulnerability classifications set out on the planning portal.

14.2.7.82 In accordance with *DMRB LA 113*, NI/1.7, the development is classified as “Essential Infrastructure”. The development is therefore permitted providing it is located within Flood Zones 1 or 2, with the exception test required if located in Flood Zones 3a or 3b.

### *Sequential Test*

14.2.7.83 As part of a Flood Risk Assessment a sequential test is required when the proposed development is located within Flood Zone 2 or 3. The sequential test compares the proposed site with other available sites to find out which has the lowest flood risk.

14.2.7.84 The design team considered alternative alignments which would still meet the project requirements.

14.2.7.85 As part of this review, a number of principal alternative routes or combination of routes were identified, considering potential environmental impacts, project design principles, impacts on landowners, buildability and design safety.

14.2.7.86 A full extensive write up of this review can be seen in Project Development Overview Report (Application Document 4.1).

14.2.7.87 This review identifies the proposed route is the most favourable with the least environmental impacts, impacts on landowners, buildability and design safety, whilst maintaining project design principles.

14.2.7.88 In respect of the Sequential Test for this scheme, the development is in Flood Zone 1 and at low risk of fluvial flooding. However, flood risk must be considered from all potential sources. The scheme is shown to be at low risk of surface water flooding. The scheme is outside of the predicted maximum extent of reservoir flooding

### *Exception Test*

14.2.7.89 The proposed scheme is located within Flood Zone 1. In accordance with Table 2 of the Flood Risk and Coastal Change guidance, the proposed alignment has been assessed as being Essential Infrastructure and is appropriate for this flood zone. An Exception Test is not required as the scheme is located within Flood Zone 1.

### *Flooding from rivers or the sea*

14.2.7.90 Baseline flood risk from rivers and sea using Environment Agency data is shown on ES Figure 14.2: Existing Flood Risk (Application Document 3.3). The Environment Agency data indicates that the development is in Flood Zone 1 and at low risk of flooding.

14.2.7.91 The Environment Agency Flood Map indicates that the vast majority of the development is at low risk of flooding from the rivers in the vicinity of the proposed design.

14.2.7.92 As noted in the previous section, outfalls from two ponds are shown as entering the Zone 3 flooding extents. These are at the south of the mainline to the east of Moorhouse Lane and southeast of the proposed Rokeby Junction. These outfalls are proposed to tie into vegetated ditches / cut off ditches and so should have minimal interaction with the flooded extents. These will be considered in more depth during detailed design.

14.2.7.93 Baseline flood modelling of all watercourse and field drains crossing the existing A66 has been undertaken.

14.2.7.94 JBA climate change uplifts have been applied for the central, higher central and upper end allowances for the Tees Management Catchment using the Environment Agency July 2021 allowances.

14.2.7.95 As Fluvial Flood Zone data is unavailable for the model extent, surface water flood maps have been used as a comparison.

14.2.7.96 Areas of Fluvial Flood Zone 2 and 3 shown within Environment Agency mapping include areas associated with Thorsgill Beck and its floodplain in the north-west section of the study area and with Tutta Beck parallel, along the south of the study area. Additional areas associated with River Greta are also observed but are limited to the river channel.

14.2.7.97 Watercourses crossing the A66 are summarised below. These are all designated as Ordinary Watercourses:

### Unnamed Tributary of Punder Gill 8.1

14.2.7.98 This watercourse is located south of the site in the east.

14.2.7.99 The watercourse passes through an existing circular concrete culvert. Metal screening is also evident at the downstream end of the final culvert in this model. This is shown in the JBA baseline results which is appended.

### Punder Gill

14.2.7.100 Upstream of Tutta Beck located south west of the mainline.

### Tutta Beck

14.2.7.101 This watercourse is located at the south of the A66.

14.2.7.102 The watercourse passes through (in order from upstream to downstream) a road culvert, wooden footbridge, a arched road culvert and another wooden footbridge.

### Unnamed Tributary of Tutta Beck 8.1

14.2.7.103 This watercourse located west of the Cross Lanes junctions, north of the mainline.

14.2.7.104 The watercourse passes through the following (in order from upstream to downstream); three pipes and a concrete culvert.

### Unnamed Tributary of Manyfold Beck 8.3

14.2.7.105 Located upstream of Manyfold Beck, north west of Cross Lanes.

### Manyfold Beck

14.2.7.106 This is located north of Cross Lanes junction.

14.2.7.107 The watercourse passes beneath an existing A66 rectangular culvert and concrete footbridge. This culvert must not be impacted by the proposed works. A proposed pond outfall is proposed at the upstream end of this existing culvert.

### Baseline Flooding Results Summary

14.2.7.108 The downstream boundary sensitivity test illustrated a maximum increase in water levels at the majority of downstream points modelled on all of the watercourses.

14.2.7.109 For Tutta Beck, the changes in peak water level compared to the baseline extend approximately 0 to 30m upstream. For Manyfold beck this extend on the upstream is approximately 130m.

14.2.7.110 Sensitivity tests were carried out for the 1% AEP existing situation model to assess the model response to the change in:

- Flow, model inflows increased by 20% ;
- Roughness coefficient, in-channel and roughness values changed by +20% and -20% ; and
- Downstream boundary, slope decreased by -20%.

14.2.7.111 With a 20% increase in flow applied as a sensitivity check, the maximum change in peak water level is estimated at Tutta Beck with a change of maximum change of 0.27m. This is the highest maximum change of the Scheme 8 results.

14.2.7.112 The levels of the 20 year flood event have been considered in the design assumptions for the proposed culverts at Tutta Beck which facilitate the Cross Lanes junction to accommodate flows and the required otter ledge. Hence, this risk has been mitigated in the proposed design.

14.2.7.113 Flooding is seen in the vicinity of the existing Manyfold Beck culvert. There is a maximum peak water increase in the JBA results in the reduction of roughness by 20% in the sensitivity check. This increases the maximum peak water level by 0.15m. No alterations to the culvert are anticipated as highway works for the proposed scheme tie in south of the culvert. A pond outfall is proposed upstream of this culverts and, as mitigation, flows will be restricted to local authority guidance. The headwall will be specified and positioned with consideration for river embankments and flood extents, as is true of all headwalls for the proposed scheme.

14.2.7.114 Maximum changes in peak flows for the Unnamed Tributary of Tutta Beck 8.1 are estimated in the increase of flow by 20% as a sensitivity check. This increases the maximum peak flow by 0.12m. A proposed outfall is situated on the upstream of this stretch of watercourse. Flooding extents in this zone have been considered when placing the proposed culverts, one of which includes a mammal crossing. One outfall is proposed from a small catchment of highways drainage and this will be attenuated before discharging to the tributary.

### *Surface water flooding*

14.2.7.115 The Environment Agency map for flood risk from surface water. The extents described above are situated outside the extent of the proposed works. Hence, the surface water flooding extents shows the scheme is at low risk of surface water flooding.

14.2.7.116 JBA have flood modelled water levels in the location of watercourse crossing.

14.2.7.117 Additionally, cut-off drainage has been provided where land outside of the highway corridor falls towards the highway. This cut-off drainage will intercept flows and convey surface water around or through, via culverts/carrier pipes, the highway.

### *Historic flooding*

14.2.7.118 Environment Agency data shows a small area of historic flooding in the east of the study area at Greta Bridge Bank associated with the River Greta. This does not impact the proposed scheme.

### *Existing highway drainage flooding*

14.2.7.119 HADDMS has one record of Historic flooding on the A66 mainline approximately where the proposed Cross Lanes overbridge is located. This was reported in September 2008.

14.2.7.120 There are several Closed cases of flooding which are likely due to gully blockages based on the location.

14.2.7.121 Two ongoing instances of flooding events remain on HADDMS. These are near the proposed pond S08-P04, recorded in 2018, and south of the mainline at the proposed Rokeby junction, recorded in 2019. These shall be investigated further during detailed design.

#### *Groundwater flooding*

14.2.7.122 The scheme is susceptible to groundwater flooding in accordance with the Groundwater Flooding Susceptibility map in Environmental Statement Figure 14.8. A complete description of the groundwater context is provided in the Environmental Statement Appendix 14.6 Hydrogeological Impact Assessment.

14.2.7.123 Where the scheme is at or above existing ground level the risk of groundwater flooding is considered to be low because the proposed drainage systems will reduce the ground water levels in the vicinity of the scheme to below the formation level of the road.

14.2.7.124 According to the Package D Ground Investigation Report Geotechnical Risk Register, the likelihood of groundwater flooding on this scheme has been categorised as “Extremely likely” with a note that groundwater was noted in the location of culvert S08-C05. This is from estimated as being a result of shallow or perched groundwater, including seepages from granular horizons within the Glacial Deposits.

14.2.7.125 The scheme is in cut at the proposed Rokeby junction. A sub surface filter drainage system will be provided to these areas should high groundwater be assessed as a risk during detailed design.

#### *Flooding from reservoirs*

14.2.7.126 The Environment Agency *Flood Map* indicates that the scheme is outside of the maximum extent of flooding from reservoirs.

#### *Flooding from other artificial waterbodies.*

14.2.7.127 The scheme is not at risk of flooding from other artificial waterbodies. This has been assessed based on the scale of the other artificial waterbodies in relation to the local topography and carriageway elevation.

#### *Coastal flooding*

14.2.7.128 Due to the location of the scheme, no risk of coastal flooding or tidal inundation to the proposed development is anticipated.

#### *Flooding from Sewers*

14.2.7.129 No reports of public sewer flooding have been raised. Northumbrian Water shall be consulted throughout the detailed design process to ensure risked of flooding are communicated.

### *Flood Risk Mitigation*

14.2.7.130 Measures have been incorporated into the drainage system to mitigate any increase to the risk of flooding as a result of the scheme. These measures are set out below and include:

- Cut off drainage
- Surface water storage ponds
- Flow control devices
- Flood risk from groundwater will be mitigated though cut-off drains at all highway earthwork cuttings and embankment.

14.2.7.131 In addition to the above, proposed methods of Flood Mitigation is outlined below.

### *Attenuation*

14.2.7.132 The detailed design of the proposed highway drainage will be in accordance with current design standards specifically the Design Manual for Roads and Bridges (DMRB) and the Manual of Contract Documents for Highway Works (MCHW). By following these design standards, the design will have low risk of surface water flooding and low risk from fluvial flooding.

14.2.7.133 In Accordance with CG 501, the proposed drainage design will ensure that there is no increase in discharge rates at each outfall. To achieve this, any increase in impermeable area as a result of the proposed alignment will need to be attenuated prior to the discharge, with sufficient storage for a 1 in 100 AEP design storm including an increase for current climate change allowances.

14.2.7.134 The detailed design will be based on updated geotechnical information, and at that stage disposal via infiltration will be explored to see if it is a practicable option. If it is not, the regulated hierarchy of discharge will be followed in finalising the drainage design. Also refer to the Karst section regarding dissolution features that are present on this scheme.

14.2.7.135 The proposed attenuation will ensure that the flooded volume is no greater than existing.

### *Flow Path*

14.2.7.136 Drainage flow paths during storm events have been considered as part of the design process. The road alignment and drainage collection systems expediate the flow of water from trafficked and hard standing areas to minimise the risk of standing water on the carriageway.

14.2.7.137 For higher rainfall return periods and in the event of drainage blockages, exceedance flow paths shall direct flood water downstream to watercourses.

## Conclusion

### *Summary*

14.2.7.138 The proposed works at Scheme 08 Rokeby involve new junctions at Cross Lanes in the west of the scheme and Rokeby at the east of the scheme. These are summarised in the following points:

- Cross Lanes Junction - a new link road is proposed, spanning over the widened A66 and connecting Rutherford Lane to the B6277. Access to and from the A66 is provided by two compact connector roads linking the A66 to the new road, for both eastbound and westbound road users. A second new link road is proposed connecting Moorhouse Lane (South of A66) to the proposed road that spans over the A66.
- Rokeby Junction – a proposed connector road intersects with the westbound carriageway then loops round, an underbridge is proposed to provide connectivity north and south of the mainline. North of the proposed A66 the side road ties-into the existing A66 alignment just west of St Marys Church. The eastbound diverge is located east of the underbridge providing connectivity between the mainline and the existing A66 north of the junction. The eastbound merge is located further to the east from the proposed roundabout at Barnard Castle Road
- The mainline will be widened and an offline bypass to the south of the Old Rectory is also proposed.

14.2.7.139 The scheme results in an increase in impermeable area being discharged to local watercourses.

14.2.7.140 Existing flow rates have been calculated, and proposed flow rates restricted to ensure that there is no increased flood risk created by the scheme.

14.2.7.141 Water quality mitigation measures have been incorporated in the proposals.

14.2.7.142 A full assessment of the capacity of the receiving drainage system should be undertaken as part of detailed design. Surface water storage will be required if the existing drainage system does not have the capacity to accept additional flows.

14.2.7.143 The scheme is at low risk of flooding from rivers, the sea, surface water, groundwater, or reservoirs.

14.2.7.144 Risk of flooding from rivers, surface water and groundwater is evident in the extent of the proposed A66 Scheme 8. These have been considered and mitigated against at this stage in the design and will be considered further during detailed design.

14.2.7.145 The proposed scheme, with flood mitigations described in this report, are not expected to increase the risk of flooding in the area.

### *Residual risks*

14.2.7.146 There are numerous incidents of flooding to the existing A66 (identified on HADDMS) that are considered minor in nature and do not directly affect the proposed dual carriageway, but affect de-trunked sections of road. These shall be further investigated during future design stages and the drainage design refined where necessary, to satisfy the de-trunking requirements agreed between NH and the Local Authority. Flood risk in these areas is not increased as a result of the proposed scheme.

14.2.7.147 Water quality mitigation measures shall be revisited as detailed design progresses, to ensure that sufficient mitigation is included.

## 14.2.8 Stephen Bank to Carkin Moor

### Introduction

14.2.8.1 This section of the document details the proposed design for this scheme, which runs from Stephen Bank to Carkin Moor in North Yorkshire. This section of the Project passes close to the villages of West and East Layton, passing to the north of Mainsgill Farm. The location of the scheme is shown on ES Figure 14.1: Surface Water Features (Application Document 3.3).

14.2.8.2 The drainage for this scheme has been designed in accordance with the Standards for Highways Design Manual for Roads and Bridges and in accordance with relevant Local Authority design standards as detailed in section 14.2.1.

### Baseline conditions

### *Surface watercourses*

14.2.8.3 Watercourses within the study area drain into the River Swale via a number of tributaries.

14.2.8.4 None of the watercourses in the study area are designated by the Environment Agency as a Main River. Table 36: Watercourses within Stephen Bank to Carkin Moor study area gives a brief description of the watercourses in the study area (from west to east). ES Figure 14.1: Surface Water Features (Application Document 3.3) displays the watercourses identified in the study area.

Table 36: Watercourses within Stephen Bank to Carkin Moor study area

| Watercourse | Description |
|---|---|
| Browson Beck | Flows south from Cottonmill Beck into Stalwath Beck, within the River Swale catchment. Located to the east of Newsham, within the south-west of the study area. |
| Sprent Beck | Flows north and joins Cottonmill Beck at same confluence point as Sker Burn, in the south-west of the study area. |

| Watercourse | Description |
|---|---|
| Sker Burn | Flows north in the south-west of the study area and into Cottonmill Beck east of Newsham. |
| Cottonmill Beck | Flows east into Browson Beck, within the River Swale catchment. Located to the east of Newsham, within the south-west of the study area. |
| Dyson Beck | Flows north into Smallways Beck, within the Aldbrough Beck catchment. Located on the west of the study area. |
| Hartforth Beck | Flows south from Grange Farm, discharges into Holme Beck at culvert of Comfort Lane. |
| Holme Beck | Flows south-west, parallel approximately 1km to the south of the existing A66, within the River Swale catchment. Located in the south-east of the study area. |
| Mains Gill | Flows south to Holme Beck along the west of Mainsgill Farm. Located in the east of the study area. Crossed by existing A66. |
| Smallways Beck | Flows north into Hutton Beck, within the Aldbrough Beck catchment. Crossed by the existing A66 to the west of Smallways, on the west of the study area. |
| Stalwath Beck | Flows east culverted under Dick Scot Lane and discharges into Dalton Beck south of the existing A66. |
| Dalton Beck | Flows east, in the south of the study area. Joins Holme Beck at Ravensworth. |
| Unnamed Tributary of Cottonmill Beck 9.3 | Flows south from existing A66 through Black Plantation and into Cottonmill Beck. |
| Unnamed Tributary of Dalton Beck 9.1 | Flows east parallel to the existing A66 and into Unnamed Tributary of Dalton Beck 9.2. |
| Unnamed Tributary of Hartforth Beck 1.1 | Flows south-east, past Hartford Grange, in the south-east of the study area, and into the Hartforth Beck. |
| Unnamed Tributary of Holme Beck 9.8 | Flows south to Holme Beck. Crossed by the existing A66 at the upper reach of the watercourse and follows field boundaries to the point it joins Hartforth Beck, to the west of Hartforth. Located on the east of the study area. |
| Unnamed Tributary of Holme Beck 9.2 | Flows south to Holme Beck via Hartforth Beck, crossed by the existing A66 at the upper reach of the watercourse and follows field boundaries to the point it joins Hartforth Beck, to the west of Hartforth. Located on the east of the study area. |
| Unnamed Tributary of Holme Beck 9.3 | Flows south into Holme Beck, crossed by the existing A66 slightly east of Collier Lane and culverted under Waitlands Lane, joins Holme Beck to the north of New Lane. In the centre of the study area. |
| Unnamed Tributary of Holme Beck 9.4 | Flows south into Holme Beck, crossed by the existing A66 between Collier Lane and Moor Lane, joins Holme Beck to the north of Ravensworth. In the centre of the study area. |
| Unnamed Tributary of Holme Beck 9.6 | Flows south, crossed by existing A66 and into Unnamed Tributary of Holme Beck 9.3. |

| Watercourse | Description |
|---|---|
| Unnamed Tributary of Holme Beck 9.1 | Flows south-west to Holme Beck, upper reach of the watercourse within Street Plantation and crossed by the existing A66. Follows field boundaries to Holme Beck, located on the east of the study area. |
| Unnamed Tributary of Hutton Beck 1.1 | Flows north, predominantly artificially straightened, in the north of the study area and into Hutton Beck. |
| Unnamed Tributary of Mains Gill 9.1 | Flows south through Middle Plantation in the north of the study area and discharges into Mains Gill east of Moor Lane. |
| Unnamed Tributary of Mains Gill 9.3 | Two field drainage features flow south into Mains Gill, join to the east of Moor Lane. Located on the west of the study area. |
| Unnamed Tributary of Smallways Beck 9.1 | Flows north, culverted by existing A66 and Lanehead Lane, and discharges into Smallways Beck south-east of Holm Hills. |
| Unnamed Tributary of Smallways Beck 9.4 | Flows west and into Unnamed Tributary of Smallways Beck 9.1 in the west of the study area. |

### *Topography*

14.2.8.5 Levels generally fall north-east to south-west along the proposed route. Catchments are relatively small, with the village of East Layton at the high point of the catchment to the north-east. Along the route, levels undulate with a low point at Fox Well. South of the existing A66, levels fall steeply to the Holme Beck valley. See ES Figure 14.2: Existing Flood Risk (Application Document 3.3) for contours.

### *Geology and soils*

14.2.8.6 A complete description of the geological and soils context is provided in ES Chapter 8 Geology and Soils (Application Document 3.2) and ES Appendix 14.6 Hydrogeological Impact Assessment (Application Document 3.4).

14.2.8.7 Topsoil within this scheme overlies the majority of the off route proposals, this is typically 200mm to 400mm thick, with an average of 320mm thick. In some areas of cultivated fields, glacial deposits beneath topsoil were given a description consistent with topsoil or cultivated material to a depth up to 750mm.

14.2.8.8 Glacial deposits predominantly comprise cohesive materials, with localised areas of higher proportions of granular materials encountered between 72+700 and 73+100 in the area of proposed off route embankment works. The granular deposits appear as sheets and lenses of varying lateral and vertical extents within the clay matrix.

14.2.8.9 Based upon total exploratory depths during the 2021 and historical ground investigations, an estimate of the proportion of materials has been established. The results indicate approximately 5% of glacial deposits comprise granular materials, with 95% comprising cohesive materials.

14.2.8.10 Based on current proposals no excavation into rock is anticipated.

## Existing drainage

### *Background*

14.2.8.11 HADDAMS and Local Authority record drawings have been used to determine the form and location of all existing drainage. Whilst site visits have been undertaken to clarify existing drainage where possible, no intrusive drainage surveys have been undertaken at this stage of design. Where proposed drainage interfaces with existing drainage, CCTV surveys shall be undertaken prior to commencement of detailed design.

### *Description of existing drainage*

14.2.8.12 Existing drainage comprises a mixture of gullies, filter drains, and over the edge drainage, either onto adjacent land or into roadside ditches.

14.2.8.13 Positive drainage systems outfall into local watercourses at strategic locations.

### *Assessment of catchment areas and existing runoff rates*

14.2.8.14 With the exception of tie-ins at the western and eastern scheme extents, this scheme is offline. As such, with the exception of some realignment works around the Collier Lane over bridge and the Mains Gill junction, the existing drainage system on the de-trunked A66 will remain unaltered.

14.2.8.15 The following information has been considered in the assessment of catchment areas and to calculate existing runoff rates:

- Existing catchment areas considered in this section therefore relate to areas beneath the proposed alignment.
- Existing catchments beneath the proposed alignment have been used to calculate restricted flow rates that will be applied to new outfalls from the proposed drainage system.
- The proposed vertical alignment has been considered, and new outfall locations determined.
- Existing topography has also been considered to ensure that only area beneath the proposed alignment that currently drains towards a proposed outfall location is included in the restricted flow rate calculations.

14.2.8.16 This approach ensures that flows to individual watercourses are not increased over the existing scenario.

14.2.8.17 The “Greenfield runoff rate estimation” tool developed by HR Wallingford (HR Wallingford, 2022a)[18] has been used to assess existing “greenfield” runoff rates. The QBAR greenfield runoff rate of 5.27 l/s/ha has been allowed for runoff from greenfield/undeveloped areas.

14.2.8.18 In line with Section 4.4.2 of NYCC LLFA SuDS Design Guidance[12], 140l/s/ha has been allowed for runoff from brownfield areas. A reduction of 30% in brownfield flows has been included.

14.2.8.19 Table 14-37: Stephen Bank to Carkin Moor existing drainage catchments summary shows existing catchments that drain to each of the proposed outfalls.

Table 14-37: Stephen Bank to Carkin Moor existing drainage catchments summary

| Catchment | Existing Greenfield Area (ha) | Existing Brownfield Area (ha) | Existing Greenfield Flow Rate (l/s) | Existing Brownfield Flow Rate (l/s) | Restricted Flow Rate Applied to Outfall[a] (l/s) |
|---|---|---|---|---|---|
| S09-01 | 1.9936 | 0.07457 | 10.51 | 103.65 | 83.06 |
| S09-02 | 1.3799 | 0.02447 | 7.27 | 34.01 | 31.08 |
| S09-03 | 6.4230 | 0 | 33.85 | 0 | 33.85 |
| S09-04 | Drainage system being realigned. No increase in impermeable area | | | | |
| S09-05 | 3.1296 | 0 | 16.49 | 0 | 16.49 |
| S09-06 | 2.3839 | 0 | 12.56 | 0 | 12.56 |
| S09-09 | Attenuation pond being relocated. Existing catchment area from record drawings = 2.52ha | | | | |
| S09-10 | 0.08272 | 0 | 5.67 | 0 | 5.67 |
| S09-11 | 0.02347 | 0.0249 | 1.24 | 3.46 | 3.66 |
| S09-12 | 4.0192 | 0.02703 | 21.18 | 37.57 | 47.48 |

a – includes 30% reduction in brownfield flow rates

### *Hydraulic modelling of existing highway surface water drainage networks*

14.2.8.20 Existing drainage networks are largely unaffected by the scheme.

14.2.8.21 No hydraulic modelling of existing drainage networks unaffected by the works has been undertaken.

## Proposed drainage

### *Collection system design*

14.2.8.22 A number of surface water collections systems will be utilised.

### *National Highways A66 Collection System*

- Primary surface water collection system will be road edge concrete surface water channels.
- Laybys and refuge areas will drain using either concrete surface water channels or gullies
- Bridge Deck Drainage units will be used to drain surface water on bridge sections.

- Filter drains will be used where required, including highway verges where the verge is contained by earthworks and cuttings/embankments.
- Open ditches and/or filter drains will be used to intercept and convey overland flow from areas outside of the highway corridor.

### *Local Authority Roads Collection System*

- Primary surface water collection system will be gullies.
- Filter drains will be used where required, including highway verges where the verge is contained by earthworks and cuttings/embankments.
- Open ditches and/or filter drains will be used to intercept and convey overland flow from areas outside of the highway corridor.

14.2.8.23 For the Project, the primary drainage collection system will consist of concrete surface water channels. For this scheme surface water channels will be placed on the road edge adjacent to the hard strip and will drain surface water from the A66 carriageway, verges, embankments, and the central reserve.

14.2.8.24 The design of the Surface water channels is in accordance with *DMRB CD 521*. The proposed vertical and horizontal highways alignment has been assessed using the process outlined in Section 4 – Design Process of *DMRB CD 521*.

14.2.8.25 The position of surface water channels in relation to the pavement edge shall follow the guidance provided in *DMRB CD 524*.

14.2.8.26 Where gullies are used, gully spacing will be determined as part of detailed design in accordance with *DMRB CD 526*.

14.2.8.27 Combined kerb and drainage systems will be designed in accordance with *DMRB CG 501*.

14.2.8.28 A simple assessment of the minimum required discharge capacity of the combined kerb and drainage systems is based on the Rational Method Equation Q = 2.78 CiA, where:

- 'Q' is the design peak rate of runoff (l/s)
- 'C' is a non-dimensional runoff coefficient (taken as 1.0)
- 'i' is the design rainfall intensity (mm/hr)
- 'A' is the total catchment area (ha)
- Note: 2.78 is a conversion factor to address the rainfall units being in mm/hr

### *Pollution controls*

14.2.8.29 In accordance with *DMRB CG 501*, the selection of pollution control measures has been determined following the process outlined below:

- Complete assessment in accordance with *DMRB LA 113*
- If mitigation is required, identify viable options/combinations of measures, taking account of:
    - Road drainage hierarchy.

  - Site constraints.
  - Storm flow and flood risk requirements.
  - Climate change allowances.
  - Road geometry.
- Review short list of options against construction and maintenance requirements.
- Confirming the measures fulfil water quality requirements - these are presented in ES Appendix 14.3: Water Quality Assessment (Application Document 3.4)

14.2.8.30 The pollution control measures vary for each proposed outfall, and include a combination of the following measures:

- Wet ponds with sediment forebays
- Vortex grit separators
- Vegetated ditches

14.2.8.31 Water quality assessments have been undertaken to ensure sufficient mitigation measures have been incorporated at each outfall. Details of the HEWRAT assessment are provided in ES Appendix 14.3: Water Quality Assessment ( Application Document 3.4).

14.2.8.32 Table 14-38 Stephen Bank to Carkin Moor pollution control mitigation measures outlines the pollution control mitigation measures included at each proposed outfall.

Table 14-38 Stephen Bank to Carkin Moor pollution control mitigation measures

| Catchment | Attenuation pond | Grit Separator | Vegetated Ditch |
|---|---|---|---|
| S09-01 | Y | Y | Y |
| S09-02 | Y | Y | Y |
| S09-03 | Y | Y | Y |
| S09-04 | N | Y | Y |
| S09-05 | Y | Y | Y |
| S09-06 | Y | N | N |
| S09-09 | Y | Y | Y |
| S09-10 | Y | Y | Y |
| S09-11 | Y | N | N |
| S09-12 | Y | N | N |

### *Climate change*

14.2.8.33 In accordance with *DMRB CG 501*, a 20% increase to peak rainfall intensity should be considered the minimum accommodated within the drainage design in order to account for potential climate change.

14.2.8.34 Environment Agency guidance[19] for allowances that should be made for climate change has been followed. Climate change allowances relating to increased peak rainfall intensity are outlined in Table 14-39: Peak rainfall intensity allowance in small and urban catchments - Stephen Bank to Carkin Moor.

Table 14-39: Peak rainfall intensity allowance in small and urban catchments - Stephen Bank to Carkin Moor

| Applies across all of England | Total potential change anticipated for the ‘2020s’ (2015 to 2039) | Total potential change anticipated for the ‘2050s’ (2040 to 2069) | Total potential change anticipated for the ‘2080s’ (2070 to 2115) |
|---|---|---|---|
| Upper end | 10% | 20% | 40% |
| Central | 5% | 10% | 20% |

14.2.8.35 Environment Agency guidance is to assess both the central and upper end allowances to understand the range of impact.

### *Surface water storage*

14.2.8.36 The proposals lead to a substantial increase in impermeable area draining to local watercourses.

14.2.8.37 In accordance with *DMRB CG 501*, the proposed drainage design will ensure that there is no increase in runoff rates as a result of the proposals. To achieve this, existing runoff rates have been assessed and flow control devices incorporated into the drainage systems. Storage for surplus flows has been provided using attenuation ponds.

14.2.8.38 The proposed drainage design makes an allowance for potential climate change. A 40% increase to rainfall intensity has been included when considering surface water storage, and attenuation ponds designed to ensure no flooding occurs during the critical 1 in 100-year storm.

### *Hydraulic modelling of proposed highway surface water drainage networks*

14.2.8.39 The proposed main carrier drainage network and surface water storage has been modelled using MicroDrainage software.

14.2.8.40 FSR rainfall data has been used, with global variables (M560, r) to suit the site location.

14.2.8.41 The equivalent impermeable area draining to proposed networks has been obtained by applying the following factors to the measured contributing areas: -

- Paved surfaces - 1.00
- Verges contained by embankments/cutting slopes - 0.5
- Embankments/Cutting Slopes - 0.25
- Attenuation pond surfaces - 1.00

14.2.8.42 Networks have been established to suit proposed vertical alignments and potential outfall locations.

14.2.8.43 HydroBrake flow controls have been incorporated downstream of attenuation ponds, with flow rates restricted to those detailed in Table 14-37: Stephen Bank to Carkin Moor existing drainage catchments summary.

14.2.8.44 Table 14-40: Stephen Bank to Carkin Moor proposed catchments table below, is a summary of proposed total catchment area size, percentage of impermeable area within each catchment and the volume of attenuation required to achieve the peak permitted discharge rate calculated for the corresponding existing catchment (see above). This is to ensure the proposed discharge rates are no greater than existing.

Table 14-40: Stephen Bank to Carkin Moor proposed catchments

| Catchment | Drained Embankment Area (ha) | Drained Verge Area (ha) | Drained Highway Area (ha) | Volume of storage provided[a] ($m^3$) | Peak Permitted Flow Rate[b] (l/s) |
|---|---|---|---|---|---|
| S09-01 | 0.436 | 1.287 | 2.334 | 3775 | 83.06 |
| S09-02 | 0.369 | 0.206 | 0.476 | 865 | 31.08 |
| S09-03 | 2.856 | 1.368 | 2.567 | 7570 | 33.85 |
| S09-04 | 0.186 | 0.502 | 1.255 | 0[c] | 265[d] |
| S09-05 | 0.320 | 1.356 | 2.494 | 5035 | 16.49 |
| S09-06 | 0.076 | 1.238 | 2.404 | 5470 | 12.56 |
| S09-09 | 0 | 0 | 2.520[e] | 5100 | 5 |
| S09-10 | 0.259 | 0.193 | 0.499 | 1140 | 5.67 |
| S09-11 | 0.078 | 0.031 | 0.275 | 330 | 3.66 |
| S09-12 | 2.613 | 0.672 | 0.746 | 2145 | 47.48 |

a – Volume provided in design from normal water level to 300mm below access track level. , as per guidance provided in The SuDS Manual (CIRIA C753).

b – 1 in-100 year storm, 40% climate change.

c – Existing highway realigned with same cross-section, new drainage system provided.

d – Peak modelled flow rate from realigned drainage system.

e – Drained area taken from record drawings. All assumed to be 100% impermeable.

### *Exceedance flood routing*

14.2.8.45 The design will consider the overland flow routes of exceedance flows, and where possible provide a route for exceedance flows that minimises the risk of flooding of properties. The routing of exceedance flows where possible will follow the discharge pipe route to receiving waters.

### *Existing watercourses*

14.2.8.46 In accordance with *DMRB CG 501* and *DMRB LA 113* the proposed highways and drainage design where possible limit impact on Environment Agency Main Rivers (where present) and ordinary watercourses. Where a watercourse has been disrupted by the proposed highways alignment a proposed culvert has been sized appropriately to allow the flow from the watercourse to be uninterrupted. Where existing culverts below the alignment are being extended to facilitate the widening of the carriageway, these will be extended at the same size as the original culvert. This will ensure that the pass forward flow does not increase from the existing scenario and therefore will not exacerbate flood risk downstream.

14.2.8.47 During detailed design the following will be required

- All new culverts will be designed in accordance with D*MRB CD 529* details and in consultation with relevant stakeholders (e.g. LLFA or EA).
- All culverts with a diameter of 900mm and above will require structural design
- It is the design intention to maintain existing outfalls on existing watercourses and to not increase the discharge rate of these outfalls.
- Where new outfalls are required the individual outfall details will be designed in accordance with DMRB CD 529 and in consultation with relevant stakeholders (e.g. LLFA or EA).

### *Land drainage and overland flow*

14.2.8.48 Where land outside of the highway corridor falls towards the highway, cut-off drainage has been provided.

14.2.8.49 Cut-off drainage comprises open ditches and/or filter drains, with culverts provided to cross the highway corridor where necessary.

14.2.8.50 Cut-off drainage will intercept and convey overland flow around the highway corridor, so that this flow does not enter the highway drainage system or cause flooding issues on the proposed highway.

### *Karst Risk*

14.2.8.51 Karst is an area of land formed of rock such as limestone that is worn away by water to make caves and other formations.

14.2.8.52 Karst Risk, is a natural human induced hazard in karst areas, resulting in dissolution of soluble rocks such as limestone, dolomite, and gypsum, potentially resulting in collapse or sink holes.

14.2.8.53 Infiltration systems must not be used close to dissolution features. All ponds and drainage systems to be lined where the Karst Risk is classed as Medium or High.

14.2.8.54 Maintenance access to all drainage systems shall be provided to allow a suitably experienced and qualified professionals to monitor Karst Risk regularly.

## Flood Risk Assessment

### *Data collection*

14.2.8.55 The risk of flooding to the development has been assessed on readily available information, published on the Environment Agency website.

14.2.8.56 In addition to readily available information, JBA has undertaken baseline hydraulic modelling of existing watercourse/culvert crossings. This modelling establishes flooding in the vicinity of the existing A66.

### *Flood risk vulnerability classification*

14.2.8.57 Guidance for flood risk vulnerability for new development sites is set out in the Government planning portal for flood risk and coastal change. Table 6: Flood risk vulnerability classification advises whether new development sites should or should not be permitted, based upon the vulnerability classifications set out on the planning portal.

14.2.8.58 In accordance with DMRB LA113[2], NI/1.7, the development is classified as “Essential Infrastructure”. The development is therefore permitted providing it is located within Flood Zones 1 or 2, with the exception test required if located in Flood Zones 3a or 3b.

14.2.8.59 A Sequential Test is not required for this scheme as it is located in an area of low flood risk. An Exception Test is not required for this scheme as it is located in Flood Zone 1.

### *Flooding from rivers or the sea*

14.2.8.60 The Environment Agency data indicates that the scheme is in Flood Zone 1 and at low risk of flooding.

14.2.8.61 Baseline flood risk from rivers and sea using Environment Agency data is shown on ES Figure 14.2: Existing Flood Risk (Application Document 3.3).

14.2.8.62 The western section of the study area contains an area within Fluvial Flood Zones 2 and 3, associated with the Cottonmill Beck and Browson Beck and this combined floodplain, as shown on the Environment Agency flood map.

14.2.8.63 Baseline fluvial modelling undertaken for the scheme has highlighted small areas of flood risk along the existing A66 corridor in the central and east of the study area, associated with tributaries of the Holme Beck and Mains Gill, and is further discussed in the following sections.

14.2.8.64 No post development modelling was undertaken for this scheme as there is no impact on existing flood plain.

### Unnamed Tributary of Holme Beck 9.6 at Ravensworth Lodge

14.2.8.65 The watercourse passes beneath the existing A66 through a culvert measuring approximately 1.1m wide, 1.1m deep. At the time of survey, up to 400mm of silt had accumulated in the culvert invert, with water level at 400mm above the concrete invert.

14.2.8.66 Existing highway level at the culvert crossing is in the order of 148.05mAOD.

14.2.8.67 The baseline modelling predicts that flooding occurs to the east of the culvert crossing, and that flood water crosses the existing A66 to the east of Ravensworth Lodge, where the highway level is lower. Flood water passes to the east of Ravensworth Lodge, and floods agricultural land to the south. The extent of flooding is shown in the baseline modelling reports, included in Annex F.

14.2.8.68 The modelled flood level on the highway during the 1 in-100-year event plus 53% climate change uplift is 147.2mAOD.

14.2.8.69 The above is consistent with anecdotal reports of flooding by landowners at Ravensworth Lodge.

### Unnamed Tributary of Holme Beck 9.3 at Foxwell Lodge

14.2.8.70 The watercourse passes beneath the existing A66 through a masonry arch culvert measuring approximately 1.5m wide by 1m deep.

14.2.8.71 Two smaller tributaries join upstream of the existing culvert crossing. There are a number of smaller culverts on the watercourse upstream.

14.2.8.72 The baseline modelling predicts that some flooding occurs between the two tributaries, although Foxwell Lodge and the associated properties are unaffected.

14.2.8.73 This is consistent with anecdotal reports of flooding from a landowner (Two Hoots).

14.2.8.74 The new highway alignment is routed to the north of Foxwell Lodge. Some minor flooding is also predicted to the north of the proposed alignment.

### Mains Gill at Mainsgill Farm

14.2.8.75 The watercourse passes beneath the existing A66 through a culvert measuring approximately 2.1m wide by 2m deep.

14.2.8.76 Downstream of the A66 crossing, there is a short open section followed by another culverted section through the farm. This culvert is 1200mm in diameter at the upstream end but reduces to 750mm in diameter further downstream.

14.2.8.77 The baseline modelling predicts flooding from the short open watercourse downstream of the A66 crossing. Flood water flows through the farmyard before joining the watercourse further downstream.

14.2.8.78 This is consistent with anecdotal reports of flooding from the landowner.

14.2.8.79 The new highway alignment is routed to the north of the Mains Gill crossing. The baseline modelling predicts some minor flooding to the north of the new alignment, along tributaries of Mains Gill (9.1 and 9.3).

### Unnamed Tributary of Holme Beck 9.8 at Carkin Moor Monument

14.2.8.80 The watercourse passes beneath the existing A66 though a small diameter (150mm) pipe crossing.

14.2.8.81 The baseline modelling predicts some flooding (measuring approx. 130m by 60m) upstream of the pipe crossing, to the north of the existing A66.

### Unnamed Tributary of Holme Beck 9.2 at Carkin Moor

14.2.8.82 The watercourse passes beneath the existing A66 though a culvert measuring approximately 1.5m wide by 1.8m deep.

14.2.8.83 The baseline modelling predicts no flooding in the vicinity of the culvert.

### Summary

14.2.8.84 EA flood maps indicate that the proposed scheme is at low risk of flooding from rivers or the sea.

14.2.8.85 Baseline hydraulic modelling has been undertaken for the five ordinary watercourses that are culverted beneath the exiting A66. Away from the proposed alignment, the modelling identifies that some flooding of the existing highway occurs at the following watercourses:

- Unnamed Tributary of Holme Beck 9.6 at Ravensworth Lodge, and
- Unnamed Tributary of Holme Beck 9.8 at Carkin Moor Monument.

14.2.8.86 Some flooding of land adjacent to the existing culverts is predicted at:

- Unnamed Tributary of Holme Beck 9.3 At Foxwell Lodge, and
- Mains Gill at Mainsgill Farm.

14.2.8.87 No flooding is predicted at the Unnamed Tributary of Holme Beck 9.2 at Carkin Moor.

14.2.8.88 Flood Mitigation is not proposed at this stage- as the flooding does not impact the proposed scheme, however it will be considered at the next design phase if required for de-trunking.

### *Surface water flooding*

14.2.8.89 In the centre of the study there are areas of ‘High’ surface water flood risk displayed adjacent to the tributaries of Holme Beck located south of, and crossing under, the existing A66.

14.2.8.90 In the east of the study area there are areas of ‘High’ surface water flood risk associated with depressions in the topography and influenced by the Unnamed Tributary of Mains Gill 9.3 and Mainsgill that cross underneath the existing A66.

14.2.8.91 In the east of the study area there are areas of ‘High’ surface water flood risk adjacent to the existing A66, likely influenced by field drains.

14.2.8.92 Baseline surface water flood risk using Environment Agency data is shown on ES Figure 14.2: Existing Flood Risk (Application Document 3.3). This indicates that much of the route is at very low risk from surface water flooding, with some low to high-risk areas located around the watercourse crossings at Unnamed Tributary of Holme Beck 9.3 at Foxwell Lodge and Mains Gill.

14.2.8.93 Cut-off drainage has been provided where land outside of the highway corridor falls towards the highway. The cut-off drainage will intercept and convey surface water flows around the highway.

### *Historic flooding*

14.2.8.94 Environment Agency data shows no historic flooding events within the study area.

### *Existing highway drainage flooding*

14.2.8.95 HADDMS identifies a number of locations along the existing A66 for this scheme that are or have previously been subject to flooding. There are seven closed/historic events, and 19 open events are recorded.

14.2.8.96 Flooding events are categorised according to severity, with the highest impact floods clustered between 350m west and 350m east of the New Lane junction at Fox Well.

14.2.8.97 During site visits undertaken in September 2021, the drainage team met local landowners and recorded anecdotal accounts of previous flooding. This is summarised below.

#### Ravensworth Lodge

14.2.8.98 The landowners noted that the culvert under the existing A66 and down Waitlands Lane changes size along its length. Downstream lengths reduce in size. To the south of Ravensworth Lodge the culvert changes to a twin pipe.

14.2.8.99 The culvert outfalls into roadside ditch. The ditch is poorly maintained and crosses a field to the east in another culvert before heading south in open ditch.

14.2.8.100 The owners note that the low point in the existing highway is just to the east of Ravensworth Lodge. This is where surface water accumulates.

14.2.8.101 The owners note that flooding occurs to the north of the existing A66. The A66 is much higher than surrounding ground.

14.2.8.102 The owners note that flooding occurs into their basement and drains away naturally over time.

14.2.8.103 The owners note that drainage has been installed within land to the east of their property, connecting A66 drainage into culvert within Waitlands Lane.

#### Mainsgill Farm - Mains Gill

14.2.8.104 The owners note that the culvert to the east of the farm on Mains Gill varies in diameter from 1200mm at inlet to 750mm at the outlet. Only the final length (south of the yard) is 750mm.

14.2.8.105 There is an additional culvert further downstream. This is smaller, and over time spoil has been placed over the culvert. During heavy rain, water backs up from this smaller culvert and floods the land between the culverts. This does not cause issues for the owners, and the owners believe that this helps alleviate flooding downstream.

14.2.8.106 Flooding has occurred on occasion from the 1200mm culvert, with flood water running though the yard, and through the pig sheds. This causes operational issues for the owners.

### High Grange Farm

14.2.8.107 The owners note that a large diameter (300mm) land drainage appears to have been severed when A66 was widened to the east of Carkin Moor. The original culvert is still present from the central reserve to the south of the original A66. The culvert exit is beneath the hand railings on top of the retaining wall running along the south of the existing A66.

14.2.8.108 It is unclear why the field drainage was not reconnected to this existing culvert during the previous widening works.

14.2.8.109 During heavy rain, water spills onto the eastbound carriageway, and runs across to the westbound carriageway. Levels fall east to west, so flood water runs along the carriageway until it can enter the watercourse adjacent to the existing attenuation ponds at the eastern extent of the Stephen Bank to Carkin Moor scheme.

14.2.8.110 The owners note that a formal outfall is required from their existing land drainage into any cut-off drainage provided for the new scheme.

### Two Hoots (at Foxwell Lodge)

14.2.8.111 Unnamed Tributary of Holme Beck 9.3 to the north of the properties is heavily overgrown. A 450mm diameter culvert has been laid beneath the driveway of Two Hoots.

14.2.8.112 During a storm event in 2007, flood water overtopped the driveways and caused external flooding. Flooding also overtopped onto the A66.

14.2.8.113 Flood water regularly builds up on land to the north of the culvert.

### The Willows (south of the scheme, adjacent to Ravensworth Nurseries)

14.2.8.114 The owners have a large ornamental attenuation pond within the garden of their property.

14.2.8.115 The Unnamed Tributary of Holme Beck 9.3 that receives runoff from land to the north, and the existing A66, enters the attenuation pond from the north and flows out of the attenuation pond to the south over a weir. The attenuation pond accumulates silt and has needed to be desilted on occasion. The watercourse regularly carries high flows and some scour to the banks has occurred. This watercourse will also receive flows from the scheme.

14.2.8.116 Downstream of the property, the watercourse passes into a culvert that runs under the nursery greenhouses.

14.2.8.117 During a storm event in 2007, flooding occurred causing extensive external and internal flooding to the property. This is based on anecdotal information provided by a landowner during a site inspection and used for baseline characterisation.

### *Groundwater flooding*

14.2.8.118 The scheme is susceptible to groundwater flooding in accordance with the Groundwater Flooding Susceptibility map in Environmental Statement Figure 14.8. A complete description of the groundwater context is provided in the Environmental Statement Appendix 14.6 Hydrogeological Impact Assessment.

14.2.8.119 Where the scheme is at or above existing ground level the risk of groundwater flooding is considered to be low because the proposed drainage systems will reduce the ground water levels in the vicinity of the scheme to below the formation level of the road.

14.2.8.120 There are a number of areas, particularly West Layton and the Mains Gill junction, where the scheme will be in cutting. A sub surface filter drainage system will be provided to these areas, or the area will be lined, should high groundwater be assessed as a risk during detailed design.

### *Flooding from reservoirs*

14.2.8.121 The Environment Agency *Flood Map* indicates that the scheme is outside of the maximum extent of flooding from reservoirs.

### *Coastal flooding*

14.2.8.122 The Environment Agency Flood Map indicates that the scheme is outside of the maximum extent of flooding from coastal flooding.

### *Flooding from sewers*

14.2.8.123 There are no reports of flooding from existing public sewers. Yorkshire Water shall be consulted throughout the detailed design process to ensure that any risk identified is managed appropriately.

### *Flood risk mitigation*

14.2.8.124 The detailed design of the proposed highway drainage will be in accordance with current design standards specifically the Design Manual for Roads and Bridges (DMRB) and the Manual of Contract Documents for Highway Works (MCHW). By following these design standards, the design of the scheme will have low risk of surface water flooding and low risk from fluvial flooding.

14.2.8.125 Flood risk from groundwater will be mitigated though cut-off drains at all highway earthwork cuttings and embankments.

14.2.8.126 In addition to the above, proposed methods of Flood Mitigation is outlined below.

### *Attenuation*

14.2.8.127 The detailed design of the proposed highway drainage will be in accordance with current design standards specifically the Design Manual for Roads and Bridges (DMRB) and the Manual of Contract Documents for Highway Works (MCHW). By following these design standards, the design of the scheme will have low risk of surface water flooding and low risk from fluvial flooding.

14.2.8.128 The design of the scheme leads to a substantial increase the impermeable area.

14.2.8.129 In Accordance with CG 501, the proposed drainage design will ensure that there is no increase in discharge rates at each outfall. To achieve this, any increase in impermeable area as a result of the proposed alignment will need to be attenuated prior to the outfall, with sufficient storage for a 1 in 100 year event.

14.2.8.130 The proposed attenuation will also make an allowance for 20% climate change for the total area served the drainage networks. Consideration has also been given to the effects of applying 40% climate change to the hydraulic models. The proposed attenuation volumes have considered the amount of flooding. The proposed attenuation will ensure that the flooded volume is less than existing.

14.2.8.131 Proposed drainage and highway design will ensure safe usage of proposed A66 route and side roads.

### *Flow path*

14.2.8.132 Drainage flow paths during storm events have been considered as part of the design process. The road alignment and drainage collection systems expediate the flow of water from trafficked and hard standing areas to minimise the risk of standing water on the carriageway.

14.2.8.133 For higher rainfall return periods and in the event of drainage blockages, exceedance flow paths shall direct flood water downstream to watercourses.

## Conclusion

### *Summary*

14.2.8.134 The scheme involves an offline dual carriageway, some realignment of the existing A66 and a link road from Warrener Lane to the existing A66.

14.2.8.135 The scheme results in a significant increase in impermeable area being discharged to local watercourses.

14.2.8.136 Existing flow rates have been calculated, and proposed flow rates are restricted to ensure that there is no increased flood risk as a result of the scheme.

14.2.8.137 Water quality mitigation measures have been incorporated in the proposals.

14.2.8.138 The scheme is not considered to be at risk of flooding from the sea and is considered to be at low risk of flooding from rivers, surface water and groundwater. The risk of flooding from reservoirs is managed through the enforcement of the Reservoirs Act 1975 by the Environment Agency.

#### *Residual risks*

14.2.8.139 The key residual risks associated with the drainage / flood risk are as follows:

- Flood events in excess of the design standard – the capacity of the designed drainage system will minimise the impact of exceedance events.
- Blockages in the drainage system – managed through routine and/or reactive maintenance.
- There are numerous incidents of flooding to the existing A66 (identified on HADDMS) that are considered minor in nature and do not directly affect the proposed dual carriageway but affect de-trunked sections of road. These shall be further investigated during future design stages and the drainage design refined where necessary, to satisfy the de-trunking requirements agreed between NH and the Local Authority. Flood risk in these areas is not increased as a result of the proposed scheme.

## 14.2.9 A1(M) Junction 53 Scotch Corner

### Introduction

14.2.9.1 This section of the document details the proposed design for this scheme, relating to the junction improvement works at the Scotch Corner junction with the A1(M). Works involve some minor kerb realignment works and re-lining.

14.2.9.2 The drainage for this scheme has been designed in accordance with the Standards for Highways Design Manual for Roads and Bridges and in accordance with relevant Local Authority design standards as detailed in Section 14.2.1.

### Baseline conditions

#### *Surface watercourses*

14.2.9.3 There are no Main Rivers within the study area. The ordinary watercourses in the study area drain south towards the River Swale, approximately 6km to the south of the scheme. Ludburn Beck flows south in the east of the study area towards Moulton, crossed by existing Middleton Tyas Lane and is culverted for the majority of its length.

### *Topography*

14.2.9.4 The scheme is located on a roundabout junction between the A66 and the A1(M). The junction is elevated above the A1(M). Outside of the junction, levels fall generally west to east, from the A66 towards Middleton Tyas. See ES Figure 14.2: Existing Flood Risk (Application Document 3.3) for contours.

### *Geology and soils*

14.2.9.5 A complete description of the geological and topological context is provided in the ES Appendix 14.6 Hydrogeological Impact Assessment.

## Existing drainage

### *Background*

14.2.9.6 The existing drainage network has been assessed using information from *HADDMS*. No intrusive drainage surveys have been undertaken at this stage of design. Where proposed drainage interfaces with existing, CCTV surveys shall be undertaken prior to commencement of detailed design.

### *Description of existing drainage*

14.2.9.7 Existing drainage comprises a mixture of gullies and combined kerb drains, discharging into carrier drains.

14.2.9.8 The Scotch Corner roundabout then connects into the main A1M drainage system.

14.2.9.9 Proposed works involve realigning kerbs to the north of the Scotch Corner roundabout, and to Middleton Tyas Lane immediately to the east.

14.2.9.10 Record drawings for the drainage associated with Middleton Tyas Lane are not available. However, levels fall west to east along Middleton Tyas Lane, and as such it is assumed that the combined kerb drains in this location connect a highway drainage system running east along Middleton Tyas Lane.

### *Assessment of catchment areas and existing runoff rates*

14.2.9.11 Catchment areas associated with the works have developed using both existing and proposed drainage catchments

14.2.9.12 A summary of the existing catchments include (see Annex C):

- Catchment S11-01 relates to works to the roundabout, which connect to the A1M drainage.
- Catchment S11-02 relates to works to Middleton Tyas Lane.

14.2.9.13 The “Greenfield runoff rate estimation” tool developed by HR Wallingford (HR Wallingford, 2022a) has been used to assess existing “greenfield” runoff rates. The QBAR greenfield runoff rate of

5.27 l/s/ha has been allowed for runoff from greenfield/undeveloped areas.

14.2.9.14 In line with the NYCC's SuDS Design Guidance, Section 4.4.2, 140l/s/ha has been allowed for runoff from brownfield areas. A reduction of 30% in brownfield flows has been included.

14.2.9.15 Table 14-41: A1(M) Junction 53 Scotch Corner existing drainage catchments summary shows existing catchments that drain to each of the proposed outfalls.

Table 14-41: A1(M) Junction 53 Scotch Corner existing drainage catchments summary

| Catchment | Existing Greenfield Area (ha) | Existing Brownfield Area (ha) | Existing Greenfield Flow Rate (l/s) | Existing Brownfield Flow Rate (l/s) | Restricted Flow Rate Applied to Outfall$^a$ (l/s) |
|---|---|---|---|---|---|
| S11-01 | 0.0258 | 0.1087 | 0.123 | 10.653 | 10.775 |
| S11-02 | 0.0195 | 0.0519 | 0.093 | 5.086 | 5.179 |

a - includes 30% reduction in brownfield flow rates

### *Hydraulic modelling of existing highway surface water drainage networks*

14.2.9.16 Proposed works to highway drainage are minor for this scheme.

14.2.9.17 No hydraulic modelling of existing drainage networks unaffected by the works has been undertaken.

14.2.9.18 Hydraulic modelling of existing networks could be undertaken during detailed design in order to establish if existing networks can accept the small increases in impermeable area without restriction.

## Proposed drainage

### *Collection system design*

14.2.9.19 The existing kerb lines will be realigned, and new combined kerb drainage units installed. Where affected by the works, existing gullies will be relocated.

14.2.9.20 Where gullies are used, gully spacing will be determined as part of detailed design in accordance with *DMRB CD 526*.

14.2.9.21 Combined kerb and drainage systems will be designed in accordance with *DMRB CG 501*.

14.2.9.22 A simple assessment of the minimum required discharge capacity of the combined kerb and drainage systems is based on the Rational Method Equation Q = 2.78 CiA, where:

- 'Q' is the design peak rate of runoff (l/s)
- 'C' is a non-dimensional runoff coefficient (taken as 1.0)
- 'i' is the design rainfall intensity (mm/hr)
- 'A' is the total catchment area (ha)
- Note: 2.78 is a conversion factor to address the rainfall units being in mm/hr

### Pollution controls

14.2.9.23 The works involve minor kerb realignment. No additional pollution control measures are proposed.

### Climate change

14.2.9.24 In accordance with *DMRB CG 501*, a 20% increase to peak rainfall intensity should be considered the minimum accommodated within the drainage design in order to account for potential climate change.

14.2.9.25 Environment Agency guidance[19] for allowances that should be made for climate change has been followed. Climate change allowances relating to increased peak rainfall intensity are outlined in Table 14-42: Peak rainfall intensity allowance in small and urban catchments - A1(M) Junction 53 Scotch Corner

Table 14-42: Peak rainfall intensity allowance in small and urban catchments - A1(M) Junction 53 Scotch Corner

| **Applies across all of England** | **Total potential change anticipated for the ‘2020s’ (2015 to 2039)** | **Total potential change anticipated for the ‘2050s’ (2040 to 2069)** | **Total potential change anticipated for the ‘2080s’ (2070 to 2115)** |
|---|---|---|---|
| Upper end | 10% | 20% | 40% |
| Central | 5% | 10% | 20% |

14.2.9.26 The guidance states that both the central and upper end allowances should be assessed to understand the range of impact.

### Surface water storage

14.2.9.27 The proposals lead to a minor increase in impermeable area.

14.2.9.28 During detailed design and following the undertaking of a detailed drainage survey, the receiving drainage systems shall be assessed to establish if they have the capacity to accept the additional drained area.

14.2.9.29 If the receiving drainage system does not have sufficient capacity, local surface water storage shall be provided, with flows restricted to those rates outlined in Table 14-41: A1(M) Junction 53 Scotch Corner existing drainage catchments summary.

14.2.9.30 Because of the minor increase in impermeable area and small catchments involved, it is likely that storage will be provided in oversized manhole or pipes.

14.2.9.31 The proposed drainage design makes an allowance for potential climate change. A 40% increase to rainfall intensity has been included when considering surface water storage, and ponds designed to ensure no flooding occurs during the critical 1 in 100-year storm.

### *Hydraulic modelling of proposed highway surface water drainage networks*

14.2.9.32 Because of the minor nature of the works, the potential surface water storage required has been assessed using MicroDrainage Source Control software.

14.2.9.33 FSR rainfall data has been used, with global variables (M560, r) to suit the site location.

14.2.9.34 HydroBrake flow controls have been incorporated as flow control devices, with flow rates restricted to those detailed in Table 14-41: A1(M) Junction 53 Scotch Corner existing drainage catchments summary.

14.2.9.35 Table 14-43: A1(M) Junction 53 Scotch Corner proposed catchments table below is a summary of proposed total catchment area size and the volume of attenuation required to achieve the peak permitted discharge rate calculated for the corresponding existing catchment (see above). This is to ensure the proposed discharge rates are no greater than existing.

Table 14-43: A1(M) Junction 53 Scotch Corner proposed catchments

| Catchment | Drained Area (ha) | Volume of Storage Required (m3) | Peak Flow Rate (1 in 100-year storm, 40% climate change) |
|---|---|---|---|
| S11-01 | 0.1346 | 144 | 10.8 |
| S11-02 | 0.0714 | 49 | 5.2 |

### *Exceedance flood routing*

14.2.9.36 The design will consider the overland flow routes of exceedance flows, and where possible provide a route for exceedance flows that minimises the risk of flooding of properties.  The routing of exceedance flows where possible will follow the discharge pipe route to receiving waters.

### *Karst Risk*

14.2.9.37 Karst is an area of land formed of rock such as limestone that is worn away by water to make caves and other formations.

14.2.9.38 Karst Risk, is a natural human induced hazard in karst areas, resulting in dissolution of soluble rocks such as limestone, dolomite, and gypsum, potentially resulting in collapse or sink holes.

14.2.9.39 Infiltration systems must not be used close to dissolution features. All ponds and drainage systems to be lined where the karst risk is classed as Medium or High.

14.2.9.40 Maintenance access to all drainage systems shall be provided to allow a suitably experienced and qualified professionals to monitor karst risk regularly.

## Flood Risk Assessment

### *Data collection*

14.2.9.41 The risk of flooding to the development has been assessed on Environment Agency *Flood Maps* and baseline hydraulic modelling of existing watercourse/culvert crossings undertaken for the Project. This modelling has established the flooding in the vicinity of the existing A66.

### *Flood risk vulnerability classification*

14.2.9.42 Guidance for flood risk vulnerability for new development sites is set out in the Government planning portal for flood risk and coastal change. Table 6: Flood risk vulnerability classification advises whether new development sites should or should not be permitted, based upon the vulnerability classifications set out on the planning portal.

14.2.9.43 In accordance with *DMRB LA 113*, NI/1.7, the development is classified as “Essential Infrastructure”. The development is therefore permitted providing it is located within Flood Zones 1 or 2, with the exception test required if located in Flood Zones 3a or 3b.

14.2.9.44 A Sequential Test is not required for this scheme as it is located in an area of low flood risk.

14.2.9.45 An Exception Test is not required for this scheme as it is located in Flood Zone 1.

### *Flooding from rivers or the sea*

14.2.9.46 Baseline flood risk from rivers and sea using Environment Agency is shown on ES Figure 14.2: Existing Flood Risk (Application Document 3.3) which indicates that the scheme is in Flood Zone 1 and at low risk of flooding.

### *Surface water flooding*

14.2.9.47 The surface water flood map indicates that much of the scheme is at very low risk from surface water flooding, with some low to high-risk areas. This is shown on ES Figure 14.2: Existing Flood Risk (Application Document 3.3).

14.2.9.48 Areas to in the west and north of the study area have ‘Low’ with small areas of ‘Medium’ pluvial water flood risk, associated with minor field drains and holding ponds.

14.2.9.49 Areas of ‘High’ pluvial water flood risk are concentrated in the south and south-west of the study area, associated with depressions in the topography and the Ludburn Beck.

### *Groundwater flooding*

14.2.9.50 A complete description of the groundwater context is provided in the Environmental Statement Appendix 14.6 Hydrogeological Impact Assessment.

14.2.9.51 The scheme is on an embankment elevated above surrounding ground, and as such is considered to be at low risk of flooding from ground water.

### *Flooding from reservoirs*

14.2.9.52 The Environment Agency F*lood Map* indicates that the scheme is outside of the maximum extent of flooding from reservoirs.

### *Coastal flooding*

14.2.9.53 The Environment Agency *Flood Map* indicates that the scheme is outside of the maximum extent of flooding from coastal flooding.

### *Flooding from sewers*

14.2.9.54 There are no reports of flooding from existing public sewers. Yorkshire Water shall be consulted throughout the detailed design process to ensure that any risk identified is managed appropriately.

### *Flood risk mitigation*

14.2.9.55 Measures have been incorporated into the drainage system to mitigate any increase to the risk of flooding as a result of the scheme. These measures include:

- Surface water storage should the downstream network not have capacity to accept additional flows
- Flow control devices

## Conclusion

### *Summary*

14.2.9.56 The scheme involves the realignment of existing kerb lines.

14.2.9.57 The collection system comprises combined kerb drainage and gullies. This drainage will be relocated as part of the works.

14.2.9.58 The scheme results in a small increase in impermeable area draining to the existing drainage system.

14.2.9.59 A full assessment of the capacity of the receiving drainage system shall be undertaken as part of detailed design. Surface water storage will be required if the existing drainage system does not have the capacity to accept additional flows.

14.2.9.60 The scheme is not considered to be at risk of flooding from the sea and is considered to be at low risk of flooding from rivers, surface water and groundwater.

14.2.9.61 Some existing surface water flooding is indicated on the Environment Agency Flood Maps.

### *Residual risks*

14.2.9.62 The downstream network shall be investigated during detailed design to confirm if it has the capacity to accept unrestricted additional flows resulting from the scheme. If the network does not have capacity for unrestricted flows, then flow controls will be incorporated and storage provided as set out in Table 14-43.

# Annex A: Proposed drainage layouts

M6 Junction 40 to Kemplay Bank

Penrith to Temple Sowerby

Temple Sowerby to Appleby

Appleby to Brough

Bowes Bypass

Cross Lanes to Rokeby

Stephen Bank to Carkin Moor

A1(M) Junction 53 Scotch Corner

# Annex B: Calculations

M6 Junction 40 to Kemplay Bank

Penrith to Temple Sowerby

Temple Sowerby to Appleby

Appleby to Brough

Bowes Bypass

Cross Lanes to Rokeby

Stephen Bank to Carkin Moor

A1(M) Junction 53 Scotch Corner

# Annex C: Existing catchment plans

M6 Junction 40 to Kemplay Bank

Penrith to Temple Sowerby

Temple Sowerby to Appleby

Appleby to Brough

Bowes Bypass

Cross Lanes to Rokeby

Stephen Bank to Carkin Moor

A1(M) Junction 53 Scotch Corner

# Annex D: Proposed catchment plans

### M6 Junction 40 to Kemplay Bank

### Penrith to Temple Sowerby

### Temple Sowerby to Appleby

### Appleby to Brough

### Bowes Bypass

### Cross Lanes to Rokeby

### Stephen Bank to Carkin Moor

### A1(M) Junction 53 Scotch Corner

## Annex E: Hydraulic modelling reports

### M6 Junction 40 to Kemplay Bank

### Penrith to Temple Sowerby

### Temple Sowerby to Appleby

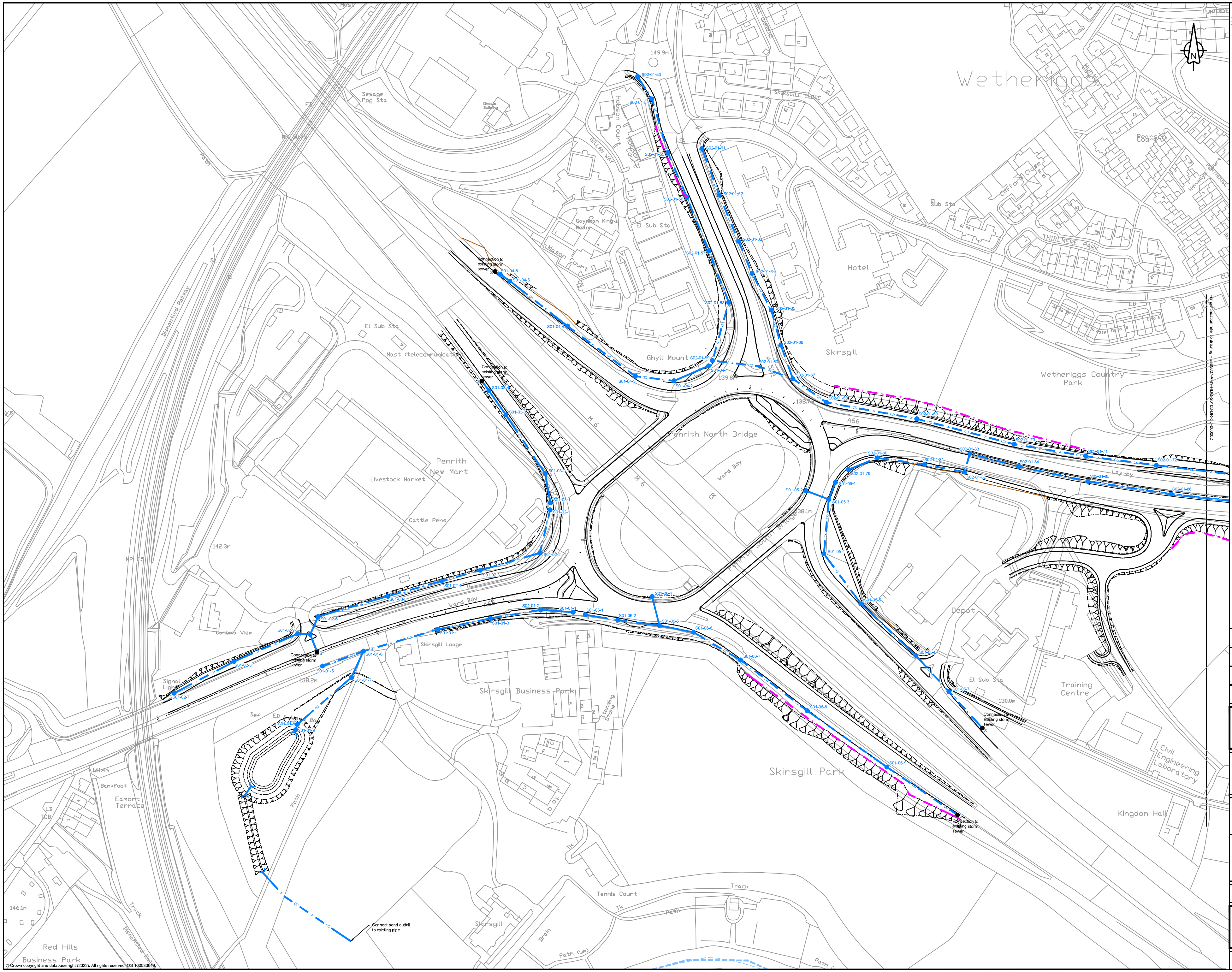
### Appleby to Brough

### Bowes Bypass

### Cross Lanes to Rokeby

### Stephen Bank to Carkin Moor

### A1(M) Junction 53 Scotch Corner



## NOTES

1. All dimensions are in metres unless otherwise stated.
2. Note that the drainage layout, as shown in this drawing, is a preliminary overview of the required pipework for the proposed scheme, and not a final detailed design. The proposed storm drainage pipework has been sized using the Modified Rational Method in order to provide preliminary sizes. Detailed MicroDrainage modelling has not been undertaken at this stage, therefore detailed proposed invert levels and gradients are not available.Surface water channel outlets and gullies are not shown.

## KEY

| | |
|---|---|
| — < — | Culvert |
| ◡ | Headwall |
| — > — CD — | Proposed CD |
| — > — F — | Proposed Filter Drain |
| — > — CD — | Existing Carrier Drain |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| - - - - | Existing watercourse |

| | | | | | |
|---|---|---|---|---|---|
| — | — | | | | |
| | — | — | — | — | — |
| | — | — | — | — | — |
| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 20/04/22 | 20/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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national highways

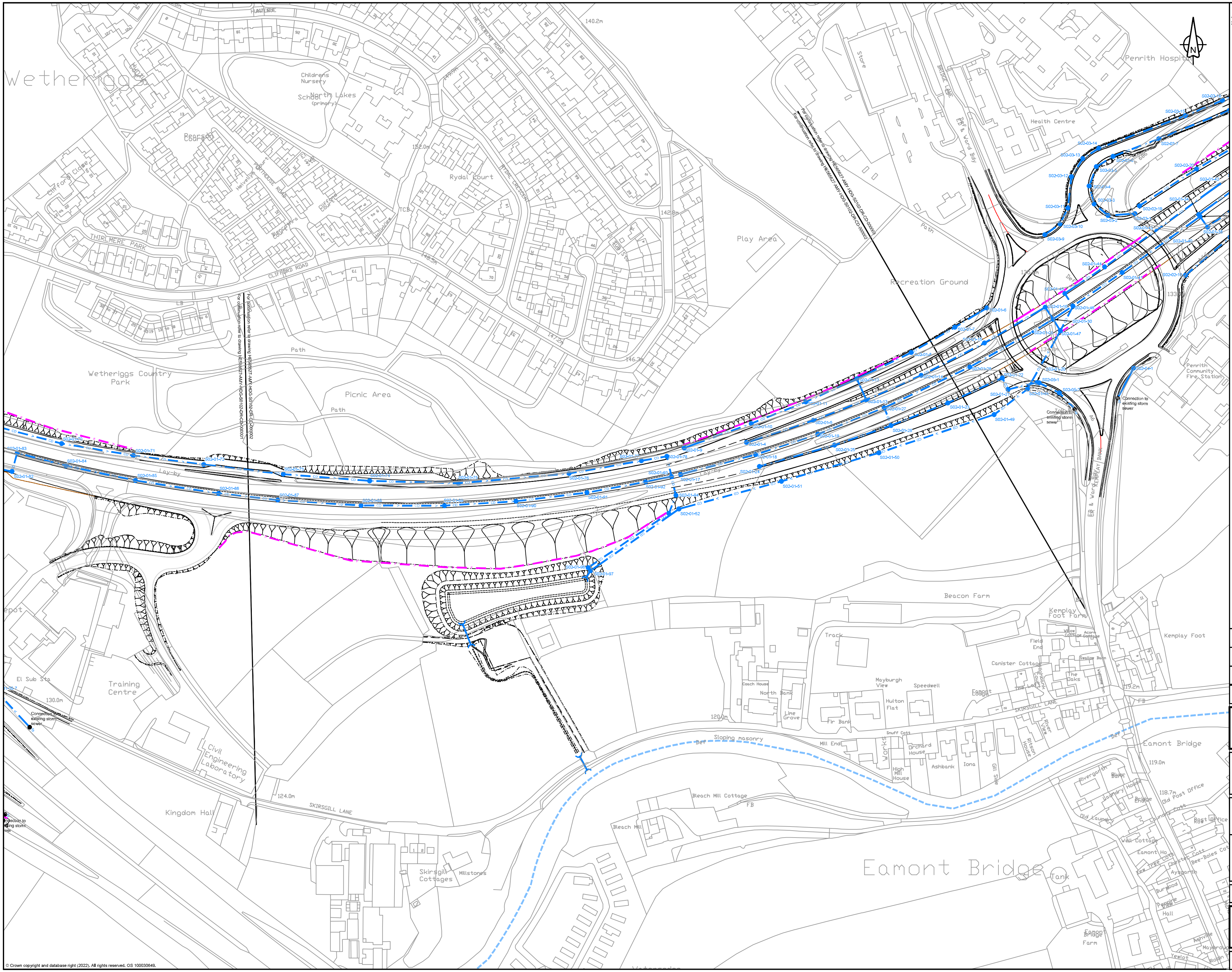
Project Name
A66 Northern Trans-Pennine

Drawing Title
M6 J40 to Kemplay Bank
Drainage Layout
Sheet 1 of 3

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| — | | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S0102 -DR-CD- 000001
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |



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| | | | | | |
|---|---|---|---|---|---|
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| | — | — | — | — | — |
| | — | — | — | — | — |
| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 20/04/22 | 20/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
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Sheet 2 of 3

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| — | | Dimensions : M |

Drawing Number
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Location | Type | Role | Number

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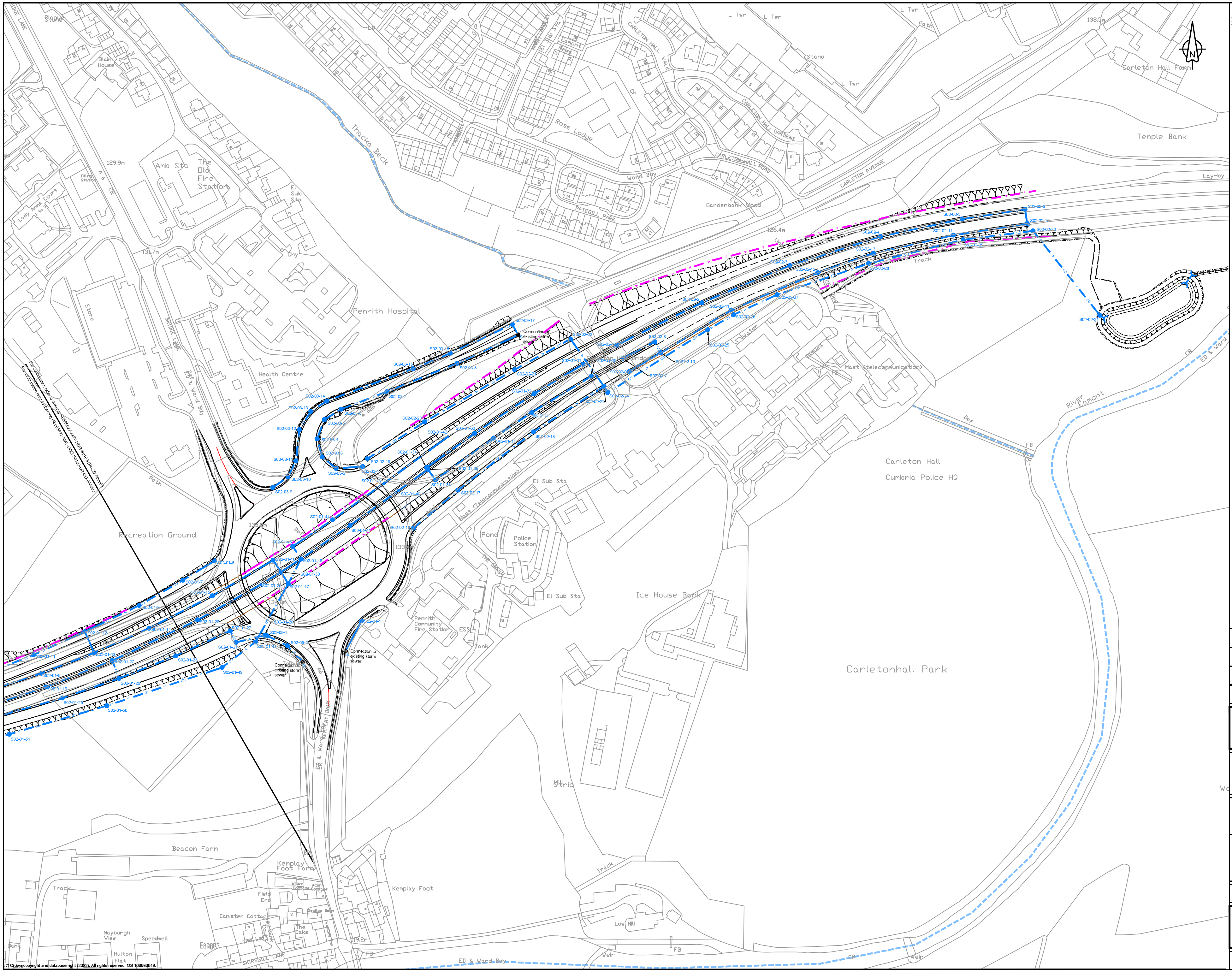

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## KEY

Culvert
Headwall
Proposed CD
Proposed Filter Drain
Existing Carrier Drain
● Proposed Chamber
● Existing Chamber
Existing watercourse

| | | | | | |
|---|---|---|---|---|---|
| — | — | | | | |
| | — | — | — | — | — |
| | — | — | — | — | — |
| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 20/04/22 | 20/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
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| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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Sheet 3 of 3

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
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S0102 -DR-CD- 000003
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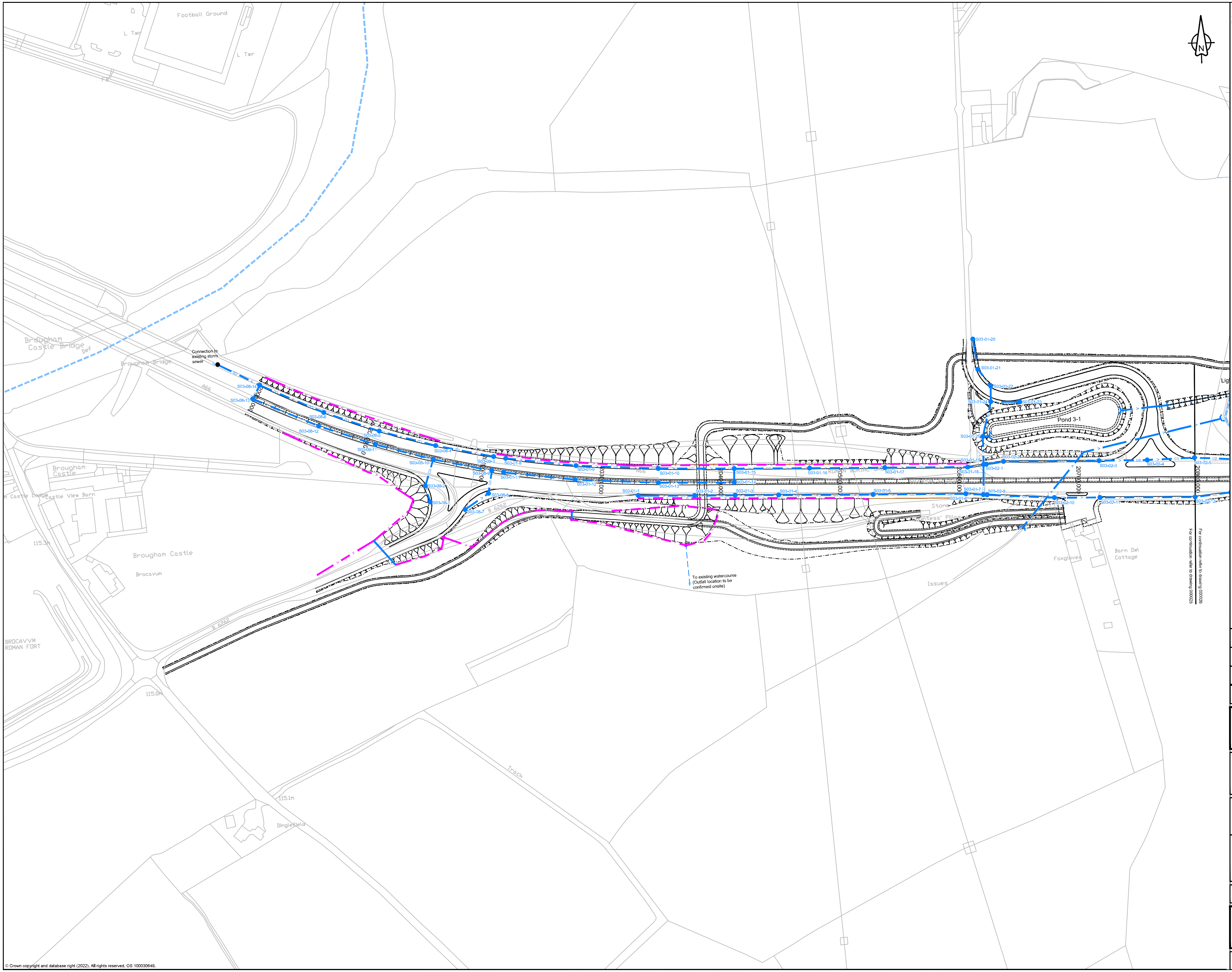

## NOTES

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2. Note that the drainage layout, as shown in this drawing, is a preliminary overview of the required pipework for the proposed scheme, and not a final detailed design. The proposed storm drainage pipework has been sized using the Modified Rational Method in order to provide preliminary sizes. Detailed MicroDrainage modelling has not been undertaken at this stage, therefore detailed proposed invert levels and gradients are not available.Surface water channel outlets and gullies are not shown.

## KEY

| | |
|---|---|
| — < — | Culvert |
| ◡ | Headwall |
| — > — CD — | Proposed CD |
| — > — F — | Proposed Filter Drain |
| — > — CD — | Existing Carrier Drain |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| - - - - - | Existing watercourse |

| | | | | | |
|---|---|---|---|---|---|
| — | — | | | | |
| | — | — | — | — | — |
| | — | — | — | — | — |
| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 20/04/22 | 20/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
Amey OW Limited
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Client
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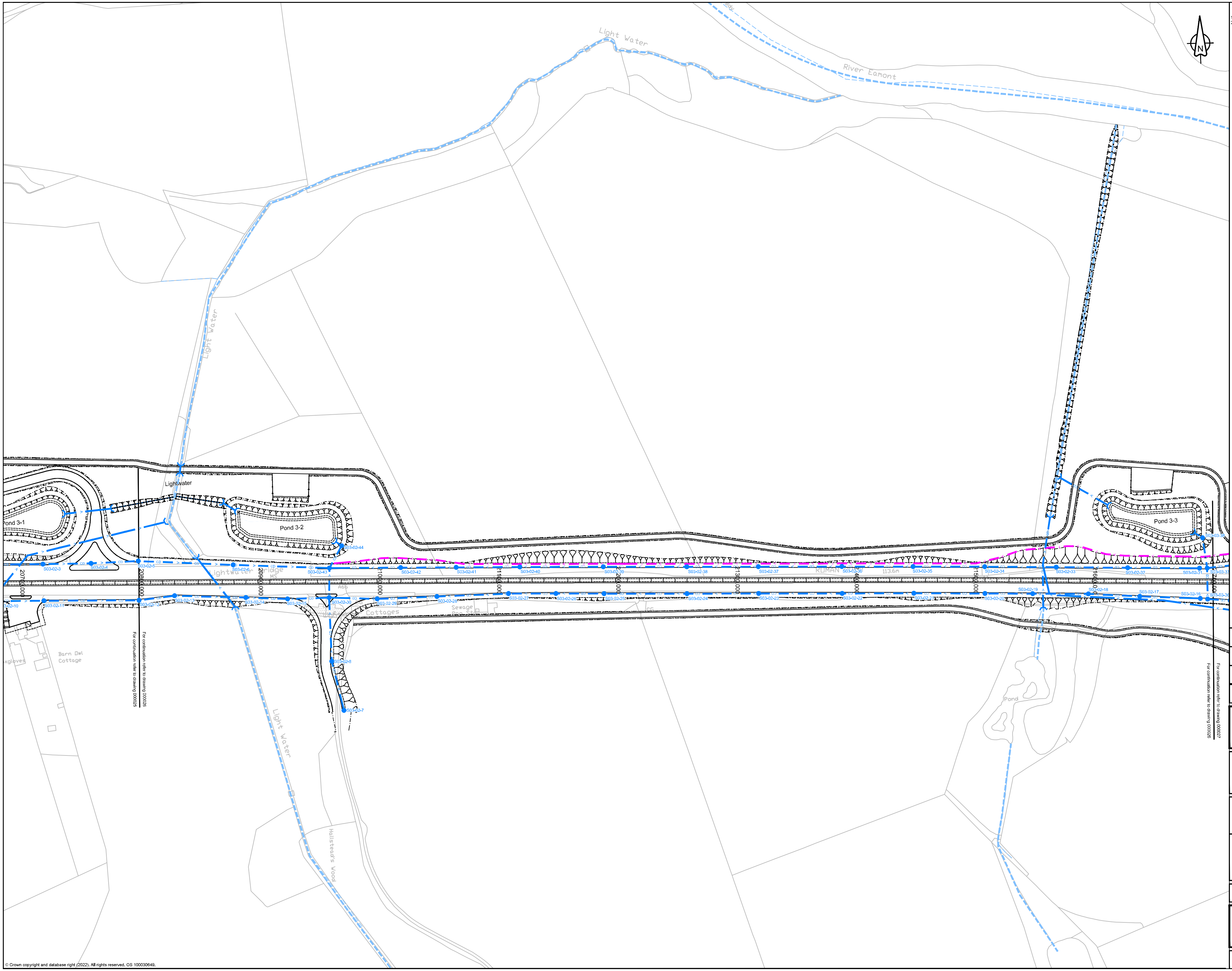
Project Name
A66 Northern Trans-Pennine

Drawing Title
Center Parcs Drainage Layout
Sheet 1 of 6

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| -- | | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S03 -DR-CD- 000025
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |



For continuation refer to drawing 000025

For continuation refer to drawing 000026

For continuation refer to drawing 000026

For continuation refer to drawing 000027

## NOTES

1. All dimensions are in metres unless otherwise stated.
2. Note that the drainage layout, as shown in this drawing, is a preliminary overview of the required pipework for the proposed scheme, and not a final detailed design. The proposed storm drainage pipework has been sized using the Modified Rational Method in order to provide preliminary sizes. Detailed MicroDrainage modelling has not been undertaken at this stage, therefore detailed proposed invert levels and gradients are not available.Surface water channel outlets and gullies are not shown.

## KEY

| | |
|---|---|
| ▬ < ▬ | Culvert |
| ◡ | Headwall |
| ▬ > ▬ CD ▬ | Proposed CD |
| ▬ > ▬ F ▬ | Proposed Filter Drain |
| ▬ > ▬ CD ▬ | Existing Carrier Drain |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| ‐ ‐ ‐ ‐ | Existing watercourse |

| | | | | | |
|---|---|---|---|---|---|
| – | – | | | | |
| | – | – | – | – | – |
| | – | – | – | – | – |
| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 20/04/22 | 20/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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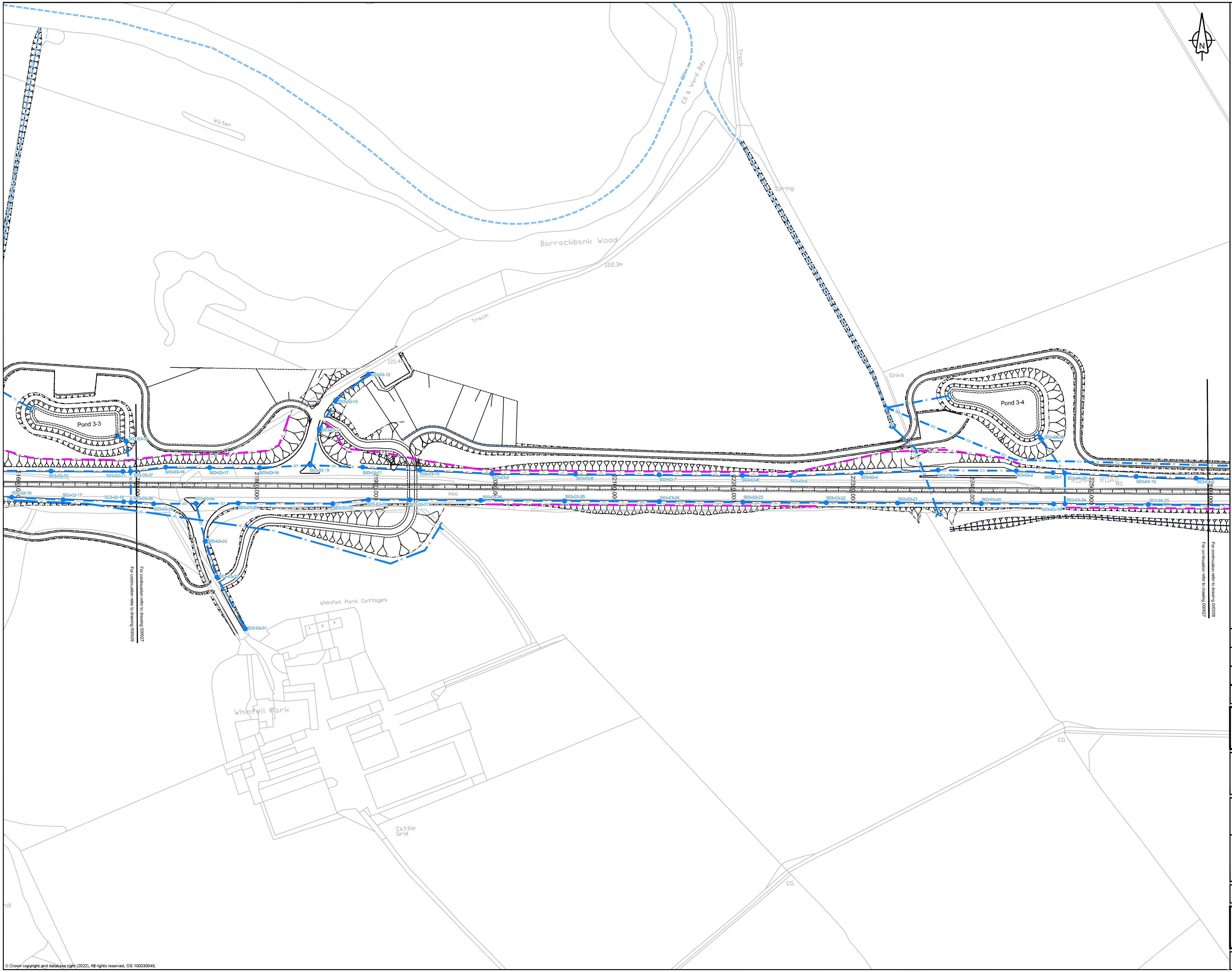
Project Name
A66 Northern Trans-Pennine

Drawing Title
Center Parcs Drainage Layout
Sheet 2 of 6

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| – | | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S03 -DR-CD-000026
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |



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## NOTES

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## KEY

| | |
|---|---|
| — < — | Culvert |
| ◡ | Headwall |
| — > — CD — | Proposed CD |
| — > — F — | Proposed Filter Drain |
| — > — CD — | Existing Carrier Drain |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| - - - - - | Existing watercourse |

| | | | | | |
|---|---|---|---|---|---|
| — | — | | | | |
| | — | — | — | — | — |
| | — | — | — | — | — |
| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 20/04/22 | 20/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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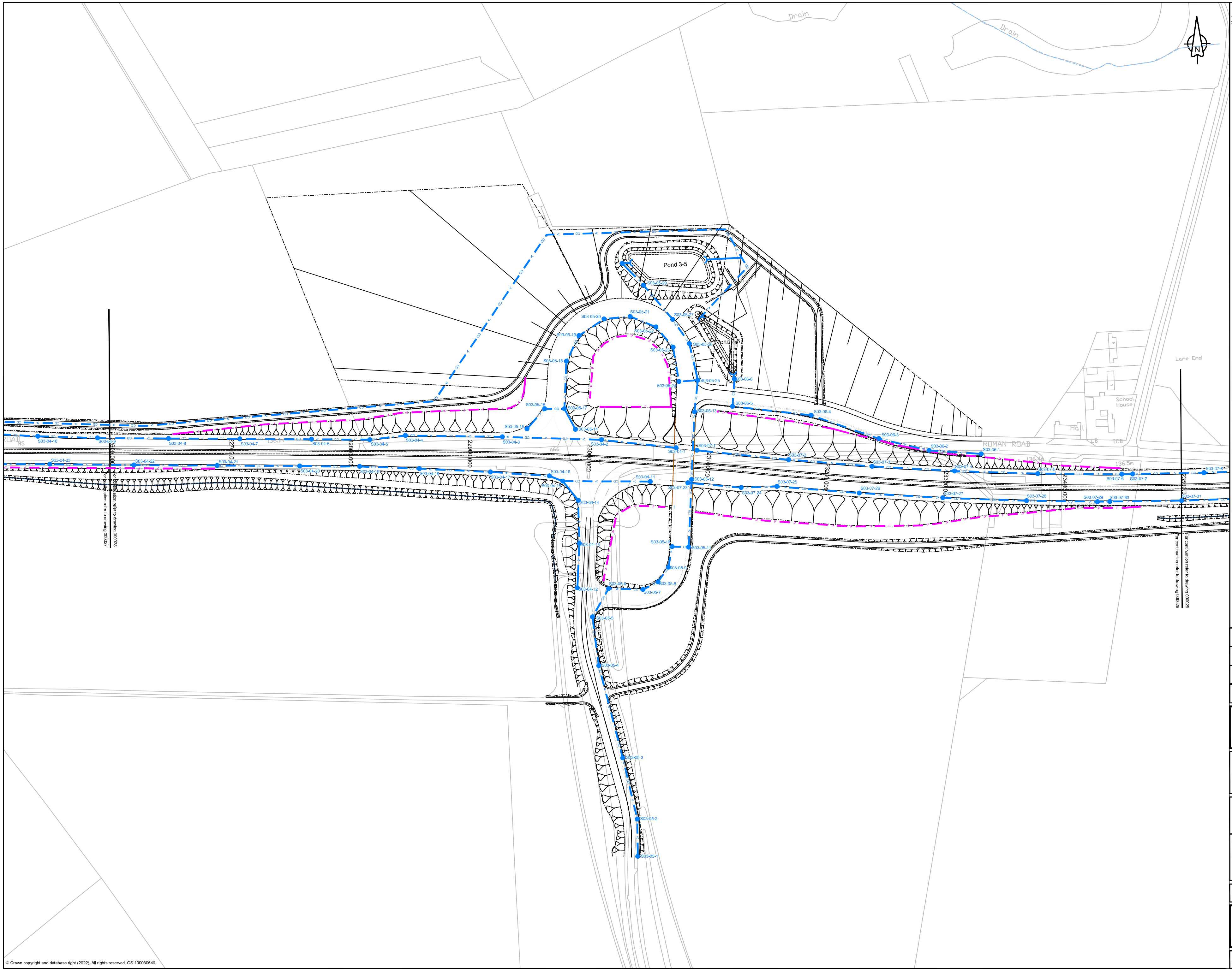
Project Name
A66 Northern Trans-Pennine

Drawing Title
Center Parcs Drainage Layout
Sheet 3 of 6

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| -- | | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S03 -DR-CD- 000027
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |



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## NOTES

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## KEY

| | |
|---|---|
| ▬ < ▬ | Culvert |
| ◡ | Headwall |
| ▬ > ▬ CD ▬ | Proposed CD |
| ▬ > ▬ F ▬ | Proposed Filter Drain |
| ▬ > ▬ CD ▬ | Existing Carrier Drain |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| ▬ ▬ ▬ | Existing watercourse |

| | | | | | |
|---|---|---|---|---|---|
| — | — | | | | |
| | — | — | — | — | — |
| | — | — | — | — | — |
| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 20/04/22 | 20/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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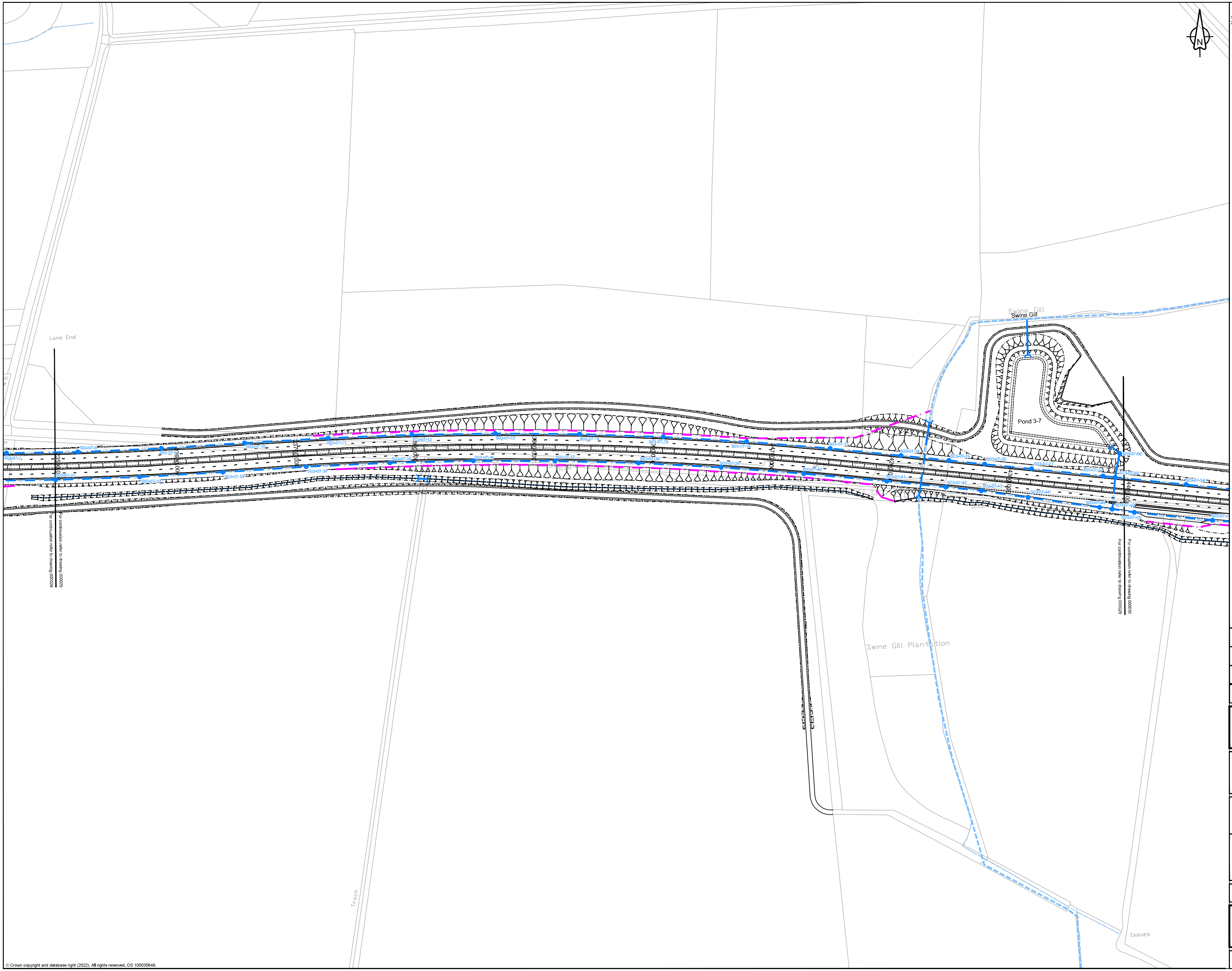
Project Name
A66 Northern Trans-Pennine

Drawing Title
Center Parcs Drainage Layout
Sheet 4 of 6

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| -- | | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S03 -DR-CD-000028
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |



## NOTES

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## KEY

| | |
|---|---|
| ━━ < ━ | Culvert |
| ◡ | Headwall |
| ━ > ━ CD ━ | Proposed CD |
| ━ > ━ F ━ | Proposed Filter Drain |
| ━ > ━ CD ━ | Existing Carrier Drain |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| ╌╌╌ | Existing watercourse |

| | | | | | |
|---|---|---|---|---|---|
| — | — | | | | |
| | — | — | — | — | — |
| | — | — | — | — | — |
| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 20/04/22 | 20/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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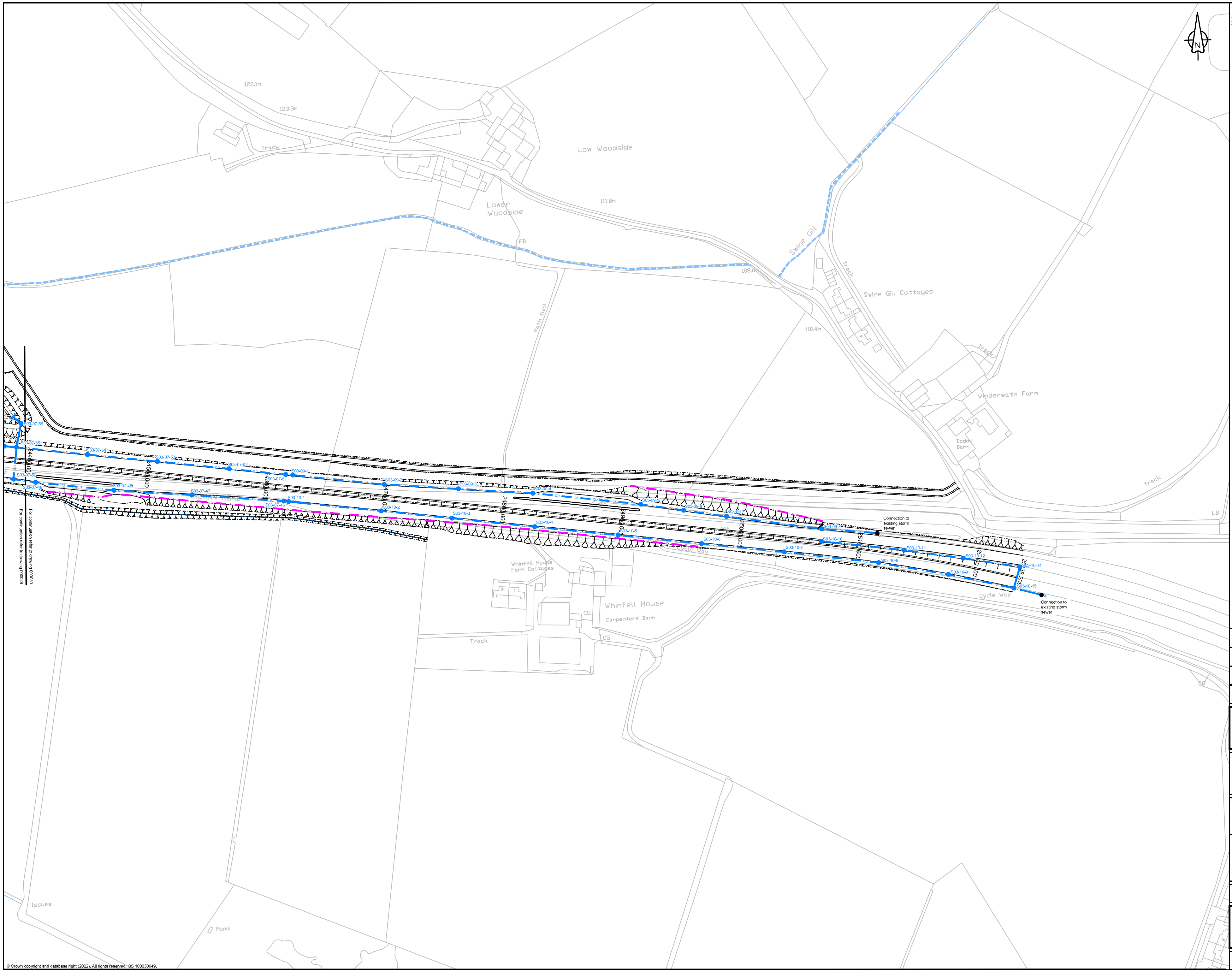
Project Name
A66 Northern Trans-Pennine

Drawing Title
Center Parcs Drainage Layout
Sheet 5 of 6

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| -- | | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S03 -DR-CD- 000029
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |



## NOTES

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## KEY

| | |
|---|---|
| — < — | Culvert |
| ◡ | Headwall |
| — > — CD — | Proposed CD |
| — > — F — | Proposed Filter Drain |
| — > — CD — | Existing Carrier Drain |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| - - - - - - | Existing watercourse |

| | | | | | |
|---|---|---|---|---|---|
| — | — | | | | |
| | — | — | — | — | — |
| | — | — | — | — | — |
| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 20/04/22 | 20/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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national highways

Project Name
A66 Northern Trans-Pennine

Drawing Title
Center Parcs Drainage Layout
Sheet 6 of 6

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| — | | Dimensions : M |

Drawing Number

| Project | Originator | Volume | Location | Type | Role | Number |
|---|---|---|---|---|---|---|
| HE565627 | AMY | HDG | S03 | DR | CD | 000030 |

HE565627 - AMY - HDG - S03 -DR-CD- 000030

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |

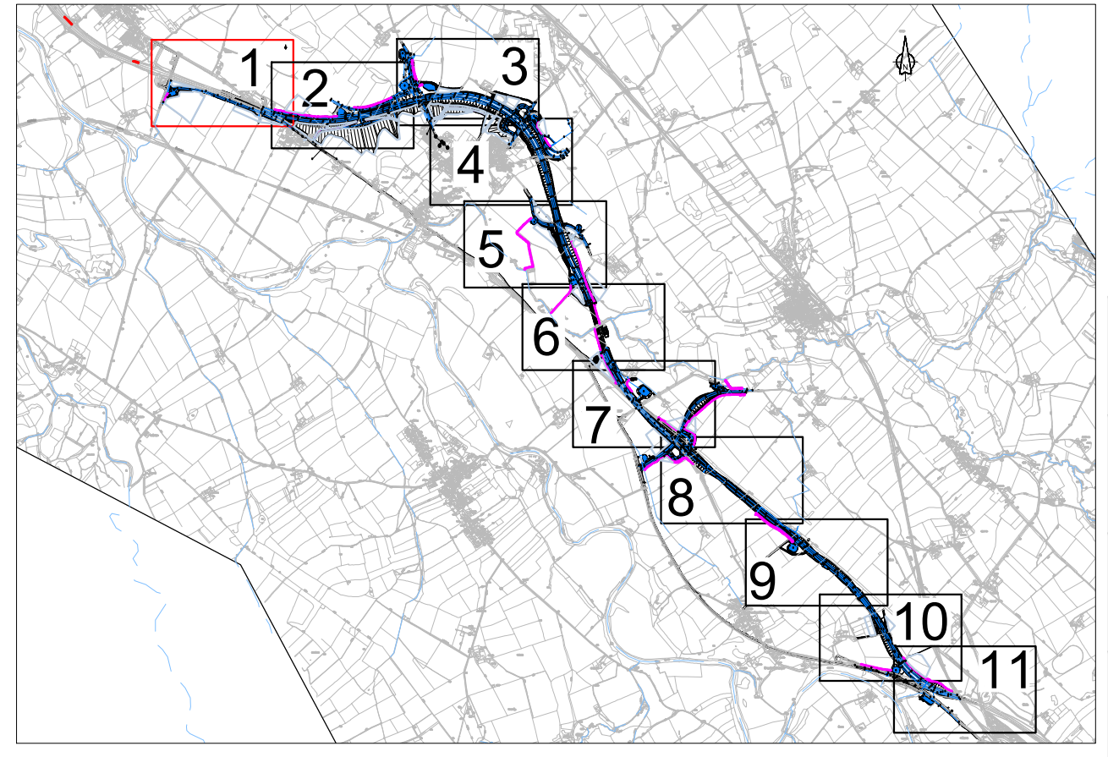
## NOTES

1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed drainage design designed in accordance with the Standards for Highways Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, as-built drawings, OS, JBA culvert surveys, site walk overs and topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   - No surcharging in 1yr storm event
   - No flooding in 1 or 5yr storm event
   - Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope
10. Ponds to have minimum 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

## Drainage Key plan

| | |
|---|---|
| – – – – | Existing watercourse |
| —— < — | Culvert |
| —— | Cut-off drain |
| — > — F — | Proposed Filter drain |
| ◡ | Headwall |
| — > — CD — | Proposed Carrier Drain |
| ▨ | Pond |
| Y Y Y Y | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S0405-01-10 | Manhole Reference |
| — > — CD — | Existing Carrier Drain |

## Site key plan



| Revision | Revision details | Created | Checked | Reviewed | Approved | Authorised |
|---|---|---|---|---|---|---|
| P01 | | GCOO<br>11/03/22 | GCOO<br>11/03/22 | ASHI<br>11/03/22 | KCRO<br>17/03/22 | KCRO<br>17/03/22 |
| P02 | SGAR3 | JMOR<br>10/05/22 | JMOR<br>10/05/22 | ASHI<br>10/05/22 | KCRO<br>10/05/22 | KCRO<br>10/05/22 |
| P03 | SGAR3 | CMAR<br>06/06/22 | CMAR<br>06/06/22 | ASHI<br>06/06/22 | KCRO<br>06/06/22 | KCRO<br>06/06/22 |
| Revision | Revision details | Created<br>dd/mm/yy | Checked<br>dd/mm/yy | Reviewed<br>dd/mm/yy | Approved<br>dd/mm/yy | Authorised<br>dd/mm/yy |

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national highways

Project Name
A66 Northern Trans-Pennine

Drawing Title
Temple Sowerby to Appleby
Drainage General Arrangement
Sheet 1 of 11
(Temple Sowerby Link)

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume
HE565627 - AMY - HDG
S0405 -DR-CD-000200
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P03 |

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## NOTES

1. All levels are in metres above Ordnance Datum.
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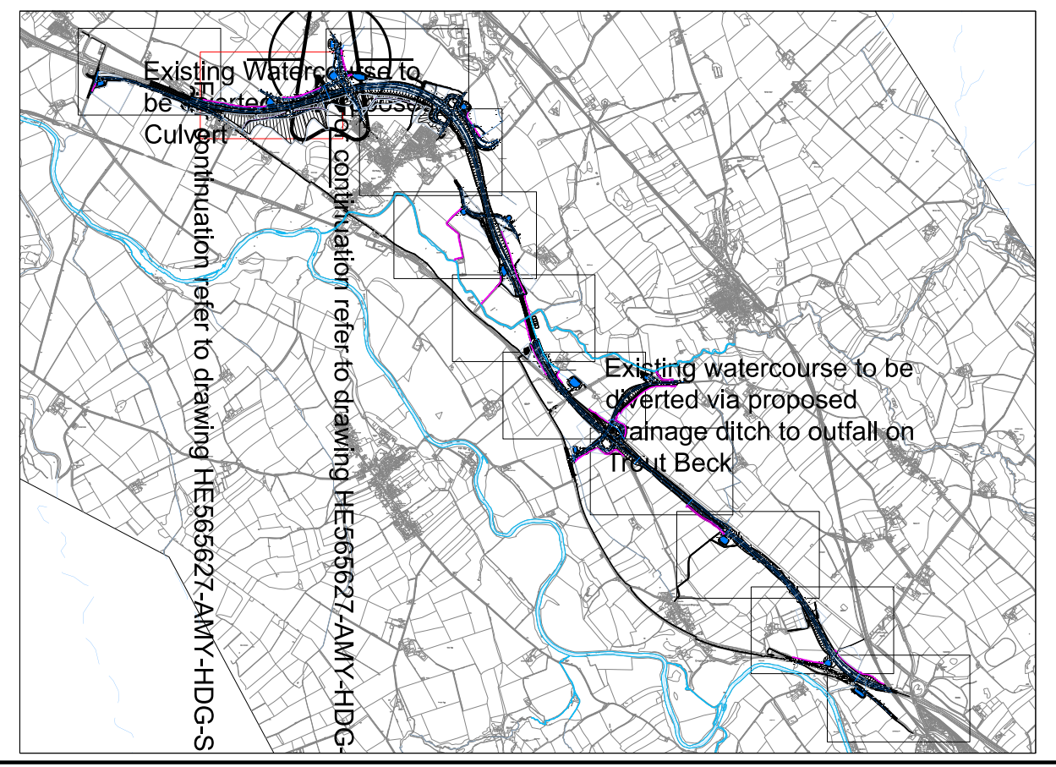
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed drainage design designed in accordance with the Standards for Highways Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, as-built drawings, OS, JBA culvert surveys, site walk overs and topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   •No surcharging in 1yr storm event
   •No flooding in 1 or 5yr storm event
   •Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope with a 500mm base.
10. Ponds to have minimum 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

## Drainage Key plan

| | |
|---|---|
| - - - - - - - | Existing watercourse |
| —— < —— | Culvert |
| —— | Cut-off drain |
| — > — F — | Proposed Filter drain |
| ◡ | Headwall |
| — > — CD — | Proposed Carrier Drain |
| | Pond |
| | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S0405-01-10 | Manhole Reference |
| — > — CD — | Existing Carrier Drain |

## Site key plan



| | | | | | |
|---|---|---|---|---|---|
| P01 | | | | | |
| | GCOO | GCOO | ASHI | KCRO | KCRO |
| | 11/03/22 | 11/03/22 | 11/03/22 | 17/03/22 | 17/03/22 |
| P02 | SGAR3 | | | | |
| | JMOR | JMOR | ASHI | KCRO | KCRO |
| | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 |
| P03 | SGAR3 | | | | |
| | CMAR | CMAR | ASHI | KCRO | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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Project Name
A66 Northern Trans-Pennine

Drawing Title
Temple Sowerby to Appleby
Drainage General Arrangement
Sheet 2 of 11
(Low Moor Caravan Park)

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume
HE565627 - AMY - HDG
S0405 -DR-CD- 000201
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P03 |

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## NOTES

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6. Proposed drainage design designed in accordance with the Standards for Highways Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, as-built drawings, OS, JBA culvert surveys, site walk overs and topographical survey information. Existing drainage is omitted from this drawing.
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   - No surcharging in 1yr storm event
   - No flooding in 1 or 5yr storm event
   - Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope
10. Ponds to have minimum 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

## RESIDUAL DESIGN HAZARDS

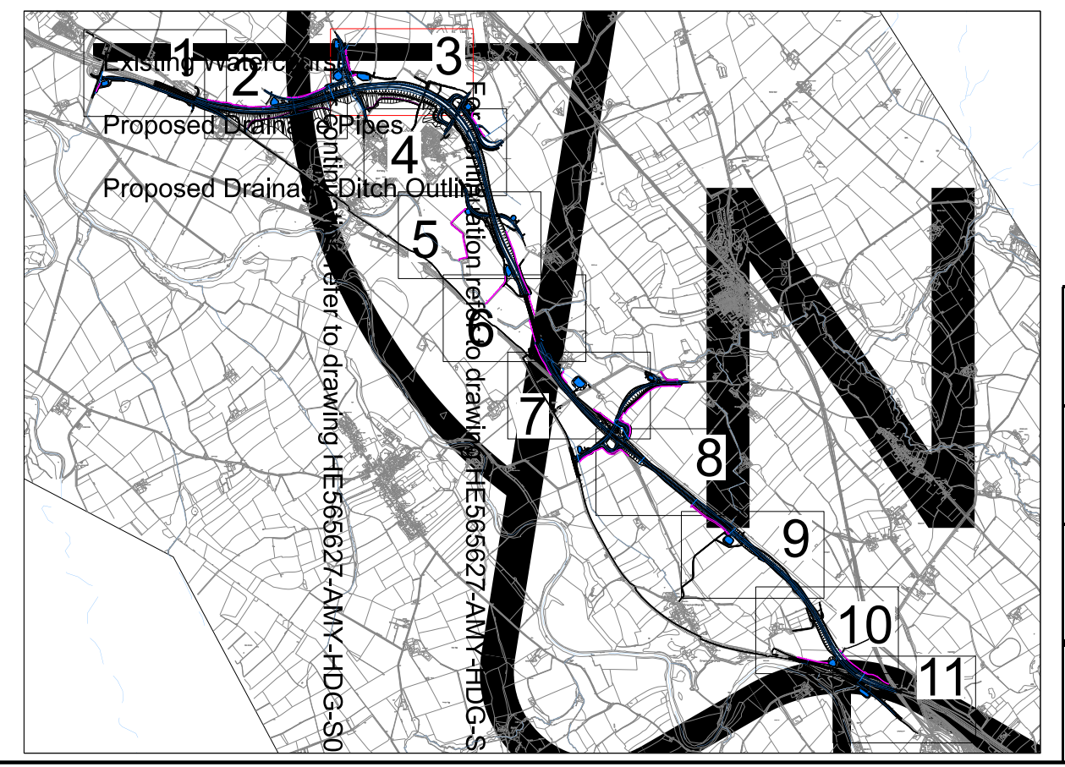
*(The following information has been collected from Preconstruction Information and the Amey Arup DJV CDM Hazard Management Process.)*

To be considered at the next Design Stage

## Drainage Key plan

| | |
|---|---|
| - - - - - | Existing watercourse |
| ━━ < ━ | Culvert |
| ━━━━ | Cut-off drain |
| ━ > ━ F ━ | Proposed Filter drain |
| ◡ | Headwall |
| ━ > ━ CD ━ | Proposed Carrier Drain |
| ▨ | Pond |
| ⊻⊻⊻ | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S0405-01-10 | Manhole Reference |
| ━ > ━ CD ━ | Existing Carrier Drain |

## Site key plan



| Revision | | | | | |
|---|---|---|---|---|---|
| P01 | | | | | |
| | GCOO | GCOO | ASHI | KCRO | KCRO |
| | 11/03/22 | 11/03/22 | 11/03/22 | 17/03/22 | 17/03/22 |
| P02 | SGAR3 | | | | |
| | JMOR | JMOR | ASHI | KCRO | KCRO |
| | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 |
| P03 | SGAR3 | | | | |
| | CMAR | CMAR | ASHI | KCRO | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
Amey OW Limited
Chancery Exchange
10 Furnival Street
London, EC4A 1AB

Client
3 Piccadilly Place
Manchester
M1 3BN

national highways

Project Name
A66 Northern Trans-Pennine

Drawing Title
Temple Sowerby to Appleby
Drainage General Arrangement
Sheet 3 of 11
(Kirkby Thore School)

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume
HE565627 - AMY - HDG
S0405 -DR-CD- 000202
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P03 |

For continuation refer to drawing HE565627-AMY-HDG-S0405-DR-CD-000202

For continuation refer to drawing HE565627-AMY-HDG-S0405-DR-CD-000204

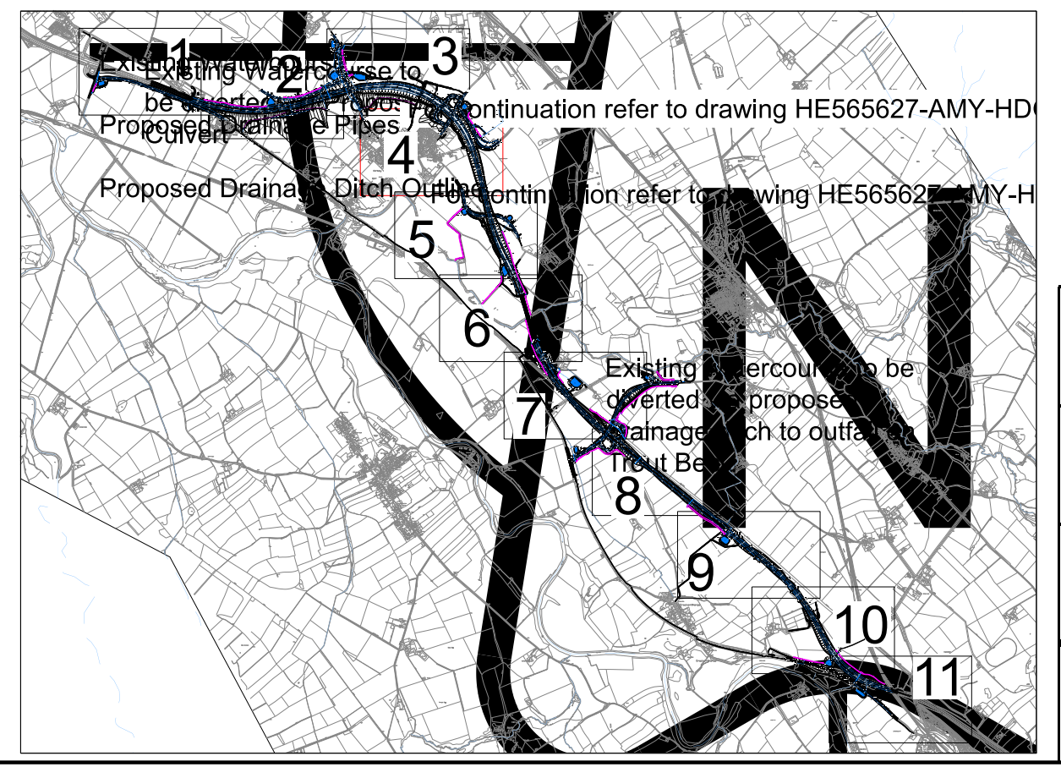
## NOTES

1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed drainage design designed in accordance with the Standards for Highways Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, as-built drawings, OS, JBA culvert surveys, site walk overs and topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   - No surcharging in 1yr storm event
   - No flooding in 1 or 5yr storm event
   - Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope
10. Ponds to have minimum 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

## Drainage Key plan

| | | | |
|---|---|---|---|
| – – – – – | Existing watercourse | ● | Proposed Chamber |
| ——— < —— | Culvert | ● | Existing Chamber |
| ——— | Cut-off drain | Ø300 | Pipe Diameter (in mm) |
| — > —— F — | Proposed Filter drain | S0405-01-10 | Manhole Reference |
| | Headwall | — > —— CD — | Existing Carrier Drain |
| — > —— CD — | Proposed Carrier Drain | | |
| | Pond | | |
| | Earthworks | | |

## Site key plan



| Revision | | | | | |
|---|---|---|---|---|---|
| P01 | | | | | |
| | GCOO | GCOO | ASHI | KCRO | KCRO |
| | 11/03/22 | 11/03/22 | 11/03/22 | 17/03/22 | 17/03/22 |
| P02 | SGAR3 | | | | |
| | JMOR | JMOR | ASHI | KCRO | KCRO |
| | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 |
| P03 | SGAR3 | | | | |
| | CMAR | CMAR | ASHI | KCRO | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
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Chancery Exchange
10 Furnival Street
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Client
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national highways

Project Name
A66 Northern Trans-Pennine

Drawing Title
Temple Sowerby to Appleby
Drainage General Arrangement
Sheet 4 of 11
(British Gypsum Junction)

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume
HE565627 - AMY - HDG
S0405 -DR-CD-000203
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P03 |

For continuation refer to drawing HE565627-AMY-HDG-S0405-DR-CD-000203

For continuation refer to drawing HE565627-AMY-HDG-S0405-DR-CD-000205

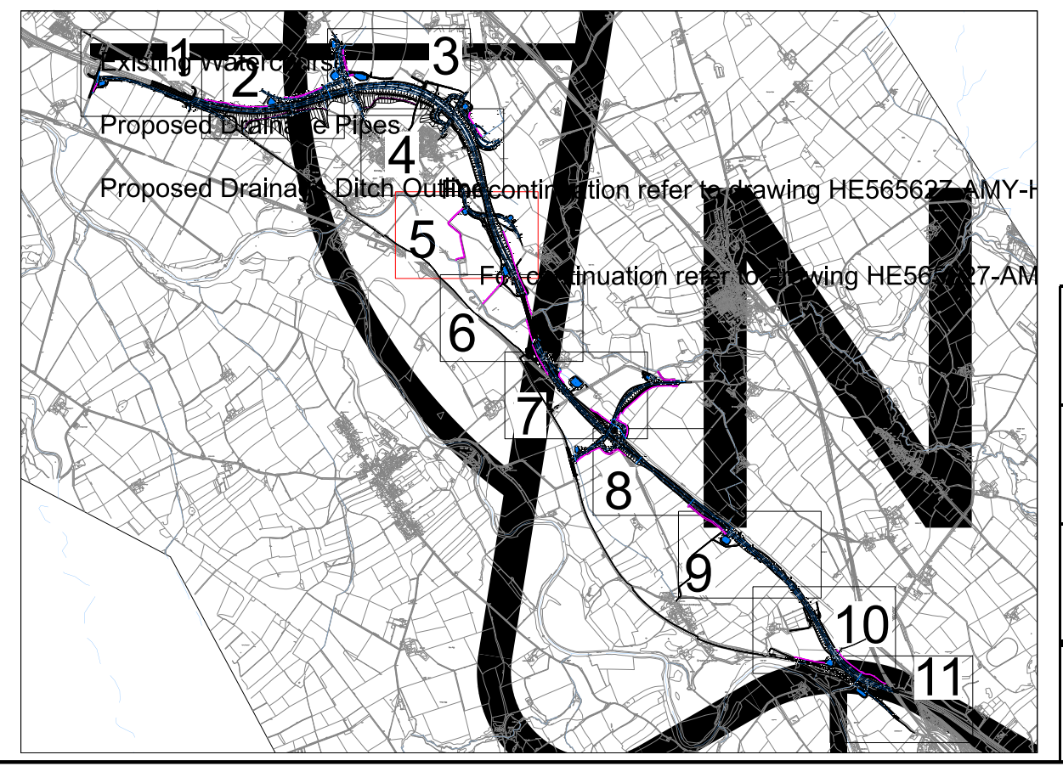
## NOTES

1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed drainage design designed in accordance with the Standards for Highways Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, as-built drawings, OS, JBA culvert surveys, site walk overs and topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   - No surcharging in 1yr storm event
   - No flooding in 1 or 5yr storm event
   - Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope with a 500mm base.
10. Ponds to have minimum 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

## Drainage Key plan

| | | | |
|---|---|---|---|
| - - - - - | Existing watercourse | ● | Proposed Chamber |
| —— < —— | Culvert | ● | Existing Chamber |
| —— | Cut-off drain | Ø300 | Pipe Diameter (in mm) |
| — > — F — | Proposed Filter drain | S0405-<br>01-10 | Manhole Reference |
| ◡ | Headwall | — > — CD — | Existing Carrier Drain |
| — > — CD — | Proposed Carrier Drain | | |
| ▨ | Pond | | |
| ⊤⊤⊤⊤ | Earthworks | | |

## Site key plan



| | | | | | |
|---|---|---|---|---|---|
| P01 | | | | | |
| | GCOO | GCOO | ASHI | KCRO | KCRO |
| | 11/03/22 | 11/03/22 | 11/03/22 | 17/03/22 | 17/03/22 |
| P02 | SGAR3 | | | | |
| | JMOR | JMOR | ASHI | KCRO | KCRO |
| | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 |
| P03 | SGAR3 | | | | |
| | CMAR | CMAR | ASHI | KCRO | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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Client
3 Piccadilly Place
Manchester
M1 3BN

national highways

Project Name
A66 Northern Trans-Pennine

Drawing Title
Temple Sowerby to Appleby
Drainage General Arrangement
Sheet 5 of 11
(Sleastonhow Lane)

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume
HE565627 - AMY - HDG
S0405 -DR-CD-000204
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P03 |

For continuation refer to drawing HE565627-AMY-HDG-S0405-DR-CD-000204

For continuation refer to drawing HE565627-AMY-HDG-S0405-DR-CD-000206

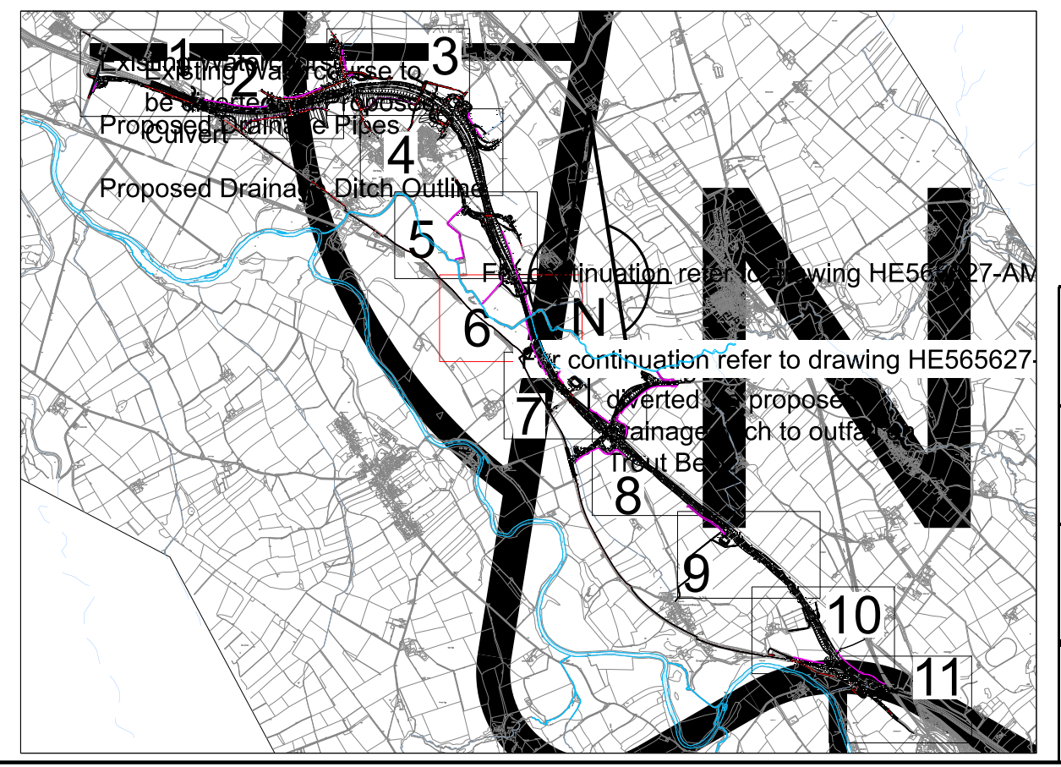
## NOTES

1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed drainage design designed in accordance with the Standards for Highways Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, as-built drawings, OS, JBA culvert surveys, site walk overs and topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   - No surcharging in 1yr storm event
   - No flooding in 1 or 5yr storm event
   - Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope
10. Ponds to have minimum 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

## Drainage Key plan

| | | | |
|---|---|---|---|
| - - - - - | Existing watercourse | ● | Proposed Chamber |
| —— < —— | Culvert | ● | Existing Chamber |
| —— | Cut-off drain | Ø300 | Pipe Diameter (in mm) |
| — > — F — | Proposed Filter drain | S0405-<br>01-10 | Manhole Reference |
| ⌣ | Headwall | — > — CD — | Existing Carrier Drain |
| — > — CD — | Proposed Carrier Drain | | |
| ▨ | Pond | | |
| ⊥⊥⊥⊥ | Earthworks | | |

## Site key plan



| Revision | | | | | |
|---|---|---|---|---|---|
| P01 | | | | | |
| | GCOO | GCOO | ASHI | KCRO | KCRO |
| | 11/03/22 | 11/03/22 | 11/03/22 | 17/03/22 | 17/03/22 |
| P02 | SGAR3 | | | | |
| | JMOR | JMOR | ASHI | KCRO | KCRO |
| | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 |
| P03 | SGAR3 | | | | |
| | CMAR | CMAR | ASHI | KCRO | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
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Client
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Manchester
M1 3BN

Project Name
A66 Northern Trans-Pennine

Drawing Title
Temple Sowerby to Appleby
Drainage General Arrangement
Sheet 6 of 11
(Trout Beck Crossing)

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number

| Project | Originator | Volume |
|---|---|---|
| HE565627 - | AMY - | HDG |

| Location | Type | Role | Number |
|---|---|---|---|
| S0405 | -DR | -CD | - 000205 |

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P03 |

continuation refer to drawing HE565627-AMY-HDG-S0405-DR-CD-000205

For continuation refer to drawing HE565627-AMY-HDG-S0405-DR-CD-000207

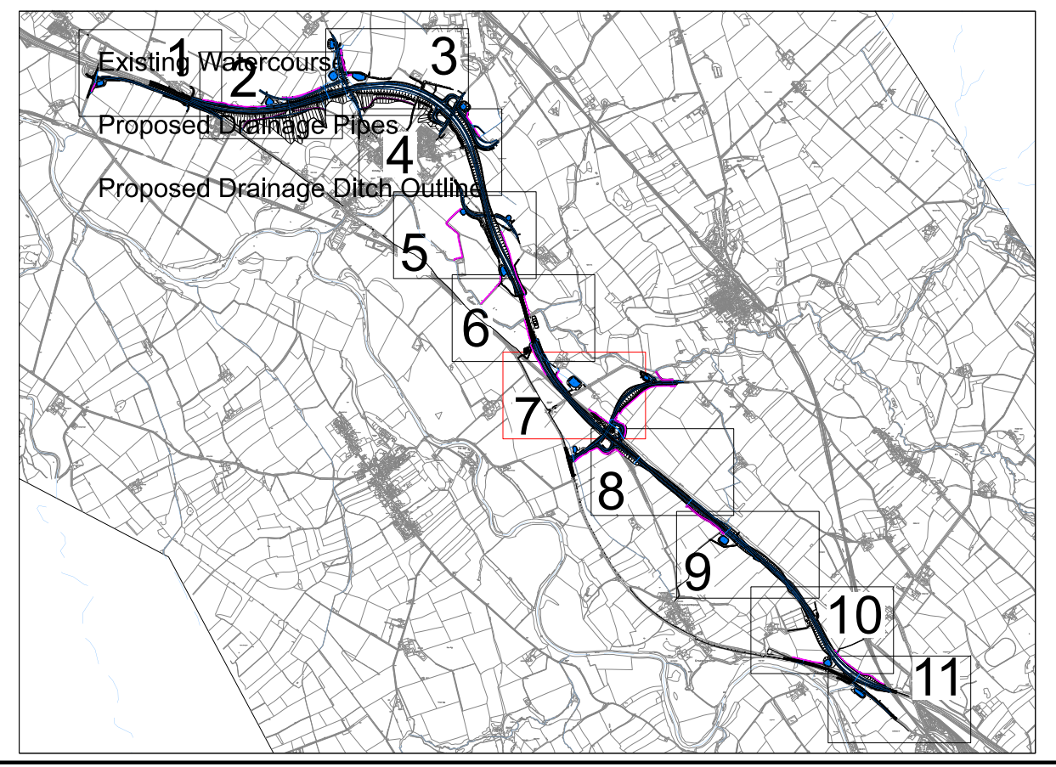
## NOTES

1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed drainage design designed in accordance with the Standards for Highways Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, as-built drawings, OS, JBA culvert surveys, site walk overs and topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   •No surcharging in 1yr storm event
   •No flooding in 1 or 5yr storm event
   •Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope
10. Ponds to have minimum 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

## Drainage Key plan

| | | | |
|---|---|---|---|
| - - - - - | Existing watercourse | ● | Proposed Chamber |
| —— < — | Culvert | ● | Existing Chamber |
| —— | Cut-off drain | Ø300 | Pipe Diameter (in mm) |
| — > — F — | Proposed Filter drain | S0405-01-10 | Manhole Reference |
| ◡ | Headwall | — > — CD — | Existing Carrier Drain |
| — > — CD — | Proposed Carrier Drain | | |
| ▨ | Pond | | |
| ⊥⊥⊥ | Earthworks | | |

## Site key plan



| | | | | | |
|---|---|---|---|---|---|
| P01 | | | | | |
| | GCOO | GCOO | ASHI | KCRO | KCRO |
| | 17/03/22 | 17/03/22 | 17/03/22 | 17/03/22 | 17/03/22 |
| P02 | SGAR3 | | | | |
| | JMOR | JMOR | ASHI | KCRO | KCRO |
| | 10/05/22 | 10/05/22 | 11/05/22 | 11/05/22 | 11/05/22 |
| P03 | SGAR3 | | | | |
| | CMAR | CMAR | ASHI | KCRO | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
Amey OW Limited
Chancery Exchange
10 Furnival Street
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3 Piccadilly Place
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national highways

Project Name
A66 Northern Trans-Pennine

Drawing Title
Temple Sowerby to Appleby
Drainage General Arrangement
Sheet 7 of 11
(Powis House Junction)

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume
HE565627 - AMY - HDG
S0405 -DR-CD- 000206
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P03 |

For continuation refer to drawing HE565627-AMY-HDG-S0405-DR-CD-000206

For continuation refer to drawing HE565627-AMY-HDG-S0405-DR-CD-000208

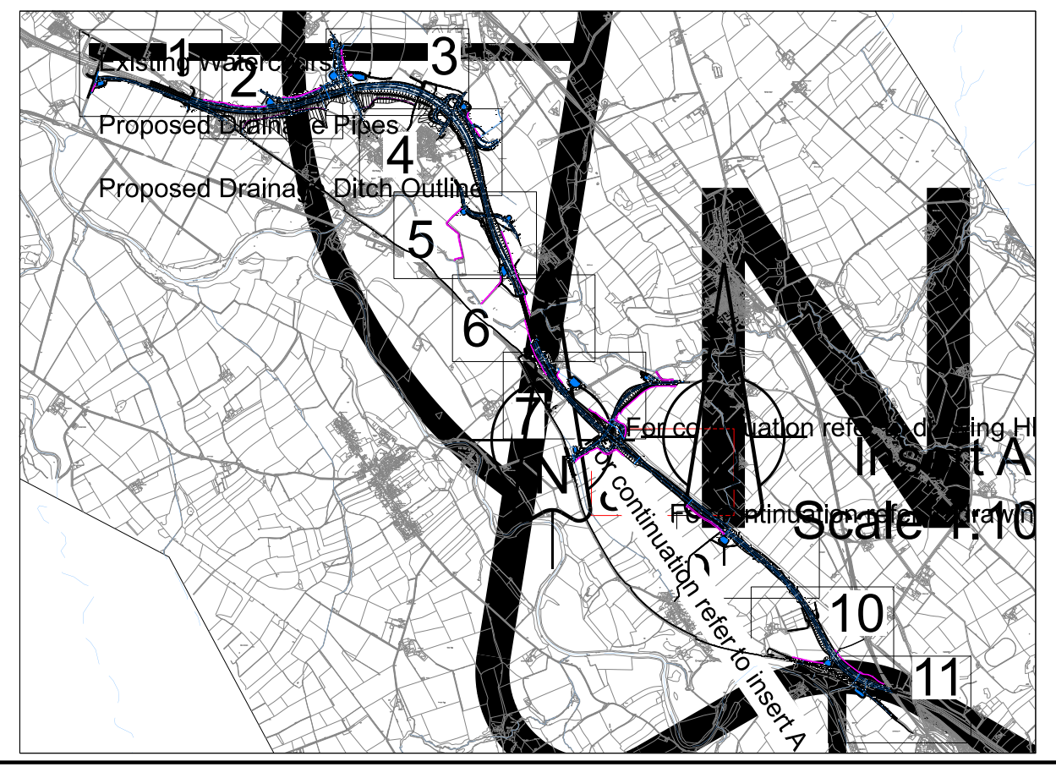
## NOTES

1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed drainage design designed in accordance with the Standards for Highways Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, as-built drawings, OS, JBA culvert surveys, site walk overs and topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   - No surcharging in 1yr storm event
   - No flooding in 1 or 5yr storm event
   - Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope.
10. Ponds to have minimum 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

## Drainage Key plan

| | | | |
|---|---|---|---|
| - - - - - - | Existing watercourse | ● | Proposed Chamber |
| —— < —— | Culvert | ● | Existing Chamber |
| —— | Cut-off drain | Ø300 | Pipe Diameter (in mm) |
| — > — F — | Proposed Filter drain | S0405-01-10 | Manhole Reference |
| ◡ | Headwall | — > — CD — | Existing Carrier Drain |
| — > — CD — | Proposed Carrier Drain | | |
| | Pond | | |
| ⊤⊤⊤⊤ | Earthworks | | |

## Site key plan



| | | | | | |
|---|---|---|---|---|---|
| P01 | | | | | |
| | GCOO | GCOO | ASHI | KCRO | KCRO |
| | 11/03/22 | 11/03/22 | 11/03/22 | 17/03/22 | 17/03/22 |
| P02 | SGAR3 | | | | |
| | JMOR | JMOR | ASHI | KCRO | KCRO |
| | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 |
| P03 | SGAR3 | | | | |
| | CMAR | CMAR | ASHI | KCRO | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
Amey OW Limited
Chancery Exchange
10 Furnival Street
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Manchester
M1 3BN

national highways

Project Name
A66 Northern Trans-Pennine

Drawing Title
Temple Sowerby to Appleby
Drainage General Arrangement
Sheet 8 of 11
(Crackenthorpe)

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume
HE565627 - AMY - HDG
S0405 -DR-CD- 000207
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P03 |

For continuation refer to drawing HE565627-AMY-HDG-S0405-DR-CD-000207

For continuation refer to drawing HE565627-AMY-HDG-S0405-DR-CD-000209

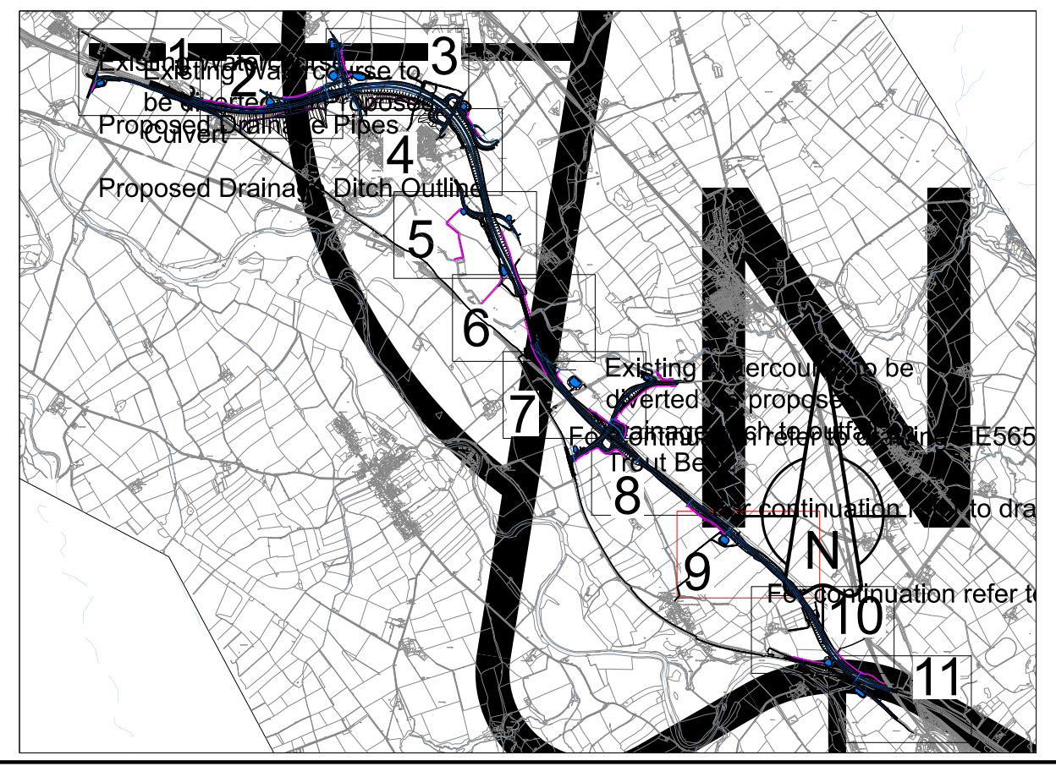
## NOTES

1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed drainage design designed in accordance with the Standards for Highways Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, as-built drawings, OS, JBA culvert surveys, site walk overs and topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   - No surcharging in 1yr storm event
   - No flooding in 1 or 5yr storm event
   - Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope.
10. Ponds to have minimum 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

## Drainage Key plan

| | |
|---|---|
| - - - - - | Existing watercourse |
| —— < —— | Culvert |
| ——— | Cut-off drain |
| — > — F — | Proposed Filter drain |
| | Headwall |
| — > — CD — | Proposed Carrier Drain |
| | Pond |
| | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S0405-01-10 | Manhole Reference |
| — > — CD — | Existing Carrier Drain |

## Site key plan



| Revision | Revision details | Created | Checked | Reviewed | Approved | Authorised |
|---|---|---|---|---|---|---|
| P01 | | GCOO<br>11/03/22 | GCOO<br>11/03/22 | ASHI<br>11/03/22 | KCRO<br>17/03/22 | KCRO<br>17/03/22 |
| P02 | SGAR3 | JMOR<br>10/05/22 | JMOR<br>10/05/22 | ASHI<br>10/05/22 | KCRO<br>10/05/22 | KCRO<br>10/05/22 |
| P03 | SGAR3 | CMAR<br>06/06/22 | CMAR<br>06/06/22 | ASHI<br>06/06/22 | KCRO<br>06/06/22 | KCRO<br>06/06/22 |
| | | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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Project Name
A66 Northern Trans-Pennine

Drawing Title
Temple Sowerby to Appleby
Drainage General Arrangement
Sheet 9 of 11
(Roger Head)

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume
HE565627 - AMY - HDG
S0405 -DR-CD- 000208
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P03 |

For continuation refer to drawing HE565627-AMY-HDG-S0405-DR-CD-000208

For continuation refer to drawing HE565627-AMY-HDG-S0405-DR-CD-000210

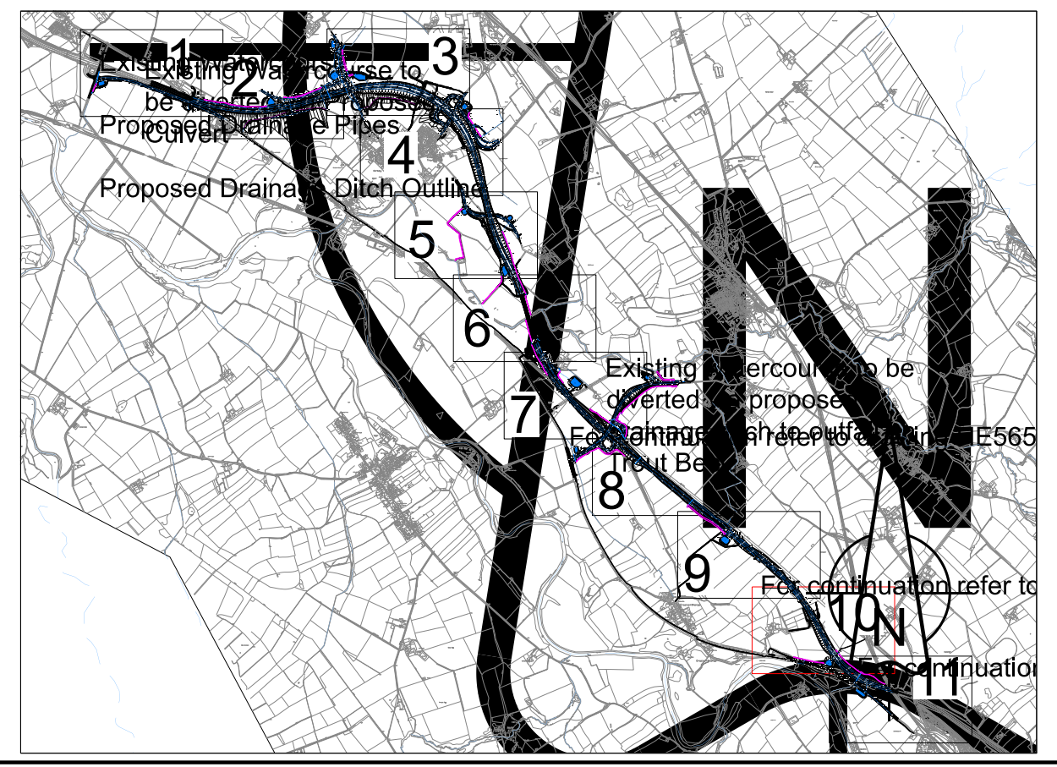
# NOTES

1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed drainage design designed in accordance with the Standards for Highways Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, as-built drawings, OS, JBA culvert surveys, site walk overs and topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   - No surcharging in 1yr storm event
   - No flooding in 1 or 5yr storm event
   - Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope.
10. Ponds to have minimum 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

## Drainage Key plan

| | | | |
|---|---|---|---|
| - - - - | Existing watercourse | ● | Proposed Chamber |
| —— < —— | Culvert | ● | Existing Chamber |
| —— | Cut-off drain | Ø300 | Pipe Diameter (in mm) |
| — > — F — | Proposed Filter drain | S0405-01-10 | Manhole Reference |
| ⌴ | Headwall | — > — CD — | Existing Carrier Drain |
| — > — CD — | Proposed Carrier Drain | | |
| | Pond | | |
| ⊤⊤⊤ | Earthworks | | |

## Site key plan



| Revision | Revision details | | | | |
|---|---|---|---|---|---|
| P01 | | | | | |
| | GCOO | GCOO | ASHI | KCRO | KCRO |
| | 11/03/22 | 11/03/22 | 11/03/22 | 17/03/22 | 17/03/22 |
| P02 | SGAR3 | | | | |
| | JMOR | JMOR | ASHI | KCRO | KCRO |
| | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 |
| P03 | SGAR3 | | | | |
| | CMAR | CMAR | ASHI | KCRO | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
Amey OW Limited
Chancery Exchange
10 Furnival Street
London, EC4A 1AB

Client
3 Piccadilly Place
Manchester
M1 3BN

Project Name
A66 Northern Trans-Pennine

Drawing Title
Temple Sowerby to Appleby
Drainage General Arrangement
Sheet 10 of 11
(B6542 Westbound Junction)

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume
HE565627 - AMY - HDG
S0405 -DR-CD-000209
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P03 |

For co S0405-C02 fer to drawing HE565627-AMY-HDG-S0405-DR-CD-000209

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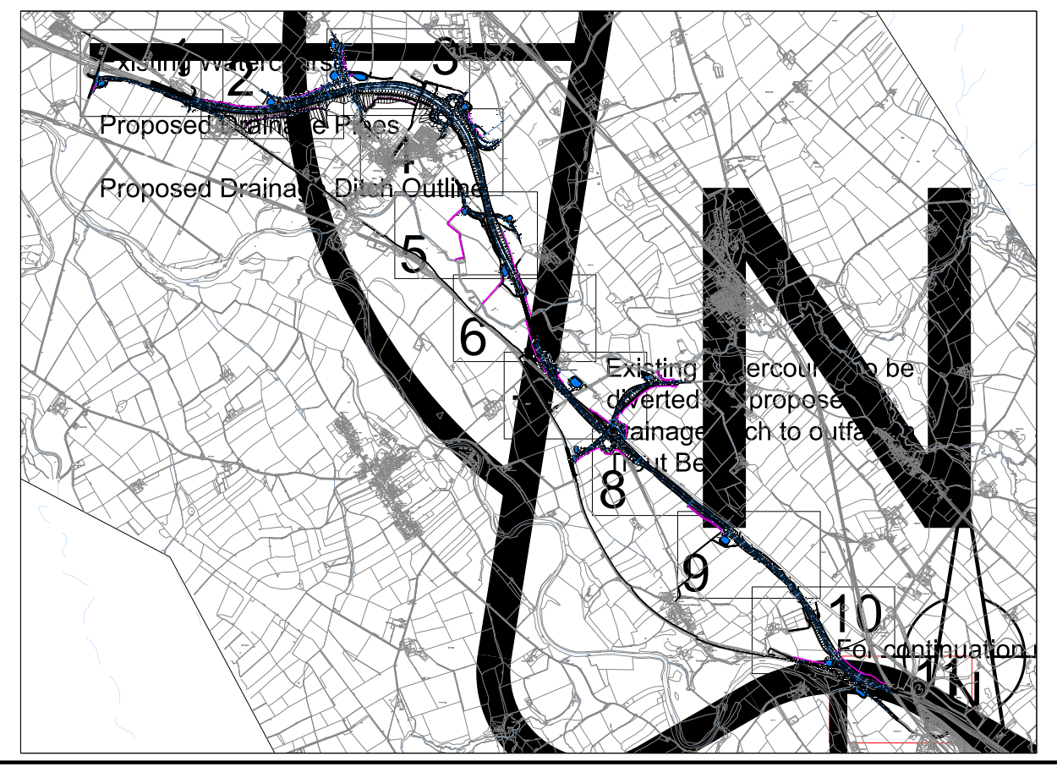
## NOTES

1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed drainage design designed in accordance with the Standards for Highways Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, as-built drawings, OS, JBA culvert surveys, site walk overs and topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   - No surcharging in 1yr storm event
   - No flooding in 1 or 5yr storm event
   - Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope
10. Ponds to have minimum 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

## Drainage Key plan

| | |
|---|---|
| - - - - - | Existing watercourse |
| —— < —— | Culvert |
| —— | Cut-off drain |
| — > — F — | Proposed Filter drain |
| ⌣ | Headwall |
| — > — CD — | Proposed Carrier Drain |
| ▨ | Pond |
| ⊻ ⊻ ⊻ | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S0405-01-10 | Manhole Reference |
| — > — CD — | Existing Carrier Drain |

## Site key plan



| Revision | Revision details | Created | Checked | Reviewed | Approved | Authorised |
|---|---|---|---|---|---|---|
| P01 | | GCOO<br>11/03/22 | GCOO<br>11/03/22 | ASHI<br>11/03/22 | KCRO<br>17/03/22 | KCRO<br>17/03/22 |
| P02 | SGAR3 | JMOR<br>10/05/22 | JMOR<br>10/05/22 | ASHI<br>10/05/22 | KCRO<br>10/05/22 | KCRO<br>10/05/22 |
| P03 | SGAR3 | CMAR<br>06/06/22 | CMAR<br>06/06/22 | ASHI<br>06/06/22 | KCRO<br>06/06/22 | KCRO<br>06/06/22 |
| | | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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national highways

Project Name
A66 Northern Trans-Pennine

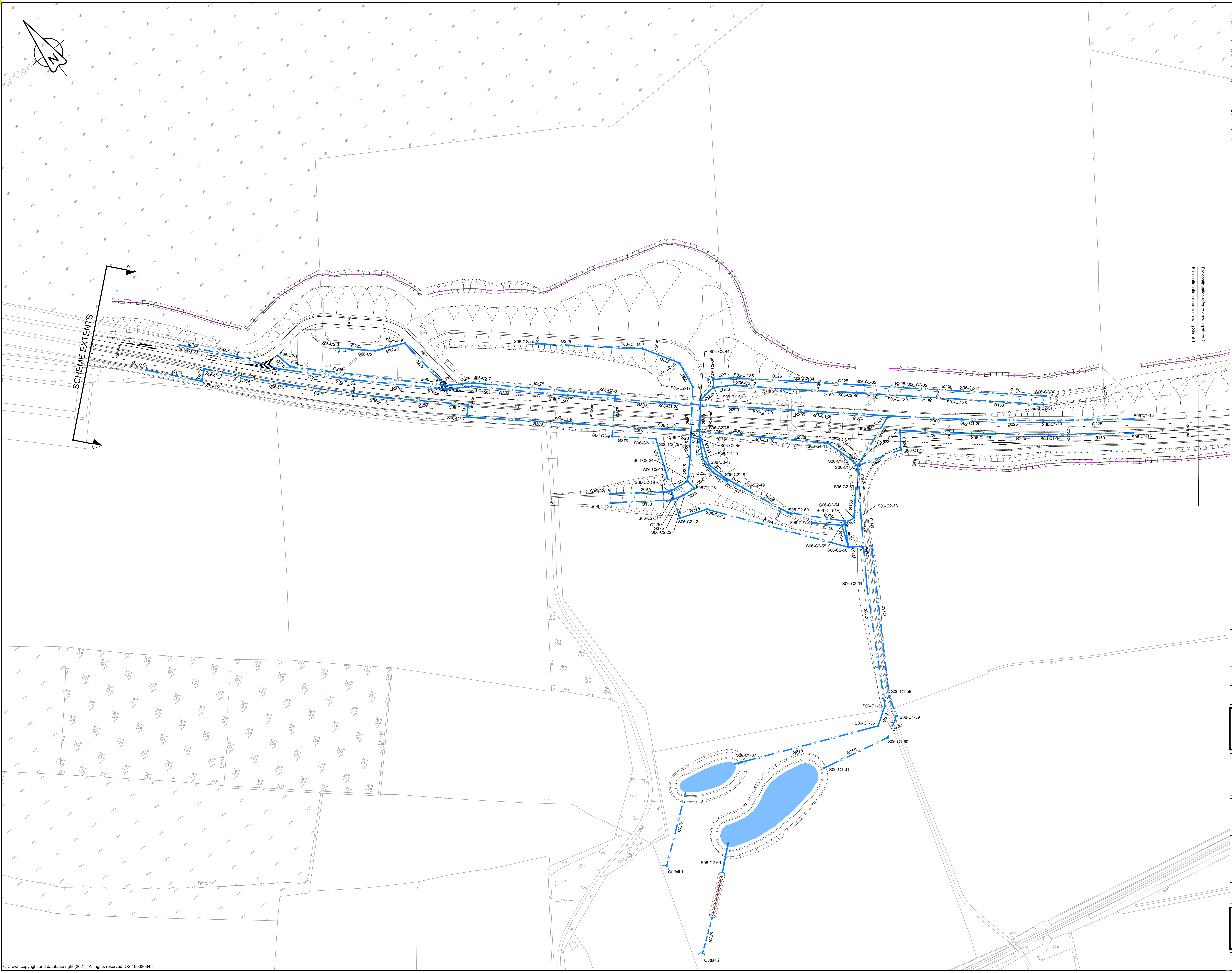
Drawing Title
Temple Sowerby to Appleby
Drainage General Arrangement
Sheet 11 of 11
(B6542 Eastbound Junction)

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number

| Project | Originator | Volume | Location | Type | Role | Number |
|---|---|---|---|---|---|---|
| HE565627 | AMY | HDG | S0405 | DR | CD | 000210 |

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P03 |



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# NOTES

1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed Drainage designed in accordance with the Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, As-built drawings, OS, JBA culvert surveys, site walk overs and Topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   •No Surcharging in 1yr storm event
   •No Flooding in 5yr storm event
   •Water not to exceed pond storage level in a 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope with a 500mm base.
10. Ponds to have 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track.
12. To be read in conjunction with culvert schedule HE565627-AMY-HDG-S09-SH-CD-000001.

# KEY

| | |
|---|---|
| ─── | Existing layout |
| ─── | Proposed layout |
| ─── | Existing watercourse |
| ▬ < ▬ | Culvert |
| ═══ | Cut-off drain |
| ▬ > ▬ F ▬ | Proposed Filter drain |
| ⌴ | Headwall |
| ▬ > ▬ CD ▬ | Proposed Drainage Pipe and Flow Arrow |
| ▨ | Pond |
| ─○─○─○─ | Proposed boundary treatment |
| ⋈ | Proposed gate |
| Y Y Y Y | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S09-01-10 | Manhole Reference |
| S09-C01 | Culvert Reference |
| ▬ > ▬ CD ▬ | Existing Carrier Drain |

| | | | | | |
|---|---|---|---|---|---|
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| | --- | --- | --- | --- | --- |
| P01.1 | SGAR3 | | | | |
| | --- | --- | --- | --- | --- |
| | --- | --- | --- | --- | --- |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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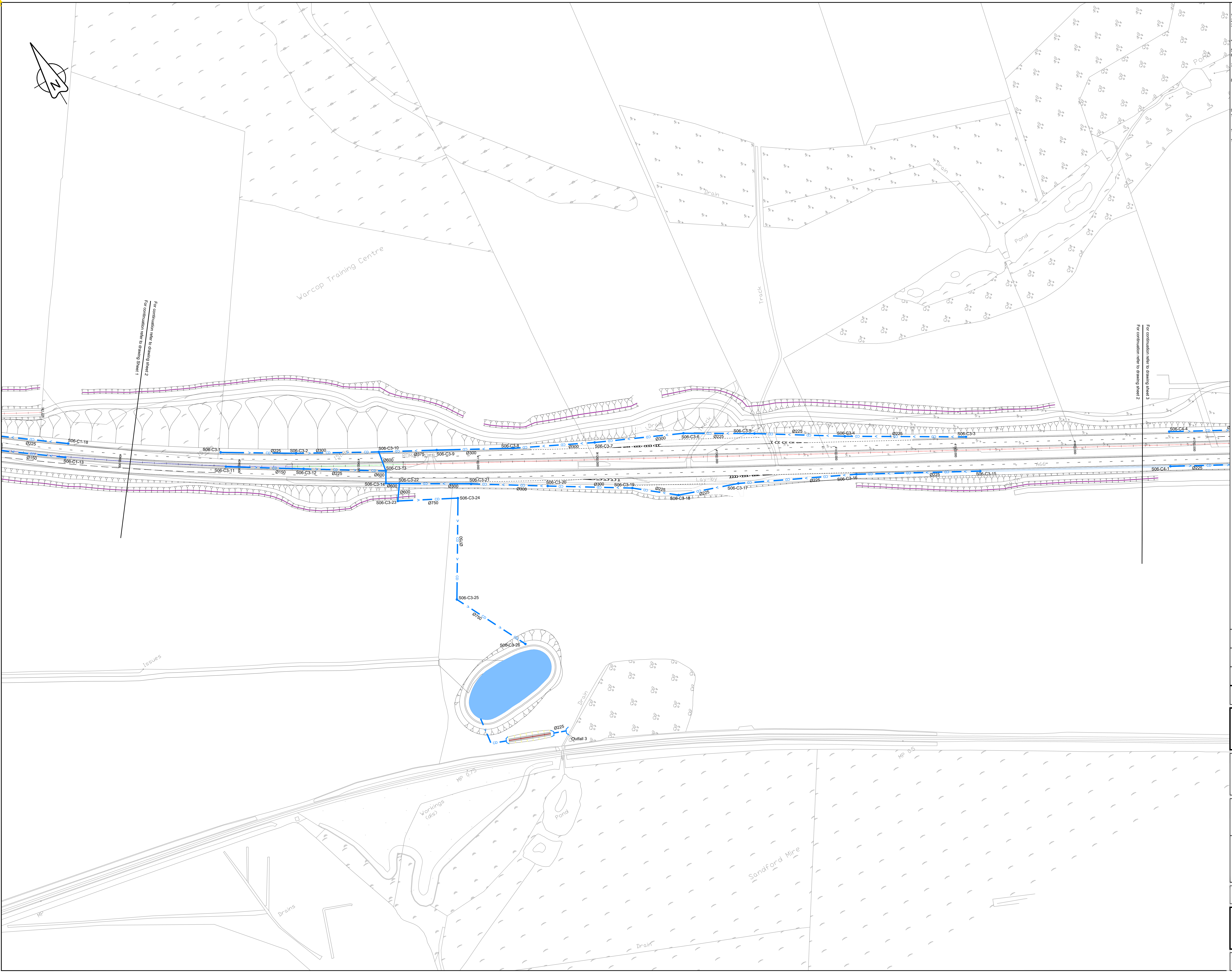
Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Proposed Drainage Design
Sheet 1 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 -DR-CD- 476021
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S0 | Initial non-contractual code | P01.1 |



## NOTES

1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed Drainage designed in accordance with the Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, As-built drawings, OS, JBA culvert surveys, site walk overs and Topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   •No Surcharging in 1yr storm event
   •No Flooding in 5yr storm event
   •Water not to exceed pond storage level in a 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope with a 500mm base.
10. Ponds to have 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track.
12. To be read in conjunction with culvert schedule HE565627-AMY-HDG-S09-SH-CD-000001.

## KEY

| | |
|---|---|
| | Existing layout |
| | Proposed layout |
| | Existing watercourse |
| — < — | Culvert |
| | Cut-off drain |
| — > — F — | Proposed Filter drain |
| | Headwall |
| — > — CD — | Proposed Drainage Pipe and Flow Arrow |
| | Pond |
| | Proposed boundary treatment |
| | Proposed gate |
| | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S09-01-10 | Manhole Reference |
| S09-C01 | Culvert Reference |
| — > — CD — | Existing Carrier Drain |

| Revision | Revision details | | | | |
|---|---|---|---|---|---|
| --- | --- | | | | |
| | --- | --- | --- | --- | --- |
| | --- | --- | --- | --- | --- |
| --- | --- | | | | |
| | --- | --- | --- | --- | --- |
| | --- | --- | --- | --- | --- |
| P01.1 | SGAR3 | | | | |
| | --- | --- | --- | --- | --- |
| | --- | --- | --- | --- | --- |
| Revision | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
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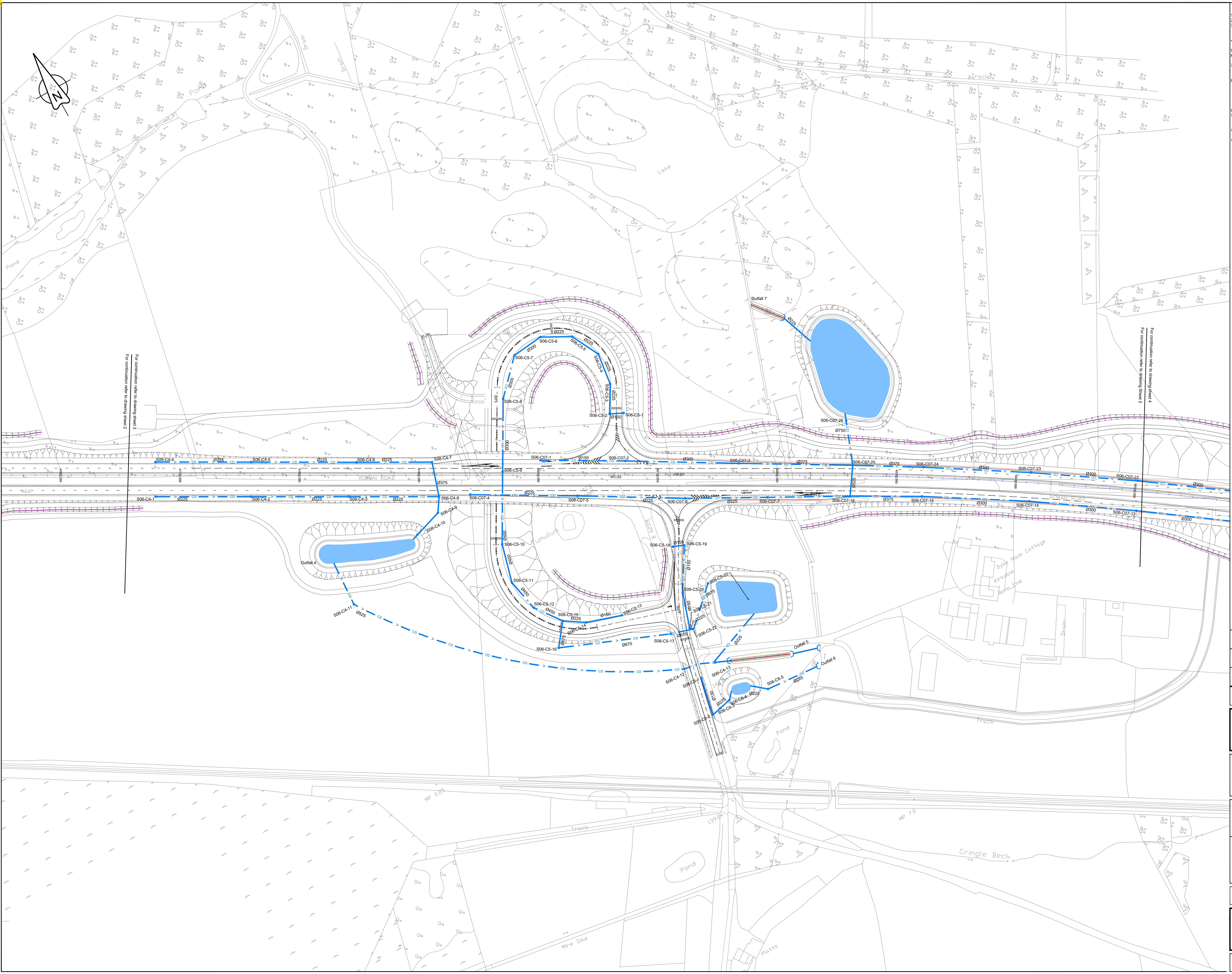
Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Proposed Drainage Design
Sheet 2 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 - DR - CD - 476022
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S0 | Initial non-contractual code | P01.1 |



# NOTES

1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed Drainage designed in accordance with the Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, As-built drawings, OS, JBA culvert surveys, site walk overs and Topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   •No Surcharging in 1yr storm event
   •No Flooding in 5yr storm event
   •Water not to exceed pond storage level in a 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope with a 500mm base.
10. Ponds to have 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track.
12. To be read in conjunction with culvert schedule HE565627-AMY-HDG-S09-SH-CD-000001.

# KEY

| | |
|---|---|
| | Existing layout |
| | Proposed layout |
| | Existing watercourse |
| — < — | Culvert |
| | Cut-off drain |
| — > — F — | Proposed Filter drain |
| | Headwall |
| — > — CD — | Proposed Drainage Pipe and Flow Arrow |
| | Pond |
| | Proposed boundary treatment |
| | Proposed gate |
| | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S09-01-10 | Manhole Reference |
| S09-C01 | Culvert Reference |
| — > — CD — | Existing Carrier Drain |

| | | | | | |
|---|---|---|---|---|---|
| --- | --- | | | | |
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| | --- | --- | --- | --- | --- |
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| | --- | --- | --- | --- | --- |
| P01.1 | SGAR3 | | | | |
| | --- | --- | --- | --- | --- |
| | --- | --- | --- | --- | --- |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
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Chancery Exchange
10 Furnival Street
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3 Piccadilly Place
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M1 3BN
national highways

Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Proposed Drainage Design
Sheet 3 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 -DR-CD- 476023
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S0 | Initial non-contractual code | P01.1 |

For continuation refer to drawing sheet 4
For continuation refer to drawing Sheet 3

For continuation refer to drawing sheet 5
For continuation refer to drawing sheet 4

# NOTES

1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed Drainage designed in accordance with the Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, As-built drawings, OS, JBA culvert surveys, site walk overs and Topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   •No Surcharging in 1yr storm event
   •No Flooding in 5yr storm event
   •Water not to exceed pond storage level in a 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope with a 500mm base.
10. Ponds to have 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track.
12. To be read in conjunction with culvert schedule HE565627-AMY-HDG-S09-SH-CD-000001.

# KEY

| | |
|---|---|
| | Existing layout |
| | Proposed layout |
| | Existing watercourse |
| < | Culvert |
| | Cut-off drain |
| > F | Proposed Filter drain |
| | Headwall |
| > CD | Proposed Drainage Pipe and Flow Arrow |
| | Pond |
| | Proposed boundary treatment |
| ⋈ | Proposed gate |
| | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S09-01-10 | Manhole Reference |
| S09-C01 | Culvert Reference |
| > CD | Existing Carrier Drain |

| | | | | | |
|---|---|---|---|---|---|
| --- | --- | | | | |
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| | --- | --- | --- | --- | --- |
| --- | --- | | | | |
| | --- | --- | --- | --- | --- |
| | --- | --- | --- | --- | --- |
| P01.1 | SGAR3 | | | | |
| | --- | --- | --- | --- | --- |
| | --- | --- | --- | --- | --- |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
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M1 3BN

national highways

Project Name
A66 Northern Trans-Pennine

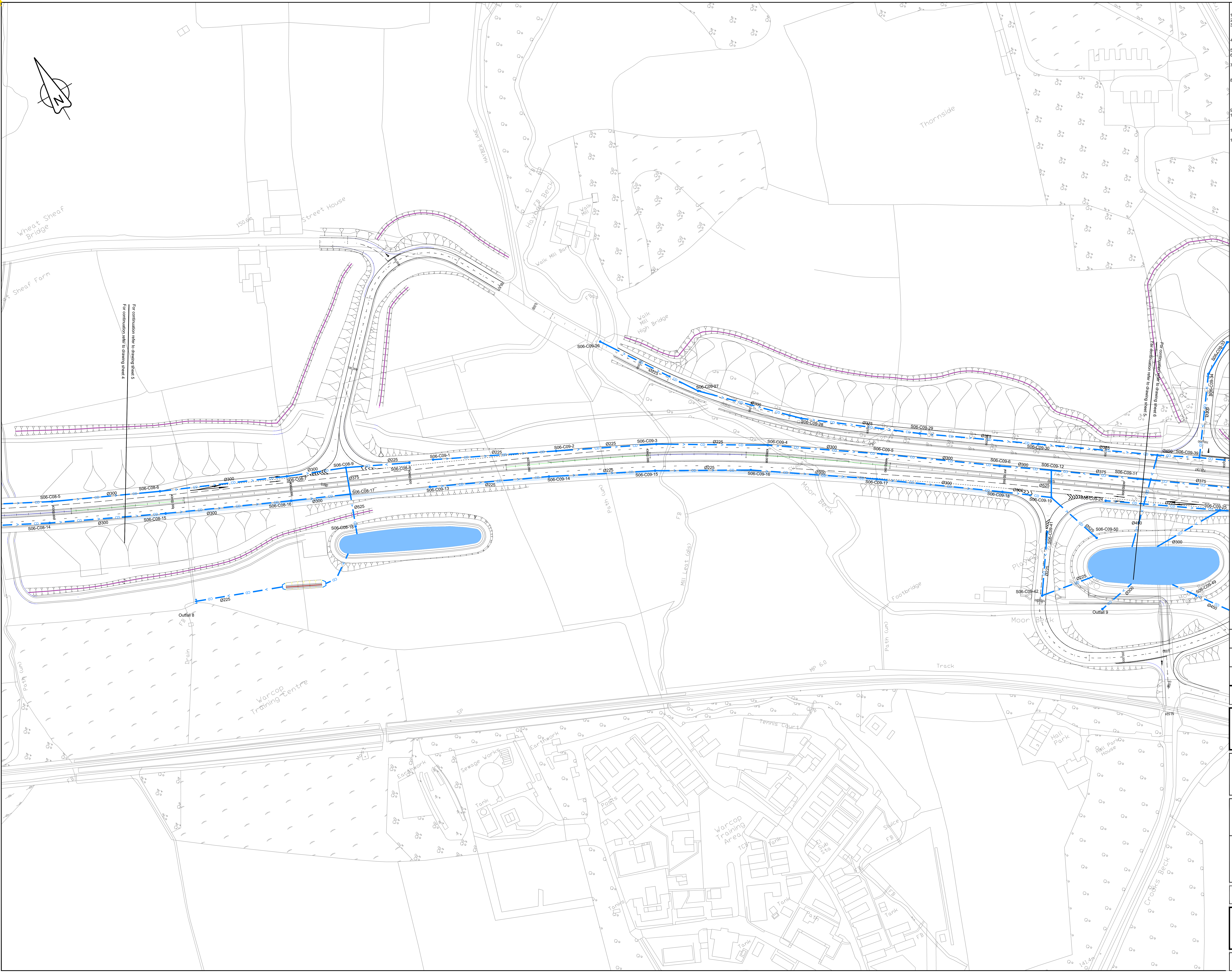
Drawing Title
Appleby to Brough
Proposed Drainage Design
Sheet 4 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | | Dimensions : M |

Drawing Number

| Project | Originator | Volume | Location | Type | Role | Number |
|---|---|---|---|---|---|---|
| HE565627 | AMY | HDG | S06 | DR | CD | 476024 |

| Suitability | Suitability Description | Revision |
|---|---|---|
| S0 | Initial non-contractual code | P01.1 |



# NOTES

1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed Drainage designed in accordance with the Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, As-built drawings, OS, JBA culvert surveys, site walk overs and Topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   - No Surcharging in 1yr storm event
   - No Flooding in 5yr storm event
   - Water not to exceed pond storage level in a 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope with a 500mm base.
10. Ponds to have 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track.
12. To be read in conjunction with culvert schedule HE565627-AMY-HDG-S09-SH-CD-000001.

# KEY

| | |
|---|---|
| | Existing layout |
| | Proposed layout |
| | Existing watercourse |
| — < — | Culvert |
| | Cut-off drain |
| - - F - | Proposed Filter drain |
| | Headwall |
| - > - CD - | Proposed Drainage Pipe and Flow Arrow |
| | Pond |
| | Proposed boundary treatment |
| | Proposed gate |
| | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S09-01-10 | Manhole Reference |
| S09-C01 | Culvert Reference |
| — > — CD — | Existing Carrier Drain |

| Revision | | | | | |
|---|---|---|---|---|---|
| --- | --- | | | | |
| | --- | --- | --- | --- | --- |
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| P01.1 | SGAR3 | | | | |
| | --- | --- | --- | --- | --- |
| | --- | --- | --- | --- | --- |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
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national highways

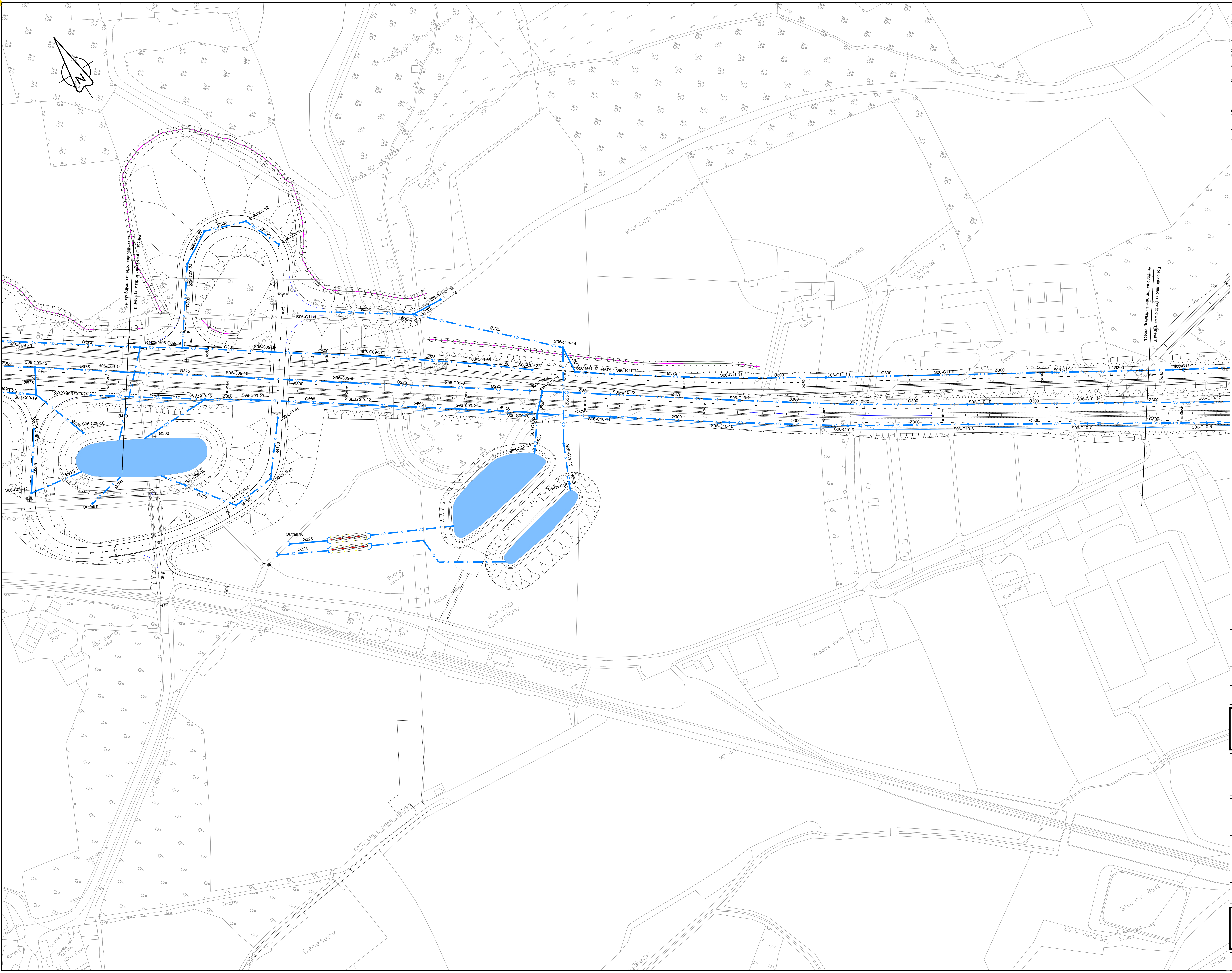
Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Proposed Drainage Design
Sheet 5 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 -DR-CD- 476025
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S0 | Initial non-contractual code | P01.1 |



## NOTES

1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
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12. To be read in conjunction with culvert schedule HE565627-AMY-HDG-S09-SH-CD-000001.

## KEY

| | |
|---|---|
| ─── | Existing layout |
| ─── | Proposed layout |
| ─── | Existing watercourse |
| ━━ < ━━ | Culvert |
| ═══ | Cut-off drain |
| ━ > ━ F ━ | Proposed Filter drain |
| ◡ | Headwall |
| ━ > ➔ CD ━ | Proposed Drainage Pipe and Flow Arrow |
| 🟦 | Pond |
| ─○─○─○─ | Proposed boundary treatment |
| ⋈ | Proposed gate |
| ─Y─Y─Y─ | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S09-01-10 | Manhole Reference |
| S09-C01 | Culvert Reference |
| ━ > ━ CD ━ | Existing Carrier Drain |

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| P01.1 | SGAR3 | | | | |
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| | --- | --- | --- | --- | --- |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
Amey OW Limited
Chancery Exchange
10 Furnival Street
London, EC4A 1AB

Client
3 Piccadilly Place
Manchester
M1 3BN

national highways

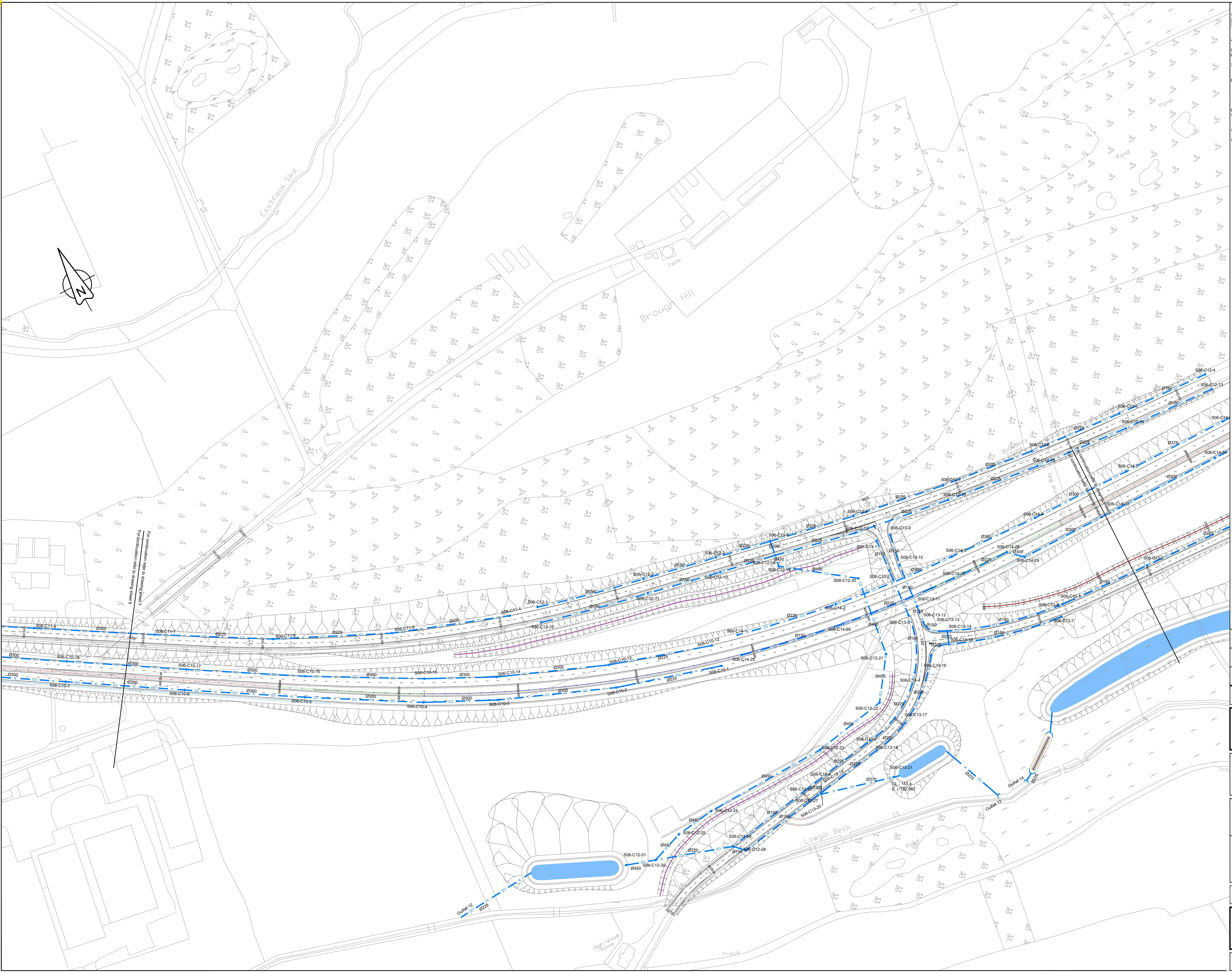
Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Proposed Drainage Design
Sheet 6 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 -DR-CD- 476026
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S0 | Initial non-contractual code | P01.1 |



# NOTES

1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed Drainage designed in accordance with the Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, As-built drawings, OS, JBA culvert surveys, site walk overs and Topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   •No Surcharging in 1yr storm event
   •No Flooding in 5yr storm event
   •Water not to exceed pond storage level in a 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope with a 500mm base.
10. Ponds to have 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track.
12. To be read in conjunction with culvert schedule HE565627-AMY-HDG-S09-SH-CD-000001.

# KEY

| | |
|---|---|
| — | Existing layout |
| — | Proposed layout |
| — | Existing watercourse |
| — < — | Culvert |
| ═ | Cut-off drain |
| — > — F — | Proposed Filter drain |
| ◡ | Headwall |
| — > ➔ CD — | Proposed Drainage Pipe and Flow Arrow |
| ▨ | Pond |
| —o—o—o—o— | Proposed boundary treatment |
| ⋈ | Proposed gate |
| Y Y Y Y | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S09-01-10 | Manhole Reference |
| S09-C01 | Culvert Reference |
| — > — CD — | Existing Carrier Drain |

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| P01.1 | SGAR3 | | | | | |
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| Revision | Revision details | | | | | |
| | Created | Checked | Reviewed | Approved | Authorised | |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | |

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national highways

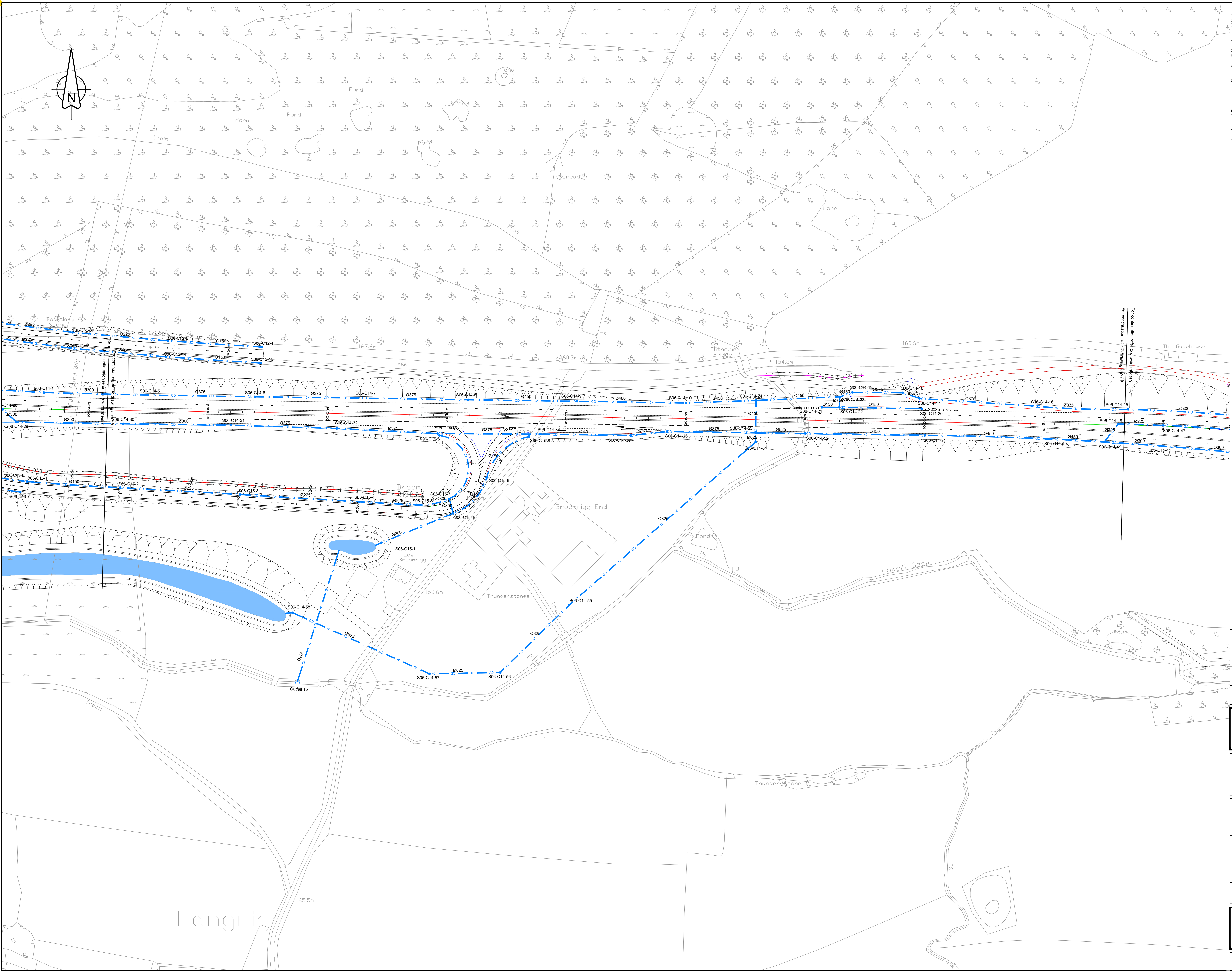
Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Proposed Drainage Design
Sheet 7 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 -DR-CD- 476027
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S0 | Initial non-contractual code | P01.1 |



## NOTES

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2. All dimensions are in millimetres unless otherwise stated.
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   •No Flooding in 5yr storm event
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12. To be read in conjunction with culvert schedule HE565627-AMY-HDG-S09-SH-CD-000001.

## KEY

| | |
|---|---|
| — | Existing layout |
| — | Proposed layout |
| — | Existing watercourse |
| — < — | Culvert |
| ═ | Cut-off drain |
| — > — F — | Proposed Filter drain |
| ◡ | Headwall |
| — > — CD — | Proposed Drainage Pipe and Flow Arrow |
| ▨ | Pond |
| — | Proposed boundary treatment |
| ↔ | Proposed gate |
| ⊤⊤⊤ | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S09-01-10 | Manhole Reference |
| S09-C01 | Culvert Reference |
| — > — CD — | Existing Carrier Drain |

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| P01.1 | SGAR3 | | | | |
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| | --- | --- | --- | --- | --- |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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national highways

Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Proposed Drainage Design
Sheet 8 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 -DR-CD- 476028
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S0 | Initial non-contractual code | P01.1 |

# NOTES

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2. All dimensions are in millimetres unless otherwise stated.
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5. Fencing and gate locations subject to agreement with landowners.
6. Proposed Drainage designed in accordance with the Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, As-built drawings, OS, JBA culvert surveys, site walk overs and Topographical survey information. Existing drainage is omitted from this drawing.
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11. Fencing and gate to be erected around pond and associated access track.
12. To be read in conjunction with culvert schedule HE565627-AMY-HDG-S09-SH-CD-000001.

# KEY

| | |
|---|---|
| — | Existing layout |
| — | Proposed layout |
| — | Existing watercourse |
| — < — | Culvert |
| ═ | Cut-off drain |
| — > — F — | Proposed Filter drain |
| ◡ | Headwall |
| — > ➔ CD — | Proposed Drainage Pipe and Flow Arrow |
| ▨ | Pond |
| —o—o—o—o— | Proposed boundary treatment |
| ⋈ | Proposed gate |
| Y Y Y Y | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S09-01-10 | Manhole Reference |
| S09-C01 | Culvert Reference |
| — > — CD — | Existing Carrier Drain |

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| P01.1 | SGAR3 | | | | |
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| | --- | --- | --- | --- | --- |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
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Client
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Manchester
M1 3BN

Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Proposed Drainage Design
Sheet 9 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 -DR-CD- 476029
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S0 | Initial non-contractual code | P01.1 |

# NOTES

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11. Fencing and gate to be erected around pond and associated access track.
12. To be read in conjunction with culvert schedule HE565627-AMY-HDG-S09-SH-CD-000001.

# KEY

Existing layout
Proposed layout
Existing watercourse
Culvert
Cut-off drain
Proposed Filter drain
Headwall
Proposed Drainage Pipe and Flow Arrow
Pond
Proposed boundary treatment
Proposed gate
Earthworks
Proposed Chamber
Existing Chamber
Ø300 Pipe Diameter (in mm)
S09-01-10 Manhole Reference
S09-C01 Culvert Reference
Existing Carrier Drain

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| P01.1 | SGAR3 | | | | |
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| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
Amey OW Limited
Chancery Exchange
10 Furnival Street
London, EC4A 1AB

Client
3 Piccadilly Place
Manchester
M1 3BN

national highways

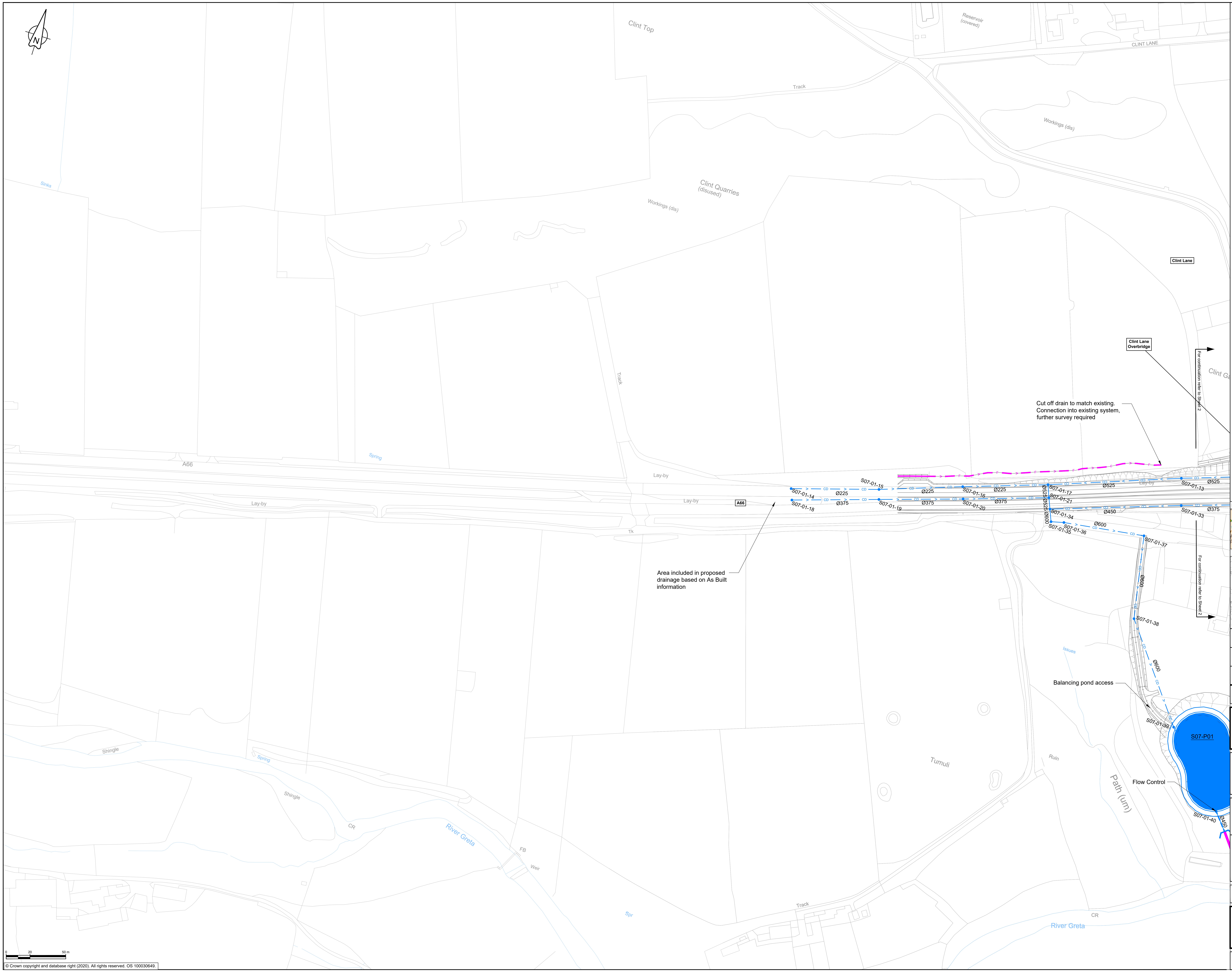
Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Proposed Drainage Design
Sheet 10 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 -DR-CD- 476030
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S0 | Initial non-contractual code | P01.1 |



Clint Lane Overbridge

For continuation refer to Sheet 2

Cut off drain to match existing. Connection into existing system, further survey required

Area included in proposed drainage based on As Built information

Balancing pond access

Flow Control

For continuation refer to Sheet 2

# NOTES

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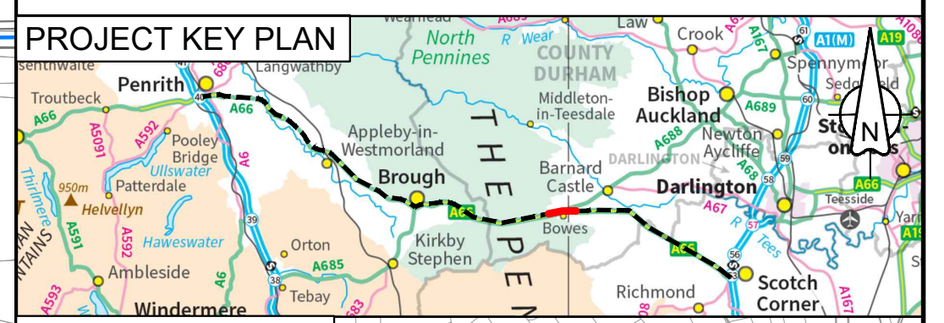
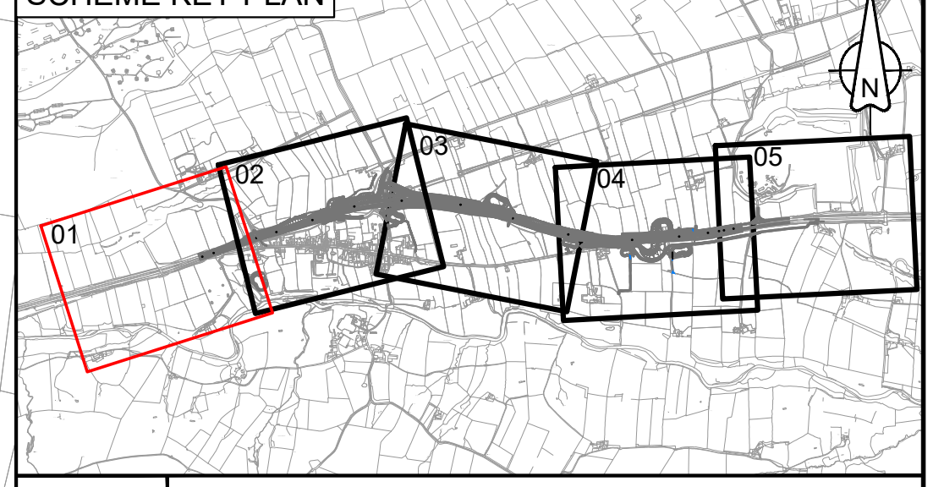
# KEY

| | |
|---|---|
| ─── | Proposed layout |
| ─── | Existing watercourse |
| ━━━ < ━ | Culvert |
| ━━━ | Cut-off drain |
| ━ > ━ F ━ | Proposed Filter drain |
| ⌴ | Headwall |
| ━ > ━ CD ━ | Proposed Carrier Drain |
| ▨ | Pond |
| ⌄⌄⌄⌄ | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S08-01-10 | Manhole Reference |
| S08-C01 | Culvert Reference |
| ━ > ━ CD ━ | Existing Carrier Drain |

PROJECT KEY PLAN



SCHEME KEY PLAN



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| C01 | SGAR3 | | | | |
| | ATUN | ATUN | JHAR | THAL | SSCO |
| | 08/06/22 | 08/06/22 | 08/06/22 | 08/06/22 | 08/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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national highways

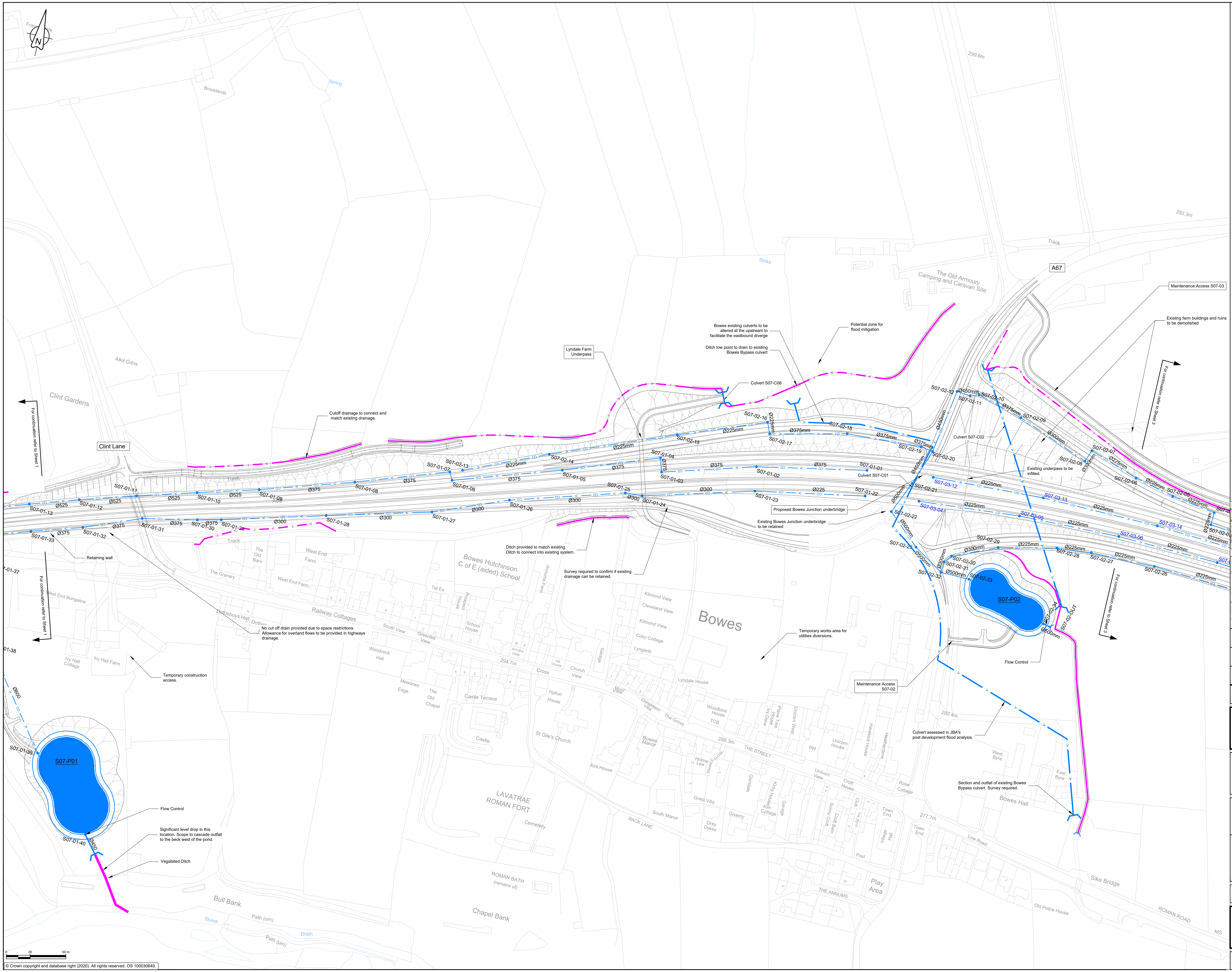
Project Name
A66 Northern Trans-Pennine

Drawing Title
Bowes Bypass
Proposed Drainage Plan
Sheet 1 of 5

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S07 -DR-CD-000001
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |



# NOTES

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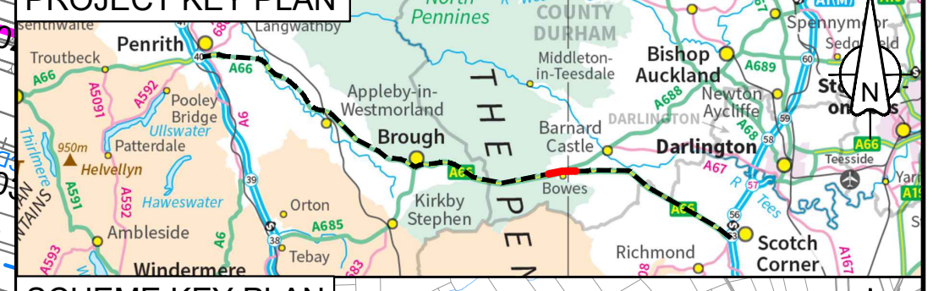
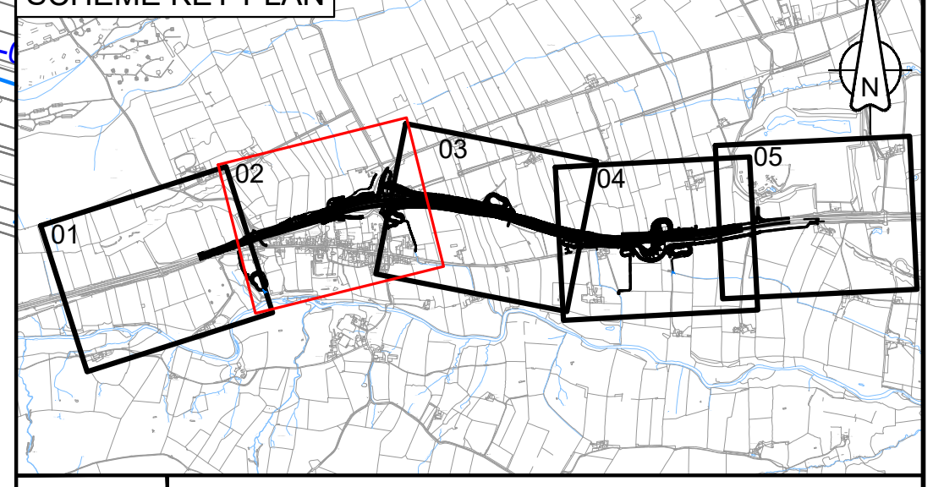
# KEY

| | |
|---|---|
| — | Proposed layout |
| — | Existing watercourse |
| — < — | Culvert |
| — | Cut-off drain |
| — > — F — | Proposed Filter drain |
| ⌣ | Headwall |
| — > — CD — | Proposed Carrier Drain |
| | Pond |
| | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S08-01-10 | Manhole Reference |
| S08-C01 | Culvert Reference |
| — > — CD — | Existing Carrier Drain |

PROJECT KEY PLAN



SCHEME KEY PLAN



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| C01 | SGAR3 | | | | |
| | ATUN | ATUN | JHAR | THAL | SSCO |
| | 08/06/22 | 08/06/22 | 08/06/22 | 08/06/22 | 08/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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national highways

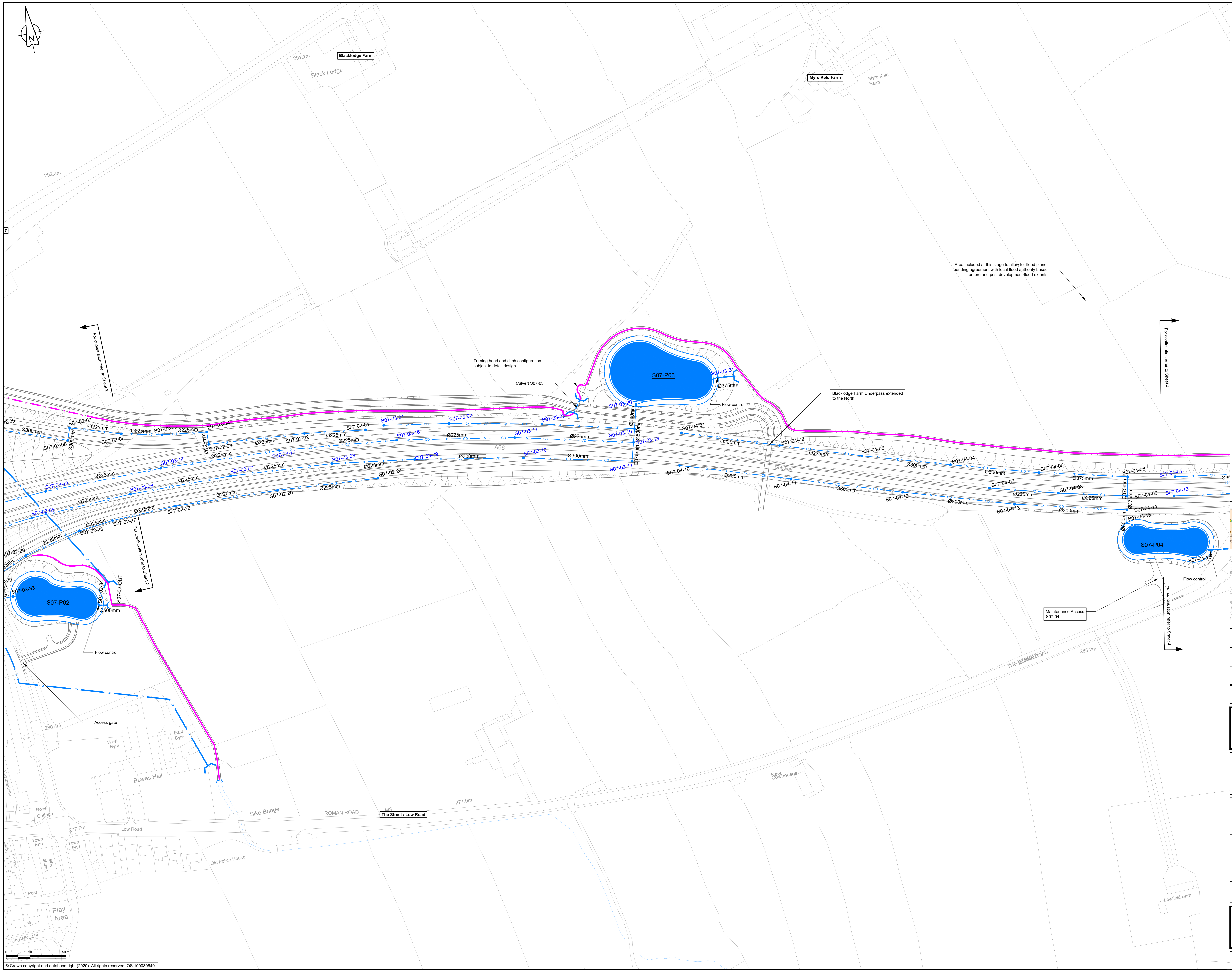
Project Name
A66 Northern Trans-Pennine

Drawing Title
Bowes Bypass
Proposed Drainage Plan
Sheet 2 of 5

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S07 -DR-CD- 000002
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |



## NOTES

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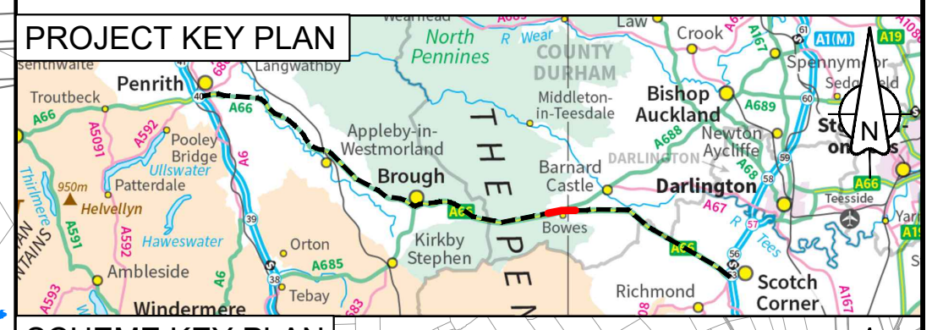
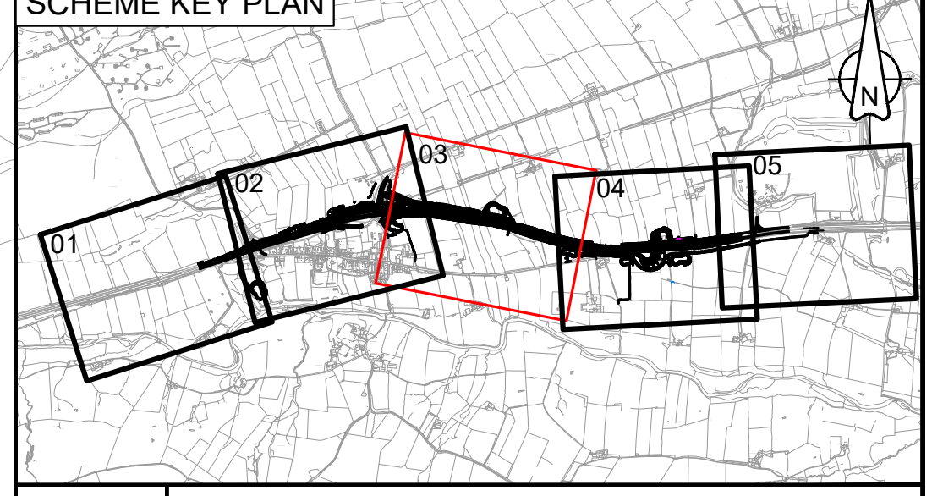
## KEY

| | |
|---|---|
| ― | Proposed layout |
| ― | Existing watercourse |
| — < — | Culvert |
| ― | Cut-off drain |
| — > — F — | Proposed Filter drain |
| | Headwall |
| — > — CD — | Proposed Carrier Drain |
| | Pond |
| | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S08-01-10 | Manhole Reference |
| S08-C01 | Culvert Reference |
| — > — CD — | Existing Carrier Drain |

PROJECT KEY PLAN



SCHEME KEY PLAN



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| C01 | SGAR3 | | | | |
| | ATUN | ATUN | JHAR | THAL | SSCO |
| | 08/06/22 | 08/06/22 | 08/06/22 | 08/06/22 | 08/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
Amey OW Limited
Chancery Exchange
10 Furnival Street
London, EC4A 1AB

Client
3 Piccadilly Place
Manchester
M1 3BN

national highways

Project Name
A66 Northern Trans-Pennine

Drawing Title
Bowes Bypass
Proposed Drainage Plan
Sheet 3 of 5

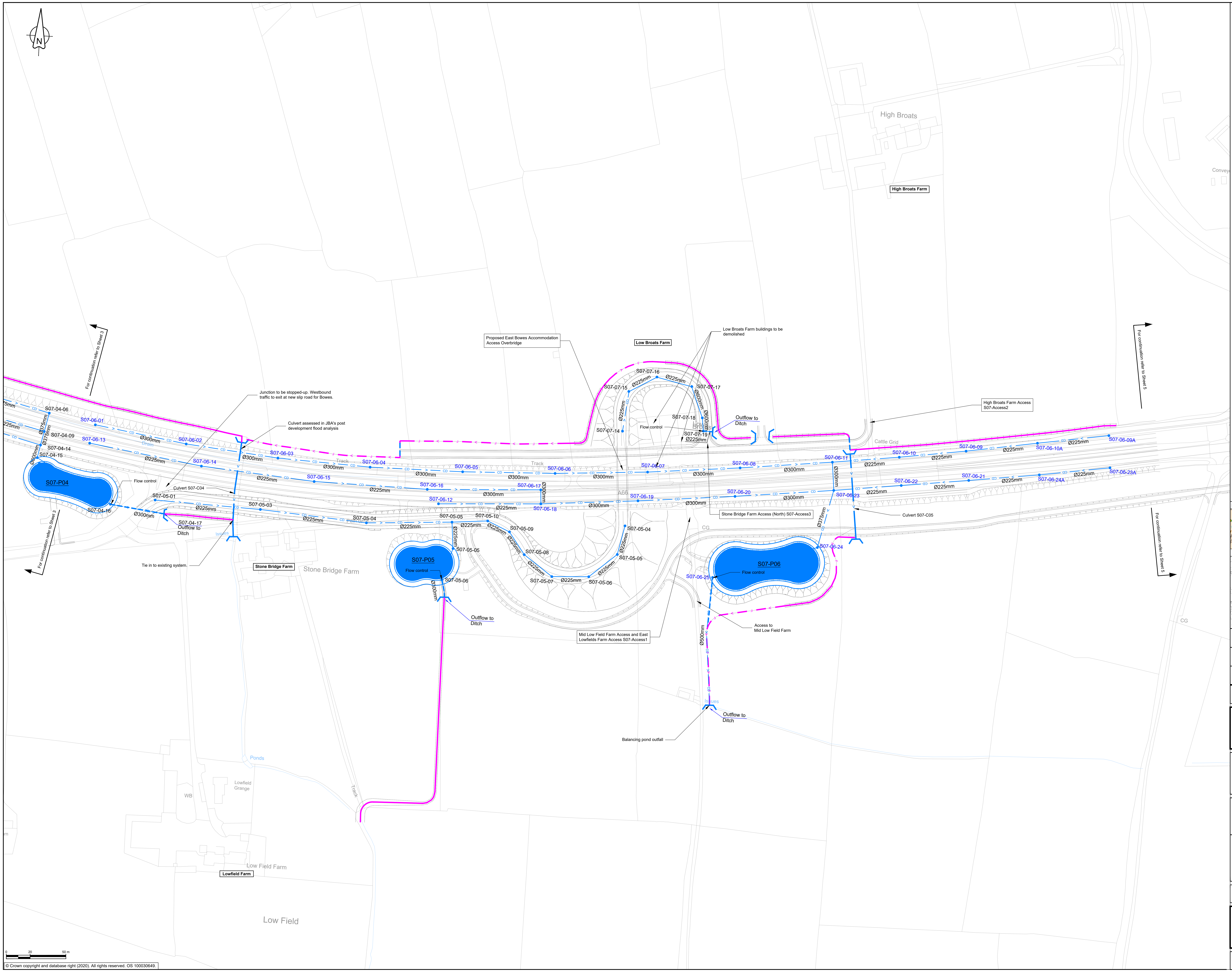
| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number

| Project | Originator | Volume | Location | Type | Role | Number |
|---|---|---|---|---|---|---|
| HE565627 | AMY | HDG | S07 | DR | CD | 000003 |

HE565627 - AMY - HDG - S07 - DR - CD - 000003

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |



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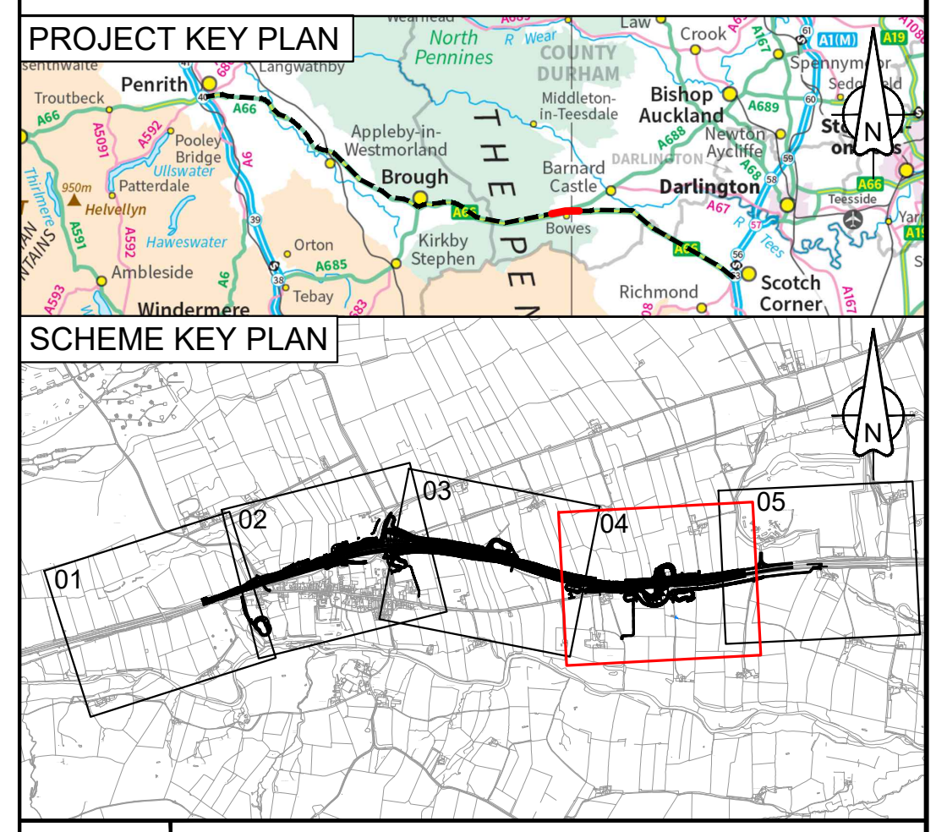
## KEY

| | |
|---|---|
| | Proposed layout |
| | Existing watercourse |
| < | Culvert |
| | Cut-off drain |
| > F | Proposed Filter drain |
| | Headwall |
| > CD | Proposed Carrier Drain |
| | Pond |
| | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S08-01-10 | Manhole Reference |
| S08-C01 | Culvert Reference |
| > CD | Existing Carrier Drain |

PROJECT KEY PLAN

SCHEME KEY PLAN



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| C01 | SGAR3 | | | | |
| | ATUN | ATUN | JHAR | THAL | SSCO |
| | 08/06/22 | 08/06/22 | 08/06/22 | 08/06/22 | 08/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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Manchester
M1 3BN
national highways

Project Name
A66 Northern Trans-Pennine

Drawing Title
Bowes Bypass
Proposed Drainage Plan
Sheet 4 of 5

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number

| Project | Originator | Volume | Location | Type | Role | Number |
|---|---|---|---|---|---|---|
| HE565627 | AMY | HDG | S07 | DR | CD | 000004 |

HE565627 - AMY - HDG - S07 - DR - CD - 000004

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |

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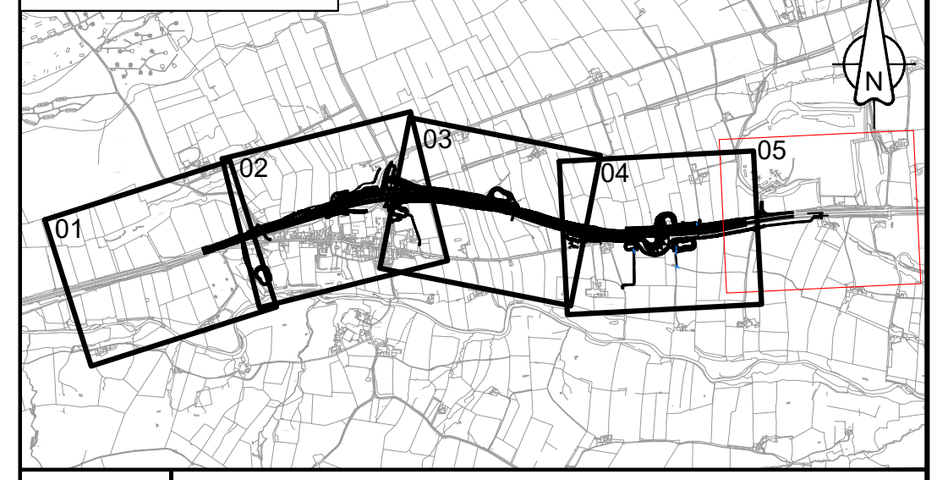
## KEY

| | |
|---|---|
| — | Proposed layout |
| — | Existing watercourse |
| — < — | Culvert |
| — | Cut-off drain |
| — > — F — | Proposed Filter drain |
| ◡ | Headwall |
| — > — CD — | Proposed Carrier Drain |
| ● | Pond |
| | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S08-01-10 | Manhole Reference |
| S08-C01 | Culvert Reference |
| — > — CD — | Existing Carrier Drain |

PROJECT KEY PLAN

SCHEME KEY PLAN



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| C01 | SGAR3 | | | | |
| | ATUN | ATUN | JHAR | THAL | SSCO |
| | 08/06/22 | 08/06/22 | 08/06/22 | 08/06/22 | 08/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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national highways

Project Name
A66 Northern Trans-Pennine

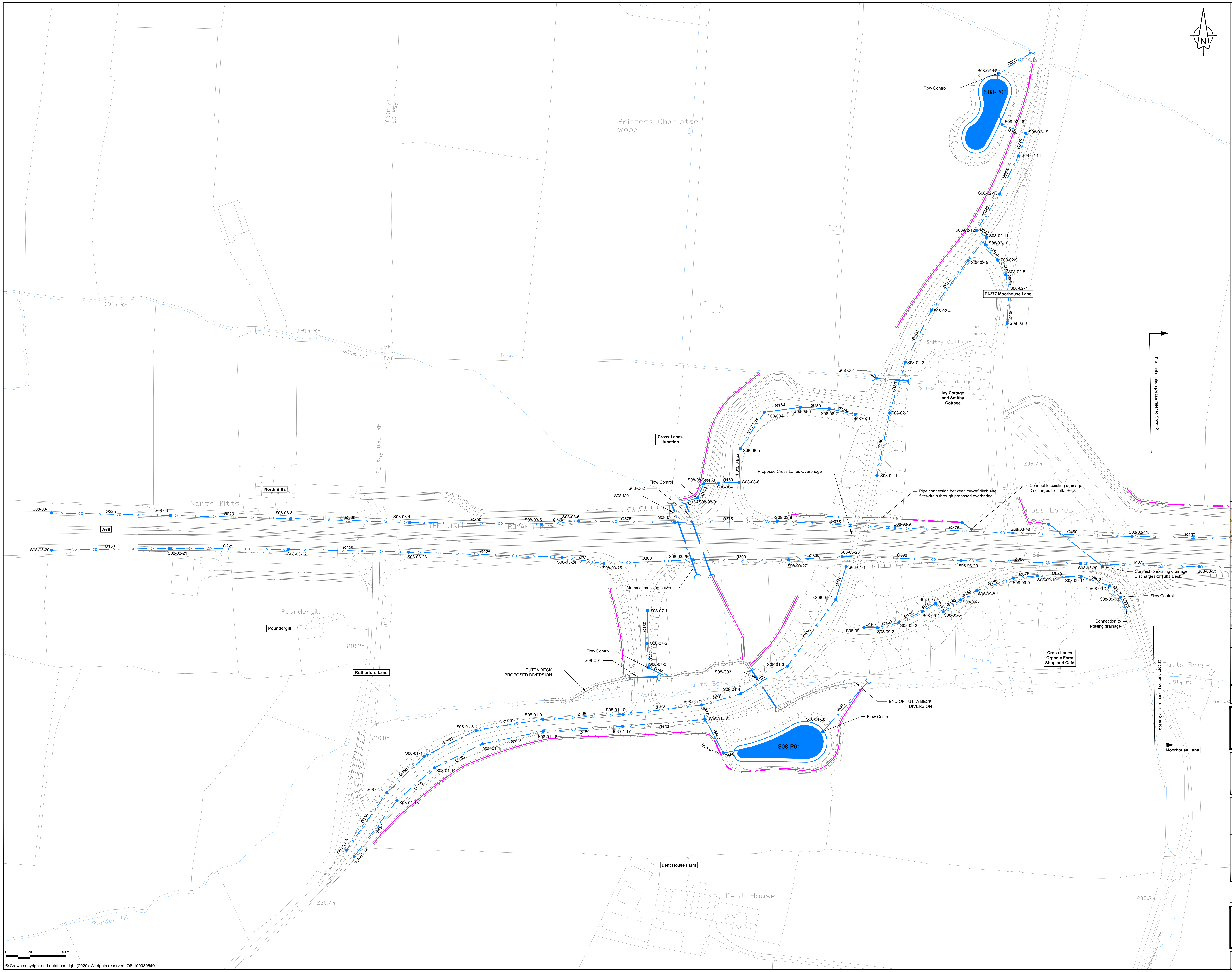
Drawing Title
Bowes Bypass
Proposed Drainage Plan
Sheet 5 of 5

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number

| Project | Originator | Volume | Location | Type | Role | Number |
|---|---|---|---|---|---|---|
| HE565627 | AMY | HDG | S07 | DR | CD | 000005 |

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |



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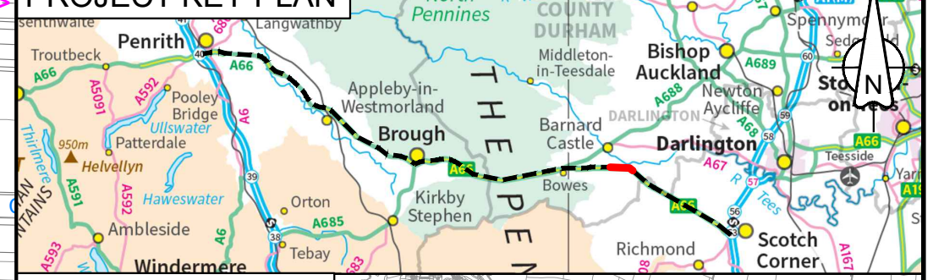
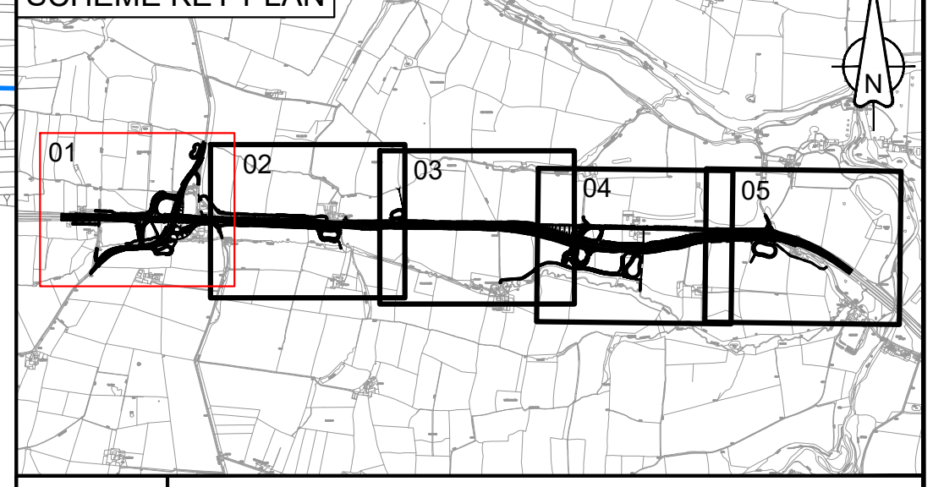
| — | Existing watercourse |
| — < — | Culvert |
| — | Cut-off drain |
| — > — F — | Proposed Filter drain |
| ◡ | Headwall |
| — > — CD — | Proposed Carrier Drain |
| ● | Pond |
| ⊥⊥⊥ | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S08-01-10 | Manhole Reference |
| S08-C01 | Culvert Reference |
| — > — CD — | Existing Carrier Drain |

PROJECT KEY PLAN



SCHEME KEY PLAN



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| C01 | SGAR3 | | | | |
| | ATUN | ATUN | JHAR | THAL | SSCO |
| | 08/06/22 | 08/06/22 | 08/06/22 | 08/06/22 | 08/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
Amey OW Limited
Chancery Exchange
10 Furnival Street
London, EC4A 1AB

Client
3 Piccadilly Place
Manchester
M1 3BN

national highways

Project Name
A66 Northern Trans-Pennine

Drawing Title
Cross Lanes to Rokeby
Proposed Drainage Plan
Sheet 1 of 5

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S08 -DR-CD- 000001
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |

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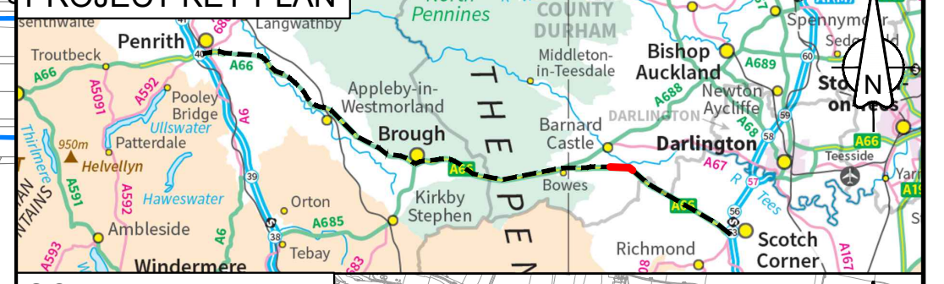
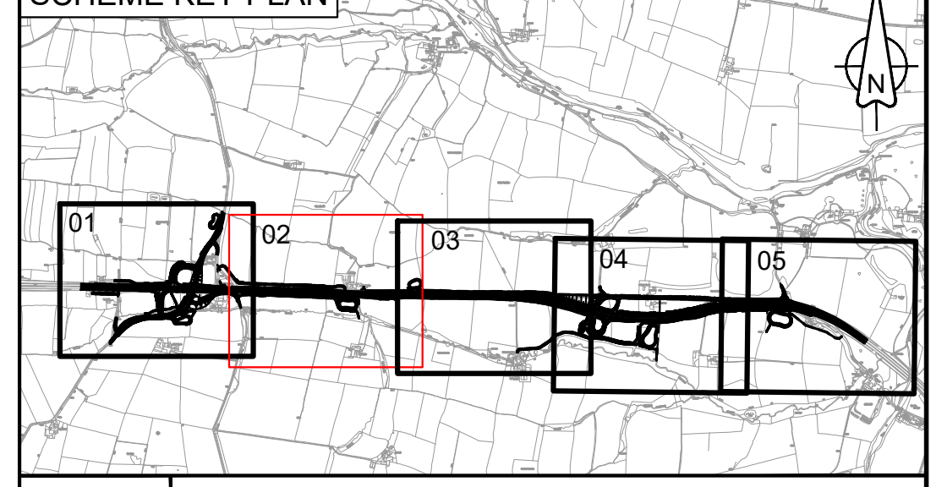
| ● | Pond |
| ▽▽▽▽ | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S08-01-10 | Manhole Reference |
| S08-C01 | Culvert Reference |
| — > — CD — | Existing Carrier Drain |

PROJECT KEY PLAN



SCHEME KEY PLAN



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| C01 | SGAR3 | | | | |
| | ATUN | ATUN | JHAR | THAL | SSCO |
| | 08/06/22 | 08/06/22 | 08/06/22 | 08/06/22 | 08/06/22 |
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| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
Amey OW Limited
Chancery Exchange
10 Furnival Street
London, EC4A 1AB

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3 Piccadilly Place
Manchester
M1 3BN

national highways

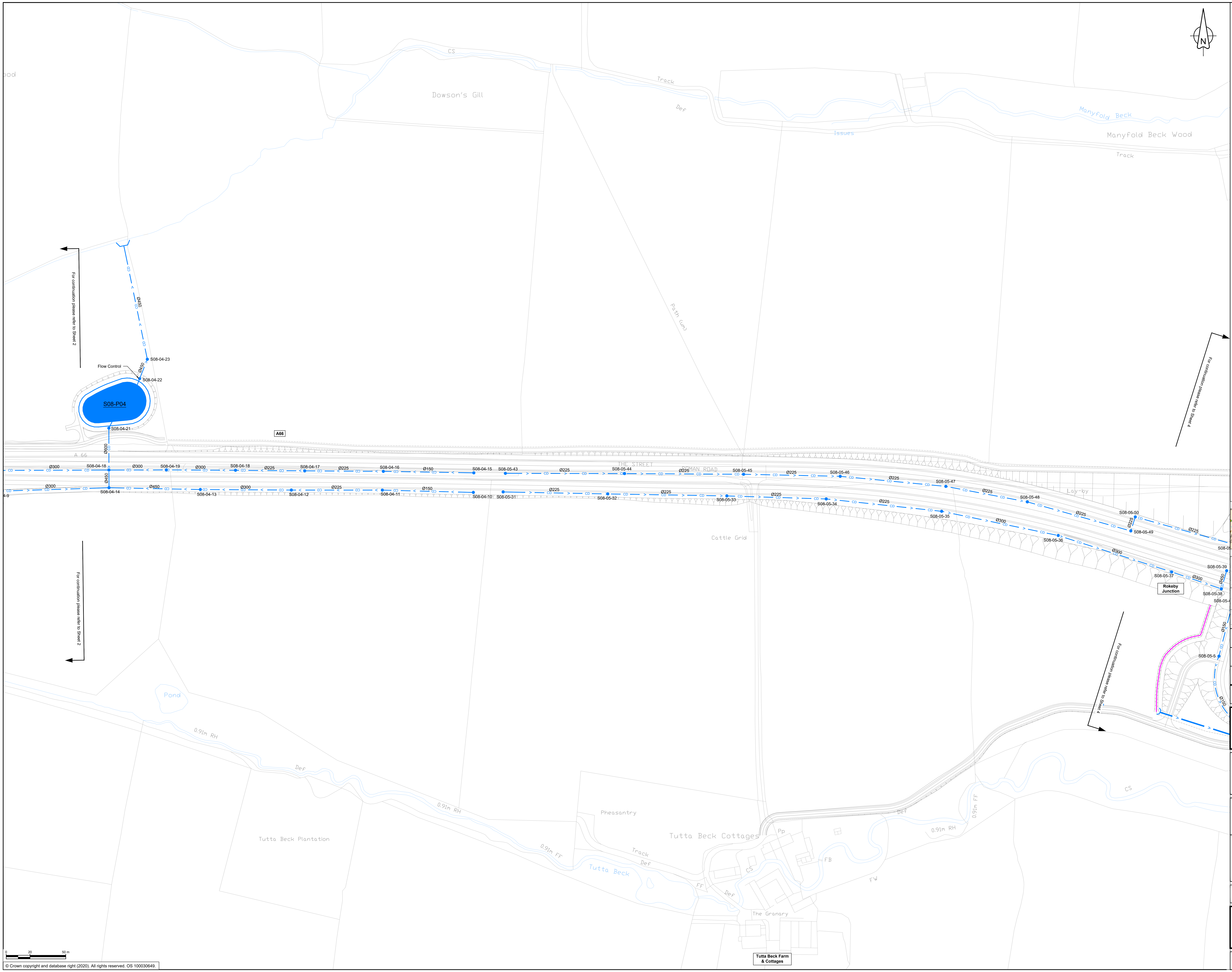
Project Name
A66 Northern Trans-Pennine

Drawing Title
Cross Lanes to Rokeby
Proposed Drainage Plan
Sheet 2 of 5

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S08 -DR-CD-000002
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |



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| | |
|---|---|
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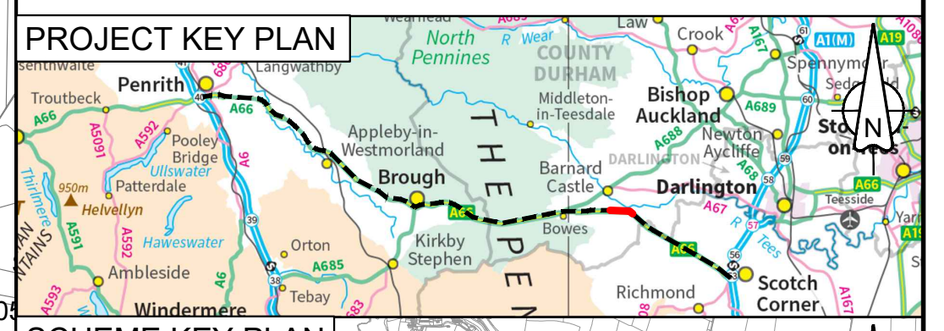
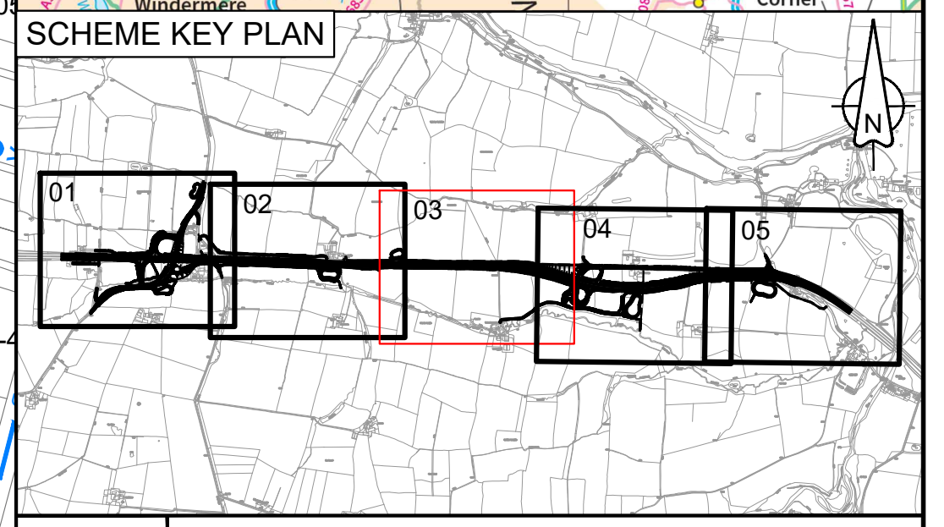
| — | Existing watercourse |
| — < — | Culvert |
| — | Cut-off drain |
| — > — F — | Proposed Filter drain |
| ◡ | Headwall |
| — > — CD — | Proposed Carrier Drain |
| ▬ | Pond |
| ▽▽▽ | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S08-01-10 | Manhole Reference |
| S08-C01 | Culvert Reference |
| — > — CD — | Existing Carrier Drain |

PROJECT KEY PLAN



SCHEME KEY PLAN



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| C01 | SGAR3 | | | | |
| | ATUN | ATUN | JHAR | THAL | SSCO |
| | 08/06/22 | 08/06/22 | 08/06/22 | 08/06/22 | 08/06/22 |
| Revision | Revision details | | | | |
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| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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3 Piccadilly Place
Manchester
M1 3BN

national highways

Project Name
A66 Northern Trans-Pennine

Drawing Title
Cross Lanes to Rokeby
Proposed Drainage Plan
Sheet 3 of 5

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S08 -DR-CD-000003
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |

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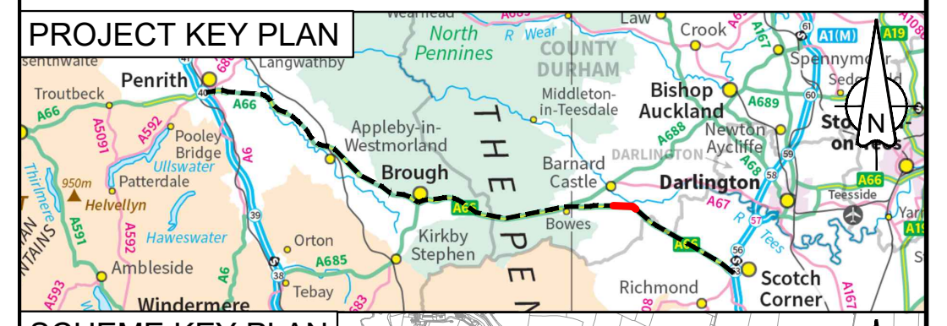
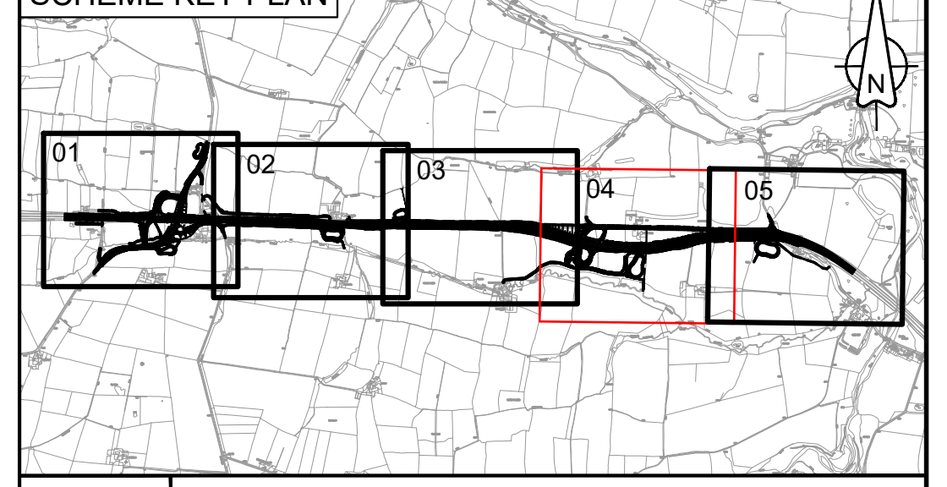
| — > — CD — | Existing Carrier Drain |

PROJECT KEY PLAN



SCHEME KEY PLAN



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| C01 | SGAR3 | | | | |
| | ATUN | ATUN | JHAR | THAL | SSCO |
| | 08/06/22 | 08/06/22 | 08/06/22 | 08/06/22 | 08/06/22 |
| Revision | Revision details | | | | |
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| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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Project Name
A66 Northern Trans-Pennine

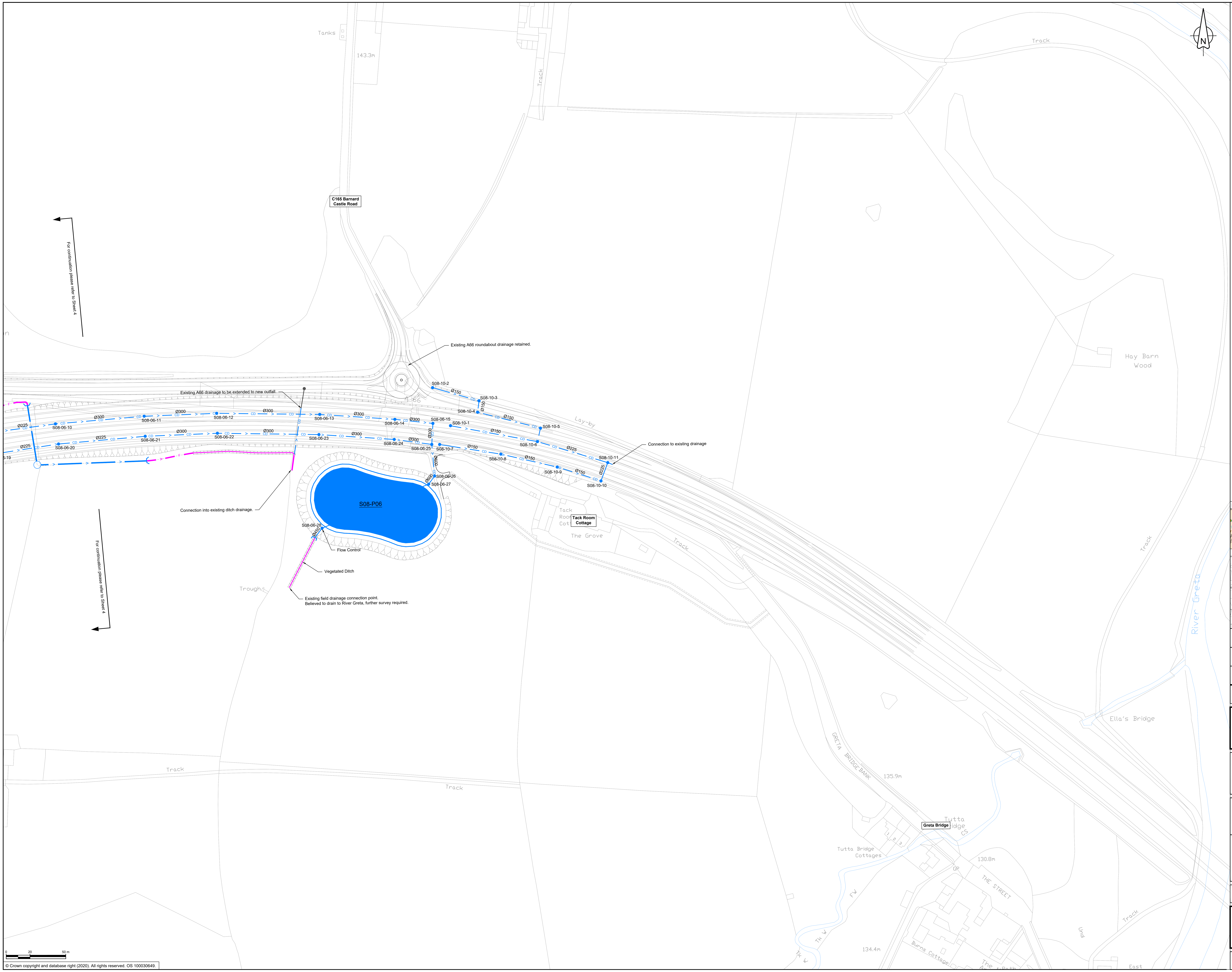
Drawing Title
Cross Lanes to Rokeby
Proposed Drainage Plan
Sheet 4 of 5

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number

| Project | Originator | Volume | Location | Type | Role | Number |
|---|---|---|---|---|---|---|
| HE565627 | AMY | HDG | S08 | DR | CD | 000004 |

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |



Existing A66 roundabout drainage retained.

Existing A66 drainage to be extended to new outfall.

Connection to existing drainage

Connection into existing ditch drainage.

Flow Control

Vegetated Ditch

Existing field drainage connection point.
Believed to drain to River Greta, further survey required.

For continuation please refer to Sheet 4

For continuation please refer to Sheet 4

## NOTES

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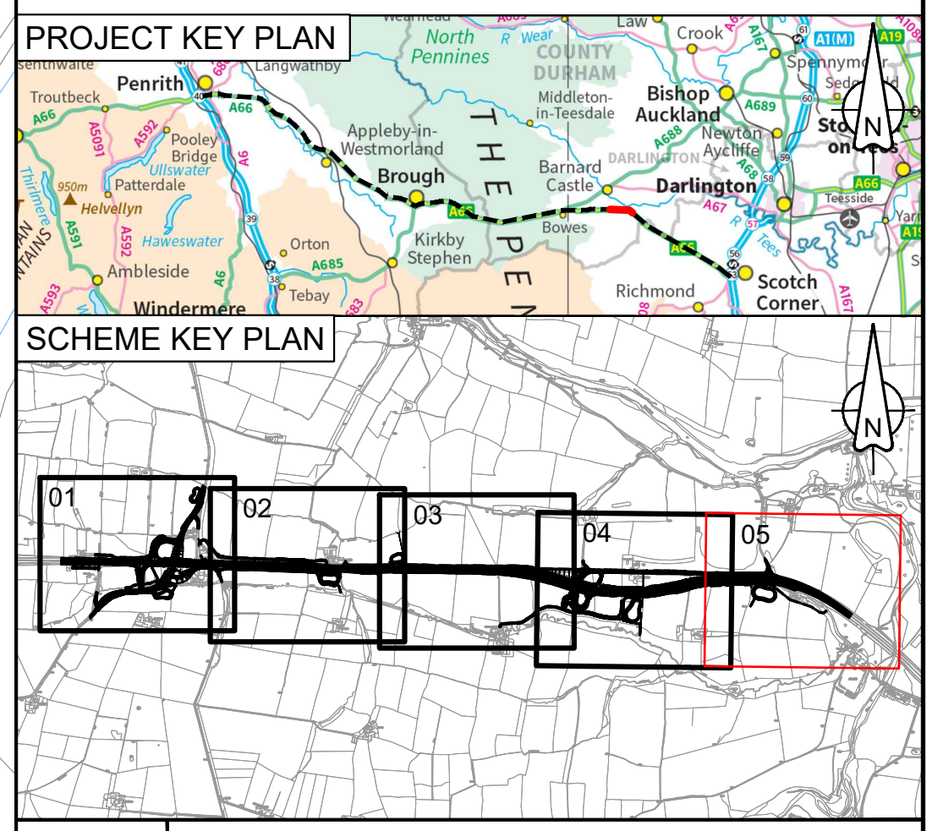
7. Existing drainage information based on HADDMS, as-built drawings, OS, JBA culvert surveys, site walk overs and topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   - No surcharging in 1yr storm event
   - No flooding in 1 or 5yr + 20% Climate Change storm event
   - Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope with a 500mm base.
10. Ponds to have minimum 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:5.
11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

## KEY

| | |
|---|---|
| | Proposed layout |
| | Existing watercourse |
| — < — | Culvert |
| | Cut-off drain |
| — > — F | Proposed Filter drain |
| | Headwall |
| — > — CD | Proposed Carrier Drain |
| | Pond |
| | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S08-01-10 | Manhole Reference |
| S08-C01 | Culvert Reference |
| — > — CD | Existing Carrier Drain |

PROJECT KEY PLAN

SCHEME KEY PLAN



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| C01 | SGAR3 | | | | |
| | ATUN | ATUN | JHAR | THAL | SSCO |
| | 08/06/22 | 08/06/22 | 08/06/22 | 08/06/22 | 08/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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London, EC4A 1AB

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Manchester
M1 3BN

national highways

Project Name
A66 Northern Trans-Pennine

Drawing Title
Cross Lanes to Rokeby
Proposed Drainage Plan
Sheet 5 of 5

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number

| Project | Originator | Volume | Location | Type | Role | Number |
|---|---|---|---|---|---|---|
| HE565627 | AMY | HDG | S08 | DR | CD | 000005 |

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |

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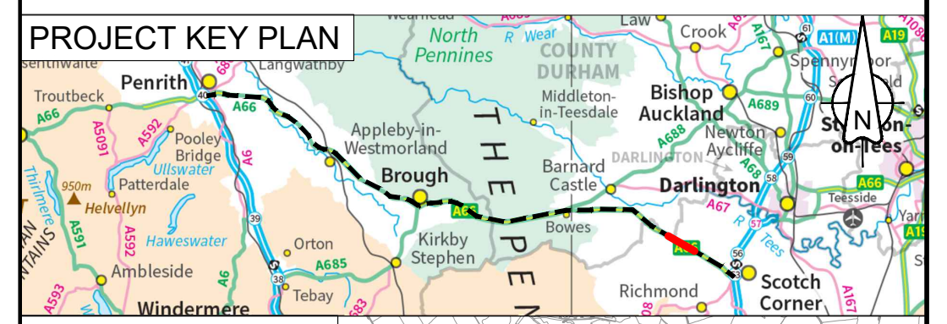
   - No flooding in 1 or 5yr storm event
   - Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope with a 500mm base.
10. Ponds to have minimum 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

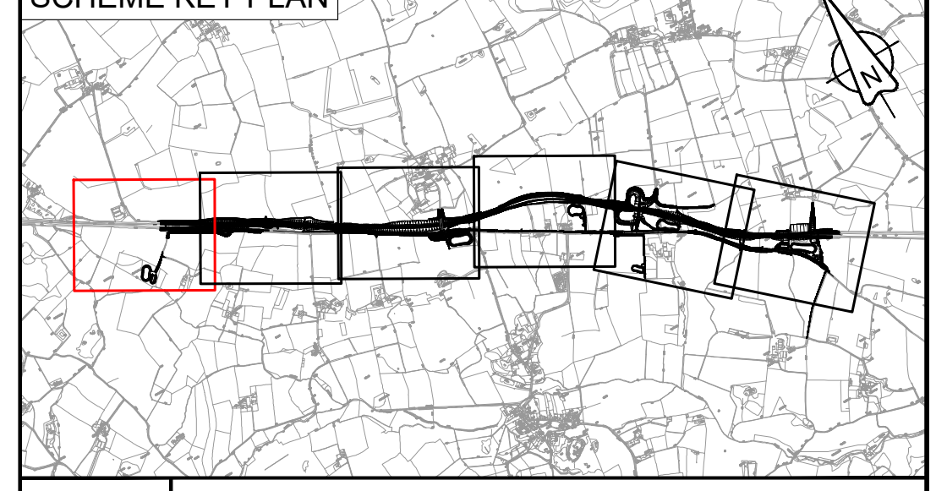
## KEY

| | |
|---|---|
| ─── | Proposed layout |
| ─── | Existing watercourse |
| ━ < ━ | Culvert |
| ─── | Cut-off drain |
| ━ > F ━ | Proposed Filter drain |
| ◡ | Headwall |
| ━ > ━ CD ━ | Proposed Carrier Drain |
| | Pond |
| | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S09-01-10 | Manhole Reference |
| S09-C01 | Culvert Reference |
| ━ > ━ CD ━ | Existing Carrier Drain |

PROJECT KEY PLAN



SCHEME KEY PLAN



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| P01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | FMOL |
| | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 |
| C01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | SSCO |
| | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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national highways

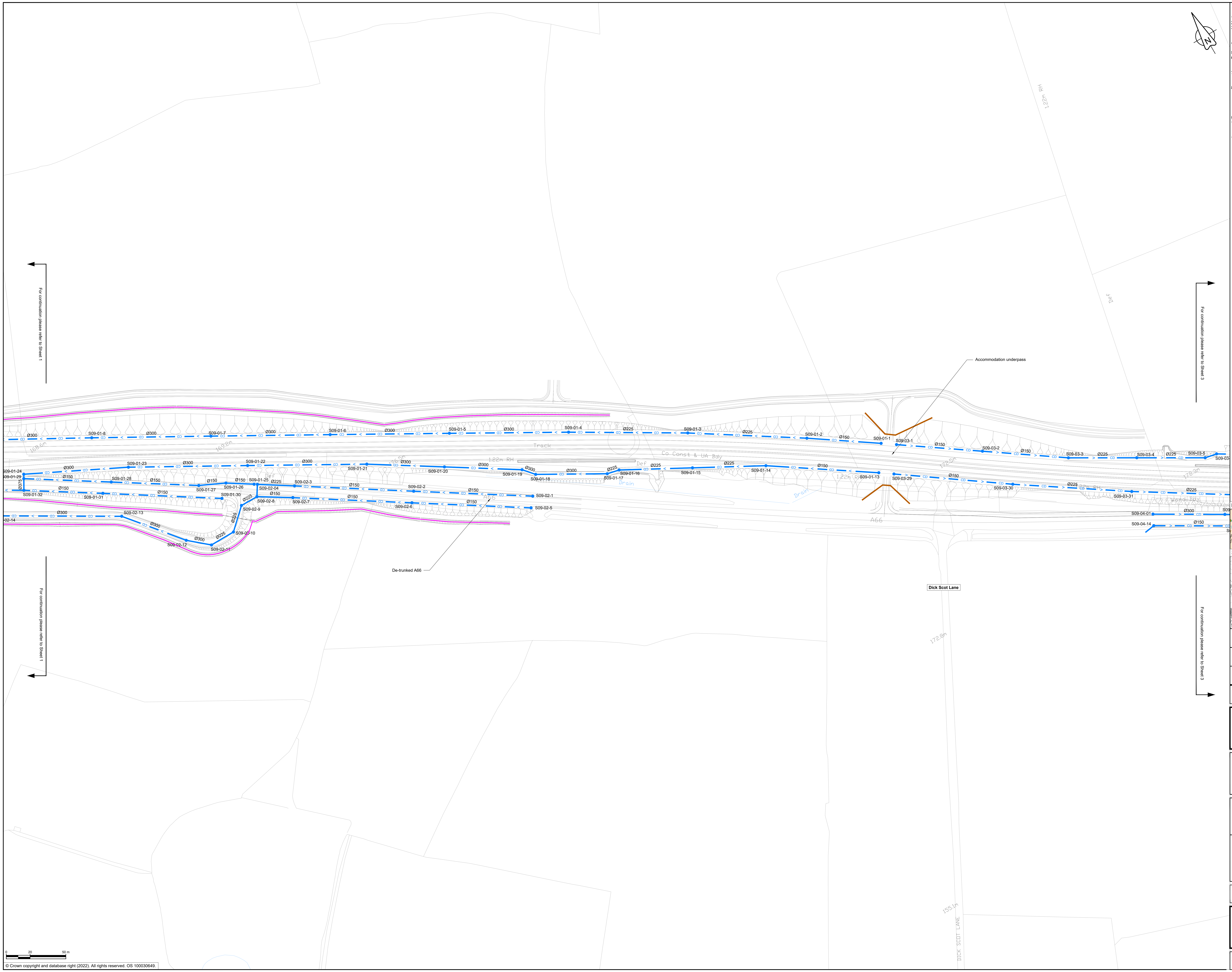
Project Name
A66 Northern Trans-Pennine

Drawing Title
Stephen Bank to Carkin Moor
Proposed Drainage Plan
Sheet 1 of 6

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S09 -DR-CD-000001
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |



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# NOTES

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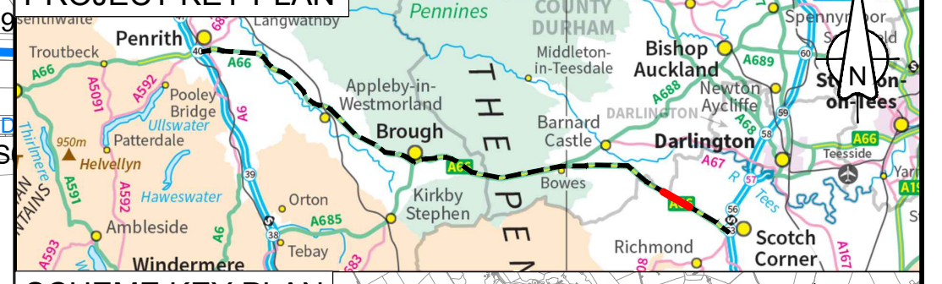
    - No flooding in 1 or 5yr storm event
    - Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope with a 500mm base.
10. Ponds to have minimum 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

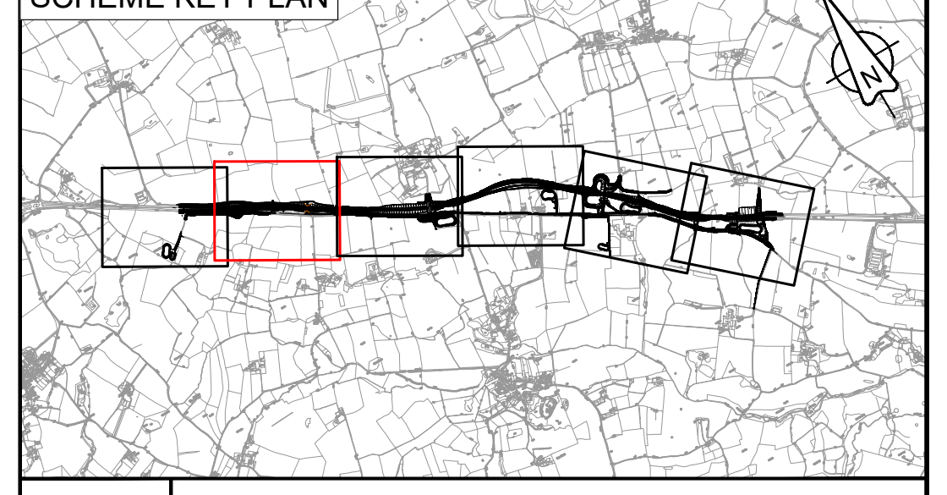
# KEY

| | |
|---|---|
| | Proposed layout |
| | Existing watercourse |
| — < — | Culvert |
| | Cut-off drain |
| — > — F | Proposed Filter drain |
| ◡ | Headwall |
| — > — CD | Proposed Carrier Drain |
| | Pond |
| | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S09-01-10 | Manhole Reference |
| S09-C01 | Culvert Reference |
| — > — CD — | Existing Carrier Drain |

PROJECT KEY PLAN



SCHEME KEY PLAN



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| | --- | --- | --- | --- | --- | |
| P01 | SGAR3 | | | | | |
| | JHAR | JHAR | CHEA | TEGG | FMOL | |
| | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 | |
| C01 | SGAR3 | | | | | |
| | JHAR | JHAR | CHEA | TEGG | SSCO | |
| | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 | |
| Revision | Revision details | | | | | |
| | Created | Checked | Reviewed | Approved | Authorised | |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | |

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Manchester
M1 3BN

Project Name
A66 Northern Trans-Pennine

Drawing Title
Stephen Bank to Carkin Moor
Proposed Drainage Plan
Sheet 2 of 6

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S09 -DR-CD-000002
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |

For continuation please refer to Sheet 2

For continuation please refer to Sheet 2

For continuation please refer to Sheet 4

For continuation please refer to Sheet 4

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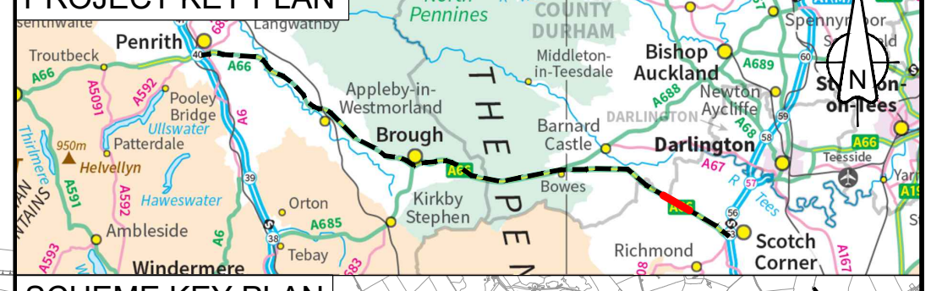
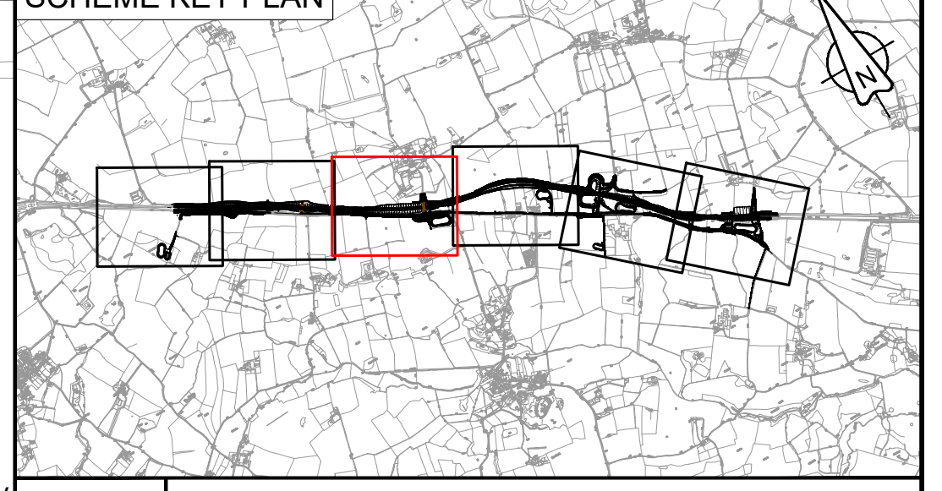
| | |
|---|---|
| ── | Proposed layout |
| ── | Existing watercourse |
| ─ < ─ | Culvert |
| ── | Cut-off drain |
| ─ > ─ F | Proposed Filter drain |
| ◡ | Headwall |
| ─ > ─ CD | Proposed Carrier Drain |
| ▬ | Pond |
| ▽▽▽ | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S09-01-10 | Manhole Reference |
| S09-C01 | Culvert Reference |
| ─ > ─ CD ─ | Existing Carrier Drain |

PROJECT KEY PLAN



SCHEME KEY PLAN



| Revision | Revision details | | | | |
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| | --- | --- | --- | --- | --- |
| P01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | FMOL |
| | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 |
| C01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | SSCO |
| | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 |
| Revision | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
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Chancery Exchange
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London, EC4A 1AB

Client
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Manchester
M1 3BN

national highways

Project Name
A66 Northern Trans-Pennine

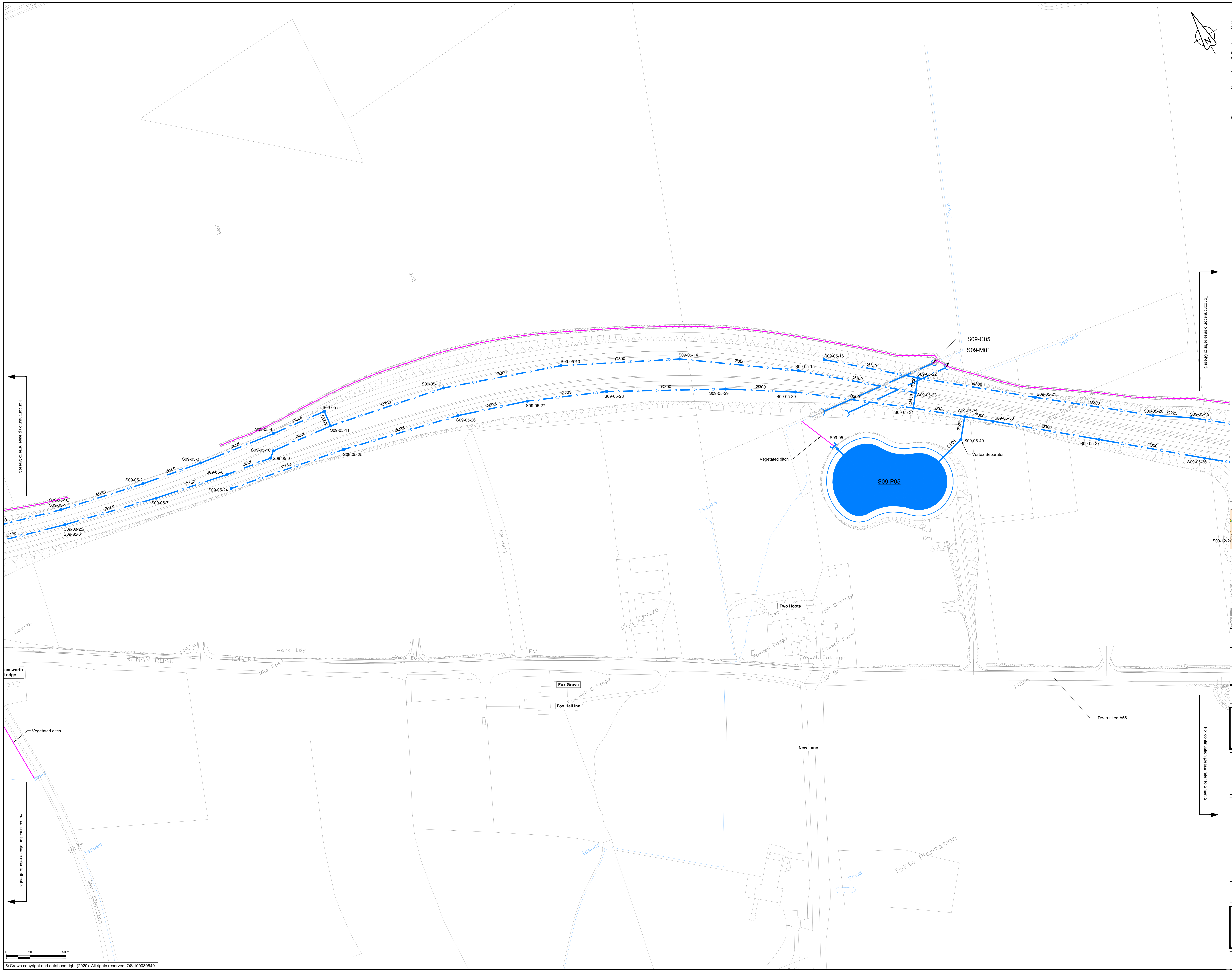
Drawing Title
Stephen Bank to Carkin Moor
Proposed Drainage Plan
Sheet 3 of 6

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number

| Project | Originator | Volume | Location | Type | Role | Number |
|---|---|---|---|---|---|---|
| HE565627 | AMY | HDG | S09 | DR | CD | 000003 |

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |



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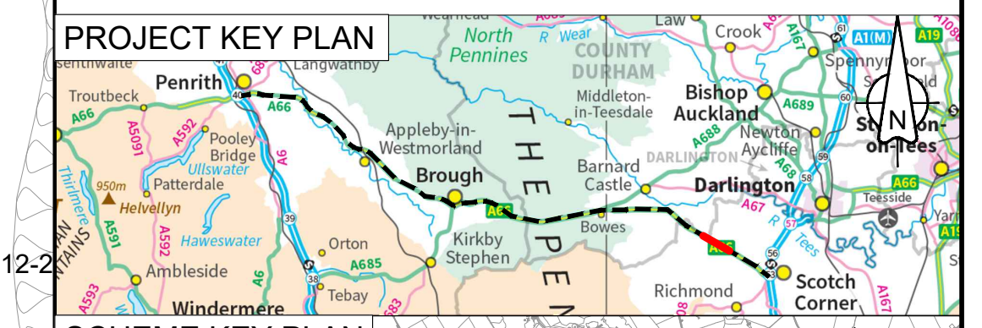
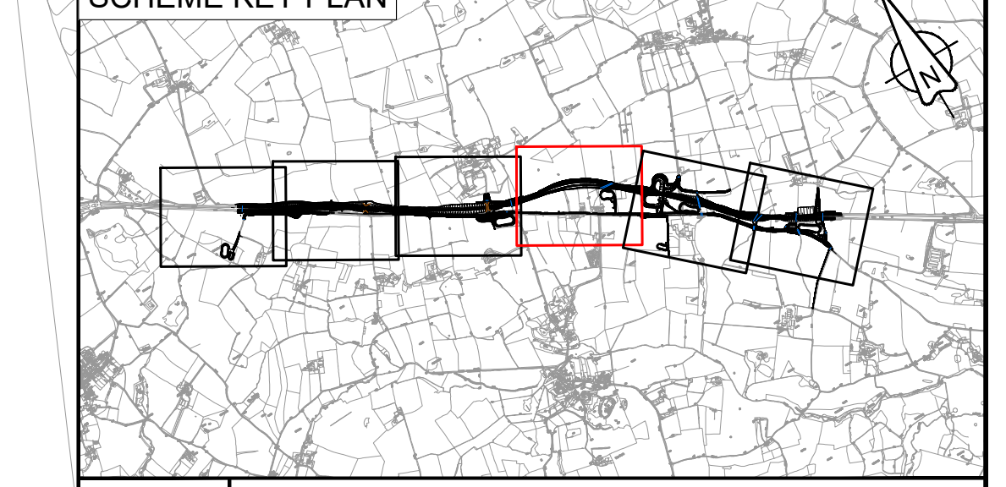
## KEY

| | |
|---|---|
| — | Proposed layout |
| — | Existing watercourse |
| — < — | Culvert |
| — | Cut-off drain |
| — > F | Proposed Filter drain |
| ⌣ | Headwall |
| — > CD | Proposed Carrier Drain |
| ● | Pond |
| ▽▽▽ | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S09-01-10 | Manhole Reference |
| S09-C01 | Culvert Reference |
| — > CD | Existing Carrier Drain |

PROJECT KEY PLAN



SCHEME KEY PLAN



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| | --- | --- | --- | --- | --- |
| P01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | FMOL |
| | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 |
| C01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | SSCO |
| | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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Chancery Exchange
10 Furnival Street
London, EC4A 1AB

Client
3 Piccadilly Place
Manchester
M1 3BN

national highways

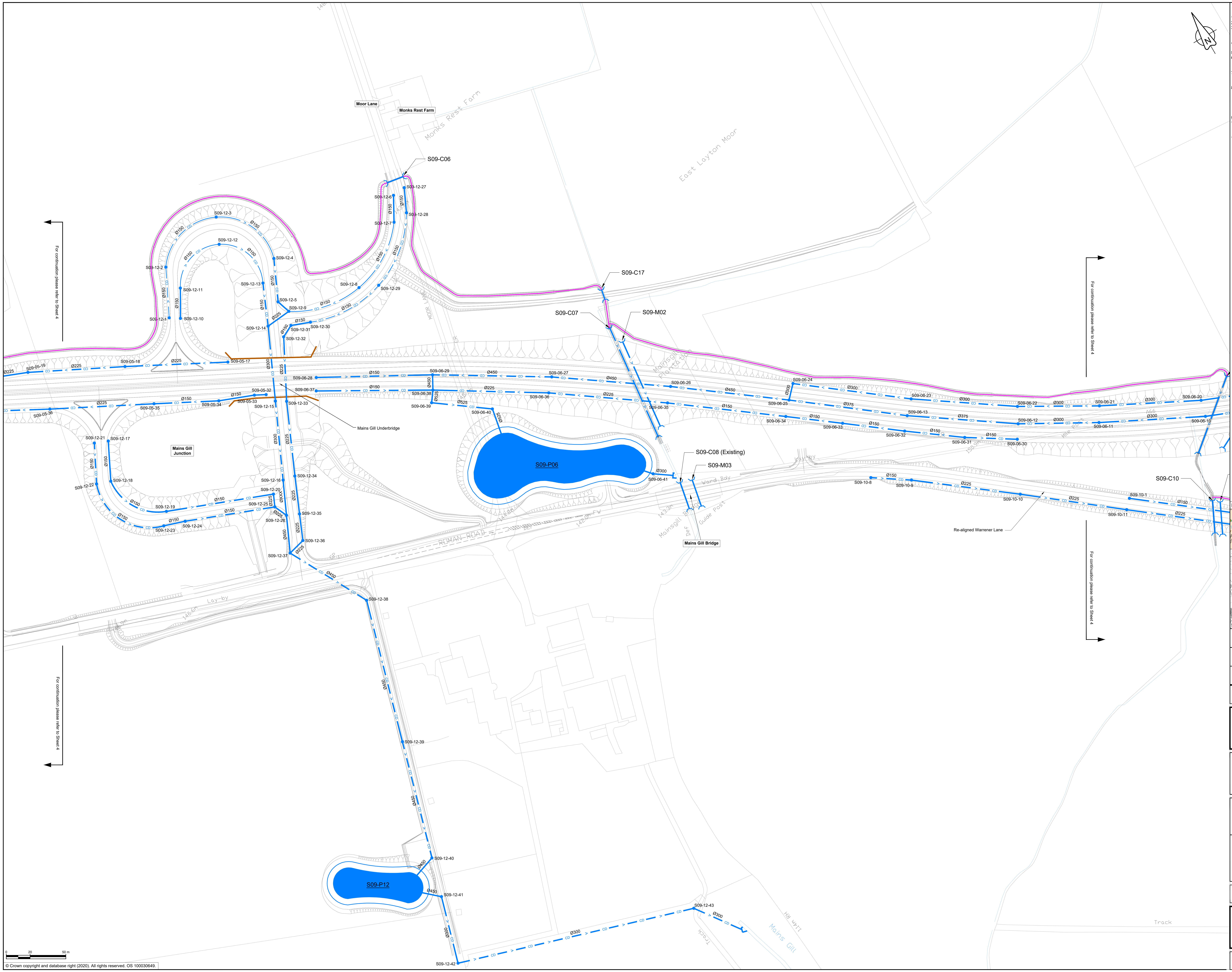
Project Name
A66 Northern Trans-Pennine

Drawing Title
Stephen Bank to Carkin Moor
Proposed Drainage Plan
Sheet 4 of 6

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S09 -DR-CD- 000004
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |



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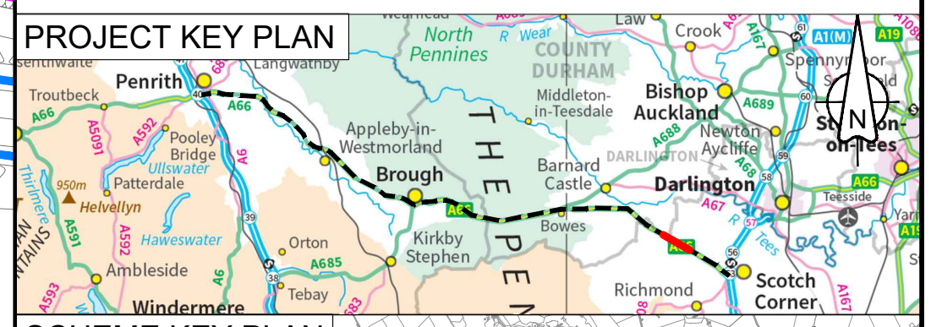
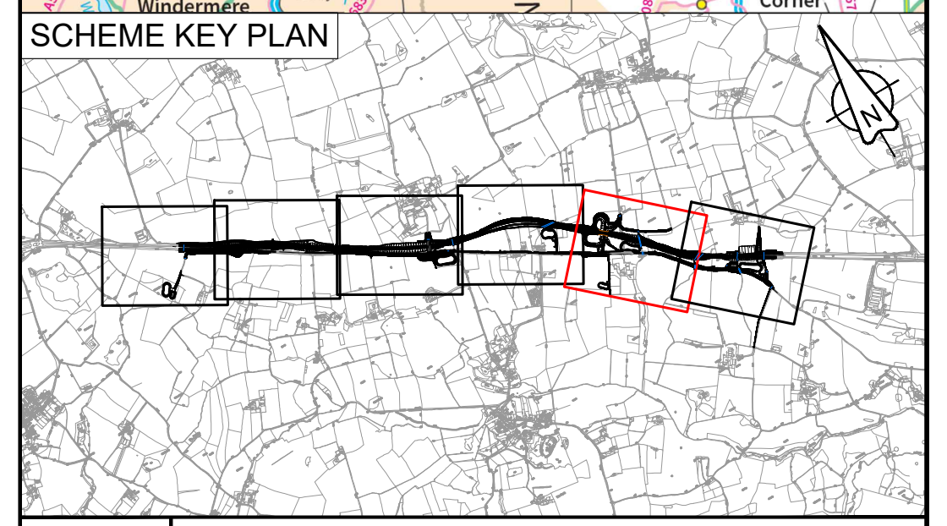
## KEY

| | |
|---|---|
| ── | Proposed layout |
| ── | Existing watercourse |
| ── < ── | Culvert |
| ── | Cut-off drain |
| — > — F — | Proposed Filter drain |
| ◡ | Headwall |
| — > — CD — | Proposed Carrier Drain |
| ▨ | Pond |
| ┴┴┴┴ | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S09-01-10 | Manhole Reference |
| S09-C01 | Culvert Reference |
| — > — CD — | Existing Carrier Drain |

PROJECT KEY PLAN



SCHEME KEY PLAN



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| | --- | --- | --- | --- | --- |
| P01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | FMOL |
| | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 |
| C01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | SSCO |
| | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
Amey OW Limited
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10 Furnival Street
London, EC4A 1AB

Client
3 Piccadilly Place
Manchester
M1 3BN
national highways

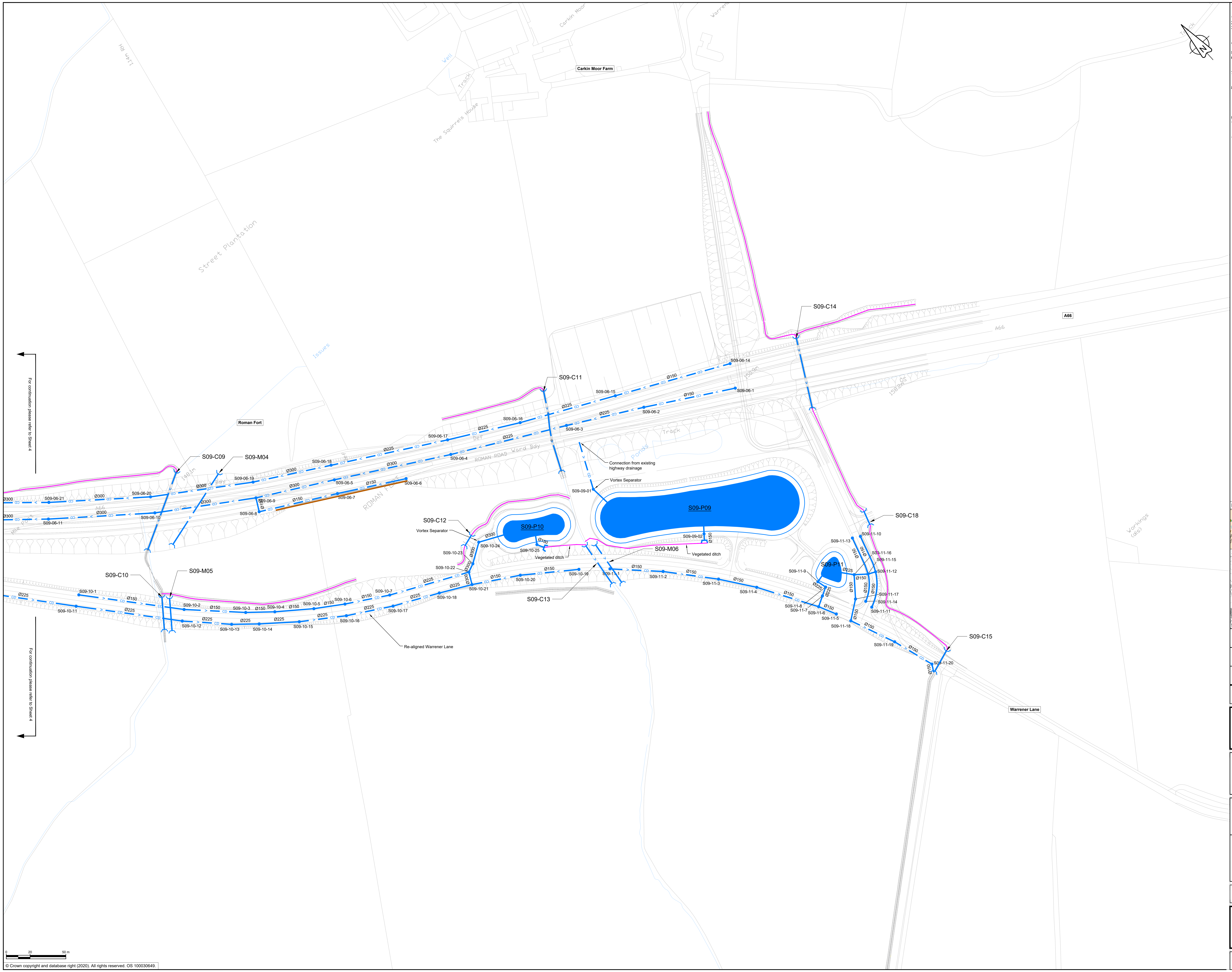
Project Name
A66 Northern Trans-Pennine

Drawing Title
Stephen Bank to Carkin Moor
Proposed Drainage Plan
Sheet 5 of 6

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S09 -DR-CD-000005
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |



## NOTES

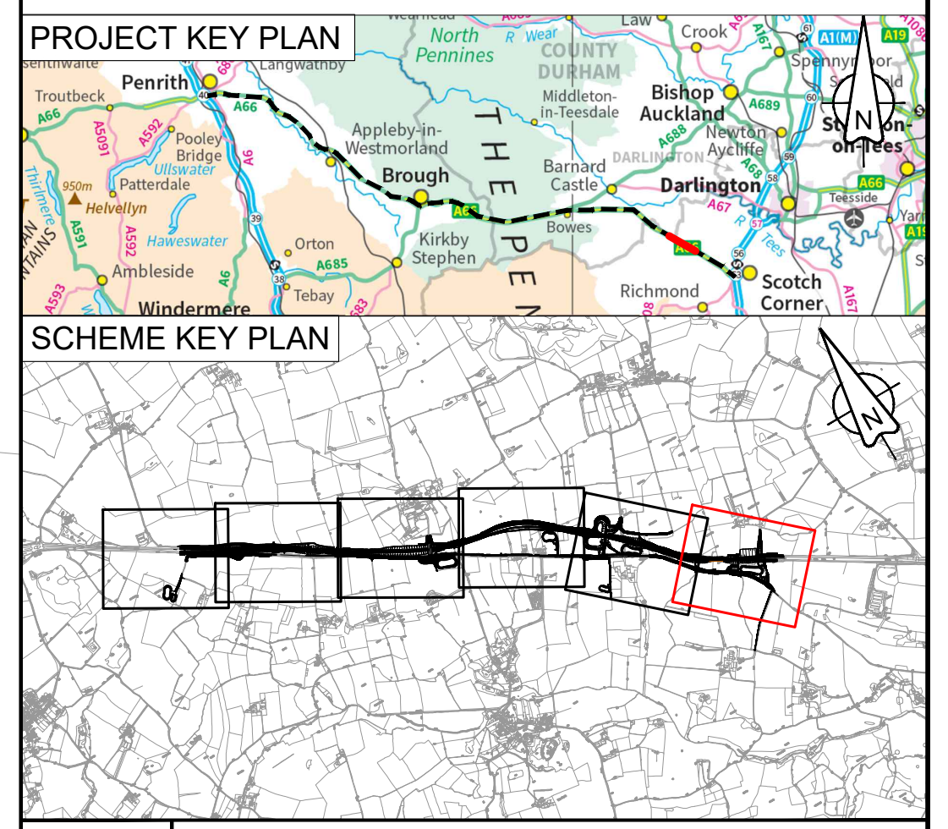
1. All levels are in metres above Ordnance Datum.
2. All dimensions are in metres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed drainage design designed in accordance with the Standards for Highways Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, as-built drawings, OS, JBA culvert surveys, site walk overs and topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
    - No surcharging in 1yr storm event
    - No flooding in 1 or 5yr storm event
    - Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope with a 500mm base.
10. Ponds to have minimum 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

## KEY

| | |
|---|---|
| ─── | Proposed layout |
| ─── | Existing watercourse |
| ── < ── | Culvert |
| ─── | Cut-off drain |
| ─ > ─ F | Proposed Filter drain |
| ◡ | Headwall |
| ─ > ─ CD ─ | Proposed Carrier Drain |
| ▨ | Pond |
| ▽▽▽ | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S09-01-10 | Manhole Reference |
| S09-C01 | Culvert Reference |
| ─ > ─ CD ─ | Existing Carrier Drain |

PROJECT KEY PLAN

SCHEME KEY PLAN



| | | | | | |
|---|---|---|---|---|---|
| --- | --- | | | | |
| | --- | --- | --- | --- | --- |
| | --- | --- | --- | --- | --- |
| P01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | FMOL |
| | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 |
| C01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | SSCO |
| | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
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Chancery Exchange
10 Furnival Street
London, EC4A 1AB

Client
3 Piccadilly Place
Manchester
M1 3BN

national highways

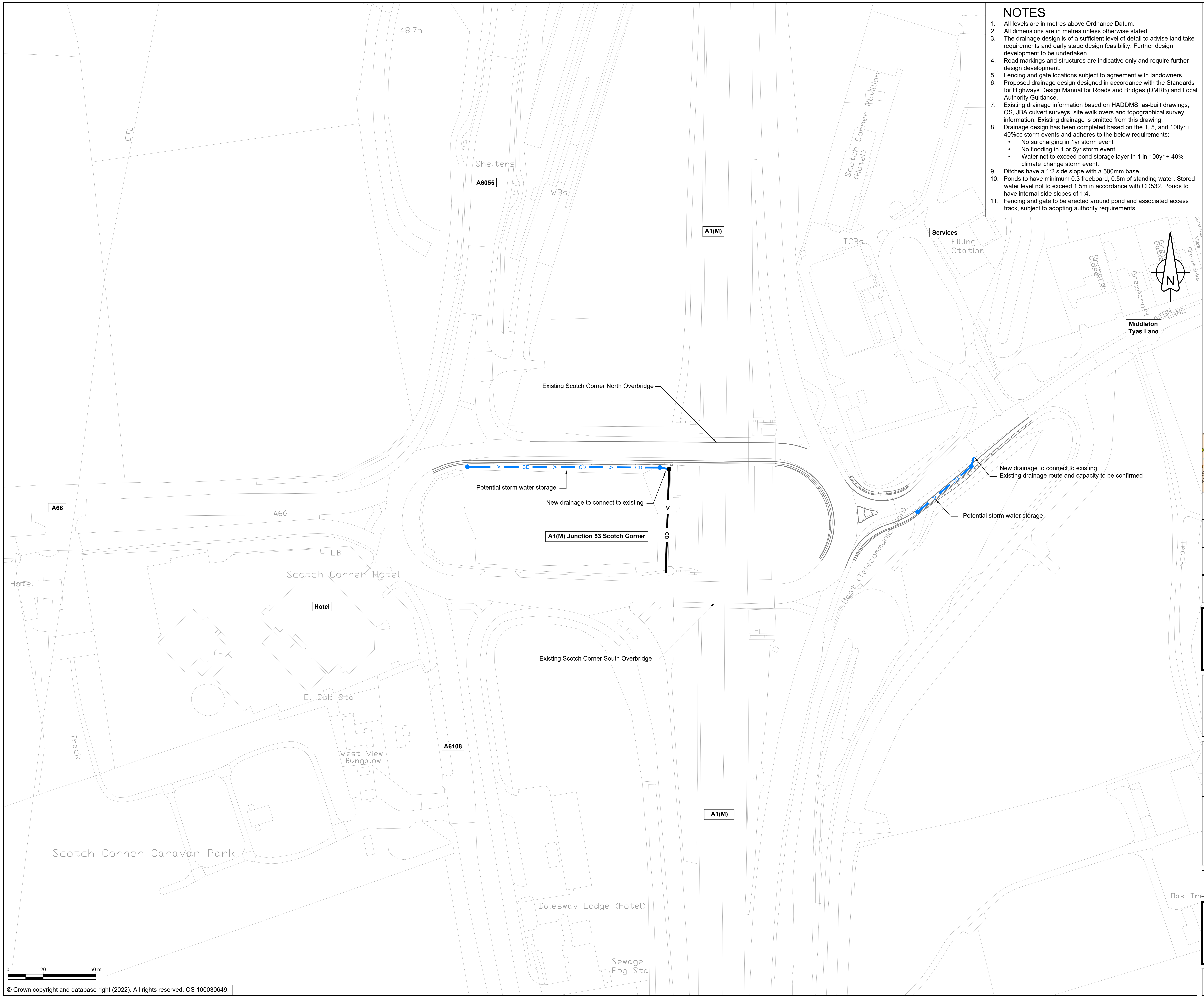
Project Name
A66 Northern Trans-Pennine

Drawing Title
Stephen Bank to Carkin Moor
Proposed Drainage Plan
Sheet 6 of 6

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S09 -DR-CD- 000006
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |



# NOTES

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8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   - No surcharging in 1yr storm event
   - No flooding in 1 or 5yr storm event
   - Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
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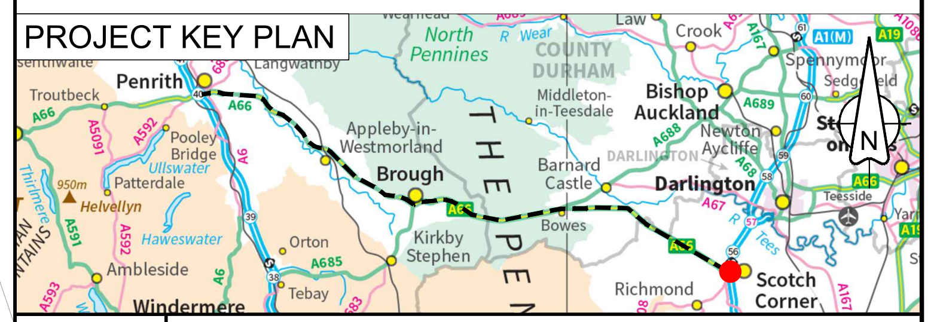
11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

# KEY

| | |
|---|---|
| — | Proposed layout |
| — | Existing watercourse |
| — < — | Culvert |
| — | Cut-off drain |
| — > — F — | Proposed Filter drain |
| ◡ | Headwall |
| — > — CD — | Proposed Carrier Drain |
| ▨ | Pond |
| ⊥⊥⊥⊥ | Earthworks |
| ● | Proposed Chamber |
| ● | Existing Chamber |
| Ø300 | Pipe Diameter (in mm) |
| S09-01-10 | Manhole Reference |
| S09-C01 | Culvert Reference |
| — > — CD — | Existing Carrier Drain |

PROJECT KEY PLAN



| | | | | | |
|---|---|---|---|---|---|
| --- | --- | | | | |
| | --- | --- | --- | --- | --- |
| | --- | --- | --- | --- | --- |
| P01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | FMOL |
| | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 |
| C01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | SSCO |
| | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer

Amey OW Limited
Chancery Exchange
10 Furnival Street
London, EC4A 1AB

Client

3 Piccadilly Place
Manchester
M1 3BN

national highways

Project Name

A66 Northern Trans-Pennine

Drawing Title

A1(M) Junction 53 Scotch Corner
Proposed Drainage Plan

| Project Ref. No. | Stage | Scale : 1:1000 @ A1 |
|---|---|---|
| --- | PCF3 | Dimensions : |

Drawing Number

| Project | Originator | Volume |
|---|---|---|
| HE565627 - | AMY - | HDG - |

| Location | Type | Role | Number |
|---|---|---|---|
| S11 | - DR - | CD - | 000001 |

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Pond 1-1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 16.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Time Area Diagram for Pond 1-1

| Time (mins) | Area (ha) | Time (mins) | Area (ha) | Time (mins) | Area (ha) |
|---|---|---|---|---|---|
| 0-4 | 0.041 | 4-8 | 0.299 | 8-12 | 0.025 |

Total Area Contributing (ha) = 0.365

Total Pipe Volume (m³) = 18.053

### Network Design Table for Pond 1-1

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 27.360 | 0.137 | 199.7 | 0.049 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S1.001 | 42.917 | 0.286 | 150.0 | 0.075 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S1.002 | 44.886 | 0.449 | 100.0 | 0.078 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S1.003 | 65.011 | 0.765 | 85.0 | 0.106 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S2.000 | 34.135 | 0.137 | 250.0 | 0.057 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 60.37 | 5.49 | 138.000 | 0.049 | 0.0 | 0.0 | 0.0 | 0.92 | 36.6 | 7.9 |
| S1.001 | 57.62 | 6.17 | 137.863 | 0.123 | 0.0 | 0.0 | 0.0 | 1.07 | 42.4 | 19.2 |
| S1.002 | 55.51 | 6.74 | 137.577 | 0.202 | 0.0 | 0.0 | 0.0 | 1.31 | 52.0 | 30.3 |
| S1.003 | 52.96 | 7.50 | 137.128 | 0.308 | 0.0 | 0.0 | 0.0 | 1.42 | 56.4 | 44.1 |
| S2.000 | 59.53 | 5.69 | 136.500 | 0.057 | 0.0 | 0.0 | 0.0 | 0.82 | 32.7 | 9.2 |

## Network Design Table for Pond 1-1

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.004 | 24.290 | 0.243 | 100.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S1.005 | 60.220 | 0.301 | 200.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.006 | 4.718 | 0.016 | 300.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.007 | 33.380 | 0.111 | 300.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.008 | 22.865 | 0.076 | 300.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.004 | 52.01 | 7.81 | 136.363 | 0.365 | 0.0 | 0.0 | 0.0 | 1.31 | 52.0 | 51.3 |
| S1.005 | 49.45 | 8.72 | 136.045 | 0.365 | 0.0 | 0.0 | 0.0 | 1.11 | 78.3 | 51.3 |
| S1.006 | 49.22 | 8.80 | 135.744 | 0.365 | 0.0 | 0.0 | 0.0 | 0.90 | 63.8 | 51.3 |
| S1.007 | 47.67 | 9.42 | 135.728 | 0.365 | 0.0 | 0.0 | 0.0 | 0.90 | 63.8 | 51.3 |
| S1.008 | 46.67 | 9.84 | 135.617 | 0.365 | 0.0 | 0.0 | 0.0 | 0.90 | 63.8 | 51.3 |

## Manhole Schedules for Pond 1-1

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backc (mr |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S01-01-1 | 139.500 | 1.500 | Open Manhole | 1200 | S1.000 | 138.000 | 225 | | | | |
| S01-01-2 | 139.690 | 1.827 | Open Manhole | 1200 | S1.001 | 137.863 | 225 | S1.000 | 137.863 | 225 | |
| S01-01-3 | 139.222 | 1.645 | Open Manhole | 1200 | S1.002 | 137.577 | 225 | S1.001 | 137.577 | 225 | |
| S01-01-4 | 138.634 | 1.506 | Open Manhole | 1200 | S1.003 | 137.128 | 225 | S1.002 | 137.128 | 225 | |
| S01-01-5 | 138.000 | 1.500 | Open Manhole | 1200 | S2.000 | 136.500 | 225 | | | | |
| S01-01-6 | 137.900 | 1.537 | Open Manhole | 1200 | S1.004 | 136.363 | 225 | S1.003 | 136.363 | 225 | |
| | | | | | | | | S2.000 | 136.363 | 225 | |
| S01-01-7 | 137.407 | 1.362 | Open Manhole | 1200 | S1.005 | 136.045 | 300 | S1.004 | 136.120 | 225 | |
| S01-01-8 | 138.145 | 2.401 | Open Manhole | 1200 | S1.006 | 135.744 | 300 | S1.005 | 135.744 | 300 | |
| S01-01-9 | 138.194 | 2.466 | Open Manhole | 1200 | S1.007 | 135.728 | 300 | S1.006 | 135.728 | 300 | |
| S01-01-10 | 138.677 | 3.060 | Open Manhole | 1200 | S1.008 | 135.617 | 300 | S1.007 | 135.617 | 300 | |
| S | 138.522 | 2.981 | Open Manhole | 0 | | OUTFALL | | S1.008 | 135.541 | 300 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S01-01-1 | 350957.704 | 528844.093 | 350957.704 | 528844.093 | Required |  |
| S01-01-2 | 350930.406 | 528845.939 | 350930.406 | 528845.939 | Required |  |
| S01-01-3 | 350888.079 | 528838.844 | 350888.079 | 528838.844 | Required |  |
| S01-01-4 | 350844.137 | 528829.690 | 350844.137 | 528829.690 | Required |  |
| S01-01-5 | 350749.680 | 528799.705 | 350749.680 | 528799.705 | Required |  |
| S01-01-6 | 350781.763 | 528811.362 | 350781.763 | 528811.362 | Required |  |
| S01-01-7 | 350771.602 | 528789.299 | 350771.602 | 528789.299 | Required |  |
| S01-01-8 | 350726.123 | 528749.826 | 350726.123 | 528749.826 | Required |  |

## Manhole Schedules for Pond 1-1

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S01-01-9 | 350724.694 | 528745.330 | 350724.694 | 528745.330 | Required |  |
| S01-01-10 | 350703.746 | 528719.342 | 350703.746 | 528719.342 | Required |  |
| S | 350693.388 | 528698.958 | | | No Entry |  |

## PIPELINE SCHEDULES for Pond 1-1

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | o | 225 | S01-01-1 | 139.500 | 138.000 | 1.275 | Open Manhole | 1200 |
| S1.001 | o | 225 | S01-01-2 | 139.690 | 137.863 | 1.602 | Open Manhole | 1200 |
| S1.002 | o | 225 | S01-01-3 | 139.222 | 137.577 | 1.420 | Open Manhole | 1200 |
| S1.003 | o | 225 | S01-01-4 | 138.634 | 137.128 | 1.281 | Open Manhole | 1200 |
| S2.000 | o | 225 | S01-01-5 | 138.000 | 136.500 | 1.275 | Open Manhole | 1200 |
| S1.004 | o | 225 | S01-01-6 | 137.900 | 136.363 | 1.312 | Open Manhole | 1200 |
| S1.005 | o | 300 | S01-01-7 | 137.407 | 136.045 | 1.062 | Open Manhole | 1200 |
| S1.006 | o | 300 | S01-01-8 | 138.145 | 135.744 | 2.101 | Open Manhole | 1200 |
| S1.007 | o | 300 | S01-01-9 | 138.194 | 135.728 | 2.166 | Open Manhole | 1200 |
| S1.008 | o | 300 | S01-01-10 | 138.677 | 135.617 | 2.760 | Open Manhole | 1200 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | 27.360 | 199.7 | S01-01-2 | 139.690 | 137.863 | 1.602 | Open Manhole | 1200 |
| S1.001 | 42.917 | 150.0 | S01-01-3 | 139.222 | 137.577 | 1.420 | Open Manhole | 1200 |
| S1.002 | 44.886 | 100.0 | S01-01-4 | 138.634 | 137.128 | 1.281 | Open Manhole | 1200 |
| S1.003 | 65.011 | 85.0 | S01-01-6 | 137.900 | 136.363 | 1.312 | Open Manhole | 1200 |
| S2.000 | 34.135 | 250.0 | S01-01-6 | 137.900 | 136.363 | 1.312 | Open Manhole | 1200 |
| S1.004 | 24.290 | 100.0 | S01-01-7 | 137.407 | 136.120 | 1.062 | Open Manhole | 1200 |
| S1.005 | 60.220 | 200.0 | S01-01-8 | 138.145 | 135.744 | 2.101 | Open Manhole | 1200 |
| S1.006 | 4.718 | 300.0 | S01-01-9 | 138.194 | 135.728 | 2.166 | Open Manhole | 1200 |
| S1.007 | 33.380 | 300.0 | S01-01-10 | 138.677 | 135.617 | 2.760 | Open Manhole | 1200 |
| S1.008 | 22.865 | 300.0 | S | 138.522 | 135.541 | 2.681 | Open Manhole | 0 |

## Area Summary for Pond 1-1

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | User | - | 100 | 0.044 | 0.044 | 0.044 |
| | User | - | 50 | 0.009 | 0.004 | 0.049 |
| 1.001 | User | - | 100 | 0.069 | 0.069 | 0.069 |
| | User | - | 50 | 0.012 | 0.006 | 0.075 |
| 1.002 | User | - | 100 | 0.076 | 0.076 | 0.076 |
| | User | - | 50 | 0.005 | 0.002 | 0.078 |
| 1.003 | User | - | 100 | 0.106 | 0.106 | 0.106 |
| 2.000 | User | - | 100 | 0.057 | 0.057 | 0.057 |
| 1.004 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.005 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.006 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.007 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.008 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total<br>0.377 | Total<br>0.365 | Total<br>0.365 |

## Free Flowing Outfall Details for Pond 1-1

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| S1.008 | S | 138.522 | 135.541 | 0.000 | 0 | 0 |

## Simulation Criteria for Pond 1-1

| | | | |
|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Additional Flow - % of Total Flow | 0.000 |
| Areal Reduction Factor | 1.000 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start (mins) | 0 | Inlet Coeffiecient | 0.800 |
| Hot Start Level (mm) | 0 | Flow per Person per Day (l/per/day) | 0.000 |
| Manhole Headloss Coeff (Global) | 0.500 | Run Time (mins) | 60 |
| Foul Sewage per hectare (l/s) | 0.000 | Output Interval (mins) | 1 |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

## Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Profile Type | Summer |
| Return Period (years) | 5 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.200 | Storm Duration (mins) | 30 |
| Ratio R | 0.300 | | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 1-1

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Ratio R | 0.300 |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 16.000 | Cv (Winter) | 0.840 |

| | | | |
|---|---|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 | DVD Status | OFF |
| Analysis Timestep | Fine | Inertia Status | OFF |
| DTS Status | ON | | |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5 |
| Climate Change (%) | 20 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| S1.000 | S01-01-1 | 15 Winter | 5 | +20% | | | | |
| S1.001 | S01-01-2 | 15 Winter | 5 | +20% | | | | |
| S1.002 | S01-01-3 | 15 Winter | 5 | +20% | | | | |
| S1.003 | S01-01-4 | 15 Winter | 5 | +20% | | | | |
| S2.000 | S01-01-5 | 15 Winter | 5 | +20% | | | | |
| S1.004 | S01-01-6 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| S1.005 | S01-01-7 | 15 Winter | 5 | +20% | | | | |
| S1.006 | S01-01-8 | 15 Winter | 5 | +20% | | | | |
| S1.007 | S01-01-9 | 15 Winter | 5 | +20% | | | | |
| S1.008 | S01-01-10 | 15 Winter | 5 | +20% | | | | |

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S01-01-1 | 138.083 | -0.142 | 0.000 | 0.28 | | | 9.7 | OK |
| S1.001 | S01-01-2 | 137.983 | -0.105 | 0.000 | 0.54 | | | 21.8 | OK |
| S1.002 | S01-01-3 | 137.717 | -0.085 | 0.000 | 0.69 | | | 34.4 | OK |
| S1.003 | S01-01-4 | 137.302 | -0.051 | 0.000 | 0.92 | | | 50.2 | OK |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 1-1

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S2.000 | S01-01-5 | 136.685 | -0.040 | 0.000 | 0.35 | | | 10.7 | OK |
| S1.004 | S01-01-6 | 136.667 | 0.079 | 0.000 | 1.16 | | | 55.7 | SURCHARGED |
| S1.005 | S01-01-7 | 136.240 | -0.106 | 0.000 | 0.74 | | | 54.8 | OK |
| S1.006 | S01-01-8 | 136.044 | 0.000 | 0.000 | 1.14 | | | 53.4 | OK |
| S1.007 | S01-01-9 | 135.957 | -0.072 | 0.000 | 0.90 | | | 52.8 | OK |
| S1.008 | S01-01-10 | 135.844 | -0.073 | 0.000 | 0.92 | | | 52.0 | OK |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| S1.000 | S01-01-1 | |
| S1.001 | S01-01-2 | |
| S1.002 | S01-01-3 | |
| S1.003 | S01-01-4 | |
| S2.000 | S01-01-5 | |
| S1.004 | S01-01-6 | |
| S1.005 | S01-01-7 | |
| S1.006 | S01-01-8 | |
| S1.007 | S01-01-9 | |
| S1.008 | S01-01-10 | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for System 1-2

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 15.900 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Time Area Diagram for System 1-2

| **Time (mins)** | **Area (ha)** | **Time (mins)** | **Area (ha)** | **Time (mins)** | **Area (ha)** |
|---|---|---|---|---|---|
| 0-4 | 0.372 | 4-8 | 0.486 | 8-12 | 0.019 |

Total Area Contributing (ha) = 0.878

Total Pipe Volume (m³) = 28.413

### Network Design Table for System 1-2

| **PN** | **Length (m)** | **Fall (m)** | **Slope (1:X)** | **I.Area (ha)** | **T.E. (mins)** | **Base Flow (l/s)** | **k (mm)** | **HYD SECT** | **DIA (mm)** | **Section Type** | **Auto Design** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 37.204 | 0.248 | 150.0 | 0.117 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S1.001 | 52.189 | 0.261 | 200.0 | 0.164 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.002 | 33.571 | 0.168 | 199.8 | 0.086 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.003 | 47.027 | 0.314 | 149.8 | 0.108 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.004 | 60.889 | 0.152 | 400.6 | 0.136 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |
| S1.005 | 16.365 | 0.409 | 40.0 | 0.013 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |

### Network Results Table

| **PN** | **Rain (mm/hr)** | **T.C. (mins)** | **US/IL (m)** | **Σ I.Area (ha)** | **Σ Base Flow (l/s)** | **Foul (l/s)** | **Add Flow (l/s)** | **Vel (m/s)** | **Cap (l/s)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 59.62 | 5.58 | 138.800 | 0.117 | 0.0 | 0.0 | 0.0 | 1.07 | 42.4 | 18.9 |
| S1.001 | 56.50 | 6.37 | 138.477 | 0.281 | 0.0 | 0.0 | 0.0 | 1.11 | 78.3 | 43.0 |
| S1.002 | 54.70 | 6.87 | 138.216 | 0.367 | 0.0 | 0.0 | 0.0 | 1.11 | 78.4 | 54.4 |
| S1.003 | 52.69 | 7.48 | 138.048 | 0.475 | 0.0 | 0.0 | 0.0 | 1.28 | 90.7 | 67.8 |
| S1.004 | 49.76 | 8.49 | 137.586 | 0.611 | 0.0 | 0.0 | 0.0 | 1.01 | 160.6 | 82.3 |
| S1.005 | 49.46 | 8.60 | 137.663 | 0.623 | 0.0 | 0.0 | 0.0 | 2.49 | 176.2 | 83.5 |

## Network Design Table for System 1-2

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S2.000 | 56.717 | 0.227 | 249.9 | 0.122 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.001 | 58.448 | 0.584 | 100.1 | 0.120 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.002 | 10.367 | 0.188 | 55.0 | 0.012 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S1.006 | 15.531 | 0.076 | 204.4 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S2.000 | 57.32 | 6.15 | 138.200 | 0.122 | 0.0 | 0.0 | 0.0 | 0.82 | 32.7 | 19.0 |
| S2.001 | 54.62 | 6.89 | 137.973 | 0.242 | 0.0 | 0.0 | 0.0 | 1.31 | 52.0 | 35.8 |
| S2.002 | 54.29 | 6.99 | 137.389 | 0.254 | 0.0 | 0.0 | 0.0 | 1.77 | 70.3 | 37.4 |
| S1.006 | 48.92 | 8.80 | 137.051 | 0.878 | 0.0 | 0.0 | 0.0 | 1.26 | 139.6 | 116.3 |

## Manhole Schedules for System 1-2

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Back (m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S01-02-1 | 140.298 | 1.498 | Open Manhole | 1200 | S1.000 | 138.800 | 225 | | | | |
| S01-02-2 | 139.896 | 1.419 | Open Manhole | 1200 | S1.001 | 138.477 | 300 | S1.000 | 138.552 | 225 | |
| S01-02-3 | 139.884 | 1.668 | Open Manhole | 1200 | S1.002 | 138.216 | 300 | S1.001 | 138.216 | 300 | |
| S01-02-4 | 139.975 | 1.927 | Open Manhole | 1200 | S1.003 | 138.048 | 300 | S1.002 | 138.048 | 300 | |
| S01-02-5 | 139.700 | 2.114 | Open Manhole | 1350 | S1.004 | 137.586 | 450 | S1.003 | 137.734 | 300 | |
| S01-02-6 | 139.300 | 1.866 | Open Manhole | 1350 | S1.005 | 137.663 | 300 | S1.004 | 137.434 | 450 | |
| S01-02-7 | 139.577 | 1.377 | Open Manhole | 1200 | S2.000 | 138.200 | 225 | | | | |
| S01-02-8 | 138.585 | 0.612 | Open Manhole | 1200 | S2.001 | 137.973 | 225 | S2.000 | 137.973 | 225 | |
| S01-02-9 | 138.959 | 1.570 | Open Manhole | 1200 | S2.002 | 137.389 | 225 | S2.001 | 137.389 | 225 | |
| S01-02-10 | 138.724 | 1.673 | Open Manhole | 1350 | S1.006 | 137.051 | 375 | S1.005 | 137.254 | 300 | |
| | | | | | | | | S2.002 | 137.201 | 225 | |
| S | 138.373 | 1.399 | Open Manhole | 0 | | OUTFALL | | S1.006 | 136.975 | 375 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S01-02-1 | 350938.359 | 528929.926 | 350938.359 | 528929.926 | Required |  |
| S01-02-2 | 350929.844 | 528893.709 | 350929.844 | 528893.709 | Required |  |
| S01-02-3 | 350879.719 | 528879.176 | 350879.719 | 528879.176 | Required |  |
| S01-02-4 | 350847.354 | 528870.258 | 350847.354 | 528870.258 | Required |  |
| S01-02-5 | 350802.112 | 528857.424 | 350802.112 | 528857.424 | Required |  |
| S01-02-6 | 350743.675 | 528840.317 | 350743.675 | 528840.317 | Required |  |
| S01-02-7 | 350622.879 | 528776.204 | 350622.879 | 528776.204 | Required |  |
| S01-02-8 | 350673.069 | 528802.619 | 350673.069 | 528802.619 | Required |  |

## Manhole Schedules for System 1-2

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S01-02-9 | 350726.626 | 528826.024 | 350726.626 | 528826.024 | Required |  |
| S01-02-10 | 350736.973 | 528825.387 | 350736.973 | 528825.387 | Required |  |
| S | 350742.405 | 528810.836 | | | No Entry |  |

## PIPELINE SCHEDULES for System 1-2

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | o | 225 | S01-02-1 | 140.298 | 138.800 | 1.273 | Open Manhole | 1200 |
| S1.001 | o | 300 | S01-02-2 | 139.896 | 138.477 | 1.119 | Open Manhole | 1200 |
| S1.002 | o | 300 | S01-02-3 | 139.884 | 138.216 | 1.368 | Open Manhole | 1200 |
| S1.003 | o | 300 | S01-02-4 | 139.975 | 138.048 | 1.627 | Open Manhole | 1200 |
| S1.004 | o | 450 | S01-02-5 | 139.700 | 137.586 | 1.664 | Open Manhole | 1350 |
| S1.005 | o | 300 | S01-02-6 | 139.300 | 137.663 | 1.337 | Open Manhole | 1350 |
| S2.000 | o | 225 | S01-02-7 | 139.577 | 138.200 | 1.152 | Open Manhole | 1200 |
| S2.001 | o | 225 | S01-02-8 | 138.585 | 137.973 | 0.387 | Open Manhole | 1200 |
| S2.002 | o | 225 | S01-02-9 | 138.959 | 137.389 | 1.345 | Open Manhole | 1200 |
| S1.006 | o | 375 | S01-02-10 | 138.724 | 137.051 | 1.298 | Open Manhole | 1350 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | 37.204 | 150.0 | S01-02-2 | 139.896 | 138.552 | 1.119 | Open Manhole | 1200 |
| S1.001 | 52.189 | 200.0 | S01-02-3 | 139.884 | 138.216 | 1.368 | Open Manhole | 1200 |
| S1.002 | 33.571 | 199.8 | S01-02-4 | 139.975 | 138.048 | 1.627 | Open Manhole | 1200 |
| S1.003 | 47.027 | 149.8 | S01-02-5 | 139.700 | 137.734 | 1.666 | Open Manhole | 1350 |
| S1.004 | 60.889 | 400.6 | S01-02-6 | 139.300 | 137.434 | 1.416 | Open Manhole | 1350 |
| S1.005 | 16.365 | 40.0 | S01-02-10 | 138.724 | 137.254 | 1.170 | Open Manhole | 1350 |
| S2.000 | 56.717 | 249.9 | S01-02-8 | 138.585 | 137.973 | 0.387 | Open Manhole | 1200 |
| S2.001 | 58.448 | 100.1 | S01-02-9 | 138.959 | 137.389 | 1.345 | Open Manhole | 1200 |
| S2.002 | 10.367 | 55.0 | S01-02-10 | 138.724 | 137.201 | 1.298 | Open Manhole | 1350 |
| S1.006 | 15.531 | 204.4 | S | 138.373 | 136.975 | 1.024 | Open Manhole | 0 |

## Area Summary for System 1-2

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | - | - | 100 | 0.117 | 0.117 | 0.117 |
| 1.001 | - | - | 100 | 0.164 | 0.164 | 0.164 |
| 1.002 | - | - | 100 | 0.086 | 0.086 | 0.086 |
| 1.003 | - | - | 100 | 0.108 | 0.108 | 0.108 |
| 1.004 | User | - | 100 | 0.117 | 0.117 | 0.117 |
|  | User | - | 50 | 0.035 | 0.017 | 0.134 |
|  | User | - | 25 | 0.005 | 0.001 | 0.136 |
| 1.005 | User | - | 100 | 0.013 | 0.013 | 0.013 |
| 2.000 | User | - | 100 | 0.116 | 0.116 | 0.116 |
|  | User | - | 50 | 0.006 | 0.003 | 0.119 |
|  | User | - | 25 | 0.014 | 0.003 | 0.122 |
| 2.001 | - | - | 100 | 0.120 | 0.120 | 0.120 |
| 2.002 | User | - | 100 | 0.012 | 0.012 | 0.012 |
| 1.006 | - | - | 100 | 0.000 | 0.000 | 0.000 |
|  |  |  |  | Total | Total | Total |
|  |  |  |  | 0.912 | 0.878 | 0.878 |

## Free Flowing Outfall Details for System 1-2

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| S1.006 | S | 138.373 | 136.975 | 0.000 | 0 | 0 |

## Simulation Criteria for System 1-2

| | | | |
|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Additional Flow - % of Total Flow | 0.000 |
| Areal Reduction Factor | 1.000 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start (mins) | 0 | Inlet Coeffiecient | 0.800 |
| Hot Start Level (mm) | 0 | Flow per Person per Day (l/per/day) | 0.000 |
| Manhole Headloss Coeff (Global) | 0.500 | Run Time (mins) | 60 |
| Foul Sewage per hectare (l/s) | 0.000 | Output Interval (mins) | 1 |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

## Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Profile Type | Summer |
| Return Period (years) | 5 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.200 | Storm Duration (mins) | 30 |
| Ratio R | 0.300 | | |

## Summary of Critical Results by Maximum Level (Rank 1) for System 1-2

### Simulation Criteria

```
          Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 0.000
                Hot Start (mins)     0     MADD Factor * 10m³/ha Storage 2.000
             Hot Start Level (mm)    0               Inlet Coeffiecient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
   Foul Sewage per hectare (l/s) 0.000

          Number of Input Hydrographs 0 Number of Storage Structures 0
            Number of Online Controls 0 Number of Time/Area Diagrams 0
           Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
        Rainfall Model               FSR      Ratio R 0.300
                Region England and Wales Cv (Summer) 0.750
            M5-60 (mm)            16.000 Cv (Winter) 0.840

   Margin for Flood Risk Warning (mm) 300.0      DVD Status OFF
                    Analysis Timestep  Fine Inertia Status OFF
                           DTS Status    ON


            Profile(s)                                Summer and Winter
      Duration(s) (mins)     15, 30, 60, 120, 180, 240, 360, 480, 600,
                               720, 960, 1440, 2160, 2880, 4320, 5760,
                                                      7200, 8640, 10080
   Return Period(s) (years)                                           5
      Climate Change (%)                                             20
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| S1.000 | S01-02-1 | 15 Winter | 5 | +20% | | | | |
| S1.001 | S01-02-2 | 15 Winter | 5 | +20% | | | | |
| S1.002 | S01-02-3 | 15 Winter | 5 | +20% | | | | |
| S1.003 | S01-02-4 | 15 Winter | 5 | +20% | | | | |
| S1.004 | S01-02-5 | 15 Winter | 5 | +20% | | | | |
| S1.005 | S01-02-6 | 15 Winter | 5 | +20% | | | | |
| S2.000 | S01-02-7 | 15 Winter | 5 | +20% | | | | |
| S2.001 | S01-02-8 | 15 Winter | 5 | +20% | | | | |
| S2.002 | S01-02-9 | 15 Winter | 5 | +20% | | | | |
| S1.006 | S01-02-10 | 15 Winter | 5 | +20% | 5/15 Summer | | | |

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S01-02-1 | 138.926 | -0.099 | 0.000 | 0.58 | | | 23.2 | OK |
| S1.001 | S01-02-2 | 138.662 | -0.115 | 0.000 | 0.67 | | | 49.4 | OK |
| S1.002 | S01-02-3 | 138.435 | -0.081 | 0.000 | 0.87 | | | 62.5 | OK |
| S1.003 | S01-02-4 | 138.275 | -0.073 | 0.000 | 0.91 | | | 77.8 | OK |

## Summary of Critical Results by Maximum Level (Rank 1) for System 1-2

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S1.004 | S01-02-5 | 137.900 | -0.136 | 0.000 | 0.63 | | | 93.2 | OK |
| S1.005 | S01-02-6 | 137.836 | -0.127 | 0.000 | 0.63 | | | 94.3 | OK |
| S2.000 | S01-02-7 | 138.352 | -0.073 | 0.000 | 0.73 | | | 23.2 | OK |
| S2.001 | S01-02-8 | 138.134 | -0.064 | 0.000 | 0.84 | | | 41.9 | OK |
| S2.002 | S01-02-9 | 137.542 | -0.072 | 0.000 | 0.73 | | | 43.1 | OK |
| S1.006 | S01-02-10 | 137.450 | 0.024 | 0.000 | 1.25 | | | 134.8 | SURCHARGED |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| S1.000 | S01-02-1 | |
| S1.001 | S01-02-2 | |
| S1.002 | S01-02-3 | |
| S1.003 | S01-02-4 | |
| S1.004 | S01-02-5 | |
| S1.005 | S01-02-6 | |
| S2.000 | S01-02-7 | |
| S2.001 | S01-02-8 | |
| S2.002 | S01-02-9 | |
| S1.006 | S01-02-10 | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for System 1-3

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 16.600 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Time Area Diagram for System 1-3

| **Time (mins)** | **Area (ha)** | **Time (mins)** | **Area (ha)** |
|---|---|---|---|
| 0-4 | 0.147 | 4-8 | 0.055 |

Total Area Contributing (ha) = 0.202

Total Pipe Volume (m³) = 5.502

### Network Design Table for System 1-3

| **PN** | **Length (m)** | **Fall (m)** | **Slope (1:X)** | **I.Area (ha)** | **T.E. (mins)** | **Base Flow (l/s)** | **k (mm)** | **HYD SECT** | **DIA (mm)** | **Section Type** | **Auto Design** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 24.722 | 0.494 | 50.0 | 0.069 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S1.001 | 59.289 | 2.964 | 20.0 | 0.088 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S1.002 | 24.950 | 0.062 | 402.4 | 0.033 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| S1.003 | 10.000 | 0.500 | 20.0 | 0.012 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |

### Network Results Table

| **PN** | **Rain (mm/hr)** | **T.C. (mins)** | **US/IL (m)** | **Σ I.Area (ha)** | **Σ Base Flow (l/s)** | **Foul (l/s)** | **Add Flow (l/s)** | **Vel (m/s)** | **Cap (l/s)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 63.90 | 5.22 | 139.000 | 0.069 | 0.0 | 0.0 | 0.0 | 1.85 | 73.7 | 11.9 |
| S1.001 | 62.36 | 5.56 | 138.506 | 0.157 | 0.0 | 0.0 | 0.0 | 2.94 | 116.9 | 26.5 |
| S1.002 | 60.08 | 6.09 | 135.467 | 0.190 | 0.0 | 0.0 | 0.0 | 0.78 | 55.0 | 30.9 |
| S1.003 | 59.85 | 6.15 | 135.405 | 0.202 | 0.0 | 0.0 | 0.0 | 2.94 | 116.9 | 32.8 |

## Manhole Schedules for System 1-3

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdr (mm |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S01-03-1 | 140.273 | 1.273 | Open Manhole | 1200 | S1.000 | 139.000 | 225 | | | | |
| S01-03-2 | 139.933 | 1.427 | Open Manhole | 1200 | S1.001 | 138.506 | 225 | S1.000 | 138.506 | 225 | |
| S01-03-3 | 138.012 | 2.545 | Open Manhole | 1200 | S1.002 | 135.467 | 300 | S1.001 | 135.542 | 225 | |
| S01-03-4 | 136.800 | 1.395 | Open Manhole | 1200 | S1.003 | 135.405 | 225 | S1.002 | 135.405 | 300 | |
| S | 136.391 | 1.486 | Open Manhole | 0 | | OUTFALL | | S1.003 | 134.905 | 225 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S01-03-1 | 350938.536 | 528935.905 | 350938.536 | 528935.905 | Required |  |
| S01-03-2 | 350934.231 | 528960.249 | 350934.231 | 528960.249 | Required |  |
| S01-03-3 | 350901.286 | 529009.543 | 350901.286 | 529009.543 | Required |  |
| S01-03-4 | 350886.943 | 529029.957 | 350886.943 | 529029.957 | Required |  |
| S | 350881.000 | 529038.000 | | | No Entry |  |

## PIPELINE SCHEDULES for System 1-3

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | o | 225 | S01-03-1 | 140.273 | 139.000 | 1.048 | Open Manhole | 1200 |
| S1.001 | o | 225 | S01-03-2 | 139.933 | 138.506 | 1.202 | Open Manhole | 1200 |
| S1.002 | o | 300 | S01-03-3 | 138.012 | 135.467 | 2.245 | Open Manhole | 1200 |
| S1.003 | o | 225 | S01-03-4 | 136.800 | 135.405 | 1.170 | Open Manhole | 1200 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | 24.722 | 50.0 | S01-03-2 | 139.933 | 138.506 | 1.202 | Open Manhole | 1200 |
| S1.001 | 59.289 | 20.0 | S01-03-3 | 138.012 | 135.542 | 2.246 | Open Manhole | 1200 |
| S1.002 | 24.950 | 402.4 | S01-03-4 | 136.800 | 135.405 | 1.095 | Open Manhole | 1200 |
| S1.003 | 10.000 | 20.0 | S | 136.391 | 134.905 | 1.261 | Open Manhole | 0 |

## Area Summary for System 1-3

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | User | - | 100 | 0.059 | 0.059 | 0.059 |
| | User | - | 50 | 0.019 | 0.010 | 0.068 |
| | User | - | 25 | 0.003 | 0.001 | 0.069 |
| 1.001 | User | - | 100 | 0.075 | 0.075 | 0.075 |
| | User | - | 50 | 0.024 | 0.012 | 0.087 |
| | User | - | 25 | 0.003 | 0.001 | 0.088 |
| 1.002 | User | - | 100 | 0.027 | 0.027 | 0.027 |
| | User | - | 50 | 0.010 | 0.005 | 0.032 |
| | User | - | 25 | 0.005 | 0.001 | 0.033 |
| 1.003 | User | - | 100 | 0.010 | 0.010 | 0.010 |
| | User | - | 50 | 0.004 | 0.002 | 0.012 |
| | User | - | 25 | 0.002 | 0.000 | 0.012 |
| | | | | Total<br>0.240 | Total<br>0.202 | Total<br>0.202 |

## Free Flowing Outfall Details for System 1-3

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| S1.003 | S | 136.391 | 134.905 | 0.000 | 0 | 0 |

## Simulation Criteria for System 1-3

| | | | |
|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Additional Flow - % of Total Flow | 0.000 |
| Areal Reduction Factor | 1.000 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start (mins) | 0 | Inlet Coeffiecient | 0.800 |
| Hot Start Level (mm) | 0 | Flow per Person per Day (l/per/day) | 0.000 |
| Manhole Headloss Coeff (Global) | 0.500 | Run Time (mins) | 60 |
| Foul Sewage per hectare (l/s) | 0.000 | Output Interval (mins) | 1 |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

## Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Profile Type | Summer |
| Return Period (years) | 5 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.200 | Storm Duration (mins) | 30 |
| Ratio R | 0.300 | | |

## Summary of Critical Results by Maximum Level (Rank 1) for System 1-3

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Ratio R | 0.300 |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 16.000 | Cv (Winter) | 0.840 |

| | | | |
|---|---|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 | DVD Status | OFF |
| Analysis Timestep | Fine | Inertia Status | OFF |
| DTS Status | ON | | |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5 |
| Climate Change (%) | 20 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S01-03-1 | 15 Winter | 5 | +20% | | | | | 139.069 |
| S1.001 | S01-03-2 | 15 Winter | 5 | +20% | | | | | 138.584 |
| S1.002 | S01-03-3 | 15 Winter | 5 | +20% | | | | | 135.655 |
| S1.003 | S01-03-4 | 15 Winter | 5 | +20% | | | | | 135.500 |

| PN | US/MH Name | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S01-03-1 | -0.156 | 0.000 | 0.21 | | | 14.0 | OK | |
| S1.001 | S01-03-2 | -0.147 | 0.000 | 0.26 | | | 28.8 | OK | |
| S1.002 | S01-03-3 | -0.112 | 0.000 | 0.70 | | | 34.4 | OK | |
| S1.003 | S01-03-4 | -0.130 | 0.000 | 0.37 | | | 36.3 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for System 1-4

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 15.900 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Time Area Diagram for System 1-4

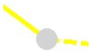
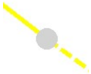
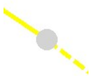
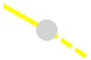
| **Time (mins)** | **Area (ha)** | **Time (mins)** | **Area (ha)** |
|---|---|---|---|
| 0-4 | 0.250 | 4-8 | 0.187 |

Total Area Contributing (ha) = 0.437

Total Pipe Volume (m³) = 9.755

## Manhole Schedules for System 1-4

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdr (mm |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S01-04-1 | 138.700 | 1.450 | Open Manhole | 1200 | S1.000 | 137.250 | 225 | | | | |
| S01-04-2 | 139.935 | 2.826 | Open Manhole | 1200 | S1.001 | 137.109 | 225 | S1.000 | 137.109 | 225 | |
| S01-04-3 | 139.749 | 2.784 | Open Manhole | 1200 | S1.002 | 136.965 | 225 | S1.001 | 136.965 | 225 | |
| S01-04-4 | 137.864 | 1.489 | Open Manhole | 1200 | S1.003 | 136.374 | 225 | S1.002 | 136.374 | 225 | |
| S01-04-5 | 135.875 | 2.225 | Open Manhole | 1350 | S1.004 | 133.650 | 450 | S1.003 | 133.908 | 225 | |
| S01-04-6 | 135.771 | 2.171 | Open Manhole | 1350 | S1.005 | 133.600 | 300 | S1.004 | 133.625 | 450 | |
| S | 135.727 | 2.178 | Open Manhole | 0 | | OUTFALL | | S1.005 | 133.549 | 300 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S01-04-1 | 351071.368 | 529050.694 | 351071.368 | 529050.694 | Required |  |
| S01-04-2 | 351042.282 | 529038.131 | 351042.282 | 529038.131 | Required |  |
| S01-04-3 | 351009.969 | 529041.927 | 351009.969 | 529041.927 | Required |  |
| S01-04-4 | 350953.042 | 529084.082 | 350953.042 | 529084.082 | Required |  |
| S01-04-5 | 350904.642 | 529121.888 | 350904.642 | 529121.888 | Required |  |
| S01-04-6 | 350896.397 | 529127.495 | 350896.397 | 529127.495 | Required |  |
| S | 350892.000 | 529130.000 | | | No Entry |  |

## PIPELINE SCHEDULES for System 1-4

### Upstream Manhole

| **PN** | **Hyd Sect** | **Diam (mm)** | **MH Name** | **C.Level (m)** | **I.Level (m)** | **D.Depth (m)** | **MH Connection** | **MH DIAM., L*W (mm)** |
|---|---|---|---|---|---|---|---|---|
| S1.000 | o | 225 | S01-04-1 | 138.700 | 137.250 | 1.225 | Open Manhole | 1200 |
| S1.001 | o | 225 | S01-04-2 | 139.935 | 137.109 | 2.601 | Open Manhole | 1200 |
| S1.002 | o | 225 | S01-04-3 | 139.749 | 136.965 | 2.559 | Open Manhole | 1200 |
| S1.003 | o | 225 | S01-04-4 | 137.864 | 136.374 | 1.264 | Open Manhole | 1200 |
| S1.004 | o | 450 | S01-04-5 | 135.875 | 133.650 | 1.775 | Open Manhole | 1350 |
| S1.005 | o | 300 | S01-04-6 | 135.771 | 133.600 | 1.871 | Open Manhole | 1350 |

### Downstream Manhole

| **PN** | **Length (m)** | **Slope (1:X)** | **MH Name** | **C.Level (m)** | **I.Level (m)** | **D.Depth (m)** | **MH Connection** | **MH DIAM., L*W (mm)** |
|---|---|---|---|---|---|---|---|---|
| S1.000 | 31.683 | 225.0 | S01-04-2 | 139.935 | 137.109 | 2.601 | Open Manhole | 1200 |
| S1.001 | 32.536 | 225.0 | S01-04-3 | 139.749 | 136.965 | 2.559 | Open Manhole | 1200 |
| S1.002 | 70.836 | 120.0 | S01-04-4 | 137.864 | 136.374 | 1.264 | Open Manhole | 1200 |
| S1.003 | 61.415 | 24.9 | S01-04-5 | 135.875 | 133.908 | 1.742 | Open Manhole | 1350 |
| S1.004 | 9.971 | 398.8 | S01-04-6 | 135.771 | 133.625 | 1.696 | Open Manhole | 1350 |
| S1.005 | 5.060 | 99.2 | S | 135.727 | 133.549 | 1.878 | Open Manhole | 0 |

## Area Summary for System 1-4

| **Pipe Number** | **PIMP Type** | **PIMP Name** | **PIMP (%)** | **Gross Area (ha)** | **Imp. Area (ha)** | **Pipe Total (ha)** |
|---|---|---|---|---|---|---|
| 1.000 | User | - | 100 | 0.066 | 0.066 | 0.066 |
| | User | - | 50 | 0.031 | 0.016 | 0.082 |
| 1.001 | User | - | 100 | 0.074 | 0.074 | 0.074 |
| | User | - | 50 | 0.032 | 0.016 | 0.089 |
| 1.002 | User | - | 100 | 0.112 | 0.112 | 0.112 |
| | User | - | 50 | 0.056 | 0.028 | 0.141 |
| | User | - | 25 | 0.011 | 0.003 | 0.143 |
| 1.003 | User | - | 100 | 0.085 | 0.085 | 0.085 |
| | User | - | 50 | 0.045 | 0.022 | 0.107 |
| | User | - | 25 | 0.006 | 0.002 | 0.109 |
| 1.004 | User | - | 100 | 0.011 | 0.011 | 0.011 |
| | User | - | 50 | 0.005 | 0.003 | 0.014 |
| | User | - | 25 | 0.001 | 0.000 | 0.014 |
| 1.005 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total | Total | Total |
| | | | | 0.535 | 0.437 | 0.437 |

## Free Flowing Outfall Details for System 1-4

| **Outfall Pipe Number** | **Outfall Name** | **C. Level (m)** | **I. Level (m)** | **Min I. Level (m)** | **D,L (mm)** | **W (mm)** |
|---|---|---|---|---|---|---|
| S1.005 | S | 135.727 | 133.549 | 0.000 | 0 | 0 |

## Simulation Criteria for System 1-4

| | | | |
|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Additional Flow - % of Total Flow | 0.000 |
| Areal Reduction Factor | 1.000 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start (mins) | 0 | Inlet Coeffiecient | 0.800 |
| Hot Start Level (mm) | 0 | Flow per Person per Day (l/per/day) | 0.000 |
| Manhole Headloss Coeff (Global) | 0.500 | Run Time (mins) | 60 |
| Foul Sewage per hectare (l/s) | 0.000 | Output Interval (mins) | 1 |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

## Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Profile Type | Summer |
| Return Period (years) | 5 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.200 | Storm Duration (mins) | 30 |
| Ratio R | 0.300 | | |

## Summary of Critical Results by Maximum Level (Rank 1) for System 1-4

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 0
Number of Online Controls 0 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.300
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 16.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5
Climate Change (%) 20

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S01-04-1 | 15 Winter | 5 | +20% | | | | | 137.368 |
| S1.001 | S01-04-2 | 15 Winter | 5 | +20% | | | | | 137.334 |
| S1.002 | S01-04-3 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 137.234 |
| S1.003 | S01-04-4 | 15 Winter | 5 | +20% | | | | | 136.504 |
| S1.004 | S01-04-5 | 15 Winter | 5 | +20% | | | | | 133.930 |
| S1.005 | S01-04-6 | 15 Winter | 5 | +20% | 5/15 Winter | | | | 133.900 |

| PN | US/MH Name | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S01-04-1 | -0.107 | 0.000 | 0.50 | | | 16.1 | OK | |
| S1.001 | S01-04-2 | 0.000 | 0.000 | 0.85 | | | 27.4 | OK | |
| S1.002 | S01-04-3 | 0.044 | 0.000 | 1.03 | | | 47.5 | SURCHARGED | |
| S1.003 | S01-04-4 | -0.095 | 0.000 | 0.62 | | | 63.0 | OK | |
| S1.004 | S01-04-5 | -0.170 | 0.000 | 0.67 | | | 64.9 | OK | |
| S1.005 | S01-04-6 | 0.000 | 0.000 | 1.05 | | | 64.3 | SURCHARGED | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for System 1-5

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 16.200 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Time Area Diagram for System 1-5

| Time (mins) | Area (ha) | Time (mins) | Area (ha) |
|---|---|---|---|
| 0-4 | 0.504 | 4-8 | 0.380 |

Total Area Contributing (ha) = 0.884

Total Pipe Volume (m³) = 29.505

### Network Design Table for System 1-5

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 15.229 | 0.381 | 40.0 | 0.037 | 5.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| S2.000 | 20.488 | 0.350 | 58.5 | 0.501 | 5.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| S1.001 | 45.939 | 0.115 | 399.5 | 0.023 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔒 |
| S1.002 | 52.196 | 2.088 | 25.0 | 0.090 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.003 | 63.190 | 3.160 | 20.0 | 0.081 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 62.92 | 5.10 | 136.800 | 0.037 | 0.0 | 0.0 | 0.0 | 2.49 | 176.3 | 6.3 |
| S2.000 | 62.62 | 5.17 | 136.400 | 0.501 | 0.0 | 0.0 | 0.0 | 2.06 | 145.5 | 84.9 |
| S1.001 | 59.83 | 5.80 | 136.119 | 0.561 | 0.0 | 0.0 | 0.0 | 1.21 | 342.7 | 90.9 |
| S1.002 | 58.71 | 6.07 | 136.004 | 0.651 | 0.0 | 0.0 | 0.0 | 3.16 | 223.2 | 103.6 |
| S1.003 | 57.55 | 6.37 | 133.916 | 0.732 | 0.0 | 0.0 | 0.0 | 3.53 | 249.6 | 114.1 |

## Network Design Table for System 1-5

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.004 | 41.277 | 1.588 | 26.0 | 0.082 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.005 | 41.277 | 0.826 | 50.0 | 0.070 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |

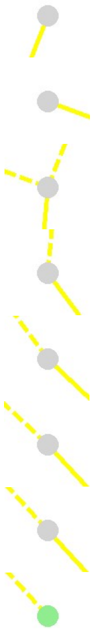
## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.004 | 56.73 | 6.59 | 130.757 | 0.814 | 0.0 | 0.0 | 0.0 | 3.10 | 218.8 | 125.1 |
| S1.005 | 55.62 | 6.90 | 129.169 | 0.884 | 0.0 | 0.0 | 0.0 | 2.23 | 157.6 | 133.1 |

## Manhole Schedules for System 1-5

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdr (mm |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S01-05-1 | 138.298 | 1.498 | Open Manhole | 1200 | S1.000 | 136.800 | 300 | | | | |
| S01-05-2 | 137.969 | 1.569 | Open Manhole | 1200 | S2.000 | 136.400 | 300 | | | | |
| S01-05-3 | 138.348 | 2.298 | Open Manhole | 1500 | S1.001 | 136.119 | 600 | S1.000 | 136.419 | 300 | |
| | | | | | | | | S2.000 | 136.050 | 300 | |
| S01-05-4 | 138.065 | 2.061 | Open Manhole | 1500 | S1.002 | 136.004 | 300 | S1.001 | 136.004 | 600 | |
| S01-05-5 | 135.874 | 1.958 | Open Manhole | 1200 | S1.003 | 133.916 | 300 | S1.002 | 133.916 | 300 | |
| S01-05-6 | 132.717 | 1.960 | Open Manhole | 1200 | S1.004 | 130.757 | 300 | S1.003 | 130.757 | 300 | |
| S01-05-7 | 130.721 | 1.552 | Open Manhole | 1200 | S1.005 | 129.169 | 300 | S1.004 | 129.169 | 300 | |
| S | 129.607 | 1.264 | Open Manhole | 0 | | OUTFALL | | S1.005 | 128.343 | 300 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S01-05-1 | 351177.763 | 528952.997 | 351177.763 | 528952.997 | Required | |
| S01-05-2 | 351153.000 | 528946.000 | 351153.000 | 528946.000 | Required | |
| S01-05-3 | 351172.190 | 528938.825 | 351172.190 | 528938.825 | Required | |
| S01-05-4 | 351168.085 | 528893.070 | 351168.085 | 528893.070 | Required | |
| S01-05-5 | 351199.182 | 528851.148 | 351199.182 | 528851.148 | Required | |
| S01-05-6 | 351245.172 | 528807.814 | 351245.172 | 528807.814 | Required | |
| S01-05-7 | 351273.086 | 528777.407 | 351273.086 | 528777.407 | Required | |
| S | 351301.000 | 528747.000 | | | No Entry | |



## PIPELINE SCHEDULES for System 1-5

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | o | 300 | S01-05-1 | 138.298 | 136.800 | 1.198 | Open Manhole | 1200 |
| S2.000 | o | 300 | S01-05-2 | 137.969 | 136.400 | 1.269 | Open Manhole | 1200 |
| S1.001 | o | 600 | S01-05-3 | 138.348 | 136.119 | 1.629 | Open Manhole | 1500 |
| S1.002 | o | 300 | S01-05-4 | 138.065 | 136.004 | 1.761 | Open Manhole | 1500 |
| S1.003 | o | 300 | S01-05-5 | 135.874 | 133.916 | 1.658 | Open Manhole | 1200 |
| S1.004 | o | 300 | S01-05-6 | 132.717 | 130.757 | 1.660 | Open Manhole | 1200 |
| S1.005 | o | 300 | S01-05-7 | 130.721 | 129.169 | 1.252 | Open Manhole | 1200 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | 15.229 | 40.0 | S01-05-3 | 138.348 | 136.419 | 1.629 | Open Manhole | 1500 |
| S2.000 | 20.488 | 58.5 | S01-05-3 | 138.348 | 136.050 | 1.998 | Open Manhole | 1500 |
| S1.001 | 45.939 | 399.5 | S01-05-4 | 138.065 | 136.004 | 1.461 | Open Manhole | 1500 |
| S1.002 | 52.196 | 25.0 | S01-05-5 | 135.874 | 133.916 | 1.658 | Open Manhole | 1200 |
| S1.003 | 63.190 | 20.0 | S01-05-6 | 132.717 | 130.757 | 1.660 | Open Manhole | 1200 |
| S1.004 | 41.277 | 26.0 | S01-05-7 | 130.721 | 129.169 | 1.252 | Open Manhole | 1200 |
| S1.005 | 41.277 | 50.0 | S | 129.607 | 128.343 | 0.964 | Open Manhole | 0 |

## Area Summary for System 1-5

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | User | - | 100 | 0.033 | 0.033 | 0.033 |
| | User | - | 50 | 0.008 | 0.004 | 0.037 |
| 2.000 | User | - | 100 | 0.501 | 0.501 | 0.501 |
| 1.001 | User | - | 50 | 0.046 | 0.023 | 0.023 |
| 1.002 | User | - | 100 | 0.061 | 0.061 | 0.061 |
| | User | - | 50 | 0.058 | 0.029 | 0.090 |
| 1.003 | User | - | 100 | 0.074 | 0.074 | 0.074 |
| | User | - | 50 | 0.015 | 0.007 | 0.081 |
| 1.004 | User | - | 100 | 0.077 | 0.077 | 0.077 |
| | User | - | 50 | 0.004 | 0.002 | 0.079 |
| | User | - | 50 | 0.006 | 0.003 | 0.082 |
| 1.005 | User | - | 50 | 0.045 | 0.022 | 0.022 |
| | User | - | 100 | 0.047 | 0.047 | 0.070 |
| | | | | Total | Total | Total |
| | | | | 0.975 | 0.884 | 0.884 |

## Free Flowing Outfall Details for System 1-5

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| S1.005 | S | 129.607 | 128.343 | 0.000 | 0 | 0 |

## Simulation Criteria for System 1-5

| | | | |
|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Additional Flow - % of Total Flow | 0.000 |
| Areal Reduction Factor | 1.000 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start (mins) | 0 | Inlet Coeffiecient | 0.800 |
| Hot Start Level (mm) | 0 | Flow per Person per Day (l/per/day) | 0.000 |
| Manhole Headloss Coeff (Global) | 0.500 | Run Time (mins) | 60 |
| Foul Sewage per hectare (l/s) | 0.000 | Output Interval (mins) | 1 |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

## Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Profile Type | Summer |
| Return Period (years) | 5 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.200 | Storm Duration (mins) | 30 |
| Ratio R | 0.300 | | |

## Summary of Critical Results by Maximum Level (Rank 1) for System 1-5

### Simulation Criteria

Areal Reduction Factor 1.000
Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0
MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0
Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500
Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0
Number of Storage Structures 0
Number of Online Controls 0
Number of Time/Area Diagrams 0
Number of Offline Controls 0
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
Ratio R 0.300
Region England and Wales
Cv (Summer) 0.750
M5-60 (mm) 16.000
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
DVD Status OFF
Analysis Timestep Fine
Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 1
Climate Change (%) 20

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S01-05-1 | 15 Winter | 1 | +20% | | | | | 136.834 |
| S2.000 | S01-05-2 | 15 Winter | 1 | +20% | | | | | 136.547 |
| S1.001 | S01-05-3 | 15 Winter | 1 | +20% | | | | | 136.313 |
| S1.002 | S01-05-4 | 15 Winter | 1 | +20% | | | | | 136.127 |
| S1.003 | S01-05-5 | 15 Winter | 1 | +20% | | | | | 134.038 |
| S1.004 | S01-05-6 | 15 Winter | 1 | +20% | | | | | 130.896 |
| S1.005 | S01-05-7 | 15 Winter | 1 | +20% | | | | | 129.346 |

| PN | US/MH Name | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S01-05-1 | -0.266 | 0.000 | 0.03 | | | 4.5 | OK | |
| S2.000 | S01-05-2 | -0.153 | 0.000 | 0.47 | | | 60.2 | OK | |
| S1.001 | S01-05-3 | -0.406 | 0.000 | 0.22 | | | 66.1 | OK | |
| S1.002 | S01-05-4 | -0.177 | 0.000 | 0.35 | | | 74.0 | OK | |
| S1.003 | S01-05-5 | -0.178 | 0.000 | 0.34 | | | 82.0 | OK | |
| S1.004 | S01-05-6 | -0.160 | 0.000 | 0.44 | | | 89.6 | OK | |
| S1.005 | S01-05-7 | -0.123 | 0.000 | 0.65 | | | 95.4 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for System 1-6

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 16.500 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Time Area Diagram for System 1-6

| **Time (mins)** | **Area (ha)** | **Time (mins)** | **Area (ha)** |
|---|---|---|---|
| 0-4 | 0.561 | 4-8 | 0.527 |

Total Area Contributing (ha) = 1.089

Total Pipe Volume (m³) = 45.560

### Network Design Table for System 1-6

| **PN** | **Length (m)** | **Fall (m)** | **Slope (1:X)** | **I.Area (ha)** | **T.E. (mins)** | **Base Flow (l/s)** | **k (mm)** | **HYD SECT** | **DIA (mm)** | **Section Type** | **Auto Design** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 59.991 | 0.857 | 70.0 | 0.075 | 5.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| S1.001 | 30.134 | 1.004 | 30.0 | 0.032 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.002 | 5.017 | 0.251 | 20.0 | 0.016 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| S2.000 | 24.885 | 0.124 | 200.0 | 0.400 | 5.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| S1.003 | 29.323 | 0.098 | 299.2 | 0.035 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔒 |

### Network Results Table

| **PN** | **Rain (mm/hr)** | **T.C. (mins)** | **US/IL (m)** | **Σ I.Area (ha)** | **Σ Base Flow (l/s)** | **Foul (l/s)** | **Add Flow (l/s)** | **Vel (m/s)** | **Cap (l/s)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 62.10 | 5.53 | 138.200 | 0.075 | 0.0 | 0.0 | 0.0 | 1.88 | 133.0 | 12.6 |
| S1.001 | 61.34 | 5.71 | 137.343 | 0.107 | 0.0 | 0.0 | 0.0 | 2.88 | 203.7 | 17.8 |
| S1.002 | 61.23 | 5.73 | 136.339 | 0.123 | 0.0 | 0.0 | 0.0 | 3.53 | 249.6 | 20.4 |
| S2.000 | 62.81 | 5.37 | 136.200 | 0.400 | 0.0 | 0.0 | 0.0 | 1.11 | 78.3 | 68.1 |
| S1.003 | 59.78 | 6.08 | 135.776 | 0.558 | 0.0 | 0.0 | 0.0 | 1.40 | 396.6 | 90.4 |

## Network Design Table for System 1-6

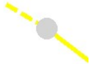
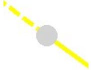
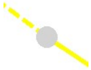
| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.004 | 45.777 | 0.153 | 299.2 | 0.090 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔒 |
| S1.005 | 70.246 | 1.405 | 50.0 | 0.148 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| S1.006 | 81.655 | 2.722 | 30.0 | 0.160 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.007 | 72.216 | 3.981 | 18.1 | 0.133 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.004 | 57.67 | 6.62 | 135.678 | 0.648 | 0.0 | 0.0 | 0.0 | 1.40 | 396.6 | 101.2 |
| S1.005 | 55.80 | 7.15 | 135.525 | 0.796 | 0.0 | 0.0 | 0.0 | 2.23 | 157.5 | 120.3 |
| S1.006 | 54.25 | 7.62 | 134.120 | 0.956 | 0.0 | 0.0 | 0.0 | 2.88 | 203.7 | 140.4 |
| S1.007 | 53.24 | 7.94 | 131.398 | 1.089 | 0.0 | 0.0 | 0.0 | 3.71 | 262.2 | 156.9 |

## Manhole Schedules for System 1-6

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdr (mm |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S01-06-1 | 139.711 | 1.511 | Open Manhole | 1200 | S1.000 | 138.200 | 300 | | | | |
| S01-06-2 | 139.117 | 1.774 | Open Manhole | 1200 | S1.001 | 137.343 | 300 | S1.000 | 137.343 | 300 | |
| S01-06-3 | 139.150 | 2.812 | Open Manhole | 1200 | S1.002 | 136.339 | 300 | S1.001 | 136.339 | 300 | |
| S01-06-4 | 137.790 | 1.590 | Open Manhole | 1200 | S2.000 | 136.200 | 300 | | | | |
| S01-06-5 | 138.921 | 3.145 | Open Manhole | 1500 | S1.003 | 135.776 | 600 | S1.002 | 136.088 | 300 | |
| | | | | | | | | S2.000 | 136.076 | 300 | |
| S01-06-6 | 138.856 | 3.178 | Open Manhole | 1500 | S1.004 | 135.678 | 600 | S1.003 | 135.678 | 600 | |
| S01-06-7 | 138.446 | 2.921 | Open Manhole | 1500 | S1.005 | 135.525 | 300 | S1.004 | 135.525 | 600 | |
| S01-06-8 | 135.965 | 1.845 | Open Manhole | 1200 | S1.006 | 134.120 | 300 | S1.005 | 134.120 | 300 | |
| S01-06-9 | 133.809 | 2.411 | Open Manhole | 1200 | S1.007 | 131.398 | 300 | S1.006 | 131.398 | 300 | |
| S9 | 129.294 | 1.876 | Open Manhole | 1200 | | OUTFALL | | S1.007 | 127.417 | 300 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S01-06-1 | 350935.810 | 528846.383 | 350935.810 | 528846.383 | Required |  |
| S01-06-2 | 350995.133 | 528837.458 | 350995.133 | 528837.458 | Required |  |
| S01-06-3 | 351025.016 | 528833.575 | 351025.016 | 528833.575 | Required |  |
| S01-06-4 | 351023.932 | 528857.134 | 351023.932 | 528857.134 | Required |  |
| S01-06-5 | 351030.000 | 528833.000 | 351030.000 | 528833.000 | Required |  |
| S01-06-6 | 351058.752 | 528827.241 | 351058.752 | 528827.241 | Required |  |
| S01-06-7 | 351098.143 | 528803.919 | 351098.143 | 528803.919 | Required |  |
| S01-06-8 | 351154.062 | 528761.404 | 351154.062 | 528761.404 | Required |  |
| S01-06-9 | 351219.826 | 528713.004 | 351219.826 | 528713.004 | Required |  |

## Manhole Schedules for System 1-6

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S9 | 351279.976 | 528673.039 | | | No Entry |  |

## PIPELINE SCHEDULES for System 1-6

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | o | 300 | S01-06-1 | 139.711 | 138.200 | 1.211 | Open Manhole | 1200 |
| S1.001 | o | 300 | S01-06-2 | 139.117 | 137.343 | 1.474 | Open Manhole | 1200 |
| S1.002 | o | 300 | S01-06-3 | 139.150 | 136.339 | 2.511 | Open Manhole | 1200 |
| S2.000 | o | 300 | S01-06-4 | 137.790 | 136.200 | 1.290 | Open Manhole | 1200 |
| S1.003 | o | 600 | S01-06-5 | 138.921 | 135.776 | 2.545 | Open Manhole | 1500 |
| S1.004 | o | 600 | S01-06-6 | 138.856 | 135.678 | 2.578 | Open Manhole | 1500 |
| S1.005 | o | 300 | S01-06-7 | 138.446 | 135.525 | 2.621 | Open Manhole | 1500 |
| S1.006 | o | 300 | S01-06-8 | 135.965 | 134.120 | 1.545 | Open Manhole | 1200 |
| S1.007 | o | 300 | S01-06-9 | 133.809 | 131.398 | 2.111 | Open Manhole | 1200 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | 59.991 | 70.0 | S01-06-2 | 139.117 | 137.343 | 1.474 | Open Manhole | 1200 |
| S1.001 | 30.134 | 30.0 | S01-06-3 | 139.150 | 136.339 | 2.512 | Open Manhole | 1200 |
| S1.002 | 5.017 | 20.0 | S01-06-5 | 138.921 | 136.088 | 2.533 | Open Manhole | 1500 |
| S2.000 | 24.885 | 200.0 | S01-06-5 | 138.921 | 136.076 | 2.546 | Open Manhole | 1500 |
| S1.003 | 29.323 | 299.2 | S01-06-6 | 138.856 | 135.678 | 2.578 | Open Manhole | 1500 |
| S1.004 | 45.777 | 299.2 | S01-06-7 | 138.446 | 135.525 | 2.321 | Open Manhole | 1500 |
| S1.005 | 70.246 | 50.0 | S01-06-8 | 135.965 | 134.120 | 1.545 | Open Manhole | 1200 |
| S1.006 | 81.655 | 30.0 | S01-06-9 | 133.809 | 131.398 | 2.111 | Open Manhole | 1200 |
| S1.007 | 72.216 | 18.1 | S9 | 129.294 | 127.417 | 1.576 | Open Manhole | 1200 |

## Area Summary for System 1-6

| **Pipe Number** | **PIMP Type** | **PIMP Name** | **PIMP (%)** | **Gross Area (ha)** | **Imp. Area (ha)** | **Pipe Total (ha)** |
|---|---|---|---|---|---|---|
| 1.000 | User | - | 100 | 0.056 | 0.056 | 0.056 |
| | User | - | 50 | 0.038 | 0.019 | 0.075 |
| 1.001 | User | - | 100 | 0.023 | 0.023 | 0.023 |
| | User | - | 50 | 0.018 | 0.009 | 0.032 |
| 1.002 | User | - | 50 | 0.032 | 0.016 | 0.016 |
| 2.000 | User | - | 100 | 0.400 | 0.400 | 0.400 |
| 1.003 | User | - | 100 | 0.035 | 0.035 | 0.035 |
| 1.004 | User | - | 100 | 0.078 | 0.078 | 0.078 |
| | User | - | 50 | 0.023 | 0.011 | 0.090 |
| 1.005 | User | - | 100 | 0.109 | 0.109 | 0.109 |
| | User | - | 50 | 0.053 | 0.026 | 0.136 |
| | User | - | 25 | 0.047 | 0.012 | 0.148 |
| 1.006 | User | - | 100 | 0.120 | 0.120 | 0.120 |
| | User | - | 25 | 0.085 | 0.021 | 0.141 |
| | User | - | 50 | 0.037 | 0.019 | 0.160 |
| 1.007 | User | - | 100 | 0.093 | 0.093 | 0.093 |
| | User | - | 25 | 0.080 | 0.020 | 0.113 |
| | User | - | 50 | 0.040 | 0.020 | 0.133 |
| | | | | Total<br>1.368 | Total<br>1.089 | Total<br>1.089 |

## Free Flowing Outfall Details for System 1-6

| **Outfall Pipe Number** | **Outfall Name** | **C. Level (m)** | **I. Level (m)** | **Min I. Level (m)** | **D,L (mm)** | **W (mm)** |
|---|---|---|---|---|---|---|
| S1.007 | S9 | 129.294 | 127.417 | 0.000 | 1200 | 0 |

## Simulation Criteria for System 1-6

| | | | |
|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Additional Flow - % of Total Flow | 0.000 |
| Areal Reduction Factor | 1.000 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start (mins) | 0 | Inlet Coeffiecient | 0.800 |
| Hot Start Level (mm) | 0 | Flow per Person per Day (l/per/day) | 0.000 |
| Manhole Headloss Coeff (Global) | 0.500 | Run Time (mins) | 60 |
| Foul Sewage per hectare (l/s) | 0.000 | Output Interval (mins) | 1 |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

## Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Ratio R | 0.300 |
| Return Period (years) | 5 | Profile Type | Summer |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 15.200 | Cv (Winter) | 0.840 |

## Synthetic Rainfall Details

Storm Duration (mins) 30

## Summary of Critical Results by Maximum Level (Rank 1) for System 1-6

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Ratio R | 0.300 |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 16.000 | Cv (Winter) | 0.840 |

| | | | |
|---|---|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 | DVD Status | OFF |
| Analysis Timestep | Fine | Inertia Status | OFF |
| DTS Status | ON | | |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5 |
| Climate Change (%) | 20 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S01-06-1 | 15 Winter | 5 | +20% | | | | | 138.269 |
| S1.001 | S01-06-2 | 15 Winter | 5 | +20% | | | | | 137.410 |
| S1.002 | S01-06-3 | 15 Winter | 5 | +20% | | | | | 136.426 |
| S2.000 | S01-06-4 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 136.527 |
| S1.003 | S01-06-5 | 15 Winter | 5 | +20% | | | | | 136.018 |
| S1.004 | S01-06-6 | 15 Winter | 5 | +20% | | | | | 135.925 |
| S1.005 | S01-06-7 | 15 Winter | 5 | +20% | | | | | 135.754 |
| S1.006 | S01-06-8 | 15 Winter | 5 | +20% | | | | | 134.329 |
| S1.007 | S01-06-9 | 15 Winter | 5 | +20% | | | | | 131.586 |

| PN | US/MH Name | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S01-06-1 | -0.231 | 0.000 | 0.12 | | | 14.8 | OK | |
| S1.001 | S01-06-2 | -0.233 | 0.000 | 0.11 | | | 20.4 | OK | |
| S1.002 | S01-06-3 | -0.213 | 0.000 | 0.19 | | | 23.2 | OK | |
| S2.000 | S01-06-4 | 0.027 | 0.000 | 1.14 | | | 79.8 | SURCHARGED | |
| S1.003 | S01-06-5 | -0.358 | 0.000 | 0.33 | | | 107.1 | OK | |

## Summary of Critical Results by Maximum Level (Rank 1) for System 1-6

| PN | US/MH Name | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|
| S1.004 | S01-06-6 | -0.353 | 0.000 | 0.35 | | | 119.9 | OK | |
| S1.005 | S01-06-7 | -0.071 | 0.000 | 0.93 | | | 139.7 | OK | |
| S1.006 | S01-06-8 | -0.091 | 0.000 | 0.82 | | | 160.4 | OK | |
| S1.007 | S01-06-9 | -0.112 | 0.000 | 0.71 | | | 177.3 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for Pond 2-1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 16.700 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

## Time Area Diagram for Pond 2-1

| **Time (mins)** | **Area (ha)** | **Time (mins)** | **Area (ha)** | **Time (mins)** | **Area (ha)** | **Time (mins)** | **Area (ha)** | **Time (mins)** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|---|
| 0-4 | 0.351 | 4-8 | 1.373 | 8-12 | 3.564 | 12-16 | 1.113 | 16-20 | 0.018 |

Total Area Contributing (ha) = 6.419

Total Pipe Volume (m³) = 643.602

## Network Design Table for Pond 2-1

« - Indicates pipe capacity < flow

| **PN** | **Length (m)** | **Fall (m)** | **Slope (1:X)** | **I.Area (ha)** | **T.E. (mins)** | **Base Flow (l/s)** | **k (mm)** | **HYD SECT** | **DIA (mm)** | **Section Type** | **Auto Design** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S18.000 | 59.157 | 1.479 | 40.0 | 0.078 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S18.001 | 47.602 | 1.442 | 33.0 | 0.068 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S19.000 | 31.401 | 0.628 | 50.0 | 0.044 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S19.001 | 42.300 | 0.846 | 50.0 | 0.057 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |

## Network Results Table

| **PN** | **Rain (mm/hr)** | **T.C. (mins)** | **US/IL (m)** | **Σ I.Area (ha)** | **Σ Base Flow (l/s)** | **Foul (l/s)** | **Add Flow (l/s)** | **Vel (m/s)** | **Cap (l/s)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|
| S18.000 | 63.11 | 5.48 | 133.900 | 0.078 | 0.0 | 0.0 | 0.0 | 2.07 | 82.5 | 13.3 |
| S18.001 | 61.58 | 5.82 | 132.421 | 0.145 | 0.0 | 0.0 | 0.0 | 2.28 | 90.9 | 24.2 |
| S19.000 | 64.00 | 5.28 | 134.200 | 0.044 | 0.0 | 0.0 | 0.0 | 1.85 | 73.7 | 7.6 |
| S19.001 | 62.27 | 5.66 | 133.572 | 0.101 | 0.0 | 0.0 | 0.0 | 1.85 | 73.7 | 17.0 |

## Network Design Table for Pond 2-1

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S19.002 | 50.686 | 0.366 | 138.5 | 0.072 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S20.000 | 60.017 | 1.012 | 59.3 | 0.165 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S20.001 | 49.235 | 0.615 | 80.1 | 0.075 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S20.002 | 46.999 | 0.513 | 91.6 | 0.067 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S19.003 | 19.298 | 1.381 | 14.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S18.002 | 50.529 | 2.197 | 23.0 | 0.072 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S18.003 | 59.685 | 2.984 | 20.0 | 0.088 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S18.004 | 59.083 | 2.110 | 28.0 | 0.093 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S18.005 | 11.913 | 0.060 | 198.6 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S21.000 | 65.138 | 1.024 | 63.6 | 0.139 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S21.001 | 54.905 | 1.018 | 53.9 | 0.062 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S21.002 | 60.080 | 3.162 | 19.0 | 0.074 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S22.000 | 24.865 | 0.414 | 60.0 | 0.028 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S22.001 | 10.755 | 0.931 | 11.5 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S22.002 | 50.324 | 0.629 | 80.0 | 0.069 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S22.003 | 51.249 | 0.256 | 200.0 | 0.059 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S19.002 | 59.13 | 6.42 | 132.726 | 0.173 | 0.0 | 0.0 | 0.0 | 1.11 | 44.1 | 27.8 |
| S20.000 | 62.60 | 5.59 | 134.500 | 0.165 | 0.0 | 0.0 | 0.0 | 1.70 | 67.7 | 28.0 |
| S20.001 | 60.60 | 6.05 | 133.413 | 0.241 | 0.0 | 0.0 | 0.0 | 1.76 | 124.3 | 39.5 |
| S20.002 | 58.72 | 6.53 | 132.798 | 0.307 | 0.0 | 0.0 | 0.0 | 1.64 | 116.2 | 48.9 |
| S19.003 | 58.43 | 6.61 | 132.285 | 0.481 | 0.0 | 0.0 | 0.0 | 4.23 | 298.8 | 76.1 |
| S18.002 | 57.49 | 6.86 | 130.904 | 0.698 | 0.0 | 0.0 | 0.0 | 3.29 | 232.7 | 108.7 |
| S18.003 | 56.49 | 7.14 | 128.707 | 0.786 | 0.0 | 0.0 | 0.0 | 3.53 | 249.6 | 120.3 |
| S18.004 | 55.52 | 7.43 | 125.648 | 0.880 | 0.0 | 0.0 | 0.0 | 3.44 | 379.5 | 132.3 |
| S18.005 | 55.01 | 7.59 | 123.538 | 0.880 | 0.0 | 0.0 | 0.0 | 1.28 | 141.6 | 132.3 |
| S21.000 | 62.28 | 5.66 | 135.200 | 0.139 | 0.0 | 0.0 | 0.0 | 1.64 | 65.3 | 23.5 |
| S21.001 | 60.12 | 6.17 | 134.176 | 0.201 | 0.0 | 0.0 | 0.0 | 1.78 | 71.0 | 32.8 |
| S21.002 | 59.03 | 6.45 | 133.083 | 0.275 | 0.0 | 0.0 | 0.0 | 3.62 | 256.1 | 44.0 |
| S22.000 | 64.18 | 5.24 | 133.900 | 0.028 | 0.0 | 0.0 | 0.0 | 1.69 | 67.3 | 4.8 |
| S22.001 | 63.96 | 5.29 | 133.486 | 0.028 | 0.0 | 0.0 | 0.0 | 3.87 | 154.0 | 4.8 |
| S22.002 | 61.40 | 5.86 | 132.554 | 0.096 | 0.0 | 0.0 | 0.0 | 1.46 | 58.2 | 16.0 |
| S22.003 | 57.74 | 6.79 | 131.925 | 0.156 | 0.0 | 0.0 | 0.0 | 0.92 | 36.6 | 24.3 |

## Network Design Table for Pond 2-1

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S23.000 | 65.514 | 1.310 | 50.0 | 0.064 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S23.001 | 50.187 | 2.007 | 25.0 | 0.051 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S22.004 | 15.983 | 1.776 | 9.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S21.003 | 79.499 | 2.741 | 29.0 | 0.107 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S21.004 | 60.583 | 2.423 | 25.0 | 0.082 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S21.005 | 20.017 | 1.329 | 15.1 | 0.041 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S18.006 | 11.657 | 0.466 | 25.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S24.000 | 50.167 | 0.201 | 249.6 | 0.074 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S24.001 | 60.117 | 0.601 | 100.0 | 0.078 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S24.002 | 49.547 | 0.854 | 58.0 | 0.060 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S24.003 | 1.897 | 0.201 | 9.4 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S25.000 | 60.349 | 0.609 | 99.1 | 0.095 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S25.001 | 38.752 | 0.230 | 168.4 | 0.053 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S25.002 | 60.008 | 0.602 | 99.7 | 0.085 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S25.003 | 10.915 | 0.121 | 90.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S24.004 | 30.818 | 0.614 | 50.2 | 0.043 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S23.000 | 62.60 | 5.59 | 135.000 | 0.064 | 0.0 | 0.0 | 0.0 | 1.85 | 73.7 | 10.8 |
| S23.001 | 61.22 | 5.91 | 133.690 | 0.114 | 0.0 | 0.0 | 0.0 | 2.63 | 104.5 | 19.0 |
| S22.004 | 57.52 | 6.85 | 131.669 | 0.270 | 0.0 | 0.0 | 0.0 | 4.39 | 174.5 | 42.1 |
| S21.003 | 55.94 | 7.30 | 129.818 | 0.652 | 0.0 | 0.0 | 0.0 | 2.93 | 207.2 | 98.8 |
| S21.004 | 54.89 | 7.62 | 127.077 | 0.734 | 0.0 | 0.0 | 0.0 | 3.16 | 223.2 | 109.2 |
| S21.005 | 54.63 | 7.71 | 124.653 | 0.776 | 0.0 | 0.0 | 0.0 | 4.07 | 287.8 | 114.7 |
| S18.006 | 54.48 | 7.75 | 123.174 | 1.655 | 0.0 | 0.0 | 0.0 | 4.08 | 648.6 | 244.2 |
| S24.000 | 60.76 | 6.02 | 127.500 | 0.074 | 0.0 | 0.0 | 0.0 | 0.82 | 32.7 | 12.1 |
| S24.001 | 57.78 | 6.78 | 127.299 | 0.152 | 0.0 | 0.0 | 0.0 | 1.31 | 52.0 | 23.7 |
| S24.002 | 56.09 | 7.26 | 126.698 | 0.211 | 0.0 | 0.0 | 0.0 | 1.72 | 68.4 | 32.1 |
| S24.003 | 56.06 | 7.27 | 125.844 | 0.211 | 0.0 | 0.0 | 0.0 | 4.28 | 170.4 | 32.1 |
| S25.000 | 61.82 | 5.77 | 127.205 | 0.095 | 0.0 | 0.0 | 0.0 | 1.31 | 52.2 | 16.0 |
| S25.001 | 59.19 | 6.41 | 126.596 | 0.148 | 0.0 | 0.0 | 0.0 | 1.00 | 39.9 | 23.8 |
| S25.002 | 56.40 | 7.17 | 126.366 | 0.234 | 0.0 | 0.0 | 0.0 | 1.31 | 52.1 | 35.7 |
| S25.003 | 56.02 | 7.28 | 125.689 | 0.234 | 0.0 | 0.0 | 0.0 | 1.66 | 117.2 | 35.7 |
| S24.004 | 55.25 | 7.51 | 125.568 | 0.488 | 0.0 | 0.0 | 0.0 | 2.23 | 157.3 | 73.0 |

## Network Design Table for Pond 2-1

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S24.005 | 49.727 | 1.156 | 43.0 | 0.172 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S24.006 | 50.023 | 0.610 | 82.0 | 0.096 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S26.000 | 66.291 | 1.657 | 40.0 | 0.113 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S26.001 | 52.855 | 1.057 | 50.0 | 0.114 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S26.002 | 40.209 | 0.134 | 300.1 | 0.089 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S26.003 | 12.556 | 0.042 | 300.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S24.007 | 23.392 | 0.404 | 57.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S18.007 | 56.096 | 0.113 | 496.4 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔓 |
| S18.008 | 35.282 | 0.071 | 497.7 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔓 |
| S18.009 | 101.884 | 0.206 | 494.2 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔓 |
| S18.010 | 85.197 | 0.170 | 500.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔓 |
| S18.011 | 89.118 | 0.178 | 500.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔓 |
| S18.012 | 90.381 | 0.181 | 499.3 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔓 |
| S27.000 | 23.036 | 0.781 | 29.5 | 0.030 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S27.001 | 46.186 | 2.004 | 23.0 | 0.059 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S27.002 | 41.038 | 1.576 | 26.0 | 0.051 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S27.003 | 48.224 | 1.871 | 25.8 | 0.066 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S27.004 | 46.423 | 1.717 | 27.0 | 0.064 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S24.005 | 54.15 | 7.86 | 124.953 | 0.660 | 0.0 | 0.0 | 0.0 | 2.40 | 170.0 | 96.8 |
| S24.006 | 52.89 | 8.27 | 123.722 | 0.756 | 0.0 | 0.0 | 0.0 | 2.00 | 221.1 | 108.3 |
| S26.000 | 62.85 | 5.53 | 126.300 | 0.113 | 0.0 | 0.0 | 0.0 | 2.07 | 82.5 | 19.3 |
| S26.001 | 60.80 | 6.01 | 124.643 | 0.228 | 0.0 | 0.0 | 0.0 | 1.85 | 73.7 | 37.5 |
| S26.002 | 58.26 | 6.65 | 123.436 | 0.316 | 0.0 | 0.0 | 0.0 | 1.04 | 114.9 | 49.9 |
| S26.003 | 57.52 | 6.85 | 123.302 | 0.316 | 0.0 | 0.0 | 0.0 | 1.04 | 115.0 | 49.9 |
| S24.007 | 52.42 | 8.44 | 123.112 | 1.072 | 0.0 | 0.0 | 0.0 | 2.38 | 263.4 | 152.2 |
| S18.007 | 50.37 | 9.19 | 122.333 | 2.727 | 0.0 | 0.0 | 0.0 | 1.25 | 551.9 | 372.0 |
| S18.008 | 49.17 | 9.66 | 122.220 | 2.727 | 0.0 | 0.0 | 0.0 | 1.25 | 551.1 | 372.0 |
| S18.009 | 46.10 | 11.01 | 122.149 | 2.727 | 0.0 | 0.0 | 0.0 | 1.25 | 553.1 | 372.0 |
| S18.010 | 43.85 | 12.15 | 121.943 | 2.727 | 0.0 | 0.0 | 0.0 | 1.24 | 549.9 | 372.0 |
| S18.011 | 41.77 | 13.35 | 121.772 | 2.727 | 0.0 | 0.0 | 0.0 | 1.24 | 549.9 | 372.0 |
| S18.012 | 39.89 | 14.56 | 121.594 | 2.727 | 0.0 | 0.0 | 0.0 | 1.25 | 550.2 | 372.0 |
| S27.000 | 64.59 | 5.16 | 148.000 | 0.030 | 0.0 | 0.0 | 0.0 | 2.42 | 96.1 | 5.2 |
| S27.001 | 63.27 | 5.44 | 147.219 | 0.088 | 0.0 | 0.0 | 0.0 | 2.74 | 108.8 | 15.1 |
| S27.002 | 62.08 | 5.71 | 145.215 | 0.139 | 0.0 | 0.0 | 0.0 | 2.57 | 102.4 | 23.4 |
| S27.003 | 60.76 | 6.02 | 143.638 | 0.205 | 0.0 | 0.0 | 0.0 | 2.59 | 102.9 | 33.7 |
| S27.004 | 59.52 | 6.32 | 141.768 | 0.268 | 0.0 | 0.0 | 0.0 | 2.53 | 100.4 | 43.3 |

## Network Design Table for Pond 2-1

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S27.005 | 50.829 | 1.779 | 28.6 | 0.113 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S27.006 | 38.942 | 0.161 | 241.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S27.007 | 30.629 | 0.469 | 65.3 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S28.000 | 41.633 | 1.665 | 25.0 | 0.072 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S28.001 | 42.074 | 1.465 | 28.7 | 0.057 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S28.002 | 29.069 | 0.969 | 30.0 | 0.045 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S28.003 | 34.790 | 0.984 | 35.3 | 0.060 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S28.004 | 30.558 | 1.307 | 23.4 | 0.061 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S28.005 | 29.867 | 0.867 | 34.4 | 0.066 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S27.008 | 34.458 | 0.459 | 75.0 | 0.071 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S27.009 | 77.174 | 0.309 | 249.8 | 0.182 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔒 |
| S27.010 | 84.446 | 0.338 | 250.0 | 0.171 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| S27.011 | 60.923 | 0.244 | 250.0 | 0.129 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| S27.012 | 59.680 | 0.239 | 250.0 | 0.146 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| S27.013 | 67.247 | 0.269 | 250.0 | 0.186 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| S27.014 | 72.682 | 0.182 | 399.4 | 0.205 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| S27.015 | 74.595 | 0.186 | 401.0 | 0.151 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| S27.016 | 92.325 | 0.231 | 399.7 | 0.194 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |
| S27.017 | 62.427 | 0.156 | 400.2 | 0.138 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |
| S27.018 | 21.696 | 0.217 | 100.0 | 0.067 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S27.005 | 58.42 | 6.61 | 139.976 | 0.381 | 0.0 | 0.0 | 0.0 | 2.95 | 208.7 | 60.3 |
| S27.006 | 56.12 | 7.25 | 138.197 | 0.381 | 0.0 | 0.0 | 0.0 | 1.01 | 71.1 | 60.3 |
| S27.007 | 55.24 | 7.52 | 138.036 | 0.381 | 0.0 | 0.0 | 0.0 | 1.95 | 137.7 | 60.3 |
| S28.000 | 64.09 | 5.26 | 144.900 | 0.072 | 0.0 | 0.0 | 0.0 | 2.63 | 104.5 | 12.4 |
| S28.001 | 62.77 | 5.55 | 143.235 | 0.129 | 0.0 | 0.0 | 0.0 | 2.45 | 97.4 | 21.9 |
| S28.002 | 62.19 | 5.68 | 141.545 | 0.174 | 0.0 | 0.0 | 0.0 | 3.72 | 592.1 | 29.3 |
| S28.003 | 61.46 | 5.85 | 140.576 | 0.235 | 0.0 | 0.0 | 0.0 | 3.43 | 545.3 | 39.0 |
| S28.004 | 60.95 | 5.97 | 139.592 | 0.296 | 0.0 | 0.0 | 0.0 | 4.22 | 671.0 | 48.8 |
| S28.005 | 60.36 | 6.11 | 138.285 | 0.362 | 0.0 | 0.0 | 0.0 | 3.47 | 552.4 | 59.2 |
| S27.008 | 54.45 | 7.76 | 137.417 | 0.814 | 0.0 | 0.0 | 0.0 | 2.35 | 373.7 | 120.0 |
| S27.009 | 51.75 | 8.67 | 136.910 | 0.995 | 0.0 | 0.0 | 0.0 | 1.41 | 305.8 | 139.5 |
| S27.010 | 49.15 | 9.67 | 136.601 | 1.167 | 0.0 | 0.0 | 0.0 | 1.41 | 305.7 | 155.3 |
| S27.011 | 47.46 | 10.39 | 136.263 | 1.295 | 0.0 | 0.0 | 0.0 | 1.41 | 305.7 | 166.5 |
| S27.012 | 45.94 | 11.09 | 136.020 | 1.441 | 0.0 | 0.0 | 0.0 | 1.41 | 305.7 | 179.2 |
| S27.013 | 44.36 | 11.89 | 135.781 | 1.627 | 0.0 | 0.0 | 0.0 | 1.41 | 305.7 | 195.5 |
| S27.014 | 42.40 | 12.97 | 135.512 | 1.833 | 0.0 | 0.0 | 0.0 | 1.11 | 241.3 | 210.4 |
| S27.015 | 40.59 | 14.09 | 135.330 | 1.984 | 0.0 | 0.0 | 0.0 | 1.11 | 240.8 | 218.1 |
| S27.016 | 38.76 | 15.36 | 135.069 | 2.178 | 0.0 | 0.0 | 0.0 | 1.21 | 342.7 | 228.6 |
| S27.017 | 37.63 | 16.22 | 134.838 | 2.316 | 0.0 | 0.0 | 0.0 | 1.21 | 342.4 | 236.0 |
| S27.018 | 37.44 | 16.37 | 134.682 | 2.383 | 0.0 | 0.0 | 0.0 | 2.44 | 688.6 | 241.6 |

## Network Design Table for Pond 2-1

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S27.019 | 17.541 | 0.199 | 88.3 | 0.000 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |
| S29.000 | 26.325 | 0.105 | 250.0 | 0.103 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S29.001 | 39.146 | 0.130 | 300.0 | 0.089 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S29.002 | 34.872 | 0.116 | 300.0 | 0.067 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S29.003 | 16.119 | 0.054 | 300.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S29.004 | 42.382 | 0.141 | 300.0 | 0.083 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S29.005 | 59.544 | 0.149 | 400.0 | 0.120 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S29.006 | 70.581 | 0.176 | 401.0 | 0.157 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S29.007 | 49.975 | 0.125 | 399.8 | 0.115 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S29.008 | 70.059 | 0.175 | 400.0 | 0.141 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S29.009 | 70.042 | 0.175 | 400.2 | 0.118 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S29.010 | 60.042 | 0.150 | 400.3 | 0.098 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S29.011 | 60.041 | 0.150 | 400.3 | 0.100 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S29.012 | 50.030 | 0.125 | 400.2 | 0.082 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S29.013 | 22.250 | 0.237 | 93.9 | 0.036 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S27.020 | 16.054 | 0.229 | 70.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |
| S27.021 | 16.020 | 1.232 | 13.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |
| S27.022 | 81.886 | 10.109 | 8.1 | 0.000 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |
| S27.023 | 3.293 | 1.029 | 3.2 | 0.000 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S27.019 | 37.30 | 16.48 | 134.465 | 2.383 | 0.0 | 0.0 | 0.0 | 2.59 | 732.8 | 241.6 |
| S29.000 | 62.84 | 5.53 | 136.800 | 0.103 | 0.0 | 0.0 | 0.0 | 0.82 | 32.7 | 17.5 |
| S29.001 | 59.79 | 6.26 | 136.620 | 0.192 | 0.0 | 0.0 | 0.0 | 0.90 | 63.8 | 31.1 |
| S29.002 | 57.35 | 6.90 | 136.489 | 0.259 | 0.0 | 0.0 | 0.0 | 0.90 | 63.8 | 40.2 |
| S29.003 | 56.31 | 7.20 | 136.373 | 0.259 | 0.0 | 0.0 | 0.0 | 0.90 | 63.8 | 40.2 |
| S29.004 | 53.77 | 7.98 | 136.319 | 0.342 | 0.0 | 0.0 | 0.0 | 0.90 | 63.8 | 49.8 |
| S29.005 | 50.96 | 8.96 | 136.028 | 0.462 | 0.0 | 0.0 | 0.0 | 1.01 | 160.7 | 63.7 |
| S29.006 | 48.05 | 10.13 | 135.879 | 0.619 | 0.0 | 0.0 | 0.0 | 1.01 | 160.5 | 80.6 |
| S29.007 | 46.23 | 10.95 | 135.703 | 0.734 | 0.0 | 0.0 | 0.0 | 1.01 | 160.7 | 91.9 |
| S29.008 | 43.94 | 12.11 | 135.578 | 0.874 | 0.0 | 0.0 | 0.0 | 1.01 | 160.7 | 104.0 |
| S29.009 | 41.91 | 13.26 | 135.403 | 0.992 | 0.0 | 0.0 | 0.0 | 1.01 | 160.6 | 112.6 |
| S29.010 | 40.34 | 14.26 | 135.228 | 1.090 | 0.0 | 0.0 | 0.0 | 1.01 | 160.6 | 119.1 |
| S29.011 | 38.91 | 15.25 | 135.078 | 1.190 | 0.0 | 0.0 | 0.0 | 1.01 | 160.6 | 125.4 |
| S29.012 | 37.81 | 16.07 | 134.928 | 1.272 | 0.0 | 0.0 | 0.0 | 1.01 | 160.6 | 130.3 |
| S29.013 | 37.59 | 16.25 | 134.803 | 1.308 | 0.0 | 0.0 | 0.0 | 2.10 | 333.8 | 133.2 |
| S27.020 | 37.19 | 16.57 | 134.266 | 3.691 | 0.0 | 0.0 | 0.0 | 2.91 | 823.7 | 371.8 |
| S27.021 | 37.14 | 16.61 | 134.037 | 3.691 | 0.0 | 0.0 | 0.0 | 6.78 | 1916.3 | 371.8 |
| S27.022 | 36.94 | 16.77 | 132.805 | 3.691 | 0.0 | 0.0 | 0.0 | 8.59 | 2428.7 | 371.8 |
| S27.023 | 36.94 | 16.77 | 122.695 | 3.691 | 0.0 | 0.0 | 0.0 | 13.67 | 3866.3 | 371.8 |

## Network Design Table for Pond 2-1

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S18.013 | 5.498 | 0.011 | 499.8 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔒 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S18.013 | 36.85 | 16.85 | 121.294 | 6.419 | 0.0 | 0.0 | 0.0 | 1.24 | 550.0« | 640.6 |

## Manhole Schedules for Pond 2-1

| **MH Name** | **MH CL (m)** | **MH Depth (m)** | **MH Connection** | **MH Diam.,L*W (mm)** | **PN** | **Pipe Out Invert Level (m)** | **Diameter (mm)** | **PN** | **Pipes In Invert Level (m)** | **Diameter (mm)** | **Bac** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S02-01-4 | 135.418 | 1.518 | Open Manhole | 1200 | S18.000 | 133.900 | 225 | | | | |
| S02-01-5 | 134.018 | 1.597 | Open Manhole | 1200 | S18.001 | 132.421 | 225 | S18.000 | 132.421 | 225 | |
| S02-01-6 | 135.766 | 1.566 | Open Manhole | 1200 | S19.000 | 134.200 | 225 | | | | |
| S02-01-7 | 135.171 | 1.599 | Open Manhole | 1200 | S19.001 | 133.572 | 225 | S19.000 | 133.572 | 225 | |
| S02-01-8 | 134.400 | 1.674 | Open Manhole | 1200 | S19.002 | 132.726 | 225 | S19.001 | 132.726 | 225 | |
| S02-01-9 | 136.148 | 1.648 | Open Manhole | 1200 | S20.000 | 134.500 | 225 | | | | |
| S02-01-10 | 135.043 | 1.630 | Open Manhole | 1200 | S20.001 | 133.413 | 300 | S20.000 | 133.488 | 225 | |
| S02-01-11 | 134.298 | 1.500 | Open Manhole | 1200 | S20.002 | 132.798 | 300 | S20.001 | 132.798 | 300 | |
| S02-01-12 | 134.071 | 1.786 | Open Manhole | 1200 | S19.003 | 132.285 | 300 | S19.002 | 132.360 | 225 | |
| | | | | | | | | S20.002 | 132.285 | 300 | |
| S02-01-13 | 132.423 | 1.519 | Open Manhole | 1200 | S18.002 | 130.904 | 300 | S18.001 | 130.979 | 225 | |
| | | | | | | | | S19.003 | 130.904 | 300 | |
| S02-01-14 | 130.269 | 1.562 | Open Manhole | 1200 | S18.003 | 128.707 | 300 | S18.002 | 128.707 | 300 | |
| S02-01-15 | 127.413 | 1.765 | Open Manhole | 1350 | S18.004 | 125.648 | 375 | S18.003 | 125.723 | 300 | |
| S02-01-16 | 125.200 | 1.662 | Open Manhole | 1350 | S18.005 | 123.538 | 375 | S18.004 | 123.538 | 375 | |
| S02-01-17 | 136.706 | 1.506 | Open Manhole | 1200 | S21.000 | 135.200 | 225 | | | | |
| S02-01-18 | 135.858 | 1.682 | Open Manhole | 1200 | S21.001 | 134.176 | 225 | S21.000 | 134.176 | 225 | |
| S02-01-19 | 134.583 | 1.500 | Open Manhole | 1200 | S21.002 | 133.083 | 300 | S21.001 | 133.158 | 225 | |
| S02-01-20 | 135.400 | 1.500 | Open Manhole | 1200 | S22.000 | 133.900 | 225 | | | | |
| S02-01-21 | 135.257 | 1.772 | Open Manhole | 1200 | S22.001 | 133.486 | 225 | S22.000 | 133.486 | 225 | |
| S02-01-22 | 133.979 | 1.425 | Open Manhole | 1200 | S22.002 | 132.554 | 225 | S22.001 | 132.554 | 225 | |
| S02-01-23 | 135.030 | 3.105 | Open Manhole | 1200 | S22.003 | 131.925 | 225 | S22.002 | 131.925 | 225 | |
| S02-01-24 | 136.520 | 1.520 | Open Manhole | 1200 | S23.000 | 135.000 | 225 | | | | |
| S02-01-25 | 135.487 | 1.797 | Open Manhole | 1200 | S23.001 | 133.690 | 225 | S23.000 | 133.690 | 225 | |
| S02-01-26 | 134.983 | 3.314 | Open Manhole | 1200 | S22.004 | 131.669 | 225 | S22.003 | 131.669 | 225 | |
| | | | | | | | | S23.001 | 131.682 | 225 | |
| S02-01-27 | 132.510 | 2.692 | Open Manhole | 1200 | S21.003 | 129.818 | 300 | S21.002 | 129.921 | 300 | |
| | | | | | | | | S22.004 | 129.893 | 225 | |
| S02-01-28 | 128.909 | 1.832 | Open Manhole | 1200 | S21.004 | 127.077 | 300 | S21.003 | 127.077 | 300 | |
| S02-01-29 | 126.286 | 1.633 | Open Manhole | 1200 | S21.005 | 124.653 | 300 | S21.004 | 124.653 | 300 | |
| S02-01-30 | 125.708 | 2.534 | Open Manhole | 1350 | S18.006 | 123.174 | 450 | S18.005 | 123.478 | 375 | |
| | | | | | | | | S21.005 | 123.324 | 300 | |
| S02-01-31 | 129.045 | 1.545 | Open Manhole | 1200 | S24.000 | 127.500 | 225 | | | | |
| S02-01-32 | 128.925 | 1.626 | Open Manhole | 1200 | S24.001 | 127.299 | 225 | S24.000 | 127.299 | 225 | |
| S02-01-33 | 128.155 | 1.457 | Open Manhole | 1200 | S24.002 | 126.698 | 225 | S24.001 | 126.698 | 225 | |
| S02-01-34 | 127.032 | 1.188 | Open Manhole | 1200 | S24.003 | 125.844 | 225 | S24.002 | 125.844 | 225 | |
| S02-01-35 | 128.555 | 1.350 | Open Manhole | 1200 | S25.000 | 127.205 | 225 | | | | |
| S02-01-36 | 128.315 | 1.719 | Open Manhole | 1200 | S25.001 | 126.596 | 225 | S25.000 | 126.596 | 225 | |

## Manhole Schedules for Pond 2-1

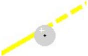
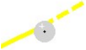
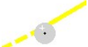
| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Ba |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S02-01-37 | 127.998 | 1.632 | Open Manhole | 1200 | S25.002 | 126.366 | 225 | S25.001 | 126.366 | 225 | |
| S02-01-38 | 127.114 | 1.425 | Open Manhole | 1350 | S25.003 | 125.689 | 300 | S25.002 | 125.764 | 225 | |
| S02-01-39 | 127.019 | 1.451 | Open Manhole | 1200 | S24.004 | 125.568 | 300 | S24.003 | 125.643 | 225 | |
| | | | | | | | | S25.003 | 125.568 | 300 | |
| S02-01-40 | 126.378 | 1.425 | Open Manhole | 1200 | S24.005 | 124.953 | 300 | S24.004 | 124.953 | 300 | |
| S02-01-41 | 125.149 | 1.427 | Open Manhole | 1350 | S24.006 | 123.722 | 375 | S24.005 | 123.797 | 300 | |
| S02-01-42 | 127.866 | 1.566 | Open Manhole | 1200 | S26.000 | 126.300 | 225 | | | | |
| S02-01-43 | 125.788 | 1.145 | Open Manhole | 1200 | S26.001 | 124.643 | 225 | S26.000 | 124.643 | 225 | |
| S02-01-44 | 124.950 | 1.514 | Open Manhole | 1350 | S26.002 | 123.436 | 375 | S26.001 | 123.586 | 225 | |
| S02-01-45 | 125.000 | 1.698 | Open Manhole | 1350 | S26.003 | 123.302 | 375 | S26.002 | 123.302 | 375 | |
| S02-01-46 | 125.440 | 2.328 | Open Manhole | 1350 | S24.007 | 123.112 | 375 | S24.006 | 123.112 | 375 | |
| | | | | | | | | S26.003 | 123.260 | 375 | |
| S02-01-47 | 126.384 | 4.051 | Open Manhole | 1800 | S18.007 | 122.333 | 750 | S18.006 | 122.708 | 450 | |
| | | | | | | | | S24.007 | 122.708 | 375 | |
| S02-01-48 | 135.085 | 12.865 | Open Manhole | 1800 | S18.008 | 122.220 | 750 | S18.007 | 122.220 | 750 | |
| S02-01-49 | 133.485 | 11.336 | Open Manhole | 1800 | S18.009 | 122.149 | 750 | S18.008 | 122.149 | 750 | |
| S02-01-50 | 133.997 | 12.054 | Open Manhole | 1800 | S18.010 | 121.943 | 750 | S18.009 | 121.943 | 750 | |
| S02-01-51 | 135.496 | 13.724 | Open Manhole | 1800 | S18.011 | 121.772 | 750 | S18.010 | 121.772 | 750 | |
| S02-01-52 | 134.284 | 12.690 | Open Manhole | 1800 | S18.012 | 121.594 | 750 | S18.011 | 121.594 | 750 | |
| S02-01-53 | 149.549 | 1.549 | Open Manhole | 1200 | S27.000 | 148.000 | 225 | | | | |
| S02-01-54 | 148.765 | 1.546 | Open Manhole | 1200 | S27.001 | 147.219 | 225 | S27.000 | 147.219 | 225 | |
| S02-01-55 | 146.640 | 1.425 | Open Manhole | 1200 | S27.002 | 145.215 | 225 | S27.001 | 145.215 | 225 | |
| S02-01-56 | 145.063 | 1.425 | Open Manhole | 1200 | S27.003 | 143.638 | 225 | S27.002 | 143.638 | 225 | |
| S02-01-57 | 143.193 | 1.425 | Open Manhole | 1200 | S27.004 | 141.768 | 225 | S27.003 | 141.768 | 225 | |
| S02-01-58 | 141.476 | 1.500 | Open Manhole | 1200 | S27.005 | 139.976 | 300 | S27.004 | 140.051 | 225 | |
| S02-01-59 | 139.697 | 1.500 | Open Manhole | 1200 | S27.006 | 138.197 | 300 | S27.005 | 138.197 | 300 | |
| S02-01-60 | 139.811 | 1.775 | Open Manhole | 1200 | S27.007 | 138.036 | 300 | S27.006 | 138.036 | 300 | |
| S02-01-61 | 146.389 | 1.489 | Open Manhole | 1200 | S28.000 | 144.900 | 225 | | | | |
| S02-01-62 | 144.805 | 1.570 | Open Manhole | 1200 | S28.001 | 143.235 | 225 | S28.000 | 143.235 | 225 | |
| S02-01-63 | 143.195 | 1.650 | Open Manhole | 1350 | S28.002 | 141.545 | 450 | S28.001 | 141.770 | 225 | |
| S02-01-64 | 142.375 | 1.798 | Open Manhole | 1350 | S28.003 | 140.576 | 450 | S28.002 | 140.576 | 450 | |
| S02-01-65 | 141.242 | 1.650 | Open Manhole | 1350 | S28.004 | 139.592 | 450 | S28.003 | 139.592 | 450 | |
| S02-01-66 | 139.935 | 1.650 | Open Manhole | 1350 | S28.005 | 138.285 | 450 | S28.004 | 138.285 | 450 | |
| S02-01-67 | 139.068 | 1.651 | Open Manhole | 1350 | S27.008 | 137.417 | 450 | S27.007 | 137.567 | 300 | |
| | | | | | | | | S28.005 | 137.418 | 450 | |
| S02-01-68 | 138.655 | 1.745 | Open Manhole | 1500 | S27.009 | 136.910 | 525 | S27.008 | 136.958 | 450 | |
| S02-01-69 | 138.620 | 2.019 | Open Manhole | 1500 | S27.010 | 136.601 | 525 | S27.009 | 136.601 | 525 | |
| S02-01-70 | 138.494 | 2.231 | Open Manhole | 1500 | S27.011 | 136.263 | 525 | S27.010 | 136.263 | 525 | |

## Manhole Schedules for Pond 2-1

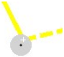
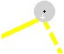
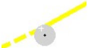
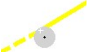
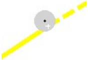
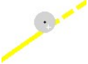
| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Bac |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S02-01-71 | 138.242 | 2.222 | Open Manhole | 1500 | S27.012 | 136.020 | 525 | S27.011 | 136.020 | 525 | |
| S02-01-72 | 137.755 | 1.974 | Open Manhole | 1500 | S27.013 | 135.781 | 525 | S27.012 | 135.781 | 525 | |
| S02-01-73 | 137.501 | 1.989 | Open Manhole | 1500 | S27.014 | 135.512 | 525 | S27.013 | 135.512 | 525 | |
| S02-01-74 | 137.127 | 1.797 | Open Manhole | 1500 | S27.015 | 135.330 | 525 | S27.014 | 135.330 | 525 | |
| S02-01-75 | 136.974 | 1.905 | Open Manhole | 1500 | S27.016 | 135.069 | 600 | S27.015 | 135.144 | 525 | |
| S02-01-76 | 136.638 | 1.800 | Open Manhole | 1500 | S27.017 | 134.838 | 600 | S27.016 | 134.838 | 600 | |
| S02-01-77 | 136.423 | 1.741 | Open Manhole | 1500 | S27.018 | 134.682 | 600 | S27.017 | 134.682 | 600 | |
| S02-01-78 | 136.303 | 1.838 | Open Manhole | 1650 | S27.019 | 134.465 | 600 | S27.018 | 134.465 | 600 | |
| S02-01-79 | 138.260 | 1.460 | Open Manhole | 1200 | S29.000 | 136.800 | 225 | | | | |
| S02-01-80 | 138.641 | 2.021 | Open Manhole | 1200 | S29.001 | 136.620 | 300 | S29.000 | 136.695 | 225 | |
| S02-01-81 | 138.871 | 2.382 | Open Manhole | 1200 | S29.002 | 136.489 | 300 | S29.001 | 136.489 | 300 | |
| S02-01-82 | 138.955 | 2.582 | Open Manhole | 1350 | S29.003 | 136.373 | 300 | S29.002 | 136.373 | 300 | |
| S02-01-83 | 138.868 | 2.549 | Open Manhole | 1350 | S29.004 | 136.319 | 300 | S29.003 | 136.319 | 300 | |
| S02-01-84 | 138.649 | 2.621 | Open Manhole | 1350 | S29.005 | 136.028 | 450 | S29.004 | 136.178 | 300 | |
| S02-01-85 | 138.331 | 2.452 | Open Manhole | 1350 | S29.006 | 135.879 | 450 | S29.005 | 135.879 | 450 | |
| S02-01-86 | 138.082 | 2.379 | Open Manhole | 1350 | S29.007 | 135.703 | 450 | S29.006 | 135.703 | 450 | |
| S02-01-87 | 137.907 | 2.329 | Open Manhole | 1350 | S29.008 | 135.578 | 450 | S29.007 | 135.578 | 450 | |
| S02-01-88 | 137.664 | 2.261 | Open Manhole | 1350 | S29.009 | 135.403 | 450 | S29.008 | 135.403 | 450 | |
| S02-01-89 | 137.429 | 2.201 | Open Manhole | 1350 | S29.010 | 135.228 | 450 | S29.009 | 135.228 | 450 | |
| S02-01-90 | 137.216 | 2.138 | Open Manhole | 1350 | S29.011 | 135.078 | 450 | S29.010 | 135.078 | 450 | |
| S02-01-91 | 137.002 | 2.074 | Open Manhole | 1350 | S29.012 | 134.928 | 450 | S29.011 | 134.928 | 450 | |
| S02-01-92 | 136.800 | 1.997 | Open Manhole | 1350 | S29.013 | 134.803 | 450 | S29.012 | 134.803 | 450 | |
| S02-01-93 | 136.800 | 2.534 | Open Manhole | 1500 | S27.020 | 134.266 | 600 | S27.019 | 134.266 | 600 | |
| | | | | | | | | S29.013 | 134.566 | 450 | |
| S02-01-94 | 137.407 | 3.370 | Open Manhole | 1650 | S27.021 | 134.037 | 600 | S27.020 | 134.037 | 600 | |
| S02-01-95 | 133.626 | 0.821 | Open Manhole | 1500 | S27.022 | 132.805 | 600 | S27.021 | 132.805 | 600 | |
| S02-01-96 | 123.950 | 1.255 | Open Manhole | 1500 | S27.023 | 122.695 | 600 | S27.022 | 122.695 | 600 | |
| S02-01-97 | 123.900 | 2.606 | Open Manhole | 1800 | S18.013 | 121.294 | 750 | S18.012 | 121.413 | 750 | |
| | | | | | | | | S27.023 | 121.666 | 600 | |
| S83 | 123.775 | 2.492 | Open Manhole | 1650 | | OUTFALL | | S18.013 | 121.283 | 750 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S02-01-4 | 351902.487 | 528985.945 | 351902.487 | 528985.945 | Required |  |

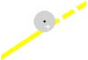
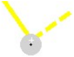
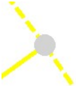
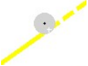
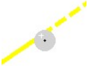
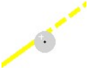
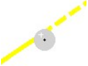
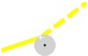
## Manhole Schedules for Pond 2-1

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S02-01-5 | 351958.680 | 529004.434 | 351958.632 | 529004.568 | Required |  |
| S02-01-6 | 352104.296 | 529098.825 | 352104.296 | 529098.825 | Required |  |
| S02-01-7 | 352077.442 | 529082.549 | 352077.369 | 529082.671 | Required |  |
| S02-01-8 | 352040.826 | 529061.369 | 352040.759 | 529061.495 | Required |  |
| S02-01-9 | 351850.197 | 528981.286 | 351850.197 | 528981.286 | Required |  |
| S02-01-10 | 351906.603 | 529001.790 | 351906.539 | 529001.959 | Required |  |
| S02-01-11 | 351952.359 | 529019.966 | 351952.289 | 529020.132 | Required |  |
| S02-01-12 | 351995.201 | 529039.293 | 351995.201 | 529039.293 | Required |  |
| S02-01-13 | 352003.054 | 529021.665 | 352003.054 | 529021.665 | Required |  |
| S02-01-14 | 352049.202 | 529042.246 | 352049.125 | 529042.408 | Required |  |
| S02-01-15 | 352102.331 | 529069.442 | 352102.262 | 529069.567 | Required |  |
| S02-01-16 | 352153.270 | 529099.375 | 352153.238 | 529099.236 | Required |  |
| S02-01-17 | 351847.263 | 528959.080 | 351847.263 | 528959.080 | Required |  |
| S02-01-18 | 351910.237 | 528975.731 | 351910.197 | 528975.868 | Required |  |
| S02-01-19 | 351962.397 | 528992.875 | 351962.336 | 528993.044 | Required |  |

## Manhole Schedules for Pond 2-1

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S02-01-20 | 352146.274 | 529036.270 | 352146.274 | 529036.270 | Required |  |
| S02-01-21 | 352122.116 | 529030.381 | 352122.176 | 529030.511 | Required |  |
| S02-01-22 | 352117.279 | 529039.987 | 352117.232 | 529039.852 | Required |  |
| S02-01-23 | 352071.537 | 529019.008 | 352071.442 | 529019.231 | Required |  |
| S02-01-24 | 351913.454 | 528965.787 | 351913.454 | 528965.787 | Required |  |
| S02-01-25 | 351976.471 | 528983.702 | 351976.428 | 528983.838 | Required |  |
| S02-01-26 | 352023.913 | 529000.073 | 352023.913 | 529000.073 | Required |  |
| S02-01-27 | 352018.248 | 529015.018 | 352018.248 | 529015.018 | Required |  |
| S02-01-28 | 352089.986 | 529049.279 | 352089.903 | 529049.439 | Required |  |
| S02-01-29 | 352142.842 | 529078.885 | 352142.750 | 529079.041 | Required |  |
| S02-01-30 | 352159.848 | 529089.442 | 352159.848 | 529089.442 | Required |  |
| S02-01-31 | 352415.530 | 529265.024 | 352415.530 | 529265.024 | Required |  |
| S02-01-32 | 352372.504 | 529239.226 | 352372.580 | 529239.105 | Required |  |
| S02-01-33 | 352322.518 | 529205.827 | 352322.599 | 529205.710 | Required |  |
| S02-01-34 | 352282.140 | 529177.112 | 352282.140 | 529177.112 | Required |  |

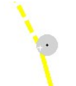
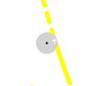
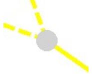
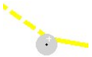
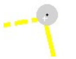
## Manhole Schedules for Pond 2-1

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S02-01-35 | 352421.964 | 529254.658 | 352421.964 | 529254.658 | Required |  |
| S02-01-36 | 352370.360 | 529223.370 | 352370.436 | 529223.250 | Required |  |
| S02-01-37 | 352338.209 | 529201.734 | 352338.290 | 529201.617 | Required |  |
| S02-01-38 | 352289.527 | 529166.648 | 352289.545 | 529166.751 | Required |  |
| S02-01-39 | 352283.308 | 529175.618 | 352283.308 | 529175.618 | Required |  |
| S02-01-40 | 352258.288 | 529157.624 | 352258.393 | 529157.478 | Required |  |
| S02-01-41 | 352217.955 | 529128.539 | 352217.873 | 529128.655 | Required |  |
| S02-01-42 | 352299.813 | 529202.873 | 352299.813 | 529202.873 | Required |  |
| S02-01-43 | 352246.273 | 529163.784 | 352246.190 | 529163.900 | Required |  |
| S02-01-44 | 352203.140 | 529133.235 | 352203.059 | 529133.353 | Required |  |
| S02-01-45 | 352169.703 | 529110.903 | 352169.843 | 529110.875 | Required |  |
| S02-01-46 | 352176.592 | 529100.406 | 352176.592 | 529100.406 | Required |  |
| S02-01-47 | 352166.007 | 529079.546 | 352166.007 | 529079.546 | Required |  |
| S02-01-48 | 352138.422 | 529030.701 | 352138.267 | 529030.835 | Required |  |
| S02-01-49 | 352110.393 | 529009.272 | 352110.297 | 529009.453 | Required |  |

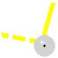
## Manhole Schedules for Pond 2-1

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S02-01-50 | 352013.683 | 528977.220 | 352013.621 | 528977.416 | Required |  |
| S02-01-51 | 351931.914 | 528953.295 | 351931.858 | 528953.492 | Required |  |
| S02-01-52 | 351845.863 | 528930.120 | 351845.949 | 528929.934 | Required |  |
| S02-01-53 | 351011.759 | 529293.582 | 351011.759 | 529293.582 | Required |  |
| S02-01-54 | 351024.066 | 529274.109 | 351023.937 | 529274.050 | Required |  |
| S02-01-55 | 351037.129 | 529229.808 | 351037.263 | 529229.856 | Required |  |
| S02-01-56 | 351053.150 | 529192.027 | 351053.018 | 529191.972 | Required |  |
| S02-01-57 | 351071.443 | 529147.408 | 351071.311 | 529147.355 | Required |  |
| S02-01-58 | 351088.217 | 529104.121 | 351088.037 | 529104.112 | Required |  |
| S02-01-59 | 351074.600 | 529055.150 | 351074.600 | 529055.150 | Required |  |
| S02-01-60 | 351113.260 | 529050.473 | 351113.218 | 529050.298 | Required |  |
| S02-01-61 | 351065.797 | 529233.034 | 351065.797 | 529233.034 | Required |  |
| S02-01-62 | 351080.292 | 529194.006 | 351080.425 | 529194.058 | Required |  |
| S02-01-63 | 351096.583 | 529155.214 | 351096.749 | 529155.283 | Required |  |
| S02-01-64 | 351107.824 | 529128.407 | 351107.987 | 529128.483 | Required |  |

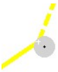
## Manhole Schedules for Pond 2-1

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S02-01-65 | 351123.915 | 529097.561 | 351123.747 | 529097.496 | Required |  |
| S02-01-66 | 351132.000 | 529068.093 | 351132.172 | 529068.147 | Required |  |
| S02-01-67 | 351142.028 | 529039.959 | 351142.028 | 529039.959 | Required |  |
| S02-01-68 | 351170.165 | 529020.068 | 351170.220 | 529020.199 | Required |  |
| S02-01-69 | 351246.104 | 529006.318 | 351246.074 | 529006.179 | Required |  |
| S02-01-70 | 351327.820 | 528985.019 | 351327.850 | 528985.158 | Required |  |
| S02-01-71 | 351387.918 | 528975.024 | 351387.939 | 528975.165 | Required |  |
| S02-01-72 | 351447.104 | 528967.361 | 351447.122 | 528967.502 | Required |  |
| S02-01-73 | 351513.869 | 528959.326 | 351513.883 | 528959.468 | Required |  |
| S02-01-74 | 351586.332 | 528953.693 | 351586.340 | 528953.835 | Required |  |
| S02-01-75 | 351660.900 | 528951.686 | 351660.895 | 528951.865 | Required |  |
| S02-01-76 | 351752.873 | 528959.747 | 351752.850 | 528959.926 | Required |  |
| S02-01-77 | 351814.358 | 528970.548 | 351814.327 | 528970.726 | Required |  |
| S02-01-78 | 351835.726 | 528974.302 | 351835.668 | 528974.215 | Required |  |
| S02-01-79 | 351188.703 | 528963.722 | 351188.703 | 528963.722 | Required |  |

## Manhole Schedules for Pond 2-1

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S02-01-80 | 351213.136 | 528973.522 | 351213.158 | 528973.343 | Required |  |
| S02-01-81 | 351251.907 | 528968.116 | 351251.878 | 528967.939 | Required |  |
| S02-01-82 | 351286.167 | 528961.613 | 351286.112 | 528961.702 | Required |  |
| S02-01-83 | 351290.564 | 528977.120 | 351290.616 | 528977.029 | Required |  |
| S02-01-84 | 351331.553 | 528966.341 | 351331.594 | 528966.517 | Required |  |
| S02-01-85 | 351389.794 | 528953.955 | 351389.827 | 528954.132 | Required |  |
| S02-01-86 | 351459.543 | 528943.150 | 351459.567 | 528943.328 | Required |  |
| S02-01-87 | 351509.213 | 528937.642 | 351509.229 | 528937.822 | Required |  |
| S02-01-88 | 351579.118 | 528933.001 | 351579.125 | 528933.181 | Required |  |
| S02-01-89 | 351649.161 | 528932.845 | 351649.155 | 528933.025 | Required |  |
| S02-01-90 | 351709.085 | 528936.591 | 351709.069 | 528936.771 | Required |  |
| S02-01-91 | 351768.685 | 528943.855 | 351768.658 | 528944.033 | Required |  |
| S02-01-92 | 351817.907 | 528952.810 | 351817.874 | 528952.987 | Required |  |
| S02-01-93 | 351839.716 | 528957.220 | 351839.716 | 528957.220 | Required |  |
| S02-01-94 | 351843.349 | 528941.583 | 351843.145 | 528941.598 | Required |  |

## Manhole Schedules for Pond 2-1

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S02-01-95 | 351837.590 | 528926.635 | 351837.449 | 528926.746 | Required |  |
| S02-01-96 | 351769.663 | 528880.905 | 351769.663 | 528880.905 | Required |  |
| S02-01-97 | 351771.763 | 528878.370 | 351771.763 | 528878.370 | Required |  |
| S83 | 351768.800 | 528873.739 | | | No Entry |  |

## PIPELINE SCHEDULES for Pond 2-1

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S18.000 | o | 225 | S02-01-4 | 135.418 | 133.900 | 1.293 | Open Manhole | 1200 |
| S18.001 | o | 225 | S02-01-5 | 134.018 | 132.421 | 1.372 | Open Manhole | 1200 |
| S19.000 | o | 225 | S02-01-6 | 135.766 | 134.200 | 1.341 | Open Manhole | 1200 |
| S19.001 | o | 225 | S02-01-7 | 135.171 | 133.572 | 1.374 | Open Manhole | 1200 |
| S19.002 | o | 225 | S02-01-8 | 134.400 | 132.726 | 1.449 | Open Manhole | 1200 |
| S20.000 | o | 225 | S02-01-9 | 136.148 | 134.500 | 1.423 | Open Manhole | 1200 |
| S20.001 | o | 300 | S02-01-10 | 135.043 | 133.413 | 1.330 | Open Manhole | 1200 |
| S20.002 | o | 300 | S02-01-11 | 134.298 | 132.798 | 1.200 | Open Manhole | 1200 |
| S19.003 | o | 300 | S02-01-12 | 134.071 | 132.285 | 1.486 | Open Manhole | 1200 |
| S18.002 | o | 300 | S02-01-13 | 132.423 | 130.904 | 1.219 | Open Manhole | 1200 |
| S18.003 | o | 300 | S02-01-14 | 130.269 | 128.707 | 1.262 | Open Manhole | 1200 |
| S18.004 | o | 375 | S02-01-15 | 127.413 | 125.648 | 1.390 | Open Manhole | 1350 |
| S18.005 | o | 375 | S02-01-16 | 125.200 | 123.538 | 1.287 | Open Manhole | 1350 |
| S21.000 | o | 225 | S02-01-17 | 136.706 | 135.200 | 1.281 | Open Manhole | 1200 |
| S21.001 | o | 225 | S02-01-18 | 135.858 | 134.176 | 1.457 | Open Manhole | 1200 |
| S21.002 | o | 300 | S02-01-19 | 134.583 | 133.083 | 1.200 | Open Manhole | 1200 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S18.000 | 59.157 | 40.0 | S02-01-5 | 134.018 | 132.421 | 1.372 | Open Manhole | 1200 |
| S18.001 | 47.602 | 33.0 | S02-01-13 | 132.423 | 130.979 | 1.219 | Open Manhole | 1200 |
| S19.000 | 31.401 | 50.0 | S02-01-7 | 135.171 | 133.572 | 1.374 | Open Manhole | 1200 |
| S19.001 | 42.300 | 50.0 | S02-01-8 | 134.400 | 132.726 | 1.449 | Open Manhole | 1200 |
| S19.002 | 50.686 | 138.5 | S02-01-12 | 134.071 | 132.360 | 1.486 | Open Manhole | 1200 |
| S20.000 | 60.017 | 59.3 | S02-01-10 | 135.043 | 133.488 | 1.330 | Open Manhole | 1200 |
| S20.001 | 49.235 | 80.1 | S02-01-11 | 134.298 | 132.798 | 1.200 | Open Manhole | 1200 |
| S20.002 | 46.999 | 91.6 | S02-01-12 | 134.071 | 132.285 | 1.486 | Open Manhole | 1200 |
| S19.003 | 19.298 | 14.0 | S02-01-13 | 132.423 | 130.904 | 1.219 | Open Manhole | 1200 |
| S18.002 | 50.529 | 23.0 | S02-01-14 | 130.269 | 128.707 | 1.262 | Open Manhole | 1200 |
| S18.003 | 59.685 | 20.0 | S02-01-15 | 127.413 | 125.723 | 1.390 | Open Manhole | 1350 |
| S18.004 | 59.083 | 28.0 | S02-01-16 | 125.200 | 123.538 | 1.287 | Open Manhole | 1350 |
| S18.005 | 11.913 | 198.6 | S02-01-30 | 125.708 | 123.478 | 1.855 | Open Manhole | 1350 |
| S21.000 | 65.138 | 63.6 | S02-01-18 | 135.858 | 134.176 | 1.457 | Open Manhole | 1200 |
| S21.001 | 54.905 | 53.9 | S02-01-19 | 134.583 | 133.158 | 1.200 | Open Manhole | 1200 |
| S21.002 | 60.080 | 19.0 | S02-01-27 | 132.510 | 129.921 | 2.289 | Open Manhole | 1200 |

## PIPELINE SCHEDULES for Pond 2-1

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S22.000 | o | 225 | S02-01-20 | 135.400 | 133.900 | 1.275 | Open Manhole | 1200 |
| S22.001 | o | 225 | S02-01-21 | 135.257 | 133.486 | 1.547 | Open Manhole | 1200 |
| S22.002 | o | 225 | S02-01-22 | 133.979 | 132.554 | 1.200 | Open Manhole | 1200 |
| S22.003 | o | 225 | S02-01-23 | 135.030 | 131.925 | 2.880 | Open Manhole | 1200 |
| S23.000 | o | 225 | S02-01-24 | 136.520 | 135.000 | 1.295 | Open Manhole | 1200 |
| S23.001 | o | 225 | S02-01-25 | 135.487 | 133.690 | 1.572 | Open Manhole | 1200 |
| S22.004 | o | 225 | S02-01-26 | 134.983 | 131.669 | 3.089 | Open Manhole | 1200 |
| S21.003 | o | 300 | S02-01-27 | 132.510 | 129.818 | 2.392 | Open Manhole | 1200 |
| S21.004 | o | 300 | S02-01-28 | 128.909 | 127.077 | 1.532 | Open Manhole | 1200 |
| S21.005 | o | 300 | S02-01-29 | 126.286 | 124.653 | 1.333 | Open Manhole | 1200 |
| S18.006 | o | 450 | S02-01-30 | 125.708 | 123.174 | 2.084 | Open Manhole | 1350 |
| S24.000 | o | 225 | S02-01-31 | 129.045 | 127.500 | 1.320 | Open Manhole | 1200 |
| S24.001 | o | 225 | S02-01-32 | 128.925 | 127.299 | 1.401 | Open Manhole | 1200 |
| S24.002 | o | 225 | S02-01-33 | 128.155 | 126.698 | 1.232 | Open Manhole | 1200 |
| S24.003 | o | 225 | S02-01-34 | 127.032 | 125.844 | 0.963 | Open Manhole | 1200 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S22.000 | 24.865 | 60.0 | S02-01-21 | 135.257 | 133.486 | 1.547 | Open Manhole | 1200 |
| S22.001 | 10.755 | 11.5 | S02-01-22 | 133.979 | 132.554 | 1.200 | Open Manhole | 1200 |
| S22.002 | 50.324 | 80.0 | S02-01-23 | 135.030 | 131.925 | 2.880 | Open Manhole | 1200 |
| S22.003 | 51.249 | 200.0 | S02-01-26 | 134.983 | 131.669 | 3.089 | Open Manhole | 1200 |
| S23.000 | 65.514 | 50.0 | S02-01-25 | 135.487 | 133.690 | 1.572 | Open Manhole | 1200 |
| S23.001 | 50.187 | 25.0 | S02-01-26 | 134.983 | 131.682 | 3.076 | Open Manhole | 1200 |
| S22.004 | 15.983 | 9.0 | S02-01-27 | 132.510 | 129.893 | 2.392 | Open Manhole | 1200 |
| S21.003 | 79.499 | 29.0 | S02-01-28 | 128.909 | 127.077 | 1.532 | Open Manhole | 1200 |
| S21.004 | 60.583 | 25.0 | S02-01-29 | 126.286 | 124.653 | 1.333 | Open Manhole | 1200 |
| S21.005 | 20.017 | 15.1 | S02-01-30 | 125.708 | 123.324 | 2.084 | Open Manhole | 1350 |
| S18.006 | 11.657 | 25.0 | S02-01-47 | 126.384 | 122.708 | 3.226 | Open Manhole | 1800 |
| S24.000 | 50.167 | 249.6 | S02-01-32 | 128.925 | 127.299 | 1.401 | Open Manhole | 1200 |
| S24.001 | 60.117 | 100.0 | S02-01-33 | 128.155 | 126.698 | 1.232 | Open Manhole | 1200 |
| S24.002 | 49.547 | 58.0 | S02-01-34 | 127.032 | 125.844 | 0.963 | Open Manhole | 1200 |
| S24.003 | 1.897 | 9.4 | S02-01-39 | 127.019 | 125.643 | 1.151 | Open Manhole | 1200 |

## PIPELINE SCHEDULES for Pond 2-1

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S25.000 | o | 225 | S02-01-35 | 128.555 | 127.205 | 1.125 | Open Manhole | 1200 |
| S25.001 | o | 225 | S02-01-36 | 128.315 | 126.596 | 1.494 | Open Manhole | 1200 |
| S25.002 | o | 225 | S02-01-37 | 127.998 | 126.366 | 1.407 | Open Manhole | 1200 |
| S25.003 | o | 300 | S02-01-38 | 127.114 | 125.689 | 1.125 | Open Manhole | 1350 |
| S24.004 | o | 300 | S02-01-39 | 127.019 | 125.568 | 1.151 | Open Manhole | 1200 |
| S24.005 | o | 300 | S02-01-40 | 126.378 | 124.953 | 1.125 | Open Manhole | 1200 |
| S24.006 | o | 375 | S02-01-41 | 125.149 | 123.722 | 1.052 | Open Manhole | 1350 |
| S26.000 | o | 225 | S02-01-42 | 127.866 | 126.300 | 1.341 | Open Manhole | 1200 |
| S26.001 | o | 225 | S02-01-43 | 125.788 | 124.643 | 0.920 | Open Manhole | 1200 |
| S26.002 | o | 375 | S02-01-44 | 124.950 | 123.436 | 1.139 | Open Manhole | 1350 |
| S26.003 | o | 375 | S02-01-45 | 125.000 | 123.302 | 1.323 | Open Manhole | 1350 |
| S24.007 | o | 375 | S02-01-46 | 125.440 | 123.112 | 1.953 | Open Manhole | 1350 |
| S18.007 | o | 750 | S02-01-47 | 126.384 | 122.333 | 3.301 | Open Manhole | 1800 |
| S18.008 | o | 750 | S02-01-48 | 135.085 | 122.220 | 12.115 | Open Manhole | 1800 |
| S18.009 | o | 750 | S02-01-49 | 133.485 | 122.149 | 10.586 | Open Manhole | 1800 |
| S18.010 | o | 750 | S02-01-50 | 133.997 | 121.943 | 11.304 | Open Manhole | 1800 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S25.000 | 60.349 | 99.1 | S02-01-36 | 128.315 | 126.596 | 1.494 | Open Manhole | 1200 |
| S25.001 | 38.752 | 168.4 | S02-01-37 | 127.998 | 126.366 | 1.407 | Open Manhole | 1200 |
| S25.002 | 60.008 | 99.7 | S02-01-38 | 127.114 | 125.764 | 1.125 | Open Manhole | 1350 |
| S25.003 | 10.915 | 90.0 | S02-01-39 | 127.019 | 125.568 | 1.151 | Open Manhole | 1200 |
| S24.004 | 30.818 | 50.2 | S02-01-40 | 126.378 | 124.953 | 1.125 | Open Manhole | 1200 |
| S24.005 | 49.727 | 43.0 | S02-01-41 | 125.149 | 123.797 | 1.052 | Open Manhole | 1350 |
| S24.006 | 50.023 | 82.0 | S02-01-46 | 125.440 | 123.112 | 1.953 | Open Manhole | 1350 |
| S26.000 | 66.291 | 40.0 | S02-01-43 | 125.788 | 124.643 | 0.920 | Open Manhole | 1200 |
| S26.001 | 52.855 | 50.0 | S02-01-44 | 124.950 | 123.586 | 1.139 | Open Manhole | 1350 |
| S26.002 | 40.209 | 300.1 | S02-01-45 | 125.000 | 123.302 | 1.323 | Open Manhole | 1350 |
| S26.003 | 12.556 | 300.0 | S02-01-46 | 125.440 | 123.260 | 1.805 | Open Manhole | 1350 |
| S24.007 | 23.392 | 57.9 | S02-01-47 | 126.384 | 122.708 | 3.301 | Open Manhole | 1800 |
| S18.007 | 56.096 | 496.4 | S02-01-48 | 135.085 | 122.220 | 12.115 | Open Manhole | 1800 |
| S18.008 | 35.282 | 497.7 | S02-01-49 | 133.485 | 122.149 | 10.586 | Open Manhole | 1800 |
| S18.009 | 101.884 | 494.2 | S02-01-50 | 133.997 | 121.943 | 11.304 | Open Manhole | 1800 |
| S18.010 | 85.197 | 500.0 | S02-01-51 | 135.496 | 121.772 | 12.974 | Open Manhole | 1800 |

## PIPELINE SCHEDULES for Pond 2-1

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S18.011 | o | 750 | S02-01-51 | 135.496 | 121.772 | 12.974 | Open Manhole | 1800 |
| S18.012 | o | 750 | S02-01-52 | 134.284 | 121.594 | 11.940 | Open Manhole | 1800 |
| S27.000 | o | 225 | S02-01-53 | 149.549 | 148.000 | 1.324 | Open Manhole | 1200 |
| S27.001 | o | 225 | S02-01-54 | 148.765 | 147.219 | 1.321 | Open Manhole | 1200 |
| S27.002 | o | 225 | S02-01-55 | 146.640 | 145.215 | 1.200 | Open Manhole | 1200 |
| S27.003 | o | 225 | S02-01-56 | 145.063 | 143.638 | 1.200 | Open Manhole | 1200 |
| S27.004 | o | 225 | S02-01-57 | 143.193 | 141.768 | 1.200 | Open Manhole | 1200 |
| S27.005 | o | 300 | S02-01-58 | 141.476 | 139.976 | 1.200 | Open Manhole | 1200 |
| S27.006 | o | 300 | S02-01-59 | 139.697 | 138.197 | 1.200 | Open Manhole | 1200 |
| S27.007 | o | 300 | S02-01-60 | 139.811 | 138.036 | 1.475 | Open Manhole | 1200 |
| S28.000 | o | 225 | S02-01-61 | 146.389 | 144.900 | 1.264 | Open Manhole | 1200 |
| S28.001 | o | 225 | S02-01-62 | 144.805 | 143.235 | 1.345 | Open Manhole | 1200 |
| S28.002 | o | 450 | S02-01-63 | 143.195 | 141.545 | 1.200 | Open Manhole | 1350 |
| S28.003 | o | 450 | S02-01-64 | 142.375 | 140.576 | 1.348 | Open Manhole | 1350 |
| S28.004 | o | 450 | S02-01-65 | 141.242 | 139.592 | 1.200 | Open Manhole | 1350 |
| S28.005 | o | 450 | S02-01-66 | 139.935 | 138.285 | 1.200 | Open Manhole | 1350 |
| S27.008 | o | 450 | S02-01-67 | 139.068 | 137.417 | 1.201 | Open Manhole | 1350 |
| S27.009 | o | 525 | S02-01-68 | 138.655 | 136.910 | 1.220 | Open Manhole | 1500 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S18.011 | 89.118 | 500.0 | S02-01-52 | 134.284 | 121.594 | 11.940 | Open Manhole | 1800 |
| S18.012 | 90.381 | 499.3 | S02-01-97 | 123.900 | 121.413 | 1.737 | Open Manhole | 1800 |
| S27.000 | 23.036 | 29.5 | S02-01-54 | 148.765 | 147.219 | 1.321 | Open Manhole | 1200 |
| S27.001 | 46.186 | 23.0 | S02-01-55 | 146.640 | 145.215 | 1.200 | Open Manhole | 1200 |
| S27.002 | 41.038 | 26.0 | S02-01-56 | 145.063 | 143.638 | 1.200 | Open Manhole | 1200 |
| S27.003 | 48.224 | 25.8 | S02-01-57 | 143.193 | 141.768 | 1.200 | Open Manhole | 1200 |
| S27.004 | 46.423 | 27.0 | S02-01-58 | 141.476 | 140.051 | 1.200 | Open Manhole | 1200 |
| S27.005 | 50.829 | 28.6 | S02-01-59 | 139.697 | 138.197 | 1.200 | Open Manhole | 1200 |
| S27.006 | 38.942 | 241.9 | S02-01-60 | 139.811 | 138.036 | 1.475 | Open Manhole | 1200 |
| S27.007 | 30.629 | 65.3 | S02-01-67 | 139.068 | 137.567 | 1.201 | Open Manhole | 1350 |
| S28.000 | 41.633 | 25.0 | S02-01-62 | 144.805 | 143.235 | 1.345 | Open Manhole | 1200 |
| S28.001 | 42.074 | 28.7 | S02-01-63 | 143.195 | 141.770 | 1.200 | Open Manhole | 1350 |
| S28.002 | 29.069 | 30.0 | S02-01-64 | 142.375 | 140.576 | 1.348 | Open Manhole | 1350 |
| S28.003 | 34.790 | 35.3 | S02-01-65 | 141.242 | 139.592 | 1.200 | Open Manhole | 1350 |
| S28.004 | 30.558 | 23.4 | S02-01-66 | 139.935 | 138.285 | 1.200 | Open Manhole | 1350 |
| S28.005 | 29.867 | 34.4 | S02-01-67 | 139.068 | 137.418 | 1.200 | Open Manhole | 1350 |
| S27.008 | 34.458 | 75.0 | S02-01-68 | 138.655 | 136.958 | 1.247 | Open Manhole | 1500 |
| S27.009 | 77.174 | 249.8 | S02-01-69 | 138.620 | 136.601 | 1.494 | Open Manhole | 1500 |

## PIPELINE SCHEDULES for Pond 2-1

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S27.010 | o | 525 | S02-01-69 | 138.620 | 136.601 | 1.494 | Open Manhole | 1500 |
| S27.011 | o | 525 | S02-01-70 | 138.494 | 136.263 | 1.706 | Open Manhole | 1500 |
| S27.012 | o | 525 | S02-01-71 | 138.242 | 136.020 | 1.697 | Open Manhole | 1500 |
| S27.013 | o | 525 | S02-01-72 | 137.755 | 135.781 | 1.449 | Open Manhole | 1500 |
| S27.014 | o | 525 | S02-01-73 | 137.501 | 135.512 | 1.464 | Open Manhole | 1500 |
| S27.015 | o | 525 | S02-01-74 | 137.127 | 135.330 | 1.272 | Open Manhole | 1500 |
| S27.016 | o | 600 | S02-01-75 | 136.974 | 135.069 | 1.305 | Open Manhole | 1500 |
| S27.017 | o | 600 | S02-01-76 | 136.638 | 134.838 | 1.200 | Open Manhole | 1500 |
| S27.018 | o | 600 | S02-01-77 | 136.423 | 134.682 | 1.141 | Open Manhole | 1500 |
| S27.019 | o | 600 | S02-01-78 | 136.303 | 134.465 | 1.238 | Open Manhole | 1650 |
| S29.000 | o | 225 | S02-01-79 | 138.260 | 136.800 | 1.235 | Open Manhole | 1200 |
| S29.001 | o | 300 | S02-01-80 | 138.641 | 136.620 | 1.721 | Open Manhole | 1200 |
| S29.002 | o | 300 | S02-01-81 | 138.871 | 136.489 | 2.082 | Open Manhole | 1200 |
| S29.003 | o | 300 | S02-01-82 | 138.955 | 136.373 | 2.282 | Open Manhole | 1350 |
| S29.004 | o | 300 | S02-01-83 | 138.868 | 136.319 | 2.249 | Open Manhole | 1350 |
| S29.005 | o | 450 | S02-01-84 | 138.649 | 136.028 | 2.171 | Open Manhole | 1350 |
| S29.006 | o | 450 | S02-01-85 | 138.331 | 135.879 | 2.002 | Open Manhole | 1350 |
| S29.007 | o | 450 | S02-01-86 | 138.082 | 135.703 | 1.929 | Open Manhole | 1350 |
| S29.008 | o | 450 | S02-01-87 | 137.907 | 135.578 | 1.879 | Open Manhole | 1350 |
| S29.009 | o | 450 | S02-01-88 | 137.664 | 135.403 | 1.811 | Open Manhole | 1350 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S27.010 | 84.446 | 250.0 | S02-01-70 | 138.494 | 136.263 | 1.706 | Open Manhole | 1500 |
| S27.011 | 60.923 | 250.0 | S02-01-71 | 138.242 | 136.020 | 1.697 | Open Manhole | 1500 |
| S27.012 | 59.680 | 250.0 | S02-01-72 | 137.755 | 135.781 | 1.449 | Open Manhole | 1500 |
| S27.013 | 67.247 | 250.0 | S02-01-73 | 137.501 | 135.512 | 1.464 | Open Manhole | 1500 |
| S27.014 | 72.682 | 399.4 | S02-01-74 | 137.127 | 135.330 | 1.272 | Open Manhole | 1500 |
| S27.015 | 74.595 | 401.0 | S02-01-75 | 136.974 | 135.144 | 1.305 | Open Manhole | 1500 |
| S27.016 | 92.325 | 399.7 | S02-01-76 | 136.638 | 134.838 | 1.200 | Open Manhole | 1500 |
| S27.017 | 62.427 | 400.2 | S02-01-77 | 136.423 | 134.682 | 1.141 | Open Manhole | 1500 |
| S27.018 | 21.696 | 100.0 | S02-01-78 | 136.303 | 134.465 | 1.238 | Open Manhole | 1650 |
| S27.019 | 17.541 | 88.3 | S02-01-93 | 136.800 | 134.266 | 1.934 | Open Manhole | 1500 |
| S29.000 | 26.325 | 250.0 | S02-01-80 | 138.641 | 136.695 | 1.721 | Open Manhole | 1200 |
| S29.001 | 39.146 | 300.0 | S02-01-81 | 138.871 | 136.489 | 2.082 | Open Manhole | 1200 |
| S29.002 | 34.872 | 300.0 | S02-01-82 | 138.955 | 136.373 | 2.282 | Open Manhole | 1350 |
| S29.003 | 16.119 | 300.0 | S02-01-83 | 138.868 | 136.319 | 2.249 | Open Manhole | 1350 |
| S29.004 | 42.382 | 300.0 | S02-01-84 | 138.649 | 136.178 | 2.171 | Open Manhole | 1350 |
| S29.005 | 59.544 | 400.0 | S02-01-85 | 138.331 | 135.879 | 2.002 | Open Manhole | 1350 |
| S29.006 | 70.581 | 401.0 | S02-01-86 | 138.082 | 135.703 | 1.929 | Open Manhole | 1350 |
| S29.007 | 49.975 | 399.8 | S02-01-87 | 137.907 | 135.578 | 1.879 | Open Manhole | 1350 |
| S29.008 | 70.059 | 400.0 | S02-01-88 | 137.664 | 135.403 | 1.811 | Open Manhole | 1350 |
| S29.009 | 70.042 | 400.2 | S02-01-89 | 137.429 | 135.228 | 1.751 | Open Manhole | 1350 |

## PIPELINE SCHEDULES for Pond 2-1

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S29.010 | o | 450 | S02-01-89 | 137.429 | 135.228 | 1.751 | Open Manhole | 1350 |
| S29.011 | o | 450 | S02-01-90 | 137.216 | 135.078 | 1.688 | Open Manhole | 1350 |
| S29.012 | o | 450 | S02-01-91 | 137.002 | 134.928 | 1.624 | Open Manhole | 1350 |
| S29.013 | o | 450 | S02-01-92 | 136.800 | 134.803 | 1.547 | Open Manhole | 1350 |
| S27.020 | o | 600 | S02-01-93 | 136.800 | 134.266 | 1.934 | Open Manhole | 1500 |
| S27.021 | o | 600 | S02-01-94 | 137.407 | 134.037 | 2.770 | Open Manhole | 1650 |
| S27.022 | o | 600 | S02-01-95 | 133.626 | 132.805 | 0.221 | Open Manhole | 1500 |
| S27.023 | o | 600 | S02-01-96 | 123.950 | 122.695 | 0.655 | Open Manhole | 1500 |
| S18.013 | o | 750 | S02-01-97 | 123.900 | 121.294 | 1.856 | Open Manhole | 1800 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S29.010 | 60.042 | 400.3 | S02-01-90 | 137.216 | 135.078 | 1.688 | Open Manhole | 1350 |
| S29.011 | 60.041 | 400.3 | S02-01-91 | 137.002 | 134.928 | 1.624 | Open Manhole | 1350 |
| S29.012 | 50.030 | 400.2 | S02-01-92 | 136.800 | 134.803 | 1.547 | Open Manhole | 1350 |
| S29.013 | 22.250 | 93.9 | S02-01-93 | 136.800 | 134.566 | 1.784 | Open Manhole | 1500 |
| S27.020 | 16.054 | 70.0 | S02-01-94 | 137.407 | 134.037 | 2.770 | Open Manhole | 1650 |
| S27.021 | 16.020 | 13.0 | S02-01-95 | 133.626 | 132.805 | 0.221 | Open Manhole | 1500 |
| S27.022 | 81.886 | 8.1 | S02-01-96 | 123.950 | 122.695 | 0.655 | Open Manhole | 1500 |
| S27.023 | 3.293 | 3.2 | S02-01-97 | 123.900 | 121.666 | 1.634 | Open Manhole | 1800 |
| S18.013 | 5.498 | 499.8 | S83 | 123.775 | 121.283 | 1.742 | Open Manhole | 1650 |

## Area Summary for Pond 2-1

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 18.000 | User | - | 100 | 0.072 | 0.072 | 0.072 |
| | User | - | 50 | 0.012 | 0.006 | 0.078 |
| 18.001 | User | - | 100 | 0.058 | 0.058 | 0.058 |
| | User | - | 50 | 0.017 | 0.009 | 0.067 |
| | User | - | 25 | 0.003 | 0.001 | 0.068 |
| 19.000 | User | - | 100 | 0.043 | 0.043 | 0.043 |
| | User | - | 50 | 0.002 | 0.001 | 0.044 |
| 19.001 | User | - | 100 | 0.056 | 0.056 | 0.056 |
| | User | - | 50 | 0.002 | 0.001 | 0.057 |
| 19.002 | User | - | 100 | 0.069 | 0.069 | 0.069 |
| | User | - | 50 | 0.003 | 0.001 | 0.070 |
| | User | - | 25 | 0.008 | 0.002 | 0.072 |
| 20.000 | User | - | 100 | 0.155 | 0.155 | 0.155 |
| | User | - | 50 | 0.004 | 0.002 | 0.157 |
| | User | - | 25 | 0.031 | 0.008 | 0.165 |
| 20.001 | User | - | 100 | 0.066 | 0.066 | 0.066 |
| | User | - | 50 | 0.002 | 0.001 | 0.068 |
| | User | - | 25 | 0.032 | 0.008 | 0.075 |
| 20.002 | User | - | 100 | 0.063 | 0.063 | 0.063 |
| | User | - | 50 | 0.002 | 0.001 | 0.064 |
| | User | - | 25 | 0.012 | 0.003 | 0.067 |
| 19.003 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 18.002 | User | - | 100 | 0.062 | 0.062 | 0.062 |
| | User | - | 50 | 0.013 | 0.007 | 0.068 |
| | User | - | 25 | 0.016 | 0.004 | 0.072 |
| 18.003 | User | - | 100 | 0.072 | 0.072 | 0.072 |
| | User | - | 50 | 0.016 | 0.008 | 0.080 |
| | User | - | 25 | 0.031 | 0.008 | 0.088 |
| 18.004 | User | - | 100 | 0.048 | 0.048 | 0.048 |
| | User | - | 100 | 0.024 | 0.024 | 0.072 |
| | User | - | 50 | 0.016 | 0.008 | 0.080 |
| | User | - | 25 | 0.039 | 0.010 | 0.090 |
| | User | - | 25 | 0.013 | 0.003 | 0.093 |
| 18.005 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 21.000 | User | - | 100 | 0.125 | 0.125 | 0.125 |
| | User | - | 50 | 0.030 | 0.015 | 0.139 |
| 21.001 | User | - | 100 | 0.059 | 0.059 | 0.059 |
| | User | - | 50 | 0.007 | 0.003 | 0.062 |
| 21.002 | User | - | 100 | 0.063 | 0.063 | 0.063 |
| | User | - | 50 | 0.022 | 0.011 | 0.074 |
| 22.000 | User | - | 100 | 0.020 | 0.020 | 0.020 |
| | User | - | 50 | 0.014 | 0.007 | 0.028 |
| 22.001 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 22.002 | User | - | 100 | 0.059 | 0.059 | 0.059 |
| | User | - | 50 | 0.020 | 0.010 | 0.069 |
| 22.003 | User | - | 100 | 0.049 | 0.049 | 0.049 |
| | User | - | 50 | 0.021 | 0.010 | 0.059 |
| 23.000 | User | - | 100 | 0.051 | 0.051 | 0.051 |
| | User | - | 50 | 0.026 | 0.013 | 0.064 |
| 23.001 | User | - | 100 | 0.040 | 0.040 | 0.040 |
| | User | - | 50 | 0.021 | 0.010 | 0.050 |

## Area Summary for Pond 2-1

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| | User | - | 25 | 0.002 | 0.000 | 0.051 |
| 22.004 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 21.003 | User | - | 100 | 0.084 | 0.084 | 0.084 |
| | User | - | 50 | 0.033 | 0.016 | 0.100 |
| | User | - | 25 | 0.028 | 0.007 | 0.107 |
| 21.004 | User | - | 100 | 0.064 | 0.064 | 0.064 |
| | User | - | 50 | 0.024 | 0.012 | 0.076 |
| | User | - | 25 | 0.022 | 0.006 | 0.082 |
| 21.005 | User | - | 100 | 0.022 | 0.022 | 0.022 |
| | User | - | 50 | 0.008 | 0.004 | 0.026 |
| | User | - | 25 | 0.062 | 0.016 | 0.041 |
| 18.006 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 24.000 | User | - | 100 | 0.065 | 0.065 | 0.065 |
| | User | - | 50 | 0.015 | 0.008 | 0.073 |
| | User | - | 25 | 0.003 | 0.001 | 0.074 |
| 24.001 | User | - | 100 | 0.064 | 0.064 | 0.064 |
| | User | - | 50 | 0.021 | 0.011 | 0.075 |
| | User | - | 25 | 0.013 | 0.003 | 0.078 |
| 24.002 | User | - | 100 | 0.054 | 0.054 | 0.054 |
| | User | - | 50 | 0.008 | 0.004 | 0.058 |
| | User | - | 25 | 0.005 | 0.001 | 0.060 |
| 24.003 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 25.000 | User | - | 100 | 0.087 | 0.087 | 0.087 |
| | User | - | 50 | 0.014 | 0.007 | 0.095 |
| | User | - | 25 | 0.003 | 0.001 | 0.095 |
| 25.001 | User | - | 100 | 0.047 | 0.047 | 0.047 |
| | User | - | 50 | 0.008 | 0.004 | 0.051 |
| | User | - | 25 | 0.008 | 0.002 | 0.053 |
| 25.002 | User | - | 100 | 0.072 | 0.072 | 0.072 |
| | User | - | 50 | 0.016 | 0.008 | 0.080 |
| | User | - | 25 | 0.020 | 0.005 | 0.085 |
| 25.003 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 24.004 | User | - | 100 | 0.032 | 0.032 | 0.032 |
| | User | - | 50 | 0.012 | 0.006 | 0.038 |
| | User | - | 25 | 0.018 | 0.005 | 0.043 |
| 24.005 | User | - | 100 | 0.097 | 0.097 | 0.097 |
| | User | - | 100 | 0.053 | 0.053 | 0.150 |
| | User | - | 50 | 0.020 | 0.010 | 0.160 |
| | User | - | 25 | 0.050 | 0.013 | 0.172 |
| 24.006 | User | - | 100 | 0.052 | 0.052 | 0.052 |
| | User | - | 50 | 0.020 | 0.010 | 0.063 |
| | User | - | 25 | 0.132 | 0.033 | 0.096 |
| 26.000 | User | - | 100 | 0.097 | 0.097 | 0.097 |
| | User | - | 50 | 0.018 | 0.009 | 0.106 |
| | User | - | 25 | 0.031 | 0.008 | 0.113 |
| 26.001 | User | - | 100 | 0.096 | 0.096 | 0.096 |
| | User | - | 25 | 0.042 | 0.011 | 0.107 |
| | User | - | 50 | 0.015 | 0.007 | 0.114 |
| 26.002 | User | - | 100 | 0.042 | 0.042 | 0.042 |
| | User | - | 50 | 0.016 | 0.008 | 0.050 |
| | User | - | 25 | 0.154 | 0.038 | 0.089 |

## Area Summary for Pond 2-1

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 26.003 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 24.007 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 18.007 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 18.008 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 18.009 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 18.010 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 18.011 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 18.012 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 27.000 | User | - | 100 | 0.028 | 0.028 | 0.028 |
|  | User | - | 50 | 0.003 | 0.002 | 0.030 |
| 27.001 | User | - | 100 | 0.054 | 0.054 | 0.054 |
|  | User | - | 50 | 0.005 | 0.002 | 0.056 |
|  | User | - | 25 | 0.009 | 0.002 | 0.059 |
| 27.002 | User | - | 100 | 0.044 | 0.044 | 0.044 |
|  | User | - | 50 | 0.004 | 0.002 | 0.046 |
|  | User | - | 25 | 0.018 | 0.005 | 0.051 |
| 27.003 | User | - | 100 | 0.056 | 0.056 | 0.056 |
|  | User | - | 50 | 0.005 | 0.002 | 0.058 |
|  | User | - | 100 | 0.006 | 0.006 | 0.064 |
|  | User | - | 25 | 0.006 | 0.002 | 0.066 |
| 27.004 | User | - | 100 | 0.059 | 0.059 | 0.059 |
|  | User | - | 50 | 0.001 | 0.001 | 0.059 |
|  | User | - | 50 | 0.009 | 0.004 | 0.064 |
| 27.005 | User | - | 100 | 0.097 | 0.097 | 0.097 |
|  | User | - | 50 | 0.031 | 0.015 | 0.113 |
| 27.006 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 27.007 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 28.000 | User | - | 100 | 0.064 | 0.064 | 0.064 |
|  | User | - | 50 | 0.015 | 0.007 | 0.072 |
| 28.001 | User | - | 100 | 0.055 | 0.055 | 0.055 |
|  | User | - | 50 | 0.004 | 0.002 | 0.057 |
|  | User | - | 25 | 0.002 | 0.001 | 0.057 |
| 28.002 | User | - | 100 | 0.038 | 0.038 | 0.038 |
|  | User | - | 50 | 0.008 | 0.004 | 0.042 |
|  | User | - | 100 | 0.003 | 0.003 | 0.045 |
| 28.003 | User | - | 100 | 0.051 | 0.051 | 0.051 |
|  | User | - | 50 | 0.014 | 0.007 | 0.058 |
|  | User | - | 25 | 0.011 | 0.003 | 0.060 |
| 28.004 | User | - | 100 | 0.057 | 0.057 | 0.057 |
|  | User | - | 50 | 0.005 | 0.002 | 0.059 |
|  | User | - | 25 | 0.008 | 0.002 | 0.061 |
| 28.005 | User | - | 100 | 0.063 | 0.063 | 0.063 |
|  | User | - | 50 | 0.006 | 0.003 | 0.066 |
| 27.008 | User | - | 100 | 0.067 | 0.067 | 0.067 |
|  | User | - | 50 | 0.008 | 0.004 | 0.071 |
| 27.009 | User | - | 100 | 0.176 | 0.176 | 0.176 |
|  | User | - | 50 | 0.011 | 0.005 | 0.182 |
| 27.010 | User | - | 100 | 0.167 | 0.167 | 0.167 |
|  | User | - | 50 | 0.008 | 0.004 | 0.171 |
| 27.011 | User | - | 100 | 0.126 | 0.126 | 0.126 |
|  | User | - | 50 | 0.006 | 0.003 | 0.129 |

## Area Summary for Pond 2-1

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 27.012 | User | - | 100 | 0.143 | 0.143 | 0.143 |
| | User | - | 50 | 0.003 | 0.002 | 0.145 |
| | User | - | 25 | 0.004 | 0.001 | 0.146 |
| 27.013 | User | - | 100 | 0.181 | 0.181 | 0.181 |
| | User | - | 50 | 0.003 | 0.002 | 0.183 |
| | User | - | 25 | 0.015 | 0.004 | 0.186 |
| 27.014 | User | - | 100 | 0.183 | 0.183 | 0.183 |
| | User | - | 50 | 0.045 | 0.023 | 0.205 |
| 27.015 | User | - | 100 | 0.151 | 0.151 | 0.151 |
| 27.016 | User | - | 100 | 0.191 | 0.191 | 0.191 |
| | User | - | 50 | 0.004 | 0.002 | 0.193 |
| | User | - | 25 | 0.004 | 0.001 | 0.194 |
| 27.017 | User | - | 100 | 0.126 | 0.126 | 0.126 |
| | User | - | 50 | 0.011 | 0.005 | 0.131 |
| | User | - | 25 | 0.027 | 0.007 | 0.138 |
| 27.018 | User | - | 100 | 0.060 | 0.060 | 0.060 |
| | User | - | 50 | 0.008 | 0.004 | 0.064 |
| | User | - | 25 | 0.012 | 0.003 | 0.067 |
| 27.019 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 29.000 | User | - | 100 | 0.101 | 0.101 | 0.101 |
| | User | - | 50 | 0.003 | 0.002 | 0.103 |
| 29.001 | User | - | 100 | 0.087 | 0.087 | 0.087 |
| | User | - | 50 | 0.003 | 0.002 | 0.089 |
| 29.002 | User | - | 100 | 0.066 | 0.066 | 0.066 |
| | User | - | 50 | 0.001 | 0.001 | 0.067 |
| 29.003 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 29.004 | User | - | 100 | 0.077 | 0.077 | 0.077 |
| | User | - | 50 | 0.012 | 0.006 | 0.083 |
| 29.005 | User | - | 100 | 0.117 | 0.117 | 0.117 |
| | User | - | 50 | 0.005 | 0.002 | 0.120 |
| 29.006 | User | - | 100 | 0.156 | 0.156 | 0.156 |
| | User | - | 50 | 0.002 | 0.001 | 0.157 |
| 29.007 | User | - | 100 | 0.105 | 0.105 | 0.105 |
| | User | - | 50 | 0.018 | 0.009 | 0.115 |
| 29.008 | User | - | 100 | 0.126 | 0.126 | 0.126 |
| | User | - | 50 | 0.029 | 0.015 | 0.141 |
| 29.009 | User | - | 100 | 0.103 | 0.103 | 0.103 |
| | User | - | 50 | 0.029 | 0.014 | 0.118 |
| 29.010 | User | - | 100 | 0.086 | 0.086 | 0.086 |
| | User | - | 50 | 0.024 | 0.012 | 0.098 |
| 29.011 | User | - | 100 | 0.087 | 0.087 | 0.087 |
| | User | - | 50 | 0.025 | 0.012 | 0.100 |
| 29.012 | User | - | 100 | 0.072 | 0.072 | 0.072 |
| | User | - | 50 | 0.020 | 0.010 | 0.082 |
| 29.013 | User | - | 100 | 0.032 | 0.032 | 0.032 |
| | User | - | 50 | 0.009 | 0.005 | 0.036 |
| 27.020 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 27.021 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 27.022 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 27.023 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 18.013 | - | - | 100 | 0.000 | 0.000 | 0.000 |

## Area Summary for Pond 2-1

| **Pipe Number** | **PIMP Type** | **PIMP Name** | **PIMP (%)** | **Gross Area (ha)** | **Imp. Area (ha)** | **Pipe Total (ha)** |
|---|---|---|---|---|---|---|
| | | | | Total<br>7.538 | Total<br>6.419 | Total<br>6.419 |

## Free Flowing Outfall Details for Pond 2-1

| **Outfall Pipe Number** | **Outfall Name** | **C. Level (m)** | **I. Level (m)** | **Min I. Level (m)** | **D,L (mm)** | **W (mm)** |
|---|---|---|---|---|---|---|
| S18.013 | S83 | 123.775 | 121.283 | 0.000 | 1650 | 0 |

## Simulation Criteria for Pond 2-1

| | | | |
|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Additional Flow - % of Total Flow | 0.000 |
| Areal Reduction Factor | 1.000 | MADD Factor * $10m^3$/ha Storage | 2.000 |
| Hot Start (mins) | 0 | Inlet Coeffiecient | 0.800 |
| Hot Start Level (mm) | 0 | Flow per Person per Day (l/per/day) | 0.000 |
| Manhole Headloss Coeff (Global) | 0.500 | Run Time (mins) | 60 |
| Foul Sewage per hectare (l/s) | 0.000 | Output Interval (mins) | 1 |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

## Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Profile Type | Summer |
| Return Period (years) | 5 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.200 | Storm Duration (mins) | 30 |
| Ratio R | 0.300 | | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 2-1

### Simulation Criteria

```
          Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 0.000
                 Hot Start (mins)     0       MADD Factor * 10m³/ha Storage 2.000
               Hot Start Level (mm)     0             Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
  Foul Sewage per hectare (l/s) 0.000

          Number of Input Hydrographs 0 Number of Storage Structures 0
            Number of Online Controls 0 Number of Time/Area Diagrams 0
           Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
        Rainfall Model              FSR      Ratio R 0.300
               Region England and Wales Cv (Summer) 0.750
            M5-60 (mm)           16.000 Cv (Winter) 0.840

   Margin for Flood Risk Warning (mm)  300.0      DVD Status OFF
                    Analysis Timestep  Fine Inertia Status OFF
                           DTS Status    ON


              Profile(s)                          Summer and Winter
         Duration(s) (mins)     15, 30, 60, 120, 180, 240, 360, 480, 600,
                                  720, 960, 1440, 2160, 2880, 4320, 5760,
                                                        7200, 8640, 10080
   Return Period(s) (years)                                             5
         Climate Change (%)                                            20
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| S18.000 | S02-01-4 | 15 Winter | 5 | +20% | | | | |
| S18.001 | S02-01-5 | 15 Winter | 5 | +20% | | | | |
| S19.000 | S02-01-6 | 15 Winter | 5 | +20% | | | | |
| S19.001 | S02-01-7 | 15 Winter | 5 | +20% | | | | |
| S19.002 | S02-01-8 | 15 Winter | 5 | +20% | | | | |
| S20.000 | S02-01-9 | 15 Winter | 5 | +20% | | | | |
| S20.001 | S02-01-10 | 15 Winter | 5 | +20% | | | | |
| S20.002 | S02-01-11 | 15 Winter | 5 | +20% | | | | |
| S19.003 | S02-01-12 | 15 Winter | 5 | +20% | | | | |
| S18.002 | S02-01-13 | 15 Winter | 5 | +20% | | | | |
| S18.003 | S02-01-14 | 15 Winter | 5 | +20% | | | | |
| S18.004 | S02-01-15 | 15 Winter | 5 | +20% | | | | |
| S18.005 | S02-01-16 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| S21.000 | S02-01-17 | 15 Winter | 5 | +20% | | | | |
| S21.001 | S02-01-18 | 15 Winter | 5 | +20% | | | | |
| S21.002 | S02-01-19 | 15 Winter | 5 | +20% | | | | |
| S22.000 | S02-01-20 | 15 Winter | 5 | +20% | | | | |
| S22.001 | S02-01-21 | 15 Winter | 5 | +20% | | | | |
| S22.002 | S02-01-22 | 15 Winter | 5 | +20% | | | | |
| S22.003 | S02-01-23 | 15 Winter | 5 | +20% | | | | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 2-1

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S18.000 | S02-01-4 | 133.968 | -0.157 | 0.000 | 0.19 | | | 15.4 | OK |
| S18.001 | S02-01-5 | 132.508 | -0.138 | 0.000 | 0.31 | | | 27.1 | OK |
| S19.000 | S02-01-6 | 134.254 | -0.171 | 0.000 | 0.13 | | | 8.8 | OK |
| S19.001 | S02-01-7 | 133.651 | -0.146 | 0.000 | 0.26 | | | 18.6 | OK |
| S19.002 | S02-01-8 | 132.870 | -0.081 | 0.000 | 0.71 | | | 30.0 | OK |
| S20.000 | S02-01-9 | 134.615 | -0.110 | 0.000 | 0.50 | | | 32.8 | OK |
| S20.001 | S02-01-10 | 133.544 | -0.169 | 0.000 | 0.39 | | | 45.4 | OK |
| S20.002 | S02-01-11 | 132.951 | -0.147 | 0.000 | 0.51 | | | 55.6 | OK |
| S19.003 | S02-01-12 | 132.404 | -0.181 | 0.000 | 0.33 | | | 86.1 | OK |
| S18.002 | S02-01-13 | 131.066 | -0.137 | 0.000 | 0.56 | | | 123.4 | OK |
| S18.003 | S02-01-14 | 128.872 | -0.135 | 0.000 | 0.58 | | | 137.7 | OK |
| S18.004 | S02-01-15 | 125.820 | -0.203 | 0.000 | 0.43 | | | 152.1 | OK |
| S18.005 | S02-01-16 | 123.984 | 0.072 | 0.000 | 1.41 | | | 151.5 | SURCHARGED |
| S21.000 | S02-01-17 | 135.306 | -0.119 | 0.000 | 0.44 | | | 27.6 | OK |
| S21.001 | S02-01-18 | 134.297 | -0.104 | 0.000 | 0.56 | | | 38.2 | OK |
| S21.002 | S02-01-19 | 133.175 | -0.208 | 0.000 | 0.21 | | | 50.2 | OK |
| S22.000 | S02-01-20 | 133.946 | -0.179 | 0.000 | 0.09 | | | 5.6 | OK |
| S22.001 | S02-01-21 | 133.516 | -0.195 | 0.000 | 0.04 | | | 5.5 | OK |
| S22.002 | S02-01-22 | 132.641 | -0.138 | 0.000 | 0.31 | | | 17.2 | OK |
| S22.003 | S02-01-23 | 132.074 | -0.076 | 0.000 | 0.75 | | | 26.3 | OK |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| S18.000 | S02-01-4 | |
| S18.001 | S02-01-5 | |
| S19.000 | S02-01-6 | |
| S19.001 | S02-01-7 | |
| S19.002 | S02-01-8 | |
| S20.000 | S02-01-9 | |
| S20.001 | S02-01-10 | |
| S20.002 | S02-01-11 | |
| S19.003 | S02-01-12 | |
| S18.002 | S02-01-13 | |
| S18.003 | S02-01-14 | |
| S18.004 | S02-01-15 | |
| S18.005 | S02-01-16 | |
| S21.000 | S02-01-17 | |
| S21.001 | S02-01-18 | |
| S21.002 | S02-01-19 | |
| S22.000 | S02-01-20 | |
| S22.001 | S02-01-21 | |
| S22.002 | S02-01-22 | |
| S22.003 | S02-01-23 | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 2-1

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) |
|---|---|---|---|---|---|---|---|---|---|
| S23.000 | S02-01-24 | 15 Winter | 5 | +20% | | | | | 135.065 |
| S23.001 | S02-01-25 | 15 Winter | 5 | +20% | | | | | 133.760 |
| S22.004 | S02-01-26 | 15 Winter | 5 | +20% | | | | | 131.754 |
| S21.003 | S02-01-27 | 15 Winter | 5 | +20% | | | | | 129.982 |
| S21.004 | S02-01-28 | 15 Winter | 5 | +20% | | | | | 127.245 |
| S21.005 | S02-01-29 | 15 Winter | 5 | +20% | | | | | 124.809 |
| S18.006 | S02-01-30 | 15 Winter | 5 | +20% | | | | | 123.463 |
| S24.000 | S02-01-31 | 15 Winter | 5 | +20% | | | | | 127.610 |
| S24.001 | S02-01-32 | 15 Winter | 5 | +20% | | | | | 127.417 |
| S24.002 | S02-01-33 | 15 Winter | 5 | +20% | | | | | 126.818 |
| S24.003 | S02-01-34 | 15 Winter | 5 | +20% | | | | | 125.965 |
| S25.000 | S02-01-35 | 15 Winter | 5 | +20% | | | | | 127.302 |
| S25.001 | S02-01-36 | 15 Winter | 5 | +20% | | | | | 126.739 |
| S25.002 | S02-01-37 | 15 Winter | 5 | +20% | | | | | 126.522 |
| S25.003 | S02-01-38 | 15 Winter | 5 | +20% | | | | | 125.832 |
| S24.004 | S02-01-39 | 15 Winter | 5 | +20% | | | | | 125.731 |
| S24.005 | S02-01-40 | 15 Winter | 5 | +20% | | | | | 125.135 |
| S24.006 | S02-01-41 | 15 Winter | 5 | +20% | | | | | 123.931 |
| S26.000 | S02-01-42 | 15 Winter | 5 | +20% | | | | | 126.383 |
| S26.001 | S02-01-43 | 15 Winter | 5 | +20% | | | | | 124.769 |
| S26.002 | S02-01-44 | 15 Winter | 5 | +20% | | | | | 123.633 |
| S26.003 | S02-01-45 | 15 Winter | 5 | +20% | | | | | 123.516 |
| S24.007 | S02-01-46 | 15 Winter | 5 | +20% | | | | | 123.363 |
| S18.007 | S02-01-47 | 15 Winter | 5 | +20% | | | | | 122.963 |
| S18.008 | S02-01-48 | 15 Winter | 5 | +20% | | | | | 122.822 |
| S18.009 | S02-01-49 | 15 Winter | 5 | +20% | | | | | 122.686 |
| S18.010 | S02-01-50 | 15 Winter | 5 | +20% | | | | | 122.453 |
| S18.011 | S02-01-51 | 30 Winter | 5 | +20% | | | | | 122.286 |
| S18.012 | S02-01-52 | 30 Winter | 5 | +20% | | | | | 122.216 |
| S27.000 | S02-01-53 | 15 Winter | 5 | +20% | | | | | 148.039 |
| S27.001 | S02-01-54 | 15 Winter | 5 | +20% | | | | | 147.278 |
| S27.002 | S02-01-55 | 15 Winter | 5 | +20% | | | | | 145.292 |
| S27.003 | S02-01-56 | 15 Winter | 5 | +20% | | | | | 143.733 |
| S27.004 | S02-01-57 | 15 Winter | 5 | +20% | | | | | 141.879 |
| S27.005 | S02-01-58 | 15 Winter | 5 | +20% | | | | | 140.095 |
| S27.006 | S02-01-59 | 15 Winter | 5 | +20% | | | | | 138.436 |
| S27.007 | S02-01-60 | 15 Winter | 5 | +20% | | | | | 138.188 |
| S28.000 | S02-01-61 | 15 Winter | 5 | +20% | | | | | 144.957 |
| S28.001 | S02-01-62 | 15 Winter | 5 | +20% | | | | | 143.314 |
| S28.002 | S02-01-63 | 15 Winter | 5 | +20% | | | | | 141.619 |
| S28.003 | S02-01-64 | 15 Winter | 5 | +20% | | | | | 140.667 |
| S28.004 | S02-01-65 | 15 Winter | 5 | +20% | | | | | 139.683 |
| S28.005 | S02-01-66 | 15 Winter | 5 | +20% | | | | | 138.394 |
| S27.008 | S02-01-67 | 15 Winter | 5 | +20% | | | | | 137.620 |
| S27.009 | S02-01-68 | 15 Winter | 5 | +20% | | | | | 137.199 |
| S27.010 | S02-01-69 | 15 Winter | 5 | +20% | | | | | 136.906 |
| S27.011 | S02-01-70 | 15 Winter | 5 | +20% | | | | | 136.583 |
| S27.012 | S02-01-71 | 15 Winter | 5 | +20% | | | | | 136.351 |
| S27.013 | S02-01-72 | 15 Winter | 5 | +20% | | | | | 136.120 |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 2-1

| PN | US/MH Name | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|
| S23.000 | S02-01-24 | -0.160 | 0.000 | 0.18 | | | 12.7 | OK | |
| S23.001 | S02-01-25 | -0.154 | 0.000 | 0.21 | | | 21.3 | OK | |
| S22.004 | S02-01-26 | -0.140 | 0.000 | 0.30 | | | 46.8 | OK | |
| S21.003 | S02-01-27 | -0.136 | 0.000 | 0.57 | | | 113.9 | OK | |
| S21.004 | S02-01-28 | -0.132 | 0.000 | 0.60 | | | 126.6 | OK | |
| S21.005 | S02-01-29 | -0.144 | 0.000 | 0.53 | | | 132.7 | OK | |
| S18.006 | S02-01-30 | -0.161 | 0.000 | 0.74 | | | 283.0 | OK | |
| S24.000 | S02-01-31 | -0.115 | 0.000 | 0.45 | | | 14.2 | OK | |
| S24.001 | S02-01-32 | -0.107 | 0.000 | 0.53 | | | 26.7 | OK | |
| S24.002 | S02-01-33 | -0.105 | 0.000 | 0.55 | | | 35.9 | OK | |
| S24.003 | S02-01-34 | -0.104 | 0.000 | 0.57 | | | 35.8 | OK | |
| S25.000 | S02-01-35 | -0.128 | 0.000 | 0.37 | | | 18.8 | OK | |
| S25.001 | S02-01-36 | -0.082 | 0.000 | 0.71 | | | 27.1 | OK | |
| S25.002 | S02-01-37 | -0.069 | 0.000 | 0.80 | | | 40.1 | OK | |
| S25.003 | S02-01-38 | -0.157 | 0.000 | 0.46 | | | 39.8 | OK | |
| S24.004 | S02-01-39 | -0.136 | 0.000 | 0.57 | | | 81.6 | OK | |
| S24.005 | S02-01-40 | -0.118 | 0.000 | 0.67 | | | 107.0 | OK | |
| S24.006 | S02-01-41 | -0.166 | 0.000 | 0.59 | | | 120.7 | OK | |
| S26.000 | S02-01-42 | -0.142 | 0.000 | 0.28 | | | 22.5 | OK | |
| S26.001 | S02-01-43 | -0.099 | 0.000 | 0.59 | | | 42.0 | OK | |
| S26.002 | S02-01-44 | -0.178 | 0.000 | 0.53 | | | 55.5 | OK | |
| S26.003 | S02-01-45 | -0.161 | 0.000 | 0.62 | | | 55.0 | OK | |
| S24.007 | S02-01-46 | -0.124 | 0.000 | 0.78 | | | 176.1 | OK | |
| S18.007 | S02-01-47 | -0.120 | 0.000 | 0.94 | | | 443.9 | OK | |
| S18.008 | S02-01-48 | -0.148 | 0.000 | 0.99 | | | 436.1 | OK | |
| S18.009 | S02-01-49 | -0.213 | 0.000 | 0.81 | | | 407.7 | OK | |
| S18.010 | S02-01-50 | -0.239 | 0.000 | 0.76 | | | 378.5 | OK | |
| S18.011 | S02-01-51 | -0.237 | 0.000 | 0.67 | | | 331.4 | OK | |
| S18.012 | S02-01-52 | -0.128 | 0.000 | 0.61 | | | 304.8 | OK | |
| S27.000 | S02-01-53 | -0.186 | 0.000 | 0.07 | | | 6.0 | OK | |
| S27.001 | S02-01-54 | -0.166 | 0.000 | 0.15 | | | 15.9 | OK | |
| S27.002 | S02-01-55 | -0.148 | 0.000 | 0.25 | | | 24.6 | OK | |
| S27.003 | S02-01-56 | -0.131 | 0.000 | 0.36 | | | 35.9 | OK | |
| S27.004 | S02-01-57 | -0.114 | 0.000 | 0.49 | | | 46.7 | OK | |
| S27.005 | S02-01-58 | -0.181 | 0.000 | 0.33 | | | 65.4 | OK | |
| S27.006 | S02-01-59 | -0.061 | 0.000 | 0.97 | | | 64.3 | OK | |
| S27.007 | S02-01-60 | -0.148 | 0.000 | 0.51 | | | 63.4 | OK | |
| S28.000 | S02-01-61 | -0.168 | 0.000 | 0.15 | | | 14.4 | OK | |
| S28.001 | S02-01-62 | -0.146 | 0.000 | 0.26 | | | 24.2 | OK | |
| S28.002 | S02-01-63 | -0.376 | 0.000 | 0.06 | | | 32.0 | OK | |
| S28.003 | S02-01-64 | -0.359 | 0.000 | 0.09 | | | 42.4 | OK | |
| S28.004 | S02-01-65 | -0.358 | 0.000 | 0.09 | | | 52.8 | OK | |
| S28.005 | S02-01-66 | -0.340 | 0.000 | 0.14 | | | 64.1 | OK | |
| S27.008 | S02-01-67 | -0.247 | 0.000 | 0.42 | | | 135.9 | OK | |
| S27.009 | S02-01-68 | -0.236 | 0.000 | 0.56 | | | 159.3 | OK | |
| S27.010 | S02-01-69 | -0.220 | 0.000 | 0.62 | | | 177.1 | OK | |
| S27.011 | S02-01-70 | -0.205 | 0.000 | 0.67 | | | 187.4 | OK | |
| S27.012 | S02-01-71 | -0.194 | 0.000 | 0.71 | | | 197.3 | OK | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 2-1

| PN | US/MH Name | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|
| S27.013 | S02-01-72 | -0.185 | 0.000 | 0.74 | | | 206.4 | OK | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 2-1

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| S27.014 | S02-01-73 | 30 Winter | 5 | +20% | | | | |
| S27.015 | S02-01-74 | 30 Winter | 5 | +20% | | | | |
| S27.016 | S02-01-75 | 30 Winter | 5 | +20% | | | | |
| S27.017 | S02-01-76 | 30 Winter | 5 | +20% | | | | |
| S27.018 | S02-01-77 | 30 Winter | 5 | +20% | | | | |
| S27.019 | S02-01-78 | 30 Winter | 5 | +20% | | | | |
| S29.000 | S02-01-79 | 15 Winter | 5 | +20% | | | | |
| S29.001 | S02-01-80 | 15 Winter | 5 | +20% | | | | |
| S29.002 | S02-01-81 | 15 Winter | 5 | +20% | | | | |
| S29.003 | S02-01-82 | 15 Winter | 5 | +20% | | | | |
| S29.004 | S02-01-83 | 15 Winter | 5 | +20% | | | | |
| S29.005 | S02-01-84 | 15 Winter | 5 | +20% | | | | |
| S29.006 | S02-01-85 | 15 Winter | 5 | +20% | | | | |
| S29.007 | S02-01-86 | 15 Winter | 5 | +20% | | | | |
| S29.008 | S02-01-87 | 30 Winter | 5 | +20% | | | | |
| S29.009 | S02-01-88 | 30 Winter | 5 | +20% | | | | |
| S29.010 | S02-01-89 | 30 Winter | 5 | +20% | | | | |
| S29.011 | S02-01-90 | 30 Winter | 5 | +20% | | | | |
| S29.012 | S02-01-91 | 30 Winter | 5 | +20% | | | | |
| S29.013 | S02-01-92 | 30 Winter | 5 | +20% | | | | |
| S27.020 | S02-01-93 | 30 Winter | 5 | +20% | | | | |
| S27.021 | S02-01-94 | 30 Winter | 5 | +20% | | | | |
| S27.022 | S02-01-95 | 30 Winter | 5 | +20% | | | | |
| S27.023 | S02-01-96 | 30 Winter | 5 | +20% | | | | |
| S18.013 | S02-01-97 | 30 Winter | 5 | +20% | 5/15 Summer | | | |

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S27.014 | S02-01-73 | 135.926 | -0.111 | 0.000 | 0.97 | | | 215.5 | OK |
| S27.015 | S02-01-74 | 135.752 | -0.103 | 0.000 | 0.99 | | | 220.3 | OK |
| S27.016 | S02-01-75 | 135.447 | -0.222 | 0.000 | 0.71 | | | 226.0 | OK |
| S27.017 | S02-01-76 | 135.226 | -0.212 | 0.000 | 0.74 | | | 228.0 | OK |
| S27.018 | S02-01-77 | 134.979 | -0.303 | 0.000 | 0.49 | | | 229.6 | OK |
| S27.019 | S02-01-78 | 134.770 | -0.295 | 0.000 | 0.51 | | | 229.5 | OK |
| S29.000 | S02-01-79 | 136.939 | -0.086 | 0.000 | 0.68 | | | 20.5 | OK |
| S29.001 | S02-01-80 | 136.788 | -0.131 | 0.000 | 0.58 | | | 34.5 | OK |
| S29.002 | S02-01-81 | 136.687 | -0.102 | 0.000 | 0.75 | | | 44.0 | OK |
| S29.003 | S02-01-82 | 136.590 | -0.083 | 0.000 | 0.80 | | | 43.3 | OK |
| S29.004 | S02-01-83 | 136.545 | -0.075 | 0.000 | 0.90 | | | 53.4 | OK |
| S29.005 | S02-01-84 | 136.242 | -0.236 | 0.000 | 0.45 | | | 66.2 | OK |
| S29.006 | S02-01-85 | 136.121 | -0.208 | 0.000 | 0.55 | | | 82.1 | OK |
| S29.007 | S02-01-86 | 135.963 | -0.190 | 0.000 | 0.62 | | | 90.9 | OK |
| S29.008 | S02-01-87 | 135.854 | -0.174 | 0.000 | 0.68 | | | 101.7 | OK |
| S29.009 | S02-01-88 | 135.692 | -0.161 | 0.000 | 0.73 | | | 109.1 | OK |
| S29.010 | S02-01-89 | 135.526 | -0.152 | 0.000 | 0.77 | | | 113.5 | OK |
| S29.011 | S02-01-90 | 135.382 | -0.146 | 0.000 | 0.79 | | | 117.1 | OK |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 2-1

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S29.012 | S02-01-91 | 135.239 | -0.139 | 0.000 | 0.82 | | | 119.4 | OK |
| S29.013 | S02-01-92 | 135.011 | -0.242 | 0.000 | 0.44 | | | 120.5 | OK |
| S27.020 | S02-01-93 | 134.647 | -0.219 | 0.000 | 0.73 | | | 349.3 | OK |
| S27.021 | S02-01-94 | 134.267 | -0.370 | 0.000 | 0.31 | | | 349.1 | OK |
| S27.022 | S02-01-95 | 132.962 | -0.442 | 0.000 | 0.16 | | | 349.1 | OK |
| S27.023 | S02-01-96 | 122.937 | -0.358 | 0.000 | 0.34 | | | 349.3 | OK |
| S18.013 | S02-01-97 | 122.158 | 0.114 | 0.000 | 1.83 | | | 629.6 | SURCHARGED |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| S27.014 | S02-01-73 | |
| S27.015 | S02-01-74 | |
| S27.016 | S02-01-75 | |
| S27.017 | S02-01-76 | |
| S27.018 | S02-01-77 | |
| S27.019 | S02-01-78 | |
| S29.000 | S02-01-79 | |
| S29.001 | S02-01-80 | |
| S29.002 | S02-01-81 | |
| S29.003 | S02-01-82 | |
| S29.004 | S02-01-83 | |
| S29.005 | S02-01-84 | |
| S29.006 | S02-01-85 | |
| S29.007 | S02-01-86 | |
| S29.008 | S02-01-87 | |
| S29.009 | S02-01-88 | |
| S29.010 | S02-01-89 | |
| S29.011 | S02-01-90 | |
| S29.012 | S02-01-91 | |
| S29.013 | S02-01-92 | |
| S27.020 | S02-01-93 | |
| S27.021 | S02-01-94 | |
| S27.022 | S02-01-95 | |
| S27.023 | S02-01-96 | |
| S18.013 | S02-01-97 | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Pond 2-2

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 15.700 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Time Area Diagram for Pond 2-2

| **Time (mins)** | **Area (ha)** | **Time (mins)** | **Area (ha)** | **Time (mins)** | **Area (ha)** |
|---|---|---|---|---|---|
| 0-4 | 0.508 | 4-8 | 1.010 | 8-12 | 0.125 |

Total Area Contributing (ha) = 1.643

Total Pipe Volume (m³) = 92.082

### Network Design Table for Pond 2-2

| **PN** | **Length (m)** | **Fall (m)** | **Slope (1:X)** | **I.Area (ha)** | **T.E. (mins)** | **Base Flow (l/s)** | **k (mm)** | **HYD SECT** | **DIA (mm)** | **Section Type** | **Auto Design** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 80.043 | 1.334 | 60.0 | 0.164 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S1.001 | 80.042 | 2.287 | 35.0 | 0.128 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S1.002 | 80.053 | 2.965 | 27.0 | 0.108 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S1.003 | 70.051 | 2.335 | 30.0 | 0.095 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.004 | 53.323 | 1.333 | 40.0 | 0.077 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.005 | 12.078 | 0.302 | 40.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |

### Network Results Table

| **PN** | **Rain (mm/hr)** | **T.C. (mins)** | **US/IL (m)** | **Σ I.Area (ha)** | **Σ Base Flow (l/s)** | **Foul (l/s)** | **Add Flow (l/s)** | **Vel (m/s)** | **Cap (l/s)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 58.02 | 5.79 | 127.400 | 0.164 | 0.0 | 0.0 | 0.0 | 1.69 | 67.3 | 25.8 |
| S1.001 | 55.70 | 6.39 | 126.066 | 0.292 | 0.0 | 0.0 | 0.0 | 2.22 | 88.2 | 44.0 |
| S1.002 | 53.85 | 6.92 | 123.779 | 0.400 | 0.0 | 0.0 | 0.0 | 2.53 | 100.5 | 58.3 |
| S1.003 | 52.53 | 7.32 | 120.739 | 0.495 | 0.0 | 0.0 | 0.0 | 2.88 | 203.7 | 70.4 |
| S1.004 | 51.43 | 7.68 | 118.404 | 0.572 | 0.0 | 0.0 | 0.0 | 2.49 | 176.2 | 79.6 |
| S1.005 | 51.19 | 7.76 | 117.146 | 0.572 | 0.0 | 0.0 | 0.0 | 2.49 | 176.3 | 79.6 |

## Network Design Table for Pond 2-2

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S2.000 | 29.805 | 0.426 | 70.0 | 0.037 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S2.001 | 10.637 | 0.106 | 100.4 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S3.000 | 30.714 | 0.205 | 150.0 | 0.033 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.002 | 69.199 | 1.384 | 50.0 | 0.141 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.003 | 79.030 | 2.395 | 33.0 | 0.123 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.004 | 49.508 | 1.980 | 25.0 | 0.068 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.005 | 68.737 | 2.291 | 30.0 | 0.090 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S2.006 | 62.683 | 1.399 | 44.8 | 0.082 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.006 | 7.909 | 0.398 | 19.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S4.000 | 49.057 | 0.818 | 60.0 | 0.055 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S4.001 | 79.960 | 1.999 | 40.0 | 0.085 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S4.002 | 70.517 | 3.526 | 20.0 | 0.086 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S5.000 | 57.053 | 0.951 | 60.0 | 0.091 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S5.001 | 87.372 | 1.589 | 55.0 | 0.109 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S5.002 | 53.524 | 0.973 | 55.0 | 0.073 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S5.003 | 48.606 | 3.030 | 16.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S2.000 | 60.00 | 5.32 | 126.900 | 0.037 | 0.0 | 0.0 | 0.0 | 1.57 | 62.2 | 5.9 |
| S2.001 | 59.41 | 5.45 | 126.474 | 0.037 | 0.0 | 0.0 | 0.0 | 1.31 | 51.9 | 5.9 |
| S3.000 | 59.30 | 5.48 | 126.800 | 0.033 | 0.0 | 0.0 | 0.0 | 1.07 | 42.4 | 5.3 |
| S2.002 | 56.78 | 6.10 | 126.368 | 0.211 | 0.0 | 0.0 | 0.0 | 1.85 | 73.7 | 32.4 |
| S2.003 | 54.67 | 6.68 | 124.984 | 0.334 | 0.0 | 0.0 | 0.0 | 2.29 | 90.9 | 49.4 |
| S2.004 | 53.60 | 6.99 | 122.589 | 0.401 | 0.0 | 0.0 | 0.0 | 2.63 | 104.5 | 58.3 |
| S2.005 | 52.31 | 7.39 | 120.534 | 0.491 | 0.0 | 0.0 | 0.0 | 2.88 | 203.6 | 69.6 |
| S2.006 | 50.97 | 7.83 | 118.243 | 0.573 | 0.0 | 0.0 | 0.0 | 2.36 | 166.5 | 79.1 |
| S1.006 | 50.86 | 7.87 | 116.844 | 1.145 | 0.0 | 0.0 | 0.0 | 3.54 | 250.4 | 157.6 |
| S4.000 | 59.29 | 5.48 | 132.200 | 0.055 | 0.0 | 0.0 | 0.0 | 1.69 | 67.3 | 8.8 |
| S4.001 | 56.69 | 6.13 | 131.382 | 0.140 | 0.0 | 0.0 | 0.0 | 2.07 | 82.5 | 21.4 |
| S4.002 | 55.21 | 6.53 | 129.383 | 0.226 | 0.0 | 0.0 | 0.0 | 2.94 | 116.9 | 33.7 |
| S5.000 | 58.95 | 5.56 | 132.400 | 0.091 | 0.0 | 0.0 | 0.0 | 1.69 | 67.3 | 14.5 |
| S5.001 | 55.72 | 6.39 | 131.449 | 0.200 | 0.0 | 0.0 | 0.0 | 1.77 | 70.3 | 30.1 |
| S5.002 | 53.94 | 6.89 | 129.860 | 0.273 | 0.0 | 0.0 | 0.0 | 1.77 | 70.3 | 39.8 |
| S5.003 | 53.12 | 7.14 | 128.887 | 0.273 | 0.0 | 0.0 | 0.0 | 3.28 | 130.6 | 39.8 |

## Network Design Table for Pond 2-2

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S4.003 | 6.159 | 0.616 | 10.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S4.004 | 99.237 | 2.481 | 40.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S4.005 | 25.221 | 0.631 | 40.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S4.006 | 39.959 | 1.766 | 22.6 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S4.007 | 81.167 | 0.841 | 96.5 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S4.008 | 81.939 | 1.821 | 45.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S4.009 | 59.014 | 1.180 | 50.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.007 | 90.332 | 3.613 | 25.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.008 | 4.590 | 0.044 | 103.4 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |

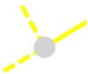
## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S4.003 | 53.04 | 7.16 | 125.857 | 0.498 | 0.0 | 0.0 | 0.0 | 4.16 | 165.5 | 71.6 |
| S4.004 | 50.99 | 7.83 | 125.166 | 0.498 | 0.0 | 0.0 | 0.0 | 2.49 | 176.3 | 71.6 |
| S4.005 | 50.50 | 7.99 | 122.685 | 0.498 | 0.0 | 0.0 | 0.0 | 2.49 | 176.3 | 71.6 |
| S4.006 | 49.93 | 8.19 | 122.054 | 0.498 | 0.0 | 0.0 | 0.0 | 3.32 | 234.6 | 71.6 |
| S4.007 | 47.70 | 9.04 | 120.289 | 0.498 | 0.0 | 0.0 | 0.0 | 1.60 | 113.2 | 71.6 |
| S4.008 | 46.30 | 9.62 | 119.447 | 0.498 | 0.0 | 0.0 | 0.0 | 2.35 | 166.1 | 71.6 |
| S4.009 | 45.31 | 10.06 | 117.626 | 0.498 | 0.0 | 0.0 | 0.0 | 2.23 | 157.5 | 71.6 |
| S1.007 | 44.29 | 10.54 | 116.446 | 1.643 | 0.0 | 0.0 | 0.0 | 3.16 | 223.2 | 197.0 |
| S1.008 | 44.21 | 10.58 | 112.683 | 1.643 | 0.0 | 0.0 | 0.0 | 2.00 | 317.9 | 197.0 |

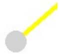
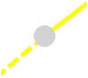
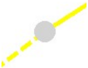
## Manhole Schedules for Pond 2-2

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Back (m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S02-02-1 | 128.932 | 1.532 | Open Manhole | 1200 | S1.000 | 127.400 | 225 | | | | |
| S02-02-2 | 127.729 | 1.663 | Open Manhole | 1200 | S1.001 | 126.066 | 225 | S1.000 | 126.066 | 225 | |
| S02-02-3 | 125.409 | 1.630 | Open Manhole | 1200 | S1.002 | 123.779 | 225 | S1.001 | 123.779 | 225 | |
| S02-02-4 | 122.401 | 1.662 | Open Manhole | 1200 | S1.003 | 120.739 | 300 | S1.002 | 120.814 | 225 | |
| S02-02-5 | 120.126 | 1.721 | Open Manhole | 1200 | S1.004 | 118.404 | 300 | S1.003 | 118.404 | 300 | |
| S02-02-6 | 118.925 | 1.854 | Open Manhole | 1200 | S1.005 | 117.146 | 300 | S1.004 | 117.071 | 300 | |
| S02-02-7 | 128.392 | 1.492 | Open Manhole | 1200 | S2.000 | 126.900 | 225 | | | | |
| S02-02-8 | 128.122 | 1.648 | Open Manhole | 1200 | S2.001 | 126.474 | 225 | S2.000 | 126.474 | 225 | |
| S02-02-9 | 128.312 | 1.512 | Open Manhole | 1200 | S3.000 | 126.800 | 225 | | | | |
| S02-02-10 | 127.676 | 1.307 | Open Manhole | 1200 | S2.002 | 126.368 | 225 | S2.001 | 126.368 | 225 | |
| | | | | | | | | S3.000 | 126.595 | 225 | |
| S02-02-11 | 126.545 | 1.560 | Open Manhole | 1200 | S2.003 | 124.984 | 225 | S2.002 | 124.984 | 225 | |
| S02-02-12 | 124.068 | 1.479 | Open Manhole | 1200 | S2.004 | 122.589 | 225 | S2.003 | 122.589 | 225 | |
| S02-02-13 | 122.177 | 1.643 | Open Manhole | 1200 | S2.005 | 120.534 | 300 | S2.004 | 120.609 | 225 | |
| S02-02-14 | 119.969 | 1.726 | Open Manhole | 1200 | S2.006 | 118.243 | 300 | S2.005 | 118.243 | 300 | |
| S02-02-15 | 118.683 | 1.839 | Open Manhole | 1200 | S1.006 | 116.844 | 300 | S1.005 | 116.844 | 300 | |
| | | | | | | | | S2.006 | 116.844 | 300 | |
| S02-02-16 | 133.715 | 1.515 | Open Manhole | 1200 | S4.000 | 132.200 | 225 | | | | |
| S02-02-17 | 132.867 | 1.484 | Open Manhole | 1200 | S4.001 | 131.382 | 225 | S4.000 | 131.382 | 225 | |
| S02-02-18 | 131.084 | 1.701 | Open Manhole | 1200 | S4.002 | 129.383 | 225 | S4.001 | 129.383 | 225 | |
| S02-02-19 | 133.974 | 1.574 | Open Manhole | 1200 | S5.000 | 132.400 | 225 | | | | |
| S02-02-20 | 132.815 | 1.366 | Open Manhole | 1200 | S5.001 | 131.449 | 225 | S5.000 | 131.449 | 225 | |
| S02-02-21 | 131.440 | 1.580 | Open Manhole | 1200 | S5.002 | 129.860 | 225 | S5.001 | 129.860 | 225 | |
| S02-02-22 | 130.606 | 1.719 | Open Manhole | 1200 | S5.003 | 128.887 | 225 | S5.002 | 128.887 | 225 | |
| S02-02-23 | 129.036 | 3.179 | Open Manhole | 1200 | S4.003 | 125.857 | 225 | S4.002 | 125.857 | 225 | |
| | | | | | | | | S5.003 | 125.857 | 225 | |
| S02-02-24 | 126.791 | 1.625 | Open Manhole | 1200 | S4.004 | 125.166 | 300 | S4.003 | 125.241 | 225 | |
| S02-02-25 | 124.037 | 1.352 | Open Manhole | 1200 | S4.005 | 122.685 | 300 | S4.004 | 122.685 | 300 | |
| S02-02-26 | 123.627 | 1.573 | Open Manhole | 1200 | S4.006 | 122.054 | 300 | S4.005 | 122.054 | 300 | |
| S02-02-27 | 121.075 | 0.786 | Open Manhole | 1200 | S4.007 | 120.289 | 300 | S4.006 | 120.289 | 300 | |
| S02-02-28 | 121.243 | 1.796 | Open Manhole | 1200 | S4.008 | 119.447 | 300 | S4.007 | 119.447 | 300 | |
| S02-02-29 | 119.177 | 1.551 | Open Manhole | 1200 | S4.009 | 117.626 | 300 | S4.008 | 117.626 | 300 | |
| S02-02-30 | 120.266 | 3.820 | Open Manhole | 1200 | S1.007 | 116.446 | 300 | S1.006 | 116.446 | 300 | |
| | | | | | | | | S4.009 | 116.446 | 300 | |
| S02-02-31 | 114.805 | 2.123 | Open Manhole | 1350 | S1.008 | 112.683 | 450 | S1.007 | 112.833 | 300 | |
| S | 113.973 | 1.334 | Open Manhole | 0 | | OUTFALL | | S1.008 | 112.638 | 450 | |

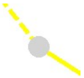
## Manhole Schedules for Pond 2-2

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S02-02-1 | 352441.451 | 529279.730 | 352441.451 | 529279.730 | Required |  |
| S02-02-2 | 352513.122 | 529315.369 | 352513.122 | 529315.369 | Required |  |
| S02-02-3 | 352586.898 | 529346.414 | 352586.898 | 529346.414 | Required |  |
| S02-02-4 | 352663.108 | 529370.921 | 352663.108 | 529370.921 | Required |  |
| S02-02-5 | 352731.600 | 529385.618 | 352731.600 | 529385.618 | Required |  |
| S02-02-6 | 352784.292 | 529393.795 | 352784.292 | 529393.795 | Required |  |
| S02-02-7 | 352447.110 | 529268.867 | 352447.110 | 529268.867 | Required |  |
| S02-02-8 | 352473.512 | 529282.697 | 352473.512 | 529282.697 | Required |  |
| S02-02-9 | 352452.174 | 529257.788 | 352452.174 | 529257.788 | Required |  |
| S02-02-10 | 352478.638 | 529273.376 | 352478.638 | 529273.376 | Required |  |
| S02-02-11 | 352537.795 | 529309.278 | 352537.795 | 529309.278 | Required |  |
| S02-02-12 | 352610.353 | 529340.600 | 352610.353 | 529340.600 | Required |  |
| S02-02-13 | 352657.122 | 529356.837 | 352657.122 | 529356.837 | Required |  |
| S02-02-14 | 352724.159 | 529372.033 | 352724.159 | 529372.033 | Required |  |
| S02-02-15 | 352786.069 | 529381.848 | 352786.069 | 529381.848 | Required |  |

## Manhole Schedules for Pond 2-2

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S02-02-16 | 352271.023 | 529126.238 | 352271.023 | 529126.238 | Required |  |
| S02-02-17 | 352308.278 | 529158.155 | 352308.278 | 529158.155 | Required |  |
| S02-02-18 | 352371.646 | 529206.921 | 352371.646 | 529206.921 | Required |  |
| S02-02-19 | 352232.352 | 529184.476 | 352232.352 | 529184.476 | Required |  |
| S02-02-20 | 352280.331 | 529215.348 | 352280.331 | 529215.348 | Required |  |
| S02-02-21 | 352355.900 | 529259.201 | 352355.900 | 529259.201 | Required |  |
| S02-02-22 | 352402.846 | 529284.911 | 352402.846 | 529284.911 | Required |  |
| S02-02-23 | 352430.870 | 529245.197 | 352430.870 | 529245.197 | Required |  |
| S02-02-24 | 352433.997 | 529239.891 | 352433.997 | 529239.891 | Required |  |
| S02-02-25 | 352518.021 | 529292.694 | 352518.021 | 529292.694 | Required |  |
| S02-02-26 | 352539.829 | 529305.362 | 352539.829 | 529305.362 | Required |  |
| S02-02-27 | 352576.132 | 529322.060 | 352576.132 | 529322.060 | Required |  |
| S02-02-28 | 352652.969 | 529348.217 | 352652.969 | 529348.217 | Required |  |
| S02-02-29 | 352732.434 | 529368.204 | 352732.434 | 529368.204 | Required |  |
| S02-02-30 | 352790.976 | 529375.646 | 352790.976 | 529375.646 | Required |  |

## Manhole Schedules for Pond 2-2

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S02-02-31 | 352847.032 | 529304.811 | 352847.032 | 529304.811 | Required |  |
| S | 352850.889 | 529302.322 | | | No Entry |  |

## PIPELINE SCHEDULES for Pond 2-2

### Upstream Manhole

| **PN** | **Hyd Sect** | **Diam (mm)** | **MH Name** | **C.Level (m)** | **I.Level (m)** | **D.Depth (m)** | **MH Connection** | **MH DIAM., L*W (mm)** |
|---|---|---|---|---|---|---|---|---|
| S1.000 | o | 225 | S02-02-1 | 128.932 | 127.400 | 1.307 | Open Manhole | 1200 |
| S1.001 | o | 225 | S02-02-2 | 127.729 | 126.066 | 1.438 | Open Manhole | 1200 |
| S1.002 | o | 225 | S02-02-3 | 125.409 | 123.779 | 1.405 | Open Manhole | 1200 |
| S1.003 | o | 300 | S02-02-4 | 122.401 | 120.739 | 1.362 | Open Manhole | 1200 |
| S1.004 | o | 300 | S02-02-5 | 120.126 | 118.404 | 1.421 | Open Manhole | 1200 |
| S1.005 | o | 300 | S02-02-6 | 118.925 | 117.146 | 1.479 | Open Manhole | 1200 |
| S2.000 | o | 225 | S02-02-7 | 128.392 | 126.900 | 1.267 | Open Manhole | 1200 |
| S2.001 | o | 225 | S02-02-8 | 128.122 | 126.474 | 1.423 | Open Manhole | 1200 |
| S3.000 | o | 225 | S02-02-9 | 128.312 | 126.800 | 1.287 | Open Manhole | 1200 |
| S2.002 | o | 225 | S02-02-10 | 127.676 | 126.368 | 1.082 | Open Manhole | 1200 |
| S2.003 | o | 225 | S02-02-11 | 126.545 | 124.984 | 1.335 | Open Manhole | 1200 |
| S2.004 | o | 225 | S02-02-12 | 124.068 | 122.589 | 1.254 | Open Manhole | 1200 |
| S2.005 | o | 300 | S02-02-13 | 122.177 | 120.534 | 1.343 | Open Manhole | 1200 |
| S2.006 | o | 300 | S02-02-14 | 119.969 | 118.243 | 1.426 | Open Manhole | 1200 |
| S1.006 | o | 300 | S02-02-15 | 118.683 | 116.844 | 1.539 | Open Manhole | 1200 |
| S4.000 | o | 225 | S02-02-16 | 133.715 | 132.200 | 1.290 | Open Manhole | 1200 |

### Downstream Manhole

| **PN** | **Length (m)** | **Slope (1:X)** | **MH Name** | **C.Level (m)** | **I.Level (m)** | **D.Depth (m)** | **MH Connection** | **MH DIAM., L*W (mm)** |
|---|---|---|---|---|---|---|---|---|
| S1.000 | 80.043 | 60.0 | S02-02-2 | 127.729 | 126.066 | 1.438 | Open Manhole | 1200 |
| S1.001 | 80.042 | 35.0 | S02-02-3 | 125.409 | 123.779 | 1.405 | Open Manhole | 1200 |
| S1.002 | 80.053 | 27.0 | S02-02-4 | 122.401 | 120.814 | 1.362 | Open Manhole | 1200 |
| S1.003 | 70.051 | 30.0 | S02-02-5 | 120.126 | 118.404 | 1.421 | Open Manhole | 1200 |
| S1.004 | 53.323 | 40.0 | S02-02-6 | 118.925 | 117.071 | 1.554 | Open Manhole | 1200 |
| S1.005 | 12.078 | 40.0 | S02-02-15 | 118.683 | 116.844 | 1.539 | Open Manhole | 1200 |
| S2.000 | 29.805 | 70.0 | S02-02-8 | 128.122 | 126.474 | 1.423 | Open Manhole | 1200 |
| S2.001 | 10.637 | 100.4 | S02-02-10 | 127.676 | 126.368 | 1.082 | Open Manhole | 1200 |
| S3.000 | 30.714 | 150.0 | S02-02-10 | 127.676 | 126.595 | 0.855 | Open Manhole | 1200 |
| S2.002 | 69.199 | 50.0 | S02-02-11 | 126.545 | 124.984 | 1.335 | Open Manhole | 1200 |
| S2.003 | 79.030 | 33.0 | S02-02-12 | 124.068 | 122.589 | 1.254 | Open Manhole | 1200 |
| S2.004 | 49.508 | 25.0 | S02-02-13 | 122.177 | 120.609 | 1.343 | Open Manhole | 1200 |
| S2.005 | 68.737 | 30.0 | S02-02-14 | 119.969 | 118.243 | 1.426 | Open Manhole | 1200 |
| S2.006 | 62.683 | 44.8 | S02-02-15 | 118.683 | 116.844 | 1.539 | Open Manhole | 1200 |
| S1.006 | 7.909 | 19.9 | S02-02-30 | 120.266 | 116.446 | 3.520 | Open Manhole | 1200 |
| S4.000 | 49.057 | 60.0 | S02-02-17 | 132.867 | 131.382 | 1.259 | Open Manhole | 1200 |

## PIPELINE SCHEDULES for Pond 2-2

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S4.001 | o | 225 | S02-02-17 | 132.867 | 131.382 | 1.259 | Open Manhole | 1200 |
| S4.002 | o | 225 | S02-02-18 | 131.084 | 129.383 | 1.476 | Open Manhole | 1200 |
| S5.000 | o | 225 | S02-02-19 | 133.974 | 132.400 | 1.349 | Open Manhole | 1200 |
| S5.001 | o | 225 | S02-02-20 | 132.815 | 131.449 | 1.141 | Open Manhole | 1200 |
| S5.002 | o | 225 | S02-02-21 | 131.440 | 129.860 | 1.355 | Open Manhole | 1200 |
| S5.003 | o | 225 | S02-02-22 | 130.606 | 128.887 | 1.494 | Open Manhole | 1200 |
| S4.003 | o | 225 | S02-02-23 | 129.036 | 125.857 | 2.954 | Open Manhole | 1200 |
| S4.004 | o | 300 | S02-02-24 | 126.791 | 125.166 | 1.325 | Open Manhole | 1200 |
| S4.005 | o | 300 | S02-02-25 | 124.037 | 122.685 | 1.052 | Open Manhole | 1200 |
| S4.006 | o | 300 | S02-02-26 | 123.627 | 122.054 | 1.273 | Open Manhole | 1200 |
| S4.007 | o | 300 | S02-02-27 | 121.075 | 120.289 | 0.486 | Open Manhole | 1200 |
| S4.008 | o | 300 | S02-02-28 | 121.243 | 119.447 | 1.496 | Open Manhole | 1200 |
| S4.009 | o | 300 | S02-02-29 | 119.177 | 117.626 | 1.251 | Open Manhole | 1200 |
| S1.007 | o | 300 | S02-02-30 | 120.266 | 116.446 | 3.520 | Open Manhole | 1200 |
| S1.008 | o | 450 | S02-02-31 | 114.805 | 112.683 | 1.673 | Open Manhole | 1350 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S4.001 | 79.960 | 40.0 | S02-02-18 | 131.084 | 129.383 | 1.476 | Open Manhole | 1200 |
| S4.002 | 70.517 | 20.0 | S02-02-23 | 129.036 | 125.857 | 2.953 | Open Manhole | 1200 |
| S5.000 | 57.053 | 60.0 | S02-02-20 | 132.815 | 131.449 | 1.141 | Open Manhole | 1200 |
| S5.001 | 87.372 | 55.0 | S02-02-21 | 131.440 | 129.860 | 1.355 | Open Manhole | 1200 |
| S5.002 | 53.524 | 55.0 | S02-02-22 | 130.606 | 128.887 | 1.494 | Open Manhole | 1200 |
| S5.003 | 48.606 | 16.0 | S02-02-23 | 129.036 | 125.857 | 2.953 | Open Manhole | 1200 |
| S4.003 | 6.159 | 10.0 | S02-02-24 | 126.791 | 125.241 | 1.325 | Open Manhole | 1200 |
| S4.004 | 99.237 | 40.0 | S02-02-25 | 124.037 | 122.685 | 1.052 | Open Manhole | 1200 |
| S4.005 | 25.221 | 40.0 | S02-02-26 | 123.627 | 122.054 | 1.273 | Open Manhole | 1200 |
| S4.006 | 39.959 | 22.6 | S02-02-27 | 121.075 | 120.289 | 0.486 | Open Manhole | 1200 |
| S4.007 | 81.167 | 96.5 | S02-02-28 | 121.243 | 119.447 | 1.496 | Open Manhole | 1200 |
| S4.008 | 81.939 | 45.0 | S02-02-29 | 119.177 | 117.626 | 1.251 | Open Manhole | 1200 |
| S4.009 | 59.014 | 50.0 | S02-02-30 | 120.266 | 116.446 | 3.520 | Open Manhole | 1200 |
| S1.007 | 90.332 | 25.0 | S02-02-31 | 114.805 | 112.833 | 1.673 | Open Manhole | 1350 |
| S1.008 | 4.590 | 103.4 | S | 113.973 | 112.638 | 0.884 | Open Manhole | 0 |

## Area Summary for Pond 2-2

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | User | - | 100 | 0.148 | 0.148 | 0.148 |
| | User | - | 50 | 0.033 | 0.016 | 0.164 |
| 1.001 | User | - | 100 | 0.111 | 0.111 | 0.111 |
| | User | - | 50 | 0.033 | 0.016 | 0.128 |
| 1.002 | - | - | 100 | 0.108 | 0.108 | 0.108 |
| 1.003 | User | - | 100 | 0.074 | 0.074 | 0.074 |
| | User | - | 50 | 0.028 | 0.014 | 0.089 |
| | User | - | 25 | 0.026 | 0.006 | 0.095 |
| 1.004 | User | - | 100 | 0.056 | 0.056 | 0.056 |
| | User | - | 50 | 0.022 | 0.011 | 0.067 |
| | User | - | 25 | 0.040 | 0.010 | 0.077 |
| 1.005 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 2.000 | User | - | 100 | 0.037 | 0.037 | 0.037 |
| 2.001 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 3.000 | User | - | 100 | 0.029 | 0.029 | 0.029 |
| | User | - | 50 | 0.008 | 0.004 | 0.033 |
| 2.002 | User | - | 100 | 0.135 | 0.135 | 0.135 |
| | User | - | 50 | 0.012 | 0.006 | 0.141 |
| 2.003 | User | - | 100 | 0.116 | 0.116 | 0.116 |
| | User | - | 50 | 0.014 | 0.007 | 0.123 |
| 2.004 | User | - | 100 | 0.064 | 0.064 | 0.064 |
| | User | - | 50 | 0.008 | 0.004 | 0.068 |
| 2.005 | User | - | 100 | 0.084 | 0.084 | 0.084 |
| | User | - | 50 | 0.012 | 0.006 | 0.090 |
| 2.006 | User | - | 100 | 0.076 | 0.076 | 0.076 |
| | User | - | 50 | 0.011 | 0.005 | 0.082 |
| 1.006 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 4.000 | User | - | 100 | 0.048 | 0.048 | 0.048 |
| | User | - | 50 | 0.014 | 0.007 | 0.055 |
| 4.001 | User | - | 100 | 0.074 | 0.074 | 0.074 |
| | User | - | 50 | 0.022 | 0.011 | 0.085 |
| 4.002 | User | - | 100 | 0.075 | 0.075 | 0.075 |
| | User | - | 50 | 0.022 | 0.011 | 0.086 |
| 5.000 | User | - | 100 | 0.079 | 0.079 | 0.079 |
| | User | - | 50 | 0.023 | 0.012 | 0.091 |
| 5.001 | - | - | 100 | 0.109 | 0.109 | 0.109 |
| 5.002 | User | - | 100 | 0.060 | 0.060 | 0.060 |
| | User | - | 50 | 0.027 | 0.013 | 0.073 |
| 5.003 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 4.003 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 4.004 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 4.005 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 4.006 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 4.007 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 4.008 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 4.009 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.007 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.008 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total | Total | Total |
| | | | | 1.835 | 1.643 | 1.643 |

## Free Flowing Outfall Details for Pond 2-2

| **Outfall Pipe Number** | **Outfall Name** | **C. Level (m)** | **I. Level (m)** | **Min I. Level (m)** | **D,L (mm)** | **W (mm)** |
|---|---|---|---|---|---|---|
| S1.008 | S | 113.973 | 112.638 | 0.000 | 0 | 0 |

## Simulation Criteria for Pond 2-2

| | | | |
|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Additional Flow - % of Total Flow | 0.000 |
| Areal Reduction Factor | 1.000 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start (mins) | 0 | Inlet Coeffiecient | 0.800 |
| Hot Start Level (mm) | 0 | Flow per Person per Day (l/per/day) | 0.000 |
| Manhole Headloss Coeff (Global) | 0.500 | Run Time (mins) | 60 |
| Foul Sewage per hectare (l/s) | 0.000 | Output Interval (mins) | 1 |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

## Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Profile Type | Summer |
| Return Period (years) | 5 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.200 | Storm Duration (mins) | 30 |
| Ratio R | 0.300 | | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 2-2

### Simulation Criteria

```
       Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 0.000
             Hot Start (mins)     0       MADD Factor * 10m³/ha Storage 2.000
           Hot Start Level (mm)   0               Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
  Foul Sewage per hectare (l/s) 0.000

         Number of Input Hydrographs 0 Number of Storage Structures 0
          Number of Online Controls 0 Number of Time/Area Diagrams 0
         Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
          Rainfall Model                FSR     Ratio R 0.300
                  Region England and Wales Cv (Summer) 0.750
              M5-60 (mm)             16.000 Cv (Winter) 0.840

       Margin for Flood Risk Warning (mm) 300.0     DVD Status OFF
                        Analysis Timestep  Fine Inertia Status OFF
                               DTS Status    ON


                 Profile(s)                            Summer and Winter
            Duration(s) (mins)    15, 30, 60, 120, 180, 240, 360, 480, 600,
                                    720, 960, 1440, 2160, 2880, 4320, 5760,
                                                           7200, 8640, 10080
        Return Period(s) (years)                                           5
            Climate Change (%)                                            20
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| S1.000 | S02-02-1 | 15 Winter | 5 | +20% | | | | |
| S1.001 | S02-02-2 | 15 Winter | 5 | +20% | | | | |
| S1.002 | S02-02-3 | 15 Winter | 5 | +20% | | | | |
| S1.003 | S02-02-4 | 15 Winter | 5 | +20% | | | | |
| S1.004 | S02-02-5 | 15 Winter | 5 | +20% | | | | |
| S1.005 | S02-02-6 | 15 Winter | 5 | +20% | 5/15 Winter | | | |
| S2.000 | S02-02-7 | 15 Winter | 5 | +20% | | | | |
| S2.001 | S02-02-8 | 15 Winter | 5 | +20% | | | | |
| S3.000 | S02-02-9 | 15 Winter | 5 | +20% | | | | |
| S2.002 | S02-02-10 | 15 Winter | 5 | +20% | | | | |
| S2.003 | S02-02-11 | 15 Winter | 5 | +20% | | | | |
| S2.004 | S02-02-12 | 15 Winter | 5 | +20% | | | | |
| S2.005 | S02-02-13 | 15 Winter | 5 | +20% | | | | |
| S2.006 | S02-02-14 | 15 Winter | 5 | +20% | | | | |
| S1.006 | S02-02-15 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| S4.000 | S02-02-16 | 15 Winter | 5 | +20% | | | | |
| S4.001 | S02-02-17 | 15 Winter | 5 | +20% | | | | |
| S4.002 | S02-02-18 | 15 Winter | 5 | +20% | | | | |
| S5.000 | S02-02-19 | 15 Winter | 5 | +20% | | | | |
| S5.001 | S02-02-20 | 15 Winter | 5 | +20% | | | | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 2-2

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S02-02-1 | 127.514 | -0.111 | 0.000 | 0.49 | | | 32.3 | OK |
| S1.001 | S02-02-2 | 126.196 | -0.095 | 0.000 | 0.62 | | | 53.0 | OK |
| S1.002 | S02-02-3 | 123.923 | -0.082 | 0.000 | 0.72 | | | 70.1 | OK |
| S1.003 | S02-02-4 | 120.879 | -0.160 | 0.000 | 0.44 | | | 85.1 | OK |
| S1.004 | S02-02-5 | 118.569 | -0.135 | 0.000 | 0.58 | | | 96.7 | OK |
| S1.005 | S02-02-6 | 117.723 | 0.277 | 0.000 | 0.65 | | | 90.1 | SURCHARGED |
| S2.000 | S02-02-7 | 126.953 | -0.172 | 0.000 | 0.13 | | | 7.3 | OK |
| S2.001 | S02-02-8 | 126.537 | -0.163 | 0.000 | 0.17 | | | 7.4 | OK |
| S3.000 | S02-02-9 | 126.862 | -0.163 | 0.000 | 0.17 | | | 6.6 | OK |
| S2.002 | S02-02-10 | 126.486 | -0.107 | 0.000 | 0.53 | | | 37.7 | OK |
| S2.003 | S02-02-11 | 125.118 | -0.091 | 0.000 | 0.65 | | | 57.1 | OK |
| S2.004 | S02-02-12 | 122.727 | -0.087 | 0.000 | 0.68 | | | 68.2 | OK |
| S2.005 | S02-02-13 | 120.671 | -0.163 | 0.000 | 0.42 | | | 82.4 | OK |
| S2.006 | S02-02-14 | 118.411 | -0.132 | 0.000 | 0.60 | | | 94.5 | OK |
| S1.006 | S02-02-15 | 117.642 | 0.498 | 0.000 | 1.10 | | | 174.5 | SURCHARGED |
| S4.000 | S02-02-16 | 132.263 | -0.162 | 0.000 | 0.17 | | | 10.9 | OK |
| S4.001 | S02-02-17 | 131.470 | -0.138 | 0.000 | 0.31 | | | 25.2 | OK |
| S4.002 | S02-02-18 | 129.475 | -0.133 | 0.000 | 0.35 | | | 39.3 | OK |
| S5.000 | S02-02-19 | 132.482 | -0.143 | 0.000 | 0.28 | | | 18.0 | OK |
| S5.001 | S02-02-20 | 131.567 | -0.107 | 0.000 | 0.52 | | | 35.6 | OK |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| S1.000 | S02-02-1 | |
| S1.001 | S02-02-2 | |
| S1.002 | S02-02-3 | |
| S1.003 | S02-02-4 | |
| S1.004 | S02-02-5 | |
| S1.005 | S02-02-6 | |
| S2.000 | S02-02-7 | |
| S2.001 | S02-02-8 | |
| S3.000 | S02-02-9 | |
| S2.002 | S02-02-10 | |
| S2.003 | S02-02-11 | |
| S2.004 | S02-02-12 | |
| S2.005 | S02-02-13 | |
| S2.006 | S02-02-14 | |
| S1.006 | S02-02-15 | |
| S4.000 | S02-02-16 | |
| S4.001 | S02-02-17 | |
| S4.002 | S02-02-18 | |
| S5.000 | S02-02-19 | |
| S5.001 | S02-02-20 | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 2-2

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| S5.002 | S02-02-21 | 15 Winter | 5 | +20% | | | | |
| S5.003 | S02-02-22 | 15 Winter | 5 | +20% | | | | |
| S4.003 | S02-02-23 | 15 Winter | 5 | +20% | | | | |
| S4.004 | S02-02-24 | 15 Winter | 5 | +20% | | | | |
| S4.005 | S02-02-25 | 15 Winter | 5 | +20% | | | | |
| S4.006 | S02-02-26 | 15 Winter | 5 | +20% | | | | |
| S4.007 | S02-02-27 | 15 Winter | 5 | +20% | | | | |
| S4.008 | S02-02-28 | 15 Winter | 5 | +20% | | | | |
| S4.009 | S02-02-29 | 15 Winter | 5 | +20% | | | | |
| S1.007 | S02-02-30 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| S1.008 | S02-02-31 | 15 Winter | 5 | +20% | 5/15 Summer | | | |

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S5.002 | S02-02-21 | 130.001 | -0.084 | 0.000 | 0.70 | | | 47.2 | OK |
| S5.003 | S02-02-22 | 128.983 | -0.129 | 0.000 | 0.38 | | | 47.3 | OK |
| S4.003 | S02-02-23 | 126.008 | -0.074 | 0.000 | 0.78 | | | 86.2 | OK |
| S4.004 | S02-02-24 | 125.317 | -0.149 | 0.000 | 0.49 | | | 84.3 | OK |
| S4.005 | S02-02-25 | 122.843 | -0.143 | 0.000 | 0.54 | | | 84.7 | OK |
| S4.006 | S02-02-26 | 122.184 | -0.170 | 0.000 | 0.39 | | | 85.0 | OK |
| S4.007 | S02-02-27 | 120.488 | -0.100 | 0.000 | 0.76 | | | 82.8 | OK |
| S4.008 | S02-02-28 | 119.600 | -0.147 | 0.000 | 0.51 | | | 81.5 | OK |
| S4.009 | S02-02-29 | 117.785 | -0.141 | 0.000 | 0.55 | | | 81.6 | OK |
| S1.007 | S02-02-30 | 117.306 | 0.560 | 0.000 | 1.06 | | | 228.6 | SURCHARGED |
| S1.008 | S02-02-31 | 113.231 | 0.098 | 0.000 | 1.35 | | | 228.7 | SURCHARGED |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| S5.002 | S02-02-21 | |
| S5.003 | S02-02-22 | |
| S4.003 | S02-02-23 | |
| S4.004 | S02-02-24 | |
| S4.005 | S02-02-25 | |
| S4.006 | S02-02-26 | |
| S4.007 | S02-02-27 | |
| S4.008 | S02-02-28 | |
| S4.009 | S02-02-29 | |
| S1.007 | S02-02-30 | |
| S1.008 | S02-02-31 | |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for System 2-3

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 15.700 | Add Flow / Climate Change (%) | 40 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 50 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

## Time Area Diagram for System 2-3 at outfall S (pipe S1.007)

| Time (mins) | Area (ha) | Time (mins) | Area (ha) |
|---|---|---|---|
| 0-4 | 0.146 | 4-8 | 0.061 |

Total Area Contributing (ha) = 0.208

Total Pipe Volume (m³) = 9.877

## Time Area Diagram at outfall S (pipe S2.008)

| Time (mins) | Area (ha) | Time (mins) | Area (ha) |
|---|---|---|---|
| 0-4 | 0.136 | 4-8 | 0.064 |

Total Area Contributing (ha) = 0.201

Total Pipe Volume (m³) = 10.730

## Network Design Table for System 2-3

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 22.528 | 0.090 | 250.0 | 0.018 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 50.00 | 5.46 | 132.500 | 0.018 | 0.0 | 0.0 | 0.9 | 0.82 | 32.7 | 3.3 |

## Network Design Table for System 2-3

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.001 | 15.253 | 0.061 | 250.0 | 0.027 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S1.002 | 15.692 | 0.063 | 250.0 | 0.023 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S1.003 | 17.277 | 0.086 | 200.0 | 0.016 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S1.004 | 16.411 | 0.164 | 100.0 | 0.013 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S1.005 | 41.211 | 2.061 | 20.0 | 0.035 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S1.006 | 63.514 | 3.529 | 18.0 | 0.041 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S1.007 | 56.518 | 3.325 | 17.0 | 0.036 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.000 | 15.610 | 0.195 | 80.0 | 0.013 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S2.001 | 14.883 | 0.186 | 80.0 | 0.031 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.002 | 26.466 | 0.204 | 130.0 | 0.023 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.003 | 17.986 | 0.180 | 100.0 | 0.014 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.004 | 15.998 | 0.291 | 55.0 | 0.011 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.005 | 77.443 | 3.688 | 21.0 | 0.050 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.006 | 33.874 | 1.993 | 17.0 | 0.022 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.007 | 57.376 | 3.375 | 17.0 | 0.038 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.008 | 10.229 | 0.068 | 150.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.001 | 50.00 | 5.77 | 132.410 | 0.045 | 0.0 | 0.0 | 2.4 | 0.82 | 32.7 | 8.5 |
| S1.002 | 50.00 | 6.08 | 132.349 | 0.067 | 0.0 | 0.0 | 3.6 | 0.82 | 32.7 | 12.7 |
| S1.003 | 50.00 | 6.40 | 132.286 | 0.083 | 0.0 | 0.0 | 4.5 | 0.92 | 36.6 | 15.7 |
| S1.004 | 50.00 | 6.61 | 132.200 | 0.096 | 0.0 | 0.0 | 5.2 | 1.31 | 52.0 | 18.2 |
| S1.005 | 50.00 | 6.84 | 132.036 | 0.131 | 0.0 | 0.0 | 7.1 | 2.94 | 116.9 | 24.8 |
| S1.006 | 50.00 | 7.18 | 129.975 | 0.172 | 0.0 | 0.0 | 9.3 | 3.10 | 123.2 | 32.6 |
| S1.007 | 50.00 | 7.48 | 126.447 | 0.208 | 0.0 | 0.0 | 11.2 | 3.19 | 126.8 | 39.4 |
| S2.000 | 50.00 | 5.18 | 133.300 | 0.013 | 0.0 | 0.0 | 0.7 | 1.46 | 58.2 | 2.5 |
| S2.001 | 50.00 | 5.35 | 133.105 | 0.044 | 0.0 | 0.0 | 2.4 | 1.46 | 58.2 | 8.4 |
| S2.002 | 50.00 | 5.73 | 132.919 | 0.067 | 0.0 | 0.0 | 3.6 | 1.15 | 45.5 | 12.7 |
| S2.003 | 50.00 | 5.96 | 132.715 | 0.081 | 0.0 | 0.0 | 4.4 | 1.31 | 52.0 | 15.4 |
| S2.004 | 50.00 | 6.11 | 132.535 | 0.092 | 0.0 | 0.0 | 5.0 | 1.77 | 70.3 | 17.4 |
| S2.005 | 50.00 | 6.56 | 132.245 | 0.142 | 0.0 | 0.0 | 7.7 | 2.87 | 114.0 | 26.8 |
| S2.006 | 50.00 | 6.74 | 128.557 | 0.163 | 0.0 | 0.0 | 8.8 | 3.19 | 126.8 | 30.9 |
| S2.007 | 50.00 | 7.04 | 126.564 | 0.201 | 0.0 | 0.0 | 10.9 | 3.19 | 126.8 | 38.0 |
| S2.008 | 50.00 | 7.20 | 123.189 | 0.201 | 0.0 | 0.0 | 10.9 | 1.07 | 42.4 | 38.0 |

## Manhole Schedules for System 2-3

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Back (m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S02-03-1 | 134.051 | 1.551 | Open Manhole | 1200 | S1.000 | 132.500 | 225 | | | | |
| S02-03-2 | 134.244 | 1.834 | Open Manhole | 1200 | S1.001 | 132.410 | 225 | S1.000 | 132.410 | 225 | |
| S02-03-3 | 134.331 | 1.982 | Open Manhole | 1200 | S1.002 | 132.349 | 225 | S1.001 | 132.349 | 225 | |
| S02-03-4 | 134.368 | 2.082 | Open Manhole | 1200 | S1.003 | 132.286 | 225 | S1.002 | 132.286 | 225 | |
| S02-03-5 | 134.070 | 1.870 | Open Manhole | 1200 | S1.004 | 132.200 | 225 | S1.003 | 132.200 | 225 | |
| S02-03-6 | 133.535 | 1.500 | Open Manhole | 1200 | S1.005 | 132.036 | 225 | S1.004 | 132.036 | 225 | |
| S02-03-7 | 131.803 | 1.828 | Open Manhole | 1200 | S1.006 | 129.975 | 225 | S1.005 | 129.975 | 225 | |
| S02-03-8 | 128.033 | 1.587 | Open Manhole | 1200 | S1.007 | 126.447 | 225 | S1.006 | 126.447 | 225 | |
| S | 124.569 | 1.447 | Open Manhole | 0 | | OUTFALL | | S1.007 | 123.122 | 225 | |
| S02-03-9 | 134.881 | 1.581 | Open Manhole | 1200 | S2.000 | 133.300 | 225 | | | | |
| S02-03-10 | 134.702 | 1.597 | Open Manhole | 1200 | S2.001 | 133.105 | 225 | S2.000 | 133.105 | 225 | |
| S02-03-11 | 134.568 | 1.649 | Open Manhole | 1200 | S2.002 | 132.919 | 225 | S2.001 | 132.919 | 225 | |
| S02-03-12 | 134.436 | 1.720 | Open Manhole | 1200 | S2.003 | 132.715 | 225 | S2.002 | 132.715 | 225 | |
| S02-03-13 | 134.172 | 1.636 | Open Manhole | 1200 | S2.004 | 132.535 | 225 | S2.003 | 132.535 | 225 | |
| S02-03-14 | 133.788 | 1.543 | Open Manhole | 1200 | S2.005 | 132.245 | 225 | S2.004 | 132.245 | 225 | |
| S02-03-15 | 130.264 | 1.707 | Open Manhole | 1200 | S2.006 | 128.557 | 225 | S2.005 | 128.557 | 225 | |
| S02-03-16 | 128.136 | 1.572 | Open Manhole | 1200 | S2.007 | 126.564 | 225 | S2.006 | 126.564 | 225 | |
| S02-03-17 | 124.482 | 1.293 | Open Manhole | 1200 | S2.008 | 123.189 | 225 | S2.007 | 123.189 | 225 | |
| S | 124.569 | 1.448 | Open Manhole | 0 | | OUTFALL | | S2.008 | 123.121 | 225 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S02-03-1 | 352228.504 | 529177.944 | 352228.504 | 529177.944 | Required |  |
| S02-03-2 | 352206.035 | 529176.309 | 352206.035 | 529176.309 | Required |  |
| S02-03-3 | 352194.299 | 529186.052 | 352194.299 | 529186.052 | Required |  |
| S02-03-4 | 352190.172 | 529201.191 | 352190.172 | 529201.191 | Required |  |
| S02-03-5 | 352196.225 | 529217.373 | 352196.225 | 529217.373 | Required |  |

## Manhole Schedules for System 2-3

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S02-03-6 | 352210.215 | 529225.951 | 352210.215 | 529225.951 | Required |  |
| S02-03-7 | 352248.684 | 529240.732 | 352248.684 | 529240.732 | Required |  |
| S02-03-8 | 352307.607 | 529264.440 | 352307.607 | 529264.440 | Required |  |
| S | 352358.893 | 529288.190 |  |  | No Entry |  |
| S02-03-9 | 352152.954 | 529160.193 | 352152.954 | 529160.193 | Required |  |
| S02-03-10 | 352165.682 | 529169.230 | 352165.682 | 529169.230 | Required |  |
| S02-03-11 | 352172.298 | 529182.561 | 352172.298 | 529182.561 | Required |  |
| S02-03-12 | 352175.269 | 529208.860 | 352175.269 | 529208.860 | Required |  |
| S02-03-13 | 352184.790 | 529224.120 | 352184.790 | 529224.120 | Required |  |
| S02-03-14 | 352198.196 | 529232.849 | 352198.196 | 529232.849 | Required |  |
| S02-03-15 | 352270.726 | 529259.992 | 352270.726 | 529259.992 | Required |  |
| S02-03-16 | 352302.033 | 529272.929 | 352302.033 | 529272.929 | Required |  |
| S02-03-17 | 352354.028 | 529297.188 | 352354.028 | 529297.188 | Required |  |
| S | 352358.893 | 529288.190 |  |  | No Entry |  |

## PIPELINE SCHEDULES for System 2-3

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | o | 225 | S02-03-1 | 134.051 | 132.500 | 1.326 | Open Manhole | 1200 |
| S1.001 | o | 225 | S02-03-2 | 134.244 | 132.410 | 1.609 | Open Manhole | 1200 |
| S1.002 | o | 225 | S02-03-3 | 134.331 | 132.349 | 1.757 | Open Manhole | 1200 |
| S1.003 | o | 225 | S02-03-4 | 134.368 | 132.286 | 1.857 | Open Manhole | 1200 |
| S1.004 | o | 225 | S02-03-5 | 134.070 | 132.200 | 1.645 | Open Manhole | 1200 |
| S1.005 | o | 225 | S02-03-6 | 133.535 | 132.036 | 1.275 | Open Manhole | 1200 |
| S1.006 | o | 225 | S02-03-7 | 131.803 | 129.975 | 1.603 | Open Manhole | 1200 |
| S1.007 | o | 225 | S02-03-8 | 128.033 | 126.447 | 1.362 | Open Manhole | 1200 |
| | | | | | | | | |
| S2.000 | o | 225 | S02-03-9 | 134.881 | 133.300 | 1.356 | Open Manhole | 1200 |
| S2.001 | o | 225 | S02-03-10 | 134.702 | 133.105 | 1.372 | Open Manhole | 1200 |
| S2.002 | o | 225 | S02-03-11 | 134.568 | 132.919 | 1.424 | Open Manhole | 1200 |
| S2.003 | o | 225 | S02-03-12 | 134.436 | 132.715 | 1.495 | Open Manhole | 1200 |
| S2.004 | o | 225 | S02-03-13 | 134.172 | 132.535 | 1.411 | Open Manhole | 1200 |
| S2.005 | o | 225 | S02-03-14 | 133.788 | 132.245 | 1.318 | Open Manhole | 1200 |
| S2.006 | o | 225 | S02-03-15 | 130.264 | 128.557 | 1.482 | Open Manhole | 1200 |
| S2.007 | o | 225 | S02-03-16 | 128.136 | 126.564 | 1.347 | Open Manhole | 1200 |
| S2.008 | o | 225 | S02-03-17 | 124.482 | 123.189 | 1.068 | Open Manhole | 1200 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | 22.528 | 250.0 | S02-03-2 | 134.244 | 132.410 | 1.609 | Open Manhole | 1200 |
| S1.001 | 15.253 | 250.0 | S02-03-3 | 134.331 | 132.349 | 1.757 | Open Manhole | 1200 |
| S1.002 | 15.692 | 250.0 | S02-03-4 | 134.368 | 132.286 | 1.857 | Open Manhole | 1200 |
| S1.003 | 17.277 | 200.0 | S02-03-5 | 134.070 | 132.200 | 1.645 | Open Manhole | 1200 |
| S1.004 | 16.411 | 100.0 | S02-03-6 | 133.535 | 132.036 | 1.275 | Open Manhole | 1200 |
| S1.005 | 41.211 | 20.0 | S02-03-7 | 131.803 | 129.975 | 1.603 | Open Manhole | 1200 |
| S1.006 | 63.514 | 18.0 | S02-03-8 | 128.033 | 126.447 | 1.362 | Open Manhole | 1200 |
| S1.007 | 56.518 | 17.0 | S | 124.569 | 123.122 | 1.222 | Open Manhole | 0 |
| | | | | | | | | |
| S2.000 | 15.610 | 80.0 | S02-03-10 | 134.702 | 133.105 | 1.372 | Open Manhole | 1200 |
| S2.001 | 14.883 | 80.0 | S02-03-11 | 134.568 | 132.919 | 1.424 | Open Manhole | 1200 |
| S2.002 | 26.466 | 130.0 | S02-03-12 | 134.436 | 132.715 | 1.495 | Open Manhole | 1200 |
| S2.003 | 17.986 | 100.0 | S02-03-13 | 134.172 | 132.535 | 1.411 | Open Manhole | 1200 |
| S2.004 | 15.998 | 55.0 | S02-03-14 | 133.788 | 132.245 | 1.318 | Open Manhole | 1200 |
| S2.005 | 77.443 | 21.0 | S02-03-15 | 130.264 | 128.557 | 1.482 | Open Manhole | 1200 |
| S2.006 | 33.874 | 17.0 | S02-03-16 | 128.136 | 126.564 | 1.347 | Open Manhole | 1200 |
| S2.007 | 57.376 | 17.0 | S02-03-17 | 124.482 | 123.189 | 1.068 | Open Manhole | 1200 |
| S2.008 | 10.229 | 150.0 | S | 124.569 | 123.121 | 1.223 | Open Manhole | 0 |

## Area Summary for System 2-3

| **Pipe Number** | **PIMP Type** | **PIMP Name** | **PIMP (%)** | **Gross Area (ha)** | **Imp. Area (ha)** | **Pipe Total (ha)** |
|---|---|---|---|---|---|---|
| 1.000 | User | - | 100 | 0.018 | 0.018 | 0.018 |
| 1.001 | User | - | 100 | 0.027 | 0.027 | 0.027 |
| | User | - | 25 | 0.001 | 0.000 | 0.027 |
| 1.002 | User | - | 100 | 0.022 | 0.022 | 0.022 |
| | User | - | 25 | 0.001 | 0.000 | 0.023 |
| 1.003 | User | - | 100 | 0.015 | 0.015 | 0.015 |
| | User | - | 25 | 0.001 | 0.000 | 0.016 |
| 1.004 | User | - | 100 | 0.012 | 0.012 | 0.012 |
| | User | - | 25 | 0.003 | 0.001 | 0.013 |
| 1.005 | User | - | 100 | 0.034 | 0.034 | 0.034 |
| | User | - | 25 | 0.004 | 0.001 | 0.035 |
| 1.006 | User | - | 100 | 0.041 | 0.041 | 0.041 |
| 1.007 | User | - | 100 | 0.033 | 0.033 | 0.033 |
| | User | - | 25 | 0.009 | 0.002 | 0.036 |
| 2.000 | User | - | 100 | 0.013 | 0.013 | 0.013 |
| 2.001 | User | - | 100 | 0.031 | 0.031 | 0.031 |
| | User | - | 25 | 0.001 | 0.000 | 0.031 |
| 2.002 | User | - | 100 | 0.022 | 0.022 | 0.022 |
| | User | - | 25 | 0.002 | 0.001 | 0.023 |
| 2.003 | User | - | 100 | 0.014 | 0.014 | 0.014 |
| | User | - | 25 | 0.001 | 0.000 | 0.014 |
| 2.004 | User | - | 100 | 0.011 | 0.011 | 0.011 |
| | User | - | 25 | 0.001 | 0.000 | 0.011 |
| 2.005 | User | - | 100 | 0.047 | 0.047 | 0.047 |
| | User | - | 25 | 0.009 | 0.002 | 0.050 |
| 2.006 | User | - | 100 | 0.019 | 0.019 | 0.019 |
| | User | - | 25 | 0.011 | 0.003 | 0.022 |
| 2.007 | User | - | 100 | 0.038 | 0.038 | 0.038 |
| 2.008 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total | Total | Total |
| | | | | 0.441 | 0.408 | 0.408 |

## Free Flowing Outfall Details for System 2-3

| **Outfall Pipe Number** | **Outfall Name** | **C. Level (m)** | **I. Level (m)** | **Min I. Level (m)** | **D,L (mm)** | **W (mm)** |
|---|---|---|---|---|---|---|
| S1.007 | S | 124.569 | 123.122 | 0.000 | 0 | 0 |

## Free Flowing Outfall Details for System 2-3

| **Outfall Pipe Number** | **Outfall Name** | **C. Level (m)** | **I. Level (m)** | **Min I. Level (m)** | **D,L (mm)** | **W (mm)** |
|---|---|---|---|---|---|---|
| S2.008 | S | 124.569 | 123.121 | 0.000 | 0 | 0 |

## Simulation Criteria for System 2-3

| | | | |
|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Additional Flow - % of Total Flow | 0.000 |
| Areal Reduction Factor | 1.000 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start (mins) | 0 | Inlet Coeffiecient | 0.800 |
| Hot Start Level (mm) | 0 | Flow per Person per Day (l/per/day) | 0.000 |
| Manhole Headloss Coeff (Global) | 0.500 | Run Time (mins) | 60 |
| Foul Sewage per hectare (l/s) | 0.000 | Output Interval (mins) | 1 |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

## Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Profile Type | Summer |
| Return Period (years) | 5 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.200 | Storm Duration (mins) | 30 |
| Ratio R | 0.300 | | |

## Summary of Critical Results by Maximum Level (Rank 1) for System 2-3

### Simulation Criteria

Areal Reduction Factor 1.000
Hot Start (mins) 0
Hot Start Level (mm) 0
Manhole Headloss Coeff (Global) 0.500
Foul Sewage per hectare (l/s) 0.000
Additional Flow - % of Total Flow 0.000
MADD Factor * 10m³/ha Storage 2.000
Inlet Coeffiecient 0.800
Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0
Number of Online Controls 0
Number of Offline Controls 0
Number of Storage Structures 0
Number of Time/Area Diagrams 0
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
Region England and Wales
M5-60 (mm) 16.000
Ratio R 0.300
Cv (Summer) 0.750
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep Fine
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5
Climate Change (%) 20

| **PN** | **US/MH Name** | **Storm** | **Return Period** | **Climate Change** | **First (X) Surcharge** | **First (Y) Flood** | **First (Z) Overflow** | **Overflow Act.** | **Water Level (m)** |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S02-03-1 | 15 Winter | 5 | +20% | | | | | 132.552 |
| S1.001 | S02-03-2 | 15 Winter | 5 | +20% | | | | | 132.492 |
| S1.002 | S02-03-3 | 15 Winter | 5 | +20% | | | | | 132.449 |
| S1.003 | S02-03-4 | 15 Winter | 5 | +20% | | | | | 132.390 |
| S1.004 | S02-03-5 | 15 Winter | 5 | +20% | | | | | 132.293 |
| S1.005 | S02-03-6 | 15 Winter | 5 | +20% | | | | | 132.104 |
| S1.006 | S02-03-7 | 15 Winter | 5 | +20% | | | | | 130.050 |
| S1.007 | S02-03-8 | 15 Winter | 5 | +20% | | | | | 126.528 |
| S2.000 | S02-03-9 | 15 Winter | 5 | +20% | | | | | 133.333 |
| S2.001 | S02-03-10 | 15 Winter | 5 | +20% | | | | | 133.165 |
| S2.002 | S02-03-11 | 15 Winter | 5 | +20% | | | | | 133.001 |
| S2.003 | S02-03-12 | 15 Winter | 5 | +20% | | | | | 132.800 |
| S2.004 | S02-03-13 | 15 Winter | 5 | +20% | | | | | 132.613 |
| S2.005 | S02-03-14 | 15 Winter | 5 | +20% | | | | | 132.316 |
| S2.006 | S02-03-15 | 15 Winter | 5 | +20% | | | | | 128.630 |
| S2.007 | S02-03-16 | 15 Winter | 5 | +20% | | | | | 126.645 |
| S2.008 | S02-03-17 | 15 Winter | 5 | +20% | | | | | 123.364 |

## Summary of Critical Results by Maximum Level (Rank 1) for System 2-3

| PN | US/MH Name | Surcharged Depth (m) | Flooded Volume ($m^3$) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S02-03-1 | -0.173 | 0.000 | 0.12 | | | 3.5 | OK | |
| S1.001 | S02-03-2 | -0.143 | 0.000 | 0.28 | | | 8.1 | OK | |
| S1.002 | S02-03-3 | -0.125 | 0.000 | 0.41 | | | 11.8 | OK | |
| S1.003 | S02-03-4 | -0.121 | 0.000 | 0.44 | | | 14.2 | OK | |
| S1.004 | S02-03-5 | -0.132 | 0.000 | 0.35 | | | 16.3 | OK | |
| S1.005 | S02-03-6 | -0.157 | 0.000 | 0.20 | | | 21.8 | OK | |
| S1.006 | S02-03-7 | -0.150 | 0.000 | 0.24 | | | 28.4 | OK | |
| S1.007 | S02-03-8 | -0.144 | 0.000 | 0.28 | | | 34.0 | OK | |
| S2.000 | S02-03-9 | -0.192 | 0.000 | 0.05 | | | 2.7 | OK | |
| S2.001 | S02-03-10 | -0.165 | 0.000 | 0.16 | | | 8.0 | OK | |
| S2.002 | S02-03-11 | -0.143 | 0.000 | 0.28 | | | 11.9 | OK | |
| S2.003 | S02-03-12 | -0.140 | 0.000 | 0.31 | | | 14.3 | OK | |
| S2.004 | S02-03-13 | -0.148 | 0.000 | 0.26 | | | 16.0 | OK | |
| S2.005 | S02-03-14 | -0.154 | 0.000 | 0.22 | | | 24.0 | OK | |
| S2.006 | S02-03-15 | -0.151 | 0.000 | 0.23 | | | 27.4 | OK | |
| S2.007 | S02-03-16 | -0.144 | 0.000 | 0.27 | | | 33.5 | OK | |
| S2.008 | S02-03-17 | -0.051 | 0.000 | 0.95 | | | 33.7 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for System 2-4

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 16.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

## Time Area Diagram for System 2-4

| **Time (mins)** | **Area (ha)** | **Time (mins)** | **Area (ha)** |
|---|---|---|---|
| 0-4 | 0.041 | 4-8 | 0.014 |

Total Area Contributing (ha) = 0.055

Total Pipe Volume (m³) = 1.144

## Network Design Table for System 2-4

| **PN** | **Length (m)** | **Fall (m)** | **Slope (1:X)** | **I.Area (ha)** | **T.E. (mins)** | **Base Flow (l/s)** | **k (mm)** | **HYD SECT** | **DIA (mm)** | **Section Type** | **Auto Design** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 28.762 | 0.554 | 51.9 | 0.055 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |

## Network Results Table

| **PN** | **Rain (mm/hr)** | **T.C. (mins)** | **US/IL (m)** | **Σ I.Area (ha)** | **Σ Base Flow (l/s)** | **Foul (l/s)** | **Add Flow (l/s)** | **Vel (m/s)** | **Cap (l/s)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 61.40 | 5.26 | 0.000 | 0.055 | 0.0 | 0.0 | 0.0 | 1.82 | 72.3 | 9.2 |

## Manhole Schedules for System 2-4

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Back |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S02-04-1 | 133.828 | 133.828 | Open Manhole | 1200 | S1.000 | 0.000 | 225 | | | | |
| S | 133.929 | 134.483 | Open Manhole | 0 | | OUTFALL | | S1.000 | -0.554 | 225 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S02-04-1 | 352227.434 | 529048.432 | 352227.434 | 529048.432 | Required |  |
| S | 352214.000 | 529023.000 | | | No Entry | |

## PIPELINE SCHEDULES for System 2-4

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | o | 225 | S02-04-1 | 133.828 | 0.000 | 133.603 | Open Manhole | 1200 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | 28.762 | 51.9 | S | 133.929 | -0.554 | 134.258 | Open Manhole | 0 |

## Area Summary for System 2-4

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | User | - | 100 | 0.055 | 0.055 | 0.055 |
| | | | | Total<br>0.055 | Total<br>0.055 | Total<br>0.055 |

## Free Flowing Outfall Details for System 2-4

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| S1.000 | S | 133.929 | -0.554 | 0.000 | 0 | 0 |

## Simulation Criteria for System 2-4

| | | | |
|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Additional Flow - % of Total Flow | 0.000 |
| Areal Reduction Factor | 1.000 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start (mins) | 0 | Inlet Coeffiecient | 0.800 |
| Hot Start Level (mm) | 0 | Flow per Person per Day (l/per/day) | 0.000 |
| Manhole Headloss Coeff (Global) | 0.500 | Run Time (mins) | 60 |
| Foul Sewage per hectare (l/s) | 0.000 | Output Interval (mins) | 1 |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

## Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Profile Type | Summer |
| Return Period (years) | 5 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.200 | Storm Duration (mins) | 30 |
| Ratio R | 0.300 | | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for System 2-5

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 16.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Time Area Diagram for System 2-5

| Time (mins) | Area (ha) | Time (mins) | Area (ha) |
|---|---|---|---|
| 0-4 | 0.049 | 4-8 | 0.008 |

Total Area Contributing (ha) = 0.057

Total Pipe Volume (m³) = 1.496

### Network Design Table for System 2-5

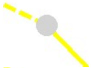
| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 19.009 | 0.303 | 62.7 | 0.024 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S1.001 | 18.620 | 0.318 | 58.5 | 0.033 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 61.72 | 5.19 | 133.900 | 0.024 | 0.0 | 0.0 | 0.0 | 1.65 | 65.8 | 3.9 |
| S1.001 | 60.91 | 5.37 | 133.597 | 0.057 | 0.0 | 0.0 | 0.0 | 1.71 | 68.1 | 9.3 |

## Manhole Schedules for System 2-5

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdr (mm |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S02-05-1 | 135.407 | 1.507 | Open Manhole | 1200 | S1.000 | 133.900 | 225 | | | | |
| S02-05-2 | 135.100 | 1.503 | Open Manhole | 1200 | S1.001 | 133.597 | 225 | S1.000 | 133.597 | 225 | |
| S | 134.662 | 1.383 | Open Manhole | 0 | | OUTFALL | | S1.001 | 133.279 | 225 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S02-05-1 | 352148.142 | 529035.912 | 352148.142 | 529035.912 | Required |  |
| S02-05-2 | 352165.198 | 529027.521 | 352165.198 | 529027.521 | Required |  |
| S | 352178.000 | 529014.000 | | | No Entry |  |

## PIPELINE SCHEDULES for System 2-5

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | o | 225 | S02-05-1 | 135.407 | 133.900 | 1.282 | Open Manhole | 1200 |
| S1.001 | o | 225 | S02-05-2 | 135.100 | 133.597 | 1.278 | Open Manhole | 1200 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | 19.009 | 62.7 | S02-05-2 | 135.100 | 133.597 | 1.278 | Open Manhole | 1200 |
| S1.001 | 18.620 | 58.5 | S | 134.662 | 133.279 | 1.158 | Open Manhole | 0 |

## Area Summary for System 2-5

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | User | - | 100 | 0.024 | 0.024 | 0.024 |
| 1.001 | User | - | 100 | 0.033 | 0.033 | 0.033 |
| | | | | Total<br>0.057 | Total<br>0.057 | Total<br>0.057 |

## Free Flowing Outfall Details for System 2-5

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| S1.001 | S | 134.662 | 133.279 | 0.000 | 0 | 0 |

## Simulation Criteria for System 2-5

| | | | |
|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Additional Flow - % of Total Flow | 0.000 |
| Areal Reduction Factor | 1.000 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start (mins) | 0 | Inlet Coeffiecient | 0.800 |
| Hot Start Level (mm) | 0 | Flow per Person per Day (l/per/day) | 0.000 |
| Manhole Headloss Coeff (Global) | 0.500 | Run Time (mins) | 60 |
| Foul Sewage per hectare (l/s) | 0.000 | Output Interval (mins) | 1 |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

## Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Profile Type | Summer |
| Return Period (years) | 5 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.200 | Storm Duration (mins) | 30 |
| Ratio R | 0.300 | | |

## Summary of Critical Results by Maximum Level (Rank 1) for System 2-5

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 0
Number of Online Controls 0 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.300
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 16.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5
Climate Change (%) 20

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S02-05-1 | 15 Winter | 5 | +20% | | | | | 133.943 |
| S1.001 | S02-05-2 | 15 Winter | 5 | +20% | | | | | 133.660 |

| PN | US/MH Name | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S02-05-1 | -0.182 | 0.000 | 0.08 | | | 4.7 | OK | |
| S1.001 | S02-05-2 | -0.162 | 0.000 | 0.17 | | | 10.4 | OK | |

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Summer | 135.820 | 0.220 | 2.6 | 65.9 | O K |
| 30 min Summer | 135.902 | 0.302 | 2.6 | 90.7 | O K |
| 60 min Summer | 135.994 | 0.394 | 2.6 | 118.2 | O K |
| 120 min Summer | 136.092 | 0.492 | 2.6 | 147.6 | O K |
| 180 min Summer | 136.148 | 0.548 | 2.6 | 164.5 | O K |
| 240 min Summer | 136.183 | 0.583 | 2.6 | 174.8 | O K |
| 360 min Summer | 136.217 | 0.617 | 2.6 | 185.0 | O K |
| 480 min Summer | 136.232 | 0.632 | 2.6 | 189.7 | O K |
| 600 min Summer | 136.237 | 0.637 | 2.6 | 191.1 | O K |
| 720 min Summer | 136.237 | 0.637 | 2.6 | 191.2 | O K |
| 960 min Summer | 136.233 | 0.633 | 2.6 | 189.9 | O K |
| 1440 min Summer | 136.214 | 0.614 | 2.6 | 184.2 | O K |
| 2160 min Summer | 136.175 | 0.575 | 2.6 | 172.4 | O K |
| 2880 min Summer | 136.130 | 0.530 | 2.6 | 158.9 | O K |
| 4320 min Summer | 136.026 | 0.426 | 2.6 | 127.9 | O K |
| 5760 min Summer | 135.940 | 0.340 | 2.6 | 102.0 | O K |
| 7200 min Summer | 135.870 | 0.270 | 2.6 | 81.1 | O K |
| 8640 min Summer | 135.817 | 0.217 | 2.6 | 65.2 | O K |
| 10080 min Summer | 135.777 | 0.177 | 2.6 | 53.2 | O K |
| 15 min Winter | 135.847 | 0.247 | 2.6 | 74.0 | O K |
| 30 min Winter | 135.940 | 0.340 | 2.6 | 101.9 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 98.758 | 0.0 | 65.4 | 23 |
| 30 min Summer | 68.473 | 0.0 | 91.3 | 38 |
| 60 min Summer | 45.415 | 0.0 | 123.7 | 68 |
| 120 min Summer | 29.220 | 0.0 | 159.3 | 126 |
| 180 min Summer | 22.277 | 0.0 | 182.3 | 186 |
| 240 min Summer | 18.252 | 0.0 | 199.1 | 246 |
| 360 min Summer | 13.626 | 0.0 | 223.0 | 364 |
| 480 min Summer | 11.062 | 0.0 | 241.3 | 484 |
| 600 min Summer | 9.405 | 0.0 | 256.3 | 600 |
| 720 min Summer | 8.233 | 0.0 | 269.1 | 648 |
| 960 min Summer | 6.665 | 0.0 | 290.0 | 772 |
| 1440 min Summer | 4.937 | 0.0 | 320.3 | 1034 |
| 2160 min Summer | 3.647 | 0.0 | 360.4 | 1456 |
| 2880 min Summer | 2.937 | 0.0 | 386.9 | 1876 |
| 4320 min Summer | 2.160 | 0.0 | 426.2 | 2640 |
| 5760 min Summer | 1.734 | 0.0 | 457.6 | 3352 |
| 7200 min Summer | 1.462 | 0.0 | 482.1 | 4040 |
| 8640 min Summer | 1.272 | 0.0 | 503.4 | 4752 |
| 10080 min Summer | 1.132 | 0.0 | 521.8 | 5440 |
| 15 min Winter | 98.758 | 0.0 | 73.5 | 23 |
| 30 min Winter | 68.473 | 0.0 | 102.3 | 37 |

## Summary of Results for 100 year Return Period (+40%)

| **Storm Event** | **Max Level (m)** | **Max Depth (m)** | **Max Control (l/s)** | **Max Volume (m³)** | **Status** |
|---|---|---|---|---|---|
| 60 min Winter | 136.044 | 0.444 | 2.6 | 133.1 | O K |
| 120 min Winter | 136.157 | 0.557 | 2.6 | 167.0 | O K |
| 180 min Winter | 136.220 | 0.620 | 2.6 | 186.0 | O K |
| 240 min Winter | 136.260 | 0.660 | 2.6 | 198.0 | O K |
| 360 min Winter | 136.302 | 0.702 | 2.6 | 210.7 | O K |
| 480 min Winter | 136.324 | 0.724 | 2.6 | 217.1 | O K |
| 600 min Winter | 136.334 | 0.734 | 2.6 | 220.1 | O K |
| 720 min Winter | 136.336 | 0.736 | 2.6 | 220.8 | O K |
| 960 min Winter | 136.327 | 0.727 | 2.6 | 218.1 | O K |
| 1440 min Winter | 136.301 | 0.701 | 2.6 | 210.4 | O K |
| 2160 min Winter | 136.243 | 0.643 | 2.6 | 193.0 | O K |
| 2880 min Winter | 136.176 | 0.576 | 2.6 | 172.9 | O K |
| 4320 min Winter | 136.013 | 0.413 | 2.6 | 123.9 | O K |
| 5760 min Winter | 135.885 | 0.285 | 2.6 | 85.4 | O K |
| 7200 min Winter | 135.795 | 0.195 | 2.6 | 58.6 | O K |
| 8640 min Winter | 135.740 | 0.140 | 2.5 | 42.1 | O K |
| 10080 min Winter | 135.708 | 0.108 | 2.3 | 32.3 | O K |

| **Storm Event** | **Rain (mm/hr)** | **Flooded Volume (m³)** | **Discharge Volume (m³)** | **Time-Peak (mins)** |
|---|---|---|---|---|
| 60 min Winter | 45.415 | 0.0 | 138.6 | 66 |
| 120 min Winter | 29.220 | 0.0 | 178.5 | 124 |
| 180 min Winter | 22.277 | 0.0 | 204.2 | 184 |
| 240 min Winter | 18.252 | 0.0 | 223.0 | 242 |
| 360 min Winter | 13.626 | 0.0 | 249.7 | 356 |
| 480 min Winter | 11.062 | 0.0 | 270.1 | 470 |
| 600 min Winter | 9.405 | 0.0 | 286.9 | 580 |
| 720 min Winter | 8.233 | 0.0 | 301.1 | 688 |
| 960 min Winter | 6.665 | 0.0 | 324.2 | 878 |
| 1440 min Winter | 4.937 | 0.0 | 355.9 | 1102 |
| 2160 min Winter | 3.647 | 0.0 | 403.7 | 1568 |
| 2880 min Winter | 2.937 | 0.0 | 433.3 | 2024 |
| 4320 min Winter | 2.160 | 0.0 | 477.6 | 2816 |
| 5760 min Winter | 1.734 | 0.0 | 512.6 | 3512 |
| 7200 min Winter | 1.462 | 0.0 | 540.0 | 4176 |
| 8640 min Winter | 1.272 | 0.0 | 564.0 | 4760 |
| 10080 min Winter | 1.132 | 0.0 | 584.7 | 5344 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 16.200 | Shortest Storm (mins) | 15 |
| Ratio R | 0.300 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 0.367

| Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 0.043 | 4 | 8 | 0.305 | 8 | 12 | 0.020 |

## Model Details

Storage is Online Cover Level (m) 138.150

## Tank or Pond Structure

Invert Level (m) 135.600

| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|
| 0.000 | 300.0 | 0.500 | 300.0 | 0.800 | 300.0 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0080-2600-0800-2600 |
| Design Head (m) | 0.800 |
| Design Flow (l/s) | 2.6 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 80 |
| Invert Level (m) | 135.600 |
| Minimum Outlet Pipe Diameter (mm) | 100 |
| Suggested Manhole Diameter (mm) | 1200 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 0.800 | 2.6 |
| Flush-Flo™ | 0.240 | 2.6 |
| Kick-Flo® | 0.514 | 2.1 |
| Mean Flow over Head Range | - | 2.3 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.100 | 2.3 | 1.200 | 3.1 | 3.000 | 4.8 | 7.000 | 7.1 |
| 0.200 | 2.6 | 1.400 | 3.4 | 3.500 | 5.1 | 7.500 | 7.4 |
| 0.300 | 2.6 | 1.600 | 3.6 | 4.000 | 5.5 | 8.000 | 7.6 |
| 0.400 | 2.5 | 1.800 | 3.8 | 4.500 | 5.8 | 8.500 | 7.8 |
| 0.500 | 2.2 | 2.000 | 4.0 | 5.000 | 6.1 | 9.000 | 8.0 |
| 0.600 | 2.3 | 2.200 | 4.1 | 5.500 | 6.4 | 9.500 | 8.3 |
| 0.800 | 2.6 | 2.400 | 4.3 | 6.000 | 6.6 | | |
| 1.000 | 2.9 | 2.600 | 4.5 | 6.500 | 6.9 | | |

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Summer | 119.535 | 0.244 | 40.3 | 1152.0 | OK |
| 30 min Summer | 119.625 | 0.334 | 48.7 | 1578.1 | OK |
| 60 min Summer | 119.727 | 0.436 | 49.6 | 2059.7 | OK |
| 120 min Summer | 119.837 | 0.546 | 49.6 | 2575.3 | OK |
| 180 min Summer | 119.899 | 0.608 | 49.6 | 2868.4 | OK |
| 240 min Summer | 119.938 | 0.647 | 49.6 | 3054.4 | OK |
| 360 min Summer | 119.980 | 0.689 | 49.6 | 3253.7 | OK |
| 480 min Summer | 120.001 | 0.710 | 49.6 | 3352.8 | OK |
| 600 min Summer | 120.012 | 0.721 | 49.6 | 3404.9 | OK |
| 720 min Summer | 120.020 | 0.729 | 49.6 | 3438.7 | OK |
| 960 min Summer | 120.025 | 0.734 | 49.6 | 3464.6 | OK |
| 1440 min Summer | 120.016 | 0.725 | 49.6 | 3421.9 | OK |
| 2160 min Summer | 119.978 | 0.687 | 49.6 | 3241.3 | OK |
| 2880 min Summer | 119.929 | 0.638 | 49.6 | 3011.5 | OK |
| 4320 min Summer | 119.830 | 0.539 | 49.6 | 2544.4 | OK |
| 5760 min Summer | 119.744 | 0.453 | 49.6 | 2140.2 | OK |
| 7200 min Summer | 119.677 | 0.386 | 49.4 | 1820.8 | OK |
| 8640 min Summer | 119.627 | 0.336 | 48.8 | 1583.7 | OK |
| 10080 min Summer | 119.590 | 0.299 | 48.0 | 1410.5 | OK |
| 15 min Winter | 119.564 | 0.273 | 45.9 | 1289.3 | OK |
| 30 min Winter | 119.666 | 0.375 | 49.3 | 1772.3 | OK |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 98.062 | 0.0 | 946.1 | 30 |
| 30 min Summer | 68.010 | 0.0 | 1376.3 | 44 |
| 60 min Summer | 45.114 | 0.0 | 2031.5 | 72 |
| 120 min Summer | 29.036 | 0.0 | 2641.9 | 130 |
| 180 min Summer | 22.144 | 0.0 | 3033.6 | 190 |
| 240 min Summer | 18.149 | 0.0 | 3321.1 | 250 |
| 360 min Summer | 13.558 | 0.0 | 3725.8 | 368 |
| 480 min Summer | 11.003 | 0.0 | 4031.5 | 482 |
| 600 min Summer | 9.356 | 0.0 | 4281.7 | 550 |
| 720 min Summer | 8.190 | 0.0 | 4492.1 | 610 |
| 960 min Summer | 6.631 | 0.0 | 4832.5 | 738 |
| 1440 min Summer | 4.912 | 0.0 | 5312.2 | 1004 |
| 2160 min Summer | 3.629 | 0.0 | 6181.0 | 1412 |
| 2880 min Summer | 2.923 | 0.0 | 6631.2 | 1816 |
| 4320 min Summer | 2.150 | 0.0 | 7265.2 | 2564 |
| 5760 min Summer | 1.726 | 0.0 | 7917.8 | 3296 |
| 7200 min Summer | 1.455 | 0.0 | 8331.0 | 3976 |
| 8640 min Summer | 1.266 | 0.0 | 8681.5 | 4672 |
| 10080 min Summer | 1.127 | 0.0 | 8958.4 | 5352 |
| 15 min Winter | 98.062 | 0.0 | 1079.9 | 30 |
| 30 min Winter | 68.010 | 0.0 | 1560.7 | 43 |

## Summary of Results for 100 year Return Period (+40%)

| **Storm Event** | **Max Level (m)** | **Max Depth (m)** | **Max Control (l/s)** | **Max Volume (m³)** | **Status** |
|---|---|---|---|---|---|
| 60 min Winter | 119.782 | 0.491 | 49.6 | 2317.3 | O K |
| 120 min Winter | 119.907 | 0.616 | 49.6 | 2905.8 | O K |
| 180 min Winter | 119.979 | 0.688 | 49.6 | 3245.1 | O K |
| 240 min Winter | 120.025 | 0.734 | 49.6 | 3466.3 | O K |
| 360 min Winter | 120.079 | 0.788 | 49.6 | 3718.2 | O K |
| 480 min Winter | 120.107 | 0.816 | 49.6 | 3853.3 | O K |
| 600 min Winter | 120.122 | 0.831 | 49.6 | 3923.1 | O K |
| 720 min Winter | 120.128 | 0.837 | 49.6 | 3950.0 | O K |
| 960 min Winter | 120.125 | 0.834 | 49.6 | 3936.9 | O K |
| 1440 min Winter | 120.106 | 0.815 | 49.6 | 3848.8 | O K |
| 2160 min Winter | 120.041 | 0.750 | 49.6 | 3540.1 | O K |
| 2880 min Winter | 119.959 | 0.668 | 49.6 | 3154.3 | O K |
| 4320 min Winter | 119.803 | 0.512 | 49.6 | 2416.1 | O K |
| 5760 min Winter | 119.680 | 0.389 | 49.4 | 1838.1 | O K |
| 7200 min Winter | 119.599 | 0.308 | 48.2 | 1452.8 | O K |
| 8640 min Winter | 119.560 | 0.269 | 45.2 | 1269.8 | O K |
| 10080 min Winter | 119.538 | 0.247 | 40.9 | 1166.0 | O K |

| **Storm Event** | **Rain (mm/hr)** | **Flooded Volume (m³)** | **Discharge Volume (m³)** | **Time-Peak (mins)** |
|---|---|---|---|---|
| 60 min Winter | 45.114 | 0.0 | 2287.4 | 72 |
| 120 min Winter | 29.036 | 0.0 | 2970.0 | 130 |
| 180 min Winter | 22.144 | 0.0 | 3407.6 | 188 |
| 240 min Winter | 18.149 | 0.0 | 3728.3 | 244 |
| 360 min Winter | 13.558 | 0.0 | 4178.7 | 360 |
| 480 min Winter | 11.003 | 0.0 | 4518.2 | 472 |
| 600 min Winter | 9.356 | 0.0 | 4795.7 | 582 |
| 720 min Winter | 8.190 | 0.0 | 5028.3 | 688 |
| 960 min Winter | 6.631 | 0.0 | 5401.4 | 794 |
| 1440 min Winter | 4.912 | 0.0 | 5906.9 | 1094 |
| 2160 min Winter | 3.629 | 0.0 | 6929.0 | 1544 |
| 2880 min Winter | 2.923 | 0.0 | 7434.4 | 1968 |
| 4320 min Winter | 2.150 | 0.0 | 8156.9 | 2732 |
| 5760 min Winter | 1.726 | 0.0 | 8874.9 | 3408 |
| 7200 min Winter | 1.455 | 0.0 | 9339.9 | 4040 |
| 8640 min Winter | 1.266 | 0.0 | 9736.6 | 4664 |
| 10080 min Winter | 1.127 | 0.0 | 10056.7 | 5352 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 16.100 | Shortest Storm (mins) | 15 |
| Ratio R | 0.300 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 6.419

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 0.313 | 8 | 12 | 3.310 | 16 | 20 | 0.041 |
| 4 | 8 | 1.222 | 12 | 16 | 1.533 | | | |

## Model Details

Storage is Online Cover Level (m) 125.605

## Tank or Pond Structure

Invert Level (m) 119.291

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 4720.0 | 1.000 | 4720.0 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0293-4970-1000-4970 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 49.7 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 293 |
| Invert Level (m) | 119.291 |
| Minimum Outlet Pipe Diameter (mm) | 375 |
| Suggested Manhole Diameter (mm) | 1800 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 1.000 | 49.7 |
| Flush-Flo™ | 0.444 | 49.6 |
| Kick-Flo® | 0.782 | 44.1 |
| Mean Flow over Head Range | - | 39.9 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.100 | 9.0 | 1.200 | 54.2 | 3.000 | 84.5 | 7.000 | 127.8 |
| 0.200 | 30.2 | 1.400 | 58.4 | 3.500 | 91.1 | 7.500 | 132.2 |
| 0.300 | 48.1 | 1.600 | 62.3 | 4.000 | 97.2 | 8.000 | 136.4 |
| 0.400 | 49.4 | 1.800 | 66.0 | 4.500 | 103.0 | 8.500 | 140.5 |
| 0.500 | 49.4 | 2.000 | 69.4 | 5.000 | 108.4 | 9.000 | 144.5 |
| 0.600 | 48.5 | 2.200 | 72.7 | 5.500 | 113.6 | 9.500 | 148.4 |
| 0.800 | 44.6 | 2.400 | 75.8 | 6.000 | 118.5 | | |
| 1.000 | 49.7 | 2.600 | 78.9 | 6.500 | 123.2 | | |

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Summer | 112.942 | 0.304 | 12.0 | 292.1 | O K |
| 30 min Summer | 113.057 | 0.419 | 12.0 | 402.3 | O K |
| 60 min Summer | 113.185 | 0.547 | 12.0 | 525.1 | O K |
| 120 min Summer | 113.323 | 0.685 | 12.0 | 657.1 | O K |
| 180 min Summer | 113.400 | 0.762 | 12.0 | 731.3 | O K |
| 240 min Summer | 113.447 | 0.809 | 12.0 | 776.2 | O K |
| 360 min Summer | 113.493 | 0.855 | 12.0 | 820.8 | O K |
| 480 min Summer | 113.512 | 0.874 | 12.0 | 839.4 | O K |
| 600 min Summer | 113.518 | 0.880 | 12.0 | 844.9 | O K |
| 720 min Summer | 113.520 | 0.882 | 12.0 | 846.5 | O K |
| 960 min Summer | 113.515 | 0.877 | 12.0 | 842.2 | O K |
| 1440 min Summer | 113.490 | 0.852 | 12.0 | 818.2 | O K |
| 2160 min Summer | 113.436 | 0.798 | 12.0 | 765.7 | O K |
| 2880 min Summer | 113.374 | 0.736 | 12.0 | 706.5 | O K |
| 4320 min Summer | 113.230 | 0.592 | 12.0 | 568.3 | O K |
| 5760 min Summer | 113.108 | 0.470 | 12.0 | 451.2 | O K |
| 7200 min Summer | 113.010 | 0.372 | 12.0 | 356.9 | O K |
| 8640 min Summer | 112.936 | 0.298 | 12.0 | 285.8 | O K |
| 10080 min Summer | 112.882 | 0.244 | 11.8 | 234.5 | O K |
| 15 min Winter | 112.980 | 0.342 | 12.0 | 327.9 | O K |
| 30 min Winter | 113.109 | 0.471 | 12.0 | 452.2 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 98.062 | 0.0 | 285.2 | 23 |
| 30 min Summer | 68.010 | 0.0 | 399.5 | 38 |
| 60 min Summer | 45.114 | 0.0 | 546.7 | 68 |
| 120 min Summer | 29.036 | 0.0 | 705.2 | 126 |
| 180 min Summer | 22.144 | 0.0 | 807.2 | 186 |
| 240 min Summer | 18.149 | 0.0 | 882.3 | 244 |
| 360 min Summer | 13.558 | 0.0 | 988.7 | 364 |
| 480 min Summer | 11.003 | 0.0 | 1069.6 | 482 |
| 600 min Summer | 9.356 | 0.0 | 1136.3 | 564 |
| 720 min Summer | 8.190 | 0.0 | 1192.9 | 618 |
| 960 min Summer | 6.631 | 0.0 | 1285.6 | 746 |
| 1440 min Summer | 4.912 | 0.0 | 1419.9 | 1012 |
| 2160 min Summer | 3.629 | 0.0 | 1602.8 | 1432 |
| 2880 min Summer | 2.923 | 0.0 | 1720.7 | 1848 |
| 4320 min Summer | 2.150 | 0.0 | 1894.7 | 2632 |
| 5760 min Summer | 1.726 | 0.0 | 2037.6 | 3344 |
| 7200 min Summer | 1.455 | 0.0 | 2146.1 | 4040 |
| 8640 min Summer | 1.266 | 0.0 | 2240.6 | 4680 |
| 10080 min Summer | 1.127 | 0.0 | 2320.7 | 5352 |
| 15 min Winter | 98.062 | 0.0 | 320.7 | 23 |
| 30 min Winter | 68.010 | 0.0 | 448.5 | 37 |

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 60 min Winter | 113.254 | 0.616 | 12.0 | 591.5 | O K |
| 120 min Winter | 113.411 | 0.773 | 12.0 | 742.0 | O K |
| 180 min Winter | 113.498 | 0.860 | 12.0 | 825.9 | O K |
| 240 min Winter | 113.553 | 0.915 | 12.0 | 878.5 | O K |
| 360 min Winter | 113.611 | 0.973 | 12.0 | 933.7 | O K |
| 480 min Winter | 113.638 | 1.000 | 12.0 | 960.1 | O K |
| 600 min Winter | 113.650 | 1.012 | 12.1 | 971.3 | O K |
| 720 min Winter | 113.651 | 1.013 | 12.1 | 972.5 | O K |
| 960 min Winter | 113.640 | 1.002 | 12.0 | 961.7 | O K |
| 1440 min Winter | 113.604 | 0.966 | 12.0 | 927.6 | O K |
| 2160 min Winter | 113.522 | 0.884 | 12.0 | 848.2 | O K |
| 2880 min Winter | 113.427 | 0.789 | 12.0 | 757.5 | O K |
| 4320 min Winter | 113.202 | 0.564 | 12.0 | 541.0 | O K |
| 5760 min Winter | 113.020 | 0.382 | 12.0 | 367.1 | O K |
| 7200 min Winter | 112.898 | 0.260 | 11.9 | 249.1 | O K |
| 8640 min Winter | 112.827 | 0.189 | 11.5 | 181.5 | O K |
| 10080 min Winter | 112.799 | 0.161 | 10.7 | 154.9 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 60 min Winter | 45.114 | 0.0 | 613.0 | 66 |
| 120 min Winter | 29.036 | 0.0 | 790.3 | 124 |
| 180 min Winter | 22.144 | 0.0 | 904.5 | 182 |
| 240 min Winter | 18.149 | 0.0 | 988.5 | 240 |
| 360 min Winter | 13.558 | 0.0 | 1107.4 | 354 |
| 480 min Winter | 11.003 | 0.0 | 1197.8 | 466 |
| 600 min Winter | 9.356 | 0.0 | 1272.2 | 576 |
| 720 min Winter | 8.190 | 0.0 | 1335.2 | 680 |
| 960 min Winter | 6.631 | 0.0 | 1437.8 | 778 |
| 1440 min Winter | 4.912 | 0.0 | 1582.6 | 1086 |
| 2160 min Winter | 3.629 | 0.0 | 1795.6 | 1552 |
| 2880 min Winter | 2.923 | 0.0 | 1927.5 | 1996 |
| 4320 min Winter | 2.150 | 0.0 | 2123.6 | 2808 |
| 5760 min Winter | 1.726 | 0.0 | 2282.6 | 3464 |
| 7200 min Winter | 1.455 | 0.0 | 2404.3 | 4104 |
| 8640 min Winter | 1.266 | 0.0 | 2510.4 | 4672 |
| 10080 min Winter | 1.127 | 0.0 | 2601.2 | 5248 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 16.100 | Shortest Storm (mins) | 15 |
| Ratio R | 0.300 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 1.643

| Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 0.508 | 4 | 8 | 1.010 | 8 | 12 | 0.125 |

## Model Details

Storage is Online Cover Level (m) 114.805

## Tank or Pond Structure

Invert Level (m) 112.638

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 960.0 | 1.000 | 960.0 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0158-1200-1000-1200 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 12.0 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 158 |
| Invert Level (m) | 112.638 |
| Minimum Outlet Pipe Diameter (mm) | 225 |
| Suggested Manhole Diameter (mm) | 1200 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 1.000 | 12.0 |
| Flush-Flo™ | 0.312 | 12.0 |
| Kick-Flo® | 0.687 | 10.1 |
| Mean Flow over Head Range | - | 10.2 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.100 | 5.7 | 1.200 | 13.1 | 3.000 | 20.2 | 7.000 | 30.4 |
| 0.200 | 11.6 | 1.400 | 14.1 | 3.500 | 21.8 | 7.500 | 31.4 |
| 0.300 | 12.0 | 1.600 | 15.0 | 4.000 | 23.2 | 8.000 | 32.4 |
| 0.400 | 11.8 | 1.800 | 15.8 | 4.500 | 24.6 | 8.500 | 33.4 |
| 0.500 | 11.6 | 2.000 | 16.7 | 5.000 | 25.8 | 9.000 | 34.3 |
| 0.600 | 11.1 | 2.200 | 17.4 | 5.500 | 27.0 | 9.500 | 35.2 |
| 0.800 | 10.8 | 2.400 | 18.2 | 6.000 | 28.2 | | |
| 1.000 | 12.0 | 2.600 | 18.9 | 6.500 | 29.3 | | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Pond 3-1

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 15.200 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Time Area Diagram for Pond 3-1

| Time (mins) | Area (ha) | Time (mins) | Area (ha) | Time (mins) | Area (ha) |
|---|---|---|---|---|---|
| 0-4 | 0.424 | 4-8 | 0.739 | 8-12 | 0.083 |

Total Area Contributing (ha) = 1.245

Total Pipe Volume (m³) = 67.536

### Network Design Table for Pond 3-1

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S4.000 | 25.640 | 0.256 | 100.0 | 0.023 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S4.001 | 17.675 | 0.118 | 150.0 | 0.021 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S4.002 | 13.085 | 0.131 | 100.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S5.000 | 24.206 | 0.269 | 90.0 | 0.028 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S4.003 | 22.553 | 0.451 | 50.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S4.000 | 58.05 | 5.33 | 109.100 | 0.023 | 0.0 | 0.0 | 0.0 | 1.31 | 52.0 | 3.6 |
| S4.001 | 56.90 | 5.60 | 108.844 | 0.044 | 0.0 | 0.0 | 0.0 | 1.07 | 42.4 | 6.7 |
| S4.002 | 56.24 | 5.77 | 108.726 | 0.044 | 0.0 | 0.0 | 0.0 | 1.31 | 52.0 | 6.7 |
| S5.000 | 58.19 | 5.29 | 108.900 | 0.028 | 0.0 | 0.0 | 0.0 | 1.38 | 54.8 | 4.4 |
| S4.003 | 55.45 | 5.97 | 108.595 | 0.071 | 0.0 | 0.0 | 0.0 | 1.85 | 73.7 | 10.7 |

## Network Design Table for Pond 3-1

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S6.000 | 59.282 | 0.224 | 264.7 | 0.092 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S6.001 | 68.929 | 0.406 | 169.7 | 0.116 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S6.002 | 63.855 | 0.532 | 120.0 | 0.120 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S7.000 | 60.176 | 0.861 | 69.9 | 0.095 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S7.001 | 69.986 | 0.417 | 167.7 | 0.100 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S7.002 | 63.506 | 0.378 | 168.0 | 0.077 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S7.003 | 11.695 | 0.039 | 300.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S6.003 | 63.079 | 0.296 | 213.1 | 0.090 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S6.004 | 63.079 | 0.985 | 64.1 | 0.089 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S6.005 | 69.615 | 1.240 | 56.1 | 0.032 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S6.006 | 13.398 | 0.447 | 30.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S8.000 | 47.221 | 0.807 | 58.5 | 0.005 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S8.001 | 34.015 | 0.635 | 53.6 | 0.053 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S8.002 | 36.498 | 0.217 | 168.2 | 0.059 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S8.003 | 79.111 | 1.057 | 74.8 | 0.128 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S8.004 | 77.845 | 1.415 | 55.0 | 0.033 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S8.005 | 14.718 | 0.327 | 45.0 | 0.085 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S8.006 | 25.155 | 0.104 | 241.6 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S6.000 | 54.47 | 6.24 | 115.500 | 0.092 | 0.0 | 0.0 | 0.0 | 0.80 | 31.8 | 13.6 |
| S6.001 | 50.66 | 7.38 | 115.276 | 0.208 | 0.0 | 0.0 | 0.0 | 1.00 | 39.8 | 28.5 |
| S6.002 | 48.52 | 8.13 | 114.795 | 0.328 | 0.0 | 0.0 | 0.0 | 1.43 | 101.4 | 43.1 |
| S7.000 | 56.75 | 5.64 | 115.900 | 0.095 | 0.0 | 0.0 | 0.0 | 1.57 | 62.3 | 14.6 |
| S7.001 | 52.52 | 6.80 | 115.039 | 0.195 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 27.7 |
| S7.002 | 49.80 | 7.67 | 114.547 | 0.272 | 0.0 | 0.0 | 0.0 | 1.21 | 85.5 | 36.7 |
| S7.003 | 49.18 | 7.89 | 114.169 | 0.272 | 0.0 | 0.0 | 0.0 | 0.90 | 63.8 | 36.7 |
| S6.003 | 46.33 | 8.98 | 114.055 | 0.690 | 0.0 | 0.0 | 0.0 | 1.24 | 136.6 | 86.6 |
| S6.004 | 45.23 | 9.44 | 113.759 | 0.779 | 0.0 | 0.0 | 0.0 | 2.27 | 250.4 | 95.4 |
| S6.005 | 44.17 | 9.92 | 112.774 | 0.811 | 0.0 | 0.0 | 0.0 | 2.42 | 267.6 | 97.0 |
| S6.006 | 44.02 | 9.99 | 111.534 | 0.811 | 0.0 | 0.0 | 0.0 | 3.32 | 366.5 | 97.0 |
| S8.000 | 57.49 | 5.46 | 115.800 | 0.005 | 0.0 | 0.0 | 0.0 | 1.71 | 68.1 | 0.8 |
| S8.001 | 56.21 | 5.78 | 114.993 | 0.058 | 0.0 | 0.0 | 0.0 | 1.79 | 71.2 | 8.8 |
| S8.002 | 53.96 | 6.38 | 114.358 | 0.117 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 17.1 |
| S8.003 | 51.07 | 7.25 | 114.141 | 0.245 | 0.0 | 0.0 | 0.0 | 1.51 | 60.2 | 33.9 |
| S8.004 | 49.26 | 7.86 | 113.009 | 0.278 | 0.0 | 0.0 | 0.0 | 2.12 | 150.2 | 37.1 |
| S8.005 | 48.96 | 7.97 | 111.593 | 0.363 | 0.0 | 0.0 | 0.0 | 2.35 | 166.1 | 48.1 |
| S8.006 | 47.83 | 8.38 | 111.266 | 0.363 | 0.0 | 0.0 | 0.0 | 1.01 | 71.2 | 48.1 |

## Network Design Table for Pond 3-1

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S6.007 | 31.275 | 3.128 | 10.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S4.004 | 3.945 | 0.010 | 400.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |

## Network Results Table

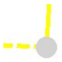
| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S6.007 | 43.83 | 10.08 | 111.087 | 1.174 | 0.0 | 0.0 | 0.0 | 5.76 | 635.9 | 139.3 |
| S4.004 | 43.69 | 10.14 | 107.884 | 1.245 | 0.0 | 0.0 | 0.0 | 1.01 | 160.7 | 147.3 |

## Manhole Schedules for Pond 3-1

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Back (m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S03-01-20 | 110.660 | 1.560 | Open Manhole | 1200 | S4.000 | 109.100 | 225 | | | | |
| S03-01-21 | 110.416 | 1.572 | Open Manhole | 1200 | S4.001 | 108.844 | 225 | S4.000 | 108.844 | 225 | |
| S03-01-22 | 110.308 | 1.582 | Open Manhole | 1200 | S4.002 | 108.726 | 225 | S4.001 | 108.726 | 225 | |
| S03-01-23 | 110.400 | 1.500 | Open Manhole | 1200 | S5.000 | 108.900 | 225 | | | | |
| S23 | 110.400 | 1.805 | Open Manhole | 1200 | S4.003 | 108.595 | 225 | S4.002 | 108.595 | 225 | |
| | | | | | | | | S5.000 | 108.631 | 225 | |
| S03-01-8 | 116.950 | 1.450 | Open Manhole | 1200 | S6.000 | 115.500 | 225 | | | | |
| S03-01-9 | 116.945 | 1.669 | Open Manhole | 1200 | S6.001 | 115.276 | 225 | S6.000 | 115.276 | 225 | |
| S03-01-10 | 116.657 | 1.863 | Open Manhole | 1200 | S6.002 | 114.795 | 300 | S6.001 | 114.870 | 225 | |
| S03-01-11 | 117.426 | 1.526 | Open Manhole | 1200 | S7.000 | 115.900 | 225 | | | | |
| S03-01-12 | 117.302 | 2.263 | Open Manhole | 1200 | S7.001 | 115.039 | 225 | S7.000 | 115.039 | 225 | |
| S03-01-13 | 116.865 | 2.318 | Open Manhole | 1200 | S7.002 | 114.547 | 300 | S7.001 | 114.622 | 225 | |
| S03-01-14 | 116.270 | 2.101 | Open Manhole | 1200 | S7.003 | 114.169 | 300 | S7.002 | 114.169 | 300 | |
| S03-01-15 | 116.027 | 1.972 | Open Manhole | 1350 | S6.003 | 114.055 | 375 | S6.002 | 114.263 | 300 | |
| | | | | | | | | S7.003 | 114.130 | 300 | |
| S03-01-16 | 115.325 | 1.566 | Open Manhole | 1350 | S6.004 | 113.759 | 375 | S6.003 | 113.759 | 375 | |
| S03-01-17 | 114.340 | 1.566 | Open Manhole | 1350 | S6.005 | 112.774 | 375 | S6.004 | 112.774 | 375 | |
| S03-01-18 | 113.100 | 1.566 | Open Manhole | 1350 | S6.006 | 111.534 | 375 | S6.005 | 111.534 | 375 | |
| S03-01-1 | 117.335 | 1.535 | Open Manhole | 1200 | S8.000 | 115.800 | 225 | | | | |
| S03-01-2 | 116.744 | 1.751 | Open Manhole | 1200 | S8.001 | 114.993 | 225 | S8.000 | 114.993 | 225 | |
| S03-01-3 | 116.109 | 1.751 | Open Manhole | 1200 | S8.002 | 114.358 | 225 | S8.001 | 114.358 | 225 | |
| S03-01-4 | 115.589 | 1.448 | Open Manhole | 1200 | S8.003 | 114.141 | 225 | S8.002 | 114.141 | 225 | |
| S03-01-5 | 114.509 | 1.500 | Open Manhole | 1200 | S8.004 | 113.009 | 300 | S8.003 | 113.084 | 225 | |
| S03-01-6 | 113.154 | 1.561 | Open Manhole | 1200 | S8.005 | 111.593 | 300 | S8.004 | 111.593 | 300 | |
| S03-01-7 | 112.871 | 1.605 | Open Manhole | 1200 | S8.006 | 111.266 | 300 | S8.005 | 111.266 | 300 | |
| S24 | 112.856 | 1.769 | Open Manhole | 1350 | S6.007 | 111.087 | 375 | S6.006 | 111.087 | 375 | |
| | | | | | | | | S8.006 | 111.162 | 300 | |
| S24 | 109.400 | 1.516 | Open Manhole | 1350 | S4.004 | 107.884 | 450 | S4.003 | 108.144 | 225 | |
| | | | | | | | | S6.007 | 107.959 | 375 | |
| S | 108.468 | 0.593 | Open Manhole | 0 | | OUTFALL | | S4.004 | 107.875 | 450 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S03-01-20 | 354664.494 | 529101.618 | 354664.494 | 529101.618 | Required | |

## Manhole Schedules for Pond 3-1

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S03-01-21 | 354667.352 | 529076.138 | 354667.352 | 529076.138 | Required |  |
| S03-01-22 | 354677.312 | 529061.536 | 354677.312 | 529061.536 | Required |  |
| S03-01-23 | 354700.927 | 529047.090 | 354700.927 | 529047.090 | Required |  |
| S23 | 354676.760 | 529048.463 | 354676.760 | 529048.463 | Required |  |
| S03-01-8 | 354268.011 | 529022.200 | 354268.011 | 529022.200 | Required |  |
| S03-01-9 | 354326.590 | 529013.101 | 354326.590 | 529013.101 | Required |  |
| S03-01-10 | 354395.254 | 529007.060 | 354395.254 | 529007.060 | Required |  |
| S03-01-11 | 354265.677 | 529010.590 | 354265.677 | 529010.590 | Required |  |
| S03-01-12 | 354325.149 | 529001.419 | 354325.149 | 529001.419 | Required |  |
| S03-01-13 | 354394.859 | 528995.213 | 354394.859 | 528995.213 | Required |  |
| S03-01-14 | 354458.283 | 528991.978 | 354458.283 | 528991.978 | Required |  |
| S03-01-15 | 354459.018 | 529003.650 | 354459.018 | 529003.650 | Required |  |
| S03-01-16 | 354522.030 | 529000.745 | 354522.030 | 529000.745 | Required |  |
| S03-01-17 | 354585.042 | 528997.841 | 354585.042 | 528997.841 | Required |  |
| S03-01-18 | 354654.585 | 528994.687 | 354654.585 | 528994.687 | Required |  |

## Manhole Schedules for Pond 3-1

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S03-01-1 | 354377.457 | 528985.334 | 354377.457 | 528985.334 | Required |  |
| S03-01-2 | 354424.608 | 528982.776 | 354424.608 | 528982.776 | Required |  |
| S03-01-3 | 354458.592 | 528981.320 | 354458.592 | 528981.320 | Required |  |
| S03-01-4 | 354495.050 | 528979.604 | 354495.050 | 528979.604 | Required |  |
| S03-01-5 | 354574.074 | 528975.912 | 354574.074 | 528975.912 | Required |  |
| S03-01-6 | 354651.842 | 528972.440 | 354651.842 | 528972.440 | Required |  |
| S03-01-7 | 354666.487 | 528970.970 | 354666.487 | 528970.970 | Required |  |
| S24 | 354667.910 | 528996.085 | 354667.910 | 528996.085 | Required |  |
| S24 | 354668.837 | 529027.346 | 354668.837 | 529027.346 | Required |  |
| S | 354672.394 | 529025.641 | | | No Entry |  |

## PIPELINE SCHEDULES for Pond 3-1

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S4.000 | o | 225 | S03-01-20 | 110.660 | 109.100 | 1.335 | Open Manhole | 1200 |
| S4.001 | o | 225 | S03-01-21 | 110.416 | 108.844 | 1.347 | Open Manhole | 1200 |
| S4.002 | o | 225 | S03-01-22 | 110.308 | 108.726 | 1.357 | Open Manhole | 1200 |
| S5.000 | o | 225 | S03-01-23 | 110.400 | 108.900 | 1.275 | Open Manhole | 1200 |
| S4.003 | o | 225 | S23 | 110.400 | 108.595 | 1.580 | Open Manhole | 1200 |
| S6.000 | o | 225 | S03-01-8 | 116.950 | 115.500 | 1.225 | Open Manhole | 1200 |
| S6.001 | o | 225 | S03-01-9 | 116.945 | 115.276 | 1.444 | Open Manhole | 1200 |
| S6.002 | o | 300 | S03-01-10 | 116.657 | 114.795 | 1.563 | Open Manhole | 1200 |
| S7.000 | o | 225 | S03-01-11 | 117.426 | 115.900 | 1.301 | Open Manhole | 1200 |
| S7.001 | o | 225 | S03-01-12 | 117.302 | 115.039 | 2.038 | Open Manhole | 1200 |
| S7.002 | o | 300 | S03-01-13 | 116.865 | 114.547 | 2.018 | Open Manhole | 1200 |
| S7.003 | o | 300 | S03-01-14 | 116.270 | 114.169 | 1.801 | Open Manhole | 1200 |
| S6.003 | o | 375 | S03-01-15 | 116.027 | 114.055 | 1.597 | Open Manhole | 1350 |
| S6.004 | o | 375 | S03-01-16 | 115.325 | 113.759 | 1.191 | Open Manhole | 1350 |
| S6.005 | o | 375 | S03-01-17 | 114.340 | 112.774 | 1.191 | Open Manhole | 1350 |
| S6.006 | o | 375 | S03-01-18 | 113.100 | 111.534 | 1.191 | Open Manhole | 1350 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S4.000 | 25.640 | 100.0 | S03-01-21 | 110.416 | 108.844 | 1.347 | Open Manhole | 1200 |
| S4.001 | 17.675 | 150.0 | S03-01-22 | 110.308 | 108.726 | 1.357 | Open Manhole | 1200 |
| S4.002 | 13.085 | 100.0 | S23 | 110.400 | 108.595 | 1.580 | Open Manhole | 1200 |
| S5.000 | 24.206 | 90.0 | S23 | 110.400 | 108.631 | 1.544 | Open Manhole | 1200 |
| S4.003 | 22.553 | 50.0 | S24 | 109.400 | 108.144 | 1.031 | Open Manhole | 1350 |
| S6.000 | 59.282 | 264.7 | S03-01-9 | 116.945 | 115.276 | 1.444 | Open Manhole | 1200 |
| S6.001 | 68.929 | 169.7 | S03-01-10 | 116.657 | 114.870 | 1.563 | Open Manhole | 1200 |
| S6.002 | 63.855 | 120.0 | S03-01-15 | 116.027 | 114.263 | 1.464 | Open Manhole | 1350 |
| S7.000 | 60.176 | 69.9 | S03-01-12 | 117.302 | 115.039 | 2.038 | Open Manhole | 1200 |
| S7.001 | 69.986 | 167.7 | S03-01-13 | 116.865 | 114.622 | 2.018 | Open Manhole | 1200 |
| S7.002 | 63.506 | 168.0 | S03-01-14 | 116.270 | 114.169 | 1.801 | Open Manhole | 1200 |
| S7.003 | 11.695 | 300.0 | S03-01-15 | 116.027 | 114.130 | 1.597 | Open Manhole | 1350 |
| S6.003 | 63.079 | 213.1 | S03-01-16 | 115.325 | 113.759 | 1.191 | Open Manhole | 1350 |
| S6.004 | 63.079 | 64.1 | S03-01-17 | 114.340 | 112.774 | 1.191 | Open Manhole | 1350 |
| S6.005 | 69.615 | 56.1 | S03-01-18 | 113.100 | 111.534 | 1.191 | Open Manhole | 1350 |
| S6.006 | 13.398 | 30.0 | S24 | 112.856 | 111.087 | 1.394 | Open Manhole | 1350 |

## PIPELINE SCHEDULES for Pond 3-1

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S8.000 | o | 225 | S03-01-1 | 117.335 | 115.800 | 1.310 | Open Manhole | 1200 |
| S8.001 | o | 225 | S03-01-2 | 116.744 | 114.993 | 1.526 | Open Manhole | 1200 |
| S8.002 | o | 225 | S03-01-3 | 116.109 | 114.358 | 1.526 | Open Manhole | 1200 |
| S8.003 | o | 225 | S03-01-4 | 115.589 | 114.141 | 1.223 | Open Manhole | 1200 |
| S8.004 | o | 300 | S03-01-5 | 114.509 | 113.009 | 1.200 | Open Manhole | 1200 |
| S8.005 | o | 300 | S03-01-6 | 113.154 | 111.593 | 1.261 | Open Manhole | 1200 |
| S8.006 | o | 300 | S03-01-7 | 112.871 | 111.266 | 1.305 | Open Manhole | 1200 |
| S6.007 | o | 375 | S24 | 112.856 | 111.087 | 1.394 | Open Manhole | 1350 |
| S4.004 | o | 450 | S24 | 109.400 | 107.884 | 1.066 | Open Manhole | 1350 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S8.000 | 47.221 | 58.5 | S03-01-2 | 116.744 | 114.993 | 1.526 | Open Manhole | 1200 |
| S8.001 | 34.015 | 53.6 | S03-01-3 | 116.109 | 114.358 | 1.526 | Open Manhole | 1200 |
| S8.002 | 36.498 | 168.2 | S03-01-4 | 115.589 | 114.141 | 1.223 | Open Manhole | 1200 |
| S8.003 | 79.111 | 74.8 | S03-01-5 | 114.509 | 113.084 | 1.200 | Open Manhole | 1200 |
| S8.004 | 77.845 | 55.0 | S03-01-6 | 113.154 | 111.593 | 1.261 | Open Manhole | 1200 |
| S8.005 | 14.718 | 45.0 | S03-01-7 | 112.871 | 111.266 | 1.305 | Open Manhole | 1200 |
| S8.006 | 25.155 | 241.6 | S24 | 112.856 | 111.162 | 1.394 | Open Manhole | 1350 |
| S6.007 | 31.275 | 10.0 | S24 | 109.400 | 107.959 | 1.066 | Open Manhole | 1350 |
| S4.004 | 3.945 | 400.0 | S | 108.468 | 107.875 | 0.143 | Open Manhole | 0 |

## Area Summary for Pond 3-1

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 4.000 | User | - | 100 | 0.016 | 0.016 | 0.016 |
| | User | - | 50 | 0.006 | 0.003 | 0.020 |
| | User | - | 50 | 0.007 | 0.003 | 0.023 |
| 4.001 | User | - | 100 | 0.016 | 0.016 | 0.016 |
| | User | - | 50 | 0.005 | 0.002 | 0.018 |
| | User | - | 50 | 0.006 | 0.003 | 0.021 |
| 4.002 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 5.000 | User | - | 100 | 0.021 | 0.021 | 0.021 |
| | User | - | 50 | 0.005 | 0.003 | 0.024 |
| | User | - | 50 | 0.008 | 0.004 | 0.028 |
| 4.003 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 6.000 | - | - | 100 | 0.092 | 0.092 | 0.092 |
| 6.001 | - | - | 100 | 0.116 | 0.116 | 0.116 |
| 6.002 | - | - | 100 | 0.120 | 0.120 | 0.120 |
| 7.000 | - | - | 100 | 0.095 | 0.095 | 0.095 |
| 7.001 | - | - | 100 | 0.100 | 0.100 | 0.100 |
| 7.002 | - | - | 100 | 0.077 | 0.077 | 0.077 |
| 7.003 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 6.003 | - | - | 100 | 0.090 | 0.090 | 0.090 |
| 6.004 | User | - | 100 | 0.075 | 0.075 | 0.075 |
| | User | - | 50 | 0.017 | 0.009 | 0.083 |
| | User | - | 25 | 0.022 | 0.005 | 0.089 |
| 6.005 | - | - | 100 | 0.032 | 0.032 | 0.032 |
| 6.006 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 8.000 | User | - | 25 | 0.019 | 0.005 | 0.005 |
| 8.001 | - | - | 100 | 0.053 | 0.053 | 0.053 |
| 8.002 | - | - | 100 | 0.059 | 0.059 | 0.059 |
| 8.003 | - | - | 100 | 0.128 | 0.128 | 0.128 |
| 8.004 | - | - | 100 | 0.033 | 0.033 | 0.033 |
| 8.005 | - | - | 100 | 0.085 | 0.085 | 0.085 |
| 8.006 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 6.007 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 4.004 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total | Total | Total |
| | | | | 1.303 | 1.245 | 1.245 |

## Free Flowing Outfall Details for Pond 3-1

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| S4.004 | S | 108.468 | 107.875 | 0.000 | 0 | 0 |

## Simulation Criteria for Pond 3-1

| | | | |
|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Additional Flow - % of Total Flow | 40.000 |
| Areal Reduction Factor | 1.000 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start (mins) | 0 | Inlet Coeffiecient | 0.800 |
| Hot Start Level (mm) | 0 | Flow per Person per Day (l/per/day) | 0.000 |
| Manhole Headloss Coeff (Global) | 0.500 | Run Time (mins) | 60 |
| Foul Sewage per hectare (l/s) | 0.000 | Output Interval (mins) | 1 |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

## Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Profile Type | Summer |
| Return Period (years) | 5 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.300 | Storm Duration (mins) | 30 |
| Ratio R | 0.300 | | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-1

### Simulation Criteria

```
           Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 40.000
                 Hot Start (mins)     0      MADD Factor * 10m³/ha Storage   2.000
               Hot Start Level (mm)   0              Inlet Coeffiecient   0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day)   0.000
  Foul Sewage per hectare (l/s) 0.000

          Number of Input Hydrographs 0 Number of Storage Structures 0
            Number of Online Controls 0 Number of Time/Area Diagrams 0
           Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
          Rainfall Model               FSR     Ratio R 0.300
                  Region England and Wales Cv (Summer) 0.750
              M5-60 (mm)            15.000 Cv (Winter) 0.840

    Margin for Flood Risk Warning (mm) 300.0     DVD Status OFF
                    Analysis Timestep  Fine Inertia Status OFF
                           DTS Status    ON


              Profile(s)                          Summer and Winter
         Duration(s) (mins)     15, 30, 60, 120, 180, 240, 360, 480, 600,
                                  720, 960, 1440, 2160, 2880, 4320, 5760,
                                                      7200, 8640, 10080
     Return Period(s) (years)                                         5
         Climate Change (%)                                          20
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| S4.000 | S03-01-20 | 15 Winter | 5 | +20% | | | | |
| S4.001 | S03-01-21 | 15 Winter | 5 | +20% | | | | |
| S4.002 | S03-01-22 | 15 Winter | 5 | +20% | | | | |
| S5.000 | S03-01-23 | 15 Winter | 5 | +20% | | | | |
| S4.003 | S23 | 15 Winter | 5 | +20% | | | | |
| S6.000 | S03-01-8 | 15 Winter | 5 | +20% | | | | |
| S6.001 | S03-01-9 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| S6.002 | S03-01-10 | 15 Winter | 5 | +20% | | | | |
| S7.000 | S03-01-11 | 15 Winter | 5 | +20% | | | | |
| S7.001 | S03-01-12 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| S7.002 | S03-01-13 | 15 Winter | 5 | +20% | | | | |
| S7.003 | S03-01-14 | 15 Winter | 5 | +20% | | | | |
| S6.003 | S03-01-15 | 15 Winter | 5 | +20% | | | | |
| S6.004 | S03-01-16 | 15 Winter | 5 | +20% | | | | |
| S6.005 | S03-01-17 | 15 Winter | 5 | +20% | | | | |
| S6.006 | S03-01-18 | 15 Winter | 5 | +20% | | | | |
| S8.000 | S03-01-1 | 15 Winter | 5 | +20% | | | | |
| S8.001 | S03-01-2 | 15 Winter | 5 | +20% | | | | |
| S8.002 | S03-01-3 | 15 Winter | 5 | +20% | | | | |
| S8.003 | S03-01-4 | 15 Winter | 5 | +20% | | | | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-1

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S4.000 | S03-01-20 | 109.153 | -0.172 | 0.000 | 0.13 | | | 6.0 | OK |
| S4.001 | S03-01-21 | 108.926 | -0.143 | 0.000 | 0.28 | | | 10.7 | OK |
| S4.002 | S03-01-22 | 108.800 | -0.151 | 0.000 | 0.24 | | | 10.7 | OK |
| S5.000 | S03-01-23 | 108.957 | -0.168 | 0.000 | 0.14 | | | 7.3 | OK |
| S4.003 | S23 | 108.674 | -0.146 | 0.000 | 0.27 | | | 18.0 | OK |
| S6.000 | S03-01-8 | 115.664 | -0.061 | 0.000 | 0.73 | | | 22.5 | OK |
| S6.001 | S03-01-9 | 115.566 | 0.065 | 0.000 | 1.07 | | | 41.3 | SURCHARGED |
| S6.002 | S03-01-10 | 114.975 | -0.120 | 0.000 | 0.65 | | | 63.1 | OK |
| S7.000 | S03-01-11 | 116.002 | -0.123 | 0.000 | 0.41 | | | 24.7 | OK |
| S7.001 | S03-01-12 | 115.375 | 0.111 | 0.000 | 1.10 | | | 42.7 | SURCHARGED |
| S7.002 | S03-01-13 | 114.734 | -0.113 | 0.000 | 0.69 | | | 56.6 | OK |
| S7.003 | S03-01-14 | 114.469 | 0.000 | 0.000 | 1.04 | | | 53.2 | OK |
| S6.003 | S03-01-15 | 114.401 | -0.028 | 0.000 | 1.00 | | | 128.2 | OK |
| S6.004 | S03-01-16 | 113.970 | -0.164 | 0.000 | 0.60 | | | 141.9 | OK |
| S6.005 | S03-01-17 | 112.980 | -0.169 | 0.000 | 0.58 | | | 146.4 | OK |
| S6.006 | S03-01-18 | 111.735 | -0.174 | 0.000 | 0.56 | | | 146.2 | OK |
| S8.000 | S03-01-1 | 115.821 | -0.204 | 0.000 | 0.02 | | | 1.3 | OK |
| S8.001 | S03-01-2 | 115.061 | -0.157 | 0.000 | 0.20 | | | 13.1 | OK |
| S8.002 | S03-01-3 | 114.498 | -0.085 | 0.000 | 0.69 | | | 26.1 | OK |
| S8.003 | S03-01-4 | 114.311 | -0.055 | 0.000 | 0.90 | | | 52.9 | OK |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| S4.000 | S03-01-20 | |
| S4.001 | S03-01-21 | |
| S4.002 | S03-01-22 | |
| S5.000 | S03-01-23 | |
| S4.003 | S23 | |
| S6.000 | S03-01-8 | |
| S6.001 | S03-01-9 | |
| S6.002 | S03-01-10 | |
| S7.000 | S03-01-11 | |
| S7.001 | S03-01-12 | |
| S7.002 | S03-01-13 | |
| S7.003 | S03-01-14 | |
| S6.003 | S03-01-15 | |
| S6.004 | S03-01-16 | |
| S6.005 | S03-01-17 | |
| S6.006 | S03-01-18 | |
| S8.000 | S03-01-1 | |
| S8.001 | S03-01-2 | |
| S8.002 | S03-01-3 | |
| S8.003 | S03-01-4 | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-1

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) |
|---|---|---|---|---|---|---|---|---|---|
| S8.004 | S03-01-5 | 15 Winter | 5 | +20% | | | | | 113.143 |
| S8.005 | S03-01-6 | 15 Winter | 5 | +20% | | | | | 111.752 |
| S8.006 | S03-01-7 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 111.595 |
| S6.007 | S24 | 15 Winter | 5 | +20% | | | | | 111.249 |
| S4.004 | S24 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 108.472 |

| PN | US/MH Name | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|
| S8.004 | S03-01-5 | -0.165 | 0.000 | 0.41 | | | 58.7 | OK | |
| S8.005 | S03-01-6 | -0.141 | 0.000 | 0.55 | | | 75.6 | OK | |
| S8.006 | S03-01-7 | 0.029 | 0.000 | 1.18 | | | 75.1 | SURCHARGED | |
| S6.007 | S24 | -0.213 | 0.000 | 0.39 | | | 219.0 | OK | |
| S4.004 | S24 | 0.138 | 0.000 | 1.94 | | | 231.6 | SURCHARGED | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Pond 3-2

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 15.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Time Area Diagram for Pond 3-2

| Time (mins) | Area (ha) | Time (mins) | Area (ha) | Time (mins) | Area (ha) | Time (mins) | Area (ha) |
|---|---|---|---|---|---|---|---|
| 0-4 | 0.849 | 4-8 | 1.592 | 8-12 | 0.514 | 12-16 | 0.041 |

Total Area Contributing (ha) = 2.996

Total Pipe Volume (m³) = 248.400

### Network Design Table for Pond 3-2

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S2.000 | 14.658 | 0.333 | 44.0 | 0.028 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S2.001 | 80.059 | 1.144 | 70.0 | 0.116 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S2.002 | 40.407 | 0.449 | 90.0 | 0.086 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S2.003 | 39.646 | 0.396 | 100.1 | 0.100 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S2.004 | 79.756 | 0.665 | 120.0 | 0.094 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S2.005 | 80.801 | 0.464 | 174.1 | 0.095 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S2.000 | 58.15 | 5.12 | 111.000 | 0.028 | 0.0 | 0.0 | 0.0 | 1.98 | 78.6 | 4.4 |
| S2.001 | 55.25 | 5.83 | 110.592 | 0.144 | 0.0 | 0.0 | 0.0 | 1.88 | 133.0 | 21.6 |
| S2.002 | 53.75 | 6.24 | 109.448 | 0.230 | 0.0 | 0.0 | 0.0 | 1.66 | 117.2 | 33.5 |
| S2.003 | 52.48 | 6.60 | 108.924 | 0.331 | 0.0 | 0.0 | 0.0 | 1.81 | 200.0 | 47.0 |
| S2.004 | 49.92 | 7.41 | 108.528 | 0.425 | 0.0 | 0.0 | 0.0 | 1.65 | 182.6 | 57.4 |
| S2.005 | 47.46 | 8.28 | 107.788 | 0.520 | 0.0 | 0.0 | 0.0 | 1.54 | 244.5 | 66.8 |

## Network Design Table for Pond 3-2

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S3.000 | 42.465 | 2.359 | 18.0 | 0.057 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S3.001 | 53.446 | 0.445 | 120.1 | 0.061 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| | | | | | | | | | | | |
| S4.000 | 57.456 | 1.149 | 50.0 | 0.091 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S4.001 | 38.315 | 0.697 | 55.0 | 0.059 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S4.002 | 79.773 | 0.997 | 80.0 | 0.174 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S4.003 | 30.107 | 0.151 | 200.0 | 0.041 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S4.004 | 59.821 | 0.299 | 200.0 | 0.077 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S4.005 | 35.043 | 0.175 | 200.2 | 0.049 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S4.006 | 34.866 | 0.200 | 174.3 | 0.074 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| | | | | | | | | | | | |
| S5.000 | 50.839 | 0.512 | 99.3 | 0.071 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S5.001 | 43.171 | 0.512 | 84.3 | 0.054 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S5.002 | 46.675 | 0.278 | 167.9 | 0.055 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S5.003 | 40.050 | 0.239 | 167.9 | 0.052 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S5.004 | 59.703 | 0.247 | 241.9 | 0.071 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S5.005 | 60.139 | 0.249 | 241.5 | 0.071 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S5.006 | 70.057 | 0.497 | 140.8 | 0.083 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S5.007 | 60.102 | 0.474 | 126.8 | 0.071 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S5.008 | 69.607 | 0.592 | 117.7 | 0.083 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S5.009 | 40.392 | 0.354 | 114.2 | 0.047 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S5.010 | 39.796 | 0.332 | 119.8 | 0.047 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S3.000 | 57.70 | 5.23 | 110.900 | 0.057 | 0.0 | 0.0 | 0.0 | 3.10 | 123.2 | 8.8 |
| S3.001 | 55.19 | 5.85 | 108.466 | 0.118 | 0.0 | 0.0 | 0.0 | 1.43 | 101.3 | 17.6 |
| | | | | | | | | | | |
| S4.000 | 56.50 | 5.52 | 111.300 | 0.091 | 0.0 | 0.0 | 0.0 | 1.85 | 73.7 | 14.0 |
| S4.001 | 55.31 | 5.82 | 110.076 | 0.151 | 0.0 | 0.0 | 0.0 | 2.13 | 150.2 | 22.6 |
| S4.002 | 52.93 | 6.47 | 109.304 | 0.325 | 0.0 | 0.0 | 0.0 | 2.03 | 223.9 | 46.5 |
| S4.003 | 51.61 | 6.87 | 108.307 | 0.366 | 0.0 | 0.0 | 0.0 | 1.28 | 141.1 | 51.1 |
| S4.004 | 49.22 | 7.65 | 108.156 | 0.443 | 0.0 | 0.0 | 0.0 | 1.28 | 141.1 | 59.0 |
| S4.005 | 48.08 | 8.05 | 107.782 | 0.492 | 0.0 | 0.0 | 0.0 | 1.43 | 227.9 | 64.0 |
| S4.006 | 47.17 | 8.40 | 107.532 | 0.566 | 0.0 | 0.0 | 0.0 | 1.69 | 366.6 | 72.3 |
| | | | | | | | | | | |
| S5.000 | 55.98 | 5.65 | 113.200 | 0.071 | 0.0 | 0.0 | 0.0 | 1.31 | 52.2 | 10.8 |
| S5.001 | 54.38 | 6.07 | 112.613 | 0.125 | 0.0 | 0.0 | 0.0 | 1.71 | 121.1 | 18.4 |
| S5.002 | 52.13 | 6.71 | 112.101 | 0.180 | 0.0 | 0.0 | 0.0 | 1.21 | 85.6 | 25.4 |
| S5.003 | 50.37 | 7.26 | 111.823 | 0.232 | 0.0 | 0.0 | 0.0 | 1.21 | 85.6 | 31.7 |
| S5.004 | 47.56 | 8.25 | 111.585 | 0.303 | 0.0 | 0.0 | 0.0 | 1.01 | 71.1 | 39.1 |
| S5.005 | 45.40 | 9.11 | 111.263 | 0.374 | 0.0 | 0.0 | 0.0 | 1.16 | 128.3 | 46.0 |
| S5.006 | 43.67 | 9.88 | 111.014 | 0.457 | 0.0 | 0.0 | 0.0 | 1.52 | 168.4 | 54.1 |
| S5.007 | 42.38 | 10.50 | 110.516 | 0.528 | 0.0 | 0.0 | 0.0 | 1.61 | 177.6 | 60.6 |
| S5.008 | 41.05 | 11.20 | 110.042 | 0.611 | 0.0 | 0.0 | 0.0 | 1.67 | 184.4 | 68.0 |
| S5.009 | 40.33 | 11.59 | 109.451 | 0.658 | 0.0 | 0.0 | 0.0 | 1.69 | 187.2 | 71.9 |
| S5.010 | 39.64 | 11.99 | 109.097 | 0.705 | 0.0 | 0.0 | 0.0 | 1.65 | 182.7 | 75.7 |

## Network Design Table for Pond 3-2

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S5.011 | 60.128 | 0.446 | 134.8 | 0.077 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S5.012 | 50.137 | 0.358 | 140.0 | 0.073 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S5.013 | 40.338 | 0.478 | 84.4 | 0.083 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S3.002 | 24.835 | 0.083 | 299.2 | 0.000 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| S6.000 | 60.294 | 0.670 | 90.0 | 0.072 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S6.001 | 59.984 | 0.500 | 120.0 | 0.080 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S6.002 | 59.996 | 0.600 | 100.0 | 0.072 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S6.003 | 60.114 | 0.401 | 149.9 | 0.071 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S6.004 | 59.749 | 0.478 | 125.0 | 0.071 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S6.005 | 70.047 | 0.584 | 120.0 | 0.083 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S6.006 | 60.021 | 0.500 | 120.0 | 0.071 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S6.007 | 70.053 | 0.584 | 120.0 | 0.083 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S6.008 | 69.987 | 0.467 | 149.9 | 0.083 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S6.009 | 53.500 | 0.535 | 100.0 | 0.083 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S6.010 | 46.543 | 0.274 | 170.0 | 0.061 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S6.011 | 59.757 | 0.658 | 90.8 | 0.024 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S2.006 | 21.261 | 0.170 | 125.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| S2.007 | 5.813 | 0.047 | 125.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S5.011 | 38.70 | 12.57 | 108.690 | 0.782 | 0.0 | 0.0 | 0.0 | 1.75 | 278.2 | 82.0 |
| S5.012 | 37.94 | 13.05 | 108.244 | 0.855 | 0.0 | 0.0 | 0.0 | 1.72 | 273.0 | 87.9 |
| S5.013 | 37.49 | 13.36 | 107.885 | 0.938 | 0.0 | 0.0 | 0.0 | 2.21 | 352.1 | 95.3 |
| S3.002 | 37.02 | 13.68 | 107.332 | 1.622 | 0.0 | 0.0 | 0.0 | 1.29 | 279.2 | 162.6 |
| S6.000 | 55.66 | 5.73 | 113.800 | 0.072 | 0.0 | 0.0 | 0.0 | 1.38 | 54.8 | 10.9 |
| S6.001 | 53.09 | 6.43 | 113.055 | 0.152 | 0.0 | 0.0 | 0.0 | 1.43 | 101.4 | 21.8 |
| S6.002 | 50.98 | 7.06 | 112.555 | 0.224 | 0.0 | 0.0 | 0.0 | 1.57 | 111.1 | 30.9 |
| S6.003 | 48.95 | 7.74 | 111.880 | 0.295 | 0.0 | 0.0 | 0.0 | 1.48 | 163.2 | 39.1 |
| S6.004 | 47.28 | 8.35 | 111.479 | 0.366 | 0.0 | 0.0 | 0.0 | 1.62 | 178.8 | 46.9 |
| S6.005 | 45.52 | 9.06 | 111.001 | 0.449 | 0.0 | 0.0 | 0.0 | 1.65 | 182.6 | 55.3 |
| S6.006 | 44.13 | 9.67 | 110.417 | 0.520 | 0.0 | 0.0 | 0.0 | 1.65 | 182.6 | 62.1 |
| S6.007 | 42.64 | 10.37 | 109.917 | 0.603 | 0.0 | 0.0 | 0.0 | 1.65 | 182.6 | 69.6 |
| S6.008 | 41.27 | 11.08 | 109.258 | 0.686 | 0.0 | 0.0 | 0.0 | 1.66 | 263.8 | 76.7 |
| S6.009 | 40.47 | 11.51 | 108.791 | 0.769 | 0.0 | 0.0 | 0.0 | 2.03 | 323.4 | 84.3 |
| S6.010 | 39.61 | 12.01 | 108.256 | 0.830 | 0.0 | 0.0 | 0.0 | 1.56 | 247.5 | 89.0 |
| S6.011 | 38.84 | 12.48 | 107.983 | 0.854 | 0.0 | 0.0 | 0.0 | 2.13 | 339.5 | 89.8 |
| S2.006 | 36.77 | 13.85 | 107.249 | 2.996 | 0.0 | 0.0 | 0.0 | 2.00 | 433.4 | 298.3 |
| S2.007 | 36.70 | 13.90 | 107.079 | 2.996 | 0.0 | 0.0 | 0.0 | 2.00 | 433.4 | 298.3 |

## Manhole Schedules for Pond 3-2

| **MH Name** | **MH CL (m)** | **MH Depth (m)** | **MH Connection** | **MH Diam.,L*W (mm)** | **PN** | **Pipe Out Invert Level (m)** | **Diameter (mm)** | **PN** |
|---|---|---|---|---|---|---|---|---|
| S03-02-1 | 112.516 | 1.516 | Open Manhole | 1200 | S2.000 | 111.000 | 225 | |
| S03-02-2 | 112.204 | 1.612 | Open Manhole | 1200 | S2.001 | 110.592 | 300 | S2.000 |
| S03-02-3 | 111.061 | 1.613 | Open Manhole | 1200 | S2.002 | 109.448 | 300 | S2.001 |
| S03-02-4 | 110.600 | 1.676 | Open Manhole | 1350 | S2.003 | 108.924 | 375 | S2.002 |
| S03-02-5 | 109.887 | 1.359 | Open Manhole | 1350 | S2.004 | 108.528 | 375 | S2.003 |
| S03-02-6 | 109.435 | 1.647 | Open Manhole | 1350 | S2.005 | 107.788 | 450 | S2.004 |
| S03-02-7 | 112.493 | 1.593 | Open Manhole | 1200 | S3.000 | 110.900 | 225 | |
| S03-02-8 | 110.084 | 1.618 | Open Manhole | 1200 | S3.001 | 108.466 | 300 | S3.000 |
| S03-02-9 | 112.834 | 1.534 | Open Manhole | 1200 | S4.000 | 111.300 | 225 | |
| S03-02-10 | 111.662 | 1.586 | Open Manhole | 1200 | S4.001 | 110.076 | 300 | S4.000 |
| S03-02-11 | 111.003 | 1.699 | Open Manhole | 1350 | S4.002 | 109.304 | 375 | S4.001 |
| S03-02-12 | 109.939 | 1.632 | Open Manhole | 1350 | S4.003 | 108.307 | 375 | S4.002 |
| S03-02-13 | 109.753 | 1.597 | Open Manhole | 1350 | S4.004 | 108.156 | 375 | S4.003 |
| S03-02-14 | 109.452 | 1.670 | Open Manhole | 1350 | S4.005 | 107.782 | 450 | S4.004 |
| S03-02-15 | 109.356 | 1.823 | Open Manhole | 1500 | S4.006 | 107.532 | 525 | S4.005 |
| S03-02-16 | 115.309 | 2.109 | Open Manhole | 1200 | S5.000 | 113.200 | 225 | |
| S03-02-17 | 114.724 | 2.111 | Open Manhole | 1200 | S5.001 | 112.613 | 300 | S5.000 |
| S03-02-18 | 114.328 | 2.227 | Open Manhole | 1200 | S5.002 | 112.101 | 300 | S5.001 |
| S03-02-19 | 113.954 | 2.131 | Open Manhole | 1200 | S5.003 | 111.823 | 300 | S5.002 |
| S03-02-20 | 113.640 | 2.056 | Open Manhole | 1200 | S5.004 | 111.585 | 300 | S5.003 |
| S03-02-21 | 113.150 | 1.887 | Open Manhole | 1350 | S5.005 | 111.263 | 375 | S5.004 |
| S03-02-22 | 112.670 | 1.656 | Open Manhole | 1350 | S5.006 | 111.014 | 375 | S5.005 |
| S03-02-23 | 112.092 | 1.575 | Open Manhole | 1350 | S5.007 | 110.516 | 375 | S5.006 |
| S03-02-24 | 111.618 | 1.575 | Open Manhole | 1350 | S5.008 | 110.042 | 375 | S5.007 |
| S03-02-25 | 111.026 | 1.575 | Open Manhole | 1350 | S5.009 | 109.451 | 375 | S5.008 |
| S03-02-26 | 110.672 | 1.575 | Open Manhole | 1350 | S5.010 | 109.097 | 375 | S5.009 |
| S03-02-27 | 110.340 | 1.650 | Open Manhole | 1350 | S5.011 | 108.690 | 450 | S5.010 |
| S03-02-28 | 109.894 | 1.651 | Open Manhole | 1350 | S5.012 | 108.244 | 450 | S5.011 |
| S03-02-29 | 109.600 | 1.715 | Open Manhole | 1350 | S5.013 | 107.885 | 450 | S5.012 |
| S0 03-02-30 | 109.417 | 2.084 | Open Manhole | 1500 | S3.002 | 107.332 | 525 | S3.001<br>S4.006<br>S5.013 |
| S03-02-31 | 115.373 | 1.573 | Open Manhole | 1200 | S6.000 | 113.800 | 225 | |
| S03-02-32 | 114.609 | 1.554 | Open Manhole | 1200 | S6.001 | 113.055 | 300 | S6.000 |
| S03-02-33 | 114.112 | 1.557 | Open Manhole | 1200 | S6.002 | 112.555 | 300 | S6.001 |
| S03-02-34 | 113.619 | 1.739 | Open Manhole | 1350 | S6.003 | 111.880 | 375 | S6.002 |
| S03-02-35 | 113.119 | 1.640 | Open Manhole | 1350 | S6.004 | 111.479 | 375 | S6.003 |
| S03-02-36 | 112.649 | 1.648 | Open Manhole | 1350 | S6.005 | 111.001 | 375 | S6.004 |

## Manhole Schedules for Pond 3-2

| **MH Name** | **MH CL (m)** | **MH Depth (m)** | **MH Connection** | **MH Diam.,L*W (mm)** | **PN** | **Pipe Out Invert Level (m)** | **Diameter (mm)** | **PN** | **Pipes In Invert Level (m)** | **Diameter (mm)** | **Back (m** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S03-02-37 | 112.055 | 1.638 | Open Manhole | 1350 | S6.006 | 110.417 | 375 | S6.005 | 110.417 | 375 | |
| S03-02-38 | 111.571 | 1.654 | Open Manhole | 1350 | S6.007 | 109.917 | 375 | S6.006 | 109.917 | 375 | |
| S03-02-39 | 111.003 | 1.744 | Open Manhole | 1350 | S6.008 | 109.258 | 450 | S6.007 | 109.333 | 375 | |
| S03-02-40 | 110.540 | 1.749 | Open Manhole | 1350 | S6.009 | 108.791 | 450 | S6.008 | 108.791 | 450 | |
| S03-02-41 | 109.979 | 1.723 | Open Manhole | 1350 | S6.010 | 108.256 | 450 | S6.009 | 108.256 | 450 | |
| S03-02-42 | 109.614 | 1.632 | Open Manhole | 1350 | S6.011 | 107.983 | 450 | S6.010 | 107.983 | 450 | |
| S03-02-43 | 109.352 | 2.103 | Open Manhole | 1500 | S2.006 | 107.249 | 525 | S2.005 | 107.324 | 450 | |
| | | | | | | | | S3.002 | 107.249 | 525 | |
| | | | | | | | | S6.011 | 107.324 | 450 | |
| S03-02-44 | 109.750 | 2.671 | Open Manhole | 1500 | S2.007 | 107.079 | 525 | S2.006 | 107.079 | 525 | |
| S | 108.765 | 1.733 | Open Manhole | 0 | | OUTFALL | | S2.007 | 107.033 | 525 | |

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S03-02-1 | 354670.238 | 528996.255 | 354670.238 | 528996.255 | Required |  |
| S03-02-2 | 354684.809 | 528997.856 | 354684.809 | 528997.856 | Required |  |
| S03-02-3 | 354764.785 | 528994.235 | 354764.785 | 528994.235 | Required |  |
| S03-02-4 | 354805.166 | 528992.798 | 354805.166 | 528992.798 | Required |  |
| S03-02-5 | 354844.812 | 528992.621 | 354844.812 | 528992.621 | Required |  |
| S03-02-6 | 354924.224 | 528985.226 | 354924.224 | 528985.226 | Required |  |
| S03-02-7 | 355010.655 | 528858.429 | 355010.655 | 528858.429 | Required |  |
| S03-02-8 | 355002.614 | 528900.126 | 355002.614 | 528900.126 | Required |  |
| S03-02-9 | 354668.554 | 528970.705 | 354668.554 | 528970.705 | Required |  |

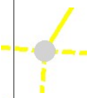
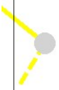
## Manhole Schedules for Pond 3-2

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S03-02-10 | 354725.758 | 528965.330 | 354725.758 | 528965.330 | Required |  |
| S03-02-11 | 354764.027 | 528963.457 | 354764.027 | 528963.457 | Required |  |
| S03-02-12 | 354843.711 | 528959.705 | 354843.711 | 528959.705 | Required |  |
| S03-02-13 | 354873.737 | 528961.927 | 354873.737 | 528961.927 | Required |  |
| S03-02-14 | 354933.377 | 528957.281 | 354933.377 | 528957.281 | Required |  |
| S03-02-15 | 354968.293 | 528954.287 | 354968.293 | 528954.287 | Required |  |
| S03-02-16 | 355733.067 | 528914.633 | 355733.067 | 528914.633 | Required |  |
| S03-02-17 | 355682.419 | 528919.036 | 355682.419 | 528919.036 | Required |  |
| S03-02-18 | 355639.463 | 528923.337 | 355639.463 | 528923.337 | Required |  |
| S03-02-19 | 355592.862 | 528925.975 | 355592.862 | 528925.975 | Required |  |
| S03-02-20 | 355552.877 | 528928.247 | 355552.877 | 528928.247 | Required |  |
| S03-02-21 | 355493.264 | 528931.524 | 355493.264 | 528931.524 | Required |  |
| S03-02-22 | 355433.201 | 528934.552 | 355433.201 | 528934.552 | Required |  |
| S03-02-23 | 355363.237 | 528938.175 | 355363.237 | 528938.175 | Required |  |
| S03-02-24 | 355303.210 | 528941.174 | 355303.210 | 528941.174 | Required |  |

## Manhole Schedules for Pond 3-2

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S03-02-25 | 355233.700 | 528944.860 | 355233.700 | 528944.860 | Required | |
| S03-02-26 | 355193.367 | 528947.051 | 355193.367 | 528947.051 | Required | |
| S03-02-27 | 355153.623 | 528949.075 | 355153.623 | 528949.075 | Required | |
| S03-02-28 | 355093.499 | 528949.755 | 355093.499 | 528949.755 | Required | |
| S03-02-29 | 355043.366 | 528950.411 | 355043.366 | 528950.411 | Required | |
| S0 03-02-30 | 355003.151 | 528953.569 | 355003.151 | 528953.569 | Required | |
| S03-02-31 | 355733.765 | 528940.032 | 355733.765 | 528940.032 | Required | |
| S03-02-32 | 355673.574 | 528943.551 | 355673.574 | 528943.551 | Required | |
| S03-02-33 | 355613.702 | 528947.202 | 355613.702 | 528947.202 | Required | |
| S03-02-34 | 355553.808 | 528950.712 | 355553.808 | 528950.712 | Required | |
| S03-02-35 | 355493.780 | 528953.932 | 355493.780 | 528953.932 | Required | |
| S03-02-36 | 355434.117 | 528957.134 | 355434.117 | 528957.134 | Required | |
| S03-02-37 | 355364.157 | 528960.634 | 355364.157 | 528960.634 | Required | |
| S03-02-38 | 355304.217 | 528963.758 | 355304.217 | 528963.758 | Required | |
| S03-02-39 | 355234.258 | 528967.387 | 355234.258 | 528967.387 | Required | |

## Manhole Schedules for Pond 3-2

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S03-02-40 | 355164.356 | 528970.856 | 355164.356 | 528970.856 | Required |  |
| S03-02-41 | 355110.916 | 528973.370 | 355110.916 | 528973.370 | Required |  |
| S03-02-42 | 355064.425 | 528975.574 | 355064.425 | 528975.574 | Required |  |
| S03-02-43 | 355004.733 | 528978.354 | 355004.733 | 528978.354 | Required |  |
| S03-02-44 | 355015.872 | 528996.464 | 355015.872 | 528996.464 | Required |  |
| S | 355011.337 | 529000.100 | | | No Entry |  |

## PIPELINE SCHEDULES for Pond 3-2

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S2.000 | o | 225 | S03-02-1 | 112.516 | 111.000 | 1.291 | Open Manhole | 1200 |
| S2.001 | o | 300 | S03-02-2 | 112.204 | 110.592 | 1.312 | Open Manhole | 1200 |
| S2.002 | o | 300 | S03-02-3 | 111.061 | 109.448 | 1.313 | Open Manhole | 1200 |
| S2.003 | o | 375 | S03-02-4 | 110.600 | 108.924 | 1.301 | Open Manhole | 1350 |
| S2.004 | o | 375 | S03-02-5 | 109.887 | 108.528 | 0.984 | Open Manhole | 1350 |
| S2.005 | o | 450 | S03-02-6 | 109.435 | 107.788 | 1.197 | Open Manhole | 1350 |
| S3.000 | o | 225 | S03-02-7 | 112.493 | 110.900 | 1.368 | Open Manhole | 1200 |
| S3.001 | o | 300 | S03-02-8 | 110.084 | 108.466 | 1.318 | Open Manhole | 1200 |
| S4.000 | o | 225 | S03-02-9 | 112.834 | 111.300 | 1.309 | Open Manhole | 1200 |
| S4.001 | o | 300 | S03-02-10 | 111.662 | 110.076 | 1.286 | Open Manhole | 1200 |
| S4.002 | o | 375 | S03-02-11 | 111.003 | 109.304 | 1.324 | Open Manhole | 1350 |
| S4.003 | o | 375 | S03-02-12 | 109.939 | 108.307 | 1.257 | Open Manhole | 1350 |
| S4.004 | o | 375 | S03-02-13 | 109.753 | 108.156 | 1.222 | Open Manhole | 1350 |
| S4.005 | o | 450 | S03-02-14 | 109.452 | 107.782 | 1.220 | Open Manhole | 1350 |
| S4.006 | o | 525 | S03-02-15 | 109.356 | 107.532 | 1.298 | Open Manhole | 1500 |
| S5.000 | o | 225 | S03-02-16 | 115.309 | 113.200 | 1.884 | Open Manhole | 1200 |
| S5.001 | o | 300 | S03-02-17 | 114.724 | 112.613 | 1.811 | Open Manhole | 1200 |
| S5.002 | o | 300 | S03-02-18 | 114.328 | 112.101 | 1.927 | Open Manhole | 1200 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|---|
| S2.000 | 14.658 | 44.0 | | S03-02-2 | 112.204 | 110.667 | 1.312 | Open Manhole | 1200 |
| S2.001 | 80.059 | 70.0 | | S03-02-3 | 111.061 | 109.448 | 1.313 | Open Manhole | 1200 |
| S2.002 | 40.407 | 90.0 | | S03-02-4 | 110.600 | 108.999 | 1.301 | Open Manhole | 1350 |
| S2.003 | 39.646 | 100.1 | | S03-02-5 | 109.887 | 108.528 | 0.984 | Open Manhole | 1350 |
| S2.004 | 79.756 | 120.0 | | S03-02-6 | 109.435 | 107.863 | 1.197 | Open Manhole | 1350 |
| S2.005 | 80.801 | 174.1 | | S03-02-43 | 109.352 | 107.324 | 1.578 | Open Manhole | 1500 |
| S3.000 | 42.465 | 18.0 | | S03-02-8 | 110.084 | 108.541 | 1.318 | Open Manhole | 1200 |
| S3.001 | 53.446 | 120.1 | SO | 03-02-30 | 109.417 | 108.021 | 1.096 | Open Manhole | 1500 |
| S4.000 | 57.456 | 50.0 | | S03-02-10 | 111.662 | 110.151 | 1.286 | Open Manhole | 1200 |
| S4.001 | 38.315 | 55.0 | | S03-02-11 | 111.003 | 109.379 | 1.324 | Open Manhole | 1350 |
| S4.002 | 79.773 | 80.0 | | S03-02-12 | 109.939 | 108.307 | 1.257 | Open Manhole | 1350 |
| S4.003 | 30.107 | 200.0 | | S03-02-13 | 109.753 | 108.156 | 1.222 | Open Manhole | 1350 |
| S4.004 | 59.821 | 200.0 | | S03-02-14 | 109.452 | 107.857 | 1.220 | Open Manhole | 1350 |
| S4.005 | 35.043 | 200.2 | | S03-02-15 | 109.356 | 107.607 | 1.298 | Open Manhole | 1500 |
| S4.006 | 34.866 | 174.3 | SO | 03-02-30 | 109.417 | 107.332 | 1.559 | Open Manhole | 1500 |
| S5.000 | 50.839 | 99.3 | | S03-02-17 | 114.724 | 112.688 | 1.811 | Open Manhole | 1200 |
| S5.001 | 43.171 | 84.3 | | S03-02-18 | 114.328 | 112.101 | 1.927 | Open Manhole | 1200 |
| S5.002 | 46.675 | 167.9 | | S03-02-19 | 113.954 | 111.823 | 1.831 | Open Manhole | 1200 |

## PIPELINE SCHEDULES for Pond 3-2

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S5.003 | o | 300 | S03-02-19 | 113.954 | 111.823 | 1.831 | Open Manhole | 1200 |
| S5.004 | o | 300 | S03-02-20 | 113.640 | 111.585 | 1.756 | Open Manhole | 1200 |
| S5.005 | o | 375 | S03-02-21 | 113.150 | 111.263 | 1.512 | Open Manhole | 1350 |
| S5.006 | o | 375 | S03-02-22 | 112.670 | 111.014 | 1.281 | Open Manhole | 1350 |
| S5.007 | o | 375 | S03-02-23 | 112.092 | 110.516 | 1.200 | Open Manhole | 1350 |
| S5.008 | o | 375 | S03-02-24 | 111.618 | 110.042 | 1.200 | Open Manhole | 1350 |
| S5.009 | o | 375 | S03-02-25 | 111.026 | 109.451 | 1.200 | Open Manhole | 1350 |
| S5.010 | o | 375 | S03-02-26 | 110.672 | 109.097 | 1.200 | Open Manhole | 1350 |
| S5.011 | o | 450 | S03-02-27 | 110.340 | 108.690 | 1.200 | Open Manhole | 1350 |
| S5.012 | o | 450 | S03-02-28 | 109.894 | 108.244 | 1.201 | Open Manhole | 1350 |
| S5.013 | o | 450 | S03-02-29 | 109.600 | 107.885 | 1.265 | Open Manhole | 1350 |
| S3.002 | o | 525 SO | 03-02-30 | 109.417 | 107.332 | 1.559 | Open Manhole | 1500 |
| S6.000 | o | 225 | S03-02-31 | 115.373 | 113.800 | 1.348 | Open Manhole | 1200 |
| S6.001 | o | 300 | S03-02-32 | 114.609 | 113.055 | 1.254 | Open Manhole | 1200 |
| S6.002 | o | 300 | S03-02-33 | 114.112 | 112.555 | 1.257 | Open Manhole | 1200 |
| S6.003 | o | 375 | S03-02-34 | 113.619 | 111.880 | 1.364 | Open Manhole | 1350 |
| S6.004 | o | 375 | S03-02-35 | 113.119 | 111.479 | 1.265 | Open Manhole | 1350 |
| S6.005 | o | 375 | S03-02-36 | 112.649 | 111.001 | 1.273 | Open Manhole | 1350 |
| S6.006 | o | 375 | S03-02-37 | 112.055 | 110.417 | 1.263 | Open Manhole | 1350 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S5.003 | 40.050 | 167.9 | S03-02-20 | 113.640 | 111.585 | 1.756 | Open Manhole | 1200 |
| S5.004 | 59.703 | 241.9 | S03-02-21 | 113.150 | 111.338 | 1.512 | Open Manhole | 1350 |
| S5.005 | 60.139 | 241.5 | S03-02-22 | 112.670 | 111.014 | 1.281 | Open Manhole | 1350 |
| S5.006 | 70.057 | 140.8 | S03-02-23 | 112.092 | 110.516 | 1.200 | Open Manhole | 1350 |
| S5.007 | 60.102 | 126.8 | S03-02-24 | 111.618 | 110.042 | 1.200 | Open Manhole | 1350 |
| S5.008 | 69.607 | 117.7 | S03-02-25 | 111.026 | 109.451 | 1.200 | Open Manhole | 1350 |
| S5.009 | 40.392 | 114.2 | S03-02-26 | 110.672 | 109.097 | 1.200 | Open Manhole | 1350 |
| S5.010 | 39.796 | 119.8 | S03-02-27 | 110.340 | 108.765 | 1.200 | Open Manhole | 1350 |
| S5.011 | 60.128 | 134.8 | S03-02-28 | 109.894 | 108.244 | 1.201 | Open Manhole | 1350 |
| S5.012 | 50.137 | 140.0 | S03-02-29 | 109.600 | 107.885 | 1.265 | Open Manhole | 1350 |
| S5.013 | 40.338 | 84.4 SO | 03-02-30 | 109.417 | 107.408 | 1.559 | Open Manhole | 1500 |
| S3.002 | 24.835 | 299.2 | S03-02-43 | 109.352 | 107.249 | 1.578 | Open Manhole | 1500 |
| S6.000 | 60.294 | 90.0 | S03-02-32 | 114.609 | 113.130 | 1.254 | Open Manhole | 1200 |
| S6.001 | 59.984 | 120.0 | S03-02-33 | 114.112 | 112.555 | 1.257 | Open Manhole | 1200 |
| S6.002 | 59.996 | 100.0 | S03-02-34 | 113.619 | 111.955 | 1.364 | Open Manhole | 1350 |
| S6.003 | 60.114 | 149.9 | S03-02-35 | 113.119 | 111.479 | 1.265 | Open Manhole | 1350 |
| S6.004 | 59.749 | 125.0 | S03-02-36 | 112.649 | 111.001 | 1.273 | Open Manhole | 1350 |
| S6.005 | 70.047 | 120.0 | S03-02-37 | 112.055 | 110.417 | 1.263 | Open Manhole | 1350 |
| S6.006 | 60.021 | 120.0 | S03-02-38 | 111.571 | 109.917 | 1.279 | Open Manhole | 1350 |

## PIPELINE SCHEDULES for Pond 3-2

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S6.007 | o | 375 | S03-02-38 | 111.571 | 109.917 | 1.279 | Open Manhole | 1350 |
| S6.008 | o | 450 | S03-02-39 | 111.003 | 109.258 | 1.294 | Open Manhole | 1350 |
| S6.009 | o | 450 | S03-02-40 | 110.540 | 108.791 | 1.299 | Open Manhole | 1350 |
| S6.010 | o | 450 | S03-02-41 | 109.979 | 108.256 | 1.273 | Open Manhole | 1350 |
| S6.011 | o | 450 | S03-02-42 | 109.614 | 107.983 | 1.182 | Open Manhole | 1350 |
| S2.006 | o | 525 | S03-02-43 | 109.352 | 107.249 | 1.578 | Open Manhole | 1500 |
| S2.007 | o | 525 | S03-02-44 | 109.750 | 107.079 | 2.146 | Open Manhole | 1500 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S6.007 | 70.053 | 120.0 | S03-02-39 | 111.003 | 109.333 | 1.294 | Open Manhole | 1350 |
| S6.008 | 69.987 | 149.9 | S03-02-40 | 110.540 | 108.791 | 1.299 | Open Manhole | 1350 |
| S6.009 | 53.500 | 100.0 | S03-02-41 | 109.979 | 108.256 | 1.273 | Open Manhole | 1350 |
| S6.010 | 46.543 | 170.0 | S03-02-42 | 109.614 | 107.983 | 1.182 | Open Manhole | 1350 |
| S6.011 | 59.757 | 90.8 | S03-02-43 | 109.352 | 107.324 | 1.578 | Open Manhole | 1500 |
| S2.006 | 21.261 | 125.0 | S03-02-44 | 109.750 | 107.079 | 2.146 | Open Manhole | 1500 |
| S2.007 | 5.813 | 125.0 | S | 108.765 | 107.033 | 1.208 | Open Manhole | 0 |

## Area Summary for Pond 3-2

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 2.000 | User | - | 100 | 0.026 | 0.026 | 0.026 |
| | User | - | 50 | 0.004 | 0.002 | 0.028 |
| 2.001 | - | - | 100 | 0.116 | 0.116 | 0.116 |
| 2.002 | - | - | 100 | 0.086 | 0.086 | 0.086 |
| 2.003 | User | - | 100 | 0.094 | 0.094 | 0.094 |
| | User | - | 50 | 0.014 | 0.007 | 0.100 |
| 2.004 | - | - | 100 | 0.094 | 0.094 | 0.094 |
| 2.005 | - | - | 100 | 0.095 | 0.095 | 0.095 |
| 3.000 | User | - | 100 | 0.036 | 0.036 | 0.036 |
| | User | - | 50 | 0.011 | 0.005 | 0.041 |
| | User | - | 25 | 0.035 | 0.009 | 0.050 |
| | User | - | 50 | 0.011 | 0.005 | 0.056 |
| | User | - | 25 | 0.004 | 0.001 | 0.057 |
| 3.001 | User | - | 100 | 0.040 | 0.040 | 0.040 |
| | User | - | 50 | 0.012 | 0.006 | 0.046 |
| | User | - | 25 | 0.027 | 0.007 | 0.053 |
| | User | - | 50 | 0.010 | 0.005 | 0.058 |
| | User | - | 25 | 0.013 | 0.003 | 0.061 |
| 4.000 | User | - | 100 | 0.083 | 0.083 | 0.083 |
| | User | - | 50 | 0.016 | 0.008 | 0.091 |
| 4.001 | User | - | 100 | 0.059 | 0.059 | 0.059 |
| 4.002 | - | - | 100 | 0.174 | 0.174 | 0.174 |
| 4.003 | - | - | 100 | 0.041 | 0.041 | 0.041 |
| 4.004 | - | - | 100 | 0.077 | 0.077 | 0.077 |
| 4.005 | - | - | 100 | 0.049 | 0.049 | 0.049 |
| 4.006 | - | - | 100 | 0.074 | 0.074 | 0.074 |
| 5.000 | - | - | 100 | 0.071 | 0.071 | 0.071 |
| 5.001 | - | - | 100 | 0.054 | 0.054 | 0.054 |
| 5.002 | - | - | 100 | 0.055 | 0.055 | 0.055 |
| 5.003 | User | - | 100 | 0.047 | 0.047 | 0.047 |
| | User | - | 50 | 0.011 | 0.005 | 0.052 |
| 5.004 | - | - | 100 | 0.071 | 0.071 | 0.071 |
| 5.005 | - | - | 100 | 0.071 | 0.071 | 0.071 |
| 5.006 | - | - | 100 | 0.083 | 0.083 | 0.083 |
| 5.007 | - | - | 100 | 0.071 | 0.071 | 0.071 |
| 5.008 | - | - | 100 | 0.083 | 0.083 | 0.083 |
| 5.009 | - | - | 100 | 0.047 | 0.047 | 0.047 |
| 5.010 | - | - | 100 | 0.047 | 0.047 | 0.047 |
| 5.011 | - | - | 100 | 0.077 | 0.077 | 0.077 |
| 5.012 | - | - | 100 | 0.073 | 0.073 | 0.073 |
| 5.013 | - | - | 100 | 0.083 | 0.083 | 0.083 |
| 3.002 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 6.000 | - | - | 100 | 0.072 | 0.072 | 0.072 |
| 6.001 | User | - | 100 | 0.072 | 0.072 | 0.072 |
| | User | - | 50 | 0.016 | 0.008 | 0.080 |
| 6.002 | - | - | 100 | 0.072 | 0.072 | 0.072 |
| 6.003 | - | - | 100 | 0.071 | 0.071 | 0.071 |
| 6.004 | - | - | 100 | 0.071 | 0.071 | 0.071 |
| 6.005 | - | - | 100 | 0.083 | 0.083 | 0.083 |
| 6.006 | - | - | 100 | 0.071 | 0.071 | 0.071 |
| 6.007 | - | - | 100 | 0.083 | 0.083 | 0.083 |

## Area Summary for Pond 3-2

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 6.008 | - | - | 100 | 0.083 | 0.083 | 0.083 |
| 6.009 | - | - | 100 | 0.083 | 0.083 | 0.083 |
| 6.010 | - | - | 100 | 0.061 | 0.061 | 0.061 |
| 6.011 | - | - | 100 | 0.024 | 0.024 | 0.024 |
| 2.006 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 2.007 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total<br>3.107 | Total<br>2.996 | Total<br>2.996 |

## Free Flowing Outfall Details for Pond 3-2

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| S2.007 | S | 108.765 | 107.033 | 0.000 | 0 | 0 |

## Simulation Criteria for Pond 3-2

| | | | |
|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Additional Flow - % of Total Flow | 40.000 |
| Areal Reduction Factor | 1.000 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start (mins) | 0 | Inlet Coeffiecient | 0.800 |
| Hot Start Level (mm) | 0 | Flow per Person per Day (l/per/day) | 0.000 |
| Manhole Headloss Coeff (Global) | 0.500 | Run Time (mins) | 60 |
| Foul Sewage per hectare (l/s) | 0.000 | Output Interval (mins) | 1 |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

## Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Profile Type | Summer |
| Return Period (years) | 5 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.300 | Storm Duration (mins) | 30 |
| Ratio R | 0.300 | | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-2

```
                            Simulation Criteria
           Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 40.000
                 Hot Start (mins)     0       MADD Factor * 10m³/ha Storage  2.000
               Hot Start Level (mm)     0              Inlet Coeffiecient  0.800
  Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day)  0.000
    Foul Sewage per hectare (l/s) 0.000

            Number of Input Hydrographs 0 Number of Storage Structures 0
              Number of Online Controls 0 Number of Time/Area Diagrams 0
             Number of Offline Controls 0 Number of Real Time Controls 0

                          Synthetic Rainfall Details
                 Rainfall Model               FSR      Ratio R 0.300
                        Region England and Wales Cv (Summer) 0.750
                     M5-60 (mm)            15.000 Cv (Winter) 0.840

           Margin for Flood Risk Warning (mm)  300.0     DVD Status OFF
                            Analysis Timestep  Fine Inertia Status OFF
                                   DTS Status    ON


                     Profile(s)                       Summer and Winter
                Duration(s) (mins)    15, 30, 60, 120, 180, 240, 360, 480, 600,
                                        720, 960, 1440, 2160, 2880, 4320, 5760,
                                                             7200, 8640, 10080
          Return Period(s) (years)                                          5
                Climate Change (%)                                         20
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| S2.000 | S03-02-1 | 15 Winter | 5 | +20% | | | | |
| S2.001 | S03-02-2 | 15 Winter | 5 | +20% | | | | |
| S2.002 | S03-02-3 | 15 Winter | 5 | +20% | | | | |
| S2.003 | S03-02-4 | 15 Winter | 5 | +20% | | | | |
| S2.004 | S03-02-5 | 15 Winter | 5 | +20% | | | | |
| S2.005 | S03-02-6 | 30 Winter | 5 | +20% | | | | |
| S3.000 | S03-02-7 | 15 Winter | 5 | +20% | | | | |
| S3.001 | S03-02-8 | 15 Winter | 5 | +20% | | | | |
| S4.000 | S03-02-9 | 15 Winter | 5 | +20% | | | | |
| S4.001 | S03-02-10 | 15 Winter | 5 | +20% | | | | |
| S4.002 | S03-02-11 | 15 Winter | 5 | +20% | | | | |
| S4.003 | S03-02-12 | 15 Winter | 5 | +20% | | | | |
| S4.004 | S03-02-13 | 15 Winter | 5 | +20% | | | | |
| S4.005 | S03-02-14 | 30 Winter | 5 | +20% | 5/15 Winter | | | |
| S4.006 | S03-02-15 | 30 Winter | 5 | +20% | 5/15 Summer | | | |
| S5.000 | S03-02-16 | 15 Winter | 5 | +20% | | | | |
| S5.001 | S03-02-17 | 15 Winter | 5 | +20% | | | | |
| S5.002 | S03-02-18 | 15 Winter | 5 | +20% | | | | |
| S5.003 | S03-02-19 | 15 Winter | 5 | +20% | | | | |
| S5.004 | S03-02-20 | 15 Winter | 5 | +20% | | | | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-2

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S2.000 | S03-02-1 | 111.049 | -0.176 | 0.000 | 0.11 | | | 7.5 | OK |
| S2.001 | S03-02-2 | 110.697 | -0.195 | 0.000 | 0.26 | | | 33.1 | OK |
| S2.002 | S03-02-3 | 109.595 | -0.153 | 0.000 | 0.48 | | | 51.8 | OK |
| S2.003 | S03-02-4 | 109.090 | -0.209 | 0.000 | 0.40 | | | 73.1 | OK |
| S2.004 | S03-02-5 | 108.725 | -0.178 | 0.000 | 0.53 | | | 91.3 | OK |
| S2.005 | S03-02-6 | 108.196 | -0.042 | 0.000 | 0.41 | | | 94.0 | OK |
| S3.000 | S03-02-7 | 110.954 | -0.171 | 0.000 | 0.13 | | | 15.1 | OK |
| S3.001 | S03-02-8 | 108.579 | -0.187 | 0.000 | 0.30 | | | 29.1 | OK |
| S4.000 | S03-02-9 | 111.391 | -0.134 | 0.000 | 0.34 | | | 23.9 | OK |
| S4.001 | S03-02-10 | 110.182 | -0.194 | 0.000 | 0.27 | | | 37.3 | OK |
| S4.002 | S03-02-11 | 109.460 | -0.219 | 0.000 | 0.35 | | | 75.0 | OK |
| S4.003 | S03-02-12 | 108.533 | -0.149 | 0.000 | 0.67 | | | 83.2 | OK |
| S4.004 | S03-02-13 | 108.399 | -0.133 | 0.000 | 0.73 | | | 96.5 | OK |
| S4.005 | S03-02-14 | 108.286 | 0.054 | 0.000 | 0.43 | | | 85.5 | SURCHARGED |
| S4.006 | S03-02-15 | 108.256 | 0.198 | 0.000 | 0.25 | | | 78.2 | SURCHARGED |
| S5.000 | S03-02-16 | 113.296 | -0.129 | 0.000 | 0.37 | | | 18.5 | OK |
| S5.001 | S03-02-17 | 112.719 | -0.194 | 0.000 | 0.27 | | | 30.5 | OK |
| S5.002 | S03-02-18 | 112.256 | -0.145 | 0.000 | 0.52 | | | 41.7 | OK |
| S5.003 | S03-02-19 | 112.003 | -0.120 | 0.000 | 0.66 | | | 52.1 | OK |
| S5.004 | S03-02-20 | 111.821 | -0.064 | 0.000 | 0.94 | | | 63.6 | OK |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| S2.000 | S03-02-1 | |
| S2.001 | S03-02-2 | |
| S2.002 | S03-02-3 | |
| S2.003 | S03-02-4 | |
| S2.004 | S03-02-5 | |
| S2.005 | S03-02-6 | |
| S3.000 | S03-02-7 | |
| S3.001 | S03-02-8 | |
| S4.000 | S03-02-9 | |
| S4.001 | S03-02-10 | |
| S4.002 | S03-02-11 | |
| S4.003 | S03-02-12 | |
| S4.004 | S03-02-13 | |
| S4.005 | S03-02-14 | |
| S4.006 | S03-02-15 | |
| S5.000 | S03-02-16 | |
| S5.001 | S03-02-17 | |
| S5.002 | S03-02-18 | |
| S5.003 | S03-02-19 | |
| S5.004 | S03-02-20 | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-2

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood |
|---|---|---|---|---|---|---|
| S5.005 | S03-02-21 | 15 Winter | 5 | +20% | | |
| S5.006 | S03-02-22 | 15 Winter | 5 | +20% | | |
| S5.007 | S03-02-23 | 15 Winter | 5 | +20% | | |
| S5.008 | S03-02-24 | 15 Winter | 5 | +20% | | |
| S5.009 | S03-02-25 | 15 Winter | 5 | +20% | | |
| S5.010 | S03-02-26 | 15 Winter | 5 | +20% | | |
| S5.011 | S03-02-27 | 30 Winter | 5 | +20% | | |
| S5.012 | S03-02-28 | 30 Winter | 5 | +20% | | |
| S5.013 | S03-02-29 | 30 Winter | 5 | +20% | | |
| S3.002 | S0 03-02-30 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S6.000 | S03-02-31 | 15 Winter | 5 | +20% | | |
| S6.001 | S03-02-32 | 15 Winter | 5 | +20% | | |
| S6.002 | S03-02-33 | 15 Winter | 5 | +20% | | |
| S6.003 | S03-02-34 | 15 Winter | 5 | +20% | | |
| S6.004 | S03-02-35 | 15 Winter | 5 | +20% | | |
| S6.005 | S03-02-36 | 15 Winter | 5 | +20% | | |
| S6.006 | S03-02-37 | 15 Winter | 5 | +20% | | |
| S6.007 | S03-02-38 | 15 Winter | 5 | +20% | | |
| S6.008 | S03-02-39 | 15 Winter | 5 | +20% | | |
| S6.009 | S03-02-40 | 15 Winter | 5 | +20% | | |
| S6.010 | S03-02-41 | 15 Winter | 5 | +20% | | |
| S6.011 | S03-02-42 | 30 Winter | 5 | +20% | | |
| S2.006 | S03-02-43 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S2.007 | S03-02-44 | 30 Winter | 5 | +20% | 5/15 Summer | |

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume ($m^3$) |
|---|---|---|---|---|---|---|
| S5.005 | S03-02-21 | | | 111.480 | -0.158 | 0.000 |
| S5.006 | S03-02-22 | | | 111.212 | -0.176 | 0.000 |
| S5.007 | S03-02-23 | | | 110.722 | -0.169 | 0.000 |
| S5.008 | S03-02-24 | | | 110.256 | -0.162 | 0.000 |
| S5.009 | S03-02-25 | | | 109.672 | -0.153 | 0.000 |
| S5.010 | S03-02-26 | | | 109.330 | -0.142 | 0.000 |
| S5.011 | S03-02-27 | | | 108.913 | -0.227 | 0.000 |
| S5.012 | S03-02-28 | | | 108.480 | -0.214 | 0.000 |
| S5.013 | S03-02-29 | | | 108.324 | -0.011 | 0.000 |
| S3.002 | S0 03-02-30 | | | 108.232 | 0.375 | 0.000 |
| S6.000 | S03-02-31 | | | 113.894 | -0.131 | 0.000 |
| S6.001 | S03-02-32 | | | 113.183 | -0.172 | 0.000 |
| S6.002 | S03-02-33 | | | 112.703 | -0.152 | 0.000 |
| S6.003 | S03-02-34 | | | 112.052 | -0.203 | 0.000 |
| S6.004 | S03-02-35 | | | 111.660 | -0.194 | 0.000 |
| S6.005 | S03-02-36 | | | 111.198 | -0.178 | 0.000 |
| S6.006 | S03-02-37 | | | 110.629 | -0.164 | 0.000 |
| S6.007 | S03-02-38 | | | 110.143 | -0.149 | 0.000 |
| S6.008 | S03-02-39 | | | 109.488 | -0.220 | 0.000 |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-2

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|---|---|---|---|---|---|---|
| S6.009 | S03-02-40 | | | 109.007 | -0.235 | 0.000 |
| S6.010 | S03-02-41 | | | 108.519 | -0.187 | 0.000 |
| S6.011 | S03-02-42 | | | 108.278 | -0.155 | 0.000 |
| S2.006 | S03-02-43 | | | 108.152 | 0.378 | 0.000 |
| S2.007 | S03-02-44 | | | 107.842 | 0.237 | 0.000 |

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|
| S5.005 | S03-02-21 | 0.62 | | | 74.5 | OK |
| S5.006 | S03-02-22 | 0.54 | | | 86.0 | OK |
| S5.007 | S03-02-23 | 0.58 | | | 95.7 | OK |
| S5.008 | S03-02-24 | 0.61 | | | 105.9 | OK |
| S5.009 | S03-02-25 | 0.65 | | | 111.1 | OK |
| S5.010 | S03-02-26 | 0.70 | | | 116.2 | OK |
| S5.011 | S03-02-27 | 0.49 | | | 125.4 | OK |
| S5.012 | S03-02-28 | 0.54 | | | 134.0 | OK |
| S5.013 | S03-02-29 | 0.45 | | | 139.5 | OK |
| S3.002 | S0 03-02-30 | 0.98 | | | 221.9 | SURCHARGED |
| S6.000 | S03-02-31 | 0.35 | | | 18.7 | OK |
| S6.001 | S03-02-32 | 0.37 | | | 35.7 | OK |
| S6.002 | S03-02-33 | 0.48 | | | 50.6 | OK |
| S6.003 | S03-02-34 | 0.42 | | | 64.2 | OK |
| S6.004 | S03-02-35 | 0.46 | | | 77.3 | OK |
| S6.005 | S03-02-36 | 0.53 | | | 91.1 | OK |
| S6.006 | S03-02-37 | 0.60 | | | 102.6 | OK |
| S6.007 | S03-02-38 | 0.66 | | | 114.3 | OK |
| S6.008 | S03-02-39 | 0.51 | | | 125.4 | OK |
| S6.009 | S03-02-40 | 0.46 | | | 135.9 | OK |
| S6.010 | S03-02-41 | 0.64 | | | 142.3 | OK |
| S6.011 | S03-02-42 | 0.43 | | | 136.0 | OK |
| S2.006 | S03-02-43 | 1.35 | | | 427.4 | SURCHARGED |
| S2.007 | S03-02-44 | 1.77 | | | 427.3 | SURCHARGED |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| S5.005 | S03-02-21 | |
| S5.006 | S03-02-22 | |
| S5.007 | S03-02-23 | |
| S5.008 | S03-02-24 | |
| S5.009 | S03-02-25 | |
| S5.010 | S03-02-26 | |
| S5.011 | S03-02-27 | |
| S5.012 | S03-02-28 | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-2

| **PN** | **US/MH Name** | **Level Exceeded** |
|---|---|---|
| S5.013 | S03-02-29 | |
| S3.002 | S0 03-02-30 | |
| S6.000 | S03-02-31 | |
| S6.001 | S03-02-32 | |
| S6.002 | S03-02-33 | |
| S6.003 | S03-02-34 | |
| S6.004 | S03-02-35 | |
| S6.005 | S03-02-36 | |
| S6.006 | S03-02-37 | |
| S6.007 | S03-02-38 | |
| S6.008 | S03-02-39 | |
| S6.009 | S03-02-40 | |
| S6.010 | S03-02-41 | |
| S6.011 | S03-02-42 | |
| S2.006 | S03-02-43 | |
| S2.007 | S03-02-44 | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Pond 3-3

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 15.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Time Area Diagram for Pond 3-3

| Time (mins) | Area (ha) | Time (mins) | Area (ha) | Time (mins) | Area (ha) |
|---|---|---|---|---|---|
| 0-4 | 0.964 | 4-8 | 1.405 | 8-12 | 0.266 |

Total Area Contributing (ha) = 2.635

Total Pipe Volume (m³) = 151.730

### Network Design Table for Pond 3-3

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 30.895 | 0.576 | 53.6 | 0.071 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S1.001 | 65.515 | 1.241 | 52.8 | 0.141 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S1.002 | 64.275 | 0.496 | 129.6 | 0.109 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.003 | 59.877 | 0.641 | 93.4 | 0.087 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.004 | 40.058 | 0.571 | 70.2 | 0.054 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.005 | 69.790 | 1.009 | 69.2 | 0.101 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.006 | 70.144 | 1.604 | 43.7 | 0.106 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 57.45 | 5.29 | 129.600 | 0.071 | 0.0 | 0.0 | 0.0 | 1.79 | 71.2 | 11.0 |
| S1.001 | 55.02 | 5.89 | 129.024 | 0.212 | 0.0 | 0.0 | 0.0 | 1.80 | 71.7 | 31.6 |
| S1.002 | 52.26 | 6.67 | 127.708 | 0.321 | 0.0 | 0.0 | 0.0 | 1.38 | 97.5 | 45.4 |
| S1.003 | 50.30 | 7.28 | 127.212 | 0.408 | 0.0 | 0.0 | 0.0 | 1.63 | 115.0 | 55.6 |
| S1.004 | 49.25 | 7.64 | 126.571 | 0.462 | 0.0 | 0.0 | 0.0 | 1.88 | 132.9 | 61.6 |
| S1.005 | 47.55 | 8.25 | 126.000 | 0.563 | 0.0 | 0.0 | 0.0 | 1.89 | 133.8 | 72.5 |
| S1.006 | 46.29 | 8.74 | 124.991 | 0.669 | 0.0 | 0.0 | 0.0 | 2.38 | 168.5 | 83.9 |

## Network Design Table for Pond 3-3

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.007 | 70.232 | 1.959 | 35.9 | 0.116 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.008 | 60.373 | 1.415 | 42.7 | 0.074 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S1.009 | 47.991 | 1.548 | 31.0 | 0.096 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S1.010 | 43.916 | 1.717 | 25.6 | 0.089 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S2.000 | 35.081 | 1.403 | 25.0 | 0.042 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S2.001 | 27.992 | 0.350 | 80.0 | 0.029 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.002 | 31.028 | 0.124 | 250.2 | 0.033 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.011 | 42.626 | 0.468 | 91.0 | 0.080 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S1.012 | 41.964 | 1.345 | 31.2 | 0.071 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S1.013 | 36.725 | 0.596 | 61.6 | 0.062 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S1.014 | 29.789 | 0.745 | 40.0 | 0.045 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔒 |
| S3.000 | 60.721 | 1.035 | 58.7 | 0.091 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S3.001 | 70.118 | 1.022 | 68.6 | 0.092 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S3.002 | 59.887 | 0.605 | 99.0 | 0.079 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S3.003 | 69.945 | 0.940 | 74.4 | 0.096 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| S3.004 | 70.122 | 1.195 | 58.7 | 0.104 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S3.005 | 79.478 | 1.655 | 48.0 | 0.119 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S3.006 | 70.191 | 1.722 | 40.8 | 0.094 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S3.007 | 59.534 | 1.869 | 31.9 | 0.091 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.007 | 45.22 | 9.19 | 123.387 | 0.785 | 0.0 | 0.0 | 0.0 | 2.63 | 186.2 | 96.1 |
| S1.008 | 44.39 | 9.55 | 121.353 | 0.859 | 0.0 | 0.0 | 0.0 | 2.78 | 307.1 | 103.3 |
| S1.009 | 43.85 | 9.79 | 119.938 | 0.955 | 0.0 | 0.0 | 0.0 | 3.26 | 360.5 | 113.4 |
| S1.010 | 43.42 | 10.00 | 118.390 | 1.044 | 0.0 | 0.0 | 0.0 | 3.60 | 397.1 | 122.8 |
| S2.000 | 57.72 | 5.22 | 118.700 | 0.042 | 0.0 | 0.0 | 0.0 | 2.63 | 104.5 | 6.6 |
| S2.001 | 56.40 | 5.54 | 117.297 | 0.071 | 0.0 | 0.0 | 0.0 | 1.46 | 58.2 | 10.8 |
| S2.002 | 54.38 | 6.06 | 116.872 | 0.104 | 0.0 | 0.0 | 0.0 | 0.99 | 69.9 | 15.3 |
| S1.011 | 42.64 | 10.37 | 116.673 | 1.228 | 0.0 | 0.0 | 0.0 | 1.90 | 209.9 | 141.8 |
| S1.012 | 42.21 | 10.59 | 116.204 | 1.299 | 0.0 | 0.0 | 0.0 | 3.25 | 359.4 | 148.5 |
| S1.013 | 41.70 | 10.85 | 114.859 | 1.361 | 0.0 | 0.0 | 0.0 | 2.31 | 255.3 | 153.7 |
| S1.014 | 41.37 | 11.02 | 114.263 | 1.406 | 0.0 | 0.0 | 0.0 | 2.87 | 317.2 | 157.6 |
| S3.000 | 56.20 | 5.59 | 129.700 | 0.091 | 0.0 | 0.0 | 0.0 | 1.71 | 68.0 | 13.9 |
| S3.001 | 53.42 | 6.33 | 128.665 | 0.183 | 0.0 | 0.0 | 0.0 | 1.58 | 62.9 | 26.5 |
| S3.002 | 50.90 | 7.09 | 127.643 | 0.262 | 0.0 | 0.0 | 0.0 | 1.31 | 52.3 | 36.1 |
| S3.003 | 48.99 | 7.73 | 127.038 | 0.358 | 0.0 | 0.0 | 0.0 | 1.82 | 129.0 | 47.5 |
| S3.004 | 47.43 | 8.30 | 126.098 | 0.462 | 0.0 | 0.0 | 0.0 | 2.06 | 145.4 | 59.3 |
| S3.005 | 46.14 | 8.80 | 124.828 | 0.581 | 0.0 | 0.0 | 0.0 | 2.62 | 289.4 | 72.6 |
| S3.006 | 45.16 | 9.21 | 123.173 | 0.675 | 0.0 | 0.0 | 0.0 | 2.85 | 314.3 | 82.5 |
| S3.007 | 44.45 | 9.52 | 121.451 | 0.766 | 0.0 | 0.0 | 0.0 | 3.22 | 355.7 | 92.2 |

## Network Design Table for Pond 3-3

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S3.008 | 34.747 | 1.554 | 22.4 | 0.073 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S3.009 | 29.982 | 0.881 | 34.0 | 0.045 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S3.010 | 79.288 | 1.239 | 64.0 | 0.084 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S3.011 | 35.461 | 1.009 | 35.1 | 0.081 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S4.000 | 49.571 | 3.305 | 15.0 | 0.044 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S4.001 | 31.542 | 2.103 | 15.0 | 0.028 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S4.002 | 32.604 | 0.543 | 60.0 | 0.034 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S3.012 | 35.461 | 0.443 | 80.0 | 0.072 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S3.013 | 19.026 | 0.634 | 30.0 | 0.003 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S3.014 | 26.061 | 0.303 | 86.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S1.015 | 25.703 | 3.427 | 7.5 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S1.016 | 5.773 | 0.577 | 10.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S3.008 | 44.12 | 9.67 | 119.582 | 0.839 | 0.0 | 0.0 | 0.0 | 3.85 | 424.8 | 100.2 |
| S3.009 | 43.77 | 9.83 | 118.028 | 0.884 | 0.0 | 0.0 | 0.0 | 3.12 | 344.1 | 104.8 |
| S3.010 | 42.55 | 10.42 | 117.147 | 0.968 | 0.0 | 0.0 | 0.0 | 2.27 | 250.5 | 111.6 |
| S3.011 | 42.21 | 10.59 | 115.833 | 1.049 | 0.0 | 0.0 | 0.0 | 3.44 | 546.9 | 119.9 |
| S4.000 | 57.64 | 5.24 | 121.000 | 0.044 | 0.0 | 0.0 | 0.0 | 3.40 | 135.0 | 6.8 |
| S4.001 | 56.99 | 5.40 | 117.695 | 0.072 | 0.0 | 0.0 | 0.0 | 3.40 | 135.0 | 11.1 |
| S4.002 | 55.69 | 5.72 | 115.592 | 0.105 | 0.0 | 0.0 | 0.0 | 1.69 | 67.3 | 15.9 |
| S3.012 | 41.70 | 10.85 | 114.824 | 1.226 | 0.0 | 0.0 | 0.0 | 2.27 | 361.8 | 138.5 |
| S3.013 | 41.54 | 10.93 | 114.380 | 1.229 | 0.0 | 0.0 | 0.0 | 3.72 | 592.1 | 138.5 |
| S3.014 | 41.17 | 11.13 | 113.746 | 1.229 | 0.0 | 0.0 | 0.0 | 2.19 | 348.7 | 138.5 |
| S1.015 | 41.05 | 11.20 | 113.443 | 2.635 | 0.0 | 0.0 | 0.0 | 6.65 | 734.5 | 292.9 |
| S1.016 | 41.02 | 11.21 | 109.941 | 2.635 | 0.0 | 0.0 | 0.0 | 6.46 | 1027.0 | 292.9 |

## Manhole Schedules for Pond 3-3

| **MH Name** | **MH CL (m)** | **MH Depth (m)** | **MH Connection** | **MH Diam.,L*W (mm)** | **PN** | **Pipe Out Invert Level (m)** | **Diameter (mm)** | **PN** | **Pipes In Invert Level (m)** | **Diameter (mm)** | **Back (m** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S03-03-1 | 131.090 | 1.490 | Open Manhole | 1200 | S1.000 | 129.600 | 225 | | | | |
| S03-03-2 | 130.203 | 1.179 | Open Manhole | 1200 | S1.001 | 129.024 | 225 | S1.000 | 129.024 | 225 | |
| S03-03-3 | 129.208 | 1.500 | Open Manhole | 1200 | S1.002 | 127.708 | 300 | S1.001 | 127.783 | 225 | |
| S03-03-4 | 128.712 | 1.500 | Open Manhole | 1200 | S1.003 | 127.212 | 300 | S1.002 | 127.212 | 300 | |
| S03-03-5 | 128.072 | 1.501 | Open Manhole | 1200 | S1.004 | 126.571 | 300 | S1.003 | 126.571 | 300 | |
| S03-03-6 | 127.500 | 1.500 | Open Manhole | 1200 | S1.005 | 126.000 | 300 | S1.004 | 126.000 | 300 | |
| S03-03-7 | 126.302 | 1.311 | Open Manhole | 1200 | S1.006 | 124.991 | 300 | S1.005 | 124.991 | 300 | |
| S03-03-8 | 124.888 | 1.501 | Open Manhole | 1200 | S1.007 | 123.387 | 300 | S1.006 | 123.387 | 300 | |
| S03-03-9 | 123.203 | 1.850 | Open Manhole | 1350 | S1.008 | 121.353 | 375 | S1.007 | 121.428 | 300 | |
| S03-03-10 | 121.640 | 1.702 | Open Manhole | 1350 | S1.009 | 119.938 | 375 | S1.008 | 119.938 | 375 | |
| S03-03-11 | 120.284 | 1.894 | Open Manhole | 1350 | S1.010 | 118.390 | 375 | S1.009 | 118.390 | 375 | |
| S03-03-12 | 120.237 | 1.537 | Open Manhole | 1200 | S2.000 | 118.700 | 225 | | | | |
| S03-03-13 | 118.795 | 1.498 | Open Manhole | 1200 | S2.001 | 117.297 | 225 | S2.000 | 117.297 | 225 | |
| S03-03-14 | 118.539 | 1.667 | Open Manhole | 1200 | S2.002 | 116.872 | 300 | S2.001 | 116.947 | 225 | |
| S03-03-15 | 119.030 | 2.357 | Open Manhole | 1350 | S1.011 | 116.673 | 375 | S1.010 | 116.673 | 375 | |
| | | | | | | | | S2.002 | 116.748 | 300 | |
| S03-03-16 | 117.908 | 1.704 | Open Manhole | 1350 | S1.012 | 116.204 | 375 | S1.011 | 116.204 | 375 | |
| S03-03-17 | 116.756 | 1.897 | Open Manhole | 1350 | S1.013 | 114.859 | 375 | S1.012 | 114.859 | 375 | |
| S03-03-18 | 115.888 | 1.625 | Open Manhole | 1350 | S1.014 | 114.263 | 375 | S1.013 | 114.263 | 375 | |
| S03-03-19 | 131.212 | 1.512 | Open Manhole | 1200 | S3.000 | 129.700 | 225 | | | | |
| S03-03-20 | 129.754 | 1.089 | Open Manhole | 1200 | S3.001 | 128.665 | 225 | S3.000 | 128.665 | 225 | |
| S03-03-21 | 129.068 | 1.425 | Open Manhole | 1200 | S3.002 | 127.643 | 225 | S3.001 | 127.643 | 225 | |
| S03-03-22 | 128.463 | 1.425 | Open Manhole | 1200 | S3.003 | 127.038 | 300 | S3.002 | 127.038 | 225 | |
| S03-03-23 | 127.523 | 1.425 | Open Manhole | 1200 | S3.004 | 126.098 | 300 | S3.003 | 126.098 | 300 | |
| S03-03-24 | 126.329 | 1.501 | Open Manhole | 1350 | S3.005 | 124.828 | 375 | S3.004 | 124.903 | 300 | |
| S03-03-25 | 124.674 | 1.501 | Open Manhole | 1350 | S3.006 | 123.173 | 375 | S3.005 | 123.173 | 375 | |
| S03-03-26 | 122.952 | 1.501 | Open Manhole | 1350 | S3.007 | 121.451 | 375 | S3.006 | 121.451 | 375 | |
| S03-03-27 | 121.347 | 1.765 | Open Manhole | 1350 | S3.008 | 119.582 | 375 | S3.007 | 119.582 | 375 | |
| S03-03-28 | 120.437 | 2.409 | Open Manhole | 1350 | S3.009 | 118.028 | 375 | S3.008 | 118.028 | 375 | |
| S03-03-29 | 119.512 | 2.365 | Open Manhole | 1350 | S3.010 | 117.147 | 375 | S3.009 | 117.147 | 375 | |
| S03-03-30 | 117.408 | 1.575 | Open Manhole | 1350 | S3.011 | 115.833 | 450 | S3.010 | 115.908 | 375 | |
| S03-03-31 | 123.243 | 2.243 | Open Manhole | 1200 | S4.000 | 121.000 | 225 | | | | |
| S03-03-32 | 119.258 | 1.563 | Open Manhole | 1200 | S4.001 | 117.695 | 225 | S4.000 | 117.695 | 225 | |
| S03-03-33 | 117.378 | 1.786 | Open Manhole | 1200 | S4.002 | 115.592 | 225 | S4.001 | 115.592 | 225 | |
| S03-03-34 | 116.626 | 1.802 | Open Manhole | 1350 | S3.012 | 114.824 | 450 | S3.011 | 114.824 | 450 | |
| | | | | | | | | S4.002 | 115.049 | 225 | |
| S03-03-35 | 116.013 | 1.633 | Open Manhole | 1350 | S3.013 | 114.380 | 450 | S3.012 | 114.380 | 450 | |
| S03-03-36 | 115.475 | 1.729 | Open Manhole | 1350 | S3.014 | 113.746 | 450 | S3.013 | 113.746 | 450 | |

## Manhole Schedules for Pond 3-3

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Back (m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S03-03-37 | 115.595 | 2.152 | Open Manhole | 1350 | S1.015 | 113.443 | 375 | S1.014 | 113.518 | 375 | |
| | | | | | | | | S3.014 | 113.443 | 450 | |
| S03-03-38 | 111.350 | 1.409 | Open Manhole | 1350 | S1.016 | 109.941 | 450 | S1.015 | 110.016 | 375 | |
| S | 109.951 | 0.587 | Open Manhole | 0 | | OUTFALL | | S1.016 | 109.364 | 450 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S03-03-1 | 356512.621 | 528898.230 | 356512.621 | 528898.230 | Required |  |
| S03-03-2 | 356481.890 | 528901.408 | 356481.890 | 528901.408 | Required |  |
| S03-03-3 | 356416.494 | 528905.357 | 356416.494 | 528905.357 | Required |  |
| S03-03-4 | 356352.227 | 528906.366 | 356352.227 | 528906.366 | Required |  |
| S03-03-5 | 356292.358 | 528907.345 | 356292.358 | 528907.345 | Required |  |
| S03-03-6 | 356252.367 | 528909.651 | 356252.367 | 528909.651 | Required |  |
| S03-03-7 | 356182.694 | 528913.691 | 356182.694 | 528913.691 | Required |  |
| S03-03-8 | 356112.678 | 528917.932 | 356112.678 | 528917.932 | Required |  |
| S03-03-9 | 356042.567 | 528922.067 | 356042.567 | 528922.067 | Required |  |
| S03-03-10 | 355982.507 | 528928.197 | 355982.507 | 528928.197 | Required |  |
| S03-03-11 | 355934.772 | 528933.153 | 355934.772 | 528933.153 | Required |  |
| S03-03-12 | 355943.771 | 529010.729 | 355943.771 | 529010.729 | Required |  |

## Manhole Schedules for Pond 3-3

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S03-03-13 | 355915.175 | 528990.408 | 355915.175 | 528990.408 | Required |  |
| S03-03-14 | 355900.069 | 528966.841 | 355900.069 | 528966.841 | Required |  |
| S03-03-15 | 355891.039 | 528937.156 | 355891.039 | 528937.156 | Required |  |
| S03-03-16 | 355848.414 | 528937.225 | 355848.414 | 528937.225 | Required |  |
| S03-03-17 | 355806.509 | 528939.455 | 355806.509 | 528939.455 | Required |  |
| S03-03-18 | 355769.856 | 528941.759 | 355769.856 | 528941.759 | Required |  |
| S03-03-19 | 356511.789 | 528871.926 | 356511.789 | 528871.926 | Required |  |
| S03-03-20 | 356451.171 | 528875.471 | 356451.171 | 528875.471 | Required |  |
| S03-03-21 | 356381.175 | 528879.596 | 356381.175 | 528879.596 | Required |  |
| S03-03-22 | 356321.389 | 528883.072 | 356321.389 | 528883.072 | Required |  |
| S03-03-23 | 356251.563 | 528887.158 | 356251.563 | 528887.158 | Required |  |
| S03-03-24 | 356181.562 | 528891.290 | 356181.562 | 528891.290 | Required |  |
| S03-03-25 | 356102.223 | 528895.990 | 356102.223 | 528895.990 | Required |  |
| S03-03-26 | 356032.155 | 528900.133 | 356032.155 | 528900.133 | Required |  |
| S03-03-27 | 355972.727 | 528903.674 | 355972.727 | 528903.674 | Required |  |

## Manhole Schedules for Pond 3-3

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S03-03-28 | 355938.033 | 528905.599 | 355938.033 | 528905.599 | Required |  |
| S03-03-29 | 355908.105 | 528903.821 | 355908.105 | 528903.821 | Required |  |
| S03-03-30 | 355828.948 | 528908.389 | 355828.948 | 528908.389 | Required |  |
| S03-03-31 | 355829.335 | 528802.877 | 355829.335 | 528802.877 | Required |  |
| S03-03-32 | 355807.795 | 528847.524 | 355807.795 | 528847.524 | Required |  |
| S03-03-33 | 355799.646 | 528877.995 | 355799.646 | 528877.995 | Required |  |
| S03-03-34 | 355793.525 | 528910.020 | 355793.525 | 528910.020 | Required |  |
| S03-03-35 | 355758.102 | 528911.651 | 355758.102 | 528911.651 | Required |  |
| S03-03-36 | 355739.189 | 528913.730 | 355739.189 | 528913.730 | Required |  |
| S03-03-37 | 355740.133 | 528939.774 | 355740.133 | 528939.774 | Required |  |
| S03-03-38 | 355737.583 | 528965.350 | 355737.583 | 528965.350 | Required |  |
| S | 355732.834 | 528968.632 | | | No Entry |  |

## PIPELINE SCHEDULES for Pond 3-3

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | o | 225 | S03-03-1 | 131.090 | 129.600 | 1.265 | Open Manhole | 1200 |
| S1.001 | o | 225 | S03-03-2 | 130.203 | 129.024 | 0.954 | Open Manhole | 1200 |
| S1.002 | o | 300 | S03-03-3 | 129.208 | 127.708 | 1.200 | Open Manhole | 1200 |
| S1.003 | o | 300 | S03-03-4 | 128.712 | 127.212 | 1.200 | Open Manhole | 1200 |
| S1.004 | o | 300 | S03-03-5 | 128.072 | 126.571 | 1.201 | Open Manhole | 1200 |
| S1.005 | o | 300 | S03-03-6 | 127.500 | 126.000 | 1.200 | Open Manhole | 1200 |
| S1.006 | o | 300 | S03-03-7 | 126.302 | 124.991 | 1.011 | Open Manhole | 1200 |
| S1.007 | o | 300 | S03-03-8 | 124.888 | 123.387 | 1.201 | Open Manhole | 1200 |
| S1.008 | o | 375 | S03-03-9 | 123.203 | 121.353 | 1.475 | Open Manhole | 1350 |
| S1.009 | o | 375 | S03-03-10 | 121.640 | 119.938 | 1.327 | Open Manhole | 1350 |
| S1.010 | o | 375 | S03-03-11 | 120.284 | 118.390 | 1.519 | Open Manhole | 1350 |
| S2.000 | o | 225 | S03-03-12 | 120.237 | 118.700 | 1.312 | Open Manhole | 1200 |
| S2.001 | o | 225 | S03-03-13 | 118.795 | 117.297 | 1.273 | Open Manhole | 1200 |
| S2.002 | o | 300 | S03-03-14 | 118.539 | 116.872 | 1.367 | Open Manhole | 1200 |
| S1.011 | o | 375 | S03-03-15 | 119.030 | 116.673 | 1.982 | Open Manhole | 1350 |
| S1.012 | o | 375 | S03-03-16 | 117.908 | 116.204 | 1.329 | Open Manhole | 1350 |
| S1.013 | o | 375 | S03-03-17 | 116.756 | 114.859 | 1.522 | Open Manhole | 1350 |
| S1.014 | o | 375 | S03-03-18 | 115.888 | 114.263 | 1.250 | Open Manhole | 1350 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | 30.895 | 53.6 | S03-03-2 | 130.203 | 129.024 | 0.954 | Open Manhole | 1200 |
| S1.001 | 65.515 | 52.8 | S03-03-3 | 129.208 | 127.783 | 1.200 | Open Manhole | 1200 |
| S1.002 | 64.275 | 129.6 | S03-03-4 | 128.712 | 127.212 | 1.200 | Open Manhole | 1200 |
| S1.003 | 59.877 | 93.4 | S03-03-5 | 128.072 | 126.571 | 1.201 | Open Manhole | 1200 |
| S1.004 | 40.058 | 70.2 | S03-03-6 | 127.500 | 126.000 | 1.200 | Open Manhole | 1200 |
| S1.005 | 69.790 | 69.2 | S03-03-7 | 126.302 | 124.991 | 1.011 | Open Manhole | 1200 |
| S1.006 | 70.144 | 43.7 | S03-03-8 | 124.888 | 123.387 | 1.201 | Open Manhole | 1200 |
| S1.007 | 70.232 | 35.9 | S03-03-9 | 123.203 | 121.428 | 1.475 | Open Manhole | 1350 |
| S1.008 | 60.373 | 42.7 | S03-03-10 | 121.640 | 119.938 | 1.327 | Open Manhole | 1350 |
| S1.009 | 47.991 | 31.0 | S03-03-11 | 120.284 | 118.390 | 1.519 | Open Manhole | 1350 |
| S1.010 | 43.916 | 25.6 | S03-03-15 | 119.030 | 116.673 | 1.982 | Open Manhole | 1350 |
| S2.000 | 35.081 | 25.0 | S03-03-13 | 118.795 | 117.297 | 1.273 | Open Manhole | 1200 |
| S2.001 | 27.992 | 80.0 | S03-03-14 | 118.539 | 116.947 | 1.367 | Open Manhole | 1200 |
| S2.002 | 31.028 | 250.2 | S03-03-15 | 119.030 | 116.748 | 1.982 | Open Manhole | 1350 |
| S1.011 | 42.626 | 91.0 | S03-03-16 | 117.908 | 116.204 | 1.329 | Open Manhole | 1350 |
| S1.012 | 41.964 | 31.2 | S03-03-17 | 116.756 | 114.859 | 1.522 | Open Manhole | 1350 |
| S1.013 | 36.725 | 61.6 | S03-03-18 | 115.888 | 114.263 | 1.249 | Open Manhole | 1350 |
| S1.014 | 29.789 | 40.0 | S03-03-37 | 115.595 | 113.518 | 1.702 | Open Manhole | 1350 |

## PIPELINE SCHEDULES for Pond 3-3

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S3.000 | o | 225 | S03-03-19 | 131.212 | 129.700 | 1.287 | Open Manhole | 1200 |
| S3.001 | o | 225 | S03-03-20 | 129.754 | 128.665 | 0.864 | Open Manhole | 1200 |
| S3.002 | o | 225 | S03-03-21 | 129.068 | 127.643 | 1.200 | Open Manhole | 1200 |
| S3.003 | o | 300 | S03-03-22 | 128.463 | 127.038 | 1.125 | Open Manhole | 1200 |
| S3.004 | o | 300 | S03-03-23 | 127.523 | 126.098 | 1.125 | Open Manhole | 1200 |
| S3.005 | o | 375 | S03-03-24 | 126.329 | 124.828 | 1.126 | Open Manhole | 1350 |
| S3.006 | o | 375 | S03-03-25 | 124.674 | 123.173 | 1.126 | Open Manhole | 1350 |
| S3.007 | o | 375 | S03-03-26 | 122.952 | 121.451 | 1.126 | Open Manhole | 1350 |
| S3.008 | o | 375 | S03-03-27 | 121.347 | 119.582 | 1.390 | Open Manhole | 1350 |
| S3.009 | o | 375 | S03-03-28 | 120.437 | 118.028 | 2.034 | Open Manhole | 1350 |
| S3.010 | o | 375 | S03-03-29 | 119.512 | 117.147 | 1.990 | Open Manhole | 1350 |
| S3.011 | o | 450 | S03-03-30 | 117.408 | 115.833 | 1.125 | Open Manhole | 1350 |
| | | | | | | | | |
| S4.000 | o | 225 | S03-03-31 | 123.243 | 121.000 | 2.018 | Open Manhole | 1200 |
| S4.001 | o | 225 | S03-03-32 | 119.258 | 117.695 | 1.338 | Open Manhole | 1200 |
| S4.002 | o | 225 | S03-03-33 | 117.378 | 115.592 | 1.561 | Open Manhole | 1200 |
| | | | | | | | | |
| S3.012 | o | 450 | S03-03-34 | 116.626 | 114.824 | 1.352 | Open Manhole | 1350 |
| S3.013 | o | 450 | S03-03-35 | 116.013 | 114.380 | 1.183 | Open Manhole | 1350 |
| S3.014 | o | 450 | S03-03-36 | 115.475 | 113.746 | 1.279 | Open Manhole | 1350 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S3.000 | 60.721 | 58.7 | S03-03-20 | 129.754 | 128.665 | 0.864 | Open Manhole | 1200 |
| S3.001 | 70.118 | 68.6 | S03-03-21 | 129.068 | 127.643 | 1.200 | Open Manhole | 1200 |
| S3.002 | 59.887 | 99.0 | S03-03-22 | 128.463 | 127.038 | 1.200 | Open Manhole | 1200 |
| S3.003 | 69.945 | 74.4 | S03-03-23 | 127.523 | 126.098 | 1.125 | Open Manhole | 1200 |
| S3.004 | 70.122 | 58.7 | S03-03-24 | 126.329 | 124.903 | 1.126 | Open Manhole | 1350 |
| S3.005 | 79.478 | 48.0 | S03-03-25 | 124.674 | 123.173 | 1.126 | Open Manhole | 1350 |
| S3.006 | 70.191 | 40.8 | S03-03-26 | 122.952 | 121.451 | 1.126 | Open Manhole | 1350 |
| S3.007 | 59.534 | 31.9 | S03-03-27 | 121.347 | 119.582 | 1.390 | Open Manhole | 1350 |
| S3.008 | 34.747 | 22.4 | S03-03-28 | 120.437 | 118.028 | 2.034 | Open Manhole | 1350 |
| S3.009 | 29.982 | 34.0 | S03-03-29 | 119.512 | 117.147 | 1.990 | Open Manhole | 1350 |
| S3.010 | 79.288 | 64.0 | S03-03-30 | 117.408 | 115.908 | 1.125 | Open Manhole | 1350 |
| S3.011 | 35.461 | 35.1 | S03-03-34 | 116.626 | 114.824 | 1.352 | Open Manhole | 1350 |
| | | | | | | | | |
| S4.000 | 49.571 | 15.0 | S03-03-32 | 119.258 | 117.695 | 1.338 | Open Manhole | 1200 |
| S4.001 | 31.542 | 15.0 | S03-03-33 | 117.378 | 115.592 | 1.561 | Open Manhole | 1200 |
| S4.002 | 32.604 | 60.0 | S03-03-34 | 116.626 | 115.049 | 1.352 | Open Manhole | 1350 |
| | | | | | | | | |
| S3.012 | 35.461 | 80.0 | S03-03-35 | 116.013 | 114.380 | 1.183 | Open Manhole | 1350 |
| S3.013 | 19.026 | 30.0 | S03-03-36 | 115.475 | 113.746 | 1.279 | Open Manhole | 1350 |
| S3.014 | 26.061 | 86.0 | S03-03-37 | 115.595 | 113.443 | 1.702 | Open Manhole | 1350 |

## PIPELINE SCHEDULES for Pond 3-3

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.015 | o | 375 | S03-03-37 | 115.595 | 113.443 | 1.777 | Open Manhole | 1350 |
| S1.016 | o | 450 | S03-03-38 | 111.350 | 109.941 | 0.959 | Open Manhole | 1350 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.015 | 25.703 | 7.5 | S03-03-38 | 111.350 | 110.016 | 0.959 | Open Manhole | 1350 |
| S1.016 | 5.773 | 10.0 | S | 109.951 | 109.364 | 0.137 | Open Manhole | 0 |

## Area Summary for Pond 3-3

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | - | - | 100 | 0.071 | 0.071 | 0.071 |
| 1.001 | - | - | 100 | 0.141 | 0.141 | 0.141 |
| 1.002 | - | - | 100 | 0.109 | 0.109 | 0.109 |
| 1.003 | - | - | 100 | 0.087 | 0.087 | 0.087 |
| 1.004 | - | - | 100 | 0.054 | 0.054 | 0.054 |
| 1.005 | - | - | 100 | 0.101 | 0.101 | 0.101 |
| 1.006 | - | - | 100 | 0.106 | 0.106 | 0.106 |
| 1.007 | - | - | 100 | 0.116 | 0.116 | 0.116 |
| 1.008 | - | - | 100 | 0.074 | 0.074 | 0.074 |
| 1.009 | - | - | 100 | 0.096 | 0.096 | 0.096 |
| 1.010 | User | - | 100 | 0.085 | 0.085 | 0.085 |
|  | User | - | 50 | 0.008 | 0.004 | 0.089 |
| 2.000 | - | - | 100 | 0.042 | 0.042 | 0.042 |
| 2.001 | - | - | 100 | 0.029 | 0.029 | 0.029 |
| 2.002 | - | - | 100 | 0.033 | 0.033 | 0.033 |
| 1.011 | - | - | 100 | 0.080 | 0.080 | 0.080 |
| 1.012 | - | - | 100 | 0.071 | 0.071 | 0.071 |
| 1.013 | - | - | 100 | 0.062 | 0.062 | 0.062 |
| 1.014 | - | - | 100 | 0.045 | 0.045 | 0.045 |
| 3.000 | - | - | 100 | 0.091 | 0.091 | 0.091 |
| 3.001 | - | - | 100 | 0.092 | 0.092 | 0.092 |
| 3.002 | - | - | 100 | 0.079 | 0.079 | 0.079 |
| 3.003 | - | - | 100 | 0.096 | 0.096 | 0.096 |
| 3.004 | - | - | 100 | 0.104 | 0.104 | 0.104 |
| 3.005 | - | - | 100 | 0.119 | 0.119 | 0.119 |
| 3.006 | - | - | 100 | 0.094 | 0.094 | 0.094 |
| 3.007 | - | - | 100 | 0.091 | 0.091 | 0.091 |
| 3.008 | - | - | 100 | 0.073 | 0.073 | 0.073 |
| 3.009 | - | - | 100 | 0.045 | 0.045 | 0.045 |
| 3.010 | - | - | 100 | 0.084 | 0.084 | 0.084 |
| 3.011 | - | - | 100 | 0.081 | 0.081 | 0.081 |
| 4.000 | User | - | 100 | 0.031 | 0.031 | 0.031 |
|  | User | - | 50 | 0.012 | 0.006 | 0.037 |
|  | User | - | 50 | 0.013 | 0.006 | 0.044 |
| 4.001 | User | - | 100 | 0.020 | 0.020 | 0.020 |
|  | User | - | 50 | 0.008 | 0.004 | 0.024 |
|  | User | - | 50 | 0.008 | 0.004 | 0.028 |
| 4.002 | User | - | 100 | 0.029 | 0.029 | 0.029 |
|  | User | - | 50 | 0.005 | 0.002 | 0.031 |
|  | User | - | 50 | 0.005 | 0.003 | 0.034 |
| 3.012 | User | - | 100 | 0.068 | 0.068 | 0.068 |
|  | User | - | 50 | 0.008 | 0.004 | 0.072 |
| 3.013 | User | - | 50 | 0.005 | 0.003 | 0.003 |
| 3.014 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.015 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.016 | - | - | 100 | 0.000 | 0.000 | 0.000 |
|  |  |  |  | Total | Total | Total |
|  |  |  |  | 2.671 | 2.635 | 2.635 |

## Free Flowing Outfall Details for Pond 3-3

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| S1.016 | S | 109.951 | 109.364 | 0.000 | 0 | 0 |

## Simulation Criteria for Pond 3-3

| | | | |
|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Additional Flow - % of Total Flow | 40.000 |
| Areal Reduction Factor | 1.000 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start (mins) | 0 | Inlet Coeffiecient | 0.800 |
| Hot Start Level (mm) | 0 | Flow per Person per Day (l/per/day) | 0.000 |
| Manhole Headloss Coeff (Global) | 0.500 | Run Time (mins) | 60 |
| Foul Sewage per hectare (l/s) | 0.000 | Output Interval (mins) | 1 |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

## Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Profile Type | Summer |
| Return Period (years) | 5 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.300 | Storm Duration (mins) | 30 |
| Ratio R | 0.300 | | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-3

### Simulation Criteria

```
           Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 40.000
                  Hot Start (mins)     0       MADD Factor * 10m³/ha Storage  2.000
              Hot Start Level (mm)     0               Inlet Coeffiecient  0.800
  Manhole Headloss Coeff (Global) 0.500  Flow per Person per Day (l/per/day)  0.000
    Foul Sewage per hectare (l/s) 0.000

         Number of Input Hydrographs 0  Number of Storage Structures 0
           Number of Online Controls 0  Number of Time/Area Diagrams 0
          Number of Offline Controls 0  Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
   Rainfall Model               FSR     Ratio R 0.300
           Region England and Wales  Cv (Summer) 0.750
       M5-60 (mm)            15.000  Cv (Winter) 0.840

  Margin for Flood Risk Warning (mm)  300.0      DVD Status OFF
                   Analysis Timestep  Fine  Inertia Status OFF
                          DTS Status    ON


                Profile(s)                         Summer and Winter
           Duration(s) (mins)    15, 30, 60, 120, 180, 240, 360, 480, 600,
                                  720, 960, 1440, 2160, 2880, 4320, 5760,
                                                      7200, 8640, 10080
      Return Period(s) (years)                                         5
           Climate Change (%)                                         20
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| S1.000 | S03-03-1 | 15 Winter | 5 | +20% | | | | |
| S1.001 | S03-03-2 | 15 Winter | 5 | +20% | | | | |
| S1.002 | S03-03-3 | 15 Winter | 5 | +20% | | | | |
| S1.003 | S03-03-4 | 15 Winter | 5 | +20% | | | | |
| S1.004 | S03-03-5 | 15 Winter | 5 | +20% | | | | |
| S1.005 | S03-03-6 | 15 Winter | 5 | +20% | | | | |
| S1.006 | S03-03-7 | 15 Winter | 5 | +20% | | | | |
| S1.007 | S03-03-8 | 15 Winter | 5 | +20% | | | | |
| S1.008 | S03-03-9 | 15 Winter | 5 | +20% | | | | |
| S1.009 | S03-03-10 | 15 Winter | 5 | +20% | | | | |
| S1.010 | S03-03-11 | 15 Winter | 5 | +20% | | | | |
| S2.000 | S03-03-12 | 15 Winter | 5 | +20% | | | | |
| S2.001 | S03-03-13 | 15 Winter | 5 | +20% | | | | |
| S2.002 | S03-03-14 | 15 Winter | 5 | +20% | 5/15 Winter | | | |
| S1.011 | S03-03-15 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| S1.012 | S03-03-16 | 15 Winter | 5 | +20% | | | | |
| S1.013 | S03-03-17 | 15 Winter | 5 | +20% | 5/15 Winter | | | |
| S1.014 | S03-03-18 | 15 Winter | 5 | +20% | | | | |
| S3.000 | S03-03-19 | 15 Winter | 5 | +20% | | | | |
| S3.001 | S03-03-20 | 15 Winter | 5 | +20% | | | | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-3

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S03-03-1 | 129.682 | -0.143 | 0.000 | 0.28 | | | 18.7 | OK |
| S1.001 | S03-03-2 | 129.168 | -0.081 | 0.000 | 0.72 | | | 50.0 | OK |
| S1.002 | S03-03-3 | 127.911 | -0.097 | 0.000 | 0.77 | | | 72.0 | OK |
| S1.003 | S03-03-4 | 127.422 | -0.090 | 0.000 | 0.81 | | | 89.1 | OK |
| S1.004 | S03-03-5 | 126.777 | -0.094 | 0.000 | 0.80 | | | 98.9 | OK |
| S1.005 | S03-03-6 | 126.228 | -0.072 | 0.000 | 0.92 | | | 117.2 | OK |
| S1.006 | S03-03-7 | 125.204 | -0.087 | 0.000 | 0.84 | | | 135.2 | OK |
| S1.007 | S03-03-8 | 123.604 | -0.083 | 0.000 | 0.87 | | | 154.3 | OK |
| S1.008 | S03-03-9 | 121.559 | -0.169 | 0.000 | 0.58 | | | 166.5 | OK |
| S1.009 | S03-03-10 | 120.138 | -0.175 | 0.000 | 0.55 | | | 181.8 | OK |
| S1.010 | S03-03-11 | 118.588 | -0.177 | 0.000 | 0.54 | | | 196.9 | OK |
| S2.000 | S03-03-12 | 118.750 | -0.175 | 0.000 | 0.11 | | | 11.2 | OK |
| S2.001 | S03-03-13 | 117.386 | -0.136 | 0.000 | 0.32 | | | 17.5 | OK |
| S2.002 | S03-03-14 | 117.236 | 0.064 | 0.000 | 0.36 | | | 22.8 | SURCHARGED |
| S1.011 | S03-03-15 | 117.217 | 0.169 | 0.000 | 1.18 | | | 226.0 | SURCHARGED |
| S1.012 | S03-03-16 | 116.442 | -0.138 | 0.000 | 0.72 | | | 236.7 | OK |
| S1.013 | S03-03-17 | 115.297 | 0.063 | 0.000 | 1.06 | | | 244.2 | SURCHARGED |
| S1.014 | S03-03-18 | 114.540 | -0.098 | 0.000 | 0.89 | | | 250.2 | OK |
| S3.000 | S03-03-19 | 129.795 | -0.130 | 0.000 | 0.36 | | | 23.7 | OK |
| S3.001 | S03-03-20 | 128.809 | -0.081 | 0.000 | 0.71 | | | 43.2 | OK |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| S1.000 | S03-03-1 | |
| S1.001 | S03-03-2 | |
| S1.002 | S03-03-3 | |
| S1.003 | S03-03-4 | |
| S1.004 | S03-03-5 | |
| S1.005 | S03-03-6 | |
| S1.006 | S03-03-7 | |
| S1.007 | S03-03-8 | |
| S1.008 | S03-03-9 | |
| S1.009 | S03-03-10 | |
| S1.010 | S03-03-11 | |
| S2.000 | S03-03-12 | |
| S2.001 | S03-03-13 | |
| S2.002 | S03-03-14 | |
| S1.011 | S03-03-15 | |
| S1.012 | S03-03-16 | |
| S1.013 | S03-03-17 | |
| S1.014 | S03-03-18 | |
| S3.000 | S03-03-19 | |
| S3.001 | S03-03-20 | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-3

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| S3.002 | S03-03-21 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| S3.003 | S03-03-22 | 15 Winter | 5 | +20% | | | | |
| S3.004 | S03-03-23 | 15 Winter | 5 | +20% | | | | |
| S3.005 | S03-03-24 | 15 Winter | 5 | +20% | | | | |
| S3.006 | S03-03-25 | 15 Winter | 5 | +20% | | | | |
| S3.007 | S03-03-26 | 15 Winter | 5 | +20% | | | | |
| S3.008 | S03-03-27 | 15 Winter | 5 | +20% | | | | |
| S3.009 | S03-03-28 | 15 Winter | 5 | +20% | | | | |
| S3.010 | S03-03-29 | 15 Winter | 5 | +20% | | | | |
| S3.011 | S03-03-30 | 15 Winter | 5 | +20% | | | | |
| S4.000 | S03-03-31 | 15 Winter | 5 | +20% | | | | |
| S4.001 | S03-03-32 | 15 Winter | 5 | +20% | | | | |
| S4.002 | S03-03-33 | 15 Winter | 5 | +20% | | | | |
| S3.012 | S03-03-34 | 15 Winter | 5 | +20% | | | | |
| S3.013 | S03-03-35 | 15 Winter | 5 | +20% | | | | |
| S3.014 | S03-03-36 | 15 Winter | 5 | +20% | | | | |
| S1.015 | S03-03-37 | 15 Winter | 5 | +20% | | | | |
| S1.016 | S03-03-38 | 15 Winter | 5 | +20% | 5/15 Winter | | | |

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S3.002 | S03-03-21 | 128.013 | 0.145 | 0.000 | 1.11 | | | 55.8 | SURCHARGED |
| S3.003 | S03-03-22 | 127.206 | -0.132 | 0.000 | 0.59 | | | 73.2 | OK |
| S3.004 | S03-03-23 | 126.279 | -0.119 | 0.000 | 0.66 | | | 92.4 | OK |
| S3.005 | S03-03-24 | 124.998 | -0.205 | 0.000 | 0.42 | | | 114.6 | OK |
| S3.006 | S03-03-25 | 123.349 | -0.199 | 0.000 | 0.45 | | | 132.3 | OK |
| S3.007 | S03-03-26 | 121.628 | -0.198 | 0.000 | 0.45 | | | 149.2 | OK |
| S3.008 | S03-03-27 | 119.754 | -0.203 | 0.000 | 0.43 | | | 162.6 | OK |
| S3.009 | S03-03-28 | 118.231 | -0.172 | 0.000 | 0.56 | | | 171.0 | OK |
| S3.010 | S03-03-29 | 117.399 | -0.123 | 0.000 | 0.78 | | | 185.4 | OK |
| S3.011 | S03-03-30 | 116.035 | -0.248 | 0.000 | 0.42 | | | 199.5 | OK |
| S4.000 | S03-03-31 | 121.046 | -0.179 | 0.000 | 0.09 | | | 11.6 | OK |
| S4.001 | S03-03-32 | 117.751 | -0.169 | 0.000 | 0.14 | | | 17.9 | OK |
| S4.002 | S03-03-33 | 115.692 | -0.125 | 0.000 | 0.40 | | | 25.4 | OK |
| S3.012 | S03-03-34 | 115.112 | -0.162 | 0.000 | 0.73 | | | 232.6 | OK |
| S3.013 | S03-03-35 | 114.610 | -0.220 | 0.000 | 0.52 | | | 232.8 | OK |
| S3.014 | S03-03-36 | 114.050 | -0.146 | 0.000 | 0.79 | | | 232.0 | OK |
| S1.015 | S03-03-37 | 113.687 | -0.132 | 0.000 | 0.75 | | | 475.9 | OK |
| S1.016 | S03-03-38 | 110.514 | 0.123 | 0.000 | 1.11 | | | 476.5 | SURCHARGED |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| S3.002 | S03-03-21 | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-3

| **PN** | **US/MH Name** | **Level Exceeded** |
|---|---|---|
| S3.003 | S03-03-22 | |
| S3.004 | S03-03-23 | |
| S3.005 | S03-03-24 | |
| S3.006 | S03-03-25 | |
| S3.007 | S03-03-26 | |
| S3.008 | S03-03-27 | |
| S3.009 | S03-03-28 | |
| S3.010 | S03-03-29 | |
| S3.011 | S03-03-30 | |
| S4.000 | S03-03-31 | |
| S4.001 | S03-03-32 | |
| S4.002 | S03-03-33 | |
| S3.012 | S03-03-34 | |
| S3.013 | S03-03-35 | |
| S3.014 | S03-03-36 | |
| S1.015 | S03-03-37 | |
| S1.016 | S03-03-38 | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Pond 3-4

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 15.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Time Area Diagram for Pond 3-4

| **Time (mins)** | **Area (ha)** | **Time (mins)** | **Area (ha)** | **Time (mins)** | **Area (ha)** |
|---|---|---|---|---|---|
| 0-4 | 0.577 | 4-8 | 1.012 | 8-12 | 0.329 |

Total Area Contributing (ha) = 1.917

Total Pipe Volume (m³) = 114.025

### Network Design Table for Pond 3-4

| **PN** | **Length (m)** | **Fall (m)** | **Slope (1:X)** | **I.Area (ha)** | **T.E. (mins)** | **Base Flow (l/s)** | **k (mm)** | **HYD SECT** | **DIA (mm)** | **Section Type** | **Auto Design** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 62.950 | 1.044 | 60.3 | 0.121 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S1.001 | 83.246 | 0.498 | 167.2 | 0.132 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S1.002 | 81.347 | 0.485 | 167.7 | 0.136 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.003 | 30.108 | 0.180 | 167.3 | 0.047 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.004 | 48.854 | 0.291 | 167.9 | 0.064 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.005 | 60.129 | 0.740 | 81.3 | 0.079 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.006 | 59.860 | 1.130 | 53.0 | 0.079 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |

### Network Results Table

| **PN** | **Rain (mm/hr)** | **T.C. (mins)** | **US/IL (m)** | **Σ I.Area (ha)** | **Σ Base Flow (l/s)** | **Foul (l/s)** | **Add Flow (l/s)** | **Vel (m/s)** | **Cap (l/s)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 56.08 | 5.62 | 138.500 | 0.121 | 0.0 | 0.0 | 0.0 | 1.69 | 67.1 | 18.4 |
| S1.001 | 51.19 | 7.00 | 137.456 | 0.253 | 0.0 | 0.0 | 0.0 | 1.01 | 40.1 | 35.1 |
| S1.002 | 47.91 | 8.12 | 136.883 | 0.389 | 0.0 | 0.0 | 0.0 | 1.21 | 85.6 | 50.5 |
| S1.003 | 46.82 | 8.53 | 136.398 | 0.436 | 0.0 | 0.0 | 0.0 | 1.21 | 85.7 | 55.3 |
| S1.004 | 45.18 | 9.20 | 136.218 | 0.500 | 0.0 | 0.0 | 0.0 | 1.21 | 85.6 | 61.2 |
| S1.005 | 43.89 | 9.78 | 135.927 | 0.579 | 0.0 | 0.0 | 0.0 | 1.75 | 123.4 | 68.8 |
| S1.006 | 42.91 | 10.24 | 135.187 | 0.658 | 0.0 | 0.0 | 0.0 | 2.16 | 153.0 | 76.5 |

## Network Design Table for Pond 3-4

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.007 | 59.534 | 1.323 | 45.0 | 0.093 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.008 | 50.151 | 1.254 | 40.0 | 0.071 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S1.009 | 59.941 | 1.713 | 35.0 | 0.080 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S2.000 | 73.323 | 1.259 | 58.2 | 0.166 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S3.000 | 37.503 | 0.641 | 58.5 | 0.070 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S3.001 | 35.920 | 0.240 | 149.7 | 0.051 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S3.002 | 20.658 | 0.120 | 172.2 | 0.028 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S2.001 | 12.088 | 0.072 | 167.9 | 0.031 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S2.002 | 49.552 | 0.297 | 166.8 | 0.077 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S2.003 | 59.714 | 0.348 | 171.6 | 0.078 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S2.004 | 50.124 | 0.303 | 165.4 | 0.067 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S2.005 | 50.279 | 0.300 | 167.6 | 0.066 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S2.006 | 69.305 | 1.071 | 64.7 | 0.092 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S2.007 | 69.815 | 1.390 | 50.2 | 0.095 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S2.008 | 70.426 | 1.667 | 42.2 | 0.098 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S2.009 | 69.925 | 1.848 | 37.8 | 0.096 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S2.010 | 26.002 | 0.203 | 128.1 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S1.010 | 35.306 | 4.413 | 8.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.007 | 42.07 | 10.66 | 134.057 | 0.751 | 0.0 | 0.0 | 0.0 | 2.35 | 166.1 | 85.6 |
| S1.008 | 41.50 | 10.95 | 132.659 | 0.822 | 0.0 | 0.0 | 0.0 | 2.87 | 317.3 | 92.4 |
| S1.009 | 40.90 | 11.28 | 131.405 | 0.902 | 0.0 | 0.0 | 0.0 | 3.07 | 339.3 | 99.9 |
| S2.000 | 55.72 | 5.71 | 138.600 | 0.166 | 0.0 | 0.0 | 0.0 | 1.72 | 68.3 | 25.1 |
| S3.000 | 57.12 | 5.36 | 139.100 | 0.070 | 0.0 | 0.0 | 0.0 | 1.71 | 68.1 | 10.8 |
| S3.001 | 55.26 | 5.83 | 138.384 | 0.121 | 0.0 | 0.0 | 0.0 | 1.28 | 90.7 | 18.1 |
| S3.002 | 54.32 | 6.08 | 138.069 | 0.149 | 0.0 | 0.0 | 0.0 | 1.38 | 152.2 | 21.9 |
| S2.001 | 53.79 | 6.23 | 137.191 | 0.346 | 0.0 | 0.0 | 0.0 | 1.40 | 154.1 | 50.4 |
| S2.002 | 51.77 | 6.82 | 137.119 | 0.423 | 0.0 | 0.0 | 0.0 | 1.40 | 154.6 | 59.3 |
| S2.003 | 49.54 | 7.54 | 136.822 | 0.501 | 0.0 | 0.0 | 0.0 | 1.38 | 152.4 | 67.2 |
| S2.004 | 47.87 | 8.13 | 136.474 | 0.568 | 0.0 | 0.0 | 0.0 | 1.41 | 155.3 | 73.6 |
| S2.005 | 46.32 | 8.73 | 136.171 | 0.634 | 0.0 | 0.0 | 0.0 | 1.40 | 154.3 | 79.5 |
| S2.006 | 45.09 | 9.24 | 135.871 | 0.726 | 0.0 | 0.0 | 0.0 | 2.26 | 249.1 | 88.7 |
| S2.007 | 44.06 | 9.70 | 134.800 | 0.821 | 0.0 | 0.0 | 0.0 | 2.56 | 283.0 | 98.0 |
| S2.008 | 43.16 | 10.12 | 133.410 | 0.919 | 0.0 | 0.0 | 0.0 | 2.79 | 308.7 | 107.4 |
| S2.009 | 42.36 | 10.51 | 131.743 | 1.015 | 0.0 | 0.0 | 0.0 | 2.95 | 326.2 | 116.4 |
| S2.010 | 41.83 | 10.78 | 129.895 | 1.015 | 0.0 | 0.0 | 0.0 | 1.60 | 176.6 | 116.4 |
| S1.010 | 40.73 | 11.37 | 129.692 | 1.917 | 0.0 | 0.0 | 0.0 | 6.44 | 711.2 | 211.5 |

## Network Design Table for Pond 3-4

| **PN** | **Length (m)** | **Fall (m)** | **Slope (1:X)** | **I.Area (ha)** | **T.E. (mins)** | **Base Flow (l/s)** | **k (mm)** | **HYD SECT** | **DIA (mm)** | **Section Type** | **Auto Design** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.011 | 4.238 | 0.042 | 100.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |

## Network Results Table

| **PN** | **Rain (mm/hr)** | **T.C. (mins)** | **US/IL (m)** | **Σ I.Area (ha)** | **Σ Base Flow (l/s)** | **Foul (l/s)** | **Add Flow (l/s)** | **Vel (m/s)** | **Cap (l/s)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.011 | 40.67 | 11.40 | 125.204 | 1.917 | 0.0 | 0.0 | 0.0 | 2.02 | 321.9 | 211.5 |

## Manhole Schedules for Pond 3-4

| **MH Name** | **MH CL (m)** | **MH Depth (m)** | **MH Connection** | **MH Diam.,L*W (mm)** | **PN** | **Pipe Out Invert Level (m)** | **Diameter (mm)** | **PN** | **Pipes In Invert Level (m)** | **Diameter (mm)** | **Back (m** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S03-04-1 | 140.086 | 1.586 | Open Manhole | 1200 | S1.000 | 138.500 | 225 | | | | |
| S03-04-2 | 139.948 | 2.492 | Open Manhole | 1200 | S1.001 | 137.456 | 225 | S1.000 | 137.456 | 225 | |
| S03-04-3 | 139.368 | 2.485 | Open Manhole | 1200 | S1.002 | 136.883 | 300 | S1.001 | 136.958 | 225 | |
| S03-04-4 | 138.616 | 2.218 | Open Manhole | 1200 | S1.003 | 136.398 | 300 | S1.002 | 136.398 | 300 | |
| S03-04-5 | 138.327 | 2.109 | Open Manhole | 1200 | S1.004 | 136.218 | 300 | S1.003 | 136.218 | 300 | |
| S03-04-6 | 137.675 | 1.748 | Open Manhole | 1200 | S1.005 | 135.927 | 300 | S1.004 | 135.927 | 300 | |
| S03-04-7 | 136.687 | 1.500 | Open Manhole | 1200 | S1.006 | 135.187 | 300 | S1.005 | 135.187 | 300 | |
| S03-04-8 | 135.556 | 1.499 | Open Manhole | 1200 | S1.007 | 134.057 | 300 | S1.006 | 134.057 | 300 | |
| S03-04-9 | 134.267 | 1.608 | Open Manhole | 1350 | S1.008 | 132.659 | 375 | S1.007 | 132.734 | 300 | |
| S03-04-10 | 133.026 | 1.621 | Open Manhole | 1350 | S1.009 | 131.405 | 375 | S1.008 | 131.405 | 375 | |
| S03-04-11 | 140.105 | 1.505 | Open Manhole | 1200 | S2.000 | 138.600 | 225 | | | | |
| S03-04-12 | 140.611 | 1.511 | Open Manhole | 1200 | S3.000 | 139.100 | 225 | | | | |
| S03-04-13 | 139.741 | 1.357 | Open Manhole | 1200 | S3.001 | 138.384 | 300 | S3.000 | 138.459 | 225 | |
| S03-04-14 | 139.325 | 1.256 | Open Manhole | 1350 | S3.002 | 138.069 | 375 | S3.001 | 138.144 | 300 | |
| S03-04-15 | 139.565 | 2.374 | Open Manhole | 1350 | S2.001 | 137.191 | 375 | S2.000 | 137.341 | 225 | |
| | | | | | | | | S3.002 | 137.949 | 375 | |
| S03-04-16 | 139.772 | 2.653 | Open Manhole | 1350 | S2.002 | 137.119 | 375 | S2.001 | 137.119 | 375 | |
| S03-04-17 | 139.434 | 2.612 | Open Manhole | 1350 | S2.003 | 136.822 | 375 | S2.002 | 136.822 | 375 | |
| S03-04-18 | 138.910 | 2.436 | Open Manhole | 1350 | S2.004 | 136.474 | 375 | S2.003 | 136.474 | 375 | |
| S03-04-19 | 138.253 | 2.082 | Open Manhole | 1350 | S2.005 | 136.171 | 375 | S2.004 | 136.171 | 375 | |
| S03-04-20 | 137.541 | 1.670 | Open Manhole | 1350 | S2.006 | 135.871 | 375 | S2.005 | 135.871 | 375 | |
| S03-04-21 | 136.376 | 1.576 | Open Manhole | 1350 | S2.007 | 134.800 | 375 | S2.006 | 134.800 | 375 | |
| S03-04-22 | 134.986 | 1.576 | Open Manhole | 1350 | S2.008 | 133.410 | 375 | S2.007 | 133.410 | 375 | |
| S03-04-23 | 133.319 | 1.576 | Open Manhole | 1350 | S2.009 | 131.743 | 375 | S2.008 | 131.743 | 375 | |
| S03-04-24 | 131.471 | 1.576 | Open Manhole | 1350 | S2.010 | 129.895 | 375 | S2.009 | 129.895 | 375 | |
| S03-04-25 | 131.377 | 1.685 | Open Manhole | 1350 | S1.010 | 129.692 | 375 | S1.009 | 129.692 | 375 | |
| | | | | | | | | S2.010 | 129.692 | 375 | |
| S03-04-26 | 126.400 | 1.196 | Open Manhole | 1350 | S1.011 | 125.204 | 450 | S1.010 | 125.279 | 375 | |
| S | 130.292 | 5.130 | Open Manhole | 0 | | OUTFALL | | S1.011 | 125.162 | 450 | |

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S03-04-1 | 357116.393 | 528853.641 | 357116.393 | 528853.641 | Required | |

## Manhole Schedules for Pond 3-4

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S03-04-2 | 357054.239 | 528863.620 | 357054.239 | 528863.620 | Required |  |
| S03-04-3 | 356971.273 | 528870.444 | 356971.273 | 528870.444 | Required |  |
| S03-04-4 | 356890.105 | 528875.843 | 356890.105 | 528875.843 | Required |  |
| S03-04-5 | 356860.062 | 528873.866 | 356860.062 | 528873.866 | Required |  |
| S03-04-6 | 356811.296 | 528876.800 | 356811.296 | 528876.800 | Required |  |
| S03-04-7 | 356751.266 | 528880.258 | 356751.266 | 528880.258 | Required |  |
| S03-04-8 | 356691.511 | 528883.787 | 356691.511 | 528883.787 | Required |  |
| S03-04-9 | 356632.079 | 528887.277 | 356632.079 | 528887.277 | Required |  |
| S03-04-10 | 356582.093 | 528891.337 | 356582.093 | 528891.337 | Required |  |
| S03-04-11 | 357093.173 | 528826.511 | 357093.173 | 528826.511 | Required |  |
| S03-04-12 | 357027.458 | 528740.645 | 357027.458 | 528740.645 | Required |  |
| S03-04-13 | 357031.082 | 528777.972 | 357031.082 | 528777.972 | Required |  |
| S03-04-14 | 357032.030 | 528813.879 | 357032.030 | 528813.879 | Required |  |
| S03-04-15 | 357019.967 | 528830.650 | 357019.967 | 528830.650 | Required |  |
| S03-04-16 | 357008.941 | 528835.605 | 357008.941 | 528835.605 | Required |  |

## Manhole Schedules for Pond 3-4

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S03-04-17 | 356959.746 | 528841.535 | 356959.746 | 528841.535 | Required |  |
| S03-04-18 | 356900.325 | 528847.447 | 356900.325 | 528847.447 | Required |  |
| S03-04-19 | 356850.402 | 528851.923 | 356850.402 | 528851.923 | Required |  |
| S03-04-20 | 356800.210 | 528854.881 | 356800.210 | 528854.881 | Required |  |
| S03-04-21 | 356731.023 | 528858.934 | 356731.023 | 528858.934 | Required |  |
| S03-04-22 | 356661.326 | 528862.994 | 356661.326 | 528862.994 | Required |  |
| S03-04-23 | 356591.038 | 528867.388 | 356591.038 | 528867.388 | Required |  |
| S03-04-24 | 356521.229 | 528871.410 | 356521.229 | 528871.410 | Required |  |
| S03-04-25 | 356522.458 | 528897.383 | 356522.458 | 528897.383 | Required |  |
| S03-04-26 | 356503.922 | 528927.431 | 356503.922 | 528927.431 | Required |  |
| S | 356501.323 | 528930.779 | | | No Entry |  |

## PIPELINE SCHEDULES for Pond 3-4

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | o | 225 | S03-04-1 | 140.086 | 138.500 | 1.361 | Open Manhole | 1200 |
| S1.001 | o | 225 | S03-04-2 | 139.948 | 137.456 | 2.267 | Open Manhole | 1200 |
| S1.002 | o | 300 | S03-04-3 | 139.368 | 136.883 | 2.185 | Open Manhole | 1200 |
| S1.003 | o | 300 | S03-04-4 | 138.616 | 136.398 | 1.918 | Open Manhole | 1200 |
| S1.004 | o | 300 | S03-04-5 | 138.327 | 136.218 | 1.809 | Open Manhole | 1200 |
| S1.005 | o | 300 | S03-04-6 | 137.675 | 135.927 | 1.448 | Open Manhole | 1200 |
| S1.006 | o | 300 | S03-04-7 | 136.687 | 135.187 | 1.200 | Open Manhole | 1200 |
| S1.007 | o | 300 | S03-04-8 | 135.556 | 134.057 | 1.199 | Open Manhole | 1200 |
| S1.008 | o | 375 | S03-04-9 | 134.267 | 132.659 | 1.233 | Open Manhole | 1350 |
| S1.009 | o | 375 | S03-04-10 | 133.026 | 131.405 | 1.246 | Open Manhole | 1350 |
| S2.000 | o | 225 | S03-04-11 | 140.105 | 138.600 | 1.280 | Open Manhole | 1200 |
| S3.000 | o | 225 | S03-04-12 | 140.611 | 139.100 | 1.286 | Open Manhole | 1200 |
| S3.001 | o | 300 | S03-04-13 | 139.741 | 138.384 | 1.057 | Open Manhole | 1200 |
| S3.002 | o | 375 | S03-04-14 | 139.325 | 138.069 | 0.881 | Open Manhole | 1350 |
| S2.001 | o | 375 | S03-04-15 | 139.565 | 137.191 | 1.999 | Open Manhole | 1350 |
| S2.002 | o | 375 | S03-04-16 | 139.772 | 137.119 | 2.278 | Open Manhole | 1350 |
| S2.003 | o | 375 | S03-04-17 | 139.434 | 136.822 | 2.237 | Open Manhole | 1350 |
| S2.004 | o | 375 | S03-04-18 | 138.910 | 136.474 | 2.061 | Open Manhole | 1350 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | 62.950 | 60.3 | S03-04-2 | 139.948 | 137.456 | 2.267 | Open Manhole | 1200 |
| S1.001 | 83.246 | 167.2 | S03-04-3 | 139.368 | 136.958 | 2.185 | Open Manhole | 1200 |
| S1.002 | 81.347 | 167.7 | S03-04-4 | 138.616 | 136.398 | 1.918 | Open Manhole | 1200 |
| S1.003 | 30.108 | 167.3 | S03-04-5 | 138.327 | 136.218 | 1.809 | Open Manhole | 1200 |
| S1.004 | 48.854 | 167.9 | S03-04-6 | 137.675 | 135.927 | 1.448 | Open Manhole | 1200 |
| S1.005 | 60.129 | 81.3 | S03-04-7 | 136.687 | 135.187 | 1.200 | Open Manhole | 1200 |
| S1.006 | 59.860 | 53.0 | S03-04-8 | 135.556 | 134.057 | 1.199 | Open Manhole | 1200 |
| S1.007 | 59.534 | 45.0 | S03-04-9 | 134.267 | 132.734 | 1.233 | Open Manhole | 1350 |
| S1.008 | 50.151 | 40.0 | S03-04-10 | 133.026 | 131.405 | 1.246 | Open Manhole | 1350 |
| S1.009 | 59.941 | 35.0 | S03-04-25 | 131.377 | 129.692 | 1.310 | Open Manhole | 1350 |
| S2.000 | 73.323 | 58.2 | S03-04-15 | 139.565 | 137.341 | 1.999 | Open Manhole | 1350 |
| S3.000 | 37.503 | 58.5 | S03-04-13 | 139.741 | 138.459 | 1.057 | Open Manhole | 1200 |
| S3.001 | 35.920 | 149.7 | S03-04-14 | 139.325 | 138.144 | 0.881 | Open Manhole | 1350 |
| S3.002 | 20.658 | 172.2 | S03-04-15 | 139.565 | 137.949 | 1.241 | Open Manhole | 1350 |
| S2.001 | 12.088 | 167.9 | S03-04-16 | 139.772 | 137.119 | 2.278 | Open Manhole | 1350 |
| S2.002 | 49.552 | 166.8 | S03-04-17 | 139.434 | 136.822 | 2.237 | Open Manhole | 1350 |
| S2.003 | 59.714 | 171.6 | S03-04-18 | 138.910 | 136.474 | 2.061 | Open Manhole | 1350 |
| S2.004 | 50.124 | 165.4 | S03-04-19 | 138.253 | 136.171 | 1.707 | Open Manhole | 1350 |

## PIPELINE SCHEDULES for Pond 3-4

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S2.005 | o | 375 | S03-04-19 | 138.253 | 136.171 | 1.707 | Open Manhole | 1350 |
| S2.006 | o | 375 | S03-04-20 | 137.541 | 135.871 | 1.295 | Open Manhole | 1350 |
| S2.007 | o | 375 | S03-04-21 | 136.376 | 134.800 | 1.201 | Open Manhole | 1350 |
| S2.008 | o | 375 | S03-04-22 | 134.986 | 133.410 | 1.201 | Open Manhole | 1350 |
| S2.009 | o | 375 | S03-04-23 | 133.319 | 131.743 | 1.201 | Open Manhole | 1350 |
| S2.010 | o | 375 | S03-04-24 | 131.471 | 129.895 | 1.201 | Open Manhole | 1350 |
| S1.010 | o | 375 | S03-04-25 | 131.377 | 129.692 | 1.310 | Open Manhole | 1350 |
| S1.011 | o | 450 | S03-04-26 | 126.400 | 125.204 | 0.746 | Open Manhole | 1350 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S2.005 | 50.279 | 167.6 | S03-04-20 | 137.541 | 135.871 | 1.295 | Open Manhole | 1350 |
| S2.006 | 69.305 | 64.7 | S03-04-21 | 136.376 | 134.800 | 1.201 | Open Manhole | 1350 |
| S2.007 | 69.815 | 50.2 | S03-04-22 | 134.986 | 133.410 | 1.201 | Open Manhole | 1350 |
| S2.008 | 70.426 | 42.2 | S03-04-23 | 133.319 | 131.743 | 1.201 | Open Manhole | 1350 |
| S2.009 | 69.925 | 37.8 | S03-04-24 | 131.471 | 129.895 | 1.201 | Open Manhole | 1350 |
| S2.010 | 26.002 | 128.1 | S03-04-25 | 131.377 | 129.692 | 1.310 | Open Manhole | 1350 |
| S1.010 | 35.306 | 8.0 | S03-04-26 | 126.400 | 125.279 | 0.746 | Open Manhole | 1350 |
| S1.011 | 4.238 | 100.9 | S | 130.292 | 125.162 | 4.680 | Open Manhole | 0 |

## Area Summary for Pond 3-4

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | - | - | 100 | 0.121 | 0.121 | 0.121 |
| 1.001 | - | - | 100 | 0.132 | 0.132 | 0.132 |
| 1.002 | - | - | 100 | 0.136 | 0.136 | 0.136 |
| 1.003 | - | - | 100 | 0.047 | 0.047 | 0.047 |
| 1.004 | - | - | 100 | 0.064 | 0.064 | 0.064 |
| 1.005 | - | - | 100 | 0.079 | 0.079 | 0.079 |
| 1.006 | - | - | 100 | 0.079 | 0.079 | 0.079 |
| 1.007 | - | - | 100 | 0.093 | 0.093 | 0.093 |
| 1.008 | - | - | 100 | 0.071 | 0.071 | 0.071 |
| 1.009 | - | - | 100 | 0.080 | 0.080 | 0.080 |
| 2.000 | - | - | 100 | 0.166 | 0.166 | 0.166 |
| 3.000 | - | - | 100 | 0.070 | 0.070 | 0.070 |
| 3.001 | - | - | 100 | 0.051 | 0.051 | 0.051 |
| 3.002 | - | - | 100 | 0.028 | 0.028 | 0.028 |
| 2.001 | - | - | 100 | 0.031 | 0.031 | 0.031 |
| 2.002 | - | - | 100 | 0.077 | 0.077 | 0.077 |
| 2.003 | - | - | 100 | 0.078 | 0.078 | 0.078 |
| 2.004 | - | - | 100 | 0.067 | 0.067 | 0.067 |
| 2.005 | - | - | 100 | 0.066 | 0.066 | 0.066 |
| 2.006 | - | - | 100 | 0.092 | 0.092 | 0.092 |
| 2.007 | - | - | 100 | 0.095 | 0.095 | 0.095 |
| 2.008 | - | - | 100 | 0.098 | 0.098 | 0.098 |
| 2.009 | - | - | 100 | 0.096 | 0.096 | 0.096 |
| 2.010 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.010 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.011 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total<br>1.917 | Total<br>1.917 | Total<br>1.917 |

## Free Flowing Outfall Details for Pond 3-4

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| S1.011 | S | 130.292 | 125.162 | 0.000 | 0 | 0 |

## Simulation Criteria for Pond 3-4

| | | | |
|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Additional Flow - % of Total Flow | 40.000 |
| Areal Reduction Factor | 1.000 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start (mins) | 0 | Inlet Coeffiecient | 0.800 |
| Hot Start Level (mm) | 0 | Flow per Person per Day (l/per/day) | 0.000 |
| Manhole Headloss Coeff (Global) | 0.500 | Run Time (mins) | 60 |
| Foul Sewage per hectare (l/s) | 0.000 | Output Interval (mins) | 1 |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

## Simulation Criteria for Pond 3-4

### Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Profile Type | Summer |
| Return Period (years) | 5 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.300 | Storm Duration (mins) | 30 |
| Ratio R | 0.300 | | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-4

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 40.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Ratio R | 0.300 |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 15.000 | Cv (Winter) | 0.840 |

| | | | |
|---|---|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 | DVD Status | OFF |
| Analysis Timestep | Fine | Inertia Status | OFF |
| DTS Status | ON | | |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5 |
| Climate Change (%) | 20 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| S1.000 | S03-04-1 | 15 Winter | 5 | +20% | | | | |
| S1.001 | S03-04-2 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| S1.002 | S03-04-3 | 15 Winter | 5 | +20% | | | | |
| S1.003 | S03-04-4 | 15 Winter | 5 | +20% | 5/15 Winter | | | |
| S1.004 | S03-04-5 | 15 Winter | 5 | +20% | 5/15 Winter | | | |
| S1.005 | S03-04-6 | 15 Winter | 5 | +20% | | | | |
| S1.006 | S03-04-7 | 15 Winter | 5 | +20% | | | | |
| S1.007 | S03-04-8 | 30 Winter | 5 | +20% | | | | |
| S1.008 | S03-04-9 | 15 Winter | 5 | +20% | | | | |
| S1.009 | S03-04-10 | 15 Winter | 5 | +20% | | | | |
| S2.000 | S03-04-11 | 15 Winter | 5 | +20% | | | | |
| S3.000 | S03-04-12 | 15 Winter | 5 | +20% | | | | |
| S3.001 | S03-04-13 | 15 Winter | 5 | +20% | | | | |
| S3.002 | S03-04-14 | 15 Winter | 5 | +20% | | | | |
| S2.001 | S03-04-15 | 15 Winter | 5 | +20% | | | | |
| S2.002 | S03-04-16 | 15 Winter | 5 | +20% | | | | |
| S2.003 | S03-04-17 | 15 Winter | 5 | +20% | | | | |
| S2.004 | S03-04-18 | 15 Winter | 5 | +20% | | | | |
| S2.005 | S03-04-19 | 15 Winter | 5 | +20% | | | | |
| S2.006 | S03-04-20 | 15 Winter | 5 | +20% | | | | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-4

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S03-04-1 | 138.613 | -0.112 | 0.000 | 0.49 | | | 31.5 | OK |
| S1.001 | S03-04-2 | 138.127 | 0.446 | 0.000 | 1.33 | | | 51.9 | SURCHARGED |
| S1.002 | S03-04-3 | 137.112 | -0.071 | 0.000 | 0.91 | | | 74.8 | OK |
| S1.003 | S03-04-4 | 136.730 | 0.032 | 0.000 | 1.01 | | | 78.4 | SURCHARGED |
| S1.004 | S03-04-5 | 136.548 | 0.030 | 0.000 | 1.07 | | | 85.8 | SURCHARGED |
| S1.005 | S03-04-6 | 136.135 | -0.092 | 0.000 | 0.82 | | | 95.7 | OK |
| S1.006 | S03-04-7 | 135.381 | -0.106 | 0.000 | 0.74 | | | 107.5 | OK |
| S1.007 | S03-04-8 | 134.258 | -0.099 | 0.000 | 0.78 | | | 122.9 | OK |
| S1.008 | S03-04-9 | 132.838 | -0.196 | 0.000 | 0.46 | | | 134.2 | OK |
| S1.009 | S03-04-10 | 131.585 | -0.195 | 0.000 | 0.46 | | | 147.3 | OK |
| S2.000 | S03-04-11 | 138.736 | -0.089 | 0.000 | 0.65 | | | 43.0 | OK |
| S3.000 | S03-04-12 | 139.183 | -0.142 | 0.000 | 0.28 | | | 18.3 | OK |
| S3.001 | S03-04-13 | 138.509 | -0.175 | 0.000 | 0.36 | | | 29.8 | OK |
| S3.002 | S03-04-14 | 138.203 | -0.241 | 0.000 | 0.28 | | | 35.8 | OK |
| S2.001 | S03-04-15 | 137.445 | -0.121 | 0.000 | 0.80 | | | 85.5 | OK |
| S2.002 | S03-04-16 | 137.355 | -0.139 | 0.000 | 0.71 | | | 100.8 | OK |
| S2.003 | S03-04-17 | 137.080 | -0.117 | 0.000 | 0.80 | | | 113.9 | OK |
| S2.004 | S03-04-18 | 136.746 | -0.103 | 0.000 | 0.86 | | | 123.7 | OK |
| S2.005 | S03-04-19 | 136.458 | -0.088 | 0.000 | 0.93 | | | 132.7 | OK |
| S2.006 | S03-04-20 | 136.086 | -0.160 | 0.000 | 0.62 | | | 145.3 | OK |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| S1.000 | S03-04-1 | |
| S1.001 | S03-04-2 | |
| S1.002 | S03-04-3 | |
| S1.003 | S03-04-4 | |
| S1.004 | S03-04-5 | |
| S1.005 | S03-04-6 | |
| S1.006 | S03-04-7 | |
| S1.007 | S03-04-8 | |
| S1.008 | S03-04-9 | |
| S1.009 | S03-04-10 | |
| S2.000 | S03-04-11 | |
| S3.000 | S03-04-12 | |
| S3.001 | S03-04-13 | |
| S3.002 | S03-04-14 | |
| S2.001 | S03-04-15 | |
| S2.002 | S03-04-16 | |
| S2.003 | S03-04-17 | |
| S2.004 | S03-04-18 | |
| S2.005 | S03-04-19 | |
| S2.006 | S03-04-20 | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-4

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| S2.007 | S03-04-21 | 15 Winter | 5 | +20% | | | | |
| S2.008 | S03-04-22 | 15 Winter | 5 | +20% | | | | |
| S2.009 | S03-04-23 | 15 Winter | 5 | +20% | | | | |
| S2.010 | S03-04-24 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| S1.010 | S03-04-25 | 15 Winter | 5 | +20% | | | | |
| S1.011 | S03-04-26 | 15 Winter | 5 | +20% | 5/15 Summer | | | |

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S2.007 | S03-04-21 | 135.009 | -0.166 | 0.000 | 0.59 | | | 157.4 | OK |
| S2.008 | S03-04-22 | 133.617 | -0.168 | 0.000 | 0.58 | | | 169.5 | OK |
| S2.009 | S03-04-23 | 131.951 | -0.167 | 0.000 | 0.59 | | | 181.0 | OK |
| S2.010 | S03-04-24 | 130.331 | 0.061 | 0.000 | 1.17 | | | 180.2 | SURCHARGED |
| S1.010 | S03-04-25 | 129.881 | -0.186 | 0.000 | 0.50 | | | 322.2 | OK |
| S1.011 | S03-04-26 | 125.916 | 0.262 | 0.000 | 1.91 | | | 322.2 | SURCHARGED |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| S2.007 | S03-04-21 | |
| S2.008 | S03-04-22 | |
| S2.009 | S03-04-23 | |
| S2.010 | S03-04-24 | |
| S1.010 | S03-04-25 | |
| S1.011 | S03-04-26 | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Pond 3-5

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 15.100 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Time Area Diagram for Pond 3-5

| **Time (mins)** | **Area (ha)** | **Time (mins)** | **Area (ha)** | **Time (mins)** | **Area (ha)** |
|---|---|---|---|---|---|
| 0-4 | 0.358 | 4-8 | 0.914 | 8-12 | 0.031 |

Total Area Contributing (ha) = 1.303

Total Pipe Volume (m³) = 67.305

### Network Design Table for Pond 3-5

| **PN** | **Length (m)** | **Fall (m)** | **Slope (1:X)** | **I.Area (ha)** | **T.E. (mins)** | **Base Flow (l/s)** | **k (mm)** | **HYD SECT** | **DIA (mm)** | **Section Type** | **Auto Design** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 31.285 | 0.542 | 57.7 | 0.059 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S1.001 | 52.810 | 1.806 | 29.2 | 0.109 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S1.002 | 79.961 | 4.876 | 16.4 | 0.145 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S1.003 | 41.279 | 2.141 | 19.3 | 0.014 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.004 | 27.387 | 1.441 | 19.0 | 0.044 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.005 | 28.725 | 1.584 | 18.1 | 0.051 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.006 | 14.195 | 0.802 | 17.7 | 0.039 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |

### Network Results Table

| **PN** | **Rain (mm/hr)** | **T.C. (mins)** | **US/IL (m)** | **Σ I.Area (ha)** | **Σ Base Flow (l/s)** | **Foul (l/s)** | **Add Flow (l/s)** | **Vel (m/s)** | **Cap (l/s)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 57.77 | 5.30 | 149.300 | 0.059 | 0.0 | 0.0 | 0.0 | 1.72 | 68.6 | 9.2 |
| S1.001 | 56.28 | 5.66 | 148.758 | 0.168 | 0.0 | 0.0 | 0.0 | 2.43 | 96.6 | 25.6 |
| S1.002 | 54.71 | 6.08 | 146.952 | 0.313 | 0.0 | 0.0 | 0.0 | 3.25 | 129.1 | 46.4 |
| S1.003 | 54.01 | 6.27 | 142.001 | 0.327 | 0.0 | 0.0 | 0.0 | 3.60 | 254.3 | 47.8 |
| S1.004 | 53.56 | 6.39 | 139.860 | 0.371 | 0.0 | 0.0 | 0.0 | 3.62 | 256.1 | 53.8 |
| S1.005 | 53.11 | 6.52 | 138.419 | 0.422 | 0.0 | 0.0 | 0.0 | 3.71 | 262.2 | 60.7 |
| S1.006 | 52.89 | 6.58 | 136.835 | 0.461 | 0.0 | 0.0 | 0.0 | 3.75 | 265.4 | 66.0 |

## Network Design Table for Pond 3-5

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.007 | 15.072 | 0.802 | 18.8 | 0.026 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.008 | 17.585 | 1.834 | 9.6 | 0.042 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.009 | 13.908 | 0.066 | 212.2 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.010 | 56.828 | 0.268 | 212.0 | 0.088 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S1.011 | 56.828 | 3.455 | 16.4 | 0.092 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S1.012 | 26.709 | 0.534 | 50.0 | 0.055 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |
| S2.000 | 19.626 | 3.098 | 6.3 | 0.009 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S3.000 | 22.327 | 0.089 | 250.0 | 0.008 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S3.001 | 16.574 | 0.066 | 250.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.001 | 39.948 | 0.160 | 249.7 | 0.122 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.002 | 23.907 | 0.096 | 250.0 | 0.045 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.003 | 25.279 | 1.149 | 22.0 | 0.041 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.004 | 21.956 | 0.998 | 22.0 | 0.035 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.005 | 23.333 | 1.061 | 22.0 | 0.043 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.006 | 22.337 | 0.798 | 28.0 | 0.037 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S2.007 | 29.194 | 0.778 | 37.5 | 0.051 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S2.008 | 15.828 | 0.214 | 74.0 | 0.148 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S1.013 | 31.459 | 0.105 | 300.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.007 | 52.66 | 6.65 | 136.033 | 0.487 | 0.0 | 0.0 | 0.0 | 3.64 | 257.6 | 69.5 |
| S1.008 | 52.47 | 6.71 | 135.231 | 0.529 | 0.0 | 0.0 | 0.0 | 5.11 | 360.9 | 75.2 |
| S1.009 | 51.76 | 6.93 | 133.397 | 0.529 | 0.0 | 0.0 | 0.0 | 1.08 | 76.0 | 75.2 |
| S1.010 | 49.43 | 7.69 | 133.256 | 0.617 | 0.0 | 0.0 | 0.0 | 1.24 | 137.0 | 82.6 |
| S1.011 | 48.83 | 7.90 | 132.988 | 0.709 | 0.0 | 0.0 | 0.0 | 4.49 | 495.6 | 93.8 |
| S1.012 | 48.40 | 8.06 | 129.533 | 0.764 | 0.0 | 0.0 | 0.0 | 2.88 | 458.1 | 100.2 |
| S2.000 | 58.81 | 5.06 | 137.500 | 0.009 | 0.0 | 0.0 | 0.0 | 5.23 | 208.1 | 1.4 |
| S3.000 | 57.14 | 5.45 | 135.100 | 0.008 | 0.0 | 0.0 | 0.0 | 0.82 | 32.7 | 1.2 |
| S3.001 | 55.80 | 5.79 | 135.011 | 0.008 | 0.0 | 0.0 | 0.0 | 0.82 | 32.7 | 1.2 |
| S2.001 | 52.85 | 6.60 | 134.402 | 0.139 | 0.0 | 0.0 | 0.0 | 0.82 | 32.7 | 19.9 |
| S2.002 | 51.26 | 7.08 | 134.242 | 0.184 | 0.0 | 0.0 | 0.0 | 0.82 | 32.7 | 25.5 |
| S2.003 | 50.79 | 7.23 | 134.146 | 0.225 | 0.0 | 0.0 | 0.0 | 2.80 | 111.4 | 30.9 |
| S2.004 | 50.39 | 7.36 | 132.997 | 0.260 | 0.0 | 0.0 | 0.0 | 2.80 | 111.4 | 35.5 |
| S2.005 | 49.98 | 7.50 | 131.999 | 0.303 | 0.0 | 0.0 | 0.0 | 2.80 | 111.4 | 41.0 |
| S2.006 | 49.61 | 7.63 | 130.863 | 0.340 | 0.0 | 0.0 | 0.0 | 2.98 | 210.9 | 45.7 |
| S2.007 | 49.07 | 7.82 | 130.065 | 0.391 | 0.0 | 0.0 | 0.0 | 2.57 | 182.0 | 51.9 |
| S2.008 | 48.72 | 7.94 | 129.212 | 0.539 | 0.0 | 0.0 | 0.0 | 2.11 | 232.9 | 71.1 |
| S1.013 | 47.21 | 8.50 | 128.923 | 1.303 | 0.0 | 0.0 | 0.0 | 1.17 | 185.8 | 166.6 |

## Network Design Table for Pond 3-5

| **PN** | **Length (m)** | **Fall (m)** | **Slope (1:X)** | **I.Area (ha)** | **T.E. (mins)** | **Base Flow (l/s)** | **k (mm)** | **HYD SECT** | **DIA (mm)** | **Section Type** | **Auto Design** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.014 | 24.607 | 0.082 | 300.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S1.015 | 37.843 | 0.126 | 300.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S1.016 | 25.622 | 0.256 | 100.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S1.017 | 4.583 | 0.382 | 12.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |

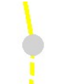
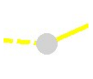
## Network Results Table

| **PN** | **Rain (mm/hr)** | **T.C. (mins)** | **US/IL (m)** | **Σ I.Area (ha)** | **Σ Base Flow (l/s)** | **Foul (l/s)** | **Add Flow (l/s)** | **Vel (m/s)** | **Cap (l/s)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.014 | 46.32 | 8.86 | 128.818 | 1.303 | 0.0 | 0.0 | 0.0 | 1.17 | 185.8 | 166.6 |
| S1.015 | 45.04 | 9.39 | 128.736 | 1.303 | 0.0 | 0.0 | 0.0 | 1.17 | 185.8 | 166.6 |
| S1.016 | 44.56 | 9.60 | 128.610 | 1.303 | 0.0 | 0.0 | 0.0 | 2.03 | 323.4 | 166.6 |
| S1.017 | 44.53 | 9.62 | 128.354 | 1.303 | 0.0 | 0.0 | 0.0 | 5.89 | 937.3 | 166.6 |

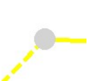
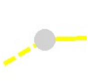
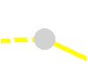
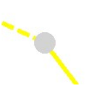
## Manhole Schedules for Pond 3-5

| **MH Name** | **MH CL (m)** | **MH Depth (m)** | **MH Connection** | **MH Diam.,L*W (mm)** | **PN** | **Pipe Out Invert Level (m)** | **Diameter (mm)** | **PN** | **Pipes In Invert Level (m)** | **Diameter (mm)** | **Back (m** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S03-05-1 | 150.556 | 1.256 | Open Manhole | 1200 | S1.000 | 149.300 | 225 | | | | |
| S03-05-2 | 149.762 | 1.004 | Open Manhole | 1200 | S1.001 | 148.758 | 225 | S1.000 | 148.758 | 225 | |
| S03-05-3 | 148.374 | 1.422 | Open Manhole | 1200 | S1.002 | 146.952 | 225 | S1.001 | 146.952 | 225 | |
| S03-05-4 | 143.501 | 1.500 | Open Manhole | 1200 | S1.003 | 142.001 | 300 | S1.002 | 142.076 | 225 | |
| S03-05-5 | 141.361 | 1.501 | Open Manhole | 1200 | S1.004 | 139.860 | 300 | S1.003 | 139.860 | 300 | |
| S03-05-6 | 139.919 | 1.500 | Open Manhole | 1200 | S1.005 | 138.419 | 300 | S1.004 | 138.419 | 300 | |
| S03-05-7 | 138.335 | 1.500 | Open Manhole | 1200 | S1.006 | 136.835 | 300 | S1.005 | 136.835 | 300 | |
| S03-05-8 | 137.194 | 1.161 | Open Manhole | 1200 | S1.007 | 136.033 | 300 | S1.006 | 136.033 | 300 | |
| S03-05-9 | 136.092 | 0.861 | Open Manhole | 1200 | S1.008 | 135.231 | 300 | S1.007 | 135.231 | 300 | |
| S03-05-10 | 134.897 | 1.500 | Open Manhole | 1200 | S1.009 | 133.397 | 300 | S1.008 | 133.397 | 300 | |
| S03-05-11 | 134.831 | 1.575 | Open Manhole | 1350 | S1.010 | 133.256 | 375 | S1.009 | 133.331 | 300 | |
| S03-05-12 | 140.165 | 7.177 | Open Manhole | 1350 | S1.011 | 132.988 | 375 | S1.010 | 132.988 | 375 | |
| S03-05-13 | 131.183 | 1.650 | Open Manhole | 1350 | S1.012 | 129.533 | 450 | S1.011 | 129.533 | 375 | |
| S03-05-14 | 139.011 | 1.511 | Open Manhole | 1200 | S2.000 | 137.500 | 225 | | | | |
| S03-05-15 | 136.666 | 1.566 | Open Manhole | 1200 | S3.000 | 135.100 | 225 | | | | |
| S03-05-16 | 138.563 | 3.553 | Open Manhole | 1200 | S3.001 | 135.011 | 225 | S3.000 | 135.011 | 225 | |
| S03-05-17 | 138.355 | 3.953 | Open Manhole | 1200 | S2.001 | 134.402 | 225 | S2.000 | 134.402 | 225 | |
| | | | | | | | | S3.001 | 134.944 | 225 | |
| S03-05-18 | 136.762 | 2.520 | Open Manhole | 1200 | S2.002 | 134.242 | 225 | S2.001 | 134.242 | 225 | |
| S03-05-19 | 135.669 | 1.523 | Open Manhole | 1200 | S2.003 | 134.146 | 225 | S2.002 | 134.146 | 225 | |
| S03-05-20 | 134.508 | 1.511 | Open Manhole | 1200 | S2.004 | 132.997 | 225 | S2.003 | 132.997 | 225 | |
| S03-05-21 | 133.499 | 1.500 | Open Manhole | 1200 | S2.005 | 131.999 | 225 | S2.004 | 131.999 | 225 | |
| S03-05-22 | 132.439 | 1.575 | Open Manhole | 1200 | S2.006 | 130.863 | 300 | S2.005 | 130.938 | 225 | |
| S03-05-23 | 131.658 | 1.592 | Open Manhole | 1200 | S2.007 | 130.065 | 300 | S2.006 | 130.065 | 300 | |
| S03-05-24 | 131.135 | 1.923 | Open Manhole | 1350 | S2.008 | 129.212 | 375 | S2.007 | 129.287 | 300 | |
| S03-05-25 | 131.061 | 2.138 | Open Manhole | 1350 | S1.013 | 128.923 | 450 | S1.012 | 128.999 | 450 | |
| | | | | | | | | S2.008 | 128.998 | 375 | |
| S03-05-26 | 131.591 | 2.773 | Open Manhole | 1350 | S1.014 | 128.818 | 450 | S1.013 | 128.818 | 450 | |
| S03-05-27 | 132.243 | 3.506 | Open Manhole | 1350 | S1.015 | 128.736 | 450 | S1.014 | 128.736 | 450 | |
| S03-05-28 | 130.000 | 1.390 | Open Manhole | 1350 | S1.016 | 128.610 | 450 | S1.015 | 128.610 | 450 | |
| S03-05-29 | 130.000 | 1.646 | Open Manhole | 1350 | S1.017 | 128.354 | 450 | S1.016 | 128.354 | 450 | |
| S | 128.480 | 0.508 | Open Manhole | 0 | | OUTFALL | | S1.017 | 127.972 | 450 | |

## Manhole Schedules for Pond 3-5

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S03-05-1 | 357066.271 | 528512.930 | 357066.271 | 528512.930 | Required |  |
| S03-05-2 | 357067.568 | 528544.188 | 357067.568 | 528544.188 | Required |  |
| S03-05-3 | 357057.981 | 528596.120 | 357057.981 | 528596.120 | Required |  |
| S03-05-4 | 357042.033 | 528674.475 | 357042.033 | 528674.475 | Required |  |
| S03-05-5 | 357038.832 | 528715.629 | 357038.832 | 528715.629 | Required |  |
| S03-05-6 | 357053.673 | 528738.646 | 357053.673 | 528738.646 | Required |  |
| S03-05-7 | 357082.304 | 528736.325 | 357082.304 | 528736.325 | Required |  |
| S03-05-8 | 357095.288 | 528742.065 | 357095.288 | 528742.065 | Required |  |
| S03-05-9 | 357104.598 | 528753.918 | 357104.598 | 528753.918 | Required |  |
| S03-05-10 | 357108.632 | 528771.034 | 357108.632 | 528771.034 | Required |  |
| S03-05-11 | 357122.488 | 528769.835 | 357122.488 | 528769.835 | Required |  |
| S03-05-12 | 357127.910 | 528826.404 | 357127.910 | 528826.404 | Required |  |
| S03-05-13 | 357133.331 | 528882.972 | 357133.331 | 528882.972 | Required |  |
| S03-05-14 | 357032.890 | 528873.528 | 357032.890 | 528873.528 | Required |  |
| S03-05-15 | 356992.281 | 528876.090 | 356992.281 | 528876.090 | Required |  |

## Manhole Schedules for Pond 3-5

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S03-05-16 | 357007.875 | 528892.070 | 357007.875 | 528892.070 | Required |  |
| S03-05-17 | 357024.428 | 528891.237 | 357024.428 | 528891.237 | Required |  |
| S03-05-18 | 357028.268 | 528930.999 | 357028.268 | 528930.999 | Required |  |
| S03-05-19 | 357039.913 | 528951.878 | 357039.913 | 528951.878 | Required |  |
| S03-05-20 | 357061.672 | 528964.745 | 357061.672 | 528964.745 | Required |  |
| S03-05-21 | 357083.608 | 528965.674 | 357083.608 | 528965.674 | Required |  |
| S03-05-22 | 357104.733 | 528955.765 | 357104.733 | 528955.765 | Required |  |
| S03-05-23 | 357118.262 | 528937.992 | 357118.262 | 528937.992 | Required |  |
| S03-05-24 | 357121.649 | 528908.995 | 357121.649 | 528908.995 | Required |  |
| S03-05-25 | 357137.473 | 528909.359 | 357137.473 | 528909.359 | Required |  |
| S03-05-26 | 357132.042 | 528940.346 | 357132.042 | 528940.346 | Required |  |
| S03-05-27 | 357119.157 | 528961.310 | 357119.157 | 528961.310 | Required |  |
| S03-05-28 | 357096.167 | 528991.369 | 357096.167 | 528991.369 | Required |  |
| S03-05-29 | 357079.253 | 529010.615 | 357079.253 | 529010.615 | Required |  |
| S | 357083.836 | 529010.615 | | | No Entry |  |

## PIPELINE SCHEDULES for Pond 3-5

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | o | 225 | S03-05-1 | 150.556 | 149.300 | 1.031 | Open Manhole | 1200 |
| S1.001 | o | 225 | S03-05-2 | 149.762 | 148.758 | 0.779 | Open Manhole | 1200 |
| S1.002 | o | 225 | S03-05-3 | 148.374 | 146.952 | 1.197 | Open Manhole | 1200 |
| S1.003 | o | 300 | S03-05-4 | 143.501 | 142.001 | 1.200 | Open Manhole | 1200 |
| S1.004 | o | 300 | S03-05-5 | 141.361 | 139.860 | 1.201 | Open Manhole | 1200 |
| S1.005 | o | 300 | S03-05-6 | 139.919 | 138.419 | 1.200 | Open Manhole | 1200 |
| S1.006 | o | 300 | S03-05-7 | 138.335 | 136.835 | 1.200 | Open Manhole | 1200 |
| S1.007 | o | 300 | S03-05-8 | 137.194 | 136.033 | 0.861 | Open Manhole | 1200 |
| S1.008 | o | 300 | S03-05-9 | 136.092 | 135.231 | 0.561 | Open Manhole | 1200 |
| S1.009 | o | 300 | S03-05-10 | 134.897 | 133.397 | 1.200 | Open Manhole | 1200 |
| S1.010 | o | 375 | S03-05-11 | 134.831 | 133.256 | 1.200 | Open Manhole | 1350 |
| S1.011 | o | 375 | S03-05-12 | 140.165 | 132.988 | 6.802 | Open Manhole | 1350 |
| S1.012 | o | 450 | S03-05-13 | 131.183 | 129.533 | 1.200 | Open Manhole | 1350 |
| S2.000 | o | 225 | S03-05-14 | 139.011 | 137.500 | 1.286 | Open Manhole | 1200 |
| S3.000 | o | 225 | S03-05-15 | 136.666 | 135.100 | 1.341 | Open Manhole | 1200 |
| S3.001 | o | 225 | S03-05-16 | 138.563 | 135.011 | 3.328 | Open Manhole | 1200 |
| S2.001 | o | 225 | S03-05-17 | 138.355 | 134.402 | 3.728 | Open Manhole | 1200 |
| S2.002 | o | 225 | S03-05-18 | 136.762 | 134.242 | 2.295 | Open Manhole | 1200 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | 31.285 | 57.7 | S03-05-2 | 149.762 | 148.758 | 0.779 | Open Manhole | 1200 |
| S1.001 | 52.810 | 29.2 | S03-05-3 | 148.374 | 146.952 | 1.197 | Open Manhole | 1200 |
| S1.002 | 79.961 | 16.4 | S03-05-4 | 143.501 | 142.076 | 1.200 | Open Manhole | 1200 |
| S1.003 | 41.279 | 19.3 | S03-05-5 | 141.361 | 139.860 | 1.201 | Open Manhole | 1200 |
| S1.004 | 27.387 | 19.0 | S03-05-6 | 139.919 | 138.419 | 1.200 | Open Manhole | 1200 |
| S1.005 | 28.725 | 18.1 | S03-05-7 | 138.335 | 136.835 | 1.200 | Open Manhole | 1200 |
| S1.006 | 14.195 | 17.7 | S03-05-8 | 137.194 | 136.033 | 0.861 | Open Manhole | 1200 |
| S1.007 | 15.072 | 18.8 | S03-05-9 | 136.092 | 135.231 | 0.561 | Open Manhole | 1200 |
| S1.008 | 17.585 | 9.6 | S03-05-10 | 134.897 | 133.397 | 1.200 | Open Manhole | 1200 |
| S1.009 | 13.908 | 212.2 | S03-05-11 | 134.831 | 133.331 | 1.200 | Open Manhole | 1350 |
| S1.010 | 56.828 | 212.0 | S03-05-12 | 140.165 | 132.988 | 6.802 | Open Manhole | 1350 |
| S1.011 | 56.828 | 16.4 | S03-05-13 | 131.183 | 129.533 | 1.275 | Open Manhole | 1350 |
| S1.012 | 26.709 | 50.0 | S03-05-25 | 131.061 | 128.999 | 1.612 | Open Manhole | 1350 |
| S2.000 | 19.626 | 6.3 | S03-05-17 | 138.355 | 134.402 | 3.728 | Open Manhole | 1200 |
| S3.000 | 22.327 | 250.0 | S03-05-16 | 138.563 | 135.011 | 3.328 | Open Manhole | 1200 |
| S3.001 | 16.574 | 250.0 | S03-05-17 | 138.355 | 134.944 | 3.185 | Open Manhole | 1200 |
| S2.001 | 39.948 | 249.7 | S03-05-18 | 136.762 | 134.242 | 2.295 | Open Manhole | 1200 |
| S2.002 | 23.907 | 250.0 | S03-05-19 | 135.669 | 134.146 | 1.298 | Open Manhole | 1200 |

## PIPELINE SCHEDULES for Pond 3-5

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S2.003 | o | 225 | S03-05-19 | 135.669 | 134.146 | 1.298 | Open Manhole | 1200 |
| S2.004 | o | 225 | S03-05-20 | 134.508 | 132.997 | 1.286 | Open Manhole | 1200 |
| S2.005 | o | 225 | S03-05-21 | 133.499 | 131.999 | 1.275 | Open Manhole | 1200 |
| S2.006 | o | 300 | S03-05-22 | 132.439 | 130.863 | 1.275 | Open Manhole | 1200 |
| S2.007 | o | 300 | S03-05-23 | 131.658 | 130.065 | 1.292 | Open Manhole | 1200 |
| S2.008 | o | 375 | S03-05-24 | 131.135 | 129.212 | 1.548 | Open Manhole | 1350 |
| | | | | | | | | |
| S1.013 | o | 450 | S03-05-25 | 131.061 | 128.923 | 1.688 | Open Manhole | 1350 |
| S1.014 | o | 450 | S03-05-26 | 131.591 | 128.818 | 2.323 | Open Manhole | 1350 |
| S1.015 | o | 450 | S03-05-27 | 132.243 | 128.736 | 3.056 | Open Manhole | 1350 |
| S1.016 | o | 450 | S03-05-28 | 130.000 | 128.610 | 0.940 | Open Manhole | 1350 |
| S1.017 | o | 450 | S03-05-29 | 130.000 | 128.354 | 1.196 | Open Manhole | 1350 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S2.003 | 25.279 | 22.0 | S03-05-20 | 134.508 | 132.997 | 1.286 | Open Manhole | 1200 |
| S2.004 | 21.956 | 22.0 | S03-05-21 | 133.499 | 131.999 | 1.275 | Open Manhole | 1200 |
| S2.005 | 23.333 | 22.0 | S03-05-22 | 132.439 | 130.938 | 1.275 | Open Manhole | 1200 |
| S2.006 | 22.337 | 28.0 | S03-05-23 | 131.658 | 130.065 | 1.292 | Open Manhole | 1200 |
| S2.007 | 29.194 | 37.5 | S03-05-24 | 131.135 | 129.287 | 1.548 | Open Manhole | 1350 |
| S2.008 | 15.828 | 74.0 | S03-05-25 | 131.061 | 128.998 | 1.688 | Open Manhole | 1350 |
| | | | | | | | | |
| S1.013 | 31.459 | 300.0 | S03-05-26 | 131.591 | 128.818 | 2.323 | Open Manhole | 1350 |
| S1.014 | 24.607 | 300.0 | S03-05-27 | 132.243 | 128.736 | 3.056 | Open Manhole | 1350 |
| S1.015 | 37.843 | 300.0 | S03-05-28 | 130.000 | 128.610 | 0.940 | Open Manhole | 1350 |
| S1.016 | 25.622 | 100.0 | S03-05-29 | 130.000 | 128.354 | 1.196 | Open Manhole | 1350 |
| S1.017 | 4.583 | 12.0 | S | 128.480 | 127.972 | 0.058 | Open Manhole | 0 |

## Area Summary for Pond 3-5

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | - | - | 100 | 0.059 | 0.059 | 0.059 |
| 1.001 | - | - | 100 | 0.109 | 0.109 | 0.109 |
| 1.002 | - | - | 100 | 0.145 | 0.145 | 0.145 |
| 1.003 | - | - | 100 | 0.014 | 0.014 | 0.014 |
| 1.004 | - | - | 100 | 0.044 | 0.044 | 0.044 |
| 1.005 | - | - | 100 | 0.051 | 0.051 | 0.051 |
| 1.006 | - | - | 100 | 0.039 | 0.039 | 0.039 |
| 1.007 | User | - | 100 | 0.024 | 0.024 | 0.024 |
|  | User | - | 50 | 0.003 | 0.002 | 0.026 |
|  | User | - | 50 | 0.001 | 0.000 | 0.026 |
| 1.008 | - | - | 100 | 0.042 | 0.042 | 0.042 |
| 1.009 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.010 | - | - | 100 | 0.088 | 0.088 | 0.088 |
| 1.011 | - | - | 100 | 0.092 | 0.092 | 0.092 |
| 1.012 | - | - | 100 | 0.055 | 0.055 | 0.055 |
| 2.000 | User | - | 50 | 0.018 | 0.009 | 0.009 |
| 3.000 | User | - | 50 | 0.016 | 0.008 | 0.008 |
| 3.001 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 2.001 | - | - | 100 | 0.122 | 0.122 | 0.122 |
| 2.002 | - | - | 100 | 0.045 | 0.045 | 0.045 |
| 2.003 | - | - | 100 | 0.041 | 0.041 | 0.041 |
| 2.004 | - | - | 100 | 0.035 | 0.035 | 0.035 |
| 2.005 | - | - | 100 | 0.043 | 0.043 | 0.043 |
| 2.006 | - | - | 100 | 0.037 | 0.037 | 0.037 |
| 2.007 | - | - | 100 | 0.051 | 0.051 | 0.051 |
| 2.008 | - | - | 100 | 0.148 | 0.148 | 0.148 |
| 1.013 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.014 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.015 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.016 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.017 | - | - | 100 | 0.000 | 0.000 | 0.000 |
|  |  |  |  | Total<br>1.322 | Total<br>1.303 | Total<br>1.303 |

## Free Flowing Outfall Details for Pond 3-5

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| S1.017 | S | 128.480 | 127.972 | 0.000 | 0 | 0 |

## Simulation Criteria for Pond 3-5

```
      Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 40.000
       Areal Reduction Factor 1.000       MADD Factor * 10m³/ha Storage  2.000
             Hot Start (mins)     0                 Inlet Coeffiecient  0.800
          Hot Start Level (mm)    0 Flow per Person per Day (l/per/day)  0.000
Manhole Headloss Coeff (Global) 0.500                    Run Time (mins)     60
  Foul Sewage per hectare (l/s) 0.000             Output Interval (mins)      1

        Number of Input Hydrographs 0 Number of Storage Structures 0
          Number of Online Controls 0 Number of Time/Area Diagrams 0
         Number of Offline Controls 0 Number of Real Time Controls 0
```

## Synthetic Rainfall Details

```
           Rainfall Model                  FSR           Profile Type  Summer
      Return Period (years)                  5           Cv (Summer)    0.750
                   Region England and Wales              Cv (Winter)    0.840
               M5-60 (mm)               15.300 Storm Duration (mins)       30
                  Ratio R                0.300
```

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-5

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 40.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Ratio R | 0.300 |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 15.000 | Cv (Winter) | 0.840 |

| | | | |
|---|---|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 | DVD Status | OFF |
| Analysis Timestep | Fine | Inertia Status | OFF |
| DTS Status | ON | | |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5 |
| Climate Change (%) | 20 |

| **PN** | **US/MH Name** | **Storm** | **Return Period** | **Climate Change** | **First (X) Surcharge** | **First (Y) Flood** | **First (Z) Overflow** | **Overflow Act.** |
|---|---|---|---|---|---|---|---|---|
| S1.000 | S03-05-1 | 15 Winter | 5 | +20% | | | | |
| S1.001 | S03-05-2 | 15 Winter | 5 | +20% | | | | |
| S1.002 | S03-05-3 | 15 Winter | 5 | +20% | | | | |
| S1.003 | S03-05-4 | 15 Winter | 5 | +20% | | | | |
| S1.004 | S03-05-5 | 15 Winter | 5 | +20% | | | | |
| S1.005 | S03-05-6 | 15 Winter | 5 | +20% | | | | |
| S1.006 | S03-05-7 | 15 Winter | 5 | +20% | | | | |
| S1.007 | S03-05-8 | 15 Winter | 5 | +20% | | | | |
| S1.008 | S03-05-9 | 15 Winter | 5 | +20% | | | | |
| S1.009 | S03-05-10 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| S1.010 | S03-05-11 | 15 Winter | 5 | +20% | 5/15 Winter | | | |
| S1.011 | S03-05-12 | 15 Winter | 5 | +20% | | | | |
| S1.012 | S03-05-13 | 15 Winter | 5 | +20% | | | | |
| S2.000 | S03-05-14 | 15 Winter | 5 | +20% | | | | |
| S3.000 | S03-05-15 | 15 Winter | 5 | +20% | | | | |
| S3.001 | S03-05-16 | 15 Winter | 5 | +20% | | | | |
| S2.001 | S03-05-17 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| S2.002 | S03-05-18 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| S2.003 | S03-05-19 | 15 Winter | 5 | +20% | | | | |
| S2.004 | S03-05-20 | 15 Winter | 5 | +20% | | | | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-5

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S03-05-1 | 149.376 | -0.149 | 0.000 | 0.24 | | | 15.5 | OK |
| S1.001 | S03-05-2 | 148.862 | -0.121 | 0.000 | 0.43 | | | 40.0 | OK |
| S1.002 | S03-05-3 | 147.076 | -0.101 | 0.000 | 0.58 | | | 72.3 | OK |
| S1.003 | S03-05-4 | 142.117 | -0.184 | 0.000 | 0.32 | | | 75.3 | OK |
| S1.004 | S03-05-5 | 139.986 | -0.174 | 0.000 | 0.37 | | | 84.9 | OK |
| S1.005 | S03-05-6 | 138.552 | -0.167 | 0.000 | 0.40 | | | 95.9 | OK |
| S1.006 | S03-05-7 | 136.981 | -0.154 | 0.000 | 0.47 | | | 104.0 | OK |
| S1.007 | S03-05-8 | 136.186 | -0.147 | 0.000 | 0.51 | | | 109.1 | OK |
| S1.008 | S03-05-9 | 135.360 | -0.171 | 0.000 | 0.38 | | | 118.0 | OK |
| S1.009 | S03-05-10 | 133.867 | 0.170 | 0.000 | 1.87 | | | 118.1 | SURCHARGED |
| S1.010 | S03-05-11 | 133.645 | 0.013 | 0.000 | 1.03 | | | 132.2 | SURCHARGED |
| S1.011 | S03-05-12 | 133.135 | -0.228 | 0.000 | 0.32 | | | 149.0 | OK |
| S1.012 | S03-05-13 | 129.853 | -0.130 | 0.000 | 0.40 | | | 154.6 | OK |
| S2.000 | S03-05-14 | 137.514 | -0.211 | 0.000 | 0.01 | | | 2.4 | OK |
| S3.000 | S03-05-15 | 135.139 | -0.186 | 0.000 | 0.07 | | | 2.0 | OK |
| S3.001 | S03-05-16 | 135.049 | -0.186 | 0.000 | 0.07 | | | 2.0 | OK |
| S2.001 | S03-05-17 | 134.669 | 0.042 | 0.000 | 0.96 | | | 29.8 | SURCHARGED |
| S2.002 | S03-05-18 | 134.517 | 0.050 | 0.000 | 1.27 | | | 38.1 | SURCHARGED |
| S2.003 | S03-05-19 | 134.252 | -0.119 | 0.000 | 0.44 | | | 45.6 | OK |
| S2.004 | S03-05-20 | 133.113 | -0.109 | 0.000 | 0.52 | | | 52.4 | OK |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| S1.000 | S03-05-1 | |
| S1.001 | S03-05-2 | |
| S1.002 | S03-05-3 | |
| S1.003 | S03-05-4 | |
| S1.004 | S03-05-5 | |
| S1.005 | S03-05-6 | |
| S1.006 | S03-05-7 | |
| S1.007 | S03-05-8 | |
| S1.008 | S03-05-9 | |
| S1.009 | S03-05-10 | |
| S1.010 | S03-05-11 | |
| S1.011 | S03-05-12 | |
| S1.012 | S03-05-13 | |
| S2.000 | S03-05-14 | |
| S3.000 | S03-05-15 | |
| S3.001 | S03-05-16 | |
| S2.001 | S03-05-17 | |
| S2.002 | S03-05-18 | |
| S2.003 | S03-05-19 | |
| S2.004 | S03-05-20 | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-5

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| S2.005 | S03-05-21 | 15 Winter | 5 | +20% | | | | |
| S2.006 | S03-05-22 | 15 Winter | 5 | +20% | | | | |
| S2.007 | S03-05-23 | 15 Winter | 5 | +20% | | | | |
| S2.008 | S03-05-24 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| S1.013 | S03-05-25 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| S1.014 | S03-05-26 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| S1.015 | S03-05-27 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| S1.016 | S03-05-28 | 15 Winter | 5 | +20% | | | | |
| S1.017 | S03-05-29 | 15 Winter | 5 | +20% | | | | |

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S2.005 | S03-05-21 | 132.125 | -0.099 | 0.000 | 0.60 | | | 60.9 | OK |
| S2.006 | S03-05-22 | 130.989 | -0.174 | 0.000 | 0.37 | | | 68.3 | OK |
| S2.007 | S03-05-23 | 130.212 | -0.154 | 0.000 | 0.48 | | | 78.5 | OK |
| S2.008 | S03-05-24 | 129.824 | 0.237 | 0.000 | 0.54 | | | 98.4 | SURCHARGED |
| S1.013 | S03-05-25 | 129.772 | 0.399 | 0.000 | 1.54 | | | 247.0 | SURCHARGED |
| S1.014 | S03-05-26 | 129.528 | 0.260 | 0.000 | 1.58 | | | 245.5 | SURCHARGED |
| S1.015 | S03-05-27 | 129.322 | 0.135 | 0.000 | 1.49 | | | 244.4 | SURCHARGED |
| S1.016 | S03-05-28 | 128.944 | -0.117 | 0.000 | 0.90 | | | 244.1 | OK |
| S1.017 | S03-05-29 | 128.633 | -0.171 | 0.000 | 0.70 | | | 244.6 | OK |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| S2.005 | S03-05-21 | |
| S2.006 | S03-05-22 | |
| S2.007 | S03-05-23 | |
| S2.008 | S03-05-24 | |
| S1.013 | S03-05-25 | |
| S1.014 | S03-05-26 | |
| S1.015 | S03-05-27 | |
| S1.016 | S03-05-28 | |
| S1.017 | S03-05-29 | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Pond 3-6

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 15.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Time Area Diagram for Pond 3-6

| **Time (mins)** | **Area (ha)** | **Time (mins)** | **Area (ha)** |
|---|---|---|---|
| 0-4 | 0.135 | 4-8 | 0.093 |

Total Area Contributing (ha) = 0.228

Total Pipe Volume (m³) = 14.315

### Network Design Table for Pond 3-6

| **PN** | **Length (m)** | **Fall (m)** | **Slope (1:X)** | **I.Area (ha)** | **T.E. (mins)** | **Base Flow (l/s)** | **k (mm)** | **HYD SECT** | **DIA (mm)** | **Section Type** | **Auto Design** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 43.869 | 1.097 | 40.0 | 0.063 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S1.001 | 43.312 | 1.083 | 40.0 | 0.061 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S1.002 | 59.953 | 1.499 | 40.0 | 0.087 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.003 | 66.382 | 0.830 | 80.0 | 0.017 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.004 | 23.063 | 0.513 | 45.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.005 | 4.071 | 0.014 | 300.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |

### Network Results Table

| **PN** | **Rain (mm/hr)** | **T.C. (mins)** | **US/IL (m)** | **Σ I.Area (ha)** | **Σ Base Flow (l/s)** | **Foul (l/s)** | **Add Flow (l/s)** | **Vel (m/s)** | **Cap (l/s)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 57.18 | 5.35 | 134.100 | 0.063 | 0.0 | 0.0 | 0.0 | 2.07 | 82.5 | 9.7 |
| S1.001 | 55.77 | 5.70 | 133.003 | 0.124 | 0.0 | 0.0 | 0.0 | 2.07 | 82.5 | 18.7 |
| S1.002 | 54.25 | 6.10 | 131.845 | 0.211 | 0.0 | 0.0 | 0.0 | 2.49 | 176.3 | 30.9 |
| S1.003 | 52.06 | 6.73 | 130.346 | 0.228 | 0.0 | 0.0 | 0.0 | 1.76 | 124.4 | 32.1 |
| S1.004 | 51.52 | 6.89 | 129.517 | 0.228 | 0.0 | 0.0 | 0.0 | 2.35 | 166.1 | 32.1 |
| S1.005 | 51.28 | 6.97 | 129.004 | 0.228 | 0.0 | 0.0 | 0.0 | 0.90 | 63.8 | 32.1 |

## Manhole Schedules for Pond 3-6

| **MH Name** | **MH CL (m)** | **MH Depth (m)** | **MH Connection** | **MH Diam.,L*W (mm)** | **PN** | **Pipe Out Invert Level (m)** | **Diameter (mm)** | **PN** | **Pipes In Invert Level (m)** | **Diameter (mm)** | **Backdr (mm** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S03-06-1 | 135.605 | 1.505 | Open Manhole | 1200 | S1.000 | 134.100 | 225 | | | | |
| S03-06-2 | 134.441 | 1.437 | Open Manhole | 1200 | S1.001 | 133.003 | 225 | S1.000 | 133.003 | 225 | |
| S03-06-3 | 133.371 | 1.526 | Open Manhole | 1200 | S1.002 | 131.845 | 300 | S1.001 | 131.920 | 225 | |
| S03-06-4 | 131.858 | 1.511 | Open Manhole | 1200 | S1.003 | 130.346 | 300 | S1.002 | 130.346 | 300 | |
| S03-06-5 | 131.197 | 1.681 | Open Manhole | 1200 | S1.004 | 129.517 | 300 | S1.003 | 129.517 | 300 | |
| S03-06-6 | 130.579 | 1.575 | Open Manhole | 1200 | S1.005 | 129.004 | 300 | S1.004 | 129.004 | 300 | |
| S | 130.056 | 1.065 | Open Manhole | 0 | | OUTFALL | | S1.005 | 128.991 | 300 | |

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S03-06-1 | 357371.660 | 528835.098 | 357371.660 | 528835.098 | Required |  |
| S03-06-2 | 357328.108 | 528840.365 | 357328.108 | 528840.365 | Required |  |
| S03-06-3 | 357286.507 | 528852.420 | 357286.507 | 528852.420 | Required |  |
| S03-06-4 | 357230.936 | 528874.919 | 357230.936 | 528874.919 | Required |  |
| S03-06-5 | 357165.467 | 528885.895 | 357165.467 | 528885.895 | Required |  |
| S03-06-6 | 357168.171 | 528908.800 | 357168.171 | 528908.800 | Required |  |
| S | 357167.528 | 528912.820 | | | No Entry |  |

## PIPELINE SCHEDULES for Pond 3-6

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | o | 225 | S03-06-1 | 135.605 | 134.100 | 1.280 | Open Manhole | 1200 |
| S1.001 | o | 225 | S03-06-2 | 134.441 | 133.003 | 1.212 | Open Manhole | 1200 |
| S1.002 | o | 300 | S03-06-3 | 133.371 | 131.845 | 1.226 | Open Manhole | 1200 |
| S1.003 | o | 300 | S03-06-4 | 131.858 | 130.346 | 1.211 | Open Manhole | 1200 |
| S1.004 | o | 300 | S03-06-5 | 131.197 | 129.517 | 1.381 | Open Manhole | 1200 |
| S1.005 | o | 300 | S03-06-6 | 130.579 | 129.004 | 1.275 | Open Manhole | 1200 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | 43.869 | 40.0 | S03-06-2 | 134.441 | 133.003 | 1.212 | Open Manhole | 1200 |
| S1.001 | 43.312 | 40.0 | S03-06-3 | 133.371 | 131.920 | 1.226 | Open Manhole | 1200 |
| S1.002 | 59.953 | 40.0 | S03-06-4 | 131.858 | 130.346 | 1.211 | Open Manhole | 1200 |
| S1.003 | 66.382 | 80.0 | S03-06-5 | 131.197 | 129.517 | 1.381 | Open Manhole | 1200 |
| S1.004 | 23.063 | 45.0 | S03-06-6 | 130.579 | 129.004 | 1.275 | Open Manhole | 1200 |
| S1.005 | 4.071 | 300.0 | S | 130.056 | 128.991 | 0.765 | Open Manhole | 0 |

## Area Summary for Pond 3-6

| **Pipe Number** | **PIMP Type** | **PIMP Name** | **PIMP (%)** | **Gross Area (ha)** | **Imp. Area (ha)** | **Pipe Total (ha)** |
|---|---|---|---|---|---|---|
| 1.000 | User | - | 100 | 0.054 | 0.054 | 0.054 |
| | User | - | 50 | 0.017 | 0.009 | 0.063 |
| 1.001 | User | - | 100 | 0.053 | 0.053 | 0.053 |
| | User | - | 50 | 0.016 | 0.008 | 0.061 |
| 1.002 | User | - | 100 | 0.075 | 0.075 | 0.075 |
| | User | - | 50 | 0.024 | 0.012 | 0.087 |
| 1.003 | User | - | 50 | 0.034 | 0.017 | 0.017 |
| 1.004 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.005 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total<br>0.274 | Total<br>0.228 | Total<br>0.228 |

## Free Flowing Outfall Details for Pond 3-6

| **Outfall Pipe Number** | **Outfall Name** | **C. Level (m)** | **I. Level (m)** | **Min I. Level (m)** | **D,L (mm)** | **W (mm)** |
|---|---|---|---|---|---|---|
| S1.005 | S | 130.056 | 128.991 | 0.000 | 0 | 0 |

## Simulation Criteria for Pond 3-6

| | | | |
|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Additional Flow - % of Total Flow | 40.000 |
| Areal Reduction Factor | 1.000 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start (mins) | 0 | Inlet Coeffiecient | 0.800 |
| Hot Start Level (mm) | 0 | Flow per Person per Day (l/per/day) | 0.000 |
| Manhole Headloss Coeff (Global) | 0.500 | Run Time (mins) | 60 |
| Foul Sewage per hectare (l/s) | 0.000 | Output Interval (mins) | 1 |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

## Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Profile Type | Summer |
| Return Period (years) | 5 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.300 | Storm Duration (mins) | 30 |
| Ratio R | 0.300 | | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-6

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 40.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Ratio R | 0.300 |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 15.000 | Cv (Winter) | 0.840 |

| | | | |
|---|---|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 | DVD Status | OFF |
| Analysis Timestep | Fine | Inertia Status | OFF |
| DTS Status | ON | | |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5 |
| Climate Change (%) | 20 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S03-06-1 | 15 Winter | 5 | +20% | | | | | 134.170 |
| S1.001 | S03-06-2 | 15 Winter | 5 | +20% | | | | | 133.101 |
| S1.002 | S03-06-3 | 15 Winter | 5 | +20% | | | | | 131.957 |
| S1.003 | S03-06-4 | 15 Winter | 5 | +20% | | | | | 130.487 |
| S1.004 | S03-06-5 | 15 Winter | 5 | +20% | | | | | 129.640 |
| S1.005 | S03-06-6 | 15 Winter | 5 | +20% | | | | | 129.304 |

| PN | US/MH Name | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S03-06-1 | -0.155 | 0.000 | 0.21 | | | 16.4 | OK | |
| S1.001 | S03-06-2 | -0.128 | 0.000 | 0.38 | | | 30.1 | OK | |
| S1.002 | S03-06-3 | -0.188 | 0.000 | 0.30 | | | 49.5 | OK | |
| S1.003 | S03-06-4 | -0.160 | 0.000 | 0.44 | | | 52.1 | OK | |
| S1.004 | S03-06-5 | -0.176 | 0.000 | 0.36 | | | 52.4 | OK | |
| S1.005 | S03-06-6 | 0.000 | 0.000 | 1.04 | | | 50.5 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Pond 3-7

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 15.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Time Area Diagram for Pond 3-7

| Time (mins) | Area (ha) | Time (mins) | Area (ha) | Time (mins) | Area (ha) | Time (mins) | Area (ha) | Time (mins) | Area (ha) |
|---|---|---|---|---|---|---|---|---|---|
| 0-4 | 0.785 | 4-8 | 2.136 | 8-12 | 1.020 | 12-16 | 0.607 | 16-20 | 0.061 |

Total Area Contributing (ha) = 4.610

Total Pipe Volume (m³) = 379.697

### Network Design Table for Pond 3-7

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 77.273 | 1.288 | 60.0 | 0.128 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S1.001 | 70.226 | 0.390 | 180.1 | 0.095 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.002 | 69.358 | 0.694 | 99.9 | 0.094 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.003 | 69.756 | 0.174 | 400.9 | 0.095 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.004 | 70.577 | 0.176 | 401.0 | 0.095 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S1.005 | 9.032 | 0.060 | 150.5 | 0.094 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S1.006 | 59.874 | 0.798 | 75.0 | 0.095 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 55.53 | 5.76 | 138.500 | 0.128 | 0.0 | 0.0 | 0.0 | 1.69 | 67.3 | 19.2 |
| S1.001 | 51.95 | 6.76 | 137.137 | 0.223 | 0.0 | 0.0 | 0.0 | 1.17 | 82.6 | 31.4 |
| S1.002 | 49.66 | 7.50 | 136.747 | 0.317 | 0.0 | 0.0 | 0.0 | 1.57 | 111.2 | 42.6 |
| S1.003 | 45.69 | 8.99 | 136.053 | 0.412 | 0.0 | 0.0 | 0.0 | 0.78 | 55.1 | 51.0 |
| S1.004 | 42.79 | 10.30 | 135.804 | 0.507 | 0.0 | 0.0 | 0.0 | 0.90 | 99.2 | 58.8 |
| S1.005 | 42.58 | 10.40 | 135.628 | 0.601 | 0.0 | 0.0 | 0.0 | 1.47 | 162.8 | 69.3 |
| S1.006 | 41.64 | 10.88 | 135.568 | 0.696 | 0.0 | 0.0 | 0.0 | 2.09 | 231.3 | 78.5 |

## Network Design Table for Pond 3-7

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.007 | 70.124 | 1.402 | 50.0 | 0.095 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S1.008 | 69.980 | 1.400 | 50.0 | 0.096 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S1.009 | 70.232 | 1.405 | 50.0 | 0.097 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S1.010 | 70.444 | 1.409 | 50.0 | 0.100 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S1.011 | 69.873 | 1.397 | 50.0 | 0.108 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S1.012 | 70.701 | 1.414 | 50.0 | 0.115 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S1.013 | 70.175 | 1.404 | 50.0 | 0.116 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S1.014 | 70.032 | 1.400 | 50.0 | 0.104 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S1.015 | 70.491 | 1.410 | 50.0 | 0.092 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S1.016 | 59.596 | 1.192 | 50.0 | 0.079 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S1.017 | 40.360 | 0.807 | 50.0 | 0.052 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S1.018 | 30.250 | 1.008 | 30.0 | 0.040 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S1.019 | 39.592 | 0.079 | 501.2 | 0.052 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| S1.020 | 60.323 | 0.121 | 498.5 | 0.079 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| S1.021 | 10.195 | 0.204 | 50.0 | 0.013 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| S2.000 | 44.962 | 0.225 | 199.8 | 0.088 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S2.001 | 30.017 | 0.150 | 200.1 | 0.082 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S2.002 | 69.280 | 0.346 | 200.2 | 0.092 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S2.003 | 70.117 | 1.753 | 40.0 | 0.093 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S2.004 | 70.302 | 0.176 | 399.4 | 0.094 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S2.005 | 59.590 | 0.149 | 399.9 | 0.079 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.007 | 40.80 | 11.33 | 134.770 | 0.791 | 0.0 | 0.0 | 0.0 | 2.57 | 283.6 | 87.4 |
| S1.008 | 39.99 | 11.79 | 133.368 | 0.887 | 0.0 | 0.0 | 0.0 | 2.57 | 283.6 | 96.1 |
| S1.009 | 39.22 | 12.24 | 131.968 | 0.984 | 0.0 | 0.0 | 0.0 | 2.57 | 283.6 | 104.5 |
| S1.010 | 38.49 | 12.70 | 130.563 | 1.084 | 0.0 | 0.0 | 0.0 | 2.57 | 283.6 | 113.0 |
| S1.011 | 37.79 | 13.15 | 129.154 | 1.192 | 0.0 | 0.0 | 0.0 | 2.57 | 283.6 | 122.0 |
| S1.012 | 37.11 | 13.61 | 127.757 | 1.307 | 0.0 | 0.0 | 0.0 | 2.57 | 283.6 | 131.4 |
| S1.013 | 36.54 | 14.02 | 126.268 | 1.423 | 0.0 | 0.0 | 0.0 | 2.88 | 458.2 | 140.8 |
| S1.014 | 35.99 | 14.42 | 124.864 | 1.527 | 0.0 | 0.0 | 0.0 | 2.88 | 458.0 | 148.8 |
| S1.015 | 35.46 | 14.83 | 123.464 | 1.619 | 0.0 | 0.0 | 0.0 | 2.88 | 458.2 | 155.5 |
| S1.016 | 35.02 | 15.18 | 122.054 | 1.698 | 0.0 | 0.0 | 0.0 | 2.88 | 458.2 | 161.0 |
| S1.017 | 34.73 | 15.41 | 120.862 | 1.750 | 0.0 | 0.0 | 0.0 | 2.88 | 458.1 | 164.6 |
| S1.018 | 34.57 | 15.55 | 120.055 | 1.790 | 0.0 | 0.0 | 0.0 | 3.72 | 592.1 | 167.5 |
| S1.019 | 33.79 | 16.21 | 118.972 | 1.842 | 0.0 | 0.0 | 0.0 | 0.99 | 215.1 | 168.5 |
| S1.020 | 32.68 | 17.22 | 118.893 | 1.921 | 0.0 | 0.0 | 0.0 | 1.00 | 215.7 | 170.0 |
| S1.021 | 32.63 | 17.27 | 118.772 | 1.934 | 0.0 | 0.0 | 0.0 | 3.17 | 687.1 | 170.9 |
| S2.000 | 55.33 | 5.81 | 138.600 | 0.088 | 0.0 | 0.0 | 0.0 | 0.92 | 36.6 | 13.2 |
| S2.001 | 53.65 | 6.27 | 138.300 | 0.170 | 0.0 | 0.0 | 0.0 | 1.11 | 78.3 | 24.7 |
| S2.002 | 50.22 | 7.31 | 138.150 | 0.262 | 0.0 | 0.0 | 0.0 | 1.11 | 78.3 | 35.6 |
| S2.003 | 48.85 | 7.78 | 137.804 | 0.355 | 0.0 | 0.0 | 0.0 | 2.49 | 176.3 | 47.0 |
| S2.004 | 45.48 | 9.08 | 135.976 | 0.449 | 0.0 | 0.0 | 0.0 | 0.90 | 99.4 | 55.3 |
| S2.005 | 43.03 | 10.18 | 135.800 | 0.528 | 0.0 | 0.0 | 0.0 | 0.90 | 99.4 | 61.5 |

## Network Design Table for Pond 3-7

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S2.006 | 10.289 | 0.051 | 201.7 | 0.013 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S2.007 | 60.271 | 0.601 | 100.3 | 0.082 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S2.008 | 70.509 | 1.364 | 51.7 | 0.098 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S2.009 | 70.091 | 1.411 | 49.7 | 0.099 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S2.010 | 70.033 | 1.401 | 50.0 | 0.097 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S2.011 | 70.298 | 1.394 | 50.4 | 0.098 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S2.012 | 70.054 | 1.422 | 49.3 | 0.105 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S2.013 | 68.484 | 1.398 | 49.0 | 0.109 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S2.014 | 70.000 | 1.167 | 60.0 | 0.114 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S2.015 | 69.474 | 1.737 | 40.0 | 0.111 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S2.016 | 69.513 | 1.390 | 50.0 | 0.104 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S2.017 | 70.020 | 1.400 | 50.0 | 0.097 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S2.018 | 49.795 | 0.674 | 73.9 | 0.067 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| S2.019 | 29.901 | 0.748 | 40.0 | 0.040 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| S2.020 | 39.622 | 0.079 | 501.5 | 0.056 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |
| S2.021 | 60.642 | 0.121 | 501.2 | 0.101 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |
| S2.022 | 10.673 | 0.030 | 355.8 | 0.018 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |
| S3.000 | 77.420 | 1.139 | 68.0 | 0.135 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S3.001 | 65.417 | 0.262 | 249.7 | 0.120 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S3.002 | 66.025 | 0.264 | 250.1 | 0.145 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S3.003 | 18.740 | 0.568 | 33.0 | 0.036 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S2.006 | 42.75 | 10.32 | 135.651 | 0.541 | 0.0 | 0.0 | 0.0 | 1.27 | 140.5 | 62.6 |
| S2.007 | 41.66 | 10.87 | 135.600 | 0.623 | 0.0 | 0.0 | 0.0 | 1.81 | 199.8 | 70.3 |
| S2.008 | 40.79 | 11.34 | 134.999 | 0.721 | 0.0 | 0.0 | 0.0 | 2.53 | 278.9 | 79.6 |
| S2.009 | 39.99 | 11.79 | 133.635 | 0.820 | 0.0 | 0.0 | 0.0 | 2.58 | 284.5 | 88.8 |
| S2.010 | 39.22 | 12.24 | 132.224 | 0.917 | 0.0 | 0.0 | 0.0 | 2.57 | 283.6 | 97.4 |
| S2.011 | 38.48 | 12.70 | 130.823 | 1.015 | 0.0 | 0.0 | 0.0 | 2.56 | 282.4 | 105.8 |
| S2.012 | 37.79 | 13.15 | 129.429 | 1.120 | 0.0 | 0.0 | 0.0 | 2.59 | 285.7 | 114.6 |
| S2.013 | 37.21 | 13.55 | 127.932 | 1.229 | 0.0 | 0.0 | 0.0 | 2.91 | 462.9 | 123.8 |
| S2.014 | 36.58 | 13.99 | 126.534 | 1.343 | 0.0 | 0.0 | 0.0 | 2.63 | 418.1 | 133.1 |
| S2.015 | 36.09 | 14.35 | 125.367 | 1.454 | 0.0 | 0.0 | 0.0 | 3.22 | 512.5 | 142.1 |
| S2.016 | 35.56 | 14.75 | 123.630 | 1.558 | 0.0 | 0.0 | 0.0 | 2.88 | 458.1 | 150.0 |
| S2.017 | 35.04 | 15.16 | 122.240 | 1.655 | 0.0 | 0.0 | 0.0 | 2.88 | 458.1 | 157.1 |
| S2.018 | 34.65 | 15.48 | 120.765 | 1.722 | 0.0 | 0.0 | 0.0 | 2.61 | 564.6 | 161.6 |
| S2.019 | 34.48 | 15.62 | 120.091 | 1.762 | 0.0 | 0.0 | 0.0 | 3.55 | 768.6 | 164.6 |
| S2.020 | 33.77 | 16.23 | 119.268 | 1.818 | 0.0 | 0.0 | 0.0 | 1.08 | 305.5 | 166.3 |
| S2.021 | 32.74 | 17.16 | 119.189 | 1.919 | 0.0 | 0.0 | 0.0 | 1.08 | 305.6 | 170.2 |
| S2.022 | 32.60 | 17.30 | 119.068 | 1.937 | 0.0 | 0.0 | 0.0 | 1.29 | 363.4 | 171.0 |
| S3.000 | 55.33 | 5.81 | 121.000 | 0.135 | 0.0 | 0.0 | 0.0 | 1.59 | 63.2 | 20.2 |
| S3.001 | 51.46 | 6.91 | 119.786 | 0.255 | 0.0 | 0.0 | 0.0 | 0.99 | 70.0 | 35.5 |
| S3.002 | 48.16 | 8.03 | 119.524 | 0.400 | 0.0 | 0.0 | 0.0 | 0.99 | 70.0 | 52.2 |
| S3.003 | 47.85 | 8.14 | 119.260 | 0.436 | 0.0 | 0.0 | 0.0 | 2.75 | 194.2 | 56.5 |

## Network Design Table for Pond 3-7

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S2.023 | 26.821 | 0.234 | 114.6 | 0.000 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |
| S4.000 | 47.784 | 0.319 | 149.8 | 0.066 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S4.001 | 60.583 | 0.242 | 250.3 | 0.079 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S4.002 | 59.018 | 0.197 | 299.6 | 0.079 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S4.003 | 59.838 | 1.534 | 39.0 | 0.079 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.022 | 20.388 | 2.039 | 10.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |
| S1.023 | 5.843 | 0.835 | 7.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S2.023 | 32.39 | 17.50 | 118.392 | 2.373 | 0.0 | 0.0 | 0.0 | 2.27 | 642.9 | 208.2 |
| S4.000 | 55.58 | 5.75 | 120.900 | 0.066 | 0.0 | 0.0 | 0.0 | 1.07 | 42.4 | 9.9 |
| S4.001 | 51.93 | 6.77 | 120.506 | 0.145 | 0.0 | 0.0 | 0.0 | 0.99 | 69.9 | 20.4 |
| S4.002 | 48.62 | 7.86 | 120.264 | 0.224 | 0.0 | 0.0 | 0.0 | 0.90 | 63.8 | 29.5 |
| S4.003 | 47.55 | 8.25 | 120.067 | 0.303 | 0.0 | 0.0 | 0.0 | 2.53 | 178.5 | 39.0 |
| S1.022 | 32.35 | 17.54 | 118.158 | 4.610 | 0.0 | 0.0 | 0.0 | 7.73 | 2185.5 | 403.8 |
| S1.023 | 32.34 | 17.55 | 116.119 | 4.610 | 0.0 | 0.0 | 0.0 | 9.24 | 2612.9 | 403.8 |

## Manhole Schedules for Pond 3-7

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backd (m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S03-07-1 | 140.085 | 1.585 | Open Manhole | 1200 | S1.000 | 138.500 | 225 | | | | |
| S03-07-2 | 139.983 | 2.846 | Open Manhole | 1200 | S1.001 | 137.137 | 300 | S1.000 | 137.212 | 225 | |
| S03-07-3 | 139.630 | 2.883 | Open Manhole | 1200 | S1.002 | 136.747 | 300 | S1.001 | 136.747 | 300 | |
| S03-07-4 | 139.054 | 3.001 | Open Manhole | 1200 | S1.003 | 136.053 | 300 | S1.002 | 136.053 | 300 | |
| S03-07-5 | 138.259 | 2.455 | Open Manhole | 1350 | S1.004 | 135.804 | 375 | S1.003 | 135.879 | 300 | |
| S03-07-6 | 137.238 | 1.610 | Open Manhole | 1350 | S1.005 | 135.628 | 375 | S1.004 | 135.628 | 375 | |
| S03-07-7 | 137.200 | 1.632 | Open Manhole | 1350 | S1.006 | 135.568 | 375 | S1.005 | 135.568 | 375 | |
| S03-07-8 | 136.011 | 1.241 | Open Manhole | 1350 | S1.007 | 134.770 | 375 | S1.006 | 134.770 | 375 | |
| S03-07-9 | 134.608 | 1.240 | Open Manhole | 1350 | S1.008 | 133.368 | 375 | S1.007 | 133.368 | 375 | |
| S03-07-10 | 133.205 | 1.237 | Open Manhole | 1350 | S1.009 | 131.968 | 375 | S1.008 | 131.968 | 375 | |
| S03-07-11 | 131.802 | 1.239 | Open Manhole | 1350 | S1.010 | 130.563 | 375 | S1.009 | 130.563 | 375 | |
| S03-07-12 | 130.399 | 1.245 | Open Manhole | 1350 | S1.011 | 129.154 | 375 | S1.010 | 129.154 | 375 | |
| S03-07-13 | 128.996 | 1.239 | Open Manhole | 1350 | S1.012 | 127.757 | 375 | S1.011 | 127.757 | 375 | |
| S03-07-14 | 127.599 | 1.331 | Open Manhole | 1350 | S1.013 | 126.268 | 450 | S1.012 | 126.343 | 375 | |
| S03-07-15 | 126.195 | 1.331 | Open Manhole | 1350 | S1.014 | 124.864 | 450 | S1.013 | 124.864 | 450 | |
| S03-07-16 | 124.795 | 1.331 | Open Manhole | 1350 | S1.015 | 123.464 | 450 | S1.014 | 123.464 | 450 | |
| S03-07-17 | 123.397 | 1.343 | Open Manhole | 1350 | S1.016 | 122.054 | 450 | S1.015 | 122.054 | 450 | |
| S03-07-18 | 122.201 | 1.339 | Open Manhole | 1350 | S1.017 | 120.862 | 450 | S1.016 | 120.862 | 450 | |
| S03-07-19 | 121.393 | 1.338 | Open Manhole | 1350 | S1.018 | 120.055 | 450 | S1.017 | 120.055 | 450 | |
| S03-07-20 | 120.936 | 1.965 | Open Manhole | 1500 | S1.019 | 118.972 | 525 | S1.018 | 119.047 | 450 | |
| S03-07-21 | 120.663 | 1.771 | Open Manhole | 1500 | S1.020 | 118.893 | 525 | S1.019 | 118.893 | 525 | |
| S03-07-22 | 121.074 | 2.302 | Open Manhole | 1500 | S1.021 | 118.772 | 525 | S1.020 | 118.772 | 525 | |
| S03-07-23 | 140.110 | 1.510 | Open Manhole | 1200 | S2.000 | 138.600 | 225 | | | | |
| S03-07-24 | 139.967 | 1.667 | Open Manhole | 1200 | S2.001 | 138.300 | 300 | S2.000 | 138.375 | 225 | |
| S03-07-25 | 139.981 | 1.831 | Open Manhole | 1200 | S2.002 | 138.150 | 300 | S2.001 | 138.150 | 300 | |
| S03-07-26 | 139.693 | 1.889 | Open Manhole | 1200 | S2.003 | 137.804 | 300 | S2.002 | 137.804 | 300 | |
| S03-07-27 | 139.136 | 3.160 | Open Manhole | 1350 | S2.004 | 135.976 | 375 | S2.003 | 136.051 | 300 | |
| S03-07-28 | 138.381 | 2.581 | Open Manhole | 1350 | S2.005 | 135.800 | 375 | S2.004 | 135.800 | 375 | |
| S03-07-29 | 137.575 | 1.924 | Open Manhole | 1350 | S2.006 | 135.651 | 375 | S2.005 | 135.651 | 375 | |
| S03-07-30 | 137.500 | 1.900 | Open Manhole | 1350 | S2.007 | 135.600 | 375 | S2.006 | 135.600 | 375 | |
| S03-07-31 | 136.373 | 1.374 | Open Manhole | 1350 | S2.008 | 134.999 | 375 | S2.007 | 134.999 | 375 | |
| S03-07-32 | 135.010 | 1.375 | Open Manhole | 1350 | S2.009 | 133.635 | 375 | S2.008 | 133.635 | 375 | |
| S03-07-33 | 133.599 | 1.375 | Open Manhole | 1350 | S2.010 | 132.224 | 375 | S2.009 | 132.224 | 375 | |
| S03-07-34 | 132.198 | 1.375 | Open Manhole | 1350 | S2.011 | 130.823 | 375 | S2.010 | 130.823 | 375 | |
| S03-07-35 | 130.804 | 1.375 | Open Manhole | 1350 | S2.012 | 129.429 | 375 | S2.011 | 129.429 | 375 | |
| S03-07-36 | 129.383 | 1.451 | Open Manhole | 1350 | S2.013 | 127.932 | 450 | S2.012 | 128.007 | 375 | |
| S03-07-37 | 128.006 | 1.472 | Open Manhole | 1350 | S2.014 | 126.534 | 450 | S2.013 | 126.534 | 450 | |
| S03-07-38 | 126.601 | 1.234 | Open Manhole | 1350 | S2.015 | 125.367 | 450 | S2.014 | 125.367 | 450 | |

## Manhole Schedules for Pond 3-7

| **MH Name** | **MH CL (m)** | **MH Depth (m)** | **MH Connection** | **MH Diam.,L*W (mm)** | **PN** | **Pipe Out Invert Level (m)** | **Diameter (mm)** | **PN** | **Pipes In Invert Level (m)** | **Diameter (mm)** | **Backd (mm** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S03-07-39 | 125.222 | 1.592 | Open Manhole | 1350 | S2.016 | 123.630 | 450 | S2.015 | 123.630 | 450 | |
| S03-07-40 | 123.831 | 1.591 | Open Manhole | 1350 | S2.017 | 122.240 | 450 | S2.016 | 122.240 | 450 | |
| S03-07-41 | 122.400 | 1.635 | Open Manhole | 1500 | S2.018 | 120.765 | 525 | S2.017 | 120.840 | 450 | |
| S03-07-42 | 121.443 | 1.352 | Open Manhole | 1500 | S2.019 | 120.091 | 525 | S2.018 | 120.091 | 525 | |
| S03-07-43 | 120.974 | 1.706 | Open Manhole | 1500 | S2.020 | 119.268 | 600 | S2.019 | 119.343 | 525 | |
| S03-07-44 | 120.667 | 1.478 | Open Manhole | 1500 | S2.021 | 119.189 | 600 | S2.020 | 119.189 | 600 | |
| S03-07-45 | 120.982 | 1.914 | Open Manhole | 1500 | S2.022 | 119.068 | 600 | S2.021 | 119.068 | 600 | |
| S03-07-46 | 122.561 | 1.561 | Open Manhole | 1200 | S3.000 | 121.000 | 225 | | | | |
| S03-07-47 | 122.295 | 2.509 | Open Manhole | 1200 | S3.001 | 119.786 | 300 | S3.000 | 119.861 | 225 | |
| S03-07-48 | 121.854 | 2.330 | Open Manhole | 1200 | S3.002 | 119.524 | 300 | S3.001 | 119.524 | 300 | |
| S03-07-49 | 121.275 | 2.015 | Open Manhole | 1200 | S3.003 | 119.260 | 300 | S3.002 | 119.260 | 300 | |
| S03-07-50 | 121.081 | 2.689 | Open Manhole | 1500 | S2.023 | 118.392 | 600 | S2.022 | 119.038 | 600 | |
| | | | | | | | | S3.003 | 118.692 | 300 | |
| S03-07-51 | 122.443 | 1.543 | Open Manhole | 1200 | S4.000 | 120.900 | 225 | | | | |
| S03-07-52 | 122.394 | 1.888 | Open Manhole | 1200 | S4.001 | 120.506 | 300 | S4.000 | 120.581 | 225 | |
| S03-07-53 | 122.163 | 1.899 | Open Manhole | 1200 | S4.002 | 120.264 | 300 | S4.001 | 120.264 | 300 | |
| S03-07-54 | 121.781 | 1.714 | Open Manhole | 1200 | S4.003 | 120.067 | 300 | S4.002 | 120.067 | 300 | |
| S03-07-55 | 121.186 | 3.028 | Open Manhole | 1500 | S1.022 | 118.158 | 600 | S1.021 | 118.568 | 525 | |
| | | | | | | | | S2.023 | 118.158 | 600 | |
| | | | | | | | | S4.003 | 118.533 | 300 | |
| S03-07-56 | 117.450 | 1.331 | Open Manhole | 1500 | S1.023 | 116.119 | 600 | S1.022 | 116.119 | 600 | |
| S | 116.012 | 0.728 | Open Manhole | 0 | | OUTFALL | | S1.023 | 115.284 | 600 | |

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S03-07-1 | 357133.700 | 528850.621 | 357133.700 | 528850.621 | Required |  |
| S03-07-2 | 357210.051 | 528838.722 | 357210.051 | 528838.722 | Required |  |
| S03-07-3 | 357279.662 | 528829.449 | 357279.662 | 528829.449 | Required |  |
| S03-07-4 | 357348.612 | 528821.935 | 357348.612 | 528821.935 | Required |  |

## Manhole Schedules for Pond 3-7

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S03-07-5 | 357418.124 | 528816.101 | 357418.124 | 528816.101 | Required |  |
| S03-07-6 | 357488.580 | 528811.967 | 357488.580 | 528811.967 | Required |  |
| S03-07-7 | 357497.607 | 528811.651 | 357497.607 | 528811.651 | Required |  |
| S03-07-8 | 357557.444 | 528809.559 | 357557.444 | 528809.559 | Required |  |
| S03-07-9 | 357627.564 | 528808.814 | 357627.564 | 528808.814 | Required |  |
| S03-07-10 | 357697.537 | 528809.759 | 357697.537 | 528809.759 | Required |  |
| S03-07-11 | 357767.767 | 528810.124 | 357767.767 | 528810.124 | Required |  |
| S03-07-12 | 357838.207 | 528809.270 | 357838.207 | 528809.270 | Required |  |
| S03-07-13 | 357908.031 | 528806.665 | 357908.031 | 528806.665 | Required |  |
| S03-07-14 | 357978.604 | 528802.425 | 357978.604 | 528802.425 | Required |  |
| S03-07-15 | 358048.522 | 528796.427 | 358048.522 | 528796.427 | Required |  |
| S03-07-16 | 358118.132 | 528788.748 | 358118.132 | 528788.748 | Required |  |
| S03-07-17 | 358187.999 | 528779.391 | 358187.999 | 528779.391 | Required |  |
| S03-07-18 | 358246.901 | 528770.323 | 358246.901 | 528770.323 | Required |  |
| S03-07-19 | 358286.788 | 528764.163 | 358286.788 | 528764.163 | Required |  |

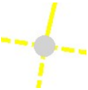
## Manhole Schedules for Pond 3-7

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S03-07-20 | 358316.665 | 528759.428 | 358316.665 | 528759.428 | Required |  |
| S03-07-21 | 358355.806 | 528753.469 | 358355.806 | 528753.469 | Required |  |
| S03-07-22 | 358415.419 | 528744.236 | 358415.419 | 528744.236 | Required |  |
| S03-07-23 | 357124.600 | 528823.723 | 357124.600 | 528823.723 | Required |  |
| S03-07-24 | 357169.128 | 528817.492 | 357169.128 | 528817.492 | Required |  |
| S03-07-25 | 357199.137 | 528816.827 | 357199.137 | 528816.827 | Required |  |
| S03-07-26 | 357267.811 | 528807.682 | 357267.811 | 528807.682 | Required |  |
| S03-07-27 | 357337.507 | 528800.012 | 357337.507 | 528800.012 | Required |  |
| S03-07-28 | 357407.543 | 528793.890 | 357407.543 | 528793.890 | Required |  |
| S03-07-29 | 357467.005 | 528789.992 | 357467.005 | 528789.992 | Required |  |
| S03-07-30 | 357477.286 | 528789.580 | 357477.286 | 528789.580 | Required |  |
| S03-07-31 | 357537.509 | 528787.165 | 357537.509 | 528787.165 | Required |  |
| S03-07-32 | 357608.007 | 528785.888 | 357608.007 | 528785.888 | Required |  |
| S03-07-33 | 357678.097 | 528786.228 | 357678.097 | 528786.228 | Required |  |
| S03-07-34 | 357748.123 | 528787.168 | 357748.123 | 528787.168 | Required |  |

## Manhole Schedules for Pond 3-7

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S03-07-35 | 357818.419 | 528786.694 | 357818.419 | 528786.694 | Required |  |
| S03-07-36 | 357888.444 | 528784.672 | 357888.444 | 528784.672 | Required |  |
| S03-07-37 | 357956.829 | 528780.982 | 357956.829 | 528780.982 | Required |  |
| S03-07-38 | 358026.625 | 528775.650 | 358026.625 | 528775.650 | Required |  |
| S03-07-39 | 358095.712 | 528768.318 | 358095.712 | 528768.318 | Required |  |
| S03-07-40 | 358164.664 | 528759.505 | 358164.664 | 528759.505 | Required |  |
| S03-07-41 | 358233.963 | 528749.480 | 358233.963 | 528749.480 | Required |  |
| S03-07-42 | 358283.184 | 528741.940 | 358283.184 | 528741.940 | Required |  |
| S03-07-43 | 358312.728 | 528737.333 | 358312.728 | 528737.333 | Required |  |
| S03-07-44 | 358351.614 | 528729.730 | 358351.614 | 528729.730 | Required |  |
| S03-07-45 | 358411.141 | 528718.158 | 358411.141 | 528718.158 | Required |  |
| S03-07-46 | 358647.134 | 528685.940 | 358647.134 | 528685.940 | Required |  |
| S03-07-47 | 358570.246 | 528694.995 | 358570.246 | 528694.995 | Required |  |
| S03-07-48 | 358505.244 | 528702.353 | 358505.244 | 528702.353 | Required |  |
| S03-07-49 | 358440.003 | 528712.498 | 358440.003 | 528712.498 | Required |  |

## Manhole Schedules for Pond 3-7

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S03-07-50 | 358421.625 | 528716.161 | 358421.625 | 528716.161 | Required |  |
| S03-07-51 | 358650.059 | 528708.028 | 358650.059 | 528708.028 | Required |  |
| S03-07-52 | 358602.840 | 528715.349 | 358602.840 | 528715.349 | Required |  |
| S03-07-53 | 358542.965 | 528724.592 | 358542.965 | 528724.592 | Required |  |
| S03-07-54 | 358484.625 | 528733.506 | 358484.625 | 528733.506 | Required |  |
| S03-07-55 | 358425.498 | 528742.701 | 358425.498 | 528742.701 | Required |  |
| S03-07-56 | 358430.217 | 528762.536 | 358430.217 | 528762.536 | Required |  |
| S | 358436.060 | 528762.536 | | | No Entry |  |

## PIPELINE SCHEDULES for Pond 3-7

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | o | 225 | S03-07-1 | 140.085 | 138.500 | 1.360 | Open Manhole | 1200 |
| S1.001 | o | 300 | S03-07-2 | 139.983 | 137.137 | 2.546 | Open Manhole | 1200 |
| S1.002 | o | 300 | S03-07-3 | 139.630 | 136.747 | 2.583 | Open Manhole | 1200 |
| S1.003 | o | 300 | S03-07-4 | 139.054 | 136.053 | 2.701 | Open Manhole | 1200 |
| S1.004 | o | 375 | S03-07-5 | 138.259 | 135.804 | 2.080 | Open Manhole | 1350 |
| S1.005 | o | 375 | S03-07-6 | 137.238 | 135.628 | 1.235 | Open Manhole | 1350 |
| S1.006 | o | 375 | S03-07-7 | 137.200 | 135.568 | 1.257 | Open Manhole | 1350 |
| S1.007 | o | 375 | S03-07-8 | 136.011 | 134.770 | 0.866 | Open Manhole | 1350 |
| S1.008 | o | 375 | S03-07-9 | 134.608 | 133.368 | 0.865 | Open Manhole | 1350 |
| S1.009 | o | 375 | S03-07-10 | 133.205 | 131.968 | 0.862 | Open Manhole | 1350 |
| S1.010 | o | 375 | S03-07-11 | 131.802 | 130.563 | 0.864 | Open Manhole | 1350 |
| S1.011 | o | 375 | S03-07-12 | 130.399 | 129.154 | 0.870 | Open Manhole | 1350 |
| S1.012 | o | 375 | S03-07-13 | 128.996 | 127.757 | 0.864 | Open Manhole | 1350 |
| S1.013 | o | 450 | S03-07-14 | 127.599 | 126.268 | 0.881 | Open Manhole | 1350 |
| S1.014 | o | 450 | S03-07-15 | 126.195 | 124.864 | 0.881 | Open Manhole | 1350 |
| S1.015 | o | 450 | S03-07-16 | 124.795 | 123.464 | 0.881 | Open Manhole | 1350 |
| S1.016 | o | 450 | S03-07-17 | 123.397 | 122.054 | 0.893 | Open Manhole | 1350 |
| S1.017 | o | 450 | S03-07-18 | 122.201 | 120.862 | 0.889 | Open Manhole | 1350 |
| S1.018 | o | 450 | S03-07-19 | 121.393 | 120.055 | 0.888 | Open Manhole | 1350 |
| S1.019 | o | 525 | S03-07-20 | 120.936 | 118.972 | 1.440 | Open Manhole | 1500 |
| S1.020 | o | 525 | S03-07-21 | 120.663 | 118.893 | 1.246 | Open Manhole | 1500 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | 77.273 | 60.0 | S03-07-2 | 139.983 | 137.212 | 2.546 | Open Manhole | 1200 |
| S1.001 | 70.226 | 180.1 | S03-07-3 | 139.630 | 136.747 | 2.583 | Open Manhole | 1200 |
| S1.002 | 69.358 | 99.9 | S03-07-4 | 139.054 | 136.053 | 2.701 | Open Manhole | 1200 |
| S1.003 | 69.756 | 400.9 | S03-07-5 | 138.259 | 135.879 | 2.080 | Open Manhole | 1350 |
| S1.004 | 70.577 | 401.0 | S03-07-6 | 137.238 | 135.628 | 1.235 | Open Manhole | 1350 |
| S1.005 | 9.032 | 150.5 | S03-07-7 | 137.200 | 135.568 | 1.257 | Open Manhole | 1350 |
| S1.006 | 59.874 | 75.0 | S03-07-8 | 136.011 | 134.770 | 0.866 | Open Manhole | 1350 |
| S1.007 | 70.124 | 50.0 | S03-07-9 | 134.608 | 133.368 | 0.865 | Open Manhole | 1350 |
| S1.008 | 69.980 | 50.0 | S03-07-10 | 133.205 | 131.968 | 0.862 | Open Manhole | 1350 |
| S1.009 | 70.232 | 50.0 | S03-07-11 | 131.802 | 130.563 | 0.864 | Open Manhole | 1350 |
| S1.010 | 70.444 | 50.0 | S03-07-12 | 130.399 | 129.154 | 0.870 | Open Manhole | 1350 |
| S1.011 | 69.873 | 50.0 | S03-07-13 | 128.996 | 127.757 | 0.864 | Open Manhole | 1350 |
| S1.012 | 70.701 | 50.0 | S03-07-14 | 127.599 | 126.343 | 0.881 | Open Manhole | 1350 |
| S1.013 | 70.175 | 50.0 | S03-07-15 | 126.195 | 124.864 | 0.881 | Open Manhole | 1350 |
| S1.014 | 70.032 | 50.0 | S03-07-16 | 124.795 | 123.464 | 0.881 | Open Manhole | 1350 |
| S1.015 | 70.491 | 50.0 | S03-07-17 | 123.397 | 122.054 | 0.893 | Open Manhole | 1350 |
| S1.016 | 59.596 | 50.0 | S03-07-18 | 122.201 | 120.862 | 0.889 | Open Manhole | 1350 |
| S1.017 | 40.360 | 50.0 | S03-07-19 | 121.393 | 120.055 | 0.888 | Open Manhole | 1350 |
| S1.018 | 30.250 | 30.0 | S03-07-20 | 120.936 | 119.047 | 1.440 | Open Manhole | 1500 |
| S1.019 | 39.592 | 501.2 | S03-07-21 | 120.663 | 118.893 | 1.246 | Open Manhole | 1500 |
| S1.020 | 60.323 | 498.5 | S03-07-22 | 121.074 | 118.772 | 1.777 | Open Manhole | 1500 |

## PIPELINE SCHEDULES for Pond 3-7

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.021 | o | 525 | S03-07-22 | 121.074 | 118.772 | 1.777 | Open Manhole | 1500 |
| S2.000 | o | 225 | S03-07-23 | 140.110 | 138.600 | 1.285 | Open Manhole | 1200 |
| S2.001 | o | 300 | S03-07-24 | 139.967 | 138.300 | 1.367 | Open Manhole | 1200 |
| S2.002 | o | 300 | S03-07-25 | 139.981 | 138.150 | 1.531 | Open Manhole | 1200 |
| S2.003 | o | 300 | S03-07-26 | 139.693 | 137.804 | 1.589 | Open Manhole | 1200 |
| S2.004 | o | 375 | S03-07-27 | 139.136 | 135.976 | 2.785 | Open Manhole | 1350 |
| S2.005 | o | 375 | S03-07-28 | 138.381 | 135.800 | 2.206 | Open Manhole | 1350 |
| S2.006 | o | 375 | S03-07-29 | 137.575 | 135.651 | 1.549 | Open Manhole | 1350 |
| S2.007 | o | 375 | S03-07-30 | 137.500 | 135.600 | 1.525 | Open Manhole | 1350 |
| S2.008 | o | 375 | S03-07-31 | 136.373 | 134.999 | 0.999 | Open Manhole | 1350 |
| S2.009 | o | 375 | S03-07-32 | 135.010 | 133.635 | 1.000 | Open Manhole | 1350 |
| S2.010 | o | 375 | S03-07-33 | 133.599 | 132.224 | 1.000 | Open Manhole | 1350 |
| S2.011 | o | 375 | S03-07-34 | 132.198 | 130.823 | 1.000 | Open Manhole | 1350 |
| S2.012 | o | 375 | S03-07-35 | 130.804 | 129.429 | 1.000 | Open Manhole | 1350 |
| S2.013 | o | 450 | S03-07-36 | 129.383 | 127.932 | 1.001 | Open Manhole | 1350 |
| S2.014 | o | 450 | S03-07-37 | 128.006 | 126.534 | 1.022 | Open Manhole | 1350 |
| S2.015 | o | 450 | S03-07-38 | 126.601 | 125.367 | 0.784 | Open Manhole | 1350 |
| S2.016 | o | 450 | S03-07-39 | 125.222 | 123.630 | 1.142 | Open Manhole | 1350 |
| S2.017 | o | 450 | S03-07-40 | 123.831 | 122.240 | 1.141 | Open Manhole | 1350 |
| S2.018 | o | 525 | S03-07-41 | 122.400 | 120.765 | 1.110 | Open Manhole | 1500 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.021 | 10.195 | 50.0 | S03-07-55 | 121.186 | 118.568 | 2.094 | Open Manhole | 1500 |
| S2.000 | 44.962 | 199.8 | S03-07-24 | 139.967 | 138.375 | 1.367 | Open Manhole | 1200 |
| S2.001 | 30.017 | 200.1 | S03-07-25 | 139.981 | 138.150 | 1.531 | Open Manhole | 1200 |
| S2.002 | 69.280 | 200.2 | S03-07-26 | 139.693 | 137.804 | 1.589 | Open Manhole | 1200 |
| S2.003 | 70.117 | 40.0 | S03-07-27 | 139.136 | 136.051 | 2.785 | Open Manhole | 1350 |
| S2.004 | 70.302 | 399.4 | S03-07-28 | 138.381 | 135.800 | 2.206 | Open Manhole | 1350 |
| S2.005 | 59.590 | 399.9 | S03-07-29 | 137.575 | 135.651 | 1.549 | Open Manhole | 1350 |
| S2.006 | 10.289 | 201.7 | S03-07-30 | 137.500 | 135.600 | 1.525 | Open Manhole | 1350 |
| S2.007 | 60.271 | 100.3 | S03-07-31 | 136.373 | 134.999 | 0.999 | Open Manhole | 1350 |
| S2.008 | 70.509 | 51.7 | S03-07-32 | 135.010 | 133.635 | 1.000 | Open Manhole | 1350 |
| S2.009 | 70.091 | 49.7 | S03-07-33 | 133.599 | 132.224 | 1.000 | Open Manhole | 1350 |
| S2.010 | 70.033 | 50.0 | S03-07-34 | 132.198 | 130.823 | 1.000 | Open Manhole | 1350 |
| S2.011 | 70.298 | 50.4 | S03-07-35 | 130.804 | 129.429 | 1.000 | Open Manhole | 1350 |
| S2.012 | 70.054 | 49.3 | S03-07-36 | 129.383 | 128.007 | 1.001 | Open Manhole | 1350 |
| S2.013 | 68.484 | 49.0 | S03-07-37 | 128.006 | 126.534 | 1.022 | Open Manhole | 1350 |
| S2.014 | 70.000 | 60.0 | S03-07-38 | 126.601 | 125.367 | 0.784 | Open Manhole | 1350 |
| S2.015 | 69.474 | 40.0 | S03-07-39 | 125.222 | 123.630 | 1.142 | Open Manhole | 1350 |
| S2.016 | 69.513 | 50.0 | S03-07-40 | 123.831 | 122.240 | 1.141 | Open Manhole | 1350 |
| S2.017 | 70.020 | 50.0 | S03-07-41 | 122.400 | 120.840 | 1.110 | Open Manhole | 1500 |
| S2.018 | 49.795 | 73.9 | S03-07-42 | 121.443 | 120.091 | 0.827 | Open Manhole | 1500 |

## PIPELINE SCHEDULES for Pond 3-7

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S2.019 | o | 525 | S03-07-42 | 121.443 | 120.091 | 0.827 | Open Manhole | 1500 |
| S2.020 | o | 600 | S03-07-43 | 120.974 | 119.268 | 1.106 | Open Manhole | 1500 |
| S2.021 | o | 600 | S03-07-44 | 120.667 | 119.189 | 0.878 | Open Manhole | 1500 |
| S2.022 | o | 600 | S03-07-45 | 120.982 | 119.068 | 1.314 | Open Manhole | 1500 |
| S3.000 | o | 225 | S03-07-46 | 122.561 | 121.000 | 1.336 | Open Manhole | 1200 |
| S3.001 | o | 300 | S03-07-47 | 122.295 | 119.786 | 2.209 | Open Manhole | 1200 |
| S3.002 | o | 300 | S03-07-48 | 121.854 | 119.524 | 2.030 | Open Manhole | 1200 |
| S3.003 | o | 300 | S03-07-49 | 121.275 | 119.260 | 1.715 | Open Manhole | 1200 |
| S2.023 | o | 600 | S03-07-50 | 121.081 | 118.392 | 2.089 | Open Manhole | 1500 |
| S4.000 | o | 225 | S03-07-51 | 122.443 | 120.900 | 1.318 | Open Manhole | 1200 |
| S4.001 | o | 300 | S03-07-52 | 122.394 | 120.506 | 1.588 | Open Manhole | 1200 |
| S4.002 | o | 300 | S03-07-53 | 122.163 | 120.264 | 1.599 | Open Manhole | 1200 |
| S4.003 | o | 300 | S03-07-54 | 121.781 | 120.067 | 1.414 | Open Manhole | 1200 |
| S1.022 | o | 600 | S03-07-55 | 121.186 | 118.158 | 2.428 | Open Manhole | 1500 |
| S1.023 | o | 600 | S03-07-56 | 117.450 | 116.119 | 0.731 | Open Manhole | 1500 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S2.019 | 29.901 | 40.0 | S03-07-43 | 120.974 | 119.343 | 1.106 | Open Manhole | 1500 |
| S2.020 | 39.622 | 501.5 | S03-07-44 | 120.667 | 119.189 | 0.878 | Open Manhole | 1500 |
| S2.021 | 60.642 | 501.2 | S03-07-45 | 120.982 | 119.068 | 1.314 | Open Manhole | 1500 |
| S2.022 | 10.673 | 355.8 | S03-07-50 | 121.081 | 119.038 | 1.443 | Open Manhole | 1500 |
| S3.000 | 77.420 | 68.0 | S03-07-47 | 122.295 | 119.861 | 2.209 | Open Manhole | 1200 |
| S3.001 | 65.417 | 249.7 | S03-07-48 | 121.854 | 119.524 | 2.030 | Open Manhole | 1200 |
| S3.002 | 66.025 | 250.1 | S03-07-49 | 121.275 | 119.260 | 1.715 | Open Manhole | 1200 |
| S3.003 | 18.740 | 33.0 | S03-07-50 | 121.081 | 118.692 | 2.089 | Open Manhole | 1500 |
| S2.023 | 26.821 | 114.6 | S03-07-55 | 121.186 | 118.158 | 2.428 | Open Manhole | 1500 |
| S4.000 | 47.784 | 149.8 | S03-07-52 | 122.394 | 120.581 | 1.588 | Open Manhole | 1200 |
| S4.001 | 60.583 | 250.3 | S03-07-53 | 122.163 | 120.264 | 1.599 | Open Manhole | 1200 |
| S4.002 | 59.018 | 299.6 | S03-07-54 | 121.781 | 120.067 | 1.414 | Open Manhole | 1200 |
| S4.003 | 59.838 | 39.0 | S03-07-55 | 121.186 | 118.533 | 2.353 | Open Manhole | 1500 |
| S1.022 | 20.388 | 10.0 | S03-07-56 | 117.450 | 116.119 | 0.731 | Open Manhole | 1500 |
| S1.023 | 5.843 | 7.0 | S | 116.012 | 115.284 | 0.128 | Open Manhole | 0 |

## Area Summary for Pond 3-7

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | - | - | 100 | 0.128 | 0.128 | 0.128 |
| 1.001 | - | - | 100 | 0.095 | 0.095 | 0.095 |
| 1.002 | - | - | 100 | 0.094 | 0.094 | 0.094 |
| 1.003 | - | - | 100 | 0.095 | 0.095 | 0.095 |
| 1.004 | - | - | 100 | 0.095 | 0.095 | 0.095 |
| 1.005 | - | - | 100 | 0.094 | 0.094 | 0.094 |
| 1.006 | - | - | 100 | 0.095 | 0.095 | 0.095 |
| 1.007 | - | - | 100 | 0.095 | 0.095 | 0.095 |
| 1.008 | - | - | 100 | 0.096 | 0.096 | 0.096 |
| 1.009 | - | - | 100 | 0.097 | 0.097 | 0.097 |
| 1.010 | - | - | 100 | 0.100 | 0.100 | 0.100 |
| 1.011 | - | - | 100 | 0.108 | 0.108 | 0.108 |
| 1.012 | - | - | 100 | 0.115 | 0.115 | 0.115 |
| 1.013 | - | - | 100 | 0.116 | 0.116 | 0.116 |
| 1.014 | - | - | 100 | 0.104 | 0.104 | 0.104 |
| 1.015 | - | - | 100 | 0.092 | 0.092 | 0.092 |
| 1.016 | - | - | 100 | 0.079 | 0.079 | 0.079 |
| 1.017 | - | - | 100 | 0.052 | 0.052 | 0.052 |
| 1.018 | User | - | 100 | 0.035 | 0.035 | 0.035 |
|  | User | - | 50 | 0.008 | 0.004 | 0.040 |
| 1.019 | - | - | 100 | 0.052 | 0.052 | 0.052 |
| 1.020 | - | - | 100 | 0.079 | 0.079 | 0.079 |
| 1.021 | - | - | 100 | 0.013 | 0.013 | 0.013 |
| 2.000 | - | - | 100 | 0.088 | 0.088 | 0.088 |
| 2.001 | - | - | 100 | 0.082 | 0.082 | 0.082 |
| 2.002 | - | - | 100 | 0.092 | 0.092 | 0.092 |
| 2.003 | - | - | 100 | 0.093 | 0.093 | 0.093 |
| 2.004 | - | - | 100 | 0.094 | 0.094 | 0.094 |
| 2.005 | - | - | 100 | 0.079 | 0.079 | 0.079 |
| 2.006 | - | - | 100 | 0.013 | 0.013 | 0.013 |
| 2.007 | - | - | 100 | 0.082 | 0.082 | 0.082 |
| 2.008 | - | - | 100 | 0.098 | 0.098 | 0.098 |
| 2.009 | - | - | 100 | 0.099 | 0.099 | 0.099 |
| 2.010 | - | - | 100 | 0.097 | 0.097 | 0.097 |
| 2.011 | - | - | 100 | 0.098 | 0.098 | 0.098 |
| 2.012 | - | - | 100 | 0.105 | 0.105 | 0.105 |
| 2.013 | - | - | 100 | 0.109 | 0.109 | 0.109 |
| 2.014 | - | - | 100 | 0.114 | 0.114 | 0.114 |
| 2.015 | - | - | 100 | 0.111 | 0.111 | 0.111 |
| 2.016 | - | - | 100 | 0.104 | 0.104 | 0.104 |
| 2.017 | - | - | 100 | 0.097 | 0.097 | 0.097 |
| 2.018 | - | - | 100 | 0.067 | 0.067 | 0.067 |
| 2.019 | - | - | 100 | 0.040 | 0.040 | 0.040 |
| 2.020 | - | - | 100 | 0.056 | 0.056 | 0.056 |
| 2.021 | User | - | 100 | 0.089 | 0.089 | 0.089 |
|  | User | - | 50 | 0.016 | 0.008 | 0.097 |
|  | User | - | 25 | 0.018 | 0.004 | 0.101 |
| 2.022 | - | - | 100 | 0.018 | 0.018 | 0.018 |
| 3.000 | - | - | 100 | 0.135 | 0.135 | 0.135 |
| 3.001 | - | - | 100 | 0.120 | 0.120 | 0.120 |
| 3.002 | - | - | 100 | 0.145 | 0.145 | 0.145 |

## Area Summary for Pond 3-7

| **Pipe Number** | **PIMP Type** | **PIMP Name** | **PIMP (%)** | **Gross Area (ha)** | **Imp. Area (ha)** | **Pipe Total (ha)** |
|---|---|---|---|---|---|---|
| 3.003 | - | - | 100 | 0.036 | 0.036 | 0.036 |
| 2.023 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 4.000 | - | - | 100 | 0.066 | 0.066 | 0.066 |
| 4.001 | - | - | 100 | 0.079 | 0.079 | 0.079 |
| 4.002 | - | - | 100 | 0.079 | 0.079 | 0.079 |
| 4.003 | - | - | 100 | 0.079 | 0.079 | 0.079 |
| 1.022 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.023 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total<br>4.635 | Total<br>4.610 | Total<br>4.610 |

## Free Flowing Outfall Details for Pond 3-7

| **Outfall Pipe Number** | **Outfall Name** | **C. Level (m)** | **I. Level (m)** | **Min I. Level (m)** | **D,L (mm)** | **W (mm)** |
|---|---|---|---|---|---|---|
| S1.023 | S | 116.012 | 115.284 | 0.000 | 0 | 0 |

## Simulation Criteria for Pond 3-7

| | | | |
|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Additional Flow - % of Total Flow | 40.000 |
| Areal Reduction Factor | 1.000 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start (mins) | 0 | Inlet Coeffiecient | 0.800 |
| Hot Start Level (mm) | 0 | Flow per Person per Day (l/per/day) | 0.000 |
| Manhole Headloss Coeff (Global) | 0.500 | Run Time (mins) | 60 |
| Foul Sewage per hectare (l/s) | 0.000 | Output Interval (mins) | 1 |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

## Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Profile Type | Summer |
| Return Period (years) | 5 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.300 | Storm Duration (mins) | 30 |
| Ratio R | 0.300 | | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-7

```
                          Simulation Criteria
      Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 40.000
            Hot Start (mins)     0       MADD Factor * 10m³/ha Storage  2.000
          Hot Start Level (mm)     0              Inlet Coeffiecient  0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day)  0.000
   Foul Sewage per hectare (l/s) 0.000

          Number of Input Hydrographs 0 Number of Storage Structures 0
            Number of Online Controls 0 Number of Time/Area Diagrams 0
           Number of Offline Controls 0 Number of Real Time Controls 0

                        Synthetic Rainfall Details
                 Rainfall Model              FSR     Ratio R 0.300
                        Region England and Wales Cv (Summer) 0.750
                    M5-60 (mm)            15.000 Cv (Winter) 0.840

           Margin for Flood Risk Warning (mm) 300.0     DVD Status OFF
                           Analysis Timestep  Fine Inertia Status OFF
                                  DTS Status    ON


                    Profile(s)                          Summer and Winter
               Duration(s) (mins)     15, 30, 60, 120, 180, 240, 360, 480, 600,
                                       720, 960, 1440, 2160, 2880, 4320, 5760,
                                                            7200, 8640, 10080
          Return Period(s) (years)                                          5
               Climate Change (%)                                          20
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| S1.000 | S03-07-1 | 15 Winter | 5 | +20% | | | | |
| S1.001 | S03-07-2 | 15 Winter | 5 | +20% | | | | |
| S1.002 | S03-07-3 | 15 Winter | 5 | +20% | | | | |
| S1.003 | S03-07-4 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| S1.004 | S03-07-5 | 15 Winter | 5 | +20% | | | | |
| S1.005 | S03-07-6 | 15 Winter | 5 | +20% | | | | |
| S1.006 | S03-07-7 | 30 Winter | 5 | +20% | | | | |
| S1.007 | S03-07-8 | 30 Winter | 5 | +20% | | | | |
| S1.008 | S03-07-9 | 30 Winter | 5 | +20% | | | | |
| S1.009 | S03-07-10 | 30 Winter | 5 | +20% | | | | |
| S1.010 | S03-07-11 | 30 Winter | 5 | +20% | | | | |
| S1.011 | S03-07-12 | 30 Winter | 5 | +20% | | | | |
| S1.012 | S03-07-13 | 30 Winter | 5 | +20% | | | | |
| S1.013 | S03-07-14 | 30 Winter | 5 | +20% | | | | |
| S1.014 | S03-07-15 | 30 Winter | 5 | +20% | | | | |
| S1.015 | S03-07-16 | 30 Winter | 5 | +20% | | | | |
| S1.016 | S03-07-17 | 30 Winter | 5 | +20% | | | | |
| S1.017 | S03-07-18 | 30 Winter | 5 | +20% | | | | |
| S1.018 | S03-07-19 | 30 Winter | 5 | +20% | | | | |
| S1.019 | S03-07-20 | 30 Winter | 5 | +20% | 5/15 Summer | | | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-7

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S03-07-1 | 138.616 | -0.109 | 0.000 | 0.51 | | | 33.1 | OK |
| S1.001 | S03-07-2 | 137.321 | -0.116 | 0.000 | 0.66 | | | 51.9 | OK |
| S1.002 | S03-07-3 | 136.929 | -0.118 | 0.000 | 0.66 | | | 70.4 | OK |
| S1.003 | S03-07-4 | 136.615 | 0.262 | 0.000 | 1.53 | | | 80.4 | SURCHARGED |
| S1.004 | S03-07-5 | 136.103 | -0.076 | 0.000 | 0.96 | | | 90.4 | OK |
| S1.005 | S03-07-6 | 135.912 | -0.091 | 0.000 | 0.92 | | | 99.1 | OK |
| S1.006 | S03-07-7 | 135.758 | -0.185 | 0.000 | 0.50 | | | 109.1 | OK |
| S1.007 | S03-07-8 | 134.948 | -0.197 | 0.000 | 0.45 | | | 121.4 | OK |
| S1.008 | S03-07-9 | 133.557 | -0.186 | 0.000 | 0.50 | | | 135.0 | OK |
| S1.009 | S03-07-10 | 132.169 | -0.174 | 0.000 | 0.56 | | | 149.5 | OK |
| S1.010 | S03-07-11 | 130.777 | -0.161 | 0.000 | 0.61 | | | 164.8 | OK |
| S1.011 | S03-07-12 | 129.382 | -0.147 | 0.000 | 0.68 | | | 181.5 | OK |
| S1.012 | S03-07-13 | 128.000 | -0.132 | 0.000 | 0.74 | | | 199.3 | OK |
| S1.013 | S03-07-14 | 126.496 | -0.222 | 0.000 | 0.51 | | | 217.0 | OK |
| S1.014 | S03-07-15 | 125.102 | -0.212 | 0.000 | 0.55 | | | 232.7 | OK |
| S1.015 | S03-07-16 | 123.710 | -0.204 | 0.000 | 0.58 | | | 246.1 | OK |
| S1.016 | S03-07-17 | 122.308 | -0.196 | 0.000 | 0.61 | | | 256.9 | OK |
| S1.017 | S03-07-18 | 121.127 | -0.185 | 0.000 | 0.65 | | | 264.1 | OK |
| S1.018 | S03-07-19 | 120.289 | -0.216 | 0.000 | 0.53 | | | 269.3 | OK |
| S1.019 | S03-07-20 | 119.695 | 0.199 | 0.000 | 1.46 | | | 273.8 | SURCHARGED |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| S1.000 | S03-07-1 | |
| S1.001 | S03-07-2 | |
| S1.002 | S03-07-3 | |
| S1.003 | S03-07-4 | |
| S1.004 | S03-07-5 | |
| S1.005 | S03-07-6 | |
| S1.006 | S03-07-7 | |
| S1.007 | S03-07-8 | |
| S1.008 | S03-07-9 | |
| S1.009 | S03-07-10 | |
| S1.010 | S03-07-11 | |
| S1.011 | S03-07-12 | |
| S1.012 | S03-07-13 | |
| S1.013 | S03-07-14 | |
| S1.014 | S03-07-15 | |
| S1.015 | S03-07-16 | |
| S1.016 | S03-07-17 | |
| S1.017 | S03-07-18 | |
| S1.018 | S03-07-19 | |
| S1.019 | S03-07-20 | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-7

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| S1.020 | S03-07-21 | 30 Winter | 5 | +20% | 5/15 Summer | | | |
| S1.021 | S03-07-22 | 30 Winter | 5 | +20% | | | | |
| S2.000 | S03-07-23 | 15 Winter | 5 | +20% | | | | |
| S2.001 | S03-07-24 | 15 Winter | 5 | +20% | | | | |
| S2.002 | S03-07-25 | 15 Winter | 5 | +20% | | | | |
| S2.003 | S03-07-26 | 15 Winter | 5 | +20% | | | | |
| S2.004 | S03-07-27 | 15 Winter | 5 | +20% | | | | |
| S2.005 | S03-07-28 | 15 Winter | 5 | +20% | | | | |
| S2.006 | S03-07-29 | 15 Winter | 5 | +20% | | | | |
| S2.007 | S03-07-30 | 30 Winter | 5 | +20% | | | | |
| S2.008 | S03-07-31 | 30 Winter | 5 | +20% | | | | |
| S2.009 | S03-07-32 | 30 Winter | 5 | +20% | | | | |
| S2.010 | S03-07-33 | 30 Winter | 5 | +20% | | | | |
| S2.011 | S03-07-34 | 30 Winter | 5 | +20% | | | | |
| S2.012 | S03-07-35 | 30 Winter | 5 | +20% | | | | |
| S2.013 | S03-07-36 | 30 Winter | 5 | +20% | | | | |
| S2.014 | S03-07-37 | 30 Winter | 5 | +20% | | | | |
| S2.015 | S03-07-38 | 30 Winter | 5 | +20% | | | | |
| S2.016 | S03-07-39 | 30 Winter | 5 | +20% | | | | |
| S2.017 | S03-07-40 | 30 Winter | 5 | +20% | | | | |
| S2.018 | S03-07-41 | 30 Winter | 5 | +20% | | | | |
| S2.019 | S03-07-42 | 30 Winter | 5 | +20% | | | | |
| S2.020 | S03-07-43 | 30 Winter | 5 | +20% | 5/30 Winter | | | |
| S2.021 | S03-07-44 | 30 Winter | 5 | +20% | 5/30 Winter | | | |
| S2.022 | S03-07-45 | 30 Summer | 5 | +20% | | | | |
| S3.000 | S03-07-46 | 15 Winter | 5 | +20% | | | | |
| S3.001 | S03-07-47 | 15 Winter | 5 | +20% | | | | |
| S3.002 | S03-07-48 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| S3.003 | S03-07-49 | 15 Winter | 5 | +20% | | | | |
| S2.023 | S03-07-50 | 30 Winter | 5 | +20% | | | | |
| S4.000 | S03-07-51 | 15 Winter | 5 | +20% | | | | |
| S4.001 | S03-07-52 | 15 Winter | 5 | +20% | | | | |
| S4.002 | S03-07-53 | 15 Winter | 5 | +20% | | | | |
| S4.003 | S03-07-54 | 15 Winter | 5 | +20% | | | | |
| S1.022 | S03-07-55 | 30 Winter | 5 | +20% | | | | |
| S1.023 | S03-07-56 | 30 Winter | 5 | +20% | | | | |

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S1.020 | S03-07-21 | 119.525 | 0.108 | 0.000 | 1.43 | | | 279.4 | SURCHARGED |
| S1.021 | S03-07-22 | 119.132 | -0.165 | 0.000 | 0.81 | | | 280.6 | OK |
| S2.000 | S03-07-23 | 138.736 | -0.089 | 0.000 | 0.65 | | | 22.7 | OK |
| S2.001 | S03-07-24 | 138.464 | -0.136 | 0.000 | 0.57 | | | 40.4 | OK |
| S2.002 | S03-07-25 | 138.356 | -0.094 | 0.000 | 0.77 | | | 57.5 | OK |
| S2.003 | S03-07-26 | 137.945 | -0.159 | 0.000 | 0.45 | | | 75.1 | OK |
| S2.004 | S03-07-27 | 136.282 | -0.069 | 0.000 | 0.94 | | | 88.5 | OK |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-7

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S2.005 | S03-07-28 | 136.146 | -0.029 | 0.000 | 0.99 | | | 92.5 | OK |
| S2.006 | S03-07-29 | 135.928 | -0.098 | 0.000 | 0.90 | | | 93.4 | OK |
| S2.007 | S03-07-30 | 135.799 | -0.176 | 0.000 | 0.55 | | | 102.1 | OK |
| S2.008 | S03-07-31 | 135.171 | -0.203 | 0.000 | 0.43 | | | 113.2 | OK |
| S2.009 | S03-07-32 | 133.816 | -0.194 | 0.000 | 0.47 | | | 125.6 | OK |
| S2.010 | S03-07-33 | 132.416 | -0.183 | 0.000 | 0.52 | | | 138.2 | OK |
| S2.011 | S03-07-34 | 131.027 | -0.171 | 0.000 | 0.57 | | | 151.9 | OK |
| S2.012 | S03-07-35 | 129.644 | -0.160 | 0.000 | 0.62 | | | 167.4 | OK |
| S2.013 | S03-07-36 | 128.138 | -0.244 | 0.000 | 0.43 | | | 183.7 | OK |
| S2.014 | S03-07-37 | 126.764 | -0.220 | 0.000 | 0.52 | | | 200.9 | OK |
| S2.015 | S03-07-38 | 125.581 | -0.236 | 0.000 | 0.46 | | | 217.6 | OK |
| S2.016 | S03-07-39 | 123.868 | -0.212 | 0.000 | 0.55 | | | 233.1 | OK |
| S2.017 | S03-07-40 | 122.487 | -0.203 | 0.000 | 0.58 | | | 247.2 | OK |
| S2.018 | S03-07-41 | 121.031 | -0.259 | 0.000 | 0.51 | | | 256.4 | OK |
| S2.019 | S03-07-42 | 120.324 | -0.292 | 0.000 | 0.41 | | | 261.8 | OK |
| S2.020 | S03-07-43 | 119.876 | 0.008 | 0.000 | 1.02 | | | 265.0 | SURCHARGED |
| S2.021 | S03-07-44 | 119.793 | 0.004 | 0.000 | 0.99 | | | 270.3 | SURCHARGED |
| S2.022 | S03-07-45 | 119.668 | 0.000 | 0.000 | 1.15 | | | 246.1 | OK |
| S3.000 | S03-07-46 | 121.125 | -0.100 | 0.000 | 0.57 | | | 34.8 | OK |
| S3.001 | S03-07-47 | 120.081 | -0.005 | 0.000 | 0.84 | | | 56.1 | OK |
| S3.002 | S03-07-48 | 119.914 | 0.090 | 0.000 | 1.16 | | | 77.3 | SURCHARGED |
| S3.003 | S03-07-49 | 119.409 | -0.151 | 0.000 | 0.49 | | | 82.6 | OK |
| S2.023 | S03-07-50 | 118.767 | -0.225 | 0.000 | 0.71 | | | 342.3 | OK |
| S4.000 | S03-07-51 | 121.004 | -0.121 | 0.000 | 0.42 | | | 17.1 | OK |
| S4.001 | S03-07-52 | 120.661 | -0.145 | 0.000 | 0.50 | | | 33.2 | OK |
| S4.002 | S03-07-53 | 120.471 | -0.093 | 0.000 | 0.78 | | | 47.6 | OK |
| S4.003 | S03-07-54 | 120.193 | -0.174 | 0.000 | 0.37 | | | 62.0 | OK |
| S1.022 | S03-07-55 | 118.446 | -0.312 | 0.000 | 0.46 | | | 664.9 | OK |
| S1.023 | S03-07-56 | 116.500 | -0.219 | 0.000 | 0.73 | | | 665.7 | OK |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| S1.020 | S03-07-21 | |
| S1.021 | S03-07-22 | |
| S2.000 | S03-07-23 | |
| S2.001 | S03-07-24 | |
| S2.002 | S03-07-25 | |
| S2.003 | S03-07-26 | |
| S2.004 | S03-07-27 | |
| S2.005 | S03-07-28 | |
| S2.006 | S03-07-29 | |
| S2.007 | S03-07-30 | |
| S2.008 | S03-07-31 | |
| S2.009 | S03-07-32 | |
| S2.010 | S03-07-33 | |
| S2.011 | S03-07-34 | |

## Summary of Critical Results by Maximum Level (Rank 1) for Pond 3-7

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| S2.012 | S03-07-35 | |
| S2.013 | S03-07-36 | |
| S2.014 | S03-07-37 | |
| S2.015 | S03-07-38 | |
| S2.016 | S03-07-39 | |
| S2.017 | S03-07-40 | |
| S2.018 | S03-07-41 | |
| S2.019 | S03-07-42 | |
| S2.020 | S03-07-43 | |
| S2.021 | S03-07-44 | |
| S2.022 | S03-07-45 | |
| S3.000 | S03-07-46 | |
| S3.001 | S03-07-47 | |
| S3.002 | S03-07-48 | |
| S3.003 | S03-07-49 | |
| S2.023 | S03-07-50 | |
| S4.000 | S03-07-51 | |
| S4.001 | S03-07-52 | |
| S4.002 | S03-07-53 | |
| S4.003 | S03-07-54 | |
| S1.022 | S03-07-55 | |
| S1.023 | S03-07-56 | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Syatem 3-8

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 15.300 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Time Area Diagram for Syatem 3-8 at outfall S (pipe S1.001)

| **Time (mins)** | **Area (ha)** | **Time (mins)** | **Area (ha)** |
|---|---|---|---|
| 0-4 | 0.058 | 4-8 | 0.009 |

Total Area Contributing (ha) = 0.068

Total Pipe Volume (m³) = 1.481

### Time Area Diagram at outfall S (pipe S2.004)

| **Time (mins)** | **Area (ha)** | **Time (mins)** | **Area (ha)** | **Time (mins)** | **Area (ha)** |
|---|---|---|---|---|---|
| 0-4 | 0.212 | 4-8 | 0.412 | 8-12 | 0.027 |

Total Area Contributing (ha) = 0.652

Total Pipe Volume (m³) = 30.198

### Network Design Table for Syatem 3-8

| **PN** | **Length (m)** | **Fall (m)** | **Slope (1:X)** | **I.Area (ha)** | **T.E. (mins)** | **Base Flow (l/s)** | **k (mm)** | **HYD SECT** | **DIA (mm)** | **Section Type** | **Auto Design** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 14.119 | 0.399 | 35.4 | 0.027 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |

### Network Results Table

| **PN** | **Rain (mm/hr)** | **T.C. (mins)** | **US/IL (m)** | **Σ I.Area (ha)** | **Σ Base Flow (l/s)** | **Foul (l/s)** | **Add Flow (l/s)** | **Vel (m/s)** | **Cap (l/s)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 59.39 | 5.11 | 114.900 | 0.027 | 0.0 | 0.0 | 0.0 | 2.21 | 87.7 | 4.4 |

## Network Design Table for Syatem 3-8

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.001 | 23.132 | 0.395 | 58.6 | 0.040 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.000 | 49.480 | 0.198 | 250.0 | 0.081 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S2.001 | 48.836 | 0.189 | 259.0 | 0.057 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.002 | 49.073 | 0.196 | 250.4 | 0.066 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S2.003 | 58.416 | 0.234 | 250.0 | 0.082 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S3.000 | 23.855 | 0.596 | 40.0 | 0.031 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S3.001 | 19.339 | 0.114 | 170.0 | 0.035 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S3.002 | 50.041 | 0.294 | 170.0 | 0.062 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S3.003 | 50.005 | 0.200 | 250.0 | 0.081 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S3.004 | 50.080 | 0.207 | 241.9 | 0.077 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S3.005 | 59.807 | 0.239 | 250.0 | 0.081 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S3.006 | 12.850 | 0.365 | 35.2 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S2.004 | 39.240 | 0.981 | 40.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.001 | 58.41 | 5.33 | 114.501 | 0.068 | 0.0 | 0.0 | 0.0 | 1.71 | 68.1 | 10.7 |
| S2.000 | 55.71 | 6.00 | 115.400 | 0.081 | 0.0 | 0.0 | 0.0 | 0.82 | 32.7 | 12.2 |
| S2.001 | 52.17 | 7.01 | 115.202 | 0.138 | 0.0 | 0.0 | 0.0 | 0.81 | 32.1 | 19.5 |
| S2.002 | 49.66 | 7.84 | 114.939 | 0.204 | 0.0 | 0.0 | 0.0 | 0.99 | 69.9 | 27.4 |
| S2.003 | 47.02 | 8.82 | 114.743 | 0.286 | 0.0 | 0.0 | 0.0 | 0.99 | 70.0 | 36.4 |
| S3.000 | 59.02 | 5.19 | 116.600 | 0.031 | 0.0 | 0.0 | 0.0 | 2.07 | 82.5 | 4.9 |
| S3.001 | 57.64 | 5.51 | 116.004 | 0.065 | 0.0 | 0.0 | 0.0 | 1.00 | 39.8 | 10.2 |
| S3.002 | 54.43 | 6.35 | 115.890 | 0.127 | 0.0 | 0.0 | 0.0 | 1.00 | 39.8 | 18.8 |
| S3.003 | 51.60 | 7.19 | 115.521 | 0.208 | 0.0 | 0.0 | 0.0 | 0.99 | 70.0 | 29.1 |
| S3.004 | 49.14 | 8.02 | 115.320 | 0.285 | 0.0 | 0.0 | 0.0 | 1.01 | 71.1 | 37.9 |
| S3.005 | 46.51 | 9.03 | 115.113 | 0.367 | 0.0 | 0.0 | 0.0 | 0.99 | 70.0 | 46.2 |
| S3.006 | 46.32 | 9.11 | 114.874 | 0.367 | 0.0 | 0.0 | 0.0 | 2.66 | 188.0 | 46.2 |
| S2.004 | 45.70 | 9.37 | 114.509 | 0.652 | 0.0 | 0.0 | 0.0 | 2.49 | 176.2 | 80.7 |

## Manhole Schedules for Syatem 3-8

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backc (mr |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S03-08-1 | 116.473 | 1.573 | Open Manhole | 1200 | S1.000 | 114.900 | 225 | | | | |
| S03-08-2 | 117.339 | 2.838 | Open Manhole | 1200 | S1.001 | 114.501 | 225 | S1.000 | 114.501 | 225 | |
| S | 117.317 | 3.211 | Open Manhole | 0 | | OUTFALL | | S1.001 | 114.106 | 225 | |
| S03-08-3 | 116.954 | 1.554 | Open Manhole | 1200 | S2.000 | 115.400 | 225 | | | | |
| S03-08-4 | 116.853 | 1.651 | Open Manhole | 1200 | S2.001 | 115.202 | 225 | S2.000 | 115.202 | 225 | |
| S03-08-5 | 116.624 | 1.685 | Open Manhole | 1200 | S2.002 | 114.939 | 300 | S2.001 | 115.014 | 225 | |
| S03-08-6 | 116.339 | 1.597 | Open Manhole | 1200 | S2.003 | 114.743 | 300 | S2.002 | 114.743 | 300 | |
| S03-08-7 | 118.144 | 1.544 | Open Manhole | 1200 | S3.000 | 116.600 | 225 | | | | |
| S03-08-8 | 117.524 | 1.521 | Open Manhole | 1200 | S3.001 | 116.004 | 225 | S3.000 | 116.004 | 225 | |
| S03-08-9 | 117.411 | 1.522 | Open Manhole | 1200 | S3.002 | 115.890 | 225 | S3.001 | 115.890 | 225 | |
| S03-08-10 | 117.318 | 1.798 | Open Manhole | 1200 | S3.003 | 115.521 | 300 | S3.002 | 115.596 | 225 | |
| S03-08-11 | 117.080 | 1.760 | Open Manhole | 1200 | S3.004 | 115.320 | 300 | S3.003 | 115.320 | 300 | |
| S03-08-12 | 116.798 | 1.684 | Open Manhole | 1200 | S3.005 | 115.113 | 300 | S3.004 | 115.113 | 300 | |
| S03-08-13 | 116.429 | 1.555 | Open Manhole | 1200 | S3.006 | 114.874 | 300 | S3.005 | 114.874 | 300 | |
| S03-08-14 | 116.130 | 1.621 | Open Manhole | 1200 | S2.004 | 114.509 | 300 | S2.003 | 114.509 | 300 | |
| | | | | | | | | S3.006 | 114.509 | 300 | |
| S | 114.989 | 1.461 | Open Manhole | 0 | | OUTFALL | | S2.004 | 113.528 | 300 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S03-08-1 | 354202.891 | 528989.028 | 354202.891 | 528989.028 | Required |  |
| S03-08-2 | 354199.541 | 529002.744 | 354199.541 | 529002.744 | Required |  |
| S | 354207.323 | 529024.527 | | | No Entry |  |
| S03-08-3 | 354257.983 | 529024.268 | 354257.983 | 529024.268 | Required |  |
| S03-08-4 | 354209.919 | 529036.024 | 354209.919 | 529036.024 | Required |  |
| S03-08-5 | 354163.324 | 529050.646 | 354163.324 | 529050.646 | Required |  |

## Manhole Schedules for Syatem 3-8

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S03-08-6 | 354117.675 | 529068.659 | 354117.675 | 529068.659 | Required |  |
| S03-08-7 | 354231.764 | 528981.211 | 354231.764 | 528981.211 | Required |  |
| S03-08-8 | 354252.081 | 528993.713 | 354252.081 | 528993.713 | Required |  |
| S03-08-9 | 354255.874 | 529012.677 | 354255.874 | 529012.677 | Required |  |
| S03-08-10 | 354207.259 | 529024.538 | 354207.259 | 529024.538 | Required |  |
| S03-08-11 | 354159.576 | 529039.599 | 354159.576 | 529039.599 | Required |  |
| S03-08-12 | 354112.825 | 529057.556 | 354112.825 | 529057.556 | Required |  |
| S03-08-13 | 354058.777 | 529083.160 | 354058.777 | 529083.160 | Required |  |
| S03-08-14 | 354065.187 | 529094.297 | 354065.187 | 529094.297 | Required |  |
| S | 354030.920 | 529113.417 | | | No Entry |  |

## PIPELINE SCHEDULES for Syatem 3-8

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | o | 225 | S03-08-1 | 116.473 | 114.900 | 1.348 | Open Manhole | 1200 |
| S1.001 | o | 225 | S03-08-2 | 117.339 | 114.501 | 2.613 | Open Manhole | 1200 |
| S2.000 | o | 225 | S03-08-3 | 116.954 | 115.400 | 1.329 | Open Manhole | 1200 |
| S2.001 | o | 225 | S03-08-4 | 116.853 | 115.202 | 1.426 | Open Manhole | 1200 |
| S2.002 | o | 300 | S03-08-5 | 116.624 | 114.939 | 1.385 | Open Manhole | 1200 |
| S2.003 | o | 300 | S03-08-6 | 116.339 | 114.743 | 1.297 | Open Manhole | 1200 |
| S3.000 | o | 225 | S03-08-7 | 118.144 | 116.600 | 1.319 | Open Manhole | 1200 |
| S3.001 | o | 225 | S03-08-8 | 117.524 | 116.004 | 1.296 | Open Manhole | 1200 |
| S3.002 | o | 225 | S03-08-9 | 117.411 | 115.890 | 1.297 | Open Manhole | 1200 |
| S3.003 | o | 300 | S03-08-10 | 117.318 | 115.521 | 1.498 | Open Manhole | 1200 |
| S3.004 | o | 300 | S03-08-11 | 117.080 | 115.320 | 1.460 | Open Manhole | 1200 |
| S3.005 | o | 300 | S03-08-12 | 116.798 | 115.113 | 1.384 | Open Manhole | 1200 |
| S3.006 | o | 300 | S03-08-13 | 116.429 | 114.874 | 1.255 | Open Manhole | 1200 |
| S2.004 | o | 300 | S03-08-14 | 116.130 | 114.509 | 1.321 | Open Manhole | 1200 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | 14.119 | 35.4 | S03-08-2 | 117.339 | 114.501 | 2.613 | Open Manhole | 1200 |
| S1.001 | 23.132 | 58.6 | S | 117.317 | 114.106 | 2.986 | Open Manhole | 0 |
| S2.000 | 49.480 | 250.0 | S03-08-4 | 116.853 | 115.202 | 1.426 | Open Manhole | 1200 |
| S2.001 | 48.836 | 259.0 | S03-08-5 | 116.624 | 115.014 | 1.385 | Open Manhole | 1200 |
| S2.002 | 49.073 | 250.4 | S03-08-6 | 116.339 | 114.743 | 1.297 | Open Manhole | 1200 |
| S2.003 | 58.416 | 250.0 | S03-08-14 | 116.130 | 114.509 | 1.321 | Open Manhole | 1200 |
| S3.000 | 23.855 | 40.0 | S03-08-8 | 117.524 | 116.004 | 1.296 | Open Manhole | 1200 |
| S3.001 | 19.339 | 170.0 | S03-08-9 | 117.411 | 115.890 | 1.297 | Open Manhole | 1200 |
| S3.002 | 50.041 | 170.0 | S03-08-10 | 117.318 | 115.596 | 1.498 | Open Manhole | 1200 |
| S3.003 | 50.005 | 250.0 | S03-08-11 | 117.080 | 115.320 | 1.460 | Open Manhole | 1200 |
| S3.004 | 50.080 | 241.9 | S03-08-12 | 116.798 | 115.113 | 1.384 | Open Manhole | 1200 |
| S3.005 | 59.807 | 250.0 | S03-08-13 | 116.429 | 114.874 | 1.255 | Open Manhole | 1200 |
| S3.006 | 12.850 | 35.2 | S03-08-14 | 116.130 | 114.509 | 1.321 | Open Manhole | 1200 |
| S2.004 | 39.240 | 40.0 | S | 114.989 | 113.528 | 1.161 | Open Manhole | 0 |

## Area Summary for Syatem 3-8

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | User | - | 100 | 0.025 | 0.025 | 0.025 |
| | User | - | 50 | 0.004 | 0.002 | 0.027 |
| 1.001 | User | - | 100 | 0.039 | 0.039 | 0.039 |
| | User | - | 50 | 0.003 | 0.001 | 0.040 |
| 2.000 | User | - | 100 | 0.072 | 0.072 | 0.072 |
| | User | - | 50 | 0.013 | 0.007 | 0.079 |
| | User | - | 25 | 0.007 | 0.002 | 0.081 |
| 2.001 | - | - | 100 | 0.057 | 0.057 | 0.057 |
| 2.002 | User | - | 100 | 0.060 | 0.060 | 0.060 |
| | User | - | 50 | 0.013 | 0.007 | 0.066 |
| 2.003 | User | - | 100 | 0.074 | 0.074 | 0.074 |
| | User | - | 50 | 0.015 | 0.008 | 0.082 |
| 3.000 | User | - | 100 | 0.020 | 0.020 | 0.020 |
| | User | - | 50 | 0.019 | 0.010 | 0.029 |
| | User | - | 25 | 0.005 | 0.001 | 0.031 |
| 3.001 | User | - | 100 | 0.035 | 0.035 | 0.035 |
| 3.002 | User | - | 100 | 0.062 | 0.062 | 0.062 |
| 3.003 | User | - | 100 | 0.073 | 0.073 | 0.073 |
| | User | - | 50 | 0.016 | 0.008 | 0.081 |
| 3.004 | User | - | 100 | 0.067 | 0.067 | 0.067 |
| | User | - | 50 | 0.021 | 0.010 | 0.077 |
| 3.005 | User | - | 100 | 0.069 | 0.069 | 0.069 |
| | User | - | 50 | 0.024 | 0.012 | 0.081 |
| 3.006 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 2.004 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total<br>0.793 | Total<br>0.720 | Total<br>0.720 |

## Free Flowing Outfall Details for Syatem 3-8

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| S1.001 | S | 117.317 | 114.106 | 0.000 | 0 | 0 |

## Free Flowing Outfall Details for Syatem 3-8

| Outfall Pipe Number | Outfall Name | C. Level (m) | I. Level (m) | Min I. Level (m) | D,L (mm) | W (mm) |
|---|---|---|---|---|---|---|
| S2.004 | S | 114.989 | 113.528 | 112.000 | 0 | 0 |

## Simulation Criteria for Syatem 3-8

```
          Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 40.000
           Areal Reduction Factor 1.000       MADD Factor * 10m³/ha Storage  2.000
                  Hot Start (mins)     0               Inlet Coeffiecient  0.800
               Hot Start Level (mm)     0 Flow per Person per Day (l/per/day)  0.000
     Manhole Headloss Coeff (Global) 0.500                  Run Time (mins)     60
       Foul Sewage per hectare (l/s) 0.000           Output Interval (mins)      1

            Number of Input Hydrographs 0 Number of Storage Structures 0
              Number of Online Controls 0 Number of Time/Area Diagrams 0
             Number of Offline Controls 0 Number of Real Time Controls 0
```

## Synthetic Rainfall Details

```
                 Rainfall Model               FSR           Profile Type  Summer
          Return Period (years)                 5            Cv (Summer)   0.750
                         Region England and Wales            Cv (Winter)   0.840
                     M5-60 (mm)            15.300 Storm Duration (mins)       30
                        Ratio R             0.300
```

## Summary of Critical Results by Maximum Level (Rank 1) for Syatem 3-8

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 40.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Ratio R | 0.300 |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 15.000 | Cv (Winter) | 0.840 |

| | | | |
|---|---|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 | DVD Status | OFF |
| Analysis Timestep | Fine | Inertia Status | OFF |
| DTS Status | ON | | |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5 |
| Climate Change (%) | 20 |

| **PN** | **US/MH Name** | **Storm** | **Return Period** | **Climate Change** | **First (X) Surcharge** | **First (Y) Flood** | **First (Z) Overflow** | **Overflow Act.** | **Water Level (m)** |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S03-08-1 | 15 Winter | 5 | +20% | | | | | 114.946 |
| S1.001 | S03-08-2 | 15 Winter | 5 | +20% | | | | | 114.579 |
| S2.000 | S03-08-3 | 15 Winter | 5 | +20% | | | | | 115.538 |
| S2.001 | S03-08-4 | 15 Winter | 5 | +20% | | | | | 115.403 |
| S2.002 | S03-08-5 | 15 Winter | 5 | +20% | | | | | 115.117 |
| S2.003 | S03-08-6 | 15 Winter | 5 | +20% | | | | | 114.958 |
| S3.000 | S03-08-7 | 15 Winter | 5 | +20% | | | | | 116.649 |
| S3.001 | S03-08-8 | 15 Winter | 5 | +20% | | | | | 116.109 |
| S3.002 | S03-08-9 | 15 Winter | 5 | +20% | | | | | 116.041 |
| S3.003 | S03-08-10 | 15 Winter | 5 | +20% | | | | | 115.708 |
| S3.004 | S03-08-11 | 15 Winter | 5 | +20% | | | | | 115.542 |
| S3.005 | S03-08-12 | 15 Winter | 5 | +20% | | | | | 115.409 |
| S3.006 | S03-08-13 | 15 Winter | 5 | +20% | | | | | 115.013 |
| S2.004 | S03-08-14 | 15 Winter | 5 | +20% | | | | | 114.703 |

## Summary of Critical Results by Maximum Level (Rank 1) for Syatem 3-8

| PN | US/MH Name | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S03-08-1 | -0.179 | 0.000 | 0.09 | | | 7.2 | OK | |
| S1.001 | S03-08-2 | -0.147 | 0.000 | 0.26 | | | 16.3 | OK | |
| S2.000 | S03-08-3 | -0.087 | 0.000 | 0.65 | | | 20.5 | OK | |
| S2.001 | S03-08-4 | -0.024 | 0.000 | 0.99 | | | 30.4 | OK | |
| S2.002 | S03-08-5 | -0.122 | 0.000 | 0.64 | | | 42.4 | OK | |
| S2.003 | S03-08-6 | -0.084 | 0.000 | 0.84 | | | 56.2 | OK | |
| S3.000 | S03-08-7 | -0.176 | 0.000 | 0.11 | | | 8.2 | OK | |
| S3.001 | S03-08-8 | -0.119 | 0.000 | 0.44 | | | 15.8 | OK | |
| S3.002 | S03-08-9 | -0.074 | 0.000 | 0.76 | | | 28.8 | OK | |
| S3.003 | S03-08-10 | -0.113 | 0.000 | 0.68 | | | 45.0 | OK | |
| S3.004 | S03-08-11 | -0.078 | 0.000 | 0.87 | | | 58.0 | OK | |
| S3.005 | S03-08-12 | -0.005 | 0.000 | 1.00 | | | 66.4 | OK | |
| S3.006 | S03-08-13 | -0.161 | 0.000 | 0.44 | | | 66.4 | OK | |
| S2.004 | S03-08-14 | -0.106 | 0.000 | 0.74 | | | 121.5 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for System 3-9

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 15.000 | Add Flow / Climate Change (%) | 5 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 50 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Time Area Diagram for System 3-9

| Time (mins) | Area (ha) | Time (mins) | Area (ha) | Time (mins) | Area (ha) |
|---|---|---|---|---|---|
| 0-4 | 0.196 | 4-8 | 0.487 | 8-12 | 0.063 |

Total Area Contributing (ha) = 0.747

Total Pipe Volume (m³) = 111.746

### Network Design Table for System 3-9

« - Indicates pipe capacity < flow

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 77.208 | 1.206 | 64.0 | 0.107 | 5.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| S1.001 | 62.482 | 0.156 | 400.0 | 0.095 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |
| S1.002 | 62.482 | 0.156 | 400.0 | 0.110 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |
| S1.003 | 91.017 | 0.455 | 200.0 | 0.197 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |
| S1.004 | 36.379 | 0.909 | 40.0 | 0.124 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 50.00 | 5.65 | 120.900 | 0.107 | 0.0 | 0.0 | 0.7 | 1.97 | 139.1 | 15.2 |
| S1.001 | 50.00 | 6.51 | 119.394 | 0.202 | 0.0 | 0.0 | 1.4 | 1.21 | 342.5 | 28.7 |
| S1.002 | 50.00 | 7.37 | 119.238 | 0.312 | 0.0 | 0.0 | 2.1 | 1.21 | 342.5 | 44.4 |
| S1.003 | 47.54 | 8.26 | 119.082 | 0.510 | 0.0 | 0.0 | 3.3 | 1.72 | 485.8 | 68.9 |
| S1.004 | 47.13 | 8.41 | 118.627 | 0.633 | 0.0 | 0.0 | 4.0 | 3.86 | 1090.6 | 84.9 |

## Network Design Table for System 3-9

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.005 | 36.379 | 0.121 | 300.6 | 0.000 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |
| S1.006 | 80.632 | 0.269 | 299.7 | 0.114 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔒 |
| S1.007 | 46.579 | 0.776 | 60.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.005 | 46.03 | 8.85 | 117.718 | 0.633 | 0.0 | 0.0 | 4.0 | 1.40 | 395.6 | 84.9 |
| S1.006 | 43.83 | 9.81 | 116.450 | 0.747 | 0.0 | 0.0 | 4.4 | 1.40 | 396.2 | 93.1 |
| S1.007 | 42.86 | 10.26 | 116.149 | 0.747 | 0.0 | 0.0 | 4.4 | 1.69 | 67.2« | 93.1 |

## Manhole Schedules for System 3-9

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdr (mm |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S03-09-1 | 122.471 | 1.571 | Open Manhole | 1200 | S1.000 | 120.900 | 300 | | | | |
| S03-09-2 | 122.262 | 2.868 | Open Manhole | 1500 | S1.001 | 119.394 | 600 | S1.000 | 119.694 | 300 | |
| S03-09-3 | 121.829 | 2.592 | Open Manhole | 1500 | S1.002 | 119.238 | 600 | S1.001 | 119.238 | 600 | |
| S03-09-4 | 121.219 | 2.137 | Open Manhole | 1500 | S1.003 | 119.082 | 600 | S1.002 | 119.082 | 600 | |
| S03-09-5 | 120.098 | 1.471 | Open Manhole | 1500 | S1.004 | 118.627 | 600 | S1.003 | 118.627 | 600 | |
| S03-09-6 | 119.515 | 1.798 | Open Manhole | 1500 | S1.005 | 117.718 | 600 | S1.004 | 117.718 | 600 | |
| S03-09-7 | 119.078 | 2.628 | Open Manhole | 1500 | S1.006 | 116.450 | 600 | S1.005 | 117.597 | 600 | 11 |
| S03-09-8 | 117.850 | 1.701 | Open Manhole | 1500 | S1.007 | 116.149 | 225 | S1.006 | 116.181 | 600 | 4 |
| S | 116.842 | 1.469 | Open Manhole | 0 | | OUTFALL | | S1.007 | 115.373 | 225 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S03-09-1 | 358655.698 | 528707.326 | 358655.698 | 528707.326 | Required |  |
| S03-09-2 | 358731.982 | 528695.419 | 358731.982 | 528695.419 | Required |  |
| S03-09-3 | 358794.079 | 528688.492 | 358794.079 | 528688.492 | Required |  |
| S03-09-4 | 358856.175 | 528681.565 | 358856.175 | 528681.565 | Required |  |
| S03-09-5 | 358946.116 | 528667.610 | 358946.116 | 528667.610 | Required |  |
| S03-09-6 | 358981.811 | 528660.593 | 358981.811 | 528660.593 | Required |  |
| S03-09-7 | 359017.507 | 528653.576 | 359017.507 | 528653.576 | Required |  |
| S03-09-8 | 359096.807 | 528638.981 | 359096.807 | 528638.981 | Required |  |
| S | 359143.000 | 528633.000 | | | No Entry |  |

## PIPELINE SCHEDULES for System 3-9

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | o | 300 | S03-09-1 | 122.471 | 120.900 | 1.271 | Open Manhole | 1200 |
| S1.001 | o | 600 | S03-09-2 | 122.262 | 119.394 | 2.268 | Open Manhole | 1500 |
| S1.002 | o | 600 | S03-09-3 | 121.829 | 119.238 | 1.992 | Open Manhole | 1500 |
| S1.003 | o | 600 | S03-09-4 | 121.219 | 119.082 | 1.537 | Open Manhole | 1500 |
| S1.004 | o | 600 | S03-09-5 | 120.098 | 118.627 | 0.871 | Open Manhole | 1500 |
| S1.005 | o | 600 | S03-09-6 | 119.515 | 117.718 | 1.198 | Open Manhole | 1500 |
| S1.006 | o | 600 | S03-09-7 | 119.078 | 116.450 | 2.028 | Open Manhole | 1500 |
| S1.007 | o | 225 | S03-09-8 | 117.850 | 116.149 | 1.476 | Open Manhole | 1500 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | 77.208 | 64.0 | S03-09-2 | 122.262 | 119.694 | 2.268 | Open Manhole | 1500 |
| S1.001 | 62.482 | 400.0 | S03-09-3 | 121.829 | 119.238 | 1.992 | Open Manhole | 1500 |
| S1.002 | 62.482 | 400.0 | S03-09-4 | 121.219 | 119.082 | 1.537 | Open Manhole | 1500 |
| S1.003 | 91.017 | 200.0 | S03-09-5 | 120.098 | 118.627 | 0.871 | Open Manhole | 1500 |
| S1.004 | 36.379 | 40.0 | S03-09-6 | 119.515 | 117.718 | 1.198 | Open Manhole | 1500 |
| S1.005 | 36.379 | 300.6 | S03-09-7 | 119.078 | 117.597 | 0.881 | Open Manhole | 1500 |
| S1.006 | 80.632 | 299.7 | S03-09-8 | 117.850 | 116.181 | 1.069 | Open Manhole | 1500 |
| S1.007 | 46.579 | 60.0 | S | 116.842 | 115.373 | 1.244 | Open Manhole | 0 |

## Area Summary for System 3-9

| **Pipe Number** | **PIMP Type** | **PIMP Name** | **PIMP (%)** | **Gross Area (ha)** | **Imp. Area (ha)** | **Pipe Total (ha)** |
|---|---|---|---|---|---|---|
| 1.000 | User | - | 100 | 0.095 | 0.095 | 0.095 |
| | User | - | 50 | 0.022 | 0.011 | 0.106 |
| | User | - | 25 | 0.004 | 0.001 | 0.107 |
| 1.001 | User | - | 100 | 0.083 | 0.083 | 0.083 |
| | User | - | 50 | 0.017 | 0.009 | 0.092 |
| | User | - | 25 | 0.014 | 0.004 | 0.095 |
| 1.002 | User | - | 100 | 0.098 | 0.098 | 0.098 |
| | User | - | 50 | 0.017 | 0.008 | 0.106 |
| | User | - | 25 | 0.016 | 0.004 | 0.110 |
| 1.003 | User | - | 100 | 0.184 | 0.184 | 0.184 |
| | User | - | 50 | 0.025 | 0.013 | 0.196 |
| | User | - | 25 | 0.004 | 0.001 | 0.197 |
| 1.004 | User | - | 100 | 0.114 | 0.114 | 0.114 |
| | User | - | 50 | 0.020 | 0.010 | 0.124 |
| 1.005 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.006 | User | - | 100 | 0.103 | 0.103 | 0.103 |
| | User | - | 50 | 0.022 | 0.011 | 0.114 |
| 1.007 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total | Total | Total |
| | | | | 0.836 | 0.747 | 0.747 |

## Free Flowing Outfall Details for System 3-9

| **Outfall Pipe Number** | **Outfall Name** | **C. Level (m)** | **I. Level (m)** | **Min I. Level (m)** | **D,L (mm)** | **W (mm)** |
|---|---|---|---|---|---|---|
| S1.007 | S | 116.842 | 115.373 | 0.000 | 0 | 0 |

## Simulation Criteria for System 3-9

| | | | |
|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Additional Flow - % of Total Flow | 40.000 |
| Areal Reduction Factor | 1.000 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start (mins) | 0 | Inlet Coeffiecient | 0.800 |
| Hot Start Level (mm) | 0 | Flow per Person per Day (l/per/day) | 0.000 |
| Manhole Headloss Coeff (Global) | 0.500 | Run Time (mins) | 60 |
| Foul Sewage per hectare (l/s) | 0.000 | Output Interval (mins) | 1 |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

## Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Ratio R | 0.300 |
| Return Period (years) | 5 | Profile Type | Summer |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 15.300 | Cv (Winter) | 0.840 |

## Synthetic Rainfall Details

Storm Duration (mins) 30

## Summary of Critical Results by Maximum Level (Rank 1) for System 3-9

### Simulation Criteria

Areal Reduction Factor 1.000
Additional Flow - % of Total Flow 40.000
Hot Start (mins) 0
MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0
Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500
Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0
Number of Storage Structures 0
Number of Online Controls 0
Number of Time/Area Diagrams 0
Number of Offline Controls 0
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
Ratio R 0.300
Region England and Wales
Cv (Summer) 0.750
M5-60 (mm) 15.000
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
DVD Status OFF
Analysis Timestep Fine
Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5
Climate Change (%) 20

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S03-09-1 | 15 Winter | 5 | +20% | | | | | 120.994 |
| S1.001 | S03-09-2 | 15 Winter | 5 | +20% | | | | | 119.558 |
| S1.002 | S03-09-3 | 15 Winter | 5 | +20% | | | | | 119.432 |
| S1.003 | S03-09-4 | 15 Winter | 5 | +20% | | | | | 119.279 |
| S1.004 | S03-09-5 | 15 Winter | 5 | +20% | | | | | 118.774 |
| S1.005 | S03-09-6 | 15 Winter | 5 | +20% | | | | | 117.972 |
| S1.006 | S03-09-7 | 30 Winter | 5 | +20% | 5/15 Winter | | | | 117.271 |
| S1.007 | S03-09-8 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 117.244 |

| PN | US/MH Name | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S03-09-1 | -0.206 | 0.000 | 0.21 | | | 28.3 | OK | |
| S1.001 | S03-09-2 | -0.436 | 0.000 | 0.15 | | | 47.5 | OK | |
| S1.002 | S03-09-3 | -0.405 | 0.000 | 0.22 | | | 68.1 | OK | |
| S1.003 | S03-09-4 | -0.403 | 0.000 | 0.23 | | | 103.3 | OK | |
| S1.004 | S03-09-5 | -0.453 | 0.000 | 0.14 | | | 125.1 | OK | |
| S1.005 | S03-09-6 | -0.346 | 0.000 | 0.38 | | | 124.8 | OK | |

Summary of Critical Results by Maximum Level (Rank 1) for System 3-9

| PN | US/MH Name | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|
| S1.006 | S03-09-7 | 0.221 | 0.000 | 0.36 | | | 131.8 | SURCHARGED | |
| S1.007 | S03-09-8 | 0.870 | 0.000 | 1.45 | | | 93.3 | SURCHARGED | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for System 3-10

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 15.200 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Time Area Diagram for System 3-10

| Time (mins) | Area (ha) | Time (mins) | Area (ha) | Time (mins) | Area (ha) |
|---|---|---|---|---|---|
| 0-4 | 0.388 | 4-8 | 0.602 | 8-12 | 0.151 |

Total Area Contributing (ha) = 1.141

Total Pipe Volume (m³) = 96.276

### Network Design Table for System 3-10

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 78.091 | 0.312 | 250.3 | 0.127 | 5.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| S1.001 | 59.554 | 1.191 | 50.0 | 0.090 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S1.002 | 69.964 | 0.175 | 400.0 | 0.110 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |
| S1.003 | 70.296 | 0.176 | 399.4 | 0.110 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔒 |
| S1.004 | 70.385 | 0.765 | 92.0 | 0.098 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| S1.005 | 69.736 | 1.337 | 52.2 | 0.093 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| S1.006 | 79.809 | 2.068 | 38.6 | 0.108 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.000 | 54.19 | 6.32 | 120.900 | 0.127 | 0.0 | 0.0 | 0.0 | 0.99 | 69.9 | 18.6 |
| S1.001 | 52.65 | 6.76 | 120.588 | 0.217 | 0.0 | 0.0 | 0.0 | 2.23 | 157.5 | 31.0 |
| S1.002 | 49.66 | 7.72 | 119.097 | 0.327 | 0.0 | 0.0 | 0.0 | 1.21 | 342.5 | 43.9 |
| S1.003 | 47.04 | 8.69 | 118.922 | 0.437 | 0.0 | 0.0 | 0.0 | 1.21 | 342.8 | 55.6 |
| S1.004 | 45.31 | 9.41 | 118.684 | 0.534 | 0.0 | 0.0 | 0.0 | 1.64 | 115.9 | 65.6 |
| S1.005 | 44.12 | 9.94 | 117.913 | 0.627 | 0.0 | 0.0 | 0.0 | 2.18 | 154.2 | 74.9 |
| S1.006 | 43.03 | 10.46 | 116.501 | 0.735 | 0.0 | 0.0 | 0.0 | 2.54 | 179.5 | 85.7 |

## Network Design Table for System 3-10

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S1.007 | 59.247 | 2.693 | 22.0 | 0.091 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| S1.008 | 56.067 | 0.140 | 400.5 | 0.103 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |
| S2.000 | 70.017 | 1.437 | 48.7 | 0.088 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| S2.001 | 49.999 | 1.058 | 47.3 | 0.063 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.002 | 48.053 | 0.447 | 107.5 | 0.060 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S2.003 | 18.401 | 0.177 | 104.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| S1.009 | 23.954 | 0.503 | 47.6 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S1.007 | 42.44 | 10.76 | 114.358 | 0.826 | 0.0 | 0.0 | 0.0 | 3.37 | 238.0 | 95.0 |
| S1.008 | 40.99 | 11.53 | 111.365 | 0.929 | 0.0 | 0.0 | 0.0 | 1.21 | 342.3 | 103.2 |
| S2.000 | 56.83 | 5.62 | 115.800 | 0.088 | 0.0 | 0.0 | 0.0 | 1.88 | 74.7 | 13.6 |
| S2.001 | 55.13 | 6.06 | 114.363 | 0.152 | 0.0 | 0.0 | 0.0 | 1.91 | 75.9 | 22.7 |
| S2.002 | 52.87 | 6.69 | 113.305 | 0.212 | 0.0 | 0.0 | 0.0 | 1.26 | 50.1 | 30.3 |
| S2.003 | 52.36 | 6.85 | 112.633 | 0.212 | 0.0 | 0.0 | 0.0 | 1.99 | 317.1 | 30.3 |
| S1.009 | 40.68 | 11.70 | 111.600 | 1.141 | 0.0 | 0.0 | 0.0 | 2.28 | 161.5 | 125.7 |

## Manhole Schedules for System 3-10

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Back (m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S03-10-1 | 122.469 | 1.569 | Open Manhole | 1200 | S1.000 | 120.900 | 300 | | | | |
| S03-10-2 | 122.267 | 1.679 | Open Manhole | 1200 | S1.001 | 120.588 | 300 | S1.000 | 120.588 | 300 | |
| S03-10-3 | 121.930 | 2.833 | Open Manhole | 1500 | S1.002 | 119.097 | 600 | S1.001 | 119.397 | 300 | |
| S03-10-4 | 121.337 | 2.415 | Open Manhole | 1500 | S1.003 | 118.922 | 600 | S1.002 | 118.922 | 600 | |
| S03-10-5 | 120.430 | 1.746 | Open Manhole | 1500 | S1.004 | 118.684 | 300 | S1.003 | 118.746 | 600 | |
| S03-10-6 | 119.396 | 1.483 | Open Manhole | 1200 | S1.005 | 117.913 | 300 | S1.004 | 117.919 | 300 | |
| S03-10-7 | 118.059 | 1.558 | Open Manhole | 1200 | S1.006 | 116.501 | 300 | S1.005 | 116.576 | 300 | |
| S03-10-8 | 115.869 | 1.511 | Open Manhole | 1200 | S1.007 | 114.358 | 300 | S1.006 | 114.433 | 300 | |
| S03-10-9 | 114.404 | 3.039 | Open Manhole | 1500 | S1.008 | 111.365 | 600 | S1.007 | 111.665 | 300 | |
| S03-10-10 | 117.510 | 1.710 | Open Manhole | 1200 | S2.000 | 115.800 | 225 | | | | |
| S03-10-11 | 115.797 | 1.434 | Open Manhole | 1200 | S2.001 | 114.363 | 225 | S2.000 | 114.363 | 225 | |
| S03-10-12 | 114.590 | 1.285 | Open Manhole | 1200 | S2.002 | 113.305 | 225 | S2.001 | 113.305 | 225 | |
| S03-10-14 | 113.585 | 0.952 | Open Manhole | 1350 | S2.003 | 112.633 | 450 | S2.002 | 112.858 | 225 | |
| S03-10-15 | 113.460 | 2.235 | Open Manhole | 1500 | S1.009 | 111.600 | 300 | S1.008 | 111.225 | 600 | |
| | | | | | | | | S2.003 | 112.456 | 450 | 1 |
| S | 113.058 | 1.961 | Open Manhole | 0 | | OUTFALL | | S1.009 | 111.097 | 300 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S03-10-1 | 358651.202 | 528685.167 | 358651.202 | 528685.167 | Required |  |
| S03-10-2 | 358728.393 | 528673.348 | 358728.393 | 528673.348 | Required |  |
| S03-10-3 | 358787.245 | 528664.225 | 358787.245 | 528664.225 | Required |  |
| S03-10-4 | 358856.361 | 528653.367 | 358856.361 | 528653.367 | Required |  |
| S03-10-5 | 358925.854 | 528642.770 | 358925.854 | 528642.770 | Required |  |
| S03-10-6 | 358995.404 | 528631.963 | 358995.404 | 528631.963 | Required |  |
| S03-10-7 | 359064.329 | 528621.362 | 359064.329 | 528621.362 | Required |  |

## Manhole Schedules for System 3-10

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S03-10-8 | 359143.026 | 528608.088 | 359143.026 | 528608.088 | Required |  |
| S03-10-9 | 359200.872 | 528595.279 | 359200.872 | 528595.279 | Required |  |
| S03-10-10 | 359095.712 | 528628.589 | 359095.712 | 528628.589 | Required |  |
| S03-10-11 | 359164.844 | 528617.500 | 359164.844 | 528617.500 | Required |  |
| S03-10-12 | 359213.977 | 528608.232 | 359213.977 | 528608.232 | Required |  |
| S03-10-14 | 359261.012 | 528598.391 | 359261.012 | 528598.391 | Required |  |
| S03-10-15 | 359255.083 | 528580.972 | 359255.083 | 528580.972 | Required |  |
| S | 359278.000 | 528574.000 | | | No Entry |  |

## PIPELINE SCHEDULES for System 3-10

### Upstream Manhole

| PN | Hyd Sect | Diam (mm) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | o | 300 | S03-10-1 | 122.469 | 120.900 | 1.269 | Open Manhole | 1200 |
| S1.001 | o | 300 | S03-10-2 | 122.267 | 120.588 | 1.379 | Open Manhole | 1200 |
| S1.002 | o | 600 | S03-10-3 | 121.930 | 119.097 | 2.233 | Open Manhole | 1500 |
| S1.003 | o | 600 | S03-10-4 | 121.337 | 118.922 | 1.815 | Open Manhole | 1500 |
| S1.004 | o | 300 | S03-10-5 | 120.430 | 118.684 | 1.446 | Open Manhole | 1500 |
| S1.005 | o | 300 | S03-10-6 | 119.396 | 117.913 | 1.183 | Open Manhole | 1200 |
| S1.006 | o | 300 | S03-10-7 | 118.059 | 116.501 | 1.258 | Open Manhole | 1200 |
| S1.007 | o | 300 | S03-10-8 | 115.869 | 114.358 | 1.211 | Open Manhole | 1200 |
| S1.008 | o | 600 | S03-10-9 | 114.404 | 111.365 | 2.439 | Open Manhole | 1500 |
| S2.000 | o | 225 | S03-10-10 | 117.510 | 115.800 | 1.485 | Open Manhole | 1200 |
| S2.001 | o | 225 | S03-10-11 | 115.797 | 114.363 | 1.209 | Open Manhole | 1200 |
| S2.002 | o | 225 | S03-10-12 | 114.590 | 113.305 | 1.060 | Open Manhole | 1200 |
| S2.003 | o | 450 | S03-10-14 | 113.585 | 112.633 | 0.502 | Open Manhole | 1350 |
| S1.009 | o | 300 | S03-10-15 | 113.460 | 111.600 | 1.560 | Open Manhole | 1500 |

### Downstream Manhole

| PN | Length (m) | Slope (1:X) | MH Name | C.Level (m) | I.Level (m) | D.Depth (m) | MH Connection | MH DIAM., L*W (mm) |
|---|---|---|---|---|---|---|---|---|
| S1.000 | 78.091 | 250.3 | S03-10-2 | 122.267 | 120.588 | 1.379 | Open Manhole | 1200 |
| S1.001 | 59.554 | 50.0 | S03-10-3 | 121.930 | 119.397 | 2.233 | Open Manhole | 1500 |
| S1.002 | 69.964 | 400.0 | S03-10-4 | 121.337 | 118.922 | 1.814 | Open Manhole | 1500 |
| S1.003 | 70.296 | 399.4 | S03-10-5 | 120.430 | 118.746 | 1.084 | Open Manhole | 1500 |
| S1.004 | 70.385 | 92.0 | S03-10-6 | 119.396 | 117.919 | 1.177 | Open Manhole | 1200 |
| S1.005 | 69.736 | 52.2 | S03-10-7 | 118.059 | 116.576 | 1.183 | Open Manhole | 1200 |
| S1.006 | 79.809 | 38.6 | S03-10-8 | 115.869 | 114.433 | 1.136 | Open Manhole | 1200 |
| S1.007 | 59.247 | 22.0 | S03-10-9 | 114.404 | 111.665 | 2.439 | Open Manhole | 1500 |
| S1.008 | 56.067 | 400.5 | S03-10-15 | 113.460 | 111.225 | 1.635 | Open Manhole | 1500 |
| S2.000 | 70.017 | 48.7 | S03-10-11 | 115.797 | 114.363 | 1.209 | Open Manhole | 1200 |
| S2.001 | 49.999 | 47.3 | S03-10-12 | 114.590 | 113.305 | 1.060 | Open Manhole | 1200 |
| S2.002 | 48.053 | 107.5 | S03-10-14 | 113.585 | 112.858 | 0.502 | Open Manhole | 1350 |
| S2.003 | 18.401 | 104.0 | S03-10-15 | 113.460 | 112.456 | 0.554 | Open Manhole | 1500 |
| S1.009 | 23.954 | 47.6 | S | 113.058 | 111.097 | 1.661 | Open Manhole | 0 |

## Area Summary for System 3-10

| **Pipe Number** | **PIMP Type** | **PIMP Name** | **PIMP (%)** | **Gross Area (ha)** | **Imp. Area (ha)** | **Pipe Total (ha)** |
|---|---|---|---|---|---|---|
| 1.000 | User | - | 100 | 0.095 | 0.095 | 0.095 |
| | User | - | 50 | 0.047 | 0.024 | 0.118 |
| | User | - | 25 | 0.033 | 0.008 | 0.127 |
| 1.001 | User | - | 100 | 0.071 | 0.071 | 0.071 |
| | User | - | 50 | 0.020 | 0.010 | 0.081 |
| | User | - | 25 | 0.038 | 0.009 | 0.090 |
| 1.002 | User | - | 100 | 0.083 | 0.083 | 0.083 |
| | User | - | 50 | 0.019 | 0.009 | 0.092 |
| | User | - | 25 | 0.069 | 0.017 | 0.110 |
| 1.003 | User | - | 100 | 0.083 | 0.083 | 0.083 |
| | User | - | 50 | 0.019 | 0.009 | 0.092 |
| | User | - | 25 | 0.070 | 0.018 | 0.110 |
| 1.004 | User | - | 100 | 0.083 | 0.083 | 0.083 |
| | User | - | 50 | 0.019 | 0.009 | 0.092 |
| | User | - | 25 | 0.022 | 0.005 | 0.098 |
| 1.005 | User | - | 100 | 0.083 | 0.083 | 0.083 |
| | User | - | 50 | 0.019 | 0.009 | 0.092 |
| | User | - | 25 | 0.001 | 0.000 | 0.093 |
| 1.006 | User | - | 100 | 0.097 | 0.097 | 0.097 |
| | User | - | 50 | 0.022 | 0.011 | 0.108 |
| 1.007 | User | - | 100 | 0.083 | 0.083 | 0.083 |
| | User | - | 50 | 0.016 | 0.008 | 0.091 |
| 1.008 | User | - | 100 | 0.096 | 0.096 | 0.096 |
| | User | - | 50 | 0.015 | 0.008 | 0.103 |
| 2.000 | User | - | 100 | 0.074 | 0.074 | 0.074 |
| | User | - | 50 | 0.028 | 0.014 | 0.088 |
| 2.001 | User | - | 100 | 0.053 | 0.053 | 0.053 |
| | User | - | 50 | 0.020 | 0.010 | 0.063 |
| 2.002 | User | - | 100 | 0.051 | 0.051 | 0.051 |
| | User | - | 50 | 0.019 | 0.010 | 0.060 |
| 2.003 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.009 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total | Total | Total |
| | | | | 1.448 | 1.141 | 1.141 |

## Free Flowing Outfall Details for System 3-10

| **Outfall Pipe Number** | **Outfall Name** | **C. Level (m)** | **I. Level (m)** | **Min I. Level (m)** | **D,L (mm)** | **W (mm)** |
|---|---|---|---|---|---|---|
| S1.009 | S | 113.058 | 111.097 | 0.000 | 0 | 0 |

## Simulation Criteria for System 3-10

```
          Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 40.000
           Areal Reduction Factor 1.000       MADD Factor * 10m³/ha Storage  2.000
                  Hot Start (mins)     0                 Inlet Coeffiecient  0.800
                Hot Start Level (mm)   0 Flow per Person per Day (l/per/day)  0.000
   Manhole Headloss Coeff (Global) 0.500                     Run Time (mins)     60
     Foul Sewage per hectare (l/s) 0.000              Output Interval (mins)      1

         Number of Input Hydrographs 0 Number of Storage Structures 0
           Number of Online Controls 0 Number of Time/Area Diagrams 0
          Number of Offline Controls 0 Number of Real Time Controls 0
```

## Synthetic Rainfall Details

```
              Rainfall Model                 FSR           Profile Type  Summer
        Return Period (years)                  5             Cv (Summer)  0.750
                      Region England and Wales             Cv (Winter)  0.840
                  M5-60 (mm)              15.300 Storm Duration (mins)     30
                     Ratio R               0.300
```

## Summary of Critical Results by Maximum Level (Rank 1) for System 3-10

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 40.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 0
Number of Online Controls 0 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.300
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 15.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080

Return Period(s) (years) 5
Climate Change (%) 20

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| S1.000 | S03-10-1 | 15 Winter | 5 | +20% | | | | |
| S1.001 | S03-10-2 | 15 Winter | 5 | +20% | | | | |
| S1.002 | S03-10-3 | 15 Winter | 5 | +20% | | | | |
| S1.003 | S03-10-4 | 15 Winter | 5 | +20% | | | | |
| S1.004 | S03-10-5 | 15 Winter | 5 | +20% | | | | |
| S1.005 | S03-10-6 | 15 Winter | 5 | +20% | | | | |
| S1.006 | S03-10-7 | 15 Winter | 5 | +20% | | | | |
| S1.007 | S03-10-8 | 15 Winter | 5 | +20% | | | | |
| S1.008 | S03-10-9 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| S2.000 | S03-10-10 | 15 Winter | 5 | +20% | | | | |
| S2.001 | S03-10-11 | 15 Winter | 5 | +20% | | | | |
| S2.002 | S03-10-12 | 15 Winter | 5 | +20% | 5/15 Winter | | | |
| S2.003 | S03-10-14 | 15 Winter | 5 | +20% | | | | |
| S1.009 | S03-10-15 | 15 Winter | 5 | +20% | 5/15 Summer | | | |

## Summary of Critical Results by Maximum Level (Rank 1) for System 3-10

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S03-10-1 | 121.051 | -0.149 | 0.000 | 0.46 | | | 31.0 | OK |
| S1.001 | S03-10-2 | 120.709 | -0.179 | 0.000 | 0.34 | | | 50.5 | OK |
| S1.002 | S03-10-3 | 119.296 | -0.401 | 0.000 | 0.23 | | | 71.2 | OK |
| S1.003 | S03-10-4 | 119.144 | -0.378 | 0.000 | 0.29 | | | 89.0 | OK |
| S1.004 | S03-10-5 | 118.913 | -0.071 | 0.000 | 0.93 | | | 102.8 | OK |
| S1.005 | S03-10-6 | 118.116 | -0.097 | 0.000 | 0.78 | | | 115.5 | OK |
| S1.006 | S03-10-7 | 116.699 | -0.102 | 0.000 | 0.75 | | | 130.2 | OK |
| S1.007 | S03-10-8 | 114.533 | -0.125 | 0.000 | 0.64 | | | 143.6 | OK |
| S1.008 | S03-10-9 | 112.352 | 0.387 | 0.000 | 0.52 | | | 157.2 | SURCHARGED |
| S2.000 | S03-10-10 | 115.889 | -0.136 | 0.000 | 0.32 | | | 23.0 | OK |
| S2.001 | S03-10-11 | 114.478 | -0.110 | 0.000 | 0.51 | | | 37.1 | OK |
| S2.002 | S03-10-12 | 113.535 | 0.005 | 0.000 | 1.01 | | | 48.4 | SURCHARGED |
| S2.003 | S03-10-14 | 112.771 | -0.312 | 0.000 | 0.20 | | | 48.3 | OK |
| S1.009 | S03-10-15 | 112.308 | 0.408 | 0.000 | 1.36 | | | 194.8 | SURCHARGED |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| S1.000 | S03-10-1 | |
| S1.001 | S03-10-2 | |
| S1.002 | S03-10-3 | |
| S1.003 | S03-10-4 | |
| S1.004 | S03-10-5 | |
| S1.005 | S03-10-6 | |
| S1.006 | S03-10-7 | |
| S1.007 | S03-10-8 | |
| S1.008 | S03-10-9 | |
| S2.000 | S03-10-10 | |
| S2.001 | S03-10-11 | |
| S2.002 | S03-10-12 | |
| S2.003 | S03-10-14 | |
| S1.009 | S03-10-15 | |

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Summer | 108.231 | 0.271 | 10.3 | 203.1 | O K |
| 30 min Summer | 108.333 | 0.373 | 10.3 | 279.8 | O K |
| 60 min Summer | 108.446 | 0.486 | 10.3 | 364.2 | O K |
| 120 min Summer | 108.564 | 0.604 | 10.3 | 453.3 | O K |
| 180 min Summer | 108.632 | 0.672 | 10.3 | 503.7 | O K |
| 240 min Summer | 108.674 | 0.714 | 10.3 | 535.5 | O K |
| 360 min Summer | 108.714 | 0.754 | 10.3 | 565.3 | O K |
| 480 min Summer | 108.722 | 0.762 | 10.3 | 571.5 | O K |
| 600 min Summer | 108.725 | 0.765 | 10.3 | 573.4 | O K |
| 720 min Summer | 108.723 | 0.763 | 10.3 | 572.6 | O K |
| 960 min Summer | 108.714 | 0.754 | 10.3 | 565.6 | O K |
| 1440 min Summer | 108.680 | 0.720 | 10.3 | 540.2 | O K |
| 2160 min Summer | 108.608 | 0.648 | 10.3 | 485.7 | O K |
| 2880 min Summer | 108.531 | 0.571 | 10.3 | 428.3 | O K |
| 4320 min Summer | 108.397 | 0.437 | 10.3 | 327.6 | O K |
| 5760 min Summer | 108.291 | 0.331 | 10.3 | 248.3 | O K |
| 7200 min Summer | 108.215 | 0.255 | 10.2 | 191.6 | O K |
| 8640 min Summer | 108.164 | 0.204 | 10.0 | 153.1 | O K |
| 10080 min Summer | 108.132 | 0.172 | 9.7 | 128.9 | O K |
| 15 min Winter | 108.264 | 0.304 | 10.3 | 228.1 | O K |
| 30 min Winter | 108.380 | 0.420 | 10.3 | 314.7 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 90.499 | 0.0 | 200.9 | 23 |
| 30 min Summer | 62.929 | 0.0 | 282.2 | 37 |
| 60 min Summer | 41.795 | 0.0 | 384.7 | 66 |
| 120 min Summer | 26.991 | 0.0 | 498.0 | 126 |
| 180 min Summer | 20.656 | 0.0 | 572.1 | 186 |
| 240 min Summer | 16.988 | 0.0 | 627.6 | 244 |
| 360 min Summer | 12.773 | 0.0 | 708.0 | 362 |
| 480 min Summer | 10.352 | 0.0 | 765.1 | 468 |
| 600 min Summer | 8.808 | 0.0 | 813.6 | 520 |
| 720 min Summer | 7.714 | 0.0 | 854.8 | 582 |
| 960 min Summer | 6.250 | 0.0 | 922.9 | 712 |
| 1440 min Summer | 4.637 | 0.0 | 1024.5 | 986 |
| 2160 min Summer | 3.430 | 0.0 | 1149.2 | 1392 |
| 2880 min Summer | 2.766 | 0.0 | 1235.1 | 1788 |
| 4320 min Summer | 2.037 | 0.0 | 1361.6 | 2512 |
| 5760 min Summer | 1.637 | 0.0 | 1465.0 | 3224 |
| 7200 min Summer | 1.380 | 0.0 | 1543.5 | 3896 |
| 8640 min Summer | 1.200 | 0.0 | 1609.2 | 4576 |
| 10080 min Summer | 1.067 | 0.0 | 1667.2 | 5240 |
| 15 min Winter | 90.499 | 0.0 | 225.9 | 23 |
| 30 min Winter | 62.929 | 0.0 | 316.9 | 37 |

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 60 min Winter | 108.507 | 0.547 | 10.3 | 410.5 | O K |
| 120 min Winter | 108.645 | 0.685 | 10.3 | 514.0 | O K |
| 180 min Winter | 108.723 | 0.763 | 10.3 | 572.2 | O K |
| 240 min Winter | 108.771 | 0.811 | 10.3 | 608.1 | O K |
| 360 min Winter | 108.820 | 0.860 | 10.3 | 645.0 | O K |
| 480 min Winter | 108.835 | 0.875 | 10.3 | 656.2 | O K |
| 600 min Winter | 108.838 | 0.878 | 10.3 | 658.6 | O K |
| 720 min Winter | 108.833 | 0.873 | 10.3 | 654.6 | O K |
| 960 min Winter | 108.819 | 0.859 | 10.3 | 644.1 | O K |
| 1440 min Winter | 108.769 | 0.809 | 10.3 | 607.0 | O K |
| 2160 min Winter | 108.667 | 0.707 | 10.3 | 530.1 | O K |
| 2880 min Winter | 108.538 | 0.578 | 10.3 | 433.4 | O K |
| 4320 min Winter | 108.331 | 0.371 | 10.3 | 278.4 | O K |
| 5760 min Winter | 108.196 | 0.236 | 10.2 | 177.0 | O K |
| 7200 min Winter | 108.126 | 0.166 | 9.7 | 124.8 | O K |
| 8640 min Winter | 108.105 | 0.145 | 8.6 | 108.5 | O K |
| 10080 min Winter | 108.091 | 0.131 | 7.7 | 98.1 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 60 min Winter | 41.795 | 0.0 | 431.4 | 66 |
| 120 min Winter | 26.991 | 0.0 | 558.2 | 124 |
| 180 min Winter | 20.656 | 0.0 | 641.1 | 182 |
| 240 min Winter | 16.988 | 0.0 | 703.2 | 240 |
| 360 min Winter | 12.773 | 0.0 | 793.2 | 352 |
| 480 min Winter | 10.352 | 0.0 | 857.1 | 464 |
| 600 min Winter | 8.808 | 0.0 | 911.3 | 568 |
| 720 min Winter | 7.714 | 0.0 | 957.5 | 662 |
| 960 min Winter | 6.250 | 0.0 | 1033.5 | 752 |
| 1440 min Winter | 4.637 | 0.0 | 1146.2 | 1066 |
| 2160 min Winter | 3.430 | 0.0 | 1287.3 | 1532 |
| 2880 min Winter | 2.766 | 0.0 | 1383.7 | 1928 |
| 4320 min Winter | 2.037 | 0.0 | 1526.1 | 2640 |
| 5760 min Winter | 1.637 | 0.0 | 1641.0 | 3280 |
| 7200 min Winter | 1.380 | 0.0 | 1729.1 | 3824 |
| 8640 min Winter | 1.200 | 0.0 | 1803.0 | 4496 |
| 10080 min Winter | 1.067 | 0.0 | 1868.6 | 5240 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.000 | Shortest Storm (mins) | 15 |
| Ratio R | 0.300 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 1.245

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 0.410 | 4 | 8 | 0.750 | 8 | 12 | 0.085 |

## Model Details

Storage is Online Cover Level (m) 109.400

## Tank or Pond Structure

Invert Level (m) 107.960

| Depth (m) | Area (m²) |
|---|---|
| 0.000 | 750.0 |
| 1.000 | 750.0 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0148-1030-1000-1030 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 10.3 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 148 |
| Invert Level (m) | 107.960 |
| Minimum Outlet Pipe Diameter (mm) | 225 |
| Suggested Manhole Diameter (mm) | 1200 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 1.000 | 10.3 |
| Flush-Flo™ | 0.307 | 10.3 |
| Kick-Flo® | 0.679 | 8.6 |
| Mean Flow over Head Range | - | 8.8 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) |
|---|---|
| 0.100 | 5.3 |
| 0.200 | 10.0 |
| 0.300 | 10.3 |
| 0.400 | 10.2 |
| 0.500 | 9.9 |
| 0.600 | 9.5 |
| 0.800 | 9.3 |
| 1.000 | 10.3 |
| 1.200 | 11.2 |
| 1.400 | 12.1 |
| 1.600 | 12.9 |
| 1.800 | 13.6 |
| 2.000 | 14.3 |
| 2.200 | 15.0 |
| 2.400 | 15.6 |
| 2.600 | 16.2 |
| 3.000 | 17.3 |
| 3.500 | 18.7 |
| 4.000 | 19.9 |
| 4.500 | 21.0 |
| 5.000 | 22.1 |
| 5.500 | 23.2 |
| 6.000 | 24.2 |
| 6.500 | 25.1 |
| 7.000 | 26.0 |
| 7.500 | 26.9 |
| 8.000 | 27.8 |
| 8.500 | 28.6 |
| 9.000 | 29.4 |
| 9.500 | 30.2 |

## Summary of Results for 100 year Return Period (+40%)

| **Storm Event** | **Max Level (m)** | **Max Depth (m)** | **Max Control (l/s)** | **Max Volume (m³)** | **Status** |
|---|---|---|---|---|---|
| 15 min Summer | 107.478 | 0.295 | 17.2 | 492.2 | O K |
| 30 min Summer | 107.591 | 0.408 | 17.3 | 681.4 | O K |
| 60 min Summer | 107.718 | 0.535 | 17.3 | 894.1 | O K |
| 120 min Summer | 107.859 | 0.676 | 17.3 | 1128.5 | O K |
| 180 min Summer | 107.943 | 0.760 | 17.3 | 1268.6 | O K |
| 240 min Summer | 107.997 | 0.814 | 17.3 | 1359.9 | O K |
| 360 min Summer | 108.060 | 0.877 | 17.3 | 1464.8 | O K |
| 480 min Summer | 108.089 | 0.906 | 17.3 | 1512.2 | O K |
| 600 min Summer | 108.104 | 0.921 | 17.3 | 1538.1 | O K |
| 720 min Summer | 108.110 | 0.927 | 17.3 | 1548.0 | O K |
| 960 min Summer | 108.113 | 0.930 | 17.3 | 1553.9 | O K |
| 1440 min Summer | 108.103 | 0.920 | 17.3 | 1535.7 | O K |
| 2160 min Summer | 108.066 | 0.883 | 17.3 | 1474.1 | O K |
| 2880 min Summer | 108.019 | 0.836 | 17.3 | 1395.6 | O K |
| 4320 min Summer | 107.915 | 0.732 | 17.3 | 1222.1 | O K |
| 5760 min Summer | 107.795 | 0.612 | 17.3 | 1022.8 | O K |
| 7200 min Summer | 107.694 | 0.511 | 17.3 | 854.1 | O K |
| 8640 min Summer | 107.609 | 0.426 | 17.3 | 710.8 | O K |
| 10080 min Summer | 107.541 | 0.358 | 17.3 | 597.6 | O K |
| 15 min Winter | 107.514 | 0.331 | 17.3 | 552.5 | O K |
| 30 min Winter | 107.641 | 0.458 | 17.3 | 765.6 | O K |

| **Storm Event** | **Rain (mm/hr)** | **Flooded Volume (m³)** | **Discharge Volume (m³)** | **Time-Peak (mins)** |
|---|---|---|---|---|
| 15 min Summer | 90.499 | 0.0 | 462.8 | 27 |
| 30 min Summer | 62.929 | 0.0 | 653.5 | 41 |
| 60 min Summer | 41.795 | 0.0 | 913.3 | 70 |
| 120 min Summer | 26.991 | 0.0 | 1183.2 | 128 |
| 180 min Summer | 20.656 | 0.0 | 1359.1 | 188 |
| 240 min Summer | 16.988 | 0.0 | 1490.3 | 246 |
| 360 min Summer | 12.773 | 0.0 | 1679.6 | 366 |
| 480 min Summer | 10.352 | 0.0 | 1812.8 | 484 |
| 600 min Summer | 8.808 | 0.0 | 1924.8 | 602 |
| 720 min Summer | 7.714 | 0.0 | 2018.7 | 690 |
| 960 min Summer | 6.250 | 0.0 | 2168.7 | 800 |
| 1440 min Summer | 4.637 | 0.0 | 2356.5 | 1056 |
| 2160 min Summer | 3.430 | 0.0 | 2753.0 | 1472 |
| 2880 min Summer | 2.766 | 0.0 | 2956.8 | 1884 |
| 4320 min Summer | 2.037 | 0.0 | 3256.1 | 2728 |
| 5760 min Summer | 1.637 | 0.0 | 3520.7 | 3464 |
| 7200 min Summer | 1.380 | 0.0 | 3708.6 | 4184 |
| 8640 min Summer | 1.200 | 0.0 | 3864.7 | 4856 |
| 10080 min Summer | 1.067 | 0.0 | 3999.7 | 5552 |
| 15 min Winter | 90.499 | 0.0 | 521.7 | 27 |
| 30 min Winter | 62.929 | 0.0 | 734.2 | 40 |

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 60 min Winter | 107.785 | 0.602 | 17.3 | 1005.9 | O K |
| 120 min Winter | 107.946 | 0.763 | 17.3 | 1273.5 | O K |
| 180 min Winter | 108.040 | 0.857 | 17.3 | 1430.7 | O K |
| 240 min Winter | 108.102 | 0.919 | 17.3 | 1535.3 | O K |
| 360 min Winter | 108.177 | 0.994 | 17.3 | 1659.7 | O K |
| 480 min Winter | 108.213 | 1.030 | 17.5 | 1720.4 | O K |
| 600 min Winter | 108.235 | 1.052 | 17.7 | 1757.6 | O K |
| 720 min Winter | 108.247 | 1.064 | 17.8 | 1776.2 | O K |
| 960 min Winter | 108.248 | 1.065 | 17.8 | 1779.1 | O K |
| 1440 min Winter | 108.229 | 1.046 | 17.7 | 1747.3 | O K |
| 2160 min Winter | 108.174 | 0.991 | 17.3 | 1654.3 | O K |
| 2880 min Winter | 108.102 | 0.919 | 17.3 | 1534.4 | O K |
| 4320 min Winter | 107.942 | 0.759 | 17.3 | 1268.0 | O K |
| 5760 min Winter | 107.753 | 0.570 | 17.3 | 952.7 | O K |
| 7200 min Winter | 107.604 | 0.421 | 17.3 | 703.6 | O K |
| 8640 min Winter | 107.493 | 0.310 | 17.2 | 518.1 | O K |
| 10080 min Winter | 107.421 | 0.238 | 16.9 | 396.6 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 60 min Winter | 41.795 | 0.0 | 1024.6 | 68 |
| 120 min Winter | 26.991 | 0.0 | 1326.2 | 126 |
| 180 min Winter | 20.656 | 0.0 | 1522.7 | 184 |
| 240 min Winter | 16.988 | 0.0 | 1669.1 | 242 |
| 360 min Winter | 12.773 | 0.0 | 1879.8 | 358 |
| 480 min Winter | 10.352 | 0.0 | 2027.3 | 472 |
| 600 min Winter | 8.808 | 0.0 | 2150.4 | 584 |
| 720 min Winter | 7.714 | 0.0 | 2252.6 | 692 |
| 960 min Winter | 6.250 | 0.0 | 2410.3 | 898 |
| 1440 min Winter | 4.637 | 0.0 | 2548.4 | 1118 |
| 2160 min Winter | 3.430 | 0.0 | 3084.0 | 1584 |
| 2880 min Winter | 2.766 | 0.0 | 3311.8 | 2048 |
| 4320 min Winter | 2.037 | 0.0 | 3644.4 | 2944 |
| 5760 min Winter | 1.637 | 0.0 | 3944.4 | 3688 |
| 7200 min Winter | 1.380 | 0.0 | 4155.3 | 4392 |
| 8640 min Winter | 1.200 | 0.0 | 4331.0 | 5008 |
| 10080 min Winter | 1.067 | 0.0 | 4484.8 | 5552 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.000 | Shortest Storm (mins) | 15 |
| Ratio R | 0.300 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 2.996

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 0.583 | 4 | 8 | 1.597 | 8 | 12 | 0.673 | 12 | 16 | 0.142 |

## Model Details

Storage is Online Cover Level (m) 109.750

## Tank or Pond Structure

Invert Level (m) 107.183

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 1670.0 | 1.000 | 1670.0 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0186-1730-1000-1730 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 17.3 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 186 |
| Invert Level (m) | 107.183 |
| Minimum Outlet Pipe Diameter (mm) | 225 |
| Suggested Manhole Diameter (mm) | 1500 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 1.000 | 17.3 |
| Flush-Flo™ | 0.330 | 17.3 |
| Kick-Flo® | 0.711 | 14.7 |
| Mean Flow over Head Range | - | 14.6 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.100 | 6.5 | 1.200 | 18.8 | 3.000 | 29.2 | 7.000 | 44.0 |
| 0.200 | 16.5 | 1.400 | 20.3 | 3.500 | 31.4 | 7.500 | 45.5 |
| 0.300 | 17.2 | 1.600 | 21.6 | 4.000 | 33.5 | 8.000 | 46.9 |
| 0.400 | 17.2 | 1.800 | 22.9 | 4.500 | 35.5 | 8.500 | 48.3 |
| 0.500 | 16.8 | 2.000 | 24.0 | 5.000 | 37.4 | 9.000 | 49.7 |
| 0.600 | 16.3 | 2.200 | 25.2 | 5.500 | 39.1 | 9.500 | 51.0 |
| 0.800 | 15.5 | 2.400 | 26.2 | 6.000 | 40.8 | | |
| 1.000 | 17.3 | 2.600 | 27.3 | 6.500 | 42.4 | | |

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Summer | 110.252 | 0.301 | 15.4 | 437.1 | O K |
| 30 min Summer | 110.368 | 0.417 | 15.4 | 604.5 | O K |
| 60 min Summer | 110.498 | 0.547 | 15.4 | 792.5 | O K |
| 120 min Summer | 110.640 | 0.689 | 15.4 | 999.4 | O K |
| 180 min Summer | 110.725 | 0.774 | 15.4 | 1121.8 | O K |
| 240 min Summer | 110.779 | 0.828 | 15.4 | 1200.9 | O K |
| 360 min Summer | 110.841 | 0.890 | 15.4 | 1290.9 | O K |
| 480 min Summer | 110.869 | 0.918 | 15.4 | 1331.0 | O K |
| 600 min Summer | 110.884 | 0.933 | 15.4 | 1352.1 | O K |
| 720 min Summer | 110.889 | 0.938 | 15.4 | 1359.6 | O K |
| 960 min Summer | 110.891 | 0.940 | 15.4 | 1363.3 | O K |
| 1440 min Summer | 110.878 | 0.927 | 15.4 | 1344.8 | O K |
| 2160 min Summer | 110.839 | 0.888 | 15.4 | 1287.8 | O K |
| 2880 min Summer | 110.791 | 0.840 | 15.4 | 1217.5 | O K |
| 4320 min Summer | 110.685 | 0.734 | 15.4 | 1063.7 | O K |
| 5760 min Summer | 110.562 | 0.611 | 15.4 | 885.3 | O K |
| 7200 min Summer | 110.457 | 0.506 | 15.4 | 734.4 | O K |
| 8640 min Summer | 110.370 | 0.419 | 15.4 | 607.5 | O K |
| 10080 min Summer | 110.301 | 0.350 | 15.4 | 507.1 | O K |
| 15 min Winter | 110.289 | 0.338 | 15.4 | 490.6 | O K |
| 30 min Winter | 110.419 | 0.468 | 15.4 | 679.1 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 91.180 | 0.0 | 414.6 | 24 |
| 30 min Summer | 63.390 | 0.0 | 584.1 | 38 |
| 60 min Summer | 42.097 | 0.0 | 811.8 | 68 |
| 120 min Summer | 27.178 | 0.0 | 1051.0 | 126 |
| 180 min Summer | 20.794 | 0.0 | 1206.8 | 186 |
| 240 min Summer | 17.096 | 0.0 | 1322.9 | 246 |
| 360 min Summer | 12.847 | 0.0 | 1490.2 | 364 |
| 480 min Summer | 10.412 | 0.0 | 1608.6 | 482 |
| 600 min Summer | 8.858 | 0.0 | 1708.2 | 600 |
| 720 min Summer | 7.757 | 0.0 | 1792.0 | 680 |
| 960 min Summer | 6.285 | 0.0 | 1926.4 | 794 |
| 1440 min Summer | 4.662 | 0.0 | 2098.6 | 1048 |
| 2160 min Summer | 3.449 | 0.0 | 2436.8 | 1472 |
| 2880 min Summer | 2.780 | 0.0 | 2617.2 | 1880 |
| 4320 min Summer | 2.047 | 0.0 | 2882.9 | 2724 |
| 5760 min Summer | 1.645 | 0.0 | 3113.3 | 3464 |
| 7200 min Summer | 1.387 | 0.0 | 3279.4 | 4184 |
| 8640 min Summer | 1.206 | 0.0 | 3418.6 | 4848 |
| 10080 min Summer | 1.073 | 0.0 | 3538.7 | 5552 |
| 15 min Winter | 91.180 | 0.0 | 467.0 | 25 |
| 30 min Winter | 63.390 | 0.0 | 655.9 | 38 |

## Summary of Results for 100 year Return Period (+40%)

| **Storm Event** | **Max Level (m)** | **Max Depth (m)** | **Max Control (l/s)** | **Max Volume (m³)** | **Status** |
|---|---|---|---|---|---|
| 60 min Winter | 110.566 | 0.615 | 15.4 | 891.5 | O K |
| 120 min Winter | 110.728 | 0.777 | 15.4 | 1127.2 | O K |
| 180 min Winter | 110.823 | 0.872 | 15.4 | 1264.9 | O K |
| 240 min Winter | 110.886 | 0.935 | 15.4 | 1356.1 | O K |
| 360 min Winter | 110.960 | 1.009 | 15.5 | 1463.5 | O K |
| 480 min Winter | 110.996 | 1.045 | 15.7 | 1515.5 | O K |
| 600 min Winter | 111.018 | 1.067 | 15.9 | 1546.8 | O K |
| 720 min Winter | 111.028 | 1.077 | 16.0 | 1561.7 | O K |
| 960 min Winter | 111.028 | 1.077 | 16.0 | 1561.7 | O K |
| 1440 min Winter | 111.007 | 1.056 | 15.8 | 1531.5 | O K |
| 2160 min Winter | 110.948 | 0.997 | 15.4 | 1445.8 | O K |
| 2880 min Winter | 110.874 | 0.923 | 15.4 | 1337.8 | O K |
| 4320 min Winter | 110.710 | 0.759 | 15.4 | 1101.1 | O K |
| 5760 min Winter | 110.516 | 0.565 | 15.4 | 818.8 | O K |
| 7200 min Winter | 110.363 | 0.412 | 15.4 | 597.0 | O K |
| 8640 min Winter | 110.251 | 0.300 | 15.4 | 434.3 | O K |
| 10080 min Winter | 110.178 | 0.227 | 15.1 | 329.7 | O K |

| **Storm Event** | **Rain (mm/hr)** | **Flooded Volume (m³)** | **Discharge Volume (m³)** | **Time-Peak (mins)** |
|---|---|---|---|---|
| 60 min Winter | 42.097 | 0.0 | 910.6 | 68 |
| 120 min Winter | 27.178 | 0.0 | 1177.9 | 126 |
| 180 min Winter | 20.794 | 0.0 | 1352.0 | 184 |
| 240 min Winter | 17.096 | 0.0 | 1481.6 | 242 |
| 360 min Winter | 12.847 | 0.0 | 1668.0 | 356 |
| 480 min Winter | 10.412 | 0.0 | 1799.3 | 470 |
| 600 min Winter | 8.858 | 0.0 | 1909.1 | 582 |
| 720 min Winter | 7.757 | 0.0 | 2000.5 | 690 |
| 960 min Winter | 6.285 | 0.0 | 2142.9 | 894 |
| 1440 min Winter | 4.662 | 0.0 | 2276.8 | 1114 |
| 2160 min Winter | 3.449 | 0.0 | 2729.7 | 1580 |
| 2880 min Winter | 2.780 | 0.0 | 2931.5 | 2048 |
| 4320 min Winter | 2.047 | 0.0 | 3227.1 | 2944 |
| 5760 min Winter | 1.645 | 0.0 | 3487.8 | 3688 |
| 7200 min Winter | 1.387 | 0.0 | 3674.2 | 4328 |
| 8640 min Winter | 1.206 | 0.0 | 3830.8 | 4936 |
| 10080 min Winter | 1.073 | 0.0 | 3967.4 | 5544 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.100 | Shortest Storm (mins) | 15 |
| Ratio R | 0.300 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 2.635

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 0.874 | 4 | 8 | 1.428 | 8 | 12 | 0.333 |

## Model Details

Storage is Online Cover Level (m) 111.350

## Tank or Pond Structure

Invert Level (m) 109.951

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 1450.0 | 1.000 | 1450.0 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0177-1540-1000-1540 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 15.4 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 177 |
| Invert Level (m) | 109.951 |
| Minimum Outlet Pipe Diameter (mm) | 225 |
| Suggested Manhole Diameter (mm) | 1200 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 1.000 | 15.4 |
| Flush-Flo™ | 0.321 | 15.4 |
| Kick-Flo® | 0.702 | 13.0 |
| Mean Flow over Head Range | - | 13.1 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.100 | 6.3 | 1.200 | 16.8 | 3.000 | 26.0 | 7.000 | 39.1 |
| 0.200 | 14.8 | 1.400 | 18.1 | 3.500 | 28.0 | 7.500 | 40.5 |
| 0.300 | 15.4 | 1.600 | 19.3 | 4.000 | 29.9 | 8.000 | 41.7 |
| 0.400 | 15.3 | 1.800 | 20.4 | 4.500 | 31.6 | 8.500 | 43.0 |
| 0.500 | 14.9 | 2.000 | 21.4 | 5.000 | 33.3 | 9.000 | 44.2 |
| 0.600 | 14.4 | 2.200 | 22.4 | 5.500 | 34.8 | 9.500 | 45.4 |
| 0.800 | 13.9 | 2.400 | 23.4 | 6.000 | 36.3 | | |
| 1.000 | 15.4 | 2.600 | 24.3 | 6.500 | 37.7 | | |

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Summer | 125.438 | 0.276 | 11.6 | 317.6 | O K |
| 30 min Summer | 125.544 | 0.382 | 11.6 | 439.0 | O K |
| 60 min Summer | 125.662 | 0.500 | 11.6 | 575.2 | O K |
| 120 min Summer | 125.792 | 0.630 | 11.6 | 724.1 | O K |
| 180 min Summer | 125.869 | 0.707 | 11.6 | 813.1 | O K |
| 240 min Summer | 125.919 | 0.757 | 11.6 | 871.0 | O K |
| 360 min Summer | 125.976 | 0.814 | 11.6 | 936.1 | O K |
| 480 min Summer | 126.001 | 0.839 | 11.6 | 964.8 | O K |
| 600 min Summer | 126.014 | 0.852 | 11.6 | 979.7 | O K |
| 720 min Summer | 126.018 | 0.856 | 11.6 | 984.4 | O K |
| 960 min Summer | 126.019 | 0.857 | 11.6 | 985.6 | O K |
| 1440 min Summer | 126.005 | 0.843 | 11.6 | 969.5 | O K |
| 2160 min Summer | 125.966 | 0.804 | 11.6 | 924.8 | O K |
| 2880 min Summer | 125.919 | 0.757 | 11.6 | 870.0 | O K |
| 4320 min Summer | 125.805 | 0.643 | 11.6 | 739.8 | O K |
| 5760 min Summer | 125.695 | 0.533 | 11.6 | 613.2 | O K |
| 7200 min Summer | 125.602 | 0.440 | 11.6 | 505.8 | O K |
| 8640 min Summer | 125.524 | 0.362 | 11.6 | 416.8 | O K |
| 10080 min Summer | 125.464 | 0.302 | 11.6 | 346.8 | O K |
| 15 min Winter | 125.472 | 0.310 | 11.6 | 356.6 | O K |
| 30 min Winter | 125.591 | 0.429 | 11.6 | 493.4 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 91.180 | 0.0 | 303.5 | 25 |
| 30 min Summer | 63.390 | 0.0 | 427.3 | 39 |
| 60 min Summer | 42.097 | 0.0 | 591.8 | 68 |
| 120 min Summer | 27.178 | 0.0 | 766.1 | 128 |
| 180 min Summer | 20.794 | 0.0 | 879.7 | 186 |
| 240 min Summer | 17.096 | 0.0 | 964.4 | 246 |
| 360 min Summer | 12.847 | 0.0 | 1086.5 | 364 |
| 480 min Summer | 10.412 | 0.0 | 1173.0 | 482 |
| 600 min Summer | 8.858 | 0.0 | 1245.9 | 600 |
| 720 min Summer | 7.757 | 0.0 | 1307.3 | 686 |
| 960 min Summer | 6.285 | 0.0 | 1406.3 | 798 |
| 1440 min Summer | 4.662 | 0.0 | 1537.5 | 1054 |
| 2160 min Summer | 3.449 | 0.0 | 1774.0 | 1472 |
| 2880 min Summer | 2.780 | 0.0 | 1905.6 | 1884 |
| 4320 min Summer | 2.047 | 0.0 | 2100.3 | 2688 |
| 5760 min Summer | 1.645 | 0.0 | 2265.5 | 3456 |
| 7200 min Summer | 1.387 | 0.0 | 2386.4 | 4176 |
| 8640 min Summer | 1.206 | 0.0 | 2487.9 | 4840 |
| 10080 min Summer | 1.073 | 0.0 | 2575.7 | 5544 |
| 15 min Winter | 91.180 | 0.0 | 341.7 | 25 |
| 30 min Winter | 63.390 | 0.0 | 479.8 | 39 |

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume ($m^3$) | Status |
|---|---|---|---|---|---|
| 60 min Winter | 125.725 | 0.563 | 11.6 | 647.3 | O K |
| 120 min Winter | 125.873 | 0.711 | 11.6 | 818.2 | O K |
| 180 min Winter | 125.961 | 0.799 | 11.6 | 918.3 | O K |
| 240 min Winter | 126.018 | 0.856 | 11.6 | 984.3 | O K |
| 360 min Winter | 126.085 | 0.923 | 11.6 | 1061.8 | O K |
| 480 min Winter | 126.118 | 0.956 | 11.6 | 1099.0 | Flood Risk |
| 600 min Winter | 126.137 | 0.975 | 11.6 | 1121.1 | Flood Risk |
| 720 min Winter | 126.146 | 0.984 | 11.6 | 1131.3 | Flood Risk |
| 960 min Winter | 126.145 | 0.983 | 11.6 | 1130.1 | Flood Risk |
| 1440 min Winter | 126.123 | 0.961 | 11.6 | 1104.6 | Flood Risk |
| 2160 min Winter | 126.065 | 0.903 | 11.6 | 1038.2 | O K |
| 2880 min Winter | 125.993 | 0.831 | 11.6 | 955.1 | O K |
| 4320 min Winter | 125.820 | 0.658 | 11.6 | 756.9 | O K |
| 5760 min Winter | 125.645 | 0.483 | 11.6 | 555.9 | O K |
| 7200 min Winter | 125.511 | 0.349 | 11.6 | 401.2 | O K |
| 8640 min Winter | 125.416 | 0.254 | 11.5 | 292.1 | O K |
| 10080 min Winter | 125.356 | 0.194 | 11.2 | 223.7 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume ($m^3$) | Discharge Volume ($m^3$) | Time-Peak (mins) |
|---|---|---|---|---|
| 60 min Winter | 42.097 | 0.0 | 663.8 | 68 |
| 120 min Winter | 27.178 | 0.0 | 858.6 | 126 |
| 180 min Winter | 20.794 | 0.0 | 985.5 | 184 |
| 240 min Winter | 17.096 | 0.0 | 1080.1 | 242 |
| 360 min Winter | 12.847 | 0.0 | 1216.2 | 356 |
| 480 min Winter | 10.412 | 0.0 | 1312.2 | 470 |
| 600 min Winter | 8.858 | 0.0 | 1392.7 | 582 |
| 720 min Winter | 7.757 | 0.0 | 1460.0 | 692 |
| 960 min Winter | 6.285 | 0.0 | 1566.0 | 896 |
| 1440 min Winter | 4.662 | 0.0 | 1677.6 | 1116 |
| 2160 min Winter | 3.449 | 0.0 | 1987.2 | 1584 |
| 2880 min Winter | 2.780 | 0.0 | 2134.4 | 2048 |
| 4320 min Winter | 2.047 | 0.0 | 2352.1 | 2940 |
| 5760 min Winter | 1.645 | 0.0 | 2538.0 | 3632 |
| 7200 min Winter | 1.387 | 0.0 | 2673.7 | 4320 |
| 8640 min Winter | 1.206 | 0.0 | 2787.8 | 4928 |
| 10080 min Winter | 1.073 | 0.0 | 2887.6 | 5456 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.100 | Shortest Storm (mins) | 15 |
| Ratio R | 0.300 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 1.917

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 0.564 | 4 | 8 | 0.990 | 8 | 12 | 0.363 |

## Model Details

Storage is Online Cover Level (m) 126.400

## Tank or Pond Structure

Invert Level (m) 125.162

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 1150.0 | 1.000 | 1150.0 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0156-1160-1000-1160 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 11.6 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 156 |
| Invert Level (m) | 125.162 |
| Minimum Outlet Pipe Diameter (mm) | 225 |
| Suggested Manhole Diameter (mm) | 1200 |

| **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|
| Design Point (Calculated) | 1.000 | 11.6 |
| Flush-Flo™ | 0.308 | 11.6 |
| Kick-Flo® | 0.683 | 9.7 |
| Mean Flow over Head Range | - | 9.9 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|
| 0.100 | 5.6 | 1.200 | 12.6 | 3.000 | 19.5 | 7.000 | 29.4 |
| 0.200 | 11.2 | 1.400 | 13.6 | 3.500 | 21.0 | 7.500 | 30.4 |
| 0.300 | 11.6 | 1.600 | 14.5 | 4.000 | 22.4 | 8.000 | 31.3 |
| 0.400 | 11.5 | 1.800 | 15.3 | 4.500 | 23.7 | 8.500 | 32.3 |
| 0.500 | 11.2 | 2.000 | 16.1 | 5.000 | 25.0 | 9.000 | 33.2 |
| 0.600 | 10.7 | 2.200 | 16.9 | 5.500 | 26.1 | 9.500 | 34.0 |
| 0.800 | 10.4 | 2.400 | 17.6 | 6.000 | 27.3 | | |
| 1.000 | 11.6 | 2.600 | 18.3 | 6.500 | 28.3 | | |

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Summer | 128.159 | 0.262 | 7.3 | 217.2 | O K |
| 30 min Summer | 128.258 | 0.361 | 7.3 | 299.9 | O K |
| 60 min Summer | 128.370 | 0.473 | 7.3 | 392.6 | O K |
| 120 min Summer | 128.493 | 0.596 | 7.3 | 494.7 | O K |
| 180 min Summer | 128.567 | 0.670 | 7.3 | 556.1 | O K |
| 240 min Summer | 128.616 | 0.719 | 7.3 | 596.9 | O K |
| 360 min Summer | 128.673 | 0.776 | 7.3 | 643.9 | O K |
| 480 min Summer | 128.700 | 0.803 | 7.3 | 666.1 | O K |
| 600 min Summer | 128.715 | 0.818 | 7.3 | 679.0 | O K |
| 720 min Summer | 128.721 | 0.824 | 7.3 | 684.3 | O K |
| 960 min Summer | 128.723 | 0.826 | 7.3 | 685.3 | O K |
| 1440 min Summer | 128.711 | 0.814 | 7.3 | 675.9 | O K |
| 2160 min Summer | 128.678 | 0.781 | 7.3 | 648.6 | O K |
| 2880 min Summer | 128.637 | 0.740 | 7.3 | 614.6 | O K |
| 4320 min Summer | 128.541 | 0.644 | 7.3 | 534.6 | O K |
| 5760 min Summer | 128.438 | 0.541 | 7.3 | 449.3 | O K |
| 7200 min Summer | 128.351 | 0.454 | 7.3 | 376.5 | O K |
| 8640 min Summer | 128.276 | 0.379 | 7.3 | 314.8 | O K |
| 10080 min Summer | 128.215 | 0.318 | 7.3 | 263.9 | O K |
| 15 min Winter | 128.191 | 0.294 | 7.3 | 243.7 | O K |
| 30 min Winter | 128.303 | 0.406 | 7.3 | 336.9 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 91.180 | 0.0 | 207.9 | 23 |
| 30 min Summer | 63.390 | 0.0 | 292.0 | 37 |
| 60 min Summer | 42.097 | 0.0 | 403.2 | 68 |
| 120 min Summer | 27.178 | 0.0 | 521.7 | 126 |
| 180 min Summer | 20.794 | 0.0 | 598.8 | 186 |
| 240 min Summer | 17.096 | 0.0 | 656.3 | 246 |
| 360 min Summer | 12.847 | 0.0 | 739.0 | 364 |
| 480 min Summer | 10.412 | 0.0 | 797.4 | 484 |
| 600 min Summer | 8.858 | 0.0 | 846.4 | 602 |
| 720 min Summer | 7.757 | 0.0 | 887.4 | 720 |
| 960 min Summer | 6.285 | 0.0 | 952.2 | 834 |
| 1440 min Summer | 4.662 | 0.0 | 1021.8 | 1088 |
| 2160 min Summer | 3.449 | 0.0 | 1206.2 | 1496 |
| 2880 min Summer | 2.780 | 0.0 | 1295.6 | 1928 |
| 4320 min Summer | 2.047 | 0.0 | 1427.5 | 2732 |
| 5760 min Summer | 1.645 | 0.0 | 1540.3 | 3464 |
| 7200 min Summer | 1.387 | 0.0 | 1622.6 | 4184 |
| 8640 min Summer | 1.206 | 0.0 | 1691.8 | 4928 |
| 10080 min Summer | 1.073 | 0.0 | 1751.9 | 5640 |
| 15 min Winter | 91.180 | 0.0 | 233.9 | 23 |
| 30 min Winter | 63.390 | 0.0 | 327.5 | 37 |

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 60 min Winter | 128.429 | 0.532 | 7.3 | 441.7 | O K |
| 120 min Winter | 128.570 | 0.673 | 7.3 | 558.7 | O K |
| 180 min Winter | 128.654 | 0.757 | 7.3 | 628.2 | O K |
| 240 min Winter | 128.710 | 0.813 | 7.3 | 674.5 | O K |
| 360 min Winter | 128.777 | 0.880 | 7.3 | 730.1 | O K |
| 480 min Winter | 128.811 | 0.914 | 7.3 | 758.2 | O K |
| 600 min Winter | 128.832 | 0.935 | 7.3 | 776.1 | O K |
| 720 min Winter | 128.844 | 0.947 | 7.3 | 785.7 | O K |
| 960 min Winter | 128.848 | 0.951 | 7.3 | 789.6 | O K |
| 1440 min Winter | 128.829 | 0.932 | 7.3 | 773.4 | O K |
| 2160 min Winter | 128.782 | 0.885 | 7.3 | 734.6 | O K |
| 2880 min Winter | 128.721 | 0.824 | 7.3 | 683.7 | O K |
| 4320 min Winter | 128.579 | 0.682 | 7.3 | 566.3 | O K |
| 5760 min Winter | 128.411 | 0.514 | 7.3 | 426.8 | O K |
| 7200 min Winter | 128.281 | 0.384 | 7.3 | 318.5 | O K |
| 8640 min Winter | 128.181 | 0.284 | 7.3 | 235.7 | O K |
| 10080 min Winter | 128.112 | 0.215 | 7.1 | 178.7 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 60 min Winter | 42.097 | 0.0 | 452.1 | 66 |
| 120 min Winter | 27.178 | 0.0 | 584.5 | 124 |
| 180 min Winter | 20.794 | 0.0 | 670.6 | 184 |
| 240 min Winter | 17.096 | 0.0 | 734.6 | 242 |
| 360 min Winter | 12.847 | 0.0 | 826.5 | 358 |
| 480 min Winter | 10.412 | 0.0 | 891.0 | 472 |
| 600 min Winter | 8.858 | 0.0 | 944.4 | 584 |
| 720 min Winter | 7.757 | 0.0 | 988.2 | 696 |
| 960 min Winter | 6.285 | 0.0 | 1052.1 | 908 |
| 1440 min Winter | 4.662 | 0.0 | 1066.0 | 1142 |
| 2160 min Winter | 3.449 | 0.0 | 1351.1 | 1608 |
| 2880 min Winter | 2.780 | 0.0 | 1450.9 | 2076 |
| 4320 min Winter | 2.047 | 0.0 | 1597.0 | 2988 |
| 5760 min Winter | 1.645 | 0.0 | 1725.5 | 3696 |
| 7200 min Winter | 1.387 | 0.0 | 1817.9 | 4400 |
| 8640 min Winter | 1.206 | 0.0 | 1895.6 | 5024 |
| 10080 min Winter | 1.073 | 0.0 | 1963.9 | 5648 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.100 | Shortest Storm (mins) | 15 |
| Ratio R | 0.300 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 1.303

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 0.396 | 4 | 8 | 0.882 | 8 | 12 | 0.025 |

## Model Details

Storage is Online Cover Level (m) 130.000

## Tank or Pond Structure

Invert Level (m) 127.897

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 830.0 | 1.000 | 830.0 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0126-7300-1000-7300 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 7.3 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 126 |
| Invert Level (m) | 127.897 |
| Minimum Outlet Pipe Diameter (mm) | 150 |
| Suggested Manhole Diameter (mm) | 1200 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 1.000 | 7.3 |
| Flush-Flo™ | 0.301 | 7.3 |
| Kick-Flo® | 0.658 | 6.0 |
| Mean Flow over Head Range | - | 6.3 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.100 | 4.5 | 1.200 | 7.9 | 3.000 | 12.2 | 7.000 | 18.3 |
| 0.200 | 7.1 | 1.400 | 8.5 | 3.500 | 13.2 | 7.500 | 19.0 |
| 0.300 | 7.3 | 1.600 | 9.1 | 4.000 | 14.0 | 8.000 | 19.6 |
| 0.400 | 7.2 | 1.800 | 9.6 | 4.500 | 14.8 | 8.500 | 20.1 |
| 0.500 | 7.0 | 2.000 | 10.1 | 5.000 | 15.6 | 9.000 | 20.7 |
| 0.600 | 6.5 | 2.200 | 10.6 | 5.500 | 16.3 | 9.500 | 21.2 |
| 0.800 | 6.6 | 2.400 | 11.0 | 6.000 | 17.0 | | |
| 1.000 | 7.3 | 2.600 | 11.4 | 6.500 | 17.7 | | |

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Summer | 129.378 | 0.387 | 5.0 | 34.9 | OK |
| 30 min Summer | 129.515 | 0.524 | 5.0 | 47.2 | OK |
| 60 min Summer | 129.649 | 0.658 | 5.0 | 59.2 | OK |
| 120 min Summer | 129.741 | 0.750 | 5.0 | 67.5 | OK |
| 180 min Summer | 129.763 | 0.772 | 5.0 | 69.5 | OK |
| 240 min Summer | 129.766 | 0.775 | 5.0 | 69.8 | OK |
| 360 min Summer | 129.745 | 0.754 | 5.0 | 67.8 | OK |
| 480 min Summer | 129.706 | 0.715 | 5.0 | 64.4 | OK |
| 600 min Summer | 129.666 | 0.675 | 5.0 | 60.8 | OK |
| 720 min Summer | 129.618 | 0.627 | 5.0 | 56.5 | OK |
| 960 min Summer | 129.519 | 0.528 | 5.0 | 47.6 | OK |
| 1440 min Summer | 129.362 | 0.371 | 5.0 | 33.4 | OK |
| 2160 min Summer | 129.214 | 0.223 | 4.9 | 20.0 | OK |
| 2880 min Summer | 129.141 | 0.150 | 4.6 | 13.5 | OK |
| 4320 min Summer | 129.096 | 0.105 | 3.8 | 9.4 | OK |
| 5760 min Summer | 129.078 | 0.087 | 3.0 | 7.8 | OK |
| 7200 min Summer | 129.069 | 0.078 | 2.6 | 7.0 | OK |
| 8640 min Summer | 129.062 | 0.071 | 2.2 | 6.4 | OK |
| 10080 min Summer | 129.057 | 0.066 | 2.0 | 5.9 | OK |
| 15 min Winter | 129.429 | 0.438 | 5.0 | 39.4 | OK |
| 30 min Winter | 129.587 | 0.596 | 5.0 | 53.6 | OK |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 91.180 | 0.0 | 38.8 | 20 |
| 30 min Summer | 63.390 | 0.0 | 54.0 | 34 |
| 60 min Summer | 42.097 | 0.0 | 71.8 | 62 |
| 120 min Summer | 27.178 | 0.0 | 92.8 | 118 |
| 180 min Summer | 20.794 | 0.0 | 106.5 | 148 |
| 240 min Summer | 17.096 | 0.0 | 116.7 | 182 |
| 360 min Summer | 12.847 | 0.0 | 131.6 | 250 |
| 480 min Summer | 10.412 | 0.0 | 142.2 | 322 |
| 600 min Summer | 8.858 | 0.0 | 151.2 | 390 |
| 720 min Summer | 7.757 | 0.0 | 158.9 | 460 |
| 960 min Summer | 6.285 | 0.0 | 171.6 | 582 |
| 1440 min Summer | 4.662 | 0.0 | 190.9 | 822 |
| 2160 min Summer | 3.449 | 0.0 | 212.0 | 1164 |
| 2880 min Summer | 2.780 | 0.0 | 227.8 | 1500 |
| 4320 min Summer | 2.047 | 0.0 | 251.6 | 2204 |
| 5760 min Summer | 1.645 | 0.0 | 269.7 | 2936 |
| 7200 min Summer | 1.387 | 0.0 | 284.2 | 3664 |
| 8640 min Summer | 1.206 | 0.0 | 296.5 | 4392 |
| 10080 min Summer | 1.073 | 0.0 | 307.7 | 5064 |
| 15 min Winter | 91.180 | 0.0 | 43.4 | 20 |
| 30 min Winter | 63.390 | 0.0 | 60.4 | 34 |

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume ($m^3$) | Status |
|---|---|---|---|---|---|
| 60 min Winter | 129.741 | 0.750 | 5.0 | 67.5 | O K |
| 120 min Winter | 129.854 | 0.863 | 5.0 | 77.7 | O K |
| 180 min Winter | 129.878 | 0.887 | 5.0 | 79.9 | O K |
| 240 min Winter | 129.879 | 0.888 | 5.0 | 79.9 | O K |
| 360 min Winter | 129.844 | 0.853 | 5.0 | 76.8 | O K |
| 480 min Winter | 129.784 | 0.793 | 5.0 | 71.4 | O K |
| 600 min Winter | 129.721 | 0.730 | 5.0 | 65.7 | O K |
| 720 min Winter | 129.650 | 0.659 | 5.0 | 59.3 | O K |
| 960 min Winter | 129.485 | 0.494 | 5.0 | 44.5 | O K |
| 1440 min Winter | 129.263 | 0.272 | 5.0 | 24.5 | O K |
| 2160 min Winter | 129.122 | 0.131 | 4.5 | 11.8 | O K |
| 2880 min Winter | 129.095 | 0.104 | 3.7 | 9.3 | O K |
| 4320 min Winter | 129.072 | 0.081 | 2.7 | 7.3 | O K |
| 5760 min Winter | 129.061 | 0.070 | 2.2 | 6.3 | O K |
| 7200 min Winter | 129.054 | 0.063 | 1.9 | 5.7 | O K |
| 8640 min Winter | 129.049 | 0.058 | 1.6 | 5.2 | O K |
| 10080 min Winter | 129.045 | 0.054 | 1.4 | 4.9 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume ($m^3$) | Discharge Volume ($m^3$) | Time-Peak (mins) |
|---|---|---|---|---|
| 60 min Winter | 42.097 | 0.0 | 80.4 | 62 |
| 120 min Winter | 27.178 | 0.0 | 103.9 | 118 |
| 180 min Winter | 20.794 | 0.0 | 119.2 | 168 |
| 240 min Winter | 17.096 | 0.0 | 130.7 | 192 |
| 360 min Winter | 12.847 | 0.0 | 147.4 | 270 |
| 480 min Winter | 10.412 | 0.0 | 159.2 | 348 |
| 600 min Winter | 8.858 | 0.0 | 169.3 | 424 |
| 720 min Winter | 7.757 | 0.0 | 178.0 | 500 |
| 960 min Winter | 6.285 | 0.0 | 192.3 | 618 |
| 1440 min Winter | 4.662 | 0.0 | 213.9 | 840 |
| 2160 min Winter | 3.449 | 0.0 | 237.4 | 1144 |
| 2880 min Winter | 2.780 | 0.0 | 255.2 | 1472 |
| 4320 min Winter | 2.047 | 0.0 | 281.8 | 2204 |
| 5760 min Winter | 1.645 | 0.0 | 302.0 | 2936 |
| 7200 min Winter | 1.387 | 0.0 | 318.3 | 3592 |
| 8640 min Winter | 1.206 | 0.0 | 332.1 | 4320 |
| 10080 min Winter | 1.073 | 0.0 | 344.6 | 5112 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.100 | Shortest Storm (mins) | 15 |
| Ratio R | 0.300 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 0.228

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|
| 0 | 4 | 0.135 | 4 | 8 | 0.093 |

## Model Details

Storage is Online Cover Level (m) 130.579

## Tank or Pond Structure

Invert Level (m) 128.991

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 90.0 | 1.000 | 90.0 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0105-5000-1000-5000 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 5.0 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 105 |
| Invert Level (m) | 128.991 |
| Minimum Outlet Pipe Diameter (mm) | 150 |
| Suggested Manhole Diameter (mm) | 1200 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 1.000 | 5.0 |
| Flush-Flo™ | 0.296 | 5.0 |
| Kick-Flo® | 0.637 | 4.1 |
| Mean Flow over Head Range | - | 4.3 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.100 | 3.6 | 1.200 | 5.4 | 3.000 | 8.4 | 7.000 | 12.5 |
| 0.200 | 4.8 | 1.400 | 5.8 | 3.500 | 9.0 | 7.500 | 12.9 |
| 0.300 | 5.0 | 1.600 | 6.2 | 4.000 | 9.6 | 8.000 | 13.3 |
| 0.400 | 4.9 | 1.800 | 6.6 | 4.500 | 10.1 | 8.500 | 13.7 |
| 0.500 | 4.7 | 2.000 | 6.9 | 5.000 | 10.6 | 9.000 | 14.1 |
| 0.600 | 4.3 | 2.200 | 7.2 | 5.500 | 11.1 | 9.500 | 14.5 |
| 0.800 | 4.5 | 2.400 | 7.5 | 6.000 | 11.6 | | |
| 1.000 | 5.0 | 2.600 | 7.8 | 6.500 | 12.1 | | |

## Summary of Results for 100 year Return Period (+40%)

| **Storm Event** | **Max Level (m)** | **Max Depth (m)** | **Max Control (l/s)** | **Max Volume (m³)** | **Status** |
|---|---|---|---|---|---|
| 15 min Summer | 115.680 | 0.223 | 8.6 | 778.9 | O K |
| 30 min Summer | 115.766 | 0.309 | 8.7 | 1081.5 | O K |
| 60 min Summer | 115.866 | 0.409 | 8.7 | 1431.1 | O K |
| 120 min Summer | 115.981 | 0.524 | 8.7 | 1834.2 | O K |
| 180 min Summer | 116.054 | 0.597 | 8.7 | 2090.7 | O K |
| 240 min Summer | 116.108 | 0.651 | 8.7 | 2277.9 | O K |
| 360 min Summer | 116.182 | 0.725 | 8.7 | 2537.4 | O K |
| 480 min Summer | 116.231 | 0.774 | 8.7 | 2707.9 | O K |
| 600 min Summer | 116.270 | 0.813 | 8.7 | 2844.5 | O K |
| 720 min Summer | 116.301 | 0.844 | 8.7 | 2953.4 | O K |
| 960 min Summer | 116.347 | 0.890 | 8.7 | 3115.8 | O K |
| 1440 min Summer | 116.403 | 0.946 | 8.7 | 3310.8 | O K |
| 2160 min Summer | 116.439 | 0.982 | 8.7 | 3436.9 | O K |
| 2880 min Summer | 116.446 | 0.989 | 8.7 | 3461.8 | O K |
| 4320 min Summer | 116.436 | 0.979 | 8.7 | 3427.5 | O K |
| 5760 min Summer | 116.418 | 0.961 | 8.7 | 3362.5 | O K |
| 7200 min Summer | 116.395 | 0.938 | 8.7 | 3283.1 | O K |
| 8640 min Summer | 116.370 | 0.913 | 8.7 | 3196.7 | O K |
| 10080 min Summer | 116.346 | 0.889 | 8.7 | 3112.5 | O K |
| 15 min Winter | 115.706 | 0.249 | 8.6 | 873.1 | O K |
| 30 min Winter | 115.803 | 0.346 | 8.7 | 1212.7 | O K |

| **Storm Event** | **Rain (mm/hr)** | **Flooded Volume (m³)** | **Discharge Volume (m³)** | **Time-Peak (mins)** |
|---|---|---|---|---|
| 15 min Summer | 91.180 | 0.0 | 539.4 | 30 |
| 30 min Summer | 63.390 | 0.0 | 697.0 | 45 |
| 60 min Summer | 42.097 | 0.0 | 1228.6 | 74 |
| 120 min Summer | 27.178 | 0.0 | 1435.7 | 132 |
| 180 min Summer | 20.794 | 0.0 | 1432.6 | 192 |
| 240 min Summer | 17.096 | 0.0 | 1400.0 | 252 |
| 360 min Summer | 12.847 | 0.0 | 1332.0 | 370 |
| 480 min Summer | 10.412 | 0.0 | 1293.7 | 490 |
| 600 min Summer | 8.858 | 0.0 | 1268.9 | 610 |
| 720 min Summer | 7.757 | 0.0 | 1253.3 | 728 |
| 960 min Summer | 6.285 | 0.0 | 1241.6 | 968 |
| 1440 min Summer | 4.662 | 0.0 | 1247.7 | 1446 |
| 2160 min Summer | 3.449 | 0.0 | 2563.7 | 2164 |
| 2880 min Summer | 2.780 | 0.0 | 2509.2 | 2860 |
| 4320 min Summer | 2.047 | 0.0 | 2428.6 | 3544 |
| 5760 min Summer | 1.645 | 0.0 | 5068.2 | 4280 |
| 7200 min Summer | 1.387 | 0.0 | 4899.0 | 5112 |
| 8640 min Summer | 1.206 | 0.0 | 4663.2 | 5960 |
| 10080 min Summer | 1.073 | 0.0 | 4421.6 | 6760 |
| 15 min Winter | 91.180 | 0.0 | 599.3 | 30 |
| 30 min Winter | 63.390 | 0.0 | 726.6 | 44 |

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 60 min Winter | 115.916 | 0.459 | 8.7 | 1605.2 | O K |
| 120 min Winter | 116.045 | 0.588 | 8.7 | 2059.2 | O K |
| 180 min Winter | 116.128 | 0.671 | 8.7 | 2349.9 | O K |
| 240 min Winter | 116.189 | 0.732 | 8.7 | 2561.3 | O K |
| 360 min Winter | 116.272 | 0.815 | 8.7 | 2852.8 | O K |
| 480 min Winter | 116.327 | 0.870 | 8.7 | 3046.4 | O K |
| 600 min Winter | 116.372 | 0.915 | 8.7 | 3202.9 | O K |
| 720 min Winter | 116.408 | 0.951 | 8.7 | 3328.5 | O K |
| 960 min Winter | 116.462 | 1.005 | 8.7 | 3518.4 | O K |
| 1440 min Winter | 116.530 | 1.073 | 9.0 | 3754.2 | O K |
| 2160 min Winter | 116.578 | 1.121 | 9.2 | 3924.1 | O K |
| 2880 min Winter | 116.595 | 1.138 | 9.2 | 3982.3 | O K |
| 4320 min Winter | 116.583 | 1.126 | 9.2 | 3942.3 | O K |
| 5760 min Winter | 116.558 | 1.101 | 9.1 | 3853.7 | O K |
| 7200 min Winter | 116.528 | 1.071 | 9.0 | 3747.0 | O K |
| 8640 min Winter | 116.492 | 1.035 | 8.8 | 3623.7 | O K |
| 10080 min Winter | 116.456 | 0.999 | 8.7 | 3497.5 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 60 min Winter | 42.097 | 0.0 | 1342.8 | 74 |
| 120 min Winter | 27.178 | 0.0 | 1445.1 | 132 |
| 180 min Winter | 20.794 | 0.0 | 1398.0 | 190 |
| 240 min Winter | 17.096 | 0.0 | 1351.0 | 248 |
| 360 min Winter | 12.847 | 0.0 | 1304.7 | 366 |
| 480 min Winter | 10.412 | 0.0 | 1286.1 | 484 |
| 600 min Winter | 8.858 | 0.0 | 1282.4 | 600 |
| 720 min Winter | 7.757 | 0.0 | 1290.5 | 718 |
| 960 min Winter | 6.285 | 0.0 | 1313.0 | 952 |
| 1440 min Winter | 4.662 | 0.0 | 1321.4 | 1416 |
| 2160 min Winter | 3.449 | 0.0 | 2650.3 | 2100 |
| 2880 min Winter | 2.780 | 0.0 | 2653.0 | 2768 |
| 4320 min Winter | 2.047 | 0.0 | 2581.7 | 3984 |
| 5760 min Winter | 1.645 | 0.0 | 5258.2 | 4504 |
| 7200 min Winter | 1.387 | 0.0 | 5074.9 | 5472 |
| 8640 min Winter | 1.206 | 0.0 | 4883.0 | 6400 |
| 10080 min Winter | 1.073 | 0.0 | 4704.2 | 7280 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 15.100 | Shortest Storm (mins) | 15 |
| Ratio R | 0.300 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 4.610

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 0.853 | 8 | 12 | 1.085 | 16 | 20 | 0.029 |
| 4 | 8 | 2.139 | 12 | 16 | 0.502 | | | |

## Model Details

Storage is Online Cover Level (m) 117.450

## Tank or Pond Structure

Invert Level (m) 115.457

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 3500.0 | 1.000 | 3500.0 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0137-8700-1000-8700 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 8.7 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 137 |
| Invert Level (m) | 115.457 |
| Minimum Outlet Pipe Diameter (mm) | 150 |
| Suggested Manhole Diameter (mm) | 1200 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 1.000 | 8.7 |
| Flush-Flo™ | 0.302 | 8.7 |
| Kick-Flo® | 0.668 | 7.2 |
| Mean Flow over Head Range | - | 7.5 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.100 | 4.9 | 1.200 | 9.5 | 3.000 | 14.6 | 7.000 | 21.9 |
| 0.200 | 8.4 | 1.400 | 10.2 | 3.500 | 15.7 | 7.500 | 22.7 |
| 0.300 | 8.7 | 1.600 | 10.9 | 4.000 | 16.8 | 8.000 | 23.4 |
| 0.400 | 8.6 | 1.800 | 11.5 | 4.500 | 17.7 | 8.500 | 24.1 |
| 0.500 | 8.4 | 2.000 | 12.1 | 5.000 | 18.7 | 9.000 | 24.8 |
| 0.600 | 7.9 | 2.200 | 12.6 | 5.500 | 19.5 | 9.500 | 25.4 |
| 0.800 | 7.8 | 2.400 | 13.1 | 6.000 | 20.4 | | |
| 1.000 | 8.7 | 2.600 | 13.7 | 6.500 | 21.2 | | |

## Simulation Criteria for Existing

```
Volumetric Runoff Coeff 0.750            Hot Start Level (mm)     0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000
 Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500     MADD Factor * 10m³/ha Storage 2.000                    Run Time (mins)    60
       Hot Start (mins)     0   Foul Sewage per hectare (l/s) 0.000               Inlet Coeffiecient 0.800             Output Interval (mins)     1

Number of Input Hydrographs 0 Number of Online Controls 0 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0
```

## Synthetic Rainfall Details

```
      Rainfall Model FSR     Region England and Wales      Ratio R  0.300 Cv (Summer) 0.750 Storm Duration (mins) 30
Return Period (years)   30 M5-60 (mm)            15.900 Profile Type Summer Cv (Winter) 0.840
```

## Storage Structures for Existing

### Tank or Pond Manhole: S0405-01-36 (Pond), DS/PN: 1.008

Invert Level (m) 146.640

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 540.0 | 1.800 | 1296.0 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

### Simulation Criteria

Areal Reduction Factor 1.000 Hot Start Level (mm) 0 Foul Sewage per hectare (l/s) 0.000 MADD Factor * 10m³/ha Storage 2.000 Flow per Person per Day (l/per/day) 0.000
Hot Start (mins) 0 Manhole Headloss Coeff (Global) 0.500 Additional Flow - % of Total Flow 0.000 Inlet Coeffiecient 0.800

Number of Input Hydrographs 0 Number of Online Controls 0 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Region England and Wales M5-60 (mm) 16.800 Ratio R 0.300 Cv (Summer) 0.750 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 Analysis Timestep Fine DTS Status ON DVD Status OFF Inertia Status OFF

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-01-1 | 15 Summer | 5 | +20% | | | | | 151.430 | -0.225 | 0.000 | 0.00 | | | 0.0 | OK | |
| 1.001 | S0405-01-2 | 15 Winter | 5 | +20% | | | | | 151.340 | -0.160 | 0.000 | 0.18 | | | 16.9 | OK | |
| 1.002 | S0405-01-3 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 148.092 | -0.074 | 0.000 | 0.75 | | | 47.8 | OK | 5 |
| 2.000 | S0405-01-4 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 154.153 | -0.118 | 0.000 | 0.44 | | | 36.5 | OK | |
| 2.001 | S0405-01-5 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 151.595 | -0.071 | 0.000 | 0.77 | | | 64.7 | OK | 6 |
| 2.002 | S0405-01-6 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 149.806 | 0.817 | 0.000 | 1.09 | | | 78.1 | SURCHARGED | 9 |
| 2.003 | S0405-01-7 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 147.406 | 0.318 | 0.000 | 1.04 | | | 85.6 | SURCHARGED | |
| 1.003 | S0405-01-8 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 147.206 | 0.230 | 0.000 | 1.44 | | | 128.3 | SURCHARGED | |
| 3.000 | S0405-01-9 | 15 Winter | 5 | +20% | | | | | 154.715 | -0.206 | 0.000 | 0.02 | | | 1.4 | OK | |
| 3.001 | S0405-01-10 | 15 Winter | 5 | +20% | | | | | 152.173 | -0.176 | 0.000 | 0.10 | | | 8.5 | OK | |
| 3.002 | S0405-01-11 | 15 Winter | 5 | +20% | | | | | 149.622 | -0.157 | 0.000 | 0.19 | | | 13.9 | OK | |
| 3.003 | S0405-01-12 | 15 Winter | 5 | +20% | 100/15 Winter | | | | 147.592 | -0.146 | 0.000 | 0.27 | | | 13.9 | OK | |
| 4.000 | S0405-01-13 | 15 Winter | 5 | +20% | | | | | 149.898 | -0.202 | 0.000 | 0.02 | | | 1.8 | OK | |
| 4.001 | S0405-01-14 | 15 Winter | 5 | +20% | | | | | 148.071 | -0.199 | 0.000 | 0.03 | | | 1.8 | OK | |
| 1.004 | S0405-01-15 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 147.098 | 0.086 | 0.000 | 1.25 | | | 143.4 | SURCHARGED | |
| 5.000 | S0405-01-16 | 15 Winter | 5 | +20% | | | | | 152.099 | -0.208 | 0.000 | 0.02 | | | 1.4 | OK | |
| 5.001 | S0405-01-17 | 15 Winter | 5 | +20% | | | | | 149.338 | -0.167 | 0.000 | 0.15 | | | 11.4 | OK | |
| 5.002 | S0405-01-18 | 15 Winter | 5 | +20% | | | | | 147.907 | -0.129 | 0.000 | 0.37 | | | 21.4 | OK | |
| 6.000 | S0405-01-19 | 15 Winter | 5 | +20% | | | | | 154.966 | -0.149 | 0.000 | 0.24 | | | 19.3 | OK | |
| 6.001 | S0405-01-20 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 152.444 | -0.120 | 0.000 | 0.43 | | | 35.0 | OK | |
| 6.002 | S0405-01-21 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 149.923 | -0.087 | 0.000 | 0.67 | | | 50.4 | OK | 4 |
| 6.003 | S0405-01-22 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 147.804 | -0.027 | 0.000 | 1.00 | | | 56.1 | OK | |
| 1.005 | S0405-01-23 | 60 Summer | 5 | +20% | 100/15 Summer | | | | 147.050 | 0.000 | 0.000 | 1.06 | | | 175.3 | OK | |
| 7.000 | S0405-01-24 | 15 Winter | 5 | +20% | | | | | 152.413 | -0.134 | 0.000 | 0.33 | | | 29.7 | OK | |
| 7.001 | S0405-01-25 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 149.333 | -0.103 | 0.000 | 0.55 | | | 30.1 | OK | |
| 7.002 | S0405-01-26 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 148.278 | -0.113 | 0.000 | 0.50 | | | 30.2 | OK | |
| 7.003 | S0405-01-27 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 148.102 | -0.103 | 0.000 | 0.57 | | | 31.0 | OK | |
| 8.000 | S0405-01-28 | 15 Winter | 5 | +20% | | | | | 155.626 | -0.202 | 0.000 | 0.02 | | | 1.7 | OK | |
| 8.001 | S0405-01-29 | 15 Winter | 5 | +20% | | | | | 154.804 | -0.196 | 0.000 | 0.04 | | | 1.7 | OK | |
| 8.002 | S0405-01-30 | 15 Winter | 5 | +20% | | | | | 154.713 | -0.187 | 0.000 | 0.07 | | | 5.4 | OK | |
| 8.003 | S0405-01-31 | 15 Winter | 5 | +20% | | | | | 152.138 | -0.175 | 0.000 | 0.11 | | | 8.6 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8.004 | S0405-01-32 | 15 Winter | 5 | +20% | | | | | 149.649 | -0.160 | 0.000 | 0.18 | | | 11.6 | OK | |
| 8.005 | S0405-01-33 | 15 Winter | 5 | +20% | | | | | 147.964 | -0.160 | 0.000 | 0.18 | | | 12.1 | OK | |
| 1.006 | S0405-01-34 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 146.965 | -0.123 | 0.000 | 0.96 | | | 254.9 | OK | |
| 1.007 | S0405-01-35 | 60 Winter | 5 | +20% | 100/15 Summer | | | | 146.911 | -0.081 | 0.000 | 0.66 | | | 176.1 | OK | |
| 1.008 | S0405-01-36 (Pond) | 60 Winter | 5 | +20% | | | | | 146.890 | -0.350 | 0.000 | 0.27 | | | 73.4 | OK | |
| 1.009 | S0405-01-37 (Flow Control) | 60 Winter | 5 | +20% | | | | | 146.818 | -0.308 | 0.000 | 0.36 | | | 72.8 | OK | |
| 1.010 | S0405-01-38 | 60 Winter | 5 | +20% | | | | | 146.781 | -0.307 | 0.000 | 0.48 | | | 72.9 | OK | |
| 1.011 | S0405-01-39 | 60 Winter | 5 | +20% | | | | | 146.704 | -0.384 | 0.000 | 0.28 | | | 72.8 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

### Simulation Criteria

Areal Reduction Factor 1.000 Hot Start Level (mm) 0 Foul Sewage per hectare (l/s) 0.000 MADD Factor * 10m³/ha Storage 2.000 Flow per Person per Day (l/per/day) 0.000
Hot Start (mins) 0 Manhole Headloss Coeff (Global) 0.500 Additional Flow - % of Total Flow 0.000 Inlet Coeffiecient 0.800

Number of Input Hydrographs 0 Number of Online Controls 0 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Region England and Wales M5-60 (mm) 16.800 Ratio R 0.300 Cv (Summer) 0.750 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 Analysis Timestep Fine DTS Status ON DVD Status OFF Inertia Status OFF

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-01-1 | 15 Summer | 100 | +40% | | | | | 151.430 | -0.225 | 0.000 | 0.00 | | | 0.0 | OK | |
| 1.001 | S0405-01-2 | 15 Winter | 100 | +40% | | | | | 151.388 | -0.112 | 0.000 | 0.49 | | | 45.9 | OK | |
| 1.002 | S0405-01-3 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 149.375 | 1.209 | 8.842 | 1.13 | | | 72.1 | FLOOD | 5 |
| 2.000 | S0405-01-4 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 154.770 | 0.499 | 0.000 | 0.84 | | | 69.0 | SURCHARGED | |
| 2.001 | S0405-01-5 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 152.878 | 1.212 | 12.091 | 0.98 | | | 82.2 | FLOOD | 6 |
| 2.002 | S0405-01-6 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 150.300 | 1.311 | 36.190 | 1.20 | | | 86.4 | FLOOD | 9 |
| 2.003 | S0405-01-7 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 148.039 | 0.952 | 0.000 | 1.20 | | | 99.0 | FLOOD RISK | |
| 1.003 | S0405-01-8 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 147.797 | 0.821 | 0.000 | 1.85 | | | 164.3 | SURCHARGED | |
| 3.000 | S0405-01-9 | 15 Winter | 100 | +40% | | | | | 154.724 | -0.196 | 0.000 | 0.04 | | | 3.1 | OK | |
| 3.001 | S0405-01-10 | 15 Winter | 100 | +40% | | | | | 152.205 | -0.144 | 0.000 | 0.27 | | | 21.9 | OK | |
| 3.002 | S0405-01-11 | 15 Winter | 100 | +40% | | | | | 149.671 | -0.108 | 0.000 | 0.50 | | | 36.5 | OK | |
| 3.003 | S0405-01-12 | 15 Winter | 100 | +40% | 100/15 Winter | | | | 147.759 | 0.021 | 0.000 | 0.66 | | | 34.3 | SURCHARGED | |
| 4.000 | S0405-01-13 | 15 Winter | 100 | +40% | | | | | 149.907 | -0.193 | 0.000 | 0.05 | | | 4.0 | OK | |
| 4.001 | S0405-01-14 | 15 Winter | 100 | +40% | | | | | 148.084 | -0.186 | 0.000 | 0.07 | | | 3.9 | OK | |
| 1.004 | S0405-01-15 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 147.624 | 0.612 | 0.000 | 1.72 | | | 197.0 | SURCHARGED | |
| 5.000 | S0405-01-16 | 15 Winter | 100 | +40% | | | | | 152.109 | -0.198 | 0.000 | 0.03 | | | 3.1 | OK | |
| 5.001 | S0405-01-17 | 15 Winter | 100 | +40% | | | | | 149.378 | -0.126 | 0.000 | 0.39 | | | 30.1 | OK | |
| 5.002 | S0405-01-18 | 15 Winter | 100 | +40% | | | | | 148.034 | -0.002 | 0.000 | 0.95 | | | 54.4 | OK | |
| 6.000 | S0405-01-19 | 15 Winter | 100 | +40% | | | | | 155.008 | -0.108 | 0.000 | 0.51 | | | 41.9 | OK | |
| 6.001 | S0405-01-20 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 153.105 | 0.541 | 0.000 | 0.85 | | | 69.3 | SURCHARGED | |
| 6.002 | S0405-01-21 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 151.214 | 1.204 | 3.745 | 1.07 | | | 80.4 | FLOOD | 4 |
| 6.003 | S0405-01-22 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 148.853 | 1.022 | 0.000 | 1.58 | | | 88.6 | FLOOD RISK | |
| 1.005 | S0405-01-23 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 147.503 | 0.452 | 0.000 | 1.99 | | | 326.9 | SURCHARGED | |
| 7.000 | S0405-01-24 | 15 Winter | 100 | +40% | | | | | 152.468 | -0.080 | 0.000 | 0.72 | | | 64.5 | OK | |
| 7.001 | S0405-01-25 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 149.833 | 0.397 | 0.000 | 1.13 | | | 62.1 | SURCHARGED | |
| 7.002 | S0405-01-26 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 148.492 | 0.101 | 0.000 | 0.99 | | | 59.9 | SURCHARGED | |
| 7.003 | S0405-01-27 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 148.309 | 0.104 | 0.000 | 1.13 | | | 61.4 | SURCHARGED | |
| 8.000 | S0405-01-28 | 15 Winter | 100 | +40% | | | | | 155.635 | -0.194 | 0.000 | 0.05 | | | 3.8 | OK | |
| 8.001 | S0405-01-29 | 15 Winter | 100 | +40% | | | | | 154.819 | -0.181 | 0.000 | 0.08 | | | 3.7 | OK | |
| 8.002 | S0405-01-30 | 15 Winter | 100 | +40% | | | | | 154.737 | -0.163 | 0.000 | 0.16 | | | 13.3 | OK | |
| 8.003 | S0405-01-31 | 15 Winter | 100 | +40% | | | | | 152.171 | -0.142 | 0.000 | 0.27 | | | 22.2 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8.004 | S0405-01-32 | 15 Winter | 100 | +40% | | | | | 149.694 | -0.115 | 0.000 | 0.45 | | | 29.6 | OK | |
| 8.005 | S0405-01-33 | 15 Winter | 100 | +40% | | | | | 148.008 | -0.116 | 0.000 | 0.46 | | | 30.8 | OK | |
| 1.006 | S0405-01-34 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 147.324 | 0.236 | 0.000 | 1.50 | | | 398.9 | SURCHARGED | |
| 1.007 | S0405-01-35 | 60 Winter | 100 | +40% | 100/15 Summer | | | | 147.196 | 0.204 | 0.000 | 1.27 | | | 340.0 | SURCHARGED | |
| 1.008 | S0405-01-36 (Pond) | 120 Winter | 100 | +40% | | | | | 147.124 | -0.116 | 0.000 | 0.65 | | | 176.1 | OK | |
| 1.009 | S0405-01-37 (Flow Control) | 120 Winter | 100 | +40% | | | | | 147.069 | -0.057 | 0.000 | 0.88 | | | 175.1 | OK | |
| 1.010 | S0405-01-38 | 120 Winter | 100 | +40% | | | | | 147.021 | -0.067 | 0.000 | 1.15 | | | 175.0 | OK | |
| 1.011 | S0405-01-39 | 120 Winter | 100 | +40% | | | | | 146.850 | -0.238 | 0.000 | 0.68 | | | 174.8 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Existing L

```
                    Pipe Sizes STANDARD Manhole Sizes STANDARD

                       FSR Rainfall Model - England and Wales
            Return Period (years)      1          Foul Sewage (l/s/ha) 0.000           Maximum Backdrop Height (m) 1.500
                      M5-60 (mm)  19.100      Volumetric Runoff Coeff. 0.750 Min Design Depth for Optimisation (m) 1.200
                         Ratio R   0.300                      PIMP (%)   100     Min Vel for Auto Design only (m/s)  1.00
          Maximum Rainfall (mm/hr)    50  Add Flow / Climate Change (%)    0       Min Slope for Optimisation (1:X)   500
Maximum Time of Concentration (mins)    30   Minimum Backdrop Height (m) 0.200

                            Designed with Level Inverts
```

### Simulation Criteria for Existing L

```
     Volumetric Runoff Coeff 0.750   Manhole Headloss Coeff (Global) 0.500                   Inlet Coeffiecient 0.800
      Areal Reduction Factor 1.000     Foul Sewage per hectare (l/s) 0.000 Flow per Person per Day (l/per/day) 0.000
             Hot Start (mins)      0 Additional Flow - % of Total Flow 0.000                      Run Time (mins)    60
          Hot Start Level (mm)     0     MADD Factor * 10m³/ha Storage 2.000                Output Interval (mins)     1

       Number of Input Hydrographs 0   Number of Offline Controls 0 Number of Time/Area Diagrams 0
        Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
         Rainfall Model FSR     Region England and Wales      Ratio R  0.250
   Return Period (years)   30 M5-60 (mm)            18.900 Profile Type Summer
```

## Synthetic Rainfall Details

Cv (Summer) 0.750 Cv (Winter) 0.840 Storm Duration (mins) 30

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Existing M

```
                       Pipe Sizes STANDARD Manhole Sizes STANDARD

                         FSR Rainfall Model - England and Wales
              Return Period (years)      5         Foul Sewage (l/s/ha) 0.000           Maximum Backdrop Height (m) 1.500
                        M5-60 (mm)  19.600      Volumetric Runoff Coeff. 0.750 Min Design Depth for Optimisation (m) 1.200
                           Ratio R   0.300                      PIMP (%)   100    Min Vel for Auto Design only (m/s)  1.00
           Maximum Rainfall (mm/hr)     50 Add Flow / Climate Change (%)     0      Min Slope for Optimisation (1:X)   500
Maximum Time of Concentration (mins)    30   Minimum Backdrop Height (m) 0.200

                              Designed with Level Soffits
```

### Simulation Criteria for Existing M

```
Volumetric Runoff Coeff 0.750   Manhole Headloss Coeff (Global) 0.500                  Inlet Coeffiecient 0.800
 Areal Reduction Factor 1.000     Foul Sewage per hectare (l/s) 0.000 Flow per Person per Day (l/per/day) 0.000
       Hot Start (mins)     0 Additional Flow - % of Total Flow 0.000                      Run Time (mins)     60
     Hot Start Level (mm)     0     MADD Factor * 10m³/ha Storage 2.000                 Output Interval (mins)      1

      Number of Input Hydrographs 0   Number of Offline Controls 0 Number of Time/Area Diagrams 0
        Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
         Rainfall Model FSR     Region England and Wales      Ratio R  0.250
  Return Period (years)   30 M5-60 (mm)             18.900 Profile Type Summer
```

## Synthetic Rainfall Details

Cv (Summer) 0.750 Cv (Winter) 0.840 Storm Duration (mins) 30

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing M

### Simulation Criteria

```
Areal Reduction Factor 1.000   Manhole Headloss Coeff (Global) 0.500       MADD Factor * 10m³/ha Storage 2.000
      Hot Start (mins)      0     Foul Sewage per hectare (l/s) 0.000                 Inlet Coeffiecient 0.800
   Hot Start Level (mm)     0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

     Number of Input Hydrographs 0   Number of Offline Controls 0 Number of Time/Area Diagrams 0
       Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
Rainfall Model               FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
        Region England and Wales    Ratio R  0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status  ON Inertia Status OFF
                 Analysis Timestep   Fine DVD Status OFF


          Profile(s)                        Summer and Winter
      Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)                                   5, 100
      Climate Change (%)                                   20, 40
```

| **PN** | **US/MH Name** | **Storm** | **Return Period** | **Climate Change** | **First (X) Surcharge** | **First (Y) Flood** | **First (Z) Overflow** | **Overflow Act.** | **Water Level (m)** | **Surcharged Depth (m)** | **Flooded Volume (m³)** | **Flow / Cap.** | **Overflow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PN/M-3.000 | MH/M-3 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 145.328 | -0.215 | 0.000 | 0.00 | |
| PN/M-4.000 | MH/M-4 | 15 Winter | 5 | +20% | | | | | 146.534 | -0.150 | 0.000 | 0.24 | |
| PN/M-3.001 | MH/M-5 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 145.340 | -0.085 | 0.000 | 0.63 | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing M

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| PN/M-3.000 | MH/M-3 |  | 0.1 | OK |  |
| PN/M-4.000 | MH/M-4 |  | 17.6 | OK |  |
| PN/M-3.001 | MH/M-5 |  | 19.8 | OK |  |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing M

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PN/M-3.002 | MH/M-6 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 144.986 | -0.090 | 0.000 | 0.62 | |
| PN/M-5.000 | MH/M-7 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 146.289 | 0.226 | 0.000 | 1.44 | |
| PN/M-6.000 | MH/M-8 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 145.778 | 0.358 | 0.000 | 0.07 | |
| PN/M-5.001 | MH/M-11 | 30 Winter | 5 | +20% | | | | | 145.765 | -0.248 | 0.000 | 0.07 | |
| PN/M-7.000 | MH/M-12 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 145.039 | 0.039 | 0.000 | 0.98 | |
| PN/M-8.000 | MH/M-18 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 145.270 | -0.110 | 0.000 | 0.71 | |
| PN/M-5.002 | MH/M-19 | 30 Summer | 5 | +20% | 100/15 Summer | | | | 144.870 | -0.082 | 0.000 | 0.87 | |
| PN/M-3.003 | MH/M-20 | 15 Winter | 5 | +20% | | | | | 144.693 | -0.116 | 0.000 | 0.47 | |

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| PN/M-3.002 | MH/M-6 | | 17.9 | OK | |
| PN/M-5.000 | MH/M-7 | | 12.5 | SURCHARGED | 4 |
| PN/M-6.000 | MH/M-8 | | 7.8 | SURCHARGED | |
| PN/M-5.001 | MH/M-11 | | 17.6 | OK | |
| PN/M-7.000 | MH/M-12 | | 10.6 | SURCHARGED | |
| PN/M-8.000 | MH/M-18 | | 33.5 | OK | |
| PN/M-5.002 | MH/M-19 | | 51.7 | OK | |
| PN/M-3.003 | MH/M-20 | | 68.7 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing M

### Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status ON Inertia Status OFF
Analysis Timestep Fine DVD Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| **PN** | **US/MH Name** | **Storm** | **Return Period** | **Climate Change** | **First (X) Surcharge** | **First (Y) Flood** | **First (Z) Overflow** | **Overflow Act.** | **Water Level (m)** | **Surcharged Depth (m)** | **Flooded Volume (m³)** | **Flow / Cap.** | **Overflow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PN/M-3.000 | MH/M-3 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 145.772 | 0.229 | 0.000 | 0.06 | |
| PN/M-4.000 | MH/M-4 | 15 Winter | 100 | +40% | | | | | 146.576 | -0.108 | 0.000 | 0.52 | |
| PN/M-3.001 | MH/M-5 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 145.776 | 0.351 | 0.000 | 1.28 | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing M

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| PN/M-3.000 | MH/M-3 | | 2.6 | SURCHARGED | |
| PN/M-4.000 | MH/M-4 | | 38.6 | OK | |
| PN/M-3.001 | MH/M-5 | | 40.6 | SURCHARGED | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing M

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PN/M-3.002 | MH/M-6 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 145.191 | 0.115 | 0.000 | 1.17 | |
| PN/M-5.000 | MH/M-7 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 147.021 | 0.958 | 1.139 | 2.40 | |
| PN/M-6.000 | MH/M-8 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 145.836 | 0.416 | 0.000 | 0.18 | |
| PN/M-5.001 | MH/M-11 | 15 Winter | 100 | +40% | | | | | 145.794 | -0.219 | 0.000 | 0.16 | |
| PN/M-7.000 | MH/M-12 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 145.826 | 0.826 | 0.000 | 1.86 | |
| PN/M-8.000 | MH/M-18 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 145.636 | 0.256 | 0.000 | 1.41 | |
| PN/M-5.002 | MH/M-19 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 145.132 | 0.180 | 0.000 | 1.96 | |
| PN/M-3.003 | MH/M-20 | 15 Winter | 100 | +40% | | | | | 144.770 | -0.039 | 0.000 | 1.00 | |

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| PN/M-3.002 | MH/M-6 | | 33.9 | SURCHARGED | |
| PN/M-5.000 | MH/M-7 | | 20.8 | FLOOD | 4 |
| PN/M-6.000 | MH/M-8 | | 20.9 | SURCHARGED | |
| PN/M-5.001 | MH/M-11 | | 41.1 | OK | |
| PN/M-7.000 | MH/M-12 | | 20.1 | SURCHARGED | |
| PN/M-8.000 | MH/M-18 | | 66.8 | SURCHARGED | |
| PN/M-5.002 | MH/M-19 | | 117.2 | SURCHARGED | |
| PN/M-3.003 | MH/M-20 | | 147.0 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Existing N

```
                         Pipe Sizes STANDARD Manhole Sizes STANDARD

                            FSR Rainfall Model - England and Wales
             Return Period (years)       5          Foul Sewage (l/s/ha) 0.000           Maximum Backdrop Height (m) 1.500
                        M5-60 (mm) 18.800      Volumetric Runoff Coeff. 0.750 Min Design Depth for Optimisation (m) 1.200
                           Ratio R  0.300                      PIMP (%)    100     Min Vel for Auto Design only (m/s)  1.00
          Maximum Rainfall (mm/hr)      50 Add Flow / Climate Change (%)      0       Min Slope for Optimisation (1:X)   500
Maximum Time of Concentration (mins)    30   Minimum Backdrop Height (m) 0.200

                                  Designed with Level Soffits
```

### Simulation Criteria for Existing N

```
Volumetric Runoff Coeff 0.750   Manhole Headloss Coeff (Global) 0.500                Inlet Coeffiecient 0.800
 Areal Reduction Factor 1.000     Foul Sewage per hectare (l/s) 0.000 Flow per Person per Day (l/per/day) 0.000
       Hot Start (mins)     0 Additional Flow - % of Total Flow 0.000                    Run Time (mins)     60
    Hot Start Level (mm)    0      MADD Factor * 10m³/ha Storage 2.000               Output Interval (mins)      1

 Number of Input Hydrographs 0   Number of Offline Controls 0 Number of Time/Area Diagrams 0
   Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
       Rainfall Model FSR     Region England and Wales      Ratio R  0.250
Return Period (years)  30 M5-60 (mm)            18.900 Profile Type Summer
```

## Synthetic Rainfall Details

Cv (Summer) 0.750 Cv (Winter) 0.840 Storm Duration (mins) 30

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing N

### Simulation Criteria

```
Areal Reduction Factor 1.000   Manhole Headloss Coeff (Global) 0.500        MADD Factor * 10m³/ha Storage 2.000
      Hot Start (mins)      0     Foul Sewage per hectare (l/s) 0.000                  Inlet Coeffiecient 0.800
  Hot Start Level (mm)      0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

          Number of Input Hydrographs 0   Number of Offline Controls 0 Number of Time/Area Diagrams 0
           Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
Rainfall Model                FSR M5-60 (mm) 18.000 Cv (Summer) 0.750
    Region England and Wales    Ratio R  0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status  ON Inertia Status OFF
                 Analysis Timestep   Fine DVD Status OFF


                    Profile(s)                        Summer and Winter
                Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
             Return Period(s) (years)                                5, 100
                Climate Change (%)                                   20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PN/N-4.000 | MH/N-1 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 159.026 | -0.094 | 0.000 | 0.61 | |
| PN/N-4.001 | MH/N-2 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 157.031 | -0.086 | 0.000 | 0.67 | |
| PN/N-4.002 | MH/N-3 | 15 Winter | 5 | +20% | | | | | 153.623 | -0.164 | 0.000 | 0.42 | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing N

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| PN/N-4.000 | MH/N-1 |  | 43.9 | OK |  |
| PN/N-4.001 | MH/N-2 |  | 62.9 | OK |  |
| PN/N-4.002 | MH/N-3 |  | 82.3 | OK |  |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing N

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PN/N-4.003 | MH/N-4 | 15 Winter | 5 | +20% | | | | | 150.301 | -0.153 | 0.000 | 0.48 | |
| PN/N-4.004 | MH/N-8 | 15 Winter | 5 | +20% | | | | | 145.243 | -0.293 | 0.000 | 0.26 | |
| PN/N-4.005 | MH/N-9 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 144.900 | -0.207 | 0.000 | 0.56 | |

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| PN/N-4.003 | MH/N-4 | | 98.0 | OK | |
| PN/N-4.004 | MH/N-8 | | 97.6 | OK | |
| PN/N-4.005 | MH/N-9 | | 97.9 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing N

### Simulation Criteria

Areal Reduction Factor 1.000
Hot Start (mins) 0
Hot Start Level (mm) 0
Manhole Headloss Coeff (Global) 0.500
Foul Sewage per hectare (l/s) 0.000
Additional Flow - % of Total Flow 0.000
MADD Factor * 10m³/ha Storage 2.000
Inlet Coeffiecient 0.800
Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0
Number of Online Controls 0
Number of Offline Controls 0
Number of Storage Structures 0
Number of Time/Area Diagrams 0
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
Region England and Wales
M5-60 (mm) 18.000
Ratio R 0.300
Cv (Summer) 0.750
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep Fine
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| **PN** | **US/MH Name** | **Storm** | **Return Period** | **Climate Change** | **First (X) Surcharge** | **First (Y) Flood** | **First (Z) Overflow** | **Overflow Act.** | **Water Level (m)** | **Surcharged Depth (m)** | **Flooded Volume (m³)** | **Flow / Cap.** | **Overflow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PN/N-4.000 | MH/N-1 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 160.300 | 1.180 | 0.000 | 1.01 | |
| PN/N-4.001 | MH/N-2 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 158.196 | 1.079 | 0.000 | 1.15 | |
| PN/N-4.002 | MH/N-3 | 15 Winter | 100 | +40% | | | | | 153.691 | -0.095 | 0.000 | 0.78 | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing N

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| PN/N-4.000 | MH/N-1 | | 73.1 | FLOOD RISK | |
| PN/N-4.001 | MH/N-2 | | 106.9 | SURCHARGED | |
| PN/N-4.002 | MH/N-3 | | 154.2 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing N

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume ($m^3$) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PN/N-4.003 | MH/N-4 | 15 Winter | 100 | +40% | | | | | 150.392 | -0.061 | 0.000 | 0.98 | |
| PN/N-4.004 | MH/N-8 | 15 Winter | 100 | +40% | | | | | 145.322 | -0.214 | 0.000 | 0.54 | |
| PN/N-4.005 | MH/N-9 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 145.116 | 0.009 | 0.000 | 1.14 | |

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| PN/N-4.003 | MH/N-4 | | 199.5 | OK | |
| PN/N-4.004 | MH/N-8 | | 199.9 | OK | |
| PN/N-4.005 | MH/N-9 | | 198.7 | SURCHARGED | |

## Simulation Criteria for Main line 007

```
Volumetric Runoff Coeff 0.750            Hot Start Level (mm)      0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000
 Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500     MADD Factor * 10m³/ha Storage 2.000                     Run Time (mins)     60
       Hot Start (mins)      0   Foul Sewage per hectare (l/s) 0.000                 Inlet Coeffiecient 0.800             Output Interval (mins)      1

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0
```

## Synthetic Rainfall Details

```
      Rainfall Model FSR     Region England and Wales      Ratio R  0.258 Cv (Summer) 0.750 Storm Duration (mins) 30
Return Period (years)   30 M5-60 (mm)            21.300 Profile Type Summer Cv (Winter) 0.840
```

## Online Controls for Main line 007

### Hydro-Brake® Optimum Manhole: S0405-4-36 (Flow Control), DS/PN: 1.011, Volume (m³): 10.9

| | | | | | |
|---|---|---|---|---|---|
| Unit Reference | MD-SHE-0230-3000-1500-3000 | Objective | Minimise upstream storage | Invert Level (m) | 153.320 |
| Design Head (m) | 1.500 | Application | Surface | Minimum Outlet Pipe Diameter (mm) | 300 |
| Design Flow (l/s) | 30.0 | Sump Available | Yes | Suggested Manhole Diameter (mm) | 1800 |
| Flush-Flo™ | Calculated | Diameter (mm) | 230 | | |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Design Point (Calculated) | 1.500 | 30.0 | Flush-Flo™ | 0.462 | 30.0 | Kick-Flo® | 1.016 | 24.9 | Mean Flow over Head Range | - | 25.7 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 7.7 | 0.500 | 29.9 | 1.200 | 27.0 | 2.000 | 34.4 | 3.000 | 41.9 | 5.000 | 53.6 | 7.000 | 63.1 | 9.000 | 71.3 |
| 0.200 | 23.1 | 0.600 | 29.6 | 1.400 | 29.0 | 2.200 | 36.0 | 3.500 | 45.1 | 5.500 | 56.1 | 7.500 | 65.2 | 9.500 | 73.2 |
| 0.300 | 29.0 | 0.800 | 28.5 | 1.600 | 30.9 | 2.400 | 37.6 | 4.000 | 48.1 | 6.000 | 58.5 | 8.000 | 67.3 | | |
| 0.400 | 29.9 | 1.000 | 25.4 | 1.800 | 32.7 | 2.600 | 39.1 | 4.500 | 50.9 | 6.500 | 60.8 | 8.500 | 69.3 | | |

## Storage Structures for Main line 007

### Tank or Pond Manhole: S0405-4-35 (Pond), DS/PN: 1.010

Invert Level (m) 153.100

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 900.0 | 1.800 | 1828.6 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Main line 007

### Simulation Criteria

Areal Reduction Factor 1.000 Hot Start Level (mm) 0 Foul Sewage per hectare (l/s) 0.000 MADD Factor * 10m³/ha Storage 2.000 Flow per Person per Day (l/per/day) 0.000
Hot Start (mins) 0 Manhole Headloss Coeff (Global) 0.500 Additional Flow - % of Total Flow 0.000 Inlet Coeffiecient 0.800

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Region England and Wales M5-60 (mm) 15.900 Ratio R 0.300 Cv (Summer) 0.750 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 Analysis Timestep Fine DTS Status ON DVD Status OFF Inertia Status OFF

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-4-1 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 162.730 | -0.170 | 0.000 | 0.12 | | | 4.7 | OK | |
| 1.001 | S0405-4-2 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 162.287 | -0.015 | 0.000 | 0.29 | | | 8.0 | OK | |
| 2.000 | S0405-4-3 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 162.967 | -0.114 | 0.000 | 0.46 | | | 18.2 | OK | |
| 1.002 | S0405-4-4 | 15 Winter | 5 | +20% | 5/15 Winter | | | | 162.285 | 0.007 | 0.000 | 0.98 | | | 38.5 | SURCHARGED | |
| 1.003 | S0405-4-5 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 161.587 | -0.093 | 0.000 | 0.77 | | | 55.6 | OK | |
| 1.004 | S0405-4-6 | 15 Winter | 5 | +20% | | | | | 161.067 | -0.164 | 0.000 | 0.42 | | | 54.9 | OK | |
| 1.005 | S0405-4-7 | 15 Winter | 5 | +20% | 100/15 Winter | | | | 159.604 | -0.147 | 0.000 | 0.50 | | | 73.7 | OK | |
| 1.006 | S0405-4-8 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 157.759 | -0.133 | 0.000 | 0.58 | | | 81.6 | OK | |
| 1.007 | S0405-4-9 | 15 Winter | 5 | +20% | | | | | 156.019 | -0.200 | 0.000 | 0.24 | | | 82.2 | OK | |
| 3.000 | S0405-4-10 | 15 Winter | 5 | +20% | | | | | 163.457 | -0.177 | 0.000 | 0.09 | | | 3.6 | OK | |
| 3.001 | S0405-4-11 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 162.867 | -0.169 | 0.000 | 0.13 | | | 5.2 | OK | |
| 3.002 | S0405-4-12 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 162.600 | -0.138 | 0.000 | 0.19 | | | 5.2 | OK | |
| 3.003 | S0405-4-13 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 162.597 | -0.125 | 0.000 | 0.37 | | | 14.6 | OK | |
| 3.004 | S0405-4-14 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 162.034 | -0.090 | 0.000 | 0.63 | | | 39.6 | OK | |
| 3.005 | S0405-4-15 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Summer | | | 160.674 | 0.049 | 0.000 | 1.01 | | | 73.6 | SURCHARGED | 6 |
| 3.006 | S0405-4-16 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 158.525 | -0.058 | 0.000 | 0.90 | | | 73.2 | OK | |
| 3.007 | S0405-4-17 | 15 Winter | 5 | +20% | | | | | 155.875 | -0.146 | 0.000 | 0.52 | | | 88.9 | OK | |
| 3.008 | S0405-4-18 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 154.297 | 0.022 | 0.000 | 1.10 | | | 88.6 | SURCHARGED | |
| 4.000 | S0405-4-19 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 163.241 | -0.180 | 0.000 | 0.08 | | | 3.0 | OK | |
| 4.001 | S0405-4-20 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 162.696 | -0.127 | 0.000 | 0.11 | | | 3.5 | OK | |
| 4.002 | S0405-4-21 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 162.693 | -0.077 | 0.000 | 0.14 | | | 4.1 | OK | |
| 5.000 | S0405-4-22 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 163.346 | -0.115 | 0.000 | 0.42 | | | 16.7 | OK | |
| 5.001 | S0405-4-23 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 162.733 | -0.130 | 0.000 | 0.37 | | | 18.3 | OK | |
| 4.003 | S0405-4-24 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 162.690 | -0.044 | 0.000 | 0.92 | | | 36.0 | OK | |
| 4.004 | S0405-4-25 | 15 Winter | 5 | +20% | 5/15 Winter | | | | 162.159 | 0.023 | 0.000 | 1.00 | | | 46.4 | SURCHARGED | |
| 4.005 | S0405-4-26 | 15 Winter | 5 | +20% | 100/30 Winter | | | | 161.230 | -0.082 | 0.000 | 0.72 | | | 47.0 | OK | |
| 4.006 | S0405-4-27 | 15 Winter | 5 | +20% | | | | | 159.594 | -0.093 | 0.000 | 0.64 | | | 47.5 | OK | |
| 4.007 | S0405-4-28 | 15 Winter | 5 | +20% | | | | | 157.499 | -0.098 | 0.000 | 0.61 | | | 47.4 | OK | |
| 4.008 | S0405-4-29 | 30 Winter | 5 | +20% | | | | | 156.194 | -0.100 | 0.000 | 0.60 | | | 48.0 | OK | |
| 3.009 | S0405-4-30 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 154.259 | 0.019 | 0.000 | 1.17 | | | 129.8 | SURCHARGED | |
| 6.000 | S0405-4-31 | 15 Winter | 5 | +20% | | | | | 157.438 | -0.148 | 0.000 | 0.26 | | | 20.7 | OK | |

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Main line 007

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m$^3$) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.010 | S0405-4-32 | 30 Winter | 5 | +20% | 5/15 Winter | | | | 154.217 | 0.012 | 0.000 | 1.34 | | | 141.2 | SURCHARGED | |
| 1.008 | S0405-4-33 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 154.176 | 0.000 | 0.000 | 1.07 | | | 222.8 | OK | |
| 1.009 | S0405-4-34 | 30 Winter | 5 | +20% | 100/180 Summer | | | | 153.751 | -0.347 | 0.000 | 0.37 | | | 222.3 | OK | |
| 1.010 | S0405-4-35 (Pond) | 960 Winter | 5 | +20% | 100/120 Summer | | | | 153.563 | -0.137 | 0.000 | 0.11 | | | 15.4 | OK | |
| 1.011 | S0405-4-36 (Flow Control) | 720 Winter | 5 | +20% | 100/120 Summer | 100/120 Summer | | | 153.579 | -0.341 | 0.000 | 0.07 | | | 14.7 | OK | 23 |
| 1.012 | S0405-4-37 | 720 Winter | 5 | +20% | 100/180 Summer | | | | 153.419 | -0.489 | 0.000 | 0.07 | | | 14.8 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Main line 007

### Simulation Criteria

Areal Reduction Factor 1.000 Hot Start Level (mm) 0 Foul Sewage per hectare (l/s) 0.000 MADD Factor * 10m³/ha Storage 2.000 Flow per Person per Day (l/per/day) 0.000
Hot Start (mins) 0 Manhole Headloss Coeff (Global) 0.500 Additional Flow - % of Total Flow 0.000 Inlet Coeffiecient 0.800

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Region England and Wales M5-60 (mm) 15.900 Ratio R 0.300 Cv (Summer) 0.750 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 Analysis Timestep Fine DTS Status ON DVD Status OFF Inertia Status OFF

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-4-1 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 163.453 | 0.553 | 0.000 | 0.23 | | | 8.8 | SURCHARGED | |
| 1.001 | S0405-4-2 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 163.428 | 1.126 | 0.000 | 0.80 | | | 22.2 | SURCHARGED | |
| 2.000 | S0405-4-3 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 163.664 | 0.583 | 0.000 | 0.80 | | | 31.4 | SURCHARGED | |
| 1.002 | S0405-4-4 | 15 Winter | 100 | +40% | 5/15 Winter | | | | 163.427 | 1.149 | 0.000 | 1.47 | | | 57.8 | SURCHARGED | |
| 1.003 | S0405-4-5 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 162.040 | 0.360 | 0.000 | 1.29 | | | 92.5 | SURCHARGED | |
| 1.004 | S0405-4-6 | 15 Winter | 100 | +40% | | | | | 161.118 | -0.114 | 0.000 | 0.69 | | | 91.2 | OK | |
| 1.005 | S0405-4-7 | 15 Winter | 100 | +40% | 100/15 Winter | | | | 159.821 | 0.069 | 0.000 | 0.92 | | | 135.6 | SURCHARGED | |
| 1.006 | S0405-4-8 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 158.280 | 0.387 | 0.000 | 1.10 | | | 154.2 | SURCHARGED | |
| 1.007 | S0405-4-9 | 15 Winter | 100 | +40% | | | | | 156.062 | -0.157 | 0.000 | 0.46 | | | 155.2 | OK | |
| 3.000 | S0405-4-10 | 15 Winter | 100 | +40% | | | | | 163.483 | -0.151 | 0.000 | 0.20 | | | 7.7 | OK | |
| 3.001 | S0405-4-11 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 163.427 | 0.391 | 0.000 | 0.53 | | | 20.2 | SURCHARGED | |
| 3.002 | S0405-4-12 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 163.448 | 0.710 | 0.000 | 0.88 | | | 24.4 | SURCHARGED | |
| 3.003 | S0405-4-13 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 163.491 | 0.768 | 0.000 | 0.73 | | | 28.7 | SURCHARGED | |
| 3.004 | S0405-4-14 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 163.486 | 1.361 | 0.000 | 0.98 | | | 61.4 | FLOOD RISK | |
| 3.005 | S0405-4-15 | 30 Winter | 100 | +40% | 5/15 Winter | 100/15 Summer | | | 161.840 | 1.215 | 14.868 | 1.23 | | | 89.5 | FLOOD | 6 |
| 3.006 | S0405-4-16 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 158.924 | 0.340 | 0.000 | 1.07 | | | 87.1 | SURCHARGED | |
| 3.007 | S0405-4-17 | 15 Winter | 100 | +40% | | | | | 155.928 | -0.093 | 0.000 | 0.79 | | | 136.3 | OK | |
| 3.008 | S0405-4-18 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 154.722 | 0.448 | 0.000 | 1.63 | | | 131.6 | SURCHARGED | |
| 4.000 | S0405-4-19 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 163.810 | 0.389 | 0.000 | 0.14 | | | 5.6 | SURCHARGED | |
| 4.001 | S0405-4-20 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 163.794 | 0.971 | 0.000 | 0.41 | | | 13.5 | SURCHARGED | |
| 4.002 | S0405-4-21 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 163.790 | 1.020 | 0.000 | 0.54 | | | 16.0 | SURCHARGED | |
| 5.000 | S0405-4-22 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 163.985 | 0.524 | 0.000 | 0.72 | | | 28.2 | SURCHARGED | |
| 5.001 | S0405-4-23 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 163.819 | 0.956 | 0.000 | 0.50 | | | 24.5 | SURCHARGED | |
| 4.003 | S0405-4-24 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 163.787 | 1.054 | 0.000 | 1.19 | | | 46.7 | SURCHARGED | |
| 4.004 | S0405-4-25 | 15 Winter | 100 | +40% | 5/15 Winter | | | | 163.040 | 0.905 | 0.000 | 1.38 | | | 63.6 | SURCHARGED | |
| 4.005 | S0405-4-26 | 30 Winter | 100 | +40% | 100/30 Winter | | | | 161.324 | 0.013 | 0.000 | 1.01 | | | 65.3 | SURCHARGED | |
| 4.006 | S0405-4-27 | 30 Winter | 100 | +40% | | | | | 159.631 | -0.056 | 0.000 | 0.91 | | | 67.2 | OK | |
| 4.007 | S0405-4-28 | 30 Winter | 100 | +40% | | | | | 157.533 | -0.064 | 0.000 | 0.86 | | | 67.1 | OK | |
| 4.008 | S0405-4-29 | 30 Winter | 100 | +40% | | | | | 156.230 | -0.063 | 0.000 | 0.86 | | | 69.4 | OK | |
| 3.009 | S0405-4-30 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 154.607 | 0.367 | 0.000 | 1.70 | | | 187.8 | SURCHARGED | |
| 6.000 | S0405-4-31 | 15 Winter | 100 | +40% | | | | | 157.481 | -0.105 | 0.000 | 0.56 | | | 44.7 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Main line 007

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.010 | S0405-4-32 | 15 Winter | 100 | +40% | 5/15 Winter | | | | 154.496 | 0.290 | 0.000 | 2.18 | | | 229.6 | SURCHARGED | |
| 1.008 | S0405-4-33 | 720 Winter | 100 | +40% | 100/15 Summer | | | | 154.424 | 0.248 | 0.000 | 0.41 | | | 84.4 | SURCHARGED | |
| 1.009 | S0405-4-34 | 720 Winter | 100 | +40% | 100/180 Summer | | | | 154.421 | 0.323 | 0.000 | 0.14 | | | 83.7 | SURCHARGED | |
| 1.010 | S0405-4-35 (Pond) | 720 Winter | 100 | +40% | 100/120 Summer | | | | 154.418 | 0.718 | 0.000 | 0.31 | | | 42.2 | SURCHARGED | |
| 1.011 | S0405-4-36 (Flow Control) | 2160 Summer | 100 | +40% | 100/120 Summer | 100/120 Summer | | | 154.868 | 0.948 | 31.750 | 0.10 | | | 21.9 | FLOOD | 23 |
| 1.012 | S0405-4-37 | 180 Summer | 100 | +40% | 100/180 Summer | | | | 154.169 | 0.261 | 0.000 | 0.59 | | | 132.8 | SURCHARGED | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Existing

```
                         Pipe Sizes STANDARD Manhole Sizes STANDARD

                         FSR Rainfall Model - England and Wales
  Return Period (years)      1 Maximum Time of Concentration (mins)    30          Add Flow / Climate Change (%)      0 Min Vel for Auto Design only (m/s) 1.00
           M5-60 (mm) 15.900                   Foul Sewage (l/s/ha) 0.000           Minimum Backdrop Height (m) 0.200   Min Slope for Optimisation (1:X)   500
              Ratio R  0.300             Volumetric Runoff Coeff. 0.750           Maximum Backdrop Height (m) 1.500
Maximum Rainfall (mm/hr)     50                               PIMP (%)   100 Min Design Depth for Optimisation (m) 1.200

                         Designed with Level Soffits
```

### Simulation Criteria for Existing

```
 Volumetric Runoff Coeff 0.750            Hot Start Level (mm)     0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000
  Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500     MADD Factor * 10m³/ha Storage 2.000                      Run Time (mins)     60
       Hot Start (mins)      0    Foul Sewage per hectare (l/s) 0.000                  Inlet Coeffiecient 0.800             Output Interval (mins)      1

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
      Rainfall Model FSR     Region England and Wales      Ratio R  0.300 Cv (Summer) 0.750 Storm Duration (mins) 30
Return Period (years)    1 M5-60 (mm)            15.900 Profile Type Summer Cv (Winter) 0.840
```

## Online Controls for Existing

### Hydro-Brake® Optimum Manhole: S0405-05-53 (Flow Control), DS/PN: 1.010, Volume (m³): 5.3

| | | | | | |
|---|---|---|---|---|---|
| Unit Reference | MD-SHE-0190-2000-1628-2000 | Objective | Minimise upstream storage | Invert Level (m) | 148.721 |
| Design Head (m) | 1.628 | Application | Surface | Minimum Outlet Pipe Diameter (mm) | 225 |
| Design Flow (l/s) | 20.0 | Sump Available | Yes | Suggested Manhole Diameter (mm) | 1500 |
| Flush-Flo™ | Calculated | Diameter (mm) | 190 | | |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Design Point (Calculated) | 1.628 | 20.0 | Flush-Flo™ | 0.483 | 20.0 | Kick-Flo® | 1.046 | 16.2 | Mean Flow over Head Range | - | 17.3 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 6.6 | 0.500 | 20.0 | 1.200 | 17.3 | 2.000 | 22.0 | 3.000 | 26.8 | 5.000 | 34.2 | 7.000 | 40.3 | 9.000 | 45.5 |
| 0.200 | 17.4 | 0.600 | 19.8 | 1.400 | 18.6 | 2.200 | 23.1 | 3.500 | 28.8 | 5.500 | 35.8 | 7.500 | 41.6 | 9.500 | 46.7 |
| 0.300 | 19.2 | 0.800 | 19.1 | 1.600 | 19.8 | 2.400 | 24.1 | 4.000 | 30.7 | 6.000 | 37.4 | 8.000 | 42.9 | | |
| 0.400 | 19.9 | 1.000 | 17.1 | 1.800 | 21.0 | 2.600 | 25.0 | 4.500 | 32.5 | 6.500 | 38.8 | 8.500 | 44.2 | | |

## Storage Structures for Existing

### Tank or Pond Manhole: S0405-05-52 (Pond), DS/PN: 1.009

Invert Level (m) 149.050

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 1365.0 | 1.800 | 2470.8 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

### Simulation Criteria

Areal Reduction Factor 1.000 Hot Start Level (mm) 0 Foul Sewage per hectare (l/s) 0.000 MADD Factor * 10m³/ha Storage 2.000 Flow per Person per Day (l/per/day) 0.000
Hot Start (mins) 0 Manhole Headloss Coeff (Global) 0.500 Additional Flow - % of Total Flow 0.000 Inlet Coeffiecient 0.800

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Region England and Wales M5-60 (mm) 15.700 Ratio R 0.300 Cv (Summer) 0.750 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 Analysis Timestep Fine DTS Status ON DVD Status OFF Inertia Status OFF

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-05-1 | 15 Winter | 5 | +20% | | | | | 159.711 | -0.200 | 0.000 | 0.03 | | | 1.8 | OK | |
| 1.001 | S0405-05-2 | 15 Winter | 5 | +20% | | | | | 158.944 | -0.195 | 0.000 | 0.04 | | | 2.2 | OK | |
| 1.002 | S0405-05-3 | 15 Winter | 5 | +20% | | | | | 158.801 | -0.184 | 0.000 | 0.07 | | | 5.3 | OK | |
| 1.003 | S0405-05-4 | 15 Winter | 5 | +20% | | | | | 156.762 | -0.187 | 0.000 | 0.06 | | | 5.2 | OK | |
| 1.004 | S0405-05-5 | 15 Winter | 5 | +20% | | | | | 154.307 | -0.187 | 0.000 | 0.07 | | | 5.2 | OK | |
| 1.005 | S0405-05-6 | 15 Winter | 5 | +20% | | | | | 153.250 | -0.187 | 0.000 | 0.07 | | | 5.2 | OK | |
| 2.000 | S0405-05-7 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 162.716 | -0.184 | 0.000 | 0.07 | | | 2.8 | OK | |
| 2.001 | S0405-05-8 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 162.467 | -0.085 | 0.000 | 0.13 | | | 3.6 | OK | 6 |
| 3.000 | S0405-05-9 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 162.921 | -0.154 | 0.000 | 0.21 | | | 10.3 | OK | |
| 2.002 | S0405-05-10 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 162.465 | -0.064 | 0.000 | 0.78 | | | 30.7 | OK | |
| 2.003 | S0405-05-11 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 162.117 | 0.186 | 0.000 | 1.12 | | | 44.0 | SURCHARGED | 6 |
| 2.004 | S0405-05-12 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 161.319 | -0.014 | 0.000 | 1.00 | | | 56.6 | OK | 6 |
| 2.005 | S0405-05-13 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 160.236 | -0.064 | 0.000 | 0.86 | | | 58.4 | OK | |
| 2.006 | S0405-05-14 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 160.037 | -0.007 | 0.000 | 1.00 | | | 68.1 | OK | |
| 2.007 | S0405-05-15 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 159.121 | -0.079 | 0.000 | 0.89 | | | 70.7 | OK | |
| 2.008 | S0405-05-16 | 15 Winter | 5 | +20% | | | | | 158.962 | -0.138 | 0.000 | 0.56 | | | 88.1 | OK | |
| 2.009 | S0405-05-17 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 156.820 | -0.130 | 0.000 | 0.60 | | | 99.6 | OK | |
| 2.010 | S0405-05-18 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 154.458 | -0.124 | 0.000 | 0.64 | | | 104.4 | OK | |
| 2.011 | S0405-05-19 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 153.456 | -0.117 | 0.000 | 0.68 | | | 109.9 | OK | |
| 4.000 | S0405-05-20 | 15 Winter | 5 | +20% | | | | | 157.404 | -0.192 | 0.000 | 0.05 | | | 3.9 | OK | |
| 4.001 | S0405-05-21 | 15 Winter | 5 | +20% | | | | | 155.183 | -0.188 | 0.000 | 0.06 | | | 5.6 | OK | |
| 4.002 | S0405-05-22 | 15 Winter | 5 | +20% | | | | | 153.572 | -0.179 | 0.000 | 0.09 | | | 7.1 | OK | |
| 4.003 | S0405-05-23 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 152.838 | 0.240 | 0.000 | 0.20 | | | 5.4 | SURCHARGED | |
| 5.000 | S0405-05-24 | 15 Winter | 5 | +20% | | | | | 163.448 | -0.175 | 0.000 | 0.10 | | | 3.9 | OK | |
| 5.001 | S0405-05-25 | 15 Winter | 5 | +20% | 100/15 Winter | | | | 162.894 | -0.165 | 0.000 | 0.14 | | | 4.2 | OK | |
| 5.002 | S0405-05-26 | 15 Winter | 5 | +20% | 100/15 Winter | | | | 162.878 | -0.141 | 0.000 | 0.27 | | | 10.7 | OK | |
| 5.003 | S0405-05-27 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 162.306 | -0.115 | 0.000 | 0.45 | | | 24.0 | OK | |
| 5.004 | S0405-05-28 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | | | 161.257 | -0.085 | 0.000 | 0.67 | | | 44.7 | OK | 3 |
| 5.005 | S0405-05-29 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 159.577 | -0.067 | 0.000 | 0.81 | | | 60.4 | OK | 6 |
| 5.006 | S0405-05-30 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 157.480 | -0.051 | 0.000 | 0.92 | | | 71.9 | OK | 7 |
| 5.007 | S0405-05-31 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | | | 155.163 | -0.044 | 0.000 | 0.94 | | | 77.2 | OK | 5 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5.008 | S0405-05-32 | 15 Winter | 5 | +20% | 5/15 Winter | | | | 154.057 | 0.144 | 0.000 | 0.96 | | | 80.3 | SURCHARGED | |
| 4.004 | S0405-05-33 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 152.837 | 0.254 | 0.000 | 0.81 | | | 83.4 | SURCHARGED | |
| 6.000 | S0405-05-34 | 15 Winter | 5 | +20% | | | | | 163.241 | -0.180 | 0.000 | 0.08 | | | 3.0 | OK | |
| 6.001 | S0405-05-35 | 15 Winter | 5 | +20% | | | | | 162.653 | -0.170 | 0.000 | 0.13 | | | 4.9 | OK | |
| 6.002 | S0405-05-36 | 15 Winter | 5 | +20% | | | | | 162.054 | -0.171 | 0.000 | 0.13 | | | 5.7 | OK | |
| 7.000 | S0405-05-37 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 163.344 | -0.118 | 0.000 | 0.41 | | | 15.9 | OK | |
| 7.001 | S0405-05-38 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 162.792 | -0.071 | 0.000 | 0.74 | | | 29.0 | OK | |
| 7.002 | S0405-05-39 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 162.195 | -0.065 | 0.000 | 0.82 | | | 36.0 | OK | |
| 7.003 | S0405-05-40 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 161.676 | -0.051 | 0.000 | 0.96 | | | 36.1 | OK | |
| 6.003 | S0405-05-41 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 161.577 | -0.078 | 0.000 | 0.75 | | | 41.7 | OK | |
| 6.004 | S0405-05-42 | 15 Winter | 5 | +20% | | | | | 161.178 | -0.092 | 0.000 | 0.64 | | | 41.4 | OK | |
| 6.005 | S0405-05-43 | 15 Winter | 5 | +20% | | | | | 159.536 | -0.103 | 0.000 | 0.56 | | | 41.4 | OK | |
| 6.006 | S0405-05-44 | 15 Winter | 5 | +20% | | | | | 157.440 | -0.108 | 0.000 | 0.53 | | | 41.3 | OK | |
| 6.007 | S0405-05-45 | 15 Winter | 5 | +20% | | | | | 155.075 | -0.111 | 0.000 | 0.51 | | | 41.2 | OK | |
| 6.008 | S0405-05-46 | 15 Winter | 5 | +20% | 100/15 Winter | | | | 153.810 | -0.106 | 0.000 | 0.55 | | | 41.3 | OK | |
| 4.005 | S0405-05-47 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 152.793 | 0.271 | 0.000 | 1.25 | | | 119.9 | SURCHARGED | |
| 2.012 | S0405-05-48 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 152.699 | 0.222 | 0.000 | 1.94 | | | 224.1 | SURCHARGED | |
| 1.006 | S0405-05-49 | 30 Winter | 5 | +20% | | | | | 152.016 | -0.374 | 0.000 | 0.18 | | | 228.1 | OK | |
| 1.007 | S0405-05-50 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 149.799 | 0.050 | 0.000 | 1.21 | | | 227.2 | SURCHARGED | |
| 1.008 | S0405-05-51 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 149.681 | 0.013 | 0.000 | 1.18 | | | 225.2 | SURCHARGED | |
| 1.009 | S0405-05-52 (Pond) | 480 Winter | 5 | +20% | 100/60 Summer | | | | 149.310 | -0.115 | 0.000 | 0.13 | | | 23.6 | OK | |
| 1.010 | S0405-05-53 (Flow Control) | 480 Winter | 5 | +20% | 5/15 Summer | 5/360 Winter | | | 150.349 | 1.253 | 0.444 | 0.12 | | | 20.0 | FLOOD | 24 |
| 1.011 | S0405-05-54 | 480 Winter | 5 | +20% | | | | | 148.594 | -0.297 | 0.000 | 0.10 | | | 20.0 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

### Simulation Criteria

Areal Reduction Factor 1.000 Hot Start Level (mm) 0 Foul Sewage per hectare (l/s) 0.000 MADD Factor * 10m³/ha Storage 2.000 Flow per Person per Day (l/per/day) 0.000
Hot Start (mins) 0 Manhole Headloss Coeff (Global) 0.500 Additional Flow - % of Total Flow 0.000 Inlet Coeffiecient 0.800

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Region England and Wales M5-60 (mm) 15.700 Ratio R 0.300 Cv (Summer) 0.750 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 Analysis Timestep Fine DTS Status ON DVD Status OFF Inertia Status OFF

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-05-1 | 15 Winter | 100 | +40% | | | | | 159.721 | -0.190 | 0.000 | 0.06 | | | 3.8 | OK | |
| 1.001 | S0405-05-2 | 15 Winter | 100 | +40% | | | | | 158.961 | -0.178 | 0.000 | 0.09 | | | 4.9 | OK | |
| 1.002 | S0405-05-3 | 15 Winter | 100 | +40% | | | | | 158.827 | -0.159 | 0.000 | 0.18 | | | 13.1 | OK | |
| 1.003 | S0405-05-4 | 15 Winter | 100 | +40% | | | | | 156.786 | -0.164 | 0.000 | 0.16 | | | 12.6 | OK | |
| 1.004 | S0405-05-5 | 15 Winter | 100 | +40% | | | | | 154.330 | -0.164 | 0.000 | 0.16 | | | 12.7 | OK | |
| 1.005 | S0405-05-6 | 15 Winter | 100 | +40% | | | | | 153.273 | -0.164 | 0.000 | 0.17 | | | 12.6 | OK | |
| 2.000 | S0405-05-7 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 164.051 | 1.152 | 0.000 | 0.16 | | | 6.0 | FLOOD RISK | |
| 2.001 | S0405-05-8 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 164.034 | 1.482 | 4.345 | 0.61 | | | 16.8 | FLOOD | 6 |
| 3.000 | S0405-05-9 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 164.197 | 1.122 | 0.000 | 0.37 | | | 18.1 | FLOOD RISK | |
| 2.002 | S0405-05-10 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 164.102 | 1.573 | 0.000 | 0.89 | | | 34.8 | FLOOD RISK | |
| 2.003 | S0405-05-11 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 163.702 | 1.771 | 3.969 | 1.40 | | | 54.8 | FLOOD | 6 |
| 2.004 | S0405-05-12 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 162.713 | 1.380 | 3.450 | 1.33 | | | 75.3 | FLOOD | 6 |
| 2.005 | S0405-05-13 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 161.145 | 0.845 | 0.000 | 1.15 | | | 78.2 | SURCHARGED | |
| 2.006 | S0405-05-14 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 160.843 | 0.799 | 0.000 | 1.37 | | | 93.6 | SURCHARGED | |
| 2.007 | S0405-05-15 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 159.240 | 0.040 | 0.000 | 1.24 | | | 98.3 | SURCHARGED | |
| 2.008 | S0405-05-16 | 15 Winter | 100 | +40% | | | | | 159.081 | -0.019 | 0.000 | 0.92 | | | 145.2 | OK | |
| 2.009 | S0405-05-17 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 157.481 | 0.531 | 0.000 | 0.98 | | | 161.9 | SURCHARGED | |
| 2.010 | S0405-05-18 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 155.332 | 0.750 | 0.000 | 1.00 | | | 161.4 | SURCHARGED | |
| 2.011 | S0405-05-19 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 154.332 | 0.759 | 0.000 | 1.06 | | | 169.9 | SURCHARGED | |
| 4.000 | S0405-05-20 | 15 Winter | 100 | +40% | | | | | 157.421 | -0.175 | 0.000 | 0.11 | | | 8.4 | OK | |
| 4.001 | S0405-05-21 | 15 Winter | 100 | +40% | | | | | 155.204 | -0.168 | 0.000 | 0.14 | | | 12.7 | OK | |
| 4.002 | S0405-05-22 | 15 Winter | 100 | +40% | | | | | 153.598 | -0.153 | 0.000 | 0.22 | | | 16.8 | OK | |
| 4.003 | S0405-05-23 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 153.350 | 0.752 | 0.000 | 0.40 | | | 11.1 | SURCHARGED | |
| 5.000 | S0405-05-24 | 15 Winter | 100 | +40% | | | | | 163.473 | -0.151 | 0.000 | 0.21 | | | 8.4 | OK | |
| 5.001 | S0405-05-25 | 15 Winter | 100 | +40% | 100/15 Winter | | | | 163.126 | 0.068 | 0.000 | 0.44 | | | 13.0 | SURCHARGED | |
| 5.002 | S0405-05-26 | 15 Winter | 100 | +40% | 100/15 Winter | | | | 163.122 | 0.103 | 0.000 | 0.61 | | | 23.9 | SURCHARGED | |
| 5.003 | S0405-05-27 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 163.115 | 0.694 | 0.000 | 0.76 | | | 40.1 | SURCHARGED | |
| 5.004 | S0405-05-28 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | | | 162.543 | 1.201 | 1.015 | 1.00 | | | 66.2 | FLOOD | 3 |
| 5.005 | S0405-05-29 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 160.851 | 1.206 | 6.294 | 1.00 | | | 74.2 | FLOOD | 6 |
| 5.006 | S0405-05-30 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 158.739 | 1.208 | 8.112 | 1.10 | | | 85.6 | FLOOD | 7 |
| 5.007 | S0405-05-31 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | | | 156.408 | 1.201 | 1.388 | 1.08 | | | 88.1 | FLOOD | 5 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5.008 | S0405-05-32 | 30 Winter | 100 | +40% | 5/15 Winter | | | | 155.099 | 1.186 | 0.000 | 1.16 | | | 96.8 | FLOOD RISK | |
| 4.004 | S0405-05-33 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 153.346 | 0.763 | 0.000 | 1.04 | | | 106.4 | SURCHARGED | |
| 6.000 | S0405-05-34 | 15 Winter | 100 | +40% | | | | | 163.262 | -0.159 | 0.000 | 0.17 | | | 6.5 | OK | |
| 6.001 | S0405-05-35 | 15 Winter | 100 | +40% | | | | | 162.686 | -0.137 | 0.000 | 0.29 | | | 11.2 | OK | |
| 6.002 | S0405-05-36 | 15 Winter | 100 | +40% | | | | | 162.085 | -0.140 | 0.000 | 0.29 | | | 13.0 | OK | |
| 7.000 | S0405-05-37 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 163.964 | 0.503 | 0.000 | 0.74 | | | 29.2 | SURCHARGED | |
| 7.001 | S0405-05-38 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 163.693 | 0.829 | 0.000 | 1.22 | | | 48.2 | SURCHARGED | |
| 7.002 | S0405-05-39 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 162.721 | 0.461 | 0.000 | 1.25 | | | 54.5 | SURCHARGED | |
| 7.003 | S0405-05-40 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 161.903 | 0.176 | 0.000 | 1.43 | | | 54.1 | SURCHARGED | |
| 6.003 | S0405-05-41 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 161.756 | 0.101 | 0.000 | 1.13 | | | 63.1 | SURCHARGED | |
| 6.004 | S0405-05-42 | 30 Winter | 100 | +40% | | | | | 161.223 | -0.047 | 0.000 | 0.98 | | | 63.7 | OK | |
| 6.005 | S0405-05-43 | 30 Winter | 100 | +40% | | | | | 159.577 | -0.062 | 0.000 | 0.87 | | | 64.3 | OK | |
| 6.006 | S0405-05-44 | 30 Winter | 100 | +40% | | | | | 157.480 | -0.068 | 0.000 | 0.83 | | | 64.8 | OK | |
| 6.007 | S0405-05-45 | 30 Winter | 100 | +40% | | | | | 155.114 | -0.072 | 0.000 | 0.80 | | | 65.0 | OK | |
| 6.008 | S0405-05-46 | 30 Winter | 100 | +40% | 100/15 Winter | | | | 154.055 | 0.139 | 0.000 | 0.88 | | | 66.4 | SURCHARGED | |
| 4.005 | S0405-05-47 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 153.282 | 0.761 | 0.000 | 1.76 | | | 168.8 | SURCHARGED | |
| 2.012 | S0405-05-48 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 153.104 | 0.627 | 0.000 | 2.90 | | | 335.1 | SURCHARGED | |
| 1.006 | S0405-05-49 | 30 Winter | 100 | +40% | | | | | 152.052 | -0.338 | 0.000 | 0.28 | | | 343.8 | OK | |
| 1.007 | S0405-05-50 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 150.121 | 0.372 | 0.000 | 1.83 | | | 342.9 | FLOOD RISK | |
| 1.008 | S0405-05-51 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 149.849 | 0.181 | 0.000 | 1.79 | | | 342.0 | SURCHARGED | |
| 1.009 | S0405-05-52 (Pond) | 1440 Winter | 100 | +40% | 100/60 Summer | | | | 149.809 | 0.384 | 0.000 | 0.13 | | | 22.4 | FLOOD RISK | |
| 1.010 | S0405-05-53 (Flow Control) | 2160 Winter | 100 | +40% | 5/15 Summer | 5/360 Winter | | | 150.353 | 1.257 | 8.333 | 0.12 | | | 19.9 | FLOOD | 24 |
| 1.011 | S0405-05-54 | 180 Winter | 100 | +40% | | | | | 148.866 | -0.025 | 0.000 | 0.34 | | | 69.2 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for 06 - Long Marton East

```
                         Pipe Sizes STANDARD Manhole Sizes STANDARD

                            FSR Rainfall Model - England and Wales
               Return Period (years)      30          Foul Sewage (l/s/ha) 0.000            Maximum Backdrop Height (m) 1.500
                          M5-60 (mm) 15.000      Volumetric Runoff Coeff. 0.750 Min Design Depth for Optimisation (m) 1.200
                             Ratio R  0.300                      PIMP (%)   100     Min Vel for Auto Design only (m/s)  1.00
             Maximum Rainfall (mm/hr)     50 Add Flow / Climate Change (%)     0       Min Slope for Optimisation (1:X)   500
Maximum Time of Concentration (mins)      30   Minimum Backdrop Height (m) 0.200

                                 Designed with Level Inverts
```

## Simulation Criteria for 06 - Long Marton East

```
Volumetric Runoff Coeff 0.750  Manhole Headloss Coeff (Global) 0.500                  Inlet Coeffiecient 0.800
 Areal Reduction Factor 1.000     Foul Sewage per hectare (l/s) 0.000 Flow per Person per Day (l/per/day) 0.000
       Hot Start (mins)     0 Additional Flow - % of Total Flow 0.000                      Run Time (mins)     60
   Hot Start Level (mm)     0     MADD Factor * 10m³/ha Storage 2.000                Output Interval (mins)      1

       Number of Input Hydrographs 0   Number of Offline Controls 0 Number of Time/Area Diagrams 0
         Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0
```

## Synthetic Rainfall Details

```
            Rainfall Model FSR     Region England and Wales      Ratio R  0.300
     Return Period (years)   30 M5-60 (mm)            15.000 Profile Type Summer
```

## Synthetic Rainfall Details

Cv (Summer) 0.750 Cv (Winter) 0.840 Storm Duration (mins) 30

## Online Controls for 06 - Long Marton East

### Hydro-Brake® Optimum Manhole: S0405-06-18 (Flow Control), DS/PN: 1.010, Volume (m³): 5.2

| | | | |
|---|---|---|---|
| Unit Reference | MD-SHE-0117-8000-2000-8000 | Sump Available | Yes |
| Design Head (m) | 2.000 | Diameter (mm) | 117 |
| Design Flow (l/s) | 8.0 | Invert Level (m) | 118.928 |
| Flush-Flo™ | Calculated | Minimum Outlet Pipe Diameter (mm) | 150 |
| Objective | Minimise upstream storage | Suggested Manhole Diameter (mm) | 1200 |
| Application | Surface | | |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| Design Point (Calculated) | 2.000 | 8.0 | Kick-Flo® | 1.045 | 5.9 |
| Flush-Flo™ | 0.511 | 7.4 | Mean Flow over Head Range | - | 6.7 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 4.1 | 0.600 | 7.4 | 1.600 | 7.2 | 2.600 | 9.0 | 5.000 | 12.3 | 7.500 | 15.0 |
| 0.200 | 6.5 | 0.800 | 7.1 | 1.800 | 7.6 | 3.000 | 9.7 | 5.500 | 12.9 | 8.000 | 15.4 |
| 0.300 | 7.1 | 1.000 | 6.2 | 2.000 | 8.0 | 3.500 | 10.4 | 6.000 | 13.5 | 8.500 | 15.9 |
| 0.400 | 7.4 | 1.200 | 6.3 | 2.200 | 8.4 | 4.000 | 11.1 | 6.500 | 14.0 | 9.000 | 16.3 |
| 0.500 | 7.4 | 1.400 | 6.8 | 2.400 | 8.7 | 4.500 | 11.7 | 7.000 | 14.5 | 9.500 | 16.8 |

## Storage Structures for 06 - Long Marton East

### Tank or Pond Manhole: S0405-06-17 (Pond), DS/PN: 1.009

Invert Level (m) 119.152

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 125.0 | 1.800 | 573.2 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 06 - Long Marton East

### Simulation Criteria

Areal Reduction Factor 1.000
Hot Start (mins) 0
Hot Start Level (mm) 0
Manhole Headloss Coeff (Global) 0.500
Foul Sewage per hectare (l/s) 0.000
Additional Flow - % of Total Flow 0.000
MADD Factor * 10$m^3$/ha Storage 2.000
Inlet Coeffiecient 0.800
Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0
Number of Online Controls 1
Number of Offline Controls 0
Number of Storage Structures 1
Number of Time/Area Diagrams 0
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
Region England and Wales
M5-60 (mm) 16.000
Ratio R 0.300
Cv (Summer) 0.750
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep Fine
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume ($m^3$) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-06-1 | 15 Summer | 5 | +20% | 100/15 Summer | | | | 129.631 | -0.225 | 0.000 | 0.00 | | |
| 1.001 | S0405-06-2 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 129.246 | -0.093 | 0.000 | 0.60 | | |
| 1.002 | S0405-06-3 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 128.183 | -0.098 | 0.000 | 0.59 | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 06 - Long Marton East

| **PN** | **US/MH Name** | **Pipe Flow (l/s)** | **Status** | **Level Exceeded** |
|---|---|---|---|---|
| 1.000 | S0405-06-1 | 0.0 | OK | |
| 1.001 | S0405-06-2 | 31.8 | OK | |
| 1.002 | S0405-06-3 | 55.7 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 06 - Long Marton East

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.003 | S0405-06-4 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 124.904 | -0.097 | 0.000 |
| 1.004 | S0405-06-5 | 15 Winter | 5 | +20% | 5/15 Winter | | | | 123.982 | 0.000 | 0.000 |
| 2.000 | S0405-06-6 | 15 Summer | 5 | +20% | | | | | 130.296 | -0.225 | 0.000 |
| 2.001 | S0405-06-7 | 15 Winter | 5 | +20% | | | | | 129.812 | -0.147 | 0.000 |
| 2.002 | S0405-06-8 | 15 Winter | 5 | +20% | | | | | 128.779 | -0.170 | 0.000 |
| 2.003 | S0405-06-9 | 15 Winter | 5 | +20% | | | | | 125.536 | -0.171 | 0.000 |
| 1.005 | S0405-06-10 | 15 Winter | 5 | +20% | | | | | 123.746 | -0.185 | 0.000 |
| 1.006 | S0405-06-11 | 15 Winter | 5 | +20% | | | | | 121.827 | -0.157 | 0.000 |
| 1.007 | S0405-06-12 | 15 Winter | 5 | +20% | | | | | 121.367 | -0.169 | 0.000 |
| 3.000 | S0405-06-13 | 15 Winter | 5 | +20% | | | | | 122.142 | -0.188 | 0.000 |
| 3.001 | S0405-06-14 | 15 Winter | 5 | +20% | | | | | 121.609 | -0.177 | 0.000 |
| 3.002 | S0405-06-15 | 1440 Summer | 5 | +20% | 5/120 Winter | | | | 120.395 | 0.752 | 0.000 |
| 1.008 | S0405-06-16 | 1440 Summer | 5 | +20% | 5/15 Winter | | | | 120.400 | 0.825 | 0.000 |
| 1.009 | S0405-06-17 (Pond) | 1440 Summer | 5 | +20% | 5/60 Winter | | | | 120.403 | 0.876 | 0.000 |
| 1.010 | S0405-06-18 (Flow Control) | 480 Winter | 5 | +20% | 5/15 Summer | 5/120 Winter | | | 120.904 | 1.601 | 7.064 |
| 1.011 | S0405-06-19 | 1440 Summer | 5 | +20% | | | | | 118.948 | -0.334 | 0.000 |

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 1.003 | S0405-06-4 | 0.61 | | | 61.2 | OK | |
| 1.004 | S0405-06-5 | 1.06 | | | 61.0 | SURCHARGED | |
| 2.000 | S0405-06-6 | 0.00 | | | 0.0 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 06 - Long Marton East

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 2.001 | S0405-06-7 | 0.24 | | | 12.3 | OK | |
| 2.002 | S0405-06-8 | 0.13 | | | 12.1 | OK | |
| 2.003 | S0405-06-9 | 0.13 | | | 13.4 | OK | |
| 1.005 | S0405-06-10 | 0.31 | | | 76.7 | OK | |
| 1.006 | S0405-06-11 | 0.46 | | | 76.7 | OK | |
| 1.007 | S0405-06-12 | 0.39 | | | 82.7 | OK | |
| 3.000 | S0405-06-13 | 0.06 | | | 5.5 | OK | |
| 3.001 | S0405-06-14 | 0.10 | | | 10.7 | OK | |
| 3.002 | S0405-06-15 | 0.02 | | | 1.1 | SURCHARGED | |
| 1.008 | S0405-06-16 | 0.14 | | | 10.6 | SURCHARGED | |
| 1.009 | S0405-06-17 (Pond) | 0.04 | | | 7.4 | SURCHARGED | |
| 1.010 | S0405-06-18 (Flow Control) | 0.14 | | | 7.3 | FLOOD | 16 |
| 1.011 | S0405-06-19 | 0.02 | | | 7.3 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 06 - Long Marton East

### Simulation Criteria

| | | | | | |
|---|---|---|---|---|---|
| Areal Reduction Factor | 1.000 | Manhole Headloss Coeff (Global) | 0.500 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start (mins) | 0 | Foul Sewage per hectare (l/s) | 0.000 | Inlet Coeffiecient | 0.800 |
| Hot Start Level (mm) | 0 | Additional Flow - % of Total Flow | 0.000 | Flow per Person per Day (l/per/day) | 0.000 |

| | | | | | |
|---|---|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Offline Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Online Controls | 1 | Number of Storage Structures | 1 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | | | |
|---|---|---|---|---|---|
| Rainfall Model | FSR | M5-60 (mm) | 16.000 | Cv (Summer) | 0.750 |
| Region | England and Wales | Ratio R | 0.300 | Cv (Winter) | 0.840 |

| | | | | | |
|---|---|---|---|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 | DTS Status | ON | Inertia Status | OFF |
| Analysis Timestep | Fine | DVD Status | OFF | | |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 240, 360, 480, 960, 1440 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-06-1 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 130.424 | 0.568 | 0.000 | 0.09 | | |
| 1.001 | S0405-06-2 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 130.441 | 1.102 | 0.000 | 1.16 | | |
| 1.002 | S0405-06-3 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 129.013 | 0.732 | 0.000 | 1.05 | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 06 - Long Marton East

| **PN** | **US/MH Name** | **Pipe Flow (l/s)** | **Status** | **Level Exceeded** |
|---|---|---|---|---|
| 1.000 | S0405-06-1 | 5.6 | SURCHARGED | |
| 1.001 | S0405-06-2 | 60.9 | SURCHARGED | |
| 1.002 | S0405-06-3 | 98.4 | SURCHARGED | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 06 - Long Marton East

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume ($m^3$) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.003 | S0405-06-4 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 125.387 | 0.386 | 0.000 |
| 1.004 | S0405-06-5 | 15 Winter | 100 | +40% | 5/15 Winter | | | | 124.103 | 0.121 | 0.000 |
| 2.000 | S0405-06-6 | 15 Summer | 100 | +40% | | | | | 130.296 | -0.225 | 0.000 |
| 2.001 | S0405-06-7 | 15 Winter | 100 | +40% | | | | | 129.874 | -0.086 | 0.000 |
| 2.002 | S0405-06-8 | 15 Winter | 100 | +40% | | | | | 128.817 | -0.132 | 0.000 |
| 2.003 | S0405-06-9 | 15 Winter | 100 | +40% | | | | | 125.574 | -0.134 | 0.000 |
| 1.005 | S0405-06-10 | 15 Winter | 100 | +40% | | | | | 123.802 | -0.129 | 0.000 |
| 1.006 | S0405-06-11 | 15 Winter | 100 | +40% | | | | | 121.906 | -0.078 | 0.000 |
| 1.007 | S0405-06-12 | 15 Winter | 100 | +40% | | | | | 121.437 | -0.099 | 0.000 |
| 3.000 | S0405-06-13 | 15 Winter | 100 | +40% | | | | | 122.160 | -0.170 | 0.000 |
| 3.001 | S0405-06-14 | 15 Winter | 100 | +40% | | | | | 121.637 | -0.150 | 0.000 |
| 3.002 | S0405-06-15 | 1440 Winter | 100 | +40% | 5/120 Winter | | | | 120.606 | 0.962 | 0.000 |
| 1.008 | S0405-06-16 | 1440 Winter | 100 | +40% | 5/15 Winter | | | | 120.607 | 1.032 | 0.000 |
| 1.009 | S0405-06-17 (Pond) | 1440 Winter | 100 | +40% | 5/60 Winter | | | | 120.606 | 1.079 | 0.000 |
| 1.010 | S0405-06-18 (Flow Control) | 1440 Winter | 100 | +40% | 5/15 Summer | 5/120 Winter | | | 120.907 | 1.604 | 15.905 |
| 1.011 | S0405-06-19 | 120 Winter | 100 | +40% | | | | | 119.106 | -0.176 | 0.000 |

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 1.003 | S0405-06-4 | 1.08 | | | 108.3 | SURCHARGED | |
| 1.004 | S0405-06-5 | 1.88 | | | 108.3 | SURCHARGED | |
| 2.000 | S0405-06-6 | 0.00 | | | 0.0 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 06 - Long Marton East

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 2.001 | S0405-06-7 | 0.64 | | | 32.9 | OK | |
| 2.002 | S0405-06-8 | 0.34 | | | 31.6 | OK | |
| 2.003 | S0405-06-9 | 0.34 | | | 34.9 | OK | |
| 1.005 | S0405-06-10 | 0.61 | | | 149.3 | OK | |
| 1.006 | S0405-06-11 | 0.89 | | | 149.7 | OK | |
| 1.007 | S0405-06-12 | 0.77 | | | 163.0 | OK | |
| 3.000 | S0405-06-13 | 0.14 | | | 11.9 | OK | |
| 3.001 | S0405-06-14 | 0.24 | | | 26.1 | OK | |
| 3.002 | S0405-06-15 | 0.03 | | | 1.6 | FLOOD RISK | |
| 1.008 | S0405-06-16 | 0.22 | | | 16.5 | FLOOD RISK | |
| 1.009 | S0405-06-17 (Pond) | 0.08 | | | 13.9 | FLOOD RISK | |
| 1.010 | S0405-06-18 (Flow Control) | 0.15 | | | 7.6 | FLOOD | 16 |
| 1.011 | S0405-06-19 | 0.18 | | | 58.1 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for Long Marton East Extension

```
                         Pipe Sizes STANDARD Manhole Sizes STANDARD

                            FSR Rainfall Model - England and Wales
               Return Period (years)      1          Foul Sewage (l/s/ha) 0.000          Maximum Backdrop Height (m) 1.500
                          M5-60 (mm) 15.500      Volumetric Runoff Coeff. 0.750 Min Design Depth for Optimisation (m) 1.200
                             Ratio R  0.300                      PIMP (%)   100    Min Vel for Auto Design only (m/s)  1.00
              Maximum Rainfall (mm/hr)     50 Add Flow / Climate Change (%)     0      Min Slope for Optimisation (1:X)   500
  Maximum Time of Concentration (mins)     30   Minimum Backdrop Height (m) 0.200

                                  Designed with Level Inverts
```

## Simulation Criteria for Long Marton East Extension

```
     Volumetric Runoff Coeff 0.750   Manhole Headloss Coeff (Global) 0.500                 Inlet Coeffiecient 0.800
      Areal Reduction Factor 1.000     Foul Sewage per hectare (l/s) 0.000 Flow per Person per Day (l/per/day) 0.000
            Hot Start (mins)     0 Additional Flow - % of Total Flow 0.000                     Run Time (mins)    60
        Hot Start Level (mm)     0     MADD Factor * 10m³/ha Storage 2.000                Output Interval (mins)     1

           Number of Input Hydrographs 0   Number of Offline Controls 0 Number of Time/Area Diagrams 0
             Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0
```

## Synthetic Rainfall Details

```
                   Rainfall Model FSR     Region England and Wales      Ratio R  0.300
            Return Period (years)    1 M5-60 (mm)             15.500 Profile Type Summer
```

## Synthetic Rainfall Details

Cv (Summer) 0.750 Cv (Winter) 0.840 Storm Duration (mins) 30

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Long Marton East Extension

### Simulation Criteria

```
Areal Reduction Factor 1.000   Manhole Headloss Coeff (Global) 0.500        MADD Factor * 10m³/ha Storage 2.000
      Hot Start (mins)      0     Foul Sewage per hectare (l/s) 0.000                 Inlet Coeffiecient 0.800
 Hot Start Level (mm)      0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

          Number of Input Hydrographs 0   Number of Offline Controls 0 Number of Time/Area Diagrams 0
           Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
Rainfall Model              FSR M5-60 (mm) 15.500 Cv (Summer) 0.750
        Region England and Wales    Ratio R  0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status  ON Inertia Status OFF
                 Analysis Timestep   Fine DVD Status OFF


              Profile(s)                          Summer and Winter
      Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)                                    5, 100
      Climate Change (%)                                    20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-06b-1 | 15 Winter | 5 | +20% | | | | | 122.043 | -0.162 | 0.000 | 0.17 | |
| 1.001 | S0405-06b-2 | 15 Winter | 5 | +20% | | | | | 121.814 | -0.137 | 0.000 | 0.31 | |
| 1.002 | S0405-06b-3 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 120.397 | -0.108 | 0.000 | 0.53 | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Long Marton East Extension

| **PN** | **US/MH Name** | **Half Drain Time (mins)** | **Pipe Flow (l/s)** | **Status** | **Level Exceeded** |
|---|---|---|---|---|---|
| 1.000 | S0405-06b-1 |  | 7.5 | OK |  |
| 1.001 | S0405-06b-2 |  | 18.9 | OK |  |
| 1.002 | S0405-06b-3 |  | 25.9 | OK |  |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Long Marton East Extension

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.000 | S0405-06b-4 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 119.588 | -0.161 | 0.000 | 0.14 | |
| 3.000 | S0405-06b-5 | 15 Winter | 5 | +20% | | | | | 123.620 | -0.161 | 0.000 | 0.17 | |
| 3.001 | S0405-06b-6 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 121.068 | -0.121 | 0.000 | 0.44 | |
| 3.002 | S0405-06b-7 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 121.009 | -0.118 | 0.000 | 0.44 | |
| 3.003 | S0405-06b-8 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 120.113 | -0.085 | 0.000 | 0.70 | |
| 3.004 | S0405-06b-9 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 119.954 | -0.082 | 0.000 | 0.73 | |
| 1.003 | S0405-06b-10 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 119.567 | 0.073 | 0.000 | 1.49 | |
| 1.004 | S0405-06b-11 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 119.337 | -0.088 | 0.000 | 0.68 | |

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 2.000 | S0405-06b-4 | | 5.4 | OK | |
| 3.000 | S0405-06b-5 | | 15.2 | OK | |
| 3.001 | S0405-06b-6 | | 15.3 | OK | |
| 3.002 | S0405-06b-7 | | 22.9 | OK | |
| 3.003 | S0405-06b-8 | | 25.9 | OK | |
| 3.004 | S0405-06b-9 | | 26.0 | OK | |
| 1.003 | S0405-06b-10 | | 55.3 | SURCHARGED | |
| 1.004 | S0405-06b-11 | | 54.8 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Long Marton East Extension

### Simulation Criteria

```
   Areal Reduction Factor 1.000  Manhole Headloss Coeff (Global) 0.500       MADD Factor * 10m³/ha Storage 2.000
         Hot Start (mins)      0    Foul Sewage per hectare (l/s) 0.000                 Inlet Coeffiecient 0.800
       Hot Start Level (mm)      0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

        Number of Input Hydrographs 0   Number of Offline Controls 0 Number of Time/Area Diagrams 0
          Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
          Rainfall Model              FSR M5-60 (mm) 15.500 Cv (Summer) 0.750
                  Region England and Wales    Ratio R  0.300 Cv (Winter) 0.840

       Margin for Flood Risk Warning (mm) 300.0 DTS Status  ON Inertia Status OFF
                        Analysis Timestep  Fine DVD Status OFF


                     Profile(s)                          Summer and Winter
             Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
       Return Period(s) (years)                                    5, 100
             Climate Change (%)                                    20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-06b-1 | 15 Winter | 100 | +40% | | | | | 122.076 | -0.129 | 0.000 | 0.37 | |
| 1.001 | S0405-06b-2 | 15 Winter | 100 | +40% | | | | | 121.880 | -0.071 | 0.000 | 0.76 | |
| 1.002 | S0405-06b-3 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 120.790 | 0.285 | 0.000 | 1.12 | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Long Marton East Extension

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 1.000 | S0405-06b-1 | | 16.0 | OK | |
| 1.001 | S0405-06b-2 | | 46.4 | OK | |
| 1.002 | S0405-06b-3 | | 54.8 | SURCHARGED | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Long Marton East Extension

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.000 | S0405-06b-4 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 120.269 | 0.520 | 0.000 | 0.21 | |
| 3.000 | S0405-06b-5 | 15 Winter | 100 | +40% | | | | | 123.653 | -0.129 | 0.000 | 0.37 | |
| 3.001 | S0405-06b-6 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 121.277 | 0.088 | 0.000 | 0.89 | |
| 3.002 | S0405-06b-7 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 121.233 | 0.105 | 0.000 | 0.91 | |
| 3.003 | S0405-06b-8 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 120.616 | 0.418 | 0.000 | 1.32 | |
| 3.004 | S0405-06b-9 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 120.396 | 0.360 | 0.000 | 1.22 | |
| 1.003 | S0405-06b-10 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 120.253 | 0.759 | 0.000 | 2.57 | |
| 1.004 | S0405-06b-11 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 119.802 | 0.377 | 0.000 | 1.18 | |

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 2.000 | S0405-06b-4 | | 8.2 | SURCHARGED | |
| 3.000 | S0405-06b-5 | | 32.7 | OK | |
| 3.001 | S0405-06b-6 | | 31.1 | SURCHARGED | |
| 3.002 | S0405-06b-7 | | 47.9 | SURCHARGED | |
| 3.003 | S0405-06b-8 | | 48.9 | SURCHARGED | |
| 3.004 | S0405-06b-9 | | 43.8 | SURCHARGED | |
| 1.003 | S0405-06b-10 | | 95.2 | SURCHARGED | |
| 1.004 | S0405-06b-11 | | 94.8 | SURCHARGED | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Existing

```
                         Pipe Sizes STANDARD Manhole Sizes STANDARD

                           FSR Rainfall Model - England and Wales
               Return Period (years)       1          Foul Sewage (l/s/ha) 0.000          Maximum Backdrop Height (m) 1.500
                          M5-60 (mm)  15.000      Volumetric Runoff Coeff. 0.750 Min Design Depth for Optimisation (m) 1.200
                             Ratio R   0.300                      PIMP (%)   100     Min Vel for Auto Design only (m/s)  1.00
              Maximum Rainfall (mm/hr)      50 Add Flow / Climate Change (%)     0       Min Slope for Optimisation (1:X)   500
  Maximum Time of Concentration (mins)      30   Minimum Backdrop Height (m) 0.200

                                  Designed with Level Inverts
```

### Simulation Criteria for Existing

```
       Volumetric Runoff Coeff 0.750   Manhole Headloss Coeff (Global) 0.500                   Inlet Coeffiecient 0.800
        Areal Reduction Factor 1.000     Foul Sewage per hectare (l/s) 0.000 Flow per Person per Day (l/per/day) 0.000
              Hot Start (mins)     0 Additional Flow - % of Total Flow 0.000                      Run Time (mins)    60
           Hot Start Level (mm)    0     MADD Factor * 10m³/ha Storage 2.000                 Output Interval (mins)     1

          Number of Input Hydrographs 0   Number of Offline Controls 0 Number of Time/Area Diagrams 0
            Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
                 Rainfall Model FSR     Region England and Wales      Ratio R  0.300
          Return Period (years)  30 M5-60 (mm)             15.000 Profile Type Summer
```

## Synthetic Rainfall Details

Cv (Summer) 0.750 Cv (Winter) 0.840 Storm Duration (mins) 30

## Online Controls for Existing

### Hydro-Brake® Optimum Manhole: S0405-11-61 (Flow Control), DS/PN: 1.009, Volume (m³): 9.1

| | | | |
|---|---|---|---|
| Unit Reference | MD-SHE-0172-1800-2200-1800 | Sump Available | Yes |
| Design Head (m) | 2.200 | Diameter (mm) | 172 |
| Design Flow (l/s) | 18.0 | Invert Level (m) | 116.029 |
| Flush-Flo™ | Calculated | Minimum Outlet Pipe Diameter (mm) | 225 |
| Objective | Minimise upstream storage | Suggested Manhole Diameter (mm) | 1800 |
| Application | Surface | | |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| Design Point (Calculated) | 2.200 | 18.0 | Kick-Flo® | 1.321 | 14.1 |
| Flush-Flo™ | 0.636 | 17.8 | Mean Flow over Head Range | - | 15.6 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 6.1 | 0.600 | 17.8 | 1.600 | 15.5 | 2.600 | 19.5 | 5.000 | 26.6 | 7.500 | 32.4 |
| 0.200 | 14.5 | 0.800 | 17.6 | 1.800 | 16.3 | 3.000 | 20.8 | 5.500 | 27.9 | 8.000 | 33.4 |
| 0.300 | 16.2 | 1.000 | 17.0 | 2.000 | 17.2 | 3.500 | 22.4 | 6.000 | 29.1 | 8.500 | 34.4 |
| 0.400 | 17.2 | 1.200 | 15.7 | 2.200 | 18.0 | 4.000 | 23.9 | 6.500 | 30.2 | 9.000 | 35.3 |
| 0.500 | 17.6 | 1.400 | 14.5 | 2.400 | 18.7 | 4.500 | 25.3 | 7.000 | 31.3 | 9.500 | 36.3 |

## Storage Structures for Existing

### Tank or Pond Manhole: S0405-11-60 (Pond), DS/PN: 1.008

Invert Level (m) 116.073

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 750.0 | 1.800 | 1611.8 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

### Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 15.100 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status ON Inertia Status OFF
Analysis Timestep Fine DVD Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-11-1 | 15 Winter | 5 | +20% | | | | | 130.132 | -0.176 | 0.000 | 0.10 | | |
| 1.001 | S0405-11-2 | 15 Winter | 5 | +20% | | | | | 129.779 | -0.158 | 0.000 | 0.18 | | |
| 1.002 | S0405-11-3 | 15 Winter | 5 | +20% | | | | | 128.658 | -0.142 | 0.000 | 0.28 | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| **PN** | **US/MH Name** | **Pipe Flow (l/s)** | **Status** | **Level Exceeded** |
|---|---|---|---|---|
| 1.000 | S0405-11-1 | 3.9 | OK | |
| 1.001 | S0405-11-2 | 9.9 | OK | |
| 1.002 | S0405-11-3 | 26.9 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.003 | S0405-11-4 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 125.230 | -0.099 | 0.000 | 0.58 | |
| 1.004 | S0405-11-5 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 123.119 | -0.067 | 0.000 | 0.88 | |
| 1.005 | S0405-11-6 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 122.654 | -0.109 | 0.000 | 0.70 | |
| 2.000 | S0405-11-7 | 15 Winter | 5 | +20% | | | | | 123.125 | -0.170 | 0.000 | 0.12 | |
| 2.001 | S0405-11-8 | 15 Winter | 5 | +20% | | | | | 122.541 | -0.162 | 0.000 | 0.16 | |
| 2.002 | S0405-11-9 | 15 Winter | 5 | +20% | | | | | 121.982 | -0.179 | 0.000 | 0.10 | |
| 1.006 | S0405-11-10 | 15 Winter | 5 | +20% | | | | | 121.863 | -0.144 | 0.000 | 0.53 | |
| 3.000 | S0405-11-11 | 15 Winter | 5 | +20% | | | | | 118.995 | -0.162 | 0.000 | 0.17 | |
| 3.001 | S0405-11-12 | 15 Winter | 5 | +20% | | | | | 118.894 | -0.143 | 0.000 | 0.28 | |
| 4.000 | S0405-11-13 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 129.556 | -0.099 | 0.000 | 0.56 | |
| 4.001 | S0405-11-14 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 129.244 | -0.127 | 0.000 | 0.60 | |
| 4.002 | S0405-11-15 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 128.121 | -0.163 | 0.000 | 0.43 | |
| 4.003 | S0405-11-16 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 127.064 | -0.150 | 0.000 | 0.50 | |
| 5.000 | S0405-11-17 | 15 Winter | 5 | +20% | | | | | 135.016 | -0.176 | 0.000 | 0.10 | |
| 5.001 | S0405-11-18 | 15 Winter | 5 | +20% | | | | | 134.739 | -0.159 | 0.000 | 0.18 | |
| 5.002 | S0405-11-19 | 15 Winter | 5 | +20% | | | | | 134.441 | -0.180 | 0.000 | 0.09 | |
| 5.003 | S0405-11-20 | 15 Winter | 5 | +20% | | | | | 131.520 | -0.184 | 0.000 | 0.07 | |
| 5.004 | S0405-11-21 | 15 Winter | 5 | +20% | | | | | 128.217 | -0.173 | 0.000 | 0.12 | |
| 4.004 | S0405-11-22 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 126.733 | -0.104 | 0.000 | 0.75 | |
| 6.000 | S0405-11-23 | 15 Winter | 5 | +20% | | | | | 134.465 | -0.176 | 0.000 | 0.11 | |
| 6.001 | S0405-11-24 | 15 Winter | 5 | +20% | | | | | 130.847 | -0.168 | 0.000 | 0.14 | |
| 4.005 | S0405-11-25 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 126.454 | -0.154 | 0.000 | 0.48 | |
| 7.000 | S0405-11-26 | 15 Winter | 5 | +20% | | | | | 133.409 | -0.140 | 0.000 | 0.29 | |
| 7.001 | S0405-11-27 | 15 Winter | 5 | +20% | | | | | 133.145 | -0.131 | 0.000 | 0.36 | |
| 7.002 | S0405-11-28 | 15 Winter | 5 | +20% | | | | | 132.956 | -0.159 | 0.000 | 0.19 | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 1.003 | S0405-11-4 | | 44.1 | OK | 4 |
| 1.004 | S0405-11-5 | | 61.3 | OK | |
| 1.005 | S0405-11-6 | | 65.5 | OK | |
| 2.000 | S0405-11-7 | | 4.8 | OK | |
| 2.001 | S0405-11-8 | | 6.3 | OK | |
| 2.002 | S0405-11-9 | | 6.3 | OK | |
| 1.006 | S0405-11-10 | | 81.2 | OK | |
| 3.000 | S0405-11-11 | | 6.2 | OK | |
| 3.001 | S0405-11-12 | | 10.6 | OK | |
| 4.000 | S0405-11-13 | | 21.8 | OK | |
| 4.001 | S0405-11-14 | | 67.3 | OK | |
| 4.002 | S0405-11-15 | | 68.4 | OK | |
| 4.003 | S0405-11-16 | | 68.9 | OK | |
| 5.000 | S0405-11-17 | | 3.9 | OK | |
| 5.001 | S0405-11-18 | | 7.0 | OK | |
| 5.002 | S0405-11-19 | | 8.5 | OK | |
| 5.003 | S0405-11-20 | | 11.1 | OK | |
| 5.004 | S0405-11-21 | | 13.9 | OK | |
| 4.004 | S0405-11-22 | | 82.3 | OK | |
| 6.000 | S0405-11-23 | | 13.4 | OK | |
| 6.001 | S0405-11-24 | | 19.5 | OK | |
| 4.005 | S0405-11-25 | | 99.9 | OK | |
| 7.000 | S0405-11-26 | | 11.3 | OK | |
| 7.001 | S0405-11-27 | | 13.5 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 7.002 | S0405-11-28 | | 18.8 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7.003 | S0405-11-29 | 15 Winter | 5 | +20% | | | | | 130.295 | -0.167 | 0.000 | 0.15 | |
| 7.004 | S0405-11-30 | 15 Winter | 5 | +20% | | | | | 128.680 | -0.165 | 0.000 | 0.16 | |
| 4.006 | S0405-11-31 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 125.806 | -0.107 | 0.000 | 0.74 | |
| 4.007 | S0405-11-32 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 124.787 | -0.053 | 0.000 | 0.95 | |
| 4.008 | S0405-11-33 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 123.847 | -0.009 | 0.000 | 0.81 | |
| 4.009 | S0405-11-34 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 123.587 | 0.122 | 0.000 | 1.29 | |
| 8.000 | S0405-11-35 | 15 Winter | 5 | +20% | | | | | 129.552 | -0.169 | 0.000 | 0.14 | |
| 9.000 | S0405-11-36 | 15 Winter | 5 | +20% | | | | | 133.409 | -0.126 | 0.000 | 0.39 | |
| 9.001 | S0405-11-37 | 15 Winter | 5 | +20% | | | | | 132.607 | -0.159 | 0.000 | 0.19 | |
| 9.002 | S0405-11-38 | 15 Winter | 5 | +20% | | | | | 130.076 | -0.160 | 0.000 | 0.18 | |
| 9.003 | S0405-11-39 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 126.252 | -0.115 | 0.000 | 0.48 | |
| 8.001 | S0405-11-40 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 126.075 | -0.121 | 0.000 | 0.43 | |
| 8.002 | S0405-11-41 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 124.389 | -0.108 | 0.000 | 0.53 | |
| 4.010 | S0405-11-42 | 15 Winter | 5 | +20% | 5/15 Winter | | | | 123.474 | 0.002 | 0.000 | 1.52 | |
| 10.000 | S0405-11-43 | 15 Winter | 5 | +20% | | | | | 130.755 | -0.213 | 0.000 | 0.01 | |
| 10.001 | S0405-11-44 | 15 Winter | 5 | +20% | | | | | 128.091 | -0.206 | 0.000 | 0.02 | |
| 11.000 | S0405-11-45 | 15 Winter | 5 | +20% | | | | | 134.991 | -0.186 | 0.000 | 0.07 | |
| 11.001 | S0405-11-46 | 15 Winter | 5 | +20% | | | | | 133.016 | -0.181 | 0.000 | 0.08 | |
| 11.002 | S0405-11-47 | 15 Winter | 5 | +20% | | | | | 131.141 | -0.180 | 0.000 | 0.09 | |
| 11.003 | S0405-11-48 | 15 Winter | 5 | +20% | | | | | 128.711 | -0.180 | 0.000 | 0.09 | |
| 11.004 | S0405-11-49 | 15 Winter | 5 | +20% | | | | | 126.266 | -0.173 | 0.000 | 0.12 | |
| 10.002 | S0405-11-50 | 15 Winter | 5 | +20% | | | | | 125.804 | -0.167 | 0.000 | 0.15 | |
| 4.011 | S0405-11-51 | 15 Winter | 5 | +20% | 100/15 Winter | | | | 123.218 | -0.220 | 0.000 | 0.51 | |
| 4.012 | S0405-11-52 | 15 Winter | 5 | +20% | 100/15 Winter | | | | 122.888 | -0.200 | 0.000 | 0.58 | |
| 4.013 | S0405-11-53 | 15 Winter | 5 | +20% | | | | | 121.998 | -0.281 | 0.000 | 0.30 | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 7.003 | S0405-11-29 | | 19.4 | OK | |
| 7.004 | S0405-11-30 | | 21.9 | OK | |
| 4.006 | S0405-11-31 | | 122.2 | OK | 5 |
| 4.007 | S0405-11-32 | | 122.1 | OK | 5 |
| 4.008 | S0405-11-33 | | 122.6 | OK | |
| 4.009 | S0405-11-34 | | 123.4 | SURCHARGED | |
| 8.000 | S0405-11-35 | | 21.0 | OK | |
| 9.000 | S0405-11-36 | | 24.2 | OK | |
| 9.001 | S0405-11-37 | | 27.5 | OK | |
| 9.002 | S0405-11-38 | | 28.2 | OK | |
| 9.003 | S0405-11-39 | | 28.2 | OK | |
| 8.001 | S0405-11-40 | | 54.5 | OK | |
| 8.002 | S0405-11-41 | | 58.9 | OK | |
| 4.010 | S0405-11-42 | | 156.9 | SURCHARGED | |
| 10.000 | S0405-11-43 | | 1.5 | OK | |
| 10.001 | S0405-11-44 | | 2.3 | OK | |
| 11.000 | S0405-11-45 | | 7.6 | OK | |
| 11.001 | S0405-11-46 | | 9.5 | OK | |
| 11.002 | S0405-11-47 | | 10.3 | OK | |
| 11.003 | S0405-11-48 | | 11.5 | OK | |
| 11.004 | S0405-11-49 | | 11.5 | OK | |
| 10.002 | S0405-11-50 | | 19.2 | OK | |
| 4.011 | S0405-11-51 | | 171.7 | OK | |
| 4.012 | S0405-11-52 | | 175.0 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 4.013 | S0405-11-53 | | 175.7 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.014 | S0405-11-54 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 121.026 | -0.188 | 0.000 |
| 4.015 | S0405-11-55 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 120.495 | -0.186 | 0.000 |
| 12.000 | S0405-11-56 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 119.630 | 0.025 | 0.000 |
| 12.001 | S0405-11-57 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 119.626 | 0.085 | 0.000 |
| 4.016 | S0405-11-58 | 60 Summer | 5 | +20% | 100/15 Summer | | | | 119.610 | 0.000 | 0.000 |
| 1.007 | S0405-11-59 | 15 Winter | 5 | +20% | | | | | 118.825 | -0.332 | 0.000 |
| 1.008 | S0405-11-60 (Pond) | 360 Winter | 5 | +20% | 100/30 Winter | | | | 116.517 | -0.156 | 0.000 |
| 1.009 | S0405-11-61 (Flow Control) | 480 Winter | 5 | +20% | 5/120 Summer | 100/60 Summer | | | 116.603 | 0.124 | 0.000 |
| 1.010 | S0405-11-62 | 1440 Summer | 5 | +20% | 100/60 Summer | | | | 115.509 | -0.381 | 0.000 |

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 4.014 | S0405-11-54 | 0.63 | | | 177.6 | OK | |
| 4.015 | S0405-11-55 | 0.64 | | | 180.5 | OK | |
| 12.000 | S0405-11-56 | 0.09 | | | 3.1 | SURCHARGED | |
| 12.001 | S0405-11-57 | 0.13 | | | 5.6 | SURCHARGED | |
| 4.016 | S0405-11-58 | 1.36 | | | 151.7 | OK | |
| 1.007 | S0405-11-59 | 0.29 | | | 266.6 | OK | |
| 1.008 | S0405-11-60 (Pond) | 0.09 | | | 20.1 | OK | |
| 1.009 | S0405-11-61 (Flow Control) | 0.04 | | | 17.4 | SURCHARGED | 14 |
| 1.010 | S0405-11-62 | 0.05 | | | 17.0 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

```
                                        Simulation Criteria
  Areal Reduction Factor 1.000   Manhole Headloss Coeff (Global) 0.500      MADD Factor * 10m³/ha Storage 2.000
        Hot Start (mins)      0    Foul Sewage per hectare (l/s) 0.000                 Inlet Coeffiecient 0.800
      Hot Start Level (mm)    0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

            Number of Input Hydrographs 0   Number of Offline Controls 0 Number of Time/Area Diagrams 0
              Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

                                      Synthetic Rainfall Details
                       Rainfall Model               FSR M5-60 (mm) 15.100 Cv (Summer) 0.750
                               Region England and Wales    Ratio R  0.300 Cv (Winter) 0.840

                     Margin for Flood Risk Warning (mm) 300.0 DTS Status  ON Inertia Status OFF
                                      Analysis Timestep  Fine DVD Status OFF


                                  Profile(s)                        Summer and Winter
                          Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
                       Return Period(s) (years)                                 5, 100
                          Climate Change (%)                                    20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-11-1 | 15 Winter | 100 | +40% | | | | | 130.156 | -0.152 | 0.000 | 0.22 | | |
| 1.001 | S0405-11-2 | 15 Winter | 100 | +40% | | | | | 129.821 | -0.116 | 0.000 | 0.44 | | |
| 1.002 | S0405-11-3 | 15 Winter | 100 | +40% | | | | | 128.723 | -0.077 | 0.000 | 0.73 | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| 1.000 | S0405-11-1 | 8.3 | OK | |
| 1.001 | S0405-11-2 | 23.7 | OK | |
| 1.002 | S0405-11-3 | 69.1 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.003 | S0405-11-4 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 126.506 | 1.177 | 3.678 | 1.05 | |
| 1.004 | S0405-11-5 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 124.212 | 1.026 | 0.000 | 1.65 | |
| 1.005 | S0405-11-6 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 123.195 | 0.432 | 0.000 | 1.24 | |
| 2.000 | S0405-11-7 | 15 Winter | 100 | +40% | | | | | 123.154 | -0.141 | 0.000 | 0.26 | |
| 2.001 | S0405-11-8 | 15 Winter | 100 | +40% | | | | | 122.575 | -0.128 | 0.000 | 0.35 | |
| 2.002 | S0405-11-9 | 15 Winter | 100 | +40% | | | | | 122.004 | -0.156 | 0.000 | 0.21 | |
| 1.006 | S0405-11-10 | 30 Winter | 100 | +40% | | | | | 121.932 | -0.075 | 0.000 | 0.91 | |
| 3.000 | S0405-11-11 | 15 Winter | 100 | +40% | | | | | 119.027 | -0.130 | 0.000 | 0.36 | |
| 3.001 | S0405-11-12 | 15 Winter | 100 | +40% | | | | | 118.949 | -0.088 | 0.000 | 0.66 | |
| 4.000 | S0405-11-13 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 130.493 | 0.837 | 0.000 | 1.05 | |
| 4.001 | S0405-11-14 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 130.100 | 0.728 | 0.000 | 1.21 | |
| 4.002 | S0405-11-15 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 128.796 | 0.513 | 0.000 | 0.75 | |
| 4.003 | S0405-11-16 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 128.228 | 1.014 | 0.000 | 0.85 | |
| 5.000 | S0405-11-17 | 15 Winter | 100 | +40% | | | | | 135.039 | -0.153 | 0.000 | 0.22 | |
| 5.001 | S0405-11-18 | 15 Winter | 100 | +40% | | | | | 134.779 | -0.119 | 0.000 | 0.43 | |
| 5.002 | S0405-11-19 | 15 Winter | 100 | +40% | | | | | 134.466 | -0.155 | 0.000 | 0.20 | |
| 5.003 | S0405-11-20 | 15 Winter | 100 | +40% | | | | | 131.545 | -0.160 | 0.000 | 0.18 | |
| 5.004 | S0405-11-21 | 15 Winter | 100 | +40% | | | | | 128.250 | -0.141 | 0.000 | 0.29 | |
| 4.004 | S0405-11-22 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 127.966 | 1.129 | 0.000 | 1.25 | |
| 6.000 | S0405-11-23 | 15 Winter | 100 | +40% | | | | | 134.489 | -0.151 | 0.000 | 0.23 | |
| 6.001 | S0405-11-24 | 15 Winter | 100 | +40% | | | | | 130.879 | -0.135 | 0.000 | 0.33 | |
| 4.005 | S0405-11-25 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 127.610 | 1.002 | 0.000 | 0.78 | |
| 7.000 | S0405-11-26 | 15 Winter | 100 | +40% | | | | | 133.457 | -0.092 | 0.000 | 0.63 | |
| 7.001 | S0405-11-27 | 15 Winter | 100 | +40% | | | | | 133.205 | -0.070 | 0.000 | 0.80 | |
| 7.002 | S0405-11-28 | 15 Winter | 100 | +40% | | | | | 132.993 | -0.122 | 0.000 | 0.42 | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 1.003 | S0405-11-4 | | 80.1 | FLOOD | 4 |
| 1.004 | S0405-11-5 | | 115.1 | FLOOD RISK | |
| 1.005 | S0405-11-6 | | 115.6 | SURCHARGED | |
| 2.000 | S0405-11-7 | | 10.3 | OK | |
| 2.001 | S0405-11-8 | | 13.8 | OK | |
| 2.002 | S0405-11-9 | | 13.7 | OK | |
| 1.006 | S0405-11-10 | | 139.6 | OK | |
| 3.000 | S0405-11-11 | | 13.2 | OK | |
| 3.001 | S0405-11-12 | | 24.6 | OK | |
| 4.000 | S0405-11-13 | | 40.7 | SURCHARGED | |
| 4.001 | S0405-11-14 | | 135.5 | SURCHARGED | |
| 4.002 | S0405-11-15 | | 119.9 | SURCHARGED | |
| 4.003 | S0405-11-16 | | 118.6 | FLOOD RISK | |
| 5.000 | S0405-11-17 | | 8.4 | OK | |
| 5.001 | S0405-11-18 | | 16.5 | OK | |
| 5.002 | S0405-11-19 | | 20.2 | OK | |
| 5.003 | S0405-11-20 | | 26.9 | OK | |
| 5.004 | S0405-11-21 | | 34.3 | OK | |
| 4.004 | S0405-11-22 | | 137.6 | FLOOD RISK | |
| 6.000 | S0405-11-23 | | 28.7 | OK | |
| 6.001 | S0405-11-24 | | 44.7 | OK | |
| 4.005 | S0405-11-25 | | 162.4 | FLOOD RISK | |
| 7.000 | S0405-11-26 | | 24.2 | OK | |
| 7.001 | S0405-11-27 | | 29.8 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 7.002 | S0405-11-28 | | 42.6 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7.003 | S0405-11-29 | 15 Winter | 100 | +40% | | | | | 130.327 | -0.135 | 0.000 | 0.34 | |
| 7.004 | S0405-11-30 | 15 Winter | 100 | +40% | | | | | 128.714 | -0.130 | 0.000 | 0.37 | |
| 4.006 | S0405-11-31 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 127.197 | 1.283 | 8.419 | 1.02 | |
| 4.007 | S0405-11-32 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 126.115 | 1.276 | 0.795 | 1.32 | |
| 4.008 | S0405-11-33 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 124.403 | 0.547 | 0.000 | 1.15 | |
| 4.009 | S0405-11-34 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 123.910 | 0.444 | 0.000 | 1.84 | |
| 8.000 | S0405-11-35 | 15 Winter | 100 | +40% | | | | | 129.581 | -0.140 | 0.000 | 0.30 | |
| 9.000 | S0405-11-36 | 15 Winter | 100 | +40% | | | | | 133.471 | -0.064 | 0.000 | 0.83 | |
| 9.001 | S0405-11-37 | 15 Winter | 100 | +40% | | | | | 132.643 | -0.123 | 0.000 | 0.41 | |
| 9.002 | S0405-11-38 | 15 Winter | 100 | +40% | | | | | 130.111 | -0.125 | 0.000 | 0.40 | |
| 9.003 | S0405-11-39 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 126.640 | 0.273 | 0.000 | 1.02 | |
| 8.001 | S0405-11-40 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 126.468 | 0.273 | 0.000 | 0.89 | |
| 8.002 | S0405-11-41 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 125.092 | 0.595 | 0.000 | 1.07 | |
| 4.010 | S0405-11-42 | 15 Winter | 100 | +40% | 5/15 Winter | | | | 123.694 | 0.222 | 0.000 | 2.70 | |
| 10.000 | S0405-11-43 | 15 Winter | 100 | +40% | | | | | 130.766 | -0.201 | 0.000 | 0.02 | |
| 10.001 | S0405-11-44 | 15 Winter | 100 | +40% | | | | | 128.102 | -0.196 | 0.000 | 0.04 | |
| 11.000 | S0405-11-45 | 15 Winter | 100 | +40% | | | | | 135.010 | -0.167 | 0.000 | 0.15 | |
| 11.001 | S0405-11-46 | 15 Winter | 100 | +40% | | | | | 133.038 | -0.159 | 0.000 | 0.19 | |
| 11.002 | S0405-11-47 | 15 Winter | 100 | +40% | | | | | 131.164 | -0.157 | 0.000 | 0.19 | |
| 11.003 | S0405-11-48 | 15 Winter | 100 | +40% | | | | | 128.735 | -0.156 | 0.000 | 0.20 | |
| 11.004 | S0405-11-49 | 15 Winter | 100 | +40% | | | | | 126.296 | -0.144 | 0.000 | 0.27 | |
| 10.002 | S0405-11-50 | 15 Winter | 100 | +40% | | | | | 125.840 | -0.131 | 0.000 | 0.36 | |
| 4.011 | S0405-11-51 | 15 Winter | 100 | +40% | 100/15 Winter | | | | 123.449 | 0.010 | 0.000 | 0.92 | |
| 4.012 | S0405-11-52 | 15 Winter | 100 | +40% | 100/15 Winter | | | | 123.150 | 0.062 | 0.000 | 1.04 | |
| 4.013 | S0405-11-53 | 15 Winter | 100 | +40% | | | | | 122.065 | -0.214 | 0.000 | 0.54 | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 7.003 | S0405-11-29 | | 44.0 | OK | |
| 7.004 | S0405-11-30 | | 50.4 | OK | |
| 4.006 | S0405-11-31 | | 169.9 | FLOOD | 5 |
| 4.007 | S0405-11-32 | | 169.9 | FLOOD | 5 |
| 4.008 | S0405-11-33 | | 174.3 | SURCHARGED | |
| 4.009 | S0405-11-34 | | 176.2 | SURCHARGED | |
| 8.000 | S0405-11-35 | | 45.1 | OK | |
| 9.000 | S0405-11-36 | | 51.8 | OK | |
| 9.001 | S0405-11-37 | | 59.6 | OK | |
| 9.002 | S0405-11-38 | | 61.6 | OK | |
| 9.003 | S0405-11-39 | | 59.7 | SURCHARGED | |
| 8.001 | S0405-11-40 | | 111.4 | SURCHARGED | |
| 8.002 | S0405-11-41 | | 119.9 | SURCHARGED | |
| 4.010 | S0405-11-42 | | 278.9 | SURCHARGED | |
| 10.000 | S0405-11-43 | | 3.2 | OK | |
| 10.001 | S0405-11-44 | | 5.5 | OK | |
| 11.000 | S0405-11-45 | | 16.3 | OK | |
| 11.001 | S0405-11-46 | | 21.4 | OK | |
| 11.002 | S0405-11-47 | | 23.5 | OK | |
| 11.003 | S0405-11-48 | | 26.4 | OK | |
| 11.004 | S0405-11-49 | | 26.2 | OK | |
| 10.002 | S0405-11-50 | | 46.0 | OK | |
| 4.011 | S0405-11-51 | | 308.3 | SURCHARGED | |
| 4.012 | S0405-11-52 | | 314.9 | SURCHARGED | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 4.013 | S0405-11-53 |  | 314.4 | OK |  |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.014 | S0405-11-54 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 121.508 | 0.294 | 0.000 |
| 4.015 | S0405-11-55 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 120.824 | 0.143 | 0.000 |
| 12.000 | S0405-11-56 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 119.763 | 0.159 | 0.000 |
| 12.001 | S0405-11-57 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 119.758 | 0.217 | 0.000 |
| 4.016 | S0405-11-58 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 119.740 | 0.130 | 0.000 |
| 1.007 | S0405-11-59 | 30 Winter | 100 | +40% | | | | | 118.900 | -0.257 | 0.000 |
| 1.008 | S0405-11-60 (Pond) | 1440 Winter | 100 | +40% | 100/30 Winter | | | | 117.721 | 1.048 | 0.000 |
| 1.009 | S0405-11-61 (Flow Control) | 960 Winter | 100 | +40% | 5/120 Summer | 100/60 Summer | | | 117.888 | 1.409 | 24.937 |
| 1.010 | S0405-11-62 | 60 Summer | 100 | +40% | 100/60 Summer | | | | 115.931 | 0.041 | 0.000 |

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 4.014 | S0405-11-54 | 1.14 | | | 318.1 | SURCHARGED | |
| 4.015 | S0405-11-55 | 1.14 | | | 320.2 | SURCHARGED | |
| 12.000 | S0405-11-56 | 0.21 | | | 7.3 | SURCHARGED | |
| 12.001 | S0405-11-57 | 0.33 | | | 13.8 | SURCHARGED | |
| 4.016 | S0405-11-58 | 2.92 | | | 326.6 | SURCHARGED | |
| 1.007 | S0405-11-59 | 0.52 | | | 475.5 | OK | |
| 1.008 | S0405-11-60 (Pond) | 0.12 | | | 25.9 | FLOOD RISK | |
| 1.009 | S0405-11-61 (Flow Control) | 0.04 | | | 17.3 | FLOOD | 14 |
| 1.010 | S0405-11-62 | 0.20 | | | 62.0 | SURCHARGED | |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for Existing

```
                       Pipe Sizes STANDARD Manhole Sizes STANDARD

                         FSR Rainfall Model - England and Wales
   Return Period (years)      1 Maximum Time of Concentration (mins)    30         Add Flow / Climate Change (%)     0 Min Vel for Auto Design only (m/s) 1.00
            M5-60 (mm) 17.100                   Foul Sewage (l/s/ha) 0.000           Minimum Backdrop Height (m) 0.200   Min Slope for Optimisation (1:X)   500
               Ratio R  0.300             Volumetric Runoff Coeff. 0.750           Maximum Backdrop Height (m) 1.500
Maximum Rainfall (mm/hr)     50                             PIMP (%)   100 Min Design Depth for Optimisation (m) 1.200

                               Designed with Level Inverts
```

## Simulation Criteria for Existing

```
 Volumetric Runoff Coeff 0.750            Hot Start Level (mm)     0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000
 Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500     MADD Factor * 10m³/ha Storage 2.000                      Run Time (mins)     60
        Hot Start (mins)     0   Foul Sewage per hectare (l/s) 0.000                 Inlet Coeffiecient 0.800              Output Interval (mins)      1

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0
```

## Synthetic Rainfall Details

```
         Rainfall Model FSR     Region England and Wales      Ratio R  0.300 Cv (Summer) 0.750 Storm Duration (mins) 30
  Return Period (years)    1 M5-60 (mm)            17.100 Profile Type Summer Cv (Winter) 0.840
```

## Online Controls for Existing

### Hydro-Brake® Optimum Manhole: S0405-09-53 (Flow Control), DS/PN: 1.015, Volume (m³): 2.7

| | |
|---|---|
| Unit Reference | MD-SHE-0247-3500-1431-3500 |
| Design Head (m) | 1.431 |
| Design Flow (l/s) | 35.0 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 247 |
| Invert Level (m) | 116.168 |
| Minimum Outlet Pipe Diameter (mm) | 300 |
| Suggested Manhole Diameter (mm) | 1800 |

| Control Points | Head (m) | Flow (l/s) | Control Points | Head (m) | Flow (l/s) | Control Points | Head (m) | Flow (l/s) | Control Points | Head (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Design Point (Calculated) | 1.431 | 34.9 | Flush-Flo™ | 0.462 | 34.9 | Kick-Flo® | 1.000 | 29.4 | Mean Flow over Head Range | - | 29.7 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 8.1 | 0.500 | 34.9 | 1.200 | 32.1 | 2.000 | 41.0 | 3.000 | 49.8 | 5.000 | 63.8 | 7.000 | 75.2 | 9.000 | 85.0 |
| 0.200 | 25.3 | 0.600 | 34.5 | 1.400 | 34.5 | 2.200 | 42.9 | 3.500 | 53.7 | 5.500 | 66.9 | 7.500 | 77.7 | 9.500 | 87.2 |
| 0.300 | 33.8 | 0.800 | 33.3 | 1.600 | 36.8 | 2.400 | 44.8 | 4.000 | 57.3 | 6.000 | 69.7 | 8.000 | 80.2 | | |
| 0.400 | 34.8 | 1.000 | 29.5 | 1.800 | 39.0 | 2.600 | 46.5 | 4.500 | 60.7 | 6.500 | 72.5 | 8.500 | 82.6 | | |

## Storage Structures for Existing

### Tank or Pond Manhole: S0405-09-51 (Pond), DS/PN: 1.014

Invert Level (m) 116.300

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 715.0 | 1.800 | 1560.3 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

### Simulation Criteria

Areal Reduction Factor 1.000 Hot Start Level (mm) 0 Foul Sewage per hectare (l/s) 0.000 MADD Factor * 10m³/ha Storage 2.000 Flow per Person per Day (l/per/day) 0.000
Hot Start (mins) 0 Manhole Headloss Coeff (Global) 0.500 Additional Flow - % of Total Flow 0.000 Inlet Coeffiecient 0.800

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Region England and Wales M5-60 (mm) 15.600 Ratio R 0.300 Cv (Summer) 0.750 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 Analysis Timestep Fine DTS Status ON DVD Status OFF Inertia Status OFF

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-09-1 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 124.915 | -0.075 | 0.000 | 0.68 | | | 26.8 | OK | |
| 1.001 | S0405-09-2 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 124.313 | -0.080 | 0.000 | 0.68 | | | 26.7 | OK | |
| 1.002 | S0405-09-3 | 15 Winter | 5 | +20% | 5/15 Winter | | | | 123.842 | 0.047 | 0.000 | 1.02 | | | 40.0 | SURCHARGED | |
| 1.003 | S0405-09-4 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 123.169 | -0.027 | 0.000 | 0.98 | | | 38.5 | OK | |
| 1.004 | S0405-09-5 | 30 Winter | 5 | +20% | | | | | 122.512 | -0.087 | 0.000 | 0.68 | | | 41.0 | OK | |
| 1.005 | S0405-09-6 | 30 Winter | 5 | +20% | 100/30 Winter | | | | 121.107 | -0.105 | 0.000 | 0.56 | | | 42.8 | OK | |
| 1.006 | S0405-09-7 | 30 Winter | 5 | +20% | 5/30 Winter | | | | 119.113 | 0.002 | 0.000 | 1.07 | | | 42.7 | SURCHARGED | |
| 1.007 | S0405-09-8 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 118.923 | -0.109 | 0.000 | 0.53 | | | 43.3 | OK | |
| 1.008 | S0405-09-9 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 118.358 | 0.416 | 0.000 | 1.16 | | | 43.2 | SURCHARGED | 9 |
| 1.009 | S0405-09-10 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 118.266 | 0.394 | 0.000 | 0.90 | | | 51.5 | SURCHARGED | 5 |
| 1.010 | S0405-09-11 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 117.454 | 0.583 | 0.000 | 1.49 | | | 54.1 | FLOOD RISK | 12 |
| 1.011 | S0405-09-12 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 117.286 | 0.496 | 0.000 | 1.48 | | | 56.5 | FLOOD RISK | 15 |
| 2.000 | S0405-09-13 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 124.965 | -0.083 | 0.000 | 0.63 | | | 24.9 | OK | 6 |
| 2.001 | S0405-09-14 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 124.564 | 0.114 | 0.000 | 0.90 | | | 35.1 | SURCHARGED | 6 |
| 2.002 | S0405-09-15 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 124.222 | 0.371 | 0.000 | 0.87 | | | 42.7 | SURCHARGED | 9 |
| 2.003 | S0405-09-16 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 123.596 | 0.671 | 0.000 | 1.04 | | | 56.3 | SURCHARGED | 11 |
| 2.004 | S0405-09-17 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 122.393 | 0.591 | 0.000 | 1.18 | | | 73.4 | SURCHARGED | 9 |
| 2.005 | S0405-09-18 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 120.266 | -0.124 | 0.000 | 0.64 | | | 88.7 | OK | |
| 2.006 | S0405-09-19 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 118.611 | -0.125 | 0.000 | 0.64 | | | 88.6 | OK | |
| 2.007 | S0405-09-20 | 30 Winter | 5 | +20% | 5/15 Summer | 100/30 Winter | | | 117.544 | 0.471 | 0.000 | 1.14 | | | 87.8 | SURCHARGED | 1 |
| 3.000 | S0405-09-21 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 117.464 | -0.200 | 0.000 | 0.03 | | | 0.9 | OK | |
| 3.001 | S0405-09-22 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 117.366 | -0.178 | 0.000 | 0.09 | | | 3.2 | OK | |
| 3.002 | S0405-09-23 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 117.289 | 0.117 | 0.000 | 0.13 | | | 4.6 | SURCHARGED | |
| 3.003 | S0405-09-24 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 117.282 | 0.354 | 0.000 | 0.36 | | | 9.9 | SURCHARGED | |
| 3.004 | S0405-09-25 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 117.282 | 0.368 | 0.000 | 0.32 | | | 10.6 | SURCHARGED | |
| 2.008 | S0405-09-26 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 117.282 | 0.411 | 0.000 | 1.80 | | | 91.6 | SURCHARGED | |
| 4.000 | S0405-09-27 | 15 Winter | 5 | +20% | | | | | 118.672 | -0.133 | 0.000 | 0.34 | | | 23.2 | OK | |
| 4.001 | S0405-09-28 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 117.201 | 0.223 | 0.000 | 0.58 | | | 20.2 | SURCHARGED | |
| 5.000 | S0405-09-29 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 117.429 | -0.163 | 0.000 | 0.13 | | | 4.2 | OK | |
| 5.001 | S0405-09-30 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 117.402 | -0.091 | 0.000 | 0.59 | | | 21.2 | OK | |
| 5.002 | S0405-09-31 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Winter | | | 117.248 | 0.255 | 0.000 | 0.62 | | | 21.7 | SURCHARGED | 3 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.009 | S0405-09-32 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 117.161 | 0.176 | 0.000 | 1.01 | | | 121.4 | SURCHARGED | |
| 6.000 | S0405-09-33 | 15 Winter | 5 | +20% | | | | | 125.003 | -0.200 | 0.000 | 0.03 | | | 1.0 | OK | |
| 6.001 | S0405-09-34 | 15 Winter | 5 | +20% | | | | | 124.413 | -0.191 | 0.000 | 0.05 | | | 1.9 | OK | |
| 6.002 | S0405-09-35 | 15 Winter | 5 | +20% | | | | | 123.839 | -0.168 | 0.000 | 0.13 | | | 6.1 | OK | |
| 6.003 | S0405-09-36 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 123.094 | -0.121 | 0.000 | 0.42 | | | 21.4 | OK | |
| 6.004 | S0405-09-37 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 122.085 | -0.102 | 0.000 | 0.55 | | | 34.4 | OK | |
| 6.005 | S0405-09-38 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 120.621 | -0.079 | 0.000 | 0.73 | | | 52.5 | OK | 5 |
| 6.006 | S0405-09-39 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 118.682 | -0.004 | 0.000 | 0.85 | | | 55.6 | OK | 6 |
| 6.007 | S0405-09-40 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 117.554 | 0.510 | 0.000 | 1.16 | | | 51.8 | SURCHARGED | 9 |
| 2.010 | S0405-09-41 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 117.121 | 0.175 | 0.000 | 1.23 | | | 172.4 | SURCHARGED | |
| 7.000 | S0405-09-42 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 117.304 | 0.617 | 0.000 | 0.11 | | | 3.8 | SURCHARGED | 7 |
| 7.001 | S0405-09-43 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 117.296 | -0.090 | 0.000 | 0.57 | | | 20.2 | OK | 4 |
| 7.002 | S0405-09-44 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 117.205 | 0.207 | 0.000 | 0.62 | | | 16.0 | SURCHARGED | 6 |
| 7.003 | S0405-09-45 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 117.195 | 0.215 | 0.000 | 0.62 | | | 21.2 | SURCHARGED | |
| 7.004 | S0405-09-46 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 117.146 | 0.304 | 0.000 | 0.74 | | | 22.7 | SURCHARGED | |
| 7.005 | S0405-09-47 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 117.116 | 0.325 | 0.000 | 0.85 | | | 28.7 | SURCHARGED | |
| 1.012 | S0405-09-48 | 30 Winter | 5 | +20% | 5/15 Summer | 100/180 Winter | | | 117.028 | 0.065 | 0.000 | 2.11 | | | 253.3 | SURCHARGED | 8 |
| 1.013 | S0405-09-49 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 116.874 | -0.146 | 0.000 | 0.92 | | | 251.9 | OK | |
| 1.014 | S0405-09-51 (Pond) | 480 Winter | 5 | +20% | 5/30 Winter | | | | 116.819 | 0.219 | 0.000 | 0.40 | | | 33.5 | SURCHARGED | |
| 1.015 | S0405-09-53 (Flow Control) | 480 Winter | 5 | +20% | 5/15 Summer | 5/480 Summer | | | 117.599 | 1.131 | 1.132 | 0.20 | | | 33.1 | FLOOD | 26 |
| 1.016 | S0405-09-55 | 360 Winter | 5 | +20% | | | | | 115.837 | -0.213 | 0.000 | 0.18 | | | 33.6 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

### Simulation Criteria

Areal Reduction Factor 1.000 Hot Start Level (mm) 0 Foul Sewage per hectare (l/s) 0.000 MADD Factor * 10m³/ha Storage 2.000 Flow per Person per Day (l/per/day) 0.000
Hot Start (mins) 0 Manhole Headloss Coeff (Global) 0.500 Additional Flow - % of Total Flow 0.000 Inlet Coeffiecient 0.800

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Region England and Wales M5-60 (mm) 15.600 Ratio R 0.300 Cv (Summer) 0.750 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 Analysis Timestep Fine DTS Status ON DVD Status OFF Inertia Status OFF

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-09-1 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 126.144 | 1.153 | 0.000 | 1.14 | | | 44.7 | FLOOD RISK | |
| 1.001 | S0405-09-2 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 125.621 | 1.229 | 0.000 | 0.95 | | | 37.2 | SURCHARGED | |
| 1.002 | S0405-09-3 | 30 Winter | 100 | +40% | 5/15 Winter | | | | 125.057 | 1.262 | 0.000 | 1.54 | | | 60.4 | FLOOD RISK | |
| 1.003 | S0405-09-4 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 123.871 | 0.674 | 0.000 | 1.42 | | | 55.5 | SURCHARGED | |
| 1.004 | S0405-09-5 | 30 Winter | 100 | +40% | | | | | 122.557 | -0.041 | 0.000 | 0.98 | | | 58.6 | OK | |
| 1.005 | S0405-09-6 | 30 Winter | 100 | +40% | 100/30 Winter | | | | 121.235 | 0.023 | 0.000 | 0.79 | | | 60.7 | SURCHARGED | |
| 1.006 | S0405-09-7 | 30 Winter | 100 | +40% | 5/30 Winter | | | | 119.946 | 0.835 | 0.000 | 1.52 | | | 60.4 | SURCHARGED | |
| 1.007 | S0405-09-8 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 119.764 | 0.732 | 0.000 | 0.75 | | | 61.6 | SURCHARGED | |
| 1.008 | S0405-09-9 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 119.158 | 1.216 | 15.798 | 1.70 | | | 63.7 | FLOOD | 9 |
| 1.009 | S0405-09-10 | 30 Summer | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 119.129 | 1.257 | 1.628 | 1.23 | | | 70.4 | FLOOD | 5 |
| 1.010 | S0405-09-11 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 117.638 | 0.767 | 37.521 | 1.52 | | | 55.2 | FLOOD | 12 |
| 1.011 | S0405-09-12 | 180 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 117.472 | 0.682 | 26.820 | 1.61 | | | 61.4 | FLOOD | 15 |
| 2.000 | S0405-09-13 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 126.252 | 1.205 | 4.504 | 0.72 | | | 28.2 | FLOOD | 6 |
| 2.001 | S0405-09-14 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 125.965 | 1.516 | 4.639 | 1.18 | | | 46.2 | FLOOD | 6 |
| 2.002 | S0405-09-15 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 125.138 | 1.287 | 18.805 | 1.03 | | | 50.4 | FLOOD | 9 |
| 2.003 | S0405-09-16 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 124.161 | 1.237 | 36.920 | 1.30 | | | 70.3 | FLOOD | 11 |
| 2.004 | S0405-09-17 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 123.090 | 1.288 | 13.262 | 1.37 | | | 85.0 | FLOOD | 9 |
| 2.005 | S0405-09-18 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 120.560 | 0.170 | 0.000 | 0.92 | | | 128.2 | SURCHARGED | |
| 2.006 | S0405-09-19 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 119.411 | 0.675 | 0.000 | 0.83 | | | 115.3 | SURCHARGED | |
| 2.007 | S0405-09-20 | 30 Winter | 100 | +40% | 5/15 Summer | 100/30 Winter | | | 118.273 | 1.200 | 0.123 | 1.52 | | | 117.4 | FLOOD | 1 |
| 3.000 | S0405-09-21 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 117.862 | 0.198 | 0.000 | 0.05 | | | 1.6 | SURCHARGED | |
| 3.001 | S0405-09-22 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 117.860 | 0.316 | 0.000 | 0.15 | | | 5.5 | SURCHARGED | |
| 3.002 | S0405-09-23 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 117.848 | 0.676 | 0.000 | 0.20 | | | 6.9 | SURCHARGED | |
| 3.003 | S0405-09-24 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 117.834 | 0.906 | 0.000 | 0.28 | | | 7.5 | FLOOD RISK | |
| 3.004 | S0405-09-25 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 117.832 | 0.918 | 0.000 | 0.24 | | | 8.0 | SURCHARGED | |
| 2.008 | S0405-09-26 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 117.823 | 0.952 | 0.000 | 2.42 | | | 123.0 | FLOOD RISK | |
| 4.000 | S0405-09-27 | 15 Winter | 100 | +40% | | | | | 118.734 | -0.071 | 0.000 | 0.72 | | | 49.9 | OK | |
| 4.001 | S0405-09-28 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 117.962 | 0.984 | 0.000 | 1.37 | | | 47.9 | FLOOD RISK | |
| 5.000 | S0405-09-29 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 118.261 | 0.669 | 0.000 | 0.58 | | | 19.1 | FLOOD RISK | |
| 5.001 | S0405-09-30 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 118.260 | 0.767 | 0.000 | 0.85 | | | 30.4 | FLOOD RISK | |
| 5.002 | S0405-09-31 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Winter | | | 117.949 | 0.956 | 0.198 | 1.30 | | | 45.6 | FLOOD | 3 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume ($m^3$) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.009 | S0405-09-32 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 117.599 | 0.614 | 0.000 | 1.68 | | | 201.8 | FLOOD RISK | |
| 6.000 | S0405-09-33 | 15 Winter | 100 | +40% | | | | | 125.015 | -0.188 | 0.000 | 0.06 | | | 2.2 | OK | |
| 6.001 | S0405-09-34 | 15 Winter | 100 | +40% | | | | | 124.433 | -0.171 | 0.000 | 0.11 | | | 4.5 | OK | |
| 6.002 | S0405-09-35 | 15 Winter | 100 | +40% | | | | | 123.878 | -0.129 | 0.000 | 0.34 | | | 15.4 | OK | |
| 6.003 | S0405-09-36 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 123.591 | 0.376 | 0.000 | 0.84 | | | 43.1 | SURCHARGED | |
| 6.004 | S0405-09-37 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 123.129 | 0.942 | 0.000 | 0.89 | | | 55.4 | FLOOD RISK | |
| 6.005 | S0405-09-38 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 121.903 | 1.203 | 3.335 | 1.00 | | | 72.4 | FLOOD | 5 |
| 6.006 | S0405-09-39 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 119.891 | 1.205 | 5.250 | 1.09 | | | 71.3 | FLOOD | 6 |
| 6.007 | S0405-09-40 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 117.945 | 0.901 | 14.029 | 1.43 | | | 64.0 | FLOOD | 9 |
| 2.010 | S0405-09-41 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 117.471 | 0.525 | 0.000 | 1.83 | | | 255.2 | FLOOD RISK | |
| 7.000 | S0405-09-42 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 117.879 | 1.192 | 4.391 | 0.53 | | | 17.5 | FLOOD | 7 |
| 7.001 | S0405-09-43 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 117.916 | 0.530 | 1.109 | 1.01 | | | 36.0 | FLOOD | 4 |
| 7.002 | S0405-09-44 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 117.628 | 0.630 | 8.100 | 1.39 | | | 35.9 | FLOOD | 6 |
| 7.003 | S0405-09-45 | 60 Summer | 100 | +40% | 5/15 Summer | | | | 117.625 | 0.645 | 0.000 | 1.02 | | | 34.8 | FLOOD RISK | |
| 7.004 | S0405-09-46 | 15 Summer | 100 | +40% | 5/15 Summer | | | | 117.553 | 0.711 | 0.000 | 1.17 | | | 35.7 | FLOOD RISK | |
| 7.005 | S0405-09-47 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 117.485 | 0.694 | 0.000 | 1.47 | | | 49.7 | FLOOD RISK | |
| 1.012 | S0405-09-48 | 480 Winter | 100 | +40% | 5/15 Summer | 100/180 Winter | | | 117.455 | 0.492 | 63.748 | 1.32 | | | 158.8 | FLOOD | 8 |
| 1.013 | S0405-09-49 | 480 Winter | 100 | +40% | 100/15 Summer | | | | 117.449 | 0.429 | 0.000 | 0.58 | | | 158.2 | SURCHARGED | |
| 1.014 | S0405-09-51 (Pond) | 480 Winter | 100 | +40% | 5/30 Winter | | | | 117.441 | 0.841 | 0.000 | 0.50 | | | 41.3 | FLOOD RISK | |
| 1.015 | S0405-09-53 (Flow Control) | 2880 Winter | 100 | +40% | 5/15 Summer | 5/480 Summer | | | 117.602 | 1.134 | 4.789 | 0.19 | | | 31.1 | FLOOD | 26 |
| 1.016 | S0405-09-55 | 2880 Summer | 100 | +40% | | | | | 115.838 | -0.212 | 0.000 | 0.17 | | | 31.4 | OK | |

## Simulation Criteria for Side Road 006 - Sleastonhow Lane East

```
 Volumetric Runoff Coeff 0.750            Hot Start Level (mm)     0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000
  Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500     MADD Factor * 10m³/ha Storage 2.000                     Run Time (mins)    60
        Hot Start (mins)     0   Foul Sewage per hectare (l/s) 0.000                Inlet Coeffiecient 0.800              Output Interval (mins)     1

Number of Input Hydrographs 0 Number of Online Controls 0 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0
```

## Synthetic Rainfall Details

```
       Rainfall Model FSR     Region England and Wales      Ratio R  0.300 Cv (Summer) 0.750 Storm Duration (mins) 30
Return Period (years)  30 M5-60 (mm)             16.400 Profile Type Summer Cv (Winter) 0.840
```

## Storage Structures for Side Road 006 - Sleastonhow Lane East

### Tank or Pond Manhole: S0405-10-10 (Pond), DS/PN: 1.005

Invert Level (m) 129.350

| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|---|---|
| 0.000 | 220.0 | 0.500 | 337.7 | 1.000 | 480.6 | 1.300 | 578.4 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Side Road 006 - Sleastonhow Lane East

### Simulation Criteria

Areal Reduction Factor 1.000 Hot Start Level (mm) 0 Foul Sewage per hectare (l/s) 0.000 MADD Factor * 10m³/ha Storage 2.000 Flow per Person per Day (l/per/day) 0.000
Hot Start (mins) 0 Manhole Headloss Coeff (Global) 0.500 Additional Flow - % of Total Flow 0.000 Inlet Coeffiecient 0.800

Number of Input Hydrographs 0 Number of Online Controls 0 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Region England and Wales M5-60 (mm) 16.500 Ratio R 0.300 Cv (Summer) 0.750 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 Analysis Timestep Fine DTS Status ON DVD Status OFF Inertia Status OFF

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-10-1 | 15 Winter | 5 | +20% | | | | | 132.817 | -0.169 | 0.000 | 0.13 | | | 8.9 | OK | |
| 1.001 | S0405-10-2 | 15 Winter | 5 | +20% | | | | | 131.527 | -0.155 | 0.000 | 0.21 | | | 13.6 | OK | |
| 1.002 | S0405-10-3 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 130.956 | -0.136 | 0.000 | 0.32 | | | 19.7 | OK | |
| 2.000 | S0405-10-4 | 15 Winter | 5 | +20% | | | | | 132.017 | -0.173 | 0.000 | 0.12 | | | 9.4 | OK | |
| 1.003 | S0405-10-5 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 130.129 | -0.065 | 0.000 | 0.84 | | | 28.9 | OK | |
| 3.000 | S0405-10-6 | 15 Winter | 5 | +20% | | | | | 132.898 | -0.164 | 0.000 | 0.16 | | | 10.1 | OK | |
| 3.001 | S0405-10-7 | 15 Winter | 5 | +20% | | | | | 131.322 | -0.143 | 0.000 | 0.28 | | | 18.2 | OK | |
| 4.000 | S0405-10-8 | 15 Winter | 5 | +20% | | | | | 132.462 | -0.173 | 0.000 | 0.12 | | | 9.8 | OK | |
| 1.004 | S0405-10-9 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 130.054 | -0.064 | 0.000 | 0.85 | | | 56.8 | OK | |
| 1.005 | S0405-10-10 (Pond) | 60 Winter | 5 | +20% | 100/30 Winter | | | | 129.475 | -0.100 | 0.000 | 0.59 | | | 17.1 | OK | |
| 1.006 | S0405-10-11 (Flow Control) | 60 Winter | 5 | +20% | 100/30 Winter | | | | 129.413 | -0.097 | 0.000 | 0.61 | | | 17.2 | OK | |
| 1.007 | S0405-10-12 | 60 Winter | 5 | +20% | 100/60 Winter | | | | 129.357 | -0.106 | 0.000 | 0.54 | | | 17.1 | OK | |
| 1.008 | S0405-10-13 | 60 Winter | 5 | +20% | | | | | 129.146 | -0.106 | 0.000 | 0.54 | | | 17.0 | OK | |
| 1.009 | S0405-10-14 | 60 Winter | 5 | +20% | | | | | 128.954 | -0.108 | 0.000 | 0.53 | | | 16.8 | OK | |
| 1.010 | S0405-10-15 | 60 Winter | 5 | +20% | | | | | 128.556 | -0.109 | 0.000 | 0.52 | | | 16.7 | OK | |
| 1.011 | S0405-10-16 | 60 Winter | 5 | +20% | 100/30 Winter | | | | 128.206 | -0.097 | 0.000 | 0.62 | | | 16.7 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Side Road 006 - Sleastonhow Lane East

### Simulation Criteria

Areal Reduction Factor 1.000 Hot Start Level (mm) 0 Foul Sewage per hectare (l/s) 0.000 MADD Factor * 10m³/ha Storage 2.000 Flow per Person per Day (l/per/day) 0.000
Hot Start (mins) 0 Manhole Headloss Coeff (Global) 0.500 Additional Flow - % of Total Flow 0.000 Inlet Coefficient 0.800

Number of Input Hydrographs 0 Number of Online Controls 0 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Region England and Wales M5-60 (mm) 16.500 Ratio R 0.300 Cv (Summer) 0.750 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 Analysis Timestep Fine DTS Status ON DVD Status OFF Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-10-1 | 15 Winter | 100 | +40% | | | | | 132.846 | -0.140 | 0.000 | 0.29 | | | 19.2 | OK | |
| 1.001 | S0405-10-2 | 15 Winter | 100 | +40% | | | | | 131.570 | -0.112 | 0.000 | 0.49 | | | 31.1 | OK | |
| 1.002 | S0405-10-3 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 131.304 | 0.212 | 0.000 | 0.72 | | | 44.1 | SURCHARGED | |
| 2.000 | S0405-10-4 | 15 Winter | 100 | +40% | | | | | 132.043 | -0.147 | 0.000 | 0.25 | | | 20.4 | OK | |
| 1.003 | S0405-10-5 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 131.023 | 0.829 | 0.000 | 1.53 | | | 52.4 | SURCHARGED | |
| 3.000 | S0405-10-6 | 15 Winter | 100 | +40% | | | | | 132.930 | -0.132 | 0.000 | 0.34 | | | 21.8 | OK | |
| 3.001 | S0405-10-7 | 15 Winter | 100 | +40% | | | | | 131.379 | -0.086 | 0.000 | 0.66 | | | 43.2 | OK | |
| 4.000 | S0405-10-8 | 15 Winter | 100 | +40% | | | | | 132.488 | -0.147 | 0.000 | 0.25 | | | 21.2 | OK | |
| 1.004 | S0405-10-9 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 130.854 | 0.736 | 0.000 | 1.54 | | | 102.7 | SURCHARGED | |
| 1.005 | S0405-10-10 (Pond) | 60 Winter | 100 | +40% | 100/30 Winter | | | | 129.611 | 0.036 | 0.000 | 1.13 | | | 32.7 | FLOOD RISK | |
| 1.006 | S0405-10-11 (Flow Control) | 60 Winter | 100 | +40% | 100/30 Winter | | | | 129.530 | 0.020 | 0.000 | 1.16 | | | 32.5 | SURCHARGED | |
| 1.007 | S0405-10-12 | 60 Winter | 100 | +40% | 100/60 Winter | | | | 129.468 | 0.005 | 0.000 | 1.03 | | | 32.4 | SURCHARGED | |
| 1.008 | S0405-10-13 | 60 Winter | 100 | +40% | | | | | 129.252 | 0.000 | 0.000 | 1.01 | | | 31.7 | OK | |
| 1.009 | S0405-10-14 | 60 Winter | 100 | +40% | | | | | 129.033 | -0.029 | 0.000 | 0.98 | | | 31.2 | OK | |
| 1.010 | S0405-10-15 | 60 Winter | 100 | +40% | | | | | 128.656 | -0.009 | 0.000 | 0.97 | | | 31.1 | OK | |
| 1.011 | S0405-10-16 | 60 Winter | 100 | +40% | 100/30 Winter | | | | 128.312 | 0.009 | 0.000 | 1.15 | | | 31.1 | SURCHARGED | |

## Simulation Criteria for Sleastonhow Lane West

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Hot Start Level (mm) | 0 | Additional Flow - % of Total Flow | 0.000 | Flow per Person per Day (l/per/day) | 0.000 |
| Areal Reduction Factor | 1.000 | Manhole Headloss Coeff (Global) | 0.500 | MADD Factor * 10m³/ha Storage | 2.000 | Run Time (mins) | 60 |
| Hot Start (mins) | 0 | Foul Sewage per hectare (l/s) | 0.000 | Inlet Coeffiecient | 0.800 | Output Interval (mins) | 1 |

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

## Synthetic Rainfall Details

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Rainfall Model | FSR | Region | England and Wales | Ratio R | 0.200 | Cv (Summer) | 0.750 | Storm Duration (mins) | 30 |
| Return Period (years) | 30 | M5-60 (mm) | 20.000 | Profile Type | Summer | Cv (Winter) | 0.840 | | |

## Online Controls for Sleastonhow Lane West

### Hydro-Brake® Optimum Manhole: S0405-11-18 (Flow Control), DS/PN: 1.006, Volume (m³): 1.7

| | | | | | |
|---|---|---|---|---|---|
| Unit Reference | MD-SHE-0282-4500-0952-4500 | Objective | Minimise upstream storage | Invert Level (m) | 119.148 |
| Design Head (m) | 0.952 | Application | Surface | Minimum Outlet Pipe Diameter (mm) | 300 |
| Design Flow (l/s) | 45.0 | Sump Available | Yes | Suggested Manhole Diameter (mm) | 1800 |
| Flush-Flo™ | Calculated | Diameter (mm) | 282 | | |

| Control Points | Head (m) | Flow (l/s) | Control Points | Head (m) | Flow (l/s) | Control Points | Head (m) | Flow (l/s) | Control Points | Head (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Design Point (Calculated) | 0.952 | 45.0 | Flush-Flo™ | 0.426 | 44.9 | Kick-Flo® | 0.747 | 40.0 | Mean Flow over Head Range | - | 36.1 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 8.8 | 0.500 | 44.7 | 1.200 | 50.3 | 2.000 | 64.4 | 3.000 | 78.4 | 5.000 | 100.5 | 7.000 | 118.5 | 9.000 | 133.9 |
| 0.200 | 29.0 | 0.600 | 43.7 | 1.400 | 54.2 | 2.200 | 67.4 | 3.500 | 84.5 | 5.500 | 105.3 | 7.500 | 122.5 | 9.500 | 137.5 |
| 0.300 | 43.8 | 0.800 | 41.4 | 1.600 | 57.8 | 2.400 | 70.3 | 4.000 | 90.1 | 6.000 | 109.9 | 8.000 | 126.4 | | |
| 0.400 | 44.9 | 1.000 | 46.1 | 1.800 | 61.2 | 2.600 | 73.1 | 4.500 | 95.5 | 6.500 | 114.2 | 8.500 | 130.2 | | |

## Storage Structures for Sleastonhow Lane West

### Tank or Pond Manhole: S0405-11-17 (Pond), DS/PN: 1.005

Invert Level (m) 119.500

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 330.0 | 1.300 | 749.8 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Sleastonhow Lane West

### Simulation Criteria

Areal Reduction Factor 1.000 Hot Start Level (mm) 0 Foul Sewage per hectare (l/s) 0.000 MADD Factor * 10$m^3$/ha Storage 2.000 Flow per Person per Day (l/per/day) 0.000
Hot Start (mins) 0 Manhole Headloss Coeff (Global) 0.500 Additional Flow - % of Total Flow 0.000 Inlet Coeffiecient 0.800

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Region England and Wales M5-60 (mm) 18.400 Ratio R 0.300 Cv (Summer) 0.750 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 Analysis Timestep Fine DTS Status ON DVD Status OFF Inertia Status OFF

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume ($m^3$) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-11-1 | 15 Winter | 5 | +20% | | | | | 131.789 | -0.174 | 0.000 | 0.12 | | | 15.5 | OK | |
| 1.001 | S0405-11-2 | 15 Winter | 5 | +20% | | | | | 128.287 | -0.158 | 0.000 | 0.19 | | | 25.7 | OK | |
| 1.002 | S0405-11-3 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 121.492 | -0.121 | 0.000 | 0.43 | | | 30.2 | OK | |
| 2.000 | S0405-11-4 | 15 Winter | 5 | +20% | | | | | 131.561 | -0.178 | 0.000 | 0.10 | | | 13.6 | OK | |
| 2.001 | S0405-11-5 | 15 Winter | 5 | +20% | | | | | 127.844 | -0.156 | 0.000 | 0.20 | | | 26.7 | OK | |
| 2.002 | S0405-11-6 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 121.058 | -0.102 | 0.000 | 0.57 | | | 29.4 | OK | 4 |
| 3.000 | S0405-11-7 | 15 Winter | 5 | +20% | | | | | 124.630 | -0.175 | 0.000 | 0.11 | | | 6.1 | OK | |
| 3.001 | S0405-11-8 | 15 Winter | 5 | +20% | | | | | 124.067 | -0.161 | 0.000 | 0.18 | | | 16.7 | OK | |
| 3.002 | S0405-11-9 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 121.546 | -0.142 | 0.000 | 0.29 | | | 20.8 | OK | |
| 2.003 | S0405-11-10 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 120.946 | 0.038 | 0.000 | 1.21 | | | 49.5 | SURCHARGED | 4 |
| 4.000 | S0405-11-11 | 15 Winter | 5 | +20% | | | | | 124.624 | -0.183 | 0.000 | 0.08 | | | 4.7 | OK | |
| 4.001 | S0405-11-12 | 15 Winter | 5 | +20% | | | | | 124.029 | -0.171 | 0.000 | 0.13 | | | 12.3 | OK | |
| 4.002 | S0405-11-13 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 121.547 | -0.153 | 0.000 | 0.22 | | | 16.7 | OK | |
| 1.003 | S0405-11-14 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 120.717 | -0.088 | 0.000 | 0.68 | | | 95.5 | OK | |
| 1.004 | S0405-11-15 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 120.031 | 0.144 | 0.000 | 1.66 | | | 94.9 | SURCHARGED | |
| 1.005 | S0405-11-17 (Pond) | 30 Winter | 5 | +20% | | | | | 119.611 | -0.189 | 0.000 | 0.29 | | | 43.7 | OK | |
| 1.006 | S0405-11-18 (Flow Control) | 30 Winter | 5 | +20% | 100/15 Summer | 100/120 Summer | | | 119.434 | -0.089 | 0.000 | 0.14 | | | 43.5 | OK | 2 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Sleastonhow Lane West

### Simulation Criteria

Areal Reduction Factor 1.000 Hot Start Level (mm) 0 Foul Sewage per hectare (l/s) 0.000 MADD Factor * 10m³/ha Storage 2.000 Flow per Person per Day (l/per/day) 0.000
Hot Start (mins) 0 Manhole Headloss Coeff (Global) 0.500 Additional Flow - % of Total Flow 0.000 Inlet Coeffiecient 0.800

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Region England and Wales M5-60 (mm) 18.400 Ratio R 0.300 Cv (Summer) 0.750 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 Analysis Timestep Fine DTS Status ON DVD Status OFF Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-11-1 | 15 Winter | 100 | +40% | | | | | 131.815 | -0.148 | 0.000 | 0.26 | | | 34.1 | OK | |
| 1.001 | S0405-11-2 | 15 Winter | 100 | +40% | | | | | 128.329 | -0.116 | 0.000 | 0.46 | | | 61.6 | OK | |
| 1.002 | S0405-11-3 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 122.598 | 0.984 | 0.000 | 0.94 | | | 65.8 | FLOOD RISK | |
| 2.000 | S0405-11-4 | 15 Winter | 100 | +40% | | | | | 131.585 | -0.154 | 0.000 | 0.22 | | | 29.9 | OK | |
| 2.001 | S0405-11-5 | 15 Winter | 100 | +40% | | | | | 127.888 | -0.112 | 0.000 | 0.49 | | | 65.7 | OK | |
| 2.002 | S0405-11-6 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 122.362 | 1.202 | 2.121 | 1.07 | | | 55.0 | FLOOD | 4 |
| 3.000 | S0405-11-7 | 15 Winter | 100 | +40% | | | | | 124.655 | -0.150 | 0.000 | 0.23 | | | 13.3 | OK | |
| 3.001 | S0405-11-8 | 15 Winter | 100 | +40% | | | | | 124.110 | -0.118 | 0.000 | 0.44 | | | 41.7 | OK | |
| 3.002 | S0405-11-9 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 122.477 | 0.788 | 0.000 | 0.66 | | | 47.5 | SURCHARGED | |
| 2.003 | S0405-11-10 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 122.113 | 1.205 | 4.969 | 2.35 | | | 96.6 | FLOOD | 4 |
| 4.000 | S0405-11-11 | 15 Winter | 100 | +40% | | | | | 124.645 | -0.162 | 0.000 | 0.17 | | | 10.3 | OK | |
| 4.001 | S0405-11-12 | 15 Winter | 100 | +40% | | | | | 124.065 | -0.135 | 0.000 | 0.33 | | | 30.8 | OK | |
| 4.002 | S0405-11-13 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 122.069 | 0.369 | 0.000 | 0.50 | | | 37.1 | SURCHARGED | |
| 1.003 | S0405-11-14 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 121.847 | 1.042 | 0.000 | 1.19 | | | 167.8 | FLOOD RISK | |
| 1.004 | S0405-11-15 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 120.434 | 0.547 | 0.000 | 2.73 | | | 156.1 | FLOOD RISK | |
| 1.005 | S0405-11-17 (Pond) | 60 Winter | 100 | +40% | | | | | 119.792 | -0.008 | 0.000 | 0.32 | | | 48.0 | FLOOD RISK | |
| 1.006 | S0405-11-18 (Flow Control) | 180 Winter | 100 | +40% | 100/15 Summer | 100/120 Summer | | | 120.100 | 0.577 | 0.224 | 0.15 | | | 44.9 | FLOOD | 2 |

## Simulation Criteria for Gypsum Junction

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Hot Start Level (mm) | 0 | Additional Flow - % of Total Flow | 0.000 | Flow per Person per Day (l/per/day) | 0.000 |
| Areal Reduction Factor | 1.000 | Manhole Headloss Coeff (Global) | 0.500 | MADD Factor * $10m^3$/ha Storage | 2.000 | Run Time (mins) | 60 |
| Hot Start (mins) | 0 | Foul Sewage per hectare (l/s) | 0.000 | Inlet Coeffiecient | 0.800 | Output Interval (mins) | 1 |

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

## Synthetic Rainfall Details

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Rainfall Model | FSR | Region | England and Wales | Ratio R | 0.300 | Cv (Summer) | 0.750 | Storm Duration (mins) | 30 |
| Return Period (years) | 30 | M5-60 (mm) | 18.600 | Profile Type | Summer | Cv (Winter) | 0.840 | | |

## Online Controls for Gypsum Junction

### Hydro-Brake® Optimum Manhole: S0405-12-25 (Flow Control), DS/PN: 1.006, Volume (m³): 3.4

| | | | | | |
|---|---|---|---|---|---|
| Unit Reference | MD-SHE-0271-4500-1800-4500 | Objective | Minimise upstream storage | Invert Level (m) | 123.661 |
| Design Head (m) | 1.800 | Application | Surface | Minimum Outlet Pipe Diameter (mm) | 300 |
| Design Flow (l/s) | 45.0 | Sump Available | Yes | Suggested Manhole Diameter (mm) | 2100 |
| Flush-Flo™ | Calculated | Diameter (mm) | 271 | | |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Design Point (Calculated) | 1.800 | 45.0 | Flush-Flo™ | 0.551 | 44.9 | Kick-Flo® | 1.209 | 37.2 | Mean Flow over Head Range | - | 38.6 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 8.6 | 0.500 | 44.9 | 1.200 | 37.6 | 2.000 | 47.3 | 3.000 | 57.6 | 5.000 | 73.7 | 7.000 | 86.9 | 9.000 | 98.2 |
| 0.200 | 27.9 | 0.600 | 44.9 | 1.400 | 39.9 | 2.200 | 49.6 | 3.500 | 62.0 | 5.500 | 77.2 | 7.500 | 89.8 | 9.500 | 100.8 |
| 0.300 | 42.3 | 0.800 | 44.0 | 1.600 | 42.5 | 2.400 | 51.7 | 4.000 | 66.2 | 6.000 | 80.6 | 8.000 | 92.7 | | |
| 0.400 | 44.2 | 1.000 | 42.2 | 1.800 | 45.0 | 2.600 | 53.7 | 4.500 | 70.1 | 6.500 | 83.8 | 8.500 | 95.5 | | |

## Storage Structures for Gypsum Junction

### Tank or Pond Manhole: S0405-12-24 (Pond), DS/PN: 1.005

Invert Level (m) 124.193

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 500.0 | 1.800 | 1233.6 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Gypsum Junction

### Simulation Criteria

Areal Reduction Factor 1.000 Hot Start Level (mm) 0 Foul Sewage per hectare (l/s) 0.000 MADD Factor * 10m³/ha Storage 2.000 Flow per Person per Day (l/per/day) 0.000
Hot Start (mins) 0 Manhole Headloss Coeff (Global) 0.500 Additional Flow - % of Total Flow 0.000 Inlet Coeffiecient 0.800

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Region England and Wales M5-60 (mm) 18.600 Ratio R 0.300 Cv (Summer) 0.750 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status OFF Inertia Status OFF
Analysis Timestep 2.5 Second Increment (Extended) DVD Status OFF

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-12-1 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 130.058 | -0.106 | 0.000 | 0.50 | | | 23.3 | OK | |
| 1.001 | S0405-12-2 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | | | 129.248 | -0.075 | 0.000 | 0.75 | | | 46.7 | OK | 2 |
| 1.002 | S0405-12-3 | 15 Winter | 5 | +20% | 100/15 Summer | 100/30 Winter | | | 127.673 | -0.137 | 0.000 | 0.32 | | | 49.7 | OK | 1 |
| 2.000 | S0405-12-4 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 126.222 | 0.462 | 0.000 | 0.11 | | | 4.1 | SURCHARGED | |
| 3.000 | S0405-12-5 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 128.171 | -0.190 | 0.000 | 0.06 | | | 1.9 | OK | |
| 4.000 | S0405-12-6 | 15 Winter | 5 | +20% | | | | | 129.910 | -0.177 | 0.000 | 0.10 | | | 6.1 | OK | |
| 4.001 | S0405-12-7 | 15 Winter | 5 | +20% | | | | | 129.300 | -0.160 | 0.000 | 0.18 | | | 6.8 | OK | |
| 4.002 | S0405-12-8 | 15 Winter | 5 | +20% | | | | | 129.006 | -0.148 | 0.000 | 0.25 | | | 9.1 | OK | |
| 4.003 | S0405-12-9 | 15 Winter | 5 | +20% | | | | | 128.889 | -0.151 | 0.000 | 0.23 | | | 14.4 | OK | |
| 3.001 | S0405-12-10 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 128.111 | -0.182 | 0.000 | 0.08 | | | 16.2 | OK | |
| 2.001 | S0405-12-11 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 126.218 | 0.569 | 0.000 | 0.61 | | | 22.2 | SURCHARGED | |
| 2.002 | S0405-12-12 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 126.171 | 0.648 | 0.000 | 0.83 | | | 29.6 | SURCHARGED | |
| 1.003 | S0405-12-13 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 126.126 | 0.705 | 0.000 | 1.89 | | | 67.5 | SURCHARGED | |
| 5.000 | S0405-12-14 | 15 Winter | 5 | +20% | | | | | 129.891 | -0.182 | 0.000 | 0.08 | | | 2.9 | OK | |
| 5.001 | S0405-12-15 | 15 Winter | 5 | +20% | | | | | 129.438 | -0.182 | 0.000 | 0.08 | | | 4.5 | OK | |
| 5.002 | S0405-12-16 | 15 Winter | 5 | +20% | | | | | 128.896 | -0.185 | 0.000 | 0.07 | | | 7.3 | OK | |
| 6.000 | S0405-12-17 | 15 Winter | 5 | +20% | | | | | 130.117 | -0.147 | 0.000 | 0.25 | | | 14.3 | OK | |
| 6.001 | S0405-12-18 | 15 Winter | 5 | +20% | | | | | 129.113 | -0.116 | 0.000 | 0.48 | | | 14.2 | OK | |
| 6.002 | S0405-12-19 | 15 Winter | 5 | +20% | | | | | 129.046 | -0.138 | 0.000 | 0.31 | | | 22.3 | OK | |
| 6.003 | S0405-12-20 | 15 Winter | 5 | +20% | | | | | 128.243 | -0.134 | 0.000 | 0.34 | | | 22.7 | OK | |
| 6.004 | S0405-12-21 | 15 Winter | 5 | +20% | 100/15 Winter | | | | 127.948 | -0.136 | 0.000 | 0.33 | | | 23.3 | OK | |
| 6.005 | S0405-12-22 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 127.441 | -0.174 | 0.000 | 0.12 | | | 24.6 | OK | |
| 1.004 | S0405-12-23 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 125.827 | 0.490 | 0.000 | 1.24 | | | 94.2 | SURCHARGED | |
| 1.005 | S0405-12-24 (Pond) | 60 Winter | 5 | +20% | 100/60 Winter | | | | 124.308 | -0.185 | 0.000 | 0.30 | | | 48.1 | OK | |
| 1.006 | S0405-12-25 (Flow Control) | 60 Winter | 5 | +20% | 5/15 Winter | | | | 124.261 | 0.300 | 0.000 | 0.85 | | | 44.7 | SURCHARGED | |
| 1.007 | S0405-12-27 | 60 Winter | 5 | +20% | | | | | 123.700 | -0.102 | 0.000 | 0.77 | | | 44.7 | OK | |
| 1.008 | S0405-12-28 | 60 Winter | 5 | +20% | | | | | 123.590 | -0.110 | 0.000 | 0.73 | | | 44.6 | OK | |
| 1.009 | S0405-12-29 | 60 Winter | 5 | +20% | | | | | 123.332 | -0.107 | 0.000 | 0.74 | | | 44.6 | OK | |
| 1.010 | S0405-12-30 | 60 Winter | 5 | +20% | | | | | 123.154 | -0.110 | 0.000 | 0.72 | | | 44.5 | OK | |
| 1.011 | S0405-12-31 | 60 Winter | 5 | +20% | | | | | 122.883 | -0.110 | 0.000 | 0.72 | | | 44.4 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Gypsum Junction

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.012 | S0405-12-32 | 60 Winter | 5 | +20% | | | | | 122.505 | -0.212 | 0.000 | 0.19 | | | 44.4 | OK | |
| 1.013 | S0405-12-33 | 60 Winter | 5 | +20% | | | | | 118.691 | -0.109 | 0.000 | 0.73 | | | 44.3 | OK | |
| 1.014 | S0405-12-34 | 60 Winter | 5 | +20% | | | | | 118.485 | -0.100 | 0.000 | 0.76 | | | 44.2 | OK | |
| 1.015 | S0405-12-35 | 60 Winter | 5 | +20% | | | | | 118.423 | -0.062 | 0.000 | 0.99 | | | 44.2 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Gypsum Junction

### Simulation Criteria

Areal Reduction Factor 1.000 Hot Start Level (mm) 0 Foul Sewage per hectare (l/s) 0.000 MADD Factor * 10m³/ha Storage 2.000 Flow per Person per Day (l/per/day) 0.000
Hot Start (mins) 0 Manhole Headloss Coeff (Global) 0.500 Additional Flow - % of Total Flow 0.000 Inlet Coeffiecient 0.800

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Region England and Wales M5-60 (mm) 18.600 Ratio R 0.300 Cv (Summer) 0.750 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status OFF Inertia Status OFF
Analysis Timestep 2.5 Second Increment (Extended) DVD Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-12-1 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 131.175 | 1.011 | 0.000 | 0.84 | | | 39.2 | FLOOD RISK | |
| 1.001 | S0405-12-2 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | | | 130.524 | 1.201 | 1.176 | 1.16 | | | 72.7 | FLOOD | 2 |
| 1.002 | S0405-12-3 | 30 Winter | 100 | +40% | 100/15 Summer | 100/30 Winter | | | 129.010 | 1.200 | 0.071 | 0.46 | | | 69.9 | FLOOD | 1 |
| 2.000 | S0405-12-4 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 128.794 | 3.034 | 0.000 | 0.26 | | | 9.5 | SURCHARGED | |
| 3.000 | S0405-12-5 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 128.828 | 0.466 | 0.000 | 0.10 | | | 3.5 | SURCHARGED | |
| 4.000 | S0405-12-6 | 15 Winter | 100 | +40% | | | | | 129.935 | -0.153 | 0.000 | 0.22 | | | 13.3 | OK | |
| 4.001 | S0405-12-7 | 15 Winter | 100 | +40% | | | | | 129.337 | -0.123 | 0.000 | 0.40 | | | 15.4 | OK | |
| 4.002 | S0405-12-8 | 15 Winter | 100 | +40% | | | | | 129.054 | -0.100 | 0.000 | 0.59 | | | 21.2 | OK | |
| 4.003 | S0405-12-9 | 15 Winter | 100 | +40% | | | | | 128.938 | -0.101 | 0.000 | 0.56 | | | 35.0 | OK | |
| 3.001 | S0405-12-10 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 128.826 | 0.533 | 0.000 | 0.16 | | | 30.9 | SURCHARGED | |
| 2.001 | S0405-12-11 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 128.790 | 3.141 | 0.000 | 1.07 | | | 39.0 | SURCHARGED | |
| 2.002 | S0405-12-12 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 128.684 | 3.161 | 0.000 | 1.20 | | | 42.9 | FLOOD RISK | |
| 1.003 | S0405-12-13 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 128.571 | 3.150 | 0.000 | 3.08 | | | 109.8 | SURCHARGED | |
| 5.000 | S0405-12-14 | 15 Winter | 100 | +40% | | | | | 129.912 | -0.161 | 0.000 | 0.17 | | | 6.4 | OK | |
| 5.001 | S0405-12-15 | 15 Winter | 100 | +40% | | | | | 129.462 | -0.157 | 0.000 | 0.19 | | | 10.4 | OK | |
| 5.002 | S0405-12-16 | 15 Winter | 100 | +40% | | | | | 128.921 | -0.160 | 0.000 | 0.18 | | | 18.0 | OK | |
| 6.000 | S0405-12-17 | 15 Winter | 100 | +40% | | | | | 130.162 | -0.103 | 0.000 | 0.55 | | | 31.4 | OK | |
| 6.001 | S0405-12-18 | 15 Winter | 100 | +40% | | | | | 129.221 | -0.008 | 0.000 | 1.00 | | | 29.9 | OK | |
| 6.002 | S0405-12-19 | 15 Winter | 100 | +40% | | | | | 129.105 | -0.079 | 0.000 | 0.72 | | | 50.9 | OK | |
| 6.003 | S0405-12-20 | 15 Winter | 100 | +40% | | | | | 128.306 | -0.071 | 0.000 | 0.79 | | | 52.9 | OK | |
| 6.004 | S0405-12-21 | 15 Winter | 100 | +40% | 100/15 Winter | | | | 128.110 | 0.027 | 0.000 | 0.77 | | | 54.3 | SURCHARGED | |
| 6.005 | S0405-12-22 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 127.970 | 0.354 | 0.000 | 0.25 | | | 53.2 | SURCHARGED | |
| 1.004 | S0405-12-23 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 127.900 | 2.563 | 0.000 | 1.95 | | | 147.5 | SURCHARGED | |
| 1.005 | S0405-12-24 (Pond) | 60 Winter | 100 | +40% | 100/60 Winter | | | | 124.505 | 0.012 | 0.000 | 0.32 | | | 51.4 | SURCHARGED | |
| 1.006 | S0405-12-25 (Flow Control) | 60 Winter | 100 | +40% | 5/15 Winter | | | | 124.459 | 0.498 | 0.000 | 0.86 | | | 44.9 | SURCHARGED | |
| 1.007 | S0405-12-27 | 360 Summer | 100 | +40% | | | | | 123.701 | -0.101 | 0.000 | 0.77 | | | 44.9 | OK | |
| 1.008 | S0405-12-28 | 360 Summer | 100 | +40% | | | | | 123.591 | -0.109 | 0.000 | 0.73 | | | 44.9 | OK | |
| 1.009 | S0405-12-29 | 360 Summer | 100 | +40% | | | | | 123.333 | -0.106 | 0.000 | 0.74 | | | 44.9 | OK | |
| 1.010 | S0405-12-30 | 360 Summer | 100 | +40% | | | | | 123.155 | -0.109 | 0.000 | 0.73 | | | 44.9 | OK | |
| 1.011 | S0405-12-31 | 360 Summer | 100 | +40% | | | | | 122.884 | -0.109 | 0.000 | 0.73 | | | 44.9 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Gypsum Junction

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.012 | S0405-12-32 | 360 Summer | 100 | +40% | | | | | 122.505 | -0.212 | 0.000 | 0.19 | | | 44.9 | OK | |
| 1.013 | S0405-12-33 | 360 Summer | 100 | +40% | | | | | 118.692 | -0.108 | 0.000 | 0.74 | | | 44.9 | OK | |
| 1.014 | S0405-12-34 | 180 Winter | 100 | +40% | | | | | 118.525 | -0.060 | 0.000 | 0.77 | | | 44.8 | OK | |
| 1.015 | S0405-12-35 | 180 Winter | 100 | +40% | | | | | 118.466 | -0.019 | 0.000 | 1.00 | | | 44.7 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Gypsum Bridge

```
                   Pipe Sizes STANDARD Manhole Sizes STANDARD

                    FSR Rainfall Model - England and Wales
          Return Period (years)      30          Foul Sewage (l/s/ha) 0.000          Maximum Backdrop Height (m) 1.500
                    M5-60 (mm)  15.700      Volumetric Runoff Coeff. 0.750 Min Design Depth for Optimisation (m) 1.200
                       Ratio R   0.300                      PIMP (%)    100     Min Vel for Auto Design only (m/s)  1.00
        Maximum Rainfall (mm/hr)     50 Add Flow / Climate Change (%)      0       Min Slope for Optimisation (1:X)   500
Maximum Time of Concentration (mins) 30   Minimum Backdrop Height (m) 0.200

                          Designed with Level Inverts
```

### Simulation Criteria for Gypsum Bridge

```
Volumetric Runoff Coeff 0.750   Manhole Headloss Coeff (Global) 0.500                Inlet Coeffiecient 0.800
 Areal Reduction Factor 1.000     Foul Sewage per hectare (l/s) 0.000 Flow per Person per Day (l/per/day) 0.000
       Hot Start (mins)     0 Additional Flow - % of Total Flow 0.000                     Run Time (mins)    60
    Hot Start Level (mm)    0     MADD Factor * 10m³/ha Storage 2.000                Output Interval (mins)     1

   Number of Input Hydrographs 0   Number of Offline Controls 0 Number of Time/Area Diagrams 0
     Number of Online Controls 1 Number of Storage Structures 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
          Rainfall Model FSR     Region England and Wales      Ratio R  0.300
   Return Period (years)   30 M5-60 (mm)             18.600 Profile Type Summer
```

## Synthetic Rainfall Details

Cv (Summer) 0.750 Cv (Winter) 0.840 Storm Duration (mins) 30

## Online Controls for Gypsum Bridge

### Orifice Manhole: S0405-12a-12, DS/PN: 1.004, Volume (m³): 2.6

Diameter (m) 0.161 Discharge Coefficient 0.600 Invert Level (m) 120.680

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Gypsum Bridge

### Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.600 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status OFF
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-12a-1 | 15 Winter | 5 | +20% | | | | | 126.389 | -0.148 | 0.000 | 0.25 | | |
| 1.001 | S0405-12a-2 | 15 Winter | 5 | +20% | | | | | 125.024 | -0.150 | 0.000 | 0.24 | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Gypsum Bridge

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| 1.000 | S0405-12a-1 | 20.6 | OK | |
| 1.001 | S0405-12a-2 | 26.7 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Gypsum Bridge

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.002 | S0405-12a-3 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 122.334 | -0.137 | 0.000 | 0.32 | |
| 1.003 | S0405-12a-4 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 121.706 | 0.663 | 0.000 | 0.55 | |
| 2.000 | S0405-12a-5 | 15 Winter | 5 | +20% | | | | | 126.654 | -0.164 | 0.000 | 0.16 | |
| 2.001 | S0405-12a-6 | 15 Winter | 5 | +20% | | | | | 124.696 | -0.157 | 0.000 | 0.20 | |
| 2.002 | S0405-12a-8 | 15 Winter | 5 | +20% | | | | | 122.774 | -0.151 | 0.000 | 0.23 | |
| 2.003 | S0405-12a-9 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 122.405 | -0.146 | 0.000 | 0.26 | |
| 2.004 | S0405-12a-10 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 121.764 | -0.125 | 0.000 | 0.41 | |
| 2.005 | S0405-12a-11 | 15 Winter | 5 | +20% | 5/15 Winter | | | | 121.714 | 0.033 | 0.000 | 0.25 | |
| 1.004 | S0405-12a-12 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 121.669 | 0.689 | 0.000 | 0.68 | |

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 1.002 | S0405-12a-3 | | 32.3 | OK | |
| 1.003 | S0405-12a-4 | | 28.8 | SURCHARGED | 6 |
| 2.000 | S0405-12a-5 | | 17.8 | OK | |
| 2.001 | S0405-12a-6 | | 19.6 | OK | |
| 2.002 | S0405-12a-8 | | 19.9 | OK | |
| 2.003 | S0405-12a-9 | | 23.1 | OK | |
| 2.004 | S0405-12a-10 | | 26.1 | OK | |
| 2.005 | S0405-12a-11 | | 24.7 | SURCHARGED | |
| 1.004 | S0405-12a-12 | | 51.4 | SURCHARGED | 6 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Gypsum Bridge

### Simulation Criteria

Areal Reduction Factor 1.000
Hot Start (mins) 0
Hot Start Level (mm) 0
Manhole Headloss Coeff (Global) 0.500
Foul Sewage per hectare (l/s) 0.000
Additional Flow - % of Total Flow 0.000
MADD Factor * 10m³/ha Storage 2.000
Inlet Coeffiecient 0.800
Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0
Number of Online Controls 1
Number of Offline Controls 0
Number of Storage Structures 0
Number of Time/Area Diagrams 0
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
Region England and Wales
M5-60 (mm) 18.600
Ratio R 0.300
Cv (Summer) 0.750
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-12a-1 | 15 Winter | 100 | +40% | | | | | 126.434 | -0.103 | 0.000 | 0.55 | | |
| 1.001 | S0405-12a-2 | 15 Winter | 100 | +40% | | | | | 125.070 | -0.104 | 0.000 | 0.54 | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Gypsum Bridge

| **PN** | **US/MH Name** | **Pipe Flow (l/s)** | **Status** | **Level Exceeded** |
|---|---|---|---|---|
| 1.000 | S0405-12a-1 | 45.4 | OK | |
| 1.001 | S0405-12a-2 | 60.7 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Gypsum Bridge

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.002 | S0405-12a-3 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 123.039 | 0.568 | 0.000 | 0.74 | |
| 1.003 | S0405-12a-4 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 122.252 | 1.209 | 8.717 | 0.78 | |
| 2.000 | S0405-12a-5 | 15 Winter | 100 | +40% | | | | | 126.686 | -0.131 | 0.000 | 0.36 | |
| 2.001 | S0405-12a-6 | 15 Winter | 100 | +40% | | | | | 124.734 | -0.119 | 0.000 | 0.44 | |
| 2.002 | S0405-12a-8 | 15 Winter | 100 | +40% | | | | | 122.910 | -0.016 | 0.000 | 0.50 | |
| 2.003 | S0405-12a-9 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 122.820 | 0.269 | 0.000 | 0.56 | |
| 2.004 | S0405-12a-10 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 122.607 | 0.719 | 0.000 | 0.87 | |
| 2.005 | S0405-12a-11 | 15 Winter | 100 | +40% | 5/15 Winter | | | | 122.445 | 0.764 | 0.000 | 0.57 | |
| 1.004 | S0405-12a-12 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 122.187 | 1.207 | 7.039 | 0.86 | |

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 1.002 | S0405-12a-3 | | 74.3 | SURCHARGED | |
| 1.003 | S0405-12a-4 | | 40.7 | FLOOD | 6 |
| 2.000 | S0405-12a-5 | | 39.2 | OK | |
| 2.001 | S0405-12a-6 | | 44.0 | OK | |
| 2.002 | S0405-12a-8 | | 43.1 | OK | |
| 2.003 | S0405-12a-9 | | 49.1 | SURCHARGED | |
| 2.004 | S0405-12a-10 | | 55.3 | SURCHARGED | |
| 2.005 | S0405-12a-11 | | 56.5 | SURCHARGED | |
| 1.004 | S0405-12a-12 | | 64.6 | FLOOD | 6 |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Gypsum 12b

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | | | |
|---|---|---|---|---|---|
| Return Period (years) | 1 | Foul Sewage (l/s/ha) | 0.000 | Maximum Backdrop Height (m) | 1.500 |
| M5-60 (mm) | 15.600 | Volumetric Runoff Coeff. | 0.750 | Min Design Depth for Optimisation (m) | 1.200 |
| Ratio R | 0.300 | PIMP (%) | 100 | Min Vel for Auto Design only (m/s) | 1.00 |
| Maximum Rainfall (mm/hr) | 50 | Add Flow / Climate Change (%) | 0 | Min Slope for Optimisation (1:X) | 500 |
| Maximum Time of Concentration (mins) | 30 | Minimum Backdrop Height (m) | 0.200 | | |

Designed with Level Inverts

### Simulation Criteria for Gypsum 12b

| | | | | | |
|---|---|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Manhole Headloss Coeff (Global) | 0.500 | Inlet Coeffiecient | 0.800 |
| Areal Reduction Factor | 1.000 | Foul Sewage per hectare (l/s) | 0.000 | Flow per Person per Day (l/per/day) | 0.000 |
| Hot Start (mins) | 0 | Additional Flow - % of Total Flow | 0.000 | Run Time (mins) | 60 |
| Hot Start Level (mm) | 0 | MADD Factor * 10m³/ha Storage | 2.000 | Output Interval (mins) | 1 |

| | | | | | |
|---|---|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Offline Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Online Controls | 0 | Number of Storage Structures | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | | | |
|---|---|---|---|---|---|
| Rainfall Model | FSR | Region | England and Wales | Ratio R | 0.300 |
| Return Period (years) | 30 | M5-60 (mm) | 18.600 | Profile Type | Summer |

## Synthetic Rainfall Details

Cv (Summer) 0.750 Cv (Winter) 0.840 Storm Duration (mins) 30

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Gypsum 12b

### Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.600 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep 2.5 Second Increment (Extended) Inertia Status OFF
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| **PN** | **US/MH Name** | **Storm** | **Return Period** | **Climate Change** | **First (X) Surcharge** | **First (Y) Flood** | **First (Z) Overflow** | **Overflow Act.** | **Water Level (m)** | **Surcharged Depth (m)** | **Flooded Volume (m³)** | **Flow / Cap.** | **Overflow (l/s)** | **Half Drain Time (mins)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-12b-1 | 15 Winter | 5 | +20% | | | | | 129.995 | -0.169 | 0.000 | 0.14 | | |
| 1.001 | S0405-12b-2 | 15 Winter | 5 | +20% | | | | | 129.764 | -0.178 | 0.000 | 0.09 | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Gypsum 12b

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| 1.000 | S0405-12b-1 | 5.1 | OK | |
| 1.001 | S0405-12b-2 | 4.9 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Gypsum 12b

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.002 | S0405-12b-3 | 15 Winter | 5 | +20% | | | | | 128.725 | -0.184 | 0.000 | 0.08 | |
| 1.003 | S0405-12b-4 | 15 Winter | 5 | +20% | | | | | 127.045 | -0.182 | 0.000 | 0.08 | |
| 1.004 | S0405-12b-5 | 15 Winter | 5 | +20% | | | | | 126.399 | -0.170 | 0.000 | 0.13 | |
| 1.005 | S0405-12b-6 | 15 Winter | 5 | +20% | | | | | 126.233 | -0.183 | 0.000 | 0.08 | |
| 1.006 | S0405-12b-7 | 15 Winter | 5 | +20% | | | | | 124.926 | -0.171 | 0.000 | 0.13 | |
| 1.007 | S0405-12b-8 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 124.877 | 0.916 | 0.000 | 0.14 | |
| 2.000 | S0405-12b-9 | 15 Winter | 5 | +20% | | | | | 130.035 | -0.172 | 0.000 | 0.12 | |
| 2.001 | S0405-12b-10 | 15 Winter | 5 | +20% | | | | | 129.675 | -0.138 | 0.000 | 0.31 | |
| 2.002 | S0405-12b-11 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 128.000 | -0.131 | 0.000 | 0.36 | |
| 2.003 | S0405-12b-12 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 126.356 | -0.119 | 0.000 | 0.44 | |
| 2.004 | S0405-12b-13 | 15 Winter | 5 | +20% | 5/15 Winter | | | | 124.974 | 0.035 | 0.000 | 0.41 | |
| 1.008 | S0405-12b-14 | 15 Winter | 5 | +20% | 5/15 Summer | 5/15 Winter | | | 124.861 | 1.200 | 0.274 | 1.48 | |
| 3.000 | S0405-12b-15 | 15 Winter | 5 | +20% | | | | | 129.880 | -0.193 | 0.000 | 0.05 | |
| 3.001 | S0405-12b-16 | 15 Winter | 5 | +20% | | | | | 128.539 | -0.169 | 0.000 | 0.14 | |
| 3.002 | S0405-12b-17 | 15 Winter | 5 | +20% | 100/15 Winter | | | | 125.661 | -0.157 | 0.000 | 0.20 | |
| 3.003 | S0405-12b-18 | 15 Winter | 5 | +20% | 5/15 Winter | | | | 124.840 | 0.076 | 0.000 | 0.34 | |
| 1.009 | S0405-12b-19 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 124.795 | 1.175 | 0.000 | 1.97 | |
| 1.010 | S0405-12b-20 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 124.669 | 1.082 | 0.000 | 1.79 | |
| 1.011 | S0405-12b-21 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 124.155 | 0.756 | 0.000 | 1.64 | |
| 1.012 | S0405-12b-22 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 123.387 | 0.293 | 0.000 | 1.63 | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Gypsum 12b

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 1.002 | S0405-12b-3 | | 6.4 | OK | |
| 1.003 | S0405-12b-4 | | 7.4 | OK | |
| 1.004 | S0405-12b-5 | | 7.4 | OK | |
| 1.005 | S0405-12b-6 | | 8.0 | OK | |
| 1.006 | S0405-12b-7 | | 12.5 | OK | |
| 1.007 | S0405-12b-8 | | 9.5 | FLOOD RISK | |
| 2.000 | S0405-12b-9 | | 5.4 | OK | |
| 2.001 | S0405-12b-10 | | 22.4 | OK | |
| 2.002 | S0405-12b-11 | | 32.7 | OK | |
| 2.003 | S0405-12b-12 | | 40.6 | OK | |
| 2.004 | S0405-12b-13 | | 43.5 | SURCHARGED | |
| 1.008 | S0405-12b-14 | | 44.1 | FLOOD | 10 |
| 3.000 | S0405-12b-15 | | 3.6 | OK | |
| 3.001 | S0405-12b-16 | | 13.9 | OK | |
| 3.002 | S0405-12b-17 | | 19.0 | OK | |
| 3.003 | S0405-12b-18 | | 24.7 | SURCHARGED | |
| 1.009 | S0405-12b-19 | | 58.9 | FLOOD RISK | 7 |
| 1.010 | S0405-12b-20 | | 51.5 | SURCHARGED | |
| 1.011 | S0405-12b-21 | | 47.9 | SURCHARGED | |
| 1.012 | S0405-12b-22 | | 46.1 | SURCHARGED | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Gypsum 12b

### Simulation Criteria

Areal Reduction Factor 1.000
Hot Start (mins) 0
Hot Start Level (mm) 0
Manhole Headloss Coeff (Global) 0.500
Foul Sewage per hectare (l/s) 0.000
Additional Flow - % of Total Flow 0.000
MADD Factor * 10m³/ha Storage 2.000
Inlet Coeffiecient 0.800
Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0
Number of Online Controls 0
Number of Offline Controls 0
Number of Storage Structures 0
Number of Time/Area Diagrams 0
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
Region England and Wales
M5-60 (mm) 18.600
Ratio R 0.300
Cv (Summer) 0.750
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-12b-1 | 15 Winter | 100 | +40% | | | | | 130.024 | -0.140 | 0.000 | 0.30 | | |
| 1.001 | S0405-12b-2 | 15 Winter | 100 | +40% | | | | | 129.787 | -0.155 | 0.000 | 0.20 | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Gypsum 12b

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| 1.000 | S0405-12b-1 | 11.3 | OK | |
| 1.001 | S0405-12b-2 | 10.7 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Gypsum 12b

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.002 | S0405-12b-3 | 15 Winter | 100 | +40% | | | | | 128.746 | -0.162 | 0.000 | 0.17 | |
| 1.003 | S0405-12b-4 | 15 Winter | 100 | +40% | | | | | 127.068 | -0.158 | 0.000 | 0.19 | |
| 1.004 | S0405-12b-5 | 15 Winter | 100 | +40% | | | | | 126.430 | -0.140 | 0.000 | 0.30 | |
| 1.005 | S0405-12b-6 | 15 Winter | 100 | +40% | | | | | 126.255 | -0.160 | 0.000 | 0.18 | |
| 1.006 | S0405-12b-7 | 15 Winter | 100 | +40% | | | | | 125.045 | -0.052 | 0.000 | 0.31 | |
| 1.007 | S0405-12b-8 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 124.937 | 0.976 | 0.000 | 0.45 | |
| 2.000 | S0405-12b-9 | 15 Winter | 100 | +40% | | | | | 130.063 | -0.145 | 0.000 | 0.27 | |
| 2.001 | S0405-12b-10 | 15 Winter | 100 | +40% | | | | | 129.745 | -0.067 | 0.000 | 0.79 | |
| 2.002 | S0405-12b-11 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 128.418 | 0.287 | 0.000 | 0.86 | |
| 2.003 | S0405-12b-12 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 127.298 | 0.824 | 0.000 | 0.97 | |
| 2.004 | S0405-12b-13 | 15 Winter | 100 | +40% | 5/15 Winter | | | | 125.863 | 0.924 | 0.000 | 0.87 | |
| 1.008 | S0405-12b-14 | 30 Winter | 100 | +40% | 5/15 Summer | 5/15 Winter | | | 124.909 | 1.248 | 47.842 | 1.55 | |
| 3.000 | S0405-12b-15 | 15 Winter | 100 | +40% | | | | | 129.897 | -0.176 | 0.000 | 0.10 | |
| 3.001 | S0405-12b-16 | 15 Winter | 100 | +40% | | | | | 128.577 | -0.131 | 0.000 | 0.36 | |
| 3.002 | S0405-12b-17 | 15 Winter | 100 | +40% | 100/15 Winter | | | | 125.870 | 0.052 | 0.000 | 0.48 | |
| 3.003 | S0405-12b-18 | 15 Winter | 100 | +40% | 5/15 Winter | | | | 125.639 | 0.875 | 0.000 | 0.81 | |
| 1.009 | S0405-12b-19 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 124.869 | 1.249 | 7.967 | 2.07 | |
| 1.010 | S0405-12b-20 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 124.756 | 1.169 | 0.000 | 2.00 | |
| 1.011 | S0405-12b-21 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 124.256 | 0.857 | 0.000 | 1.70 | |
| 1.012 | S0405-12b-22 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 123.429 | 0.335 | 0.000 | 1.70 | |

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Gypsum 12b

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 1.002 | S0405-12b-3 | | 14.1 | OK | |
| 1.003 | S0405-12b-4 | | 16.8 | OK | |
| 1.004 | S0405-12b-5 | | 16.7 | OK | |
| 1.005 | S0405-12b-6 | | 18.3 | OK | |
| 1.006 | S0405-12b-7 | | 30.5 | OK | |
| 1.007 | S0405-12b-8 | | 30.4 | FLOOD RISK | |
| 2.000 | S0405-12b-9 | | 11.8 | OK | |
| 2.001 | S0405-12b-10 | | 57.2 | OK | |
| 2.002 | S0405-12b-11 | | 77.0 | SURCHARGED | |
| 2.003 | S0405-12b-12 | | 88.4 | SURCHARGED | |
| 2.004 | S0405-12b-13 | | 93.1 | FLOOD RISK | |
| 1.008 | S0405-12b-14 | | 46.5 | FLOOD | 10 |
| 3.000 | S0405-12b-15 | | 7.8 | OK | |
| 3.001 | S0405-12b-16 | | 36.0 | OK | |
| 3.002 | S0405-12b-17 | | 46.0 | SURCHARGED | |
| 3.003 | S0405-12b-18 | | 58.8 | SURCHARGED | |
| 1.009 | S0405-12b-19 | | 61.6 | FLOOD | 7 |
| 1.010 | S0405-12b-20 | | 57.3 | SURCHARGED | |
| 1.011 | S0405-12b-21 | | 49.4 | SURCHARGED | |
| 1.012 | S0405-12b-22 | | 48.1 | SURCHARGED | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Existing

```
                     Pipe Sizes STANDARD Manhole Sizes STANDARD

                      FSR Rainfall Model - England and Wales
              Return Period (years)       1         Foul Sewage (l/s/ha) 0.000          Maximum Backdrop Height (m) 1.500
                        M5-60 (mm) 15.000      Volumetric Runoff Coeff. 0.750 Min Design Depth for Optimisation (m) 1.200
                           Ratio R  0.300                      PIMP (%)   100    Min Vel for Auto Design only (m/s)  1.00
            Maximum Rainfall (mm/hr)     50 Add Flow / Climate Change (%)     0      Min Slope for Optimisation (1:X)   500
  Maximum Time of Concentration (mins)     30   Minimum Backdrop Height (m) 0.200

                           Designed with Level Soffits
```

### Simulation Criteria for Existing

```
   Volumetric Runoff Coeff 0.750   Manhole Headloss Coeff (Global) 0.500                 Inlet Coeffiecient 0.800
    Areal Reduction Factor 1.000     Foul Sewage per hectare (l/s) 0.000 Flow per Person per Day (l/per/day) 0.000
          Hot Start (mins)     0 Additional Flow - % of Total Flow 0.000                      Run Time (mins)    60
     Hot Start Level (mm)      0     MADD Factor * 10m³/ha Storage 2.000                Output Interval (mins)     1

      Number of Input Hydrographs 0   Number of Offline Controls 0 Number of Time/Area Diagrams 0
        Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
            Rainfall Model FSR     Region England and Wales      Ratio R  0.300
     Return Period (years)    1 M5-60 (mm)            15.000 Profile Type Summer
```

| | | |
|---|---|---|
| Amey Group Plc | | Page 2 |
| South East Hub, Explorer II<br>Fleming Way, Crawley<br>West Sussex, RH10 9GT | | |
| Date 09/05/2022 16:41<br>File 13 - GYPSUM JUNCTION (MAINLINE).MDX | Designed by 149806<br>Checked by | |
| Innovyze | Network 2020.1.3 | |

## Synthetic Rainfall Details

Cv (Summer) 0.750 Cv (Winter) 0.840 Storm Duration (mins) 30

## Online Controls for Existing

### Hydro-Brake® Optimum Manhole: E71, DS/PN: E1.021, Volume ($m^3$): 7.9

| | |
|---|---|
| Unit Reference | MD-SHE-0193-2200-1964-2200 |
| Design Head (m) | 1.964 |
| Design Flow (l/s) | 22.0 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |

| | |
|---|---|
| Sump Available | Yes |
| Diameter (mm) | 193 |
| Invert Level (m) | 113.036 |
| Minimum Outlet Pipe Diameter (mm) | 225 |
| Suggested Manhole Diameter (mm) | 1800 |

| **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|
| Design Point (Calculated) | 1.964 | 22.0 |
| Flush-Flo™ | 0.567 | 22.0 |

| **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|
| Kick-Flo® | 1.218 | 17.5 |
| Mean Flow over Head Range | - | 19.1 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 6.7 | 0.600 | 22.0 | 1.600 | 19.9 | 2.600 | 25.1 | 5.000 | 34.4 | 7.500 | 41.9 |
| 0.200 | 17.9 | 0.800 | 21.5 | 1.800 | 21.1 | 3.000 | 26.9 | 5.500 | 36.0 | 8.000 | 43.2 |
| 0.300 | 20.5 | 1.000 | 20.5 | 2.000 | 22.2 | 3.500 | 29.0 | 6.000 | 37.6 | 8.500 | 44.5 |
| 0.400 | 21.5 | 1.200 | 17.9 | 2.200 | 23.2 | 4.000 | 30.9 | 6.500 | 39.1 | 9.000 | 45.7 |
| 0.500 | 21.9 | 1.400 | 18.7 | 2.400 | 24.2 | 4.500 | 32.7 | 7.000 | 40.5 | 9.500 | 46.9 |

## Storage Structures for Existing

### Tank or Pond Manhole: E70, DS/PN: E1.020

Invert Level (m) 113.700

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 2149.5 | 1.300 | 3250.8 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

### Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10$m^3$/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 15.100 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status ON Inertia Status OFF
Analysis Timestep Fine DVD Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume ($m^3$) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E1.000 | E69 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 118.364 | 0.391 | 0.000 | 0.46 | | | 21.3 |
| E1.001 | E70 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 118.351 | 0.477 | 0.000 | 0.56 | | | 23.2 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Status | Level Exceeded |
|---|---|---|---|
| E1.000 | E69 | SURCHARGED | |
| E1.001 | E70 | SURCHARGED | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E2.000 | E18 | 15 Winter | 5 | +20% | | | | | 122.359 | -0.145 | 0.000 | 0.27 | | |
| E2.001 | E19 | 15 Winter | 5 | +20% | | | | | 122.249 | -0.147 | 0.000 | 0.26 | | |
| E2.002 | E20 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 121.379 | -0.134 | 0.000 | 0.34 | | |
| E2.003 | E21 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 120.503 | -0.110 | 0.000 | 0.52 | | |
| E2.004 | E22 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 119.302 | -0.111 | 0.000 | 0.51 | | |
| E2.005 | E12 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Summer | | | 118.624 | 0.062 | 0.000 | 0.91 | | |
| E1.002 | E13 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 118.335 | 0.506 | 0.000 | 0.83 | | |
| E1.003 | E20 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 118.256 | 0.481 | 0.000 | 0.63 | | |
| E3.000 | E26 | 15 Winter | 5 | +20% | | | | | 123.636 | -0.178 | 0.000 | 0.10 | | |
| E3.001 | E27 | 15 Winter | 5 | +20% | | | | | 121.931 | -0.178 | 0.000 | 0.10 | | |
| E3.002 | E28 | 15 Winter | 5 | +20% | | | | | 120.137 | -0.175 | 0.000 | 0.11 | | |
| E3.003 | E29 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 118.461 | -0.140 | 0.000 | 0.31 | | |
| E1.004 | E20 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 118.220 | 0.587 | 0.000 | 0.90 | | |
| E1.005 | E32 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 117.972 | 0.714 | 0.000 | 1.57 | | |
| E4.000 | E11 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 124.994 | -0.091 | 0.000 | 0.61 | | |
| E4.001 | E12 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 124.482 | 0.482 | 0.000 | 1.11 | | |
| E4.002 | E13 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 123.837 | 0.433 | 0.000 | 1.01 | | |
| E4.003 | E14 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 122.754 | 0.424 | 0.000 | 0.96 | | |
| E4.004 | E15 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 121.107 | 0.626 | 0.000 | 1.11 | | |
| E4.005 | E16 | 30 Winter | 5 | +20% | 5/15 Summer | 100/30 Summer | | | 118.519 | 0.153 | 0.000 | 1.12 | | |
| E1.006 | E33 | 30 Winter | 5 | +20% | 100/15 Summer | 100/30 Summer | | | 117.526 | -0.024 | 0.000 | 0.30 | | |
| E5.000 | E5 | 15 Winter | 5 | +20% | | | | | 125.118 | -0.196 | 0.000 | 0.04 | | |
| E5.001 | E6 | 15 Winter | 5 | +20% | | | | | 123.422 | -0.181 | 0.000 | 0.08 | | |
| E5.002 | E7 | 15 Winter | 5 | +20% | | | | | 121.732 | -0.161 | 0.000 | 0.17 | | |
| E5.003 | E8 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 120.014 | -0.123 | 0.000 | 0.39 | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| E2.000 | E18 | 8.1 | OK | |
| E2.001 | E19 | 16.2 | OK | |
| E2.002 | E20 | 25.6 | OK | |
| E2.003 | E21 | 40.6 | OK | |
| E2.004 | E22 | 46.5 | OK | |
| E2.005 | E12 | 56.3 | SURCHARGED | 7 |
| E1.002 | E13 | 60.4 | SURCHARGED | 9 |
| E1.003 | E20 | 60.8 | SURCHARGED | 13 |
| E3.000 | E26 | 8.1 | OK | |
| E3.001 | E27 | 9.1 | OK | |
| E3.002 | E28 | 12.8 | OK | |
| E3.003 | E29 | 22.5 | OK | |
| E1.004 | E20 | 86.3 | SURCHARGED | 13 |
| E1.005 | E32 | 96.9 | SURCHARGED | |
| E4.000 | E11 | 31.1 | OK | 6 |
| E4.001 | E12 | 43.3 | SURCHARGED | 8 |
| E4.002 | E13 | 53.6 | SURCHARGED | 9 |
| E4.003 | E14 | 67.4 | SURCHARGED | 11 |
| E4.004 | E15 | 83.5 | SURCHARGED | 11 |
| E4.005 | E16 | 104.8 | SURCHARGED | 8 |
| E1.006 | E33 | 189.9 | OK | 7 |
| E5.000 | E5 | 2.5 | OK | |
| E5.001 | E6 | 5.4 | OK | |
| E5.002 | E7 | 11.4 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| **PN** | **US/MH Name** | **Pipe Flow (l/s)** | **Status** | **Level Exceeded** |
|---|---|---|---|---|
| E5.003 | E8 | 20.1 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E5.004 | E9 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 119.052 | -0.092 | 0.000 | 0.62 | |
| E5.005 | E10 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 118.093 | -0.066 | 0.000 | 0.82 | |
| E6.000 | E34 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 119.664 | -0.102 | 0.000 | 0.49 | |
| E6.001 | E35 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 119.301 | -0.065 | 0.000 | 0.79 | |
| E6.002 | E36 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 119.040 | -0.006 | 0.000 | 1.00 | |
| E1.007 | E37 | 30 Winter | 5 | +20% | 5/30 Winter | 100/120 Summer | | | 117.516 | 0.004 | 0.000 | 0.35 | |
| E7.000 | E1 | 15 Winter | 5 | +20% | 100/15 Winter | | | | 122.963 | -0.122 | 0.000 | 0.41 | |
| E7.001 | E2 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 121.217 | -0.104 | 0.000 | 0.55 | |
| E7.002 | E3 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | | | 119.127 | -0.065 | 0.000 | 0.84 | |
| E7.003 | E4 | 15 Winter | 5 | +20% | 100/15 Summer | 100/60 Summer | | | 118.766 | -0.015 | 0.000 | 1.00 | |
| E8.000 | E38 | 15 Summer | 5 | +20% | | | | | 119.891 | -0.225 | 0.000 | 0.00 | |
| E8.001 | E39 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 118.273 | -0.083 | 0.000 | 0.68 | |
| E8.002 | E40 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 117.536 | -0.011 | 0.000 | 0.60 | |
| E1.008 | E41 | 30 Winter | 5 | +20% | 5/30 Winter | 100/120 Summer | | | 117.501 | 0.087 | 0.000 | 0.48 | |
| E9.000 | E42 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 125.001 | -0.046 | 0.000 | 0.75 | |
| E9.001 | E43 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 124.816 | 0.169 | 0.000 | 1.12 | |
| E9.002 | E44 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Winter | | | 124.306 | 0.154 | 0.000 | 1.15 | |
| E9.003 | E45 | 30 Winter | 5 | +20% | 100/15 Summer | 100/30 Winter | | | 123.368 | -0.067 | 0.000 | 0.83 | |
| E9.004 | E46 | 30 Winter | 5 | +20% | 5/30 Winter | | | | 122.040 | 0.060 | 0.000 | 0.80 | |
| E9.005 | E47 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 120.938 | 0.994 | 0.000 | 1.90 | |
| E1.009 | E49 | 30 Winter | 5 | +20% | 5/15 Summer | 100/120 Winter | | | 117.486 | 1.381 | 0.000 | 1.62 | |
| E1.010 | E50 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 117.142 | 1.241 | 0.000 | 1.66 | |
| E10.000 | E51 | 15 Winter | 5 | +20% | | | | | 128.748 | -0.197 | 0.000 | 0.04 | |
| E10.001 | E52 | 15 Winter | 5 | +20% | | | | | 126.835 | -0.170 | 0.000 | 0.14 | |
| E10.002 | E53 | 15 Winter | 5 | +20% | | | | | 123.352 | -0.154 | 0.000 | 0.21 | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| E5.004 | E9 | | 31.6 | OK | |
| E5.005 | E10 | | 44.4 | OK | |
| E6.000 | E34 | | 15.8 | OK | |
| E6.001 | E35 | | 25.0 | OK | |
| E6.002 | E36 | | 31.7 | OK | |
| E1.007 | E37 | | 259.1 | SURCHARGED | 3 |
| E7.000 | E1 | | 27.5 | OK | |
| E7.001 | E2 | | 40.2 | OK | |
| E7.002 | E3 | | 45.0 | OK | 3 |
| E7.003 | E4 | | 50.0 | OK | |
| E8.000 | E38 | | 0.0 | OK | |
| E8.001 | E39 | | 34.8 | OK | |
| E8.002 | E40 | | 30.5 | OK | |
| E1.008 | E41 | | 333.3 | SURCHARGED | 2 |
| E9.000 | E42 | | 23.9 | OK | 6 |
| E9.001 | E43 | | 35.9 | SURCHARGED | 6 |
| E9.002 | E44 | | 41.8 | SURCHARGED | 5 |
| E9.003 | E45 | | 47.4 | OK | 1 |
| E9.004 | E46 | | 55.3 | SURCHARGED | |
| E9.005 | E47 | | 60.8 | FLOOD RISK | 11 |
| E1.009 | E49 | | 330.9 | SURCHARGED | |
| E1.010 | E50 | | 323.6 | SURCHARGED | |
| E10.000 | E51 | | 4.3 | OK | |
| E10.001 | E52 | | 18.6 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| **PN** | **US/MH Name** | **Half Drain Time (mins)** | **Pipe Flow (l/s)** | **Status** | **Level Exceeded** |
|---|---|---|---|---|---|
| E10.002 | E53 | | 24.9 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E10.003 | E54 | 15 Winter | 5 | +20% | | | | | 121.540 | -0.141 | 0.000 | 0.29 | |
| E10.004 | E55 | 15 Winter | 5 | +20% | | | | | 120.582 | -0.173 | 0.000 | 0.12 | |
| E1.011 | E56 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 116.922 | 1.128 | 0.000 | 1.72 | |
| E11.000 | E57 | 15 Winter | 5 | +20% | | | | | 128.721 | -0.194 | 0.000 | 0.05 | |
| E11.001 | E58 | 15 Winter | 5 | +20% | | | | | 127.328 | -0.184 | 0.000 | 0.08 | |
| E11.002 | E59 | 15 Winter | 5 | +20% | | | | | 124.719 | -0.176 | 0.000 | 0.10 | |
| E11.003 | E60 | 15 Winter | 5 | +20% | | | | | 121.733 | -0.152 | 0.000 | 0.23 | |
| E11.004 | E61 | 15 Winter | 5 | +20% | | | | | 120.310 | -0.175 | 0.000 | 0.11 | |
| E1.012 | E62 | 60 Winter | 5 | +20% | 5/15 Summer | | | | 116.733 | 1.035 | 0.000 | 1.61 | |
| E1.013 | E63 | 60 Winter | 5 | +20% | 5/15 Summer | | | | 116.483 | 0.909 | 0.000 | 1.67 | |
| E1.014 | E64 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 116.311 | 0.817 | 0.000 | 1.55 | |
| E1.015 | E65 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 115.927 | 0.637 | 0.000 | 1.50 | |
| E1.016 | E66 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 115.510 | 0.423 | 0.000 | 1.45 | |
| E1.017 | E67 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 115.080 | 0.197 | 0.000 | 1.41 | |
| E1.018 | E68 | 30 Winter | 5 | +20% | 100/120 Winter | | | | 114.488 | -0.192 | 0.000 | 0.72 | |
| E1.019 | E69 | 360 Winter | 5 | +20% | 100/60 Summer | | | | 114.066 | -0.112 | 0.000 | 0.35 | |
| E1.020 | E70 | 360 Winter | 5 | +20% | 5/15 Summer | | | | 114.058 | 0.558 | 0.000 | 0.64 | |
| E1.021 | E71 | 1440 Winter | 5 | +20% | 5/15 Summer | 5/120 Summer | | | 115.002 | 1.666 | 2.697 | 0.69 | |

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| E10.003 | E54 | | 30.1 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| **PN** | **US/MH Name** | **Half Drain Time (mins)** | **Pipe Flow (l/s)** | **Status** | **Level Exceeded** |
|---|---|---|---|---|---|
| E10.004 | E55 | | 30.3 | OK | |
| E1.011 | E56 | | 330.8 | SURCHARGED | |
| E11.000 | E57 | | 4.7 | OK | |
| E11.001 | E58 | | 8.3 | OK | |
| E11.002 | E59 | | 13.8 | OK | |
| E11.003 | E60 | | 22.5 | OK | |
| E11.004 | E61 | | 25.1 | OK | |
| E1.012 | E62 | | 317.6 | SURCHARGED | |
| E1.013 | E63 | | 314.5 | SURCHARGED | |
| E1.014 | E64 | | 316.5 | SURCHARGED | |
| E1.015 | E65 | | 306.2 | SURCHARGED | |
| E1.016 | E66 | | 296.4 | SURCHARGED | |
| E1.017 | E67 | | 289.0 | SURCHARGED | |
| E1.018 | E68 | | 288.2 | OK | |
| E1.019 | E69 | | 145.8 | OK | |
| E1.020 | E70 | | 30.5 | SURCHARGED | |
| E1.021 | E71 | | 21.1 | FLOOD | 51 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

### Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 15.100 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status ON Inertia Status OFF
Analysis Timestep Fine DVD Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E1.000 | E69 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 119.250 | 1.277 | 0.000 | 0.98 | | | 45.4 |
| E1.001 | E70 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 119.139 | 1.265 | 0.000 | 1.52 | | | 62.8 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Status | Level Exceeded |
|---|---|---|---|
| E1.000 | E69 | SURCHARGED | |
| E1.001 | E70 | FLOOD RISK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E2.000 | E18 | 15 Winter | 100 | +40% | | | | | 122.404 | -0.100 | 0.000 | 0.57 | |
| E2.001 | E19 | 15 Winter | 100 | +40% | | | | | 122.302 | -0.094 | 0.000 | 0.62 | |
| E2.002 | E20 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 121.745 | 0.232 | 0.000 | 0.76 | |
| E2.003 | E21 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 121.430 | 0.817 | 0.000 | 1.00 | |
| E2.004 | E22 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 120.408 | 0.995 | 0.000 | 0.99 | |
| E2.005 | E12 | 30 Winter | 100 | +40% | 5/15 Winter | 100/15 Summer | | | 119.775 | 1.213 | 12.816 | 1.10 | |
| E1.002 | E13 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 119.058 | 1.229 | 29.441 | 0.97 | |
| E1.003 | E20 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 119.001 | 1.226 | 100.562 | 1.28 | |
| E3.000 | E26 | 15 Winter | 100 | +40% | | | | | 123.659 | -0.155 | 0.000 | 0.21 | |
| E3.001 | E27 | 15 Winter | 100 | +40% | | | | | 121.954 | -0.155 | 0.000 | 0.21 | |
| E3.002 | E28 | 15 Winter | 100 | +40% | | | | | 120.166 | -0.146 | 0.000 | 0.25 | |
| E3.003 | E29 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 119.321 | 0.720 | 0.000 | 0.69 | |
| E1.004 | E20 | 120 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 118.988 | 1.355 | 88.052 | 1.32 | |
| E1.005 | E32 | 120 Summer | 100 | +40% | 5/15 Summer | | | | 119.083 | 1.825 | 0.000 | 2.00 | |
| E4.000 | E11 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 126.199 | 1.114 | 5.252 | 0.65 | |
| E4.001 | E12 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 125.773 | 1.773 | 13.540 | 1.22 | |
| E4.002 | E13 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 124.887 | 1.483 | 19.077 | 1.12 | |
| E4.003 | E14 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 123.543 | 1.213 | 19.613 | 1.00 | |
| E4.004 | E15 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 121.710 | 1.229 | 29.130 | 1.24 | |
| E4.005 | E16 | 60 Winter | 100 | +40% | 5/15 Summer | 100/30 Summer | | | 119.571 | 1.205 | 11.181 | 1.29 | |
| E1.006 | E33 | 60 Winter | 100 | +40% | 100/15 Summer | 100/30 Summer | | | 119.008 | 1.458 | 82.879 | 0.65 | |
| E5.000 | E5 | 15 Winter | 100 | +40% | | | | | 125.132 | -0.182 | 0.000 | 0.08 | |
| E5.001 | E6 | 15 Winter | 100 | +40% | | | | | 123.447 | -0.156 | 0.000 | 0.19 | |
| E5.002 | E7 | 15 Winter | 100 | +40% | | | | | 121.775 | -0.118 | 0.000 | 0.43 | |
| E5.003 | E8 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 121.046 | 0.909 | 0.000 | 0.76 | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| **PN** | **US/MH Name** | **Half Drain Time (mins)** | **Pipe Flow (l/s)** | **Status** | **Level Exceeded** |
|---|---|---|---|---|---|
| E2.000 | E18 | | 17.3 | OK | |
| E2.001 | E19 | | 37.8 | OK | |
| E2.002 | E20 | | 56.4 | SURCHARGED | |
| E2.003 | E21 | | 78.7 | SURCHARGED | |
| E2.004 | E22 | | 89.4 | FLOOD RISK | |
| E2.005 | E12 | | 67.5 | FLOOD | 7 |
| E1.002 | E13 | | 70.8 | FLOOD | 9 |
| E1.003 | E20 | | 123.0 | FLOOD | 13 |
| E3.000 | E26 | | 17.3 | OK | |
| E3.001 | E27 | | 19.9 | OK | |
| E3.002 | E28 | | 29.0 | OK | |
| E3.003 | E29 | | 50.6 | SURCHARGED | |
| E1.004 | E20 | | 125.9 | FLOOD | 13 |
| E1.005 | E32 | | 123.4 | FLOOD RISK | |
| E4.000 | E11 | | 33.2 | FLOOD | 6 |
| E4.001 | E12 | | 47.8 | FLOOD | 8 |
| E4.002 | E13 | | 59.1 | FLOOD | 9 |
| E4.003 | E14 | | 69.7 | FLOOD | 11 |
| E4.004 | E15 | | 93.3 | FLOOD | 11 |
| E4.005 | E16 | | 120.7 | FLOOD | 8 |
| E1.006 | E33 | | 414.7 | FLOOD | 7 |
| E5.000 | E5 | | 5.3 | OK | |
| E5.001 | E6 | | 12.9 | OK | |
| E5.002 | E7 | | 28.4 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| **PN** | **US/MH Name** | **Half Drain Time (mins)** | **Pipe Flow (l/s)** | **Status** | **Level Exceeded** |
|---|---|---|---|---|---|
| E5.003 | E8 | | 38.7 | SURCHARGED | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E5.004 | E9 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 120.770 | 1.626 | 0.000 | 0.93 | |
| E5.005 | E10 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 120.150 | 1.991 | 0.000 | 1.10 | |
| E6.000 | E34 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 120.440 | 0.674 | 0.000 | 0.84 | |
| E6.001 | E35 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 120.189 | 0.823 | 0.000 | 1.26 | |
| E6.002 | E36 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 119.700 | 0.654 | 0.000 | 1.66 | |
| E1.007 | E37 | 120 Summer | 100 | +40% | 5/30 Winter | 100/120 Summer | | | 119.570 | 2.058 | 15.284 | 0.34 | |
| E7.000 | E1 | 15 Winter | 100 | +40% | 100/15 Winter | | | | 123.114 | 0.029 | 0.000 | 0.84 | |
| E7.001 | E2 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 122.163 | 0.842 | 0.000 | 0.93 | |
| E7.002 | E3 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | | | 120.397 | 1.205 | 1.964 | 1.23 | |
| E7.003 | E4 | 60 Winter | 100 | +40% | 100/15 Summer | 100/60 Summer | | | 119.959 | 1.178 | 0.131 | 1.24 | |
| E8.000 | E38 | 60 Winter | 100 | +40% | | | | | 119.898 | -0.218 | 0.000 | 0.00 | |
| E8.001 | E39 | 60 Winter | 100 | +40% | 100/15 Summer | | | | 119.912 | 1.556 | 0.000 | 0.84 | |
| E8.002 | E40 | 120 Summer | 100 | +40% | 100/15 Summer | | | | 119.860 | 2.313 | 0.000 | 0.56 | |
| E1.008 | E41 | 120 Summer | 100 | +40% | 5/30 Winter | 100/120 Summer | | | 119.834 | 2.420 | 13.834 | 0.40 | |
| E9.000 | E42 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 126.246 | 1.199 | 5.340 | 0.76 | |
| E9.001 | E43 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 126.020 | 1.373 | 7.413 | 1.44 | |
| E9.002 | E44 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Winter | | | 125.357 | 1.205 | 5.338 | 1.56 | |
| E9.003 | E45 | 30 Winter | 100 | +40% | 100/15 Summer | 100/30 Winter | | | 124.635 | 1.200 | 0.037 | 1.07 | |
| E9.004 | E46 | 30 Winter | 100 | +40% | 5/30 Winter | | | | 123.158 | 1.178 | 0.000 | 1.04 | |
| E9.005 | E47 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 121.166 | 1.222 | 22.171 | 2.05 | |
| E1.009 | E49 | 120 Winter | 100 | +40% | 5/15 Summer | 100/120 Winter | | | 120.122 | 4.017 | 0.147 | 1.57 | |
| E1.010 | E50 | 60 Winter | 100 | +40% | 5/15 Summer | | | | 118.640 | 2.739 | 0.000 | 1.77 | |
| E10.000 | E51 | 15 Winter | 100 | +40% | | | | | 128.762 | -0.183 | 0.000 | 0.08 | |
| E10.001 | E52 | 15 Winter | 100 | +40% | | | | | 126.872 | -0.133 | 0.000 | 0.35 | |
| E10.002 | E53 | 15 Winter | 100 | +40% | | | | | 123.401 | -0.105 | 0.000 | 0.55 | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| E5.004 | E9 | | 47.2 | SURCHARGED | |
| E5.005 | E10 | | 59.7 | FLOOD RISK | |
| E6.000 | E34 | | 26.9 | SURCHARGED | |
| E6.001 | E35 | | 40.3 | SURCHARGED | |
| E6.002 | E36 | | 52.6 | SURCHARGED | |
| E1.007 | E37 | | 247.7 | FLOOD | 3 |
| E7.000 | E1 | | 56.7 | SURCHARGED | |
| E7.001 | E2 | | 68.1 | FLOOD RISK | |
| E7.002 | E3 | | 65.4 | FLOOD | 3 |
| E7.003 | E4 | | 61.8 | FLOOD | |
| E8.000 | E38 | | 0.0 | OK | |
| E8.001 | E39 | | 43.0 | SURCHARGED | |
| E8.002 | E40 | | 28.4 | SURCHARGED | |
| E1.008 | E41 | | 278.6 | FLOOD | 2 |
| E9.000 | E42 | | 24.2 | FLOOD | 6 |
| E9.001 | E43 | | 46.0 | FLOOD | 6 |
| E9.002 | E44 | | 56.8 | FLOOD | 5 |
| E9.003 | E45 | | 61.1 | FLOOD | 1 |
| E9.004 | E46 | | 71.9 | FLOOD RISK | |
| E9.005 | E47 | | 65.6 | FLOOD | 11 |
| E1.009 | E49 | | 321.2 | FLOOD | |
| E1.010 | E50 | | 344.4 | SURCHARGED | |
| E10.000 | E51 | | 9.1 | OK | |
| E10.001 | E52 | | 47.9 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| **PN** | **US/MH Name** | **Half Drain Time (mins)** | **Pipe Flow (l/s)** | **Status** | **Level Exceeded** |
|---|---|---|---|---|---|
| E10.002 | E53 | | 65.3 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume ($m^3$) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| E10.003 | E54 | 15 Winter | 100 | +40% | | | | | 121.605 | -0.076 | 0.000 | 0.77 | |
| E10.004 | E55 | 15 Winter | 100 | +40% | | | | | 120.617 | -0.138 | 0.000 | 0.31 | |
| E1.011 | E56 | 60 Winter | 100 | +40% | 5/15 Summer | | | | 118.405 | 2.611 | 0.000 | 1.97 | |
| E11.000 | E57 | 15 Winter | 100 | +40% | | | | | 128.738 | -0.177 | 0.000 | 0.10 | |
| E11.001 | E58 | 15 Winter | 100 | +40% | | | | | 127.352 | -0.160 | 0.000 | 0.18 | |
| E11.002 | E59 | 15 Winter | 100 | +40% | | | | | 124.748 | -0.147 | 0.000 | 0.26 | |
| E11.003 | E60 | 15 Winter | 100 | +40% | | | | | 121.785 | -0.100 | 0.000 | 0.59 | |
| E11.004 | E61 | 15 Winter | 100 | +40% | | | | | 120.343 | -0.142 | 0.000 | 0.29 | |
| E1.012 | E62 | 60 Winter | 100 | +40% | 5/15 Summer | | | | 118.151 | 2.453 | 0.000 | 2.08 | |
| E1.013 | E63 | 60 Winter | 100 | +40% | 5/15 Summer | | | | 117.767 | 2.193 | 0.000 | 2.13 | |
| E1.014 | E64 | 60 Winter | 100 | +40% | 5/15 Summer | | | | 117.448 | 1.954 | 0.000 | 1.92 | |
| E1.015 | E65 | 60 Winter | 100 | +40% | 5/15 Summer | | | | 116.741 | 1.451 | 0.000 | 1.88 | |
| E1.016 | E66 | 60 Winter | 100 | +40% | 5/15 Summer | | | | 116.053 | 0.966 | 0.000 | 1.85 | |
| E1.017 | E67 | 60 Winter | 100 | +40% | 5/15 Summer | | | | 115.342 | 0.460 | 0.000 | 1.82 | |
| E1.018 | E68 | 240 Winter | 100 | +40% | 100/120 Winter | | | | 114.818 | 0.138 | 0.000 | 0.86 | |
| E1.019 | E69 | 960 Winter | 100 | +40% | 100/60 Summer | | | | 114.710 | 0.532 | 0.000 | 0.39 | |
| E1.020 | E70 | 960 Winter | 100 | +40% | 5/15 Summer | | | | 114.704 | 1.204 | 0.000 | 0.53 | |
| E1.021 | E71 | 1440 Winter | 100 | +40% | 5/15 Summer | 5/120 Summer | | | 115.004 | 1.668 | 4.970 | 0.71 | |

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| E10.003 | E54 | | 79.2 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| E10.004 | E55 | | 79.0 | OK | |
| E1.011 | E56 | | 379.6 | SURCHARGED | |
| E11.000 | E57 | | 10.1 | OK | |
| E11.001 | E58 | | 19.9 | OK | |
| E11.002 | E59 | | 34.5 | OK | |
| E11.003 | E60 | | 58.0 | OK | |
| E11.004 | E61 | | 64.7 | OK | |
| E1.012 | E62 | | 411.6 | SURCHARGED | |
| E1.013 | E63 | | 401.5 | SURCHARGED | |
| E1.014 | E64 | | 391.9 | SURCHARGED | |
| E1.015 | E65 | | 384.1 | SURCHARGED | |
| E1.016 | E66 | | 377.6 | SURCHARGED | |
| E1.017 | E67 | | 371.5 | SURCHARGED | |
| E1.018 | E68 | | 340.5 | SURCHARGED | |
| E1.019 | E69 | | 163.0 | SURCHARGED | |
| E1.020 | E70 | | 24.9 | FLOOD RISK | |
| E1.021 | E71 | | 21.5 | FLOOD | 51 |

## Simulation Criteria for Kirkby Thore School North 1

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Hot Start Level (mm) | 0 | Additional Flow - % of Total Flow | 0.000 | Flow per Person per Day (l/per/day) | 0.000 |
| Areal Reduction Factor | 1.000 | Manhole Headloss Coeff (Global) | 0.500 | MADD Factor * 10m³/ha Storage | 2.000 | Run Time (mins) | 60 |
| Hot Start (mins) | 0 | Foul Sewage per hectare (l/s) | 0.000 | Inlet Coeffiecient | 0.800 | Output Interval (mins) | 1 |

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

## Synthetic Rainfall Details

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Rainfall Model | FSR | Region | England and Wales | Ratio R | 0.200 | Cv (Summer) | 0.750 | Storm Duration (mins) | 30 |
| Return Period (years) | 30 | M5-60 (mm) | 20.000 | Profile Type | Summer | Cv (Winter) | 0.840 | | |

## Online Controls for Kirkby Thore School North 1

### Hydro-Brake® Optimum Manhole: S0405-14-70, DS/PN: 1.014, Volume (m³): 4.2

| | | | | | |
|---|---|---|---|---|---|
| Unit Reference | MD-SHE-0169-1500-1426-1500 | Objective | Minimise upstream storage | Invert Level (m) | 107.173 |
| Design Head (m) | 1.426 | Application | Surface | Minimum Outlet Pipe Diameter (mm) | 225 |
| Design Flow (l/s) | 15.0 | Sump Available | Yes | Suggested Manhole Diameter (mm) | 1500 |
| Flush-Flo™ | Calculated | Diameter (mm) | 169 | | |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Design Point (Calculated) | 1.426 | 15.0 | Flush-Flo™ | 0.421 | 15.0 | Kick-Flo® | 0.918 | 12.2 | Mean Flow over Head Range | - | 13.0 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 6.0 | 0.500 | 14.9 | 1.200 | 13.8 | 2.000 | 17.6 | 3.000 | 21.4 | 5.000 | 27.3 | 7.000 | 32.1 | 9.000 | 36.3 |
| 0.200 | 13.7 | 0.600 | 14.7 | 1.400 | 14.9 | 2.200 | 18.4 | 3.500 | 23.0 | 5.500 | 28.6 | 7.500 | 33.2 | 9.500 | 37.2 |
| 0.300 | 14.7 | 0.800 | 13.7 | 1.600 | 15.8 | 2.400 | 19.2 | 4.000 | 24.5 | 6.000 | 29.8 | 8.000 | 34.3 | | |
| 0.400 | 15.0 | 1.000 | 12.7 | 1.800 | 16.8 | 2.600 | 20.0 | 4.500 | 26.0 | 6.500 | 31.0 | 8.500 | 35.3 | | |

## Storage Structures for Kirkby Thore School North 1

### Tank or Pond Manhole: S0405-14-68, DS/PN: 1.013

Invert Level (m) 107.300

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 470.0 | 1.800 | 1186.2 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Kirkby Thore School North 1

### Simulation Criteria

Areal Reduction Factor 1.000 Hot Start Level (mm) 0 Foul Sewage per hectare (l/s) 0.000 MADD Factor * 10m³/ha Storage 2.000 Flow per Person per Day (l/per/day) 0.000
Hot Start (mins) 0 Manhole Headloss Coeff (Global) 0.500 Additional Flow - % of Total Flow 0.000 Inlet Coeffiecient 0.800

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Region England and Wales M5-60 (mm) 18.400 Ratio R 0.300 Cv (Summer) 0.750 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 Analysis Timestep Fine DTS Status ON DVD Status OFF Inertia Status OFF

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-14-1 | 15 Winter | 5 | +20% | | | | | 120.557 | -0.178 | 0.000 | 0.10 | | | 8.2 | OK | |
| 1.001 | S0405-14-2 | 15 Winter | 5 | +20% | | | | | 119.741 | -0.175 | 0.000 | 0.11 | | | 13.1 | OK | |
| 1.002 | S0405-14-3 | 15 Winter | 5 | +20% | | | | | 115.546 | -0.154 | 0.000 | 0.21 | | | 18.6 | OK | |
| 2.000 | S0405-14-4 | 15 Winter | 5 | +20% | | | | | 120.664 | -0.169 | 0.000 | 0.14 | | | 15.2 | OK | |
| 2.001 | S0405-14-5 | 15 Winter | 5 | +20% | | | | | 116.612 | -0.149 | 0.000 | 0.24 | | | 22.5 | OK | |
| 3.000 | S0405-14-6 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 114.079 | -0.161 | 0.000 | 0.16 | | | 6.4 | OK | |
| 2.002 | S0405-14-7 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 113.670 | -0.126 | 0.000 | 0.40 | | | 28.8 | OK | |
| 4.000 | S0405-14-8 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 113.672 | -0.173 | 0.000 | 0.12 | | | 4.5 | OK | |
| 1.003 | S0405-14-9 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 113.478 | -0.056 | 0.000 | 0.53 | | | 48.4 | OK | |
| 1.004 | S0405-14-10 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 113.362 | 0.246 | 0.000 | 1.17 | | | 46.7 | SURCHARGED | 4 |
| 1.005 | S0405-14-11 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 112.471 | -0.077 | 0.000 | 0.75 | | | 46.0 | OK | |
| 1.006 | S0405-14-12 | 15 Winter | 5 | +20% | 5/15 Winter | | | | 111.648 | 0.048 | 0.000 | 1.03 | | | 43.8 | SURCHARGED | |
| 1.007 | S0405-14-13 | 15 Winter | 5 | +20% | | | | | 110.972 | -0.117 | 0.000 | 0.46 | | | 43.5 | OK | |
| 5.000 | S0405-14-26 | 15 Winter | 5 | +20% | | | | | 116.454 | -0.159 | 0.000 | 0.18 | | | 11.7 | OK | |
| 5.001 | S0405-14-15 | 15 Winter | 5 | +20% | | | | | 115.489 | -0.150 | 0.000 | 0.24 | | | 22.4 | OK | |
| 5.002 | S0405-14-16 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 113.583 | -0.083 | 0.000 | 0.67 | | | 32.7 | OK | 3 |
| 6.000 | S0405-14-17 | 15 Winter | 5 | +20% | | | | | 120.992 | -0.189 | 0.000 | 0.06 | | | 4.9 | OK | |
| 6.001 | S0405-14-18 | 15 Winter | 5 | +20% | | | | | 119.653 | -0.165 | 0.000 | 0.16 | | | 5.0 | OK | |
| 6.002 | S0405-14-19 | 15 Winter | 5 | +20% | | | | | 119.592 | -0.176 | 0.000 | 0.11 | | | 10.9 | OK | |
| 6.003 | S0405-14-20 | 15 Winter | 5 | +20% | | | | | 116.774 | -0.157 | 0.000 | 0.20 | | | 20.4 | OK | |
| 5.003 | S0405-14-21 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 112.831 | 0.077 | 0.000 | 1.45 | | | 51.9 | SURCHARGED | |
| 7.000 | S0405-14-22 | 15 Winter | 5 | +20% | | | | | 116.441 | -0.173 | 0.000 | 0.12 | | | 9.5 | OK* | |
| 8.000 | S0405-14-23 | 15 Winter | 5 | +20% | | | | | 117.616 | -0.130 | 0.000 | 0.33 | | | 12.8 | OK | |
| 8.001 | S0405-14-24 | 15 Winter | 5 | +20% | | | | | 117.003 | -0.146 | 0.000 | 0.27 | | | 18.7 | OK | |
| 8.002 | S0405-14-25 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 115.855 | -0.128 | 0.000 | 0.38 | | | 25.0 | OK | |
| 9.000 | S0405-14-26 | 15 Winter | 5 | +20% | | | | | 116.452 | -0.162 | 0.000 | 0.17 | | | 10.4 | OK | |
| 9.001 | S0405-14-27 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 115.656 | -0.140 | 0.000 | 0.30 | | | 18.4 | OK | |
| 8.003 | S0405-14-28 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 115.126 | 0.170 | 0.000 | 1.14 | | | 40.5 | SURCHARGED | 3 |
| 10.000 | S0405-14-29 | 15 Winter | 5 | +20% | | | | | 116.436 | -0.177 | 0.000 | 0.10 | | | 6.2 | OK | |
| 10.001 | S0405-14-30 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 115.627 | -0.158 | 0.000 | 0.19 | | | 12.4 | OK | |
| 11.000 | S0405-14-31 | 15 Winter | 5 | +20% | | | | | 117.606 | -0.141 | 0.000 | 0.26 | | | 10.2 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Kirkby Thore School North 1

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11.001 | S0405-14-32 | 15 Winter | 5 | +20% | | | | | 116.994 | -0.155 | 0.000 | 0.21 | | | 15.1 | OK | |
| 11.002 | S0405-14-33 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 115.811 | -0.140 | 0.000 | 0.30 | | | 20.6 | OK | |
| 8.004 | S0405-14-34 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 115.029 | 0.072 | 0.000 | 1.40 | | | 70.9 | SURCHARGED | |
| 8.005 | S0405-14-35 | 15 Winter | 5 | +20% | 5/15 Winter | | | | 114.950 | 0.007 | 0.000 | 0.99 | | | 67.7 | SURCHARGED | |
| 8.006 | S0405-14-36 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 114.553 | -0.060 | 0.000 | 0.91 | | | 62.5 | OK | |
| 8.007 | S0405-14-37 | 15 Winter | 5 | +20% | 5/15 Winter | | | | 114.211 | 0.012 | 0.000 | 1.24 | | | 61.4 | SURCHARGED | |
| 7.001 | S0405-14-38 | 30 Winter | 5 | +20% | | | | | 114.025 | -0.149 | 0.000 | 0.49 | | | 64.1 | OK | |
| 7.002 | S0405-14-39 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 113.145 | -0.104 | 0.000 | 0.74 | | | 65.3 | OK | |
| 12.000 | S0405-14-40 | 15 Winter | 5 | +20% | | | | | 119.757 | -0.179 | 0.000 | 0.09 | | | 9.4 | OK | |
| 12.001 | S0405-14-41 | 15 Winter | 5 | +20% | | | | | 115.992 | -0.162 | 0.000 | 0.17 | | | 17.7 | OK | |
| 5.004 | S0405-14-42 | 30 Winter | 5 | +20% | | | | | 112.561 | -0.191 | 0.000 | 0.28 | | | 115.1 | OK | |
| 5.005 | S0405-14-43 | 30 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 109.986 | -0.132 | 0.000 | 0.60 | | | 115.3 | OK | 6 |
| 5.006 | S0405-14-44 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 108.734 | 0.253 | 0.000 | 1.40 | | | 112.1 | SURCHARGED | 7 |
| 5.007 | S0405-14-45 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 108.605 | 0.198 | 0.000 | 1.34 | | | 108.8 | SURCHARGED | |
| 5.008 | S0405-14-46 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 108.443 | 0.128 | 0.000 | 1.66 | | | 108.4 | SURCHARGED | |
| 1.008 | S0405-14-47 | 15 Winter | 5 | +20% | 5/15 Winter | | | | 108.360 | 0.009 | 0.000 | 1.05 | | | 140.2 | SURCHARGED | |
| 1.009 | S0405-14-48 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 108.156 | -0.055 | 0.000 | 1.00 | | | 134.1 | OK | |
| 1.010 | S0405-14-49 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 107.964 | -0.091 | 0.000 | 0.98 | | | 131.5 | OK | |
| 1.011 | S0405-14-50 | 360 Winter | 5 | +20% | | | | | 107.844 | -0.064 | 0.000 | 0.29 | | | 42.0 | OK* | |
| 13.000 | S0405-14-51 | 15 Winter | 5 | +20% | | | | | 121.224 | -0.149 | 0.000 | 0.24 | | | 20.2 | OK | |
| 13.001 | S0405-14-52 | 15 Winter | 5 | +20% | | | | | 118.537 | -0.155 | 0.000 | 0.21 | | | 24.0 | OK | |
| 13.002 | S0405-14-53 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 117.159 | -0.106 | 0.000 | 0.55 | | | 26.0 | OK | |
| 13.003 | S0405-14-54 | 15 Winter | 5 | +20% | | | | | 116.925 | -0.146 | 0.000 | 0.27 | | | 27.2 | OK | |
| 13.004 | S0405-14-55 | 15 Winter | 5 | +20% | | | | | 116.439 | -0.131 | 0.000 | 0.36 | | | 35.5 | OK | |
| 13.005 | S0405-14-56 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 113.775 | -0.116 | 0.000 | 0.47 | | | 42.8 | OK | |
| 13.006 | S0405-14-57 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | | | 111.546 | -0.100 | 0.000 | 0.59 | | | 47.7 | OK | 1 |
| 14.000 | S0405-14-58 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 109.429 | -0.108 | 0.000 | 0.16 | | | 6.2 | OK | |
| 13.007 | S0405-14-59 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 109.415 | 0.327 | 0.000 | 1.51 | | | 49.8 | SURCHARGED | |
| 15.000 | S0405-14-60 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 109.427 | -0.158 | 0.000 | 0.18 | | | 8.1 | OK | |
| 16.000 | S0405-14-61 | 15 Winter | 5 | +20% | | | | | 119.698 | -0.180 | 0.000 | 0.09 | | | 8.7 | OK | |
| 16.001 | S0405-14-62 | 15 Winter | 5 | +20% | | | | | 115.888 | -0.164 | 0.000 | 0.16 | | | 15.6 | OK | |
| 16.002 | S0405-14-63 | 15 Winter | 5 | +20% | | | | | 112.280 | -0.155 | 0.000 | 0.21 | | | 19.1 | OK | |
| 16.003 | S0405-14-64 | 15 Winter | 5 | +20% | | | | | 110.373 | -0.142 | 0.000 | 0.29 | | | 21.8 | OK | |
| 13.008 | S0405-14-65 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 109.287 | 0.255 | 0.000 | 3.05 | | | 75.2 | SURCHARGED | |
| 1.012 | S0405-14-66 | 360 Winter | 5 | +20% | 100/15 Winter | | | | 107.840 | -0.035 | 0.000 | 0.32 | | | 56.7 | OK | |
| 1.013 | S0405-14-68 | 360 Winter | 5 | +20% | 5/30 Summer | | | | 107.838 | 0.238 | 0.000 | 0.36 | | | 21.4 | SURCHARGED | |
| 1.014 | S0405-14-70 | 360 Summer | 5 | +20% | 5/30 Summer | 5/120 Summer | | | 108.599 | 1.051 | 0.678 | 0.18 | | | 14.5 | FLOOD | 39 |
| 1.015 | S0405-14-71 | 2160 Summer | 5 | +20% | | | | | 107.245 | -0.276 | 0.000 | 0.14 | | | 13.9 | OK | |
| 1.016 | S0405-14-72 | 4320 Summer | 5 | +20% | | | | | 107.171 | -0.276 | 0.000 | 0.13 | | | 13.9 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Kirkby Thore School North 1

### Simulation Criteria

Areal Reduction Factor 1.000 Hot Start Level (mm) 0 Foul Sewage per hectare (l/s) 0.000 MADD Factor * 10m³/ha Storage 2.000 Flow per Person per Day (l/per/day) 0.000
Hot Start (mins) 0 Manhole Headloss Coeff (Global) 0.500 Additional Flow - % of Total Flow 0.000 Inlet Coeffiecient 0.800

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Region England and Wales M5-60 (mm) 18.400 Ratio R 0.300 Cv (Summer) 0.750 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 Analysis Timestep Fine DTS Status ON DVD Status OFF Inertia Status OFF

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-14-1 | 15 Winter | 100 | +40% | | | | | 120.581 | -0.154 | 0.000 | 0.21 | | | 18.1 | OK | |
| 1.001 | S0405-14-2 | 15 Winter | 100 | +40% | | | | | 119.770 | -0.146 | 0.000 | 0.26 | | | 31.6 | OK | |
| 1.002 | S0405-14-3 | 15 Winter | 100 | +40% | | | | | 115.594 | -0.107 | 0.000 | 0.52 | | | 45.4 | OK | |
| 2.000 | S0405-14-4 | 15 Winter | 100 | +40% | | | | | 120.693 | -0.140 | 0.000 | 0.30 | | | 33.3 | OK | |
| 2.001 | S0405-14-5 | 15 Winter | 100 | +40% | | | | | 116.661 | -0.100 | 0.000 | 0.57 | | | 52.5 | OK | |
| 3.000 | S0405-14-6 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 114.918 | 0.678 | 0.000 | 0.33 | | | 12.9 | SURCHARGED | |
| 2.002 | S0405-14-7 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 114.874 | 1.078 | 0.000 | 0.70 | | | 50.6 | FLOOD RISK | |
| 4.000 | S0405-14-8 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 114.765 | 0.920 | 0.000 | 0.18 | | | 7.1 | FLOOD RISK | |
| 1.003 | S0405-14-9 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 114.740 | 1.206 | 0.000 | 0.99 | | | 90.3 | FLOOD RISK | |
| 1.004 | S0405-14-10 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 114.319 | 1.203 | 2.985 | 1.68 | | | 67.4 | FLOOD | 4 |
| 1.005 | S0405-14-11 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 112.988 | 0.440 | 0.000 | 0.99 | | | 60.1 | SURCHARGED | |
| 1.006 | S0405-14-12 | 30 Winter | 100 | +40% | 5/15 Winter | | | | 112.078 | 0.478 | 0.000 | 1.39 | | | 59.2 | SURCHARGED | |
| 1.007 | S0405-14-13 | 30 Winter | 100 | +40% | | | | | 110.994 | -0.095 | 0.000 | 0.63 | | | 59.2 | OK | |
| 5.000 | S0405-14-26 | 15 Winter | 100 | +40% | | | | | 116.489 | -0.125 | 0.000 | 0.40 | | | 25.6 | OK | |
| 5.001 | S0405-14-15 | 15 Winter | 100 | +40% | | | | | 115.544 | -0.095 | 0.000 | 0.57 | | | 53.8 | OK | |
| 5.002 | S0405-14-16 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 114.868 | 1.202 | 1.951 | 1.30 | | | 63.2 | FLOOD | 3 |
| 6.000 | S0405-14-17 | 15 Winter | 100 | +40% | | | | | 121.011 | -0.170 | 0.000 | 0.13 | | | 10.8 | OK | |
| 6.001 | S0405-14-18 | 15 Winter | 100 | +40% | | | | | 119.685 | -0.133 | 0.000 | 0.35 | | | 10.9 | OK | |
| 6.002 | S0405-14-19 | 15 Winter | 100 | +40% | | | | | 119.622 | -0.146 | 0.000 | 0.26 | | | 26.8 | OK | |
| 6.003 | S0405-14-20 | 15 Winter | 100 | +40% | | | | | 116.822 | -0.109 | 0.000 | 0.50 | | | 52.1 | OK | |
| 5.003 | S0405-14-21 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 113.344 | 0.590 | 0.000 | 2.98 | | | 106.5 | SURCHARGED | |
| 7.000 | S0405-14-22 | 15 Winter | 100 | +40% | | | | | 116.468 | -0.146 | 0.000 | 0.26 | | | 20.8 | OK* | |
| 8.000 | S0405-14-23 | 15 Winter | 100 | +40% | | | | | 117.677 | -0.070 | 0.000 | 0.72 | | | 28.1 | OK | |
| 8.001 | S0405-14-24 | 15 Winter | 100 | +40% | | | | | 117.052 | -0.096 | 0.000 | 0.60 | | | 42.5 | OK | |
| 8.002 | S0405-14-25 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 116.705 | 0.722 | 0.000 | 0.71 | | | 47.1 | SURCHARGED | |
| 9.000 | S0405-14-26 | 15 Winter | 100 | +40% | | | | | 116.485 | -0.128 | 0.000 | 0.37 | | | 22.9 | OK | |
| 9.001 | S0405-14-27 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 116.356 | 0.560 | 0.000 | 0.57 | | | 35.5 | SURCHARGED | |
| 8.003 | S0405-14-28 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 116.160 | 1.203 | 3.341 | 1.86 | | | 66.0 | FLOOD | 3 |
| 10.000 | S0405-14-29 | 15 Winter | 100 | +40% | | | | | 116.460 | -0.153 | 0.000 | 0.22 | | | 13.6 | OK | |
| 10.001 | S0405-14-30 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 116.064 | 0.279 | 0.000 | 0.37 | | | 24.0 | SURCHARGED | |
| 11.000 | S0405-14-31 | 15 Winter | 100 | +40% | | | | | 117.655 | -0.092 | 0.000 | 0.57 | | | 22.5 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Kirkby Thore School North 1

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11.001 | S0405-14-32 | 15 Winter | 100 | +40% | | | | | 117.035 | -0.115 | 0.000 | 0.47 | | | 34.6 | OK | |
| 11.002 | S0405-14-33 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 116.276 | 0.325 | 0.000 | 0.63 | | | 43.1 | SURCHARGED | |
| 8.004 | S0405-14-34 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 116.031 | 1.074 | 0.000 | 2.35 | | | 118.5 | FLOOD RISK | |
| 8.005 | S0405-14-35 | 15 Winter | 100 | +40% | 5/15 Winter | | | | 115.885 | 0.941 | 0.000 | 1.61 | | | 110.0 | SURCHARGED | |
| 8.006 | S0405-14-36 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 115.201 | 0.588 | 0.000 | 1.41 | | | 97.4 | SURCHARGED | |
| 8.007 | S0405-14-37 | 30 Winter | 100 | +40% | 5/15 Winter | | | | 114.313 | 0.114 | 0.000 | 1.98 | | | 97.9 | SURCHARGED | |
| 7.001 | S0405-14-38 | 30 Winter | 100 | +40% | | | | | 114.149 | -0.026 | 0.000 | 0.82 | | | 107.0 | OK | |
| 7.002 | S0405-14-39 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 113.524 | 0.275 | 0.000 | 1.26 | | | 110.5 | SURCHARGED | |
| 12.000 | S0405-14-40 | 15 Winter | 100 | +40% | | | | | 119.779 | -0.157 | 0.000 | 0.19 | | | 20.5 | OK | |
| 12.001 | S0405-14-41 | 15 Winter | 100 | +40% | | | | | 116.032 | -0.122 | 0.000 | 0.41 | | | 42.3 | OK | |
| 5.004 | S0405-14-42 | 15 Winter | 100 | +40% | | | | | 112.615 | -0.138 | 0.000 | 0.57 | | | 231.6 | OK | |
| 5.005 | S0405-14-43 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 111.407 | 1.289 | 13.883 | 1.04 | | | 199.7 | FLOOD | 6 |
| 5.006 | S0405-14-44 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 109.884 | 1.403 | 22.595 | 2.34 | | | 187.6 | FLOOD | 7 |
| 5.007 | S0405-14-45 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 109.659 | 1.252 | 0.000 | 2.26 | | | 183.9 | SURCHARGED | |
| 5.008 | S0405-14-46 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 109.373 | 1.058 | 0.000 | 2.73 | | | 178.4 | SURCHARGED | |
| 1.008 | S0405-14-47 | 30 Winter | 100 | +40% | 5/15 Winter | | | | 109.221 | 0.870 | 0.000 | 1.64 | | | 219.1 | SURCHARGED | |
| 1.009 | S0405-14-48 | 60 Winter | 100 | +40% | 100/15 Summer | | | | 108.892 | 0.681 | 0.000 | 1.53 | | | 205.9 | SURCHARGED | |
| 1.010 | S0405-14-49 | 60 Winter | 100 | +40% | 100/15 Summer | | | | 108.561 | 0.506 | 0.000 | 1.52 | | | 203.7 | SURCHARGED | |
| 1.011 | S0405-14-50 | 15 Summer | 100 | +40% | | | | | 107.908 | 0.000 | 0.000 | 1.44 | | | 206.2 | SURCHARGED* | |
| 13.000 | S0405-14-51 | 15 Winter | 100 | +40% | | | | | 121.267 | -0.106 | 0.000 | 0.53 | | | 44.4 | OK | |
| 13.001 | S0405-14-52 | 15 Winter | 100 | +40% | | | | | 118.577 | -0.115 | 0.000 | 0.47 | | | 53.8 | OK | |
| 13.002 | S0405-14-53 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 117.365 | 0.100 | 0.000 | 1.24 | | | 59.1 | SURCHARGED | |
| 13.003 | S0405-14-54 | 15 Winter | 100 | +40% | | | | | 116.974 | -0.096 | 0.000 | 0.62 | | | 62.1 | OK | |
| 13.004 | S0405-14-55 | 15 Winter | 100 | +40% | | | | | 116.508 | -0.062 | 0.000 | 0.85 | | | 83.8 | OK | |
| 13.005 | S0405-14-56 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 114.789 | 0.899 | 0.000 | 0.94 | | | 86.3 | SURCHARGED | |
| 13.006 | S0405-14-57 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | | | 112.846 | 1.200 | 0.282 | 1.09 | | | 87.9 | FLOOD | 1 |
| 14.000 | S0405-14-58 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 110.644 | 1.107 | 0.000 | 0.27 | | | 10.4 | FLOOD RISK | |
| 13.007 | S0405-14-59 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 110.611 | 1.524 | 0.000 | 3.03 | | | 99.9 | SURCHARGED | |
| 15.000 | S0405-14-60 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 110.199 | 0.615 | 0.000 | 0.30 | | | 13.2 | SURCHARGED | |
| 16.000 | S0405-14-61 | 15 Winter | 100 | +40% | | | | | 119.720 | -0.157 | 0.000 | 0.19 | | | 19.1 | OK | |
| 16.001 | S0405-14-62 | 15 Winter | 100 | +40% | | | | | 115.926 | -0.126 | 0.000 | 0.38 | | | 37.2 | OK | |
| 16.002 | S0405-14-63 | 15 Winter | 100 | +40% | | | | | 112.326 | -0.109 | 0.000 | 0.51 | | | 47.2 | OK | |
| 16.003 | S0405-14-64 | 15 Winter | 100 | +40% | | | | | 110.466 | -0.050 | 0.000 | 0.71 | | | 53.2 | OK | |
| 13.008 | S0405-14-65 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 110.147 | 1.115 | 0.000 | 6.06 | | | 149.4 | SURCHARGED | |
| 1.012 | S0405-14-66 | 480 Winter | 100 | +40% | 100/15 Winter | | | | 108.517 | 0.642 | 0.000 | 0.57 | | | 99.6 | SURCHARGED | |
| 1.013 | S0405-14-68 | 480 Winter | 100 | +40% | 5/30 Summer | | | | 108.512 | 0.912 | 0.000 | 0.37 | | | 21.7 | FLOOD RISK | |
| 1.014 | S0405-14-70 | 1440 Winter | 100 | +40% | 5/30 Summer | 5/120 Summer | | | 108.602 | 1.054 | 5.148 | 0.18 | | | 14.6 | FLOOD | 39 |
| 1.015 | S0405-14-71 | 2880 Winter | 100 | +40% | | | | | 107.245 | -0.276 | 0.000 | 0.14 | | | 14.1 | OK | |
| 1.016 | S0405-14-72 | 4320 Summer | 100 | +40% | | | | | 107.169 | -0.278 | 0.000 | 0.13 | | | 13.8 | OK | |

| | | |
|---|---|---|
| Amey Group Plc | | Page 1 |
| South East Hub, Explorer II<br>Fleming Way, Crawley<br>West Sussex, RH10 9GT | | |
| Date 09/05/2022 17:22<br>File 15 - Priest Lane (mainline).MDX | Designed by 149806<br>Checked by | |
| Innovyze | Network 2020.1.3 | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Existing

```
                         Pipe Sizes STANDARD Manhole Sizes STANDARD

                            FSR Rainfall Model - England and Wales
                 Return Period (years)      30          Foul Sewage (l/s/ha) 0.000           Maximum Backdrop Height (m) 1.500
                           M5-60 (mm)  21.800      Volumetric Runoff Coeff. 0.750 Min Design Depth for Optimisation (m) 1.200
                              Ratio R   0.213                      PIMP (%)   100     Min Vel for Auto Design only (m/s)  1.00
               Maximum Rainfall (mm/hr)     50 Add Flow / Climate Change (%)     0       Min Slope for Optimisation (1:X)   375
  Maximum Time of Concentration (mins)      30   Minimum Backdrop Height (m) 0.200

                                   Designed with Level Inverts
```

### Simulation Criteria for Existing

```
       Volumetric Runoff Coeff 0.750   Manhole Headloss Coeff (Global) 0.500                  Inlet Coeffiecient 0.800
        Areal Reduction Factor 1.000     Foul Sewage per hectare (l/s) 0.000 Flow per Person per Day (l/per/day) 0.000
              Hot Start (mins)     0 Additional Flow - % of Total Flow 0.000                      Run Time (mins)     60
           Hot Start Level (mm)     0     MADD Factor * 10m³/ha Storage 2.000                 Output Interval (mins)      1

                Number of Input Hydrographs 0   Number of Offline Controls 0 Number of Time/Area Diagrams 0
                  Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
                            Rainfall Model FSR     Region England and Wales      Ratio R  0.213
                       Return Period (years)   30 M5-60 (mm)            21.800 Profile Type Summer
```

## Synthetic Rainfall Details

Cv (Summer) 0.750 Cv (Winter) 0.840 Storm Duration (mins) 30

## Online Controls for Existing

### Hydro-Brake® Optimum Manhole: S0405-02-76, DS/PN: 1.017, Volume ($m^3$): 14.3

| | | | |
|---|---|---|---|
| Unit Reference | MD-SHE-0254-4000-2000-4000 | Sump Available | Yes |
| Design Head (m) | 2.000 | Diameter (mm) | 254 |
| Design Flow (l/s) | 40.0 | Invert Level (m) | 108.545 |
| Flush-Flo™ | Calculated | Minimum Outlet Pipe Diameter (mm) | 300 |
| Objective | Minimise upstream storage | Suggested Manhole Diameter (mm) | 2100 |
| Application | Surface | | |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| Design Point (Calculated) | 2.000 | 40.0 | Kick-Flo® | 1.297 | 32.5 |
| Flush-Flo™ | 0.599 | 39.8 | Mean Flow over Head Range | - | 34.5 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 8.2 | 0.600 | 39.8 | 1.600 | 35.9 | 2.600 | 45.4 | 5.000 | 62.2 | 7.500 | 75.8 |
| 0.200 | 26.1 | 0.800 | 39.3 | 1.800 | 38.0 | 3.000 | 48.6 | 5.500 | 65.2 | 8.000 | 78.2 |
| 0.300 | 36.8 | 1.000 | 38.0 | 2.000 | 40.0 | 3.500 | 52.4 | 6.000 | 68.0 | 8.500 | 80.5 |
| 0.400 | 38.7 | 1.200 | 35.2 | 2.200 | 41.8 | 4.000 | 55.8 | 6.500 | 70.7 | 9.000 | 82.8 |
| 0.500 | 39.6 | 1.400 | 33.7 | 2.400 | 43.6 | 4.500 | 59.1 | 7.000 | 73.3 | 9.500 | 85.0 |

## Storage Structures for Existing

### Tank or Pond Manhole: S0405-02-75, DS/PN: 1.016

Invert Level (m) 110.650

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 1625.0 | 1.800 | 2816.7 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

```
                                          Simulation Criteria
   Areal Reduction Factor 1.000  Manhole Headloss Coeff (Global) 0.500       MADD Factor * 10m³/ha Storage 2.000
         Hot Start (mins)      0    Foul Sewage per hectare (l/s) 0.000               Inlet Coeffiecient 0.800
     Hot Start Level (mm)      0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

             Number of Input Hydrographs 0   Number of Offline Controls 0 Number of Time/Area Diagrams 0
               Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

                                       Synthetic Rainfall Details
                         Rainfall Model               FSR M5-60 (mm) 21.800 Cv (Summer) 0.750
                                Region England and Wales     Ratio R  0.213 Cv (Winter) 0.840

                      Margin for Flood Risk Warning (mm) 300.0 DTS Status  ON Inertia Status OFF
                                     Analysis Timestep  Fine DVD Status OFF


                          Profile(s)                                                  Summer and Winter
                   Duration(s) (mins)  15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880,
                                                                                4320, 5760, 7200, 8640, 10080
                Return Period(s) (years)                                                           5, 100
                   Climate Change (%)                                                              20, 40


                                                                                 Water  Surcharged Flooded                    Half Drain
            US/MH                    Return Climate First (X) First (Y) First (Z) Overflow  Level    Depth   Volume  Flow / Overflow    Time
   PN       Name         Storm       Period  Change  Surcharge   Flood   Overflow    Act.     (m)      (m)     (m³)    Cap.   (l/s)     (mins)

 1.000 S0405-02-1 15 Winter       5     +20%                                              120.419   -0.145   0.000   0.24
 1.001 S0405-02-2 15 Winter       5     +20%                                              119.816   -0.150   0.000   0.22
```

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| 1.000 | S0405-02-1 | 9.4 | OK | |
| 1.001 | S0405-02-2 | 8.7 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| **PN** | **US/MH Name** | **Storm** | **Return Period** | **Climate Change** | **First (X) Surcharge** | **First (Y) Flood** | **First (Z) Overflow** | **Overflow Act.** | **Water Level (m)** | **Surcharged Depth (m)** | **Flooded Volume (m³)** | **Flow / Cap.** | **Overflow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.002 | S0405-02-3 | 15 Winter | 5 | +20% | | | | | 119.229 | -0.139 | 0.000 | 0.30 | |
| 1.003 | S0405-02-4 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 118.125 | -0.151 | 0.000 | 0.24 | |
| 1.004 | S0405-02-5 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 117.107 | -0.151 | 0.000 | 0.24 | |
| 1.005 | S0405-02-6 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 116.773 | -0.089 | 0.000 | 0.66 | |
| 1.006 | S0405-02-7 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 115.991 | 0.052 | 0.000 | 1.26 | |
| 1.007 | S0405-02-8 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 115.783 | -0.053 | 0.000 | 0.91 | |
| 1.008 | S0405-02-9 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 114.097 | 0.572 | 0.000 | 0.90 | |
| 1.009 | S0405-02-10 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 112.277 | 0.998 | 0.000 | 0.71 | |
| 2.000 | S0405-02-11 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 118.248 | -0.074 | 0.000 | 0.72 | |
| 2.001 | S0405-02-12 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 117.260 | -0.103 | 0.000 | 0.54 | |
| 2.002 | S0405-02-13 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 115.726 | -0.115 | 0.000 | 0.46 | |
| 2.003 | S0405-02-14 | 30 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 113.794 | -0.058 | 0.000 | 0.71 | |
| 2.004 | S0405-02-15 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 112.913 | 1.107 | 0.000 | 0.87 | |
| 2.005 | S0405-02-16 | 30 Winter | 5 | +20% | 5/15 Summer | 5/15 Winter | | | 112.339 | 1.280 | 5.536 | 2.19 | |
| 3.000 | S0405-02-17 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 119.429 | 0.421 | 0.000 | 1.26 | |
| 3.001 | S0405-02-18 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 118.428 | -0.099 | 0.000 | 0.75 | |
| 3.002 | S0405-02-19 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 117.746 | -0.126 | 0.000 | 0.63 | |
| 3.003 | S0405-02-20 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 116.359 | -0.128 | 0.000 | 0.62 | |
| 3.004 | S0405-02-21 | 30 Winter | 5 | +20% | 100/15 Summer | 100/30 Summer | | | 114.428 | -0.119 | 0.000 | 0.67 | |
| 3.005 | S0405-02-22 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 113.071 | 0.712 | 0.000 | 0.78 | |
| 2.006 | S0405-02-23 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 112.302 | 1.127 | 0.000 | 0.93 | |
| 1.010 | S0405-02-24 | 30 Winter | 5 | +20% | 5/15 Summer | 5/2880 Winter | | | 111.989 | 1.075 | 0.000 | 1.54 | |
| 4.000 | S0405-02-25 | 15 Winter | 5 | +20% | | | | | 119.510 | -0.144 | 0.000 | 0.25 | |
| 4.001 | S0405-02-26 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 118.969 | -0.116 | 0.000 | 0.43 | |
| 4.002 | S0405-02-27 | 15 Winter | 5 | +20% | | | | | 118.364 | -0.123 | 0.000 | 0.41 | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 1.002 | S0405-02-3 | | 15.7 | OK | |
| 1.003 | S0405-02-4 | | 19.4 | OK | |
| 1.004 | S0405-02-5 | | 20.0 | OK | |
| 1.005 | S0405-02-6 | | 47.0 | OK | 6 |
| 1.006 | S0405-02-7 | | 53.9 | SURCHARGED | 9 |
| 1.007 | S0405-02-8 | | 70.8 | OK | 6 |
| 1.008 | S0405-02-9 | | 69.7 | SURCHARGED | 9 |
| 1.009 | S0405-02-10 | | 76.3 | FLOOD RISK | 11 |
| 2.000 | S0405-02-11 | | 35.8 | OK | |
| 2.001 | S0405-02-12 | | 34.2 | OK | |
| 2.002 | S0405-02-13 | | 33.3 | OK | |
| 2.003 | S0405-02-14 | | 52.1 | OK | 7 |
| 2.004 | S0405-02-15 | | 55.0 | FLOOD RISK | 11 |
| 2.005 | S0405-02-16 | | 65.5 | FLOOD | 17 |
| 3.000 | S0405-02-17 | | 49.3 | SURCHARGED | 7 |
| 3.001 | S0405-02-18 | | 65.5 | OK | |
| 3.002 | S0405-02-19 | | 79.5 | OK | |
| 3.003 | S0405-02-20 | | 92.8 | OK | |
| 3.004 | S0405-02-21 | | 106.9 | OK | 3 |
| 3.005 | S0405-02-22 | | 109.9 | SURCHARGED | 9 |
| 2.006 | S0405-02-23 | | 157.2 | FLOOD RISK | 11 |
| 1.010 | S0405-02-24 | | 231.5 | FLOOD RISK | 10 |
| 4.000 | S0405-02-25 | | 9.7 | OK | |
| 4.001 | S0405-02-26 | | 17.0 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 4.002 | S0405-02-27 |  | 23.5 | OK |  |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume ($m^3$) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.003 | S0405-02-28 | 15 Winter | 5 | +20% | 100/15 Winter | | | | 117.084 | -0.123 | 0.000 | 0.41 | |
| 4.004 | S0405-02-29 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 115.187 | -0.122 | 0.000 | 0.42 | |
| 4.005 | S0405-02-30 | 30 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 112.780 | -0.101 | 0.000 | 0.58 | |
| 4.006 | S0405-02-31 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 112.085 | 0.890 | 0.000 | 0.49 | |
| 1.011 | S0405-02-32 | 30 Winter | 5 | +20% | 5/15 Summer | 5/2880 Winter | | | 111.938 | 0.978 | 0.000 | 1.37 | |
| 5.000 | S0405-02-33 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 120.113 | -0.084 | 0.000 | 0.63 | |
| 5.001 | S0405-02-34 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Winter | | | 119.658 | 0.060 | 0.000 | 1.02 | |
| 5.002 | S0405-02-35 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 118.923 | -0.077 | 0.000 | 0.74 | |
| 5.003 | S0405-02-36 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 117.829 | -0.096 | 0.000 | 0.62 | |
| 5.004 | S0405-02-37 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 116.930 | -0.049 | 0.000 | 0.97 | |
| 5.005 | S0405-02-38 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 116.808 | -0.084 | 0.000 | 0.70 | |
| 5.006 | S0405-02-39 | 30 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 114.657 | -0.064 | 0.000 | 0.85 | |
| 5.007 | S0405-02-40 | 30 Winter | 5 | +20% | 5/15 Winter | 100/15 Winter | | | 112.427 | 0.257 | 0.000 | 0.61 | |
| 6.000 | S0405-02-41 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 119.900 | -0.095 | 0.000 | 0.56 | |
| 6.001 | S0405-02-42 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 119.378 | -0.026 | 0.000 | 0.95 | |
| 6.002 | S0405-02-43 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 118.751 | -0.055 | 0.000 | 0.89 | |
| 6.003 | S0405-02-44 | 30 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 117.463 | -0.053 | 0.000 | 0.92 | |
| 6.004 | S0405-02-45 | 30 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 115.526 | -0.007 | 0.000 | 1.00 | |
| 6.005 | S0405-02-46 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 113.043 | -0.125 | 0.000 | 0.63 | |
| 6.006 | S0405-02-47 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 112.188 | 0.913 | 0.000 | 0.69 | |
| 1.012 | S0405-02-48 | 30 Winter | 5 | +20% | 5/15 Summer | 5/2880 Summer | | | 111.902 | 0.892 | 0.000 | 1.64 | |
| 7.000 | S0405-02-49 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | | | 119.972 | -0.138 | 0.000 | 0.30 | |
| 7.001 | S0405-02-50 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | | | 119.688 | -0.104 | 0.000 | 0.56 | |
| 8.000 | S0405-02-51 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 119.685 | -0.176 | 0.000 | 0.10 | |
| 8.001 | S0405-02-52 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 119.452 | -0.095 | 0.000 | 0.18 | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 4.003 | S0405-02-28 | | 29.0 | OK | |
| 4.004 | S0405-02-29 | | 33.8 | OK | |
| 4.005 | S0405-02-30 | | 38.3 | OK | 6 |
| 4.006 | S0405-02-31 | | 35.5 | SURCHARGED | 8 |
| 1.011 | S0405-02-32 | | 266.1 | SURCHARGED | |
| 5.000 | S0405-02-33 | | 24.6 | OK | 5 |
| 5.001 | S0405-02-34 | | 40.1 | SURCHARGED | 3 |
| 5.002 | S0405-02-35 | | 39.1 | OK | |
| 5.003 | S0405-02-36 | | 40.5 | OK | |
| 5.004 | S0405-02-37 | | 40.5 | OK | |
| 5.005 | S0405-02-38 | | 52.7 | OK | |
| 5.006 | S0405-02-39 | | 70.1 | OK | 8 |
| 5.007 | S0405-02-40 | | 83.0 | SURCHARGED | 4 |
| 6.000 | S0405-02-41 | | 21.9 | OK | 6 |
| 6.001 | S0405-02-42 | | 37.2 | OK | 6 |
| 6.002 | S0405-02-43 | | 51.7 | OK | 7 |
| 6.003 | S0405-02-44 | | 66.2 | OK | 7 |
| 6.004 | S0405-02-45 | | 79.6 | OK | 6 |
| 6.005 | S0405-02-46 | | 94.1 | OK | |
| 6.006 | S0405-02-47 | | 95.0 | FLOOD RISK | 9 |
| 1.012 | S0405-02-48 | | 436.1 | SURCHARGED | |
| 7.000 | S0405-02-49 | | 11.7 | OK | 3 |
| 7.001 | S0405-02-50 | | 21.4 | OK | 3 |
| 8.000 | S0405-02-51 | | 4.0 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 8.001 | S0405-02-52 | | 7.1 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8.002 | S0405-02-53 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 119.437 | 0.205 | 0.000 | 0.57 | |
| 7.002 | S0405-02-54 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Winter | | | 119.434 | 0.232 | 0.000 | 1.05 | |
| 7.003 | S0405-02-55 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 118.799 | 0.195 | 0.000 | 1.08 | |
| 7.004 | S0405-02-56 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 117.451 | -0.053 | 0.000 | 0.94 | |
| 7.005 | S0405-02-57 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 115.980 | -0.075 | 0.000 | 0.78 | |
| 7.006 | S0405-02-58 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 113.614 | -0.073 | 0.000 | 0.79 | |
| 7.007 | S0405-02-59 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 112.864 | 0.414 | 0.000 | 1.22 | |
| 7.008 | S0405-02-60 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 112.674 | 0.352 | 0.000 | 0.89 | |
| 7.009 | S0405-02-61 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 112.060 | 0.437 | 0.000 | 1.01 | |
| 7.010 | S0405-02-62 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 111.971 | 0.444 | 0.000 | 0.52 | |
| 9.000 | S0405-02-63 | 15 Winter | 5 | +20% | | | | | 120.439 | -0.197 | 0.000 | 0.04 | |
| 9.001 | S0405-02-64 | 15 Winter | 5 | +20% | | | | | 120.390 | -0.174 | 0.000 | 0.11 | |
| 9.002 | S0405-02-65 | 15 Winter | 5 | +20% | | | | | 120.217 | -0.176 | 0.000 | 0.11 | |
| 9.003 | S0405-02-66 | 15 Winter | 5 | +20% | | | | | 119.909 | -0.129 | 0.000 | 0.34 | |
| 9.004 | S0405-02-67 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 119.318 | -0.122 | 0.000 | 0.41 | |
| 9.005 | S0405-02-68 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 118.071 | -0.118 | 0.000 | 0.45 | |
| 9.006 | S0405-02-69 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 116.200 | -0.123 | 0.000 | 0.41 | |
| 9.007 | S0405-02-70 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 113.467 | -0.115 | 0.000 | 0.47 | |
| 9.008 | S0405-02-71 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Winter | | | 112.054 | 0.563 | 0.000 | 0.77 | |
| 1.013 | S0405-02-72 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 111.844 | 0.194 | 0.000 | 1.03 | |
| 1.014 | S0405-02-73 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 111.739 | 0.189 | 0.000 | 1.54 | |
| 1.015 | S0405-02-74 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 111.588 | 0.088 | 0.000 | 1.44 | |
| 1.016 | S0405-02-75 | 480 Winter | 5 | +20% | 5/60 Winter | | | | 111.237 | 0.212 | 0.000 | 0.13 | |
| 1.017 | S0405-02-76 | 1440 Winter | 5 | +20% | 5/15 Summer | 5/480 Winter | | | 112.500 | 3.580 | 2.805 | 0.71 | |
| 1.018 | S0405-02-77 | 1440 Summer | 5 | +20% | | | | | 108.857 | -0.055 | 0.000 | 0.76 | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 8.002 | S0405-02-53 | | 16.6 | SURCHARGED | 8 |
| 7.002 | S0405-02-54 | | 41.0 | SURCHARGED | 1 |
| 7.003 | S0405-02-55 | | 57.9 | SURCHARGED | 7 |
| 7.004 | S0405-02-56 | | 57.7 | OK | |
| 7.005 | S0405-02-57 | | 61.1 | OK | |
| 7.006 | S0405-02-58 | | 62.6 | OK | |
| 7.007 | S0405-02-59 | | 61.4 | SURCHARGED | |
| 7.008 | S0405-02-60 | | 62.1 | SURCHARGED | |
| 7.009 | S0405-02-61 | | 63.9 | SURCHARGED | |
| 7.010 | S0405-02-62 | | 65.7 | SURCHARGED | |
| 9.000 | S0405-02-63 | | 1.2 | OK | |
| 9.001 | S0405-02-64 | | 4.3 | OK | |
| 9.002 | S0405-02-65 | | 4.1 | OK | |
| 9.003 | S0405-02-66 | | 13.4 | OK | |
| 9.004 | S0405-02-67 | | 23.3 | OK | |
| 9.005 | S0405-02-68 | | 31.3 | OK | |
| 9.006 | S0405-02-69 | | 35.0 | OK | |
| 9.007 | S0405-02-70 | | 35.0 | OK | |
| 9.008 | S0405-02-71 | | 35.0 | SURCHARGED | 5 |
| 1.013 | S0405-02-72 | | 525.3 | SURCHARGED | |
| 1.014 | S0405-02-73 | | 519.3 | SURCHARGED | |
| 1.015 | S0405-02-74 | | 512.0 | SURCHARGED | |
| 1.016 | S0405-02-75 | | 54.5 | SURCHARGED | |
| 1.017 | S0405-02-76 | | 44.1 | FLOOD | 19 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 1.018 | S0405-02-77 | | 44.3 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.019 | S0405-02-78 | 2160 Winter | 5 | +20% | | | | | 108.797 | -0.063 | 0.000 | 0.75 | | |
| 1.020 | S0405-02-79 | 1440 Summer | 5 | +20% | | | | | 108.741 | -0.062 | 0.000 | 0.91 | | |
| 1.021 | S0405-02-80 | 2160 Winter | 5 | +20% | | | | | 108.674 | -0.092 | 0.000 | 0.92 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| 1.019 | S0405-02-78 | 44.1 | OK | |
| 1.020 | S0405-02-79 | 44.3 | OK | |
| 1.021 | S0405-02-80 | 44.1 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

### Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 21.800 Cv (Summer) 0.750
Region England and Wales Ratio R 0.213 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status ON Inertia Status OFF
Analysis Timestep Fine DVD Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-02-1 | 15 Winter | 100 | +40% | | | | | 120.465 | -0.099 | 0.000 | 0.53 | | |
| 1.001 | S0405-02-2 | 15 Winter | 100 | +40% | | | | | 119.858 | -0.108 | 0.000 | 0.49 | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| **PN** | **US/MH Name** | **Pipe Flow (l/s)** | **Status** | **Level Exceeded** |
|---|---|---|---|---|
| 1.000 | S0405-02-1 | 20.8 | OK | |
| 1.001 | S0405-02-2 | 19.2 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.002 | S0405-02-3 | 15 Winter | 100 | +40% | | | | | 119.286 | -0.082 | 0.000 | 0.67 | |
| 1.003 | S0405-02-4 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 118.455 | 0.179 | 0.000 | 0.52 | |
| 1.004 | S0405-02-5 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 118.178 | 0.921 | 0.000 | 0.52 | |
| 1.005 | S0405-02-6 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 118.070 | 1.209 | 8.555 | 1.00 | |
| 1.006 | S0405-02-7 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 117.163 | 1.224 | 24.238 | 1.58 | |
| 1.007 | S0405-02-8 | 30 Summer | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 117.039 | 1.203 | 2.948 | 0.99 | |
| 1.008 | S0405-02-9 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 114.810 | 1.285 | 9.816 | 1.00 | |
| 1.009 | S0405-02-10 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 112.496 | 1.216 | 16.378 | 0.79 | |
| 2.000 | S0405-02-11 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 119.394 | 1.072 | 0.000 | 1.37 | |
| 2.001 | S0405-02-12 | 30 Summer | 100 | +40% | 100/15 Summer | | | | 117.631 | 0.268 | 0.000 | 0.94 | |
| 2.002 | S0405-02-13 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 116.330 | 0.490 | 0.000 | 0.80 | |
| 2.003 | S0405-02-14 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 115.061 | 1.210 | 9.590 | 1.00 | |
| 2.004 | S0405-02-15 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 113.036 | 1.231 | 31.207 | 0.94 | |
| 2.005 | S0405-02-16 | 60 Winter | 100 | +40% | 5/15 Summer | 5/15 Winter | | | 112.450 | 1.392 | 116.796 | 3.74 | |
| 3.000 | S0405-02-17 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 120.224 | 1.217 | 16.875 | 1.73 | |
| 3.001 | S0405-02-18 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 119.137 | 0.610 | 0.000 | 1.11 | |
| 3.002 | S0405-02-19 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 118.469 | 0.598 | 0.000 | 0.91 | |
| 3.003 | S0405-02-20 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 117.345 | 0.858 | 0.000 | 0.90 | |
| 3.004 | S0405-02-21 | 30 Winter | 100 | +40% | 100/15 Summer | 100/30 Summer | | | 115.749 | 1.202 | 1.711 | 0.98 | |
| 3.005 | S0405-02-22 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 113.662 | 1.303 | 27.605 | 1.00 | |
| 2.006 | S0405-02-23 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 112.424 | 1.250 | 51.022 | 1.03 | |
| 1.010 | S0405-02-24 | 60 Winter | 100 | +40% | 5/15 Summer | 5/2880 Winter | | | 112.165 | 1.252 | 52.032 | 2.27 | |
| 4.000 | S0405-02-25 | 15 Winter | 100 | +40% | | | | | 119.557 | -0.097 | 0.000 | 0.55 | |
| 4.001 | S0405-02-26 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 119.118 | 0.033 | 0.000 | 0.99 | |
| 4.002 | S0405-02-27 | 30 Summer | 100 | +40% | | | | | 118.440 | -0.046 | 0.000 | 0.93 | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 1.002 | S0405-02-3 | | 35.8 | OK | |
| 1.003 | S0405-02-4 | | 42.5 | SURCHARGED | |
| 1.004 | S0405-02-5 | | 43.8 | FLOOD RISK | |
| 1.005 | S0405-02-6 | | 71.5 | FLOOD | 6 |
| 1.006 | S0405-02-7 | | 67.4 | FLOOD | 9 |
| 1.007 | S0405-02-8 | | 76.9 | FLOOD | 6 |
| 1.008 | S0405-02-9 | | 77.7 | FLOOD | 9 |
| 1.009 | S0405-02-10 | | 84.6 | FLOOD | 11 |
| 2.000 | S0405-02-11 | | 68.5 | FLOOD RISK | |
| 2.001 | S0405-02-12 | | 59.2 | SURCHARGED | |
| 2.002 | S0405-02-13 | | 57.2 | SURCHARGED | |
| 2.003 | S0405-02-14 | | 72.9 | FLOOD | 7 |
| 2.004 | S0405-02-15 | | 59.3 | FLOOD | 11 |
| 2.005 | S0405-02-16 | | 111.7 | FLOOD | 17 |
| 3.000 | S0405-02-17 | | 67.7 | FLOOD | 7 |
| 3.001 | S0405-02-18 | | 96.3 | SURCHARGED | |
| 3.002 | S0405-02-19 | | 116.0 | SURCHARGED | |
| 3.003 | S0405-02-20 | | 136.0 | SURCHARGED | |
| 3.004 | S0405-02-21 | | 156.6 | FLOOD | 3 |
| 3.005 | S0405-02-22 | | 140.8 | FLOOD | 9 |
| 2.006 | S0405-02-23 | | 173.6 | FLOOD | 11 |
| 1.010 | S0405-02-24 | | 341.0 | FLOOD | 10 |
| 4.000 | S0405-02-25 | | 21.4 | OK | |
| 4.001 | S0405-02-26 | | 38.8 | SURCHARGED | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 4.002 | S0405-02-27 | | 53.5 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| **PN** | **US/MH Name** | **Storm** | **Return Period** | **Climate Change** | **First (X) Surcharge** | **First (Y) Flood** | **First (Z) Overflow** | **Overflow Act.** | **Water Level (m)** | **Surcharged Depth (m)** | **Flooded Volume (m³)** | **Flow / Cap.** | **Overflow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.003 | S0405-02-28 | 30 Winter | 100 | +40% | 100/15 Winter | | | | 117.372 | 0.166 | 0.000 | 0.90 | |
| 4.004 | S0405-02-29 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 115.940 | 0.631 | 0.000 | 0.87 | |
| 4.005 | S0405-02-30 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 114.085 | 1.204 | 4.064 | 1.00 | |
| 4.006 | S0405-02-31 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 112.407 | 1.212 | 11.917 | 0.72 | |
| 1.011 | S0405-02-32 | 60 Winter | 100 | +40% | 5/15 Summer | 5/2880 Winter | | | 112.161 | 1.201 | 0.000 | 1.79 | |
| 5.000 | S0405-02-33 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 121.401 | 1.205 | 4.789 | 0.96 | |
| 5.001 | S0405-02-34 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Winter | | | 121.167 | 1.569 | 0.327 | 1.74 | |
| 5.002 | S0405-02-35 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 120.055 | 1.054 | 0.000 | 1.08 | |
| 5.003 | S0405-02-36 | 60 Winter | 100 | +40% | 100/15 Summer | | | | 118.766 | 0.841 | 0.000 | 0.86 | |
| 5.004 | S0405-02-37 | 60 Winter | 100 | +40% | 100/15 Summer | | | | 118.074 | 1.096 | 0.000 | 1.39 | |
| 5.005 | S0405-02-38 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 117.972 | 1.080 | 0.000 | 0.96 | |
| 5.006 | S0405-02-39 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 115.933 | 1.212 | 12.077 | 1.10 | |
| 5.007 | S0405-02-40 | 30 Summer | 100 | +40% | 5/15 Winter | 100/15 Winter | | | 113.371 | 1.201 | 1.190 | 0.93 | |
| 6.000 | S0405-02-41 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 121.199 | 1.204 | 4.193 | 0.77 | |
| 6.001 | S0405-02-42 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 120.986 | 1.582 | 3.051 | 1.22 | |
| 6.002 | S0405-02-43 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 120.090 | 1.284 | 7.057 | 1.03 | |
| 6.003 | S0405-02-44 | 60 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 118.724 | 1.208 | 7.937 | 1.12 | |
| 6.004 | S0405-02-45 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 116.813 | 1.280 | 5.071 | 1.18 | |
| 6.005 | S0405-02-46 | 30 Summer | 100 | +40% | 100/15 Summer | | | | 113.917 | 0.750 | 0.000 | 0.86 | |
| 6.006 | S0405-02-47 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 112.488 | 1.213 | 12.687 | 0.83 | |
| 1.012 | S0405-02-48 | 60 Winter | 100 | +40% | 5/15 Summer | 5/2880 Summer | | | 112.135 | 1.125 | 0.000 | 1.78 | |
| 7.000 | S0405-02-49 | 30 Summer | 100 | +40% | 100/15 Summer | 100/15 Winter | | | 121.310 | 1.200 | 0.190 | 0.53 | |
| 7.001 | S0405-02-50 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | | | 121.211 | 1.419 | 0.475 | 0.97 | |
| 8.000 | S0405-02-51 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 120.901 | 1.040 | 0.000 | 0.18 | |
| 8.001 | S0405-02-52 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 120.877 | 1.330 | 0.000 | 0.34 | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 4.003 | S0405-02-28 | | 63.2 | SURCHARGED | |
| 4.004 | S0405-02-29 | | 69.3 | SURCHARGED | |
| 4.005 | S0405-02-30 | | 66.2 | FLOOD | 6 |
| 4.006 | S0405-02-31 | | 51.6 | FLOOD | 8 |
| 1.011 | S0405-02-32 | | 346.9 | FLOOD RISK | |
| 5.000 | S0405-02-33 | | 37.8 | FLOOD | 5 |
| 5.001 | S0405-02-34 | | 68.4 | FLOOD | 3 |
| 5.002 | S0405-02-35 | | 57.2 | SURCHARGED | |
| 5.003 | S0405-02-36 | | 56.6 | SURCHARGED | |
| 5.004 | S0405-02-37 | | 57.5 | FLOOD RISK | |
| 5.005 | S0405-02-38 | | 72.5 | FLOOD RISK | |
| 5.006 | S0405-02-39 | | 90.8 | FLOOD | 8 |
| 5.007 | S0405-02-40 | | 125.1 | FLOOD | 4 |
| 6.000 | S0405-02-41 | | 30.1 | FLOOD | 6 |
| 6.001 | S0405-02-42 | | 48.0 | FLOOD | 6 |
| 6.002 | S0405-02-43 | | 59.6 | FLOOD | 7 |
| 6.003 | S0405-02-44 | | 80.7 | FLOOD | 7 |
| 6.004 | S0405-02-45 | | 94.2 | FLOOD | 6 |
| 6.005 | S0405-02-46 | | 127.7 | SURCHARGED | |
| 6.006 | S0405-02-47 | | 114.1 | FLOOD | 9 |
| 1.012 | S0405-02-48 | | 474.3 | FLOOD RISK | |
| 7.000 | S0405-02-49 | | 20.2 | FLOOD | 3 |
| 7.001 | S0405-02-50 | | 37.3 | FLOOD | 3 |
| 8.000 | S0405-02-51 | | 7.0 | FLOOD RISK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 8.001 | S0405-02-52 | | 13.1 | FLOOD RISK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8.002 | S0405-02-53 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 120.842 | 1.610 | 18.789 | 1.92 | |
| 7.002 | S0405-02-54 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Winter | | | 121.024 | 1.822 | 0.001 | 1.41 | |
| 7.003 | S0405-02-55 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 120.150 | 1.546 | 6.805 | 1.45 | |
| 7.004 | S0405-02-56 | 60 Winter | 100 | +40% | 100/15 Summer | | | | 118.423 | 0.920 | 0.000 | 1.12 | |
| 7.005 | S0405-02-57 | 60 Winter | 100 | +40% | 100/15 Summer | | | | 116.697 | 0.642 | 0.000 | 0.93 | |
| 7.006 | S0405-02-58 | 60 Winter | 100 | +40% | 100/15 Summer | | | | 114.669 | 0.981 | 0.000 | 0.95 | |
| 7.007 | S0405-02-59 | 60 Winter | 100 | +40% | 5/15 Summer | | | | 113.559 | 1.109 | 0.000 | 1.49 | |
| 7.008 | S0405-02-60 | 60 Winter | 100 | +40% | 5/15 Summer | | | | 113.277 | 0.956 | 0.000 | 1.10 | |
| 7.009 | S0405-02-61 | 60 Winter | 100 | +40% | 5/15 Summer | | | | 112.349 | 0.726 | 0.000 | 1.21 | |
| 7.010 | S0405-02-62 | 60 Winter | 100 | +40% | 5/15 Summer | | | | 112.210 | 0.683 | 0.000 | 0.63 | |
| 9.000 | S0405-02-63 | 15 Winter | 100 | +40% | | | | | 120.456 | -0.180 | 0.000 | 0.08 | |
| 9.001 | S0405-02-64 | 15 Winter | 100 | +40% | | | | | 120.423 | -0.141 | 0.000 | 0.29 | |
| 9.002 | S0405-02-65 | 15 Winter | 100 | +40% | | | | | 120.250 | -0.143 | 0.000 | 0.27 | |
| 9.003 | S0405-02-66 | 15 Winter | 100 | +40% | | | | | 120.012 | -0.027 | 0.000 | 0.88 | |
| 9.004 | S0405-02-67 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 119.515 | 0.074 | 0.000 | 0.96 | |
| 9.005 | S0405-02-68 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 118.397 | 0.207 | 0.000 | 1.00 | |
| 9.006 | S0405-02-69 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 116.730 | 0.407 | 0.000 | 0.89 | |
| 9.007 | S0405-02-70 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 114.783 | 1.201 | 0.000 | 0.96 | |
| 9.008 | S0405-02-71 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Winter | | | 112.843 | 1.352 | 1.893 | 1.53 | |
| 1.013 | S0405-02-72 | 600 Winter | 100 | +40% | 5/15 Summer | | | | 112.061 | 0.411 | 0.000 | 0.60 | |
| 1.014 | S0405-02-73 | 600 Winter | 100 | +40% | 5/15 Summer | | | | 112.054 | 0.504 | 0.000 | 0.91 | |
| 1.015 | S0405-02-74 | 600 Winter | 100 | +40% | 5/15 Summer | | | | 112.045 | 0.545 | 0.000 | 0.86 | |
| 1.016 | S0405-02-75 | 600 Winter | 100 | +40% | 5/60 Winter | | | | 112.035 | 1.010 | 0.000 | 0.12 | |
| 1.017 | S0405-02-76 | 1440 Winter | 100 | +40% | 5/15 Summer | 5/480 Winter | | | 112.502 | 3.582 | 5.486 | 0.74 | |
| 1.018 | S0405-02-77 | 600 Winter | 100 | +40% | | | | | 108.912 | 0.000 | 0.000 | 0.83 | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 8.002 | S0405-02-53 | | 56.0 | FLOOD | 8 |
| 7.002 | S0405-02-54 | | 55.4 | FLOOD | 1 |
| 7.003 | S0405-02-55 | | 77.3 | FLOOD | 7 |
| 7.004 | S0405-02-56 | | 68.5 | SURCHARGED | |
| 7.005 | S0405-02-57 | | 72.7 | SURCHARGED | |
| 7.006 | S0405-02-58 | | 75.1 | FLOOD RISK | |
| 7.007 | S0405-02-59 | | 75.2 | FLOOD RISK | |
| 7.008 | S0405-02-60 | | 76.4 | SURCHARGED | |
| 7.009 | S0405-02-61 | | 76.5 | SURCHARGED | |
| 7.010 | S0405-02-62 | | 80.4 | SURCHARGED | |
| 9.000 | S0405-02-63 | | 2.8 | OK | |
| 9.001 | S0405-02-64 | | 11.0 | OK | |
| 9.002 | S0405-02-65 | | 10.4 | OK | |
| 9.003 | S0405-02-66 | | 34.6 | OK | |
| 9.004 | S0405-02-67 | | 54.7 | SURCHARGED | |
| 9.005 | S0405-02-68 | | 69.5 | SURCHARGED | |
| 9.006 | S0405-02-69 | | 75.4 | SURCHARGED | |
| 9.007 | S0405-02-70 | | 71.0 | FLOOD RISK | |
| 9.008 | S0405-02-71 | | 69.6 | FLOOD | 5 |
| 1.013 | S0405-02-72 | | 307.1 | SURCHARGED | |
| 1.014 | S0405-02-73 | | 306.8 | SURCHARGED | |
| 1.015 | S0405-02-74 | | 305.7 | SURCHARGED | |
| 1.016 | S0405-02-75 | | 52.0 | SURCHARGED | |
| 1.017 | S0405-02-76 | | 46.3 | FLOOD | 19 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 1.018 | S0405-02-77 | | 48.2 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Existing

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.019 | S0405-02-78 | 600 Winter | 100 | +40% | | | | | 108.860 | 0.000 | 0.000 | 0.83 | | |
| 1.020 | S0405-02-79 | 600 Winter | 100 | +40% | | | | | 108.803 | 0.000 | 0.000 | 0.99 | | |
| 1.021 | S0405-02-80 | 600 Winter | 100 | +40% | | | | | 108.766 | 0.000 | 0.000 | 1.01 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| 1.019 | S0405-02-78 | 48.2 | OK | |
| 1.020 | S0405-02-79 | 48.2 | OK | |
| 1.021 | S0405-02-80 | 48.2 | OK | |

## Simulation Criteria for Main Line 001

```
Volumetric Runoff Coeff 0.750            Hot Start Level (mm)      0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000
 Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500     MADD Factor * 10m³/ha Storage 4.000                      Run Time (mins)     60
       Hot Start (mins)      0   Foul Sewage per hectare (l/s) 0.000                Inlet Coeffiecient 0.800             Output Interval (mins)      1

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0
```

## Synthetic Rainfall Details

```
      Rainfall Model FSR     Region England and Wales      Ratio R  0.300 Cv (Summer) 0.750 Storm Duration (mins) 30
Return Period (years)  30 M5-60 (mm)            15.000 Profile Type Summer Cv (Winter) 0.840
```

## Online Controls for Main Line 001

### Hydro-Brake® Optimum Manhole: S0405-16-47(Flow Control), DS/PN: 1.013, Volume (m³): 12.1

| | | | | | |
|---|---|---|---|---|---|
| Unit Reference | MD-SHE-0201-2400-2000-2400 | Objective | Minimise upstream storage | Invert Level (m) | 116.900 |
| Design Head (m) | 2.000 | Application | Surface | Minimum Outlet Pipe Diameter (mm) | 225 |
| Design Flow (l/s) | 24.0 | Sump Available | Yes | Suggested Manhole Diameter (mm) | 1800 |
| Flush-Flo™ | Calculated | Diameter (mm) | 201 | | |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Design Point (Calculated) | 2.000 | 24.0 | Flush-Flo™ | 0.583 | 24.0 | Kick-Flo® | 1.248 | 19.2 | Mean Flow over Head Range | - | 20.9 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 6.9 | 0.500 | 23.9 | 1.200 | 20.1 | 2.000 | 24.0 | 3.000 | 29.1 | 5.000 | 37.2 | 7.000 | 43.8 | 9.000 | 49.5 |
| 0.200 | 19.0 | 0.600 | 24.0 | 1.400 | 20.2 | 2.200 | 25.1 | 3.500 | 31.4 | 5.500 | 39.0 | 7.500 | 45.3 | 9.500 | 50.8 |
| 0.300 | 22.3 | 0.800 | 23.6 | 1.600 | 21.6 | 2.400 | 26.2 | 4.000 | 33.4 | 6.000 | 40.7 | 8.000 | 46.7 | | |
| 0.400 | 23.4 | 1.000 | 22.5 | 1.800 | 22.8 | 2.600 | 27.2 | 4.500 | 35.4 | 6.500 | 42.3 | 8.500 | 48.1 | | |

## Storage Structures for Main Line 001

### Tank or Pond Manhole: S0405-16-46 (Pond), DS/PN: 1.012

Invert Level (m) 117.180

| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|---|---|
| 0.000 | 984.0 | 0.500 | 1219.0 | 1.500 | 1764.3 | 1.800 | 1947.5 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Main Line 001

### Simulation Criteria

Areal Reduction Factor 1.000 Hot Start Level (mm) 0 Foul Sewage per hectare (l/s) 0.000 MADD Factor * 10m³/ha Storage 4.000 Flow per Person per Day (l/per/day) 0.000
Hot Start (mins) 0 Manhole Headloss Coeff (Global) 0.500 Additional Flow - % of Total Flow 0.000 Inlet Coeffiecient 0.800

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Region England and Wales M5-60 (mm) 20.800 Ratio R 0.200 Cv (Summer) 0.750 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 Analysis Timestep Fine DTS Status ON DVD Status OFF Inertia Status OFF

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-16-1 | 15 Winter | 5 | +20% | | | | | 126.357 | -0.173 | 0.000 | 0.11 | | | 4.2 | OK | |
| 1.001 | S0405-16-2 | 15 Winter | 5 | +20% | | | | | 125.776 | -0.156 | 0.000 | 0.19 | | | 7.4 | OK | |
| 1.002 | S0405-16-3 | 15 Winter | 5 | +20% | | | | | 125.187 | -0.147 | 0.000 | 0.25 | | | 13.0 | OK | |
| 1.003 | S0405-16-4 | 15 Winter | 5 | +20% | | | | | 124.117 | -0.141 | 0.000 | 0.29 | | | 19.8 | OK | |
| 1.004 | S0405-16-5 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 122.357 | -0.127 | 0.000 | 0.39 | | | 26.7 | OK | |
| 1.005 | S0405-16-6 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 120.552 | -0.087 | 0.000 | 0.69 | | | 30.7 | OK | |
| 2.000 | S0405-16-7 | 15 Winter | 5 | +20% | | | | | 120.409 | -0.148 | 0.000 | 0.22 | | | 8.8 | OK | |
| 2.001 | S0405-16-8 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 119.884 | -0.075 | 0.000 | 0.21 | | | 7.9 | OK | |
| 1.006 | S0405-16-9 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 119.868 | 0.157 | 0.000 | 0.54 | | | 34.3 | SURCHARGED | |
| 3.000 | S0405-16-10 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 120.109 | -0.086 | 0.000 | 0.61 | | | 24.1 | OK | |
| 3.001 | S0405-16-11 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 119.838 | 0.240 | 0.000 | 0.54 | | | 19.3 | SURCHARGED | |
| 4.000 | S0405-16-12 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 126.194 | -0.094 | 0.000 | 0.56 | | | 22.1 | OK | |
| 4.001 | S0405-16-13 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 125.586 | -0.105 | 0.000 | 0.51 | | | 20.2 | OK | |
| 4.002 | S0405-16-14 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 125.003 | -0.089 | 0.000 | 0.65 | | | 37.4 | OK | |
| 4.003 | S0405-16-15 | 30 Winter | 5 | +20% | 100/15 Summer | 100/30 Winter | | | 123.747 | -0.069 | 0.000 | 0.81 | | | 56.2 | OK | 3 |
| 4.004 | S0405-16-16 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 121.877 | -0.071 | 0.000 | 0.80 | | | 55.6 | OK | |
| 4.005 | S0405-16-17 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 120.422 | 0.316 | 0.000 | 0.99 | | | 53.5 | SURCHARGED | |
| 1.007 | S0405-16-18 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 119.802 | 0.167 | 0.000 | 0.77 | | | 105.7 | SURCHARGED | |
| 5.000 | S0405-16-19 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 120.004 | -0.106 | 0.000 | 0.48 | | | 18.9 | OK | |
| 5.001 | S0405-16-20 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 119.757 | 0.246 | 0.000 | 0.49 | | | 18.3 | SURCHARGED | |
| 6.000 | S0405-16-21 | 15 Winter | 5 | +20% | | | | | 125.969 | -0.165 | 0.000 | 0.14 | | | 6.0 | OK | |
| 6.001 | S0405-16-22 | 15 Winter | 5 | +20% | | | | | 125.271 | -0.160 | 0.000 | 0.18 | | | 7.3 | OK | |
| 6.002 | S0405-16-23 | 15 Winter | 5 | +20% | | | | | 125.080 | -0.155 | 0.000 | 0.20 | | | 10.3 | OK | |
| 6.003 | S0405-16-24 | 15 Winter | 5 | +20% | | | | | 124.161 | -0.159 | 0.000 | 0.19 | | | 10.9 | OK | |
| 6.004 | S0405-16-25 | 15 Winter | 5 | +20% | | | | | 123.902 | -0.156 | 0.000 | 0.20 | | | 13.2 | OK | |
| 6.005 | S0405-16-26 | 15 Winter | 5 | +20% | | | | | 123.107 | -0.126 | 0.000 | 0.40 | | | 13.7 | OK | |
| 6.006 | S0405-16-27 | 15 Winter | 5 | +20% | | | | | 123.008 | -0.154 | 0.000 | 0.21 | | | 13.5 | OK | |
| 6.007 | S0405-16-28 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 121.431 | -0.155 | 0.000 | 0.21 | | | 15.4 | OK | |
| 6.008 | S0405-16-29 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 120.830 | 0.265 | 0.000 | 0.61 | | | 18.1 | SURCHARGED | 7 |
| 7.000 | S0405-16-30 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 125.949 | -0.108 | 0.000 | 0.47 | | | 18.4 | OK | |
| 7.001 | S0405-16-31 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 125.412 | -0.070 | 0.000 | 0.78 | | | 30.1 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Main Line 001

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7.002 | S0405-16-32 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | | | 125.051 | -0.062 | 0.000 | 0.86 | | | 44.5 | OK | 4 |
| 7.003 | S0405-16-33 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 124.374 | -0.078 | 0.000 | 0.76 | | | 44.5 | OK | |
| 7.004 | S0405-16-34 | 15 Winter | 5 | +20% | 100/15 Summer | 100/30 Winter | | | 124.217 | -0.043 | 0.000 | 0.96 | | | 61.6 | OK | 1 |
| 7.005 | S0405-16-35 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 123.401 | -0.060 | 0.000 | 1.00 | | | 61.6 | OK | |
| 7.006 | S0405-16-36 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 123.263 | -0.137 | 0.000 | 0.57 | | | 78.1 | OK | |
| 7.007 | S0405-16-37 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 122.264 | -0.121 | 0.000 | 0.66 | | | 89.8 | OK | |
| 7.008 | S0405-16-38 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 121.278 | -0.116 | 0.000 | 0.69 | | | 94.3 | OK | |
| 6.009 | S0405-16-39 | 30 Winter | 5 | +20% | 5/15 Winter | | | | 120.818 | 0.211 | 0.000 | 0.96 | | | 120.1 | SURCHARGED | |
| 1.008 | S0405-16-40 | 60 Summer | 5 | +20% | 100/15 Summer | | | | 119.714 | 0.000 | 0.000 | 1.01 | | | 216.9 | OK | |
| 8.000 | S0405-16-41 | 15 Winter | 5 | +20% | | | | | 119.706 | -0.159 | 0.000 | 0.17 | | | 6.5 | OK | |
| 8.001 | S0405-16-42 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 119.482 | 0.214 | 0.000 | 0.26 | | | 9.7 | SURCHARGED | |
| 1.009 | S0405-16-43 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 119.473 | 0.000 | 0.000 | 1.06 | | | 241.2 | OK | |
| 1.010 | S0405-16-44 | 30 Winter | 5 | +20% | | | | | 119.085 | -0.379 | 0.000 | 0.29 | | | 240.7 | OK | |
| 1.011 | S0405-16-45 | 30 Winter | 5 | +20% | 100/360 Winter | | | | 117.940 | -0.337 | 0.000 | 0.40 | | | 240.7 | OK | |
| 1.012 | S0405-16-46 (Pond) | 600 Winter | 5 | +20% | 100/60 Winter | | | | 117.636 | -0.144 | 0.000 | 0.16 | | | 23.4 | OK | |
| 1.013 | S0405-16-47(Flow Control) | 480 Winter | 5 | +20% | 5/120 Winter | 100/60 Winter | | | 117.688 | 0.188 | 0.000 | 0.03 | | | 22.8 | SURCHARGED | 24 |
| 1.014 | S0405-16-48 | 180 Summer | 5 | +20% | 100/180 Summer | | | | 116.197 | -0.521 | 0.000 | 0.04 | | | 22.8 | OK | |
| 1.015 | S0405-16-49 | 2880 Summer | 5 | +20% | | | | | 115.901 | -0.523 | 0.000 | 0.04 | | | 22.7 | OK | |
| 1.016 | S0405-16-50 | 240 Winter | 5 | +20% | | | | | 115.398 | -0.536 | 0.000 | 0.03 | | | 22.8 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Main Line 001

### Simulation Criteria

Areal Reduction Factor 1.000 Hot Start Level (mm) 0 Foul Sewage per hectare (l/s) 0.000 MADD Factor * 10m³/ha Storage 4.000 Flow per Person per Day (l/per/day) 0.000
Hot Start (mins) 0 Manhole Headloss Coeff (Global) 0.500 Additional Flow - % of Total Flow 0.000 Inlet Coeffiecient 0.800

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Region England and Wales M5-60 (mm) 20.800 Ratio R 0.200 Cv (Summer) 0.750 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 Analysis Timestep Fine DTS Status ON DVD Status OFF Inertia Status OFF

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-16-1 | 15 Winter | 100 | +40% | | | | | 126.384 | -0.146 | 0.000 | 0.23 | | | 9.1 | OK | |
| 1.001 | S0405-16-2 | 15 Winter | 100 | +40% | | | | | 125.819 | -0.113 | 0.000 | 0.44 | | | 17.3 | OK | |
| 1.002 | S0405-16-3 | 15 Winter | 100 | +40% | | | | | 125.242 | -0.092 | 0.000 | 0.60 | | | 31.8 | OK | |
| 1.003 | S0405-16-4 | 30 Summer | 100 | +40% | | | | | 124.183 | -0.075 | 0.000 | 0.73 | | | 49.8 | OK | |
| 1.004 | S0405-16-5 | 30 Summer | 100 | +40% | 100/15 Summer | | | | 122.652 | 0.167 | 0.000 | 0.88 | | | 60.8 | SURCHARGED | |
| 1.005 | S0405-16-6 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 121.324 | 0.685 | 0.000 | 1.43 | | | 64.3 | SURCHARGED | |
| 2.000 | S0405-16-7 | 30 Winter | 100 | +40% | | | | | 120.473 | -0.084 | 0.000 | 0.46 | | | 18.2 | OK | |
| 2.001 | S0405-16-8 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 120.433 | 0.474 | 0.000 | 0.47 | | | 18.0 | SURCHARGED | |
| 1.006 | S0405-16-9 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 120.399 | 0.689 | 0.000 | 1.17 | | | 74.6 | SURCHARGED | |
| 3.000 | S0405-16-10 | 30 Summer | 100 | +40% | 100/15 Summer | | | | 120.953 | 0.757 | 0.000 | 1.08 | | | 42.4 | SURCHARGED | |
| 3.001 | S0405-16-11 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 120.275 | 0.678 | 0.000 | 1.32 | | | 47.8 | SURCHARGED | |
| 4.000 | S0405-16-12 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 126.824 | 0.536 | 0.000 | 1.02 | | | 40.1 | SURCHARGED | |
| 4.001 | S0405-16-13 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 126.531 | 0.841 | 0.000 | 0.75 | | | 29.6 | SURCHARGED | |
| 4.002 | S0405-16-14 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 126.140 | 1.048 | 0.000 | 0.93 | | | 53.3 | FLOOD RISK | |
| 4.003 | S0405-16-15 | 30 Winter | 100 | +40% | 100/15 Summer | 100/30 Winter | | | 125.018 | 1.202 | 1.887 | 1.09 | | | 76.3 | FLOOD | 3 |
| 4.004 | S0405-16-16 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 123.081 | 1.134 | 0.000 | 1.03 | | | 71.4 | FLOOD RISK | |
| 4.005 | S0405-16-17 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 121.141 | 1.035 | 0.000 | 1.36 | | | 73.4 | FLOOD RISK | |
| 1.007 | S0405-16-18 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 120.090 | 0.455 | 0.000 | 1.36 | | | 186.1 | SURCHARGED | |
| 5.000 | S0405-16-19 | 30 Summer | 100 | +40% | 100/15 Summer | | | | 120.565 | 0.455 | 0.000 | 0.92 | | | 36.1 | SURCHARGED | |
| 5.001 | S0405-16-20 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 120.050 | 0.539 | 0.000 | 1.15 | | | 43.0 | SURCHARGED | |
| 6.000 | S0405-16-21 | 15 Winter | 100 | +40% | | | | | 126.001 | -0.133 | 0.000 | 0.31 | | | 13.3 | OK | |
| 6.001 | S0405-16-22 | 15 Winter | 100 | +40% | | | | | 125.306 | -0.125 | 0.000 | 0.40 | | | 16.1 | OK | |
| 6.002 | S0405-16-23 | 15 Winter | 100 | +40% | | | | | 125.123 | -0.112 | 0.000 | 0.47 | | | 23.9 | OK | |
| 6.003 | S0405-16-24 | 15 Winter | 100 | +40% | | | | | 124.199 | -0.121 | 0.000 | 0.43 | | | 25.3 | OK | |
| 6.004 | S0405-16-25 | 15 Winter | 100 | +40% | | | | | 123.943 | -0.114 | 0.000 | 0.47 | | | 30.7 | OK | |
| 6.005 | S0405-16-26 | 15 Winter | 100 | +40% | | | | | 123.182 | -0.051 | 0.000 | 0.94 | | | 32.2 | OK | |
| 6.006 | S0405-16-27 | 30 Summer | 100 | +40% | | | | | 123.052 | -0.111 | 0.000 | 0.49 | | | 31.6 | OK | |
| 6.007 | S0405-16-28 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 122.014 | 0.428 | 0.000 | 0.48 | | | 35.0 | SURCHARGED | |
| 6.008 | S0405-16-29 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 121.783 | 1.218 | 17.679 | 2.14 | | | 63.7 | FLOOD | 7 |
| 7.000 | S0405-16-30 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 127.121 | 1.064 | 0.000 | 0.74 | | | 29.2 | FLOOD RISK | |
| 7.001 | S0405-16-31 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 126.839 | 1.357 | 0.000 | 1.13 | | | 43.6 | FLOOD RISK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Main Line 001

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 7.002 | S0405-16-32 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | | | 126.347 | 1.234 | 2.867 | 1.22 | | | 63.7 | FLOOD | 4 |
| 7.003 | S0405-16-33 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 125.630 | 1.178 | 0.000 | 1.10 | | | 64.5 | FLOOD RISK | |
| 7.004 | S0405-16-34 | 30 Winter | 100 | +40% | 100/15 Summer | 100/30 Winter | | | 125.460 | 1.201 | 0.685 | 1.31 | | | 84.1 | FLOOD | 1 |
| 7.005 | S0405-16-35 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 124.018 | 0.557 | 0.000 | 1.42 | | | 88.1 | SURCHARGED | |
| 7.006 | S0405-16-36 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 123.913 | 0.513 | 0.000 | 0.82 | | | 113.5 | SURCHARGED | |
| 7.007 | S0405-16-37 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 123.264 | 0.879 | 0.000 | 0.95 | | | 129.0 | SURCHARGED | |
| 7.008 | S0405-16-38 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 122.375 | 0.982 | 0.000 | 1.01 | | | 136.8 | FLOOD RISK | |
| 6.009 | S0405-16-39 | 30 Winter | 100 | +40% | 5/15 Winter | | | | 121.821 | 1.214 | 0.000 | 1.30 | | | 162.9 | FLOOD RISK | |
| 1.008 | S0405-16-40 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 119.821 | 0.107 | 0.000 | 1.80 | | | 387.7 | SURCHARGED | |
| 8.000 | S0405-16-41 | 15 Winter | 100 | +40% | | | | | 119.741 | -0.124 | 0.000 | 0.36 | | | 14.3 | OK | |
| 8.001 | S0405-16-42 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 119.622 | 0.355 | 0.000 | 0.33 | | | 12.2 | SURCHARGED | |
| 1.009 | S0405-16-43 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 119.594 | 0.121 | 0.000 | 1.76 | | | 399.1 | SURCHARGED | |
| 1.010 | S0405-16-44 | 30 Winter | 100 | +40% | | | | | 119.158 | -0.306 | 0.000 | 0.48 | | | 399.2 | OK | |
| 1.011 | S0405-16-45 | 960 Winter | 100 | +40% | 100/360 Winter | | | | 118.506 | 0.229 | 0.000 | 0.16 | | | 98.6 | SURCHARGED | |
| 1.012 | S0405-16-46 (Pond) | 960 Winter | 100 | +40% | 100/60 Winter | | | | 118.502 | 0.722 | 0.000 | 0.31 | | | 44.7 | SURCHARGED | |
| 1.013 | S0405-16-47(Flow Control) | 480 Summer | 100 | +40% | 5/120 Winter | 100/60 Winter | | | 118.723 | 1.223 | 29.960 | 0.03 | | | 22.7 | FLOOD | 24 |
| 1.014 | S0405-16-48 | 180 Summer | 100 | +40% | 100/180 Summer | | | | 116.834 | 0.116 | 0.000 | 0.21 | | | 113.0 | SURCHARGED | |
| 1.015 | S0405-16-49 | 180 Winter | 100 | +40% | | | | | 116.243 | -0.181 | 0.000 | 0.31 | | | 176.7 | OK | |
| 1.016 | S0405-16-50 | 180 Summer | 100 | +40% | | | | | 115.604 | -0.330 | 0.000 | 0.13 | | | 112.7 | OK | |

## Simulation Criteria for Side Road 001 (Temple Sowerby West)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Hot Start Level (mm) | 0 | Additional Flow - % of Total Flow | 0.000 | Flow per Person per Day (l/per/day) | 0.000 |
| Areal Reduction Factor | 1.000 | Manhole Headloss Coeff (Global) | 0.500 | MADD Factor * $10m^3$/ha Storage | 4.000 | Run Time (mins) | 60 |
| Hot Start (mins) | 0 | Foul Sewage per hectare (l/s) | 0.000 | Inlet Coeffiecient | 0.800 | Output Interval (mins) | 1 |

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

## Synthetic Rainfall Details

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Rainfall Model | FSR | Region | England and Wales | Ratio R | 0.300 | Cv (Summer) | 0.750 | Storm Duration (mins) | 30 |
| Return Period (years) | 30 | M5-60 (mm) | 15.000 | Profile Type | Summer | Cv (Winter) | 0.840 | | |

## Online Controls for Side Road 001 (Temple Sowerby West)

### Hydro-Brake® Optimum Manhole: S0405-18-21, DS/PN: 1.010, Volume (m³): 3.7

| | | | | | |
|---|---|---|---|---|---|
| Unit Reference | MD-SHE-0131-1000-2000-1000 | Objective | Minimise upstream storage | Invert Level (m) | 108.100 |
| Design Head (m) | 2.000 | Application | Surface | Minimum Outlet Pipe Diameter (mm) | 150 |
| Design Flow (l/s) | 10.0 | Sump Available | Yes | Suggested Manhole Diameter (mm) | 1500 |
| Flush-Flo™ | Calculated | Diameter (mm) | 131 | | |

| Control Points | Head (m) | Flow (l/s) | Control Points | Head (m) | Flow (l/s) | Control Points | Head (m) | Flow (l/s) | Control Points | Head (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Design Point (Calculated) | 2.000 | 10.0 | Flush-Flo™ | 0.569 | 9.8 | Kick-Flo® | 1.167 | 7.8 | Mean Flow over Head Range | - | 8.7 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 4.7 | 0.500 | 9.8 | 1.200 | 7.9 | 2.000 | 10.0 | 3.000 | 12.1 | 5.000 | 15.4 | 7.000 | 18.1 | 9.000 | 20.5 |
| 0.200 | 8.3 | 0.600 | 9.8 | 1.400 | 8.5 | 2.200 | 10.5 | 3.500 | 13.0 | 5.500 | 16.2 | 7.500 | 18.7 | 9.500 | 21.0 |
| 0.300 | 9.2 | 0.800 | 9.6 | 1.600 | 9.0 | 2.400 | 10.9 | 4.000 | 13.9 | 6.000 | 16.8 | 8.000 | 19.3 | | |
| 0.400 | 9.6 | 1.000 | 9.0 | 1.800 | 9.5 | 2.600 | 11.3 | 4.500 | 14.7 | 6.500 | 17.5 | 8.500 | 19.9 | | |

## Storage Structures for Side Road 001 (Temple Sowerby West)

### Tank or Pond Manhole: S0405-18-20, DS/PN: 1.009

Invert Level (m) 108.200

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 690.0 | 1.800 | 1523.3 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Side Road 001 (Temple Sowerby West)

### Simulation Criteria

Areal Reduction Factor 1.000 Hot Start Level (mm) 0 Foul Sewage per hectare (l/s) 0.000 MADD Factor * 10m³/ha Storage 4.000 Flow per Person per Day (l/per/day) 0.000
Hot Start (mins) 0 Manhole Headloss Coeff (Global) 0.500 Additional Flow - % of Total Flow 0.000 Inlet Coeffiecient 0.800

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Region England and Wales M5-60 (mm) 20.800 Ratio R 0.200 Cv (Summer) 0.750 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 Analysis Timestep Fine DTS Status ON DVD Status OFF Inertia Status OFF

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-18-1 | 15 Winter | 5 | +20% | 100/15 Winter | | | | 125.343 | -0.172 | 0.000 | 0.12 | | | 4.6 | OK | |
| 1.001 | S0405-18-2 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 125.227 | -0.124 | 0.000 | 0.38 | | | 14.9 | OK | |
| 1.002 | S0405-18-3 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 124.664 | -0.089 | 0.000 | 0.62 | | | 24.5 | OK | |
| 1.003 | S0405-18-4 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 124.096 | -0.059 | 0.000 | 0.86 | | | 33.6 | OK | |
| 1.004 | S0405-18-5 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 123.466 | -0.090 | 0.000 | 0.66 | | | 43.0 | OK | |
| 1.005 | S0405-18-6 | 30 Winter | 5 | +20% | 100/30 Summer | | | | 121.789 | -0.111 | 0.000 | 0.51 | | | 44.7 | OK | |
| 1.006 | S0405-18-7 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 118.861 | -0.099 | 0.000 | 0.59 | | | 59.9 | OK | |
| 1.007 | S0405-18-8 | 30 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 114.953 | -0.086 | 0.000 | 0.69 | | | 77.8 | OK | 6 |
| 1.008 | S0405-18-9 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 110.151 | -0.065 | 0.000 | 0.85 | | | 87.1 | OK | |
| 2.000 | S0405-18-10 | 15 Summer | 5 | +20% | | | | | 125.409 | -0.225 | 0.000 | 0.00 | | | 0.0 | OK | |
| 2.001 | S0405-18-11 | 15 Winter | 5 | +20% | | | | | 124.890 | -0.146 | 0.000 | 0.24 | | | 9.6 | OK | |
| 2.002 | S0405-18-12 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 124.330 | -0.108 | 0.000 | 0.49 | | | 19.3 | OK | |
| 2.003 | S0405-18-13 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 123.729 | -0.111 | 0.000 | 0.49 | | | 28.7 | OK | |
| 2.004 | S0405-18-14 | 30 Winter | 5 | +20% | | | | | 122.400 | -0.120 | 0.000 | 0.44 | | | 34.1 | OK | |
| 2.005 | S0405-18-15 | 30 Winter | 5 | +20% | | | | | 120.081 | -0.127 | 0.000 | 0.39 | | | 36.4 | OK | |
| 2.006 | S0405-18-16 | 30 Winter | 5 | +20% | | | | | 116.714 | -0.131 | 0.000 | 0.36 | | | 39.3 | OK | |
| 2.007 | S0405-18-17 | 30 Winter | 5 | +20% | 100/30 Summer | | | | 112.228 | -0.127 | 0.000 | 0.39 | | | 42.4 | OK | |
| 2.008 | S0405-18-18 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 108.757 | -0.043 | 0.000 | 0.62 | | | 42.2 | OK | |
| 2.009 | S0405-18-19 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Winter | | | 108.656 | 0.156 | 0.000 | 1.79 | | | 41.9 | SURCHARGED | 4 |
| 1.009 | S0405-18-20 | 720 Winter | 5 | +20% | 5/120 Summer | | | | 108.587 | 0.162 | 0.000 | 0.81 | | | 11.0 | SURCHARGED | |
| 1.010 | S0405-18-21 | 720 Winter | 5 | +20% | 5/240 Winter | 100/360 Winter | | | 108.926 | 0.376 | 0.000 | 0.01 | | | 9.4 | SURCHARGED | |
| 1.011 | S0405-18-22 | 360 Summer | 5 | +20% | | | | | 105.827 | -0.412 | 0.000 | 0.02 | | | 9.4 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Side Road 001 (Temple Sowerby West)

### Simulation Criteria

Areal Reduction Factor 1.000 Hot Start Level (mm) 0 Foul Sewage per hectare (l/s) 0.000 MADD Factor * 10m³/ha Storage 4.000 Flow per Person per Day (l/per/day) 0.000
Hot Start (mins) 0 Manhole Headloss Coeff (Global) 0.500 Additional Flow - % of Total Flow 0.000 Inlet Coeffiecient 0.800

Number of Input Hydrographs 0 Number of Online Controls 1 Number of Offline Controls 0 Number of Storage Structures 1 Number of Time/Area Diagrams 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Region England and Wales M5-60 (mm) 20.800 Ratio R 0.200 Cv (Summer) 0.750 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 Analysis Timestep Fine DTS Status ON DVD Status OFF Inertia Status OFF

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| **PN** | **US/MH Name** | **Storm** | **Return Period** | **Climate Change** | **First (X) Surcharge** | **First (Y) Flood** | **First (Z) Overflow** | **Overflow Act.** | **Water Level (m)** | **Surcharged Depth (m)** | **Flooded Volume (m³)** | **Flow / Cap.** | **Overflow (l/s)** | **Half Drain Time (mins)** | **Pipe Flow (l/s)** | **Status** | **Level Exceeded** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-18-1 | 30 Winter | 100 | +40% | 100/15 Winter | | | | 125.819 | 0.304 | 0.000 | 0.23 | | | 8.7 | SURCHARGED | |
| 1.001 | S0405-18-2 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 125.806 | 0.455 | 0.000 | 0.72 | | | 28.4 | SURCHARGED | |
| 1.002 | S0405-18-3 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 125.632 | 0.880 | 0.000 | 1.00 | | | 39.2 | SURCHARGED | |
| 1.003 | S0405-18-4 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 125.023 | 0.869 | 0.000 | 1.40 | | | 55.0 | SURCHARGED | |
| 1.004 | S0405-18-5 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 123.798 | 0.241 | 0.000 | 1.05 | | | 68.8 | SURCHARGED | |
| 1.005 | S0405-18-6 | 30 Winter | 100 | +40% | 100/30 Summer | | | | 122.001 | 0.101 | 0.000 | 0.84 | | | 73.9 | SURCHARGED | |
| 1.006 | S0405-18-7 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 120.103 | 1.143 | 0.000 | 0.98 | | | 99.2 | FLOOD RISK | |
| 1.007 | S0405-18-8 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 116.321 | 1.282 | 6.962 | 1.05 | | | 117.8 | FLOOD | 6 |
| 1.008 | S0405-18-9 | 30 Summer | 100 | +40% | 100/15 Summer | | | | 111.482 | 1.266 | 0.000 | 1.30 | | | 134.2 | FLOOD RISK | |
| 2.000 | S0405-18-10 | 15 Summer | 100 | +40% | | | | | 125.409 | -0.225 | 0.000 | 0.00 | | | 0.0 | OK | |
| 2.001 | S0405-18-11 | 15 Winter | 100 | +40% | | | | | 124.955 | -0.081 | 0.000 | 0.65 | | | 25.6 | OK | |
| 2.002 | S0405-18-12 | 30 Summer | 100 | +40% | 100/15 Summer | | | | 124.682 | 0.244 | 0.000 | 1.07 | | | 42.0 | SURCHARGED | |
| 2.003 | S0405-18-13 | 30 Summer | 100 | +40% | 100/15 Summer | | | | 123.961 | 0.121 | 0.000 | 1.04 | | | 60.9 | SURCHARGED | |
| 2.004 | S0405-18-14 | 30 Summer | 100 | +40% | | | | | 122.471 | -0.049 | 0.000 | 0.94 | | | 72.9 | OK | |
| 2.005 | S0405-18-15 | 30 Summer | 100 | +40% | | | | | 120.144 | -0.064 | 0.000 | 0.84 | | | 78.4 | OK | |
| 2.006 | S0405-18-16 | 30 Summer | 100 | +40% | | | | | 116.774 | -0.071 | 0.000 | 0.79 | | | 85.8 | OK | |
| 2.007 | S0405-18-17 | 30 Winter | 100 | +40% | 100/30 Summer | | | | 112.455 | 0.100 | 0.000 | 0.84 | | | 91.7 | SURCHARGED | |
| 2.008 | S0405-18-18 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 109.920 | 1.120 | 0.000 | 1.35 | | | 91.8 | FLOOD RISK | |
| 2.009 | S0405-18-19 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Winter | | | 109.436 | 0.936 | 1.128 | 3.69 | | | 86.5 | FLOOD | 4 |
| 1.009 | S0405-18-20 | 960 Winter | 100 | +40% | 5/120 Summer | | | | 109.070 | 0.645 | 0.000 | 0.77 | | | 10.5 | SURCHARGED | |
| 1.010 | S0405-18-21 | 720 Winter | 100 | +40% | 5/240 Winter | 100/360 Winter | | | 109.858 | 1.308 | 0.010 | 0.01 | | | 9.4 | FLOOD | |
| 1.011 | S0405-18-22 | 2880 Summer | 100 | +40% | | | | | 105.827 | -0.412 | 0.000 | 0.02 | | | 9.4 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for Priest Lane Underpass

```
                 Pipe Sizes STANDARD Manhole Sizes STANDARD

                   FSR Rainfall Model - England and Wales
            Return Period (years)     30          Foul Sewage (l/s/ha) 0.000           Maximum Backdrop Height (m) 1.500
                      M5-60 (mm)  15.500      Volumetric Runoff Coeff. 0.750 Min Design Depth for Optimisation (m) 1.200
                         Ratio R   0.300                      PIMP (%)   100     Min Vel for Auto Design only (m/s)  1.00
          Maximum Rainfall (mm/hr)    50 Add Flow / Climate Change (%)     0       Min Slope for Optimisation (1:X)   500
Maximum Time of Concentration (mins)  30   Minimum Backdrop Height (m) 0.200

                        Designed with Level Inverts
```

## Simulation Criteria for Priest Lane Underpass

```
 Volumetric Runoff Coeff 0.750   Manhole Headloss Coeff (Global) 0.500                 Inlet Coeffiecient 0.800
  Areal Reduction Factor 1.000      Foul Sewage per hectare (l/s) 0.000 Flow per Person per Day (l/per/day) 0.000
        Hot Start (mins)     0 Additional Flow - % of Total Flow 0.000                      Run Time (mins)    60
     Hot Start Level (mm)    0      MADD Factor * 10m³/ha Storage 2.000               Output Interval (mins)     1

  Number of Input Hydrographs 0   Number of Offline Controls 0 Number of Time/Area Diagrams 0
    Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0
```

## Synthetic Rainfall Details

```
       Rainfall Model FSR     Region England and Wales      Ratio R  0.287
Return Period (years) 100 M5-60 (mm)            20.600 Profile Type Summer
```

## Synthetic Rainfall Details

Cv (Summer) 0.750 Cv (Winter) 0.840 Storm Duration (mins) 30

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Priest Lane Underpass

### Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.700 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status ON Inertia Status OFF
Analysis Timestep Fine DVD Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-19-1 | 15 Winter | 5 | +20% | | | | | 119.047 | -0.153 | 0.000 | 0.22 | | |
| 1.001 | S0405-19-2 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 116.442 | -0.116 | 0.000 | 0.46 | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Priest Lane Underpass

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| 1.000 | S0405-19-1 | 20.6 | OK | |
| 1.001 | S0405-19-2 | 40.5 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Priest Lane Underpass

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.000 | S0405-19-3 | 15 Winter | 5 | +20% | | | | | 121.434 | -0.166 | 0.000 | 0.15 | |
| 2.001 | S0405-19-4 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 118.429 | -0.125 | 0.000 | 0.40 | |
| 2.002 | S0405-19-5 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 114.890 | 0.421 | 0.000 | 0.81 | |
| 1.002 | S0405-19-6 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 114.796 | 0.401 | 0.000 | 1.27 | |
| 1.003 | S0405-19-7 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 113.926 | -0.076 | 0.000 | 0.99 | |
| 1.004 | S0405-19-8 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 113.847 | -0.105 | 0.000 | 0.85 | |
| 1.005 | S0405-19-9 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 113.676 | -0.105 | 0.000 | 0.86 | |
| 1.006 | S0405-19-10 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 113.561 | -0.117 | 0.000 | 0.79 | |
| 1.007 | S0405-19-11 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 113.347 | -0.126 | 0.000 | 0.75 | |
| 1.008 | S0405-19-12 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 113.206 | -0.061 | 0.000 | 1.00 | |

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 2.000 | S0405-19-3 | | 15.9 | OK | |
| 2.001 | S0405-19-4 | | 43.7 | OK | |
| 2.002 | S0405-19-5 | | 41.0 | SURCHARGED | 6 |
| 1.002 | S0405-19-6 | | 87.9 | SURCHARGED | 5 |
| 1.003 | S0405-19-7 | | 86.7 | OK | |
| 1.004 | S0405-19-8 | | 84.4 | OK | |
| 1.005 | S0405-19-9 | | 82.2 | OK | |
| 1.006 | S0405-19-10 | | 79.3 | OK | |
| 1.007 | S0405-19-11 | | 75.6 | OK | |

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Priest Lane Underpass

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 1.008 | S0405-19-12 | | 71.4 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Priest Lane Underpass

### Simulation Criteria

Areal Reduction Factor 1.000
Hot Start (mins) 0
Hot Start Level (mm) 0
Manhole Headloss Coeff (Global) 0.500
Foul Sewage per hectare (l/s) 0.000
Additional Flow - % of Total Flow 0.000
MADD Factor * 10m³/ha Storage 2.000
Inlet Coeffiecient 0.800
Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0
Number of Online Controls 0
Number of Offline Controls 0
Number of Storage Structures 0
Number of Time/Area Diagrams 0
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
Region England and Wales
M5-60 (mm) 18.700
Ratio R 0.300
Cv (Summer) 0.750
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep Fine
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-19-1 | 15 Winter | 100 | +40% | | | | | 119.087 | -0.113 | 0.000 | 0.48 | | |
| 1.001 | S0405-19-2 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 117.676 | 1.118 | 0.000 | 0.95 | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Priest Lane Underpass

| **PN** | **US/MH Name** | **Pipe Flow (l/s)** | **Status** | **Level Exceeded** |
|---|---|---|---|---|
| 1.000 | S0405-19-1 | 45.4 | OK | |
| 1.001 | S0405-19-2 | 83.2 | FLOOD RISK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Priest Lane Underpass

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.000 | S0405-19-3 | 15 Winter | 100 | +40% | | | | | 121.466 | -0.134 | 0.000 | 0.34 | |
| 2.001 | S0405-19-4 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 119.024 | 0.470 | 0.000 | 0.90 | |
| 2.002 | S0405-19-5 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 115.688 | 1.219 | 18.705 | 1.63 | |
| 1.002 | S0405-19-6 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 115.603 | 1.208 | 8.044 | 1.79 | |
| 1.003 | S0405-19-7 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 114.229 | 0.227 | 0.000 | 1.36 | |
| 1.004 | S0405-19-8 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 114.146 | 0.194 | 0.000 | 1.18 | |
| 1.005 | S0405-19-9 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 113.932 | 0.151 | 0.000 | 1.20 | |
| 1.006 | S0405-19-10 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 113.791 | 0.112 | 0.000 | 1.13 | |
| 1.007 | S0405-19-11 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 113.547 | 0.075 | 0.000 | 1.10 | |
| 1.008 | S0405-19-12 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 113.301 | 0.034 | 0.000 | 1.55 | |

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 2.000 | S0405-19-3 | | 34.9 | OK | |
| 2.001 | S0405-19-4 | | 97.5 | SURCHARGED | |
| 2.002 | S0405-19-5 | | 82.0 | FLOOD | 6 |
| 1.002 | S0405-19-6 | | 123.9 | FLOOD | 5 |
| 1.003 | S0405-19-7 | | 118.6 | SURCHARGED | |
| 1.004 | S0405-19-8 | | 117.4 | SURCHARGED | |
| 1.005 | S0405-19-9 | | 114.7 | SURCHARGED | |
| 1.006 | S0405-19-10 | | 113.6 | SURCHARGED | |
| 1.007 | S0405-19-11 | | 111.0 | SURCHARGED | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Priest Lane Underpass

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 1.008 | S0405-19-12 |  | 110.4 | SURCHARGED |  |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Priest Lane Filter

```
                          Pipe Sizes STANDARD Manhole Sizes STANDARD

                            FSR Rainfall Model - England and Wales
           Return Period (years)     1          Foul Sewage (l/s/ha) 0.000          Maximum Backdrop Height (m) 1.500
                    M5-60 (mm) 20.600      Volumetric Runoff Coeff. 0.750 Min Design Depth for Optimisation (m) 1.200
                       Ratio R  0.287                      PIMP (%)   100     Min Vel for Auto Design only (m/s)  1.00
        Maximum Rainfall (mm/hr)    50 Add Flow / Climate Change (%)     0       Min Slope for Optimisation (1:X)   500
Maximum Time of Concentration (mins)    30   Minimum Backdrop Height (m) 0.200

                                  Designed with Level Inverts
```

### Simulation Criteria for Priest Lane Filter

```
      Volumetric Runoff Coeff 0.750   Manhole Headloss Coeff (Global) 0.500                 Inlet Coeffiecient 0.800
       Areal Reduction Factor 1.000      Foul Sewage per hectare (l/s) 0.000 Flow per Person per Day (l/per/day) 0.000
             Hot Start (mins)     0 Additional Flow - % of Total Flow 0.000                      Run Time (mins)    60
         Hot Start Level (mm)     0      MADD Factor * 10m³/ha Storage 2.000                Output Interval (mins)     1

              Number of Input Hydrographs 0   Number of Offline Controls 0 Number of Time/Area Diagrams 0
                Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
                     Rainfall Model FSR     Region England and Wales      Ratio R  0.287
              Return Period (years) 100 M5-60 (mm)             20.600 Profile Type Summer
```

## Synthetic Rainfall Details

Cv (Summer) 0.750 Cv (Winter) 0.840 Storm Duration (mins) 30

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Priest Lane Filter

### Simulation Criteria

```
Areal Reduction Factor 1.000  Manhole Headloss Coeff (Global) 0.500       MADD Factor * 10m³/ha Storage 2.000
      Hot Start (mins)      0    Foul Sewage per hectare (l/s) 0.000                Inlet Coeffiecient 0.800
   Hot Start Level (mm)     0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

     Number of Input Hydrographs 0   Number of Offline Controls 0 Number of Time/Area Diagrams 0
       Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
Rainfall Model              FSR M5-60 (mm) 18.700 Cv (Summer) 0.750
        Region England and Wales     Ratio R  0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status  ON Inertia Status OFF
                 Analysis Timestep  Fine DVD Status OFF
```

```
          Profile(s)                                               Summer and Winter
     Duration(s) (mins)  15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880,
                                                            4320, 5760, 7200, 8640, 10080
Return Period(s) (years)                                                          5, 100
     Climate Change (%)                                                           20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-20-1 | 15 Summer | 5 | +20% | | | | | 122.615 | -0.225 | 0.000 | 0.00 | | |
| 1.001 | S0405-20-2 | 15 Winter | 5 | +20% | | | | | 122.447 | -0.178 | 0.000 | 0.09 | | |

5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Priest Lane Filter

| **PN** | **US/MH Name** | **Pipe Flow (l/s)** | **Status** | **Level Exceeded** |
|---|---|---|---|---|
| 1.000 | S0405-20-1 | 0.0 | OK | |
| 1.001 | S0405-20-2 | 6.1 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Priest Lane Filter

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume ($m^3$) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.002 | S0405-20-3 | 15 Winter | 5 | +20% | | | | | 121.317 | -0.151 | 0.000 | 0.23 | |
| 1.003 | S0405-20-4 | 15 Winter | 5 | +20% | | | | | 119.530 | -0.146 | 0.000 | 0.27 | |
| 1.004 | S0405-20-5 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 117.939 | -0.136 | 0.000 | 0.33 | |
| 1.005 | S0405-20-6 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 115.857 | -0.057 | 0.000 | 0.86 | |
| 1.006 | S0405-20-7 | 15 Winter | 5 | +20% | | | | | 115.384 | -0.121 | 0.000 | 0.42 | |

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 1.002 | S0405-20-3 | | 16.4 | OK | |
| 1.003 | S0405-20-4 | | 25.4 | OK | |
| 1.004 | S0405-20-5 | | 35.1 | OK | |
| 1.005 | S0405-20-6 | | 33.5 | OK | 3 |
| 1.006 | S0405-20-7 | | 32.8 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Priest Lane Filter

### Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 0 Number of Storage Structures 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.700 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DTS Status ON Inertia Status OFF
Analysis Timestep Fine DVD Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S0405-20-1 | 15 Summer | 100 | +40% | | | | | 122.615 | -0.225 | 0.000 | 0.00 | | |
| 1.001 | S0405-20-2 | 15 Winter | 100 | +40% | | | | | 122.478 | -0.147 | 0.000 | 0.26 | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Priest Lane Filter

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| 1.000 | S0405-20-1 | 0.0 | OK | |
| 1.001 | S0405-20-2 | 16.9 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Priest Lane Filter

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.002 | S0405-20-3 | 15 Winter | 100 | +40% | | | | | 121.376 | -0.092 | 0.000 | 0.62 | |
| 1.003 | S0405-20-4 | 15 Winter | 100 | +40% | | | | | 119.596 | -0.079 | 0.000 | 0.72 | |
| 1.004 | S0405-20-5 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 118.568 | 0.493 | 0.000 | 0.81 | |
| 1.005 | S0405-20-6 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 117.116 | 1.202 | 1.203 | 1.98 | |
| 1.006 | S0405-20-7 | 15 Winter | 100 | +40% | | | | | 115.459 | -0.046 | 0.000 | 0.98 | |

| PN | US/MH Name | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|
| 1.002 | S0405-20-3 | | 44.5 | OK | |
| 1.003 | S0405-20-4 | | 68.4 | OK | |
| 1.004 | S0405-20-5 | | 86.5 | SURCHARGED | |
| 1.005 | S0405-20-6 | | 76.7 | FLOOD | 3 |
| 1.006 | S0405-20-7 | | 75.9 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Catchment 1 - Ch 40420

Pipe Sizes Min 150 Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 20.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Network Design Table for Catchment 1 - Ch 40420

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 13.591 | 0.241 | 56.4 | 0.126 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 1.001 | 130.897 | 1.824 | 71.7 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 2.000 | 30.340 | 0.180 | 168.4 | 0.103 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 2.001 | 26.077 | 0.819 | 31.8 | 0.138 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 2.002 | 49.214 | 1.724 | 28.5 | 0.108 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 1.002 | 23.463 | 0.495 | 47.4 | 0.160 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 1.003 | 119.282 | 0.437 | 272.7 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔒 |
| 1.004 | 34.181 | 0.953 | 35.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔒 |
| 1.005 | 36.700 | 1.292 | 28.4 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔒 |
| 1.006 | 27.094 | 0.730 | 37.1 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔒 |
| 1.007 | 42.287 | 1.208 | 35.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔒 |
| 1.008 | 23.980 | 0.347 | 69.1 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔒 |
| 1.009 | 122.780 | 5.822 | 21.1 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔒 |
| 3.000 | 89.272 | 5.432 | 16.4 | 0.307 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 3.001 | 33.362 | 3.360 | 9.9 | 0.448 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 3.002 | 22.728 | 1.390 | 16.4 | 0.256 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 77.56 | 5.13 | 156.183 | 0.126 | 0.0 | 0.0 | 0.0 | 1.75 | 69.4 | 26.5 |
| 1.001 | 70.32 | 6.54 | 155.942 | 0.126 | 0.0 | 0.0 | 0.0 | 1.55 | 61.5 | 26.5 |
| 2.000 | 75.46 | 5.50 | 156.840 | 0.103 | 0.0 | 0.0 | 0.0 | 1.00 | 39.9 | 21.0 |
| 2.001 | 74.47 | 5.69 | 156.660 | 0.241 | 0.0 | 0.0 | 0.0 | 2.33 | 92.5 | 48.5 |
| 2.002 | 72.77 | 6.02 | 155.841 | 0.349 | 0.0 | 0.0 | 0.0 | 2.46 | 97.7 | 68.8 |
| 1.002 | 69.55 | 6.71 | 154.042 | 0.635 | 0.0 | 0.0 | 0.0 | 2.29 | 161.8 | 119.7 |
| 1.003 | 62.49 | 8.53 | 153.473 | 0.635 | 0.0 | 0.0 | 0.0 | 1.09 | 120.6 | 119.7 |
| 1.004 | 61.86 | 8.72 | 153.035 | 0.635 | 0.0 | 0.0 | 0.0 | 3.03 | 335.1 | 119.7 |
| 1.005 | 61.28 | 8.90 | 152.082 | 0.635 | 0.0 | 0.0 | 0.0 | 3.41 | 376.7 | 119.7 |
| 1.006 | 60.79 | 9.05 | 150.790 | 0.635 | 0.0 | 0.0 | 0.0 | 2.98 | 329.4 | 119.7 |
| 1.007 | 60.07 | 9.28 | 150.060 | 0.635 | 0.0 | 0.0 | 0.0 | 3.07 | 339.2 | 119.7 |
| 1.008 | 59.52 | 9.46 | 148.852 | 0.635 | 0.0 | 0.0 | 0.0 | 2.18 | 241.0 | 119.7 |
| 1.009 | 58.01 | 9.98 | 148.505 | 0.635 | 0.0 | 0.0 | 0.0 | 3.96 | 437.5 | 119.7 |
| 3.000 | 75.71 | 5.46 | 153.857 | 0.307 | 0.0 | 0.0 | 0.0 | 3.24 | 129.0 | 62.9 |
| 3.001 | 74.99 | 5.59 | 148.425 | 0.755 | 0.0 | 0.0 | 0.0 | 4.18 | 166.1 | 153.3 |
| 3.002 | 74.48 | 5.69 | 144.990 | 1.011 | 0.0 | 0.0 | 0.0 | 3.91 | 276.2 | 203.8 |

## Network Design Table for Catchment 1 - Ch 40420

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.003 | 42.296 | 0.432 | 97.9 | 0.448 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |
| 4.000 | 49.595 | 3.367 | 14.7 | 0.040 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔒 |
| 4.001 | 17.483 | 0.905 | 19.3 | 0.074 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔒 |
| 5.000 | 50.669 | 3.332 | 15.2 | 0.036 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔒 |
| 5.001 | 10.766 | 0.801 | 13.4 | 0.070 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔒 |
| 5.002 | 11.025 | 0.066 | 167.9 | 0.023 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 5.003 | 8.278 | 0.049 | 167.9 | 0.018 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 4.002 | 19.524 | 0.783 | 24.9 | 0.027 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 4.003 | 17.551 | 0.334 | 52.5 | 0.034 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 3.004 | 7.383 | 0.068 | 108.9 | 0.090 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔒 |
| 6.000 | 14.411 | 0.917 | 15.7 | 0.132 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔒 |
| 6.001 | 13.990 | 0.791 | 17.7 | 0.050 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔒 |
| 6.002 | 16.442 | 0.309 | 53.2 | 0.048 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 7.000 | 71.894 | 3.928 | 18.3 | 0.028 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔒 |
| 7.001 | 44.993 | 0.926 | 48.6 | 0.037 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔒 |
| 7.002 | 35.094 | 0.208 | 168.4 | 0.040 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 7.003 | 59.914 | 0.356 | 168.4 | 0.020 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 7.004 | 50.230 | 2.678 | 18.8 | 0.016 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 7.005 | 17.078 | 1.438 | 11.9 | 0.096 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 7.006 | 6.653 | 0.070 | 94.7 | 0.057 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 8.000 | 72.651 | 3.911 | 18.6 | 0.018 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔒 |
| 8.001 | 42.002 | 0.724 | 58.0 | 0.025 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔒 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 3.003 | 72.73 | 6.03 | 143.450 | 1.458 | 0.0 | 0.0 | 0.0 | 2.06 | 326.9 | 287.2 |
| 4.000 | 76.51 | 5.31 | 148.707 | 0.040 | 0.0 | 0.0 | 0.0 | 2.64 | 46.6 | 8.3 |
| 4.001 | 75.81 | 5.44 | 145.340 | 0.114 | 0.0 | 0.0 | 0.0 | 2.30 | 40.7 | 23.4 |
| 5.000 | 76.44 | 5.33 | 148.683 | 0.036 | 0.0 | 0.0 | 0.0 | 2.60 | 45.9 | 7.5 |
| 5.001 | 76.08 | 5.39 | 145.351 | 0.106 | 0.0 | 0.0 | 0.0 | 2.76 | 48.8 | 21.9 |
| 5.002 | 75.09 | 5.57 | 144.475 | 0.129 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 26.2 |
| 5.003 | 74.37 | 5.71 | 144.409 | 0.146 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 29.5 |
| 4.002 | 73.73 | 5.83 | 144.360 | 0.287 | 0.0 | 0.0 | 0.0 | 2.63 | 104.6 | 57.3 |
| 4.003 | 72.91 | 6.00 | 143.577 | 0.321 | 0.0 | 0.0 | 0.0 | 1.81 | 72.0 | 63.3 |
| 3.004 | 72.45 | 6.09 | 142.943 | 1.869 | 0.0 | 0.0 | 0.0 | 2.15 | 464.6 | 366.6 |
| 6.000 | 77.76 | 5.09 | 145.267 | 0.132 | 0.0 | 0.0 | 0.0 | 2.55 | 45.1 | 27.9 |
| 6.001 | 77.20 | 5.19 | 144.350 | 0.182 | 0.0 | 0.0 | 0.0 | 2.41 | 42.5 | 38.1 |
| 6.002 | 76.34 | 5.34 | 143.484 | 0.231 | 0.0 | 0.0 | 0.0 | 1.80 | 71.5 | 47.7 |
| 7.000 | 75.45 | 5.51 | 154.004 | 0.028 | 0.0 | 0.0 | 0.0 | 2.37 | 41.8 | 5.6 |
| 7.001 | 72.77 | 6.02 | 150.076 | 0.065 | 0.0 | 0.0 | 0.0 | 1.45 | 25.6 | 12.7 |
| 7.002 | 70.02 | 6.61 | 149.075 | 0.104 | 0.0 | 0.0 | 0.0 | 1.00 | 39.9 | 19.8 |
| 7.003 | 65.87 | 7.60 | 148.867 | 0.124 | 0.0 | 0.0 | 0.0 | 1.00 | 39.9 | 22.1 |
| 7.004 | 64.83 | 7.88 | 148.511 | 0.140 | 0.0 | 0.0 | 0.0 | 3.04 | 120.7 | 24.6 |
| 7.005 | 64.55 | 7.95 | 145.833 | 0.236 | 0.0 | 0.0 | 0.0 | 3.82 | 151.8 | 41.2 |
| 7.006 | 64.25 | 8.03 | 144.395 | 0.293 | 0.0 | 0.0 | 0.0 | 1.34 | 53.4 | 51.0 |
| 8.000 | 75.40 | 5.52 | 153.785 | 0.018 | 0.0 | 0.0 | 0.0 | 2.35 | 41.5 | 3.8 |
| 8.001 | 72.67 | 6.04 | 149.874 | 0.044 | 0.0 | 0.0 | 0.0 | 1.32 | 23.4 | 8.6 |

## Network Design Table for Catchment 1 - Ch 40420

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8.002 | 42.001 | 0.424 | 99.0 | 0.038 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔒 |
| 8.003 | 55.993 | 0.565 | 99.0 | 0.013 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔒 |
| 8.004 | 46.485 | 2.357 | 19.7 | 0.011 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔒 |
| 8.005 | 17.591 | 1.404 | 12.5 | 0.064 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔒 |
| 7.007 | 14.841 | 0.829 | 17.9 | 0.031 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 7.008 | 33.267 | 0.320 | 103.9 | 0.014 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 3.005 | 1.743 | 0.003 | 500.0 | 0.053 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔒 |
| 3.006 | 21.769 | 0.044 | 500.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔒 |
| 3.007 | 16.518 | 0.033 | 500.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔒 |
| 3.008 | 17.977 | 0.036 | 500.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔒 |
| 3.009 | 43.201 | 0.086 | 500.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔒 |
| 3.010 | 47.824 | 0.096 | 500.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔒 |
| 3.011 | 22.219 | 0.044 | 500.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔒 |
| 9.000 | 25.211 | 0.718 | 35.1 | 0.028 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔒 |
| 10.000 | 24.964 | 1.524 | 16.4 | 0.210 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔒 |
| 10.001 | 11.906 | 0.087 | 136.8 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 9.001 | 19.203 | 3.077 | 6.2 | 0.028 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 1.010 | 19.447 | 0.039 | 500.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔒 |
| 1.011 | 127.588 | 7.353 | 17.4 | 0.098 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔒 |
| 1.012 | 17.027 | 0.034 | 500.0 | 0.040 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔒 |
| 1.013 | 19.241 | 0.038 | 500.0 | 0.025 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔒 |
| 1.014 | 65.689 | 0.751 | 87.4 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔒 |
| 1.015 | 97.839 | 0.092 | 1063.5 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 8.002 | 69.43 | 6.74 | 149.150 | 0.081 | 0.0 | 0.0 | 0.0 | 1.01 | 17.8 | 15.3 |
| 8.003 | 65.64 | 7.66 | 148.726 | 0.095 | 0.0 | 0.0 | 0.0 | 1.01 | 17.8 | 16.8 |
| 8.004 | 64.36 | 8.00 | 148.160 | 0.105 | 0.0 | 0.0 | 0.0 | 2.28 | 40.3 | 18.4 |
| 8.005 | 63.99 | 8.10 | 145.804 | 0.169 | 0.0 | 0.0 | 0.0 | 2.86 | 50.6 | 29.3 |
| 7.007 | 63.71 | 8.18 | 144.325 | 0.493 | 0.0 | 0.0 | 0.0 | 3.11 | 123.6 | 85.1 |
| 7.008 | 62.45 | 8.54 | 143.420 | 0.507 | 0.0 | 0.0 | 0.0 | 1.54 | 109.0 | 85.8 |
| 3.005 | 62.38 | 8.57 | 142.650 | 2.660 | 0.0 | 0.0 | 0.0 | 1.24 | 549.9 | 449.3 |
| 3.006 | 61.41 | 8.86 | 142.647 | 2.660 | 0.0 | 0.0 | 0.0 | 1.24 | 549.9 | 449.3 |
| 3.007 | 60.70 | 9.08 | 142.603 | 2.660 | 0.0 | 0.0 | 0.0 | 1.24 | 549.9 | 449.3 |
| 3.008 | 59.95 | 9.32 | 142.570 | 2.660 | 0.0 | 0.0 | 0.0 | 1.24 | 549.9 | 449.3 |
| 3.009 | 58.24 | 9.90 | 142.534 | 2.660 | 0.0 | 0.0 | 0.0 | 1.24 | 549.9 | 449.3 |
| 3.010 | 56.48 | 10.54 | 142.448 | 2.660 | 0.0 | 0.0 | 0.0 | 1.24 | 549.9 | 449.3 |
| 3.011 | 55.70 | 10.84 | 142.352 | 2.660 | 0.0 | 0.0 | 0.0 | 1.24 | 549.9 | 449.3 |
| 9.000 | 76.89 | 5.25 | 146.703 | 0.028 | 0.0 | 0.0 | 0.0 | 1.70 | 30.1 | 5.8 |
| 10.000 | 77.34 | 5.17 | 147.596 | 0.210 | 0.0 | 0.0 | 0.0 | 2.50 | 44.2 | 44.1 |
| 10.001 | 76.34 | 5.34 | 145.997 | 0.210 | 0.0 | 0.0 | 0.0 | 1.12 | 44.4 | 44.1 |
| 9.001 | 76.00 | 5.40 | 145.910 | 0.266 | 0.0 | 0.0 | 0.0 | 5.27 | 209.6 | 54.8 |
| 1.010 | 55.05 | 11.10 | 142.308 | 3.561 | 0.0 | 0.0 | 0.0 | 1.24 | 549.9 | 530.9 |
| 1.011 | 54.27 | 11.41 | 142.269 | 3.659 | 0.0 | 0.0 | 0.0 | 6.74 | 2976.2 | 537.8 |
| 1.012 | 53.73 | 11.64 | 134.916 | 3.699 | 0.0 | 0.0 | 0.0 | 1.24 | 549.9 | 538.2 |
| 1.013 | 53.14 | 11.90 | 134.882 | 3.724 | 0.0 | 0.0 | 0.0 | 1.24 | 549.9 | 538.2 |
| 1.014 | 52.32 | 12.26 | 134.843 | 3.724 | 0.0 | 0.0 | 0.0 | 2.99 | 1322.9 | 538.2 |
| 1.015 | 68.65 | 6.92 | 134.092 | 0.000 | 26.1 | 0.0 | 0.0 | 0.85 | 375.4 | 26.1 |

## Network Design Table for Catchment 1 - Ch 40420

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.016 | 25.421 | 1.028 | 24.7 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔓 |

## Network Results Table

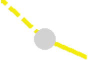
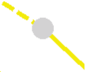
| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.016 | 68.33 | 6.99 | 134.000 | 0.000 | 26.1 | 0.0 | 0.0 | 5.64 | 2492.2 | 26.1 |

## Manhole Schedules for Catchment 1 - Ch 40420

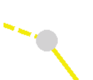
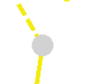
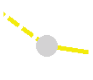
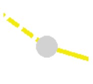
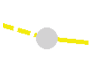
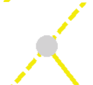
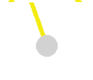
| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C1-1 | 157.608 | 1.425 | Open Manhole | 1200 | 1.000 | 156.183 | 225 | | | | |
| S06-C1-2 | 157.367 | 1.425 | Open Manhole | 1200 | 1.001 | 155.942 | 225 | 1.000 | 155.942 | 225 | |
| S06-C1-3 | 158.265 | 1.425 | Open Manhole | 1200 | 2.000 | 156.840 | 225 | | | | |
| S06-C1-4 | 158.284 | 1.625 | Open Manhole | 1200 | 2.001 | 156.660 | 225 | 2.000 | 156.660 | 225 | |
| S06-C1-5 | 157.266 | 1.425 | Open Manhole | 1200 | 2.002 | 155.841 | 225 | 2.001 | 155.841 | 225 | |
| S06-C1-6 | 155.542 | 1.500 | Open Manhole | 1200 | 1.002 | 154.042 | 300 | 1.001 | 154.117 | 225 | |
| | | | | | | | | 2.002 | 154.117 | 225 | |
| S06-C1-7 | 155.048 | 1.575 | Open Manhole | 1350 | 1.003 | 153.473 | 375 | 1.002 | 153.548 | 300 | |
| S06-C1-8 | 154.826 | 1.791 | Open Manhole | 1350 | 1.004 | 153.035 | 375 | 1.003 | 153.035 | 375 | |
| S06-C1-9 | 153.657 | 1.575 | Open Manhole | 1350 | 1.005 | 152.082 | 375 | 1.004 | 152.082 | 375 | |
| S06-C1-10 | 152.365 | 1.575 | Open Manhole | 1350 | 1.006 | 150.790 | 375 | 1.005 | 150.790 | 375 | |
| S06-C1-11 | 151.635 | 1.575 | Open Manhole | 1350 | 1.007 | 150.060 | 375 | 1.006 | 150.060 | 375 | |
| S06-C1-12 | 150.427 | 1.575 | Open Manhole | 1350 | 1.008 | 148.852 | 375 | 1.007 | 148.852 | 375 | |
| S06-C1-13 | 150.080 | 1.575 | Open Manhole | 1350 | 1.009 | 148.505 | 375 | 1.008 | 148.505 | 375 | |
| S06-C1-14 | 155.282 | 1.425 | Open Manhole | 1200 | 3.000 | 153.857 | 225 | | | | |
| S06-C1-15 | 149.850 | 1.425 | Open Manhole | 1200 | 3.001 | 148.425 | 225 | 3.000 | 148.425 | 225 | |
| S06-C1-16 | 146.490 | 1.500 | Open Manhole | 1200 | 3.002 | 144.990 | 300 | 3.001 | 145.065 | 225 | |
| S06-C1-17 | 145.100 | 1.650 | Open Manhole | 1350 | 3.003 | 143.450 | 450 | 3.002 | 143.600 | 300 | |
| S06-C1-18 | 150.057 | 1.350 | Open Manhole | 1200 | 4.000 | 148.707 | 150 | | | | |
| S06-C1-19 | 146.690 | 1.350 | Open Manhole | 1200 | 4.001 | 145.340 | 150 | 4.000 | 145.340 | 150 | |
| S06-C1-20 | 150.033 | 1.350 | Open Manhole | 1200 | 5.000 | 148.683 | 150 | | | | |
| S06-C1-21 | 146.701 | 1.350 | Open Manhole | 1200 | 5.001 | 145.351 | 150 | 5.000 | 145.351 | 150 | |
| S06-C1-22 | 145.900 | 1.425 | Open Manhole | 1200 | 5.002 | 144.475 | 225 | 5.001 | 144.550 | 150 | |
| S06-C1-23 | 145.900 | 1.491 | Open Manhole | 1200 | 5.003 | 144.409 | 225 | 5.002 | 144.409 | 225 | |
| S06-C1-24 | 145.902 | 1.542 | Open Manhole | 1200 | 4.002 | 144.360 | 225 | 4.001 | 144.435 | 150 | |
| | | | | | | | | 5.003 | 144.360 | 225 | |
| S06-C1-25 | 145.002 | 1.425 | Open Manhole | 1200 | 4.003 | 143.577 | 225 | 4.002 | 143.577 | 225 | |
| S06-C1-26 | 144.668 | 1.725 | Open Manhole | 1500 | 3.004 | 142.943 | 525 | 3.003 | 143.018 | 450 | |
| | | | | | | | | 4.003 | 143.243 | 225 | |
| S06-C1-27 | 146.617 | 1.350 | Open Manhole | 1200 | 6.000 | 145.267 | 150 | | | | |
| S06-C1-28 | 145.700 | 1.350 | Open Manhole | 1200 | 6.001 | 144.350 | 150 | 6.000 | 144.350 | 150 | |
| S06-C1-29 | 144.909 | 1.425 | Open Manhole | 1200 | 6.002 | 143.484 | 225 | 6.001 | 143.559 | 150 | |
| S06-C1-30 | 155.354 | 1.350 | Open Manhole | 1200 | 7.000 | 154.004 | 150 | | | | |
| S06-C1-31 | 151.426 | 1.350 | Open Manhole | 1200 | 7.001 | 150.076 | 150 | 7.000 | 150.076 | 150 | |
| S06-C1-32 | 150.500 | 1.425 | Open Manhole | 1200 | 7.002 | 149.075 | 225 | 7.001 | 149.150 | 150 | |
| S06-C1-33 | 150.500 | 1.633 | Open Manhole | 1200 | 7.003 | 148.867 | 225 | 7.002 | 148.867 | 225 | |
| S06-C1-34 | 150.707 | 2.196 | Open Manhole | 1200 | 7.004 | 148.511 | 225 | 7.003 | 148.511 | 225 | |
| S06-C1-35 | 147.258 | 1.425 | Open Manhole | 1200 | 7.005 | 145.833 | 225 | 7.004 | 145.833 | 225 | |
| S06-C1-36 | 145.820 | 1.425 | Open Manhole | 1200 | 7.006 | 144.395 | 225 | 7.005 | 144.395 | 225 | |
| S06-C1-37 | 155.135 | 1.350 | Open Manhole | 1200 | 8.000 | 153.785 | 150 | | | | |
| S06-C1-38 | 151.224 | 1.350 | Open Manhole | 1200 | 8.001 | 149.874 | 150 | 8.000 | 149.874 | 150 | |
| S06-C1-39 | 150.500 | 1.350 | Open Manhole | 1200 | 8.002 | 149.150 | 150 | 8.001 | 149.150 | 150 | |
| S06-C1-40 | 150.500 | 1.774 | Open Manhole | 1200 | 8.003 | 148.726 | 150 | 8.002 | 148.726 | 150 | |
| S06-C1-41 | 150.474 | 2.314 | Open Manhole | 1200 | 8.004 | 148.160 | 150 | 8.003 | 148.160 | 150 | |
| S06-C1-42 | 147.154 | 1.350 | Open Manhole | 1200 | 8.005 | 145.804 | 150 | 8.004 | 145.804 | 150 | |
| S06-C1-43 | 145.750 | 1.425 | Open Manhole | 1200 | 7.007 | 144.325 | 225 | 7.006 | 144.325 | 225 | |
| | | | | | | | | 8.005 | 144.400 | 150 | |
| S06-C1-44 | 144.920 | 1.500 | Open Manhole | 1200 | 7.008 | 143.420 | 300 | 7.007 | 143.495 | 225 | |

## Manhole Schedules for Catchment 1 - Ch 40420

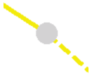
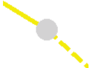
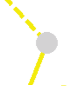
| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C1-45 | 144.600 | 1.950 | Open Manhole | 1800 | 3.005 | 142.650 | 750 | 3.004 | 142.875 | 525 | |
| | | | | | | | | 6.002 | 143.175 | 225 | |
| | | | | | | | | 7.008 | 143.100 | 300 | |
| S06-C1-46 | 144.900 | 2.253 | Open Manhole | 1800 | 3.006 | 142.647 | 750 | 3.005 | 142.647 | 750 | |
| S06-C1-47 | 145.600 | 2.997 | Open Manhole | 1800 | 3.007 | 142.603 | 750 | 3.006 | 142.603 | 750 | |
| S06-C1-48 | 146.700 | 4.130 | Open Manhole | 1800 | 3.008 | 142.570 | 750 | 3.007 | 142.570 | 750 | |
| S06-C1-49 | 147.600 | 5.066 | Open Manhole | 1800 | 3.009 | 142.534 | 750 | 3.008 | 142.534 | 750 | |
| S06-C1-50 | 148.600 | 6.152 | Open Manhole | 1800 | 3.010 | 142.448 | 750 | 3.009 | 142.448 | 750 | |
| S06-C1-51 | 147.814 | 5.462 | Open Manhole | 1800 | 3.011 | 142.352 | 750 | 3.010 | 142.352 | 750 | |
| S06-C1-52 | 148.053 | 1.350 | Open Manhole | 1200 | 9.000 | 146.703 | 150 | | | | |
| S06-C1-53 | 148.946 | 1.350 | Open Manhole | 1200 | 10.000 | 147.596 | 150 | | | | |
| S06-C1-54 | 147.422 | 1.425 | Open Manhole | 1200 | 10.001 | 145.997 | 225 | 10.000 | 146.072 | 150 | |
| S06-C1-55 | 147.490 | 1.580 | Open Manhole | 1200 | 9.001 | 145.910 | 225 | 9.000 | 145.985 | 150 | |
| | | | | | | | | 10.001 | 145.910 | 225 | |
| S06-C1-56 | 147.348 | 5.040 | Open Manhole | 1800 | 1.010 | 142.308 | 750 | 1.009 | 142.683 | 375 | |
| | | | | | | | | 3.011 | 142.308 | 750 | |
| | | | | | | | | 9.001 | 142.833 | 225 | |
| S06-C1-57 | 146.679 | 4.410 | Open Manhole | 1800 | 1.011 | 142.269 | 750 | 1.010 | 142.269 | 750 | |
| S06-C1-58 | 136.860 | 1.944 | Open Manhole | 1800 | 1.012 | 134.916 | 750 | 1.011 | 134.916 | 750 | |
| S06-C1-59 | 137.022 | 2.140 | Open Manhole | 1800 | 1.013 | 134.882 | 750 | 1.012 | 134.882 | 750 | |
| S06-C1-60 | 136.999 | 2.156 | Open Manhole | 1800 | 1.014 | 134.843 | 750 | 1.013 | 134.843 | 750 | |
| S06-C1-61 | 135.559 | 1.467 | Open Manhole | 1800 | 1.015 | 134.092 | 750 | 1.014 | 134.092 | 750 | |
| S06-C1-62 | 135.559 | 1.559 | Open Manhole | 1800 | 1.016 | 134.000 | 750 | 1.015 | 134.000 | 750 | |
| Outfall 1 | 133.900 | 0.928 | Open Manhole | 0 | | OUTFALL | | 1.016 | 132.972 | 750 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C1-1 | 371788.451 | 518223.634 | 371788.451 | 518223.634 | Required |  |
| S06-C1-2 | 371791.012 | 518210.286 | 371791.012 | 518210.286 | Required |  |
| S06-C1-3 | 371832.282 | 518197.453 | 371832.282 | 518197.453 | Required |  |
| S06-C1-4 | 371854.757 | 518177.072 | 371854.757 | 518177.072 | Required |  |
| S06-C1-5 | 371878.622 | 518166.561 | 371878.622 | 518166.561 | Required |  |
| S06-C1-6 | 371883.424 | 518117.582 | 371883.424 | 518117.582 | Required |  |
| S06-C1-7 | 371903.091 | 518104.786 | 371903.091 | 518104.786 | Required |  |
| S06-C1-8 | 371989.957 | 518023.039 | 371989.957 | 518023.039 | Required |  |

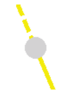
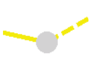
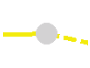
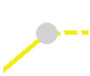
## Manhole Schedules for Catchment 1 - Ch 40420

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C1-9 | 371966.824 | 517997.875 | 371966.824 | 517997.875 | Required |  |
| S06-C1-10 | 371994.367 | 517973.621 | 371994.367 | 517973.621 | Required |  |
| S06-C1-11 | 371984.521 | 517948.379 | 371984.521 | 517948.379 | Required |  |
| S06-C1-12 | 371969.065 | 517909.018 | 371969.065 | 517909.018 | Required |  |
| S06-C1-13 | 371991.575 | 517900.752 | 371991.575 | 517900.752 | Required |  |
| S06-C1-14 | 371964.589 | 518098.341 | 371964.589 | 518098.341 | Required |  |
| S06-C1-15 | 372032.201 | 518040.047 | 372032.201 | 518040.047 | Required |  |
| S06-C1-16 | 372049.139 | 518011.305 | 372049.139 | 518011.305 | Required |  |
| S06-C1-17 | 372045.715 | 517988.836 | 372045.715 | 517988.836 | Required |  |
| S06-C1-18 | 371935.858 | 517960.999 | 371935.858 | 517960.999 | Required |  |
| S06-C1-19 | 371976.041 | 517931.931 | 371976.041 | 517931.931 | Required |  |
| S06-C1-20 | 371931.688 | 517954.786 | 371931.688 | 517954.786 | Required |  |
| S06-C1-21 | 371972.855 | 517925.245 | 371972.855 | 517925.245 | Required |  |
| S06-C1-22 | 371983.174 | 517922.176 | 371983.174 | 517922.176 | Required |  |
| S06-C1-23 | 371994.139 | 517921.027 | 371994.139 | 517921.027 | Required |  |
| S06-C1-24 | 371993.319 | 517929.264 | 371993.319 | 517929.264 | Required |  |
| S06-C1-25 | 372006.966 | 517943.227 | 372006.966 | 517943.227 | Required |  |
| S06-C1-26 | 372018.354 | 517956.582 | 372018.354 | 517956.582 | Required |  |
| S06-C1-27 | 372019.459 | 517908.661 | 372019.459 | 517908.661 | Required |  |
| S06-C1-28 | 372014.648 | 517922.245 | 372014.648 | 517922.245 | Required |  |

## Manhole Schedules for Catchment 1 - Ch 40420

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C1-29 | 372015.106 | 517936.228 | 372015.106 | 517936.228 | Required |  |
| S06-C1-30 | 372273.362 | 517799.886 | 372273.362 | 517799.886 | Required |  |
| S06-C1-31 | 372219.485 | 517847.488 | 372219.485 | 517847.488 | Required |  |
| S06-C1-32 | 372185.831 | 517877.351 | 372185.831 | 517877.351 | Required |  |
| S06-C1-33 | 372159.647 | 517900.717 | 372159.647 | 517900.717 | Required |  |
| S06-C1-34 | 372114.768 | 517940.410 | 372114.768 | 517940.410 | Required |  |
| S06-C1-35 | 372077.150 | 517973.695 | 372077.150 | 517973.695 | Required |  |
| S06-C1-36 | 372062.818 | 517982.983 | 372062.818 | 517982.983 | Required |  |
| S06-C1-37 | 372267.273 | 517795.748 | 372267.273 | 517795.748 | Required |  |
| S06-C1-38 | 372213.121 | 517844.180 | 372213.121 | 517844.180 | Required |  |
| S06-C1-39 | 372181.802 | 517872.167 | 372181.802 | 517872.167 | Required |  |
| S06-C1-40 | 372150.483 | 517900.153 | 372150.483 | 517900.153 | Required |  |
| S06-C1-41 | 372108.210 | 517936.871 | 372108.210 | 517936.871 | Required |  |
| S06-C1-42 | 372074.000 | 517968.344 | 372074.000 | 517968.344 | Required |  |
| S06-C1-43 | 372059.000 | 517977.534 | 372059.000 | 517977.534 | Required |  |
| S06-C1-44 | 372044.216 | 517976.233 | 372044.216 | 517976.233 | Required |  |
| S06-C1-45 | 372022.855 | 517950.730 | 372022.855 | 517950.730 | Required |  |
| S06-C1-46 | 372024.043 | 517949.455 | 372024.043 | 517949.455 | Required |  |
| S06-C1-47 | 372016.098 | 517929.188 | 372016.098 | 517929.188 | Required |  |
| S06-C1-48 | 372019.502 | 517913.025 | 372019.502 | 517913.025 | Required |  |

## Manhole Schedules for Catchment 1 - Ch 40420

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S06-C1-49 | 372026.356 | 517896.406 | 372026.356 | 517896.406 | Required |  |
| S06-C1-50 | 372043.241 | 517856.641 | 372043.241 | 517856.641 | Required |  |
| S06-C1-51 | 372076.074 | 517821.869 | 372076.074 | 517821.869 | Required |  |
| S06-C1-52 | 372053.645 | 517837.645 | 372053.645 | 517837.645 | Required |  |
| S06-C1-53 | 372100.571 | 517837.564 | 372100.571 | 517837.564 | Required |  |
| S06-C1-54 | 372083.882 | 517818.999 | 372083.882 | 517818.999 | Required |  |
| S06-C1-55 | 372072.062 | 517820.428 | 372072.062 | 517820.428 | Required |  |
| S06-C1-56 | 372065.198 | 517802.494 | 372065.198 | 517802.494 | Required |  |
| S06-C1-57 | 372081.187 | 517791.425 | 372081.187 | 517791.425 | Required |  |
| S06-C1-58 | 372014.492 | 517682.657 | 372014.492 | 517682.657 | Required |  |
| S06-C1-59 | 372009.432 | 517666.399 | 372009.432 | 517666.399 | Required |  |
| S06-C1-60 | 371992.737 | 517656.833 | 371992.737 | 517656.833 | Required |  |
| S06-C1-61 | 371928.621 | 517671.124 | 371928.621 | 517671.124 | Required |  |
| S06-C1-62 | 371830.826 | 517668.204 | 371830.826 | 517668.204 | Required |  |
| Outfall 1 | 371811.527 | 517651.658 |  |  | No Entry |  |

## Area Summary for Catchment 1 - Ch 40420

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | As Zoned | Default | 100 | 0.126 | 0.126 | 0.126 |
| | | Slopes | 25 | 0.001 | 0.000 | 0.126 |
| 1.001 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 2.000 | As Zoned | Default | 100 | 0.103 | 0.103 | 0.103 |
| 2.001 | As Zoned | Default | 100 | 0.138 | 0.138 | 0.138 |
| 2.002 | As Zoned | Default | 100 | 0.108 | 0.108 | 0.108 |
| 1.002 | As Zoned | Default | 100 | 0.160 | 0.160 | 0.160 |
| | | Verge | 50 | 0.000 | 0.000 | 0.160 |
| 1.003 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.004 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.005 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.006 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.007 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.008 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.009 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 3.000 | As Zoned | Default | 100 | 0.307 | 0.307 | 0.307 |
| 3.001 | As Zoned | Default | 100 | 0.448 | 0.448 | 0.448 |
| 3.002 | As Zoned | Default | 100 | 0.256 | 0.256 | 0.256 |
| 3.003 | As Zoned | Default | 100 | 0.448 | 0.448 | 0.448 |
| 4.000 | As Zoned | Default | 100 | 0.040 | 0.040 | 0.040 |
| 4.001 | As Zoned | Default | 100 | 0.074 | 0.074 | 0.074 |
| 5.000 | As Zoned | Default | 100 | 0.036 | 0.036 | 0.036 |
| 5.001 | As Zoned | Default | 100 | 0.070 | 0.070 | 0.070 |
| 5.002 | As Zoned | Default | 100 | 0.023 | 0.023 | 0.023 |
| 5.003 | As Zoned | Default | 100 | 0.018 | 0.018 | 0.018 |
| 4.002 | As Zoned | Default | 100 | 0.027 | 0.027 | 0.027 |
| 4.003 | As Zoned | Default | 100 | 0.034 | 0.034 | 0.034 |
| 3.004 | As Zoned | Default | 100 | 0.043 | 0.043 | 0.043 |
| | | Verge | 50 | 0.004 | 0.002 | 0.045 |
| | | Slopes | 25 | 0.003 | 0.001 | 0.046 |
| | As Zoned | Default | 100 | 0.044 | 0.044 | 0.090 |
| 6.000 | As Zoned | Default | 100 | 0.132 | 0.132 | 0.132 |
| 6.001 | As Zoned | Default | 100 | 0.050 | 0.050 | 0.050 |
| 6.002 | As Zoned | Default | 100 | 0.048 | 0.048 | 0.048 |
| 7.000 | As Zoned | Default | 100 | 0.028 | 0.028 | 0.028 |
| 7.001 | As Zoned | Default | 100 | 0.037 | 0.037 | 0.037 |
| 7.002 | As Zoned | Default | 100 | 0.040 | 0.040 | 0.040 |
| 7.003 | As Zoned | Default | 100 | 0.020 | 0.020 | 0.020 |
| 7.004 | As Zoned | Default | 100 | 0.016 | 0.016 | 0.016 |
| 7.005 | As Zoned | Default | 100 | 0.096 | 0.096 | 0.096 |
| 7.006 | As Zoned | Default | 100 | 0.057 | 0.057 | 0.057 |
| 8.000 | As Zoned | Default | 100 | 0.018 | 0.018 | 0.018 |
| 8.001 | As Zoned | Default | 100 | 0.025 | 0.025 | 0.025 |
| 8.002 | As Zoned | Default | 100 | 0.038 | 0.038 | 0.038 |
| 8.003 | As Zoned | Default | 100 | 0.013 | 0.013 | 0.013 |
| 8.004 | As Zoned | Default | 100 | 0.011 | 0.011 | 0.011 |
| 8.005 | As Zoned | Default | 100 | 0.064 | 0.064 | 0.064 |
| | | Verge | 50 | 0.000 | 0.000 | 0.064 |
| | | Slopes | 25 | 0.001 | 0.000 | 0.064 |
| 7.007 | As Zoned | Default | 100 | 0.030 | 0.030 | 0.030 |
| | | Verge | 50 | 0.001 | 0.000 | 0.030 |
| | | Slopes | 25 | 0.004 | 0.001 | 0.031 |
| 7.008 | As Zoned | Default | 100 | 0.014 | 0.014 | 0.014 |
| | | Slopes | 25 | 0.000 | 0.000 | 0.014 |
| 3.005 | As Zoned | Default | 100 | 0.053 | 0.053 | 0.053 |
| | | Slopes | 25 | 0.000 | 0.000 | 0.053 |
| 3.006 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 3.007 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 3.008 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 3.009 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 3.010 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 3.011 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 9.000 | As Zoned | Default | 100 | 0.028 | 0.028 | 0.028 |
| 10.000 | As Zoned | Default | 100 | 0.023 | 0.023 | 0.023 |
| | As Zoned | Default | 100 | 0.089 | 0.089 | 0.112 |

## Area Summary for Catchment 1 - Ch 40420

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| | | Verge | 50 | 0.000 | 0.000 | 0.112 |
| | | Slopes | 25 | 0.000 | 0.000 | 0.089 |
| | User | - | 100 | 0.098 | 0.098 | 0.210 |
| 10.001 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 9.001 | As Zoned | Default | 100 | 0.028 | 0.028 | 0.028 |
| 1.010 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.011 | User | - | 100 | 0.050 | 0.050 | 0.050 |
| | User | - | 100 | 0.048 | 0.048 | 0.098 |
| 1.012 | As Zoned | Default | 100 | 0.040 | 0.040 | 0.040 |
| 1.013 | As Zoned | Default | 100 | 0.025 | 0.025 | 0.025 |
| 1.014 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.015 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.016 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total | Total | Total |
| | | | | 3.732 | 3.724 | 3.724 |

## Online Controls for Catchment 1 - Ch 40420

### Hydro-Brake® Optimum Manhole: S06-C1-61, DS/PN: 1.015, Volume ($m^3$): 32.0

| | |
|---|---|
| Unit Reference | MD-SHE-0219-2610-1280-2610 |
| Design Head (m) | 1.280 |
| Design Flow (l/s) | 26.1 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 219 |
| Invert Level (m) | 134.092 |
| Minimum Outlet Pipe Diameter (mm) | 300 |
| Suggested Manhole Diameter (mm) | 1800 |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.280 | 26.1 | Kick-Flo® | 0.888 | 21.9 |
| Flush-Flo™ | 0.407 | 26.1 | Mean Flow over Head Range | - | 22.2 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 7.4 | 0.800 | 23.8 | 2.000 | 32.3 | 4.000 | 45.1 | 7.000 | 59.2 |
| 0.200 | 21.6 | 1.000 | 23.2 | 2.200 | 33.8 | 4.500 | 47.8 | 7.500 | 61.2 |
| 0.300 | 25.6 | 1.200 | 25.3 | 2.400 | 35.3 | 5.000 | 50.3 | 8.000 | 63.1 |
| 0.400 | 26.1 | 1.400 | 27.2 | 2.600 | 36.7 | 5.500 | 52.6 | 8.500 | 65.0 |
| 0.500 | 25.9 | 1.600 | 29.0 | 3.000 | 39.3 | 6.000 | 54.9 | 9.000 | 66.9 |
| 0.600 | 25.5 | 1.800 | 30.7 | 3.500 | 42.3 | 6.500 | 57.1 | 9.500 | 68.7 |

## Offline Controls for Catchment 1 - Ch 40420

### Weir Manhole: S06-C1-61, DS/PN: 1.015, Loop to PN: None

Discharge Coef 0.544 Width (m) 10.000 Invert Level (m) 135.372

## Storage Structures for Catchment 1 - Ch 40420

### Tank or Pond Manhole: S06-C1-61, DS/PN: 1.015

Invert Level (m) 134.092

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|---|---|---|---|
| 0.000 | 2222.7 | 1.000 | 2928.1 | 1.280 | 4201.2 | 1.467 | 4672.3 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 1 - Ch 40420

### Simulation Criteria

Areal Reduction Factor 1.000
Hot Start (mins) 0
Hot Start Level (mm) 0
Manhole Headloss Coeff (Global) 0.500
Foul Sewage per hectare (l/s) 0.000
Additional Flow - % of Total Flow 0.000
MADD Factor * 10m³/ha Storage 0.000
Inlet Coeffiecient 0.800
Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0
Number of Online Controls 1
Number of Offline Controls 1
Number of Storage Structures 1
Number of Time/Area Diagrams 0
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
Region England and Wales
M5-60 (mm) 20.000
Ratio R 0.300
Cv (Summer) 0.750
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Overflow Vol (m³) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C1-1 | 15 minute 5 year Winter I+20% | 157.608 | 156.300 | -0.108 | 0.000 | 0.53 | | | 32.0 |
| 1.001 | S06-C1-2 | 15 minute 5 year Winter I+20% | 157.367 | 156.059 | -0.108 | 0.000 | 0.48 | | | 29.2 |
| 2.000 | S06-C1-3 | 15 minute 5 year Winter I+20% | 158.265 | 156.980 | -0.085 | 0.000 | 0.68 | | | 25.5 |
| 2.001 | S06-C1-4 | 15 minute 5 year Winter I+20% | 158.284 | 156.793 | -0.092 | 0.000 | 0.64 | | | 55.1 |
| 2.002 | S06-C1-5 | 15 minute 5 year Winter I+20% | 157.266 | 156.000 | -0.066 | 0.000 | 0.84 | | | 78.3 |
| 1.002 | S06-C1-6 | 15 minute 5 year Winter I+20% | 155.542 | 154.411 | 0.069 | 0.000 | 0.95 | | | 135.7 |
| 1.003 | S06-C1-7 | 15 minute 5 year Winter I+20% | 155.048 | 153.977 | 0.130 | 0.000 | 1.08 | | | 126.4 |
| 1.004 | S06-C1-8 | 15 minute 5 year Winter I+20% | 154.826 | 153.204 | -0.206 | 0.000 | 0.42 | | | 126.5 |
| 1.005 | S06-C1-9 | 15 minute 5 year Winter I+20% | 153.657 | 152.240 | -0.217 | 0.000 | 0.37 | | | 126.2 |
| 1.006 | S06-C1-10 | 15 minute 5 year Winter I+20% | 152.365 | 150.964 | -0.201 | 0.000 | 0.44 | | | 125.7 |
| 1.007 | S06-C1-11 | 15 minute 5 year Winter I+20% | 151.635 | 150.227 | -0.208 | 0.000 | 0.41 | | | 125.8 |
| 1.008 | S06-C1-12 | 15 minute 5 year Winter I+20% | 150.427 | 149.064 | -0.163 | 0.000 | 0.61 | | | 126.4 |
| 1.009 | S06-C1-13 | 15 minute 5 year Winter I+20% | 150.080 | 148.644 | -0.236 | 0.000 | 0.30 | | | 125.4 |
| 3.000 | S06-C1-14 | 15 minute 5 year Winter I+20% | 155.282 | 153.986 | -0.096 | 0.000 | 0.61 | | | 76.3 |
| 3.001 | S06-C1-15 | 15 minute 5 year Winter I+20% | 149.850 | 149.084 | 0.434 | 0.000 | 1.05 | | | 164.1 |
| 3.002 | S06-C1-16 | 15 minute 5 year Winter I+20% | 146.490 | 145.343 | 0.053 | 0.000 | 0.88 | | | 215.3 |
| 3.003 | S06-C1-17 | 15 minute 5 year Winter I+20% | 145.100 | 144.252 | 0.352 | 0.000 | 1.04 | | | 303.4 |
| 4.000 | S06-C1-18 | 15 minute 5 year Winter I+20% | 150.057 | 148.755 | -0.102 | 0.000 | 0.22 | | | 10.1 |
| 4.001 | S06-C1-19 | 15 minute 5 year Winter I+20% | 146.690 | 145.432 | -0.058 | 0.000 | 0.68 | | | 25.8 |
| 5.000 | S06-C1-20 | 15 minute 5 year Winter I+20% | 150.033 | 148.729 | -0.104 | 0.000 | 0.20 | | | 9.1 |
| 5.001 | S06-C1-21 | 15 minute 5 year Winter I+20% | 146.701 | 145.432 | -0.070 | 0.000 | 0.55 | | | 24.0 |
| 5.002 | S06-C1-22 | 15 minute 5 year Winter I+20% | 145.900 | 144.679 | -0.021 | 0.000 | 0.84 | | | 28.3 |
| 5.003 | S06-C1-23 | 15 minute 5 year Winter I+20% | 145.900 | 144.624 | -0.010 | 0.000 | 1.00 | | | 31.3 |
| 4.002 | S06-C1-24 | 15 minute 5 year Winter I+20% | 145.902 | 144.495 | -0.090 | 0.000 | 0.66 | | | 62.8 |
| 4.003 | S06-C1-25 | 15 minute 5 year Winter I+20% | 145.002 | 144.157 | 0.355 | 0.000 | 1.06 | | | 68.2 |
| 3.004 | S06-C1-26 | 15 minute 5 year Winter I+20% | 144.668 | 143.796 | 0.328 | 0.000 | 1.56 | | | 388.3 |
| 6.000 | S06-C1-27 | 15 minute 5 year Winter I+20% | 146.617 | 145.370 | -0.046 | 0.000 | 0.81 | | | 33.6 |
| 6.001 | S06-C1-28 | 15 minute 5 year Winter I+20% | 145.700 | 144.671 | 0.171 | 0.000 | 1.10 | | | 43.0 |
| 6.002 | S06-C1-29 | 15 minute 5 year Winter I+20% | 144.909 | 143.729 | 0.020 | 0.000 | 0.82 | | | 51.7 |
| 7.000 | S06-C1-30 | 15 minute 5 year Winter I+20% | 155.354 | 154.046 | -0.108 | 0.000 | 0.17 | | | 6.8 |
| 7.001 | S06-C1-31 | 15 minute 5 year Winter I+20% | 151.426 | 150.161 | -0.066 | 0.000 | 0.59 | | | 14.7 |
| 7.002 | S06-C1-32 | 15 minute 5 year Winter I+20% | 150.500 | 149.203 | -0.097 | 0.000 | 0.60 | | | 22.7 |
| 7.003 | S06-C1-33 | 15 minute 5 year Winter I+20% | 150.500 | 149.005 | -0.086 | 0.000 | 0.67 | | | 25.7 |
| 7.004 | S06-C1-34 | 15 minute 5 year Winter I+20% | 150.707 | 148.587 | -0.149 | 0.000 | 0.25 | | | 28.6 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 1 - Ch 40420

| PN | US/MH Name | Status |
|---|---|---|
| 1.000 | S06-C1-1 | OK |
| 1.001 | S06-C1-2 | OK |
| 2.000 | S06-C1-3 | OK |
| 2.001 | S06-C1-4 | OK |
| 2.002 | S06-C1-5 | OK |
| 1.002 | S06-C1-6 | SURCHARGED |
| 1.003 | S06-C1-7 | SURCHARGED |
| 1.004 | S06-C1-8 | OK |
| 1.005 | S06-C1-9 | OK |
| 1.006 | S06-C1-10 | OK |
| 1.007 | S06-C1-11 | OK |
| 1.008 | S06-C1-12 | OK |
| 1.009 | S06-C1-13 | OK |
| 3.000 | S06-C1-14 | OK |
| 3.001 | S06-C1-15 | SURCHARGED |
| 3.002 | S06-C1-16 | SURCHARGED |
| 3.003 | S06-C1-17 | SURCHARGED |
| 4.000 | S06-C1-18 | OK |
| 4.001 | S06-C1-19 | OK |
| 5.000 | S06-C1-20 | OK |
| 5.001 | S06-C1-21 | OK |
| 5.002 | S06-C1-22 | OK |
| 5.003 | S06-C1-23 | OK |
| 4.002 | S06-C1-24 | OK |
| 4.003 | S06-C1-25 | SURCHARGED |
| 3.004 | S06-C1-26 | SURCHARGED |
| 6.000 | S06-C1-27 | OK |
| 6.001 | S06-C1-28 | SURCHARGED |
| 6.002 | S06-C1-29 | SURCHARGED |
| 7.000 | S06-C1-30 | OK |
| 7.001 | S06-C1-31 | OK |
| 7.002 | S06-C1-32 | OK |
| 7.003 | S06-C1-33 | OK |
| 7.004 | S06-C1-34 | OK |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 1 - Ch 40420

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Overflow Vol (m³) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 7.005 | S06-C1-35 | 15 minute 5 year Winter I+20% | 147.258 | 145.925 | -0.133 | 0.000 | 0.34 | | | 46.5 |
| 7.006 | S06-C1-36 | 15 minute 5 year Winter I+20% | 145.820 | 144.713 | 0.094 | 0.000 | 1.55 | | | 57.7 |
| 8.000 | S06-C1-37 | 15 minute 5 year Winter I+20% | 155.135 | 153.819 | -0.116 | 0.000 | 0.11 | | | 4.6 |
| 8.001 | S06-C1-38 | 15 minute 5 year Winter I+20% | 151.224 | 149.944 | -0.080 | 0.000 | 0.44 | | | 9.9 |
| 8.002 | S06-C1-39 | 15 minute 5 year Winter I+20% | 150.500 | 149.311 | 0.011 | 0.000 | 0.97 | | | 16.8 |
| 8.003 | S06-C1-40 | 15 minute 5 year Winter I+20% | 150.500 | 148.936 | 0.060 | 0.000 | 1.05 | | | 18.3 |
| 8.004 | S06-C1-41 | 15 minute 5 year Winter I+20% | 150.474 | 148.236 | -0.074 | 0.000 | 0.51 | | | 19.9 |
| 8.005 | S06-C1-42 | 15 minute 5 year Winter I+20% | 147.154 | 145.896 | -0.058 | 0.000 | 0.67 | | | 31.7 |
| 7.007 | S06-C1-43 | 15 minute 5 year Winter I+20% | 145.750 | 144.490 | -0.059 | 0.000 | 0.88 | | | 95.7 |
| 7.008 | S06-C1-44 | 15 minute 5 year Winter I+20% | 144.920 | 143.846 | 0.126 | 0.000 | 0.98 | | | 97.5 |
| 3.005 | S06-C1-45 | 15 minute 5 year Winter I+20% | 144.600 | 143.597 | 0.197 | 0.000 | 1.46 | | | 542.7 |
| 3.006 | S06-C1-46 | 15 minute 5 year Winter I+20% | 144.900 | 143.567 | 0.170 | 0.000 | 1.45 | | | 538.0 |
| 3.007 | S06-C1-47 | 15 minute 5 year Winter I+20% | 145.600 | 143.502 | 0.149 | 0.000 | 1.77 | | | 532.5 |
| 3.008 | S06-C1-48 | 15 minute 5 year Winter I+20% | 146.700 | 143.436 | 0.116 | 0.000 | 1.64 | | | 526.4 |
| 3.009 | S06-C1-49 | 15 minute 5 year Winter I+20% | 147.600 | 143.381 | 0.097 | 0.000 | 1.12 | | | 511.0 |
| 3.010 | S06-C1-50 | 15 minute 5 year Winter I+20% | 148.600 | 143.298 | 0.100 | 0.000 | 1.06 | | | 491.7 |
| 3.011 | S06-C1-51 | 15 minute 5 year Winter I+20% | 147.814 | 143.197 | 0.095 | 0.000 | 1.28 | | | 481.1 |
| 9.000 | S06-C1-52 | 15 minute 5 year Winter I+20% | 148.053 | 146.754 | -0.099 | 0.000 | 0.25 | | | 7.1 |
| 10.000 | S06-C1-53 | 15 minute 5 year Winter I+20% | 148.946 | 148.326 | 0.580 | 0.000 | 1.15 | | | 48.2 |
| 10.001 | S06-C1-54 | 15 minute 5 year Winter I+20% | 147.422 | 146.268 | 0.046 | 0.000 | 1.28 | | | 48.5 |
| 9.001 | S06-C1-55 | 15 minute 5 year Winter I+20% | 147.490 | 145.998 | -0.137 | 0.000 | 0.32 | | | 60.0 |
| 1.010 | S06-C1-56 | 15 minute 5 year Winter I+20% | 147.348 | 143.134 | 0.077 | 0.000 | 1.81 | | | 615.2 |
| 1.011 | S06-C1-57 | 15 minute 5 year Winter I+20% | 146.679 | 142.510 | -0.509 | 0.000 | 0.22 | | | 621.1 |
| 1.012 | S06-C1-58 | 15 minute 5 year Winter I+20% | 136.860 | 135.862 | 0.196 | 0.000 | 1.99 | | | 612.2 |
| 1.013 | S06-C1-59 | 15 minute 5 year Winter I+20% | 137.022 | 135.710 | 0.078 | 0.000 | 1.81 | | | 610.0 |
| 1.014 | S06-C1-60 | 15 minute 5 year Winter I+20% | 136.999 | 135.231 | -0.363 | 0.000 | 0.53 | | | 608.4 |
| 1.015 | S06-C1-61 | 960 minute 5 year Winter I+20% | 135.559 | 134.552 | -0.290 | 0.000 | 0.07 | 0.0 | 0.000 | 26.0 |
| 1.016 | S06-C1-62 | 480 minute 5 year Summer I+20% | 135.559 | 134.058 | -0.692 | 0.000 | 0.02 | | | 26.0 |

| PN | US/MH Name | Status |
|---|---|---|
| 7.005 | S06-C1-35 | OK |
| 7.006 | S06-C1-36 | SURCHARGED |
| 8.000 | S06-C1-37 | OK |
| 8.001 | S06-C1-38 | OK |
| 8.002 | S06-C1-39 | SURCHARGED |
| 8.003 | S06-C1-40 | SURCHARGED |
| 8.004 | S06-C1-41 | OK |
| 8.005 | S06-C1-42 | OK |
| 7.007 | S06-C1-43 | OK |
| 7.008 | S06-C1-44 | SURCHARGED |
| 3.005 | S06-C1-45 | SURCHARGED |
| 3.006 | S06-C1-46 | SURCHARGED |
| 3.007 | S06-C1-47 | SURCHARGED |
| 3.008 | S06-C1-48 | SURCHARGED |
| 3.009 | S06-C1-49 | SURCHARGED |
| 3.010 | S06-C1-50 | SURCHARGED |
| 3.011 | S06-C1-51 | SURCHARGED |
| 9.000 | S06-C1-52 | OK |
| 10.000 | S06-C1-53 | SURCHARGED |
| 10.001 | S06-C1-54 | SURCHARGED |
| 9.001 | S06-C1-55 | OK |
| 1.010 | S06-C1-56 | SURCHARGED |
| 1.011 | S06-C1-57 | OK |
| 1.012 | S06-C1-58 | SURCHARGED |
| 1.013 | S06-C1-59 | SURCHARGED |
| 1.014 | S06-C1-60 | OK |
| 1.015 | S06-C1-61 | OK |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 1 - Ch 40420

| PN | US/MH Name | Status |
|---|---|---|
| 1.016 | S06-C1-62 | OK |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 1 - Ch 40420

### Simulation Criteria

Areal Reduction Factor 1.000
Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0
MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0
Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500
Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0
Number of Offline Controls 1
Number of Time/Area Diagrams 0
Number of Online Controls 1
Number of Storage Structures 1
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
M5-60 (mm) 20.000
Cv (Summer) 0.750
Region England and Wales
Ratio R 0.300
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| **PN** | **US/MH Name** | **Event** | **US/CL (m)** | **Water Level (m)** | **Surcharged Depth (m)** | **Flooded Volume (m³)** | **Flow / Cap.** | **Overflow (l/s)** | **Overflow Vol (m³)** | **Pipe Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C1-1 | 15 minute 100 year Winter I+40% | 157.608 | 157.514 | 1.106 | 0.000 | 1.01 | | | 61.0 |
| 1.001 | S06-C1-2 | 15 minute 100 year Winter I+40% | 157.367 | 157.251 | 1.084 | 0.000 | 0.92 | | | 55.8 |
| 2.000 | S06-C1-3 | 15 minute 100 year Winter I+40% | 158.265 | 158.272 | 1.207 | 7.208 | 1.49 | | | 55.6 |
| 2.001 | S06-C1-4 | 15 minute 100 year Winter I+40% | 158.284 | 158.285 | 1.400 | 0.195 | 1.09 | | | 93.4 |
| 2.002 | S06-C1-5 | 30 minute 100 year Winter I+40% | 157.266 | 157.279 | 1.213 | 13.124 | 1.20 | | | 111.9 |
| 1.002 | S06-C1-6 | 15 minute 100 year Winter I+40% | 155.542 | 155.547 | 1.205 | 4.929 | 1.37 | | | 196.5 |
| 1.003 | S06-C1-7 | 15 minute 100 year Summer I+40% | 155.048 | 154.630 | 0.783 | 0.000 | 1.65 | | | 191.9 |
| 1.004 | S06-C1-8 | 30 minute 100 year Winter I+40% | 154.826 | 153.255 | -0.155 | 0.000 | 0.65 | | | 194.8 |
| 1.005 | S06-C1-9 | 30 minute 100 year Winter I+40% | 153.657 | 152.286 | -0.171 | 0.000 | 0.57 | | | 194.7 |
| 1.006 | S06-C1-10 | 30 minute 100 year Winter I+40% | 152.365 | 151.017 | -0.148 | 0.000 | 0.68 | | | 194.6 |
| 1.007 | S06-C1-11 | 30 minute 100 year Winter I+40% | 151.635 | 150.276 | -0.159 | 0.000 | 0.63 | | | 194.6 |
| 1.008 | S06-C1-12 | 30 minute 100 year Winter I+40% | 150.427 | 149.138 | -0.089 | 0.000 | 0.94 | | | 194.7 |
| 1.009 | S06-C1-13 | 30 minute 100 year Winter I+40% | 150.080 | 148.683 | -0.197 | 0.000 | 0.46 | | | 194.6 |
| 3.000 | S06-C1-14 | 15 minute 100 year Winter I+40% | 155.282 | 155.289 | 1.207 | 6.895 | 1.00 | | | 125.4 |
| 3.001 | S06-C1-15 | 30 minute 100 year Winter I+40% | 149.850 | 149.924 | 1.274 | 74.120 | 1.17 | | | 182.2 |
| 3.002 | S06-C1-16 | 15 minute 100 year Winter I+40% | 146.490 | 146.503 | 1.213 | 13.231 | 1.00 | | | 243.9 |
| 3.003 | S06-C1-17 | 30 minute 100 year Winter I+40% | 145.100 | 145.145 | 1.245 | 45.156 | 1.31 | | | 383.1 |
| 4.000 | S06-C1-18 | 15 minute 100 year Winter I+40% | 150.057 | 148.782 | -0.075 | 0.000 | 0.49 | | | 22.3 |
| 4.001 | S06-C1-19 | 15 minute 100 year Winter I+40% | 146.690 | 146.694 | 1.204 | 4.194 | 1.06 | | | 40.4 |
| 5.000 | S06-C1-20 | 15 minute 100 year Winter I+40% | 150.033 | 148.754 | -0.079 | 0.000 | 0.45 | | | 20.1 |
| 5.001 | S06-C1-21 | 15 minute 100 year Winter I+40% | 146.701 | 146.703 | 1.202 | 2.016 | 1.00 | | | 43.7 |
| 5.002 | S06-C1-22 | 15 minute 100 year Winter I+40% | 145.900 | 145.906 | 1.206 | 5.686 | 1.40 | | | 47.2 |
| 5.003 | S06-C1-23 | 15 minute 100 year Winter I+40% | 145.900 | 145.891 | 1.257 | 0.000 | 1.57 | | | 49.0 |
| 4.002 | S06-C1-24 | 15 minute 100 year Winter I+40% | 145.902 | 145.805 | 1.220 | 0.000 | 0.98 | | | 92.5 |
| 4.003 | S06-C1-25 | 30 minute 100 year Winter I+40% | 145.002 | 145.019 | 1.217 | 16.897 | 1.43 | | | 91.8 |
| 3.004 | S06-C1-26 | 30 minute 100 year Winter I+40% | 144.668 | 144.668 | 1.200 | 0.235 | 1.94 | | | 482.7 |
| 6.000 | S06-C1-27 | 15 minute 100 year Winter I+40% | 146.617 | 146.623 | 1.206 | 6.377 | 1.00 | | | 41.5 |
| 6.001 | S06-C1-28 | 30 minute 100 year Winter I+40% | 145.700 | 145.707 | 1.207 | 6.594 | 1.28 | | | 50.1 |
| 6.002 | S06-C1-29 | 30 minute 100 year Summer I+40% | 144.909 | 144.721 | 1.011 | 0.000 | 1.09 | | | 69.3 |
| 7.000 | S06-C1-30 | 15 minute 100 year Winter I+40% | 155.354 | 154.068 | -0.086 | 0.000 | 0.37 | | | 15.1 |
| 7.001 | S06-C1-31 | 15 minute 100 year Winter I+40% | 151.426 | 151.177 | 0.950 | 0.000 | 1.21 | | | 30.1 |
| 7.002 | S06-C1-32 | 15 minute 100 year Winter I+40% | 150.500 | 149.800 | 0.500 | 0.000 | 1.25 | | | 46.9 |
| 7.003 | S06-C1-33 | 15 minute 100 year Winter I+40% | 150.500 | 149.466 | 0.374 | 0.000 | 1.39 | | | 53.5 |
| 7.004 | S06-C1-34 | 15 minute 100 year Winter I+40% | 150.707 | 148.625 | -0.111 | 0.000 | 0.51 | | | 58.5 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 1 - Ch 40420

| PN | US/MH Name | Status |
|---|---|---|
| 1.000 | S06-C1-1 | FLOOD RISK |
| 1.001 | S06-C1-2 | FLOOD RISK |
| 2.000 | S06-C1-3 | FLOOD |
| 2.001 | S06-C1-4 | FLOOD |
| 2.002 | S06-C1-5 | FLOOD |
| 1.002 | S06-C1-6 | FLOOD |
| 1.003 | S06-C1-7 | SURCHARGED |
| 1.004 | S06-C1-8 | OK |
| 1.005 | S06-C1-9 | OK |
| 1.006 | S06-C1-10 | OK |
| 1.007 | S06-C1-11 | OK |
| 1.008 | S06-C1-12 | OK |
| 1.009 | S06-C1-13 | OK |
| 3.000 | S06-C1-14 | FLOOD |
| 3.001 | S06-C1-15 | FLOOD |
| 3.002 | S06-C1-16 | FLOOD |
| 3.003 | S06-C1-17 | FLOOD |
| 4.000 | S06-C1-18 | OK |
| 4.001 | S06-C1-19 | FLOOD |
| 5.000 | S06-C1-20 | OK |
| 5.001 | S06-C1-21 | FLOOD |
| 5.002 | S06-C1-22 | FLOOD |
| 5.003 | S06-C1-23 | FLOOD RISK |
| 4.002 | S06-C1-24 | FLOOD RISK |
| 4.003 | S06-C1-25 | FLOOD |
| 3.004 | S06-C1-26 | FLOOD |
| 6.000 | S06-C1-27 | FLOOD |
| 6.001 | S06-C1-28 | FLOOD |
| 6.002 | S06-C1-29 | FLOOD RISK |
| 7.000 | S06-C1-30 | OK |
| 7.001 | S06-C1-31 | FLOOD RISK |
| 7.002 | S06-C1-32 | SURCHARGED |
| 7.003 | S06-C1-33 | SURCHARGED |
| 7.004 | S06-C1-34 | OK |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 1 - Ch 40420

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Overflow Vol (m³) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 7.005 | S06-C1-35 | 15 minute 100 year Winter I+40% | 147.258 | 146.745 | 0.687 | 0.000 | 0.79 | | | 106.2 |
| 7.006 | S06-C1-36 | 30 minute 100 year Winter I+40% | 145.820 | 145.846 | 1.226 | 25.902 | 2.27 | | | 84.7 |
| 8.000 | S06-C1-37 | 15 minute 100 year Winter I+40% | 155.135 | 153.836 | -0.099 | 0.000 | 0.25 | | | 10.1 |
| 8.001 | S06-C1-38 | 15 minute 100 year Winter I+40% | 151.224 | 151.094 | 1.070 | 0.000 | 0.87 | | | 19.7 |
| 8.002 | S06-C1-39 | 15 minute 100 year Winter I+40% | 150.500 | 150.502 | 1.202 | 2.313 | 1.46 | | | 25.2 |
| 8.003 | S06-C1-40 | 15 minute 100 year Winter I+40% | 150.500 | 149.854 | 0.979 | 0.000 | 1.57 | | | 27.3 |
| 8.004 | S06-C1-41 | 30 minute 100 year Winter I+40% | 150.474 | 148.473 | 0.162 | 0.000 | 0.80 | | | 31.3 |
| 8.005 | S06-C1-42 | 15 minute 100 year Winter I+40% | 147.154 | 147.156 | 1.202 | 2.039 | 1.04 | | | 49.0 |
| 7.007 | S06-C1-43 | 15 minute 100 year Winter I+40% | 145.750 | 145.721 | 1.171 | 0.000 | 1.15 | | | 124.5 |
| 7.008 | S06-C1-44 | 30 minute 100 year Winter I+40% | 144.920 | 144.843 | 1.123 | 0.000 | 1.21 | | | 120.6 |
| 3.005 | S06-C1-45 | 30 minute 100 year Winter I+40% | 144.600 | 144.405 | 1.005 | 0.000 | 1.82 | | | 675.6 |
| 3.006 | S06-C1-46 | 15 minute 100 year Winter I+40% | 144.900 | 144.266 | 0.869 | 0.000 | 1.90 | | | 704.1 |
| 3.007 | S06-C1-47 | 15 minute 100 year Winter I+40% | 145.600 | 144.118 | 0.765 | 0.000 | 2.31 | | | 693.9 |
| 3.008 | S06-C1-48 | 15 minute 100 year Winter I+40% | 146.700 | 143.964 | 0.644 | 0.000 | 2.12 | | | 678.0 |
| 3.009 | S06-C1-49 | 15 minute 100 year Winter I+40% | 147.600 | 143.807 | 0.523 | 0.000 | 1.44 | | | 654.4 |
| 3.010 | S06-C1-50 | 15 minute 100 year Winter I+40% | 148.600 | 143.643 | 0.445 | 0.000 | 1.38 | | | 638.8 |
| 3.011 | S06-C1-51 | 15 minute 100 year Winter I+40% | 147.814 | 143.468 | 0.366 | 0.000 | 1.68 | | | 633.1 |
| 9.000 | S06-C1-52 | 15 minute 100 year Winter I+40% | 148.053 | 146.783 | -0.070 | 0.000 | 0.55 | | | 15.7 |
| 10.000 | S06-C1-53 | 15 minute 100 year Winter I+40% | 148.946 | 148.961 | 1.215 | 15.417 | 1.32 | | | 55.5 |
| 10.001 | S06-C1-54 | 15 minute 100 year Winter I+40% | 147.422 | 146.314 | 0.092 | 0.000 | 1.46 | | | 55.5 |
| 9.001 | S06-C1-55 | 15 minute 100 year Winter I+40% | 147.490 | 146.018 | -0.117 | 0.000 | 0.46 | | | 87.6 |
| 1.010 | S06-C1-56 | 15 minute 100 year Winter I+40% | 147.348 | 143.304 | 0.246 | 0.000 | 2.60 | | | 885.2 |
| 1.011 | S06-C1-57 | 30 minute 100 year Winter I+40% | 146.679 | 142.565 | -0.454 | 0.000 | 0.33 | | | 911.5 |
| 1.012 | S06-C1-58 | 30 minute 100 year Winter I+40% | 136.860 | 136.256 | 0.590 | 0.000 | 2.99 | | | 920.2 |
| 1.013 | S06-C1-59 | 30 minute 100 year Winter I+40% | 137.022 | 135.909 | 0.277 | 0.000 | 2.75 | | | 927.7 |
| 1.014 | S06-C1-60 | 30 minute 100 year Winter I+40% | 136.999 | 135.353 | -0.240 | 0.000 | 0.80 | | | 925.4 |
| 1.015 | S06-C1-61 | 960 minute 100 year Winter I+40% | 135.559 | 135.186 | 0.344 | 0.000 | 0.07 | 0.0 | 0.000 | 26.0 |
| 1.016 | S06-C1-62 | 1440 minute 100 year Winter I+40% | 135.559 | 134.058 | -0.692 | 0.000 | 0.02 | | | 26.0 |

| PN | US/MH Name | Status |
|---|---|---|
| 7.005 | S06-C1-35 | SURCHARGED |
| 7.006 | S06-C1-36 | FLOOD |
| 8.000 | S06-C1-37 | OK |
| 8.001 | S06-C1-38 | FLOOD RISK |
| 8.002 | S06-C1-39 | FLOOD |
| 8.003 | S06-C1-40 | SURCHARGED |
| 8.004 | S06-C1-41 | SURCHARGED |
| 8.005 | S06-C1-42 | FLOOD |
| 7.007 | S06-C1-43 | FLOOD RISK |
| 7.008 | S06-C1-44 | FLOOD RISK |
| 3.005 | S06-C1-45 | FLOOD RISK |
| 3.006 | S06-C1-46 | SURCHARGED |
| 3.007 | S06-C1-47 | SURCHARGED |
| 3.008 | S06-C1-48 | SURCHARGED |
| 3.009 | S06-C1-49 | SURCHARGED |
| 3.010 | S06-C1-50 | SURCHARGED |
| 3.011 | S06-C1-51 | SURCHARGED |
| 9.000 | S06-C1-52 | OK |
| 10.000 | S06-C1-53 | FLOOD |
| 10.001 | S06-C1-54 | SURCHARGED |
| 9.001 | S06-C1-55 | OK |
| 1.010 | S06-C1-56 | SURCHARGED |
| 1.011 | S06-C1-57 | OK |
| 1.012 | S06-C1-58 | SURCHARGED |
| 1.013 | S06-C1-59 | SURCHARGED |
| 1.014 | S06-C1-60 | OK |
| 1.015 | S06-C1-61 | SURCHARGED |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 1 - Ch 40420

| PN | US/MH Name | Status |
|---|---|---|
| 1.016 | S06-C1-62 | OK |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for Catchment 2 - Ch 40470

Pipe Sizes Min 150 Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 20.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

## Network Design Table for Catchment 2 - Ch 40470

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 46.897 | 0.465 | 100.9 | 0.067 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔒 |
| 1.001 | 10.376 | 0.062 | 168.2 | 0.062 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 1.002 | 70.220 | 0.932 | 75.4 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 1.003 | 85.101 | 1.308 | 65.1 | 0.093 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 1.004 | 67.828 | 1.036 | 65.5 | 0.111 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 1.005 | 10.372 | 0.043 | 241.6 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 1.006 | 88.981 | 1.530 | 58.2 | 0.088 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 1.007 | 85.141 | 1.311 | 64.9 | 0.117 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 1.008 | 75.745 | 1.192 | 63.5 | 0.111 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 1.009 | 53.522 | 0.766 | 69.9 | 0.105 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 1.010 | 22.900 | 0.590 | 38.8 | 0.084 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 1.011 | 8.283 | 0.276 | 30.0 | 0.083 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 2.000 | 70.579 | 0.699 | 100.9 | 0.068 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔒 |
| 2.001 | 64.631 | 0.941 | 68.6 | 0.075 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 2.002 | 59.996 | 0.647 | 92.8 | 0.088 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 2.003 | 16.078 | 0.066 | 241.9 | 0.081 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 2.004 | 38.621 | 0.737 | 52.4 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 73.99 | 5.78 | 157.860 | 0.067 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 13.4 |
| 1.001 | 73.12 | 5.95 | 157.320 | 0.128 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 25.4 |
| 1.002 | 69.47 | 6.73 | 157.259 | 0.128 | 0.0 | 0.0 | 0.0 | 1.51 | 60.0 | 25.4 |
| 1.003 | 65.86 | 7.60 | 156.327 | 0.221 | 0.0 | 0.0 | 0.0 | 1.62 | 64.6 | 39.5 |
| 1.004 | 63.29 | 8.30 | 155.019 | 0.332 | 0.0 | 0.0 | 0.0 | 1.62 | 64.4 | 56.9 |
| 1.005 | 62.70 | 8.47 | 153.908 | 0.332 | 0.0 | 0.0 | 0.0 | 1.01 | 71.2 | 56.9 |
| 1.006 | 60.35 | 9.19 | 153.865 | 0.420 | 0.0 | 0.0 | 0.0 | 2.07 | 146.0 | 68.7 |
| 1.007 | 58.19 | 9.92 | 152.335 | 0.537 | 0.0 | 0.0 | 0.0 | 1.95 | 138.1 | 84.7 |
| 1.008 | 56.43 | 10.56 | 151.024 | 0.648 | 0.0 | 0.0 | 0.0 | 1.98 | 139.6 | 99.1 |
| 1.009 | 55.21 | 11.03 | 149.832 | 0.753 | 0.0 | 0.0 | 0.0 | 1.88 | 133.1 | 112.6 |
| 1.010 | 54.84 | 11.18 | 149.066 | 0.837 | 0.0 | 0.0 | 0.0 | 2.53 | 179.0 | 124.4 |
| 1.011 | 54.72 | 11.23 | 148.476 | 0.921 | 0.0 | 0.0 | 0.0 | 2.88 | 203.6 | 136.4 |
| 2.000 | 72.03 | 6.18 | 151.441 | 0.068 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 13.3 |
| 2.001 | 68.91 | 6.86 | 150.667 | 0.144 | 0.0 | 0.0 | 0.0 | 1.58 | 62.8 | 26.8 |
| 2.002 | 65.90 | 7.59 | 149.725 | 0.231 | 0.0 | 0.0 | 0.0 | 1.36 | 54.0 | 41.3 |
| 2.003 | 64.89 | 7.86 | 149.004 | 0.312 | 0.0 | 0.0 | 0.0 | 1.01 | 71.1 | 54.9 |
| 2.004 | 63.81 | 8.16 | 148.937 | 0.312 | 0.0 | 0.0 | 0.0 | 2.18 | 153.9 | 54.9 |

## Network Design Table for Catchment 2 - Ch 40470

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.000 | 76.457 | 0.760 | 100.6 | 0.127 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 3.001 | 68.152 | 1.017 | 67.0 | 0.125 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 3.002 | 61.331 | 0.528 | 116.2 | 0.097 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 4.000 | 49.246 | 0.735 | 67.0 | 0.129 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 4.001 | 36.313 | 0.512 | 70.9 | 0.098 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 4.002 | 63.781 | 1.000 | 63.8 | 0.052 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 4.003 | 78.579 | 1.122 | 70.0 | 0.074 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 4.004 | 20.428 | 0.288 | 71.0 | 0.094 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 4.005 | 80.777 | 1.278 | 63.2 | 0.042 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 4.006 | 81.501 | 1.202 | 67.8 | 0.131 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 4.007 | 81.992 | 1.262 | 65.0 | 0.120 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 4.008 | 46.115 | 0.698 | 66.1 | 0.112 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 4.009 | 59.411 | 0.458 | 129.8 | 0.068 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔒 |
| 3.003 | 49.039 | 0.561 | 87.4 | 0.161 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |
| 1.012 | 41.909 | 1.961 | 21.4 | 0.058 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |
| 1.013 | 60.167 | 3.073 | 19.6 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |
| 1.014 | 100.455 | 7.729 | 13.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔒 |
| 1.015 | 17.894 | 0.036 | 500.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 675 | Pipe/Conduit | 🔒 |
| 1.016 | 124.365 | 0.897 | 138.7 | 0.000 | 0.00 | 0.0 | 0.600 | o | 675 | Pipe/Conduit | 🔒 |
| 1.017 | 46.958 | 0.117 | 401.4 | 0.000 | 0.00 | 0.0 | 0.600 | o | 675 | Pipe/Conduit | 🔓 |
| 1.018 | 63.896 | 0.098 | 655.1 | 0.000 | 0.00 | 0.0 | 0.600 | o | 675 | Pipe/Conduit | 🔓 |

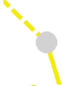
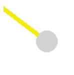
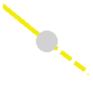
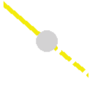
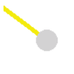
## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 3.000 | 73.00 | 5.98 | 151.141 | 0.127 | 0.0 | 0.0 | 0.0 | 1.30 | 51.8 | 25.1 |
| 3.001 | 69.66 | 6.69 | 150.381 | 0.252 | 0.0 | 0.0 | 0.0 | 1.60 | 63.6 | 47.5 |
| 3.002 | 66.70 | 7.39 | 149.289 | 0.349 | 0.0 | 0.0 | 0.0 | 1.46 | 103.0 | 63.0 |
| 4.000 | 75.41 | 5.51 | 157.391 | 0.129 | 0.0 | 0.0 | 0.0 | 1.60 | 63.6 | 26.4 |
| 4.001 | 73.38 | 5.90 | 156.655 | 0.227 | 0.0 | 0.0 | 0.0 | 1.55 | 61.8 | 45.1 |
| 4.002 | 70.28 | 6.55 | 156.143 | 0.279 | 0.0 | 0.0 | 0.0 | 1.64 | 65.2 | 53.1 |
| 4.003 | 67.28 | 7.25 | 155.068 | 0.353 | 0.0 | 0.0 | 0.0 | 1.88 | 133.0 | 64.3 |
| 4.004 | 66.55 | 7.43 | 153.946 | 0.446 | 0.0 | 0.0 | 0.0 | 1.87 | 132.0 | 80.5 |
| 4.005 | 63.98 | 8.11 | 153.658 | 0.489 | 0.0 | 0.0 | 0.0 | 1.98 | 140.0 | 84.7 |
| 4.006 | 61.54 | 8.82 | 152.380 | 0.620 | 0.0 | 0.0 | 0.0 | 1.91 | 135.1 | 103.3 |
| 4.007 | 59.35 | 9.52 | 151.179 | 0.739 | 0.0 | 0.0 | 0.0 | 1.95 | 138.1 | 118.9 |
| 4.008 | 58.19 | 9.91 | 149.917 | 0.852 | 0.0 | 0.0 | 0.0 | 1.94 | 136.9 | 134.3 |
| 4.009 | 56.48 | 10.54 | 149.144 | 0.919 | 0.0 | 0.0 | 0.0 | 1.59 | 175.5 | 140.6 |
| 3.003 | 55.51 | 10.91 | 148.611 | 1.429 | 0.0 | 0.0 | 0.0 | 2.18 | 346.1 | 214.9 |
| 1.012 | 54.34 | 11.39 | 148.050 | 2.721 | 0.0 | 0.0 | 0.0 | 4.41 | 701.9 | 400.4 |
| 1.013 | 53.82 | 11.60 | 146.089 | 2.721 | 0.0 | 0.0 | 0.0 | 4.61 | 733.4 | 400.4 |
| 1.014 | 53.13 | 11.90 | 143.016 | 2.721 | 0.0 | 0.0 | 0.0 | 5.66 | 900.6 | 400.4 |
| 1.015 | 52.56 | 12.16 | 135.062 | 2.721 | 0.0 | 0.0 | 0.0 | 1.17 | 417.0 | 400.4 |
| 1.016 | 50.58 | 13.09 | 135.027 | 2.721 | 0.0 | 0.0 | 0.0 | 2.22 | 795.7 | 400.4 |
| 1.017 | 74.94 | 5.60 | 134.130 | 0.000 | 149.6 | 0.0 | 0.0 | 1.30 | 465.9 | 149.6 |
| 1.018 | 69.83 | 6.65 | 134.013 | 0.000 | 149.6 | 0.0 | 0.0 | 1.02 | 363.7 | 149.6 |

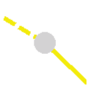
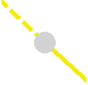
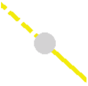
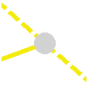
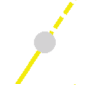
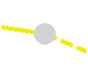
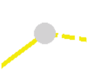
## Manhole Schedules for Catchment 2 - Ch 40470

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C2-1 | 159.210 | 1.350 | Open Manhole | 1200 | 1.000 | 157.860 | 150 | | | | |
| S06-C2-2 | 158.881 | 1.561 | Open Manhole | 1200 | 1.001 | 157.320 | 225 | 1.000 | 157.395 | 150 | |
| S06-C2-3 | 158.816 | 1.558 | Open Manhole | 1200 | 1.002 | 157.259 | 225 | 1.001 | 157.259 | 225 | |
| S06-C2-4 | 157.752 | 1.425 | Open Manhole | 1200 | 1.003 | 156.327 | 225 | 1.002 | 156.327 | 225 | |
| S06-C2-5 | 156.444 | 1.425 | Open Manhole | 1200 | 1.004 | 155.019 | 225 | 1.003 | 155.019 | 225 | |
| S06-C2-6 | 155.408 | 1.500 | Open Manhole | 1200 | 1.005 | 153.908 | 300 | 1.004 | 153.983 | 225 | |
| S06-C2-7 | 155.451 | 1.587 | Open Manhole | 1200 | 1.006 | 153.865 | 300 | 1.005 | 153.865 | 300 | |
| S06-C2-8 | 153.835 | 1.500 | Open Manhole | 1200 | 1.007 | 152.335 | 300 | 1.006 | 152.335 | 300 | |
| S06-C2-9 | 152.524 | 1.500 | Open Manhole | 1200 | 1.008 | 151.024 | 300 | 1.007 | 151.024 | 300 | |
| S06-C2-10 | 151.332 | 1.500 | Open Manhole | 1200 | 1.009 | 149.832 | 300 | 1.008 | 149.832 | 300 | |
| S06-C2-11 | 150.566 | 1.500 | Open Manhole | 1200 | 1.010 | 149.066 | 300 | 1.009 | 149.066 | 300 | |
| S06-C2-12 | 149.976 | 1.500 | Open Manhole | 1200 | 1.011 | 148.476 | 300 | 1.010 | 148.476 | 300 | |
| S06-C2-13 | 152.791 | 1.350 | Open Manhole | 1200 | 2.000 | 151.441 | 150 | | | | |
| S06-C2-14 | 152.108 | 1.441 | Open Manhole | 1200 | 2.001 | 150.667 | 225 | 2.000 | 150.742 | 150 | |
| S06-C2-15 | 151.150 | 1.425 | Open Manhole | 1200 | 2.002 | 149.725 | 225 | 2.001 | 149.725 | 225 | |
| S06-C2-16 | 150.504 | 1.500 | Open Manhole | 1200 | 2.003 | 149.004 | 300 | 2.002 | 149.079 | 225 | |
| S06-C2-17 | 150.558 | 1.621 | Open Manhole | 1200 | 2.004 | 148.937 | 300 | 2.003 | 148.937 | 300 | |
| S06-C2-18 | 152.566 | 1.425 | Open Manhole | 1200 | 3.000 | 151.141 | 225 | | | | |
| S06-C2-19 | 151.806 | 1.425 | Open Manhole | 1200 | 3.001 | 150.381 | 225 | 3.000 | 150.381 | 225 | |
| S06-C2-20 | 150.789 | 1.500 | Open Manhole | 1200 | 3.002 | 149.289 | 300 | 3.001 | 149.364 | 225 | |
| S06-C2-21 | 158.816 | 1.425 | Open Manhole | 1200 | 4.000 | 157.391 | 225 | | | | |
| S06-C2-22 | 158.080 | 1.425 | Open Manhole | 1200 | 4.001 | 156.655 | 225 | 4.000 | 156.655 | 225 | |
| S06-C2-23 | 157.568 | 1.425 | Open Manhole | 1200 | 4.002 | 156.143 | 225 | 4.001 | 156.143 | 225 | |
| S06-C2-24 | 156.568 | 1.500 | Open Manhole | 1200 | 4.003 | 155.068 | 300 | 4.002 | 155.143 | 225 | |
| S06-C2-25 | 155.446 | 1.500 | Open Manhole | 1200 | 4.004 | 153.946 | 300 | 4.003 | 153.946 | 300 | |
| S06-C2-26 | 155.158 | 1.500 | Open Manhole | 1200 | 4.005 | 153.658 | 300 | 4.004 | 153.658 | 300 | |
| S06-C2-27 | 153.880 | 1.500 | Open Manhole | 1200 | 4.006 | 152.380 | 300 | 4.005 | 152.380 | 300 | |
| S06-C2-28 | 152.679 | 1.500 | Open Manhole | 1200 | 4.007 | 151.179 | 300 | 4.006 | 151.179 | 300 | |
| S06-C2-29 | 151.417 | 1.500 | Open Manhole | 1200 | 4.008 | 149.917 | 300 | 4.007 | 149.917 | 300 | |
| S06-C2-30 | 150.719 | 1.575 | Open Manhole | 1350 | 4.009 | 149.144 | 375 | 4.008 | 149.219 | 300 | |
| S06-C2-31 | 150.261 | 1.650 | Open Manhole | 1350 | 3.003 | 148.611 | 450 | 3.002 | 148.761 | 300 | |
| | | | | | | | | 4.009 | 148.686 | 375 | |
| S06-C2-32 | 149.700 | 1.650 | Open Manhole | 1350 | 1.012 | 148.050 | 450 | 1.011 | 148.200 | 300 | |
| | | | | | | | | 2.004 | 148.200 | 300 | |
| | | | | | | | | 3.003 | 148.050 | 450 | |
| S06-C2-33 | 147.739 | 1.650 | Open Manhole | 1350 | 1.013 | 146.089 | 450 | 1.012 | 146.089 | 450 | |
| S06-C2-34 | 144.666 | 1.650 | Open Manhole | 1350 | 1.014 | 143.016 | 450 | 1.013 | 143.016 | 450 | |
| S06-C2-35 | 136.900 | 1.838 | Open Manhole | 1500 | 1.015 | 135.062 | 675 | 1.014 | 135.287 | 450 | |
| S06-C2-36 | 136.900 | 1.873 | Open Manhole | 1500 | 1.016 | 135.027 | 675 | 1.015 | 135.027 | 675 | |
| S06-C2-37 | 135.757 | 1.627 | Open Manhole | 1500 | 1.017 | 134.130 | 675 | 1.016 | 134.130 | 675 | |
| S06-C2-38 | 135.757 | 1.744 | Open Manhole | 1500 | 1.018 | 134.013 | 675 | 1.017 | 134.013 | 675 | |
| Outfall 2 | 134.800 | 0.885 | Open Manhole | 0 | | OUTFALL | | 1.018 | 133.915 | 675 | |

## Manhole Schedules for Catchment 2 - Ch 40470

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C2-1 | 371694.666 | 518282.303 | 371694.666 | 518282.303 | Required |  |
| S06-C2-2 | 371725.095 | 518246.618 | 371725.095 | 518246.618 | Required |  |
| S06-C2-3 | 371733.185 | 518253.115 | 371733.185 | 518253.115 | Required |  |
| S06-C2-4 | 371779.441 | 518200.284 | 371779.441 | 518200.284 | Required |  |
| S06-C2-5 | 371838.805 | 518139.308 | 371838.805 | 518139.308 | Required |  |
| S06-C2-6 | 371888.491 | 518093.135 | 371888.491 | 518093.135 | Required |  |
| S06-C2-7 | 371881.149 | 518085.808 | 371881.149 | 518085.808 | Required |  |
| S06-C2-8 | 371947.598 | 518026.630 | 371947.598 | 518026.630 | Required |  |
| S06-C2-9 | 372011.321 | 517970.163 | 372011.321 | 517970.163 | Required |  |
| S06-C2-10 | 372066.641 | 517918.424 | 372066.641 | 517918.424 | Required |  |
| S06-C2-11 | 372105.456 | 517881.573 | 372105.456 | 517881.573 | Required |  |
| S06-C2-12 | 372112.173 | 517859.681 | 372112.173 | 517859.681 | Required |  |
| S06-C2-13 | 372311.599 | 517730.531 | 372311.599 | 517730.531 | Required |  |
| S06-C2-14 | 372255.231 | 517773.006 | 372255.231 | 517773.006 | Required |  |
| S06-C2-15 | 372204.979 | 517813.649 | 372204.979 | 517813.649 | Required |  |
| S06-C2-16 | 372159.474 | 517852.749 | 372159.474 | 517852.749 | Required |  |
| S06-C2-17 | 372150.173 | 517839.634 | 372150.173 | 517839.634 | Required |  |
| S06-C2-18 | 372319.694 | 517739.124 | 372319.694 | 517739.124 | Required |  |
| S06-C2-19 | 372258.730 | 517785.267 | 372258.730 | 517785.267 | Required |  |
| S06-C2-20 | 372205.871 | 517828.286 | 372205.871 | 517828.286 | Required |  |

## Manhole Schedules for Catchment 2 - Ch 40470

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C2-21 | 371729.372 | 518281.762 | 371729.372 | 518281.762 | Required |  |
| S06-C2-22 | 371761.297 | 518244.266 | 371761.297 | 518244.266 | Required |  |
| S06-C2-23 | 371782.399 | 518214.713 | 371782.399 | 518214.713 | Required |  |
| S06-C2-24 | 371826.190 | 518168.341 | 371826.190 | 518168.341 | Required |  |
| S06-C2-25 | 371882.925 | 518113.974 | 371882.925 | 518113.974 | Required |  |
| S06-C2-26 | 371900.361 | 518103.330 | 371900.361 | 518103.330 | Required |  |
| S06-C2-27 | 371958.892 | 518047.660 | 371958.892 | 518047.660 | Required |  |
| S06-C2-28 | 372019.190 | 517992.828 | 372019.190 | 517992.828 | Required |  |
| S06-C2-29 | 372080.484 | 517938.369 | 372080.484 | 517938.369 | Required |  |
| S06-C2-30 | 372114.995 | 517907.782 | 372114.995 | 517907.782 | Required |  |
| S06-C2-31 | 372159.458 | 517868.377 | 372159.458 | 517868.377 | Required |  |
| S06-C2-32 | 372113.418 | 517851.491 | 372113.418 | 517851.491 | Required |  |
| S06-C2-33 | 372089.694 | 517816.943 | 372089.694 | 517816.943 | Required |  |
| S06-C2-34 | 372056.675 | 517766.646 | 372056.675 | 517766.646 | Required |  |
| S06-C2-35 | 372007.080 | 517679.288 | 372007.080 | 517679.288 | Required |  |
| S06-C2-36 | 371992.138 | 517669.443 | 371992.138 | 517669.443 | Required |  |
| S06-C2-37 | 371877.819 | 517718.411 | 371877.819 | 517718.411 | Required |  |
| S06-C2-38 | 371831.424 | 517725.655 | 371831.424 | 517725.655 | Required |  |
| Outfall 2 | 371780.486 | 517687.080 |  |  | No Entry |  |

## Area Summary for Catchment 2 - Ch 40470

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | As Zoned | Default | 100 | 0.058 | 0.058 | 0.058 |
| | | Verge | 50 | 0.014 | 0.007 | 0.065 |
| | | Slopes | 25 | 0.004 | 0.001 | 0.067 |
| 1.001 | As Zoned | Default | 100 | 0.054 | 0.054 | 0.054 |
| | | Verge | 50 | 0.014 | 0.007 | 0.061 |
| | | Slopes | 25 | 0.002 | 0.001 | 0.062 |
| 1.002 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.003 | As Zoned | Default | 100 | 0.082 | 0.082 | 0.082 |
| | | Verge | 50 | 0.022 | 0.011 | 0.093 |
| | | Slopes | 25 | 0.001 | 0.000 | 0.093 |
| 1.004 | As Zoned | Default | 100 | 0.099 | 0.099 | 0.099 |
| | | Verge | 50 | 0.023 | 0.011 | 0.110 |
| | | Slopes | 25 | 0.000 | 0.000 | 0.111 |
| 1.005 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.006 | As Zoned | Default | 100 | 0.079 | 0.079 | 0.079 |
| | | Verge | 50 | 0.019 | 0.010 | 0.088 |
| 1.007 | As Zoned | Default | 100 | 0.104 | 0.104 | 0.104 |
| | | Verge | 50 | 0.026 | 0.013 | 0.117 |
| | | Slopes | 25 | 0.000 | 0.000 | 0.117 |
| 1.008 | As Zoned | Default | 100 | 0.098 | 0.098 | 0.098 |
| | | Verge | 50 | 0.025 | 0.012 | 0.110 |
| | | Slopes | 25 | 0.000 | 0.000 | 0.111 |
| 1.009 | As Zoned | Default | 100 | 0.094 | 0.094 | 0.094 |
| | | Verge | 50 | 0.022 | 0.011 | 0.105 |
| | | Slopes | 25 | 0.001 | 0.000 | 0.105 |
| 1.010 | As Zoned | Default | 100 | 0.077 | 0.077 | 0.077 |
| | | Verge | 50 | 0.015 | 0.007 | 0.084 |
| | | Slopes | 25 | 0.001 | 0.000 | 0.084 |
| 1.011 | As Zoned | Default | 100 | 0.083 | 0.083 | 0.083 |
| 2.000 | As Zoned | Default | 100 | 0.068 | 0.068 | 0.068 |
| 2.001 | As Zoned | Default | 100 | 0.075 | 0.075 | 0.075 |
| | | Verge | 50 | 0.000 | 0.000 | 0.075 |
| 2.002 | As Zoned | Default | 100 | 0.087 | 0.087 | 0.087 |
| | | Verge | 50 | 0.000 | 0.000 | 0.088 |
| 2.003 | As Zoned | Default | 100 | 0.081 | 0.081 | 0.081 |
| | | Verge | 50 | 0.000 | 0.000 | 0.081 |
| 2.004 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 3.000 | As Zoned | Default | 100 | 0.074 | 0.074 | 0.074 |
| | | Verge | 50 | 0.018 | 0.009 | 0.083 |
| | | Slopes | 25 | 0.172 | 0.043 | 0.127 |
| 3.001 | As Zoned | Default | 100 | 0.088 | 0.088 | 0.088 |
| | | Verge | 50 | 0.022 | 0.011 | 0.099 |
| | | Slopes | 25 | 0.105 | 0.026 | 0.125 |
| 3.002 | As Zoned | Default | 100 | 0.080 | 0.080 | 0.080 |
| | | Verge | 50 | 0.020 | 0.010 | 0.090 |
| | | Slopes | 25 | 0.027 | 0.007 | 0.097 |
| 4.000 | As Zoned | Default | 100 | 0.100 | 0.100 | 0.100 |
| | | Verge | 50 | 0.020 | 0.010 | 0.110 |
| | | Slopes | 25 | 0.078 | 0.020 | 0.129 |
| 4.001 | As Zoned | Default | 100 | 0.080 | 0.080 | 0.080 |
| | | Verge | 50 | 0.015 | 0.007 | 0.088 |
| | | Slopes | 25 | 0.039 | 0.010 | 0.098 |
| 4.002 | As Zoned | Default | 100 | 0.050 | 0.050 | 0.050 |
| | | Verge | 50 | 0.003 | 0.002 | 0.052 |
| | | Slopes | 25 | 0.003 | 0.001 | 0.052 |
| 4.003 | As Zoned | Default | 100 | 0.073 | 0.073 | 0.073 |
| | | Verge | 50 | 0.001 | 0.001 | 0.074 |
| 4.004 | As Zoned | Default | 100 | 0.092 | 0.092 | 0.092 |
| | | Verge | 50 | 0.003 | 0.001 | 0.094 |
| 4.005 | As Zoned | Default | 100 | 0.042 | 0.042 | 0.042 |
| | | Verge | 50 | 0.000 | 0.000 | 0.042 |
| | | Slopes | 25 | 0.000 | 0.000 | 0.042 |
| 4.006 | As Zoned | Default | 100 | 0.114 | 0.114 | 0.114 |
| | | Verge | 50 | 0.023 | 0.012 | 0.126 |
| | | Slopes | 25 | 0.020 | 0.005 | 0.131 |

## Area Summary for Catchment 2 - Ch 40470

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 4.007 | As Zoned | Default | 100 | 0.103 | 0.103 | 0.103 |
| | | Verge | 50 | 0.024 | 0.012 | 0.114 |
| | | Slopes | 25 | 0.020 | 0.005 | 0.120 |
| 4.008 | As Zoned | Default | 100 | 0.096 | 0.096 | 0.096 |
| | | Verge | 50 | 0.024 | 0.012 | 0.108 |
| | | Slopes | 25 | 0.019 | 0.005 | 0.112 |
| 4.009 | As Zoned | Default | 100 | 0.058 | 0.058 | 0.058 |
| | | Verge | 50 | 0.014 | 0.007 | 0.065 |
| | | Slopes | 25 | 0.011 | 0.003 | 0.068 |
| 3.003 | As Zoned | Default | 100 | 0.072 | 0.072 | 0.072 |
| | | Verge | 50 | 0.018 | 0.009 | 0.081 |
| | | Slopes | 25 | 0.006 | 0.002 | 0.083 |
| | As Zoned | Default | 100 | 0.069 | 0.069 | 0.151 |
| | | Verge | 50 | 0.017 | 0.009 | 0.160 |
| | | Slopes | 25 | 0.005 | 0.001 | 0.161 |
| 1.012 | As Zoned | Default | 100 | 0.058 | 0.058 | 0.058 |
| | | Verge | 50 | 0.000 | 0.000 | 0.058 |
| 1.013 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.014 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.015 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.016 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.017 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.018 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total<br>3.305 | Total<br>2.721 | Total<br>2.721 |

## Online Controls for Catchment 2 - Ch 40470

### Hydro-Brake® Optimum Manhole: S06-C2-37, DS/PN: 1.017, Volume (m³): 46.8

| | |
|---|---|
| Unit Reference | MD-SHE-0463-1496-1280-1496 |
| Design Head (m) | 1.280 |
| Design Flow (l/s) | 149.6 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 463 |
| Invert Level (m) | 134.130 |
| Minimum Outlet Pipe Diameter (mm) | 500 |
| Suggested Manhole Diameter (mm) | Site Specific Design (Contact Hydro International) |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.280 | 149.6 | Kick-Flo® | 1.055 | 136.1 |
| Flush-Flo™ | 0.659 | 149.3 | Mean Flow over Head Range | - | 115.9 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 12.0 | 0.800 | 147.7 | 2.000 | 186.0 | 4.000 | 261.1 | 7.000 | 343.7 |
| 0.200 | 43.9 | 1.000 | 139.9 | 2.200 | 194.8 | 4.500 | 276.6 | 7.500 | 355.6 |
| 0.300 | 87.7 | 1.200 | 145.0 | 2.400 | 203.3 | 5.000 | 291.3 | 8.000 | 367.0 |
| 0.400 | 132.6 | 1.400 | 156.3 | 2.600 | 211.4 | 5.500 | 305.3 | 8.500 | 378.2 |
| 0.500 | 146.6 | 1.600 | 166.8 | 3.000 | 226.8 | 6.000 | 318.6 | 9.000 | 389.0 |
| 0.600 | 149.0 | 1.800 | 176.7 | 3.500 | 244.6 | 6.500 | 331.4 | 9.500 | 399.4 |

## Offline Controls for Catchment 2 - Ch 40470

### Weir Manhole: S06-C2-37, DS/PN: 1.017, Loop to PN: None

Discharge Coef 0.544 Width (m) 10.000 Invert Level (m) 135.372

## Storage Structures for Catchment 2 - Ch 40470

### Tank or Pond Manhole: S06-C2-37, DS/PN: 1.017

Invert Level (m) 134.130

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|---|---|---|---|
| 0.000 | 683.4 | 1.000 | 1051.4 | 1.280 | 1774.0 | 1.467 | 1944.4 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 2 - Ch 40470

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| **PN** | **US/MH Name** | **Event** | **US/CL (m)** | **Water Level (m)** | **Surcharged Depth (m)** | **Flooded Volume (m³)** | **Flow / Cap.** | **Overflow (l/s)** | **Overflow Vol (m³)** | **Pipe Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C2-1 | 15 minute 5 year Winter I+20% | 159.210 | 157.980 | -0.030 | 0.000 | 0.96 | | | 16.4 |
| 1.001 | S06-C2-2 | 15 minute 5 year Winter I+20% | 158.881 | 157.486 | -0.059 | 0.000 | 0.88 | | | 29.6 |
| 1.002 | S06-C2-3 | 15 minute 5 year Winter I+20% | 158.816 | 157.372 | -0.112 | 0.000 | 0.50 | | | 28.8 |
| 1.003 | S06-C2-4 | 15 minute 5 year Winter I+20% | 157.752 | 156.475 | -0.077 | 0.000 | 0.74 | | | 46.5 |
| 1.004 | S06-C2-5 | 15 minute 5 year Winter I+20% | 156.444 | 155.347 | 0.104 | 0.000 | 1.03 | | | 64.2 |
| 1.005 | S06-C2-6 | 15 minute 5 year Winter I+20% | 155.408 | 154.236 | 0.028 | 0.000 | 1.15 | | | 64.4 |
| 1.006 | S06-C2-7 | 15 minute 5 year Winter I+20% | 155.451 | 154.027 | -0.137 | 0.000 | 0.56 | | | 78.5 |
| 1.007 | S06-C2-8 | 15 minute 5 year Winter I+20% | 153.835 | 152.530 | -0.105 | 0.000 | 0.73 | | | 97.4 |
| 1.008 | S06-C2-9 | 15 minute 5 year Winter I+20% | 152.524 | 151.241 | -0.083 | 0.000 | 0.86 | | | 115.0 |
| 1.009 | S06-C2-10 | 15 minute 5 year Winter I+20% | 151.332 | 150.173 | 0.041 | 0.000 | 1.03 | | | 129.8 |
| 1.010 | S06-C2-11 | 15 minute 5 year Winter I+20% | 150.566 | 149.337 | -0.029 | 0.000 | 0.90 | | | 141.8 |
| 1.011 | S06-C2-12 | 15 minute 5 year Winter I+20% | 149.976 | 148.864 | 0.088 | 0.000 | 1.17 | | | 153.6 |
| 2.000 | S06-C2-13 | 15 minute 5 year Winter I+20% | 152.791 | 151.568 | -0.024 | 0.000 | 0.94 | | | 16.4 |
| 2.001 | S06-C2-14 | 15 minute 5 year Winter I+20% | 152.108 | 150.784 | -0.108 | 0.000 | 0.52 | | | 31.5 |
| 2.002 | S06-C2-15 | 15 minute 5 year Winter I+20% | 151.150 | 149.901 | -0.049 | 0.000 | 0.94 | | | 48.9 |
| 2.003 | S06-C2-16 | 15 minute 5 year Winter I+20% | 150.504 | 149.306 | 0.002 | 0.000 | 1.06 | | | 63.7 |
| 2.004 | S06-C2-17 | 15 minute 5 year Winter I+20% | 150.558 | 149.078 | -0.159 | 0.000 | 0.44 | | | 63.1 |
| 3.000 | S06-C2-18 | 15 minute 5 year Winter I+20% | 152.566 | 151.273 | -0.093 | 0.000 | 0.61 | | | 30.9 |
| 3.001 | S06-C2-19 | 15 minute 5 year Winter I+20% | 151.806 | 150.552 | -0.054 | 0.000 | 0.90 | | | 55.6 |
| 3.002 | S06-C2-20 | 15 minute 5 year Winter I+20% | 150.789 | 149.489 | -0.100 | 0.000 | 0.76 | | | 74.6 |
| 4.000 | S06-C2-21 | 15 minute 5 year Winter I+20% | 158.816 | 157.509 | -0.107 | 0.000 | 0.53 | | | 32.0 |
| 4.001 | S06-C2-22 | 15 minute 5 year Winter I+20% | 158.080 | 156.825 | -0.055 | 0.000 | 0.91 | | | 53.0 |
| 4.002 | S06-C2-23 | 15 minute 5 year Winter I+20% | 157.568 | 156.344 | -0.024 | 0.000 | 0.99 | | | 62.6 |
| 4.003 | S06-C2-24 | 15 minute 5 year Winter I+20% | 156.568 | 155.237 | -0.131 | 0.000 | 0.59 | | | 76.1 |
| 4.004 | S06-C2-25 | 15 minute 5 year Winter I+20% | 155.446 | 154.154 | -0.092 | 0.000 | 0.81 | | | 93.9 |
| 4.005 | S06-C2-26 | 15 minute 5 year Winter I+20% | 155.158 | 153.855 | -0.104 | 0.000 | 0.75 | | | 100.6 |
| 4.006 | S06-C2-27 | 15 minute 5 year Winter I+20% | 153.880 | 152.656 | -0.025 | 0.000 | 0.93 | | | 120.8 |
| 4.007 | S06-C2-28 | 15 minute 5 year Winter I+20% | 152.679 | 151.692 | 0.213 | 0.000 | 1.00 | | | 132.9 |
| 4.008 | S06-C2-29 | 15 minute 5 year Winter I+20% | 151.417 | 150.423 | 0.206 | 0.000 | 1.14 | | | 146.9 |
| 4.009 | S06-C2-30 | 15 minute 5 year Winter I+20% | 150.719 | 149.433 | -0.086 | 0.000 | 0.94 | | | 155.0 |
| 3.003 | S06-C2-31 | 15 minute 5 year Winter I+20% | 150.261 | 148.915 | -0.146 | 0.000 | 0.79 | | | 247.6 |
| 1.012 | S06-C2-32 | 15 minute 5 year Winter I+20% | 149.700 | 148.344 | -0.156 | 0.000 | 0.76 | | | 473.5 |
| 1.013 | S06-C2-33 | 15 minute 5 year Winter I+20% | 147.739 | 146.367 | -0.172 | 0.000 | 0.70 | | | 472.6 |
| 1.014 | S06-C2-34 | 15 minute 5 year Winter I+20% | 144.666 | 143.255 | -0.211 | 0.000 | 0.55 | | | 472.6 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 2 - Ch 40470

| PN | US/MH Name | Status |
|---|---|---|
| 1.000 | S06-C2-1 | OK |
| 1.001 | S06-C2-2 | OK |
| 1.002 | S06-C2-3 | OK |
| 1.003 | S06-C2-4 | OK |
| 1.004 | S06-C2-5 | SURCHARGED |
| 1.005 | S06-C2-6 | SURCHARGED |
| 1.006 | S06-C2-7 | OK |
| 1.007 | S06-C2-8 | OK |
| 1.008 | S06-C2-9 | OK |
| 1.009 | S06-C2-10 | SURCHARGED |
| 1.010 | S06-C2-11 | OK |
| 1.011 | S06-C2-12 | SURCHARGED |
| 2.000 | S06-C2-13 | OK |
| 2.001 | S06-C2-14 | OK |
| 2.002 | S06-C2-15 | OK |
| 2.003 | S06-C2-16 | SURCHARGED |
| 2.004 | S06-C2-17 | OK |
| 3.000 | S06-C2-18 | OK |
| 3.001 | S06-C2-19 | OK |
| 3.002 | S06-C2-20 | OK |
| 4.000 | S06-C2-21 | OK |
| 4.001 | S06-C2-22 | OK |
| 4.002 | S06-C2-23 | OK |
| 4.003 | S06-C2-24 | OK |
| 4.004 | S06-C2-25 | OK |
| 4.005 | S06-C2-26 | OK |
| 4.006 | S06-C2-27 | OK |
| 4.007 | S06-C2-28 | SURCHARGED |
| 4.008 | S06-C2-29 | SURCHARGED |
| 4.009 | S06-C2-30 | OK |
| 3.003 | S06-C2-31 | OK |
| 1.012 | S06-C2-32 | OK |
| 1.013 | S06-C2-33 | OK |
| 1.014 | S06-C2-34 | OK |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 2 - Ch 40470

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Overflow Vol (m³) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.015 | S06-C2-35 | 15 minute 5 year Winter I+20% | 136.900 | 135.809 | 0.072 | 0.000 | 1.88 | | | 470.6 |
| 1.016 | S06-C2-36 | 15 minute 5 year Winter I+20% | 136.900 | 135.417 | -0.285 | 0.000 | 0.62 | | | 464.6 |
| 1.017 | S06-C2-37 | 120 minute 5 year Winter I+20% | 135.757 | 134.632 | -0.173 | 0.000 | 0.27 | 0.0 | 0.000 | 108.7 |
| 1.018 | S06-C2-38 | 120 minute 5 year Winter I+20% | 135.757 | 134.283 | -0.405 | 0.000 | 0.34 | | | 108.5 |

| PN | US/MH Name | Status |
|---|---|---|
| 1.015 | S06-C2-35 | SURCHARGED |
| 1.016 | S06-C2-36 | OK |
| 1.017 | S06-C2-37 | OK |
| 1.018 | S06-C2-38 | OK |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 2 - Ch 40470

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 0.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | | | |
|---|---|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Offline Controls | 1 | Number of Time/Area Diagrams | 0 |
| Number of Online Controls | 1 | Number of Storage Structures | 1 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | | | |
|---|---|---|---|---|---|
| Rainfall Model | | FSR M5-60 (mm) | 20.000 | Cv (Summer) | 0.750 |
| Region | England and Wales | Ratio R | 0.300 | Cv (Winter) | 0.840 |

| | |
|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 |
| Analysis Timestep | 2.5 Second Increment (Extended) |
| DTS Status | OFF |
| DVD Status | ON |
| Inertia Status | ON |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 240, 360, 480, 960, 1440 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Overflow Vol (m³) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C2-1 | 15 minute 100 year Winter I+40% | 159.210 | 159.212 | 1.202 | 1.964 | 1.47 | | | 25.3 |
| 1.001 | S06-C2-2 | 15 minute 100 year Winter I+40% | 158.881 | 158.618 | 1.073 | 0.000 | 1.54 | | | 51.6 |
| 1.002 | S06-C2-3 | 15 minute 100 year Winter I+40% | 158.816 | 158.471 | 0.987 | 0.000 | 0.83 | | | 48.2 |
| 1.003 | S06-C2-4 | 15 minute 100 year Winter I+40% | 157.752 | 157.757 | 1.205 | 4.895 | 1.00 | | | 62.9 |
| 1.004 | S06-C2-5 | 30 minute 100 year Winter I+40% | 156.444 | 156.452 | 1.208 | 8.496 | 1.43 | | | 89.0 |
| 1.005 | S06-C2-6 | 15 minute 100 year Winter I+40% | 155.408 | 154.941 | 0.734 | 0.000 | 1.70 | | | 95.1 |
| 1.006 | S06-C2-7 | 15 minute 100 year Winter I+40% | 155.451 | 154.851 | 0.686 | 0.000 | 0.79 | | | 111.3 |
| 1.007 | S06-C2-8 | 30 minute 100 year Winter I+40% | 153.835 | 153.840 | 1.205 | 4.806 | 1.00 | | | 132.9 |
| 1.008 | S06-C2-9 | 30 minute 100 year Winter I+40% | 152.524 | 152.540 | 1.216 | 16.322 | 1.19 | | | 159.3 |
| 1.009 | S06-C2-10 | 30 minute 100 year Winter I+40% | 151.332 | 151.340 | 1.208 | 7.653 | 1.38 | | | 174.0 |
| 1.010 | S06-C2-11 | 15 minute 100 year Winter I+40% | 150.566 | 150.435 | 1.068 | 0.000 | 1.19 | | | 187.8 |
| 1.011 | S06-C2-12 | 15 minute 100 year Winter I+40% | 149.976 | 149.628 | 0.852 | 0.000 | 1.75 | | | 229.8 |
| 2.000 | S06-C2-13 | 15 minute 100 year Winter I+40% | 152.791 | 152.794 | 1.203 | 2.710 | 1.52 | | | 26.4 |
| 2.001 | S06-C2-14 | 15 minute 100 year Winter I+40% | 152.108 | 152.046 | 1.154 | 0.000 | 0.92 | | | 56.0 |
| 2.002 | S06-C2-15 | 15 minute 100 year Winter I+40% | 151.150 | 151.152 | 1.202 | 1.979 | 1.58 | | | 82.3 |
| 2.003 | S06-C2-16 | 15 minute 100 year Winter I+40% | 150.504 | 149.599 | 0.296 | 0.000 | 2.04 | | | 122.9 |
| 2.004 | S06-C2-17 | 15 minute 100 year Winter I+40% | 150.558 | 149.386 | 0.149 | 0.000 | 0.80 | | | 114.6 |
| 3.000 | S06-C2-18 | 15 minute 100 year Winter I+40% | 152.566 | 152.568 | 1.203 | 2.714 | 1.00 | | | 50.2 |
| 3.001 | S06-C2-19 | 15 minute 100 year Winter I+40% | 151.806 | 151.813 | 1.207 | 6.785 | 1.40 | | | 86.5 |
| 3.002 | S06-C2-20 | 15 minute 100 year Winter I+40% | 150.789 | 150.371 | 0.782 | 0.000 | 1.23 | | | 120.2 |
| 4.000 | S06-C2-21 | 15 minute 100 year Winter I+40% | 158.816 | 158.817 | 1.201 | 1.153 | 0.99 | | | 60.6 |
| 4.001 | S06-C2-22 | 15 minute 100 year Winter I+40% | 158.080 | 158.092 | 1.212 | 11.797 | 1.29 | | | 75.4 |
| 4.002 | S06-C2-23 | 15 minute 100 year Winter I+40% | 157.568 | 157.570 | 1.202 | 1.592 | 1.33 | | | 83.9 |
| 4.003 | S06-C2-24 | 15 minute 100 year Winter I+40% | 156.568 | 156.286 | 0.918 | 0.000 | 0.83 | | | 105.6 |
| 4.004 | S06-C2-25 | 15 minute 100 year Winter I+40% | 155.446 | 155.450 | 1.204 | 4.038 | 1.10 | | | 127.0 |
| 4.005 | S06-C2-26 | 15 minute 100 year Winter I+40% | 155.158 | 155.159 | 1.200 | 0.263 | 0.99 | | | 133.4 |
| 4.006 | S06-C2-27 | 30 minute 100 year Winter I+40% | 153.880 | 153.902 | 1.222 | 22.050 | 1.01 | | | 131.3 |
| 4.007 | S06-C2-28 | 30 minute 100 year Winter I+40% | 152.679 | 152.694 | 1.215 | 15.424 | 1.25 | | | 166.3 |
| 4.008 | S06-C2-29 | 15 minute 100 year Winter I+40% | 151.417 | 151.419 | 1.202 | 2.068 | 1.40 | | | 180.1 |
| 4.009 | S06-C2-30 | 15 minute 100 year Winter I+40% | 150.719 | 150.348 | 0.829 | 0.000 | 1.18 | | | 193.2 |
| 3.003 | S06-C2-31 | 15 minute 100 year Winter I+40% | 150.261 | 149.717 | 0.656 | 0.000 | 1.16 | | | 364.5 |
| 1.012 | S06-C2-32 | 15 minute 100 year Winter I+40% | 149.700 | 148.974 | 0.474 | 0.000 | 1.10 | | | 687.0 |
| 1.013 | S06-C2-33 | 15 minute 100 year Winter I+40% | 147.739 | 146.607 | 0.068 | 0.000 | 1.01 | | | 684.5 |
| 1.014 | S06-C2-34 | 15 minute 100 year Winter I+40% | 144.666 | 143.322 | -0.144 | 0.000 | 0.80 | | | 685.1 |

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 2 - Ch 40470

| PN | US/MH Name | Status |
|---|---|---|
| 1.000 | S06-C2-1 | FLOOD |
| 1.001 | S06-C2-2 | FLOOD RISK |
| 1.002 | S06-C2-3 | SURCHARGED |
| 1.003 | S06-C2-4 | FLOOD |
| 1.004 | S06-C2-5 | FLOOD |
| 1.005 | S06-C2-6 | SURCHARGED |
| 1.006 | S06-C2-7 | SURCHARGED |
| 1.007 | S06-C2-8 | FLOOD |
| 1.008 | S06-C2-9 | FLOOD |
| 1.009 | S06-C2-10 | FLOOD |
| 1.010 | S06-C2-11 | FLOOD RISK |
| 1.011 | S06-C2-12 | SURCHARGED |
| 2.000 | S06-C2-13 | FLOOD |
| 2.001 | S06-C2-14 | FLOOD RISK |
| 2.002 | S06-C2-15 | FLOOD |
| 2.003 | S06-C2-16 | SURCHARGED |
| 2.004 | S06-C2-17 | SURCHARGED |
| 3.000 | S06-C2-18 | FLOOD |
| 3.001 | S06-C2-19 | FLOOD |
| 3.002 | S06-C2-20 | SURCHARGED |
| 4.000 | S06-C2-21 | FLOOD |
| 4.001 | S06-C2-22 | FLOOD |
| 4.002 | S06-C2-23 | FLOOD |
| 4.003 | S06-C2-24 | FLOOD RISK |
| 4.004 | S06-C2-25 | FLOOD |
| 4.005 | S06-C2-26 | FLOOD |
| 4.006 | S06-C2-27 | FLOOD |
| 4.007 | S06-C2-28 | FLOOD |
| 4.008 | S06-C2-29 | FLOOD |
| 4.009 | S06-C2-30 | SURCHARGED |
| 3.003 | S06-C2-31 | SURCHARGED |
| 1.012 | S06-C2-32 | SURCHARGED |
| 1.013 | S06-C2-33 | SURCHARGED |
| 1.014 | S06-C2-34 | OK |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 2 - Ch 40470

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Overflow Vol (m³) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.015 | S06-C2-35 | 15 minute 100 year Winter I+40% | 136.900 | 135.961 | 0.223 | 0.000 | 2.73 | | | 684.7 |
| 1.016 | S06-C2-36 | 60 minute 100 year Winter I+40% | 136.900 | 135.554 | -0.147 | 0.000 | 0.86 | | | 643.2 |
| 1.017 | S06-C2-37 | 120 minute 100 year Winter I+40% | 135.757 | 135.231 | 0.426 | 0.000 | 0.37 | 0.0 | 0.000 | 149.0 |
| 1.018 | S06-C2-38 | 240 minute 100 year Winter I+40% | 135.757 | 134.335 | -0.353 | 0.000 | 0.46 | | | 149.0 |

| PN | US/MH Name | Status |
|---|---|---|
| 1.015 | S06-C2-35 | SURCHARGED |
| 1.016 | S06-C2-36 | OK |
| 1.017 | S06-C2-37 | SURCHARGED |
| 1.018 | S06-C2-38 | OK |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for Catchment 3 - Ch 41120

Pipe Sizes Min 150 Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 20.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

## Network Design Table for Catchment 3 - Ch 41120

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 63.019 | 0.631 | 99.9 | 0.146 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.001 | 69.426 | 0.585 | 118.7 | 0.150 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 2.000 | 101.528 | 1.212 | 83.8 | 0.161 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.001 | 75.622 | 1.704 | 44.4 | 0.189 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.002 | 59.479 | 2.017 | 29.5 | 0.165 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.003 | 74.741 | 1.267 | 59.0 | 0.144 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 2.004 | 68.601 | 1.805 | 38.0 | 0.140 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 2.005 | 63.904 | 1.319 | 48.4 | 0.109 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 2.006 | 48.527 | 0.381 | 127.5 | 0.116 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 1.002 | 16.986 | 0.034 | 500.0 | 0.274 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |
| 3.000 | 65.045 | 0.699 | 93.1 | 0.093 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 3.001 | 68.898 | 0.462 | 149.2 | 0.091 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.003 | 10.353 | 0.021 | 500.0 | 0.066 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |
| 1.004 | 11.257 | 0.023 | 500.0 | 0.052 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 73.88 | 5.80 | 151.116 | 0.146 | 0.0 | 0.0 | 0.0 | 1.31 | 52.0 | 29.2 |
| 1.001 | 70.03 | 6.61 | 150.410 | 0.296 | 0.0 | 0.0 | 0.0 | 1.44 | 101.9 | 56.1 |
| 2.000 | 71.99 | 6.18 | 159.605 | 0.161 | 0.0 | 0.0 | 0.0 | 1.43 | 56.8 | 31.5 |
| 2.001 | 69.06 | 6.82 | 158.393 | 0.350 | 0.0 | 0.0 | 0.0 | 1.97 | 78.3 | 65.5 |
| 2.002 | 67.33 | 7.23 | 156.689 | 0.515 | 0.0 | 0.0 | 0.0 | 2.42 | 96.1 | 93.9 |
| 2.003 | 64.96 | 7.84 | 154.597 | 0.660 | 0.0 | 0.0 | 0.0 | 2.05 | 145.0 | 116.0 |
| 2.004 | 63.34 | 8.29 | 153.330 | 0.800 | 0.0 | 0.0 | 0.0 | 2.56 | 180.9 | 137.2 |
| 2.005 | 61.74 | 8.76 | 151.525 | 0.909 | 0.0 | 0.0 | 0.0 | 2.26 | 160.1 | 151.9 |
| 2.006 | 60.13 | 9.26 | 150.130 | 1.024 | 0.0 | 0.0 | 0.0 | 1.60 | 177.1 | 166.8 |
| 1.002 | 59.33 | 9.52 | 149.525 | 1.594 | 0.0 | 0.0 | 0.0 | 1.08 | 306.0 | 256.2 |
| 3.000 | 72.69 | 6.04 | 151.387 | 0.093 | 0.0 | 0.0 | 0.0 | 1.04 | 18.4 | 18.3 |
| 3.001 | 67.82 | 7.12 | 150.613 | 0.183 | 0.0 | 0.0 | 0.0 | 1.07 | 42.5 | 33.7 |
| 1.003 | 58.86 | 9.68 | 149.491 | 1.843 | 0.0 | 0.0 | 0.0 | 1.08 | 306.0 | 293.9 |
| 1.004 | 58.36 | 9.86 | 149.470 | 1.895 | 0.0 | 0.0 | 0.0 | 1.08 | 306.0 | 299.5 |

## Network Design Table for Catchment 3 - Ch 41120

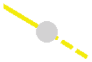
| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.000 | 103.700 | 1.235 | 84.0 | 0.127 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 4.001 | 99.234 | 1.877 | 52.9 | 0.169 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 4.002 | 50.986 | 1.633 | 31.2 | 0.032 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 4.003 | 39.150 | 0.857 | 45.7 | 0.097 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 4.004 | 70.916 | 1.719 | 41.2 | 0.102 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 4.005 | 64.211 | 1.632 | 39.3 | 0.141 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 4.006 | 60.042 | 0.921 | 65.2 | 0.108 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.005 | 14.697 | 2.253 | 6.5 | 0.094 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |
| 1.006 | 50.368 | 0.101 | 500.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔓 |
| 1.007 | 84.875 | 2.473 | 34.3 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔓 |
| 1.008 | 72.199 | 6.471 | 11.2 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔓 |
| 1.009 | 87.361 | 6.103 | 14.3 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 4.000 | 71.86 | 6.21 | 159.697 | 0.127 | 0.0 | 0.0 | 0.0 | 1.43 | 56.8 | 24.7 |
| 4.001 | 67.77 | 7.13 | 158.462 | 0.296 | 0.0 | 0.0 | 0.0 | 1.80 | 71.7 | 54.3 |
| 4.002 | 66.31 | 7.49 | 156.584 | 0.328 | 0.0 | 0.0 | 0.0 | 2.35 | 93.4 | 58.9 |
| 4.003 | 65.02 | 7.83 | 154.952 | 0.425 | 0.0 | 0.0 | 0.0 | 1.94 | 77.2 | 74.9 |
| 4.004 | 63.27 | 8.31 | 154.020 | 0.528 | 0.0 | 0.0 | 0.0 | 2.46 | 173.6 | 90.4 |
| 4.005 | 61.82 | 8.73 | 152.300 | 0.669 | 0.0 | 0.0 | 0.0 | 2.51 | 177.7 | 112.0 |
| 4.006 | 60.18 | 9.25 | 150.668 | 0.777 | 0.0 | 0.0 | 0.0 | 1.95 | 137.8 | 126.6 |
| 1.005 | 58.28 | 9.88 | 149.447 | 2.766 | 0.0 | 0.0 | 0.0 | 9.57 | 2706.8 | 436.6 |
| 1.006 | 56.43 | 10.56 | 147.044 | 2.766 | 0.0 | 0.0 | 0.0 | 1.24 | 549.9 | 436.6 |
| 1.007 | 55.66 | 10.85 | 146.944 | 2.766 | 0.0 | 0.0 | 0.0 | 4.79 | 2114.4 | 436.6 |
| 1.008 | 55.30 | 11.00 | 144.471 | 2.766 | 0.0 | 0.0 | 0.0 | 8.40 | 3713.1 | 436.6 |
| 1.009 | 54.81 | 11.19 | 138.000 | 2.766 | 0.0 | 0.0 | 0.0 | 7.42 | 3277.5 | 436.6 |

## Manhole Schedules for Catchment 3 - Ch 41120

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | | Pipe Out | | | Pipes In | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | PN | Invert Level (m) | Diameter (mm) | PN | Invert Level (m) | Diameter (mm) | Backdrop (mm) |
| S06-C3-1 | 152.541 | 1.425 | Open Manhole | 1200 | 1.000 | 151.116 | 225 | | | | |
| S06-C3-2 | 151.910 | 1.500 | Open Manhole | 1200 | 1.001 | 150.410 | 300 | 1.000 | 150.485 | 225 | |
| S06-C3-3 | 161.030 | 1.425 | Open Manhole | 1200 | 2.000 | 159.605 | 225 | | | | |
| S06-C3-4 | 159.818 | 1.425 | Open Manhole | 1200 | 2.001 | 158.393 | 225 | 2.000 | 158.393 | 225 | |
| S06-C3-5 | 158.114 | 1.425 | Open Manhole | 1200 | 2.002 | 156.689 | 225 | 2.001 | 156.689 | 225 | |
| S06-C3-6 | 156.097 | 1.500 | Open Manhole | 1200 | 2.003 | 154.597 | 300 | 2.002 | 154.672 | 225 | |
| S06-C3-7 | 154.830 | 1.500 | Open Manhole | 1200 | 2.004 | 153.330 | 300 | 2.003 | 153.330 | 300 | |
| S06-C3-8 | 153.025 | 1.500 | Open Manhole | 1200 | 2.005 | 151.525 | 300 | 2.004 | 151.525 | 300 | |
| S06-C3-9 | 151.705 | 1.575 | Open Manhole | 1350 | 2.006 | 150.130 | 375 | 2.005 | 150.205 | 300 | |
| S06-C3-10 | 151.325 | 1.800 | Open Manhole | 1500 | 1.002 | 149.525 | 600 | 1.001 | 149.825 | 300 | |
| | | | | | | | | 2.006 | 149.750 | 375 | |
| S06-C3-11 | 152.737 | 1.350 | Open Manhole | 1200 | 3.000 | 151.387 | 150 | | | | |
| S06-C3-12 | 152.066 | 1.453 | Open Manhole | 1200 | 3.001 | 150.613 | 225 | 3.000 | 150.688 | 150 | |
| S06-C3-13 | 151.576 | 2.085 | Open Manhole | 1500 | 1.003 | 149.491 | 600 | 1.002 | 149.491 | 600 | |
| | | | | | | | | 3.001 | 150.151 | 225 | 285 |
| S06-C3-14 | 151.421 | 1.951 | Open Manhole | 1500 | 1.004 | 149.470 | 600 | 1.003 | 149.470 | 600 | |
| S06-C3-15 | 161.122 | 1.425 | Open Manhole | 1200 | 4.000 | 159.697 | 225 | | | | |
| S06-C3-16 | 159.887 | 1.425 | Open Manhole | 1200 | 4.001 | 158.462 | 225 | 4.000 | 158.462 | 225 | |
| S06-C3-17 | 158.009 | 1.425 | Open Manhole | 1200 | 4.002 | 156.584 | 225 | 4.001 | 156.584 | 225 | |
| S06-C3-18 | 156.377 | 1.425 | Open Manhole | 1200 | 4.003 | 154.952 | 225 | 4.002 | 154.952 | 225 | |
| S06-C3-19 | 155.520 | 1.500 | Open Manhole | 1200 | 4.004 | 154.020 | 300 | 4.003 | 154.095 | 225 | |
| S06-C3-20 | 153.800 | 1.500 | Open Manhole | 1200 | 4.005 | 152.300 | 300 | 4.004 | 152.300 | 300 | |
| S06-C3-21 | 152.168 | 1.500 | Open Manhole | 1200 | 4.006 | 150.668 | 300 | 4.005 | 150.668 | 300 | |
| S06-C3-22 | 151.392 | 1.944 | Open Manhole | 1500 | 1.005 | 149.447 | 600 | 1.004 | 149.447 | 600 | |
| | | | | | | | | 4.006 | 149.747 | 300 | |
| S06-C3-23 | 148.994 | 1.950 | Open Manhole | 1800 | 1.006 | 147.044 | 750 | 1.005 | 147.194 | 600 | |
| S06-C3-24 | 150.979 | 4.036 | Open Manhole | 1800 | 1.007 | 146.944 | 750 | 1.006 | 146.944 | 750 | |
| S06-C3-25 | 146.421 | 1.950 | Open Manhole | 1800 | 1.008 | 144.471 | 750 | 1.007 | 144.471 | 750 | |
| S06-C3-26 | 140.574 | 2.574 | Open Manhole | 1800 | 1.009 | 138.000 | 750 | 1.008 | 138.000 | 750 | |
| Outfall 3 | 137.200 | 5.303 | Open Manhole | 0 | | OUTFALL | | 1.009 | 131.897 | 750 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C3-1 | 372425.457 | 517667.274 | 372425.457 | 517667.274 | Required |  |
| S06-C3-2 | 372479.161 | 517634.299 | 372479.161 | 517634.299 | Required |  |
| S06-C3-3 | 372967.906 | 517358.205 | 372967.906 | 517358.205 | Required |  |
| S06-C3-4 | 372881.011 | 517410.716 | 372881.011 | 517410.716 | Required |  |
| S06-C3-5 | 372817.305 | 517451.461 | 372817.305 | 517451.461 | Required |  |

## Manhole Schedules for Catchment 3 - Ch 41120

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C3-6 | 372766.371 | 517482.177 | 372766.371 | 517482.177 | Required |  |
| S06-C3-7 | 372698.593 | 517513.679 | 372698.593 | 517513.679 | Required |  |
| S06-C3-8 | 372637.379 | 517544.645 | 372637.379 | 517544.645 | Required |  |
| S06-C3-9 | 372581.762 | 517576.116 | 372581.762 | 517576.116 | Required |  |
| S06-C3-10 | 372539.337 | 517599.677 | 372539.337 | 517599.677 | Required |  |
| S06-C3-11 | 372423.112 | 517654.750 | 372423.112 | 517654.750 | Required |  |
| S06-C3-12 | 372477.968 | 517619.797 | 372477.968 | 517619.797 | Required |  |
| S06-C3-13 | 372536.205 | 517582.982 | 372536.205 | 517582.982 | Required |  |
| S06-C3-14 | 372530.964 | 517574.053 | 372530.964 | 517574.053 | Required |  |
| S06-C3-15 | 372963.429 | 517327.460 | 372963.429 | 517327.460 | Required |  |
| S06-C3-16 | 372873.096 | 517378.390 | 372873.096 | 517378.390 | Required |  |
| S06-C3-17 | 372784.227 | 517422.544 | 372784.227 | 517422.544 | Required |  |
| S06-C3-18 | 372736.262 | 517439.834 | 372736.262 | 517439.834 | Required |  |
| S06-C3-19 | 372706.064 | 517464.749 | 372706.064 | 517464.749 | Required |  |
| S06-C3-20 | 372646.069 | 517502.559 | 372646.069 | 517502.559 | Required |  |
| S06-C3-21 | 372591.923 | 517537.074 | 372591.923 | 517537.074 | Required |  |
| S06-C3-22 | 372540.537 | 517568.129 | 372540.537 | 517568.129 | Required |  |
| S06-C3-23 | 372531.913 | 517556.227 | 372531.913 | 517556.227 | Required |  |
| S06-C3-24 | 372576.304 | 517532.429 | 372576.304 | 517532.429 | Required |  |
| S06-C3-25 | 372532.059 | 517459.998 | 372532.059 | 517459.998 | Required |  |

## Manhole Schedules for Catchment 3 - Ch 41120

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C3-26 | 372563.879 | 517395.190 | 372563.879 | 517395.190 | Required |  |
| Outfall 3 | 372494.748 | 517341.778 | | | No Entry |  |

## Area Summary for Catchment 3 - Ch 41120

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | As Zoned | Default | 100 | 0.076 | 0.076 | 0.076 |
| | | Verge | 50 | 0.019 | 0.010 | 0.086 |
| | | Slopes | 25 | 0.236 | 0.059 | 0.146 |
| 1.001 | As Zoned | Default | 100 | 0.073 | 0.073 | 0.073 |
| | | Verge | 50 | 0.019 | 0.009 | 0.082 |
| | | Slopes | 25 | 0.265 | 0.066 | 0.150 |
| 2.000 | As Zoned | Default | 100 | 0.137 | 0.137 | 0.137 |
| | | Verge | 50 | 0.026 | 0.013 | 0.150 |
| | | Slopes | 25 | 0.046 | 0.012 | 0.161 |
| 2.001 | As Zoned | Default | 100 | 0.155 | 0.155 | 0.155 |
| | | Verge | 50 | 0.036 | 0.018 | 0.173 |
| | | Slopes | 25 | 0.064 | 0.016 | 0.189 |
| 2.002 | As Zoned | Default | 100 | 0.134 | 0.134 | 0.134 |
| | | Verge | 50 | 0.030 | 0.015 | 0.149 |
| | | Slopes | 25 | 0.068 | 0.017 | 0.165 |
| 2.003 | As Zoned | Default | 100 | 0.128 | 0.128 | 0.128 |
| | | Verge | 50 | 0.032 | 0.016 | 0.143 |
| | | Slopes | 25 | 0.003 | 0.001 | 0.144 |
| 2.004 | As Zoned | Default | 100 | 0.133 | 0.133 | 0.133 |
| | | Verge | 50 | 0.014 | 0.007 | 0.140 |
| 2.005 | As Zoned | Default | 100 | 0.106 | 0.106 | 0.106 |
| | | Verge | 50 | 0.007 | 0.003 | 0.109 |
| 2.006 | As Zoned | Default | 100 | 0.096 | 0.096 | 0.096 |
| | | Verge | 50 | 0.018 | 0.009 | 0.106 |
| | | Slopes | 25 | 0.044 | 0.011 | 0.116 |
| 1.002 | As Zoned | Default | 100 | 0.159 | 0.159 | 0.159 |
| | | Verge | 50 | 0.034 | 0.017 | 0.176 |
| | | Slopes | 25 | 0.390 | 0.097 | 0.274 |
| 3.000 | As Zoned | Default | 100 | 0.083 | 0.083 | 0.083 |
| | | Verge | 50 | 0.020 | 0.010 | 0.093 |
| 3.001 | As Zoned | Default | 100 | 0.081 | 0.081 | 0.081 |
| | | Verge | 50 | 0.019 | 0.009 | 0.091 |
| 1.003 | As Zoned | Default | 100 | 0.063 | 0.063 | 0.063 |
| | | Verge | 50 | 0.007 | 0.003 | 0.066 |
| 1.004 | As Zoned | Default | 100 | 0.028 | 0.028 | 0.028 |
| | | Verge | 50 | 0.013 | 0.007 | 0.034 |
| | As Zoned | Default | 100 | 0.016 | 0.016 | 0.050 |
| | | Verge | 50 | 0.003 | 0.002 | 0.052 |
| | | Slopes | 25 | 0.000 | 0.000 | 0.052 |
| 4.000 | As Zoned | Default | 100 | 0.115 | 0.115 | 0.115 |
| | | Verge | 50 | 0.023 | 0.011 | 0.127 |
| 4.001 | As Zoned | Default | 100 | 0.153 | 0.153 | 0.153 |
| | | Verge | 50 | 0.030 | 0.015 | 0.168 |
| | | Slopes | 25 | 0.000 | 0.000 | 0.169 |
| 4.002 | As Zoned | Default | 100 | 0.157 | 0.157 | 0.157 |
| | | Verge | 50 | 0.039 | 0.019 | 0.176 |
| | | Slopes | 25 | 0.202 | 0.050 | 0.032 |
| 4.003 | As Zoned | Default | 100 | 0.093 | 0.093 | 0.093 |
| | | Verge | 50 | 0.007 | 0.003 | 0.096 |
| | | Slopes | 25 | 0.003 | 0.001 | 0.097 |
| 4.004 | As Zoned | Default | 100 | 0.088 | 0.088 | 0.088 |
| | | Verge | 50 | 0.021 | 0.011 | 0.099 |
| | | Slopes | 25 | 0.011 | 0.003 | 0.102 |
| 4.005 | As Zoned | Default | 100 | 0.123 | 0.123 | 0.123 |
| | | Verge | 50 | 0.028 | 0.014 | 0.137 |
| | | Slopes | 25 | 0.015 | 0.004 | 0.141 |
| 4.006 | As Zoned | Default | 100 | 0.094 | 0.094 | 0.094 |
| | | Verge | 50 | 0.025 | 0.012 | 0.107 |
| | | Slopes | 25 | 0.005 | 0.001 | 0.108 |
| 1.005 | As Zoned | Default | 100 | 0.085 | 0.085 | 0.085 |
| | | Verge | 50 | 0.018 | 0.009 | 0.094 |
| | | Slopes | 25 | 0.002 | 0.000 | 0.094 |
| 1.006 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.007 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.008 | - | - | 100 | 0.000 | 0.000 | 0.000 |

## Area Summary for Catchment 3 - Ch 41120

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.009 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total | Total | Total |
| | | | | 4.215 | 2.766 | 2.766 |

## Online Controls for Catchment 3 - Ch 41120

### Hydro-Brake® Optimum Manhole: S06-C3-26, DS/PN: 1.009, Volume (m³): 37.7

| | |
|---|---|
| Unit Reference | MD-SHE-0229-2780-1000-2780 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 27.8 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 229 |
| Invert Level (m) | 138.000 |
| Minimum Outlet Pipe Diameter (mm) | 300 |
| Suggested Manhole Diameter (mm) | 1500 |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.000 | 27.8 | Kick-Flo® | 0.743 | 24.1 |
| Flush-Flo™ | 0.373 | 27.8 | Mean Flow over Head Range | - | 23.1 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 7.6 | 0.800 | 25.0 | 2.000 | 38.8 | 4.000 | 54.2 | 7.000 | 71.1 |
| 0.200 | 22.9 | 1.000 | 27.8 | 2.200 | 40.6 | 4.500 | 57.4 | 7.500 | 73.5 |
| 0.300 | 27.6 | 1.200 | 30.3 | 2.400 | 42.3 | 5.000 | 60.4 | 8.000 | 75.9 |
| 0.400 | 27.8 | 1.400 | 32.7 | 2.600 | 44.0 | 5.500 | 63.2 | 8.500 | 78.1 |
| 0.500 | 27.4 | 1.600 | 34.8 | 3.000 | 47.1 | 6.000 | 66.0 | 9.000 | 80.4 |
| 0.600 | 26.7 | 1.800 | 36.8 | 3.500 | 50.8 | 6.500 | 68.6 | 9.500 | 82.5 |

## Offline Controls for Catchment 3 - Ch 41120

### Weir Manhole: S06-C3-26, DS/PN: 1.009, Loop to PN: None

Discharge Coef 0.544 Width (m) 10.000 Invert Level (m) 139.000

## Storage Structures for Catchment 3 - Ch 41120

### Tank or Pond Manhole: S06-C3-26, DS/PN: 1.009

Invert Level (m) 138.000

| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|---|---|
| 0.000 | 2445.6 | 1.000 | 3055.0 | 1.001 | 3248.9 | 2.574 | 5119.7 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 3 - Ch 41120

### Simulation Criteria

Areal Reduction Factor 1.000
Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0
MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0
Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500
Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0
Number of Offline Controls 1
Number of Time/Area Diagrams 0
Number of Online Controls 1
Number of Storage Structures 1
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
M5-60 (mm) 20.000
Cv (Summer) 0.750
Region England and Wales
Ratio R 0.300
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C3-1 | 15 minute 5 year Winter I+20% | 152.541 | 151.261 | -0.080 | 0.000 | 0.71 | | 35.9 | OK |
| 1.001 | S06-C3-2 | 15 minute 5 year Winter I+20% | 151.910 | 150.596 | -0.114 | 0.000 | 0.67 | | 65.5 | OK |
| 2.000 | S06-C3-3 | 15 minute 5 year Winter I+20% | 161.030 | 159.750 | -0.080 | 0.000 | 0.69 | | 38.5 | OK |
| 2.001 | S06-C3-4 | 15 minute 5 year Winter I+20% | 159.818 | 158.725 | 0.107 | 0.000 | 0.94 | | 71.6 | SURCHARGED |
| 2.002 | S06-C3-5 | 15 minute 5 year Winter I+20% | 158.114 | 157.261 | 0.347 | 0.000 | 1.08 | | 100.4 | SURCHARGED |
| 2.003 | S06-C3-6 | 15 minute 5 year Winter I+20% | 156.097 | 154.824 | -0.073 | 0.000 | 0.91 | | 126.9 | OK |
| 2.004 | S06-C3-7 | 15 minute 5 year Winter I+20% | 154.830 | 153.604 | -0.026 | 0.000 | 0.88 | | 151.9 | OK |
| 2.005 | S06-C3-8 | 15 minute 5 year Winter I+20% | 153.025 | 152.275 | 0.450 | 0.000 | 1.09 | | 166.2 | SURCHARGED |
| 2.006 | S06-C3-9 | 15 minute 5 year Winter I+20% | 151.705 | 150.708 | 0.203 | 0.000 | 1.13 | | 184.6 | SURCHARGED |
| 1.002 | S06-C3-10 | 15 minute 5 year Winter I+20% | 151.325 | 150.222 | 0.098 | 0.000 | 1.57 | | 288.2 | SURCHARGED |
| 3.000 | S06-C3-11 | 15 minute 5 year Winter I+20% | 152.737 | 151.839 | 0.302 | 0.000 | 1.16 | | 21.0 | SURCHARGED |
| 3.001 | S06-C3-12 | 15 minute 5 year Winter I+20% | 152.066 | 150.788 | -0.050 | 0.000 | 0.95 | | 39.2 | OK |
| 1.003 | S06-C3-13 | 15 minute 5 year Winter I+20% | 151.576 | 150.165 | 0.075 | 0.000 | 2.24 | | 338.0 | SURCHARGED |
| 1.004 | S06-C3-14 | 15 minute 5 year Winter I+20% | 151.421 | 150.102 | 0.032 | 0.000 | 2.24 | | 346.6 | SURCHARGED |
| 4.000 | S06-C3-15 | 15 minute 5 year Winter I+20% | 161.122 | 159.821 | -0.101 | 0.000 | 0.54 | | 30.1 | OK |
| 4.001 | S06-C3-16 | 15 minute 5 year Winter I+20% | 159.887 | 158.634 | -0.053 | 0.000 | 0.91 | | 63.6 | OK |
| 4.002 | S06-C3-17 | 15 minute 5 year Winter I+20% | 158.009 | 156.736 | -0.074 | 0.000 | 0.78 | | 70.0 | OK |
| 4.003 | S06-C3-18 | 15 minute 5 year Winter I+20% | 156.377 | 155.509 | 0.332 | 0.000 | 1.18 | | 86.0 | SURCHARGED |
| 4.004 | S06-C3-19 | 15 minute 5 year Winter I+20% | 155.520 | 154.193 | -0.127 | 0.000 | 0.62 | | 103.4 | OK |
| 4.005 | S06-C3-20 | 15 minute 5 year Winter I+20% | 153.800 | 152.498 | -0.102 | 0.000 | 0.75 | | 128.0 | OK |
| 4.006 | S06-C3-21 | 15 minute 5 year Winter I+20% | 152.168 | 151.173 | 0.205 | 0.000 | 1.11 | | 145.6 | SURCHARGED |
| 1.005 | S06-C3-22 | 15 minute 5 year Winter I+20% | 151.392 | 149.688 | -0.360 | 0.000 | 0.34 | | 507.2 | OK |
| 1.006 | S06-C3-23 | 30 minute 5 year Summer I+20% | 148.994 | 147.794 | 0.000 | 0.000 | 1.02 | | 475.3 | OK |
| 1.007 | S06-C3-24 | 15 minute 5 year Winter I+20% | 150.979 | 147.205 | -0.489 | 0.000 | 0.26 | | 503.0 | OK |
| 1.008 | S06-C3-25 | 15 minute 5 year Winter I+20% | 146.421 | 144.666 | -0.555 | 0.000 | 0.15 | | 503.4 | OK |
| 1.009 | S06-C3-26 | 480 minute 5 year Winter I+20% | 140.574 | 138.299 | -0.451 | 0.000 | 0.01 | 0.0 | 27.6 | OK |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 3 - Ch 41120

### Simulation Criteria

Areal Reduction Factor 1.000
Hot Start (mins) 0
Hot Start Level (mm) 0
Manhole Headloss Coeff (Global) 0.500
Foul Sewage per hectare (l/s) 0.000
Additional Flow - % of Total Flow 0.000
MADD Factor * 10m³/ha Storage 0.000
Inlet Coeffiecient 0.800
Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0
Number of Online Controls 1
Number of Offline Controls 1
Number of Storage Structures 1
Number of Time/Area Diagrams 0
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
Region England and Wales
M5-60 (mm) 20.000
Ratio R 0.300
Cv (Summer) 0.750
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C3-1 | 15 minute 100 year Winter I+40% | 152.541 | 152.545 | 1.204 | 4.685 | 1.41 | | 70.9 | FLOOD |
| 1.001 | S06-C3-2 | 15 minute 100 year Winter I+40% | 151.910 | 151.911 | 1.201 | 1.116 | 1.28 | | 125.2 | FLOOD |
| 2.000 | S06-C3-3 | 15 minute 100 year Winter I+40% | 161.030 | 161.036 | 1.206 | 6.351 | 0.99 | | 55.3 | FLOOD |
| 2.001 | S06-C3-4 | 30 minute 100 year Winter I+40% | 159.818 | 159.842 | 1.224 | 23.636 | 1.00 | | 76.1 | FLOOD |
| 2.002 | S06-C3-5 | 30 minute 100 year Winter I+40% | 158.114 | 158.137 | 1.223 | 22.629 | 1.27 | | 117.5 | FLOOD |
| 2.003 | S06-C3-6 | 15 minute 100 year Winter I+40% | 156.097 | 156.103 | 1.206 | 6.079 | 1.04 | | 144.6 | FLOOD |
| 2.004 | S06-C3-7 | 15 minute 100 year Winter I+40% | 154.830 | 154.838 | 1.208 | 8.085 | 1.00 | | 172.8 | FLOOD |
| 2.005 | S06-C3-8 | 30 minute 100 year Winter I+40% | 153.025 | 153.044 | 1.219 | 19.384 | 1.32 | | 201.3 | FLOOD |
| 2.006 | S06-C3-9 | 15 minute 100 year Winter I+40% | 151.705 | 151.703 | 1.198 | 0.000 | 1.35 | | 220.0 | FLOOD RISK |
| 1.002 | S06-C3-10 | 15 minute 100 year Winter I+40% | 151.325 | 151.013 | 0.888 | 0.000 | 2.66 | | 487.3 | SURCHARGED |
| 3.000 | S06-C3-11 | 15 minute 100 year Winter I+40% | 152.737 | 152.744 | 1.207 | 6.890 | 1.65 | | 29.8 | FLOOD |
| 3.001 | S06-C3-12 | 15 minute 100 year Winter I+40% | 152.066 | 152.066 | 1.229 | 0.078 | 1.61 | | 66.2 | FLOOD |
| 1.003 | S06-C3-13 | 15 minute 100 year Winter I+40% | 151.576 | 150.763 | 0.673 | 0.000 | 3.90 | | 588.2 | SURCHARGED |
| 1.004 | S06-C3-14 | 15 minute 100 year Winter I+40% | 151.421 | 150.406 | 0.336 | 0.000 | 3.97 | | 614.2 | SURCHARGED |
| 4.000 | S06-C3-15 | 15 minute 100 year Winter I+40% | 161.122 | 161.124 | 1.202 | 1.645 | 0.99 | | 54.9 | FLOOD |
| 4.001 | S06-C3-16 | 15 minute 100 year Winter I+40% | 159.887 | 159.902 | 1.215 | 14.848 | 1.11 | | 77.8 | FLOOD |
| 4.002 | S06-C3-17 | 15 minute 100 year Winter I+40% | 158.009 | 157.932 | 1.123 | 0.000 | 0.97 | | 86.8 | FLOOD RISK |
| 4.003 | S06-C3-18 | 30 minute 100 year Winter I+40% | 156.377 | 156.386 | 1.209 | 9.189 | 1.55 | | 113.7 | FLOOD |
| 4.004 | S06-C3-19 | 15 minute 100 year Winter I+40% | 155.520 | 155.196 | 0.877 | 0.000 | 0.88 | | 145.8 | SURCHARGED |
| 4.005 | S06-C3-20 | 15 minute 100 year Winter I+40% | 153.800 | 153.809 | 1.208 | 8.239 | 1.00 | | 169.7 | FLOOD |
| 4.006 | S06-C3-21 | 15 minute 100 year Winter I+40% | 152.168 | 152.173 | 1.205 | 4.592 | 1.52 | | 199.8 | FLOOD |
| 1.005 | S06-C3-22 | 15 minute 100 year Winter I+40% | 151.392 | 149.773 | -0.274 | 0.000 | 0.57 | | 860.1 | OK |
| 1.006 | S06-C3-23 | 15 minute 100 year Winter I+40% | 148.994 | 148.003 | 0.208 | 0.000 | 1.81 | | 842.2 | SURCHARGED |
| 1.007 | S06-C3-24 | 15 minute 100 year Winter I+40% | 150.979 | 147.292 | -0.402 | 0.000 | 0.44 | | 833.8 | OK |
| 1.008 | S06-C3-25 | 15 minute 100 year Winter I+40% | 146.421 | 144.728 | -0.493 | 0.000 | 0.25 | | 836.8 | OK |
| 1.009 | S06-C3-26 | 480 minute 100 year Winter I+40% | 140.574 | 138.726 | -0.024 | 0.000 | 0.01 | 0.0 | 27.8 | OK |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for Catchment 4 - Ch 41855

Pipe Sizes Min 150 Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 20.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

## Network Design Table for Catchment 4 - Ch 41855

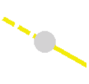
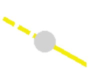
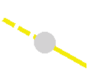
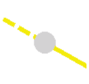
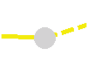
| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 79.986 | 0.859 | 93.1 | 0.132 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.001 | 81.881 | 1.481 | 55.3 | 0.130 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.002 | 75.415 | 1.898 | 39.7 | 0.137 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.000 | 80.226 | 0.864 | 92.8 | 0.145 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.001 | 88.209 | 1.599 | 55.2 | 0.143 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.002 | 63.263 | 1.594 | 39.7 | 0.149 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.003 | 29.485 | 0.169 | 174.6 | 0.118 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 1.003 | 13.509 | 0.027 | 491.3 | 0.126 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| 1.004 | 30.938 | 0.063 | 491.3 | 0.000 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| 1.005 | 85.950 | 0.175 | 491.3 | 0.000 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| 1.006 | 317.744 | 13.036 | 24.4 | 0.000 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| 1.007 | 13.810 | 0.028 | 491.3 | 0.000 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| 1.008 | 25.928 | 0.053 | 491.3 | 0.000 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 72.97 | 5.98 | 159.715 | 0.132 | 0.0 | 0.0 | 0.0 | 1.36 | 53.9 | 26.1 |
| 1.001 | 69.35 | 6.76 | 158.856 | 0.262 | 0.0 | 0.0 | 0.0 | 1.76 | 70.1 | 49.2 |
| 1.002 | 66.81 | 7.36 | 157.375 | 0.399 | 0.0 | 0.0 | 0.0 | 2.08 | 82.8 | 72.3 |
| 2.000 | 72.96 | 5.98 | 159.703 | 0.145 | 0.0 | 0.0 | 0.0 | 1.36 | 54.0 | 28.7 |
| 2.001 | 69.08 | 6.82 | 158.839 | 0.288 | 0.0 | 0.0 | 0.0 | 1.76 | 70.2 | 53.9 |
| 2.002 | 66.96 | 7.32 | 157.240 | 0.437 | 0.0 | 0.0 | 0.0 | 2.08 | 82.8 | 79.2 |
| 2.003 | 65.55 | 7.68 | 155.495 | 0.555 | 0.0 | 0.0 | 0.0 | 1.37 | 151.1 | 98.4 |
| 1.003 | 64.71 | 7.91 | 155.176 | 1.080 | 0.0 | 0.0 | 0.0 | 1.00 | 217.3 | 189.3 |
| 1.004 | 62.87 | 8.42 | 155.149 | 1.080 | 0.0 | 0.0 | 0.0 | 1.00 | 217.3 | 189.3 |
| 1.005 | 58.38 | 9.85 | 155.086 | 1.080 | 0.0 | 0.0 | 0.0 | 1.00 | 217.3 | 189.3 |
| 1.006 | 55.26 | 11.01 | 154.911 | 1.080 | 0.0 | 0.0 | 0.0 | 4.55 | 985.1 | 189.3 |
| 1.007 | 54.69 | 11.24 | 141.875 | 1.080 | 0.0 | 0.0 | 0.0 | 1.00 | 217.3 | 189.3 |
| 1.008 | 53.66 | 11.67 | 141.847 | 1.080 | 0.0 | 0.0 | 0.0 | 1.00 | 217.3 | 189.3 |

## Manhole Schedules for Catchment 4 - Ch 41855

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | Pipe Out | | | Pipes In | | | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | PN | Invert Level (m) | Diameter (mm) | PN | Invert Level (m) | Diameter (mm) | |
| S06-C4-1 | 161.140 | 1.425 | Open Manhole | 1200 | 1.000 | 159.715 | 225 | | | | |
| S06-C4-2 | 160.281 | 1.425 | Open Manhole | 1200 | 1.001 | 158.856 | 225 | 1.000 | 158.856 | 225 | |
| S06-C4-3 | 158.800 | 1.425 | Open Manhole | 1200 | 1.002 | 157.375 | 225 | 1.001 | 157.375 | 225 | |
| S06-C4-4 | 161.128 | 1.425 | Open Manhole | 1200 | 2.000 | 159.703 | 225 | | | | |
| S06-C4-5 | 160.264 | 1.425 | Open Manhole | 1200 | 2.001 | 158.839 | 225 | 2.000 | 158.839 | 225 | |
| S06-C4-6 | 158.665 | 1.425 | Open Manhole | 1200 | 2.002 | 157.240 | 225 | 2.001 | 157.240 | 225 | |
| S06-C4-7 | 157.070 | 1.575 | Open Manhole | 1350 | 2.003 | 155.495 | 375 | 2.002 | 155.645 | 225 | |
| S06-C4-8 | 156.901 | 1.725 | Open Manhole | 1500 | 1.003 | 155.176 | 525 | 1.002 | 155.476 | 225 | |
| | | | | | | | | 2.003 | 155.326 | 375 | |
| S06-C4-9 | 159.000 | 3.851 | Open Manhole | 1500 | 1.004 | 155.149 | 525 | 1.003 | 155.149 | 525 | |
| S06-C4-10 | 159.166 | 4.080 | Open Manhole | 1500 | 1.005 | 155.086 | 525 | 1.004 | 155.086 | 525 | |
| S06-C4-11 | 159.166 | 4.255 | Open Manhole | 1500 | 1.006 | 154.911 | 525 | 1.005 | 154.911 | 525 | |
| S06-C4-12 | 143.600 | 1.725 | Open Manhole | 1500 | 1.007 | 141.875 | 525 | 1.006 | 141.875 | 525 | |
| S06-C4-13 | 143.600 | 1.753 | Open Manhole | 1500 | 1.008 | 141.847 | 525 | 1.007 | 141.847 | 525 | |
| Outfall 4 | 143.600 | 1.806 | Open Manhole | 0 | | OUTFALL | | 1.008 | 141.794 | 525 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C4-1 | 373102.181 | 517249.223 | 373102.181 | 517249.223 | Required |  |
| S06-C4-2 | 373171.873 | 517209.970 | 373171.873 | 517209.970 | Required |  |
| S06-C4-3 | 373243.229 | 517169.810 | 373243.229 | 517169.810 | Required |  |
| S06-C4-4 | 373116.211 | 517274.626 | 373116.211 | 517274.626 | Required |  |
| S06-C4-5 | 373186.084 | 517235.206 | 373186.084 | 517235.206 | Required |  |
| S06-C4-6 | 373262.881 | 517191.813 | 373262.881 | 517191.813 | Required |  |
| S06-C4-7 | 373318.064 | 517160.875 | 373318.064 | 517160.875 | Required |  |
| S06-C4-8 | 373308.957 | 517132.833 | 373308.957 | 517132.833 | Required |  |
| S06-C4-9 | 373301.586 | 517121.512 | 373301.586 | 517121.512 | Required |  |
| S06-C4-10 | 373272.078 | 517112.214 | 373272.078 | 517112.214 | Required |  |
| S06-C4-11 | 373186.234 | 517116.464 | 373186.234 | 517116.464 | Required |  |

## Manhole Schedules for Catchment 4 - Ch 41855

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S06-C4-12 | 373417.185 | 516906.415 | 373417.185 | 516906.415 | Required |  |
| S06-C4-13 | 373430.731 | 516903.725 | 373430.731 | 516903.725 | Required |  |
| Outfall 4 | 373454.462 | 516893.283 | | | No Entry |  |

## Area Summary for Catchment 4 - Ch 41855

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | As Zoned | Default | 100 | 0.124 | 0.124 | 0.124 |
| | | Verge | 50 | 0.016 | 0.008 | 0.132 |
| 1.001 | As Zoned | Default | 100 | 0.118 | 0.118 | 0.118 |
| | | Verge | 50 | 0.023 | 0.012 | 0.130 |
| | | Slopes | 25 | 0.003 | 0.001 | 0.130 |
| 1.002 | As Zoned | Default | 100 | 0.124 | 0.124 | 0.124 |
| | | Verge | 50 | 0.024 | 0.012 | 0.136 |
| | | Slopes | 25 | 0.009 | 0.002 | 0.137 |
| 2.000 | As Zoned | Default | 100 | 0.125 | 0.125 | 0.125 |
| | | Verge | 50 | 0.023 | 0.012 | 0.137 |
| | | Slopes | 25 | 0.031 | 0.008 | 0.145 |
| 2.001 | As Zoned | Default | 100 | 0.125 | 0.125 | 0.125 |
| | | Verge | 50 | 0.023 | 0.012 | 0.137 |
| | | Slopes | 25 | 0.021 | 0.005 | 0.143 |
| 2.002 | As Zoned | Default | 100 | 0.135 | 0.135 | 0.135 |
| | | Verge | 50 | 0.026 | 0.013 | 0.147 |
| | | Slopes | 25 | 0.005 | 0.001 | 0.149 |
| 2.003 | As Zoned | Default | 100 | 0.107 | 0.107 | 0.107 |
| | | Verge | 50 | 0.021 | 0.010 | 0.117 |
| | | Slopes | 25 | 0.002 | 0.000 | 0.118 |
| 1.003 | As Zoned | Default | 100 | 0.113 | 0.113 | 0.113 |
| | | Verge | 50 | 0.022 | 0.011 | 0.124 |
| | | Slopes | 25 | 0.012 | 0.003 | 0.126 |
| 1.004 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.005 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.006 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.007 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.008 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total | Total | Total |
| | | | | 1.232 | 1.080 | 1.080 |

## Online Controls for Catchment 4 - Ch 41855

### Hydro-Brake® Optimum Manhole: S06-C4-10, DS/PN: 1.005, Volume (m³): 13.6

| | |
|---|---|
| Unit Reference | MD-SHE-0158-1190-1000-1190 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 11.9 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 158 |
| Invert Level (m) | 155.086 |
| Minimum Outlet Pipe Diameter (mm) | 225 |
| Suggested Manhole Diameter (mm) | 1200 |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.000 | 11.9 | Kick-Flo® | 0.687 | 10.0 |
| Flush-Flo™ | 0.311 | 11.9 | Mean Flow over Head Range | - | 10.2 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 5.7 | 0.800 | 10.7 | 2.000 | 16.5 | 4.000 | 23.0 | 7.000 | 30.1 |
| 0.200 | 11.5 | 1.000 | 11.9 | 2.200 | 17.3 | 4.500 | 24.3 | 7.500 | 31.1 |
| 0.300 | 11.9 | 1.200 | 13.0 | 2.400 | 18.0 | 5.000 | 25.6 | 8.000 | 32.1 |
| 0.400 | 11.8 | 1.400 | 13.9 | 2.600 | 18.7 | 5.500 | 26.8 | 8.500 | 33.1 |
| 0.500 | 11.5 | 1.600 | 14.9 | 3.000 | 20.0 | 6.000 | 28.0 | 9.000 | 34.0 |
| 0.600 | 11.0 | 1.800 | 15.7 | 3.500 | 21.6 | 6.500 | 29.1 | 9.500 | 34.9 |

## Offline Controls for Catchment 4 - Ch 41855

### Weir Manhole: S06-C4-10, DS/PN: 1.005, Loop to PN: None

Discharge Coef 0.544 Width (m) 10.000 Invert Level (m) 156.086

## Storage Structures for Catchment 4 - Ch 41855

### Tank or Pond Manhole: S06-C4-10, DS/PN: 1.005

Invert Level (m) 155.090

| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|---|---|
| 0.000 | 1068.9 | 1.000 | 1628.0 | 1.001 | 1806.6 | 4.076 | 4390.4 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 4 - Ch 41855

### Simulation Criteria

Areal Reduction Factor 1.000
Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0
MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0
Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500
Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0
Number of Offline Controls 1
Number of Time/Area Diagrams 0
Number of Online Controls 1
Number of Storage Structures 1
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
M5-60 (mm) 20.000
Cv (Summer) 0.750
Region England and Wales
Ratio R 0.300
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C4-1 | 15 minute 5 year Winter I+20% | 161.140 | 159.847 | -0.093 | 0.000 | 0.61 | | 32.1 | OK |
| 1.001 | S06-C4-2 | 15 minute 5 year Winter I+20% | 160.281 | 159.020 | -0.061 | 0.000 | 0.85 | | 57.8 | OK |
| 1.002 | S06-C4-3 | 15 minute 5 year Winter I+20% | 158.800 | 157.717 | 0.117 | 0.000 | 1.02 | | 82.0 | SURCHARGED |
| 2.000 | S06-C4-4 | 15 minute 5 year Winter I+20% | 161.128 | 159.843 | -0.084 | 0.000 | 0.67 | | 35.3 | OK |
| 2.001 | S06-C4-5 | 15 minute 5 year Winter I+20% | 160.264 | 159.035 | -0.029 | 0.000 | 0.91 | | 62.5 | OK |
| 2.002 | S06-C4-6 | 15 minute 5 year Winter I+20% | 158.665 | 157.764 | 0.299 | 0.000 | 1.09 | | 87.1 | SURCHARGED |
| 2.003 | S06-C4-7 | 15 minute 5 year Winter I+20% | 157.070 | 155.839 | -0.031 | 0.000 | 0.81 | | 107.7 | OK |
| 1.003 | S06-C4-8 | 15 minute 5 year Winter I+20% | 156.901 | 155.726 | 0.025 | 0.000 | 1.75 | | 212.3 | SURCHARGED |
| 1.004 | S06-C4-9 | 30 minute 5 year Winter I+20% | 159.000 | 155.674 | 0.000 | 0.000 | 1.07 | | 196.4 | OK |
| 1.005 | S06-C4-10 | 480 minute 5 year Winter I+20% | 159.166 | 155.332 | -0.279 | 0.000 | 0.06 | 0.0 | 11.8 | OK |
| 1.006 | S06-C4-11 | 480 minute 5 year Winter I+20% | 159.166 | 154.941 | -0.495 | 0.000 | 0.01 | | 11.8 | OK |
| 1.007 | S06-C4-12 | 480 minute 5 year Winter I+20% | 143.600 | 141.984 | -0.416 | 0.000 | 0.10 | | 11.8 | OK |
| 1.008 | S06-C4-13 | 480 minute 5 year Winter I+20% | 143.600 | 141.935 | -0.437 | 0.000 | 0.07 | | 11.8 | OK |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 4 - Ch 41855

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C4-1 | 15 minute 100 year Winter I+40% | 161.140 | 161.143 | 1.203 | 3.077 | 0.99 | | 52.1 | FLOOD |
| 1.001 | S06-C4-2 | 30 minute 100 year Winter I+40% | 160.281 | 160.293 | 1.212 | 12.448 | 1.00 | | 68.4 | FLOOD |
| 1.002 | S06-C4-3 | 15 minute 100 year Winter I+40% | 158.800 | 158.809 | 1.209 | 8.807 | 1.27 | | 102.4 | FLOOD |
| 2.000 | S06-C4-4 | 15 minute 100 year Winter I+40% | 161.128 | 161.133 | 1.205 | 4.886 | 0.99 | | 52.2 | FLOOD |
| 2.001 | S06-C4-5 | 30 minute 100 year Winter I+40% | 160.264 | 160.280 | 1.216 | 16.465 | 1.06 | | 72.4 | FLOOD |
| 2.002 | S06-C4-6 | 15 minute 100 year Winter I+40% | 158.665 | 158.675 | 1.211 | 10.645 | 1.33 | | 106.3 | FLOOD |
| 2.003 | S06-C4-7 | 15 minute 100 year Winter I+40% | 157.070 | 156.269 | 0.399 | 0.000 | 1.24 | | 165.6 | SURCHARGED |
| 1.003 | S06-C4-8 | 15 minute 100 year Winter I+40% | 156.901 | 155.999 | 0.298 | 0.000 | 2.74 | | 333.6 | SURCHARGED |
| 1.004 | S06-C4-9 | 15 minute 100 year Winter I+40% | 159.000 | 155.802 | 0.128 | 0.000 | 1.83 | | 333.7 | SURCHARGED |
| 1.005 | S06-C4-10 | 480 minute 100 year Winter I+40% | 159.166 | 155.675 | 0.064 | 0.000 | 0.06 | 0.0 | 11.9 | SURCHARGED |
| 1.006 | S06-C4-11 | 960 minute 100 year Summer I+40% | 159.166 | 154.942 | -0.494 | 0.000 | 0.01 | | 11.9 | OK |
| 1.007 | S06-C4-12 | 480 minute 100 year Summer I+40% | 143.600 | 141.984 | -0.416 | 0.000 | 0.10 | | 11.9 | OK |
| 1.008 | S06-C4-13 | 360 minute 100 year Summer I+40% | 143.600 | 141.935 | -0.437 | 0.000 | 0.07 | | 11.9 | OK |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for Catchment 5 - Ch 42175

Pipe Sizes Min 150 Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 20.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

## Network Design Table for Catchment 5 - Ch 42175

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 11.857 | 0.400 | 29.6 | 0.067 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.001 | 25.055 | 0.400 | 62.6 | 0.063 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.002 | 26.984 | 0.437 | 61.7 | 0.046 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.003 | 26.256 | 0.384 | 68.4 | 0.066 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.004 | 26.749 | 0.442 | 60.5 | 0.071 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.005 | 26.544 | 0.384 | 69.1 | 0.078 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.006 | 37.672 | 0.553 | 68.1 | 0.107 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.007 | 60.782 | 1.700 | 35.8 | 0.180 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.008 | 60.782 | 0.178 | 340.5 | 0.288 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 1.009 | 33.185 | 0.293 | 113.4 | 0.298 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 1.010 | 27.666 | 0.436 | 63.5 | 0.242 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 1.011 | 26.873 | 0.216 | 124.4 | 0.159 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 2.000 | 30.621 | 0.364 | 84.1 | 0.079 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 2.001 | 19.608 | 0.125 | 156.5 | 0.090 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.012 | 22.865 | 0.046 | 500.0 | 0.233 | 0.00 | 0.0 | 0.600 | o | 675 | Pipe/Conduit | 🔓 |
| 1.013 | 94.503 | 0.189 | 500.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 675 | Pipe/Conduit | 🔓 |
| 1.014 | 19.056 | 0.038 | 500.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 675 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 77.69 | 5.11 | 150.150 | 0.067 | 0.0 | 0.0 | 0.0 | 1.86 | 32.8 | 14.2 |
| 1.001 | 76.26 | 5.36 | 149.675 | 0.130 | 0.0 | 0.0 | 0.0 | 1.66 | 65.8 | 26.9 |
| 1.002 | 74.79 | 5.63 | 149.275 | 0.176 | 0.0 | 0.0 | 0.0 | 1.67 | 66.3 | 35.7 |
| 1.003 | 73.37 | 5.90 | 148.838 | 0.242 | 0.0 | 0.0 | 0.0 | 1.58 | 63.0 | 48.0 |
| 1.004 | 72.06 | 6.17 | 148.454 | 0.313 | 0.0 | 0.0 | 0.0 | 1.68 | 67.0 | 61.1 |
| 1.005 | 70.95 | 6.40 | 147.937 | 0.391 | 0.0 | 0.0 | 0.0 | 1.89 | 133.9 | 75.2 |
| 1.006 | 69.46 | 6.73 | 147.553 | 0.498 | 0.0 | 0.0 | 0.0 | 1.91 | 134.8 | 93.7 |
| 1.007 | 67.82 | 7.12 | 147.000 | 0.678 | 0.0 | 0.0 | 0.0 | 2.64 | 186.5 | 124.5 |
| 1.008 | 64.22 | 8.04 | 145.150 | 0.966 | 0.0 | 0.0 | 0.0 | 1.10 | 174.3 | 168.0 |
| 1.009 | 63.19 | 8.33 | 144.972 | 1.264 | 0.0 | 0.0 | 0.0 | 1.91 | 303.5 | 216.3 |
| 1.010 | 62.57 | 8.51 | 144.679 | 1.506 | 0.0 | 0.0 | 0.0 | 2.56 | 406.5 | 255.2 |
| 1.011 | 61.74 | 8.76 | 144.243 | 1.664 | 0.0 | 0.0 | 0.0 | 1.82 | 289.7 | 278.3 |
| 2.000 | 75.67 | 5.47 | 144.817 | 0.079 | 0.0 | 0.0 | 0.0 | 1.10 | 19.4 | 16.2 |
| 2.001 | 74.01 | 5.78 | 144.377 | 0.169 | 0.0 | 0.0 | 0.0 | 1.04 | 41.5 | 33.9 |
| 1.012 | 60.69 | 9.08 | 143.802 | 2.067 | 0.0 | 0.0 | 0.0 | 1.17 | 417.0 | 339.6 |
| 1.013 | 56.75 | 10.44 | 143.756 | 2.067 | 0.0 | 0.0 | 0.0 | 1.17 | 417.0 | 339.6 |
| 1.014 | 56.03 | 10.71 | 143.567 | 2.067 | 0.0 | 0.0 | 0.0 | 1.17 | 417.0 | 339.6 |

## Network Design Table for Catchment 5 - Ch 42175

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.000 | 9.257 | 0.176 | 52.6 | 0.010 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 3.001 | 39.694 | 1.452 | 27.3 | 0.074 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 3.002 | 29.942 | 1.864 | 16.1 | 0.045 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 3.003 | 3.000 | 0.131 | 23.0 | 0.061 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.015 | 53.062 | 0.977 | 54.3 | 0.000 | 0.00 | 0.0 | 0.600 | o | 675 | Pipe/Conduit | 🔓 |
| 1.016 | 71.961 | 0.144 | 500.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 675 | Pipe/Conduit | 🔓 |

## Network Results Table

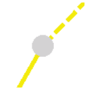
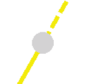
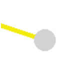
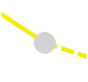
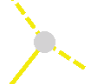
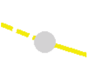
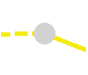
| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 3.000 | 77.66 | 5.11 | 147.677 | 0.010 | 0.0 | 0.0 | 0.0 | 1.39 | 24.6 | 2.1 |
| 3.001 | 75.74 | 5.45 | 147.501 | 0.084 | 0.0 | 0.0 | 0.0 | 1.93 | 34.2 | 17.1 |
| 3.002 | 74.68 | 5.65 | 146.048 | 0.128 | 0.0 | 0.0 | 0.0 | 2.53 | 44.6 | 26.0 |
| 3.003 | 74.58 | 5.67 | 144.110 | 0.189 | 0.0 | 0.0 | 0.0 | 2.74 | 109.1 | 38.2 |
| 1.015 | 55.40 | 10.96 | 143.529 | 2.256 | 0.0 | 0.0 | 0.0 | 3.56 | 1274.5 | 339.6 |
| 1.016 | 52.94 | 11.99 | 142.350 | 2.256 | 0.0 | 0.0 | 0.0 | 1.17 | 417.0 | 339.6 |

## Manhole Schedules for Catchment 5 - Ch 42175

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C5-1 | 151.500 | 1.350 | Open Manhole | 1200 | 1.000 | 150.150 | 150 | | | | |
| S06-C5-2 | 151.100 | 1.425 | Open Manhole | 1200 | 1.001 | 149.675 | 225 | 1.000 | 149.750 | 150 | |
| S06-C5-3 | 150.700 | 1.425 | Open Manhole | 1200 | 1.002 | 149.275 | 225 | 1.001 | 149.275 | 225 | |
| S06-C5-4 | 150.263 | 1.425 | Open Manhole | 1200 | 1.003 | 148.838 | 225 | 1.002 | 148.838 | 225 | |
| S06-C5-5 | 149.879 | 1.425 | Open Manhole | 1200 | 1.004 | 148.454 | 225 | 1.003 | 148.454 | 225 | |
| S06-C5-6 | 149.437 | 1.500 | Open Manhole | 1200 | 1.005 | 147.937 | 300 | 1.004 | 148.012 | 225 | |
| S06-C5-7 | 149.053 | 1.500 | Open Manhole | 1200 | 1.006 | 147.553 | 300 | 1.005 | 147.553 | 300 | |
| S06-C5-8 | 148.500 | 1.500 | Open Manhole | 1200 | 1.007 | 147.000 | 300 | 1.006 | 147.000 | 300 | |
| S06-C5-9 | 146.800 | 1.650 | Open Manhole | 1350 | 1.008 | 145.150 | 450 | 1.007 | 145.300 | 300 | |
| S06-C5-10 | 146.800 | 1.828 | Open Manhole | 1350 | 1.009 | 144.972 | 450 | 1.008 | 144.972 | 450 | |
| S06-C5-11 | 146.329 | 1.650 | Open Manhole | 1350 | 1.010 | 144.679 | 450 | 1.009 | 144.679 | 450 | |
| S06-C5-12 | 145.893 | 1.650 | Open Manhole | 1350 | 1.011 | 144.243 | 450 | 1.010 | 144.243 | 450 | |
| S06-C5-13 | 146.167 | 1.350 | Open Manhole | 1200 | 2.000 | 144.817 | 150 | | | | |
| S06-C5-14 | 145.802 | 1.425 | Open Manhole | 1200 | 2.001 | 144.377 | 225 | 2.000 | 144.452 | 150 | |
| S06-C5-15 | 145.677 | 1.875 | Open Manhole | 1500 | 1.012 | 143.802 | 675 | 1.011 | 144.027 | 450 | |
| | | | | | | | | 2.001 | 144.252 | 225 | |
| S06-C5-16 | 147.282 | 3.526 | Open Manhole | 1500 | 1.013 | 143.756 | 675 | 1.012 | 143.756 | 675 | |
| S06-C5-17 | 145.742 | 2.175 | Open Manhole | 1500 | 1.014 | 143.567 | 675 | 1.013 | 143.567 | 675 | |
| S06-C5-18 | 149.027 | 1.350 | Open Manhole | 1200 | 3.000 | 147.677 | 150 | | | | |
| S06-C5-19 | 148.851 | 1.350 | Open Manhole | 1200 | 3.001 | 147.501 | 150 | 3.000 | 147.501 | 150 | |
| S06-C5-20 | 147.398 | 1.350 | Open Manhole | 1200 | 3.002 | 146.048 | 150 | 3.001 | 146.048 | 150 | |
| S06-C5-21 | 145.535 | 1.425 | Open Manhole | 1200 | 3.003 | 144.110 | 225 | 3.002 | 144.185 | 150 | |
| S06-C5-22 | 145.535 | 2.006 | Open Manhole | 1500 | 1.015 | 143.529 | 675 | 1.014 | 143.529 | 675 | |
| | | | | | | | | 3.003 | 143.979 | 225 | |
| S06-C5-23 | 146.253 | 3.903 | Open Manhole | 1500 | 1.016 | 142.350 | 675 | 1.015 | 142.552 | 675 | 202 |
| Outfall 5 | 145.695 | 3.489 | Open Manhole | 0 | | OUTFALL | | 1.016 | 142.206 | 675 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C5-1 | 373478.103 | 517117.990 | 373478.103 | 517117.990 | Required |  |
| S06-C5-2 | 373467.374 | 517123.038 | 373467.374 | 517123.038 | Required |  |
| S06-C5-3 | 373480.129 | 517144.604 | 373480.129 | 517144.604 | Required |  |
| S06-C5-4 | 373483.724 | 517171.348 | 373483.724 | 517171.348 | Required |  |
| S06-C5-5 | 373471.859 | 517194.770 | 373471.859 | 517194.770 | Required |  |
| S06-C5-6 | 373448.395 | 517207.614 | 373448.395 | 517207.614 | Required |  |
| S06-C5-7 | 373421.990 | 517204.900 | 373421.990 | 517204.900 | Required |  |

## Manhole Schedules for Catchment 5 - Ch 42175

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S06-C5-8 | 373395.889 | 517177.735 | 373395.889 | 517177.735 | Required |  |
| S06-C5-9 | 373365.706 | 517124.977 | 373365.706 | 517124.977 | Required |  |
| S06-C5-10 | 373335.523 | 517072.219 | 373335.523 | 517072.219 | Required |  |
| S06-C5-11 | 373326.846 | 517040.189 | 373326.846 | 517040.189 | Required |  |
| S06-C5-12 | 373332.458 | 517013.099 | 373332.458 | 517013.099 | Required |  |
| S06-C5-13 | 373393.794 | 516971.102 | 373393.794 | 516971.102 | Required |  |
| S06-C5-14 | 373364.699 | 516980.647 | 373364.699 | 516980.647 | Required |  |
| S06-C5-15 | 373348.295 | 516991.388 | 373348.295 | 516991.388 | Required |  |
| S06-C5-16 | 373334.156 | 516973.418 | 373334.156 | 516973.418 | Required |  |
| S06-C5-17 | 373421.615 | 516937.616 | 373421.615 | 516937.616 | Required |  |
| S06-C5-18 | 373459.258 | 517000.213 | 373459.258 | 517000.213 | Required |  |
| S06-C5-19 | 373467.858 | 516996.787 | 373467.858 | 516996.787 | Required |  |
| S06-C5-20 | 373447.435 | 516962.751 | 373447.435 | 516962.751 | Required |  |
| S06-C5-21 | 373437.979 | 516934.341 | 373437.979 | 516934.341 | Required |  |
| S06-C5-22 | 373439.814 | 516931.968 | 373439.814 | 516931.968 | Required |  |
| S06-C5-23 | 373492.873 | 516932.594 | 373492.873 | 516932.594 | Required |  |
| Outfall 5 | 373559.761 | 516906.056 | | | No Entry |  |

## Area Summary for Catchment 5 - Ch 42175

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | As Zoned | Default | 100 | 0.067 | 0.067 | 0.067 |
| 1.001 | As Zoned | Default | 100 | 0.063 | 0.063 | 0.063 |
| 1.002 | As Zoned | Default | 100 | 0.046 | 0.046 | 0.046 |
| 1.003 | As Zoned | Default | 100 | 0.066 | 0.066 | 0.066 |
| 1.004 | As Zoned | Default | 100 | 0.071 | 0.071 | 0.071 |
| 1.005 | As Zoned | Default | 100 | 0.078 | 0.078 | 0.078 |
| 1.006 | As Zoned | Default | 100 | 0.107 | 0.107 | 0.107 |
| 1.007 | As Zoned | Default | 100 | 0.180 | 0.180 | 0.180 |
| 1.008 | As Zoned | Default | 100 | 0.288 | 0.288 | 0.288 |
| 1.009 | As Zoned | Default | 100 | 0.298 | 0.298 | 0.298 |
| 1.010 | As Zoned | Default | 100 | 0.242 | 0.242 | 0.242 |
| 1.011 | As Zoned | Default | 100 | 0.159 | 0.159 | 0.159 |
| 2.000 | As Zoned | Default | 100 | 0.079 | 0.079 | 0.079 |
| 2.001 | As Zoned | Default | 100 | 0.090 | 0.090 | 0.090 |
| 1.012 | As Zoned | Default | 100 | 0.076 | 0.076 | 0.076 |
|  | As Zoned | Default | 100 | 0.040 | 0.040 | 0.040 |
|  | As Zoned | Default | 100 | 0.117 | 0.117 | 0.233 |
| 1.013 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.014 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 3.000 | As Zoned | Default | 100 | 0.010 | 0.010 | 0.010 |
| 3.001 | As Zoned | Default | 100 | 0.074 | 0.074 | 0.074 |
| 3.002 | As Zoned | Default | 100 | 0.045 | 0.045 | 0.045 |
| 3.003 | As Zoned | Default | 100 | 0.061 | 0.061 | 0.061 |
| 1.015 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.016 | - | - | 100 | 0.000 | 0.000 | 0.000 |
|  |  |  |  | Total | Total | Total |
|  |  |  |  | 2.256 | 2.256 | 2.256 |

## Online Controls for Catchment 5 - Ch 42175

### Hydro-Brake® Optimum Manhole: S06-C5-23, DS/PN: 1.016, Volume (m³): 25.3

| | |
|---|---|
| Unit Reference | MD-SHE-0182-1730-1300-1730 |
| Design Head (m) | 1.300 |
| Design Flow (l/s) | 17.3 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 182 |
| Invert Level (m) | 142.350 |
| Minimum Outlet Pipe Diameter (mm) | 225 |
| Suggested Manhole Diameter (mm) | 1500 |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.300 | 17.3 | Kick-Flo® | 0.868 | 14.3 |
| Flush-Flo™ | 0.395 | 17.3 | Mean Flow over Head Range | - | 14.9 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 6.4 | 0.800 | 15.4 | 2.000 | 21.2 | 4.000 | 29.6 | 7.000 | 38.8 |
| 0.200 | 16.0 | 1.000 | 15.3 | 2.200 | 22.2 | 4.500 | 31.3 | 7.500 | 40.1 |
| 0.300 | 17.1 | 1.200 | 16.7 | 2.400 | 23.2 | 5.000 | 33.0 | 8.000 | 41.4 |
| 0.400 | 17.3 | 1.400 | 17.9 | 2.600 | 24.1 | 5.500 | 34.5 | 8.500 | 42.6 |
| 0.500 | 17.1 | 1.600 | 19.1 | 3.000 | 25.8 | 6.000 | 36.0 | 9.000 | 43.8 |
| 0.600 | 16.8 | 1.800 | 20.2 | 3.500 | 27.8 | 6.500 | 37.4 | 9.500 | 45.0 |

## Offline Controls for Catchment 5 - Ch 42175

### Weir Manhole: S06-C5-23, DS/PN: 1.016, Loop to PN: None

Discharge Coef 0.544 Width (m) 10.000 Invert Level (m) 143.650

## Storage Structures for Catchment 5 - Ch 42175

### Tank or Pond Manhole: S06-C5-23, DS/PN: 1.016

Invert Level (m) 142.350

| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|---|---|
| 0.000 | 1292.7 | 1.300 | 1900.0 | 1.301 | 2053.7 | 2.328 | 3416.5 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 5 - Ch 42175

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m$^3$/ha Storage 0.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m$^3$) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C5-1 | 15 minute 5 year Winter I+20% | 151.500 | 150.232 | -0.068 | 0.000 | 0.58 | | 17.1 | OK |
| 1.001 | S06-C5-2 | 15 minute 5 year Winter I+20% | 151.100 | 149.789 | -0.111 | 0.000 | 0.50 | | 30.4 | OK |
| 1.002 | S06-C5-3 | 15 minute 5 year Winter I+20% | 150.700 | 149.410 | -0.090 | 0.000 | 0.66 | | 40.3 | OK |
| 1.003 | S06-C5-4 | 15 minute 5 year Winter I+20% | 150.263 | 149.050 | -0.013 | 0.000 | 0.90 | | 52.6 | OK |
| 1.004 | S06-C5-5 | 15 minute 5 year Winter I+20% | 149.879 | 148.737 | 0.058 | 0.000 | 1.07 | | 66.5 | SURCHARGED |
| 1.005 | S06-C5-6 | 15 minute 5 year Winter I+20% | 149.437 | 148.120 | -0.117 | 0.000 | 0.68 | | 81.7 | OK |
| 1.006 | S06-C5-7 | 15 minute 5 year Winter I+20% | 149.053 | 147.764 | -0.089 | 0.000 | 0.83 | | 103.1 | OK |
| 1.007 | S06-C5-8 | 15 minute 5 year Winter I+20% | 148.500 | 147.203 | -0.097 | 0.000 | 0.78 | | 139.0 | OK |
| 1.008 | S06-C5-9 | 15 minute 5 year Winter I+20% | 146.800 | 145.676 | 0.076 | 0.000 | 1.19 | | 191.8 | SURCHARGED |
| 1.009 | S06-C5-10 | 15 minute 5 year Winter I+20% | 146.800 | 145.341 | -0.081 | 0.000 | 0.91 | | 239.1 | OK |
| 1.010 | S06-C5-11 | 15 minute 5 year Winter I+20% | 146.329 | 145.103 | -0.026 | 0.000 | 0.81 | | 279.3 | OK |
| 1.011 | S06-C5-12 | 15 minute 5 year Winter I+20% | 145.893 | 144.820 | 0.127 | 0.000 | 1.24 | | 305.3 | SURCHARGED |
| 2.000 | S06-C5-13 | 15 minute 5 year Winter I+20% | 146.167 | 145.001 | 0.035 | 0.000 | 1.04 | | 19.3 | SURCHARGED |
| 2.001 | S06-C5-14 | 15 minute 5 year Winter I+20% | 145.802 | 144.608 | 0.005 | 0.000 | 0.99 | | 37.2 | SURCHARGED |
| 1.012 | S06-C5-15 | 15 minute 5 year Winter I+20% | 145.677 | 144.477 | 0.000 | 0.000 | 1.26 | | 377.3 | OK |
| 1.013 | S06-C5-16 | 15 minute 5 year Winter I+20% | 147.282 | 144.401 | -0.031 | 0.000 | 0.91 | | 348.9 | OK |
| 1.014 | S06-C5-17 | 30 minute 5 year Summer I+20% | 145.742 | 144.244 | 0.002 | 0.000 | 1.23 | | 323.4 | SURCHARGED |
| 3.000 | S06-C5-18 | 15 minute 5 year Winter I+20% | 149.027 | 147.710 | -0.116 | 0.000 | 0.11 | | 2.5 | OK |
| 3.001 | S06-C5-19 | 15 minute 5 year Winter I+20% | 148.851 | 147.581 | -0.070 | 0.000 | 0.55 | | 18.2 | OK |
| 3.002 | S06-C5-20 | 15 minute 5 year Winter I+20% | 147.398 | 146.138 | -0.061 | 0.000 | 0.65 | | 27.8 | OK |
| 3.003 | S06-C5-21 | 15 minute 5 year Winter I+20% | 145.535 | 144.265 | -0.070 | 0.000 | 0.80 | | 40.9 | OK |
| 1.015 | S06-C5-22 | 15 minute 5 year Winter I+20% | 145.535 | 143.796 | -0.408 | 0.000 | 0.33 | | 365.7 | OK |
| 1.016 | S06-C5-23 | 480 minute 5 year Winter I+20% | 146.253 | 142.800 | -0.225 | 0.000 | 0.05 | 0.0 | 17.2 | OK |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 5 - Ch 42175

### Simulation Criteria

Areal Reduction Factor 1.000
Hot Start (mins) 0
Hot Start Level (mm) 0
Manhole Headloss Coeff (Global) 0.500
Foul Sewage per hectare (l/s) 0.000
Additional Flow - % of Total Flow 0.000
MADD Factor * 10m³/ha Storage 0.000
Inlet Coeffiecient 0.800
Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0
Number of Online Controls 1
Number of Offline Controls 1
Number of Storage Structures 1
Number of Time/Area Diagrams 0
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
Region England and Wales
M5-60 (mm) 20.000
Ratio R 0.300
Cv (Summer) 0.750
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C5-1 | 15 minute 100 year Winter I+40% | 151.500 | 151.501 | 1.201 | 0.775 | 1.12 | | 33.3 | FLOOD |
| 1.001 | S06-C5-2 | 15 minute 100 year Winter I+40% | 151.100 | 151.100 | 1.200 | 0.354 | 1.00 | | 60.4 | FLOOD |
| 1.002 | S06-C5-3 | 15 minute 100 year Winter I+40% | 150.700 | 150.704 | 1.204 | 3.847 | 1.00 | | 61.3 | FLOOD |
| 1.003 | S06-C5-4 | 30 minute 100 year Winter I+40% | 150.263 | 150.275 | 1.212 | 11.593 | 1.29 | | 75.2 | FLOOD |
| 1.004 | S06-C5-5 | 15 minute 100 year Winter I+40% | 149.879 | 149.886 | 1.207 | 6.596 | 1.64 | | 101.5 | FLOOD |
| 1.005 | S06-C5-6 | 15 minute 100 year Winter I+40% | 149.437 | 149.437 | 1.200 | 0.286 | 0.96 | | 115.9 | FLOOD |
| 1.006 | S06-C5-7 | 15 minute 100 year Winter I+40% | 149.053 | 149.061 | 1.208 | 8.292 | 1.02 | | 126.9 | FLOOD |
| 1.007 | S06-C5-8 | 15 minute 100 year Winter I+40% | 148.500 | 148.509 | 1.209 | 9.141 | 0.99 | | 176.0 | FLOOD |
| 1.008 | S06-C5-9 | 15 minute 100 year Winter I+40% | 146.800 | 146.853 | 1.253 | 53.412 | 2.16 | | 348.2 | FLOOD |
| 1.009 | S06-C5-10 | 15 minute 100 year Summer I+40% | 146.800 | 146.800 | 1.379 | 0.586 | 1.30 | | 344.6 | FLOOD |
| 1.010 | S06-C5-11 | 15 minute 100 year Winter I+40% | 146.329 | 146.342 | 1.213 | 12.947 | 1.20 | | 416.2 | FLOOD |
| 1.011 | S06-C5-12 | 15 minute 100 year Winter I+40% | 145.893 | 145.893 | 1.200 | 0.028 | 1.90 | | 465.4 | FLOOD |
| 2.000 | S06-C5-13 | 15 minute 100 year Winter I+40% | 146.167 | 146.170 | 1.203 | 3.352 | 1.84 | | 34.2 | FLOOD |
| 2.001 | S06-C5-14 | 15 minute 100 year Winter I+40% | 145.802 | 145.683 | 1.081 | 0.000 | 1.96 | | 73.5 | FLOOD RISK |
| 1.012 | S06-C5-15 | 15 minute 100 year Winter I+40% | 145.677 | 145.192 | 0.715 | 0.000 | 2.23 | | 667.6 | SURCHARGED |
| 1.013 | S06-C5-16 | 15 minute 100 year Winter I+40% | 147.282 | 144.918 | 0.487 | 0.000 | 1.59 | | 607.9 | SURCHARGED |
| 1.014 | S06-C5-17 | 15 minute 100 year Winter I+40% | 145.742 | 144.400 | 0.158 | 0.000 | 2.31 | | 605.1 | SURCHARGED |
| 3.000 | S06-C5-18 | 15 minute 100 year Winter I+40% | 149.027 | 148.880 | 1.054 | 0.000 | 0.50 | | 10.8 | FLOOD RISK |
| 3.001 | S06-C5-19 | 15 minute 100 year Winter I+40% | 148.851 | 148.851 | 1.200 | 0.193 | 1.03 | | 33.9 | FLOOD |
| 3.002 | S06-C5-20 | 15 minute 100 year Winter I+40% | 147.398 | 147.398 | 1.200 | 0.040 | 1.24 | | 53.1 | FLOOD |
| 3.003 | S06-C5-21 | 15 minute 100 year Winter I+40% | 145.535 | 144.577 | 0.242 | 0.000 | 1.67 | | 85.1 | SURCHARGED |
| 1.015 | S06-C5-22 | 15 minute 100 year Winter I+40% | 145.535 | 143.913 | -0.291 | 0.000 | 0.62 | | 679.5 | OK |
| 1.016 | S06-C5-23 | 960 minute 100 year Winter I+40% | 146.253 | 143.437 | 0.412 | 0.000 | 0.05 | 0.0 | 17.2 | SURCHARGED |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for Catchment 6 - Ch 42170

Pipe Sizes Min 150 Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 20.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 0.750 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

## Network Design Table for Catchment 6 - Ch 42170

| **PN** | **Length (m)** | **Fall (m)** | **Slope (1:X)** | **I.Area (ha)** | **T.E. (mins)** | **Base Flow (l/s)** | **k (mm)** | **HYD SECT** | **DIA (mm)** | **Section Type** | **Auto Design** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 32.256 | 1.516 | 21.3 | 0.058 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.001 | 13.242 | 0.079 | 167.9 | 0.083 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.002 | 20.157 | 0.127 | 158.5 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.003 | 23.053 | 0.982 | 23.5 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.004 | 44.819 | 0.267 | 167.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |

## Network Results Table

| **PN** | **Rain (mm/hr)** | **T.C. (mins)** | **US/IL (m)** | **Σ I.Area (ha)** | **Σ Base Flow (l/s)** | **Foul (l/s)** | **Add Flow (l/s)** | **Vel (m/s)** | **Cap (l/s)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 76.89 | 5.25 | 141.797 | 0.058 | 0.0 | 0.0 | 0.0 | 2.19 | 38.8 | 12.2 |
| 1.001 | 75.68 | 5.46 | 140.206 | 0.141 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 28.9 |
| 1.002 | 73.96 | 5.79 | 140.127 | 0.141 | 0.0 | 0.0 | 0.0 | 1.04 | 41.2 | 28.9 |
| 1.003 | 73.24 | 5.93 | 140.000 | 0.141 | 0.0 | 0.0 | 0.0 | 2.71 | 107.8 | 28.9 |
| 1.004 | 69.72 | 6.67 | 139.018 | 0.141 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 28.9 |

## Manhole Schedules for Catchment 6 - Ch 42170

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C6-1 | 142.697 | 0.900 | Open Manhole | 1200 | 1.000 | 141.797 | 150 | | | | |
| S06-C6-2 | 141.181 | 0.975 | Open Manhole | 1200 | 1.001 | 140.206 | 225 | 1.000 | 140.281 | 150 | |
| S06-C6-3 | 142.014 | 1.887 | Open Manhole | 1200 | 1.002 | 140.127 | 225 | 1.001 | 140.127 | 225 | |
| S06-C6-4 | 141.979 | 1.979 | Open Manhole | 1200 | 1.003 | 140.000 | 225 | 1.002 | 140.000 | 225 | |
| S06-C6-5 | 140.000 | 0.982 | Open Manhole | 1200 | 1.004 | 139.018 | 225 | 1.003 | 139.018 | 225 | |
| Outfall 6 | 140.000 | 1.249 | Open Manhole | 0 | | OUTFALL | | 1.004 | 138.751 | 225 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C6-1 | 373425.861 | 516893.002 | 373425.861 | 516893.002 | Required |  |
| S06-C6-2 | 373419.185 | 516861.444 | 373419.185 | 516861.444 | Required | |
| S06-C6-3 | 373432.293 | 516859.565 | 373432.293 | 516859.565 | Required | |
| S06-C6-4 | 373450.165 | 516868.887 | 373450.165 | 516868.887 | Required | |
| S06-C6-5 | 373470.113 | 516857.332 | 373470.113 | 516857.332 | Required | |
| Outfall 6 | 373514.782 | 516853.665 | | | No Entry | |

## Area Summary for Catchment 6 - Ch 42170

| **Pipe Number** | **PIMP Type** | **PIMP Name** | **PIMP (%)** | **Gross Area (ha)** | **Imp. Area (ha)** | **Pipe Total (ha)** |
|---|---|---|---|---|---|---|
| 1.000 | As Zoned | Default | 100 | 0.058 | 0.058 | 0.058 |
| 1.001 | As Zoned | Default | 100 | 0.083 | 0.083 | 0.083 |
| 1.002 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.003 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.004 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total | Total | Total |
| | | | | 0.141 | 0.141 | 0.141 |

## Online Controls for Catchment 6 - Ch 42170

### Hydro-Brake® Optimum Manhole: S06-C6-4, DS/PN: 1.003, Volume (m³): 3.0

| | |
|---|---|
| Unit Reference | MD-SHE-0065-1900-1000-1900 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 1.9 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 65 |
| Invert Level (m) | 140.000 |
| Minimum Outlet Pipe Diameter (mm) | 100 |
| Suggested Manhole Diameter (mm) | 1200 |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.000 | 1.9 | Kick-Flo® | 0.582 | 1.5 |
| Flush-Flo™ | 0.286 | 1.8 | Mean Flow over Head Range | - | 1.6 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 1.5 | 0.800 | 1.7 | 2.000 | 2.6 | 4.000 | 3.6 | 7.000 | 4.7 |
| 0.200 | 1.8 | 1.000 | 1.9 | 2.200 | 2.7 | 4.500 | 3.8 | 7.500 | 4.8 |
| 0.300 | 1.8 | 1.200 | 2.1 | 2.400 | 2.8 | 5.000 | 4.0 | 8.000 | 5.0 |
| 0.400 | 1.8 | 1.400 | 2.2 | 2.600 | 2.9 | 5.500 | 4.2 | 8.500 | 5.1 |
| 0.500 | 1.7 | 1.600 | 2.4 | 3.000 | 3.1 | 6.000 | 4.3 | 9.000 | 5.3 |
| 0.600 | 1.5 | 1.800 | 2.5 | 3.500 | 3.4 | 6.500 | 4.5 | 9.500 | 5.4 |

## Offline Controls for Catchment 6 - Ch 42170

### Weir Manhole: S06-C6-4, DS/PN: 1.003, Loop to PN: None

Discharge Coef 0.544 Width (m) 10.000 Invert Level (m) 141.000

## Storage Structures for Catchment 6 - Ch 42170

### Tank or Pond Manhole: S06-C6-4, DS/PN: 1.003

Invert Level (m) 140.000

| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|---|---|
| 0.000 | 127.2 | 1.000 | 282.5 | 1.001 | 340.1 | 1.979 | 894.3 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 6 - Ch 42170

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 0.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | | | |
|---|---|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Offline Controls | 1 | Number of Time/Area Diagrams | 0 |
| Number of Online Controls | 1 | Number of Storage Structures | 1 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | | | |
|---|---|---|---|---|---|
| Rainfall Model | | FSR M5-60 (mm) | 20.000 | Cv (Summer) | 0.750 |
| Region | England and Wales | Ratio R | 0.300 | Cv (Winter) | 0.840 |

| | |
|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 |
| Analysis Timestep | 2.5 Second Increment (Extended) |
| DTS Status | OFF |
| DVD Status | ON |
| Inertia Status | ON |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 240, 360, 480, 960, 1440 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| **PN** | **US/MH Name** | **Event** | **US/CL (m)** | **Water Level (m)** | **Surcharged Depth (m)** | **Flooded Volume (m³)** | **Flow / Cap.** | **Overflow (l/s)** | **Pipe Flow (l/s)** | **Status** |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C6-1 | 15 minute 5 year Winter I+20% | 142.697 | 141.863 | -0.084 | 0.000 | 0.40 | | 14.8 | OK |
| 1.001 | S06-C6-2 | 15 minute 5 year Winter I+20% | 141.181 | 140.380 | -0.051 | 0.000 | 0.93 | | 32.3 | OK |
| 1.002 | S06-C6-3 | 15 minute 5 year Winter I+20% | 142.014 | 140.291 | -0.061 | 0.000 | 0.87 | | 32.5 | OK |
| 1.003 | S06-C6-4 | 360 minute 5 year Winter I+20% | 141.979 | 140.213 | -0.012 | 0.000 | 0.02 | 0.0 | 1.8 | OK |
| 1.004 | S06-C6-5 | 360 minute 5 year Winter I+20% | 140.000 | 139.049 | -0.194 | 0.000 | 0.05 | | 1.8 | OK |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 6 - Ch 42170

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| **PN** | **US/MH Name** | **Event** | **US/CL (m)** | **Water Level (m)** | **Surcharged Depth (m)** | **Flooded Volume (m³)** | **Flow / Cap.** | **Overflow (l/s)** | **Pipe Flow (l/s)** | **Status** |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C6-1 | 15 minute 100 year Winter I+40% | 142.697 | 142.160 | 0.213 | 0.000 | 0.84 | | 31.4 | SURCHARGED |
| 1.001 | S06-C6-2 | 15 minute 100 year Winter I+40% | 141.181 | 141.149 | 0.718 | 0.000 | 2.19 | | 75.8 | FLOOD RISK |
| 1.002 | S06-C6-3 | 15 minute 100 year Winter I+40% | 142.014 | 140.750 | 0.398 | 0.000 | 2.04 | | 76.0 | SURCHARGED |
| 1.003 | S06-C6-4 | 360 minute 100 year Winter I+40% | 141.979 | 140.516 | 0.291 | 0.000 | 0.02 | 0.0 | 1.8 | SURCHARGED |
| 1.004 | S06-C6-5 | 1440 minute 100 year Summer I+40% | 140.000 | 139.049 | -0.194 | 0.000 | 0.05 | | 1.8 | OK |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for Catchment 7 - Ch 42250

Pipe Sizes Min 150 Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 20.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

## Network Design Table for Catchment 7 - Ch 42250

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 71.103 | 5.874 | 12.1 | 0.231 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.001 | 95.000 | 0.427 | 222.5 | 0.141 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.002 | 95.398 | 0.297 | 321.0 | 0.119 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 2.000 | 90.000 | 1.950 | 46.2 | 0.144 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.001 | 90.000 | 4.500 | 20.0 | 0.129 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.002 | 69.066 | 1.701 | 40.6 | 0.107 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.003 | 69.066 | 0.380 | 181.9 | 0.104 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 3.000 | 78.537 | 0.468 | 167.9 | 0.148 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 3.001 | 90.000 | 1.071 | 84.0 | 0.141 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 3.002 | 89.999 | 1.785 | 50.4 | 0.164 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 3.003 | 89.996 | 2.615 | 34.4 | 0.187 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 3.004 | 89.996 | 3.397 | 26.5 | 0.187 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 3.005 | 90.000 | 3.603 | 25.0 | 0.186 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 3.006 | 90.040 | 2.872 | 31.3 | 0.190 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 3.007 | 60.185 | 0.723 | 83.2 | 0.128 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 2.004 | 25.919 | 0.118 | 220.1 | 0.000 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 75.99 | 5.41 | 152.850 | 0.231 | 0.0 | 0.0 | 0.0 | 2.91 | 51.5 | 47.5 |
| 1.001 | 68.67 | 6.91 | 146.826 | 0.372 | 0.0 | 0.0 | 0.0 | 1.05 | 74.2 | 69.2 |
| 1.002 | 62.62 | 8.50 | 146.324 | 0.491 | 0.0 | 0.0 | 0.0 | 1.01 | 111.1 | 83.3 |
| 2.000 | 74.02 | 5.78 | 154.825 | 0.144 | 0.0 | 0.0 | 0.0 | 1.93 | 76.8 | 28.9 |
| 2.001 | 71.49 | 6.29 | 152.875 | 0.273 | 0.0 | 0.0 | 0.0 | 2.94 | 116.9 | 52.9 |
| 2.002 | 68.96 | 6.85 | 148.375 | 0.381 | 0.0 | 0.0 | 0.0 | 2.06 | 81.9 | 71.1 |
| 2.003 | 65.47 | 7.71 | 146.524 | 0.485 | 0.0 | 0.0 | 0.0 | 1.34 | 148.0 | 85.9 |
| 3.000 | 71.43 | 6.30 | 162.829 | 0.148 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 28.6 |
| 3.001 | 66.85 | 7.35 | 162.361 | 0.289 | 0.0 | 0.0 | 0.0 | 1.43 | 56.8 | 52.3 |
| 3.002 | 64.27 | 8.03 | 161.215 | 0.453 | 0.0 | 0.0 | 0.0 | 2.22 | 156.9 | 78.9 |
| 3.003 | 62.31 | 8.59 | 159.430 | 0.640 | 0.0 | 0.0 | 0.0 | 2.69 | 190.1 | 108.0 |
| 3.004 | 60.72 | 9.07 | 156.815 | 0.827 | 0.0 | 0.0 | 0.0 | 3.07 | 216.8 | 136.0 |
| 3.005 | 59.26 | 9.55 | 153.417 | 1.013 | 0.0 | 0.0 | 0.0 | 3.16 | 223.3 | 162.6 |
| 3.006 | 57.72 | 10.08 | 149.815 | 1.203 | 0.0 | 0.0 | 0.0 | 2.82 | 199.2 | 188.1 |
| 3.007 | 56.35 | 10.59 | 146.867 | 1.331 | 0.0 | 0.0 | 0.0 | 1.99 | 219.5 | 203.1 |
| 2.004 | 55.61 | 10.87 | 145.994 | 1.816 | 0.0 | 0.0 | 0.0 | 1.51 | 326.0 | 273.4 |

## Network Design Table for Catchment 7 - Ch 42250

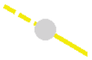
| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.000 | 78.217 | 0.464 | 168.4 | 0.104 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 4.001 | 90.005 | 0.725 | 124.2 | 0.104 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 4.002 | 89.991 | 1.794 | 50.2 | 0.116 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 4.003 | 89.984 | 2.605 | 34.5 | 0.158 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 4.004 | 89.996 | 3.369 | 26.7 | 0.181 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 4.005 | 90.000 | 3.583 | 25.1 | 0.164 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 4.006 | 90.000 | 2.843 | 31.7 | 0.122 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 4.007 | 59.369 | 0.622 | 95.4 | 0.070 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 1.003 | 75.860 | 0.152 | 500.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔓 |
| 1.004 | 86.156 | 0.587 | 146.8 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔓 |

## Network Results Table

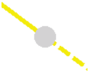
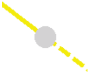
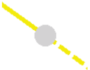
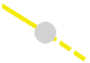
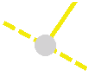
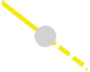
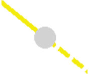
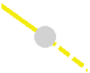
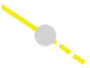
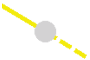
| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 4.000 | 71.45 | 6.30 | 162.434 | 0.104 | 0.0 | 0.0 | 0.0 | 1.00 | 39.9 | 20.1 |
| 4.001 | 65.96 | 7.58 | 161.970 | 0.208 | 0.0 | 0.0 | 0.0 | 1.17 | 46.6 | 37.1 |
| 4.002 | 62.99 | 8.39 | 161.245 | 0.324 | 0.0 | 0.0 | 0.0 | 1.85 | 73.6 | 55.3 |
| 4.003 | 60.76 | 9.06 | 159.451 | 0.482 | 0.0 | 0.0 | 0.0 | 2.23 | 88.8 | 79.4 |
| 4.004 | 59.25 | 9.55 | 156.771 | 0.663 | 0.0 | 0.0 | 0.0 | 3.05 | 215.9 | 106.4 |
| 4.005 | 57.88 | 10.03 | 153.402 | 0.827 | 0.0 | 0.0 | 0.0 | 3.15 | 222.6 | 129.7 |
| 4.006 | 56.42 | 10.56 | 149.819 | 0.949 | 0.0 | 0.0 | 0.0 | 2.80 | 198.2 | 145.0 |
| 4.007 | 55.05 | 11.09 | 146.901 | 1.019 | 0.0 | 0.0 | 0.0 | 1.86 | 204.9 | 151.9 |
| 1.003 | 52.66 | 12.11 | 145.652 | 3.326 | 0.0 | 0.0 | 0.0 | 1.24 | 549.9 | 474.3 |
| 1.004 | 51.31 | 12.73 | 145.500 | 3.326 | 0.0 | 0.0 | 0.0 | 2.31 | 1019.6 | 474.3 |

## Manhole Schedules for Catchment 7 - Ch 42250

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C07-1 | 154.200 | 1.350 | Open Manhole | 1200 | 1.000 | 152.850 | 150 | | | | |
| S06-C07-2 | 147.854 | 1.028 | Open Manhole | 1200 | 1.001 | 146.826 | 300 | 1.000 | 146.976 | 150 | |
| S06-C07-3 | 147.854 | 1.530 | Open Manhole | 1350 | 1.002 | 146.324 | 375 | 1.001 | 146.399 | 300 | |
| S06-C07-4 | 156.250 | 1.425 | Open Manhole | 1200 | 2.000 | 154.825 | 225 | | | | |
| S06-C07-5 | 154.300 | 1.425 | Open Manhole | 1200 | 2.001 | 152.875 | 225 | 2.000 | 152.875 | 225 | |
| S06-C07-6 | 149.800 | 1.425 | Open Manhole | 1200 | 2.002 | 148.375 | 225 | 2.001 | 148.375 | 225 | |
| S06-C07-7 | 148.099 | 1.575 | Open Manhole | 1350 | 2.003 | 146.524 | 375 | 2.002 | 146.674 | 225 | |
| S06-C07-8 | 164.254 | 1.425 | Open Manhole | 1200 | 3.000 | 162.829 | 225 | | | | |
| S06-C07-9 | 164.020 | 1.659 | Open Manhole | 1200 | 3.001 | 162.361 | 225 | 3.000 | 162.361 | 225 | |
| S06-C07-10 | 162.715 | 1.500 | Open Manhole | 1200 | 3.002 | 161.215 | 300 | 3.001 | 161.290 | 225 | |
| S06-C07-11 | 160.930 | 1.500 | Open Manhole | 1200 | 3.003 | 159.430 | 300 | 3.002 | 159.430 | 300 | |
| S06-C07-12 | 158.315 | 1.500 | Open Manhole | 1200 | 3.004 | 156.815 | 300 | 3.003 | 156.815 | 300 | |
| S06-C07-13 | 154.917 | 1.500 | Open Manhole | 1200 | 3.005 | 153.417 | 300 | 3.004 | 153.417 | 300 | |
| S06-C07-14 | 151.315 | 1.500 | Open Manhole | 1200 | 3.006 | 149.815 | 300 | 3.005 | 149.815 | 300 | |
| S06-C07-15 | 148.442 | 1.575 | Open Manhole | 1350 | 3.007 | 146.867 | 375 | 3.006 | 146.942 | 300 | |
| S06-C07-16 | 147.713 | 1.719 | Open Manhole | 1500 | 2.004 | 145.994 | 525 | 2.003 | 146.144 | 375 | |
| | | | | | | | | 3.007 | 146.144 | 375 | |
| S06-C07-17 | 163.859 | 1.425 | Open Manhole | 1200 | 4.000 | 162.434 | 225 | | | | |
| S06-C07-18 | 163.637 | 1.667 | Open Manhole | 1200 | 4.001 | 161.970 | 225 | 4.000 | 161.970 | 225 | |
| S06-C07-19 | 162.670 | 1.425 | Open Manhole | 1200 | 4.002 | 161.245 | 225 | 4.001 | 161.245 | 225 | |
| S06-C07-20 | 160.876 | 1.425 | Open Manhole | 1200 | 4.003 | 159.451 | 225 | 4.002 | 159.451 | 225 | |
| S06-C07-21 | 158.271 | 1.500 | Open Manhole | 1200 | 4.004 | 156.771 | 300 | 4.003 | 156.846 | 225 | |
| S06-C07-22 | 154.902 | 1.500 | Open Manhole | 1200 | 4.005 | 153.402 | 300 | 4.004 | 153.402 | 300 | |
| S06-C07-23 | 151.319 | 1.500 | Open Manhole | 1200 | 4.006 | 149.819 | 300 | 4.005 | 149.819 | 300 | |
| S06-C07-24 | 148.476 | 1.575 | Open Manhole | 1350 | 4.007 | 146.901 | 375 | 4.006 | 146.976 | 300 | |
| S06-C07-25 | 147.854 | 2.202 | Open Manhole | 1800 | 1.003 | 145.652 | 750 | 1.002 | 146.027 | 375 | |
| | | | | | | | | 2.004 | 145.877 | 525 | |
| | | | | | | | | 4.007 | 146.279 | 375 | 252 |
| S06-C07-26 | 147.501 | 2.001 | Open Manhole | 1800 | 1.004 | 145.500 | 750 | 1.003 | 145.500 | 750 | |
| Outfall 7 | 157.289 | 12.376 | Open Manhole | 0 | | OUTFALL | | 1.004 | 144.913 | 750 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C07-1 | 373397.942 | 517117.677 | 373397.942 | 517117.677 | Required |  |
| S06-C07-2 | 373459.629 | 517082.317 | 373459.629 | 517082.317 | Required |  |
| S06-C07-3 | 373541.403 | 517033.964 | 373541.403 | 517033.964 | Required |  |
| S06-C07-4 | 373332.554 | 517121.446 | 373332.554 | 517121.446 | Required |  |
| S06-C07-5 | 373410.508 | 517076.467 | 373410.508 | 517076.467 | Required |  |

## Manhole Schedules for Catchment 7 - Ch 42250

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C07-6 | 373487.849 | 517030.442 | 373487.849 | 517030.442 | Required |  |
| S06-C07-7 | 373548.483 | 516997.371 | 373548.483 | 516997.371 | Required |  |
| S06-C07-8 | 374163.673 | 516573.980 | 374163.673 | 516573.980 | Required |  |
| S06-C07-9 | 374100.971 | 516621.273 | 374100.971 | 516621.273 | Required |  |
| S06-C07-10 | 374029.124 | 516675.478 | 374029.124 | 516675.478 | Required |  |
| S06-C07-11 | 373957.267 | 516729.666 | 373957.267 | 516729.666 | Required |  |
| S06-C07-12 | 373885.179 | 516783.541 | 373885.179 | 516783.541 | Required |  |
| S06-C07-13 | 373812.096 | 516836.059 | 373812.096 | 516836.059 | Required |  |
| S06-C07-14 | 373737.828 | 516886.895 | 373737.828 | 516886.895 | Required |  |
| S06-C07-15 | 373661.458 | 516934.590 | 373661.458 | 516934.590 | Required |  |
| S06-C07-16 | 373609.117 | 516964.300 | 373609.117 | 516964.300 | Required |  |
| S06-C07-17 | 374172.561 | 516589.700 | 374172.561 | 516589.700 | Required |  |
| S06-C07-18 | 374110.630 | 516637.475 | 374110.630 | 516637.475 | Required |  |
| S06-C07-19 | 374039.947 | 516693.195 | 374039.947 | 516693.195 | Required |  |
| S06-C07-20 | 373969.938 | 516749.739 | 373969.938 | 516749.739 | Required |  |
| S06-C07-21 | 373898.706 | 516804.722 | 373898.706 | 516804.722 | Required |  |
| S06-C07-22 | 373825.549 | 516857.137 | 373825.549 | 516857.137 | Required |  |
| S06-C07-23 | 373750.751 | 516907.190 | 373750.751 | 516907.190 | Required |  |
| S06-C07-24 | 373674.636 | 516955.216 | 373674.636 | 516955.216 | Required |  |
| S06-C07-25 | 373623.706 | 516985.724 | 373623.706 | 516985.724 | Required |  |

## Manhole Schedules for Catchment 7 - Ch 42250

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C07-26 | 373650.952 | 517056.521 | 373650.952 | 517056.521 | Required |  |
| Outfall 7 | 373611.590 | 517133.160 | | | No Entry |  |

## Area Summary for Catchment 7 - Ch 42250

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | User | - | 100 | 0.216 | 0.216 | 0.216 |
|  | Classification | Verge | 50 | 0.030 | 0.015 | 0.231 |
| 1.001 | User | - | 100 | 0.131 | 0.131 | 0.131 |
|  | Classification | Verge | 50 | 0.020 | 0.010 | 0.141 |
| 1.002 | User | - | 100 | 0.106 | 0.106 | 0.106 |
|  | Classification | Verge | 50 | 0.028 | 0.014 | 0.119 |
| 2.000 | User | - | 100 | 0.123 | 0.123 | 0.123 |
|  | Classification | Verge | 50 | 0.042 | 0.021 | 0.144 |
| 2.001 | User | - | 100 | 0.121 | 0.121 | 0.121 |
|  | Classification | Verge | 50 | 0.016 | 0.008 | 0.129 |
| 2.002 | User | - | 100 | 0.103 | 0.103 | 0.103 |
|  | Classification | Verge | 50 | 0.009 | 0.005 | 0.107 |
| 2.003 | User | - | 100 | 0.094 | 0.094 | 0.094 |
|  | Classification | Verge | 50 | 0.020 | 0.010 | 0.104 |
| 3.000 | User | - | 100 | 0.085 | 0.085 | 0.085 |
|  | User | - | 100 | 0.013 | 0.013 | 0.098 |
|  | Classification | Verge | 50 | 0.025 | 0.013 | 0.111 |
|  | Classification | Cutting | 25 | 0.148 | 0.037 | 0.148 |
| 3.001 | User | - | 100 | 0.094 | 0.094 | 0.094 |
|  | User | - | 100 | 0.033 | 0.033 | 0.126 |
|  | Classification | Verge | 50 | 0.026 | 0.013 | 0.140 |
|  | Classification | Cutting | 25 | 0.006 | 0.001 | 0.141 |
| 3.002 | User | - | 100 | 0.088 | 0.088 | 0.088 |
|  | User | - | 100 | 0.063 | 0.063 | 0.151 |
|  | Classification | Verge | 50 | 0.026 | 0.013 | 0.164 |
| 3.003 | User | - | 100 | 0.093 | 0.093 | 0.093 |
|  | User | - | 100 | 0.081 | 0.081 | 0.174 |
|  | Classification | Verge | 50 | 0.025 | 0.013 | 0.187 |
| 3.004 | User | - | 100 | 0.090 | 0.090 | 0.090 |
|  | User | - | 100 | 0.084 | 0.084 | 0.174 |
|  | Classification | Verge | 50 | 0.025 | 0.013 | 0.187 |
| 3.005 | User | - | 100 | 0.089 | 0.089 | 0.089 |
|  | User | - | 100 | 0.084 | 0.084 | 0.173 |
|  | Classification | Verge | 50 | 0.026 | 0.013 | 0.186 |
| 3.006 | User | - | 100 | 0.094 | 0.094 | 0.094 |
|  | User | - | 100 | 0.083 | 0.083 | 0.177 |
|  | Classification | Verge | 50 | 0.026 | 0.013 | 0.190 |
| 3.007 | User | - | 100 | 0.064 | 0.064 | 0.064 |
|  | User | - | 100 | 0.055 | 0.055 | 0.119 |
|  | Classification | Verge | 50 | 0.017 | 0.009 | 0.128 |
| 2.004 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 4.000 | User | - | 100 | 0.091 | 0.091 | 0.091 |
|  | Classification | Verge | 50 | 0.026 | 0.013 | 0.104 |
| 4.001 | User | - | 100 | 0.091 | 0.091 | 0.091 |
|  | Classification | Verge | 50 | 0.026 | 0.013 | 0.104 |
| 4.002 | User | - | 100 | 0.093 | 0.093 | 0.093 |
|  | Classification | Verge | 50 | 0.027 | 0.013 | 0.106 |
|  | Classification | Cutting | 25 | 0.041 | 0.010 | 0.116 |
| 4.003 | User | - | 100 | 0.093 | 0.093 | 0.093 |
|  | Classification | Verge | 50 | 0.026 | 0.013 | 0.107 |
|  | Classification | Cutting | 25 | 0.207 | 0.052 | 0.158 |
| 4.004 | User | - | 100 | 0.092 | 0.092 | 0.092 |
|  | Classification | Verge | 50 | 0.027 | 0.014 | 0.106 |
|  | Classification | Cutting | 25 | 0.301 | 0.075 | 0.181 |
| 4.005 | User | - | 100 | 0.093 | 0.093 | 0.093 |
|  | Classification | Verge | 50 | 0.026 | 0.013 | 0.106 |
|  | Classification | Cutting | 25 | 0.233 | 0.058 | 0.164 |
| 4.006 | User | - | 100 | 0.094 | 0.094 | 0.094 |
|  | Classification | Verge | 50 | 0.027 | 0.013 | 0.107 |
|  | Classification | Cutting | 25 | 0.059 | 0.015 | 0.122 |
| 4.007 | User | - | 100 | 0.061 | 0.061 | 0.061 |
|  | Classification | Verge | 50 | 0.018 | 0.009 | 0.070 |
| 1.003 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.004 | - | - | 100 | 0.000 | 0.000 | 0.000 |

## Area Summary for Catchment 7 - Ch 42250

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| | | | | Total<br>4.355 | Total<br>3.326 | Total<br>3.326 |

## Online Controls for Catchment 7 - Ch 42250

### Hydro-Brake® Optimum Manhole: S06-C07-26, DS/PN: 1.004, Volume (m³): 37.8

| | |
|---|---|
| Unit Reference | MD-SHE-0258-3680-1000-3680 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 36.8 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 258 |
| Invert Level (m) | 145.500 |
| Minimum Outlet Pipe Diameter (mm) | 300 |
| Suggested Manhole Diameter (mm) | 1800 |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.000 | 36.8 | Kick-Flo® | 0.764 | 32.3 |
| Flush-Flo™ | 0.407 | 36.8 | Mean Flow over Head Range | - | 30.1 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 8.3 | 0.800 | 33.0 | 2.000 | 51.3 | 4.000 | 71.8 | 7.000 | 94.3 |
| 0.200 | 26.5 | 1.000 | 36.8 | 2.200 | 53.8 | 4.500 | 76.1 | 7.500 | 97.5 |
| 0.300 | 36.1 | 1.200 | 40.1 | 2.400 | 56.1 | 5.000 | 80.1 | 8.000 | 100.7 |
| 0.400 | 36.8 | 1.400 | 43.2 | 2.600 | 58.3 | 5.500 | 83.9 | 8.500 | 103.7 |
| 0.500 | 36.5 | 1.600 | 46.1 | 3.000 | 62.5 | 6.000 | 87.5 | 9.000 | 106.6 |
| 0.600 | 35.7 | 1.800 | 48.8 | 3.500 | 67.3 | 6.500 | 91.0 | 9.500 | 109.5 |

## Offline Controls for Catchment 7 - Ch 42250

### Weir Manhole: S06-C07-26, DS/PN: 1.004, Loop to PN: None

Discharge Coef 0.544 Width (m) 10.000 Invert Level (m) 146.500

## Storage Structures for Catchment 7 - Ch 42250

### Tank or Pond Manhole: S06-C07-26, DS/PN: 1.004

Invert Level (m) 145.500

| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|---|---|
| 0.000 | 3883.0 | 1.000 | 4611.9 | 1.001 | 4841.6 | 2.001 | 6631.9 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 7 - Ch 42250

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| **PN** | **US/MH Name** | **Event** | **US/CL (m)** | **Water Level (m)** | **Surcharged Depth (m)** | **Flooded Volume (m³)** | **Flow / Cap.** | **Overflow (l/s)** | **Pipe Flow (l/s)** | **Status** |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C07-1 | 15 minute 5 year Winter I+20% | 154.200 | 153.478 | 0.478 | 0.000 | 1.03 | | 51.9 | SURCHARGED |
| 1.001 | S06-C07-2 | 15 minute 5 year Winter I+20% | 147.854 | 147.233 | 0.107 | 0.000 | 1.08 | | 77.7 | SURCHARGED |
| 1.002 | S06-C07-3 | 15 minute 5 year Winter I+20% | 147.854 | 146.642 | -0.057 | 0.000 | 0.86 | | 91.6 | OK |
| 2.000 | S06-C07-4 | 15 minute 5 year Winter I+20% | 156.250 | 154.936 | -0.113 | 0.000 | 0.47 | | 35.5 | OK |
| 2.001 | S06-C07-5 | 15 minute 5 year Winter I+20% | 154.300 | 152.995 | -0.105 | 0.000 | 0.55 | | 62.5 | OK |
| 2.002 | S06-C07-6 | 15 minute 5 year Winter I+20% | 149.800 | 148.725 | 0.125 | 0.000 | 1.03 | | 81.9 | SURCHARGED |
| 2.003 | S06-C07-7 | 15 minute 5 year Winter I+20% | 148.099 | 146.765 | -0.134 | 0.000 | 0.72 | | 100.2 | OK |
| 3.000 | S06-C07-8 | 15 minute 5 year Winter I+20% | 164.254 | 163.031 | -0.023 | 0.000 | 0.89 | | 34.5 | OK |
| 3.001 | S06-C07-9 | 15 minute 5 year Winter I+20% | 164.020 | 162.681 | 0.096 | 0.000 | 1.03 | | 57.3 | SURCHARGED |
| 3.002 | S06-C07-10 | 15 minute 5 year Winter I+20% | 162.715 | 161.381 | -0.134 | 0.000 | 0.58 | | 87.4 | OK |
| 3.003 | S06-C07-11 | 15 minute 5 year Winter I+20% | 160.930 | 159.613 | -0.117 | 0.000 | 0.67 | | 123.5 | OK |
| 3.004 | S06-C07-12 | 15 minute 5 year Winter I+20% | 158.315 | 157.014 | -0.101 | 0.000 | 0.76 | | 159.4 | OK |
| 3.005 | S06-C07-13 | 15 minute 5 year Winter I+20% | 154.917 | 153.721 | 0.003 | 0.000 | 0.89 | | 192.6 | SURCHARGED |
| 3.006 | S06-C07-14 | 15 minute 5 year Winter I+20% | 151.315 | 151.077 | 0.963 | 0.000 | 1.11 | | 214.1 | FLOOD RISK |
| 3.007 | S06-C07-15 | 15 minute 5 year Winter I+20% | 148.442 | 147.526 | 0.283 | 0.000 | 1.12 | | 230.7 | SURCHARGED |
| 2.004 | S06-C07-16 | 15 minute 5 year Winter I+20% | 147.713 | 146.606 | 0.086 | 0.000 | 1.21 | | 319.0 | SURCHARGED |
| 4.000 | S06-C07-17 | 15 minute 5 year Winter I+20% | 163.859 | 162.572 | -0.088 | 0.000 | 0.63 | | 24.4 | OK |
| 4.001 | S06-C07-18 | 15 minute 5 year Winter I+20% | 163.637 | 162.159 | -0.036 | 0.000 | 0.95 | | 43.3 | OK |
| 4.002 | S06-C07-19 | 15 minute 5 year Winter I+20% | 162.670 | 161.415 | -0.055 | 0.000 | 0.90 | | 64.4 | OK |
| 4.003 | S06-C07-20 | 15 minute 5 year Winter I+20% | 160.876 | 159.853 | 0.177 | 0.000 | 1.03 | | 89.4 | SURCHARGED |
| 4.004 | S06-C07-21 | 15 minute 5 year Winter I+20% | 158.271 | 156.938 | -0.133 | 0.000 | 0.58 | | 121.8 | OK |
| 4.005 | S06-C07-22 | 15 minute 5 year Winter I+20% | 154.902 | 153.592 | -0.110 | 0.000 | 0.71 | | 153.2 | OK |
| 4.006 | S06-C07-23 | 15 minute 5 year Winter I+20% | 151.319 | 150.046 | -0.073 | 0.000 | 0.91 | | 174.7 | OK |
| 4.007 | S06-C07-24 | 15 minute 5 year Winter I+20% | 148.476 | 147.198 | -0.078 | 0.000 | 0.98 | | 187.4 | OK |
| 1.003 | S06-C07-25 | 15 minute 5 year Winter I+20% | 147.854 | 146.432 | 0.030 | 0.000 | 1.20 | | 586.4 | SURCHARGED |
| 1.004 | S06-C07-26 | 960 minute 5 year Winter I+20% | 147.501 | 145.745 | -0.505 | 0.000 | 0.04 | 0.0 | 34.0 | OK |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 7 - Ch 42250

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 0.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | | | |
|---|---|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Offline Controls | 1 | Number of Time/Area Diagrams | 0 |
| Number of Online Controls | 1 | Number of Storage Structures | 1 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | | | |
|---|---|---|---|---|---|
| Rainfall Model | | FSR M5-60 (mm) | 20.000 | Cv (Summer) | 0.750 |
| Region | England and Wales | Ratio R | 0.300 | Cv (Winter) | 0.840 |

| | |
|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 |
| Analysis Timestep | 2.5 Second Increment (Extended) |
| DTS Status | OFF |
| DVD Status | ON |
| Inertia Status | ON |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 240, 360, 480, 960, 1440 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| **PN** | **US/MH Name** | **Event** | **US/CL (m)** | **Water Level (m)** | **Surcharged Depth (m)** | **Flooded Volume (m³)** | **Flow / Cap.** | **Overflow (l/s)** | **Pipe Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C07-1 | 15 minute 100 year Winter I+40% | 154.200 | 154.220 | 1.220 | 19.646 | 1.10 | | 55.5 |
| 1.001 | S06-C07-2 | 15 minute 100 year Winter I+40% | 147.854 | 147.861 | 0.735 | 7.259 | 1.43 | | 102.9 |
| 1.002 | S06-C07-3 | 15 minute 100 year Winter I+40% | 147.854 | 147.286 | 0.587 | 0.000 | 1.33 | | 141.3 |
| 2.000 | S06-C07-4 | 15 minute 100 year Winter I+40% | 156.250 | 156.169 | 1.120 | 0.000 | 0.94 | | 70.8 |
| 2.001 | S06-C07-5 | 15 minute 100 year Winter I+40% | 154.300 | 154.302 | 1.202 | 2.095 | 1.00 | | 113.9 |
| 2.002 | S06-C07-6 | 30 minute 100 year Winter I+40% | 149.800 | 149.824 | 1.224 | 24.158 | 1.30 | | 102.8 |
| 2.003 | S06-C07-7 | 15 minute 100 year Winter I+40% | 148.099 | 147.333 | 0.434 | 0.000 | 1.08 | | 150.5 |
| 3.000 | S06-C07-8 | 30 minute 100 year Winter I+40% | 164.254 | 164.267 | 1.213 | 13.015 | 1.54 | | 60.0 |
| 3.001 | S06-C07-9 | 15 minute 100 year Winter I+40% | 164.020 | 164.027 | 1.441 | 7.866 | 1.45 | | 80.6 |
| 3.002 | S06-C07-10 | 15 minute 100 year Winter I+40% | 162.715 | 162.692 | 1.177 | 0.000 | 0.95 | | 144.6 |
| 3.003 | S06-C07-11 | 15 minute 100 year Winter I+40% | 160.930 | 160.938 | 1.208 | 8.255 | 1.00 | | 183.4 |
| 3.004 | S06-C07-12 | 30 minute 100 year Winter I+40% | 158.315 | 158.333 | 1.218 | 18.248 | 1.00 | | 209.2 |
| 3.005 | S06-C07-13 | 30 minute 100 year Winter I+40% | 154.917 | 154.955 | 1.238 | 37.770 | 1.00 | | 215.6 |
| 3.006 | S06-C07-14 | 60 minute 100 year Winter I+40% | 151.315 | 151.368 | 1.253 | 53.405 | 1.17 | | 224.9 |
| 3.007 | S06-C07-15 | 15 minute 100 year Winter I+40% | 148.442 | 148.141 | 0.898 | 0.000 | 1.33 | | 274.2 |
| 2.004 | S06-C07-16 | 15 minute 100 year Winter I+40% | 147.713 | 146.910 | 0.391 | 0.000 | 1.57 | | 413.1 |
| 4.000 | S06-C07-17 | 15 minute 100 year Winter I+40% | 163.859 | 163.865 | 1.206 | 5.674 | 0.79 | | 30.7 |
| 4.001 | S06-C07-18 | 15 minute 100 year Winter I+40% | 163.637 | 163.643 | 1.448 | 5.612 | 1.15 | | 52.4 |
| 4.002 | S06-C07-19 | 30 minute 100 year Winter I+40% | 162.670 | 162.680 | 1.209 | 9.292 | 1.00 | | 71.9 |
| 4.003 | S06-C07-20 | 15 minute 100 year Winter I+40% | 160.876 | 160.889 | 1.213 | 12.783 | 1.21 | | 105.1 |
| 4.004 | S06-C07-21 | 15 minute 100 year Winter I+40% | 158.271 | 157.876 | 0.805 | 0.000 | 0.93 | | 193.2 |
| 4.005 | S06-C07-22 | 15 minute 100 year Winter I+40% | 154.902 | 154.914 | 1.212 | 12.490 | 1.00 | | 215.1 |
| 4.006 | S06-C07-23 | 30 minute 100 year Winter I+40% | 151.319 | 151.340 | 1.221 | 20.601 | 1.16 | | 222.0 |
| 4.007 | S06-C07-24 | 15 minute 100 year Winter I+40% | 148.476 | 147.751 | 0.475 | 0.000 | 1.33 | | 254.3 |
| 1.003 | S06-C07-25 | 15 minute 100 year Winter I+40% | 147.854 | 146.621 | 0.219 | 0.000 | 1.64 | | 803.0 |
| 1.004 | S06-C07-26 | 960 minute 100 year Winter I+40% | 147.501 | 146.058 | -0.192 | 0.000 | 0.04 | 0.0 | 36.7 |

| **PN** | **US/MH Name** | **Status** |
|---|---|---|
| 1.000 | S06-C07-1 | FLOOD |
| 1.001 | S06-C07-2 | FLOOD |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 7 - Ch 42250

| PN | US/MH Name | Status |
|---|---|---|
| 1.002 | S06-C07-3 | SURCHARGED |
| 2.000 | S06-C07-4 | FLOOD RISK |
| 2.001 | S06-C07-5 | FLOOD |
| 2.002 | S06-C07-6 | FLOOD |
| 2.003 | S06-C07-7 | SURCHARGED |
| 3.000 | S06-C07-8 | FLOOD |
| 3.001 | S06-C07-9 | FLOOD |
| 3.002 | S06-C07-10 | FLOOD RISK |
| 3.003 | S06-C07-11 | FLOOD |
| 3.004 | S06-C07-12 | FLOOD |
| 3.005 | S06-C07-13 | FLOOD |
| 3.006 | S06-C07-14 | FLOOD |
| 3.007 | S06-C07-15 | SURCHARGED |
| 2.004 | S06-C07-16 | SURCHARGED |
| 4.000 | S06-C07-17 | FLOOD |
| 4.001 | S06-C07-18 | FLOOD |
| 4.002 | S06-C07-19 | FLOOD |
| 4.003 | S06-C07-20 | FLOOD |
| 4.004 | S06-C07-21 | SURCHARGED |
| 4.005 | S06-C07-22 | FLOOD |
| 4.006 | S06-C07-23 | FLOOD |
| 4.007 | S06-C07-24 | SURCHARGED |
| 1.003 | S06-C07-25 | SURCHARGED |
| 1.004 | S06-C07-26 | OK |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Catchment 8 - Ch 43650

Pipe Sizes Min 150 Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 20.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Network Design Table for Catchment 8 - Ch 43650

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 78.248 | 0.631 | 124.0 | 0.140 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.001 | 86.959 | 1.228 | 70.8 | 0.102 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.002 | 59.324 | 0.821 | 72.3 | 0.067 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.003 | 105.496 | 1.513 | 69.7 | 0.118 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.004 | 90.798 | 1.298 | 69.9 | 0.109 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.005 | 107.075 | 1.563 | 68.5 | 0.161 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.006 | 49.909 | 1.168 | 42.7 | 0.072 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 2.000 | 53.432 | 0.325 | 164.6 | 0.081 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.007 | 22.472 | 0.214 | 104.8 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 3.000 | 80.477 | 0.714 | 112.6 | 0.187 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 3.001 | 64.449 | 0.904 | 71.3 | 0.080 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 3.002 | 75.678 | 1.077 | 70.3 | 0.084 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 3.003 | 103.000 | 1.462 | 70.5 | 0.116 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 3.004 | 97.494 | 1.713 | 56.9 | 0.113 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 3.005 | 105.518 | 1.571 | 67.2 | 0.125 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 3.006 | 50.019 | 2.282 | 21.9 | 0.059 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 72.34 | 6.11 | 162.337 | 0.140 | 0.0 | 0.0 | 0.0 | 1.17 | 46.6 | 27.4 |
| 1.001 | 68.12 | 7.04 | 161.706 | 0.242 | 0.0 | 0.0 | 0.0 | 1.56 | 61.9 | 44.7 |
| 1.002 | 65.55 | 7.69 | 160.478 | 0.309 | 0.0 | 0.0 | 0.0 | 1.54 | 61.2 | 54.9 |
| 1.003 | 62.20 | 8.62 | 159.582 | 0.427 | 0.0 | 0.0 | 0.0 | 1.89 | 133.3 | 72.0 |
| 1.004 | 59.64 | 9.42 | 158.069 | 0.537 | 0.0 | 0.0 | 0.0 | 1.88 | 133.1 | 86.7 |
| 1.005 | 56.96 | 10.36 | 156.771 | 0.698 | 0.0 | 0.0 | 0.0 | 1.90 | 134.5 | 107.6 |
| 1.006 | 56.04 | 10.70 | 155.208 | 0.770 | 0.0 | 0.0 | 0.0 | 2.41 | 170.5 | 116.9 |
| 2.000 | 73.51 | 5.88 | 153.639 | 0.081 | 0.0 | 0.0 | 0.0 | 1.02 | 40.4 | 16.1 |
| 1.007 | 55.50 | 10.92 | 153.164 | 0.851 | 0.0 | 0.0 | 0.0 | 1.77 | 195.5 | 127.9 |
| 3.000 | 72.45 | 6.09 | 162.748 | 0.187 | 0.0 | 0.0 | 0.0 | 1.23 | 49.0 | 36.7 |
| 3.001 | 69.24 | 6.78 | 162.033 | 0.267 | 0.0 | 0.0 | 0.0 | 1.55 | 61.7 | 50.0 |
| 3.002 | 66.45 | 7.45 | 161.054 | 0.351 | 0.0 | 0.0 | 0.0 | 1.88 | 132.7 | 63.1 |
| 3.003 | 63.05 | 8.37 | 159.977 | 0.467 | 0.0 | 0.0 | 0.0 | 1.88 | 132.6 | 79.7 |
| 3.004 | 60.49 | 9.15 | 158.516 | 0.580 | 0.0 | 0.0 | 0.0 | 2.09 | 147.6 | 95.0 |
| 3.005 | 57.77 | 10.06 | 156.803 | 0.705 | 0.0 | 0.0 | 0.0 | 1.92 | 135.8 | 110.3 |
| 3.006 | 57.09 | 10.31 | 155.232 | 0.765 | 0.0 | 0.0 | 0.0 | 3.37 | 238.4 | 118.2 |

## Network Design Table for Catchment 8 - Ch 43650

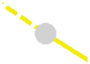
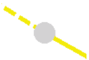
| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.008 | 41.700 | 0.150 | 278.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| 1.009 | 144.132 | 8.086 | 17.8 | 0.000 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |

## Network Results Table

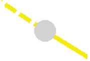
| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.008 | 54.22 | 11.44 | 152.950 | 1.616 | 0.0 | 0.0 | 0.0 | 1.34 | 289.7 | 237.2 |
| 1.009 | 75.75 | 5.45 | 152.800 | 0.000 | 23.0 | 0.0 | 0.0 | 5.32 | 1152.4 | 23.0 |

## Manhole Schedules for Catchment 8 - Ch 43650

| **MH Name** | **MH CL (m)** | **MH Depth (m)** | **MH Connection** | **MH Diam.,L*W (mm)** | **PN** | **Pipe Out Invert Level (m)** | **Diameter (mm)** | **PN** | **Pipes In Invert Level (m)** | **Diameter (mm)** | **Backdrop (mm)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C08-1 | 163.762 | 1.425 | Open Manhole | 1200 | 1.000 | 162.337 | 225 | | | | |
| S06-C08-2 | 163.132 | 1.426 | Open Manhole | 1200 | 1.001 | 161.706 | 225 | 1.000 | 161.706 | 225 | |
| S06-C08-3 | 161.904 | 1.426 | Open Manhole | 1200 | 1.002 | 160.478 | 225 | 1.001 | 160.478 | 225 | |
| S06-C08-4 | 161.083 | 1.501 | Open Manhole | 1200 | 1.003 | 159.582 | 300 | 1.002 | 159.657 | 225 | |
| S06-C08-5 | 159.570 | 1.501 | Open Manhole | 1200 | 1.004 | 158.069 | 300 | 1.003 | 158.069 | 300 | |
| S06-C08-6 | 158.272 | 1.501 | Open Manhole | 1200 | 1.005 | 156.771 | 300 | 1.004 | 156.771 | 300 | |
| S06-C08-7 | 156.709 | 1.501 | Open Manhole | 1200 | 1.006 | 155.208 | 300 | 1.005 | 155.208 | 300 | |
| S06-C08-8 | 155.223 | 1.583 | Open Manhole | 1200 | 2.000 | 153.639 | 225 | | | | |
| S06-C08-9 | 155.541 | 2.376 | Open Manhole | 1350 | 1.007 | 153.164 | 375 | 1.006 | 154.040 | 300 | 801 |
| | | | | | | | | 2.000 | 153.314 | 225 | |
| S06-C08-10 | 164.173 | 1.425 | Open Manhole | 1200 | 3.000 | 162.748 | 225 | | | | |
| S06-C08-11 | 163.458 | 1.425 | Open Manhole | 1200 | 3.001 | 162.033 | 225 | 3.000 | 162.033 | 225 | |
| S06-C08-12 | 162.554 | 1.500 | Open Manhole | 1200 | 3.002 | 161.054 | 300 | 3.001 | 161.129 | 225 | |
| S06-C08-13 | 161.477 | 1.500 | Open Manhole | 1200 | 3.003 | 159.977 | 300 | 3.002 | 159.977 | 300 | |
| S06-C08-14 | 160.016 | 1.500 | Open Manhole | 1200 | 3.004 | 158.516 | 300 | 3.003 | 158.516 | 300 | |
| S06-C08-15 | 158.303 | 1.500 | Open Manhole | 1200 | 3.005 | 156.803 | 300 | 3.004 | 156.803 | 300 | |
| S06-C08-16 | 156.732 | 1.500 | Open Manhole | 1200 | 3.006 | 155.232 | 300 | 3.005 | 155.232 | 300 | |
| S06-C08-17 | 156.033 | 3.083 | Open Manhole | 1500 | 1.008 | 152.950 | 525 | 1.007 | 152.950 | 375 | |
| | | | | | | | | 3.006 | 152.950 | 300 | |
| S06-C08-18 | 155.104 | 2.304 | Open Manhole | 1500 | 1.009 | 152.800 | 525 | 1.008 | 152.800 | 525 | |
| Outfall 8 | 145.389 | 0.675 | Open Manhole | 0 | | OUTFALL | | 1.009 | 144.714 | 525 | |

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S06-C08-1 | 374195.467 | 516573.944 | 374195.467 | 516573.944 | Required |  |
| S06-C08-2 | 374260.133 | 516529.885 | 374260.133 | 516529.885 | Required |  |
| S06-C08-3 | 374333.807 | 516483.690 | 374333.807 | 516483.690 | Required |  |
| S06-C08-4 | 374385.431 | 516454.461 | 374385.431 | 516454.461 | Required |  |
| S06-C08-5 | 374479.095 | 516405.916 | 374479.095 | 516405.916 | Required |  |
| S06-C08-6 | 374561.671 | 516368.159 | 374561.671 | 516368.159 | Required |  |
| S06-C08-7 | 374660.028 | 516325.840 | 374660.028 | 516325.840 | Required |  |
| S06-C08-8 | 374754.614 | 516284.372 | 374754.614 | 516284.372 | Required |  |
| S06-C08-9 | 374706.434 | 516307.472 | 374706.434 | 516307.472 | Required |  |

## Manhole Schedules for Catchment 8 - Ch 43650

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C08-10 | 374189.328 | 516554.657 | 374189.328 | 516554.657 | Required |  |
| S06-C08-11 | 374256.368 | 516510.135 | 374256.368 | 516510.135 | Required |  |
| S06-C08-12 | 374311.175 | 516476.227 | 374311.175 | 516476.227 | Required |  |
| S06-C08-13 | 374376.875 | 516438.667 | 374376.875 | 516438.667 | Required |  |
| S06-C08-14 | 374468.375 | 516391.373 | 374468.375 | 516391.373 | Required |  |
| S06-C08-15 | 374556.518 | 516349.708 | 374556.518 | 516349.708 | Required |  |
| S06-C08-16 | 374652.748 | 516306.422 | 374652.748 | 516306.422 | Required |  |
| S06-C08-17 | 374698.591 | 516286.413 | 374698.591 | 516286.413 | Required |  |
| S06-C08-18 | 374684.037 | 516247.335 | 374684.037 | 516247.335 | Required |  |
| Outfall 8 | 374542.221 | 516273.068 | | | No Entry |  |

## Area Summary for Catchment 8 - Ch 43650

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | Classification | Default | 100 | 0.122 | 0.122 | 0.122 |
| | Classification | Verge | 50 | 0.028 | 0.014 | 0.136 |
| | Classification | Cutting | 25 | 0.015 | 0.004 | 0.140 |
| 1.001 | Classification | Default | 100 | 0.089 | 0.089 | 0.089 |
| | Classification | Verge | 50 | 0.025 | 0.012 | 0.102 |
| | Classification | Cutting | 25 | 0.003 | 0.001 | 0.102 |
| 1.002 | Classification | Default | 100 | 0.059 | 0.059 | 0.059 |
| | Classification | Verge | 50 | 0.017 | 0.008 | 0.067 |
| 1.003 | Classification | Default | 100 | 0.104 | 0.104 | 0.104 |
| | Classification | Verge | 50 | 0.028 | 0.014 | 0.118 |
| 1.004 | Classification | Default | 100 | 0.097 | 0.097 | 0.097 |
| | Classification | Verge | 50 | 0.024 | 0.012 | 0.109 |
| 1.005 | Classification | Default | 100 | 0.145 | 0.145 | 0.145 |
| | Classification | Verge | 50 | 0.031 | 0.016 | 0.161 |
| 1.006 | Classification | Default | 100 | 0.072 | 0.072 | 0.072 |
| 2.000 | Classification | Default | 100 | 0.078 | 0.078 | 0.078 |
| | Classification | Verge | 50 | 0.006 | 0.003 | 0.081 |
| 1.007 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 3.000 | Classification | Default | 100 | 0.107 | 0.107 | 0.107 |
| | Classification | Verge | 50 | 0.040 | 0.020 | 0.127 |
| | Classification | Cutting | 25 | 0.238 | 0.060 | 0.187 |
| 3.001 | Classification | Default | 100 | 0.061 | 0.061 | 0.061 |
| | Classification | Verge | 50 | 0.026 | 0.013 | 0.074 |
| | Classification | Cutting | 25 | 0.022 | 0.006 | 0.080 |
| 3.002 | Classification | Default | 100 | 0.069 | 0.069 | 0.069 |
| | Classification | Verge | 50 | 0.030 | 0.015 | 0.084 |
| 3.003 | Classification | Default | 100 | 0.094 | 0.094 | 0.094 |
| | Classification | Verge | 50 | 0.043 | 0.022 | 0.116 |
| 3.004 | Classification | Default | 100 | 0.097 | 0.097 | 0.097 |
| | Classification | Verge | 50 | 0.032 | 0.016 | 0.113 |
| 3.005 | Classification | Default | 100 | 0.110 | 0.110 | 0.110 |
| | Classification | Verge | 50 | 0.031 | 0.016 | 0.125 |
| 3.006 | Classification | Default | 100 | 0.052 | 0.052 | 0.052 |
| | Classification | Verge | 50 | 0.015 | 0.007 | 0.059 |
| 1.008 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.009 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total | Total | Total |
| | | | | 2.013 | 1.616 | 1.616 |

## Online Controls for Catchment 8 - Ch 43650

### Hydro-Brake® Optimum Manhole: S06-C08-18, DS/PN: 1.009, Volume (m³): 12.8

| | |
|---|---|
| Unit Reference | MD-SHE-0213-2350-1000-2350 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 23.5 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 213 |
| Invert Level (m) | 152.800 |
| Minimum Outlet Pipe Diameter (mm) | 300 |
| Suggested Manhole Diameter (mm) | 1500 |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.000 | 23.5 | Kick-Flo® | 0.732 | 20.3 |
| Flush-Flo™ | 0.355 | 23.5 | Mean Flow over Head Range | - | 19.6 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 7.2 | 0.800 | 21.1 | 2.000 | 32.7 | 4.000 | 45.7 | 7.000 | 60.0 |
| 0.200 | 20.7 | 1.000 | 23.5 | 2.200 | 34.3 | 4.500 | 48.4 | 7.500 | 62.0 |
| 0.300 | 23.4 | 1.200 | 25.6 | 2.400 | 35.7 | 5.000 | 51.0 | 8.000 | 64.0 |
| 0.400 | 23.4 | 1.400 | 27.6 | 2.600 | 37.2 | 5.500 | 53.4 | 8.500 | 65.9 |
| 0.500 | 23.1 | 1.600 | 29.4 | 3.000 | 39.8 | 6.000 | 55.7 | 9.000 | 67.8 |
| 0.600 | 22.4 | 1.800 | 31.1 | 3.500 | 42.9 | 6.500 | 57.9 | 9.500 | 69.6 |

## Offline Controls for Catchment 8 - Ch 43650

### Weir Manhole: S06-C08-18, DS/PN: 1.009, Loop to PN: None

Discharge Coef 0.544 Width (m) 10.000 Invert Level (m) 153.800

## Storage Structures for Catchment 8 - Ch 43650

### Tank or Pond Manhole: S06-C08-18, DS/PN: 1.009

Invert Level (m) 152.800

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|---|---|---|---|
| 0.000 | 1980.7 | 1.000 | 2770.5 | 1.001 | 3018.3 | 2.304 | 4950.1 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 8 - Ch 43650

### Simulation Criteria

```
        Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 0.000
              Hot Start (mins)     0         MADD Factor * 10m³/ha Storage 0.000
            Hot Start Level (mm)   0                 Inlet Coeffiecient 0.800
   Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
       Foul Sewage per hectare (l/s) 0.000

 Number of Input Hydrographs 0   Number of Offline Controls 1 Number of Time/Area Diagrams 0
  Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
Rainfall Model               FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
        Region England and Wales    Ratio R  0.300 Cv (Winter) 0.840

 Margin for Flood Risk Warning (mm)                          300.0
                 Analysis Timestep 2.5 Second Increment (Extended)
                        DTS Status                             OFF
                        DVD Status                              ON
                    Inertia Status                              ON


                    Profile(s)                    Summer and Winter
           Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
       Return Period(s) (years)                               5, 100
            Climate Change (%)                                20, 40
```

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C08-1 | 15 minute 5 year Winter I+20% | 163.762 | 162.489 | -0.073 | 0.000 | 0.74 | | 33.6 | OK |
| 1.001 | S06-C08-2 | 15 minute 5 year Winter I+20% | 163.132 | 161.875 | -0.056 | 0.000 | 0.88 | | 53.3 | OK |
| 1.002 | S06-C08-3 | 15 minute 5 year Winter I+20% | 161.904 | 160.817 | 0.114 | 0.000 | 1.06 | | 62.8 | SURCHARGED |
| 1.003 | S06-C08-4 | 15 minute 5 year Winter I+20% | 161.083 | 159.759 | -0.123 | 0.000 | 0.64 | | 82.4 | OK |
| 1.004 | S06-C08-5 | 15 minute 5 year Winter I+20% | 159.570 | 158.273 | -0.096 | 0.000 | 0.78 | | 100.3 | OK |
| 1.005 | S06-C08-6 | 15 minute 5 year Winter I+20% | 158.272 | 157.010 | -0.061 | 0.000 | 0.96 | | 125.5 | OK |
| 1.006 | S06-C08-7 | 15 minute 5 year Winter I+20% | 156.709 | 155.423 | -0.085 | 0.000 | 0.85 | | 137.1 | OK |
| 2.000 | S06-C08-8 | 15 minute 5 year Winter I+20% | 155.223 | 153.756 | -0.108 | 0.000 | 0.51 | | 19.9 | OK |
| 1.007 | S06-C08-9 | 15 minute 5 year Winter I+20% | 155.541 | 153.674 | 0.135 | 0.000 | 0.90 | | 150.5 | SURCHARGED |
| 3.000 | S06-C08-10 | 15 minute 5 year Winter I+20% | 164.173 | 162.938 | -0.035 | 0.000 | 0.94 | | 45.0 | OK |
| 3.001 | S06-C08-11 | 15 minute 5 year Winter I+20% | 163.458 | 162.245 | -0.013 | 0.000 | 0.99 | | 59.3 | OK |
| 3.002 | S06-C08-12 | 15 minute 5 year Winter I+20% | 162.554 | 161.222 | -0.132 | 0.000 | 0.59 | | 74.7 | OK |
| 3.003 | S06-C08-13 | 15 minute 5 year Winter I+20% | 161.477 | 160.174 | -0.103 | 0.000 | 0.74 | | 95.0 | OK |
| 3.004 | S06-C08-14 | 15 minute 5 year Winter I+20% | 160.016 | 158.722 | -0.094 | 0.000 | 0.79 | | 113.2 | OK |
| 3.005 | S06-C08-15 | 15 minute 5 year Winter I+20% | 158.303 | 157.084 | -0.019 | 0.000 | 0.99 | | 130.9 | OK |
| 3.006 | S06-C08-16 | 15 minute 5 year Winter I+20% | 156.732 | 155.403 | -0.128 | 0.000 | 0.62 | | 139.4 | OK |
| 1.008 | S06-C08-17 | 15 minute 5 year Winter I+20% | 156.033 | 153.494 | 0.019 | 0.000 | 1.14 | | 289.4 | SURCHARGED |
| 1.009 | S06-C08-18 | 480 minute 5 year Winter I+20% | 155.104 | 153.005 | -0.320 | 0.000 | 0.02 | 0.0 | 21.3 | OK |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 8 - Ch 43650

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C08-1 | 15 minute 100 year Winter I+40% | 163.762 | 163.768 | 1.206 | 5.242 | 1.02 | | 46.3 |
| 1.001 | S06-C08-2 | 30 minute 100 year Winter I+40% | 163.132 | 163.140 | 1.209 | 8.117 | 1.07 | | 64.6 |
| 1.002 | S06-C08-3 | 30 minute 100 year Winter I+40% | 161.904 | 161.907 | 1.205 | 3.988 | 1.38 | | 81.3 |
| 1.003 | S06-C08-4 | 15 minute 100 year Winter I+40% | 161.083 | 161.007 | 1.125 | 0.000 | 0.93 | | 120.2 |
| 1.004 | S06-C08-5 | 30 minute 100 year Winter I+40% | 159.570 | 159.576 | 1.207 | 6.423 | 1.00 | | 128.6 |
| 1.005 | S06-C08-6 | 30 minute 100 year Winter I+40% | 158.272 | 158.280 | 1.208 | 7.740 | 1.28 | | 167.6 |
| 1.006 | S06-C08-7 | 15 minute 100 year Winter I+40% | 156.709 | 155.961 | 0.453 | 0.000 | 1.18 | | 189.1 |
| 2.000 | S06-C08-8 | 15 minute 100 year Winter I+40% | 155.223 | 154.514 | 0.650 | 0.000 | 1.05 | | 40.7 |
| 1.007 | S06-C08-9 | 15 minute 100 year Winter I+40% | 155.541 | 154.128 | 0.589 | 0.000 | 1.38 | | 229.4 |
| 3.000 | S06-C08-10 | 15 minute 100 year Winter I+40% | 164.173 | 164.184 | 1.211 | 11.013 | 1.32 | | 63.1 |
| 3.001 | S06-C08-11 | 15 minute 100 year Winter I+40% | 163.458 | 163.461 | 1.203 | 2.857 | 1.29 | | 77.1 |
| 3.002 | S06-C08-12 | 15 minute 100 year Winter I+40% | 162.554 | 162.336 | 0.983 | 0.000 | 0.83 | | 105.4 |
| 3.003 | S06-C08-13 | 15 minute 100 year Winter I+40% | 161.477 | 161.480 | 1.203 | 3.088 | 1.00 | | 128.5 |
| 3.004 | S06-C08-14 | 30 minute 100 year Winter I+40% | 160.016 | 160.022 | 1.207 | 6.655 | 1.07 | | 153.3 |
| 3.005 | S06-C08-15 | 30 minute 100 year Winter I+40% | 158.303 | 158.306 | 1.203 | 3.208 | 1.33 | | 175.7 |
| 3.006 | S06-C08-16 | 15 minute 100 year Winter I+40% | 156.732 | 155.494 | -0.037 | 0.000 | 0.88 | | 197.5 |
| 1.008 | S06-C08-17 | 15 minute 100 year Winter I+40% | 156.033 | 153.725 | 0.250 | 0.000 | 1.68 | | 425.6 |
| 1.009 | S06-C08-18 | 480 minute 100 year Winter I+40% | 155.104 | 153.267 | -0.058 | 0.000 | 0.02 | 0.0 | 23.5 |

| PN | US/MH Name | Status |
|---|---|---|
| 1.000 | S06-C08-1 | FLOOD |
| 1.001 | S06-C08-2 | FLOOD |
| 1.002 | S06-C08-3 | FLOOD |
| 1.003 | S06-C08-4 | FLOOD RISK |
| 1.004 | S06-C08-5 | FLOOD |
| 1.005 | S06-C08-6 | FLOOD |
| 1.006 | S06-C08-7 | SURCHARGED |
| 2.000 | S06-C08-8 | SURCHARGED |
| 1.007 | S06-C08-9 | SURCHARGED |
| 3.000 | S06-C08-10 | FLOOD |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 8 - Ch 43650

| PN | US/MH Name | Status |
|---|---|---|
| 3.001 | S06-C08-11 | FLOOD |
| 3.002 | S06-C08-12 | FLOOD RISK |
| 3.003 | S06-C08-13 | FLOOD |
| 3.004 | S06-C08-14 | FLOOD |
| 3.005 | S06-C08-15 | FLOOD |
| 3.006 | S06-C08-16 | OK |
| 1.008 | S06-C08-17 | SURCHARGED |
| 1.009 | S06-C08-18 | OK |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Catchment 9 - Ch 44200

Pipe Sizes Min 150 Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 20.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Network Design Table for Catchment 9 - Ch 44200

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 103.321 | 1.160 | 89.1 | 0.140 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.001 | 84.172 | 0.807 | 104.3 | 0.156 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.002 | 93.163 | 1.404 | 66.3 | 0.133 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.003 | 96.006 | 1.827 | 52.5 | 0.136 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.004 | 99.201 | 1.434 | 69.2 | 0.135 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.005 | 43.502 | 3.083 | 14.1 | 0.058 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 2.000 | 67.647 | 0.837 | 80.8 | 0.099 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 2.001 | 90.000 | 0.537 | 167.7 | 0.118 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.002 | 90.000 | 0.735 | 122.4 | 0.111 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 2.003 | 94.585 | 0.408 | 231.7 | 0.125 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 2.004 | 72.605 | 0.226 | 321.4 | 0.094 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 1.006 | 22.747 | 0.046 | 491.3 | 0.000 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| 3.000 | 100.194 | 1.237 | 81.0 | 0.179 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 3.001 | 89.067 | 1.649 | 54.0 | 0.145 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 3.002 | 80.191 | 1.100 | 72.9 | 0.121 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 3.003 | 105.840 | 1.337 | 79.1 | 0.156 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 71.71 | 6.24 | 153.496 | 0.140 | 0.0 | 0.0 | 0.0 | 1.39 | 55.1 | 27.3 |
| 1.001 | 67.66 | 7.15 | 152.261 | 0.296 | 0.0 | 0.0 | 0.0 | 1.54 | 108.8 | 54.3 |
| 1.002 | 64.53 | 7.96 | 151.454 | 0.429 | 0.0 | 0.0 | 0.0 | 1.93 | 136.6 | 75.0 |
| 1.003 | 61.95 | 8.69 | 150.050 | 0.565 | 0.0 | 0.0 | 0.0 | 2.17 | 153.7 | 94.9 |
| 1.004 | 59.21 | 9.57 | 148.223 | 0.700 | 0.0 | 0.0 | 0.0 | 1.89 | 133.8 | 112.2 |
| 1.005 | 58.70 | 9.74 | 146.789 | 0.758 | 0.0 | 0.0 | 0.0 | 4.21 | 297.4 | 120.5 |
| 2.000 | 72.85 | 6.01 | 146.599 | 0.099 | 0.0 | 0.0 | 0.0 | 1.12 | 19.8 | 19.6 |
| 2.001 | 66.28 | 7.50 | 145.687 | 0.217 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 38.9 |
| 2.002 | 62.42 | 8.55 | 145.075 | 0.328 | 0.0 | 0.0 | 0.0 | 1.42 | 100.4 | 55.4 |
| 2.003 | 57.71 | 10.09 | 144.340 | 0.452 | 0.0 | 0.0 | 0.0 | 1.03 | 72.7 | 70.7 |
| 2.004 | 54.57 | 11.29 | 143.857 | 0.546 | 0.0 | 0.0 | 0.0 | 1.01 | 111.0 | 80.7 |
| 1.006 | 53.67 | 11.67 | 143.481 | 1.304 | 0.0 | 0.0 | 0.0 | 1.00 | 217.3 | 189.5 |
| 3.000 | 72.16 | 6.15 | 153.633 | 0.179 | 0.0 | 0.0 | 0.0 | 1.45 | 57.8 | 35.1 |
| 3.001 | 68.38 | 6.98 | 152.396 | 0.325 | 0.0 | 0.0 | 0.0 | 1.78 | 70.9 | 60.1 |
| 3.002 | 65.47 | 7.71 | 150.672 | 0.445 | 0.0 | 0.0 | 0.0 | 1.84 | 130.3 | 78.9 |
| 3.003 | 61.92 | 8.70 | 149.573 | 0.601 | 0.0 | 0.0 | 0.0 | 1.77 | 125.0 | 100.8 |

## Network Design Table for Catchment 9 - Ch 44200

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3.004 | 105.755 | 1.616 | 65.4 | 0.165 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 3.005 | 41.230 | 2.959 | 13.9 | 0.070 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.007 | 84.556 | 2.049 | 41.3 | 0.000 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| 4.000 | 55.552 | 0.550 | 100.9 | 0.079 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 4.001 | 90.000 | 0.736 | 122.2 | 0.118 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 4.002 | 90.000 | 0.796 | 113.1 | 0.117 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 4.003 | 38.189 | 0.158 | 241.6 | 0.051 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 5.000 | 96.142 | 1.161 | 82.8 | 0.232 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 4.004 | 89.730 | 2.352 | 38.2 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 6.000 | 91.874 | 1.301 | 70.6 | 0.171 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 6.001 | 89.439 | 0.370 | 241.6 | 0.187 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 6.002 | 100.000 | 0.312 | 321.0 | 0.200 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 6.003 | 100.000 | 1.653 | 60.5 | 0.214 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 6.004 | 100.000 | 3.405 | 29.4 | 0.132 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 7.000 | 33.612 | 0.333 | 100.9 | 0.081 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 7.001 | 35.731 | 0.148 | 241.9 | 0.159 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 7.002 | 30.866 | 0.128 | 241.9 | 0.124 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 7.003 | 70.492 | 7.591 | 9.3 | 0.099 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 8.000 | 46.325 | 0.459 | 100.9 | 0.067 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 8.001 | 90.000 | 0.536 | 167.9 | 0.108 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 8.002 | 90.000 | 0.372 | 241.9 | 0.102 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 3.004 | 59.08 | 9.61 | 148.235 | 0.766 | 0.0 | 0.0 | 0.0 | 1.95 | 137.6 | 122.5 |
| 3.005 | 58.61 | 9.77 | 146.619 | 0.835 | 0.0 | 0.0 | 0.0 | 4.23 | 299.3 | 132.6 |
| 1.007 | 52.75 | 12.07 | 143.435 | 2.139 | 0.0 | 0.0 | 0.0 | 3.49 | 756.4 | 305.6 |
| 4.000 | 73.26 | 5.93 | 146.634 | 0.079 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 15.7 |
| 4.001 | 67.49 | 7.20 | 146.008 | 0.197 | 0.0 | 0.0 | 0.0 | 1.18 | 47.0 | 36.1 |
| 4.002 | 63.61 | 8.21 | 145.197 | 0.315 | 0.0 | 0.0 | 0.0 | 1.48 | 104.4 | 54.2 |
| 4.003 | 61.46 | 8.84 | 144.401 | 0.365 | 0.0 | 0.0 | 0.0 | 1.01 | 71.2 | 60.8 |
| 5.000 | 72.33 | 6.11 | 145.479 | 0.232 | 0.0 | 0.0 | 0.0 | 1.44 | 57.2 | 45.4 |
| 4.004 | 59.62 | 9.43 | 144.243 | 0.597 | 0.0 | 0.0 | 0.0 | 2.55 | 180.5 | 96.4 |
| 6.000 | 72.97 | 5.98 | 151.493 | 0.171 | 0.0 | 0.0 | 0.0 | 1.56 | 62.0 | 33.7 |
| 6.001 | 66.41 | 7.46 | 150.117 | 0.358 | 0.0 | 0.0 | 0.0 | 1.01 | 71.2 | 64.3 |
| 6.002 | 60.57 | 9.12 | 149.672 | 0.557 | 0.0 | 0.0 | 0.0 | 1.01 | 111.1 | 91.5 |
| 6.003 | 58.42 | 9.83 | 149.360 | 0.772 | 0.0 | 0.0 | 0.0 | 2.33 | 257.7 | 122.1 |
| 6.004 | 57.04 | 10.33 | 147.707 | 0.904 | 0.0 | 0.0 | 0.0 | 3.35 | 370.5 | 139.6 |
| 7.000 | 75.16 | 5.56 | 152.815 | 0.081 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 16.4 |
| 7.001 | 72.14 | 6.15 | 152.332 | 0.240 | 0.0 | 0.0 | 0.0 | 1.01 | 71.1 | 46.8 |
| 7.002 | 69.77 | 6.66 | 152.184 | 0.363 | 0.0 | 0.0 | 0.0 | 1.01 | 71.1 | 68.6 |
| 7.003 | 68.78 | 6.89 | 152.057 | 0.462 | 0.0 | 0.0 | 0.0 | 5.19 | 366.8 | 86.0 |
| 8.000 | 74.04 | 5.77 | 146.261 | 0.067 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 13.5 |
| 8.001 | 67.21 | 7.26 | 145.727 | 0.175 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 31.9 |
| 8.002 | 61.75 | 8.75 | 145.116 | 0.278 | 0.0 | 0.0 | 0.0 | 1.01 | 71.1 | 46.4 |

## Network Design Table for Catchment 9 - Ch 44200

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8.003 | 67.517 | 0.279 | 241.9 | 0.071 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 7.004 | 35.210 | 0.088 | 401.4 | 0.037 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 6.005 | 94.484 | 2.336 | 40.4 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 9.000 | 71.155 | 0.424 | 167.9 | 0.145 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 9.001 | 32.787 | 0.492 | 66.6 | 0.031 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 9.002 | 49.012 | 1.838 | 26.7 | 0.045 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 9.003 | 51.909 | 0.215 | 241.4 | 0.049 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 10.000 | 51.481 | 3.024 | 17.0 | 0.109 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 10.001 | 51.506 | 3.221 | 16.0 | 0.047 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 10.002 | 46.867 | 2.457 | 19.1 | 0.044 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 9.004 | 41.262 | 0.813 | 50.8 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 9.005 | 41.262 | 0.103 | 402.6 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 1.008 | 43.257 | 0.087 | 497.2 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |

## Network Results Table

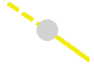
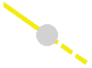
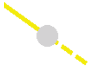
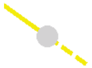
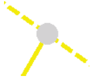
| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 8.003 | 58.32 | 9.87 | 144.744 | 0.348 | 0.0 | 0.0 | 0.0 | 1.01 | 71.1 | 55.0 |
| 7.004 | 56.71 | 10.45 | 144.315 | 0.847 | 0.0 | 0.0 | 0.0 | 1.01 | 160.4 | 130.1 |
| 6.005 | 55.43 | 10.94 | 144.228 | 1.751 | 0.0 | 0.0 | 0.0 | 3.20 | 509.6 | 262.8 |
| 9.000 | 72.01 | 6.18 | 146.001 | 0.145 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 28.2 |
| 9.001 | 70.42 | 6.52 | 145.577 | 0.176 | 0.0 | 0.0 | 0.0 | 1.60 | 63.8 | 33.6 |
| 9.002 | 68.99 | 6.84 | 145.085 | 0.222 | 0.0 | 0.0 | 0.0 | 2.54 | 101.1 | 41.4 |
| 9.003 | 66.25 | 7.50 | 143.022 | 0.271 | 0.0 | 0.0 | 0.0 | 1.30 | 207.4 | 48.5 |
| 10.000 | 76.31 | 5.35 | 152.148 | 0.109 | 0.0 | 0.0 | 0.0 | 2.45 | 43.4 | 22.5 |
| 10.001 | 74.48 | 5.69 | 149.124 | 0.156 | 0.0 | 0.0 | 0.0 | 2.53 | 44.7 | 31.5 |
| 10.002 | 72.76 | 6.03 | 145.903 | 0.200 | 0.0 | 0.0 | 0.0 | 2.32 | 40.9 | 39.4 |
| 9.004 | 65.32 | 7.74 | 142.807 | 0.470 | 0.0 | 0.0 | 0.0 | 2.86 | 454.7 | 83.2 |
| 9.005 | 62.85 | 8.43 | 141.994 | 0.470 | 0.0 | 0.0 | 0.0 | 1.01 | 160.2 | 83.2 |
| 1.008 | 72.73 | 6.03 | 141.386 | 0.000 | 20.0 | 0.0 | 0.0 | 0.70 | 49.4 | 20.0 |

## Manhole Schedules for Catchment 9 - Ch 44200

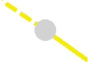
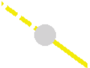
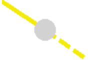
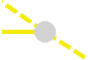
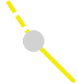
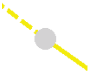
| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C09-1 | 154.921 | 1.425 | Open Manhole | 1200 | 1.000 | 153.496 | 225 | | | | |
| S06-C09-2 | 153.761 | 1.500 | Open Manhole | 1200 | 1.001 | 152.261 | 300 | 1.000 | 152.336 | 225 | |
| S06-C09-3 | 152.954 | 1.500 | Open Manhole | 1200 | 1.002 | 151.454 | 300 | 1.001 | 151.454 | 300 | |
| S06-C09-4 | 151.550 | 1.500 | Open Manhole | 1200 | 1.003 | 150.050 | 300 | 1.002 | 150.050 | 300 | |
| S06-C09-5 | 149.723 | 1.500 | Open Manhole | 1200 | 1.004 | 148.223 | 300 | 1.003 | 148.223 | 300 | |
| S06-C09-6 | 148.289 | 1.500 | Open Manhole | 1200 | 1.005 | 146.789 | 300 | 1.004 | 146.789 | 300 | |
| S06-C09-7 | 147.949 | 1.350 | Open Manhole | 1200 | 2.000 | 146.599 | 150 | | | | |
| S06-C09-8 | 147.360 | 1.673 | Open Manhole | 1200 | 2.001 | 145.687 | 225 | 2.000 | 145.762 | 150 | |
| S06-C09-9 | 146.576 | 1.501 | Open Manhole | 1200 | 2.002 | 145.075 | 300 | 2.001 | 145.150 | 225 | |
| S06-C09-10 | 145.840 | 1.500 | Open Manhole | 1200 | 2.003 | 144.340 | 300 | 2.002 | 144.340 | 300 | |
| S06-C09-11 | 146.634 | 2.777 | Open Manhole | 1350 | 2.004 | 143.857 | 375 | 2.003 | 143.932 | 300 | |
| S06-C09-12 | 147.659 | 4.178 | Open Manhole | 1500 | 1.006 | 143.481 | 525 | 1.005 | 143.706 | 300 | |
| | | | | | | | | 2.004 | 143.631 | 375 | |
| S06-C09-13 | 155.058 | 1.425 | Open Manhole | 1200 | 3.000 | 153.633 | 225 | | | | |
| S06-C09-14 | 153.821 | 1.425 | Open Manhole | 1200 | 3.001 | 152.396 | 225 | 3.000 | 152.396 | 225 | |
| S06-C09-15 | 152.172 | 1.500 | Open Manhole | 1200 | 3.002 | 150.672 | 300 | 3.001 | 150.747 | 225 | |
| S06-C09-16 | 151.073 | 1.500 | Open Manhole | 1200 | 3.003 | 149.573 | 300 | 3.002 | 149.573 | 300 | |
| S06-C09-17 | 149.735 | 1.500 | Open Manhole | 1200 | 3.004 | 148.235 | 300 | 3.003 | 148.235 | 300 | |
| S06-C09-18 | 148.119 | 1.500 | Open Manhole | 1200 | 3.005 | 146.619 | 300 | 3.004 | 146.619 | 300 | |
| S06-C09-19 | 147.015 | 3.581 | Open Manhole | 1500 | 1.007 | 143.435 | 525 | 1.006 | 143.435 | 525 | |
| | | | | | | | | 3.005 | 143.660 | 300 | |
| S06-C09-20 | 147.984 | 1.350 | Open Manhole | 1200 | 4.000 | 146.634 | 150 | | | | |
| S06-C09-21 | 147.494 | 1.486 | Open Manhole | 1200 | 4.001 | 146.008 | 225 | 4.000 | 146.083 | 150 | |
| S06-C09-22 | 146.697 | 1.500 | Open Manhole | 1200 | 4.002 | 145.197 | 300 | 4.001 | 145.272 | 225 | |
| S06-C09-23 | 145.901 | 1.500 | Open Manhole | 1200 | 4.003 | 144.401 | 300 | 4.002 | 144.401 | 300 | |
| S06-C09-24 | 146.904 | 1.425 | Open Manhole | 1200 | 5.000 | 145.479 | 225 | | | | |
| S06-C09-25 | 145.787 | 1.544 | Open Manhole | 1200 | 4.004 | 144.243 | 300 | 4.003 | 144.243 | 300 | |
| | | | | | | | | 5.000 | 144.318 | 225 | |
| S06-C09-26 | 152.918 | 1.425 | Open Manhole | 1200 | 6.000 | 151.493 | 225 | | | | |
| S06-C09-27 | 151.617 | 1.500 | Open Manhole | 1200 | 6.001 | 150.117 | 300 | 6.000 | 150.192 | 225 | |
| S06-C09-28 | 152.937 | 3.265 | Open Manhole | 1350 | 6.002 | 149.672 | 375 | 6.001 | 149.747 | 300 | |
| S06-C09-29 | 151.151 | 1.791 | Open Manhole | 1350 | 6.003 | 149.360 | 375 | 6.002 | 149.360 | 375 | |
| S06-C09-30 | 149.282 | 1.575 | Open Manhole | 1350 | 6.004 | 147.707 | 375 | 6.003 | 147.707 | 375 | |
| S06-C09-31 | 154.165 | 1.350 | Open Manhole | 1200 | 7.000 | 152.815 | 150 | | | | |
| S06-C09-32 | 156.031 | 3.699 | Open Manhole | 1200 | 7.001 | 152.332 | 300 | 7.000 | 152.482 | 150 | |
| S06-C09-33 | 155.726 | 3.541 | Open Manhole | 1200 | 7.002 | 152.184 | 300 | 7.001 | 152.184 | 300 | |
| S06-C09-34 | 153.640 | 1.584 | Open Manhole | 1200 | 7.003 | 152.057 | 300 | 7.002 | 152.057 | 300 | |
| S06-C09-35 | 147.611 | 1.350 | Open Manhole | 1200 | 8.000 | 146.261 | 150 | | | | |
| S06-C09-36 | 147.299 | 1.572 | Open Manhole | 1200 | 8.001 | 145.727 | 225 | 8.000 | 145.802 | 150 | |
| S06-C09-37 | 146.831 | 1.714 | Open Manhole | 1200 | 8.002 | 145.116 | 300 | 8.001 | 145.191 | 225 | |
| S06-C09-38 | 146.339 | 1.595 | Open Manhole | 1200 | 8.003 | 144.744 | 300 | 8.002 | 144.744 | 300 | |
| S06-C09-39 | 146.069 | 1.754 | Open Manhole | 1350 | 7.004 | 144.315 | 450 | 7.003 | 144.465 | 300 | |
| | | | | | | | | 8.003 | 144.465 | 300 | |
| S06-C09-40 | 147.518 | 3.291 | Open Manhole | 1350 | 6.005 | 144.228 | 450 | 6.004 | 144.303 | 375 | |
| | | | | | | | | 7.004 | 144.228 | 450 | |
| S06-C09-41 | 147.426 | 1.425 | Open Manhole | 1200 | 9.000 | 146.001 | 225 | | | | |
| S06-C09-42 | 147.070 | 1.493 | Open Manhole | 1200 | 9.001 | 145.577 | 225 | 9.000 | 145.577 | 225 | |

## Manhole Schedules for Catchment 9 - Ch 44200

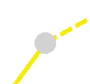
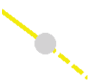
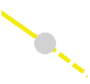
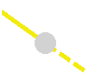
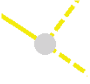
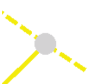
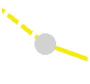
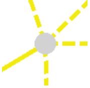
| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C09-43 | 146.510 | 1.425 | Open Manhole | 1200 | 9.002 | 145.085 | 225 | 9.001 | 145.085 | 225 | |
| S06-C09-44 | 144.672 | 1.650 | Open Manhole | 1350 | 9.003 | 143.022 | 450 | 9.002 | 143.247 | 225 | |
| S06-C09-45 | 153.498 | 1.350 | Open Manhole | 1200 | 10.000 | 152.148 | 150 | | | | |
| S06-C09-46 | 150.474 | 1.350 | Open Manhole | 1200 | 10.001 | 149.124 | 150 | 10.000 | 149.124 | 150 | |
| S06-C09-47 | 147.253 | 1.350 | Open Manhole | 1200 | 10.002 | 145.903 | 150 | 10.001 | 145.903 | 150 | |
| S06-C09-48 | 144.796 | 1.989 | Open Manhole | 1350 | 9.004 | 142.807 | 450 | 9.003 | 142.807 | 450 | |
| | | | | | | | | 10.002 | 143.446 | 150 | 339 |
| S06-C09-49 | 143.644 | 1.650 | Junction | | 9.005 | 141.994 | 450 | 9.004 | 141.994 | 450 | |
| S06-C09-50 | 143.551 | 2.165 | Open Manhole | 1500 | 1.008 | 141.386 | 300 | 1.007 | 141.386 | 525 | |
| | | | | | | | | 4.004 | 141.891 | 300 | 505 |
| | | | | | | | | 6.005 | 141.891 | 450 | 655 |
| | | | | | | | | 9.005 | 141.891 | 450 | 655 |
| Outfall 9 | 144.202 | 2.903 | Open Manhole | 0 | | OUTFALL | | 1.008 | 141.299 | 300 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C09-1 | 374773.111 | 516276.748 | 374773.111 | 516276.748 | Required |  |
| S06-C09-2 | 374865.980 | 516231.466 | 374865.980 | 516231.466 | Required |  |
| S06-C09-3 | 374941.573 | 516194.443 | 374941.573 | 516194.443 | Required |  |
| S06-C09-4 | 375021.831 | 516147.135 | 375021.831 | 516147.135 | Required |  |
| S06-C09-5 | 375100.996 | 516092.821 | 375100.996 | 516092.821 | Required |  |
| S06-C09-6 | 375181.469 | 516034.814 | 375181.469 | 516034.814 | Required |  |
| S06-C09-7 | 375555.329 | 515769.672 | 375555.329 | 515769.672 | Required |  |
| S06-C09-8 | 375500.061 | 515808.680 | 375500.061 | 515808.680 | Required |  |
| S06-C09-9 | 375426.531 | 515860.577 | 375426.531 | 515860.577 | Required |  |
| S06-C09-10 | 375353.291 | 515912.884 | 375353.291 | 515912.884 | Required |  |
| S06-C09-11 | 375276.183 | 515967.663 | 375276.183 | 515967.663 | Required |  |
| S06-C09-12 | 375217.196 | 516009.994 | 375217.196 | 516009.994 | Required |  |

## Manhole Schedules for Catchment 9 - Ch 44200

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C09-13 | 374759.289 | 516258.296 | 374759.289 | 516258.296 | Required |  |
| S06-C09-14 | 374850.081 | 516215.920 | 374850.081 | 516215.920 | Required |  |
| S06-C09-15 | 374929.542 | 516175.685 | 374929.542 | 516175.685 | Required |  |
| S06-C09-16 | 374999.283 | 516136.102 | 374999.283 | 516136.102 | Required |  |
| S06-C09-17 | 375086.890 | 516076.713 | 375086.890 | 516076.713 | Required |  |
| S06-C09-18 | 375172.664 | 516014.850 | 375172.664 | 516014.850 | Required |  |
| S06-C09-19 | 375205.796 | 515990.311 | 375205.796 | 515990.311 | Required |  |
| S06-C09-20 | 375547.111 | 515753.354 | 375547.111 | 515753.354 | Required |  |
| S06-C09-21 | 375501.802 | 515785.496 | 375501.802 | 515785.496 | Required |  |
| S06-C09-22 | 375428.397 | 515837.570 | 375428.397 | 515837.570 | Required |  |
| S06-C09-23 | 375354.866 | 515889.466 | 375354.866 | 515889.466 | Required |  |
| S06-C09-24 | 375243.889 | 515965.137 | 375243.889 | 515965.137 | Required |  |
| S06-C09-25 | 375322.895 | 515910.352 | 375322.895 | 515910.352 | Required |  |
| S06-C09-26 | 374943.727 | 516292.295 | 374943.727 | 516292.295 | Required |  |
| S06-C09-27 | 374994.157 | 516215.500 | 374994.157 | 516215.500 | Required |  |
| S06-C09-28 | 375057.545 | 516152.402 | 375057.545 | 516152.402 | Required |  |
| S06-C09-29 | 375137.117 | 516091.836 | 375137.117 | 516091.836 | Required |  |
| S06-C09-30 | 375218.934 | 516034.338 | 375218.934 | 516034.338 | Required |  |
| S06-C09-31 | 375444.785 | 515986.242 | 375444.785 | 515986.242 | Required |  |

## Manhole Schedules for Catchment 9 - Ch 44200

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C09-32 | 375432.100 | 516017.369 | 375432.100 | 516017.369 | Required |  |
| S06-C09-33 | 375398.393 | 516029.226 | 375398.393 | 516029.226 | Required |  |
| S06-C09-34 | 375371.482 | 516014.110 | 375371.482 | 516014.110 | Required |  |
| S06-C09-35 | 375566.651 | 515783.197 | 375566.651 | 515783.197 | Required |  |
| S06-C09-36 | 375530.589 | 515812.276 | 375530.589 | 515812.276 | Required |  |
| S06-C09-37 | 375458.546 | 515866.218 | 375458.546 | 515866.218 | Required |  |
| S06-C09-38 | 375384.948 | 515918.018 | 375384.948 | 515918.018 | Required |  |
| S06-C09-39 | 375329.936 | 515957.162 | 375329.936 | 515957.162 | Required |  |
| S06-C09-40 | 375300.542 | 515976.545 | 375300.542 | 515976.545 | Required |  |
| S06-C09-41 | 375188.471 | 515966.981 | 375188.471 | 515966.981 | Required |  |
| S06-C09-42 | 375147.992 | 515908.462 | 375147.992 | 515908.462 | Required |  |
| S06-C09-43 | 375147.992 | 515875.675 | 375147.992 | 515875.675 | Required |  |
| S06-C09-44 | 375186.479 | 515845.328 | 375186.479 | 515845.328 | Required |  |
| S06-C09-45 | 375365.625 | 515864.639 | 375365.625 | 515864.639 | Required |  |
| S06-C09-46 | 375332.961 | 515824.848 | 375332.961 | 515824.848 | Required |  |
| S06-C09-47 | 375281.638 | 515820.505 | 375281.638 | 515820.505 | Required |  |
| S06-C09-48 | 375235.344 | 515827.812 | 375235.344 | 515827.812 | Required |  |
| S06-C09-49 | 375234.254 | 515869.059 | | | No Entry |  |
| S06-C09-50 | 375233.164 | 515910.307 | 375233.164 | 515910.307 | Required |  |

## Manhole Schedules for Catchment 9 - Ch 44200

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| Outfall 9 | 375196.141 | 515887.937 |  |  | No Entry |  |

## Area Summary for Catchment 9 - Ch 44200

| **Pipe Number** | **PIMP Type** | **PIMP Name** | **PIMP (%)** | **Gross Area (ha)** | **Imp. Area (ha)** | **Pipe Total (ha)** |
|---|---|---|---|---|---|---|
| 1.000 | Classification | Default | 100 | 0.126 | 0.126 | 0.126 |
| | Classification | Verge | 50 | 0.029 | 0.014 | 0.140 |
| 1.001 | Classification | Default | 100 | 0.136 | 0.136 | 0.136 |
| | Classification | Verge | 50 | 0.039 | 0.020 | 0.156 |
| 1.002 | Classification | Default | 100 | 0.114 | 0.114 | 0.114 |
| | Classification | Verge | 50 | 0.037 | 0.018 | 0.133 |
| 1.003 | Classification | Default | 100 | 0.119 | 0.119 | 0.119 |
| | Classification | Verge | 50 | 0.035 | 0.017 | 0.136 |
| 1.004 | Classification | Default | 100 | 0.120 | 0.120 | 0.120 |
| | Classification | Verge | 50 | 0.029 | 0.014 | 0.135 |
| 1.005 | Classification | Default | 100 | 0.051 | 0.051 | 0.051 |
| | Classification | Verge | 50 | 0.013 | 0.006 | 0.058 |
| 2.000 | Classification | Default | 100 | 0.088 | 0.088 | 0.088 |
| | Classification | Verge | 50 | 0.022 | 0.011 | 0.099 |
| 2.001 | Classification | Default | 100 | 0.104 | 0.104 | 0.104 |
| | Classification | Verge | 50 | 0.026 | 0.013 | 0.118 |
| 2.002 | Classification | Default | 100 | 0.099 | 0.099 | 0.099 |
| | Classification | Verge | 50 | 0.014 | 0.007 | 0.106 |
| | Classification | Verge | 50 | 0.009 | 0.005 | 0.111 |
| 2.003 | Classification | Default | 100 | 0.111 | 0.111 | 0.111 |
| | Classification | Verge | 50 | 0.027 | 0.014 | 0.125 |
| 2.004 | Classification | Default | 100 | 0.083 | 0.083 | 0.083 |
| | Classification | Verge | 50 | 0.021 | 0.010 | 0.094 |
| 1.006 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 3.000 | Classification | Default | 100 | 0.157 | 0.157 | 0.157 |
| | Classification | Verge | 50 | 0.044 | 0.022 | 0.179 |
| 3.001 | Classification | Default | 100 | 0.131 | 0.131 | 0.131 |
| | Classification | Verge | 50 | 0.029 | 0.015 | 0.145 |
| 3.002 | Classification | Default | 100 | 0.109 | 0.109 | 0.109 |
| | Classification | Verge | 50 | 0.023 | 0.012 | 0.121 |
| 3.003 | Classification | Default | 100 | 0.140 | 0.140 | 0.140 |
| | Classification | Verge | 50 | 0.030 | 0.015 | 0.156 |
| 3.004 | Classification | Default | 100 | 0.149 | 0.149 | 0.149 |
| | Classification | Verge | 50 | 0.031 | 0.015 | 0.165 |
| 3.005 | Classification | Default | 100 | 0.069 | 0.069 | 0.069 |
| | Classification | Verge | 50 | 0.002 | 0.001 | 0.070 |
| 1.007 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 4.000 | Classification | Default | 100 | 0.070 | 0.070 | 0.070 |
| | Classification | Verge | 50 | 0.018 | 0.009 | 0.079 |
| 4.001 | Classification | Default | 100 | 0.105 | 0.105 | 0.105 |
| | Classification | Verge | 50 | 0.026 | 0.013 | 0.118 |
| 4.002 | Classification | Default | 100 | 0.104 | 0.104 | 0.104 |
| | Classification | Verge | 50 | 0.026 | 0.013 | 0.117 |
| 4.003 | Classification | Default | 100 | 0.045 | 0.045 | 0.045 |
| | Classification | Verge | 50 | 0.011 | 0.006 | 0.051 |
| 5.000 | Classification | Default | 100 | 0.144 | 0.144 | 0.144 |
| | Classification | Default | 100 | 0.073 | 0.073 | 0.217 |
| | Classification | Verge | 50 | 0.029 | 0.015 | 0.232 |
| 4.004 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 6.000 | Classification | Default | 100 | 0.114 | 0.114 | 0.114 |
| | Classification | Verge | 50 | 0.008 | 0.004 | 0.118 |
| | Classification | Verge | 50 | 0.032 | 0.016 | 0.135 |
| | Classification | Cutting | 25 | 0.005 | 0.001 | 0.136 |
| | Classification | Cutting | 25 | 0.096 | 0.024 | 0.160 |
| | Classification | Cutting | 25 | 0.007 | 0.002 | 0.162 |
| | Classification | Verge | 50 | 0.018 | 0.009 | 0.171 |
| 6.001 | Classification | Default | 100 | 0.084 | 0.084 | 0.084 |
| | Classification | Cutting | 25 | 0.005 | 0.001 | 0.085 |
| | Classification | Cutting | 25 | 0.317 | 0.079 | 0.164 |
| | Classification | Verge | 50 | 0.022 | 0.011 | 0.175 |
| | Classification | Verge | 50 | 0.023 | 0.012 | 0.187 |
| 6.002 | Classification | Default | 100 | 0.096 | 0.096 | 0.096 |
| | Classification | Verge | 50 | 0.026 | 0.013 | 0.109 |

## Area Summary for Catchment 9 - Ch 44200

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| | Classification | Verge | 50 | 0.024 | 0.012 | 0.121 |
| | Classification | Cutting | 25 | 0.316 | 0.079 | 0.200 |
| 6.003 | Classification | Default | 100 | 0.093 | 0.093 | 0.093 |
| | Classification | Verge | 50 | 0.025 | 0.012 | 0.105 |
| | Classification | Verge | 50 | 0.025 | 0.013 | 0.118 |
| | Classification | Cutting | 25 | 0.386 | 0.096 | 0.214 |
| 6.004 | Classification | Default | 100 | 0.093 | 0.093 | 0.093 |
| | Classification | Cutting | 25 | 0.058 | 0.015 | 0.107 |
| | Classification | Verge | 50 | 0.025 | 0.013 | 0.120 |
| | Classification | Verge | 50 | 0.025 | 0.012 | 0.132 |
| 7.000 | Classification | Default | 100 | 0.032 | 0.032 | 0.032 |
| | Classification | Verge | 50 | 0.017 | 0.008 | 0.040 |
| | Classification | Verge | 50 | 0.017 | 0.009 | 0.049 |
| | Classification | Cutting | 25 | 0.126 | 0.032 | 0.081 |
| 7.001 | Classification | Default | 100 | 0.034 | 0.034 | 0.034 |
| | Classification | Verge | 50 | 0.019 | 0.009 | 0.044 |
| | Classification | Verge | 50 | 0.021 | 0.011 | 0.054 |
| | Classification | Cutting | 25 | 0.419 | 0.105 | 0.159 |
| 7.002 | Classification | Default | 100 | 0.029 | 0.029 | 0.029 |
| | Classification | Verge | 50 | 0.014 | 0.007 | 0.036 |
| | Classification | Verge | 50 | 0.016 | 0.008 | 0.044 |
| | Classification | Cutting | 25 | 0.317 | 0.079 | 0.124 |
| 7.003 | Classification | Default | 100 | 0.059 | 0.059 | 0.059 |
| | Classification | Verge | 50 | 0.025 | 0.012 | 0.072 |
| | Classification | Cutting | 25 | 0.078 | 0.020 | 0.092 |
| | Classification | Verge | 50 | 0.014 | 0.007 | 0.099 |
| 8.000 | Classification | Default | 100 | 0.053 | 0.053 | 0.053 |
| | Classification | Verge | 50 | 0.014 | 0.007 | 0.060 |
| | Classification | Verge | 50 | 0.014 | 0.007 | 0.067 |
| 8.001 | Classification | Default | 100 | 0.084 | 0.084 | 0.084 |
| | Classification | Verge | 50 | 0.023 | 0.012 | 0.096 |
| | Classification | Verge | 50 | 0.025 | 0.013 | 0.108 |
| 8.002 | Classification | Default | 100 | 0.084 | 0.084 | 0.084 |
| | Classification | Verge | 50 | 0.002 | 0.001 | 0.085 |
| | Classification | Verge | 50 | 0.018 | 0.009 | 0.094 |
| | Classification | Verge | 50 | 0.018 | 0.009 | 0.102 |
| 8.003 | Classification | Default | 100 | 0.062 | 0.062 | 0.062 |
| | Classification | Verge | 50 | 0.017 | 0.008 | 0.071 |
| 7.004 | Classification | Default | 100 | 0.033 | 0.033 | 0.033 |
| | Classification | Verge | 50 | 0.009 | 0.004 | 0.037 |
| 6.005 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 9.000 | Classification | Default | 100 | 0.145 | 0.145 | 0.145 |
| 9.001 | Classification | Default | 100 | 0.031 | 0.031 | 0.031 |
| 9.002 | Classification | Default | 100 | 0.045 | 0.045 | 0.045 |
| 9.003 | Classification | Default | 100 | 0.049 | 0.049 | 0.049 |
| 10.000 | Classification | Default | 100 | 0.109 | 0.109 | 0.109 |
| 10.001 | Classification | Default | 100 | 0.047 | 0.047 | 0.047 |
| 10.002 | Classification | Default | 100 | 0.044 | 0.044 | 0.044 |
| 9.004 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 9.005 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.008 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total | Total | Total |
| | | | | 7.108 | 4.957 | 4.957 |

## Online Controls for Catchment 9 - Ch 44200

### Non Return Valve Manhole: S06-C09-49, DS/PN: 9.005, Volume (m³): 6.5

### Hydro-Brake® Optimum Manhole: S06-C09-50, DS/PN: 1.008, Volume (m³): 49.3

| | |
|---|---|
| Unit Reference | MD-SHE-0283-4700-1300-4700 |
| Design Head (m) | 1.300 |
| Design Flow (l/s) | 47.0 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 283 |
| Invert Level (m) | 141.386 |
| Minimum Outlet Pipe Diameter (mm) | 300 |
| Suggested Manhole Diameter (mm) | 1800 |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.300 | 46.9 | Kick-Flo® | 0.955 | 40.4 |
| Flush-Flo™ | 0.471 | 46.9 | Mean Flow over Head Range | - | 39.2 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 8.8 | 0.800 | 44.5 | 2.000 | 57.7 | 4.000 | 80.7 | 7.000 | 106.0 |
| 0.200 | 29.2 | 1.000 | 41.3 | 2.200 | 60.4 | 4.500 | 85.5 | 7.500 | 109.7 |
| 0.300 | 45.3 | 1.200 | 45.1 | 2.400 | 63.0 | 5.000 | 90.0 | 8.000 | 113.2 |
| 0.400 | 46.7 | 1.400 | 48.6 | 2.600 | 65.5 | 5.500 | 94.3 | 8.500 | 116.6 |
| 0.500 | 46.9 | 1.600 | 51.8 | 3.000 | 70.2 | 6.000 | 98.4 | 9.000 | 119.9 |
| 0.600 | 46.4 | 1.800 | 54.8 | 3.500 | 75.7 | 6.500 | 102.3 | 9.500 | 123.1 |

## Offline Controls for Catchment 9 - Ch 44200

### Weir Manhole: S06-C09-50, DS/PN: 1.008, Loop to PN: None

Discharge Coef 0.544 Width (m) 10.000 Invert Level (m) 142.686

## Storage Structures for Catchment 9 - Ch 44200

### Tank or Pond Manhole: S06-C09-50, DS/PN: 1.008

Invert Level (m) 141.386

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|---|---|---|---|
| 0.000 | 3061.1 | 1.300 | 4083.0 | 1.301 | 5654.3 | 2.165 | 7610.8 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 9 - Ch 44200

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 1 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C09-1 | 15 minute 5 year Winter I+20% | 154.921 | 153.631 | -0.090 | 0.000 | 0.62 | | 33.4 | OK |
| 1.001 | S06-C09-2 | 15 minute 5 year Winter I+20% | 153.761 | 152.435 | -0.126 | 0.000 | 0.61 | | 64.0 | OK |
| 1.002 | S06-C09-3 | 15 minute 5 year Winter I+20% | 152.954 | 151.639 | -0.115 | 0.000 | 0.67 | | 88.9 | OK |
| 1.003 | S06-C09-4 | 15 minute 5 year Winter I+20% | 151.550 | 150.250 | -0.100 | 0.000 | 0.76 | | 112.8 | OK |
| 1.004 | S06-C09-5 | 15 minute 5 year Winter I+20% | 149.723 | 148.602 | 0.079 | 0.000 | 1.02 | | 132.5 | SURCHARGED |
| 1.005 | S06-C09-6 | 15 minute 5 year Winter I+20% | 148.289 | 146.941 | -0.148 | 0.000 | 0.51 | | 141.0 | OK |
| 2.000 | S06-C09-7 | 15 minute 5 year Winter I+20% | 147.949 | 147.144 | 0.395 | 0.000 | 1.11 | | 21.6 | SURCHARGED |
| 2.001 | S06-C09-8 | 15 minute 5 year Winter I+20% | 147.360 | 146.053 | 0.141 | 0.000 | 1.09 | | 42.7 | SURCHARGED |
| 2.002 | S06-C09-9 | 15 minute 5 year Winter I+20% | 146.576 | 145.252 | -0.123 | 0.000 | 0.63 | | 61.4 | OK |
| 2.003 | S06-C09-10 | 15 minute 5 year Winter I+20% | 145.840 | 144.743 | 0.103 | 0.000 | 1.10 | | 77.6 | SURCHARGED |
| 2.004 | S06-C09-11 | 15 minute 5 year Winter I+20% | 146.634 | 144.171 | -0.061 | 0.000 | 0.83 | | 87.2 | OK |
| 1.006 | S06-C09-12 | 15 minute 5 year Winter I+20% | 147.659 | 144.012 | 0.006 | 0.000 | 1.34 | | 223.8 | SURCHARGED |
| 3.000 | S06-C09-13 | 15 minute 5 year Winter I+20% | 155.058 | 153.788 | -0.070 | 0.000 | 0.76 | | 43.0 | OK |
| 3.001 | S06-C09-14 | 15 minute 5 year Winter I+20% | 153.821 | 152.661 | 0.039 | 0.000 | 1.00 | | 69.3 | SURCHARGED |
| 3.002 | S06-C09-15 | 15 minute 5 year Winter I+20% | 152.172 | 150.867 | -0.106 | 0.000 | 0.73 | | 91.6 | OK |
| 3.003 | S06-C09-16 | 15 minute 5 year Winter I+20% | 151.073 | 149.875 | 0.002 | 0.000 | 0.95 | | 115.9 | SURCHARGED |
| 3.004 | S06-C09-17 | 15 minute 5 year Winter I+20% | 149.735 | 148.669 | 0.134 | 0.000 | 1.04 | | 138.9 | SURCHARGED |
| 3.005 | S06-C09-18 | 15 minute 5 year Winter I+20% | 148.119 | 146.775 | -0.144 | 0.000 | 0.53 | | 148.2 | OK |
| 1.007 | S06-C09-19 | 15 minute 5 year Winter I+20% | 147.015 | 143.705 | -0.254 | 0.000 | 0.52 | | 369.5 | OK |
| 4.000 | S06-C09-20 | 15 minute 5 year Winter I+20% | 147.984 | 146.897 | 0.113 | 0.000 | 1.08 | | 18.6 | SURCHARGED |
| 4.001 | S06-C09-21 | 15 minute 5 year Winter I+20% | 147.494 | 146.181 | -0.052 | 0.000 | 0.90 | | 41.3 | OK |
| 4.002 | S06-C09-22 | 15 minute 5 year Winter I+20% | 146.697 | 145.373 | -0.124 | 0.000 | 0.62 | | 62.4 | OK |
| 4.003 | S06-C09-23 | 15 minute 5 year Winter I+20% | 145.901 | 144.708 | 0.007 | 0.000 | 1.05 | | 69.1 | SURCHARGED |
| 5.000 | S06-C09-24 | 15 minute 5 year Winter I+20% | 146.904 | 145.757 | 0.053 | 0.000 | 0.98 | | 54.9 | SURCHARGED |
| 4.004 | S06-C09-25 | 15 minute 5 year Winter I+20% | 145.787 | 144.425 | -0.118 | 0.000 | 0.68 | | 118.3 | OK |
| 6.000 | S06-C09-26 | 15 minute 5 year Winter I+20% | 152.918 | 151.635 | -0.083 | 0.000 | 0.68 | | 41.5 | OK |
| 6.001 | S06-C09-27 | 15 minute 5 year Winter I+20% | 151.617 | 150.527 | 0.110 | 0.000 | 1.08 | | 74.2 | SURCHARGED |
| 6.002 | S06-C09-28 | 15 minute 5 year Winter I+20% | 152.937 | 150.002 | -0.045 | 0.000 | 0.97 | | 103.3 | OK |
| 6.003 | S06-C09-29 | 15 minute 5 year Winter I+20% | 151.151 | 149.560 | -0.175 | 0.000 | 0.55 | | 135.4 | OK |
| 6.004 | S06-C09-30 | 15 minute 5 year Winter I+20% | 149.282 | 147.881 | -0.201 | 0.000 | 0.44 | | 155.6 | OK |
| 7.000 | S06-C09-31 | 15 minute 5 year Winter I+20% | 154.165 | 153.075 | 0.110 | 0.000 | 1.14 | | 19.4 | SURCHARGED |
| 7.001 | S06-C09-32 | 15 minute 5 year Winter I+20% | 156.031 | 152.615 | -0.017 | 0.000 | 0.78 | | 51.2 | OK |
| 7.002 | S06-C09-33 | 15 minute 5 year Winter I+20% | 155.726 | 152.520 | 0.036 | 0.000 | 1.16 | | 74.9 | SURCHARGED |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 9 - Ch 44200

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|
| 7.003 | S06-C09-34 | 15 minute 5 year Winter I+20% | 153.640 | 152.162 | -0.195 | 0.000 | 0.27 | | 93.6 |
| 8.000 | S06-C09-35 | 15 minute 5 year Winter I+20% | 147.611 | 146.383 | -0.028 | 0.000 | 0.96 | | 16.6 |
| 8.001 | S06-C09-36 | 15 minute 5 year Winter I+20% | 147.299 | 145.926 | -0.027 | 0.000 | 0.94 | | 36.7 |
| 8.002 | S06-C09-37 | 15 minute 5 year Winter I+20% | 146.831 | 145.326 | -0.091 | 0.000 | 0.78 | | 53.4 |
| 8.003 | S06-C09-38 | 15 minute 5 year Winter I+20% | 146.339 | 144.996 | -0.048 | 0.000 | 0.90 | | 61.1 |
| 7.004 | S06-C09-39 | 15 minute 5 year Winter I+20% | 146.069 | 144.765 | 0.000 | 0.000 | 1.08 | | 151.8 |
| 6.005 | S06-C09-40 | 15 minute 5 year Winter I+20% | 147.518 | 144.488 | -0.190 | 0.000 | 0.63 | | 305.0 |
| 9.000 | S06-C09-41 | 15 minute 5 year Winter I+20% | 147.426 | 146.175 | -0.051 | 0.000 | 0.89 | | 34.5 |
| 9.001 | S06-C09-42 | 15 minute 5 year Winter I+20% | 147.070 | 145.715 | -0.088 | 0.000 | 0.68 | | 40.5 |
| 9.002 | S06-C09-43 | 15 minute 5 year Winter I+20% | 146.510 | 145.200 | -0.110 | 0.000 | 0.51 | | 49.8 |
| 9.003 | S06-C09-44 | 15 minute 5 year Winter I+20% | 144.672 | 143.196 | -0.276 | 0.000 | 0.31 | | 58.5 |
| 10.000 | S06-C09-45 | 15 minute 5 year Winter I+20% | 153.498 | 152.237 | -0.061 | 0.000 | 0.64 | | 27.2 |
| 10.001 | S06-C09-46 | 15 minute 5 year Winter I+20% | 150.474 | 149.233 | -0.041 | 0.000 | 0.86 | | 37.3 |
| 10.002 | S06-C09-47 | 15 minute 5 year Winter I+20% | 147.253 | 146.437 | 0.384 | 0.000 | 1.08 | | 42.9 |
| 9.004 | S06-C09-48 | 15 minute 5 year Winter I+20% | 144.796 | 142.959 | -0.298 | 0.000 | 0.25 | | 101.2 |
| 9.005 | S06-C09-49 | 15 minute 5 year Winter I+20% | 143.644 | 142.254 | -0.190 | 0.000 | 0.63 | | 100.7 |
| 1.008 | S06-C09-50 | 480 minute 5 year Winter I+20% | 143.551 | 141.809 | 0.123 | 0.000 | 1.01 | 0.0 | 46.4 |

| PN | US/MH Name | Status |
|---|---|---|
| 7.003 | S06-C09-34 | OK |
| 8.000 | S06-C09-35 | OK |
| 8.001 | S06-C09-36 | OK |
| 8.002 | S06-C09-37 | OK |
| 8.003 | S06-C09-38 | OK |
| 7.004 | S06-C09-39 | OK |
| 6.005 | S06-C09-40 | OK |
| 9.000 | S06-C09-41 | OK |
| 9.001 | S06-C09-42 | OK |
| 9.002 | S06-C09-43 | OK |
| 9.003 | S06-C09-44 | OK |
| 10.000 | S06-C09-45 | OK |
| 10.001 | S06-C09-46 | OK |
| 10.002 | S06-C09-47 | SURCHARGED |
| 9.004 | S06-C09-48 | OK |
| 9.005 | S06-C09-49 | OK* |
| 1.008 | S06-C09-50 | SURCHARGED |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 9 - Ch 44200

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0 Inlet Coeffecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 1 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C09-1 | 15 minute 100 year Winter I+40% | 154.921 | 154.923 | 1.202 | 2.439 | 1.03 | | 55.5 |
| 1.001 | S06-C09-2 | 15 minute 100 year Winter I+40% | 153.761 | 153.764 | 1.203 | 2.847 | 1.00 | | 104.6 |
| 1.002 | S06-C09-3 | 15 minute 100 year Winter I+40% | 152.954 | 152.959 | 1.205 | 5.350 | 1.00 | | 132.0 |
| 1.003 | S06-C09-4 | 30 minute 100 year Winter I+40% | 151.550 | 151.560 | 1.210 | 10.043 | 1.00 | | 149.0 |
| 1.004 | S06-C09-5 | 30 minute 100 year Winter I+40% | 149.723 | 149.730 | 1.207 | 7.387 | 1.36 | | 176.5 |
| 1.005 | S06-C09-6 | 15 minute 100 year Winter I+40% | 148.289 | 146.983 | -0.107 | 0.000 | 0.73 | | 203.2 |
| 2.000 | S06-C09-7 | 30 minute 100 year Winter I+40% | 147.949 | 147.960 | 1.210 | 10.368 | 1.56 | | 30.3 |
| 2.001 | S06-C09-8 | 15 minute 100 year Winter I+40% | 147.360 | 147.366 | 1.454 | 5.443 | 1.51 | | 59.1 |
| 2.002 | S06-C09-9 | 15 minute 100 year Winter I+40% | 146.576 | 146.578 | 1.202 | 1.646 | 0.99 | | 95.8 |
| 2.003 | S06-C09-10 | 30 minute 100 year Winter I+40% | 145.840 | 145.844 | 1.204 | 4.212 | 1.77 | | 124.6 |
| 2.004 | S06-C09-11 | 30 minute 100 year Winter I+40% | 146.634 | 144.640 | 0.409 | 0.000 | 1.43 | | 150.3 |
| 1.006 | S06-C09-12 | 30 minute 100 year Winter I+40% | 147.659 | 144.137 | 0.131 | 0.000 | 2.06 | | 344.9 |
| 3.000 | S06-C09-13 | 15 minute 100 year Winter I+40% | 155.058 | 155.066 | 1.208 | 8.324 | 1.00 | | 56.4 |
| 3.001 | S06-C09-14 | 30 minute 100 year Winter I+40% | 153.821 | 153.837 | 1.216 | 15.926 | 1.16 | | 80.3 |
| 3.002 | S06-C09-15 | 15 minute 100 year Winter I+40% | 152.172 | 152.173 | 1.201 | 1.255 | 0.99 | | 124.2 |
| 3.003 | S06-C09-16 | 30 minute 100 year Winter I+40% | 151.073 | 151.094 | 1.221 | 21.457 | 1.21 | | 147.5 |
| 3.004 | S06-C09-17 | 15 minute 100 year Winter I+40% | 149.735 | 149.739 | 1.204 | 4.277 | 1.32 | | 176.9 |
| 3.005 | S06-C09-18 | 15 minute 100 year Winter I+40% | 148.119 | 146.815 | -0.103 | 0.000 | 0.75 | | 208.3 |
| 1.007 | S06-C09-19 | 30 minute 100 year Winter I+40% | 147.015 | 143.783 | -0.177 | 0.000 | 0.77 | | 543.3 |
| 4.000 | S06-C09-20 | 15 minute 100 year Winter I+40% | 147.984 | 147.990 | 1.206 | 6.105 | 1.76 | | 30.4 |
| 4.001 | S06-C09-21 | 15 minute 100 year Winter I+40% | 147.494 | 147.497 | 1.263 | 2.609 | 1.40 | | 64.1 |
| 4.002 | S06-C09-22 | 15 minute 100 year Winter I+40% | 146.697 | 146.188 | 0.691 | 0.000 | 1.10 | | 111.4 |
| 4.003 | S06-C09-23 | 15 minute 100 year Winter I+40% | 145.901 | 145.306 | 0.604 | 0.000 | 1.79 | | 117.9 |
| 5.000 | S06-C09-24 | 15 minute 100 year Winter I+40% | 146.904 | 146.915 | 1.210 | 10.185 | 1.41 | | 78.6 |
| 4.004 | S06-C09-25 | 15 minute 100 year Winter I+40% | 145.787 | 144.862 | 0.319 | 0.000 | 1.07 | | 186.3 |
| 6.000 | S06-C09-26 | 15 minute 100 year Winter I+40% | 152.918 | 152.924 | 1.206 | 6.009 | 1.00 | | 60.4 |
| 6.001 | S06-C09-27 | 15 minute 100 year Winter I+40% | 151.617 | 151.629 | 1.212 | 11.789 | 1.86 | | 127.8 |
| 6.002 | S06-C09-28 | 15 minute 100 year Winter I+40% | 152.937 | 150.978 | 0.932 | 0.000 | 1.73 | | 184.7 |
| 6.003 | S06-C09-29 | 15 minute 100 year Winter I+40% | 151.151 | 149.839 | 0.104 | 0.000 | 1.03 | | 253.7 |
| 6.004 | S06-C09-30 | 15 minute 100 year Winter I+40% | 149.282 | 148.098 | 0.016 | 0.000 | 0.86 | | 307.2 |
| 7.000 | S06-C09-31 | 15 minute 100 year Winter I+40% | 154.165 | 154.169 | 1.204 | 4.477 | 2.13 | | 36.2 |
| 7.001 | S06-C09-32 | 15 minute 100 year Winter I+40% | 156.031 | 153.828 | 1.196 | 0.000 | 1.67 | | 109.7 |
| 7.002 | S06-C09-33 | 15 minute 100 year Winter I+40% | 155.726 | 153.387 | 0.903 | 0.000 | 2.77 | | 179.2 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 9 - Ch 44200

| PN | US/MH Name | Status |
|---|---|---|
| 1.000 | S06-C09-1 | FLOOD |
| 1.001 | S06-C09-2 | FLOOD |
| 1.002 | S06-C09-3 | FLOOD |
| 1.003 | S06-C09-4 | FLOOD |
| 1.004 | S06-C09-5 | FLOOD |
| 1.005 | S06-C09-6 | OK |
| 2.000 | S06-C09-7 | FLOOD |
| 2.001 | S06-C09-8 | FLOOD |
| 2.002 | S06-C09-9 | FLOOD |
| 2.003 | S06-C09-10 | FLOOD |
| 2.004 | S06-C09-11 | SURCHARGED |
| 1.006 | S06-C09-12 | SURCHARGED |
| 3.000 | S06-C09-13 | FLOOD |
| 3.001 | S06-C09-14 | FLOOD |
| 3.002 | S06-C09-15 | FLOOD |
| 3.003 | S06-C09-16 | FLOOD |
| 3.004 | S06-C09-17 | FLOOD |
| 3.005 | S06-C09-18 | OK |
| 1.007 | S06-C09-19 | OK |
| 4.000 | S06-C09-20 | FLOOD |
| 4.001 | S06-C09-21 | FLOOD |
| 4.002 | S06-C09-22 | SURCHARGED |
| 4.003 | S06-C09-23 | SURCHARGED |
| 5.000 | S06-C09-24 | FLOOD |
| 4.004 | S06-C09-25 | SURCHARGED |
| 6.000 | S06-C09-26 | FLOOD |
| 6.001 | S06-C09-27 | FLOOD |
| 6.002 | S06-C09-28 | SURCHARGED |
| 6.003 | S06-C09-29 | SURCHARGED |
| 6.004 | S06-C09-30 | SURCHARGED |
| 7.000 | S06-C09-31 | FLOOD |
| 7.001 | S06-C09-32 | SURCHARGED |
| 7.002 | S06-C09-33 | SURCHARGED |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 9 - Ch 44200

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|
| 7.003 | S06-C09-34 | 15 minute 100 year Winter I+40% | 153.640 | 152.239 | -0.118 | 0.000 | 0.66 | | 232.1 |
| 8.000 | S06-C09-35 | 15 minute 100 year Winter I+40% | 147.611 | 147.616 | 1.205 | 4.779 | 1.73 | | 29.7 |
| 8.001 | S06-C09-36 | 15 minute 100 year Winter I+40% | 147.299 | 147.304 | 1.352 | 5.067 | 1.42 | | 55.7 |
| 8.002 | S06-C09-37 | 15 minute 100 year Winter I+40% | 146.831 | 146.832 | 1.416 | 1.326 | 1.15 | | 79.1 |
| 8.003 | S06-C09-38 | 15 minute 100 year Winter I+40% | 146.339 | 146.345 | 1.300 | 5.916 | 1.75 | | 118.8 |
| 7.004 | S06-C09-39 | 15 minute 100 year Winter I+40% | 146.069 | 146.071 | 1.306 | 2.140 | 2.11 | | 296.6 |
| 6.005 | S06-C09-40 | 15 minute 100 year Winter I+40% | 147.518 | 145.725 | 1.047 | 0.000 | 1.20 | | 581.8 |
| 9.000 | S06-C09-41 | 15 minute 100 year Winter I+40% | 147.426 | 147.427 | 1.201 | 0.621 | 1.78 | | 69.1 |
| 9.001 | S06-C09-42 | 15 minute 100 year Winter I+40% | 147.070 | 146.117 | 0.315 | 0.000 | 1.28 | | 76.8 |
| 9.002 | S06-C09-43 | 15 minute 100 year Winter I+40% | 146.510 | 145.263 | -0.047 | 0.000 | 0.95 | | 92.2 |
| 9.003 | S06-C09-44 | 15 minute 100 year Winter I+40% | 144.672 | 143.284 | -0.188 | 0.000 | 0.62 | | 116.6 |
| 10.000 | S06-C09-45 | 15 minute 100 year Winter I+40% | 153.498 | 153.500 | 1.202 | 2.299 | 1.00 | | 42.3 |
| 10.001 | S06-C09-46 | 30 minute 100 year Winter I+40% | 150.474 | 150.481 | 1.207 | 6.523 | 1.00 | | 43.6 |
| 10.002 | S06-C09-47 | 30 minute 100 year Winter I+40% | 147.253 | 147.258 | 1.205 | 5.487 | 1.22 | | 48.7 |
| 9.004 | S06-C09-48 | 15 minute 100 year Winter I+40% | 144.796 | 143.007 | -0.250 | 0.000 | 0.41 | | 164.7 |
| 9.005 | S06-C09-49 | 15 minute 100 year Winter I+40% | 143.644 | 142.415 | -0.029 | 0.000 | 1.00 | | 160.2 |
| 1.008 | S06-C09-50 | 480 minute 100 year Winter I+40% | 143.551 | 142.400 | 0.714 | 0.000 | 1.01 | 0.0 | 46.8 |

| PN | US/MH Name | Status |
|---|---|---|
| 7.003 | S06-C09-34 | OK |
| 8.000 | S06-C09-35 | FLOOD |
| 8.001 | S06-C09-36 | FLOOD |
| 8.002 | S06-C09-37 | FLOOD |
| 8.003 | S06-C09-38 | FLOOD |
| 7.004 | S06-C09-39 | FLOOD |
| 6.005 | S06-C09-40 | SURCHARGED |
| 9.000 | S06-C09-41 | FLOOD |
| 9.001 | S06-C09-42 | SURCHARGED |
| 9.002 | S06-C09-43 | OK |
| 9.003 | S06-C09-44 | OK |
| 10.000 | S06-C09-45 | FLOOD |
| 10.001 | S06-C09-46 | FLOOD |
| 10.002 | S06-C09-47 | FLOOD |
| 9.004 | S06-C09-48 | OK |
| 9.005 | S06-C09-49 | OK* |
| 1.008 | S06-C09-50 | SURCHARGED |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for Catchment 10 - Ch 44550

Pipe Sizes Min 150 Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 20.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

## Network Design Table for Catchment 10 - Ch 44550

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 89.840 | 0.534 | 168.2 | 0.134 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.001 | 99.833 | 0.560 | 178.3 | 0.140 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.002 | 62.255 | 0.772 | 80.6 | 0.091 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.003 | 99.315 | 2.106 | 47.2 | 0.151 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.004 | 100.949 | 2.415 | 41.8 | 0.136 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.005 | 99.798 | 2.831 | 35.3 | 0.131 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.006 | 99.798 | 3.369 | 29.6 | 0.131 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.007 | 101.063 | 3.620 | 27.9 | 0.143 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.008 | 99.022 | 3.534 | 28.0 | 0.134 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.009 | 100.011 | 2.947 | 33.9 | 0.131 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.010 | 61.133 | 0.683 | 89.5 | 0.079 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 2.000 | 87.539 | 0.521 | 168.2 | 0.205 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.001 | 94.607 | 0.608 | 155.7 | 0.183 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 2.002 | 60.643 | 0.817 | 74.2 | 0.117 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 2.003 | 99.839 | 1.550 | 64.4 | 0.166 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 2.004 | 99.626 | 2.284 | 43.6 | 0.135 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 2.005 | 100.354 | 2.852 | 35.2 | 0.131 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 2.006 | 100.250 | 3.387 | 29.6 | 0.131 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 70.55 | 6.49 | 169.949 | 0.134 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 25.6 |
| 1.001 | 64.71 | 7.91 | 169.340 | 0.274 | 0.0 | 0.0 | 0.0 | 1.17 | 83.0 | 48.0 |
| 1.002 | 62.61 | 8.50 | 168.780 | 0.365 | 0.0 | 0.0 | 0.0 | 1.75 | 123.9 | 61.9 |
| 1.003 | 60.26 | 9.22 | 168.008 | 0.517 | 0.0 | 0.0 | 0.0 | 2.30 | 162.2 | 84.3 |
| 1.004 | 58.21 | 9.91 | 165.902 | 0.653 | 0.0 | 0.0 | 0.0 | 2.44 | 172.4 | 102.9 |
| 1.005 | 56.49 | 10.54 | 163.487 | 0.784 | 0.0 | 0.0 | 0.0 | 2.66 | 187.8 | 119.9 |
| 1.006 | 55.02 | 11.11 | 160.656 | 0.915 | 0.0 | 0.0 | 0.0 | 2.90 | 204.9 | 136.3 |
| 1.007 | 53.66 | 11.67 | 157.287 | 1.058 | 0.0 | 0.0 | 0.0 | 2.99 | 211.1 | 153.7 |
| 1.008 | 52.40 | 12.23 | 153.667 | 1.192 | 0.0 | 0.0 | 0.0 | 2.98 | 210.8 | 169.1 |
| 1.009 | 51.09 | 12.84 | 150.134 | 1.323 | 0.0 | 0.0 | 0.0 | 2.71 | 191.4 | 183.1 |
| 1.010 | 50.01 | 13.37 | 147.112 | 1.403 | 0.0 | 0.0 | 0.0 | 1.92 | 211.7 | 190.0 |
| 2.000 | 70.73 | 6.45 | 169.323 | 0.205 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 39.3 |
| 2.001 | 65.47 | 7.70 | 168.728 | 0.388 | 0.0 | 0.0 | 0.0 | 1.26 | 88.9 | 68.8 |
| 2.002 | 63.44 | 8.26 | 168.120 | 0.505 | 0.0 | 0.0 | 0.0 | 1.83 | 129.2 | 86.7 |
| 2.003 | 60.62 | 9.11 | 167.303 | 0.670 | 0.0 | 0.0 | 0.0 | 1.96 | 138.7 | 110.0 |
| 2.004 | 58.52 | 9.80 | 165.753 | 0.805 | 0.0 | 0.0 | 0.0 | 2.39 | 168.7 | 127.6 |
| 2.005 | 56.77 | 10.43 | 163.469 | 0.936 | 0.0 | 0.0 | 0.0 | 2.66 | 188.0 | 144.0 |
| 2.006 | 55.27 | 11.01 | 160.617 | 1.068 | 0.0 | 0.0 | 0.0 | 2.90 | 205.0 | 159.8 |

## Network Design Table for Catchment 10 - Ch 44550

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.007 | 101.953 | 3.646 | 28.0 | 0.133 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 2.008 | 98.218 | 3.516 | 27.9 | 0.129 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 2.009 | 98.941 | 2.893 | 34.2 | 0.130 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 2.010 | 57.010 | 0.633 | 90.1 | 0.079 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 2.011 | 19.220 | 0.039 | 490.6 | 0.000 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| 1.011 | 37.994 | 0.935 | 40.6 | 0.000 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| 1.012 | 217.287 | 2.794 | 77.8 | 0.000 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |

## Network Results Table

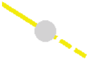
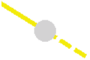
| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2.007 | 53.89 | 11.58 | 157.230 | 1.201 | 0.0 | 0.0 | 0.0 | 2.98 | 211.0 | 175.3 |
| 2.008 | 52.63 | 12.12 | 153.584 | 1.330 | 0.0 | 0.0 | 0.0 | 2.99 | 211.1 | 189.6 |
| 2.009 | 51.48 | 12.65 | 149.993 | 1.460 | 0.0 | 0.0 | 0.0 | 3.11 | 343.2 | 203.5 |
| 2.010 | 50.45 | 13.15 | 147.100 | 1.539 | 0.0 | 0.0 | 0.0 | 1.91 | 210.9 | 210.2 |
| 2.011 | 49.82 | 13.47 | 146.317 | 1.539 | 0.0 | 0.0 | 0.0 | 1.00 | 217.4 | 210.2 |
| 1.011 | 49.47 | 13.65 | 146.278 | 2.941 | 0.0 | 0.0 | 0.0 | 3.52 | 762.3 | 394.1 |
| 1.012 | 46.92 | 15.08 | 145.343 | 2.941 | 0.0 | 0.0 | 0.0 | 2.54 | 550.2 | 394.1 |

## Manhole Schedules for Catchment 10 - Ch 44550

| **MH Name** | **MH CL (m)** | **MH Depth (m)** | **MH Connection** | **MH Diam.,L*W (mm)** | **PN** | **Pipe Out Invert Level (m)** | **Diameter (mm)** | **PN** | **Pipes In Invert Level (m)** | **Diameter (mm)** | **Backdrop (mm)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C10-1 | 171.374 | 1.425 | Open Manhole | 1200 | 1.000 | 169.949 | 225 | | | | |
| S06-C10-2 | 171.112 | 1.772 | Open Manhole | 1200 | 1.001 | 169.340 | 300 | 1.000 | 169.415 | 225 | |
| S06-C10-3 | 170.280 | 1.500 | Open Manhole | 1200 | 1.002 | 168.780 | 300 | 1.001 | 168.780 | 300 | |
| S06-C10-4 | 169.507 | 1.500 | Open Manhole | 1200 | 1.003 | 168.008 | 300 | 1.002 | 168.008 | 300 | |
| S06-C10-5 | 167.402 | 1.500 | Open Manhole | 1200 | 1.004 | 165.902 | 300 | 1.003 | 165.902 | 300 | |
| S06-C10-6 | 164.986 | 1.500 | Open Manhole | 1200 | 1.005 | 163.487 | 300 | 1.004 | 163.487 | 300 | |
| S06-C10-7 | 162.155 | 1.500 | Open Manhole | 1200 | 1.006 | 160.656 | 300 | 1.005 | 160.656 | 300 | |
| S06-C10-8 | 158.787 | 1.500 | Open Manhole | 1200 | 1.007 | 157.287 | 300 | 1.006 | 157.287 | 300 | |
| S06-C10-9 | 155.167 | 1.500 | Open Manhole | 1200 | 1.008 | 153.667 | 300 | 1.007 | 153.667 | 300 | |
| S06-C10-10 | 151.633 | 1.500 | Open Manhole | 1200 | 1.009 | 150.134 | 300 | 1.008 | 150.134 | 300 | |
| S06-C10-11 | 148.687 | 1.575 | Open Manhole | 1350 | 1.010 | 147.112 | 375 | 1.009 | 147.187 | 300 | |
| S06-C10-12 | 170.748 | 1.425 | Open Manhole | 1200 | 2.000 | 169.323 | 225 | | | | |
| S06-C10-13 | 170.413 | 1.685 | Open Manhole | 1200 | 2.001 | 168.728 | 300 | 2.000 | 168.803 | 225 | |
| S06-C10-14 | 169.620 | 1.500 | Open Manhole | 1200 | 2.002 | 168.120 | 300 | 2.001 | 168.120 | 300 | |
| S06-C10-15 | 168.803 | 1.500 | Open Manhole | 1200 | 2.003 | 167.303 | 300 | 2.002 | 167.303 | 300 | |
| S06-C10-16 | 167.253 | 1.500 | Open Manhole | 1200 | 2.004 | 165.753 | 300 | 2.003 | 165.753 | 300 | |
| S06-C10-17 | 164.969 | 1.500 | Open Manhole | 1200 | 2.005 | 163.469 | 300 | 2.004 | 163.469 | 300 | |
| S06-C10-18 | 162.117 | 1.500 | Open Manhole | 1200 | 2.006 | 160.617 | 300 | 2.005 | 160.617 | 300 | |
| S06-C10-19 | 158.730 | 1.500 | Open Manhole | 1200 | 2.007 | 157.230 | 300 | 2.006 | 157.230 | 300 | |
| S06-C10-20 | 155.084 | 1.500 | Open Manhole | 1200 | 2.008 | 153.584 | 300 | 2.007 | 153.584 | 300 | |
| S06-C10-21 | 151.568 | 1.575 | Open Manhole | 1350 | 2.009 | 149.993 | 375 | 2.008 | 150.068 | 300 | |
| S06-C10-22 | 148.675 | 1.575 | Open Manhole | 1350 | 2.010 | 147.100 | 375 | 2.009 | 147.100 | 375 | |
| S06-C10-23 | 148.042 | 1.725 | Open Manhole | 1500 | 2.011 | 146.317 | 525 | 2.010 | 146.467 | 375 | |
| S06-C10-24 | 148.004 | 1.726 | Open Manhole | 1500 | 1.011 | 146.278 | 525 | 1.010 | 146.428 | 375 | |
| | | | | | | | | 2.011 | 146.278 | 525 | |
| S06-C10-25 | 146.632 | 1.289 | Open Manhole | 1500 | 1.012 | 145.343 | 525 | 1.011 | 145.343 | 525 | |
| Outfall 10 | 143.258 | 0.709 | Open Manhole | 0 | | OUTFALL | | 1.012 | 142.549 | 525 | |

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S06-C10-1 | 376422.967 | 515245.042 | 376422.967 | 515245.042 | Required |  |
| S06-C10-2 | 376336.912 | 515270.842 | 376336.912 | 515270.842 | Required |  |
| S06-C10-3 | 376244.591 | 515308.836 | 376244.591 | 515308.836 | Required |  |
| S06-C10-4 | 376188.878 | 515336.615 | 376188.878 | 515336.615 | Required |  |
| S06-C10-5 | 376103.629 | 515387.568 | 376103.629 | 515387.568 | Required |  |
| S06-C10-6 | 376017.808 | 515440.725 | 376017.808 | 515440.725 | Required |  |

## Manhole Schedules for Catchment 10 - Ch 44550

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C10-7 | 375933.478 | 515494.091 | 375933.478 | 515494.091 | Required |  |
| S06-C10-8 | 375849.147 | 515547.458 | 375849.147 | 515547.458 | Required |  |
| S06-C10-9 | 375763.473 | 515601.064 | 375763.473 | 515601.064 | Required |  |
| S06-C10-10 | 375681.735 | 515656.959 | 375681.735 | 515656.959 | Required |  |
| S06-C10-11 | 375600.211 | 515714.889 | 375600.211 | 515714.889 | Required |  |
| S06-C10-12 | 376424.025 | 515263.838 | 376424.025 | 515263.838 | Required |  |
| S06-C10-13 | 376340.631 | 515290.453 | 376340.631 | 515290.453 | Required |  |
| S06-C10-14 | 376253.038 | 515326.200 | 376253.038 | 515326.200 | Required |  |
| S06-C10-15 | 376198.998 | 515353.718 | 376198.998 | 515353.718 | Required |  |
| S06-C10-16 | 376112.119 | 515402.911 | 376112.119 | 515402.911 | Required |  |
| S06-C10-17 | 376027.318 | 515455.198 | 376027.318 | 515455.198 | Required |  |
| S06-C10-18 | 375942.402 | 515508.681 | 375942.402 | 515508.681 | Required |  |
| S06-C10-19 | 375857.479 | 515561.955 | 375857.479 | 515561.955 | Required |  |
| S06-C10-20 | 375771.796 | 515617.208 | 375771.796 | 515617.208 | Required |  |
| S06-C10-21 | 375691.099 | 515673.196 | 375691.099 | 515673.196 | Required |  |
| S06-C10-22 | 375610.416 | 515730.465 | 375610.416 | 515730.465 | Required |  |
| S06-C10-23 | 375563.985 | 515763.544 | 375563.985 | 515763.544 | Required |  |
| S06-C10-24 | 375550.242 | 515750.107 | 375550.242 | 515750.107 | Required |  |
| S06-C10-25 | 375527.756 | 515719.482 | 375527.756 | 515719.482 | Required |  |
| Outfall 10 | 375316.515 | 515770.381 | | | No Entry |  |

## Area Summary for Catchment 10 - Ch 44550

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | Classification | Default | 100 | 0.107 | 0.107 | 0.107 |
| | Classification | Verge | 50 | 0.045 | 0.022 | 0.130 |
| | Classification | Cutting | 25 | 0.018 | 0.004 | 0.134 |
| 1.001 | Classification | Default | 100 | 0.098 | 0.098 | 0.098 |
| | Classification | Verge | 50 | 0.041 | 0.021 | 0.118 |
| | Classification | Cutting | 25 | 0.085 | 0.021 | 0.140 |
| 1.002 | Classification | Verge | 50 | 0.026 | 0.013 | 0.013 |
| | Classification | Cutting | 25 | 0.068 | 0.017 | 0.030 |
| | Classification | Default | 100 | 0.061 | 0.061 | 0.091 |
| 1.003 | Classification | Default | 100 | 0.104 | 0.104 | 0.104 |
| | Classification | Verge | 50 | 0.036 | 0.018 | 0.122 |
| | Classification | Cutting | 25 | 0.118 | 0.029 | 0.151 |
| 1.004 | Classification | Default | 100 | 0.116 | 0.116 | 0.116 |
| | Classification | Verge | 50 | 0.029 | 0.015 | 0.131 |
| | Classification | Cutting | 25 | 0.020 | 0.005 | 0.136 |
| 1.005 | Classification | Default | 100 | 0.116 | 0.116 | 0.116 |
| | Classification | Verge | 50 | 0.029 | 0.015 | 0.131 |
| 1.006 | Classification | Default | 100 | 0.116 | 0.116 | 0.116 |
| | Classification | Verge | 50 | 0.029 | 0.015 | 0.131 |
| | Classification | Cutting | 25 | 0.001 | 0.000 | 0.131 |
| 1.007 | Classification | Default | 100 | 0.117 | 0.117 | 0.117 |
| | Classification | Verge | 50 | 0.031 | 0.016 | 0.133 |
| | Classification | Cutting | 25 | 0.039 | 0.010 | 0.143 |
| 1.008 | Classification | Default | 100 | 0.116 | 0.116 | 0.116 |
| | Classification | Verge | 50 | 0.029 | 0.014 | 0.130 |
| | Classification | Cutting | 25 | 0.017 | 0.004 | 0.134 |
| 1.009 | Classification | Default | 100 | 0.116 | 0.116 | 0.116 |
| | Classification | Verge | 50 | 0.029 | 0.015 | 0.131 |
| | Classification | Cutting | 25 | 0.002 | 0.000 | 0.131 |
| 1.010 | Classification | Default | 100 | 0.070 | 0.070 | 0.070 |
| | Classification | Verge | 50 | 0.018 | 0.009 | 0.079 |
| 2.000 | Classification | Default | 100 | 0.173 | 0.173 | 0.173 |
| | Classification | Verge | 50 | 0.032 | 0.016 | 0.189 |
| | Classification | Cutting | 25 | 0.065 | 0.016 | 0.205 |
| 2.001 | Classification | Default | 100 | 0.151 | 0.151 | 0.151 |
| | Classification | Verge | 50 | 0.027 | 0.014 | 0.165 |
| | Classification | Cutting | 25 | 0.073 | 0.018 | 0.183 |
| 2.002 | Classification | Default | 100 | 0.097 | 0.097 | 0.097 |
| | Classification | Verge | 50 | 0.018 | 0.009 | 0.106 |
| | Classification | Cutting | 25 | 0.043 | 0.011 | 0.117 |
| 2.003 | Classification | Default | 100 | 0.146 | 0.146 | 0.146 |
| | Classification | Verge | 50 | 0.028 | 0.014 | 0.160 |
| | Classification | Cutting | 25 | 0.024 | 0.006 | 0.166 |
| 2.004 | Classification | Default | 100 | 0.121 | 0.121 | 0.121 |
| | Classification | Verge | 50 | 0.029 | 0.014 | 0.135 |
| 2.005 | Classification | Default | 100 | 0.116 | 0.116 | 0.116 |
| | Classification | Verge | 50 | 0.029 | 0.015 | 0.131 |
| 2.006 | Classification | Default | 100 | 0.117 | 0.117 | 0.117 |
| | Classification | Verge | 50 | 0.029 | 0.015 | 0.131 |
| 2.007 | Classification | Default | 100 | 0.118 | 0.118 | 0.118 |
| | Classification | Verge | 50 | 0.030 | 0.015 | 0.133 |
| 2.008 | Classification | Default | 100 | 0.115 | 0.115 | 0.115 |
| | Classification | Verge | 50 | 0.028 | 0.014 | 0.128 |
| | Classification | Cutting | 25 | 0.002 | 0.000 | 0.129 |
| 2.009 | Classification | Default | 100 | 0.115 | 0.115 | 0.115 |
| | Classification | Verge | 50 | 0.029 | 0.014 | 0.130 |
| 2.010 | Classification | Default | 100 | 0.070 | 0.070 | 0.070 |
| | Classification | Verge | 50 | 0.017 | 0.009 | 0.079 |
| 2.011 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.011 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.012 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total<br>3.692 | Total<br>2.941 | Total<br>2.941 |

## Online Controls for Catchment 10 - Ch 44550

### Hydro-Brake® Optimum Manhole: S06-C10-25, DS/PN: 1.012, Volume (m³): 10.2

| | |
|---|---|
| Unit Reference | MD-SHE-0247-3320-1000-3320 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 33.2 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 247 |
| Invert Level (m) | 145.343 |
| Minimum Outlet Pipe Diameter (mm) | 300 |
| Suggested Manhole Diameter (mm) | 1800 |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.000 | 33.2 | Kick-Flo® | 0.751 | 29.0 |
| Flush-Flo™ | 0.390 | 33.2 | Mean Flow over Head Range | - | 27.3 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 8.1 | 0.800 | 29.8 | 2.000 | 46.3 | 4.000 | 64.8 | 7.000 | 85.1 |
| 0.200 | 25.2 | 1.000 | 33.2 | 2.200 | 48.5 | 4.500 | 68.6 | 7.500 | 88.0 |
| 0.300 | 32.8 | 1.200 | 36.2 | 2.400 | 50.6 | 5.000 | 72.2 | 8.000 | 90.8 |
| 0.400 | 33.2 | 1.400 | 39.0 | 2.600 | 52.6 | 5.500 | 75.6 | 8.500 | 93.5 |
| 0.500 | 32.8 | 1.600 | 41.6 | 3.000 | 56.4 | 6.000 | 78.9 | 9.000 | 96.2 |
| 0.600 | 32.0 | 1.800 | 44.0 | 3.500 | 60.7 | 6.500 | 82.1 | 9.500 | 98.7 |

## Offline Controls for Catchment 10 - Ch 44550

### Weir Manhole: S06-C10-25, DS/PN: 1.012, Loop to PN: None

Discharge Coef 0.544 Width (m) 10.000 Invert Level (m) 146.343

## Storage Structures for Catchment 10 - Ch 44550

## Tank or Pond Manhole: S06-C10-25, DS/PN: 1.012

Invert Level (m) 145.343

| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|---|---|
| 0.000 | 2640.4 | 1.000 | 3342.2 | 1.001 | 3563.6 | 1.289 | 5036.7 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 10 - Ch 44550

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| **PN** | **US/MH Name** | **Event** | **US/CL (m)** | **Water Level (m)** | **Surcharged Depth (m)** | **Flooded Volume (m³)** | **Flow / Cap.** | **Overflow (l/s)** | **Pipe Flow (l/s)** | **Status** |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C10-1 | 15 minute 5 year Winter I+20% | 171.374 | 170.113 | -0.061 | 0.000 | 0.79 | | 30.9 | OK |
| 1.001 | S06-C10-2 | 15 minute 5 year Winter I+20% | 171.112 | 169.535 | -0.105 | 0.000 | 0.70 | | 56.1 | OK |
| 1.002 | S06-C10-3 | 15 minute 5 year Winter I+20% | 170.280 | 168.952 | -0.128 | 0.000 | 0.61 | | 72.5 | OK |
| 1.003 | S06-C10-4 | 15 minute 5 year Winter I+20% | 169.507 | 168.183 | -0.124 | 0.000 | 0.63 | | 99.3 | OK |
| 1.004 | S06-C10-5 | 15 minute 5 year Winter I+20% | 167.402 | 166.097 | -0.105 | 0.000 | 0.73 | | 122.6 | OK |
| 1.005 | S06-C10-6 | 15 minute 5 year Winter I+20% | 164.986 | 163.692 | -0.095 | 0.000 | 0.79 | | 144.1 | OK |
| 1.006 | S06-C10-7 | 15 minute 5 year Winter I+20% | 162.155 | 160.868 | -0.088 | 0.000 | 0.83 | | 164.9 | OK |
| 1.007 | S06-C10-8 | 15 minute 5 year Winter I+20% | 158.787 | 157.514 | -0.073 | 0.000 | 0.91 | | 187.0 | OK |
| 1.008 | S06-C10-9 | 15 minute 5 year Winter I+20% | 155.167 | 154.528 | 0.560 | 0.000 | 0.96 | | 195.7 | SURCHARGED |
| 1.009 | S06-C10-10 | 15 minute 5 year Winter I+20% | 151.633 | 151.319 | 0.885 | 0.000 | 1.12 | | 208.1 | SURCHARGED |
| 1.010 | S06-C10-11 | 15 minute 5 year Winter I+20% | 148.687 | 147.596 | 0.109 | 0.000 | 1.09 | | 215.4 | SURCHARGED |
| 2.000 | S06-C10-12 | 15 minute 5 year Winter I+20% | 170.748 | 169.884 | 0.335 | 0.000 | 1.20 | | 46.9 | SURCHARGED |
| 2.001 | S06-C10-13 | 15 minute 5 year Winter I+20% | 170.413 | 168.964 | -0.064 | 0.000 | 0.92 | | 79.6 | OK |
| 2.002 | S06-C10-14 | 15 minute 5 year Winter I+20% | 169.620 | 168.329 | -0.091 | 0.000 | 0.82 | | 100.3 | OK |
| 2.003 | S06-C10-15 | 15 minute 5 year Winter I+20% | 168.803 | 167.538 | -0.064 | 0.000 | 0.95 | | 127.9 | OK |
| 2.004 | S06-C10-16 | 15 minute 5 year Winter I+20% | 167.253 | 165.980 | -0.072 | 0.000 | 0.91 | | 149.0 | OK |
| 2.005 | S06-C10-17 | 15 minute 5 year Winter I+20% | 164.969 | 163.699 | -0.070 | 0.000 | 0.93 | | 169.4 | OK |
| 2.006 | S06-C10-18 | 15 minute 5 year Winter I+20% | 162.117 | 160.850 | -0.066 | 0.000 | 0.95 | | 189.2 | OK |
| 2.007 | S06-C10-19 | 15 minute 5 year Winter I+20% | 158.730 | 157.770 | 0.240 | 0.000 | 0.98 | | 201.0 | SURCHARGED |
| 2.008 | S06-C10-20 | 15 minute 5 year Winter I+20% | 155.084 | 154.254 | 0.370 | 0.000 | 1.05 | | 215.0 | SURCHARGED |
| 2.009 | S06-C10-21 | 15 minute 5 year Winter I+20% | 151.568 | 150.226 | -0.142 | 0.000 | 0.70 | | 230.3 | OK |
| 2.010 | S06-C10-22 | 30 minute 5 year Winter I+20% | 148.675 | 147.796 | 0.321 | 0.000 | 1.22 | | 239.4 | SURCHARGED |
| 2.011 | S06-C10-23 | 15 minute 5 year Winter I+20% | 148.042 | 146.856 | 0.014 | 0.000 | 1.60 | | 239.1 | SURCHARGED |
| 1.011 | S06-C10-24 | 15 minute 5 year Winter I+20% | 148.004 | 146.599 | -0.204 | 0.000 | 0.69 | | 454.3 | OK |
| 1.012 | S06-C10-25 | 480 minute 5 year Winter I+20% | 146.632 | 145.632 | -0.237 | 0.000 | 0.06 | 0.0 | 32.6 | OK |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 10 - Ch 44550

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 0.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | | | |
|---|---|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Offline Controls | 1 | Number of Time/Area Diagrams | 0 |
| Number of Online Controls | 1 | Number of Storage Structures | 1 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | | | |
|---|---|---|---|---|---|
| Rainfall Model | FSR | M5-60 (mm) | 20.000 | Cv (Summer) | 0.750 |
| Region | England and Wales | Ratio R | 0.300 | Cv (Winter) | 0.840 |

| | |
|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 |
| Analysis Timestep | 2.5 Second Increment (Extended) |
| DTS Status | OFF |
| DVD Status | ON |
| Inertia Status | ON |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 240, 360, 480, 960, 1440 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| **PN** | **US/MH Name** | **Event** | **US/CL (m)** | **Water Level (m)** | **Surcharged Depth (m)** | **Flooded Volume (m³)** | **Flow / Cap.** | **Overflow (l/s)** | **Pipe Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C10-1 | 15 minute 100 year Winter I+40% | 171.374 | 171.380 | 1.206 | 5.867 | 1.37 | | 53.6 |
| 1.001 | S06-C10-2 | 15 minute 100 year Winter I+40% | 171.112 | 171.113 | 1.473 | 0.658 | 1.21 | | 97.4 |
| 1.002 | S06-C10-3 | 15 minute 100 year Winter I+40% | 170.280 | 170.282 | 1.201 | 1.780 | 1.00 | | 117.9 |
| 1.003 | S06-C10-4 | 30 minute 100 year Winter I+40% | 169.507 | 169.509 | 1.201 | 1.497 | 1.00 | | 156.9 |
| 1.004 | S06-C10-5 | 30 minute 100 year Winter I+40% | 167.402 | 167.414 | 1.212 | 11.967 | 1.00 | | 167.2 |
| 1.005 | S06-C10-6 | 30 minute 100 year Winter I+40% | 164.986 | 165.000 | 1.213 | 13.235 | 1.00 | | 182.1 |
| 1.006 | S06-C10-7 | 30 minute 100 year Winter I+40% | 162.155 | 162.169 | 1.214 | 13.758 | 1.00 | | 198.5 |
| 1.007 | S06-C10-8 | 60 minute 100 year Winter I+40% | 158.787 | 158.814 | 1.227 | 27.626 | 1.00 | | 204.7 |
| 1.008 | S06-C10-9 | 60 minute 100 year Winter I+40% | 155.167 | 155.206 | 1.239 | 39.161 | 1.00 | | 204.8 |
| 1.009 | S06-C10-10 | 60 minute 100 year Winter I+40% | 151.633 | 151.657 | 1.223 | 23.518 | 1.17 | | 217.3 |
| 1.010 | S06-C10-11 | 15 minute 100 year Winter I+40% | 148.687 | 147.923 | 0.436 | 0.000 | 1.28 | | 253.4 |
| 2.000 | S06-C10-12 | 30 minute 100 year Winter I+40% | 170.748 | 170.769 | 1.221 | 21.203 | 1.56 | | 60.7 |
| 2.001 | S06-C10-13 | 15 minute 100 year Winter I+40% | 170.413 | 170.419 | 1.391 | 6.047 | 1.22 | | 104.9 |
| 2.002 | S06-C10-14 | 30 minute 100 year Winter I+40% | 169.620 | 169.627 | 1.207 | 7.463 | 1.00 | | 122.5 |
| 2.003 | S06-C10-15 | 30 minute 100 year Winter I+40% | 168.803 | 168.822 | 1.219 | 19.335 | 1.08 | | 145.6 |
| 2.004 | S06-C10-16 | 30 minute 100 year Winter I+40% | 167.253 | 167.260 | 1.207 | 7.232 | 1.00 | | 163.5 |
| 2.005 | S06-C10-17 | 30 minute 100 year Winter I+40% | 164.969 | 164.980 | 1.211 | 11.386 | 1.00 | | 182.2 |
| 2.006 | S06-C10-18 | 30 minute 100 year Winter I+40% | 162.117 | 162.131 | 1.214 | 14.297 | 1.00 | | 198.7 |
| 2.007 | S06-C10-19 | 60 minute 100 year Winter I+40% | 158.730 | 158.754 | 1.224 | 23.843 | 1.07 | | 218.5 |
| 2.008 | S06-C10-20 | 30 minute 100 year Winter I+40% | 155.084 | 155.094 | 1.210 | 10.275 | 1.16 | | 237.5 |
| 2.009 | S06-C10-21 | 15 minute 100 year Winter I+40% | 151.568 | 150.910 | 0.542 | 0.000 | 0.88 | | 289.1 |
| 2.010 | S06-C10-22 | 15 minute 100 year Winter I+40% | 148.675 | 148.675 | 1.200 | 0.085 | 1.64 | | 323.4 |
| 2.011 | S06-C10-23 | 15 minute 100 year Winter I+40% | 148.042 | 146.954 | 0.112 | 0.000 | 2.16 | | 321.7 |
| 1.011 | S06-C10-24 | 15 minute 100 year Winter I+40% | 148.004 | 146.655 | -0.148 | 0.000 | 0.86 | | 569.0 |
| 1.012 | S06-C10-25 | 480 minute 100 year Winter I+40% | 146.632 | 146.036 | 0.168 | 0.000 | 0.06 | 0.0 | 33.2 |

| **PN** | **US/MH Name** | **Status** |
|---|---|---|
| 1.000 | S06-C10-1 | FLOOD |
| 1.001 | S06-C10-2 | FLOOD |
| 1.002 | S06-C10-3 | FLOOD |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 10 - Ch 44550

| PN | US/MH Name | Status |
|---|---|---|
| 1.003 | S06-C10-4 | FLOOD |
| 1.004 | S06-C10-5 | FLOOD |
| 1.005 | S06-C10-6 | FLOOD |
| 1.006 | S06-C10-7 | FLOOD |
| 1.007 | S06-C10-8 | FLOOD |
| 1.008 | S06-C10-9 | FLOOD |
| 1.009 | S06-C10-10 | FLOOD |
| 1.010 | S06-C10-11 | SURCHARGED |
| 2.000 | S06-C10-12 | FLOOD |
| 2.001 | S06-C10-13 | FLOOD |
| 2.002 | S06-C10-14 | FLOOD |
| 2.003 | S06-C10-15 | FLOOD |
| 2.004 | S06-C10-16 | FLOOD |
| 2.005 | S06-C10-17 | FLOOD |
| 2.006 | S06-C10-18 | FLOOD |
| 2.007 | S06-C10-19 | FLOOD |
| 2.008 | S06-C10-20 | FLOOD |
| 2.009 | S06-C10-21 | SURCHARGED |
| 2.010 | S06-C10-22 | FLOOD |
| 2.011 | S06-C10-23 | SURCHARGED |
| 1.011 | S06-C10-24 | OK |
| 1.012 | S06-C10-25 | SURCHARGED |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for Catchment 11 - Ch 44600

Pipe Sizes Min 150 Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 20.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

## Network Design Table for Catchment 11 - Ch 44600

| **PN** | **Length (m)** | **Fall (m)** | **Slope (1:X)** | **I.Area (ha)** | **T.E. (mins)** | **Base Flow (l/s)** | **k (mm)** | **HYD SECT** | **DIA (mm)** | **Section Type** | **Auto Design** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 90.070 | 0.809 | 111.3 | 0.215 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.000 | 26.037 | 0.600 | 43.4 | 0.029 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.001 | 128.386 | 2.201 | 58.3 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 3.000 | 99.565 | 2.049 | 48.6 | 0.190 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 3.001 | 99.633 | 1.734 | 57.5 | 0.132 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 3.002 | 99.271 | 2.737 | 36.3 | 0.155 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 3.003 | 101.000 | 2.593 | 38.9 | 0.150 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 3.004 | 100.000 | 2.593 | 38.6 | 0.150 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 3.005 | 89.500 | 2.322 | 38.5 | 0.132 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 3.006 | 89.858 | 3.357 | 26.8 | 0.119 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 3.007 | 87.584 | 1.210 | 72.4 | 0.113 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 3.008 | 32.623 | 0.651 | 50.1 | 0.076 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 3.009 | 22.699 | 2.781 | 8.2 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 1.002 | 80.340 | 0.164 | 490.6 | 0.000 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| 1.003 | 39.739 | 0.081 | 490.6 | 0.000 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |

## Network Results Table

| **PN** | **Rain (mm/hr)** | **T.C. (mins)** | **US/IL (m)** | **Σ I.Area (ha)** | **Σ Base Flow (l/s)** | **Foul (l/s)** | **Add Flow (l/s)** | **Vel (m/s)** | **Cap (l/s)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 71.85 | 6.21 | 147.154 | 0.215 | 0.0 | 0.0 | 0.0 | 1.24 | 49.2 | 41.9 |
| 2.000 | 76.68 | 5.28 | 147.020 | 0.029 | 0.0 | 0.0 | 0.0 | 1.53 | 27.1 | 6.0 |
| 1.001 | 66.42 | 7.46 | 146.345 | 0.244 | 0.0 | 0.0 | 0.0 | 1.72 | 68.2 | 43.9 |
| 3.000 | 73.48 | 5.88 | 166.172 | 0.190 | 0.0 | 0.0 | 0.0 | 1.88 | 74.8 | 37.8 |
| 3.001 | 68.98 | 6.84 | 164.123 | 0.322 | 0.0 | 0.0 | 0.0 | 1.73 | 68.7 | 60.2 |
| 3.002 | 65.87 | 7.60 | 162.390 | 0.477 | 0.0 | 0.0 | 0.0 | 2.18 | 86.6 | 85.1 |
| 3.003 | 63.41 | 8.27 | 159.578 | 0.627 | 0.0 | 0.0 | 0.0 | 2.53 | 178.6 | 107.7 |
| 3.004 | 61.20 | 8.92 | 156.985 | 0.778 | 0.0 | 0.0 | 0.0 | 2.54 | 179.5 | 128.9 |
| 3.005 | 59.37 | 9.51 | 154.392 | 0.910 | 0.0 | 0.0 | 0.0 | 2.54 | 179.6 | 146.3 |
| 3.006 | 57.94 | 10.00 | 152.069 | 1.029 | 0.0 | 0.0 | 0.0 | 3.05 | 215.7 | 161.5 |
| 3.007 | 56.09 | 10.69 | 148.637 | 1.142 | 0.0 | 0.0 | 0.0 | 2.13 | 235.5 | 173.4 |
| 3.008 | 55.54 | 10.90 | 147.427 | 1.218 | 0.0 | 0.0 | 0.0 | 2.56 | 283.3 | 183.1 |
| 3.009 | 55.39 | 10.96 | 146.776 | 1.218 | 0.0 | 0.0 | 0.0 | 6.38 | 704.1 | 183.1 |
| 1.002 | 52.26 | 12.29 | 143.844 | 1.462 | 0.0 | 0.0 | 0.0 | 1.00 | 217.4 | 206.8 |
| 1.003 | 50.86 | 12.95 | 143.681 | 1.462 | 0.0 | 0.0 | 0.0 | 1.00 | 217.4 | 206.8 |

## Network Design Table for Catchment 11 - Ch 44600

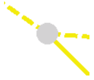
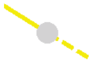
| **PN** | **Length (m)** | **Fall (m)** | **Slope (1:X)** | **I.Area (ha)** | **T.E. (mins)** | **Base Flow (l/s)** | **k (mm)** | **HYD SECT** | **DIA (mm)** | **Section Type** | **Auto Design** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.004 | 251.040 | 0.950 | 264.3 | 0.000 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |

## Network Results Table

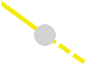
| **PN** | **Rain (mm/hr)** | **T.C. (mins)** | **US/IL (m)** | **Σ I.Area (ha)** | **Σ Base Flow (l/s)** | **Foul (l/s)** | **Add Flow (l/s)** | **Vel (m/s)** | **Cap (l/s)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.004 | 45.43 | 16.00 | 143.600 | 1.462 | 0.0 | 0.0 | 0.0 | 1.37 | 297.2 | 206.8 |

## Manhole Schedules for Catchment 11 - Ch 44600

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | Pipe Out PN | Pipe Out Invert Level (m) | Pipe Out Diameter (mm) | Pipes In PN | Pipes In Invert Level (m) | Pipes In Diameter (mm) | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C11-1 | 148.579 | 1.425 | Open Manhole | 1200 | 1.000 | 147.154 | 225 | | | | |
| S06-C11-2 | 148.370 | 1.350 | Open Manhole | 1200 | 2.000 | 147.020 | 150 | | | | |
| S06-C11-3 | 147.770 | 1.425 | Open Manhole | 1200 | 1.001 | 146.345 | 225 | 1.000 | 146.345 | 225 | |
| | | | | | | | | 2.000 | 146.420 | 150 | |
| S06-C11-4 | 167.597 | 1.425 | Open Manhole | 1200 | 3.000 | 166.172 | 225 | | | | |
| S06-C11-5 | 165.548 | 1.425 | Open Manhole | 1200 | 3.001 | 164.123 | 225 | 3.000 | 164.123 | 225 | |
| S06-C11-6 | 163.815 | 1.425 | Open Manhole | 1200 | 3.002 | 162.390 | 225 | 3.001 | 162.390 | 225 | |
| S06-C11-7 | 161.078 | 1.500 | Open Manhole | 1200 | 3.003 | 159.578 | 300 | 3.002 | 159.653 | 225 | |
| S06-C11-8 | 158.485 | 1.500 | Open Manhole | 1200 | 3.004 | 156.985 | 300 | 3.003 | 156.985 | 300 | |
| S06-C11-9 | 155.892 | 1.500 | Open Manhole | 1200 | 3.005 | 154.392 | 300 | 3.004 | 154.392 | 300 | |
| S06-C11-10 | 153.569 | 1.500 | Open Manhole | 1200 | 3.006 | 152.069 | 300 | 3.005 | 152.069 | 300 | |
| S06-C11-11 | 150.212 | 1.575 | Open Manhole | 1350 | 3.007 | 148.637 | 375 | 3.006 | 148.712 | 300 | |
| S06-C11-12 | 149.002 | 1.575 | Open Manhole | 1350 | 3.008 | 147.427 | 375 | 3.007 | 147.427 | 375 | |
| S06-C11-13 | 148.351 | 1.575 | Open Manhole | 1350 | 3.009 | 146.776 | 375 | 3.008 | 146.776 | 375 | |
| S06-C11-14 | 145.500 | 1.656 | Open Manhole | 1500 | 1.002 | 143.844 | 525 | 1.001 | 144.144 | 225 | |
| | | | | | | | | 3.009 | 143.995 | 375 | |
| S06-C11-15 | 145.500 | 1.819 | Open Manhole | 1500 | 1.003 | 143.681 | 525 | 1.002 | 143.681 | 525 | |
| S06-C11-16 | 147.330 | 3.730 | Open Manhole | 1500 | 1.004 | 143.600 | 525 | 1.003 | 143.600 | 525 | |
| Outfall 11 | 143.221 | 0.571 | Open Manhole | 0 | | OUTFALL | | 1.004 | 142.650 | 525 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C11-1 | 375433.477 | 515927.012 | 375433.477 | 515927.012 | Required |  |
| S06-C11-2 | 375533.799 | 515874.203 | 375533.799 | 515874.203 | Required |  |
| S06-C11-3 | 375507.837 | 515876.185 | 375507.837 | 515876.185 | Required |  |
| S06-C11-4 | 376286.878 | 515366.161 | 376286.878 | 515366.161 | Required |  |
| S06-C11-5 | 376193.274 | 515400.097 | 376193.274 | 515400.097 | Required |  |
| S06-C11-6 | 376103.381 | 515443.062 | 376103.381 | 515443.062 | Required |  |
| S06-C11-7 | 376017.824 | 515493.408 | 376017.824 | 515493.408 | Required |  |
| S06-C11-8 | 375931.653 | 515546.093 | 375931.653 | 515546.093 | Required |  |
| S06-C11-9 | 375846.336 | 515598.255 | 375846.336 | 515598.255 | Required |  |
| S06-C11-10 | 375769.977 | 515644.941 | 375769.977 | 515644.941 | Required |  |

## Manhole Schedules for Catchment 11 - Ch 44600

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S06-C11-11 | 375694.060 | 515693.014 | 375694.060 | 515693.014 | Required |  |
| S06-C11-12 | 375622.151 | 515743.014 | 375622.151 | 515743.014 | Required |  |
| S06-C11-13 | 375595.925 | 515762.417 | 375595.925 | 515762.417 | Required |  |
| S06-C11-14 | 375598.214 | 515785.000 | 375598.214 | 515785.000 | Required |  |
| S06-C11-15 | 375555.351 | 515717.050 | 375555.351 | 515717.050 | Required |  |
| S06-C11-16 | 375538.909 | 515680.872 | 375538.909 | 515680.872 | Required |  |
| Outfall 11 | 375303.450 | 515767.934 | | | No Entry |  |

## Area Summary for Catchment 11 - Ch 44600

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | Classification | Default | 100 | 0.187 | 0.187 | 0.187 |
| | Classification | Verge | 50 | 0.033 | 0.016 | 0.203 |
| | Classification | Verge | 50 | 0.024 | 0.012 | 0.215 |
| 2.000 | Classification | Default | 100 | 0.023 | 0.023 | 0.023 |
| | Classification | Verge | 50 | 0.006 | 0.003 | 0.026 |
| | Classification | Verge | 50 | 0.006 | 0.003 | 0.029 |
| 1.001 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 3.000 | Classification | Default | 100 | 0.130 | 0.130 | 0.130 |
| | Classification | Verge | 50 | 0.045 | 0.022 | 0.152 |
| | Classification | Verge | 50 | 0.031 | 0.015 | 0.168 |
| | Classification | Cutting | 25 | 0.088 | 0.022 | 0.190 |
| 3.001 | Classification | Default | 100 | 0.102 | 0.102 | 0.102 |
| | Classification | Verge | 50 | 0.035 | 0.018 | 0.120 |
| | Classification | Verge | 50 | 0.025 | 0.012 | 0.132 |
| 3.002 | Classification | Default | 100 | 0.103 | 0.103 | 0.103 |
| | Classification | Verge | 50 | 0.025 | 0.012 | 0.115 |
| | Classification | Verge | 50 | 0.025 | 0.013 | 0.128 |
| | Classification | Cutting | 25 | 0.108 | 0.027 | 0.155 |
| 3.003 | Classification | Default | 100 | 0.104 | 0.104 | 0.104 |
| | Classification | Verge | 50 | 0.025 | 0.013 | 0.116 |
| | Classification | Verge | 50 | 0.015 | 0.008 | 0.124 |
| | Classification | Cutting | 25 | 0.106 | 0.027 | 0.150 |
| 3.004 | Classification | Default | 100 | 0.104 | 0.104 | 0.104 |
| | Classification | Verge | 50 | 0.026 | 0.013 | 0.117 |
| | Classification | Verge | 50 | 0.025 | 0.013 | 0.129 |
| | Classification | Cutting | 25 | 0.084 | 0.021 | 0.150 |
| | Classification | Cutting | 25 | 0.001 | 0.000 | 0.150 |
| 3.005 | Classification | Default | 100 | 0.092 | 0.092 | 0.092 |
| | Classification | Verge | 50 | 0.023 | 0.011 | 0.104 |
| | Classification | Cutting | 25 | 0.002 | 0.001 | 0.104 |
| | Classification | Cutting | 25 | 0.048 | 0.012 | 0.116 |
| | Classification | Verge | 50 | 0.032 | 0.016 | 0.132 |
| | Classification | Cutting | 25 | 0.001 | 0.000 | 0.132 |
| 3.006 | Classification | Default | 100 | 0.092 | 0.092 | 0.092 |
| | Classification | Verge | 50 | 0.031 | 0.016 | 0.108 |
| | Classification | Cutting | 25 | 0.005 | 0.001 | 0.109 |
| | Classification | Verge | 50 | 0.020 | 0.010 | 0.119 |
| 3.007 | Classification | Default | 100 | 0.090 | 0.090 | 0.090 |
| | Classification | Verge | 50 | 0.024 | 0.012 | 0.102 |
| | Classification | Verge | 50 | 0.022 | 0.011 | 0.113 |
| 3.008 | Classification | Default | 100 | 0.060 | 0.060 | 0.060 |
| | Classification | Verge | 50 | 0.017 | 0.009 | 0.069 |
| | Classification | Verge | 50 | 0.014 | 0.007 | 0.076 |
| 3.009 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.002 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.003 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.004 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total | Total | Total |
| | | | | 2.058 | 1.462 | 1.462 |

## Online Controls for Catchment 11 - Ch 44600

### Hydro-Brake® Optimum Manhole: S06-C11-16, DS/PN: 1.004, Volume (m³): 14.9

| | |
|---|---|
| Unit Reference | MD-SHE-0181-1610-1000-1610 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 16.1 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 181 |
| Invert Level (m) | 143.600 |
| Minimum Outlet Pipe Diameter (mm) | 225 |
| Suggested Manhole Diameter (mm) | 1500 |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.000 | 16.1 | Kick-Flo® | 0.709 | 13.7 |
| Flush-Flo™ | 0.327 | 16.1 | Mean Flow over Head Range | - | 13.6 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 6.4 | 0.800 | 14.5 | 2.000 | 22.3 | 4.000 | 31.2 | 7.000 | 40.8 |
| 0.200 | 15.4 | 1.000 | 16.1 | 2.200 | 23.4 | 4.500 | 33.0 | 7.500 | 42.2 |
| 0.300 | 16.1 | 1.200 | 17.5 | 2.400 | 24.4 | 5.000 | 34.7 | 8.000 | 43.6 |
| 0.400 | 16.0 | 1.400 | 18.8 | 2.600 | 25.3 | 5.500 | 36.3 | 8.500 | 44.9 |
| 0.500 | 15.7 | 1.600 | 20.1 | 3.000 | 27.1 | 6.000 | 37.9 | 9.000 | 46.1 |
| 0.600 | 15.1 | 1.800 | 21.2 | 3.500 | 29.2 | 6.500 | 39.4 | 9.500 | 47.4 |

## Offline Controls for Catchment 11 - Ch 44600

### Weir Manhole: S06-C11-16, DS/PN: 1.004, Loop to PN: None

Discharge Coef 0.544 Width (m) 10.000 Invert Level (m) 144.600

## Storage Structures for Catchment 11 - Ch 44600

### Tank or Pond Manhole: S06-C11-16, DS/PN: 1.004

Invert Level (m) 143.600

| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|---|---|
| 0.000 | 1020.7 | 1.000 | 1581.7 | 1.001 | 1760.9 | 3.730 | 5395.5 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 11 - Ch 44600

### Simulation Criteria

Areal Reduction Factor 1.000
Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0
MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0
Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500
Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0
Number of Offline Controls 1
Number of Time/Area Diagrams 0
Number of Online Controls 1
Number of Storage Structures 1
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
M5-60 (mm) 20.000
Cv (Summer) 0.750
Region England and Wales
Ratio R 0.300
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Event | US/CL (m) | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C11-1 | 15 minute 5 year Winter I+20% | 148.579 | 147.546 | 0.167 | 0.000 | 1.05 | | 50.6 | SURCHARGED |
| 2.000 | S06-C11-2 | 15 minute 5 year Winter I+20% | 148.370 | 147.075 | -0.095 | 0.000 | 0.28 | | 7.2 | OK |
| 1.001 | S06-C11-3 | 15 minute 5 year Winter I+20% | 147.770 | 146.505 | -0.065 | 0.000 | 0.81 | | 54.4 | OK |
| 3.000 | S06-C11-4 | 15 minute 5 year Winter I+20% | 167.597 | 166.306 | -0.091 | 0.000 | 0.63 | | 46.4 | OK |
| 3.001 | S06-C11-5 | 15 minute 5 year Winter I+20% | 165.548 | 164.607 | 0.258 | 0.000 | 0.98 | | 65.7 | SURCHARGED |
| 3.002 | S06-C11-6 | 15 minute 5 year Winter I+20% | 163.815 | 162.982 | 0.368 | 0.000 | 1.06 | | 90.1 | SURCHARGED |
| 3.003 | S06-C11-7 | 15 minute 5 year Winter I+20% | 161.078 | 159.760 | -0.118 | 0.000 | 0.67 | | 116.1 | OK |
| 3.004 | S06-C11-8 | 15 minute 5 year Winter I+20% | 158.485 | 157.196 | -0.088 | 0.000 | 0.82 | | 143.2 | OK |
| 3.005 | S06-C11-9 | 15 minute 5 year Winter I+20% | 155.892 | 154.627 | -0.064 | 0.000 | 0.96 | | 166.9 | OK |
| 3.006 | S06-C11-10 | 15 minute 5 year Winter I+20% | 153.569 | 152.293 | -0.076 | 0.000 | 0.90 | | 187.5 | OK |
| 3.007 | S06-C11-11 | 15 minute 5 year Winter I+20% | 150.212 | 148.921 | -0.091 | 0.000 | 0.90 | | 203.4 | OK |
| 3.008 | S06-C11-12 | 15 minute 5 year Winter I+20% | 149.002 | 147.696 | -0.106 | 0.000 | 0.85 | | 215.6 | OK |
| 3.009 | S06-C11-13 | 15 minute 5 year Winter I+20% | 148.351 | 146.932 | -0.219 | 0.000 | 0.36 | | 216.1 | OK |
| 1.002 | S06-C11-14 | 15 minute 5 year Winter I+20% | 145.500 | 144.521 | 0.152 | 0.000 | 1.32 | | 252.2 | SURCHARGED |
| 1.003 | S06-C11-15 | 15 minute 5 year Winter I+20% | 145.500 | 144.242 | 0.036 | 0.000 | 1.32 | | 249.5 | SURCHARGED |
| 1.004 | S06-C11-16 | 480 minute 5 year Winter I+20% | 147.330 | 143.919 | -0.205 | 0.000 | 0.06 | 0.0 | 16.1 | OK |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 11 - Ch 44600

### Simulation Criteria

```
         Areal Reduction Factor 1.000    Additional Flow - % of Total Flow 0.000
               Hot Start (mins)     0        MADD Factor * 10m³/ha Storage 0.000
           Hot Start Level (mm)     0                Inlet Coeffiecient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
      Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0   Number of Offline Controls 1 Number of Time/Area Diagrams 0
  Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
Rainfall Model                FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
        Region England and Wales    Ratio R  0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)                           300.0
                 Analysis Timestep 2.5 Second Increment (Extended)
                        DTS Status                             OFF
                        DVD Status                              ON
                    Inertia Status                              ON


            Profile(s)                             Summer and Winter
      Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
 Return Period(s) (years)                                     5, 100
       Climate Change (%)                                     20, 40
```

| **PN** | **US/MH Name** | **Event** | **US/CL (m)** | **Water Level (m)** | **Surcharged Depth (m)** | **Flooded Volume (m³)** | **Flow / Cap.** | **Overflow (l/s)** | **Pipe Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C11-1 | 15 minute 100 year Winter I+40% | 148.579 | 148.589 | 1.210 | 10.808 | 1.45 | | 69.8 |
| 2.000 | S06-C11-2 | 30 minute 100 year Winter I+40% | 148.370 | 147.410 | 0.240 | 0.000 | 0.51 | | 13.1 |
| 1.001 | S06-C11-3 | 30 minute 100 year Winter I+40% | 147.770 | 147.338 | 0.768 | 0.000 | 1.04 | | 69.5 |
| 3.000 | S06-C11-4 | 15 minute 100 year Winter I+40% | 167.597 | 167.602 | 1.205 | 5.394 | 1.00 | | 72.9 |
| 3.001 | S06-C11-5 | 30 minute 100 year Winter I+40% | 165.548 | 165.575 | 1.227 | 27.195 | 1.04 | | 70.1 |
| 3.002 | S06-C11-6 | 30 minute 100 year Winter I+40% | 163.815 | 163.829 | 1.215 | 14.704 | 1.20 | | 102.0 |
| 3.003 | S06-C11-7 | 15 minute 100 year Winter I+40% | 161.078 | 160.994 | 1.116 | 0.000 | 0.96 | | 166.3 |
| 3.004 | S06-C11-8 | 15 minute 100 year Winter I+40% | 158.485 | 158.499 | 1.214 | 14.410 | 1.00 | | 174.0 |
| 3.005 | S06-C11-9 | 30 minute 100 year Winter I+40% | 155.892 | 155.911 | 1.219 | 19.091 | 1.21 | | 209.3 |
| 3.006 | S06-C11-10 | 15 minute 100 year Winter I+40% | 153.569 | 153.571 | 1.202 | 1.985 | 1.09 | | 226.3 |
| 3.007 | S06-C11-11 | 15 minute 100 year Winter I+40% | 150.212 | 149.903 | 0.891 | 0.000 | 1.21 | | 271.9 |
| 3.008 | S06-C11-12 | 15 minute 100 year Winter I+40% | 149.002 | 148.101 | 0.299 | 0.000 | 1.21 | | 305.8 |
| 3.009 | S06-C11-13 | 15 minute 100 year Winter I+40% | 148.351 | 146.966 | -0.186 | 0.000 | 0.51 | | 305.7 |
| 1.002 | S06-C11-14 | 30 minute 100 year Winter I+40% | 145.500 | 144.975 | 0.606 | 0.000 | 1.87 | | 359.2 |
| 1.003 | S06-C11-15 | 30 minute 100 year Winter I+40% | 145.500 | 144.391 | 0.185 | 0.000 | 1.89 | | 358.2 |
| 1.004 | S06-C11-16 | 480 minute 100 year Winter I+40% | 147.330 | 144.376 | 0.251 | 0.000 | 0.06 | 0.0 | 16.1 |

| **PN** | **US/MH Name** | **Status** |
|---|---|---|
| 1.000 | S06-C11-1 | FLOOD |
| 2.000 | S06-C11-2 | SURCHARGED |
| 1.001 | S06-C11-3 | SURCHARGED |
| 3.000 | S06-C11-4 | FLOOD |
| 3.001 | S06-C11-5 | FLOOD |
| 3.002 | S06-C11-6 | FLOOD |
| 3.003 | S06-C11-7 | FLOOD RISK |
| 3.004 | S06-C11-8 | FLOOD |
| 3.005 | S06-C11-9 | FLOOD |
| 3.006 | S06-C11-10 | FLOOD |
| 3.007 | S06-C11-11 | SURCHARGED |
| 3.008 | S06-C11-12 | SURCHARGED |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 11 - Ch 44600

| PN | US/MH Name | Status |
|---|---|---|
| 3.009 | S06-C11-13 | OK |
| 1.002 | S06-C11-14 | SURCHARGED |
| 1.003 | S06-C11-15 | SURCHARGED |
| 1.004 | S06-C11-16 | SURCHARGED |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for Catchment 12 - Ch 45450

Pipe Sizes Min 150 Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years) 5
M5-60 (mm) 20.000
Ratio R 0.300
Maximum Rainfall (mm/hr) 150
Maximum Time of Concentration (mins) 30
Foul Sewage (l/s/ha) 0.000
Volumetric Runoff Coeff. 0.750

PIMP (%) 100
Add Flow / Climate Change (%) 0
Minimum Backdrop Height (m) 0.200
Maximum Backdrop Height (m) 1.500
Min Design Depth for Optimisation (m) 1.200
Min Vel for Auto Design only (m/s) 1.00
Min Slope for Optimisation (1:X) 500

Designed with Level Soffits

## Network Design Table for Catchment 12 - Ch 45450

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 91.638 | 1.400 | 65.5 | 0.096 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.001 | 63.222 | 1.326 | 47.7 | 0.039 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.002 | 47.543 | 0.294 | 161.8 | 0.029 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.000 | 78.835 | 0.781 | 100.9 | 0.057 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 2.001 | 79.931 | 0.475 | 168.4 | 0.060 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.002 | 79.608 | 0.473 | 168.4 | 0.050 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.003 | 79.534 | 2.091 | 38.0 | 0.046 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.004 | 72.764 | 0.702 | 103.6 | 0.042 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.003 | 12.521 | 0.083 | 150.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 3.000 | 92.614 | 1.574 | 58.8 | 0.041 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 3.001 | 63.137 | 1.367 | 46.2 | 0.062 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 3.002 | 48.207 | 0.385 | 125.3 | 0.049 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 4.000 | 79.250 | 0.785 | 100.9 | 0.063 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 4.001 | 80.358 | 0.478 | 168.2 | 0.063 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 4.002 | 79.891 | 0.475 | 168.2 | 0.065 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 71.78 | 6.23 | 166.950 | 0.096 | 0.0 | 0.0 | 0.0 | 1.24 | 22.0 | 18.7 |
| 1.001 | 68.52 | 6.95 | 165.550 | 0.135 | 0.0 | 0.0 | 0.0 | 1.46 | 25.8 | 25.0 |
| 1.002 | 65.41 | 7.72 | 164.149 | 0.163 | 0.0 | 0.0 | 0.0 | 1.03 | 40.8 | 29.0 |
| 2.000 | 71.37 | 6.31 | 168.452 | 0.057 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 11.0 |
| 2.001 | 65.72 | 7.64 | 167.596 | 0.117 | 0.0 | 0.0 | 0.0 | 1.00 | 39.9 | 20.9 |
| 2.002 | 61.08 | 8.96 | 167.121 | 0.167 | 0.0 | 0.0 | 0.0 | 1.00 | 39.9 | 27.7 |
| 2.003 | 59.16 | 9.58 | 166.649 | 0.214 | 0.0 | 0.0 | 0.0 | 2.13 | 84.6 | 34.2 |
| 2.004 | 56.51 | 10.53 | 164.558 | 0.256 | 0.0 | 0.0 | 0.0 | 1.28 | 51.1 | 39.2 |
| 1.003 | 56.08 | 10.69 | 163.780 | 0.419 | 0.0 | 0.0 | 0.0 | 1.28 | 90.6 | 63.7 |
| 3.000 | 72.03 | 6.18 | 167.173 | 0.041 | 0.0 | 0.0 | 0.0 | 1.31 | 23.2 | 8.0 |
| 3.001 | 68.80 | 6.88 | 165.599 | 0.103 | 0.0 | 0.0 | 0.0 | 1.48 | 26.2 | 19.3 |
| 3.002 | 65.98 | 7.57 | 164.157 | 0.153 | 0.0 | 0.0 | 0.0 | 1.17 | 46.4 | 27.3 |
| 4.000 | 71.34 | 6.32 | 168.450 | 0.063 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 12.1 |
| 4.001 | 65.67 | 7.65 | 167.590 | 0.125 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 22.3 |
| 4.002 | 61.03 | 8.98 | 167.112 | 0.190 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 31.5 |

## Network Design Table for Catchment 12 - Ch 45450

| **PN** | **Length (m)** | **Fall (m)** | **Slope (1:X)** | **I.Area (ha)** | **T.E. (mins)** | **Base Flow (l/s)** | **k (mm)** | **HYD SECT** | **DIA (mm)** | **Section Type** | **Auto Design** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4.003 | 82.558 | 2.155 | 38.3 | 0.059 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 4.004 | 69.684 | 0.710 | 98.1 | 0.070 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.004 | 9.623 | 0.024 | 400.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 1.005 | 67.423 | 0.168 | 400.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 1.006 | 67.375 | 0.168 | 400.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 1.007 | 41.082 | 0.102 | 400.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 1.008 | 63.584 | 0.159 | 400.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 1.009 | 104.665 | 0.261 | 400.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 1.010 | 33.567 | 0.084 | 400.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 1.011 | 28.834 | 16.753 | 1.7 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 5.000 | 81.666 | 5.681 | 14.4 | 0.076 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 6.000 | 76.014 | 5.769 | 13.2 | 0.041 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 6.001 | 11.091 | 0.112 | 99.4 | 0.000 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 5.001 | 66.028 | 0.393 | 168.2 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.012 | 31.234 | 0.078 | 400.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 1.013 | 60.619 | 0.151 | 401.5 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |

## Network Results Table

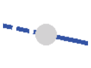
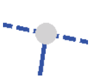
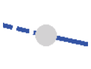
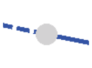
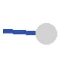
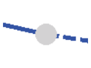
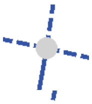
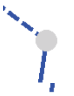
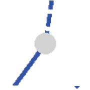
| **PN** | **Rain (mm/hr)** | **T.C. (mins)** | **US/IL (m)** | **Σ I.Area (ha)** | **Σ Base Flow (l/s)** | **Foul (l/s)** | **Add Flow (l/s)** | **Vel (m/s)** | **Cap (l/s)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|
| 4.003 | 59.03 | 9.63 | 166.637 | 0.249 | 0.0 | 0.0 | 0.0 | 2.12 | 84.3 | 39.8 |
| 4.004 | 56.57 | 10.51 | 164.482 | 0.319 | 0.0 | 0.0 | 0.0 | 1.32 | 52.5 | 48.9 |
| 1.004 | 55.67 | 10.85 | 163.547 | 0.891 | 0.0 | 0.0 | 0.0 | 1.01 | 160.5 | 134.3 |
| 1.005 | 52.99 | 11.96 | 163.523 | 0.891 | 0.0 | 0.0 | 0.0 | 1.01 | 160.5 | 134.3 |
| 1.006 | 50.61 | 13.08 | 163.355 | 0.891 | 0.0 | 0.0 | 0.0 | 1.01 | 160.5 | 134.3 |
| 1.007 | 49.28 | 13.75 | 163.187 | 0.891 | 0.0 | 0.0 | 0.0 | 1.01 | 160.5 | 134.3 |
| 1.008 | 47.38 | 14.80 | 163.084 | 0.891 | 0.0 | 0.0 | 0.0 | 1.01 | 160.5 | 134.3 |
| 1.009 | 44.62 | 16.53 | 162.926 | 0.891 | 0.0 | 0.0 | 0.0 | 1.01 | 160.5 | 134.3 |
| 1.010 | 43.81 | 17.09 | 162.664 | 0.891 | 0.0 | 0.0 | 0.0 | 1.01 | 160.5 | 134.3 |
| 1.011 | 43.77 | 17.12 | 162.581 | 0.891 | 0.0 | 0.0 | 0.0 | 15.58 | 2478.5 | 134.3 |
| 5.000 | 75.43 | 5.51 | 152.201 | 0.076 | 0.0 | 0.0 | 0.0 | 2.67 | 47.2 | 15.6 |
| 6.000 | 75.73 | 5.45 | 152.401 | 0.041 | 0.0 | 0.0 | 0.0 | 2.79 | 49.3 | 8.3 |
| 6.001 | 74.75 | 5.64 | 146.632 | 0.041 | 0.0 | 0.0 | 0.0 | 1.01 | 17.8 | 8.3 |
| 5.001 | 69.46 | 6.73 | 146.446 | 0.117 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 22.0 |
| 1.012 | 43.06 | 17.63 | 145.828 | 1.008 | 0.0 | 0.0 | 0.0 | 1.01 | 160.5 | 134.3 |
| 1.013 | 41.74 | 18.64 | 145.750 | 1.008 | 0.0 | 0.0 | 0.0 | 1.01 | 160.4 | 134.3 |

## Manhole Schedules for Catchment 12 - Ch 45450

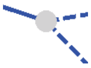
| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | Pipe Out | | | Pipes In | | | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | PN | Invert Level (m) | Diameter (mm) | PN | Invert Level (m) | Diameter (mm) | |
| S06-C12-1 | 168.300 | 1.350 | Open Manhole | 1200 | 1.000 | 166.950 | 150 | | | | |
| S06-C12-2 | 166.900 | 1.350 | Open Manhole | 1200 | 1.001 | 165.550 | 150 | 1.000 | 165.550 | 150 | |
| S06-C12-3 | 165.574 | 1.425 | Open Manhole | 1200 | 1.002 | 164.149 | 225 | 1.001 | 164.224 | 150 | |
| S06-C12-4 | 169.802 | 1.350 | Open Manhole | 1200 | 2.000 | 168.452 | 150 | | | | |
| S06-C12-5 | 171.467 | 3.871 | Open Manhole | 1200 | 2.001 | 167.596 | 225 | 2.000 | 167.671 | 150 | |
| S06-C12-6 | 171.042 | 3.921 | Open Manhole | 1200 | 2.002 | 167.121 | 225 | 2.001 | 167.121 | 225 | |
| S06-C12-7 | 168.500 | 1.851 | Open Manhole | 1200 | 2.003 | 166.649 | 225 | 2.002 | 166.649 | 225 | |
| S06-C12-8 | 165.983 | 1.425 | Open Manhole | 1200 | 2.004 | 164.558 | 225 | 2.003 | 164.558 | 225 | |
| S06-C12-9 | 165.280 | 1.500 | Open Manhole | 1200 | 1.003 | 163.780 | 300 | 1.002 | 163.855 | 225 | |
| | | | | | | | | 2.004 | 163.855 | 225 | |
| S06-C12-10 | 168.523 | 1.350 | Open Manhole | 1200 | 3.000 | 167.173 | 150 | | | | |
| S06-C12-11 | 166.949 | 1.350 | Open Manhole | 1200 | 3.001 | 165.599 | 150 | 3.000 | 165.599 | 150 | |
| S06-C12-12 | 165.582 | 1.425 | Open Manhole | 1200 | 3.002 | 164.157 | 225 | 3.001 | 164.232 | 150 | |
| S06-C12-13 | 169.800 | 1.350 | Open Manhole | 1200 | 4.000 | 168.450 | 150 | | | | |
| S06-C12-14 | 171.311 | 3.721 | Open Manhole | 1200 | 4.001 | 167.590 | 225 | 4.000 | 167.665 | 150 | |
| S06-C12-15 | 170.873 | 3.761 | Open Manhole | 1200 | 4.002 | 167.112 | 225 | 4.001 | 167.112 | 225 | |
| S06-C12-16 | 168.379 | 1.742 | Open Manhole | 1200 | 4.003 | 166.637 | 225 | 4.002 | 166.637 | 225 | |
| S06-C12-17 | 165.907 | 1.425 | Open Manhole | 1200 | 4.004 | 164.482 | 225 | 4.003 | 164.482 | 225 | |
| S06-C12-18 | 165.197 | 1.650 | Open Manhole | 1350 | 1.004 | 163.547 | 450 | 1.003 | 163.697 | 300 | |
| | | | | | | | | 3.002 | 163.772 | 225 | |
| | | | | | | | | 4.004 | 163.772 | 225 | |
| S06-C12-19 | 167.526 | 4.003 | Open Manhole | 1350 | 1.005 | 163.523 | 450 | 1.004 | 163.523 | 450 | |
| S06-C12-20 | 165.197 | 1.842 | Open Manhole | 1350 | 1.006 | 163.355 | 450 | 1.005 | 163.355 | 450 | |
| S06-C12-21 | 165.197 | 2.010 | Open Manhole | 1350 | 1.007 | 163.187 | 450 | 1.006 | 163.187 | 450 | |
| S06-C12-22 | 165.197 | 2.113 | Open Manhole | 1350 | 1.008 | 163.084 | 450 | 1.007 | 163.084 | 450 | |
| S06-C12-23 | 165.197 | 2.271 | Open Manhole | 1350 | 1.009 | 162.926 | 450 | 1.008 | 162.926 | 450 | |
| S06-C12-24 | 165.197 | 2.533 | Open Manhole | 1350 | 1.010 | 162.664 | 450 | 1.009 | 162.664 | 450 | |
| S06-C12-25 | 165.197 | 2.616 | Open Manhole | 1350 | 1.011 | 162.581 | 450 | 1.010 | 162.581 | 450 | |
| S06-C12-26 | 153.551 | 1.350 | Open Manhole | 1200 | 5.000 | 152.201 | 150 | | | | |
| S06-C12-27 | 153.751 | 1.350 | Open Manhole | 1200 | 6.000 | 152.401 | 150 | | | | |
| S06-C12-28 | 147.951 | 1.319 | Open Manhole | 1200 | 6.001 | 146.632 | 150 | 6.000 | 146.632 | 150 | |
| S06-C12-29 | 147.575 | 1.130 | Open Manhole | 1200 | 5.001 | 146.446 | 225 | 5.000 | 146.521 | 150 | |
| | | | | | | | | 6.001 | 146.521 | 150 | |
| S06-C12-30 | 151.603 | 5.775 | Open Manhole | 1350 | 1.012 | 145.828 | 450 | 1.011 | 145.828 | 450 | |
| | | | | | | | | 5.001 | 146.053 | 225 | |
| S06-C12-31 | 147.030 | 1.280 | Open Manhole | 1350 | 1.013 | 145.750 | 450 | 1.012 | 145.750 | 450 | |
| Outfall 12 | 146.139 | 0.540 | Open Manhole | 0 | | OUTFALL | | 1.013 | 145.599 | 450 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C12-1 | 376310.978 | 515361.459 | 376310.978 | 515361.459 | Required |  |
| S06-C12-2 | 376400.081 | 515340.176 | 376400.081 | 515340.176 | Required |  |

## Manhole Schedules for Catchment 12 - Ch 45450

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C12-3 | 376461.953 | 515327.180 | 376461.953 | 515327.180 | Required |  |
| S06-C12-4 | 376895.486 | 515267.477 | 376895.486 | 515267.477 | Required |  |
| S06-C12-5 | 376816.823 | 515272.683 | 376816.823 | 515272.683 | Required |  |
| S06-C12-6 | 376737.211 | 515279.813 | 376737.211 | 515279.813 | Required |  |
| S06-C12-7 | 376658.232 | 515289.809 | 376658.232 | 515289.809 | Required |  |
| S06-C12-8 | 376579.781 | 515302.888 | 376579.781 | 515302.888 | Required |  |
| S06-C12-9 | 376508.484 | 515317.426 | 376508.484 | 515317.426 | Required |  |
| S06-C12-10 | 376307.484 | 515348.824 | 376307.484 | 515348.824 | Required |  |
| S06-C12-11 | 376397.645 | 515327.740 | 376397.645 | 515327.740 | Required |  |
| S06-C12-12 | 376459.386 | 515314.538 | 376459.386 | 515314.538 | Required |  |
| S06-C12-13 | 376894.516 | 515254.080 | 376894.516 | 515254.080 | Required |  |
| S06-C12-14 | 376815.435 | 515259.255 | 376815.435 | 515259.255 | Required |  |
| S06-C12-15 | 376735.409 | 515266.559 | 376735.409 | 515266.559 | Required |  |
| S06-C12-16 | 376656.216 | 515277.100 | 376656.216 | 515277.100 | Required |  |
| S06-C12-17 | 376574.628 | 515289.720 | 376574.628 | 515289.720 | Required |  |
| S06-C12-18 | 376506.649 | 515305.040 | 376506.649 | 515305.040 | Required |  |
| S06-C12-19 | 376504.947 | 515295.568 | 376504.947 | 515295.568 | Required |  |
| S06-C12-20 | 376558.800 | 515255.000 | 376558.800 | 515255.000 | Required |  |
| S06-C12-21 | 376549.094 | 515188.327 | 376549.094 | 515188.327 | Required |  |
| S06-C12-22 | 376524.989 | 515155.060 | 376524.989 | 515155.060 | Required |  |

## Manhole Schedules for Catchment 12 - Ch 45450

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S06-C12-23 | 376462.388 | 515143.923 | 376462.388 | 515143.923 | Required |  |
| S06-C12-24 | 376357.740 | 515142.083 | 376357.740 | 515142.083 | Required |  |
| S06-C12-25 | 376324.459 | 515137.706 | 376324.459 | 515137.706 | Required |  |
| S06-C12-26 | 376440.488 | 515120.660 | 376440.488 | 515120.660 | Required |  |
| S06-C12-27 | 376442.662 | 515111.410 | 376442.662 | 515111.410 | Required |  |
| S06-C12-28 | 376367.617 | 515099.310 | 376367.617 | 515099.310 | Required |  |
| S06-C12-29 | 376359.923 | 515107.297 | 376359.923 | 515107.297 | Required |  |
| S06-C12-30 | 376297.265 | 515128.122 | 376297.265 | 515128.122 | Required |  |
| S06-C12-31 | 376267.596 | 515137.885 | 376267.596 | 515137.885 | Required |  |
| Outfall 12 | 376207.360 | 515131.080 | | | No Entry |  |

## Area Summary for Catchment 12 - Ch 45450

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | User | - | 100 | 0.085 | 0.085 | 0.085 |
| | User | - | 50 | 0.022 | 0.011 | 0.096 |
| 1.001 | User | - | 100 | 0.030 | 0.030 | 0.030 |
| | User | - | 50 | 0.016 | 0.008 | 0.039 |
| 1.002 | User | - | 100 | 0.023 | 0.023 | 0.023 |
| | User | - | 50 | 0.012 | 0.006 | 0.029 |
| 2.000 | User | - | 100 | 0.038 | 0.038 | 0.038 |
| | User | - | 50 | 0.019 | 0.010 | 0.048 |
| | User | - | 30 | 0.030 | 0.009 | 0.057 |
| 2.001 | User | - | 100 | 0.039 | 0.039 | 0.039 |
| | User | - | 50 | 0.019 | 0.010 | 0.049 |
| | User | - | 30 | 0.037 | 0.011 | 0.060 |
| 2.002 | User | - | 100 | 0.037 | 0.037 | 0.037 |
| | User | - | 50 | 0.020 | 0.010 | 0.047 |
| | User | - | 30 | 0.010 | 0.003 | 0.050 |
| 2.003 | User | - | 100 | 0.036 | 0.036 | 0.036 |
| | User | - | 50 | 0.019 | 0.010 | 0.046 |
| 2.004 | User | - | 100 | 0.033 | 0.033 | 0.033 |
| | User | - | 50 | 0.018 | 0.009 | 0.042 |
| 1.003 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 3.000 | User | - | 50 | 0.032 | 0.016 | 0.016 |
| | User | - | 30 | 0.056 | 0.017 | 0.033 |
| | User | - | 100 | 0.009 | 0.009 | 0.041 |
| 3.001 | User | - | 100 | 0.037 | 0.037 | 0.037 |
| | User | - | 50 | 0.023 | 0.011 | 0.048 |
| | User | - | 30 | 0.047 | 0.014 | 0.062 |
| 3.002 | User | - | 100 | 0.026 | 0.026 | 0.026 |
| | User | - | 50 | 0.017 | 0.008 | 0.035 |
| | User | - | 30 | 0.048 | 0.014 | 0.049 |
| 4.000 | User | - | 100 | 0.045 | 0.045 | 0.045 |
| | User | - | 50 | 0.028 | 0.014 | 0.059 |
| | User | - | 30 | 0.011 | 0.003 | 0.063 |
| 4.001 | User | - | 100 | 0.046 | 0.046 | 0.046 |
| | User | - | 50 | 0.026 | 0.013 | 0.059 |
| | User | - | 30 | 0.013 | 0.004 | 0.063 |
| 4.002 | User | - | 100 | 0.045 | 0.045 | 0.045 |
| | User | - | 50 | 0.028 | 0.014 | 0.059 |
| | User | - | 30 | 0.019 | 0.006 | 0.065 |
| 4.003 | User | - | 100 | 0.049 | 0.049 | 0.049 |
| | User | - | 50 | 0.014 | 0.007 | 0.056 |
| | User | - | 30 | 0.010 | 0.003 | 0.059 |
| 4.004 | User | - | 100 | 0.041 | 0.041 | 0.041 |
| | User | - | 50 | 0.027 | 0.014 | 0.054 |
| | User | - | 30 | 0.051 | 0.015 | 0.070 |
| 1.004 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.005 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.006 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.007 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.008 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.009 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.010 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.011 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 5.000 | User | - | 100 | 0.032 | 0.032 | 0.032 |
| | User | - | 50 | 0.012 | 0.006 | 0.038 |
| | User | - | 30 | 0.126 | 0.038 | 0.076 |
| 6.000 | User | - | 100 | 0.031 | 0.031 | 0.031 |
| | User | - | 50 | 0.012 | 0.006 | 0.037 |
| | User | - | 30 | 0.012 | 0.004 | 0.041 |
| 6.001 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 5.001 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.012 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.013 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total | Total | Total |
| | | | | 1.521 | 1.008 | 1.008 |

## Online Controls for Catchment 12 - Ch 45450

### Hydro-Brake® Optimum Manhole: S06-C12-31, DS/PN: 1.013, Volume $(m^3)$: 6.6

| | |
|---|---|
| Unit Reference | MD-SHE-0146-1010-1000-1010 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 10.1 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 146 |
| Invert Level (m) | 145.750 |
| Minimum Outlet Pipe Diameter (mm) | 225 |
| Suggested Manhole Diameter (mm) | 1200 |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.000 | 10.1 | Kick-Flo® | 0.676 | 8.4 |
| Flush-Flo™ | 0.305 | 10.1 | Mean Flow over Head Range | - | 8.7 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 5.3 | 0.800 | 9.1 | 2.000 | 14.0 | 4.000 | 19.5 | 7.000 | 25.5 |
| 0.200 | 9.8 | 1.000 | 10.1 | 2.200 | 14.7 | 4.500 | 20.6 | 7.500 | 26.4 |
| 0.300 | 10.1 | 1.200 | 11.0 | 2.400 | 15.3 | 5.000 | 21.7 | 8.000 | 27.2 |
| 0.400 | 10.0 | 1.400 | 11.8 | 2.600 | 15.9 | 5.500 | 22.7 | 8.500 | 28.0 |
| 0.500 | 9.7 | 1.600 | 12.6 | 3.000 | 17.0 | 6.000 | 23.7 | 9.000 | 28.8 |
| 0.600 | 9.2 | 1.800 | 13.3 | 3.500 | 18.3 | 6.500 | 24.6 | 9.500 | 29.6 |

## Offline Controls for Catchment 12 - Ch 45450

### Weir Manhole: S06-C12-31, DS/PN: 1.013, Loop to PN: None

Discharge Coef 0.544 Width (m) 10.000 Invert Level (m) 146.750

## Storage Structures for Catchment 12 - Ch 45450

### Tank or Pond Manhole: S06-C12-31, DS/PN: 1.013

Invert Level (m) 145.750

| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|---|---|
| 0.000 | 903.4 | 1.000 | 1419.0 | 1.001 | 1583.0 | 1.280 | 2372.0 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 12 - Ch 45450

### Simulation Criteria

Areal Reduction Factor 1.000
Hot Start (mins) 0
Hot Start Level (mm) 0
Manhole Headloss Coeff (Global) 0.500
Foul Sewage per hectare (l/s) 0.000
Additional Flow - % of Total Flow 0.000
MADD Factor * 10m³/ha Storage 0.000
Inlet Coeffiecient 0.800
Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0
Number of Online Controls 1
Number of Offline Controls 1
Number of Storage Structures 1
Number of Time/Area Diagrams 0
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
Region England and Wales
M5-60 (mm) 20.000
Ratio R 0.300
Cv (Summer) 0.750
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C12-1 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 167.276 | 0.176 |
| 1.001 | S06-C12-2 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 165.890 | 0.190 |
| 1.002 | S06-C12-3 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 164.310 | -0.065 |
| 2.000 | S06-C12-4 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 168.558 | -0.044 |
| 2.001 | S06-C12-5 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 167.732 | -0.089 |
| 2.002 | S06-C12-6 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 167.285 | -0.061 |
| 2.003 | S06-C12-7 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 166.760 | -0.113 |
| 2.004 | S06-C12-8 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | | | 164.737 | -0.045 |
| 1.003 | S06-C12-9 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 164.124 | 0.044 |
| 3.000 | S06-C12-10 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 167.244 | -0.078 |
| 3.001 | S06-C12-11 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 165.710 | -0.039 |
| 3.002 | S06-C12-12 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 164.302 | -0.080 |
| 4.000 | S06-C12-13 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 168.563 | -0.037 |
| 4.001 | S06-C12-14 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 167.732 | -0.083 |
| 4.002 | S06-C12-15 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 167.292 | -0.045 |
| 4.003 | S06-C12-16 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 166.759 | -0.102 |
| 4.004 | S06-C12-17 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 164.886 | 0.179 |
| 1.004 | S06-C12-18 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 164.024 | 0.027 |
| 1.005 | S06-C12-19 | 15 Winter | 5 | +20% | 5/15 Winter | | | | 163.973 | 0.000 |
| 1.006 | S06-C12-20 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 163.734 | -0.071 |
| 1.007 | S06-C12-21 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 163.556 | -0.081 |
| 1.008 | S06-C12-22 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 163.433 | -0.101 |
| 1.009 | S06-C12-23 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 163.261 | -0.115 |
| 1.010 | S06-C12-24 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 163.006 | -0.108 |
| 1.011 | S06-C12-25 | 30 Winter | 5 | +20% | | | | | 162.653 | -0.378 |
| 5.000 | S06-C12-26 | 15 Winter | 5 | +20% | | | | | 152.269 | -0.082 |
| 6.000 | S06-C12-27 | 15 Winter | 5 | +20% | | | | | 152.448 | -0.103 |
| 6.001 | S06-C12-28 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 146.720 | -0.062 |
| 5.001 | S06-C12-29 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 146.593 | -0.077 |
| 1.012 | S06-C12-30 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 146.177 | -0.101 |
| 1.013 | S06-C12-31 | 480 Winter | 5 | +20% | 100/120 Summer | | | 0 | 146.019 | -0.181 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 12 - Ch 45450

| PN | US/MH Name | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C12-1 | 0.000 | 1.00 | | | 21.6 | SURCHARGED | 6 |
| 1.001 | S06-C12-2 | 0.000 | 1.07 | | | 27.0 | SURCHARGED | 6 |
| 1.002 | S06-C12-3 | 0.000 | 0.81 | | | 31.6 | OK | |
| 2.000 | S06-C12-4 | 0.000 | 0.77 | | | 13.5 | OK | 3 |
| 2.001 | S06-C12-5 | 0.000 | 0.63 | | | 24.6 | OK | |
| 2.002 | S06-C12-6 | 0.000 | 0.84 | | | 32.6 | OK | |
| 2.003 | S06-C12-7 | 0.000 | 0.48 | | | 39.8 | OK | |
| 2.004 | S06-C12-8 | 0.000 | 0.93 | | | 46.0 | OK | 5 |
| 1.003 | S06-C12-9 | 0.000 | 1.07 | | | 77.3 | SURCHARGED | |
| 3.000 | S06-C12-10 | 0.000 | 0.43 | | | 9.8 | OK | |
| 3.001 | S06-C12-11 | 0.000 | 0.87 | | | 22.4 | OK | 5 |
| 3.002 | S06-C12-12 | 0.000 | 0.72 | | | 32.2 | OK | |
| 4.000 | S06-C12-13 | 0.000 | 0.85 | | | 14.8 | OK | 4 |
| 4.001 | S06-C12-14 | 0.000 | 0.67 | | | 26.3 | OK | |
| 4.002 | S06-C12-15 | 0.000 | 0.95 | | | 36.9 | OK | |
| 4.003 | S06-C12-16 | 0.000 | 0.56 | | | 46.3 | OK | |
| 4.004 | S06-C12-17 | 0.000 | 1.09 | | | 55.7 | SURCHARGED | 6 |
| 1.004 | S06-C12-18 | 0.000 | 1.66 | | | 158.8 | SURCHARGED | |
| 1.005 | S06-C12-19 | 0.000 | 1.04 | | | 155.0 | SURCHARGED | |
| 1.006 | S06-C12-20 | 0.000 | 0.99 | | | 147.8 | OK | |
| 1.007 | S06-C12-21 | 0.000 | 1.00 | | | 142.7 | OK | |
| 1.008 | S06-C12-22 | 0.000 | 0.94 | | | 140.4 | OK | |
| 1.009 | S06-C12-23 | 0.000 | 0.87 | | | 132.4 | OK | |
| 1.010 | S06-C12-24 | 0.000 | 0.93 | | | 129.9 | OK | |
| 1.011 | S06-C12-25 | 0.000 | 0.06 | | | 130.0 | OK | |
| 5.000 | S06-C12-26 | 0.000 | 0.41 | | | 18.9 | OK | |
| 6.000 | S06-C12-27 | 0.000 | 0.21 | | | 10.1 | OK | |
| 6.001 | S06-C12-28 | 0.000 | 0.63 | | | 10.2 | OK | |
| 5.001 | S06-C12-29 | 0.000 | 0.76 | | | 29.3 | OK | |
| 1.012 | S06-C12-30 | 0.000 | 0.96 | | | 132.8 | OK | |
| 1.013 | S06-C12-31 | 0.000 | 0.07 | 0.0 | | 10.1 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 12 - Ch 45450

### Simulation Criteria

Areal Reduction Factor 1.000
Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0
MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0
Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500
Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0
Number of Offline Controls 1
Number of Time/Area Diagrams 0
Number of Online Controls 1
Number of Storage Structures 1
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
M5-60 (mm) 20.000
Cv (Summer) 0.750
Region England and Wales
Ratio R 0.300
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C12-1 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 168.307 | 1.207 |
| 1.001 | S06-C12-2 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 166.901 | 1.201 |
| 1.002 | S06-C12-3 | 60 Winter | 100 | +40% | 100/15 Summer | | | | 165.136 | 0.761 |
| 2.000 | S06-C12-4 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 169.803 | 1.201 |
| 2.001 | S06-C12-5 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 168.804 | 0.983 |
| 2.002 | S06-C12-6 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 168.229 | 0.883 |
| 2.003 | S06-C12-7 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 167.224 | 0.350 |
| 2.004 | S06-C12-8 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | | | 165.986 | 1.203 |
| 1.003 | S06-C12-9 | 60 Winter | 100 | +40% | 5/15 Summer | | | | 164.916 | 0.835 |
| 3.000 | S06-C12-10 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 168.048 | 0.725 |
| 3.001 | S06-C12-11 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 166.951 | 1.203 |
| 3.002 | S06-C12-12 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 165.016 | 0.635 |
| 4.000 | S06-C12-13 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 169.803 | 1.203 |
| 4.001 | S06-C12-14 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 169.387 | 1.573 |
| 4.002 | S06-C12-15 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 168.987 | 1.650 |
| 4.003 | S06-C12-16 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 167.861 | 0.999 |
| 4.004 | S06-C12-17 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 165.918 | 1.211 |
| 1.004 | S06-C12-18 | 60 Winter | 100 | +40% | 5/15 Summer | | | | 164.769 | 0.772 |
| 1.005 | S06-C12-19 | 60 Winter | 100 | +40% | 5/15 Winter | | | | 164.652 | 0.679 |
| 1.006 | S06-C12-20 | 60 Winter | 100 | +40% | 100/15 Summer | | | | 164.368 | 0.563 |
| 1.007 | S06-C12-21 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 164.081 | 0.445 |
| 1.008 | S06-C12-22 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 163.888 | 0.354 |
| 1.009 | S06-C12-23 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 163.608 | 0.232 |
| 1.010 | S06-C12-24 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 163.174 | 0.060 |
| 1.011 | S06-C12-25 | 30 Winter | 100 | +40% | | | | | 162.672 | -0.358 |
| 5.000 | S06-C12-26 | 15 Winter | 100 | +40% | | | | | 152.315 | -0.036 |
| 6.000 | S06-C12-27 | 15 Winter | 100 | +40% | | | | | 152.474 | -0.077 |
| 6.001 | S06-C12-28 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 147.403 | 0.621 |
| 5.001 | S06-C12-29 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 147.217 | 0.547 |
| 1.012 | S06-C12-30 | 480 Winter | 100 | +40% | 100/15 Summer | | | | 146.403 | 0.125 |
| 1.013 | S06-C12-31 | 480 Winter | 100 | +40% | 100/120 Summer | | | 0 | 146.399 | 0.199 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 12 - Ch 45450

| PN | US/MH Name | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C12-1 | 6.935 | 1.11 | | | 24.2 | FLOOD | 6 |
| 1.001 | S06-C12-2 | 1.401 | 1.25 | | | 31.5 | FLOOD | 6 |
| 1.002 | S06-C12-3 | 0.000 | 0.95 | | | 36.9 | SURCHARGED | |
| 2.000 | S06-C12-4 | 0.869 | 1.27 | | | 22.0 | FLOOD | 3 |
| 2.001 | S06-C12-5 | 0.000 | 1.08 | | | 41.9 | SURCHARGED | |
| 2.002 | S06-C12-6 | 0.000 | 1.47 | | | 57.3 | SURCHARGED | |
| 2.003 | S06-C12-7 | 0.000 | 0.77 | | | 63.1 | SURCHARGED | |
| 2.004 | S06-C12-8 | 2.963 | 1.41 | | | 69.9 | FLOOD | 5 |
| 1.003 | S06-C12-9 | 0.000 | 1.39 | | | 100.5 | SURCHARGED | |
| 3.000 | S06-C12-10 | 0.000 | 0.80 | | | 18.3 | SURCHARGED | |
| 3.001 | S06-C12-11 | 2.707 | 1.25 | | | 32.0 | FLOOD | 5 |
| 3.002 | S06-C12-12 | 0.000 | 1.13 | | | 50.3 | SURCHARGED | |
| 4.000 | S06-C12-13 | 2.935 | 1.34 | | | 23.3 | FLOOD | 4 |
| 4.001 | S06-C12-14 | 0.000 | 1.05 | | | 40.7 | SURCHARGED | |
| 4.002 | S06-C12-15 | 0.000 | 1.55 | | | 60.3 | SURCHARGED | |
| 4.003 | S06-C12-16 | 0.000 | 0.92 | | | 75.5 | SURCHARGED | |
| 4.004 | S06-C12-17 | 10.670 | 1.52 | | | 77.2 | FLOOD | 6 |
| 1.004 | S06-C12-18 | 0.000 | 2.18 | | | 208.7 | SURCHARGED | |
| 1.005 | S06-C12-19 | 0.000 | 1.38 | | | 206.6 | SURCHARGED | |
| 1.006 | S06-C12-20 | 0.000 | 1.36 | | | 203.7 | SURCHARGED | |
| 1.007 | S06-C12-21 | 0.000 | 1.46 | | | 208.9 | SURCHARGED | |
| 1.008 | S06-C12-22 | 0.000 | 1.37 | | | 203.7 | SURCHARGED | |
| 1.009 | S06-C12-23 | 0.000 | 1.29 | | | 197.4 | SURCHARGED | |
| 1.010 | S06-C12-24 | 0.000 | 1.40 | | | 196.7 | SURCHARGED | |
| 1.011 | S06-C12-25 | 0.000 | 0.09 | | | 196.6 | OK | |
| 5.000 | S06-C12-26 | 0.000 | 0.90 | | | 41.9 | OK | |
| 6.000 | S06-C12-27 | 0.000 | 0.46 | | | 22.3 | OK | |
| 6.001 | S06-C12-28 | 0.000 | 1.31 | | | 20.9 | SURCHARGED | |
| 5.001 | S06-C12-29 | 0.000 | 1.52 | | | 58.7 | SURCHARGED | |
| 1.012 | S06-C12-30 | 0.000 | 0.56 | | | 77.6 | SURCHARGED | |
| 1.013 | S06-C12-31 | 0.000 | 0.07 | 0.0 | | 10.1 | SURCHARGED | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Catchment 13 - Ch 45700

Pipe Sizes Min 150 Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 20.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Network Design Table for Catchment 13 - Ch 45700

| **PN** | **Length (m)** | **Fall (m)** | **Slope (1:X)** | **I.Area (ha)** | **T.E. (mins)** | **Base Flow (l/s)** | **k (mm)** | **HYD SECT** | **DIA (mm)** | **Section Type** | **Auto Design** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 27.290 | 0.270 | 101.1 | 0.070 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.001 | 40.177 | 0.398 | 100.9 | 0.020 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.002 | 49.201 | 5.926 | 8.3 | 0.043 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.003 | 70.132 | 2.649 | 26.5 | 0.067 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.004 | 57.680 | 2.620 | 22.0 | 0.064 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.005 | 9.618 | 0.040 | 238.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 2.000 | 97.441 | 1.355 | 71.9 | 0.053 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 3.000 | 96.344 | 1.338 | 72.0 | 0.072 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 4.000 | 26.649 | 1.718 | 15.5 | 0.019 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 4.001 | 37.772 | 2.477 | 15.2 | 0.014 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 4.002 | 13.875 | 0.140 | 99.3 | 0.013 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 4.003 | 16.642 | 1.158 | 14.4 | 0.023 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 4.004 | 6.932 | 0.070 | 99.0 | 0.009 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 3.001 | 11.210 | 0.067 | 167.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |

### Network Results Table

| **PN** | **Rain (mm/hr)** | **T.C. (mins)** | **US/IL (m)** | **Σ I.Area (ha)** | **Σ Base Flow (l/s)** | **Foul (l/s)** | **Add Flow (l/s)** | **Vel (m/s)** | **Cap (l/s)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 75.73 | 5.46 | 164.432 | 0.070 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 14.3 |
| 1.001 | 72.28 | 6.12 | 164.162 | 0.089 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 17.5 |
| 1.002 | 71.16 | 6.36 | 163.764 | 0.132 | 0.0 | 0.0 | 0.0 | 3.52 | 62.2 | 25.4 |
| 1.003 | 69.10 | 6.82 | 157.763 | 0.199 | 0.0 | 0.0 | 0.0 | 2.55 | 101.5 | 37.3 |
| 1.004 | 67.64 | 7.16 | 155.114 | 0.263 | 0.0 | 0.0 | 0.0 | 2.80 | 111.4 | 48.2 |
| 1.005 | 66.99 | 7.32 | 152.419 | 0.263 | 0.0 | 0.0 | 0.0 | 1.01 | 71.7 | 48.2 |
| 2.000 | 71.12 | 6.37 | 160.666 | 0.053 | 0.0 | 0.0 | 0.0 | 1.19 | 21.0 | 10.3 |
| 3.000 | 71.18 | 6.35 | 160.386 | 0.072 | 0.0 | 0.0 | 0.0 | 1.19 | 21.0 | 13.8 |
| 4.000 | 77.31 | 5.17 | 164.401 | 0.019 | 0.0 | 0.0 | 0.0 | 2.57 | 45.4 | 4.0 |
| 4.001 | 75.94 | 5.42 | 162.683 | 0.033 | 0.0 | 0.0 | 0.0 | 2.59 | 45.8 | 6.9 |
| 4.002 | 74.71 | 5.64 | 160.205 | 0.047 | 0.0 | 0.0 | 0.0 | 1.01 | 17.8 | 9.4 |
| 4.003 | 74.16 | 5.75 | 160.066 | 0.070 | 0.0 | 0.0 | 0.0 | 2.67 | 47.2 | 14.0 |
| 4.004 | 73.58 | 5.86 | 158.908 | 0.079 | 0.0 | 0.0 | 0.0 | 1.01 | 17.8 | 15.7 |
| 3.001 | 70.32 | 6.54 | 158.763 | 0.151 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 28.7 |

## Network Design Table for Catchment 13 - Ch 45700

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.001 | 19.008 | 0.321 | 59.2 | 0.022 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.002 | 61.183 | 2.024 | 30.2 | 0.042 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.003 | 32.765 | 1.134 | 28.9 | 0.003 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.004 | 59.081 | 2.764 | 21.4 | 0.005 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.006 | 1.168 | 0.004 | 321.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 1.007 | 68.555 | 0.214 | 321.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 1.008 | 82.862 | 0.258 | 321.2 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |

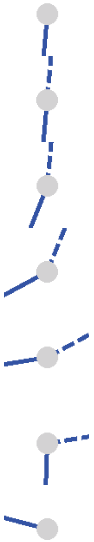
## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2.001 | 69.49 | 6.73 | 158.696 | 0.226 | 0.0 | 0.0 | 0.0 | 1.70 | 67.7 | 42.5 |
| 2.002 | 67.67 | 7.15 | 158.375 | 0.268 | 0.0 | 0.0 | 0.0 | 2.39 | 95.0 | 49.1 |
| 2.003 | 66.76 | 7.38 | 156.351 | 0.271 | 0.0 | 0.0 | 0.0 | 2.44 | 97.1 | 49.1 |
| 2.004 | 65.41 | 7.72 | 155.218 | 0.276 | 0.0 | 0.0 | 0.0 | 2.84 | 113.0 | 49.1 |
| 1.006 | 65.33 | 7.74 | 152.304 | 0.539 | 0.0 | 0.0 | 0.0 | 1.01 | 111.1 | 95.4 |
| 1.007 | 61.35 | 8.88 | 152.300 | 0.539 | 0.0 | 0.0 | 0.0 | 1.01 | 111.1 | 95.4 |
| 1.008 | 57.25 | 10.25 | 152.087 | 0.539 | 0.0 | 0.0 | 0.0 | 1.01 | 111.1 | 95.4 |

## Manhole Schedules for Catchment 13 - Ch 45700

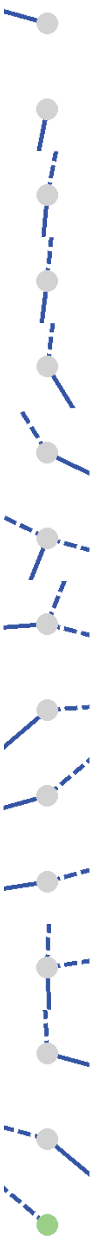
| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | Pipe Out | | | Pipes In | | | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | PN | Invert Level (m) | Diameter (mm) | PN | Invert Level (m) | Diameter (mm) | |
| S06-C13-1 | 165.782 | 1.350 | Open Manhole | 1200 | 1.000 | 164.432 | 150 | | | | |
| S06-C13-2 | 170.935 | 6.773 | Open Manhole | 1200 | 1.001 | 164.162 | 150 | 1.000 | 164.162 | 150 | |
| S06-C13-3 | 170.935 | 7.171 | Open Manhole | 1200 | 1.002 | 163.764 | 150 | 1.001 | 163.764 | 150 | |
| S06-C13-4 | 159.188 | 1.424 | Open Manhole | 1200 | 1.003 | 157.763 | 225 | 1.002 | 157.838 | 150 | |
| S06-C13-5 | 156.539 | 1.424 | Open Manhole | 1200 | 1.004 | 155.114 | 225 | 1.003 | 155.114 | 225 | |
| S06-C13-6 | 153.800 | 1.381 | Open Manhole | 1200 | 1.005 | 152.419 | 300 | 1.004 | 152.494 | 225 | |
| S06-C13-7 | 162.016 | 1.350 | Open Manhole | 1200 | 2.000 | 160.666 | 150 | | | | |
| S06-C13-8 | 161.736 | 1.350 | Open Manhole | 1200 | 3.000 | 160.386 | 150 | | | | |
| S06-C13-9 | 165.751 | 1.350 | Open Manhole | 1200 | 4.000 | 164.401 | 150 | | | | |
| S06-C13-10 | 164.033 | 1.350 | Open Manhole | 1200 | 4.001 | 162.683 | 150 | 4.000 | 162.683 | 150 | |
| S06-C13-11 | 161.555 | 1.350 | Open Manhole | 1200 | 4.002 | 160.205 | 150 | 4.001 | 160.205 | 150 | |
| S06-C13-12 | 167.600 | 7.534 | Open Manhole | 1200 | 4.003 | 160.066 | 150 | 4.002 | 160.066 | 150 | |
| S06-C13-13 | 160.258 | 1.350 | Open Manhole | 1200 | 4.004 | 158.908 | 150 | 4.003 | 158.908 | 150 | |
| S06-C13-14 | 160.399 | 1.636 | Open Manhole | 1200 | 3.001 | 158.763 | 225 | 3.000 | 159.049 | 150 | 211 |
| | | | | | | | | 4.004 | 158.838 | 150 | |
| S06-C13-15 | 160.661 | 1.965 | Open Manhole | 1200 | 2.001 | 158.696 | 225 | 2.000 | 159.311 | 150 | 540 |
| | | | | | | | | 3.001 | 158.696 | 225 | |
| S06-C13-16 | 159.800 | 1.425 | Open Manhole | 1200 | 2.002 | 158.375 | 225 | 2.001 | 158.375 | 225 | |
| S06-C13-17 | 157.776 | 1.425 | Open Manhole | 1200 | 2.003 | 156.351 | 225 | 2.002 | 156.351 | 225 | |
| S06-C13-18 | 156.643 | 1.425 | Open Manhole | 1200 | 2.004 | 155.218 | 225 | 2.003 | 155.218 | 225 | |
| S06-C13-19 | 153.946 | 1.642 | Open Manhole | 1350 | 1.006 | 152.304 | 375 | 1.005 | 152.379 | 300 | |
| | | | | | | | | 2.004 | 152.454 | 225 | |
| S06-C13-20 | 153.900 | 1.600 | Open Manhole | 1350 | 1.007 | 152.300 | 375 | 1.006 | 152.300 | 375 | |
| S06-C13-21 | 153.367 | 1.280 | Open Manhole | 1350 | 1.008 | 152.087 | 375 | 1.007 | 152.087 | 375 | |
| Outfall 13 | 152.800 | 0.971 | Open Manhole | 0 | | OUTFALL | | 1.008 | 151.829 | 375 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C13-1 | 376587.120 | 515275.468 | 376587.120 | 515275.468 | Required | |
| S06-C13-2 | 376584.694 | 515248.286 | 376584.694 | 515248.286 | Required | |
| S06-C13-3 | 376581.092 | 515208.271 | 376581.092 | 515208.271 | Required | |
| S06-C13-4 | 376563.021 | 515163.274 | 376563.021 | 515163.274 | Required | |
| S06-C13-5 | 376502.978 | 515130.734 | 376502.978 | 515130.734 | Required | |
| S06-C13-6 | 376446.040 | 515121.514 | 376446.040 | 515121.514 | Required | |
| S06-C13-7 | 376693.203 | 515146.067 | 376693.203 | 515146.067 | Required | |



## Manhole Schedules for Catchment 13 - Ch 45700

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S06-C13-8 | 376695.776 | 515155.228 | 376695.776 | 515155.228 | Required | |
| S06-C13-9 | 376599.582 | 515274.540 | 376599.582 | 515274.540 | Required | |
| S06-C13-10 | 376594.422 | 515248.396 | 376594.422 | 515248.396 | Required | |
| S06-C13-11 | 376590.867 | 515210.791 | 376590.867 | 515210.791 | Required | |
| S06-C13-12 | 376589.121 | 515197.026 | 376589.121 | 515197.026 | Required | |
| S06-C13-13 | 376597.141 | 515183.942 | 376597.141 | 515183.942 | Required | |
| S06-C13-14 | 376603.363 | 515180.886 | 376603.363 | 515180.886 | Required | |
| S06-C13-15 | 376599.193 | 515170.480 | 376599.193 | 515170.480 | Required | |
| S06-C13-16 | 376581.639 | 515169.152 | 376581.639 | 515169.152 | Required | |
| S06-C13-17 | 376535.475 | 515129.862 | 376535.475 | 515129.862 | Required | |
| S06-C13-18 | 376504.036 | 515121.091 | 376504.036 | 515121.091 | Required | |
| S06-C13-19 | 376445.673 | 515111.903 | 376445.673 | 515111.903 | Required | |
| S06-C13-20 | 376445.737 | 515110.737 | 376445.737 | 515110.737 | Required | |
| S06-C13-21 | 376511.894 | 515092.764 | 376511.894 | 515092.764 | Required | |
| Outfall 13 | 376575.435 | 515039.579 | | | No Entry | |



## Area Summary for Catchment 13 - Ch 45700

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | User | - | 50 | 0.009 | 0.004 | 0.004 |
| | User | - | 30 | 0.043 | 0.013 | 0.017 |
| | User | - | 100 | 0.052 | 0.052 | 0.070 |
| 1.001 | User | - | 50 | 0.006 | 0.003 | 0.003 |
| | User | - | 100 | 0.017 | 0.017 | 0.020 |
| 1.002 | User | - | 100 | 0.020 | 0.020 | 0.020 |
| | User | - | 50 | 0.008 | 0.004 | 0.024 |
| | User | - | 30 | 0.063 | 0.019 | 0.043 |
| 1.003 | User | - | 100 | 0.041 | 0.041 | 0.041 |
| | User | - | 50 | 0.010 | 0.005 | 0.046 |
| | User | - | 30 | 0.071 | 0.021 | 0.067 |
| 1.004 | User | - | 100 | 0.047 | 0.047 | 0.047 |
| | User | - | 50 | 0.008 | 0.004 | 0.051 |
| | User | - | 30 | 0.044 | 0.013 | 0.064 |
| 1.005 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 2.000 | User | - | 100 | 0.039 | 0.039 | 0.039 |
| | User | - | 50 | 0.014 | 0.007 | 0.046 |
| | User | - | 30 | 0.026 | 0.008 | 0.053 |
| 3.000 | User | - | 100 | 0.039 | 0.039 | 0.039 |
| | User | - | 50 | 0.014 | 0.007 | 0.047 |
| | User | - | 30 | 0.084 | 0.025 | 0.072 |
| 4.000 | User | - | 50 | 0.010 | 0.005 | 0.005 |
| | User | - | 30 | 0.046 | 0.014 | 0.019 |
| 4.001 | User | - | 100 | 0.014 | 0.014 | 0.014 |
| 4.002 | User | - | 100 | 0.005 | 0.005 | 0.005 |
| | User | - | 50 | 0.004 | 0.002 | 0.007 |
| | User | - | 50 | 0.012 | 0.006 | 0.013 |
| 4.003 | User | - | 100 | 0.016 | 0.016 | 0.016 |
| | User | - | 30 | 0.020 | 0.006 | 0.022 |
| | User | - | 50 | 0.002 | 0.001 | 0.023 |
| 4.004 | User | - | 30 | 0.012 | 0.004 | 0.004 |
| | User | - | 50 | 0.001 | 0.001 | 0.004 |
| | User | - | 100 | 0.005 | 0.005 | 0.009 |
| 3.001 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 2.001 | User | - | 100 | 0.018 | 0.018 | 0.018 |
| | User | - | 50 | 0.003 | 0.001 | 0.019 |
| | User | - | 30 | 0.010 | 0.003 | 0.022 |
| 2.002 | User | - | 100 | 0.028 | 0.028 | 0.028 |
| | User | - | 50 | 0.009 | 0.005 | 0.033 |
| | User | - | 30 | 0.030 | 0.009 | 0.042 |
| 2.003 | User | - | 50 | 0.005 | 0.002 | 0.002 |
| | User | - | 30 | 0.002 | 0.001 | 0.003 |
| 2.004 | User | - | 50 | 0.009 | 0.004 | 0.004 |
| | User | - | 30 | 0.003 | 0.001 | 0.005 |
| 1.006 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.007 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.008 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total | Total | Total |
| | | | | 0.919 | 0.539 | 0.539 |

## Online Controls for Catchment 13 - Ch 45700

### Hydro-Brake® Optimum Manhole: S06-C13-21, DS/PN: 1.008, Volume ($m^3$): 9.3

| | |
|---|---|
| Unit Reference | MD-SHE-0120-6600-1000-6600 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 6.6 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 120 |
| Invert Level (m) | 152.087 |
| Minimum Outlet Pipe Diameter (mm) | 150 |
| Suggested Manhole Diameter (mm) | 1200 |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.000 | 6.6 | Kick-Flo® | 0.652 | 5.4 |
| Flush-Flo™ | 0.299 | 6.6 | Mean Flow over Head Range | - | 5.7 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 4.3 | 0.800 | 5.9 | 2.000 | 9.1 | 4.000 | 12.7 | 7.000 | 16.6 |
| 0.200 | 6.4 | 1.000 | 6.6 | 2.200 | 9.6 | 4.500 | 13.4 | 7.500 | 17.1 |
| 0.300 | 6.6 | 1.200 | 7.2 | 2.400 | 10.0 | 5.000 | 14.1 | 8.000 | 17.7 |
| 0.400 | 6.5 | 1.400 | 7.7 | 2.600 | 10.3 | 5.500 | 14.8 | 8.500 | 18.2 |
| 0.500 | 6.3 | 1.600 | 8.2 | 3.000 | 11.1 | 6.000 | 15.4 | 9.000 | 18.7 |
| 0.600 | 5.9 | 1.800 | 8.7 | 3.500 | 11.9 | 6.500 | 16.0 | 9.500 | 19.2 |

## Offline Controls for Catchment 13 - Ch 45700

### Weir Manhole: S06-C13-21, DS/PN: 1.008, Loop to PN: None

Discharge Coef 0.544 Width (m) 10.000 Invert Level (m) 153.087

## Storage Structures for Catchment 13 - Ch 45700

### Tank or Pond Manhole: S06-C13-21, DS/PN: 1.008

Invert Level (m) 152.087

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|---|---|---|---|
| 0.000 | 370.2 | 1.000 | 693.8 | 1.001 | 801.7 | 1.280 | 1342.0 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 13 - Ch 45700

### Simulation Criteria

Areal Reduction Factor 1.000    Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0    MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0    Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500    Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0    Number of Offline Controls 1    Number of Time/Area Diagrams 0
Number of Online Controls 1    Number of Storage Structures 1    Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR    M5-60 (mm) 20.000    Cv (Summer) 0.750
Region England and Wales    Ratio R 0.300    Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C13-1 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 164.657 | 0.075 | 0.000 |
| 1.001 | S06-C13-2 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 164.411 | 0.099 | 0.000 |
| 1.002 | S06-C13-3 | 15 Winter | 5 | +20% | | | | | 163.835 | -0.079 | 0.000 |
| 1.003 | S06-C13-4 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 157.865 | -0.123 | 0.000 |
| 1.004 | S06-C13-5 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 155.228 | -0.111 | 0.000 |
| 1.005 | S06-C13-6 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 152.857 | 0.138 | 0.000 |
| 2.000 | S06-C13-7 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 160.755 | -0.061 | 0.000 |
| 3.000 | S06-C13-8 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 160.497 | -0.040 | 0.000 |
| 4.000 | S06-C13-9 | 15 Winter | 5 | +20% | | | | | 164.435 | -0.117 | 0.000 |
| 4.001 | S06-C13-10 | 15 Winter | 5 | +20% | | | | | 162.726 | -0.107 | 0.000 |
| 4.002 | S06-C13-11 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 160.296 | -0.060 | 0.000 |
| 4.003 | S06-C13-12 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 160.128 | -0.088 | 0.000 |
| 4.004 | S06-C13-13 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 159.085 | 0.027 | 0.000 |
| 3.001 | S06-C13-14 | 15 Winter | 5 | +20% | 5/15 Winter | | | | 158.997 | 0.009 | 0.000 |
| 2.001 | S06-C13-15 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 158.860 | -0.061 | 0.000 |
| 2.002 | S06-C13-16 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 158.510 | -0.090 | 0.000 |
| 2.003 | S06-C13-17 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 156.488 | -0.089 | 0.000 |
| 2.004 | S06-C13-18 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 155.340 | -0.102 | 0.000 |
| 1.006 | S06-C13-19 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 152.782 | 0.103 | 0.000 |
| 1.007 | S06-C13-20 | 15 Winter | 5 | +20% | 5/15 Winter | | | | 152.695 | 0.020 | 0.000 |
| 1.008 | S06-C13-21 | 360 Winter | 5 | +20% | 100/30 Winter | | | 0 | 152.375 | -0.086 | 0.000 |

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 1.000 | S06-C13-1 | 0.97 | | | 16.3 | SURCHARGED | 4 |
| 1.001 | S06-C13-2 | 1.12 | | | 19.1 | SURCHARGED | |
| 1.002 | S06-C13-3 | 0.45 | | | 27.2 | OK | |
| 1.003 | S06-C13-4 | 0.42 | | | 41.1 | OK | |
| 1.004 | S06-C13-5 | 0.50 | | | 54.1 | OK | |
| 1.005 | S06-C13-6 | 0.96 | | | 53.2 | SURCHARGED | |
| 2.000 | S06-C13-7 | 0.64 | | | 13.3 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 13 - Ch 45700

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 3.000 | S06-C13-8 | 0.87 | | | 17.9 | OK | 4 |
| 4.000 | S06-C13-9 | 0.11 | | | 4.8 | OK | |
| 4.001 | S06-C13-10 | 0.18 | | | 7.9 | OK | |
| 4.002 | S06-C13-11 | 0.66 | | | 10.7 | OK | |
| 4.003 | S06-C13-12 | 0.36 | | | 15.7 | OK | |
| 4.004 | S06-C13-13 | 1.15 | | | 17.5 | SURCHARGED | |
| 3.001 | S06-C13-14 | 1.04 | | | 35.3 | SURCHARGED | |
| 2.001 | S06-C13-15 | 0.87 | | | 53.3 | OK | |
| 2.002 | S06-C13-16 | 0.67 | | | 61.0 | OK | |
| 2.003 | S06-C13-17 | 0.67 | | | 61.3 | OK | |
| 2.004 | S06-C13-18 | 0.57 | | | 62.1 | OK | |
| 1.006 | S06-C13-19 | 1.26 | | | 114.2 | SURCHARGED | |
| 1.007 | S06-C13-20 | 1.06 | | | 110.9 | SURCHARGED | |
| 1.008 | S06-C13-21 | 0.06 | 0.0 | | 6.6 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 13 - Ch 45700

### Simulation Criteria

Areal Reduction Factor 1.000
Hot Start (mins) 0
Hot Start Level (mm) 0
Manhole Headloss Coeff (Global) 0.500
Foul Sewage per hectare (l/s) 0.000
Additional Flow - % of Total Flow 0.000
MADD Factor * 10m³/ha Storage 0.000
Inlet Coeffiecient 0.800
Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0
Number of Online Controls 1
Number of Offline Controls 1
Number of Storage Structures 1
Number of Time/Area Diagrams 0
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
Region England and Wales
M5-60 (mm) 20.000
Ratio R 0.300
Cv (Summer) 0.750
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C13-1 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 165.784 | 1.202 | 2.303 |
| 1.001 | S06-C13-2 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 165.357 | 1.045 | 0.000 |
| 1.002 | S06-C13-3 | 15 Winter | 100 | +40% | | | | | 163.878 | -0.036 | 0.000 |
| 1.003 | S06-C13-4 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 158.407 | 0.419 | 0.000 |
| 1.004 | S06-C13-5 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 156.462 | 1.123 | 0.000 |
| 1.005 | S06-C13-6 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 153.691 | 0.972 | 0.000 |
| 2.000 | S06-C13-7 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 161.594 | 0.778 | 0.000 |
| 3.000 | S06-C13-8 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 161.738 | 1.202 | 1.761 |
| 4.000 | S06-C13-9 | 15 Winter | 100 | +40% | | | | | 164.452 | -0.099 | 0.000 |
| 4.001 | S06-C13-10 | 15 Winter | 100 | +40% | | | | | 162.752 | -0.081 | 0.000 |
| 4.002 | S06-C13-11 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 160.870 | 0.514 | 0.000 |
| 4.003 | S06-C13-12 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 160.633 | 0.418 | 0.000 |
| 4.004 | S06-C13-13 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 160.140 | 1.082 | 0.000 |
| 3.001 | S06-C13-14 | 15 Winter | 100 | +40% | 5/15 Winter | | | | 159.853 | 0.865 | 0.000 |
| 2.001 | S06-C13-15 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 159.675 | 0.754 | 0.000 |
| 2.002 | S06-C13-16 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 159.069 | 0.469 | 0.000 |
| 2.003 | S06-C13-17 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 156.866 | 0.290 | 0.000 |
| 2.004 | S06-C13-18 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 155.630 | 0.188 | 0.000 |
| 1.006 | S06-C13-19 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 153.509 | 0.830 | 0.000 |
| 1.007 | S06-C13-20 | 15 Winter | 100 | +40% | 5/15 Winter | | | | 153.242 | 0.566 | 0.000 |
| 1.008 | S06-C13-21 | 480 Winter | 100 | +40% | 100/30 Winter | | | 0 | 152.793 | 0.332 | 0.000 |

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 1.000 | S06-C13-1 | 1.58 | | | 26.6 | FLOOD | 4 |
| 1.001 | S06-C13-2 | 1.87 | | | 32.0 | SURCHARGED | |
| 1.002 | S06-C13-3 | 0.89 | | | 53.9 | OK | |
| 1.003 | S06-C13-4 | 0.88 | | | 86.8 | SURCHARGED | |
| 1.004 | S06-C13-5 | 1.03 | | | 110.5 | FLOOD RISK | |
| 1.005 | S06-C13-6 | 1.96 | | | 108.9 | FLOOD RISK | |
| 2.000 | S06-C13-7 | 1.19 | | | 24.6 | SURCHARGED | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 13 - Ch 45700

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 3.000 | S06-C13-8 | 1.24 | | | 25.6 | FLOOD | 4 |
| 4.000 | S06-C13-9 | 0.25 | | | 10.7 | OK | |
| 4.001 | S06-C13-10 | 0.43 | | | 19.2 | OK | |
| 4.002 | S06-C13-11 | 1.42 | | | 23.2 | SURCHARGED | |
| 4.003 | S06-C13-12 | 0.74 | | | 32.3 | SURCHARGED | |
| 4.004 | S06-C13-13 | 2.15 | | | 32.6 | FLOOD RISK | |
| 3.001 | S06-C13-14 | 1.73 | | | 58.5 | SURCHARGED | |
| 2.001 | S06-C13-15 | 1.41 | | | 85.8 | SURCHARGED | |
| 2.002 | S06-C13-16 | 1.06 | | | 97.2 | SURCHARGED | |
| 2.003 | S06-C13-17 | 1.05 | | | 95.8 | SURCHARGED | |
| 2.004 | S06-C13-18 | 0.92 | | | 100.3 | SURCHARGED | |
| 1.006 | S06-C13-19 | 2.23 | | | 202.7 | SURCHARGED | |
| 1.007 | S06-C13-20 | 1.90 | | | 199.7 | SURCHARGED | |
| 1.008 | S06-C13-21 | 0.06 | 0.0 | | 6.6 | SURCHARGED | |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for Catchment 14 - Ch 45950

Pipe Sizes Min 150 Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 20.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

## Network Design Table for Catchment 14 - Ch 45950

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 86.053 | 0.512 | 167.9 | 0.154 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.001 | 105.089 | 0.447 | 235.3 | 0.177 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.002 | 76.901 | 0.900 | 85.4 | 0.121 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.003 | 85.899 | 1.500 | 57.3 | 0.139 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.004 | 90.734 | 0.307 | 295.6 | 0.153 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 1.005 | 85.940 | 1.188 | 72.4 | 0.144 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 1.006 | 92.709 | 1.190 | 77.9 | 0.162 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 1.007 | 91.232 | 0.237 | 385.0 | 0.137 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 1.008 | 91.127 | 0.242 | 377.3 | 0.122 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 1.009 | 58.828 | 6.778 | 8.7 | 0.096 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 2.000 | 90.421 | 3.856 | 23.4 | 0.244 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.001 | 78.563 | 0.815 | 96.4 | 0.120 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 2.002 | 92.191 | 0.382 | 241.2 | 0.026 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 2.003 | 109.437 | 5.058 | 21.6 | 0.087 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 2.004 | 80.771 | 0.262 | 307.8 | 0.198 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 2.005 | 94.149 | 6.918 | 13.6 | 0.157 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 2.006 | 15.040 | 0.464 | 32.4 | 0.019 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 2.007 | 41.956 | 1.000 | 42.0 | 0.067 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 70.85 | 6.43 | 169.234 | 0.154 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 29.6 |
| 1.001 | 63.86 | 8.14 | 168.647 | 0.331 | 0.0 | 0.0 | 0.0 | 1.02 | 72.1 | 57.2 |
| 1.002 | 61.29 | 8.89 | 168.200 | 0.452 | 0.0 | 0.0 | 0.0 | 1.70 | 120.3 | 75.1 |
| 1.003 | 59.16 | 9.58 | 167.300 | 0.591 | 0.0 | 0.0 | 0.0 | 2.08 | 147.2 | 94.7 |
| 1.004 | 55.23 | 11.02 | 165.725 | 0.745 | 0.0 | 0.0 | 0.0 | 1.05 | 115.8 | 111.4 |
| 1.005 | 53.60 | 11.70 | 165.418 | 0.889 | 0.0 | 0.0 | 0.0 | 2.13 | 235.5 | 129.1 |
| 1.006 | 51.92 | 12.45 | 164.230 | 1.051 | 0.0 | 0.0 | 0.0 | 2.05 | 226.9 | 147.8 |
| 1.007 | 48.96 | 13.92 | 162.966 | 1.188 | 0.0 | 0.0 | 0.0 | 1.03 | 163.8 | 157.5 |
| 1.008 | 46.41 | 15.38 | 162.729 | 1.310 | 0.0 | 0.0 | 0.0 | 1.04 | 165.5 | 164.6 |
| 1.009 | 46.18 | 15.53 | 162.487 | 1.406 | 0.0 | 0.0 | 0.0 | 6.93 | 1102.5 | 175.8 |
| 2.000 | 75.18 | 5.56 | 174.931 | 0.244 | 0.0 | 0.0 | 0.0 | 2.71 | 107.9 | 49.7 |
| 2.001 | 71.09 | 6.37 | 171.000 | 0.364 | 0.0 | 0.0 | 0.0 | 1.60 | 113.2 | 70.0 |
| 2.002 | 64.75 | 7.90 | 170.185 | 0.390 | 0.0 | 0.0 | 0.0 | 1.01 | 71.2 | 70.0 |
| 2.003 | 62.83 | 8.43 | 169.803 | 0.477 | 0.0 | 0.0 | 0.0 | 3.39 | 240.0 | 81.1 |
| 2.004 | 58.68 | 9.74 | 164.669 | 0.674 | 0.0 | 0.0 | 0.0 | 1.03 | 113.5 | 107.2 |
| 2.005 | 57.77 | 10.06 | 164.407 | 0.831 | 0.0 | 0.0 | 0.0 | 4.93 | 544.9 | 130.1 |
| 2.006 | 57.56 | 10.14 | 157.489 | 0.850 | 0.0 | 0.0 | 0.0 | 3.19 | 352.7 | 132.5 |
| 2.007 | 56.87 | 10.39 | 157.025 | 0.917 | 0.0 | 0.0 | 0.0 | 2.80 | 309.7 | 141.2 |

## Network Design Table for Catchment 14 - Ch 45950

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.008 | 11.231 | 0.051 | 221.2 | 0.011 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 3.000 | 69.051 | 10.833 | 6.4 | 0.078 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 4.000 | 14.594 | 9.876 | 1.5 | 0.016 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 3.001 | 8.815 | 0.151 | 58.5 | 0.000 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 2.009 | 70.206 | 0.190 | 369.2 | 0.109 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 1.010 | 27.175 | 1.644 | 16.5 | 0.000 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 5.000 | 89.177 | 4.914 | 18.1 | 0.095 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 5.001 | 99.759 | 0.595 | 167.7 | 0.101 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 5.002 | 49.709 | 0.348 | 142.7 | 0.052 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 5.003 | 15.660 | 0.065 | 242.2 | 0.013 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 5.004 | 89.263 | 0.368 | 242.2 | 0.105 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 5.005 | 90.177 | 0.372 | 242.2 | 0.105 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 5.006 | 88.912 | 0.277 | 321.4 | 0.108 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 5.007 | 84.447 | 1.881 | 44.9 | 0.145 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 5.008 | 85.447 | 1.346 | 63.5 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 5.009 | 76.516 | 0.249 | 307.8 | 0.144 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 5.010 | 30.413 | 0.101 | 301.7 | 0.045 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 5.011 | 74.168 | 4.938 | 15.0 | 0.085 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 6.000 | 91.856 | 0.910 | 100.9 | 0.086 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 6.001 | 56.398 | 0.336 | 167.9 | 0.091 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 6.002 | 15.488 | 0.092 | 167.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2.008 | 56.51 | 10.53 | 155.950 | 0.927 | 0.0 | 0.0 | 0.0 | 1.36 | 216.8 | 141.9 |
| 3.000 | 76.66 | 5.29 | 167.183 | 0.078 | 0.0 | 0.0 | 0.0 | 4.02 | 71.0 | 16.3 |
| 4.000 | 78.14 | 5.03 | 166.226 | 0.016 | 0.0 | 0.0 | 0.0 | 8.36 | 147.7 | 3.5 |
| 3.001 | 76.04 | 5.40 | 156.350 | 0.095 | 0.0 | 0.0 | 0.0 | 1.32 | 23.3 | 19.5 |
| 2.009 | 53.73 | 11.64 | 155.899 | 1.131 | 0.0 | 0.0 | 0.0 | 1.05 | 167.3 | 164.6 |
| 1.010 | 46.03 | 15.62 | 155.709 | 2.537 | 0.0 | 0.0 | 0.0 | 5.02 | 798.2 | 316.3 |
| 5.000 | 74.81 | 5.63 | 169.819 | 0.095 | 0.0 | 0.0 | 0.0 | 2.38 | 42.0 | 19.1 |
| 5.001 | 67.16 | 7.28 | 164.830 | 0.196 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 35.6 |
| 5.002 | 64.24 | 8.04 | 164.235 | 0.248 | 0.0 | 0.0 | 0.0 | 1.09 | 43.4 | 43.2 |
| 5.003 | 63.31 | 8.29 | 163.811 | 0.261 | 0.0 | 0.0 | 0.0 | 1.01 | 71.1 | 44.8 |
| 5.004 | 58.60 | 9.77 | 163.747 | 0.366 | 0.0 | 0.0 | 0.0 | 1.01 | 71.1 | 58.1 |
| 5.005 | 54.62 | 11.27 | 163.378 | 0.471 | 0.0 | 0.0 | 0.0 | 1.01 | 71.1 | 69.7 |
| 5.006 | 51.29 | 12.74 | 162.931 | 0.579 | 0.0 | 0.0 | 0.0 | 1.01 | 111.0 | 80.4 |
| 5.007 | 50.23 | 13.26 | 162.654 | 0.724 | 0.0 | 0.0 | 0.0 | 2.71 | 299.3 | 98.5 |
| 5.008 | 49.03 | 13.89 | 160.774 | 0.724 | 0.0 | 0.0 | 0.0 | 2.28 | 251.5 | 98.5 |
| 5.009 | 46.83 | 15.13 | 159.428 | 0.868 | 0.0 | 0.0 | 0.0 | 1.03 | 113.5 | 110.1 |
| 5.010 | 46.03 | 15.62 | 159.180 | 0.914 | 0.0 | 0.0 | 0.0 | 1.04 | 114.6 | 113.9 |
| 5.011 | 45.61 | 15.88 | 159.079 | 0.998 | 0.0 | 0.0 | 0.0 | 4.70 | 518.6 | 123.3 |
| 6.000 | 70.36 | 6.53 | 171.750 | 0.086 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 16.4 |
| 6.001 | 66.40 | 7.46 | 170.765 | 0.177 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 31.8 |
| 6.002 | 65.41 | 7.72 | 170.429 | 0.177 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 31.8 |

## Network Design Table for Catchment 14 - Ch 45950

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 7.000 | 92.899 | 0.921 | 100.9 | 0.051 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 7.001 | 68.234 | 0.911 | 74.9 | 0.039 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 6.003 | 79.718 | 1.867 | 42.7 | 0.187 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 6.004 | 99.348 | 2.832 | 35.1 | 0.212 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 6.005 | 48.883 | 3.722 | 13.1 | 0.082 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 8.000 | 107.529 | 1.041 | 103.3 | 0.107 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 8.001 | 100.017 | 1.916 | 52.2 | 0.115 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 8.002 | 37.875 | 1.174 | 32.3 | 0.045 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 8.003 | 18.959 | 6.582 | 2.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 6.006 | 48.883 | 0.149 | 327.1 | 0.077 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 6.007 | 101.476 | 3.818 | 26.6 | 0.124 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 6.008 | 100.227 | 3.573 | 28.0 | 0.117 | 0.00 | 0.0 | 0.600 | o | 450 | Pipe/Conduit | 🔓 |
| 6.009 | 41.489 | 0.085 | 490.6 | 0.048 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| 1.011 | 7.661 | 0.015 | 500.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 825 | Pipe/Conduit | 🔓 |
| 1.012 | 207.380 | 0.415 | 500.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 825 | Pipe/Conduit | 🔓 |
| 1.013 | 80.881 | 4.377 | 18.5 | 0.000 | 0.00 | 0.0 | 0.600 | o | 825 | Pipe/Conduit | 🔓 |
| 1.014 | 59.215 | 0.118 | 500.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 825 | Pipe/Conduit | 🔓 |
| 1.015 | 132.686 | 0.265 | 500.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 825 | Pipe/Conduit | 🔓 |
| 1.016 | 296.649 | 3.000 | 98.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 825 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 7.000 | 70.28 | 6.55 | 172.243 | 0.051 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 9.7 |
| 7.001 | 66.16 | 7.53 | 171.322 | 0.090 | 0.0 | 0.0 | 0.0 | 1.16 | 20.5 | 16.1 |
| 6.003 | 63.01 | 8.38 | 170.337 | 0.454 | 0.0 | 0.0 | 0.0 | 2.01 | 79.8 | 77.5 |
| 6.004 | 60.94 | 9.01 | 168.395 | 0.667 | 0.0 | 0.0 | 0.0 | 2.66 | 188.3 | 110.0 |
| 6.005 | 60.35 | 9.19 | 165.563 | 0.749 | 0.0 | 0.0 | 0.0 | 4.36 | 308.3 | 122.4 |
| 8.000 | 71.00 | 6.39 | 172.630 | 0.107 | 0.0 | 0.0 | 0.0 | 1.29 | 51.1 | 20.6 |
| 8.001 | 67.01 | 7.31 | 171.589 | 0.222 | 0.0 | 0.0 | 0.0 | 1.81 | 72.2 | 40.4 |
| 8.002 | 65.93 | 7.59 | 169.672 | 0.267 | 0.0 | 0.0 | 0.0 | 2.31 | 91.9 | 47.7 |
| 8.003 | 65.77 | 7.63 | 168.499 | 0.267 | 0.0 | 0.0 | 0.0 | 7.77 | 308.8 | 47.7 |
| 6.006 | 58.18 | 9.92 | 161.691 | 1.093 | 0.0 | 0.0 | 0.0 | 1.12 | 177.9 | 172.2 |
| 6.007 | 56.99 | 10.35 | 161.542 | 1.216 | 0.0 | 0.0 | 0.0 | 3.96 | 629.2 | 187.7 |
| 6.008 | 55.84 | 10.78 | 157.723 | 1.333 | 0.0 | 0.0 | 0.0 | 3.85 | 612.4 | 201.6 |
| 6.009 | 54.14 | 11.47 | 154.075 | 1.381 | 0.0 | 0.0 | 0.0 | 1.00 | 217.4 | 202.5 |
| 1.011 | 45.46 | 15.98 | 153.690 | 4.916 | 0.0 | 0.0 | 0.0 | 1.32 | 706.1 | 605.3 |
| 1.012 | 41.80 | 18.59 | 153.675 | 4.916 | 0.0 | 0.0 | 0.0 | 1.32 | 706.1 | 605.3 |
| 1.013 | 41.55 | 18.79 | 153.260 | 4.916 | 0.0 | 0.0 | 0.0 | 6.92 | 3701.5 | 605.3 |
| 1.014 | 40.65 | 19.54 | 148.884 | 4.916 | 0.0 | 0.0 | 0.0 | 1.32 | 706.1 | 605.3 |
| 1.015 | 38.78 | 21.21 | 148.765 | 4.916 | 0.0 | 0.0 | 0.0 | 1.32 | 706.1 | 605.3 |
| 1.016 | 37.13 | 22.87 | 148.500 | 4.916 | 0.0 | 0.0 | 0.0 | 2.99 | 1596.2 | 605.3 |

## Manhole Schedules for Catchment 14 - Ch 45950

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C14-1 | 170.659 | 1.425 | Open Manhole | 1200 | 1.000 | 169.234 | 225 | | | | |
| S06-C14-2 | 170.387 | 1.741 | Open Manhole | 1200 | 1.001 | 168.647 | 300 | 1.000 | 168.722 | 225 | |
| S06-C14-3 | 169.700 | 1.500 | Open Manhole | 1200 | 1.002 | 168.200 | 300 | 1.001 | 168.200 | 300 | |
| S06-C14-4 | 168.800 | 1.500 | Open Manhole | 1200 | 1.003 | 167.300 | 300 | 1.002 | 167.300 | 300 | |
| S06-C14-5 | 167.300 | 1.575 | Open Manhole | 1350 | 1.004 | 165.725 | 375 | 1.003 | 165.800 | 300 | |
| S06-C14-6 | 167.854 | 2.436 | Open Manhole | 1350 | 1.005 | 165.418 | 375 | 1.004 | 165.418 | 375 | |
| S06-C14-7 | 165.805 | 1.575 | Open Manhole | 1350 | 1.006 | 164.230 | 375 | 1.005 | 164.230 | 375 | |
| S06-C14-8 | 164.616 | 1.650 | Open Manhole | 1350 | 1.007 | 162.966 | 450 | 1.006 | 163.041 | 375 | |
| S06-C14-9 | 165.654 | 2.925 | Open Manhole | 1350 | 1.008 | 162.729 | 450 | 1.007 | 162.729 | 450 | |
| S06-C14-10 | 166.657 | 4.170 | Open Manhole | 1350 | 1.009 | 162.487 | 450 | 1.008 | 162.487 | 450 | |
| S06-C14-11 | 176.356 | 1.425 | Open Manhole | 1200 | 2.000 | 174.931 | 225 | | | | |
| S06-C14-12 | 172.500 | 1.500 | Open Manhole | 1200 | 2.001 | 171.000 | 300 | 2.000 | 171.075 | 225 | |
| S06-C14-13 | 171.685 | 1.500 | Open Manhole | 1200 | 2.002 | 170.185 | 300 | 2.001 | 170.185 | 300 | |
| S06-C14-14 | 172.194 | 2.391 | Open Manhole | 1200 | 2.003 | 169.803 | 300 | 2.002 | 169.803 | 300 | |
| S06-C14-15 | 166.244 | 1.575 | Open Manhole | 1350 | 2.004 | 164.669 | 375 | 2.003 | 164.744 | 300 | |
| S06-C14-16 | 170.232 | 5.825 | Open Manhole | 1350 | 2.005 | 164.407 | 375 | 2.004 | 164.407 | 375 | |
| S06-C14-17 | 159.064 | 1.575 | Open Manhole | 1350 | 2.006 | 157.489 | 375 | 2.005 | 157.489 | 375 | |
| S06-C14-18 | 158.600 | 1.575 | Open Manhole | 1350 | 2.007 | 157.025 | 375 | 2.006 | 157.025 | 375 | |
| S06-C14-19 | 157.600 | 1.650 | Open Manhole | 1350 | 2.008 | 155.950 | 450 | 2.007 | 156.025 | 375 | |
| S06-C14-20 | 168.533 | 1.350 | Open Manhole | 1200 | 3.000 | 167.183 | 150 | | | | |
| S06-C14-21 | 167.576 | 1.350 | Open Manhole | 1200 | 4.000 | 166.226 | 150 | | | | |
| S06-C14-22 | 157.700 | 1.350 | Open Manhole | 1200 | 3.001 | 156.350 | 150 | 3.000 | 156.350 | 150 | |
| | | | | | | | | 4.000 | 156.350 | 150 | |
| S06-C14-23 | 157.549 | 1.650 | Open Manhole | 1350 | 2.009 | 155.899 | 450 | 2.008 | 155.899 | 450 | |
| | | | | | | | | 3.001 | 156.199 | 150 | |
| S06-C14-24 | 167.864 | 12.155 | Open Manhole | 1350 | 1.010 | 155.709 | 450 | 1.009 | 155.709 | 450 | |
| | | | | | | | | 2.009 | 155.709 | 450 | |
| S06-C14-25 | 171.169 | 1.350 | Open Manhole | 1200 | 5.000 | 169.819 | 150 | | | | |
| S06-C14-26 | 166.255 | 1.425 | Open Manhole | 1200 | 5.001 | 164.830 | 225 | 5.000 | 164.905 | 150 | |
| S06-C14-27 | 166.896 | 2.661 | Open Manhole | 1200 | 5.002 | 164.235 | 225 | 5.001 | 164.235 | 225 | |
| S06-C14-28 | 166.853 | 3.041 | Open Manhole | 1200 | 5.003 | 163.811 | 300 | 5.002 | 163.886 | 225 | |
| S06-C14-29 | 166.270 | 2.523 | Open Manhole | 1200 | 5.004 | 163.747 | 300 | 5.003 | 163.747 | 300 | |
| S06-C14-30 | 166.691 | 3.313 | Open Manhole | 1200 | 5.005 | 163.378 | 300 | 5.004 | 163.378 | 300 | |
| S06-C14-31 | 165.795 | 2.864 | Open Manhole | 1350 | 5.006 | 162.931 | 375 | 5.005 | 163.006 | 300 | |
| S06-C14-32 | 164.294 | 1.640 | Open Manhole | 1350 | 5.007 | 162.654 | 375 | 5.006 | 162.654 | 375 | |
| S06-C14-33 | 162.349 | 1.575 | Open Manhole | 1350 | 5.008 | 160.774 | 375 | 5.007 | 160.774 | 375 | |
| S06-C14-34 | 161.003 | 1.575 | Open Manhole | 1350 | 5.009 | 159.428 | 375 | 5.008 | 159.428 | 375 | |
| S06-C14-35 | 162.761 | 3.581 | Open Manhole | 1350 | 5.010 | 159.180 | 375 | 5.009 | 159.180 | 375 | |
| S06-C14-36 | 163.048 | 3.969 | Open Manhole | 1350 | 5.011 | 159.079 | 375 | 5.010 | 159.079 | 375 | |
| S06-C14-37 | 173.100 | 1.350 | Open Manhole | 1200 | 6.000 | 171.750 | 150 | | | | |
| S06-C14-38 | 172.700 | 1.935 | Open Manhole | 1200 | 6.001 | 170.765 | 225 | 6.000 | 170.840 | 150 | |
| S06-C14-39 | 172.028 | 1.599 | Open Manhole | 1200 | 6.002 | 170.429 | 225 | 6.001 | 170.429 | 225 | |
| S06-C14-40 | 173.593 | 1.350 | Open Manhole | 1200 | 7.000 | 172.243 | 150 | | | | |
| S06-C14-41 | 172.840 | 1.518 | Open Manhole | 1200 | 7.001 | 171.322 | 150 | 7.000 | 171.322 | 150 | |
| S06-C14-42 | 171.802 | 1.466 | Open Manhole | 1200 | 6.003 | 170.337 | 225 | 6.002 | 170.337 | 225 | |
| | | | | | | | | 7.001 | 170.412 | 150 | |
| S06-C14-43 | 169.895 | 1.500 | Open Manhole | 1200 | 6.004 | 168.395 | 300 | 6.003 | 168.470 | 225 | |
| S06-C14-44 | 167.063 | 1.500 | Open Manhole | 1200 | 6.005 | 165.563 | 300 | 6.004 | 165.563 | 300 | |

## Manhole Schedules for Catchment 14 - Ch 45950

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | Pipe Out PN | Pipe Out Invert Level (m) | Pipe Out Diameter (mm) | Pipes In PN | Pipes In Invert Level (m) | Pipes In Diameter (mm) | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C14-45 | 174.055 | 1.425 | Open Manhole | 1200 | 8.000 | 172.630 | 225 | | | | |
| S06-C14-46 | 173.014 | 1.425 | Open Manhole | 1200 | 8.001 | 171.589 | 225 | 8.000 | 171.589 | 225 | |
| S06-C14-47 | 171.097 | 1.425 | Open Manhole | 1200 | 8.002 | 169.672 | 225 | 8.001 | 169.672 | 225 | |
| S06-C14-48 | 169.924 | 1.425 | Open Manhole | 1200 | 8.003 | 168.499 | 225 | 8.002 | 168.499 | 225 | |
| S06-C14-49 | 163.341 | 1.650 | Open Manhole | 1350 | 6.006 | 161.691 | 450 | 6.005 | 161.841 | 300 | |
| | | | | | | | | 8.003 | 161.916 | 225 | |
| S06-C14-50 | 163.341 | 1.799 | Open Manhole | 1350 | 6.007 | 161.542 | 450 | 6.006 | 161.542 | 450 | |
| S06-C14-51 | 159.373 | 1.650 | Open Manhole | 1350 | 6.008 | 157.723 | 450 | 6.007 | 157.723 | 450 | |
| S06-C14-52 | 155.800 | 1.725 | Open Manhole | 1500 | 6.009 | 154.075 | 525 | 6.008 | 154.150 | 450 | |
| S06-C14-53 | 155.800 | 2.110 | Open Manhole | 1800 | 1.011 | 153.690 | 825 | 1.010 | 154.065 | 450 | |
| | | | | | | | | 5.011 | 154.140 | 375 | |
| | | | | | | | | 6.009 | 153.990 | 525 | |
| S06-C14-54 | 165.051 | 11.376 | Open Manhole | 1800 | 1.012 | 153.675 | 825 | 1.011 | 153.675 | 825 | |
| S06-C14-55 | 156.466 | 3.206 | Open Manhole | 1800 | 1.013 | 153.260 | 825 | 1.012 | 153.260 | 825 | |
| S06-C14-56 | 150.700 | 1.816 | Open Manhole | 1800 | 1.014 | 148.884 | 825 | 1.013 | 148.884 | 825 | |
| S06-C14-57 | 151.300 | 2.535 | Open Manhole | 1800 | 1.015 | 148.765 | 825 | 1.014 | 148.765 | 825 | |
| S06-C14-58 | 149.780 | 1.280 | Open Manhole | 1800 | 1.016 | 148.500 | 825 | 1.015 | 148.500 | 825 | |
| Outfall 14 | 147.200 | 1.700 | Open Manhole | 0 | | OUTFALL | | 1.016 | 145.500 | 825 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C14-1 | 376447.311 | 515261.482 | 376447.311 | 515261.482 | Required |  |
| S06-C14-2 | 376531.753 | 515245.049 | 376531.753 | 515245.049 | Required |  |
| S06-C14-3 | 376636.204 | 515233.864 | 376636.204 | 515233.864 | Required |  |
| S06-C14-4 | 376712.973 | 515229.368 | 376712.973 | 515229.368 | Required |  |
| S06-C14-5 | 376798.848 | 515227.316 | 376798.848 | 515227.316 | Required |  |
| S06-C14-6 | 376889.571 | 515225.842 | 376889.571 | 515225.842 | Required |  |
| S06-C14-7 | 376975.504 | 515224.801 | 376975.504 | 515224.801 | Required |  |
| S06-C14-8 | 377068.201 | 515223.324 | 377068.201 | 515223.324 | Required |  |
| S06-C14-9 | 377159.424 | 515222.071 | 377159.424 | 515222.071 | Required |  |
| S06-C14-10 | 377250.540 | 515220.631 | 377250.540 | 515220.631 | Required |  |

## Manhole Schedules for Catchment 14 - Ch 45950

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S06-C14-11 | 377989.580 | 515178.967 | 377989.580 | 515178.967 | Required |  |
| S06-C14-12 | 377899.521 | 515187.040 | 377899.521 | 515187.040 | Required |  |
| S06-C14-13 | 377821.593 | 515197.013 | 377821.593 | 515197.013 | Required |  |
| S06-C14-14 | 377730.127 | 515208.554 | 377730.127 | 515208.554 | Required |  |
| S06-C14-15 | 377620.916 | 515215.290 | 377620.916 | 515215.290 | Required |  |
| S06-C14-16 | 377540.234 | 515218.204 | 377540.234 | 515218.204 | Required |  |
| S06-C14-17 | 377446.292 | 515224.462 | 377446.292 | 515224.462 | Required |  |
| S06-C14-18 | 377432.008 | 515229.170 | 377432.008 | 515229.170 | Required |  |
| S06-C14-19 | 377390.054 | 515229.544 | 377390.054 | 515229.544 | Required |  |
| S06-C14-20 | 377448.146 | 515215.836 | 377448.146 | 515215.836 | Required |  |
| S06-C14-21 | 377364.511 | 515216.958 | 377364.511 | 515216.958 | Required |  |
| S06-C14-22 | 377379.105 | 515216.978 | 377379.105 | 515216.978 | Required |  |
| S06-C14-23 | 377379.471 | 515225.785 | 377379.471 | 515225.785 | Required |  |
| S06-C14-24 | 377309.327 | 515222.827 | 377309.327 | 515222.827 | Required |  |
| S06-C14-25 | 376442.287 | 515244.934 | 376442.287 | 515244.934 | Required |  |
| S06-C14-26 | 376529.744 | 515227.671 | 376529.744 | 515227.671 | Required |  |
| S06-C14-27 | 376628.908 | 515217.204 | 376628.908 | 515217.204 | Required |  |
| S06-C14-28 | 376678.575 | 515215.263 | 376678.575 | 515215.263 | Required |  |
| S06-C14-29 | 376690.038 | 515204.595 | 376690.038 | 515204.595 | Required |  |
| S06-C14-30 | 376779.291 | 515203.246 | 376779.291 | 515203.246 | Required |  |

## Manhole Schedules for Catchment 14 - Ch 45950

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C14-31 | 376869.460 | 515202.028 | 376869.460 | 515202.028 | Required |  |
| S06-C14-32 | 376958.330 | 515199.301 | 376958.330 | 515199.301 | Required |  |
| S06-C14-33 | 377042.666 | 515194.979 | 377042.666 | 515194.979 | Required |  |
| S06-C14-34 | 377128.112 | 515194.544 | 377128.112 | 515194.544 | Required |  |
| S06-C14-35 | 377204.620 | 515193.427 | 377204.620 | 515193.427 | Required |  |
| S06-C14-36 | 377234.854 | 515196.722 | 377234.854 | 515196.722 | Required |  |
| S06-C14-37 | 377987.739 | 515156.600 | 377987.739 | 515156.600 | Required |  |
| S06-C14-38 | 377896.371 | 515165.953 | 377896.371 | 515165.953 | Required |  |
| S06-C14-39 | 377840.522 | 515173.806 | 377840.522 | 515173.806 | Required |  |
| S06-C14-40 | 377987.482 | 515144.942 | 377987.482 | 515144.942 | Required |  |
| S06-C14-41 | 377895.043 | 515154.174 | 377895.043 | 515154.174 | Required |  |
| S06-C14-42 | 377827.694 | 515165.127 | 377827.694 | 515165.127 | Required |  |
| S06-C14-43 | 377748.583 | 515174.935 | 377748.583 | 515174.935 | Required |  |
| S06-C14-44 | 377649.714 | 515184.592 | 377649.714 | 515184.592 | Required |  |
| S06-C14-45 | 377856.694 | 515180.101 | 377856.694 | 515180.101 | Required |  |
| S06-C14-46 | 377750.064 | 515193.972 | 377750.064 | 515193.972 | Required |  |
| S06-C14-47 | 377650.390 | 515201.923 | 377650.390 | 515201.923 | Required |  |
| S06-C14-48 | 377612.531 | 515203.058 | 377612.531 | 515203.058 | Required |  |
| S06-C14-49 | 377600.954 | 515188.045 | 377600.954 | 515188.045 | Required |  |
| S06-C14-50 | 377552.142 | 515190.666 | 377552.142 | 515190.666 | Required |  |

## Manhole Schedules for Catchment 14 - Ch 45950

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S06-C14-51 | 377450.712 | 515193.479 | 377450.712 | 515193.479 | Required |  |
| S06-C14-52 | 377350.498 | 515195.099 | 377350.498 | 515195.099 | Required |  |
| S06-C14-53 | 377309.014 | 515195.654 | 377309.014 | 515195.654 | Required |  |
| S06-C14-54 | 377309.020 | 515187.993 | 377309.020 | 515187.993 | Required |  |
| S06-C14-55 | 377152.917 | 515051.471 | 377152.917 | 515051.471 | Required |  |
| S06-C14-56 | 377095.089 | 514994.922 | 377095.089 | 514994.922 | Required |  |
| S06-C14-57 | 377035.885 | 514993.824 | 377035.885 | 514993.824 | Required |  |
| S06-C14-58 | 376914.045 | 515046.366 | 376914.045 | 515046.366 | Required |  |
| Outfall 14 | 376617.625 | 515034.721 | | | No Entry |  |

## Area Summary for Catchment 14 - Ch 45950

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | User | - | 100 | 0.138 | 0.138 | 0.138 |
| | User | - | 30 | 0.013 | 0.004 | 0.142 |
| | User | - | 50 | 0.025 | 0.013 | 0.154 |
| 1.001 | User | - | 100 | 0.162 | 0.162 | 0.162 |
| | User | - | 50 | 0.030 | 0.015 | 0.177 |
| 1.002 | User | - | 100 | 0.105 | 0.105 | 0.105 |
| | User | - | 30 | 0.018 | 0.005 | 0.110 |
| | User | - | 50 | 0.022 | 0.011 | 0.121 |
| 1.003 | User | - | 100 | 0.104 | 0.104 | 0.104 |
| | User | - | 30 | 0.074 | 0.022 | 0.127 |
| | User | - | 50 | 0.025 | 0.012 | 0.139 |
| 1.004 | User | - | 100 | 0.105 | 0.105 | 0.105 |
| | User | - | 30 | 0.117 | 0.035 | 0.140 |
| | User | - | 50 | 0.026 | 0.013 | 0.153 |
| 1.005 | User | - | 100 | 0.099 | 0.099 | 0.099 |
| | User | - | 30 | 0.109 | 0.033 | 0.132 |
| | User | - | 50 | 0.025 | 0.012 | 0.144 |
| 1.006 | User | - | 100 | 0.108 | 0.108 | 0.108 |
| | User | - | 30 | 0.135 | 0.041 | 0.148 |
| | User | - | 50 | 0.027 | 0.013 | 0.162 |
| 1.007 | User | - | 100 | 0.105 | 0.105 | 0.105 |
| | User | - | 30 | 0.064 | 0.019 | 0.124 |
| | User | - | 50 | 0.026 | 0.013 | 0.137 |
| 1.008 | User | - | 100 | 0.105 | 0.105 | 0.105 |
| | User | - | 30 | 0.013 | 0.004 | 0.109 |
| | User | - | 50 | 0.026 | 0.013 | 0.122 |
| 1.009 | User | - | 100 | 0.078 | 0.078 | 0.078 |
| | User | - | 100 | 0.017 | 0.017 | 0.096 |
| 2.000 | User | - | 100 | 0.195 | 0.195 | 0.195 |
| | User | - | 30 | 0.118 | 0.035 | 0.231 |
| | User | - | 50 | 0.027 | 0.013 | 0.244 |
| 2.001 | User | - | 100 | 0.093 | 0.093 | 0.093 |
| | User | - | 30 | 0.051 | 0.015 | 0.109 |
| | User | - | 50 | 0.022 | 0.011 | 0.120 |
| 2.002 | User | - | 30 | 0.041 | 0.012 | 0.012 |
| | User | - | 50 | 0.027 | 0.014 | 0.026 |
| 2.003 | User | - | 30 | 0.237 | 0.071 | 0.071 |
| | User | - | 50 | 0.031 | 0.016 | 0.087 |
| 2.004 | User | - | 100 | 0.088 | 0.088 | 0.088 |
| | User | - | 30 | 0.326 | 0.098 | 0.186 |
| | User | - | 50 | 0.023 | 0.012 | 0.198 |
| 2.005 | User | - | 100 | 0.144 | 0.144 | 0.144 |
| | User | - | 50 | 0.027 | 0.013 | 0.157 |
| 2.006 | User | - | 100 | 0.014 | 0.014 | 0.014 |
| | User | - | 30 | 0.007 | 0.002 | 0.016 |
| | User | - | 50 | 0.005 | 0.003 | 0.019 |
| 2.007 | User | - | 100 | 0.045 | 0.045 | 0.045 |
| | User | - | 30 | 0.004 | 0.001 | 0.046 |
| | User | - | 100 | 0.021 | 0.021 | 0.067 |
| 2.008 | User | - | 100 | 0.008 | 0.008 | 0.008 |
| | User | - | 50 | 0.004 | 0.002 | 0.011 |
| 3.000 | User | - | 100 | 0.078 | 0.078 | 0.078 |
| 4.000 | User | - | 100 | 0.016 | 0.016 | 0.016 |
| 3.001 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 2.009 | User | - | 100 | 0.099 | 0.099 | 0.099 |
| | User | - | 50 | 0.020 | 0.010 | 0.109 |
| 1.010 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 5.000 | User | - | 100 | 0.095 | 0.095 | 0.095 |
| 5.001 | User | - | 100 | 0.101 | 0.101 | 0.101 |
| 5.002 | User | - | 100 | 0.052 | 0.052 | 0.052 |
| 5.003 | User | - | 100 | 0.013 | 0.013 | 0.013 |
| 5.004 | User | - | 100 | 0.105 | 0.105 | 0.105 |
| 5.005 | User | - | 100 | 0.105 | 0.105 | 0.105 |
| 5.006 | User | - | 100 | 0.108 | 0.108 | 0.108 |
| 5.007 | User | - | 100 | 0.124 | 0.124 | 0.124 |

## Area Summary for Catchment 14 - Ch 45950

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| | User | - | 30 | 0.029 | 0.009 | 0.133 |
| | User | - | 50 | 0.024 | 0.012 | 0.145 |
| 5.008 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 5.009 | User | - | 100 | 0.133 | 0.133 | 0.133 |
| | User | - | 50 | 0.022 | 0.011 | 0.144 |
| 5.010 | User | - | 100 | 0.041 | 0.041 | 0.041 |
| | User | - | 30 | 0.014 | 0.004 | 0.045 |
| 5.011 | User | - | 100 | 0.085 | 0.085 | 0.085 |
| 6.000 | User | - | 100 | 0.086 | 0.086 | 0.086 |
| 6.001 | User | - | 100 | 0.064 | 0.064 | 0.064 |
| | User | - | 100 | 0.027 | 0.027 | 0.091 |
| 6.002 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 7.000 | User | - | 30 | 0.108 | 0.032 | 0.032 |
| | User | - | 50 | 0.037 | 0.019 | 0.051 |
| 7.001 | User | - | 30 | 0.086 | 0.026 | 0.026 |
| | User | - | 50 | 0.026 | 0.013 | 0.039 |
| 6.003 | User | - | 100 | 0.149 | 0.149 | 0.149 |
| | User | - | 30 | 0.086 | 0.026 | 0.175 |
| | User | - | 50 | 0.024 | 0.012 | 0.187 |
| 6.004 | User | - | 100 | 0.184 | 0.184 | 0.184 |
| | User | - | 30 | 0.041 | 0.012 | 0.197 |
| | User | - | 50 | 0.032 | 0.016 | 0.212 |
| 6.005 | User | - | 100 | 0.071 | 0.071 | 0.071 |
| | User | - | 30 | 0.012 | 0.004 | 0.075 |
| | User | - | 50 | 0.014 | 0.007 | 0.082 |
| 8.000 | User | - | 100 | 0.107 | 0.107 | 0.107 |
| 8.001 | User | - | 100 | 0.115 | 0.115 | 0.115 |
| 8.002 | User | - | 100 | 0.045 | 0.045 | 0.045 |
| 8.003 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 6.006 | User | - | 100 | 0.077 | 0.077 | 0.077 |
| 6.007 | User | - | 100 | 0.124 | 0.124 | 0.124 |
| 6.008 | User | - | 100 | 0.117 | 0.117 | 0.117 |
| 6.009 | User | - | 100 | 0.048 | 0.048 | 0.048 |
| 1.011 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.012 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.013 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.014 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.015 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.016 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total<br>6.408 | Total<br>4.916 | Total<br>4.916 |

## Online Controls for Catchment 14 - Ch 45950

### Hydro-Brake® Optimum Manhole: S06-C14-58, DS/PN: 1.016, Volume (m³): 73.2

| | |
|---|---|
| Unit Reference | MD-SHE-0295-5030-1000-5030 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 50.3 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 295 |
| Invert Level (m) | 148.500 |
| Minimum Outlet Pipe Diameter (mm) | 375 |
| Suggested Manhole Diameter (mm) | 1800 |

| Control Points | Head (m) | Flow (l/s) | Control Points | Head (m) | Flow (l/s) |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.000 | 50.3 | Kick-Flo® | 0.786 | 44.8 |
| Flush-Flo™ | 0.449 | 50.2 | Mean Flow over Head Range | - | 40.3 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 9.1 | 0.800 | 45.2 | 2.000 | 70.3 | 4.000 | 98.4 | 7.000 | 129.3 |
| 0.200 | 30.4 | 1.000 | 50.3 | 2.200 | 73.6 | 4.500 | 104.2 | 7.500 | 133.8 |
| 0.300 | 48.6 | 1.200 | 54.9 | 2.400 | 76.8 | 5.000 | 109.7 | 8.000 | 138.1 |
| 0.400 | 50.1 | 1.400 | 59.1 | 2.600 | 79.8 | 5.500 | 115.0 | 8.500 | 142.2 |
| 0.500 | 50.1 | 1.600 | 63.1 | 3.000 | 85.6 | 6.000 | 120.0 | 9.000 | 146.3 |
| 0.600 | 49.2 | 1.800 | 66.8 | 3.500 | 92.2 | 6.500 | 124.7 | 9.500 | 150.2 |

## Offline Controls for Catchment 14 - Ch 45950

### Weir Manhole: S06-C14-58, DS/PN: 1.016, Loop to PN: None

Discharge Coef 0.544 Width (m) 10.000 Invert Level (m) 149.500

## Storage Structures for Catchment 14 - Ch 45950

### Tank or Pond Manhole: S06-C14-58, DS/PN: 1.016

Invert Level (m) 148.500

| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|---|---|
| 0.000 | 4390.8 | 1.000 | 6103.7 | 1.001 | 6628.6 | 1.280 | 9022.7 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 14 - Ch 45950

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 0.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | | | |
|---|---|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Offline Controls | 1 | Number of Time/Area Diagrams | 0 |
| Number of Online Controls | 1 | Number of Storage Structures | 1 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | | | |
|---|---|---|---|---|---|
| Rainfall Model | FSR | M5-60 (mm) | 20.000 | Cv (Summer) | 0.750 |
| Region | England and Wales | Ratio R | 0.300 | Cv (Winter) | 0.840 |

| | |
|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 |
| Analysis Timestep | 2.5 Second Increment (Extended) |
| DTS Status | OFF |
| DVD Status | ON |
| Inertia Status | ON |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 240, 360, 480, 960, 1440 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C14-1 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 169.432 | -0.027 | 0.000 |
| 1.001 | S06-C14-2 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 168.920 | -0.026 | 0.000 |
| 1.002 | S06-C14-3 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 168.397 | -0.103 | 0.000 |
| 1.003 | S06-C14-4 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 167.501 | -0.099 | 0.000 |
| 1.004 | S06-C14-5 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 166.229 | 0.129 | 0.000 |
| 1.005 | S06-C14-6 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 165.642 | -0.151 | 0.000 |
| 1.006 | S06-C14-7 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 164.481 | -0.124 | 0.000 |
| 1.007 | S06-C14-8 | 30 Winter | 5 | +20% | 5/15 Summer | | | | 163.536 | 0.121 | 0.000 |
| 1.008 | S06-C14-9 | 30 Winter | 5 | +20% | 5/15 Winter | | | | 163.245 | 0.066 | 0.000 |
| 1.009 | S06-C14-10 | 30 Winter | 5 | +20% | | | | | 162.616 | -0.321 | 0.000 |
| 2.000 | S06-C14-11 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 175.057 | -0.100 | 0.000 |
| 2.001 | S06-C14-12 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 171.205 | -0.095 | 0.000 |
| 2.002 | S06-C14-13 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 170.655 | 0.170 | 0.000 |
| 2.003 | S06-C14-14 | 15 Winter | 5 | +20% | | | | | 169.934 | -0.168 | 0.000 |
| 2.004 | S06-C14-15 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 165.109 | 0.065 | 0.000 |
| 2.005 | S06-C14-16 | 15 Winter | 5 | +20% | | | | | 164.540 | -0.241 | 0.000 |
| 2.006 | S06-C14-17 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 157.687 | -0.177 | 0.000 |
| 2.007 | S06-C14-18 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 157.224 | -0.176 | 0.000 |
| 2.008 | S06-C14-19 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 156.516 | 0.116 | 0.000 |
| 3.000 | S06-C14-20 | 15 Winter | 5 | +20% | | | | | 167.238 | -0.095 | 0.000 |
| 4.000 | S06-C14-21 | 15 Winter | 5 | +20% | | | | | 166.244 | -0.133 | 0.000 |
| 3.001 | S06-C14-22 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 156.557 | 0.057 | 0.000 |
| 2.009 | S06-C14-23 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 156.420 | 0.071 | 0.000 |
| 1.010 | S06-C14-24 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 155.940 | -0.220 | 0.000 |
| 5.000 | S06-C14-25 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 169.902 | -0.067 | 0.000 |
| 5.001 | S06-C14-26 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 165.219 | 0.164 | 0.000 |
| 5.002 | S06-C14-27 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 164.546 | 0.086 | 0.000 |
| 5.003 | S06-C14-28 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 164.045 | -0.067 | 0.000 |
| 5.004 | S06-C14-29 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 163.999 | -0.047 | 0.000 |
| 5.005 | S06-C14-30 | 15 Winter | 5 | +20% | 5/15 Winter | | | | 163.708 | 0.030 | 0.000 |
| 5.006 | S06-C14-31 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 163.185 | -0.121 | 0.000 |
| 5.007 | S06-C14-32 | 30 Winter | 5 | +20% | | | | | 162.810 | -0.220 | 0.000 |
| 5.008 | S06-C14-33 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 160.944 | -0.205 | 0.000 |
| 5.009 | S06-C14-34 | 30 Winter | 5 | +20% | 5/15 Winter | | | | 159.867 | 0.064 | 0.000 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 14 - Ch 45950

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 1.000 | S06-C14-1 | 0.92 | | | 35.8 | OK | 6 |
| 1.001 | S06-C14-2 | 0.95 | | | 66.6 | OK | 5 |
| 1.002 | S06-C14-3 | 0.75 | | | 86.5 | OK | 6 |
| 1.003 | S06-C14-4 | 0.77 | | | 109.3 | OK | 6 |
| 1.004 | S06-C14-5 | 1.17 | | | 129.1 | SURCHARGED | 6 |
| 1.005 | S06-C14-6 | 0.66 | | | 147.5 | OK | |
| 1.006 | S06-C14-7 | 0.77 | | | 167.2 | OK | 6 |
| 1.007 | S06-C14-8 | 1.13 | | | 175.3 | SURCHARGED | |
| 1.008 | S06-C14-9 | 1.15 | | | 179.4 | SURCHARGED | |
| 1.009 | S06-C14-10 | 0.18 | | | 185.3 | OK | |
| 2.000 | S06-C14-11 | 0.57 | | | 60.5 | OK | 4 |
| 2.001 | S06-C14-12 | 0.77 | | | 83.9 | OK | 5 |
| 2.002 | S06-C14-13 | 1.15 | | | 79.2 | SURCHARGED | 1 |
| 2.003 | S06-C14-14 | 0.39 | | | 92.1 | OK | |
| 2.004 | S06-C14-15 | 1.11 | | | 119.6 | SURCHARGED | |
| 2.005 | S06-C14-16 | 0.27 | | | 142.5 | OK | |
| 2.006 | S06-C14-17 | 0.54 | | | 145.3 | OK | 4 |
| 2.007 | S06-C14-18 | 0.55 | | | 155.2 | OK | 5 |
| 2.008 | S06-C14-19 | 1.02 | | | 158.3 | SURCHARGED | 6 |
| 3.000 | S06-C14-20 | 0.28 | | | 19.8 | OK | |
| 4.000 | S06-C14-21 | 0.03 | | | 4.2 | OK | |
| 3.001 | S06-C14-22 | 1.16 | | | 23.7 | SURCHARGED | 6 |
| 2.009 | S06-C14-23 | 1.19 | | | 185.0 | SURCHARGED | 4 |
| 1.010 | S06-C14-24 | 0.52 | | | 351.8 | OK | |
| 5.000 | S06-C14-25 | 0.57 | | | 23.4 | OK | 2 |
| 5.001 | S06-C14-26 | 1.03 | | | 40.2 | SURCHARGED | 6 |
| 5.002 | S06-C14-27 | 1.12 | | | 46.5 | SURCHARGED | |
| 5.003 | S06-C14-28 | 0.80 | | | 48.1 | OK | |
| 5.004 | S06-C14-29 | 0.89 | | | 61.3 | OK | |
| 5.005 | S06-C14-30 | 1.04 | | | 71.4 | SURCHARGED | |
| 5.006 | S06-C14-31 | 0.78 | | | 82.9 | OK | |
| 5.007 | S06-C14-32 | 0.36 | | | 101.6 | OK | |
| 5.008 | S06-C14-33 | 0.42 | | | 101.2 | OK | |
| 5.009 | S06-C14-34 | 1.08 | | | 116.2 | SURCHARGED | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 14 - Ch 45950

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5.010 | S06-C14-35 | 30 Winter | 5 | +20% | 5/15 Winter | | | | 159.576 | 0.022 | 0.000 |
| 5.011 | S06-C14-36 | 30 Winter | 5 | +20% | | | | | 159.208 | -0.246 | 0.000 |
| 6.000 | S06-C14-37 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 172.172 | 0.272 | 0.000 |
| 6.001 | S06-C14-38 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Summer | | | 171.018 | 0.028 | 0.000 |
| 6.002 | S06-C14-39 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 170.766 | 0.112 | 0.000 |
| 7.000 | S06-C14-40 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 172.340 | -0.053 | 0.000 |
| 7.001 | S06-C14-41 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 171.452 | -0.021 | 0.000 |
| 6.003 | S06-C14-42 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 170.693 | 0.131 | 0.000 |
| 6.004 | S06-C14-43 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 168.576 | -0.119 | 0.000 |
| 6.005 | S06-C14-44 | 15 Winter | 5 | +20% | | | | | 165.709 | -0.154 | 0.000 |
| 8.000 | S06-C14-45 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | | | 172.749 | -0.106 | 0.000 |
| 8.001 | S06-C14-46 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | | | 171.728 | -0.086 | 0.000 |
| 8.002 | S06-C14-47 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 169.805 | -0.092 | 0.000 |
| 8.003 | S06-C14-48 | 15 Winter | 5 | +20% | | | | | 168.567 | -0.157 | 0.000 |
| 6.006 | S06-C14-49 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 162.222 | 0.080 | 0.000 |
| 6.007 | S06-C14-50 | 15 Winter | 5 | +20% | | | | | 161.734 | -0.258 | 0.000 |
| 6.008 | S06-C14-51 | 15 Winter | 5 | +20% | 100/15 Winter | | | | 157.928 | -0.246 | 0.000 |
| 6.009 | S06-C14-52 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 154.687 | 0.087 | 0.000 |
| 1.011 | S06-C14-53 | 30 Winter | 5 | +20% | 5/15 Winter | | | | 154.561 | 0.045 | 0.000 |
| 1.012 | S06-C14-54 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 154.500 | 0.000 | 0.000 |
| 1.013 | S06-C14-55 | 30 Winter | 5 | +20% | | | | | 153.511 | -0.575 | 0.000 |
| 1.014 | S06-C14-56 | 30 Summer | 5 | +20% | 100/15 Summer | | | | 149.709 | 0.000 | 0.000 |
| 1.015 | S06-C14-57 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 149.430 | -0.161 | 0.000 |
| 1.016 | S06-C14-58 | 960 Winter | 5 | +20% | | | | 0 | 148.803 | -0.522 | 0.000 |

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 5.010 | S06-C14-35 | 1.18 | | | 119.6 | SURCHARGED | |
| 5.011 | S06-C14-36 | 0.26 | | | 126.6 | OK | |
| 6.000 | S06-C14-37 | 1.08 | | | 18.8 | SURCHARGED | 7 |
| 6.001 | S06-C14-38 | 0.90 | | | 34.7 | SURCHARGED | 4 |
| 6.002 | S06-C14-39 | 1.04 | | | 36.8 | SURCHARGED | 4 |
| 7.000 | S06-C14-40 | 0.67 | | | 11.6 | OK | 5 |
| 7.001 | S06-C14-41 | 0.93 | | | 18.7 | OK | 6 |
| 6.003 | S06-C14-42 | 1.03 | | | 80.2 | SURCHARGED | 6 |
| 6.004 | S06-C14-43 | 0.66 | | | 120.5 | OK | |
| 6.005 | S06-C14-44 | 0.47 | | | 136.6 | OK | |
| 8.000 | S06-C14-45 | 0.50 | | | 25.0 | OK | 1 |
| 8.001 | S06-C14-46 | 0.67 | | | 47.7 | OK | 1 |
| 8.002 | S06-C14-47 | 0.65 | | | 56.3 | OK | |
| 8.003 | S06-C14-48 | 0.20 | | | 56.3 | OK | |
| 6.006 | S06-C14-49 | 1.27 | | | 204.2 | SURCHARGED | |
| 6.007 | S06-C14-50 | 0.38 | | | 225.9 | OK | |
| 6.008 | S06-C14-51 | 0.42 | | | 244.4 | OK | |
| 6.009 | S06-C14-52 | 1.24 | | | 234.9 | SURCHARGED | 6 |
| 1.011 | S06-C14-53 | 1.95 | | | 698.8 | SURCHARGED | |
| 1.012 | S06-C14-54 | 0.99 | | | 661.0 | OK | |
| 1.013 | S06-C14-55 | 0.20 | | | 661.3 | OK | |
| 1.014 | S06-C14-56 | 1.01 | | | 608.7 | OK | |
| 1.015 | S06-C14-57 | 1.00 | | | 651.9 | OK | |
| 1.016 | S06-C14-58 | 0.03 | 0.0 | | 48.7 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 14 - Ch 45950

### Simulation Criteria

Areal Reduction Factor 1.000
Hot Start (mins) 0
Hot Start Level (mm) 0
Manhole Headloss Coeff (Global) 0.500
Foul Sewage per hectare (l/s) 0.000
Additional Flow - % of Total Flow 0.000
MADD Factor * 10m³/ha Storage 0.000
Inlet Coeffiecient 0.800
Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0
Number of Online Controls 1
Number of Offline Controls 1
Number of Storage Structures 1
Number of Time/Area Diagrams 0
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
Region England and Wales
M5-60 (mm) 20.000
Ratio R 0.300
Cv (Summer) 0.750
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C14-1 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 170.672 | 1.213 | 12.618 |
| 1.001 | S06-C14-2 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 170.392 | 1.446 | 4.836 |
| 1.002 | S06-C14-3 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 169.705 | 1.205 | 5.445 |
| 1.003 | S06-C14-4 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 168.806 | 1.206 | 6.248 |
| 1.004 | S06-C14-5 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 167.313 | 1.213 | 13.386 |
| 1.005 | S06-C14-6 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 167.063 | 1.270 | 0.000 |
| 1.006 | S06-C14-7 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 165.814 | 1.208 | 8.276 |
| 1.007 | S06-C14-8 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 164.576 | 1.161 | 0.000 |
| 1.008 | S06-C14-9 | 30 Winter | 100 | +40% | 5/15 Winter | | | | 163.847 | 0.668 | 0.000 |
| 1.009 | S06-C14-10 | 30 Winter | 100 | +40% | | | | | 162.662 | -0.275 | 0.000 |
| 2.000 | S06-C14-11 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 176.360 | 1.204 | 3.558 |
| 2.001 | S06-C14-12 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 172.509 | 1.209 | 9.000 |
| 2.002 | S06-C14-13 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 171.685 | 1.200 | 0.024 |
| 2.003 | S06-C14-14 | 15 Winter | 100 | +40% | | | | | 169.989 | -0.113 | 0.000 |
| 2.004 | S06-C14-15 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 166.226 | 1.181 | 0.000 |
| 2.005 | S06-C14-16 | 15 Winter | 100 | +40% | | | | | 164.616 | -0.166 | 0.000 |
| 2.006 | S06-C14-17 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 159.070 | 1.206 | 6.263 |
| 2.007 | S06-C14-18 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 158.602 | 1.202 | 2.180 |
| 2.008 | S06-C14-19 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 157.630 | 1.230 | 29.830 |
| 3.000 | S06-C14-20 | 15 Winter | 100 | +40% | | | | | 167.270 | -0.063 | 0.000 |
| 4.000 | S06-C14-21 | 15 Winter | 100 | +40% | | | | | 166.252 | -0.124 | 0.000 |
| 3.001 | S06-C14-22 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 157.703 | 1.203 | 3.246 |
| 2.009 | S06-C14-23 | 30 Summer | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 157.550 | 1.201 | 0.882 |
| 1.010 | S06-C14-24 | 30 Summer | 100 | +40% | 100/15 Summer | | | | 157.042 | 0.883 | 0.000 |
| 5.000 | S06-C14-25 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 171.170 | 1.201 | 0.604 |
| 5.001 | S06-C14-26 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 166.277 | 1.222 | 21.722 |
| 5.002 | S06-C14-27 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 166.349 | 1.889 | 0.000 |
| 5.003 | S06-C14-28 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 165.918 | 1.807 | 0.000 |
| 5.004 | S06-C14-29 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 165.851 | 1.804 | 0.000 |
| 5.005 | S06-C14-30 | 30 Winter | 100 | +40% | 5/15 Winter | | | | 165.045 | 1.367 | 0.000 |
| 5.006 | S06-C14-31 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 163.688 | 0.382 | 0.000 |
| 5.007 | S06-C14-32 | 30 Winter | 100 | +40% | | | | | 162.885 | -0.144 | 0.000 |
| 5.008 | S06-C14-33 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 161.852 | 0.703 | 0.000 |
| 5.009 | S06-C14-34 | 30 Winter | 100 | +40% | 5/15 Winter | | | | 160.994 | 1.191 | 0.000 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 14 - Ch 45950

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 1.000 | S06-C14-1 | 1.49 | | | 58.1 | FLOOD | 6 |
| 1.001 | S06-C14-2 | 1.44 | | | 101.2 | FLOOD | 5 |
| 1.002 | S06-C14-3 | 1.00 | | | 115.7 | FLOOD | 6 |
| 1.003 | S06-C14-4 | 1.00 | | | 141.7 | FLOOD | 6 |
| 1.004 | S06-C14-5 | 1.77 | | | 195.8 | FLOOD | 6 |
| 1.005 | S06-C14-6 | 0.96 | | | 216.6 | SURCHARGED | |
| 1.006 | S06-C14-7 | 1.11 | | | 241.7 | FLOOD | 6 |
| 1.007 | S06-C14-8 | 1.72 | | | 266.4 | FLOOD RISK | |
| 1.008 | S06-C14-9 | 1.90 | | | 297.5 | SURCHARGED | |
| 1.009 | S06-C14-10 | 0.32 | | | 323.2 | OK | |
| 2.000 | S06-C14-11 | 1.00 | | | 105.3 | FLOOD | 4 |
| 2.001 | S06-C14-12 | 1.22 | | | 132.8 | FLOOD | 5 |
| 2.002 | S06-C14-13 | 1.87 | | | 128.6 | FLOOD | 1 |
| 2.003 | S06-C14-14 | 0.68 | | | 158.7 | OK | |
| 2.004 | S06-C14-15 | 2.20 | | | 237.8 | FLOOD RISK | |
| 2.005 | S06-C14-16 | 0.58 | | | 301.4 | OK | |
| 2.006 | S06-C14-17 | 1.01 | | | 268.1 | FLOOD | 4 |
| 2.007 | S06-C14-18 | 1.00 | | | 281.5 | FLOOD | 5 |
| 2.008 | S06-C14-19 | 1.78 | | | 276.9 | FLOOD | 6 |
| 3.000 | S06-C14-20 | 0.63 | | | 43.8 | OK | |
| 4.000 | S06-C14-21 | 0.07 | | | 9.2 | OK | |
| 3.001 | S06-C14-22 | 2.10 | | | 42.9 | FLOOD | 6 |
| 2.009 | S06-C14-23 | 2.07 | | | 322.7 | FLOOD | 4 |
| 1.010 | S06-C14-24 | 0.89 | | | 601.7 | SURCHARGED | |
| 5.000 | S06-C14-25 | 1.00 | | | 41.3 | FLOOD | 2 |
| 5.001 | S06-C14-26 | 1.46 | | | 57.2 | FLOOD | 6 |
| 5.002 | S06-C14-27 | 1.45 | | | 60.4 | SURCHARGED | |
| 5.003 | S06-C14-28 | 1.06 | | | 63.5 | SURCHARGED | |
| 5.004 | S06-C14-29 | 1.36 | | | 93.7 | SURCHARGED | |
| 5.005 | S06-C14-30 | 1.86 | | | 127.9 | SURCHARGED | |
| 5.006 | S06-C14-31 | 1.47 | | | 156.3 | SURCHARGED | |
| 5.007 | S06-C14-32 | 0.69 | | | 195.9 | OK | |
| 5.008 | S06-C14-33 | 0.80 | | | 191.2 | SURCHARGED | |
| 5.009 | S06-C14-34 | 2.03 | | | 219.1 | FLOOD RISK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 14 - Ch 45950

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5.010 | S06-C14-35 | 30 Winter | 100 | +40% | 5/15 Winter | | | | 159.946 | 0.392 | 0.000 |
| 5.011 | S06-C14-36 | 30 Winter | 100 | +40% | | | | | 159.268 | -0.185 | 0.000 |
| 6.000 | S06-C14-37 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 173.109 | 1.209 | 8.887 |
| 6.001 | S06-C14-38 | 15 Winter | 100 | +40% | 5/15 Winter | 100/15 Summer | | | 172.701 | 1.712 | 1.286 |
| 6.002 | S06-C14-39 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 172.028 | 1.374 | 0.106 |
| 7.000 | S06-C14-40 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 173.594 | 1.201 | 1.418 |
| 7.001 | S06-C14-41 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 172.843 | 1.371 | 2.647 |
| 6.003 | S06-C14-42 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 171.820 | 1.258 | 17.225 |
| 6.004 | S06-C14-43 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 169.488 | 0.793 | 0.000 |
| 6.005 | S06-C14-44 | 15 Winter | 100 | +40% | | | | | 165.779 | -0.084 | 0.000 |
| 8.000 | S06-C14-45 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | | | 174.055 | 1.200 | 0.035 |
| 8.001 | S06-C14-46 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | | | 173.015 | 1.201 | 0.929 |
| 8.002 | S06-C14-47 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 170.251 | 0.354 | 0.000 |
| 8.003 | S06-C14-48 | 15 Winter | 100 | +40% | | | | | 168.592 | -0.132 | 0.000 |
| 6.006 | S06-C14-49 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 162.831 | 0.690 | 0.000 |
| 6.007 | S06-C14-50 | 15 Winter | 100 | +40% | | | | | 161.830 | -0.161 | 0.000 |
| 6.008 | S06-C14-51 | 15 Winter | 100 | +40% | 100/15 Winter | | | | 158.267 | 0.093 | 0.000 |
| 6.009 | S06-C14-52 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 155.850 | 1.250 | 49.814 |
| 1.011 | S06-C14-53 | 15 Winter | 100 | +40% | 5/15 Winter | | | | 155.695 | 1.179 | 0.000 |
| 1.012 | S06-C14-54 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 155.317 | 0.816 | 0.000 |
| 1.013 | S06-C14-55 | 30 Winter | 100 | +40% | | | | | 153.594 | -0.491 | 0.000 |
| 1.014 | S06-C14-56 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 150.491 | 0.782 | 0.000 |
| 1.015 | S06-C14-57 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 150.074 | 0.484 | 0.000 |
| 1.016 | S06-C14-58 | 960 Winter | 100 | +40% | | | | 0 | 149.185 | -0.140 | 0.000 |

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 5.010 | S06-C14-35 | 2.24 | | | 227.3 | SURCHARGED | |
| 5.011 | S06-C14-36 | 0.51 | | | 248.4 | OK | |
| 6.000 | S06-C14-37 | 1.37 | | | 23.9 | FLOOD | 7 |
| 6.001 | S06-C14-38 | 1.41 | | | 54.3 | FLOOD | 4 |
| 6.002 | S06-C14-39 | 1.51 | | | 53.4 | FLOOD | 4 |
| 7.000 | S06-C14-40 | 0.90 | | | 15.7 | FLOOD | 5 |
| 7.001 | S06-C14-41 | 1.06 | | | 21.5 | FLOOD | 6 |
| 6.003 | S06-C14-42 | 1.30 | | | 100.7 | FLOOD | 6 |
| 6.004 | S06-C14-43 | 1.12 | | | 203.9 | SURCHARGED | |
| 6.005 | S06-C14-44 | 0.85 | | | 246.7 | OK | |
| 8.000 | S06-C14-45 | 0.96 | | | 48.0 | FLOOD | 1 |
| 8.001 | S06-C14-46 | 1.20 | | | 84.9 | FLOOD | 1 |
| 8.002 | S06-C14-47 | 1.14 | | | 99.1 | SURCHARGED | |
| 8.003 | S06-C14-48 | 0.36 | | | 99.1 | OK | |
| 6.006 | S06-C14-49 | 2.33 | | | 376.0 | SURCHARGED | |
| 6.007 | S06-C14-50 | 0.72 | | | 433.2 | OK | |
| 6.008 | S06-C14-51 | 0.82 | | | 480.3 | SURCHARGED | |
| 6.009 | S06-C14-52 | 2.11 | | | 401.1 | FLOOD | 6 |
| 1.011 | S06-C14-53 | 3.19 | | | 1145.2 | FLOOD RISK | |
| 1.012 | S06-C14-54 | 1.64 | | | 1100.0 | SURCHARGED | |
| 1.013 | S06-C14-55 | 0.34 | | | 1128.2 | OK | |
| 1.014 | S06-C14-56 | 1.87 | | | 1126.9 | FLOOD RISK | |
| 1.015 | S06-C14-57 | 1.72 | | | 1123.3 | SURCHARGED | |
| 1.016 | S06-C14-58 | 0.03 | 0.0 | | 50.2 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for Catchment 15 - Ch 46130

Pipe Sizes Min 150 Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 20.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

## Network Design Table for Catchment 15 - Ch 46130

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 78.047 | 0.773 | 100.9 | 0.077 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.001 | 100.541 | 1.434 | 70.1 | 0.094 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.002 | 99.873 | 1.394 | 71.6 | 0.093 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.003 | 48.081 | 0.671 | 71.6 | 0.045 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.004 | 28.223 | 0.298 | 94.6 | 0.036 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 2.000 | 72.137 | 5.131 | 14.1 | 0.092 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.005 | 12.555 | 0.052 | 241.2 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 3.000 | 52.142 | 2.470 | 21.1 | 0.094 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 3.001 | 42.574 | 1.106 | 38.5 | 0.000 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.006 | 74.103 | 0.413 | 179.2 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.007 | 131.851 | 0.401 | 328.8 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 71.43 | 6.30 | 160.387 | 0.077 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 14.9 |
| 1.001 | 66.77 | 7.37 | 159.539 | 0.171 | 0.0 | 0.0 | 0.0 | 1.56 | 62.2 | 30.9 |
| 1.002 | 62.78 | 8.45 | 158.104 | 0.263 | 0.0 | 0.0 | 0.0 | 1.55 | 61.5 | 44.8 |
| 1.003 | 61.06 | 8.97 | 156.710 | 0.309 | 0.0 | 0.0 | 0.0 | 1.55 | 61.5 | 51.0 |
| 1.004 | 60.15 | 9.26 | 155.964 | 0.344 | 0.0 | 0.0 | 0.0 | 1.62 | 114.3 | 56.1 |
| 2.000 | 75.78 | 5.45 | 160.947 | 0.092 | 0.0 | 0.0 | 0.0 | 2.70 | 47.7 | 18.8 |
| 1.005 | 59.51 | 9.46 | 155.665 | 0.436 | 0.0 | 0.0 | 0.0 | 1.01 | 71.2 | 70.2 |
| 3.000 | 76.06 | 5.39 | 159.734 | 0.094 | 0.0 | 0.0 | 0.0 | 2.20 | 38.9 | 19.3 |
| 3.001 | 73.74 | 5.83 | 157.264 | 0.094 | 0.0 | 0.0 | 0.0 | 1.63 | 28.8 | 19.3 |
| 1.006 | 56.53 | 10.52 | 155.613 | 0.530 | 0.0 | 0.0 | 0.0 | 1.17 | 82.8 | 81.1 |
| 1.007 | 66.07 | 7.55 | 155.200 | 0.000 | 50.2 | 0.0 | 0.0 | 0.86 | 60.9 | 50.2 |

## Manhole Schedules for Catchment 15 - Ch 46130

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | Pipe Out PN | Pipe Out Invert Level (m) | Pipe Out Diameter (mm) | Pipes In PN | Pipes In Invert Level (m) | Pipes In Diameter (mm) | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C15-1 | 161.737 | 1.350 | Open Manhole | 1200 | 1.000 | 160.387 | 150 | | | | |
| S06-C15-2 | 160.967 | 1.428 | Open Manhole | 1200 | 1.001 | 159.539 | 225 | 1.000 | 159.614 | 150 | |
| S06-C15-3 | 159.529 | 1.425 | Open Manhole | 1200 | 1.002 | 158.104 | 225 | 1.001 | 158.104 | 225 | |
| S06-C15-4 | 158.135 | 1.425 | Open Manhole | 1200 | 1.003 | 156.710 | 225 | 1.002 | 156.710 | 225 | |
| S06-C15-5 | 157.464 | 1.500 | Open Manhole | 1200 | 1.004 | 155.964 | 300 | 1.003 | 156.039 | 225 | |
| S06-C15-6 | 162.297 | 1.350 | Open Manhole | 1200 | 2.000 | 160.947 | 150 | | | | |
| S06-C15-7 | 157.156 | 1.491 | Open Manhole | 1200 | 1.005 | 155.665 | 300 | 1.004 | 155.665 | 300 | |
| | | | | | | | | 2.000 | 155.815 | 150 | |
| S06-C15-8 | 161.084 | 1.350 | Open Manhole | 1200 | 3.000 | 159.734 | 150 | | | | |
| S06-C15-9 | 158.614 | 1.350 | Open Manhole | 1200 | 3.001 | 157.264 | 150 | 3.000 | 157.264 | 150 | |
| S06-C15-10 | 157.508 | 1.894 | Open Manhole | 1200 | 1.006 | 155.613 | 300 | 1.005 | 155.613 | 300 | |
| | | | | | | | | 3.001 | 156.158 | 150 | 394 |
| S06-C15-11 | 156.480 | 1.280 | Open Manhole | 1200 | 1.007 | 155.200 | 300 | 1.006 | 155.200 | 300 | |
| Outfall 15 | 155.200 | 0.401 | Open Manhole | 0 | | OUTFALL | | 1.007 | 154.799 | 300 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C15-1 | 376698.917 | 515154.848 | 376698.917 | 515154.848 | Required |  |
| S06-C15-2 | 376776.794 | 515149.776 | 376776.794 | 515149.776 | Required |  |
| S06-C15-3 | 376877.167 | 515143.969 | 376877.167 | 515143.969 | Required |  |
| S06-C15-4 | 376976.854 | 515137.869 | 376976.854 | 515137.869 | Required |  |
| S06-C15-5 | 377024.863 | 515135.229 | 377024.863 | 515135.229 | Required |  |
| S06-C15-6 | 377044.225 | 515193.497 | 377044.225 | 515193.497 | Required |  |
| S06-C15-7 | 377052.404 | 515140.308 | 377052.404 | 515140.308 | Required |  |
| S06-C15-8 | 377119.218 | 515192.553 | 377119.218 | 515192.553 | Required |  |
| S06-C15-9 | 377083.683 | 515158.051 | 377083.683 | 515158.051 | Required |  |
| S06-C15-10 | 377055.680 | 515128.188 | 377055.680 | 515128.188 | Required |  |
| S06-C15-11 | 376985.483 | 515104.446 | 376985.483 | 515104.446 | Required |  |
| Outfall 15 | 376925.231 | 514987.167 | | | No Entry |  |

## Area Summary for Catchment 15 - Ch 46130

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | User | - | 100 | 0.065 | 0.065 | 0.065 |
| | User | - | 30 | 0.019 | 0.006 | 0.071 |
| | User | - | 50 | 0.012 | 0.006 | 0.077 |
| 1.001 | User | - | 100 | 0.080 | 0.080 | 0.080 |
| | User | - | 30 | 0.020 | 0.006 | 0.086 |
| | User | - | 50 | 0.015 | 0.008 | 0.094 |
| 1.002 | User | - | 100 | 0.080 | 0.080 | 0.080 |
| | User | - | 30 | 0.017 | 0.005 | 0.085 |
| | User | - | 50 | 0.016 | 0.008 | 0.093 |
| 1.003 | User | - | 100 | 0.039 | 0.039 | 0.039 |
| | User | - | 30 | 0.010 | 0.003 | 0.042 |
| | User | - | 50 | 0.007 | 0.004 | 0.045 |
| 1.004 | User | - | 100 | 0.029 | 0.029 | 0.029 |
| | User | - | 30 | 0.007 | 0.002 | 0.031 |
| | User | - | 50 | 0.010 | 0.005 | 0.036 |
| 2.000 | User | - | 100 | 0.056 | 0.056 | 0.056 |
| | User | - | 30 | 0.024 | 0.007 | 0.063 |
| | User | - | 50 | 0.057 | 0.029 | 0.092 |
| 1.005 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 3.000 | User | - | 100 | 0.079 | 0.079 | 0.079 |
| | User | - | 30 | 0.016 | 0.005 | 0.084 |
| | User | - | 50 | 0.021 | 0.010 | 0.094 |
| 3.001 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.006 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.007 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total | Total | Total |
| | | | | 0.678 | 0.530 | 0.530 |

## Online Controls for Catchment 15 - Ch 46130

### Hydro-Brake® Optimum Manhole: S06-C15-11, DS/PN: 1.007, Volume (m³): 6.6

| | |
|---|---|
| Unit Reference | MD-SHE-0126-7300-1000-7300 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 7.3 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 126 |
| Invert Level (m) | 155.200 |
| Minimum Outlet Pipe Diameter (mm) | 150 |
| Suggested Manhole Diameter (mm) | 1200 |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.000 | 7.3 | Kick-Flo® | 0.658 | 6.0 |
| Flush-Flo™ | 0.301 | 7.3 | Mean Flow over Head Range | - | 6.3 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 4.5 | 0.800 | 6.6 | 2.000 | 10.1 | 4.000 | 14.0 | 7.000 | 18.3 |
| 0.200 | 7.1 | 1.000 | 7.3 | 2.200 | 10.6 | 4.500 | 14.8 | 7.500 | 19.0 |
| 0.300 | 7.3 | 1.200 | 7.9 | 2.400 | 11.0 | 5.000 | 15.6 | 8.000 | 19.6 |
| 0.400 | 7.2 | 1.400 | 8.5 | 2.600 | 11.4 | 5.500 | 16.3 | 8.500 | 20.1 |
| 0.500 | 7.0 | 1.600 | 9.1 | 3.000 | 12.2 | 6.000 | 17.0 | 9.000 | 20.7 |
| 0.600 | 6.5 | 1.800 | 9.6 | 3.500 | 13.2 | 6.500 | 17.7 | 9.500 | 21.2 |

## Offline Controls for Catchment 15 - Ch 46130

### Weir Manhole: S06-C15-11, DS/PN: 1.007, Loop to PN: None

Discharge Coef 0.544 Width (m) 10.000 Invert Level (m) 156.200

## Storage Structures for Catchment 15 - Ch 46130

### Tank or Pond Manhole: S06-C15-11, DS/PN: 1.007

Invert Level (m) 155.200

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|---|---|---|---|
| 0.000 | 378.8 | 1.000 | 673.3 | 1.001 | 772.6 | 1.280 | 1275.5 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 15 - Ch 46130

### Simulation Criteria

```
           Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 0.000
                  Hot Start (mins)     0       MADD Factor * 10m³/ha Storage 0.000
                Hot Start Level (mm)     0                Inlet Coeffiecient 0.800
   Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
     Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0   Number of Offline Controls 1 Number of Time/Area Diagrams 0
  Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
Rainfall Model               FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
       Region England and Wales     Ratio R  0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)                              300.0
                Analysis Timestep 2.5 Second Increment (Extended)
                       DTS Status                                OFF
                       DVD Status                                 ON
                   Inertia Status                                 ON

               Profile(s)                       Summer and Winter
          Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
         Return Period(s) (years)                              5, 100
            Climate Change (%)                                 20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C15-1 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 160.632 | 0.095 | 0.000 |
| 1.001 | S06-C15-2 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 159.666 | -0.097 | 0.000 |
| 1.002 | S06-C15-3 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 158.273 | -0.057 | 0.000 |
| 1.003 | S06-C15-4 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Summer | | | 156.985 | 0.049 | 0.000 |
| 1.004 | S06-C15-5 | 15 Winter | 5 | +20% | 5/15 Winter | | | | 156.327 | 0.063 | 0.000 |
| 2.000 | S06-C15-6 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 161.022 | -0.075 | 0.000 |
| 1.005 | S06-C15-7 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 156.183 | 0.218 | 0.000 |
| 3.000 | S06-C15-8 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 159.821 | -0.063 | 0.000 |
| 3.001 | S06-C15-9 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 157.371 | -0.043 | 0.000 |
| 1.006 | S06-C15-10 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 156.080 | 0.167 | 0.000 |
| 1.007 | S06-C15-11 | 360 Winter | 5 | +20% | 100/15 Winter | | | 0 | 155.478 | -0.022 | 0.000 |

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 1.000 | S06-C15-1 | 1.03 | | | 17.8 | SURCHARGED | 5 |
| 1.001 | S06-C15-2 | 0.59 | | | 35.8 | OK | 3 |
| 1.002 | S06-C15-3 | 0.87 | | | 52.3 | OK | 6 |
| 1.003 | S06-C15-4 | 0.99 | | | 58.2 | SURCHARGED | 5 |
| 1.004 | S06-C15-5 | 0.64 | | | 66.4 | SURCHARGED | |
| 2.000 | S06-C15-6 | 0.49 | | | 22.7 | OK | |
| 1.005 | S06-C15-7 | 1.36 | | | 79.2 | SURCHARGED | 4 |
| 3.000 | S06-C15-8 | 0.62 | | | 23.4 | OK | 3 |
| 3.001 | S06-C15-9 | 0.85 | | | 23.7 | OK | 4 |
| 1.006 | S06-C15-10 | 1.18 | | | 94.0 | SURCHARGED | |
| 1.007 | S06-C15-11 | 0.12 | 0.0 | | 7.0 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 15 - Ch 46130

### Simulation Criteria

Areal Reduction Factor 1.000    Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0    MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0    Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500    Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0    Number of Offline Controls 1    Number of Time/Area Diagrams 0
Number of Online Controls 1    Number of Storage Structures 1    Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR    M5-60 (mm) 20.000    Cv (Summer) 0.750
Region England and Wales    Ratio R 0.300    Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C15-1 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 161.742 | 1.205 | 4.662 |
| 1.001 | S06-C15-2 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 160.968 | 1.204 | 0.712 |
| 1.002 | S06-C15-3 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 159.539 | 1.209 | 9.460 |
| 1.003 | S06-C15-4 | 30 Winter | 100 | +40% | 5/15 Winter | 100/15 Summer | | | 158.138 | 1.203 | 2.822 |
| 1.004 | S06-C15-5 | 15 Winter | 100 | +40% | 5/15 Winter | | | | 157.352 | 1.088 | 0.000 |
| 2.000 | S06-C15-6 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 161.750 | 0.653 | 0.000 |
| 1.005 | S06-C15-7 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 157.157 | 1.191 | 0.759 |
| 3.000 | S06-C15-8 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 161.085 | 1.201 | 0.770 |
| 3.001 | S06-C15-9 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 158.614 | 1.201 | 0.575 |
| 1.006 | S06-C15-10 | 15 Summer | 100 | +40% | 5/15 Summer | | | | 156.949 | 1.035 | 0.000 |
| 1.007 | S06-C15-11 | 360 Winter | 100 | +40% | 100/15 Winter | | | 0 | 155.880 | 0.380 | 0.000 |

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 1.000 | S06-C15-1 | 1.48 | | | 25.8 | FLOOD | 5 |
| 1.001 | S06-C15-2 | 0.98 | | | 59.6 | FLOOD | 3 |
| 1.002 | S06-C15-3 | 1.16 | | | 70.0 | FLOOD | 6 |
| 1.003 | S06-C15-4 | 1.39 | | | 81.7 | FLOOD | 5 |
| 1.004 | S06-C15-5 | 0.89 | | | 91.7 | FLOOD RISK | |
| 2.000 | S06-C15-6 | 0.94 | | | 44.3 | SURCHARGED | |
| 1.005 | S06-C15-7 | 2.03 | | | 117.8 | FLOOD | 4 |
| 3.000 | S06-C15-8 | 1.06 | | | 40.2 | FLOOD | 3 |
| 3.001 | S06-C15-9 | 1.30 | | | 36.4 | FLOOD | 4 |
| 1.006 | S06-C15-10 | 1.84 | | | 146.0 | SURCHARGED | |
| 1.007 | S06-C15-11 | 0.12 | 0.0 | | 7.0 | SURCHARGED | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Catchment 16 - Ch 47230

Pipe Sizes Min 150 Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 20.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Network Design Table for Catchment 16 - Ch 47230

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 32.033 | 1.259 | 25.4 | 0.012 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.001 | 33.404 | 2.137 | 15.6 | 0.012 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.002 | 48.211 | 4.912 | 9.8 | 0.024 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.003 | 47.233 | 3.106 | 15.2 | 0.042 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.004 | 44.856 | 0.873 | 51.4 | 0.030 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.005 | 45.096 | 0.268 | 168.2 | 0.017 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.006 | 16.823 | 0.632 | 26.6 | 0.010 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.007 | 62.308 | 5.205 | 12.0 | 0.031 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.008 | 7.500 | 0.045 | 166.7 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 2.000 | 38.423 | 1.236 | 31.1 | 0.014 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 2.001 | 36.068 | 2.159 | 16.7 | 0.013 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 2.002 | 48.642 | 4.963 | 9.8 | 0.029 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 2.003 | 36.141 | 3.045 | 11.9 | 0.028 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 2.004 | 44.947 | 0.884 | 50.8 | 0.031 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.005 | 45.254 | 0.269 | 168.2 | 0.017 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.006 | 18.521 | 0.631 | 29.3 | 0.014 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.007 | 62.410 | 5.250 | 11.9 | 0.032 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 76.77 | 5.27 | 177.508 | 0.012 | 0.0 | 0.0 | 0.0 | 2.00 | 35.4 | 2.4 |
| 1.001 | 75.57 | 5.48 | 176.249 | 0.024 | 0.0 | 0.0 | 0.0 | 2.56 | 45.3 | 4.8 |
| 1.002 | 74.25 | 5.73 | 174.112 | 0.048 | 0.0 | 0.0 | 0.0 | 3.24 | 57.2 | 9.6 |
| 1.003 | 72.71 | 6.04 | 169.200 | 0.090 | 0.0 | 0.0 | 0.0 | 2.60 | 45.9 | 17.7 |
| 1.004 | 70.76 | 6.44 | 166.019 | 0.120 | 0.0 | 0.0 | 0.0 | 1.83 | 72.7 | 23.0 |
| 1.005 | 67.50 | 7.19 | 165.146 | 0.137 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 25.1 |
| 1.006 | 67.05 | 7.30 | 164.878 | 0.148 | 0.0 | 0.0 | 0.0 | 2.55 | 101.2 | 26.8 |
| 1.007 | 65.97 | 7.57 | 164.246 | 0.179 | 0.0 | 0.0 | 0.0 | 3.80 | 151.2 | 31.9 |
| 1.008 | 65.58 | 7.68 | 158.966 | 0.179 | 0.0 | 0.0 | 0.0 | 1.22 | 85.9 | 31.9 |
| 2.000 | 76.29 | 5.35 | 177.508 | 0.014 | 0.0 | 0.0 | 0.0 | 1.81 | 32.0 | 2.9 |
| 2.001 | 74.97 | 5.60 | 176.272 | 0.027 | 0.0 | 0.0 | 0.0 | 2.48 | 43.8 | 5.4 |
| 2.002 | 73.66 | 5.85 | 174.113 | 0.056 | 0.0 | 0.0 | 0.0 | 3.24 | 57.2 | 11.1 |
| 2.003 | 72.63 | 6.05 | 169.150 | 0.083 | 0.0 | 0.0 | 0.0 | 2.94 | 52.0 | 16.4 |
| 2.004 | 70.69 | 6.46 | 166.030 | 0.114 | 0.0 | 0.0 | 0.0 | 1.84 | 73.1 | 21.8 |
| 2.005 | 67.43 | 7.21 | 165.146 | 0.131 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 23.8 |
| 2.006 | 66.92 | 7.34 | 164.877 | 0.145 | 0.0 | 0.0 | 0.0 | 2.42 | 96.4 | 26.3 |
| 2.007 | 65.84 | 7.61 | 164.245 | 0.177 | 0.0 | 0.0 | 0.0 | 3.82 | 151.7 | 31.6 |

## Network Design Table for Catchment 16 - Ch 47230

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.009 | 55.000 | 0.228 | 241.6 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.010 | 62.360 | 0.258 | 241.7 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.011 | 88.264 | 0.365 | 241.8 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |

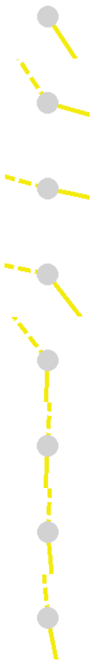
## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.009 | 62.31 | 8.59 | 158.921 | 0.356 | 0.0 | 0.0 | 0.0 | 1.01 | 71.2 | 60.0 |
| 1.010 | 59.05 | 9.62 | 158.693 | 0.356 | 0.0 | 0.0 | 0.0 | 1.01 | 71.2 | 60.0 |
| 1.011 | 55.09 | 11.08 | 158.435 | 0.356 | 0.0 | 0.0 | 0.0 | 1.01 | 71.2 | 60.0 |

## Manhole Schedules for Catchment 16 - Ch 47230

| **MH Name** | **MH CL (m)** | **MH Depth (m)** | **MH Connection** | **MH Diam.,L*W (mm)** | **PN** | **Pipe Out Invert Level (m)** | **Diameter (mm)** | **PN** | **Pipes In Invert Level (m)** | **Diameter (mm)** | **Backdrop (mm)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C16-1 | 178.858 | 1.350 | Open Manhole | 1200 | 1.000 | 177.508 | 150 | | | | |
| S06-C16-2 | 177.599 | 1.350 | Open Manhole | 1200 | 1.001 | 176.249 | 150 | 1.000 | 176.249 | 150 | |
| S06-C16-3 | 175.462 | 1.350 | Open Manhole | 1200 | 1.002 | 174.112 | 150 | 1.001 | 174.112 | 150 | |
| S06-C16-4 | 170.550 | 1.350 | Open Manhole | 1200 | 1.003 | 169.200 | 150 | 1.002 | 169.200 | 150 | |
| S06-C16-5 | 167.444 | 1.425 | Open Manhole | 1200 | 1.004 | 166.019 | 225 | 1.003 | 166.094 | 150 | |
| S06-C16-6 | 166.571 | 1.425 | Open Manhole | 1200 | 1.005 | 165.146 | 225 | 1.004 | 165.146 | 225 | |
| S06-C16-7 | 166.350 | 1.472 | Open Manhole | 1200 | 1.006 | 164.878 | 225 | 1.005 | 164.878 | 225 | |
| S06-C16-8 | 165.671 | 1.425 | Open Manhole | 1200 | 1.007 | 164.246 | 225 | 1.006 | 164.246 | 225 | |
| S06-C16-9 | 159.757 | 0.791 | Open Manhole | 1200 | 1.008 | 158.966 | 300 | 1.007 | 159.041 | 225 | |
| S06-C16-10 | 178.858 | 1.350 | Open Manhole | 1200 | 2.000 | 177.508 | 150 | | | | |
| S06-C16-11 | 177.622 | 1.350 | Open Manhole | 1200 | 2.001 | 176.272 | 150 | 2.000 | 176.272 | 150 | |
| S06-C16-12 | 175.463 | 1.350 | Open Manhole | 1200 | 2.002 | 174.113 | 150 | 2.001 | 174.113 | 150 | |
| S06-C16-13 | 170.500 | 1.350 | Open Manhole | 1200 | 2.003 | 169.150 | 150 | 2.002 | 169.150 | 150 | |
| S06-C16-14 | 167.455 | 1.425 | Open Manhole | 1200 | 2.004 | 166.030 | 225 | 2.003 | 166.105 | 150 | |
| S06-C16-15 | 166.571 | 1.425 | Open Manhole | 1200 | 2.005 | 165.146 | 225 | 2.004 | 165.146 | 225 | |
| S06-C16-16 | 166.360 | 1.483 | Open Manhole | 1200 | 2.006 | 164.877 | 225 | 2.005 | 164.877 | 225 | |
| S06-C16-17 | 165.670 | 1.425 | Open Manhole | 1200 | 2.007 | 164.245 | 225 | 2.006 | 164.245 | 225 | |
| S06-C16-18 | 159.757 | 0.836 | Open Manhole | 1200 | 1.009 | 158.921 | 300 | 1.008 | 158.921 | 300 | |
| | | | | | | | | 2.007 | 158.996 | 225 | |
| S06-C16-19 | 161.718 | 3.025 | Open Manhole | 1200 | 1.010 | 158.693 | 300 | 1.009 | 158.693 | 300 | |
| S06-C16-21 | 159.735 | 1.300 | Open Manhole | 1200 | 1.011 | 158.435 | 300 | 1.010 | 158.435 | 300 | |
| Outfall 16 | 158.435 | 0.365 | Open Manhole | 0 | | OUTFALL | | 1.011 | 158.070 | 300 | |

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S06-C16-1 | 377957.307 | 515310.001 | 377957.307 | 515310.001 | Required | |
| S06-C16-2 | 377974.342 | 515284.137 | 377974.342 | 515284.137 | Required | |
| S06-C16-3 | 378006.497 | 515275.086 | 378006.497 | 515275.086 | Required | |
| S06-C16-4 | 378053.670 | 515265.136 | 378053.670 | 515265.136 | Required | |
| S06-C16-5 | 378080.438 | 515230.896 | 378080.438 | 515230.896 | Required | |
| S06-C16-6 | 378078.316 | 515186.090 | 378078.316 | 515186.090 | Required | |
| S06-C16-7 | 378076.188 | 515141.044 | 378076.188 | 515141.044 | Required | |
| S06-C16-8 | 378077.724 | 515124.351 | 378077.724 | 515124.351 | Required | |



## Manhole Schedules for Catchment 16 - Ch 47230

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C16-9 | 378090.209 | 515063.307 | 378090.209 | 515063.307 | Required |  |
| S06-C16-10 | 377949.879 | 515308.915 | 377949.879 | 515308.915 | Required |  |
| S06-C16-11 | 377970.306 | 515277.826 | 377970.306 | 515277.826 | Required |  |
| S06-C16-12 | 378004.937 | 515267.749 | 378004.937 | 515267.749 | Required |  |
| S06-C16-13 | 378052.531 | 515257.707 | 378052.531 | 515257.707 | Required |  |
| S06-C16-14 | 378072.948 | 515231.342 | 378072.948 | 515231.342 | Required |  |
| S06-C16-15 | 378070.825 | 515186.445 | 378070.825 | 515186.445 | Required |  |
| S06-C16-16 | 378068.683 | 515141.242 | 378068.683 | 515141.242 | Required |  |
| S06-C16-17 | 378070.373 | 515122.863 | 378070.373 | 515122.863 | Required |  |
| S06-C16-18 | 378082.879 | 515061.719 | 378082.879 | 515061.719 | Required |  |
| S06-C16-19 | 378027.880 | 515061.493 | 378027.880 | 515061.493 | Required |  |
| S06-C16-21 | 377965.520 | 515061.180 | 377965.520 | 515061.180 | Required |  |
| Outfall 16 | 377885.198 | 515024.589 | | | No Entry |  |

## Area Summary for Catchment 16 - Ch 47230

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | User | - | 100 | 0.009 | 0.009 | 0.009 |
| | User | - | 50 | 0.005 | 0.002 | 0.012 |
| 1.001 | User | - | 100 | 0.009 | 0.009 | 0.009 |
| | User | - | 50 | 0.005 | 0.003 | 0.012 |
| 1.002 | User | - | 100 | 0.014 | 0.014 | 0.014 |
| | User | - | 50 | 0.007 | 0.004 | 0.018 |
| | User | - | 25 | 0.024 | 0.006 | 0.024 |
| 1.003 | User | - | 100 | 0.014 | 0.014 | 0.014 |
| | User | - | 50 | 0.007 | 0.003 | 0.018 |
| | User | - | 25 | 0.099 | 0.025 | 0.042 |
| 1.004 | User | - | 100 | 0.014 | 0.014 | 0.014 |
| | User | - | 50 | 0.007 | 0.003 | 0.018 |
| | User | - | 25 | 0.049 | 0.012 | 0.030 |
| 1.005 | User | - | 100 | 0.014 | 0.014 | 0.014 |
| | User | - | 50 | 0.007 | 0.004 | 0.017 |
| 1.006 | User | - | 100 | 0.005 | 0.005 | 0.005 |
| | User | - | 50 | 0.003 | 0.001 | 0.006 |
| | User | - | 25 | 0.017 | 0.004 | 0.010 |
| 1.007 | User | - | 100 | 0.016 | 0.016 | 0.016 |
| | User | - | 50 | 0.009 | 0.004 | 0.020 |
| | User | - | 25 | 0.043 | 0.011 | 0.031 |
| 1.008 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 2.000 | User | - | 100 | 0.010 | 0.010 | 0.010 |
| | User | - | 50 | 0.006 | 0.003 | 0.013 |
| | User | - | 25 | 0.004 | 0.001 | 0.014 |
| 2.001 | User | - | 100 | 0.010 | 0.010 | 0.010 |
| | User | - | 50 | 0.005 | 0.003 | 0.012 |
| | User | - | 25 | 0.002 | 0.001 | 0.013 |
| 2.002 | User | - | 100 | 0.014 | 0.014 | 0.014 |
| | User | - | 50 | 0.007 | 0.004 | 0.018 |
| | User | - | 25 | 0.043 | 0.011 | 0.029 |
| 2.003 | User | - | 100 | 0.013 | 0.013 | 0.013 |
| | User | - | 50 | 0.005 | 0.003 | 0.015 |
| | User | - | 25 | 0.048 | 0.012 | 0.028 |
| 2.004 | User | - | 100 | 0.014 | 0.014 | 0.014 |
| | User | - | 50 | 0.007 | 0.003 | 0.018 |
| | User | - | 25 | 0.053 | 0.013 | 0.031 |
| 2.005 | User | - | 100 | 0.014 | 0.014 | 0.014 |
| | User | - | 50 | 0.006 | 0.003 | 0.017 |
| 2.006 | User | - | 100 | 0.005 | 0.005 | 0.005 |
| | User | - | 50 | 0.003 | 0.001 | 0.006 |
| | User | - | 25 | 0.032 | 0.008 | 0.014 |
| 2.007 | User | - | 100 | 0.016 | 0.016 | 0.016 |
| | User | - | 50 | 0.009 | 0.004 | 0.020 |
| | User | - | 25 | 0.048 | 0.012 | 0.032 |
| 1.009 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.010 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.011 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total<br>0.750 | Total<br>0.356 | Total<br>0.356 |

## Online Controls for Catchment 16 - Ch 47230

### Hydro-Brake® Optimum Manhole: S06-C16-21, DS/PN: 1.011, Volume (m³): 5.8

| | |
|---|---|
| Unit Reference | MD-SHE-0098-4300-1000-4300 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 4.3 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 98 |
| Invert Level (m) | 158.435 |
| Minimum Outlet Pipe Diameter (mm) | 150 |
| Suggested Manhole Diameter (mm) | 1200 |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.000 | 4.3 | Kick-Flo® | 0.636 | 3.5 |
| Flush-Flo™ | 0.298 | 4.3 | Mean Flow over Head Range | - | 3.7 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 3.2 | 0.800 | 3.9 | 2.000 | 5.9 | 4.000 | 8.2 | 7.000 | 10.7 |
| 0.200 | 4.2 | 1.000 | 4.3 | 2.200 | 6.2 | 4.500 | 8.7 | 7.500 | 11.1 |
| 0.300 | 4.3 | 1.200 | 4.7 | 2.400 | 6.5 | 5.000 | 9.1 | 8.000 | 11.4 |
| 0.400 | 4.2 | 1.400 | 5.0 | 2.600 | 6.7 | 5.500 | 9.6 | 8.500 | 11.8 |
| 0.500 | 4.1 | 1.600 | 5.3 | 3.000 | 7.2 | 6.000 | 10.0 | 9.000 | 12.1 |
| 0.600 | 3.7 | 1.800 | 5.6 | 3.500 | 7.7 | 6.500 | 10.4 | 9.500 | 12.4 |

## Offline Controls for Catchment 16 - Ch 47230

### Weir Manhole: S06-C16-21, DS/PN: 1.011, Loop to PN: None

Discharge Coef 0.544 Width (m) 10.000 Invert Level (m) 159.435

## Storage Structures for Catchment 16 - Ch 47230

### Tank or Pond Manhole: S06-C16-21, DS/PN: 1.011

Invert Level (m) 158.435

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|---|---|
| 0.000 | 246.0 | 1.000 | 523.1 | 1.300 | 616.8 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 16 - Ch 47230

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10$m^3$/ha Storage 0.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C16-1 | 15 Winter | 5 | +20% | | | | | 177.538 | -0.120 |
| 1.001 | S06-C16-2 | 15 Winter | 5 | +20% | | | | | 176.285 | -0.114 |
| 1.002 | S06-C16-3 | 15 Winter | 5 | +20% | | | | | 174.157 | -0.105 |
| 1.003 | S06-C16-4 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 169.270 | -0.080 |
| 1.004 | S06-C16-5 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 166.115 | -0.129 |
| 1.005 | S06-C16-6 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 165.295 | -0.075 |
| 1.006 | S06-C16-7 | 15 Winter | 5 | +20% | | | | | 164.969 | -0.134 |
| 1.007 | S06-C16-8 | 15 Winter | 5 | +20% | | | | | 164.323 | -0.148 |
| 1.008 | S06-C16-9 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 159.265 | 0.000 |
| 2.000 | S06-C16-10 | 15 Winter | 5 | +20% | | | | | 177.542 | -0.116 |
| 2.001 | S06-C16-11 | 15 Winter | 5 | +20% | | | | | 176.311 | -0.111 |
| 2.002 | S06-C16-12 | 15 Winter | 5 | +20% | | | | | 174.161 | -0.102 |
| 2.003 | S06-C16-13 | 15 Winter | 5 | +20% | 100/15 Winter | | | | 169.213 | -0.087 |
| 2.004 | S06-C16-14 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 166.123 | -0.132 |
| 2.005 | S06-C16-15 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 165.290 | -0.080 |
| 2.006 | S06-C16-16 | 15 Winter | 5 | +20% | | | | | 164.969 | -0.133 |
| 2.007 | S06-C16-17 | 15 Winter | 5 | +20% | | | | | 164.322 | -0.148 |
| 1.009 | S06-C16-18 | 15 Winter | 5 | +20% | 5/15 Winter | | | | 159.246 | 0.025 |
| 1.010 | S06-C16-19 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 158.948 | -0.045 |
| 1.011 | S06-C16-21 | 360 Winter | 5 | +20% | 100/15 Winter | | | 0 | 158.717 | -0.018 |

| PN | US/MH Name | Flooded Volume ($m^3$) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C16-1 | 0.000 | 0.09 | | | 2.9 | OK | |
| 1.001 | S06-C16-2 | 0.000 | 0.13 | | | 5.5 | OK | |
| 1.002 | S06-C16-3 | 0.000 | 0.19 | | | 10.6 | OK | |
| 1.003 | S06-C16-4 | 0.000 | 0.44 | | | 19.7 | OK | |
| 1.004 | S06-C16-5 | 0.000 | 0.38 | | | 26.1 | OK | |
| 1.005 | S06-C16-6 | 0.000 | 0.76 | | | 29.0 | OK | |
| 1.006 | S06-C16-7 | 0.000 | 0.34 | | | 31.0 | OK | |
| 1.007 | S06-C16-8 | 0.000 | 0.25 | | | 37.0 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 16 - Ch 47230

| PN | US/MH Name | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|
| 1.008 | S06-C16-9 | 0.000 | 0.59 | | | 36.3 | OK | 6 |
| 2.000 | S06-C16-10 | 0.000 | 0.11 | | | 3.5 | OK | |
| 2.001 | S06-C16-11 | 0.000 | 0.15 | | | 6.2 | OK | |
| 2.002 | S06-C16-12 | 0.000 | 0.22 | | | 12.4 | OK | |
| 2.003 | S06-C16-13 | 0.000 | 0.36 | | | 18.3 | OK | |
| 2.004 | S06-C16-14 | 0.000 | 0.36 | | | 24.9 | OK | |
| 2.005 | S06-C16-15 | 0.000 | 0.73 | | | 27.7 | OK | |
| 2.006 | S06-C16-16 | 0.000 | 0.35 | | | 30.5 | OK | |
| 2.007 | S06-C16-17 | 0.000 | 0.25 | | | 36.8 | OK | |
| 1.009 | S06-C16-18 | 0.000 | 1.05 | | | 70.5 | SURCHARGED | |
| 1.010 | S06-C16-19 | 0.000 | 0.99 | | | 67.2 | OK | |
| 1.011 | S06-C16-21 | 0.000 | 0.06 | 0.0 | | 4.2 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 16 - Ch 47230

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C16-1 | 15 Winter | 100 | +40% | | | | | 177.553 | -0.105 |
| 1.001 | S06-C16-2 | 15 Winter | 100 | +40% | | | | | 176.307 | -0.092 |
| 1.002 | S06-C16-3 | 15 Winter | 100 | +40% | | | | | 174.188 | -0.074 |
| 1.003 | S06-C16-4 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 169.955 | 0.605 |
| 1.004 | S06-C16-5 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 166.603 | 0.360 |
| 1.005 | S06-C16-6 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 165.934 | 0.563 |
| 1.006 | S06-C16-7 | 15 Winter | 100 | +40% | | | | | 165.028 | -0.074 |
| 1.007 | S06-C16-8 | 15 Winter | 100 | +40% | | | | | 164.370 | -0.101 |
| 1.008 | S06-C16-9 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 159.775 | 0.510 |
| 2.000 | S06-C16-10 | 15 Winter | 100 | +40% | | | | | 177.559 | -0.099 |
| 2.001 | S06-C16-11 | 15 Winter | 100 | +40% | | | | | 176.335 | -0.087 |
| 2.002 | S06-C16-12 | 15 Winter | 100 | +40% | | | | | 174.196 | -0.067 |
| 2.003 | S06-C16-13 | 15 Winter | 100 | +40% | 100/15 Winter | | | | 169.322 | 0.022 |
| 2.004 | S06-C16-14 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 166.630 | 0.375 |
| 2.005 | S06-C16-15 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 165.959 | 0.589 |
| 2.006 | S06-C16-16 | 15 Winter | 100 | +40% | | | | | 165.036 | -0.066 |
| 2.007 | S06-C16-17 | 15 Winter | 100 | +40% | | | | | 164.372 | -0.098 |
| 1.009 | S06-C16-18 | 15 Winter | 100 | +40% | 5/15 Winter | | | | 159.756 | 0.535 |
| 1.010 | S06-C16-19 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 159.331 | 0.338 |
| 1.011 | S06-C16-21 | 480 Winter | 100 | +40% | 100/15 Winter | | | 0 | 159.102 | 0.367 |

| PN | US/MH Name | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C16-1 | 0.000 | 0.19 | | | 6.5 | OK | |
| 1.001 | S06-C16-2 | 0.000 | 0.31 | | | 13.6 | OK | |
| 1.002 | S06-C16-3 | 0.000 | 0.50 | | | 27.9 | OK | |
| 1.003 | S06-C16-4 | 0.000 | 1.04 | | | 46.4 | SURCHARGED | |
| 1.004 | S06-C16-5 | 0.000 | 0.87 | | | 60.4 | SURCHARGED | |
| 1.005 | S06-C16-6 | 0.000 | 1.74 | | | 66.5 | SURCHARGED | |
| 1.006 | S06-C16-7 | 0.000 | 0.78 | | | 70.1 | OK | |
| 1.007 | S06-C16-8 | 0.000 | 0.57 | | | 83.3 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 16 - Ch 47230

| PN | US/MH Name | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|
| 1.008 | S06-C16-9 | 18.865 | 1.44 | | | 88.1 | FLOOD | 6 |
| 2.000 | S06-C16-10 | 0.000 | 0.25 | | | 7.7 | OK | |
| 2.001 | S06-C16-11 | 0.000 | 0.36 | | | 15.3 | OK | |
| 2.002 | S06-C16-12 | 0.000 | 0.58 | | | 32.5 | OK | |
| 2.003 | S06-C16-13 | 0.000 | 0.96 | | | 48.0 | SURCHARGED | |
| 2.004 | S06-C16-14 | 0.000 | 0.89 | | | 62.2 | SURCHARGED | |
| 2.005 | S06-C16-15 | 0.000 | 1.76 | | | 67.0 | SURCHARGED | |
| 2.006 | S06-C16-16 | 0.000 | 0.84 | | | 72.4 | OK | |
| 2.007 | S06-C16-17 | 0.000 | 0.59 | | | 86.0 | OK | |
| 1.009 | S06-C16-18 | 0.000 | 1.60 | | | 108.0 | FLOOD RISK | |
| 1.010 | S06-C16-19 | 0.000 | 1.45 | | | 98.7 | SURCHARGED | |
| 1.011 | S06-C16-21 | 0.000 | 0.06 | 0.0 | | 4.1 | SURCHARGED | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Catchment 17 - Ch 47130

Pipe Sizes Min 150 Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 20.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Network Design Table for Catchment 17 - Ch 47130

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 59.790 | 0.592 | 101.0 | 0.045 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.001 | 59.769 | 1.199 | 49.8 | 0.047 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.002 | 61.384 | 0.375 | 163.7 | 0.049 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.003 | 13.055 | 0.114 | 114.6 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.000 | 59.008 | 0.585 | 100.9 | 0.034 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 2.001 | 59.009 | 1.208 | 48.9 | 0.036 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 2.002 | 60.661 | 0.500 | 121.3 | 0.041 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.004 | 9.047 | 0.038 | 238.1 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.005 | 91.072 | 0.861 | 105.8 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.006 | 44.040 | 0.147 | 300.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.007 | 85.059 | 0.567 | 150.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |

### Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 72.90 | 6.00 | 176.979 | 0.045 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 8.9 |
| 1.001 | 69.63 | 6.69 | 176.387 | 0.092 | 0.0 | 0.0 | 0.0 | 1.43 | 25.2 | 17.3 |
| 1.002 | 65.50 | 7.70 | 175.113 | 0.140 | 0.0 | 0.0 | 0.0 | 1.02 | 40.5 | 24.9 |
| 1.003 | 64.83 | 7.88 | 174.738 | 0.140 | 0.0 | 0.0 | 0.0 | 1.22 | 48.5 | 24.9 |
| 2.000 | 72.97 | 5.98 | 176.992 | 0.034 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 6.8 |
| 2.001 | 69.76 | 6.66 | 176.407 | 0.070 | 0.0 | 0.0 | 0.0 | 1.44 | 25.5 | 13.3 |
| 2.002 | 66.20 | 7.52 | 175.124 | 0.112 | 0.0 | 0.0 | 0.0 | 1.19 | 47.2 | 20.0 |
| 1.004 | 64.28 | 8.02 | 174.549 | 0.252 | 0.0 | 0.0 | 0.0 | 1.01 | 71.7 | 43.9 |
| 1.005 | 60.90 | 9.02 | 174.511 | 0.252 | 0.0 | 0.0 | 0.0 | 1.53 | 108.0 | 43.9 |
| 1.006 | 58.43 | 9.83 | 173.650 | 0.252 | 0.0 | 0.0 | 0.0 | 0.90 | 63.8 | 43.9 |
| 1.007 | 55.45 | 10.94 | 173.503 | 0.252 | 0.0 | 0.0 | 0.0 | 1.28 | 90.6 | 43.9 |

## Network Design Table for Catchment 17 - Ch 47130

| **PN** | **Length (m)** | **Fall (m)** | **Slope (1:X)** | **I.Area (ha)** | **T.E. (mins)** | **Base Flow (l/s)** | **k (mm)** | **HYD SECT** | **DIA (mm)** | **Section Type** | **Auto Design** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.008 | 38.256 | 1.766 | 21.7 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.009 | 59.477 | 2.974 | 20.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |

## Network Results Table

| **PN** | **Rain (mm/hr)** | **T.C. (mins)** | **US/IL (m)** | **Σ I.Area (ha)** | **Σ Base Flow (l/s)** | **Foul (l/s)** | **Add Flow (l/s)** | **Vel (m/s)** | **Cap (l/s)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.008 | 54.98 | 11.13 | 172.936 | 0.252 | 0.0 | 0.0 | 0.0 | 3.39 | 239.9 | 43.9 |
| 1.009 | 54.29 | 11.41 | 171.170 | 0.252 | 0.0 | 0.0 | 0.0 | 3.53 | 249.6 | 43.9 |

## Manhole Schedules for Catchment 17 - Ch 47130

| **MH Name** | **MH CL (m)** | **MH Depth (m)** | **MH Connection** | **MH Diam.,L*W (mm)** | **PN** | **Pipe Out Invert Level (m)** | **Diameter (mm)** | **PN** | **Pipes In Invert Level (m)** | **Diameter (mm)** | **Backdr (mm** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C17-1 | 178.329 | 1.350 | Open Manhole | 1200 | 1.000 | 176.979 | 150 | | | | |
| S06-C17-2 | 177.787 | 1.400 | Open Manhole | 1200 | 1.001 | 176.387 | 150 | 1.000 | 176.387 | 150 | |
| S06-C17-3 | 176.538 | 1.425 | Open Manhole | 1200 | 1.002 | 175.113 | 225 | 1.001 | 175.188 | 150 | |
| S06-C17-4 | 175.487 | 0.749 | Open Manhole | 1200 | 1.003 | 174.738 | 225 | 1.002 | 174.738 | 225 | |
| S06-C17-5 | 178.342 | 1.350 | Open Manhole | 1200 | 2.000 | 176.992 | 150 | | | | |
| S06-C17-6 | 177.798 | 1.391 | Open Manhole | 1200 | 2.001 | 176.407 | 150 | 2.000 | 176.407 | 150 | |
| S06-C17-7 | 176.549 | 1.425 | Open Manhole | 1200 | 2.002 | 175.124 | 225 | 2.001 | 175.199 | 150 | |
| S06-C17-8 | 177.022 | 2.472 | Open Manhole | 1200 | 1.004 | 174.549 | 300 | 1.003 | 174.624 | 225 | |
| | | | | | | | | 2.002 | 174.624 | 225 | |
| S06-C17-9 | 176.900 | 2.389 | Open Manhole | 1200 | 1.005 | 174.511 | 300 | 1.004 | 174.511 | 300 | |
| S06-C17-13 | 177.552 | 3.902 | Open Manhole | 1200 | 1.006 | 173.650 | 300 | 1.005 | 173.650 | 300 | |
| S06-C17-14 | 177.641 | 4.138 | Open Manhole | 1200 | 1.007 | 173.503 | 300 | 1.006 | 173.503 | 300 | |
| S06-C17-15 | 174.377 | 1.441 | Open Manhole | 1200 | 1.008 | 172.936 | 300 | 1.007 | 172.936 | 300 | |
| S06-C17-16 | 172.095 | 0.925 | Open Manhole | 1200 | 1.009 | 171.170 | 300 | 1.008 | 171.170 | 300 | |
| Outfall 17 | 168.522 | 0.326 | Open Manhole | 0 | | OUTFALL | | 1.009 | 168.196 | 300 | |

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S06-C17-1 | 378086.439 | 515198.425 | 378086.439 | 515198.425 | Required |  |
| S06-C17-2 | 378026.703 | 515200.730 | 378026.703 | 515200.730 | Required |  |
| S06-C17-3 | 377967.222 | 515206.504 | 377967.222 | 515206.504 | Required |  |
| S06-C17-4 | 377906.582 | 515215.973 | 377906.582 | 515215.973 | Required |  |
| S06-C17-5 | 378086.500 | 515211.210 | 378086.500 | 515211.210 | Required |  |
| S06-C17-6 | 378027.544 | 515213.505 | 378027.544 | 515213.505 | Required |  |
| S06-C17-7 | 377968.820 | 515219.202 | 377968.820 | 515219.202 | Required |  |

## Manhole Schedules for Catchment 17 - Ch 47130

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C17-8 | 377908.938 | 515228.814 | 377908.938 | 515228.814 | Required |  |
| S06-C17-9 | 377911.043 | 515237.612 | 377911.043 | 515237.612 | Required | |
| S06-C17-13 | 378001.668 | 515246.622 | 378001.668 | 515246.622 | Required | |
| S06-C17-14 | 378033.328 | 515216.008 | 378033.328 | 515216.008 | Required | |
| S06-C17-15 | 378037.605 | 515131.057 | 378037.605 | 515131.057 | Required | |
| S06-C17-16 | 378036.550 | 515092.816 | 378036.550 | 515092.816 | Required | |
| Outfall 17 | 378033.303 | 515033.428 | | | No Entry | |

## Area Summary for Catchment 17 - Ch 47130

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | User | - | 100 | 0.033 | 0.033 | 0.033 |
| | User | - | 50 | 0.021 | 0.010 | 0.043 |
| | User | - | 25 | 0.006 | 0.001 | 0.045 |
| 1.001 | User | - | 100 | 0.033 | 0.033 | 0.033 |
| | User | - | 50 | 0.021 | 0.010 | 0.044 |
| | User | - | 25 | 0.012 | 0.003 | 0.047 |
| 1.002 | User | - | 100 | 0.036 | 0.036 | 0.036 |
| | User | - | 50 | 0.019 | 0.009 | 0.045 |
| | User | - | 25 | 0.014 | 0.003 | 0.049 |
| 1.003 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 2.000 | User | - | 100 | 0.027 | 0.027 | 0.027 |
| | User | - | 50 | 0.015 | 0.007 | 0.034 |
| 2.001 | User | - | 100 | 0.027 | 0.027 | 0.027 |
| | User | - | 50 | 0.015 | 0.007 | 0.035 |
| | User | - | 25 | 0.006 | 0.002 | 0.036 |
| 2.002 | User | - | 100 | 0.031 | 0.031 | 0.031 |
| | User | - | 50 | 0.014 | 0.007 | 0.038 |
| | User | - | 25 | 0.015 | 0.004 | 0.041 |
| 1.004 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.005 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.006 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.007 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.008 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.009 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total | Total | Total |
| | | | | 0.344 | 0.252 | 0.252 |

## Online Controls for Catchment 17 - Ch 47130

### Hydro-Brake® Optimum Manhole: S06-C17-13, DS/PN: 1.006, Volume (m³): 10.8

| | |
|---|---|
| Unit Reference | MD-SHE-0078-2700-1000-2700 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 2.7 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 78 |
| Invert Level (m) | 173.650 |
| Minimum Outlet Pipe Diameter (mm) | 100 |
| Suggested Manhole Diameter (mm) | 1200 |

| **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|
| Design Point (Calculated) | 1.000 | 2.7 |
| Flush-Flo™ | 0.300 | 2.7 |
| Kick-Flo® | 0.622 | 2.2 |
| Mean Flow over Head Range | - | 2.4 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|
| 0.100 | 2.2 | 1.200 | 2.9 | 3.000 | 4.5 | 7.000 | 6.7 |
| 0.200 | 2.6 | 1.400 | 3.2 | 3.500 | 4.8 | 7.500 | 6.9 |
| 0.300 | 2.7 | 1.600 | 3.4 | 4.000 | 5.1 | 8.000 | 7.1 |
| 0.400 | 2.7 | 1.800 | 3.5 | 4.500 | 5.4 | 8.500 | 7.3 |
| 0.500 | 2.5 | 2.000 | 3.7 | 5.000 | 5.7 | 9.000 | 7.5 |
| 0.600 | 2.3 | 2.200 | 3.9 | 5.500 | 6.0 | 9.500 | 7.7 |
| 0.800 | 2.4 | 2.400 | 4.0 | 6.000 | 6.2 | | |
| 1.000 | 2.7 | 2.600 | 4.2 | 6.500 | 6.5 | | |

## Offline Controls for Catchment 17 - Ch 47130

### Weir Manhole: S06-C17-13, DS/PN: 1.006, Loop to PN: None

Discharge Coef 0.544 Width (m) 10.000 Invert Level (m) 174.650

## Storage Structures for Catchment 17 - Ch 47130

### Tank or Pond Manhole: S06-C17-13, DS/PN: 1.006

Invert Level (m) 173.650

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|---|---|---|---|
| 0.000 | 77.5 | 1.000 | 208.9 | 1.300 | 259.3 | 3.902 | 1092.6 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 17 - Ch 47130

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 0.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 1 |
| Number of Online Controls | 1 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 1 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Ratio R | 0.300 |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 20.000 | Cv (Winter) | 0.840 |

| | | | |
|---|---|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 | DVD Status | OFF |
| Analysis Timestep | Fine | Inertia Status | OFF |
| DTS Status | ON | | |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| 1.000 | S06-C17-1 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| 1.001 | S06-C17-2 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| 1.002 | S06-C17-3 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| 1.003 | S06-C17-4 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| 2.000 | S06-C17-5 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| 2.001 | S06-C17-6 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| 2.002 | S06-C17-7 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| 1.004 | S06-C17-8 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| 1.005 | S06-C17-9 | 15 Winter | 5 | +20% | | | |
| 1.006 | S06-C17-13 | 240 Winter | 5 | +20% | 5/30 Summer | | 100/180 Winter |
| 1.007 | S06-C17-14 | 720 Winter | 5 | +20% | | | |
| 1.008 | S06-C17-15 | 960 Summer | 5 | +20% | | | |
| 1.009 | S06-C17-16 | 480 Winter | 5 | +20% | | | |

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C17-1 | | 177.069 | -0.060 | 0.000 | 0.63 | | | 10.9 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 17 - Ch 47130

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume ($m^3$) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|
| 1.001 | S06-C17-2 |  | 176.493 | -0.044 | 0.000 | 0.82 |  |  | 20.2 |
| 1.002 | S06-C17-3 |  | 175.264 | -0.074 | 0.000 | 0.75 |  |  | 29.3 |
| 1.003 | S06-C17-4 |  | 174.877 | -0.086 | 0.000 | 0.70 |  |  | 29.2 |
| 2.000 | S06-C17-5 |  | 177.067 | -0.074 | 0.000 | 0.48 |  |  | 8.3 |
| 2.001 | S06-C17-6 |  | 176.495 | -0.062 | 0.000 | 0.62 |  |  | 15.6 |
| 2.002 | S06-C17-7 |  | 175.242 | -0.108 | 0.000 | 0.52 |  |  | 23.6 |
| 1.004 | S06-C17-8 |  | 174.782 | -0.067 | 0.000 | 0.96 |  |  | 52.6 |
| 1.005 | S06-C17-9 |  | 174.661 | -0.150 | 0.000 | 0.49 |  |  | 51.2 |
| 1.006 | S06-C17-13 | 7 | 174.149 | 0.199 | 0.000 | 0.05 | 0.0 |  | 2.7 |
| 1.007 | S06-C17-14 |  | 173.538 | -0.266 | 0.000 | 0.03 |  |  | 2.7 |
| 1.008 | S06-C17-15 |  | 172.953 | -0.283 | 0.000 | 0.01 |  |  | 2.7 |
| 1.009 | S06-C17-16 |  | 171.186 | -0.284 | 0.000 | 0.01 |  |  | 2.7 |

| PN | US/MH Name | Status | Level Exceeded |
|---|---|---|---|
| 1.000 | S06-C17-1 | OK | 3 |
| 1.001 | S06-C17-2 | OK | 3 |
| 1.002 | S06-C17-3 | OK |  |
| 1.003 | S06-C17-4 | OK |  |
| 2.000 | S06-C17-5 | OK |  |
| 2.001 | S06-C17-6 | OK |  |
| 2.002 | S06-C17-7 | OK |  |
| 1.004 | S06-C17-8 | OK |  |
| 1.005 | S06-C17-9 | OK |  |
| 1.006 | S06-C17-13 | SURCHARGED |  |
| 1.007 | S06-C17-14 | OK |  |
| 1.008 | S06-C17-15 | OK |  |
| 1.009 | S06-C17-16 | OK |  |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 17 - Ch 47130

### Simulation Criteria

```
         Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 0.000
               Hot Start (mins)     0       MADD Factor * 10m³/ha Storage 0.000
             Hot Start Level (mm)   0                 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
  Foul Sewage per hectare (l/s) 0.000

         Number of Input Hydrographs 0 Number of Storage Structures 1
           Number of Online Controls 1 Number of Time/Area Diagrams 0
          Number of Offline Controls 1 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
Rainfall Model                FSR      Ratio R 0.300
        Region England and Wales Cv (Summer) 0.750
 M5-60 (mm)              20.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0      DVD Status OFF
                 Analysis Timestep  Fine  Inertia Status OFF
                        DTS Status    ON


          Profile(s)                          Summer and Winter
      Duration(s) (mins)     15, 30, 60, 120, 180, 240, 360, 480, 600,
                                                     720, 960, 1440
   Return Period(s) (years)                                    5, 100
      Climate Change (%)                                       20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| 1.000 | S06-C17-1 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| 1.001 | S06-C17-2 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| 1.002 | S06-C17-3 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| 1.003 | S06-C17-4 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| 2.000 | S06-C17-5 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| 2.001 | S06-C17-6 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| 2.002 | S06-C17-7 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| 1.004 | S06-C17-8 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| 1.005 | S06-C17-9 | 15 Winter | 100 | +40% | | | |
| 1.006 | S06-C17-13 | 480 Winter | 100 | +40% | 5/30 Summer | | 100/180 Winter |
| 1.007 | S06-C17-14 | 480 Winter | 100 | +40% | | | |
| 1.008 | S06-C17-15 | 480 Winter | 100 | +40% | | | |
| 1.009 | S06-C17-16 | 480 Winter | 100 | +40% | | | |

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C17-1 | | 178.329 | 1.200 | 0.487 | 1.01 | | | 17.4 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 17 - Ch 47130

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|
| 1.001 | S06-C17-2 | | 177.787 | 1.250 | 0.531 | 1.33 | | | 32.9 |
| 1.002 | S06-C17-3 | | 175.811 | 0.473 | 0.000 | 1.35 | | | 52.7 |
| 1.003 | S06-C17-4 | | 175.116 | 0.153 | 0.000 | 1.22 | | | 51.2 |
| 2.000 | S06-C17-5 | | 177.590 | 0.449 | 0.000 | 0.88 | | | 15.2 |
| 2.001 | S06-C17-6 | | 177.142 | 0.585 | 0.000 | 1.17 | | | 29.2 |
| 2.002 | S06-C17-7 | | 175.510 | 0.161 | 0.000 | 1.05 | | | 47.9 |
| 1.004 | S06-C17-8 | | 174.948 | 0.098 | 0.000 | 1.77 | | | 97.2 |
| 1.005 | S06-C17-9 | | 174.738 | -0.073 | 0.000 | 0.92 | | | 95.6 |
| 1.006 | S06-C17-13 | 7 | 174.663 | 0.713 | 0.000 | 0.05 | 3.6 | | 2.7 |
| 1.007 | S06-C17-14 | | 173.538 | -0.266 | 0.000 | 0.03 | | | 2.7 |
| 1.008 | S06-C17-15 | | 172.954 | -0.283 | 0.000 | 0.01 | | | 2.7 |
| 1.009 | S06-C17-16 | | 171.186 | -0.284 | 0.000 | 0.01 | | | 2.7 |

| PN | US/MH Name | Status | Level Exceeded |
|---|---|---|---|
| 1.000 | S06-C17-1 | FLOOD | 3 |
| 1.001 | S06-C17-2 | FLOOD | 3 |
| 1.002 | S06-C17-3 | SURCHARGED | |
| 1.003 | S06-C17-4 | SURCHARGED | |
| 2.000 | S06-C17-5 | SURCHARGED | |
| 2.001 | S06-C17-6 | SURCHARGED | |
| 2.002 | S06-C17-7 | SURCHARGED | |
| 1.004 | S06-C17-8 | SURCHARGED | |
| 1.005 | S06-C17-9 | OK | |
| 1.006 | S06-C17-13 | SURCHARGED | |
| 1.007 | S06-C17-14 | OK | |
| 1.008 | S06-C17-15 | OK | |
| 1.009 | S06-C17-16 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for Catchment 18 - Ch 47400

Pipe Sizes M8M73M74 Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 20.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

## Network Design Table for Catchment 18 - Ch 47400

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C18-1.000 | 56.000 | 0.555 | 100.9 | 0.010 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| S06-C18-1.001 | 56.000 | 0.555 | 100.9 | 0.073 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| S06-C18-1.002 | 56.149 | 0.334 | 168.2 | 0.059 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S06-C18-1.003 | 14.480 | 0.086 | 168.2 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S06-C18-1.004 | 63.492 | 0.378 | 168.2 | 0.082 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S06-C18-1.005 | 73.250 | 0.374 | 195.9 | 0.077 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S06-C18-1.006 | 73.250 | 1.299 | 56.4 | 0.076 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S06-C18-1.007 | 73.247 | 0.230 | 318.5 | 0.079 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S06-C18-2.000 | 75.000 | 0.445 | 168.4 | 0.177 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S06-C18-2.001 | 75.000 | 0.468 | 160.3 | 0.164 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S06-C18-2.002 | 76.382 | 1.102 | 69.3 | 0.136 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S06-C18-2.003 | 14.494 | 0.045 | 321.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S06-C18-2.004 | 60.045 | 1.051 | 57.1 | 0.077 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S06-C18-2.005 | 70.000 | 1.326 | 52.8 | 0.074 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S06-C18-2.006 | 75.826 | 0.777 | 97.6 | 0.082 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S06-C18-1.008 | 17.457 | 0.223 | 78.3 | 0.117 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S06-C18-1.000 | 73.22 | 5.93 | 170.391 | 0.010 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 1.9 |
| S06-C18-1.001 | 68.88 | 6.87 | 169.836 | 0.083 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 15.5 |
| S06-C18-1.002 | 65.12 | 7.80 | 169.206 | 0.142 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 25.0 |
| S06-C18-1.003 | 64.23 | 8.04 | 168.872 | 0.142 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 25.0 |
| S06-C18-1.004 | 60.67 | 9.09 | 168.786 | 0.224 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 36.8 |
| S06-C18-1.005 | 57.45 | 10.18 | 168.333 | 0.301 | 0.0 | 0.0 | 0.0 | 1.12 | 79.2 | 46.8 |
| S06-C18-1.006 | 55.90 | 10.76 | 167.960 | 0.377 | 0.0 | 0.0 | 0.0 | 2.10 | 148.3 | 57.0 |
| S06-C18-1.007 | 52.97 | 11.97 | 165.714 | 0.456 | 0.0 | 0.0 | 0.0 | 1.01 | 111.5 | 65.4 |
| S06-C18-2.000 | 71.70 | 6.24 | 171.229 | 0.177 | 0.0 | 0.0 | 0.0 | 1.00 | 39.9 | 34.5 |
| S06-C18-2.001 | 67.25 | 7.25 | 170.709 | 0.342 | 0.0 | 0.0 | 0.0 | 1.24 | 87.6 | 62.3 |
| S06-C18-2.002 | 64.64 | 7.93 | 170.241 | 0.478 | 0.0 | 0.0 | 0.0 | 1.89 | 133.7 | 83.7 |
| S06-C18-2.003 | 63.77 | 8.17 | 169.064 | 0.478 | 0.0 | 0.0 | 0.0 | 1.01 | 111.1 | 83.7 |
| S06-C18-2.004 | 62.32 | 8.58 | 169.019 | 0.555 | 0.0 | 0.0 | 0.0 | 2.40 | 265.2 | 93.7 |
| S06-C18-2.005 | 60.79 | 9.05 | 167.968 | 0.629 | 0.0 | 0.0 | 0.0 | 2.50 | 275.9 | 103.6 |
| S06-C18-2.006 | 58.70 | 9.74 | 166.643 | 0.711 | 0.0 | 0.0 | 0.0 | 1.83 | 202.6 | 113.0 |
| S06-C18-1.008 | 52.65 | 12.11 | 165.484 | 1.283 | 0.0 | 0.0 | 0.0 | 2.05 | 226.4 | 183.0 |

## Network Design Table for Catchment 18 - Ch 47400

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C18-3.000 | 27.477 | 0.163 | 168.2 | 0.117 | 5.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S06-C18-3.001 | 25.248 | 0.150 | 168.2 | 0.058 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S06-C18-4.000 | 8.269 | 0.232 | 35.6 | 0.003 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| S06-C18-3.002 | 12.174 | 0.072 | 168.2 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S06-C18-3.003 | 19.379 | 0.115 | 168.2 | 0.029 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S06-C18-3.004 | 17.730 | 0.073 | 241.9 | 0.041 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S06-C18-3.005 | 26.209 | 0.377 | 69.5 | 0.069 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S06-C18-3.006 | 28.656 | 0.680 | 42.2 | 0.069 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S06-C18-3.007 | 52.476 | 0.926 | 56.7 | 0.119 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S06-C18-3.008 | 34.159 | 0.561 | 60.9 | 0.071 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S06-C18-3.009 | 42.000 | 0.769 | 54.6 | 0.083 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S06-C18-3.010 | 42.000 | 0.328 | 128.0 | 0.086 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S06-C18-3.011 | 42.476 | 0.336 | 126.2 | 0.089 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| S06-C18-5.000 | 59.990 | 0.594 | 100.9 | 0.080 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| S06-C18-5.001 | 60.036 | 0.357 | 168.2 | 0.051 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S06-C18-5.002 | 14.520 | 0.086 | 168.2 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S06-C18-6.000 | 13.012 | 0.307 | 42.4 | 0.072 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| S06-C18-5.003 | 80.000 | 1.225 | 65.3 | 0.114 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S06-C18-5.004 | 72.000 | 1.802 | 39.9 | 0.155 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| S06-C18-5.005 | 48.000 | 0.964 | 49.8 | 0.096 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S06-C18-5.006 | 48.000 | 0.885 | 54.2 | 0.096 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| S06-C18-5.007 | 49.191 | 0.428 | 115.0 | 0.102 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S06-C18-3.000 | 75.72 | 5.46 | 170.339 | 0.117 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 24.1 |
| S06-C18-3.001 | 73.52 | 5.87 | 170.175 | 0.176 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 35.0 |
| S06-C18-4.000 | 77.84 | 5.08 | 170.914 | 0.003 | 0.0 | 0.0 | 0.0 | 1.69 | 29.9 | 0.6 |
| S06-C18-3.002 | 72.51 | 6.08 | 170.025 | 0.178 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 35.0 |
| S06-C18-3.003 | 70.98 | 6.40 | 169.953 | 0.207 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 39.9 |
| S06-C18-3.004 | 69.64 | 6.69 | 169.763 | 0.249 | 0.0 | 0.0 | 0.0 | 1.01 | 71.1 | 46.9 |
| S06-C18-3.005 | 68.64 | 6.92 | 169.689 | 0.318 | 0.0 | 0.0 | 0.0 | 1.89 | 133.5 | 59.1 |
| S06-C18-3.006 | 67.81 | 7.12 | 169.312 | 0.387 | 0.0 | 0.0 | 0.0 | 2.43 | 171.7 | 71.1 |
| S06-C18-3.007 | 66.12 | 7.54 | 168.632 | 0.506 | 0.0 | 0.0 | 0.0 | 2.09 | 147.9 | 90.5 |
| S06-C18-3.008 | 65.04 | 7.82 | 167.707 | 0.576 | 0.0 | 0.0 | 0.0 | 2.02 | 142.7 | 101.5 |
| S06-C18-3.009 | 63.84 | 8.15 | 167.146 | 0.659 | 0.0 | 0.0 | 0.0 | 2.13 | 150.7 | 114.0 |
| S06-C18-3.010 | 62.32 | 8.58 | 165.925 | 0.745 | 0.0 | 0.0 | 0.0 | 1.60 | 176.7 | 125.7 |
| S06-C18-3.011 | 60.88 | 9.02 | 165.597 | 0.834 | 0.0 | 0.0 | 0.0 | 1.61 | 178.0 | 137.5 |
| S06-C18-5.000 | 72.89 | 6.00 | 171.828 | 0.080 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 15.7 |
| S06-C18-5.001 | 68.32 | 6.99 | 171.158 | 0.131 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 24.2 |
| S06-C18-5.002 | 67.32 | 7.24 | 170.801 | 0.131 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 24.2 |
| S06-C18-6.000 | 77.50 | 5.14 | 171.097 | 0.072 | 0.0 | 0.0 | 0.0 | 1.55 | 27.4 | 15.2 |
| S06-C18-5.003 | 64.16 | 8.06 | 170.715 | 0.317 | 0.0 | 0.0 | 0.0 | 1.62 | 64.5 | 55.0 |
| S06-C18-5.004 | 62.14 | 8.64 | 169.489 | 0.472 | 0.0 | 0.0 | 0.0 | 2.08 | 82.5 | 79.4 |
| S06-C18-5.005 | 60.97 | 8.99 | 167.612 | 0.568 | 0.0 | 0.0 | 0.0 | 2.23 | 157.9 | 93.8 |
| S06-C18-5.006 | 59.80 | 9.37 | 166.648 | 0.664 | 0.0 | 0.0 | 0.0 | 2.14 | 151.2 | 107.5 |
| S06-C18-5.007 | 58.37 | 9.85 | 165.688 | 0.766 | 0.0 | 0.0 | 0.0 | 1.69 | 186.5 | 121.1 |

## Network Design Table for Catchment 18 - Ch 47400

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C18-1.009 | 9.990 | 0.020 | 500.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔒 |
| S06-C18-1.010 | 41.352 | 0.083 | 500.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔓 |
| S06-C18-1.011 | 41.643 | 2.100 | 19.8 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔓 |
| S06-C18-1.012 | 8.882 | 0.018 | 500.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔓 |
| S06-C18-1.013 | 115.902 | 0.125 | 927.2 | 0.000 | 0.00 | 0.0 | 0.600 | o | 900 | Pipe/Conduit | 🔒 |
| S06-C18-1.014 | 25.485 | 0.100 | 254.9 | 0.240 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔒 |
| S06-C18-1.015 | 42.026 | 0.100 | 420.3 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔓 |
| S06-C18-1.016 | 32.790 | 4.200 | 7.8 | 0.000 | 0.00 | 0.0 | 0.600 | o | 750 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| S06-C18-1.009 | 52.36 | 12.25 | 164.886 | 2.883 | 0.0 | 0.0 | 0.0 | 1.24 | 549.9 | 408.8 |
| S06-C18-1.010 | 51.17 | 12.80 | 164.866 | 2.883 | 0.0 | 0.0 | 0.0 | 1.24 | 549.9 | 408.8 |
| S06-C18-1.011 | 50.94 | 12.91 | 164.783 | 2.883 | 0.0 | 0.0 | 0.0 | 6.30 | 2783.8 | 408.8 |
| S06-C18-1.012 | 50.70 | 13.03 | 162.683 | 2.883 | 0.0 | 0.0 | 0.0 | 1.24 | 549.9 | 408.8 |
| S06-C18-1.013 | 47.18 | 14.92 | 162.665 | 2.883 | 0.0 | 0.0 | 0.0 | 1.02 | 649.3 | 408.8 |
| S06-C18-1.014 | 46.77 | 15.16 | 162.540 | 3.123 | 0.0 | 0.0 | 0.0 | 1.75 | 772.4 | 408.8 |
| S06-C18-1.015 | 45.93 | 15.68 | 162.440 | 3.123 | 0.0 | 0.0 | 0.0 | 1.36 | 600.3 | 408.8 |
| S06-C18-1.016 | 45.84 | 15.73 | 162.340 | 3.123 | 0.0 | 0.0 | 0.0 | 10.05 | 4440.0 | 408.8 |

## Manhole Schedules for Catchment 18 - Ch 47400

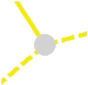
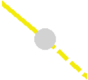
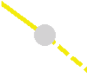
| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | Pipe Out PN | Pipe Out Invert Level (m) | Pipe Out Diameter (mm) | Pipes In PN | Pipes In Invert Level (m) | Pipes In Diameter (mm) | Back (m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C18-1 | 171.741 | 1.350 | Open Manhole | 1200 | S06-C18-1.000 | 170.391 | 150 | | | | |
| S06-C18-2 | 171.901 | 2.065 | Open Manhole | 1200 | S06-C18-1.001 | 169.836 | 150 | S06-C18-1.000 | 169.836 | 150 | |
| S06-C18-3 | 171.777 | 2.571 | Open Manhole | 1200 | S06-C18-1.002 | 169.206 | 225 | S06-C18-1.001 | 169.281 | 150 | |
| S06-C18-4 | 171.563 | 2.691 | Open Manhole | 1200 | S06-C18-1.003 | 168.872 | 225 | S06-C18-1.002 | 168.872 | 225 | |
| S06-C18-5 | 171.635 | 2.849 | Open Manhole | 1200 | S06-C18-1.004 | 168.786 | 225 | S06-C18-1.003 | 168.786 | 225 | |
| S06-C18-6 | 170.756 | 2.422 | Open Manhole | 1200 | S06-C18-1.005 | 168.333 | 300 | S06-C18-1.004 | 168.408 | 225 | |
| S06-C18-7 | 169.460 | 1.500 | Open Manhole | 1200 | S06-C18-1.006 | 167.960 | 300 | S06-C18-1.005 | 167.960 | 300 | |
| S06-C18-8 | 168.161 | 2.447 | Open Manhole | 1350 | S06-C18-1.007 | 165.714 | 375 | S06-C18-1.006 | 166.660 | 300 | |
| S06-C18-9 | 172.654 | 1.425 | Open Manhole | 1200 | S06-C18-2.000 | 171.229 | 225 | | | | |
| S06-C18-10 | 172.594 | 1.885 | Open Manhole | 1200 | S06-C18-2.001 | 170.709 | 300 | S06-C18-2.000 | 170.784 | 225 | |
| S06-C18-11 | 171.741 | 1.500 | Open Manhole | 1200 | S06-C18-2.002 | 170.241 | 300 | S06-C18-2.001 | 170.241 | 300 | |
| S06-C18-12 | 170.639 | 1.575 | Open Manhole | 1350 | S06-C18-2.003 | 169.064 | 375 | S06-C18-2.002 | 169.139 | 300 | |
| S06-C18-13 | 170.680 | 1.661 | Open Manhole | 1350 | S06-C18-2.004 | 169.019 | 375 | S06-C18-2.003 | 169.019 | 375 | |
| S06-C18-14 | 169.543 | 1.575 | Open Manhole | 1350 | S06-C18-2.005 | 167.968 | 375 | S06-C18-2.004 | 167.968 | 375 | |
| S06-C18-15 | 168.218 | 1.575 | Open Manhole | 1350 | S06-C18-2.006 | 166.643 | 375 | S06-C18-2.005 | 166.643 | 375 | |
| S06-C18-16 | 167.441 | 1.957 | Open Manhole | 1350 | S06-C18-1.008 | 165.484 | 375 | S06-C18-1.007 | 165.484 | 375 | |
| | | | | | | | | S06-C18-2.006 | 165.866 | 375 | |
| S06-C18-17 | 171.764 | 1.425 | Open Manhole | 1200 | S06-C18-3.000 | 170.339 | 225 | | | | |
| S06-C18-18 | 171.785 | 1.610 | Open Manhole | 1200 | S06-C18-3.001 | 170.175 | 225 | S06-C18-3.000 | 170.175 | 225 | |
| S06-C18-19 | 172.264 | 1.350 | Open Manhole | 1200 | S06-C18-4.000 | 170.914 | 150 | | | | |
| S06-C18-20 | 172.032 | 2.006 | Open Manhole | 1200 | S06-C18-3.002 | 170.025 | 225 | S06-C18-3.001 | 170.025 | 225 | |
| | | | | | | | | S06-C18-4.000 | 170.682 | 150 | |
| S06-C18-21 | 171.977 | 2.025 | Open Manhole | 1200 | S06-C18-3.003 | 169.953 | 225 | S06-C18-3.002 | 169.953 | 225 | |
| S06-C18-22 | 171.674 | 1.911 | Open Manhole | 1200 | S06-C18-3.004 | 169.763 | 300 | S06-C18-3.003 | 169.838 | 225 | |
| S06-C18-23 | 171.539 | 1.850 | Open Manhole | 1200 | S06-C18-3.005 | 169.689 | 300 | S06-C18-3.004 | 169.689 | 300 | |
| S06-C18-24 | 170.812 | 1.500 | Open Manhole | 1200 | S06-C18-3.006 | 169.312 | 300 | S06-C18-3.005 | 169.312 | 300 | |
| S06-C18-25 | 170.132 | 1.500 | Open Manhole | 1200 | S06-C18-3.007 | 168.632 | 300 | S06-C18-3.006 | 168.632 | 300 | |
| S06-C18-26 | 169.207 | 1.500 | Open Manhole | 1200 | S06-C18-3.008 | 167.707 | 300 | S06-C18-3.007 | 167.707 | 300 | |
| S06-C18-27 | 168.646 | 1.500 | Open Manhole | 1200 | S06-C18-3.009 | 167.146 | 300 | S06-C18-3.008 | 167.146 | 300 | |
| S06-C18-28 | 167.877 | 1.952 | Open Manhole | 1350 | S06-C18-3.010 | 165.925 | 375 | S06-C18-3.009 | 166.377 | 300 | |
| S06-C18-29 | 167.172 | 1.575 | Open Manhole | 1350 | S06-C18-3.011 | 165.597 | 375 | S06-C18-3.010 | 165.597 | 375 | |
| S06-C18-30 | 173.178 | 1.350 | Open Manhole | 1200 | S06-C18-5.000 | 171.828 | 150 | | | | |
| S06-C18-31 | 172.938 | 1.780 | Open Manhole | 1200 | S06-C18-5.001 | 171.158 | 225 | S06-C18-5.000 | 171.233 | 150 | |
| S06-C18-32 | 172.333 | 1.532 | Open Manhole | 1200 | S06-C18-5.002 | 170.801 | 225 | S06-C18-5.001 | 170.801 | 225 | |
| S06-C18-33 | 172.447 | 1.350 | Open Manhole | 1200 | S06-C18-6.000 | 171.097 | 150 | | | | |
| S06-C18-34 | 172.207 | 1.492 | Open Manhole | 1200 | S06-C18-5.003 | 170.715 | 225 | S06-C18-5.002 | 170.715 | 225 | |
| | | | | | | | | S06-C18-6.000 | 170.790 | 150 | |
| S06-C18-35 | 170.914 | 1.425 | Open Manhole | 1200 | S06-C18-5.004 | 169.489 | 225 | S06-C18-5.003 | 169.489 | 225 | |
| S06-C18-36 | 169.112 | 1.500 | Open Manhole | 1200 | S06-C18-5.005 | 167.612 | 300 | S06-C18-5.004 | 167.687 | 225 | |
| S06-C18-37 | 168.148 | 1.500 | Open Manhole | 1200 | S06-C18-5.006 | 166.648 | 300 | S06-C18-5.005 | 166.648 | 300 | |
| S06-C18-38 | 167.263 | 1.575 | Open Manhole | 1350 | S06-C18-5.007 | 165.688 | 375 | S06-C18-5.006 | 165.763 | 300 | |
| S06-C18-39 | 166.911 | 2.025 | Open Manhole | 1800 | S06-C18-1.009 | 164.886 | 750 | S06-C18-1.008 | 165.261 | 375 | |
| | | | | | | | | S06-C18-3.011 | 165.261 | 375 | |
| | | | | | | | | S06-C18-5.007 | 165.261 | 375 | |
| S06-C18-40 | 166.800 | 1.934 | Open Manhole | 1800 | S06-C18-1.010 | 164.866 | 750 | S06-C18-1.009 | 164.866 | 750 | |
| S06-C18-41 | 166.800 | 2.017 | Open Manhole | 1800 | S06-C18-1.011 | 164.783 | 750 | S06-C18-1.010 | 164.783 | 750 | |

## Manhole Schedules for Catchment 18 - Ch 47400

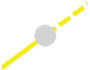
| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Back (m |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C18-42 | 164.200 | 1.517 | Open Manhole | 1800 | S06-C18-1.012 | 162.683 | 750 | S06-C18-1.011 | 162.683 | 750 | |
| S06-C18-43 | 164.200 | 1.535 | Junction | | S06-C18-1.013 | 162.665 | 900 | S06-C18-1.012 | 162.665 | 750 | |
| S06-C18-44 | 164.200 | 1.660 | Junction | | S06-C18-1.014 | 162.540 | 750 | S06-C18-1.013 | 162.540 | 900 | |
| S06-C18-45 | 164.200 | 1.760 | Open Manhole | 1800 | S06-C18-1.015 | 162.440 | 750 | S06-C18-1.014 | 162.440 | 750 | |
| S06-C18-46 | 164.200 | 1.860 | Open Manhole | 1800 | S06-C18-1.016 | 162.340 | 750 | S06-C18-1.015 | 162.340 | 750 | |
| Outfall 18 | 159.800 | 1.660 | Open Manhole | 0 | | OUTFALL | | S06-C18-1.016 | 158.140 | 750 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C18-1 | 378779.233 | 514856.992 | 378779.233 | 514856.992 | Required |  |
| S06-C18-2 | 378740.184 | 514897.131 | 378740.184 | 514897.131 | Required |  |
| S06-C18-3 | 378701.502 | 514937.625 | 378701.502 | 514937.625 | Required |  |
| S06-C18-4 | 378663.031 | 514978.523 | 378663.031 | 514978.523 | Required |  |
| S06-C18-5 | 378652.537 | 514968.545 | 378652.537 | 514968.545 | Required |  |
| S06-C18-6 | 378607.120 | 515012.913 | 378607.120 | 515012.913 | Required |  |
| S06-C18-7 | 378549.161 | 515057.704 | 378549.161 | 515057.704 | Required |  |
| S06-C18-8 | 378485.943 | 515094.705 | 378485.943 | 515094.705 | Required |  |
| S06-C18-9 | 377990.350 | 515179.006 | 377990.350 | 515179.006 | Required |  |
| S06-C18-10 | 378065.222 | 515174.627 | 378065.222 | 515174.627 | Required |  |
| S06-C18-11 | 378140.191 | 515172.468 | 378140.191 | 515172.468 | Required |  |
| S06-C18-12 | 378216.556 | 515170.851 | 378216.556 | 515170.851 | Required |  |
| S06-C18-13 | 378216.118 | 515156.364 | 378216.118 | 515156.364 | Required |  |
| S06-C18-14 | 378276.084 | 515153.282 | 378276.084 | 515153.282 | Required |  |

## Manhole Schedules for Catchment 18 - Ch 47400

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C18-15 | 378345.384 | 515143.411 | 378345.384 | 515143.411 | Required |  |
| S06-C18-16 | 378418.468 | 515123.205 | 378418.468 | 515123.205 | Required |  |
| S06-C18-17 | 378686.530 | 514910.040 | 378686.530 | 514910.040 | Required |  |
| S06-C18-18 | 378662.424 | 514921.883 | 378662.424 | 514921.883 | Required |  |
| S06-C18-19 | 378632.250 | 514910.138 | 378632.250 | 514910.138 | Required |  |
| S06-C18-20 | 378638.509 | 514915.519 | 378638.509 | 514915.519 | Required |  |
| S06-C18-21 | 378631.872 | 514925.725 | 378631.872 | 514925.725 | Required |  |
| S06-C18-22 | 378639.025 | 514943.276 | 378639.025 | 514943.276 | Required |  |
| S06-C18-23 | 378633.642 | 514959.815 | 378633.642 | 514959.815 | Required |  |
| S06-C18-24 | 378615.443 | 514978.675 | 378615.443 | 514978.675 | Required |  |
| S06-C18-25 | 378594.171 | 514997.875 | 378594.171 | 514997.875 | Required |  |
| S06-C18-26 | 378553.871 | 515031.486 | 378553.871 | 515031.486 | Required |  |
| S06-C18-27 | 378526.363 | 515051.737 | 378526.363 | 515051.737 | Required |  |
| S06-C18-28 | 378490.066 | 515072.869 | 378490.066 | 515072.869 | Required |  |
| S06-C18-29 | 378452.271 | 515091.185 | 378452.271 | 515091.185 | Required |  |
| S06-C18-30 | 377999.264 | 515157.973 | 377999.264 | 515157.973 | Required |  |
| S06-C18-31 | 378059.213 | 515155.774 | 378059.213 | 515155.774 | Required |  |
| S06-C18-32 | 378119.242 | 515154.797 | 378119.242 | 515154.797 | Required |  |
| S06-C18-33 | 378105.991 | 515140.502 | 378105.991 | 515140.502 | Required |  |

## Manhole Schedules for Catchment 18 - Ch 47400

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S06-C18-34 | 378119.001 | 515140.279 | 378119.001 | 515140.279 | Required |  |
| S06-C18-35 | 378198.992 | 515139.120 | 378198.992 | 515139.120 | Required |  |
| S06-C18-36 | 378270.930 | 515136.123 | 378270.930 | 515136.123 | Required |  |
| S06-C18-37 | 378318.602 | 515130.525 | 378318.602 | 515130.525 | Required |  |
| S06-C18-38 | 378365.612 | 515120.825 | 378365.612 | 515120.825 | Required |  |
| S06-C18-39 | 378412.736 | 515106.717 | 378412.736 | 515106.717 | Required |  |
| S06-C18-40 | 378409.397 | 515097.301 | 378409.397 | 515097.301 | Required |  |
| S06-C18-41 | 378370.426 | 515111.131 | 378370.426 | 515111.131 | Required |  |
| S06-C18-42 | 378337.029 | 515086.257 | 378337.029 | 515086.257 | Required |  |
| S06-C18-43 | 378329.906 | 515080.951 | | | No Entry |  |
| S06-C18-44 | 378219.724 | 515044.987 | | | No Entry |  |
| S06-C18-45 | 378194.245 | 515044.424 | 378194.245 | 515044.424 | Required |  |
| S06-C18-46 | 378152.226 | 515043.698 | 378152.226 | 515043.698 | Required |  |
| Outfall 18 | 378122.624 | 515057.801 | | | No Entry |  |

## Area Summary for Catchment 18 - Ch 47400

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | User | - | 50 | 0.020 | 0.010 | 0.010 |
| 1.001 | User | - | 100 | 0.065 | 0.065 | 0.065 |
|  | User | - | 50 | 0.016 | 0.008 | 0.073 |
| 1.002 | User | - | 100 | 0.051 | 0.051 | 0.051 |
|  | User | - | 50 | 0.016 | 0.008 | 0.059 |
| 1.003 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.004 | User | - | 100 | 0.082 | 0.082 | 0.082 |
| 1.005 | User | - | 100 | 0.077 | 0.077 | 0.077 |
| 1.006 | User | - | 100 | 0.076 | 0.076 | 0.076 |
| 1.007 | User | - | 100 | 0.079 | 0.079 | 0.079 |
| 2.000 | User | - | 100 | 0.133 | 0.133 | 0.133 |
|  | User | - | 25 | 0.135 | 0.034 | 0.167 |
|  | User | - | 50 | 0.022 | 0.011 | 0.177 |
| 2.001 | User | - | 100 | 0.122 | 0.122 | 0.122 |
|  | User | - | 25 | 0.127 | 0.032 | 0.153 |
|  | User | - | 50 | 0.022 | 0.011 | 0.164 |
| 2.002 | User | - | 100 | 0.097 | 0.097 | 0.097 |
|  | User | - | 25 | 0.110 | 0.027 | 0.125 |
|  | User | - | 50 | 0.023 | 0.011 | 0.136 |
| 2.003 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 2.004 | User | - | 100 | 0.077 | 0.077 | 0.077 |
| 2.005 | User | - | 100 | 0.074 | 0.074 | 0.074 |
| 2.006 | User | - | 100 | 0.082 | 0.082 | 0.082 |
| 1.008 | User | - | 25 | 0.070 | 0.018 | 0.018 |
|  | User | - | 50 | 0.084 | 0.042 | 0.060 |
|  | User | - | 50 | 0.114 | 0.057 | 0.117 |
| 3.000 | User | - | 100 | 0.113 | 0.113 | 0.113 |
|  | User | - | 50 | 0.005 | 0.003 | 0.116 |
|  | User | - | 25 | 0.006 | 0.001 | 0.117 |
| 3.001 | User | - | 100 | 0.056 | 0.056 | 0.056 |
|  | User | - | 50 | 0.004 | 0.002 | 0.058 |
| 4.000 | User | - | 100 | 0.002 | 0.002 | 0.002 |
|  | User | - | 50 | 0.002 | 0.001 | 0.003 |
| 3.002 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 3.003 | User | - | 100 | 0.026 | 0.026 | 0.026 |
|  | User | - | 50 | 0.006 | 0.003 | 0.029 |
| 3.004 | User | - | 100 | 0.039 | 0.039 | 0.039 |
|  | User | - | 50 | 0.005 | 0.003 | 0.041 |
| 3.005 | User | - | 100 | 0.065 | 0.065 | 0.065 |
|  | User | - | 50 | 0.008 | 0.004 | 0.069 |
|  | User | - | 25 | 0.004 | 0.001 | 0.069 |
| 3.006 | User | - | 100 | 0.063 | 0.063 | 0.063 |
|  | User | - | 50 | 0.008 | 0.004 | 0.067 |
|  | User | - | 25 | 0.007 | 0.002 | 0.069 |
| 3.007 | User | - | 100 | 0.107 | 0.107 | 0.107 |
|  | User | - | 50 | 0.015 | 0.008 | 0.115 |
|  | User | - | 25 | 0.015 | 0.004 | 0.119 |
| 3.008 | User | - | 100 | 0.064 | 0.064 | 0.064 |
|  | User | - | 50 | 0.010 | 0.005 | 0.069 |
|  | User | - | 25 | 0.009 | 0.002 | 0.071 |
| 3.009 | User | - | 100 | 0.075 | 0.075 | 0.075 |
|  | User | - | 50 | 0.012 | 0.006 | 0.081 |
|  | User | - | 25 | 0.008 | 0.002 | 0.083 |
| 3.010 | User | - | 100 | 0.077 | 0.077 | 0.077 |
|  | User | - | 50 | 0.012 | 0.006 | 0.084 |
|  | User | - | 25 | 0.009 | 0.002 | 0.086 |
| 3.011 | User | - | 100 | 0.080 | 0.080 | 0.080 |
|  | User | - | 50 | 0.012 | 0.006 | 0.086 |
|  | User | - | 25 | 0.011 | 0.003 | 0.089 |
| 5.000 | User | - | 100 | 0.080 | 0.080 | 0.080 |
| 5.001 | User | - | 100 | 0.051 | 0.051 | 0.051 |
| 5.002 | - | - | 100 | 0.000 | 0.000 | 0.000 |

## Area Summary for Catchment 18 - Ch 47400

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 6.000 | User | - | 100 | 0.026 | 0.026 | 0.026 |
| | User | - | 50 | 0.046 | 0.023 | 0.050 |
| | User | - | 50 | 0.004 | 0.002 | 0.051 |
| | User | - | 25 | 0.079 | 0.020 | 0.071 |
| | User | - | 25 | 0.004 | 0.001 | 0.072 |
| 5.003 | User | - | 100 | 0.094 | 0.094 | 0.094 |
| | User | - | 50 | 0.023 | 0.012 | 0.106 |
| | User | - | 25 | 0.033 | 0.008 | 0.114 |
| 5.004 | User | - | 100 | 0.139 | 0.139 | 0.139 |
| | User | - | 50 | 0.021 | 0.010 | 0.149 |
| | User | - | 25 | 0.023 | 0.006 | 0.155 |
| 5.005 | User | - | 100 | 0.088 | 0.088 | 0.088 |
| | User | - | 50 | 0.014 | 0.007 | 0.095 |
| | User | - | 25 | 0.005 | 0.001 | 0.096 |
| 5.006 | User | - | 100 | 0.087 | 0.087 | 0.087 |
| | User | - | 50 | 0.014 | 0.007 | 0.094 |
| | User | - | 25 | 0.006 | 0.001 | 0.096 |
| 5.007 | User | - | 100 | 0.092 | 0.092 | 0.092 |
| | User | - | 50 | 0.014 | 0.007 | 0.099 |
| | User | - | 25 | 0.011 | 0.003 | 0.102 |
| 1.009 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.010 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.011 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.012 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.013 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.014 | - | - | 100 | 0.240 | 0.240 | 0.240 |
| 1.015 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.016 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total | Total | Total |
| | | | | 3.902 | 3.123 | 3.123 |

## Online Controls for Catchment 18 - Ch 47400

### Hydro-Brake® Optimum Manhole: S06-C18-45, DS/PN: S06-C18-1.015, Volume (m³): 15.3

|  |  |
|---|---|
| Unit Reference | MD-SHE-0240-3160-1160-3160 |
| Design Head (m) | 1.160 |
| Design Flow (l/s) | 31.6 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 240 |
| Invert Level (m) | 162.440 |
| Minimum Outlet Pipe Diameter (mm) | 300 |
| Suggested Manhole Diameter (mm) | 1800 |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.160 | 31.5 | Kick-Flo® | 0.841 | 27.0 |
| Flush-Flo™ | 0.405 | 31.5 | Mean Flow over Head Range | - | 26.4 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 7.9 | 0.800 | 28.2 | 2.000 | 41.0 | 4.000 | 57.3 | 7.000 | 75.2 |
| 0.200 | 24.4 | 1.000 | 29.4 | 2.200 | 42.9 | 4.500 | 60.7 | 7.500 | 77.7 |
| 0.300 | 31.0 | 1.200 | 32.1 | 2.400 | 44.7 | 5.000 | 63.8 | 8.000 | 80.2 |
| 0.400 | 31.5 | 1.400 | 34.5 | 2.600 | 46.5 | 5.500 | 66.9 | 8.500 | 82.6 |
| 0.500 | 31.3 | 1.600 | 36.8 | 3.000 | 49.8 | 6.000 | 69.7 | 9.000 | 85.0 |
| 0.600 | 30.7 | 1.800 | 39.0 | 3.500 | 53.7 | 6.500 | 72.5 | 9.500 | 87.2 |

## Offline Controls for Catchment 18 - Ch 47400

### Weir Manhole: S06-C18-45, DS/PN: S06-C18-1.015, Loop to PN: None

Discharge Coef 0.544 Width (m) 10.000 Invert Level (m) 163.600

## Storage Structures for Catchment 18 - Ch 47400

### Tank or Pond Manhole: S06-C18-45, DS/PN: S06-C18-1.015

Invert Level (m) 162.440

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|---|---|---|---|
| 0.000 | 1539.9 | 1.160 | 2253.1 | 1.161 | 2400.0 | 1.460 | 2612.2 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 18 - Ch 47400

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| S06-C18-1.000 | S06-C18-1 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 170.429 | -0.112 |
| S06-C18-1.001 | S06-C18-2 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 169.985 | -0.001 |
| S06-C18-1.002 | S06-C18-3 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 169.354 | -0.077 |
| S06-C18-1.003 | S06-C18-4 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 169.091 | -0.006 |
| S06-C18-1.004 | S06-C18-5 | 15 Winter | 5 | +20% | 5/15 Winter | | | | 169.040 | 0.029 |
| S06-C18-1.005 | S06-C18-6 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 168.519 | -0.114 |
| S06-C18-1.006 | S06-C18-7 | 15 Winter | 5 | +20% | 100/15 Winter | | | | 168.102 | -0.158 |
| S06-C18-1.007 | S06-C18-8 | 15 Winter | 5 | +20% | 5/15 Winter | | | | 166.104 | 0.015 |
| S06-C18-2.000 | S06-C18-9 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 171.583 | 0.129 |
| S06-C18-2.001 | S06-C18-10 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 170.932 | -0.077 |
| S06-C18-2.002 | S06-C18-11 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 170.440 | -0.100 |
| S06-C18-2.003 | S06-C18-12 | 30 Summer | 5 | +20% | 100/15 Summer | | | | 169.439 | 0.000 |
| S06-C18-2.004 | S06-C18-13 | 15 Winter | 5 | +20% | 100/15 Winter | | | | 169.195 | -0.199 |
| S06-C18-2.005 | S06-C18-14 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 168.149 | -0.194 |
| S06-C18-2.006 | S06-C18-15 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 166.875 | -0.142 |
| S06-C18-1.008 | S06-C18-16 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 165.990 | 0.131 |
| S06-C18-3.000 | S06-C18-17 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 170.536 | -0.028 |
| S06-C18-3.001 | S06-C18-18 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 170.445 | 0.045 |
| S06-C18-4.000 | S06-C18-19 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 170.930 | -0.134 |
| S06-C18-3.002 | S06-C18-20 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 170.299 | 0.049 |
| S06-C18-3.003 | S06-C18-21 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 170.213 | 0.035 |
| S06-C18-3.004 | S06-C18-22 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 169.970 | -0.092 |
| S06-C18-3.005 | S06-C18-23 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 169.844 | -0.146 |
| S06-C18-3.006 | S06-C18-24 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 169.460 | -0.152 |
| S06-C18-3.007 | S06-C18-25 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 168.821 | -0.112 |
| S06-C18-3.008 | S06-C18-26 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 167.923 | -0.084 |
| S06-C18-3.009 | S06-C18-27 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | | | 167.371 | -0.075 |
| S06-C18-3.010 | S06-C18-28 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 166.207 | -0.093 |
| S06-C18-3.011 | S06-C18-29 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 165.966 | -0.006 |
| S06-C18-5.000 | S06-C18-30 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 172.101 | 0.124 |
| S06-C18-5.001 | S06-C18-31 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 171.305 | -0.078 |
| S06-C18-5.002 | S06-C18-32 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Winter | | | 171.055 | 0.029 |
| S06-C18-6.000 | S06-C18-33 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 171.193 | -0.053 |
| S06-C18-5.003 | S06-C18-34 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Summer | | | 171.013 | 0.073 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 18 - Ch 47400

| PN | US/MH Name | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|
| S06-C18-1.000 | S06-C18-1 | 0.000 | 0.14 | | | 2.4 | OK | 4 |
| S06-C18-1.001 | S06-C18-2 | 0.000 | 0.99 | | | 17.1 | OK | 4 |
| S06-C18-1.002 | S06-C18-3 | 0.000 | 0.74 | | | 28.4 | OK | |
| S06-C18-1.003 | S06-C18-4 | 0.000 | 0.79 | | | 27.7 | OK | |
| S06-C18-1.004 | S06-C18-5 | 0.000 | 1.04 | | | 40.1 | SURCHARGED | |
| S06-C18-1.005 | S06-C18-6 | 0.000 | 0.68 | | | 51.7 | OK | |
| S06-C18-1.006 | S06-C18-7 | 0.000 | 0.45 | | | 64.3 | OK | |
| S06-C18-1.007 | S06-C18-8 | 0.000 | 0.70 | | | 74.3 | SURCHARGED | |
| S06-C18-2.000 | S06-C18-9 | 0.000 | 1.07 | | | 41.6 | SURCHARGED | 5 |
| S06-C18-2.001 | S06-C18-10 | 0.000 | 0.87 | | | 73.0 | OK | 3 |
| S06-C18-2.002 | S06-C18-11 | 0.000 | 0.76 | | | 97.4 | OK | 2 |
| S06-C18-2.003 | S06-C18-12 | 0.000 | 1.03 | | | 87.7 | OK | |
| S06-C18-2.004 | S06-C18-13 | 0.000 | 0.44 | | | 109.9 | OK | |
| S06-C18-2.005 | S06-C18-14 | 0.000 | 0.46 | | | 120.8 | OK | |
| S06-C18-2.006 | S06-C18-15 | 0.000 | 0.69 | | | 133.1 | OK | |
| S06-C18-1.008 | S06-C18-16 | 0.000 | 1.20 | | | 221.5 | SURCHARGED | |
| S06-C18-3.000 | S06-C18-17 | 0.000 | 0.78 | | | 28.8 | OK | 5 |
| S06-C18-3.001 | S06-C18-18 | 0.000 | 1.01 | | | 37.4 | SURCHARGED | 1 |
| S06-C18-4.000 | S06-C18-19 | 0.000 | 0.03 | | | 0.7 | OK | |
| S06-C18-3.002 | S06-C18-20 | 0.000 | 1.09 | | | 37.3 | SURCHARGED | |
| S06-C18-3.003 | S06-C18-21 | 0.000 | 1.18 | | | 42.5 | SURCHARGED | |
| S06-C18-3.004 | S06-C18-22 | 0.000 | 0.81 | | | 49.6 | OK | |
| S06-C18-3.005 | S06-C18-23 | 0.000 | 0.52 | | | 61.9 | OK | |
| S06-C18-3.006 | S06-C18-24 | 0.000 | 0.48 | | | 75.0 | OK | |
| S06-C18-3.007 | S06-C18-25 | 0.000 | 0.70 | | | 98.2 | OK | 5 |
| S06-C18-3.008 | S06-C18-26 | 0.000 | 0.86 | | | 112.2 | OK | 5 |
| S06-C18-3.009 | S06-C18-27 | 0.000 | 0.91 | | | 128.3 | OK | 1 |
| S06-C18-3.010 | S06-C18-28 | 0.000 | 0.89 | | | 142.8 | OK | |
| S06-C18-3.011 | S06-C18-29 | 0.000 | 0.94 | | | 152.7 | OK | |
| S06-C18-5.000 | S06-C18-30 | 0.000 | 1.08 | | | 18.6 | SURCHARGED | 6 |
| S06-C18-5.001 | S06-C18-31 | 0.000 | 0.73 | | | 28.2 | OK | |
| S06-C18-5.002 | S06-C18-32 | 0.000 | 0.86 | | | 30.1 | SURCHARGED | 1 |
| S06-C18-6.000 | S06-C18-33 | 0.000 | 0.73 | | | 18.3 | OK | 6 |
| S06-C18-5.003 | S06-C18-34 | 0.000 | 0.94 | | | 58.9 | SURCHARGED | 6 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 18 - Ch 47400

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| S06-C18-5.004 | S06-C18-35 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 169.960 | 0.245 |
| S06-C18-5.005 | S06-C18-36 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 167.797 | -0.115 |
| S06-C18-5.006 | S06-C18-37 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | | | 166.863 | -0.085 |
| S06-C18-5.007 | S06-C18-38 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 165.949 | -0.115 |
| S06-C18-1.009 | S06-C18-39 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 165.666 | 0.031 |
| S06-C18-1.010 | S06-C18-40 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 165.616 | 0.000 |
| S06-C18-1.011 | S06-C18-41 | 15 Winter | 5 | +20% | | | | | 165.020 | -0.512 |
| S06-C18-1.012 | S06-C18-42 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 163.433 | 0.000 |
| S06-C18-1.013 | S06-C18-43 | 15 Winter | 5 | +20% | | | | | 163.261 | -0.304 |
| S06-C18-1.014 | S06-C18-44 | 30 Winter | 5 | +20% | 100/15 Summer | | | | 163.040 | -0.250 |
| S06-C18-1.015 | S06-C18-45 | 480 Winter | 5 | +20% | 100/60 Winter | | | 0 | 162.894 | -0.296 |
| S06-C18-1.016 | S06-C18-46 | 960 Winter | 5 | +20% | | | | | 162.375 | -0.715 |

| PN | US/MH Name | Flooded Volume ($m^3$) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|
| S06-C18-5.004 | S06-C18-35 | 0.000 | 1.06 | | | 85.3 | SURCHARGED | 6 |
| S06-C18-5.005 | S06-C18-36 | 0.000 | 0.69 | | | 102.4 | OK | |
| S06-C18-5.006 | S06-C18-37 | 0.000 | 0.85 | | | 120.9 | OK | 1 |
| S06-C18-5.007 | S06-C18-38 | 0.000 | 0.81 | | | 139.9 | OK | |
| S06-C18-1.009 | S06-C18-39 | 0.000 | 2.05 | | | 503.1 | SURCHARGED | |
| S06-C18-1.010 | S06-C18-40 | 0.000 | 1.11 | | | 500.6 | OK | |
| S06-C18-1.011 | S06-C18-41 | 0.000 | 0.22 | | | 499.5 | OK | |
| S06-C18-1.012 | S06-C18-42 | 0.000 | 1.88 | | | 498.2 | OK | |
| S06-C18-1.013 | S06-C18-43 | 0.000 | 0.72 | | | 469.0 | OK* | |
| S06-C18-1.014 | S06-C18-44 | 0.000 | 0.78 | | | 471.4 | OK* | |
| S06-C18-1.015 | S06-C18-45 | 0.000 | 0.06 | 0.0 | | 31.5 | OK | |
| S06-C18-1.016 | S06-C18-46 | 0.000 | 0.01 | | | 31.5 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 18 - Ch 47400

### Simulation Criteria

Areal Reduction Factor 1.000
Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0
MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0
Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500
Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0
Number of Offline Controls 1
Number of Time/Area Diagrams 0
Number of Online Controls 1
Number of Storage Structures 1
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
M5-60 (mm) 20.000
Cv (Summer) 0.750
Region England and Wales
Ratio R 0.300
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
DVD Status OFF
Analysis Timestep Fine
Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| S06-C18-1.000 | S06-C18-1 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 171.744 | 1.203 |
| S06-C18-1.001 | S06-C18-2 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 171.902 | 1.916 |
| S06-C18-1.002 | S06-C18-3 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 171.115 | 1.684 |
| S06-C18-1.003 | S06-C18-4 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 170.597 | 1.500 |
| S06-C18-1.004 | S06-C18-5 | 15 Winter | 100 | +40% | 5/15 Winter | | | | 170.471 | 1.460 |
| S06-C18-1.005 | S06-C18-6 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 168.947 | 0.313 |
| S06-C18-1.006 | S06-C18-7 | 15 Winter | 100 | +40% | 100/15 Winter | | | | 168.294 | 0.034 |
| S06-C18-1.007 | S06-C18-8 | 15 Winter | 100 | +40% | 5/15 Winter | | | | 167.465 | 1.376 |
| S06-C18-2.000 | S06-C18-9 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 172.669 | 1.215 |
| S06-C18-2.001 | S06-C18-10 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 172.595 | 1.586 |
| S06-C18-2.002 | S06-C18-11 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 171.741 | 1.201 |
| S06-C18-2.003 | S06-C18-12 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 169.622 | 0.183 |
| S06-C18-2.004 | S06-C18-13 | 15 Winter | 100 | +40% | 100/15 Winter | | | | 169.448 | 0.054 |
| S06-C18-2.005 | S06-C18-14 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 168.857 | 0.513 |
| S06-C18-2.006 | S06-C18-15 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 168.064 | 1.046 |
| S06-C18-1.008 | S06-C18-16 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 167.067 | 1.208 |
| S06-C18-3.000 | S06-C18-17 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 171.772 | 1.208 |
| S06-C18-3.001 | S06-C18-18 | 15 Summer | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 171.785 | 1.385 |
| S06-C18-4.000 | S06-C18-19 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 171.592 | 0.528 |
| S06-C18-3.002 | S06-C18-20 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 171.587 | 1.337 |
| S06-C18-3.003 | S06-C18-21 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 171.481 | 1.303 |
| S06-C18-3.004 | S06-C18-22 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 171.191 | 1.128 |
| S06-C18-3.005 | S06-C18-23 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 171.071 | 1.082 |
| S06-C18-3.006 | S06-C18-24 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 170.740 | 1.128 |
| S06-C18-3.007 | S06-C18-25 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 170.142 | 1.210 |
| S06-C18-3.008 | S06-C18-26 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 169.214 | 1.207 |
| S06-C18-3.009 | S06-C18-27 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | | | 168.646 | 1.200 |
| S06-C18-3.010 | S06-C18-28 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 167.510 | 1.210 |
| S06-C18-3.011 | S06-C18-29 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 166.929 | 0.957 |
| S06-C18-5.000 | S06-C18-30 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 173.184 | 1.206 |
| S06-C18-5.001 | S06-C18-31 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 172.829 | 1.446 |
| S06-C18-5.002 | S06-C18-32 | 15 Winter | 100 | +40% | 5/15 Winter | 100/15 Winter | | | 172.333 | 1.307 |
| S06-C18-6.000 | S06-C18-33 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 172.450 | 1.203 |
| S06-C18-5.003 | S06-C18-34 | 30 Winter | 100 | +40% | 5/15 Winter | 100/15 Summer | | | 172.222 | 1.282 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 18 - Ch 47400

| PN | US/MH Name | Flooded Volume ($m^3$) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|
| S06-C18-1.000 | S06-C18-1 | 2.567 | 0.98 | | | 17.0 | FLOOD | 4 |
| S06-C18-1.001 | S06-C18-2 | 0.680 | 1.43 | | | 24.6 | FLOOD | 4 |
| S06-C18-1.002 | S06-C18-3 | 0.000 | 1.22 | | | 47.0 | SURCHARGED | |
| S06-C18-1.003 | S06-C18-4 | 0.000 | 1.39 | | | 48.8 | SURCHARGED | |
| S06-C18-1.004 | S06-C18-5 | 0.000 | 1.94 | | | 75.1 | SURCHARGED | |
| S06-C18-1.005 | S06-C18-6 | 0.000 | 1.30 | | | 98.7 | SURCHARGED | |
| S06-C18-1.006 | S06-C18-7 | 0.000 | 0.85 | | | 121.0 | SURCHARGED | |
| S06-C18-1.007 | S06-C18-8 | 0.000 | 1.31 | | | 138.5 | SURCHARGED | |
| S06-C18-2.000 | S06-C18-9 | 14.598 | 1.86 | | | 72.1 | FLOOD | 5 |
| S06-C18-2.001 | S06-C18-10 | 0.550 | 1.42 | | | 119.9 | FLOOD | 3 |
| S06-C18-2.002 | S06-C18-11 | 0.603 | 1.39 | | | 178.0 | FLOOD | 2 |
| S06-C18-2.003 | S06-C18-12 | 0.000 | 2.04 | | | 174.1 | SURCHARGED | |
| S06-C18-2.004 | S06-C18-13 | 0.000 | 0.78 | | | 193.5 | SURCHARGED | |
| S06-C18-2.005 | S06-C18-14 | 0.000 | 0.78 | | | 203.7 | SURCHARGED | |
| S06-C18-2.006 | S06-C18-15 | 0.000 | 1.16 | | | 222.0 | FLOOD RISK | |
| S06-C18-1.008 | S06-C18-16 | 0.000 | 2.08 | | | 383.6 | SURCHARGED | |
| S06-C18-3.000 | S06-C18-17 | 8.234 | 1.45 | | | 53.7 | FLOOD | 5 |
| S06-C18-3.001 | S06-C18-18 | 0.008 | 1.80 | | | 66.4 | FLOOD | 1 |
| S06-C18-4.000 | S06-C18-19 | 0.000 | 0.14 | | | 3.6 | SURCHARGED | |
| S06-C18-3.002 | S06-C18-20 | 0.000 | 1.79 | | | 61.3 | SURCHARGED | |
| S06-C18-3.003 | S06-C18-21 | 0.000 | 1.80 | | | 65.1 | SURCHARGED | |
| S06-C18-3.004 | S06-C18-22 | 0.000 | 1.28 | | | 77.9 | SURCHARGED | |
| S06-C18-3.005 | S06-C18-23 | 0.000 | 0.91 | | | 108.6 | SURCHARGED | |
| S06-C18-3.006 | S06-C18-24 | 0.000 | 0.92 | | | 142.8 | FLOOD RISK | |
| S06-C18-3.007 | S06-C18-25 | 9.971 | 1.02 | | | 142.8 | FLOOD | 5 |
| S06-C18-3.008 | S06-C18-26 | 6.683 | 1.35 | | | 176.4 | FLOOD | 5 |
| S06-C18-3.009 | S06-C18-27 | 0.077 | 1.30 | | | 182.2 | FLOOD | 1 |
| S06-C18-3.010 | S06-C18-28 | 0.000 | 1.32 | | | 213.2 | SURCHARGED | |
| S06-C18-3.011 | S06-C18-29 | 0.000 | 1.55 | | | 252.0 | FLOOD RISK | |
| S06-C18-5.000 | S06-C18-30 | 6.109 | 1.18 | | | 20.5 | FLOOD | 6 |
| S06-C18-5.001 | S06-C18-31 | 0.000 | 1.08 | | | 41.6 | FLOOD RISK | |
| S06-C18-5.002 | S06-C18-32 | 0.041 | 1.28 | | | 44.9 | FLOOD | 1 |
| S06-C18-6.000 | S06-C18-33 | 3.355 | 0.88 | | | 21.9 | FLOOD | 6 |
| S06-C18-5.003 | S06-C18-34 | 14.730 | 1.22 | | | 76.8 | FLOOD | 6 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 18 - Ch 47400

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) |
|---|---|---|---|---|---|---|---|---|---|---|
| S06-C18-5.004 | S06-C18-35 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 170.927 | 1.213 |
| S06-C18-5.005 | S06-C18-36 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 168.913 | 1.001 |
| S06-C18-5.006 | S06-C18-37 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | | | 168.148 | 1.200 |
| S06-C18-5.007 | S06-C18-38 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 166.789 | 0.726 |
| S06-C18-1.009 | S06-C18-39 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 166.083 | 0.447 |
| S06-C18-1.010 | S06-C18-40 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 165.789 | 0.174 |
| S06-C18-1.011 | S06-C18-41 | 15 Winter | 100 | +40% | | | | | 165.098 | -0.435 |
| S06-C18-1.012 | S06-C18-42 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 163.909 | 0.476 |
| S06-C18-1.013 | S06-C18-43 | 15 Summer | 100 | +40% | | | | | 163.565 | 0.000 |
| S06-C18-1.014 | S06-C18-44 | 1440 Winter | 100 | +40% | 100/15 Summer | | | | 163.440 | 0.150 |
| S06-C18-1.015 | S06-C18-45 | 480 Winter | 100 | +40% | 100/60 Winter | | | 0 | 163.517 | 0.327 |
| S06-C18-1.016 | S06-C18-46 | 30 Summer | 100 | +40% | | | | | 162.375 | -0.715 |

| PN | US/MH Name | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|---|
| S06-C18-5.004 | S06-C18-35 | 12.757 | 1.29 | | | 103.7 | FLOOD | 6 |
| S06-C18-5.005 | S06-C18-36 | 0.000 | 0.91 | | | 134.3 | FLOOD RISK | |
| S06-C18-5.006 | S06-C18-37 | 0.033 | 1.24 | | | 176.6 | FLOOD | 1 |
| S06-C18-5.007 | S06-C18-38 | 0.000 | 1.26 | | | 217.8 | SURCHARGED | |
| S06-C18-1.009 | S06-C18-39 | 0.000 | 3.47 | | | 850.8 | SURCHARGED | |
| S06-C18-1.010 | S06-C18-40 | 0.000 | 1.86 | | | 840.8 | SURCHARGED | |
| S06-C18-1.011 | S06-C18-41 | 0.000 | 0.37 | | | 839.7 | OK | |
| S06-C18-1.012 | S06-C18-42 | 0.000 | 3.11 | | | 825.0 | FLOOD RISK | |
| S06-C18-1.013 | S06-C18-43 | 0.000 | 1.16 | | | 750.9 | SURCHARGED* | |
| S06-C18-1.014 | S06-C18-44 | 0.000 | 0.17 | | | 102.6 | SURCHARGED* | |
| S06-C18-1.015 | S06-C18-45 | 0.000 | 0.06 | 0.0 | | 31.5 | SURCHARGED | |
| S06-C18-1.016 | S06-C18-46 | 0.000 | 0.01 | | | 31.5 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for Catchment 19 - Ch 47600

Pipe Sizes Min 150 Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 20.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

## Network Design Table for Catchment 19 - Ch 47600

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 79.672 | 0.824 | 96.7 | 0.018 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.001 | 81.024 | 1.448 | 55.9 | 0.037 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.002 | 79.482 | 1.277 | 62.2 | 0.067 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.003 | 80.068 | 1.262 | 63.4 | 0.086 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.004 | 80.053 | 1.261 | 63.5 | 0.085 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 2.000 | 18.014 | 0.355 | 50.7 | 0.003 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 2.001 | 38.247 | 0.383 | 99.9 | 0.019 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 2.002 | 29.201 | 0.290 | 100.7 | 0.024 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔒 |
| 3.000 | 17.422 | 0.439 | 39.7 | 0.010 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 3.001 | 31.347 | 0.315 | 99.5 | 0.028 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 3.002 | 35.439 | 0.356 | 99.5 | 0.007 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 3.003 | 6.538 | 0.066 | 99.4 | 0.000 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 2.003 | 43.037 | 0.256 | 168.2 | 0.029 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.004 | 42.942 | 0.255 | 168.2 | 0.027 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.005 | 67.378 | 0.851 | 79.1 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 71.44 | 6.30 | 173.024 | 0.018 | 0.0 | 0.0 | 0.0 | 1.02 | 18.1 | 3.5 |
| 1.001 | 67.06 | 7.30 | 172.200 | 0.055 | 0.0 | 0.0 | 0.0 | 1.35 | 23.8 | 10.0 |
| 1.002 | 63.16 | 8.34 | 170.752 | 0.123 | 0.0 | 0.0 | 0.0 | 1.28 | 22.6 | 21.0 |
| 1.003 | 60.48 | 9.15 | 169.400 | 0.208 | 0.0 | 0.0 | 0.0 | 1.64 | 65.4 | 34.1 |
| 1.004 | 58.06 | 9.96 | 168.137 | 0.293 | 0.0 | 0.0 | 0.0 | 1.64 | 65.4 | 46.0 |
| 2.000 | 77.08 | 5.21 | 168.985 | 0.003 | 0.0 | 0.0 | 0.0 | 1.42 | 25.0 | 0.7 |
| 2.001 | 73.66 | 5.85 | 168.629 | 0.022 | 0.0 | 0.0 | 0.0 | 1.01 | 17.8 | 4.5 |
| 2.002 | 71.28 | 6.33 | 168.246 | 0.046 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 8.9 |
| 3.000 | 77.26 | 5.18 | 168.989 | 0.010 | 0.0 | 0.0 | 0.0 | 1.60 | 28.3 | 2.0 |
| 3.001 | 74.42 | 5.70 | 168.550 | 0.038 | 0.0 | 0.0 | 0.0 | 1.01 | 17.8 | 7.6 |
| 3.002 | 71.50 | 6.29 | 168.235 | 0.045 | 0.0 | 0.0 | 0.0 | 1.01 | 17.8 | 8.7 |
| 3.003 | 70.99 | 6.39 | 167.878 | 0.045 | 0.0 | 0.0 | 0.0 | 1.01 | 17.8 | 8.7 |
| 2.003 | 67.85 | 7.11 | 167.738 | 0.121 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 22.1 |
| 2.004 | 65.04 | 7.82 | 167.482 | 0.148 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 26.0 |
| 2.005 | 62.32 | 8.58 | 167.226 | 0.148 | 0.0 | 0.0 | 0.0 | 1.47 | 58.5 | 26.0 |

## Network Design Table for Catchment 19 - Ch 47600

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.006 | 40.719 | 0.242 | 168.2 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.005 | 80.042 | 0.390 | 205.2 | 0.077 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 4.000 | 81.957 | 1.200 | 68.3 | 0.056 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 4.001 | 82.022 | 3.475 | 23.6 | 0.056 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 4.002 | 81.911 | 4.654 | 17.6 | 0.057 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 4.003 | 81.979 | 1.832 | 44.8 | 0.059 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.006 | 12.821 | 0.040 | 320.5 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 5.000 | 48.038 | 0.476 | 100.9 | 0.062 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 5.001 | 48.366 | 0.656 | 73.8 | 0.066 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 5.002 | 26.268 | 0.476 | 55.2 | 0.032 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 5.003 | 17.196 | 0.102 | 168.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 6.000 | 42.691 | 1.581 | 27.0 | 0.023 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 6.001 | 31.985 | 2.046 | 15.6 | 0.003 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 6.002 | 10.839 | 0.770 | 14.1 | 0.005 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 5.004 | 10.218 | 0.061 | 167.9 | 0.011 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 7.000 | 27.740 | 0.275 | 100.9 | 0.017 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 7.001 | 30.731 | 0.304 | 100.9 | 0.018 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 7.002 | 24.612 | 0.466 | 52.8 | 0.014 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 7.003 | 26.409 | 2.288 | 11.5 | 0.014 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 8.000 | 49.524 | 2.522 | 19.6 | 0.012 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 2.006 | 60.14 | 9.26 | 166.375 | 0.148 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 26.0 |
| 1.005 | 54.84 | 11.18 | 166.058 | 0.517 | 0.0 | 0.0 | 0.0 | 1.09 | 77.3 | 76.8 |
| 4.000 | 72.29 | 6.12 | 176.978 | 0.056 | 0.0 | 0.0 | 0.0 | 1.22 | 21.5 | 10.9 |
| 4.001 | 69.26 | 6.78 | 175.778 | 0.111 | 0.0 | 0.0 | 0.0 | 2.08 | 36.8 | 20.9 |
| 4.002 | 66.89 | 7.34 | 172.303 | 0.168 | 0.0 | 0.0 | 0.0 | 2.41 | 42.6 | 30.5 |
| 4.003 | 64.22 | 8.04 | 167.574 | 0.227 | 0.0 | 0.0 | 0.0 | 1.96 | 78.0 | 39.5 |
| 1.006 | 54.32 | 11.39 | 165.593 | 0.744 | 0.0 | 0.0 | 0.0 | 1.01 | 111.2 | 109.5 |
| 5.000 | 73.90 | 5.80 | 172.803 | 0.062 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 12.4 |
| 5.001 | 71.30 | 6.33 | 172.252 | 0.128 | 0.0 | 0.0 | 0.0 | 1.52 | 60.6 | 24.7 |
| 5.002 | 70.15 | 6.58 | 171.597 | 0.160 | 0.0 | 0.0 | 0.0 | 1.76 | 70.1 | 30.4 |
| 5.003 | 68.89 | 6.86 | 171.121 | 0.160 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 30.4 |
| 6.000 | 76.22 | 5.37 | 176.284 | 0.023 | 0.0 | 0.0 | 0.0 | 1.95 | 34.4 | 4.7 |
| 6.001 | 75.08 | 5.57 | 174.703 | 0.026 | 0.0 | 0.0 | 0.0 | 2.56 | 45.2 | 5.2 |
| 6.002 | 74.73 | 5.64 | 172.657 | 0.031 | 0.0 | 0.0 | 0.0 | 2.70 | 47.7 | 6.3 |
| 5.004 | 68.17 | 7.03 | 171.019 | 0.203 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 37.4 |
| 7.000 | 75.69 | 5.46 | 178.113 | 0.017 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 3.6 |
| 7.001 | 73.02 | 5.97 | 177.838 | 0.035 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 7.0 |
| 7.002 | 71.58 | 6.27 | 177.534 | 0.049 | 0.0 | 0.0 | 0.0 | 1.39 | 24.5 | 9.5 |
| 7.003 | 70.88 | 6.42 | 177.067 | 0.063 | 0.0 | 0.0 | 0.0 | 2.98 | 52.7 | 12.1 |
| 8.000 | 76.24 | 5.36 | 177.630 | 0.012 | 0.0 | 0.0 | 0.0 | 2.28 | 40.4 | 2.4 |

## Network Design Table for Catchment 19 - Ch 47600

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9.000 | 27.495 | 0.739 | 37.2 | 0.003 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 9.001 | 15.921 | 0.421 | 37.8 | 0.002 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 8.001 | 10.805 | 0.329 | 32.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 7.004 | 22.179 | 1.655 | 13.4 | 0.043 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 7.005 | 22.656 | 1.597 | 14.2 | 0.014 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 5.005 | 17.243 | 0.336 | 51.3 | 0.014 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 5.006 | 80.348 | 1.011 | 79.5 | 0.072 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 5.007 | 80.713 | 1.245 | 64.8 | 0.031 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 5.008 | 80.709 | 1.295 | 62.3 | 0.018 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 5.009 | 80.693 | 1.105 | 73.0 | 0.024 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 10.000 | 83.022 | 1.201 | 69.1 | 0.048 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 10.001 | 83.023 | 3.472 | 23.9 | 0.048 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 10.002 | 83.039 | 4.658 | 17.8 | 0.049 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 10.003 | 83.780 | 1.619 | 51.7 | 0.051 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.007 | 8.060 | 1.878 | 4.3 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |
| 1.008 | 37.991 | 0.095 | 400.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| 1.009 | 6.098 | 0.015 | 400.8 | 0.000 | 0.00 | 0.0 | 0.600 | o | 525 | Pipe/Conduit | 🔓 |
| 1.010 | 13.293 | 0.027 | 492.3 | 0.000 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔒 |
| 1.011 | 36.757 | 0.075 | 492.3 | 0.000 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |
| 1.012 | 6.228 | 0.013 | 492.3 | 0.000 | 0.00 | 0.0 | 0.600 | o | 600 | Pipe/Conduit | 🔓 |
| 1.013 | 5.702 | 0.019 | 300.1 | 0.135 | 0.00 | 0.0 | 0.600 | o | 500 | Pipe/Conduit | 🔒 |
| 1.014 | 35.693 | 0.095 | 377.3 | 0.000 | 0.00 | 0.0 | 0.600 | o | 500 | Pipe/Conduit | 🔓 |

## Network Results Table

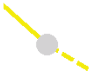
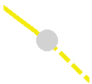
| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 9.000 | 76.72 | 5.28 | 176.267 | 0.003 | 0.0 | 0.0 | 0.0 | 1.66 | 29.2 | 0.7 |
| 9.001 | 75.82 | 5.44 | 175.529 | 0.005 | 0.0 | 0.0 | 0.0 | 1.64 | 29.0 | 1.1 |
| 8.001 | 75.26 | 5.54 | 175.107 | 0.017 | 0.0 | 0.0 | 0.0 | 1.76 | 31.1 | 3.5 |
| 7.004 | 70.27 | 6.55 | 174.779 | 0.124 | 0.0 | 0.0 | 0.0 | 2.77 | 48.9 | 23.5 |
| 7.005 | 69.64 | 6.69 | 173.124 | 0.137 | 0.0 | 0.0 | 0.0 | 2.69 | 47.5 | 25.9 |
| 5.005 | 67.52 | 7.19 | 170.958 | 0.354 | 0.0 | 0.0 | 0.0 | 1.83 | 72.8 | 64.7 |
| 5.006 | 64.56 | 7.95 | 170.547 | 0.426 | 0.0 | 0.0 | 0.0 | 1.76 | 124.8 | 74.5 |
| 5.007 | 62.15 | 8.64 | 169.536 | 0.457 | 0.0 | 0.0 | 0.0 | 1.96 | 138.2 | 76.9 |
| 5.008 | 59.98 | 9.31 | 168.291 | 0.475 | 0.0 | 0.0 | 0.0 | 2.00 | 141.0 | 77.2 |
| 5.009 | 57.84 | 10.04 | 166.996 | 0.499 | 0.0 | 0.0 | 0.0 | 1.84 | 130.2 | 78.1 |
| 10.000 | 72.19 | 6.14 | 176.991 | 0.048 | 0.0 | 0.0 | 0.0 | 1.21 | 21.4 | 9.3 |
| 10.001 | 69.11 | 6.81 | 175.790 | 0.095 | 0.0 | 0.0 | 0.0 | 2.07 | 36.5 | 17.9 |
| 10.002 | 66.70 | 7.39 | 172.318 | 0.144 | 0.0 | 0.0 | 0.0 | 2.40 | 42.4 | 26.1 |
| 10.003 | 63.81 | 8.16 | 167.585 | 0.196 | 0.0 | 0.0 | 0.0 | 1.82 | 72.5 | 33.8 |
| 1.007 | 54.29 | 11.41 | 165.553 | 1.439 | 0.0 | 0.0 | 0.0 | 8.80 | 971.4 | 211.5 |
| 1.008 | 52.96 | 11.98 | 163.525 | 1.439 | 0.0 | 0.0 | 0.0 | 1.11 | 240.8 | 211.5 |
| 1.009 | 52.75 | 12.07 | 163.430 | 1.439 | 0.0 | 0.0 | 0.0 | 1.11 | 240.8 | 211.5 |
| 1.010 | 52.30 | 12.27 | 163.440 | 1.439 | 0.0 | 0.0 | 0.0 | 1.09 | 308.4 | 211.5 |
| 1.011 | 51.10 | 12.83 | 163.413 | 1.439 | 0.0 | 0.0 | 0.0 | 1.09 | 308.4 | 211.5 |
| 1.012 | 50.91 | 12.93 | 163.338 | 1.439 | 0.0 | 0.0 | 0.0 | 1.09 | 308.4 | 211.5 |
| 1.013 | 50.75 | 13.00 | 163.326 | 1.574 | 0.0 | 0.0 | 0.0 | 1.25 | 245.2 | 216.3 |
| 1.014 | 49.69 | 13.54 | 163.307 | 1.574 | 0.0 | 0.0 | 0.0 | 1.11 | 218.4 | 216.3 |

## Manhole Schedules for Catchment 19 - Ch 47600

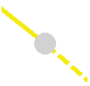
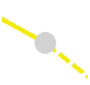
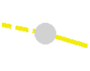
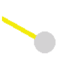
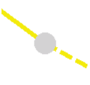
| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C19-1 | 174.374 | 1.350 | Open Manhole | 1200 | 1.000 | 173.024 | 150 | | | | |
| S06-C19-2 | 173.550 | 1.350 | Open Manhole | 1200 | 1.001 | 172.200 | 150 | 1.000 | 172.200 | 150 | |
| S06-C19-3 | 172.102 | 1.350 | Open Manhole | 1200 | 1.002 | 170.752 | 150 | 1.001 | 170.752 | 150 | |
| S06-C19-4 | 170.825 | 1.425 | Open Manhole | 1200 | 1.003 | 169.400 | 225 | 1.002 | 169.475 | 150 | |
| S06-C19-5 | 169.562 | 1.425 | Open Manhole | 1200 | 1.004 | 168.137 | 225 | 1.003 | 168.137 | 225 | |
| S06-C19-6 | 170.335 | 1.350 | Open Manhole | 1200 | 2.000 | 168.985 | 150 | | | | |
| S06-C19-7 | 169.979 | 1.350 | Open Manhole | 1200 | 2.001 | 168.629 | 150 | 2.000 | 168.629 | 150 | |
| S06-C19-8 | 169.817 | 1.571 | Open Manhole | 1200 | 2.002 | 168.246 | 150 | 2.001 | 168.246 | 150 | |
| S06-C19-9 | 170.339 | 1.350 | Open Manhole | 1200 | 3.000 | 168.989 | 150 | | | | |
| S06-C19-10 | 169.900 | 1.350 | Open Manhole | 1200 | 3.001 | 168.550 | 150 | 3.000 | 168.550 | 150 | |
| S06-C19-11 | 169.818 | 1.583 | Open Manhole | 1200 | 3.002 | 168.235 | 150 | 3.001 | 168.235 | 150 | |
| S06-C19-12 | 169.852 | 1.974 | Open Manhole | 1200 | 3.003 | 167.878 | 150 | 3.002 | 167.878 | 150 | |
| S06-C19-13 | 169.731 | 1.993 | Open Manhole | 1200 | 2.003 | 167.738 | 225 | 2.002 | 167.956 | 150 | 143 |
| | | | | | | | | 3.003 | 167.813 | 150 | |
| S06-C19-14 | 169.925 | 2.444 | Open Manhole | 1200 | 2.004 | 167.482 | 225 | 2.003 | 167.482 | 225 | |
| S06-C19-15 | 169.351 | 2.124 | Open Manhole | 1200 | 2.005 | 167.226 | 225 | 2.004 | 167.226 | 225 | |
| S06-C19-16 | 167.800 | 1.425 | Open Manhole | 1200 | 2.006 | 166.375 | 225 | 2.005 | 166.375 | 225 | |
| S06-C19-17 | 168.301 | 2.243 | Open Manhole | 1200 | 1.005 | 166.058 | 300 | 1.004 | 166.876 | 225 | 743 |
| | | | | | | | | 2.006 | 166.133 | 225 | |
| S06-C19-18 | 178.328 | 1.350 | Open Manhole | 1200 | 4.000 | 176.978 | 150 | | | | |
| S06-C19-19 | 177.128 | 1.350 | Open Manhole | 1200 | 4.001 | 175.778 | 150 | 4.000 | 175.778 | 150 | |
| S06-C19-20 | 173.653 | 1.350 | Open Manhole | 1200 | 4.002 | 172.303 | 150 | 4.001 | 172.303 | 150 | |
| S06-C19-21 | 168.999 | 1.425 | Open Manhole | 1200 | 4.003 | 167.574 | 225 | 4.002 | 167.649 | 150 | |
| S06-C19-22 | 167.286 | 1.693 | Open Manhole | 1350 | 1.006 | 165.593 | 375 | 1.005 | 165.668 | 300 | |
| | | | | | | | | 4.003 | 165.743 | 225 | |
| S06-C19-23 | 174.153 | 1.350 | Open Manhole | 1200 | 5.000 | 172.803 | 150 | | | | |
| S06-C19-24 | 173.786 | 1.533 | Open Manhole | 1200 | 5.001 | 172.252 | 225 | 5.000 | 172.327 | 150 | |
| S06-C19-25 | 173.022 | 1.425 | Open Manhole | 1200 | 5.002 | 171.597 | 225 | 5.001 | 171.597 | 225 | |
| S06-C19-26 | 172.546 | 1.425 | Open Manhole | 1200 | 5.003 | 171.121 | 225 | 5.002 | 171.121 | 225 | |
| S06-C19-27 | 177.634 | 1.350 | Open Manhole | 1200 | 6.000 | 176.284 | 150 | | | | |
| S06-C19-28 | 176.053 | 1.350 | Open Manhole | 1200 | 6.001 | 174.703 | 150 | 6.000 | 174.703 | 150 | |
| S06-C19-29 | 174.007 | 1.350 | Open Manhole | 1200 | 6.002 | 172.657 | 150 | 6.001 | 172.657 | 150 | |
| S06-C19-30 | 173.238 | 2.219 | Open Manhole | 1200 | 5.004 | 171.019 | 225 | 5.003 | 171.019 | 225 | |
| | | | | | | | | 6.002 | 171.888 | 150 | 794 |
| S06-C19-31 | 179.463 | 1.350 | Open Manhole | 1200 | 7.000 | 178.113 | 150 | | | | |
| S06-C19-32 | 179.232 | 1.394 | Open Manhole | 1200 | 7.001 | 177.838 | 150 | 7.000 | 177.838 | 150 | |
| S06-C19-33 | 178.943 | 1.409 | Open Manhole | 1200 | 7.002 | 177.534 | 150 | 7.001 | 177.534 | 150 | |
| S06-C19-34 | 178.417 | 1.350 | Open Manhole | 1200 | 7.003 | 177.067 | 150 | 7.002 | 177.067 | 150 | |
| S06-C19-35 | 178.980 | 1.350 | Open Manhole | 1200 | 8.000 | 177.630 | 150 | | | | |
| S06-C19-36 | 177.617 | 1.350 | Open Manhole | 1200 | 9.000 | 176.267 | 150 | | | | |
| S06-C19-37 | 176.879 | 1.350 | Open Manhole | 1200 | 9.001 | 175.529 | 150 | 9.000 | 175.529 | 150 | |
| S06-C19-38 | 176.457 | 1.350 | Open Manhole | 1200 | 8.001 | 175.107 | 150 | 8.000 | 175.107 | 150 | |
| | | | | | | | | 9.001 | 175.107 | 150 | |
| S06-C19-39 | 176.129 | 1.350 | Open Manhole | 1200 | 7.004 | 174.779 | 150 | 7.003 | 174.779 | 150 | |
| | | | | | | | | 8.001 | 174.779 | 150 | |
| S06-C19-40 | 174.474 | 1.350 | Open Manhole | 1200 | 7.005 | 173.124 | 150 | 7.004 | 173.124 | 150 | |

## Manhole Schedules for Catchment 19 - Ch 47600

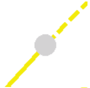
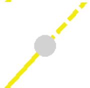
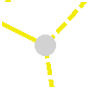
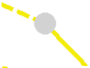
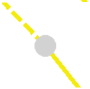
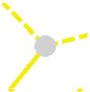
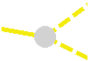
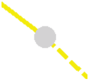
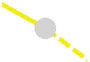
| MH | MH | MH | MH | MH | | Pipe Out | | | Pipes In | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Name** | **CL (m)** | **Depth (m)** | **Connection** | **Diam.,L*W (mm)** | **PN** | **Invert Level (m)** | **Diameter (mm)** | **PN** | **Invert Level (m)** | **Diameter (mm)** | **Backdrop (mm)** |
| S06-C19-41 | 172.876 | 1.918 | Open Manhole | 1200 | 5.005 | 170.958 | 225 | 5.004 | 170.958 | 225 | |
| | | | | | | | | 7.005 | 171.526 | 150 | 493 |
| S06-C19-42 | 172.047 | 1.500 | Open Manhole | 1200 | 5.006 | 170.547 | 300 | 5.005 | 170.622 | 225 | |
| S06-C19-43 | 171.036 | 1.500 | Open Manhole | 1200 | 5.007 | 169.536 | 300 | 5.006 | 169.536 | 300 | |
| S06-C19-44 | 169.791 | 1.500 | Open Manhole | 1200 | 5.008 | 168.291 | 300 | 5.007 | 168.291 | 300 | |
| S06-C19-45 | 168.496 | 1.500 | Open Manhole | 1200 | 5.009 | 166.996 | 300 | 5.008 | 166.996 | 300 | |
| S06-C19-46 | 178.341 | 1.350 | Open Manhole | 1200 | 10.000 | 176.991 | 150 | | | | |
| S06-C19-47 | 177.140 | 1.350 | Open Manhole | 1200 | 10.001 | 175.790 | 150 | 10.000 | 175.790 | 150 | |
| S06-C19-48 | 173.668 | 1.350 | Open Manhole | 1200 | 10.002 | 172.318 | 150 | 10.001 | 172.318 | 150 | |
| S06-C19-49 | 169.010 | 1.425 | Open Manhole | 1200 | 10.003 | 167.585 | 225 | 10.002 | 167.660 | 150 | |
| S06-C19-50 | 167.391 | 1.838 | Open Manhole | 1350 | 1.007 | 165.553 | 375 | 1.006 | 165.553 | 375 | |
| | | | | | | | | 5.009 | 165.891 | 300 | 263 |
| | | | | | | | | 10.003 | 165.966 | 225 | 263 |
| S06-C19-51 | 165.250 | 1.725 | Open Manhole | 1500 | 1.008 | 163.525 | 525 | 1.007 | 163.675 | 375 | |
| S06-C19-52 | 167.200 | 3.770 | Open Manhole | 1500 | 1.009 | 163.430 | 525 | 1.008 | 163.430 | 525 | |
| S06-C19-53 | 165.388 | 1.973 | Junction | | 1.010 | 163.440 | 600 | 1.009 | 163.415 | 525 | |
| S06-C19-54 | 165.388 | 1.975 | Junction | | 1.011 | 163.413 | 600 | 1.010 | 163.413 | 600 | |
| S06-C19-55 | 165.388 | 2.050 | Junction | | 1.012 | 163.338 | 600 | 1.011 | 163.338 | 600 | |
| S06-C19-56 | 165.388 | 2.062 | Junction | | 1.013 | 163.326 | 500 | 1.012 | 163.326 | 600 | |
| S06-C19-57 | 167.200 | 3.893 | Open Manhole | 1500 | 1.014 | 163.307 | 500 | 1.013 | 163.307 | 500 | |
| Outfall 19 | 165.700 | 2.488 | Open Manhole | 0 | | OUTFALL | | 1.014 | 163.212 | 500 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C19-1 | 378801.039 | 514875.857 | 378801.039 | 514875.857 | Required |  |
| S06-C19-2 | 378733.012 | 514917.024 | 378733.012 | 514917.024 | Required |  |
| S06-C19-3 | 378672.970 | 514971.332 | 378672.970 | 514971.332 | Required |  |
| S06-C19-4 | 378615.748 | 515026.470 | 378615.748 | 515026.470 | Required |  |
| S06-C19-5 | 378552.038 | 515074.867 | 378552.038 | 515074.867 | Required |  |
| S06-C19-6 | 378616.110 | 514915.393 | 378616.110 | 514915.393 | Required |  |
| S06-C19-7 | 378603.260 | 514928.017 | 378603.260 | 514928.017 | Required |  |
| S06-C19-8 | 378595.226 | 514963.214 | 378595.226 | 514963.214 | Required |  |

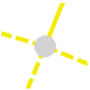
## Manhole Schedules for Catchment 19 - Ch 47600

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C19-9 | 378620.428 | 514920.185 | 378620.428 | 514920.185 | Required |  |
| S06-C19-10 | 378607.984 | 514932.378 | 378607.984 | 514932.378 | Required |  |
| S06-C19-11 | 378601.399 | 514961.141 | 378601.399 | 514961.141 | Required |  |
| S06-C19-12 | 378595.066 | 514994.295 | 378595.066 | 514994.295 | Required |  |
| S06-C19-13 | 378589.786 | 514990.441 | 378589.786 | 514990.441 | Required |  |
| S06-C19-14 | 378557.199 | 515018.553 | 378557.199 | 515018.553 | Required |  |
| S06-C19-15 | 378523.612 | 515045.203 | 378523.612 | 515045.203 | Required |  |
| S06-C19-16 | 378464.545 | 515077.620 | 378464.545 | 515077.620 | Required |  |
| S06-C19-17 | 378482.394 | 515114.218 | 378482.394 | 515114.218 | Required |  |
| S06-C19-18 | 378086.487 | 515198.395 | 378086.487 | 515198.395 | Required |  |
| S06-C19-19 | 378168.345 | 515194.881 | 378168.345 | 515194.881 | Required |  |
| S06-C19-20 | 378249.716 | 515184.745 | 378249.716 | 515184.745 | Required |  |
| S06-C19-21 | 378329.893 | 515168.090 | 378329.893 | 515168.090 | Required |  |
| S06-C19-22 | 378408.446 | 515144.741 | 378408.446 | 515144.741 | Required |  |
| S06-C19-23 | 378806.628 | 514887.390 | 378806.628 | 514887.390 | Required |  |
| S06-C19-24 | 378764.576 | 514910.534 | 378764.576 | 514910.534 | Required |  |
| S06-C19-25 | 378725.709 | 514939.258 | 378725.709 | 514939.258 | Required |  |
| S06-C19-26 | 378707.970 | 514958.632 | 378707.970 | 514958.632 | Required |  |
| S06-C19-27 | 378763.675 | 515036.702 | 378763.675 | 515036.702 | Required |  |

## Manhole Schedules for Catchment 19 - Ch 47600

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C19-28 | 378734.073 | 515006.181 | 378734.073 | 515006.181 | Required |  |
| S06-C19-29 | 378712.679 | 514982.505 | 378712.679 | 514982.505 | Required |  |
| S06-C19-30 | 378705.460 | 514974.497 | 378705.460 | 514974.497 | Required |  |
| S06-C19-31 | 378630.303 | 515054.027 | 378630.303 | 515054.027 | Required |  |
| S06-C19-32 | 378655.962 | 515062.839 | 378655.962 | 515062.839 | Required |  |
| S06-C19-33 | 378683.331 | 515050.899 | 378683.331 | 515050.899 | Required |  |
| S06-C19-34 | 378700.429 | 515033.196 | 378700.429 | 515033.196 | Required |  |
| S06-C19-35 | 378689.123 | 515056.418 | 378689.123 | 515056.418 | Required |  |
| S06-C19-36 | 378759.903 | 515041.695 | 378759.903 | 515041.695 | Required |  |
| S06-C19-37 | 378738.269 | 515024.754 | 378738.269 | 515024.754 | Required |  |
| S06-C19-38 | 378723.642 | 515020.906 | 378723.642 | 515020.906 | Required |  |
| S06-C19-39 | 378716.843 | 515012.508 | 378716.843 | 515012.508 | Required |  |
| S06-C19-40 | 378714.426 | 514992.724 | 378714.426 | 514992.724 | Required |  |
| S06-C19-41 | 378696.332 | 514979.090 | 378696.332 | 514979.090 | Required |  |
| S06-C19-42 | 378680.414 | 514981.967 | 378680.414 | 514981.967 | Required |  |
| S06-C19-43 | 378622.456 | 515037.586 | 378622.456 | 515037.586 | Required |  |
| S06-C19-44 | 378558.086 | 515086.175 | 378558.086 | 515086.175 | Required |  |
| S06-C19-45 | 378487.835 | 515125.788 | 378487.835 | 515125.788 | Required |  |
| S06-C19-46 | 378086.484 | 515211.223 | 378086.484 | 515211.223 | Required |  |

## Manhole Schedules for Catchment 19 - Ch 47600

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C19-47 | 378169.406 | 515207.637 | 378169.406 | 515207.637 | Required |  |
| S06-C19-48 | 378251.770 | 515197.379 | 378251.770 | 515197.379 | Required |  |
| S06-C19-49 | 378333.035 | 515180.499 | 378333.035 | 515180.499 | Required |  |
| S06-C19-50 | 378413.305 | 515156.606 | 378413.305 | 515156.606 | Required |  |
| S06-C19-51 | 378416.304 | 515164.087 | 378416.304 | 515164.087 | Required |  |
| S06-C19-52 | 378453.988 | 515168.911 | 378453.988 | 515168.911 | Required |  |
| S06-C19-53 | 378460.036 | 515169.685 |  |  | No Entry |  |
| S06-C19-54 | 378465.013 | 515182.011 |  |  | No Entry |  |
| S06-C19-55 | 378447.546 | 515214.353 |  |  | No Entry |  |
| S06-C19-56 | 378441.666 | 515216.405 |  |  | No Entry |  |
| S06-C19-57 | 378436.115 | 515215.102 | 378436.115 | 515215.102 | Required |  |
| Outfall 19 | 378401.366 | 515206.946 |  |  | No Entry |  |

## Area Summary for Catchment 19 - Ch 47600

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | User | - | 50 | 0.036 | 0.018 | 0.018 |
| 1.001 | User | - | 100 | 0.020 | 0.020 | 0.020 |
| | User | - | 50 | 0.034 | 0.017 | 0.037 |
| 1.002 | User | - | 100 | 0.056 | 0.056 | 0.056 |
| | User | - | 50 | 0.023 | 0.011 | 0.067 |
| 1.003 | User | - | 100 | 0.076 | 0.076 | 0.076 |
| | User | - | 50 | 0.020 | 0.010 | 0.086 |
| 1.004 | User | - | 100 | 0.074 | 0.074 | 0.074 |
| | User | - | 50 | 0.020 | 0.010 | 0.085 |
| 2.000 | User | - | 25 | 0.008 | 0.002 | 0.002 |
| | User | - | 50 | 0.003 | 0.001 | 0.003 |
| 2.001 | User | - | 25 | 0.064 | 0.016 | 0.016 |
| | User | - | 50 | 0.006 | 0.003 | 0.019 |
| 2.002 | User | - | 25 | 0.021 | 0.005 | 0.005 |
| | User | - | 50 | 0.004 | 0.002 | 0.007 |
| | User | - | 100 | 0.016 | 0.016 | 0.024 |
| 3.000 | User | - | 100 | 0.006 | 0.006 | 0.006 |
| | User | - | 50 | 0.003 | 0.001 | 0.007 |
| | User | - | 25 | 0.008 | 0.002 | 0.010 |
| 3.001 | User | - | 100 | 0.020 | 0.020 | 0.020 |
| | User | - | 50 | 0.005 | 0.002 | 0.022 |
| | User | - | 25 | 0.023 | 0.006 | 0.028 |
| 3.002 | User | - | 50 | 0.005 | 0.003 | 0.003 |
| | User | - | 25 | 0.019 | 0.005 | 0.007 |
| 3.003 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 2.003 | User | - | 25 | 0.018 | 0.005 | 0.005 |
| | User | - | 50 | 0.006 | 0.003 | 0.008 |
| | User | - | 100 | 0.022 | 0.022 | 0.029 |
| 2.004 | User | - | 25 | 0.008 | 0.002 | 0.002 |
| | User | - | 50 | 0.006 | 0.003 | 0.005 |
| | User | - | 100 | 0.022 | 0.022 | 0.027 |
| 2.005 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 2.006 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.005 | User | - | 100 | 0.064 | 0.064 | 0.064 |
| | User | - | 50 | 0.025 | 0.012 | 0.077 |
| 4.000 | User | - | 100 | 0.037 | 0.037 | 0.037 |
| | User | - | 50 | 0.037 | 0.018 | 0.056 |
| 4.001 | User | - | 100 | 0.037 | 0.037 | 0.037 |
| | User | - | 50 | 0.037 | 0.018 | 0.056 |
| 4.002 | User | - | 100 | 0.039 | 0.039 | 0.039 |
| | User | - | 50 | 0.037 | 0.018 | 0.057 |
| 4.003 | User | - | 100 | 0.040 | 0.040 | 0.040 |
| | User | - | 50 | 0.036 | 0.018 | 0.059 |
| 1.006 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 5.000 | User | - | 100 | 0.043 | 0.043 | 0.043 |
| | User | - | 50 | 0.012 | 0.006 | 0.049 |
| | User | - | 25 | 0.053 | 0.013 | 0.062 |
| 5.001 | User | - | 100 | 0.045 | 0.045 | 0.045 |
| | User | - | 50 | 0.012 | 0.006 | 0.051 |
| | User | - | 25 | 0.057 | 0.014 | 0.066 |
| 5.002 | User | - | 100 | 0.024 | 0.024 | 0.024 |
| | User | - | 50 | 0.007 | 0.003 | 0.027 |
| | User | - | 25 | 0.022 | 0.005 | 0.032 |
| 5.003 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 6.000 | User | - | 100 | 0.019 | 0.019 | 0.019 |
| | User | - | 50 | 0.006 | 0.003 | 0.023 |
| 6.001 | User | - | 50 | 0.005 | 0.002 | 0.002 |
| | User | - | 25 | 0.002 | 0.001 | 0.003 |
| 6.002 | User | - | 100 | 0.004 | 0.004 | 0.004 |
| | User | - | 50 | 0.002 | 0.001 | 0.005 |
| | User | - | 25 | 0.002 | 0.000 | 0.005 |
| 5.004 | User | - | 100 | 0.008 | 0.008 | 0.008 |

## Area Summary for Catchment 19 - Ch 47600

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| | User | - | 50 | 0.003 | 0.001 | 0.010 |
| | User | - | 25 | 0.006 | 0.001 | 0.011 |
| 7.000 | User | - | 100 | 0.014 | 0.014 | 0.014 |
| | User | - | 50 | 0.006 | 0.003 | 0.017 |
| 7.001 | User | - | 100 | 0.015 | 0.015 | 0.015 |
| | User | - | 50 | 0.006 | 0.003 | 0.018 |
| 7.002 | User | - | 100 | 0.010 | 0.010 | 0.010 |
| | User | - | 50 | 0.007 | 0.004 | 0.014 |
| 7.003 | User | - | 100 | 0.008 | 0.008 | 0.008 |
| | User | - | 50 | 0.010 | 0.005 | 0.013 |
| | User | - | 25 | 0.004 | 0.001 | 0.014 |
| 8.000 | User | - | 50 | 0.020 | 0.010 | 0.010 |
| | User | - | 25 | 0.008 | 0.002 | 0.012 |
| 9.000 | User | - | 100 | 0.000 | 0.000 | 0.000 |
| | User | - | 50 | 0.004 | 0.002 | 0.002 |
| | User | - | 25 | 0.004 | 0.001 | 0.003 |
| 9.001 | User | - | 50 | 0.003 | 0.001 | 0.001 |
| | User | - | 25 | 0.003 | 0.001 | 0.002 |
| 8.001 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 7.004 | User | - | 100 | 0.039 | 0.039 | 0.039 |
| | User | - | 50 | 0.005 | 0.002 | 0.042 |
| | User | - | 25 | 0.006 | 0.002 | 0.043 |
| 7.005 | User | - | 100 | 0.009 | 0.009 | 0.009 |
| | User | - | 50 | 0.003 | 0.002 | 0.011 |
| | User | - | 25 | 0.013 | 0.003 | 0.014 |
| 5.005 | User | - | 100 | 0.010 | 0.010 | 0.010 |
| | User | - | 50 | 0.003 | 0.002 | 0.011 |
| | User | - | 25 | 0.010 | 0.003 | 0.014 |
| 5.006 | User | - | 100 | 0.040 | 0.040 | 0.040 |
| | User | - | 50 | 0.020 | 0.010 | 0.050 |
| | User | - | 25 | 0.090 | 0.022 | 0.072 |
| 5.007 | User | - | 50 | 0.020 | 0.010 | 0.010 |
| | User | - | 25 | 0.084 | 0.021 | 0.031 |
| 5.008 | User | - | 50 | 0.020 | 0.010 | 0.010 |
| | User | - | 25 | 0.031 | 0.008 | 0.018 |
| 5.009 | User | - | 100 | 0.014 | 0.014 | 0.014 |
| | User | - | 50 | 0.020 | 0.010 | 0.024 |
| 10.000 | User | - | 100 | 0.037 | 0.037 | 0.037 |
| | User | - | 50 | 0.021 | 0.010 | 0.048 |
| 10.001 | User | - | 100 | 0.037 | 0.037 | 0.037 |
| | User | - | 50 | 0.021 | 0.010 | 0.048 |
| 10.002 | User | - | 100 | 0.039 | 0.039 | 0.039 |
| | User | - | 50 | 0.021 | 0.010 | 0.049 |
| 10.003 | User | - | 100 | 0.041 | 0.041 | 0.041 |
| | User | - | 50 | 0.021 | 0.011 | 0.051 |
| 1.007 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.008 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.009 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.010 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.011 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.012 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.013 | - | - | 100 | 0.135 | 0.135 | 0.135 |
| 1.014 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total<br>2.309 | Total<br>1.574 | Total<br>1.574 |

## Online Controls for Catchment 19 - Ch 47600

### Hydro-Brake® Optimum Manhole: S06-C19-57, DS/PN: 1.014, Volume (m³): 7.9

| | |
|---|---|
| Unit Reference | MD-SHE-0167-1490-1500-1490 |
| Design Head (m) | 1.500 |
| Design Flow (l/s) | 14.9 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 167 |
| Invert Level (m) | 163.307 |
| Minimum Outlet Pipe Diameter (mm) | 225 |
| Suggested Manhole Diameter (mm) | 1500 |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.500 | 14.9 | Kick-Flo® | 0.960 | 12.1 |
| Flush-Flo™ | 0.445 | 14.9 | Mean Flow over Head Range | - | 12.9 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 6.0 | 0.800 | 13.9 | 2.000 | 17.1 | 4.000 | 23.8 | 7.000 | 31.1 |
| 0.200 | 13.4 | 1.000 | 12.3 | 2.200 | 17.9 | 4.500 | 25.2 | 7.500 | 32.2 |
| 0.300 | 14.5 | 1.200 | 13.4 | 2.400 | 18.6 | 5.000 | 26.5 | 8.000 | 33.2 |
| 0.400 | 14.9 | 1.400 | 14.4 | 2.600 | 19.4 | 5.500 | 27.7 | 8.500 | 34.2 |
| 0.500 | 14.9 | 1.600 | 15.4 | 3.000 | 20.7 | 6.000 | 28.9 | 9.000 | 35.2 |
| 0.600 | 14.7 | 1.800 | 16.2 | 3.500 | 22.3 | 6.500 | 30.0 | 9.500 | 36.1 |

## Offline Controls for Catchment 19 - Ch 47600

### Weir Manhole: S06-C19-57, DS/PN: 1.014, Loop to PN: None

Discharge Coef 0.544 Width (m) 10.000 Invert Level (m) 164.807

## Storage Structures for Catchment 19 - Ch 47600

## Tank or Pond Manhole: S06-C19-57, DS/PN: 1.014

Invert Level (m) 163.307

| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|---|---|
| 0.000 | 657.4 | 1.500 | 1315.9 | 1.501 | 1800.0 | 3.760 | 3415.5 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 19 - Ch 47600

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C19-1 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 173.076 | -0.098 | 0.000 |
| 1.001 | S06-C19-2 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 172.277 | -0.073 | 0.000 |
| 1.002 | S06-C19-3 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 171.046 | 0.145 | 0.000 |
| 1.003 | S06-C19-4 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | | | 169.530 | -0.095 | 0.000 |
| 1.004 | S06-C19-5 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 168.303 | -0.059 | 0.000 |
| 2.000 | S06-C19-6 | 15 Winter | 5 | +20% | | | | | 169.003 | -0.131 | 0.000 |
| 2.001 | S06-C19-7 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 168.684 | -0.095 | 0.000 |
| 2.002 | S06-C19-8 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 168.329 | -0.067 | 0.000 |
| 3.000 | S06-C19-9 | 15 Winter | 5 | +20% | 100/15 Winter | | | | 169.020 | -0.119 | 0.000 |
| 3.001 | S06-C19-10 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 168.625 | -0.075 | 0.000 |
| 3.002 | S06-C19-11 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 168.317 | -0.068 | 0.000 |
| 3.003 | S06-C19-12 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 167.967 | -0.061 | 0.000 |
| 2.003 | S06-C19-13 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 167.874 | -0.089 | 0.000 |
| 2.004 | S06-C19-14 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 167.634 | -0.073 | 0.000 |
| 2.005 | S06-C19-15 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 167.342 | -0.109 | 0.000 |
| 2.006 | S06-C19-16 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Winter | | | 166.701 | 0.101 | 0.000 |
| 1.005 | S06-C19-17 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 166.568 | 0.210 | 0.000 |
| 4.000 | S06-C19-18 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 177.068 | -0.060 | 0.000 |
| 4.001 | S06-C19-19 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 175.870 | -0.058 | 0.000 |
| 4.002 | S06-C19-20 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 172.412 | -0.041 | 0.000 |
| 4.003 | S06-C19-21 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 167.705 | -0.094 | 0.000 |
| 1.006 | S06-C19-22 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 166.013 | 0.045 | 0.000 |
| 5.000 | S06-C19-23 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 172.917 | -0.037 | 0.000 |
| 5.001 | S06-C19-24 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 172.366 | -0.111 | 0.000 |
| 5.002 | S06-C19-25 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | | | 171.716 | -0.106 | 0.000 |
| 5.003 | S06-C19-26 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 171.453 | 0.107 | 0.000 |
| 6.000 | S06-C19-27 | 15 Winter | 5 | +20% | | | | | 176.326 | -0.108 | 0.000 |
| 6.001 | S06-C19-28 | 15 Winter | 5 | +20% | | | | | 174.741 | -0.112 | 0.000 |
| 6.002 | S06-C19-29 | 15 Winter | 5 | +20% | | | | | 172.700 | -0.108 | 0.000 |
| 5.004 | S06-C19-30 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 171.361 | 0.117 | 0.000 |
| 7.000 | S06-C19-31 | 15 Winter | 5 | +20% | | | | | 178.165 | -0.098 | 0.000 |
| 7.001 | S06-C19-32 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 177.912 | -0.076 | 0.000 |
| 7.002 | S06-C19-33 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 177.606 | -0.078 | 0.000 |
| 7.003 | S06-C19-34 | 15 Winter | 5 | +20% | | | | | 177.121 | -0.096 | 0.000 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 19 - Ch 47600

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 1.000 | S06-C19-1 | 0.24 | | | 4.2 | OK | |
| 1.001 | S06-C19-2 | 0.50 | | | 11.7 | OK | |
| 1.002 | S06-C19-3 | 1.04 | | | 23.2 | SURCHARGED | 6 |
| 1.003 | S06-C19-4 | 0.62 | | | 39.2 | OK | 1 |
| 1.004 | S06-C19-5 | 0.88 | | | 56.1 | OK | 4 |
| 2.000 | S06-C19-6 | 0.04 | | | 0.9 | OK | |
| 2.001 | S06-C19-7 | 0.28 | | | 4.9 | OK | |
| 2.002 | S06-C19-8 | 0.59 | | | 9.9 | OK | |
| 3.000 | S06-C19-9 | 0.09 | | | 2.4 | OK | |
| 3.001 | S06-C19-10 | 0.49 | | | 8.4 | OK | |
| 3.002 | S06-C19-11 | 0.57 | | | 9.8 | OK | |
| 3.003 | S06-C19-12 | 0.65 | | | 9.8 | OK | |
| 2.003 | S06-C19-13 | 0.66 | | | 25.2 | OK | |
| 2.004 | S06-C19-14 | 0.78 | | | 29.8 | OK | |
| 2.005 | S06-C19-15 | 0.52 | | | 29.2 | OK | |
| 2.006 | S06-C19-16 | 0.78 | | | 29.5 | SURCHARGED | 3 |
| 1.005 | S06-C19-17 | 1.16 | | | 86.6 | SURCHARGED | |
| 4.000 | S06-C19-18 | 0.63 | | | 13.4 | OK | 3 |
| 4.001 | S06-C19-19 | 0.68 | | | 24.5 | OK | 4 |
| 4.002 | S06-C19-20 | 0.86 | | | 35.9 | OK | 6 |
| 4.003 | S06-C19-21 | 0.62 | | | 47.2 | OK | |
| 1.006 | S06-C19-22 | 1.51 | | | 125.9 | SURCHARGED | |
| 5.000 | S06-C19-23 | 0.89 | | | 15.3 | OK | 4 |
| 5.001 | S06-C19-24 | 0.50 | | | 28.9 | OK | |
| 5.002 | S06-C19-25 | 0.55 | | | 35.6 | OK | 1 |
| 5.003 | S06-C19-26 | 0.95 | | | 33.9 | SURCHARGED | 4 |
| 6.000 | S06-C19-27 | 0.17 | | | 5.6 | OK | |
| 6.001 | S06-C19-28 | 0.14 | | | 6.3 | OK | |
| 6.002 | S06-C19-29 | 0.18 | | | 7.5 | OK | |
| 5.004 | S06-C19-30 | 1.27 | | | 42.4 | SURCHARGED | |
| 7.000 | S06-C19-31 | 0.26 | | | 4.3 | OK | |
| 7.001 | S06-C19-32 | 0.48 | | | 8.1 | OK | |
| 7.002 | S06-C19-33 | 0.47 | | | 10.9 | OK | |
| 7.003 | S06-C19-34 | 0.28 | | | 13.9 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 19 - Ch 47600

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8.000 | S06-C19-35 | 15 Winter | 5 | +20% | | | | | 177.657 | -0.122 | 0.000 |
| 9.000 | S06-C19-36 | 15 Winter | 5 | +20% | | | | | 176.285 | -0.133 | 0.000 |
| 9.001 | S06-C19-37 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 175.550 | -0.129 | 0.000 |
| 8.001 | S06-C19-38 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 175.147 | -0.111 | 0.000 |
| 7.004 | S06-C19-39 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 174.862 | -0.067 | 0.000 |
| 7.005 | S06-C19-40 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 173.214 | -0.060 | 0.000 |
| 5.005 | S06-C19-41 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 171.263 | 0.080 | 0.000 |
| 5.006 | S06-C19-42 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 170.737 | -0.110 | 0.000 |
| 5.007 | S06-C19-43 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 169.719 | -0.118 | 0.000 |
| 5.008 | S06-C19-44 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 168.474 | -0.117 | 0.000 |
| 5.009 | S06-C19-45 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 167.193 | -0.104 | 0.000 |
| 10.000 | S06-C19-46 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 177.073 | -0.068 | 0.000 |
| 10.001 | S06-C19-47 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 175.874 | -0.066 | 0.000 |
| 10.002 | S06-C19-48 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 172.416 | -0.052 | 0.000 |
| 10.003 | S06-C19-49 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 167.710 | -0.100 | 0.000 |
| 1.007 | S06-C19-50 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 165.735 | -0.193 | 0.000 |
| 1.008 | S06-C19-51 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 164.260 | 0.210 | 0.000 |
| 1.009 | S06-C19-52 | 15 Winter | 5 | +20% | 5/15 Summer | | | | 164.124 | 0.169 | 0.000 |
| 1.010 | S06-C19-53 | 15 Winter | 5 | +20% | | | | | 164.029 | -0.011 | 0.000 |
| 1.011 | S06-C19-54 | 15 Winter | 5 | +20% | | | | | 163.991 | -0.022 | 0.000 |
| 1.012 | S06-C19-55 | 15 Winter | 5 | +20% | | | | | 163.920 | -0.018 | 0.000 |
| 1.013 | S06-C19-56 | 15 Winter | 5 | +20% | 5/15 Winter | | | | 163.908 | 0.082 | 0.000 |
| 1.014 | S06-C19-57 | 480 Winter | 5 | +20% | 100/30 Summer | | | 0 | 163.795 | -0.012 | 0.000 |

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 8.000 | S06-C19-35 | 0.08 | | | 3.0 | OK | |
| 9.000 | S06-C19-36 | 0.03 | | | 0.8 | OK | |
| 9.001 | S06-C19-37 | 0.05 | | | 1.3 | OK | |
| 8.001 | S06-C19-38 | 0.15 | | | 4.3 | OK | |
| 7.004 | S06-C19-39 | 0.59 | | | 27.2 | OK | |
| 7.005 | S06-C19-40 | 0.67 | | | 30.1 | OK | |
| 5.005 | S06-C19-41 | 1.12 | | | 72.5 | SURCHARGED | |
| 5.006 | S06-C19-42 | 0.71 | | | 85.3 | OK | |
| 5.007 | S06-C19-43 | 0.67 | | | 89.3 | OK | |
| 5.008 | S06-C19-44 | 0.68 | | | 91.8 | OK | |
| 5.009 | S06-C19-45 | 0.76 | | | 95.2 | OK | |
| 10.000 | S06-C19-46 | 0.54 | | | 11.4 | OK | |
| 10.001 | S06-C19-47 | 0.58 | | | 21.0 | OK | |
| 10.002 | S06-C19-48 | 0.74 | | | 30.8 | OK | 4 |
| 10.003 | S06-C19-49 | 0.58 | | | 41.2 | OK | |
| 1.007 | S06-C19-50 | 0.48 | | | 256.4 | OK | |
| 1.008 | S06-C19-51 | 1.21 | | | 252.4 | SURCHARGED | |
| 1.009 | S06-C19-52 | 1.61 | | | 249.3 | SURCHARGED | |
| 1.010 | S06-C19-53 | 1.04 | | | 249.2 | OK* | |
| 1.011 | S06-C19-54 | 0.78 | | | 240.9 | OK* | |
| 1.012 | S06-C19-55 | 0.69 | | | 237.8 | OK* | |
| 1.013 | S06-C19-56 | 1.11 | | | 243.6 | SURCHARGED* | |
| 1.014 | S06-C19-57 | 0.08 | 0.0 | | 14.9 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 19 - Ch 47600

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C19-1 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 173.417 | 0.243 | 0.000 |
| 1.001 | S06-C19-2 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 173.278 | 0.929 | 0.000 |
| 1.002 | S06-C19-3 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 172.109 | 1.207 | 7.413 |
| 1.003 | S06-C19-4 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | | | 170.825 | 1.200 | 0.145 |
| 1.004 | S06-C19-5 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 169.565 | 1.203 | 2.398 |
| 2.000 | S06-C19-6 | 15 Winter | 100 | +40% | | | | | 169.013 | -0.121 | 0.000 |
| 2.001 | S06-C19-7 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 168.982 | 0.203 | 0.000 |
| 2.002 | S06-C19-8 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 168.941 | 0.545 | 0.000 |
| 3.000 | S06-C19-9 | 15 Winter | 100 | +40% | 100/15 Winter | | | | 169.159 | 0.020 | 0.000 |
| 3.001 | S06-C19-10 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 169.147 | 0.447 | 0.000 |
| 3.002 | S06-C19-11 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 169.012 | 0.628 | 0.000 |
| 3.003 | S06-C19-12 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 168.812 | 0.784 | 0.000 |
| 2.003 | S06-C19-13 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 168.762 | 0.799 | 0.000 |
| 2.004 | S06-C19-14 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 168.564 | 0.858 | 0.000 |
| 2.005 | S06-C19-15 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 168.267 | 0.815 | 0.000 |
| 2.006 | S06-C19-16 | 30 Winter | 100 | +40% | 5/15 Winter | 100/15 Winter | | | 167.802 | 1.202 | 1.972 |
| 1.005 | S06-C19-17 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 167.666 | 1.308 | 0.000 |
| 4.000 | S06-C19-18 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 178.328 | 1.201 | 0.551 |
| 4.001 | S06-C19-19 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 177.129 | 1.201 | 1.018 |
| 4.002 | S06-C19-20 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 173.657 | 1.204 | 3.764 |
| 4.003 | S06-C19-21 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 168.078 | 0.279 | 0.000 |
| 1.006 | S06-C19-22 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 166.470 | 0.502 | 0.000 |
| 5.000 | S06-C19-23 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 174.155 | 1.201 | 1.345 |
| 5.001 | S06-C19-24 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 173.584 | 1.107 | 0.000 |
| 5.002 | S06-C19-25 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | | | 173.022 | 1.200 | 0.076 |
| 5.003 | S06-C19-26 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 172.551 | 1.205 | 5.505 |
| 6.000 | S06-C19-27 | 15 Winter | 100 | +40% | | | | | 176.348 | -0.086 | 0.000 |
| 6.001 | S06-C19-28 | 15 Winter | 100 | +40% | | | | | 174.763 | -0.090 | 0.000 |
| 6.002 | S06-C19-29 | 15 Winter | 100 | +40% | | | | | 172.725 | -0.083 | 0.000 |
| 5.004 | S06-C19-30 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 172.490 | 1.247 | 0.000 |
| 7.000 | S06-C19-31 | 15 Winter | 100 | +40% | | | | | 178.195 | -0.068 | 0.000 |
| 7.001 | S06-C19-32 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 178.069 | 0.081 | 0.000 |
| 7.002 | S06-C19-33 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 177.725 | 0.041 | 0.000 |
| 7.003 | S06-C19-34 | 15 Winter | 100 | +40% | | | | | 177.155 | -0.062 | 0.000 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 19 - Ch 47600

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 1.000 | S06-C19-1 | 0.48 | | | 8.5 | SURCHARGED | |
| 1.001 | S06-C19-2 | 0.87 | | | 20.4 | FLOOD RISK | |
| 1.002 | S06-C19-3 | 1.40 | | | 31.0 | FLOOD | 6 |
| 1.003 | S06-C19-4 | 0.98 | | | 62.5 | FLOOD | 1 |
| 1.004 | S06-C19-5 | 1.31 | | | 83.2 | FLOOD | 4 |
| 2.000 | S06-C19-6 | 0.08 | | | 1.9 | OK | |
| 2.001 | S06-C19-7 | 0.67 | | | 11.5 | SURCHARGED | |
| 2.002 | S06-C19-8 | 1.18 | | | 20.1 | SURCHARGED | |
| 3.000 | S06-C19-9 | 0.20 | | | 5.4 | SURCHARGED | |
| 3.001 | S06-C19-10 | 1.04 | | | 17.7 | SURCHARGED | |
| 3.002 | S06-C19-11 | 0.95 | | | 16.3 | SURCHARGED | |
| 3.003 | S06-C19-12 | 1.10 | | | 16.5 | SURCHARGED | |
| 2.003 | S06-C19-13 | 1.08 | | | 41.1 | SURCHARGED | |
| 2.004 | S06-C19-14 | 1.25 | | | 47.7 | SURCHARGED | |
| 2.005 | S06-C19-15 | 0.77 | | | 43.5 | SURCHARGED | |
| 2.006 | S06-C19-16 | 1.28 | | | 48.8 | FLOOD | 3 |
| 1.005 | S06-C19-17 | 1.79 | | | 133.2 | SURCHARGED | |
| 4.000 | S06-C19-18 | 1.00 | | | 21.1 | FLOOD | 3 |
| 4.001 | S06-C19-19 | 1.00 | | | 36.2 | FLOOD | 4 |
| 4.002 | S06-C19-20 | 1.12 | | | 47.1 | FLOOD | 6 |
| 4.003 | S06-C19-21 | 1.02 | | | 77.3 | SURCHARGED | |
| 1.006 | S06-C19-22 | 2.35 | | | 196.6 | SURCHARGED | |
| 5.000 | S06-C19-23 | 1.48 | | | 25.5 | FLOOD | 4 |
| 5.001 | S06-C19-24 | 0.87 | | | 50.5 | FLOOD RISK | |
| 5.002 | S06-C19-25 | 1.00 | | | 64.6 | FLOOD | 1 |
| 5.003 | S06-C19-26 | 2.00 | | | 71.3 | FLOOD | 4 |
| 6.000 | S06-C19-27 | 0.37 | | | 12.5 | OK | |
| 6.001 | S06-C19-28 | 0.32 | | | 14.1 | OK | |
| 6.002 | S06-C19-29 | 0.40 | | | 17.2 | OK | |
| 5.004 | S06-C19-30 | 2.34 | | | 78.3 | SURCHARGED | |
| 7.000 | S06-C19-31 | 0.57 | | | 9.6 | OK | |
| 7.001 | S06-C19-32 | 1.06 | | | 17.9 | SURCHARGED | |
| 7.002 | S06-C19-33 | 1.04 | | | 24.3 | SURCHARGED | |
| 7.003 | S06-C19-34 | 0.63 | | | 31.9 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 19 - Ch 47600

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8.000 | S06-C19-35 | 15 Winter | 100 | +40% | | | | | 177.671 | -0.109 | 0.000 |
| 9.000 | S06-C19-36 | 15 Winter | 100 | +40% | | | | | 176.293 | -0.124 | 0.000 |
| 9.001 | S06-C19-37 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 176.041 | 0.362 | 0.000 |
| 8.001 | S06-C19-38 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 176.043 | 0.785 | 0.000 |
| 7.004 | S06-C19-39 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 176.032 | 1.103 | 0.000 |
| 7.005 | S06-C19-40 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 174.353 | 1.079 | 0.000 |
| 5.005 | S06-C19-41 | 15 Winter | 100 | +40% | 5/15 Summer | | | | 172.363 | 1.180 | 0.000 |
| 5.006 | S06-C19-42 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 171.485 | 0.638 | 0.000 |
| 5.007 | S06-C19-43 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 170.231 | 0.395 | 0.000 |
| 5.008 | S06-C19-44 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 168.962 | 0.371 | 0.000 |
| 5.009 | S06-C19-45 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 167.631 | 0.334 | 0.000 |
| 10.000 | S06-C19-46 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 178.053 | 0.912 | 0.000 |
| 10.001 | S06-C19-47 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 176.981 | 1.041 | 0.000 |
| 10.002 | S06-C19-48 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 173.670 | 1.202 | 1.861 |
| 10.003 | S06-C19-49 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 167.980 | 0.170 | 0.000 |
| 1.007 | S06-C19-50 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 166.224 | 0.296 | 0.000 |
| 1.008 | S06-C19-51 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 165.209 | 1.159 | 0.000 |
| 1.009 | S06-C19-52 | 30 Winter | 100 | +40% | 5/15 Summer | | | | 164.871 | 0.916 | 0.000 |
| 1.010 | S06-C19-53 | 15 Summer | 100 | +40% | | | | | 164.040 | 0.000 | 0.000 |
| 1.011 | S06-C19-54 | 15 Summer | 100 | +40% | | | | | 164.013 | 0.000 | 0.000 |
| 1.012 | S06-C19-55 | 15 Summer | 100 | +40% | | | | | 163.938 | 0.000 | 0.000 |
| 1.013 | S06-C19-56 | 15 Summer | 100 | +40% | 5/15 Winter | | | | 163.926 | 0.100 | 0.000 |
| 1.014 | S06-C19-57 | 480 Winter | 100 | +40% | 100/30 Summer | | | 0 | 164.476 | 0.669 | 0.000 |

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 8.000 | S06-C19-35 | 0.17 | | | 6.6 | OK | |
| 9.000 | S06-C19-36 | 0.07 | | | 1.9 | OK | |
| 9.001 | S06-C19-37 | 0.30 | | | 8.1 | SURCHARGED | |
| 8.001 | S06-C19-38 | 0.69 | | | 19.3 | SURCHARGED | |
| 7.004 | S06-C19-39 | 1.02 | | | 47.1 | FLOOD RISK | |
| 7.005 | S06-C19-40 | 1.13 | | | 50.9 | FLOOD RISK | |
| 5.005 | S06-C19-41 | 1.72 | | | 111.9 | SURCHARGED | |
| 5.006 | S06-C19-42 | 1.15 | | | 138.3 | SURCHARGED | |
| 5.007 | S06-C19-43 | 1.02 | | | 136.4 | SURCHARGED | |
| 5.008 | S06-C19-44 | 1.01 | | | 137.7 | SURCHARGED | |
| 5.009 | S06-C19-45 | 1.14 | | | 142.3 | SURCHARGED | |
| 10.000 | S06-C19-46 | 0.93 | | | 19.7 | FLOOD RISK | |
| 10.001 | S06-C19-47 | 0.97 | | | 34.9 | FLOOD RISK | |
| 10.002 | S06-C19-48 | 1.12 | | | 46.8 | FLOOD | 4 |
| 10.003 | S06-C19-49 | 1.05 | | | 73.8 | SURCHARGED | |
| 1.007 | S06-C19-50 | 0.74 | | | 395.3 | SURCHARGED | |
| 1.008 | S06-C19-51 | 1.89 | | | 394.3 | FLOOD RISK | |
| 1.009 | S06-C19-52 | 2.54 | | | 394.1 | SURCHARGED | |
| 1.010 | S06-C19-53 | 1.56 | | | 375.7 | SURCHARGED* | |
| 1.011 | S06-C19-54 | 1.22 | | | 375.8 | SURCHARGED* | |
| 1.012 | S06-C19-55 | 1.08 | | | 375.9 | SURCHARGED* | |
| 1.013 | S06-C19-56 | 1.77 | | | 388.9 | SURCHARGED* | |
| 1.014 | S06-C19-57 | 0.08 | 0.0 | | 14.9 | SURCHARGED | |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for Catchment 20 - Ch 47950

Pipe Sizes Min 150 Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 5 | PIMP (%) | 100 |
| M5-60 (mm) | 20.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.200 |
| Maximum Rainfall (mm/hr) | 150 | Maximum Backdrop Height (m) | 1.500 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

## Network Design Table for Catchment 20 - Ch 47950

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 74.679 | 0.819 | 91.2 | 0.095 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.001 | 74.868 | 0.446 | 167.9 | 0.062 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 2.000 | 21.453 | 0.213 | 100.9 | 0.013 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.002 | 13.300 | 0.079 | 167.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 3.000 | 41.632 | 0.413 | 100.9 | 0.010 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 3.001 | 26.304 | 0.261 | 100.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 3.002 | 85.551 | 1.293 | 66.2 | 0.023 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 4.000 | 21.336 | 0.263 | 81.0 | 0.015 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 1.003 | 3.632 | 0.608 | 6.0 | 0.047 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 1.004 | 59.233 | 0.300 | 197.4 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.005 | 48.727 | 0.247 | 197.4 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.006 | 57.536 | 0.291 | 197.4 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.007 | 72.638 | 1.862 | 39.0 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | 72.00 | 6.18 | 172.779 | 0.095 | 0.0 | 0.0 | 0.0 | 1.05 | 18.6 | 18.6 |
| 1.001 | 66.57 | 7.42 | 171.885 | 0.157 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 28.3 |
| 2.000 | 76.26 | 5.36 | 171.350 | 0.013 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 2.6 |
| 1.002 | 65.71 | 7.64 | 171.062 | 0.170 | 0.0 | 0.0 | 0.0 | 1.01 | 40.0 | 30.2 |
| 3.000 | 74.45 | 5.69 | 173.024 | 0.010 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 2.0 |
| 3.001 | 72.24 | 6.13 | 172.612 | 0.010 | 0.0 | 0.0 | 0.0 | 1.00 | 17.7 | 2.0 |
| 3.002 | 67.13 | 7.28 | 172.351 | 0.033 | 0.0 | 0.0 | 0.0 | 1.24 | 21.9 | 6.0 |
| 4.000 | 76.48 | 5.32 | 171.322 | 0.015 | 0.0 | 0.0 | 0.0 | 1.12 | 19.8 | 3.1 |
| 1.003 | 65.67 | 7.65 | 170.983 | 0.264 | 0.0 | 0.0 | 0.0 | 5.39 | 214.3 | 47.0 |
| 1.004 | 62.47 | 8.54 | 170.300 | 0.264 | 0.0 | 0.0 | 0.0 | 1.12 | 78.8 | 47.0 |
| 1.005 | 60.11 | 9.27 | 170.000 | 0.264 | 0.0 | 0.0 | 0.0 | 1.12 | 78.8 | 47.0 |
| 1.006 | 57.60 | 10.13 | 169.753 | 0.264 | 0.0 | 0.0 | 0.0 | 1.12 | 78.8 | 47.0 |
| 1.007 | 56.30 | 10.61 | 169.462 | 0.264 | 0.0 | 0.0 | 0.0 | 2.52 | 178.5 | 47.0 |

## Network Design Table for Catchment 20 - Ch 47950

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.008 | 41.760 | 0.173 | 241.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.009 | 6.892 | 0.028 | 246.2 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 1.010 | 27.829 | 0.070 | 397.6 | 0.000 | 0.00 | 0.0 | 0.600 | o | 500 | Pipe/Conduit | 🔒 |
| 1.011 | 6.108 | 0.025 | 244.3 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 5.000 | 78.358 | 0.959 | 81.7 | 0.042 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 5.001 | 6.096 | 0.275 | 22.2 | 0.000 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 5.002 | 20.374 | 0.865 | 23.5 | 0.017 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 5.003 | 47.724 | 2.207 | 21.6 | 0.036 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 5.004 | 47.713 | 2.227 | 21.4 | 0.038 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 5.005 | 40.115 | 0.825 | 48.6 | 0.032 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 5.006 | 5.988 | 0.060 | 100.0 | 0.001 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔒 |
| 6.000 | 14.068 | 0.289 | 48.7 | 0.014 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔒 |
| 6.001 | 6.450 | 0.065 | 99.3 | 0.000 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 6.002 | 5.081 | 0.030 | 167.9 | 0.008 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 5.007 | 9.880 | 0.099 | 99.8 | 0.000 | 0.00 | 0.0 | 0.600 | o | 225 | Pipe/Conduit | 🔓 |
| 7.000 | 35.000 | 1.467 | 23.9 | 0.007 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 7.001 | 34.745 | 1.359 | 25.6 | 0.008 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 7.002 | 42.708 | 1.676 | 25.5 | 0.013 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 7.003 | 42.677 | 1.608 | 26.5 | 0.008 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔓 |
| 7.004 | 39.502 | 0.439 | 90.0 | 0.008 | 0.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔒 |
| 8.000 | 8.007 | 0.101 | 79.3 | 0.002 | 5.00 | 0.0 | 0.600 | o | 150 | Pipe/Conduit | 🔒 |
| 5.008 | 4.387 | 0.018 | 241.6 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |

## Network Results Table

| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1.008 | 54.55 | 11.30 | 167.600 | 0.264 | 0.0 | 0.0 | 0.0 | 1.01 | 71.1 | 47.0 |
| 1.009 | 54.27 | 11.41 | 167.427 | 0.264 | 0.0 | 0.0 | 0.0 | 1.00 | 70.5 | 47.0 |
| 1.010 | 53.27 | 11.84 | 167.399 | 0.264 | 0.0 | 0.0 | 0.0 | 1.08 | 212.7 | 47.0 |
| 1.011 | 53.04 | 11.94 | 167.327 | 0.264 | 0.0 | 0.0 | 0.0 | 1.00 | 70.8 | 47.0 |
| 5.000 | 72.04 | 6.17 | 176.509 | 0.042 | 0.0 | 0.0 | 0.0 | 1.11 | 19.7 | 8.2 |
| 5.001 | 71.81 | 6.22 | 175.550 | 0.042 | 0.0 | 0.0 | 0.0 | 2.15 | 38.0 | 8.2 |
| 5.002 | 71.04 | 6.38 | 175.275 | 0.059 | 0.0 | 0.0 | 0.0 | 2.08 | 36.8 | 11.4 |
| 5.003 | 69.39 | 6.75 | 174.410 | 0.095 | 0.0 | 0.0 | 0.0 | 2.18 | 38.4 | 17.8 |
| 5.004 | 67.83 | 7.11 | 172.202 | 0.132 | 0.0 | 0.0 | 0.0 | 2.19 | 38.6 | 24.3 |
| 5.005 | 66.39 | 7.47 | 169.901 | 0.164 | 0.0 | 0.0 | 0.0 | 1.88 | 74.8 | 29.5 |
| 5.006 | 66.09 | 7.54 | 169.039 | 0.165 | 0.0 | 0.0 | 0.0 | 1.31 | 52.0 | 29.5 |
| 6.000 | 77.37 | 5.16 | 169.278 | 0.014 | 0.0 | 0.0 | 0.0 | 1.45 | 25.5 | 2.9 |
| 6.001 | 76.76 | 5.27 | 168.989 | 0.014 | 0.0 | 0.0 | 0.0 | 1.01 | 17.8 | 2.9 |
| 6.002 | 76.15 | 5.38 | 168.924 | 0.022 | 0.0 | 0.0 | 0.0 | 0.77 | 13.7 | 4.6 |
| 5.007 | 65.60 | 7.67 | 168.819 | 0.187 | 0.0 | 0.0 | 0.0 | 1.31 | 52.0 | 33.2 |
| 7.000 | 76.69 | 5.28 | 175.650 | 0.007 | 0.0 | 0.0 | 0.0 | 2.07 | 36.6 | 1.5 |
| 7.001 | 75.10 | 5.57 | 174.183 | 0.015 | 0.0 | 0.0 | 0.0 | 2.00 | 35.3 | 3.1 |
| 7.002 | 73.25 | 5.93 | 172.823 | 0.028 | 0.0 | 0.0 | 0.0 | 2.00 | 35.4 | 5.6 |
| 7.003 | 71.49 | 6.29 | 171.147 | 0.037 | 0.0 | 0.0 | 0.0 | 1.96 | 34.7 | 7.1 |
| 7.004 | 68.69 | 6.91 | 169.539 | 0.044 | 0.0 | 0.0 | 0.0 | 1.06 | 18.7 | 8.3 |
| 8.000 | 77.62 | 5.12 | 169.215 | 0.002 | 0.0 | 0.0 | 0.0 | 1.13 | 20.0 | 0.3 |
| 5.008 | 65.33 | 7.74 | 168.645 | 0.233 | 0.0 | 0.0 | 0.0 | 1.01 | 71.2 | 41.2 |

## Network Design Table for Catchment 20 - Ch 47950

| PN | Length (m) | Fall (m) | Slope (1:X) | I.Area (ha) | T.E. (mins) | Base Flow (l/s) | k (mm) | HYD SECT | DIA (mm) | Section Type | Auto Design |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5.009 | 11.004 | 0.046 | 241.6 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 5.010 | 18.774 | 0.078 | 241.6 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 5.011 | 6.000 | 0.025 | 241.6 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 5.012 | 46.356 | 0.192 | 241.6 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔓 |
| 5.013 | 7.347 | 0.030 | 244.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| 5.014 | 19.021 | 0.042 | 452.9 | 0.000 | 0.00 | 0.0 | 0.600 | o | 500 | Pipe/Conduit | 🔒 |
| 5.015 | 6.279 | 0.025 | 251.1 | 0.063 | 0.00 | 0.0 | 0.600 | o | 300 | Pipe/Conduit | 🔒 |
| | | | | | | | | | | | |
| 1.012 | 30.663 | 0.099 | 309.7 | 0.000 | 0.00 | 0.0 | 0.600 | o | 375 | Pipe/Conduit | 🔓 |

## Network Results Table

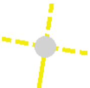
| PN | Rain (mm/hr) | T.C. (mins) | US/IL (m) | Σ I.Area (ha) | Σ Base Flow (l/s) | Foul (l/s) | Add Flow (l/s) | Vel (m/s) | Cap (l/s) | Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| 5.009 | 64.64 | 7.93 | 168.627 | 0.233 | 0.0 | 0.0 | 0.0 | 1.01 | 71.2 | 41.2 |
| 5.010 | 63.52 | 8.24 | 168.581 | 0.233 | 0.0 | 0.0 | 0.0 | 1.01 | 71.2 | 41.2 |
| 5.011 | 63.17 | 8.34 | 168.503 | 0.233 | 0.0 | 0.0 | 0.0 | 1.01 | 71.2 | 41.2 |
| 5.012 | 60.63 | 9.10 | 168.479 | 0.233 | 0.0 | 0.0 | 0.0 | 1.01 | 71.2 | 41.2 |
| 5.013 | 60.24 | 9.22 | 167.429 | 0.233 | 0.0 | 0.0 | 0.0 | 1.00 | 70.7 | 41.2 |
| 5.014 | 59.29 | 9.54 | 167.399 | 0.233 | 0.0 | 0.0 | 0.0 | 1.01 | 199.1 | 41.2 |
| 5.015 | 58.98 | 9.64 | 167.327 | 0.296 | 0.0 | 0.0 | 0.0 | 0.99 | 69.8 | 47.3 |
| | | | | | | | | | | |
| 1.012 | 51.93 | 12.44 | 167.227 | 0.560 | 0.0 | 0.0 | 0.0 | 1.02 | 113.1 | 78.8 |

## Manhole Schedules for Catchment 20 - Ch 47950

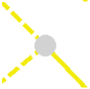
| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C20-1 | 174.129 | 1.350 | Open Manhole | 1200 | 1.000 | 172.779 | 150 | | | | |
| S06-C20-2 | 173.388 | 1.503 | Open Manhole | 1200 | 1.001 | 171.885 | 225 | 1.000 | 171.960 | 150 | |
| S06-C20-3 | 172.700 | 1.350 | Open Manhole | 1200 | 2.000 | 171.350 | 150 | | | | |
| S06-C20-4 | 173.051 | 1.989 | Open Manhole | 1200 | 1.002 | 171.062 | 225 | 1.001 | 171.439 | 225 | 377 |
| | | | | | | | | 2.000 | 171.137 | 150 | |
| S06-C20-5 | 174.374 | 1.350 | Open Manhole | 1200 | 3.000 | 173.024 | 150 | | | | |
| S06-C20-6 | 174.075 | 1.463 | Open Manhole | 1200 | 3.001 | 172.612 | 150 | 3.000 | 172.612 | 150 | |
| S06-C20-7 | 173.720 | 1.369 | Open Manhole | 1200 | 3.002 | 172.351 | 150 | 3.001 | 172.351 | 150 | |
| S06-C20-8 | 172.672 | 1.350 | Open Manhole | 1200 | 4.000 | 171.322 | 150 | | | | |
| S06-C20-9 | 172.607 | 1.624 | Open Manhole | 1200 | 1.003 | 170.983 | 225 | 1.002 | 170.983 | 225 | |
| | | | | | | | | 3.002 | 171.058 | 150 | |
| | | | | | | | | 4.000 | 171.058 | 150 | |
| S06-C20-10 | 171.800 | 1.500 | Open Manhole | 1200 | 1.004 | 170.300 | 300 | 1.003 | 170.375 | 225 | |
| S06-C20-11 | 171.500 | 1.500 | Open Manhole | 1200 | 1.005 | 170.000 | 300 | 1.004 | 170.000 | 300 | |
| S06-C20-12 | 173.000 | 3.247 | Open Manhole | 1200 | 1.006 | 169.753 | 300 | 1.005 | 169.753 | 300 | |
| S06-C20-13 | 175.000 | 5.538 | Open Manhole | 1200 | 1.007 | 169.462 | 300 | 1.006 | 169.462 | 300 | |
| S06-C20-14 | 169.100 | 1.500 | Open Manhole | 1200 | 1.008 | 167.600 | 300 | 1.007 | 167.600 | 300 | |
| S06-C20-15 | 171.400 | 3.973 | Open Manhole | 1200 | 1.009 | 167.427 | 300 | 1.008 | 167.427 | 300 | |
| S06-C20-16 | 171.400 | 4.001 | Junction | | 1.010 | 167.399 | 500 | 1.009 | 167.399 | 300 | |
| S06-C20-17 | 171.400 | 4.073 | Junction | | 1.011 | 167.327 | 300 | 1.010 | 167.329 | 500 | 202 |
| S06-C20-18 | 177.859 | 1.350 | Open Manhole | 1200 | 5.000 | 176.509 | 150 | | | | |
| S06-C20-19 | 176.900 | 1.350 | Open Manhole | 1200 | 5.001 | 175.550 | 150 | 5.000 | 175.550 | 150 | |
| S06-C20-20 | 176.625 | 1.350 | Open Manhole | 1200 | 5.002 | 175.275 | 150 | 5.001 | 175.275 | 150 | |
| S06-C20-21 | 175.760 | 1.350 | Open Manhole | 1200 | 5.003 | 174.410 | 150 | 5.002 | 174.410 | 150 | |
| S06-C20-22 | 173.552 | 1.350 | Open Manhole | 1200 | 5.004 | 172.202 | 150 | 5.003 | 172.202 | 150 | |
| S06-C20-23 | 171.326 | 1.425 | Open Manhole | 1200 | 5.005 | 169.901 | 225 | 5.004 | 169.976 | 150 | |
| S06-C20-24 | 170.500 | 1.461 | Open Manhole | 1200 | 5.006 | 169.039 | 225 | 5.005 | 169.075 | 225 | 36 |
| S06-C20-25 | 170.628 | 1.350 | Open Manhole | 1200 | 6.000 | 169.278 | 150 | | | | |
| S06-C20-26 | 170.339 | 1.350 | Open Manhole | 1200 | 6.001 | 168.989 | 150 | 6.000 | 168.989 | 150 | |
| S06-C20-27 | 170.335 | 1.411 | Open Manhole | 1200 | 6.002 | 168.924 | 150 | 6.001 | 168.924 | 150 | |
| S06-C20-28 | 170.480 | 1.661 | Open Manhole | 1200 | 5.007 | 168.819 | 225 | 5.006 | 168.979 | 225 | 160 |
| | | | | | | | | 6.002 | 168.894 | 150 | |
| S06-C20-29 | 177.000 | 1.350 | Open Manhole | 1200 | 7.000 | 175.650 | 150 | | | | |
| S06-C20-30 | 175.533 | 1.350 | Open Manhole | 1200 | 7.001 | 174.183 | 150 | 7.000 | 174.183 | 150 | |
| S06-C20-31 | 174.173 | 1.350 | Open Manhole | 1200 | 7.002 | 172.823 | 150 | 7.001 | 172.823 | 150 | |
| S06-C20-32 | 172.497 | 1.350 | Open Manhole | 1200 | 7.003 | 171.147 | 150 | 7.002 | 171.147 | 150 | |
| S06-C20-33 | 170.889 | 1.350 | Open Manhole | 1200 | 7.004 | 169.539 | 150 | 7.003 | 169.539 | 150 | |
| S06-C20-34 | 170.565 | 1.350 | Open Manhole | 1200 | 8.000 | 169.215 | 150 | | | | |
| S06-C20-35 | 170.464 | 1.819 | Open Manhole | 1200 | 5.008 | 168.645 | 300 | 5.007 | 168.720 | 225 | |
| | | | | | | | | 7.004 | 169.100 | 150 | 305 |
| | | | | | | | | 8.000 | 169.114 | 150 | 319 |
| S06-C20-36 | 169.796 | 1.169 | Open Manhole | 1200 | 5.009 | 168.627 | 300 | 5.008 | 168.627 | 300 | |
| S06-C20-37 | 169.978 | 1.396 | Open Manhole | 1200 | 5.010 | 168.581 | 300 | 5.009 | 168.581 | 300 | |
| S06-C20-38 | 170.759 | 2.256 | Open Manhole | 1200 | 5.011 | 168.503 | 300 | 5.010 | 168.503 | 300 | |
| S06-C20-39 | 170.886 | 2.407 | Open Manhole | 1200 | 5.012 | 168.479 | 300 | 5.011 | 168.479 | 300 | |
| S06-C20-40 | 171.400 | 3.971 | Open Manhole | 1200 | 5.013 | 167.429 | 300 | 5.012 | 168.287 | 300 | 858 |

## Manhole Schedules for Catchment 20 - Ch 47950

| MH Name | MH CL (m) | MH Depth (m) | MH Connection | MH Diam.,L*W (mm) | PN | Pipe Out Invert Level (m) | Diameter (mm) | PN | Pipes In Invert Level (m) | Diameter (mm) | Backdrop (mm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| S06-C20-41 | 171.400 | 4.001 | Junction | | 5.014 | 167.399 | 500 | 5.013 | 167.399 | 300 | |
| S06-C20-42 | 171.400 | 4.073 | Junction | | 5.015 | 167.327 | 300 | 5.014 | 167.357 | 500 | 230 |
| S06-C20-43 | 171.400 | 4.173 | Open Manhole | 1350 | 1.012 | 167.227 | 375 | 1.011 | 167.302 | 300 | |
| | | | | | | | | 5.015 | 167.302 | 300 | |
| Outfall 20 | 168.200 | 1.072 | Open Manhole | 0 | | OUTFALL | | 1.012 | 167.128 | 375 | |

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C20-1 | 378806.810 | 514887.857 | 378806.810 | 514887.857 | Required |  |
| S06-C20-2 | 378877.352 | 514863.767 | 378877.352 | 514863.767 | Required |  |
| S06-C20-3 | 378972.214 | 514847.225 | 378972.214 | 514847.225 | Required |  |
| S06-C20-4 | 378951.014 | 514850.510 | 378951.014 | 514850.510 | Required |  |
| S06-C20-5 | 378801.074 | 514875.841 | 378801.074 | 514875.841 | Required |  |
| S06-C20-6 | 378839.748 | 514860.481 | 378839.748 | 514860.481 | Required |  |
| S06-C20-7 | 378864.977 | 514853.043 | 378864.977 | 514853.043 | Required |  |
| S06-C20-8 | 378970.125 | 514834.107 | 378970.125 | 514834.107 | Required |  |
| S06-C20-9 | 378949.038 | 514837.358 | 378949.038 | 514837.358 | Required |  |
| S06-C20-10 | 378948.482 | 514833.768 | 378948.482 | 514833.768 | Required |  |
| S06-C20-11 | 378889.976 | 514843.020 | 378889.976 | 514843.020 | Required |  |
| S06-C20-12 | 378842.640 | 514854.577 | 378842.640 | 514854.577 | Required |  |
| S06-C20-13 | 378789.226 | 514875.963 | 378789.226 | 514875.963 | Required |  |
| S06-C20-14 | 378736.659 | 514825.833 | 378736.659 | 514825.833 | Required |  |
| S06-C20-15 | 378698.670 | 514843.174 | 378698.670 | 514843.174 | Required |  |

## Manhole Schedules for Catchment 20 - Ch 47950

| **MH Name** | **Manhole Easting (m)** | **Manhole Northing (m)** | **Intersection Easting (m)** | **Intersection Northing (m)** | **Manhole Access** | **Layout (North)** |
|---|---|---|---|---|---|---|
| S06-C20-16 | 378691.801 | 514842.610 | | | No Entry |  |
| S06-C20-17 | 378664.488 | 514837.277 | | | No Entry |  |
| S06-C20-18 | 378628.269 | 515052.305 | 378628.269 | 515052.305 | Required |  |
| S06-C20-19 | 378573.569 | 514996.198 | 378573.569 | 514996.198 | Required |  |
| S06-C20-20 | 378570.089 | 514991.194 | 378570.089 | 514991.194 | Required |  |
| S06-C20-21 | 378555.869 | 514976.604 | 378555.869 | 514976.604 | Required |  |
| S06-C20-22 | 378544.505 | 514932.458 | 378544.505 | 514932.458 | Required |  |
| S06-C20-23 | 378576.933 | 514900.399 | 378576.933 | 514900.399 | Required |  |
| S06-C20-24 | 378615.086 | 514907.974 | 378615.086 | 514907.974 | Required |  |
| S06-C20-25 | 378630.579 | 514924.286 | 378630.579 | 514924.286 | Required |  |
| S06-C20-26 | 378620.428 | 514920.185 | 378620.428 | 514920.185 | Required |  |
| S06-C20-27 | 378616.110 | 514915.393 | 378616.110 | 514915.393 | Required |  |
| S06-C20-28 | 378619.685 | 514911.783 | 378619.685 | 514911.783 | Required |  |
| S06-C20-29 | 378568.198 | 515001.433 | 378568.198 | 515001.433 | Required |  |
| S06-C20-30 | 378544.285 | 514975.876 | 378544.285 | 514975.876 | Required |  |
| S06-C20-31 | 378534.390 | 514943.179 | 378534.390 | 514943.179 | Required |  |
| S06-C20-32 | 378551.351 | 514905.194 | 378551.351 | 514905.194 | Required |  |
| S06-C20-33 | 378590.236 | 514890.411 | 378590.236 | 514890.411 | Required |  |
| S06-C20-34 | 378632.250 | 514910.138 | 378632.250 | 514910.138 | Required |  |

## Manhole Schedules for Catchment 20 - Ch 47950

| MH Name | Manhole Easting (m) | Manhole Northing (m) | Intersection Easting (m) | Intersection Northing (m) | Manhole Access | Layout (North) |
|---|---|---|---|---|---|---|
| S06-C20-35 | 378626.467 | 514904.599 | 378626.467 | 514904.599 | Required | |
| S06-C20-36 | 378629.575 | 514901.502 | 378629.575 | 514901.502 | Required | |
| S06-C20-37 | 378637.143 | 514909.490 | 378637.143 | 514909.490 | Required | |
| S06-C20-38 | 378654.210 | 514917.310 | 378654.210 | 514917.310 | Required | |
| S06-C20-39 | 378656.709 | 514911.855 | 378656.709 | 514911.855 | Required | |
| S06-C20-40 | 378665.726 | 514866.385 | 378665.726 | 514866.385 | Required | |
| S06-C20-41 | 378667.153 | 514859.177 | | | No Entry | |
| S06-C20-42 | 378660.869 | 514841.224 | | | No Entry | |
| S06-C20-43 | 378658.698 | 514835.333 | 378658.698 | 514835.333 | Required | |
| Outfall 20 | 378629.630 | 514825.573 | | | No Entry | |

## Area Summary for Catchment 20 - Ch 47950

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| 1.000 | User | - | 100 | 0.068 | 0.068 | 0.068 |
| | User | - | 50 | 0.019 | 0.009 | 0.078 |
| | User | - | 25 | 0.071 | 0.018 | 0.095 |
| 1.001 | User | - | 100 | 0.046 | 0.046 | 0.046 |
| | User | - | 50 | 0.019 | 0.009 | 0.055 |
| | User | - | 25 | 0.027 | 0.007 | 0.062 |
| 2.000 | User | - | 100 | 0.010 | 0.010 | 0.010 |
| | User | - | 50 | 0.005 | 0.003 | 0.013 |
| 1.002 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 3.000 | User | - | 50 | 0.020 | 0.010 | 0.010 |
| 3.001 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 3.002 | User | - | 100 | 0.023 | 0.023 | 0.023 |
| 4.000 | User | - | 100 | 0.010 | 0.010 | 0.010 |
| | User | - | 50 | 0.010 | 0.005 | 0.015 |
| 1.003 | User | - | 100 | 0.027 | 0.027 | 0.027 |
| | User | - | 50 | 0.039 | 0.020 | 0.047 |
| 1.004 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.005 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.006 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.007 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.008 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.009 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.010 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 1.011 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 5.000 | User | - | 100 | 0.034 | 0.034 | 0.034 |
| | User | - | 50 | 0.016 | 0.008 | 0.042 |
| 5.001 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 5.002 | User | - | 100 | 0.012 | 0.012 | 0.012 |
| | User | - | 50 | 0.010 | 0.005 | 0.017 |
| 5.003 | User | - | 100 | 0.023 | 0.023 | 0.023 |
| | User | - | 50 | 0.019 | 0.010 | 0.033 |
| | User | - | 25 | 0.011 | 0.003 | 0.036 |
| 5.004 | User | - | 100 | 0.023 | 0.023 | 0.023 |
| | User | - | 50 | 0.019 | 0.010 | 0.033 |
| | User | - | 25 | 0.019 | 0.005 | 0.038 |
| 5.005 | User | - | 100 | 0.024 | 0.024 | 0.024 |
| | User | - | 50 | 0.015 | 0.008 | 0.031 |
| | User | - | 25 | 0.003 | 0.001 | 0.032 |
| 5.006 | User | - | 50 | 0.001 | 0.001 | 0.001 |
| 6.000 | User | - | 100 | 0.012 | 0.012 | 0.012 |
| | User | - | 50 | 0.004 | 0.002 | 0.014 |
| 6.001 | User | - | 25 | 0.000 | 0.000 | 0.000 |
| 6.002 | User | - | 100 | 0.008 | 0.008 | 0.008 |
| 5.007 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 7.000 | User | - | 50 | 0.014 | 0.007 | 0.007 |
| 7.001 | User | - | 50 | 0.014 | 0.007 | 0.007 |
| | User | - | 25 | 0.006 | 0.001 | 0.008 |
| 7.002 | User | - | 50 | 0.017 | 0.009 | 0.009 |
| | User | - | 25 | 0.017 | 0.004 | 0.013 |
| 7.003 | User | - | 50 | 0.017 | 0.008 | 0.008 |
| 7.004 | User | - | 50 | 0.016 | 0.008 | 0.008 |
| 8.000 | User | - | 50 | 0.003 | 0.002 | 0.002 |
| 5.008 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 5.009 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 5.010 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 5.011 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 5.012 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 5.013 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 5.014 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| 5.015 | - | - | 100 | 0.063 | 0.063 | 0.063 |
| 1.012 | - | - | 100 | 0.000 | 0.000 | 0.000 |
| | | | | Total | Total | Total |

## Area Summary for Catchment 20 - Ch 47950

| Pipe Number | PIMP Type | PIMP Name | PIMP (%) | Gross Area (ha) | Imp. Area (ha) | Pipe Total (ha) |
|---|---|---|---|---|---|---|
| | | | | 0.815 | 0.560 | 0.560 |

## Online Controls for Catchment 20 - Ch 47950

### Hydro-Brake® Optimum Manhole: S06-C20-43, DS/PN: 1.012, Volume (m³): 6.8

| | |
|---|---|
| Unit Reference | MD-SHE-0113-5800-1000-5800 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 5.8 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 113 |
| Invert Level (m) | 167.227 |
| Minimum Outlet Pipe Diameter (mm) | 150 |
| Suggested Manhole Diameter (mm) | 1200 |

| **Control Points** | **Head (m)** | **Flow (l/s)** | **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| Design Point (Calculated) | 1.000 | 5.8 | Kick-Flo® | 0.645 | 4.7 |
| Flush-Flo™ | 0.296 | 5.8 | Mean Flow over Head Range | - | 5.0 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|---|---|
| 0.100 | 3.9 | 0.800 | 5.2 | 2.000 | 8.0 | 4.000 | 11.1 | 7.000 | 14.5 |
| 0.200 | 5.6 | 1.000 | 5.8 | 2.200 | 8.4 | 4.500 | 11.8 | 7.500 | 15.0 |
| 0.300 | 5.8 | 1.200 | 6.3 | 2.400 | 8.7 | 5.000 | 12.4 | 8.000 | 15.5 |
| 0.400 | 5.7 | 1.400 | 6.8 | 2.600 | 9.1 | 5.500 | 13.0 | 8.500 | 16.0 |
| 0.500 | 5.5 | 1.600 | 7.2 | 3.000 | 9.7 | 6.000 | 13.5 | 9.000 | 16.4 |
| 0.600 | 5.1 | 1.800 | 7.6 | 3.500 | 10.4 | 6.500 | 14.0 | 9.500 | 16.8 |

## Offline Controls for Catchment 20 - Ch 47950

### Weir Manhole: S06-C20-43, DS/PN: 1.012, Loop to PN: None

Discharge Coef 0.544 Width (m) 10.000 Invert Level (m) 168.227

## Storage Structures for Catchment 20 - Ch 47950

### Tank or Pond Manhole: S06-C20-43, DS/PN: 1.012

Invert Level (m) 167.227

| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|---|---|
| 0.000 | 351.9 | 1.000 | 668.1 | 1.001 | 800.0 | 4.001 | 2455.6 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 20 - Ch 47950

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C20-1 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | | 173.285 | 0.356 | 0.000 |
| 1.001 | S06-C20-2 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 172.047 | -0.063 | 0.000 |
| 2.000 | S06-C20-3 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 171.395 | -0.105 | 0.000 |
| 1.002 | S06-C20-4 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 171.287 | 0.000 | 0.000 |
| 3.000 | S06-C20-5 | 15 Winter | 5 | +20% | | | | | 173.062 | -0.112 | 0.000 |
| 3.001 | S06-C20-6 | 15 Winter | 5 | +20% | | | | | 172.649 | -0.113 | 0.000 |
| 3.002 | S06-C20-7 | 15 Winter | 5 | +20% | | | | | 172.411 | -0.090 | 0.000 |
| 4.000 | S06-C20-8 | 15 Winter | 5 | +20% | | | | | 171.367 | -0.104 | 0.000 |
| 1.003 | S06-C20-9 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 171.096 | -0.113 | 0.000 |
| 1.004 | S06-C20-10 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 170.489 | -0.111 | 0.000 |
| 1.005 | S06-C20-11 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 170.187 | -0.113 | 0.000 |
| 1.006 | S06-C20-12 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 169.937 | -0.116 | 0.000 |
| 1.007 | S06-C20-13 | 15 Winter | 5 | +20% | | | | | 169.573 | -0.189 | 0.000 |
| 1.008 | S06-C20-14 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 167.797 | -0.103 | 0.000 |
| 1.009 | S06-C20-15 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 167.664 | -0.063 | 0.000 |
| 1.010 | S06-C20-16 | 15 Winter | 5 | +20% | | | | | 167.586 | -0.313 | 0.000 |
| 1.011 | S06-C20-17 | 360 Winter | 5 | +20% | 100/15 Summer | | | | 167.551 | -0.076 | 0.000 |
| 5.000 | S06-C20-18 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 176.590 | -0.070 | 0.000 |
| 5.001 | S06-C20-19 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 175.608 | -0.092 | 0.000 |
| 5.002 | S06-C20-20 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 175.340 | -0.085 | 0.000 |
| 5.003 | S06-C20-21 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 174.490 | -0.069 | 0.000 |
| 5.004 | S06-C20-22 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | | 172.301 | -0.051 | 0.000 |
| 5.005 | S06-C20-23 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 170.013 | -0.113 | 0.000 |
| 5.006 | S06-C20-24 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 169.238 | -0.026 | 0.000 |
| 6.000 | S06-C20-25 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 169.317 | -0.111 | 0.000 |
| 6.001 | S06-C20-26 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 169.039 | -0.100 | 0.000 |
| 6.002 | S06-C20-27 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 169.013 | -0.061 | 0.000 |
| 5.007 | S06-C20-28 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 169.004 | -0.040 | 0.000 |
| 7.000 | S06-C20-29 | 15 Winter | 5 | +20% | | | | | 175.672 | -0.128 | 0.000 |
| 7.001 | S06-C20-30 | 15 Winter | 5 | +20% | | | | | 174.215 | -0.118 | 0.000 |
| 7.002 | S06-C20-31 | 15 Winter | 5 | +20% | | | | | 172.867 | -0.107 | 0.000 |
| 7.003 | S06-C20-32 | 15 Winter | 5 | +20% | | | | | 171.197 | -0.100 | 0.000 |
| 7.004 | S06-C20-33 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 169.617 | -0.072 | 0.000 |
| 8.000 | S06-C20-34 | 15 Winter | 5 | +20% | | | | | 169.231 | -0.134 | 0.000 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 20 - Ch 47950

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 1.000 | S06-C20-1 | 1.15 | | | 21.1 | SURCHARGED | 6 |
| 1.001 | S06-C20-2 | 0.85 | | | 33.1 | OK | |
| 2.000 | S06-C20-3 | 0.19 | | | 3.1 | OK | |
| 1.002 | S06-C20-4 | 1.00 | | | 34.7 | OK | |
| 3.000 | S06-C20-5 | 0.14 | | | 2.4 | OK | |
| 3.001 | S06-C20-6 | 0.14 | | | 2.4 | OK | |
| 3.002 | S06-C20-7 | 0.32 | | | 7.0 | OK | |
| 4.000 | S06-C20-8 | 0.20 | | | 3.7 | OK | |
| 1.003 | S06-C20-9 | 0.49 | | | 54.0 | OK | |
| 1.004 | S06-C20-10 | 0.70 | | | 52.7 | OK | |
| 1.005 | S06-C20-11 | 0.70 | | | 51.9 | OK | |
| 1.006 | S06-C20-12 | 0.68 | | | 50.7 | OK | |
| 1.007 | S06-C20-13 | 0.30 | | | 50.7 | OK | |
| 1.008 | S06-C20-14 | 0.76 | | | 50.2 | OK | |
| 1.009 | S06-C20-15 | 0.98 | | | 49.8 | OK | |
| 1.010 | S06-C20-16 | 0.23 | | | 49.4 | OK* | |
| 1.011 | S06-C20-17 | 0.18 | | | 11.2 | OK* | |
| 5.000 | S06-C20-18 | 0.52 | | | 10.0 | OK | |
| 5.001 | S06-C20-19 | 0.31 | | | 10.0 | OK | |
| 5.002 | S06-C20-20 | 0.39 | | | 13.5 | OK | |
| 5.003 | S06-C20-21 | 0.55 | | | 20.7 | OK | |
| 5.004 | S06-C20-22 | 0.75 | | | 28.3 | OK | 4 |
| 5.005 | S06-C20-23 | 0.49 | | | 34.7 | OK | |
| 5.006 | S06-C20-24 | 1.00 | | | 34.5 | OK | |
| 6.000 | S06-C20-25 | 0.15 | | | 3.5 | OK | |
| 6.001 | S06-C20-26 | 0.23 | | | 3.5 | OK | |
| 6.002 | S06-C20-27 | 0.48 | | | 5.2 | OK | |
| 5.007 | S06-C20-28 | 0.89 | | | 38.7 | OK | |
| 7.000 | S06-C20-29 | 0.05 | | | 1.8 | OK | |
| 7.001 | S06-C20-30 | 0.10 | | | 3.5 | OK | |
| 7.002 | S06-C20-31 | 0.18 | | | 6.3 | OK | |
| 7.003 | S06-C20-32 | 0.24 | | | 8.0 | OK | |
| 7.004 | S06-C20-33 | 0.53 | | | 9.6 | OK | |
| 8.000 | S06-C20-34 | 0.02 | | | 0.4 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 20 - Ch 47950

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5.008 | S06-C20-35 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 168.927 | -0.018 | 0.000 |
| 5.009 | S06-C20-36 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 168.838 | -0.088 | 0.000 |
| 5.010 | S06-C20-37 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 168.790 | -0.091 | 0.000 |
| 5.011 | S06-C20-38 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 168.736 | -0.067 | 0.000 |
| 5.012 | S06-C20-39 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 168.666 | -0.112 | 0.000 |
| 5.013 | S06-C20-40 | 15 Winter | 5 | +20% | 100/15 Summer | | | | 167.655 | -0.074 | 0.000 |
| 5.014 | S06-C20-41 | 15 Winter | 5 | +20% | | | | | 167.592 | -0.307 | 0.000 |
| 5.015 | S06-C20-42 | 360 Winter | 5 | +20% | 100/15 Summer | | | | 167.551 | -0.076 | 0.000 |
| 1.012 | S06-C20-43 | 360 Winter | 5 | +20% | 100/30 Summer | | | 0 | 167.550 | -0.052 | 0.000 |

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 5.008 | S06-C20-35 | 1.00 | | | 47.7 | OK | |
| 5.009 | S06-C20-36 | 0.84 | | | 47.7 | OK | |
| 5.010 | S06-C20-37 | 0.77 | | | 47.7 | OK | |
| 5.011 | S06-C20-38 | 0.96 | | | 47.6 | OK | |
| 5.012 | S06-C20-39 | 0.71 | | | 47.6 | OK | |
| 5.013 | S06-C20-40 | 0.92 | | | 47.6 | OK | |
| 5.014 | S06-C20-41 | 0.26 | | | 47.7 | OK* | |
| 5.015 | S06-C20-42 | 0.21 | | | 12.7 | OK* | |
| 1.012 | S06-C20-43 | 0.06 | 0.0 | | 5.8 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 20 - Ch 47950

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 0.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Offline Controls 1 Number of Time/Area Diagrams 0
Number of Online Controls 1 Number of Storage Structures 1 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 20.000 Cv (Summer) 0.750
Region England and Wales Ratio R 0.300 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.000 | S06-C20-1 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | | 174.135 | 1.206 | 6.006 |
| 1.001 | S06-C20-2 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 172.637 | 0.527 | 0.000 |
| 2.000 | S06-C20-3 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 171.616 | 0.116 | 0.000 |
| 1.002 | S06-C20-4 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 171.590 | 0.302 | 0.000 |
| 3.000 | S06-C20-5 | 15 Winter | 100 | +40% | | | | | 173.083 | -0.091 | 0.000 |
| 3.001 | S06-C20-6 | 15 Winter | 100 | +40% | | | | | 172.669 | -0.092 | 0.000 |
| 3.002 | S06-C20-7 | 15 Winter | 100 | +40% | | | | | 172.460 | -0.041 | 0.000 |
| 4.000 | S06-C20-8 | 15 Winter | 100 | +40% | | | | | 171.392 | -0.080 | 0.000 |
| 1.003 | S06-C20-9 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 171.361 | 0.153 | 0.000 |
| 1.004 | S06-C20-10 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 170.890 | 0.290 | 0.000 |
| 1.005 | S06-C20-11 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 170.473 | 0.173 | 0.000 |
| 1.006 | S06-C20-12 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 170.137 | 0.084 | 0.000 |
| 1.007 | S06-C20-13 | 15 Winter | 100 | +40% | | | | | 169.612 | -0.150 | 0.000 |
| 1.008 | S06-C20-14 | 30 Winter | 100 | +40% | 100/15 Summer | | | | 168.102 | 0.202 | 0.000 |
| 1.009 | S06-C20-15 | 480 Winter | 100 | +40% | 100/15 Summer | | | | 167.997 | 0.270 | 0.000 |
| 1.010 | S06-C20-16 | 1440 Winter | 100 | +40% | | | | | 167.899 | 0.000 | 0.000 |
| 1.011 | S06-C20-17 | 1440 Summer | 100 | +40% | 100/15 Summer | | | | 167.829 | 0.202 | 0.000 |
| 5.000 | S06-C20-18 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 176.959 | 0.300 | 0.000 |
| 5.001 | S06-C20-19 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 175.955 | 0.255 | 0.000 |
| 5.002 | S06-C20-20 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 175.869 | 0.444 | 0.000 |
| 5.003 | S06-C20-21 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 175.529 | 0.970 | 0.000 |
| 5.004 | S06-C20-22 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | | 173.553 | 1.201 | 0.828 |
| 5.005 | S06-C20-23 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 170.232 | 0.106 | 0.000 |
| 5.006 | S06-C20-24 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 169.685 | 0.421 | 0.000 |
| 6.000 | S06-C20-25 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 169.571 | 0.143 | 0.000 |
| 6.001 | S06-C20-26 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 169.553 | 0.414 | 0.000 |
| 6.002 | S06-C20-27 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 169.542 | 0.468 | 0.000 |
| 5.007 | S06-C20-28 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 169.529 | 0.486 | 0.000 |
| 7.000 | S06-C20-29 | 15 Winter | 100 | +40% | | | | | 175.683 | -0.117 | 0.000 |
| 7.001 | S06-C20-30 | 15 Winter | 100 | +40% | | | | | 174.235 | -0.098 | 0.000 |
| 7.002 | S06-C20-31 | 15 Winter | 100 | +40% | | | | | 172.897 | -0.076 | 0.000 |
| 7.003 | S06-C20-32 | 15 Winter | 100 | +40% | | | | | 171.235 | -0.063 | 0.000 |
| 7.004 | S06-C20-33 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 169.996 | 0.307 | 0.000 |
| 8.000 | S06-C20-34 | 15 Winter | 100 | +40% | | | | | 169.328 | -0.037 | 0.000 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 20 - Ch 47950

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 1.000 | S06-C20-1 | 1.57 | | | 28.7 | FLOOD | 6 |
| 1.001 | S06-C20-2 | 1.45 | | | 56.5 | SURCHARGED | |
| 2.000 | S06-C20-3 | 0.39 | | | 6.5 | SURCHARGED | |
| 1.002 | S06-C20-4 | 1.75 | | | 60.7 | SURCHARGED | |
| 3.000 | S06-C20-5 | 0.31 | | | 5.4 | OK | |
| 3.001 | S06-C20-6 | 0.31 | | | 5.3 | OK | |
| 3.002 | S06-C20-7 | 0.81 | | | 17.5 | OK | |
| 4.000 | S06-C20-8 | 0.44 | | | 8.2 | OK | |
| 1.003 | S06-C20-9 | 0.89 | | | 98.2 | SURCHARGED | |
| 1.004 | S06-C20-10 | 1.28 | | | 96.1 | SURCHARGED | |
| 1.005 | S06-C20-11 | 1.20 | | | 88.7 | SURCHARGED | |
| 1.006 | S06-C20-12 | 1.15 | | | 85.8 | SURCHARGED | |
| 1.007 | S06-C20-13 | 0.50 | | | 85.6 | OK | |
| 1.008 | S06-C20-14 | 1.26 | | | 83.6 | SURCHARGED | |
| 1.009 | S06-C20-15 | 0.38 | | | 19.5 | SURCHARGED | |
| 1.010 | S06-C20-16 | 0.04 | | | 8.7 | SURCHARGED* | |
| 1.011 | S06-C20-17 | 0.18 | | | 11.1 | SURCHARGED* | |
| 5.000 | S06-C20-18 | 1.05 | | | 20.4 | SURCHARGED | |
| 5.001 | S06-C20-19 | 0.65 | | | 20.7 | SURCHARGED | |
| 5.002 | S06-C20-20 | 0.73 | | | 25.2 | SURCHARGED | |
| 5.003 | S06-C20-21 | 0.94 | | | 35.1 | FLOOD RISK | |
| 5.004 | S06-C20-22 | 1.24 | | | 46.6 | FLOOD | 4 |
| 5.005 | S06-C20-23 | 0.87 | | | 61.8 | SURCHARGED | |
| 5.006 | S06-C20-24 | 1.66 | | | 57.3 | SURCHARGED | |
| 6.000 | S06-C20-25 | 0.31 | | | 7.2 | SURCHARGED | |
| 6.001 | S06-C20-26 | 0.39 | | | 5.9 | SURCHARGED | |
| 6.002 | S06-C20-27 | 0.89 | | | 9.6 | SURCHARGED | |
| 5.007 | S06-C20-28 | 1.45 | | | 62.7 | SURCHARGED | |
| 7.000 | S06-C20-29 | 0.11 | | | 3.9 | OK | |
| 7.001 | S06-C20-30 | 0.26 | | | 8.8 | OK | |
| 7.002 | S06-C20-31 | 0.47 | | | 16.3 | OK | |
| 7.003 | S06-C20-32 | 0.62 | | | 20.8 | OK | |
| 7.004 | S06-C20-33 | 1.27 | | | 23.1 | SURCHARGED | |
| 8.000 | S06-C20-34 | 0.06 | | | 1.1 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Catchment 20 - Ch 47950

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5.008 | S06-C20-35 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 169.326 | 0.381 | 0.000 |
| 5.009 | S06-C20-36 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 169.218 | 0.291 | 0.000 |
| 5.010 | S06-C20-37 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 169.109 | 0.228 | 0.000 |
| 5.011 | S06-C20-38 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 168.971 | 0.168 | 0.000 |
| 5.012 | S06-C20-39 | 15 Winter | 100 | +40% | 100/15 Summer | | | | 168.864 | 0.085 | 0.000 |
| 5.013 | S06-C20-40 | 480 Winter | 100 | +40% | 100/15 Summer | | | | 167.997 | 0.268 | 0.000 |
| 5.014 | S06-C20-41 | 1440 Winter | 100 | +40% | | | | | 167.899 | 0.000 | 0.000 |
| 5.015 | S06-C20-42 | 1440 Winter | 100 | +40% | 100/15 Summer | | | | 167.857 | 0.230 | 0.000 |
| 1.012 | S06-C20-43 | 480 Winter | 100 | +40% | 100/30 Summer | | | 0 | 167.994 | 0.392 | 0.000 |

| PN | US/MH Name | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|---|
| 5.008 | S06-C20-35 | 1.74 | | | 83.2 | SURCHARGED | |
| 5.009 | S06-C20-36 | 1.46 | | | 82.7 | SURCHARGED | |
| 5.010 | S06-C20-37 | 1.34 | | | 82.4 | SURCHARGED | |
| 5.011 | S06-C20-38 | 1.66 | | | 82.4 | SURCHARGED | |
| 5.012 | S06-C20-39 | 1.23 | | | 82.3 | SURCHARGED | |
| 5.013 | S06-C20-40 | 0.35 | | | 18.0 | SURCHARGED | |
| 5.014 | S06-C20-41 | 0.04 | | | 7.9 | SURCHARGED* | |
| 5.015 | S06-C20-42 | 0.16 | | | 9.8 | SURCHARGED* | |
| 1.012 | S06-C20-43 | 0.06 | 0.0 | | 5.8 | SURCHARGED | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Storm

```
                  Pipe Sizes STANDARD Manhole Sizes STANDARD

                    FSR Rainfall Model - England and Wales
          Return Period (years)      1                         PIMP (%)   100
                   M5-60 (mm) 17.000        Add Flow / Climate Change (%)     0
                      Ratio R  0.300         Minimum Backdrop Height (m) 0.000
       Maximum Rainfall (mm/hr)     50         Maximum Backdrop Height (m) 0.000
Maximum Time of Concentration (mins)     30 Min Design Depth for Optimisation (m) 1.200
          Foul Sewage (l/s/ha)  0.000     Min Vel for Auto Design only (m/s)  0.58
       Volumetric Runoff Coeff.  0.750       Min Slope for Optimisation (1:X)   500

                         Designed with Level Soffits
```

### Simulation Criteria for Storm

```
        Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 0.000
         Areal Reduction Factor 1.000       MADD Factor * 10m³/ha Storage 2.000
                Hot Start (mins)     0                  Inlet Coeffiecient 0.800
              Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
  Manhole Headloss Coeff (Global) 0.500                    Run Time (mins)    60
     Foul Sewage per hectare (l/s) 0.000               Output Interval (mins)     1

       Number of Input Hydrographs 0 Number of Storage Structures 1
        Number of Online Controls 0 Number of Time/Area Diagrams 0
       Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
          Rainfall Model                  FSR         Profile Type Summer
     Return Period (years)                  1          Cv (Summer)   0.750
                      Region England and Wales          Cv (Winter)   0.840
               M5-60 (mm)              17.000 Storm Duration (mins)      30
                  Ratio R               0.300
```

## Summary of Critical Results by Maximum Level (Rank 1) for Storm

### Simulation Criteria

Areal Reduction Factor 1.000  Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0  MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0  Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500  Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0  Number of Storage Structures 1
Number of Online Controls 0  Number of Time/Area Diagrams 0
Number of Offline Controls 0  Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR  Ratio R 0.300
Region England and Wales  Cv (Summer) 0.750
M5-60 (mm) 17.000  Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0  DVD Status OFF
Analysis Timestep Fine  Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| **PN** | **US/MH Name** | **Storm** | **Return Period** | **Climate Change** | **First (X) Surcharge** | **First (Y) Flood** | **First (Z) Overflow** | **Overflow Act.** |
|---|---|---|---|---|---|---|---|---|
| S1.000 | S07-01-01 | 15 Winter | 100 | +40% | | | | |
| S1.001 | S07-01-02 | 15 Winter | 100 | +40% | | | | |
| S1.002 | S07-01-03 | 15 Winter | 100 | +40% | 100/15 Summer | | | |
| S1.003 | S07-01-04 | 15 Winter | 100 | +40% | | | | |
| S1.004 | S07-01-05 | 15 Winter | 100 | +40% | 100/15 Summer | | | |
| S1.005 | S07-01-06 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | |
| S1.006 | S07-01-07 | 15 Winter | 100 | +40% | 100/15 Summer | | | |
| S1.007 | S07-01-08 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | | |
| S1.008 | S07-01-09 | 30 Summer | 100 | +40% | 100/15 Summer | | | |
| S1.009 | S07-01-10 | 60 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | | |
| S1.010 | S07-01-11 | 60 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | | |
| S1.011 | S07-01-12 | 30 Winter | 100 | +40% | 100/15 Summer | 100/30 Winter | | |
| S1.012 | S07-01-13 | 30 Winter | 100 | +40% | 100/15 Summer | | | |
| S2.000 | S07-01-14 | 15 Winter | 100 | +40% | | | | |
| S2.001 | S07-01-15 | 15 Winter | 100 | +40% | | | | |
| S2.002 | S07-01-16 | 15 Winter | 100 | +40% | 100/15 Summer | | | |
| S1.013 | S07-01-17 | 30 Winter | 100 | +40% | 100/15 Summer | | | |
| S3.000 | S07-01-18 | 15 Winter | 100 | +40% | | | | |
| S3.001 | S07-01-19 | 15 Winter | 100 | +40% | | | | |
| S3.002 | S07-01-20 | 15 Winter | 100 | +40% | | | | |

## Summary of Critical Results by Maximum Level (Rank 1) for Storm

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S07-01-01 | 289.462 | -0.108 | 0.000 | 0.73 | | | 62.3 | OK |
| S1.001 | S07-01-02 | 289.310 | -0.074 | 0.000 | 0.84 | | | 107.2 | OK |
| S1.002 | S07-01-03 | 289.044 | 0.019 | 0.000 | 2.02 | | | 106.3 | SURCHARGED |
| S1.003 | S07-01-04 | 288.973 | -0.028 | 0.000 | 0.78 | | | 147.2 | OK |
| S1.004 | S07-01-05 | 288.554 | 0.373 | 0.000 | 0.59 | | | 134.9 | SURCHARGED |
| S1.005 | S07-01-06 | 288.092 | 1.214 | 13.262 | 3.13 | | | 199.7 | FLOOD |
| S1.006 | S07-01-07 | 287.924 | 1.061 | 0.000 | 1.02 | | | 251.6 | FLOOD RISK |
| S1.007 | S07-01-08 | 286.798 | 1.288 | 10.961 | 1.05 | | | 250.4 | FLOOD |
| S1.008 | S07-01-09 | 285.656 | 1.399 | 0.000 | 1.39 | | | 268.6 | FLOOD RISK |
| S1.009 | S07-01-10 | 285.443 | 1.290 | 23.330 | 1.23 | | | 237.4 | FLOOD |
| S1.010 | S07-01-11 | 285.291 | 1.240 | 38.358 | 1.38 | | | 264.3 | FLOOD |
| S1.011 | S07-01-12 | 285.290 | 1.335 | 1.639 | 1.57 | | | 296.7 | FLOOD |
| S1.012 | S07-01-13 | 285.264 | 1.393 | 0.000 | 1.33 | | | 295.0 | FLOOD RISK |
| S2.000 | S07-01-14 | 288.755 | -0.141 | 0.000 | 0.29 | | | 20.0 | OK |
| S2.001 | S07-01-15 | 287.457 | -0.043 | 0.000 | 0.94 | | | 60.4 | OK |
| S2.002 | S07-01-16 | 286.440 | 0.087 | 0.000 | 0.98 | | | 97.7 | SURCHARGED |
| S1.013 | S07-01-17 | 285.086 | 1.481 | 0.000 | 1.32 | | | 327.7 | SURCHARGED |
| S3.000 | S07-01-18 | 288.587 | -0.299 | 0.000 | 0.09 | | | 22.7 | OK |
| S3.001 | S07-01-19 | 287.265 | -0.254 | 0.000 | 0.22 | | | 65.1 | OK |
| S3.002 | S07-01-20 | 285.573 | -0.227 | 0.000 | 0.32 | | | 108.2 | OK |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| S1.000 | S07-01-01 | |
| S1.001 | S07-01-02 | |
| S1.002 | S07-01-03 | |
| S1.003 | S07-01-04 | |
| S1.004 | S07-01-05 | |
| S1.005 | S07-01-06 | 5 |
| S1.006 | S07-01-07 | |
| S1.007 | S07-01-08 | 5 |
| S1.008 | S07-01-09 | |
| S1.009 | S07-01-10 | 6 |
| S1.010 | S07-01-11 | 7 |
| S1.011 | S07-01-12 | 1 |
| S1.012 | S07-01-13 | |
| S2.000 | S07-01-14 | |
| S2.001 | S07-01-15 | |
| S2.002 | S07-01-16 | |
| S1.013 | S07-01-17 | |
| S3.000 | S07-01-18 | |
| S3.001 | S07-01-19 | |
| S3.002 | S07-01-20 | |

## Summary of Critical Results by Maximum Level (Rank 1) for Storm

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| S1.014 | S07-01-21 | 30 Winter | 100 | +40% | 5/15 Winter | | | |
| S4.000 | S07-01-22 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | |
| S4.001 | S07-01-23 | 30 Winter | 100 | +40% | 100/15 Summer | 100/30 Winter | | |
| S4.002 | S07-01-24 | 30 Winter | 100 | +40% | 100/15 Summer | | | |
| S4.003 | S07-01-25 | 30 Winter | 100 | +40% | 100/15 Summer | | | |
| S4.004 | S07-01-26 | 30 Winter | 100 | +40% | 100/15 Summer | | | |
| S4.005 | S07-01-27 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | | |
| S4.006 | S07-01-28 | 60 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | | |
| S4.007 | S07-01-29 | 60 Winter | 100 | +40% | 5/30 Winter | 100/15 Winter | | |
| S4.008 | S07-01-30 | 60 Winter | 100 | +40% | 5/15 Winter | 100/15 Winter | | |
| S4.009 | S07-01-31 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Winter | | |
| S4.010 | S07-01-32 | 30 Winter | 100 | +40% | 5/15 Summer | 100/30 Summer | | |
| S4.011 | S07-01-33 | 30 Winter | 100 | +40% | 100/15 Summer | | | |
| S1.015 | S07-01-34 | 30 Winter | 100 | +40% | 5/15 Summer | | | |
| S1.016 | S07-01-35 | 30 Winter | 100 | +40% | 5/30 Winter | | | |
| S1.017 | S07-01-36 | 30 Winter | 100 | +40% | 100/15 Summer | | | |
| S1.018 | S07-01-37 | 30 Winter | 100 | +40% | 5/30 Winter | | | |
| S1.019 | S07-01-38 | 60 Winter | 100 | +40% | | | | |
| S1.020 | S07-01-39 | 60 Winter | 100 | +40% | | | | |
| S1.021 | S07-01-40 | 120 Winter | 100 | +40% | 100/60 Winter | | | |

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S1.014 | S07-01-21 | 284.915 | 1.405 | 0.000 | 1.77 | | | 390.2 | SURCHARGED |
| S4.000 | S07-01-22 | 289.057 | 1.210 | 9.960 | 1.98 | | | 44.8 | FLOOD |
| S4.001 | S07-01-23 | 289.024 | 1.365 | 0.277 | 1.50 | | | 72.1 | FLOOD |
| S4.002 | S07-01-24 | 288.784 | 1.317 | 0.000 | 1.99 | | | 64.1 | FLOOD RISK |
| S4.003 | S07-01-25 | 288.718 | 1.280 | 0.000 | 1.08 | | | 81.8 | FLOOD RISK |
| S4.004 | S07-01-26 | 288.098 | 1.147 | 0.000 | 0.95 | | | 113.3 | FLOOD RISK |
| S4.005 | S07-01-27 | 287.328 | 1.205 | 5.311 | 0.98 | | | 121.1 | FLOOD |
| S4.006 | S07-01-28 | 286.211 | 1.268 | 22.788 | 1.21 | | | 123.3 | FLOOD |
| S4.007 | S07-01-29 | 285.346 | 1.193 | 1.883 | 1.00 | | | 127.7 | FLOOD |
| S4.008 | S07-01-30 | 285.258 | 1.222 | 8.812 | 1.29 | | | 136.8 | FLOOD |
| S4.009 | S07-01-31 | 285.089 | 1.207 | 7.264 | 1.70 | | | 139.6 | FLOOD |
| S4.010 | S07-01-32 | 284.980 | 1.199 | 4.034 | 1.79 | | | 145.2 | FLOOD |
| S4.011 | S07-01-33 | 284.907 | 1.213 | 0.000 | 1.09 | | | 153.5 | SURCHARGED |
| S1.015 | S07-01-34 | 284.658 | 1.195 | 0.000 | 3.65 | | | 550.1 | SURCHARGED |
| S1.016 | S07-01-35 | 284.362 | 0.920 | 0.000 | 3.72 | | | 551.2 | SURCHARGED |
| S1.017 | S07-01-36 | 284.073 | 0.652 | 0.000 | 1.47 | | | 539.8 | SURCHARGED |
| S1.018 | S07-01-37 | 283.548 | 0.364 | 0.000 | 1.90 | | | 524.7 | SURCHARGED |
| S1.019 | S07-01-38 | 282.750 | -0.295 | 0.000 | 0.51 | | | 574.8 | OK |
| S1.020 | S07-01-39 | 279.419 | -0.556 | 0.000 | 0.38 | | | 571.6 | OK |
| S1.021 | S07-01-40 | 279.101 | 0.038 | 0.000 | 1.06 | | | 310.8 | SURCHARGED |

## Summary of Critical Results by Maximum Level (Rank 1) for Storm

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| S1.014 | S07-01-21 | |
| S4.000 | S07-01-22 | 6 |
| S4.001 | S07-01-23 | 1 |
| S4.002 | S07-01-24 | |
| S4.003 | S07-01-25 | |
| S4.004 | S07-01-26 | |
| S4.005 | S07-01-27 | 5 |
| S4.006 | S07-01-28 | 7 |
| S4.007 | S07-01-29 | 6 |
| S4.008 | S07-01-30 | 7 |
| S4.009 | S07-01-31 | 6 |
| S4.010 | S07-01-32 | 4 |
| S4.011 | S07-01-33 | |
| S1.015 | S07-01-34 | |
| S1.016 | S07-01-35 | |
| S1.017 | S07-01-36 | |
| S1.018 | S07-01-37 | |
| S1.019 | S07-01-38 | |
| S1.020 | S07-01-39 | |
| S1.021 | S07-01-40 | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Storm

```
                    Pipe Sizes A66 Manhole Sizes A66

                FSR Rainfall Model - England and Wales
              Return Period (years)      1                       PIMP (%)    100
                        M5-60 (mm)  17.200         Add Flow / Climate Change (%)      0
                           Ratio R   0.300           Minimum Backdrop Height (m)  0.000
            Maximum Rainfall (mm/hr)      50           Maximum Backdrop Height (m)  0.000
 Maximum Time of Concentration (mins)      30 Min Design Depth for Optimisation (m)  1.250
                Foul Sewage (l/s/ha)   0.000      Min Vel for Auto Design only (m/s)   1.00
              Volumetric Runoff Coeff.   0.750        Min Slope for Optimisation (1:X)    500

                       Designed with Level Inverts
```

### Simulation Criteria for Storm

```
          Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 0.000
           Areal Reduction Factor 1.000         MADD Factor * 10m³/ha Storage 2.000
                  Hot Start (mins)     0                   Inlet Coeffiecient 0.800
                Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
     Manhole Headloss Coeff (Global) 0.500                      Run Time (mins)    60
      Foul Sewage per hectare (l/s) 0.000                Output Interval (mins)     1

           Number of Input Hydrographs 0 Number of Storage Structures 1
             Number of Online Controls 1 Number of Time/Area Diagrams 0
            Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
              Rainfall Model                  FSR          Profile Type  Summer
         Return Period (years)                  1           Cv (Summer)   0.750
                     Region England and Wales           Cv (Winter)   0.840
                  M5-60 (mm)               17.200 Storm Duration (mins)      30
                     Ratio R                0.300
```

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 1
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.300
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 17.200 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| C03 1.000 | 1 | 15 Winter | 5 | +20% | | | | |
| C03 1.001 | 2 | 15 Winter | 5 | +20% | | | | |
| C03 2.000 | 3 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | |
| C03 2.001 | 4 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | |
| C03 2.002 | 5 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | |
| C03 2.003 | 6 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | |
| C03 2.004 | 7 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| C03 2.005 | 8 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | |
| C03 2.006 | 9 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| C03 3.000 | 10 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | |
| C03 3.001 | 11 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Summer | | |
| C03 3.002 | 12 | 15 Winter | 5 | +20% | 100/15 Summer | | | |
| C03 3.003 | 13 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Summer | | |
| C03 3.004 | 14 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | |
| C03 2.007 | 15 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| C03 1.002 | 16 | 30 Winter | 5 | +20% | 100/15 Summer | | | |
| C03 1.003 | 17 | 15 Winter | 5 | +20% | 100/15 Summer | | | |
| C03 1.004 | 18 | 15 Winter | 5 | +20% | 100/15 Summer | | | |
| C03 1.005 | 19 | 15 Winter | 5 | +20% | | | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| C03 1.000 | 1 | 284.848 | -0.164 | 0.000 | 0.16 | | | 12.7 | OK |
| C03 1.001 | 2 | 283.471 | -0.145 | 0.000 | 0.27 | | | 26.2 | OK |
| C03 2.000 | 3 | 287.818 | 0.064 | 0.000 | 0.92 | | | 35.8 | SURCHARGED |
| C03 2.001 | 4 | 287.494 | 0.247 | 0.000 | 0.98 | | | 47.3 | SURCHARGED |
| C03 2.002 | 5 | 286.785 | 0.316 | 0.000 | 1.05 | | | 60.1 | SURCHARGED |
| C03 2.003 | 6 | 285.588 | 0.213 | 0.000 | 1.00 | | | 73.3 | SURCHARGED |
| C03 2.004 | 7 | 283.830 | 0.233 | 0.000 | 1.05 | | | 75.9 | SURCHARGED |
| C03 2.005 | 8 | 282.467 | 0.217 | 0.000 | 0.86 | | | 133.2 | SURCHARGED |
| C03 2.006 | 9 | 281.539 | 0.455 | 0.000 | 2.46 | | | 132.9 | SURCHARGED |
| C03 3.000 | 10 | 289.373 | -0.057 | 0.000 | 0.82 | | | 34.7 | OK |
| C03 3.001 | 11 | 288.823 | 0.047 | 0.000 | 1.01 | | | 54.7 | SURCHARGED |
| C03 3.002 | 12 | 287.597 | -0.063 | 0.000 | 0.85 | | | 53.8 | OK |
| C03 3.003 | 13 | 286.203 | 0.093 | 0.000 | 0.95 | | | 68.9 | SURCHARGED |
| C03 3.004 | 14 | 284.421 | 0.319 | 0.000 | 1.06 | | | 100.0 | SURCHARGED |
| C03 2.007 | 15 | 281.424 | 0.292 | 0.000 | 2.77 | | | 232.3 | SURCHARGED |
| C03 1.002 | 16 | 281.254 | 0.000 | 0.000 | 1.47 | | | 247.4 | OK |
| C03 1.003 | 17 | 281.109 | -0.113 | 0.000 | 0.94 | | | 246.3 | OK |
| C03 1.004 | 18 | 280.997 | -0.138 | 0.000 | 0.94 | | | 244.5 | OK |
| C03 1.005 | 19 | 280.708 | -0.351 | 0.000 | 0.36 | | | 244.7 | OK |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| C03 1.000 | 1 | |
| C03 1.001 | 2 | |
| C03 2.000 | 3 | 7 |
| C03 2.001 | 4 | 8 |
| C03 2.002 | 5 | 8 |
| C03 2.003 | 6 | 7 |
| C03 2.004 | 7 | |
| C03 2.005 | 8 | 5 |
| C03 2.006 | 9 | |
| C03 3.000 | 10 | 5 |
| C03 3.001 | 11 | 6 |
| C03 3.002 | 12 | |
| C03 3.003 | 13 | 7 |
| C03 3.004 | 14 | 7 |
| C03 2.007 | 15 | |
| C03 1.002 | 16 | |
| C03 1.003 | 17 | |
| C03 1.004 | 18 | |
| C03 1.005 | 19 | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| C03 1.006 | 20 | 30 Winter | 5 | +20% | 100/15 Summer | | | |
| C03 1.007 | 21 | 30 Winter | 5 | +20% | 100/15 Summer | | | |
| C03 1.008 | 22 | 480 Winter | 5 | +20% | | | | |

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume ($m^3$) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| C03 1.006 | 20 | 280.603 | 0.000 | 0.000 | 1.49 | | | 244.5 | OK |
| C03 1.007 | 21 | 280.452 | -0.123 | 0.000 | 0.99 | | | 278.5 | OK |
| C03 1.008 | 22 | 279.984 | -0.266 | 0.000 | 0.03 | | | 30.3 | OK |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| C03 1.006 | 20 | |
| C03 1.007 | 21 | |
| C03 1.008 | 22 | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

### Simulation Criteria

```
        Areal Reduction Factor 1.000    Additional Flow - % of Total Flow 0.000
              Hot Start (mins)     0        MADD Factor * 10m³/ha Storage 2.000
           Hot Start Level (mm)     0                   Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
  Foul Sewage per hectare (l/s) 0.000

     Number of Input Hydrographs 0 Number of Storage Structures 1
       Number of Online Controls 1 Number of Time/Area Diagrams 0
      Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
  Rainfall Model                FSR      Ratio R 0.300
          Region England and Wales Cv (Summer) 0.750
  M5-60 (mm)                 17.200 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0     DVD Status OFF
                 Analysis Timestep  Fine Inertia Status OFF
                        DTS Status    ON


        Profile(s)                                Summer and Winter
  Duration(s) (mins)     15, 30, 60, 120, 180, 240, 360, 480, 600,
                           720, 960, 1440, 2160, 2880, 4320, 5760,
                                                 7200, 8640, 10080
Return Period(s) (years)                                     5, 100
  Climate Change (%)                                         20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| C03 1.000 | 1 | 15 Winter | 100 | +40% | | | | |
| C03 1.001 | 2 | 15 Winter | 100 | +40% | | | | |
| C03 2.000 | 3 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | |
| C03 2.001 | 4 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | |
| C03 2.002 | 5 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | |
| C03 2.003 | 6 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | |
| C03 2.004 | 7 | 15 Winter | 100 | +40% | 5/15 Summer | | | |
| C03 2.005 | 8 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | |
| C03 2.006 | 9 | 15 Winter | 100 | +40% | 5/15 Summer | | | |
| C03 3.000 | 10 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | |
| C03 3.001 | 11 | 30 Winter | 100 | +40% | 5/15 Winter | 100/15 Summer | | |
| C03 3.002 | 12 | 15 Winter | 100 | +40% | 100/15 Summer | | | |
| C03 3.003 | 13 | 30 Winter | 100 | +40% | 5/15 Winter | 100/15 Summer | | |
| C03 3.004 | 14 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | |
| C03 2.007 | 15 | 15 Winter | 100 | +40% | 5/15 Summer | | | |
| C03 1.002 | 16 | 15 Winter | 100 | +40% | 100/15 Summer | | | |
| C03 1.003 | 17 | 15 Winter | 100 | +40% | 100/15 Summer | | | |
| C03 1.004 | 18 | 15 Winter | 100 | +40% | 100/15 Summer | | | |
| C03 1.005 | 19 | 30 Winter | 100 | +40% | | | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| C03 1.000 | 1 | 284.880 | -0.132 | 0.000 | 0.35 | | | 27.6 | OK |
| C03 1.001 | 2 | 283.527 | -0.088 | 0.000 | 0.67 | | | 64.7 | OK |
| C03 2.000 | 3 | 289.014 | 1.259 | 9.360 | 0.98 | | | 38.3 | FLOOD |
| C03 2.001 | 4 | 288.526 | 1.279 | 14.759 | 1.01 | | | 48.9 | FLOOD |
| C03 2.002 | 5 | 287.735 | 1.266 | 15.861 | 1.27 | | | 72.9 | FLOOD |
| C03 2.003 | 6 | 286.636 | 1.261 | 11.129 | 1.17 | | | 85.6 | FLOOD |
| C03 2.004 | 7 | 285.085 | 1.488 | 0.000 | 1.22 | | | 88.3 | FLOOD RISK |
| C03 2.005 | 8 | 283.811 | 1.561 | 10.576 | 1.25 | | | 192.8 | FLOOD |
| C03 2.006 | 9 | 281.962 | 0.878 | 0.000 | 3.54 | | | 191.2 | SURCHARGED |
| C03 3.000 | 10 | 290.685 | 1.255 | 4.927 | 1.00 | | | 42.3 | FLOOD |
| C03 3.001 | 11 | 290.033 | 1.258 | 7.607 | 1.22 | | | 66.1 | FLOOD |
| C03 3.002 | 12 | 288.755 | 1.094 | 0.000 | 0.94 | | | 59.2 | FLOOD RISK |
| C03 3.003 | 13 | 287.369 | 1.260 | 9.763 | 1.14 | | | 83.0 | FLOOD |
| C03 3.004 | 14 | 285.371 | 1.269 | 18.991 | 1.23 | | | 115.7 | FLOOD |
| C03 2.007 | 15 | 281.730 | 0.598 | 0.000 | 3.66 | | | 306.7 | SURCHARGED |
| C03 1.002 | 16 | 281.443 | 0.188 | 0.000 | 2.10 | | | 353.8 | SURCHARGED |
| C03 1.003 | 17 | 281.321 | 0.100 | 0.000 | 1.33 | | | 349.5 | SURCHARGED |
| C03 1.004 | 18 | 281.168 | 0.033 | 0.000 | 1.34 | | | 346.9 | SURCHARGED |
| C03 1.005 | 19 | 280.952 | -0.107 | 0.000 | 0.51 | | | 347.1 | OK |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| C03 1.000 | 1 | |
| C03 1.001 | 2 | |
| C03 2.000 | 3 | 7 |
| C03 2.001 | 4 | 8 |
| C03 2.002 | 5 | 8 |
| C03 2.003 | 6 | 7 |
| C03 2.004 | 7 | |
| C03 2.005 | 8 | 5 |
| C03 2.006 | 9 | |
| C03 3.000 | 10 | 5 |
| C03 3.001 | 11 | 6 |
| C03 3.002 | 12 | |
| C03 3.003 | 13 | 7 |
| C03 3.004 | 14 | 7 |
| C03 2.007 | 15 | |
| C03 1.002 | 16 | |
| C03 1.003 | 17 | |
| C03 1.004 | 18 | |
| C03 1.005 | 19 | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| C03 1.006 | 20 | 30 Winter | 100 | +40% | 100/15 Summer | | | |
| C03 1.007 | 21 | 30 Winter | 100 | +40% | 100/15 Summer | | | |
| C03 1.008 | 22 | 240 Winter | 100 | +40% | | | | |

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| C03 1.006 | 20 | 280.876 | 0.273 | 0.000 | 2.12 | | | 348.7 | SURCHARGED |
| C03 1.007 | 21 | 280.808 | 0.233 | 0.000 | 1.55 | | | 437.3 | SURCHARGED |
| C03 1.008 | 22 | 280.145 | -0.105 | 0.000 | 0.09 | | | 94.1 | OK |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| C03 1.006 | 20 | |
| C03 1.007 | 21 | |
| C03 1.008 | 22 | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Storm

```
                  Pipe Sizes STANDARD Manhole Sizes STANDARD

                     FSR Rainfall Model - England and Wales
              Return Period (years)      1                        PIMP (%)   100
                         M5-60 (mm) 17.000         Add Flow / Climate Change (%)     0
                            Ratio R  0.300          Minimum Backdrop Height (m) 0.200
           Maximum Rainfall (mm/hr)     50          Maximum Backdrop Height (m) 1.500
Maximum Time of Concentration (mins)     30 Min Design Depth for Optimisation (m) 1.200
                Foul Sewage (l/s/ha)  0.000     Min Vel for Auto Design only (m/s)  0.58
           Volumetric Runoff Coeff.  0.750       Min Slope for Optimisation (1:X)   500

                          Designed with Level Soffits
```

### Simulation Criteria for Storm

```
          Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 0.000
           Areal Reduction Factor 1.000       MADD Factor * 10m³/ha Storage 2.000
                  Hot Start (mins)     0                  Inlet Coeffiecient 0.800
              Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
     Manhole Headloss Coeff (Global) 0.500                    Run Time (mins)    60
       Foul Sewage per hectare (l/s) 0.000              Output Interval (mins)     1

           Number of Input Hydrographs 0 Number of Storage Structures 1
             Number of Online Controls 1 Number of Time/Area Diagrams 0
            Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
            Rainfall Model                  FSR         Profile Type  Summer
       Return Period (years)                  1          Cv (Summer)   0.750
                      Region England and Wales          Cv (Winter)   0.840
                  M5-60 (mm)             17.000 Storm Duration (mins)      30
                     Ratio R              0.300
```

## Summary of Critical Results by Maximum Level (Rank 1) for Storm

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 1
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.300
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 17.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| S1.000 | S1 | 15 Winter | 100 | +40% | | | | |
| S1.001 | S3 | 15 Winter | 100 | +40% | 100/15 Summer | | | |
| S1.002 | S4 | 15 Winter | 100 | +40% | 100/15 Summer | | | |
| S2.000 | S4 | 15 Winter | 100 | +40% | | | | |
| S2.001 | S5 | 15 Winter | 100 | +40% | | | | |
| S2.002 | S6 | 15 Winter | 100 | +40% | | | | |
| S2.003 | S7 | 15 Winter | 100 | +40% | | | | |
| S2.004 | S8 | 15 Winter | 100 | +40% | 100/15 Summer | | | |
| S2.005 | S9 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | | |
| S2.006 | S10 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | | |
| S1.003 | S5 | 15 Winter | 100 | +40% | 100/15 Summer | | | |
| S1.004 | S5 | 15 Winter | 100 | +40% | 5/15 Summer | | | |
| S1.005 | S6 | 60 Winter | 100 | +40% | 100/15 Winter | | | |

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S1.000 | S1 | 265.273 | -0.135 | 0.000 | 0.33 | | | 25.9 | OK |

## Summary of Critical Results by Maximum Level (Rank 1) for Storm

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| S1.001 | S3 | 264.446 | 1.199 | 0.000 | 0.89 | | | 31.8 | FLOOD RISK |
| S1.002 | S4 | 264.108 | 1.310 | 0.000 | 1.46 | | | 52.1 | SURCHARGED |
| S2.000 | S4 | 271.279 | -0.171 | 0.000 | 0.13 | | | 14.0 | OK |
| S2.001 | S5 | 270.094 | -0.156 | 0.000 | 0.20 | | | 26.4 | OK |
| S2.002 | S6 | 267.906 | -0.144 | 0.000 | 0.28 | | | 38.0 | OK |
| S2.003 | S7 | 265.530 | -0.120 | 0.000 | 0.44 | | | 51.8 | OK |
| S2.004 | S8 | 264.293 | 0.343 | 0.000 | 0.56 | | | 49.8 | SURCHARGED |
| S2.005 | S9 | 264.123 | 0.950 | 0.275 | 1.08 | | | 53.3 | FLOOD |
| S2.006 | S10 | 263.900 | 0.950 | 0.094 | 1.17 | | | 74.3 | FLOOD |
| S1.003 | S5 | 263.292 | 0.853 | 0.000 | 1.28 | | | 145.2 | SURCHARGED |
| S1.004 | S5 | 261.225 | 0.038 | 0.000 | 2.61 | | | 144.7 | SURCHARGED |
| S1.005 | S6 | 261.061 | 0.032 | 0.000 | 0.30 | | | 33.0 | SURCHARGED |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| S1.000 | S1 | |
| S1.001 | S3 | |
| S1.002 | S4 | |
| S2.000 | S4 | |
| S2.001 | S5 | |
| S2.002 | S6 | |
| S2.003 | S7 | |
| S2.004 | S8 | |
| S2.005 | S9 | 1 |
| S2.006 | S10 | 1 |
| S1.003 | S5 | |
| S1.004 | S5 | |
| S1.005 | S6 | |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for C02B

```
                    Pipe Sizes STANDARD Manhole Sizes STANDARD

                       FSR Rainfall Model - England and Wales
              Return Period (years)       1                PIMP (%)    100
                         M5-60 (mm)  17.200      Add Flow / Climate Change (%)      0
                            Ratio R   0.300        Minimum Backdrop Height (m)  0.000
           Maximum Rainfall (mm/hr)      50        Maximum Backdrop Height (m)  0.000
Maximum Time of Concentration (mins)     30 Min Design Depth for Optimisation (m)  1.200
                Foul Sewage (l/s/ha)  0.000     Min Vel for Auto Design only (m/s)   1.00
           Volumetric Runoff Coeff.   0.750       Min Slope for Optimisation (1:X)    500

                           Designed with Level Soffits
```

## Simulation Criteria for C02B

```
       Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 0.000
        Areal Reduction Factor 1.000       MADD Factor * 10m³/ha Storage 2.000
              Hot Start (mins)     0                 Inlet Coeffiecient 0.800
            Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
   Manhole Headloss Coeff (Global) 0.500                     Run Time (mins)    60
     Foul Sewage per hectare (l/s) 0.000               Output Interval (mins)     1

          Number of Input Hydrographs 0 Number of Storage Structures 1
            Number of Online Controls 1 Number of Time/Area Diagrams 0
           Number of Offline Controls 0 Number of Real Time Controls 0
```

## Synthetic Rainfall Details

```
          Rainfall Model                FSR          Profile Type  Summer
     Return Period (years)                  1          Cv (Summer)   0.750
                      Region England and Wales          Cv (Winter)   0.840
              M5-60 (mm)             17.200 Storm Duration (mins)      30
                 Ratio R              0.300
```

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for C02B

### Simulation Criteria

Areal Reduction Factor 1.000
Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0
MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0
Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500
Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0
Number of Storage Structures 1
Number of Online Controls 1
Number of Time/Area Diagrams 0
Number of Offline Controls 0
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
Ratio R 0.300
Region England and Wales
Cv (Summer) 0.750
M5-60 (mm) 17.200
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
DVD Status OFF
Analysis Timestep Fine
Inertia Status OFF
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S07-02-1.000 | S07-02-1 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S07-02-1.001 | S07-02-2 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S07-02-1.002 | S07-02-3 | 15 Winter | 5 | +20% | 5/15 Winter | | |
| S07-02-1.003 | S07-02-4 | 15 Winter | 5 | +20% | 5/15 Winter | | |
| S07-02-1.004 | S07-02-5 | 15 Winter | 5 | +20% | 5/15 Summer | | |
| S07-02-1.005 | S07-02-6 | 15 Winter | 5 | +20% | 5/15 Summer | | |
| S07-02-1.006 | S07-02-7 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S07-02-1.007 | S07-02-8 | 30 Winter | 5 | +20% | 100/15 Summer | | |
| S07-02-1.008 | S07-02-9 | 30 Winter | 5 | +20% | 100/15 Summer | | |
| S07-02-1.009 | S07-02-10 | 30 Winter | 5 | +20% | | | |
| S07-02-1.010 | S07-02-11 | 30 Winter | 5 | +20% | | | |
| S07-02-1.011 | S07-02-12 | 30 Winter | 5 | +20% | | | |
| S07-02-2.000 | S07-02-13 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Summer | |
| S07-02-2.001 | S07-02-14 | 15 Winter | 5 | +20% | 5/15 Summer | | |
| S07-02-2.002 | S07-02-15 | 15 Winter | 5 | +20% | | | |
| S07-02-2.003 | S07-02-16 | 15 Winter | 5 | +20% | | | |
| S07-02-2.004 | S07-02-17 | 15 Winter | 5 | +20% | | | |
| S07-02-2.005 | S07-02-18 | 15 Winter | 5 | +20% | 100/30 Winter | | |
| S07-02-2.006 | S07-02-19 | 15 Winter | 5 | +20% | 100/15 Summer | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for C02B

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S07-02-1.000 | S07-02-1 | | 284.357 | -0.118 | 0.000 | 0.44 | | |
| S07-02-1.001 | S07-02-2 | | 284.079 | -0.054 | 0.000 | 0.86 | | |
| S07-02-1.002 | S07-02-3 | | 283.799 | 0.025 | 0.000 | 0.84 | | |
| S07-02-1.003 | S07-02-4 | | 283.766 | 0.038 | 0.000 | 0.91 | | |
| S07-02-1.004 | S07-02-5 | | 283.632 | 0.071 | 0.000 | 0.99 | | |
| S07-02-1.005 | S07-02-6 | | 283.485 | 0.077 | 0.000 | 1.19 | | |
| S07-02-1.006 | S07-02-7 | | 283.109 | -0.106 | 0.000 | 0.68 | | |
| S07-02-1.007 | S07-02-8 | | 283.082 | -0.086 | 0.000 | 0.84 | | |
| S07-02-1.008 | S07-02-9 | | 282.788 | -0.164 | 0.000 | 0.60 | | |
| S07-02-1.009 | S07-02-10 | | 282.611 | -0.208 | 0.000 | 0.56 | | |
| S07-02-1.010 | S07-02-11 | | 282.568 | -0.226 | 0.000 | 0.50 | | |
| S07-02-1.011 | S07-02-12 | | 282.429 | -0.327 | 0.000 | 0.17 | | |
| S07-02-2.000 | S07-02-13 | | 287.805 | 0.005 | 0.000 | 0.84 | | |
| S07-02-2.001 | S07-02-14 | | 287.621 | 0.150 | 0.000 | 1.12 | | |
| S07-02-2.002 | S07-02-15 | | 286.986 | -0.124 | 0.000 | 0.41 | | |
| S07-02-2.003 | S07-02-16 | | 284.488 | -0.112 | 0.000 | 0.50 | | |
| S07-02-2.004 | S07-02-17 | | 284.044 | -0.256 | 0.000 | 0.22 | | |
| S07-02-2.005 | S07-02-18 | | 282.587 | -0.213 | 0.000 | 0.38 | | |
| S07-02-2.006 | S07-02-19 | | 281.710 | -0.190 | 0.000 | 0.49 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S07-02-1.000 | S07-02-1 | 18.0 | OK | |
| S07-02-1.001 | S07-02-2 | 28.7 | OK | |
| S07-02-1.002 | S07-02-3 | 24.3 | SURCHARGED | |
| S07-02-1.003 | S07-02-4 | 29.8 | SURCHARGED | |
| S07-02-1.004 | S07-02-5 | 32.3 | SURCHARGED | |
| S07-02-1.005 | S07-02-6 | 39.1 | SURCHARGED | |
| S07-02-1.006 | S07-02-7 | 39.7 | OK | |
| S07-02-1.007 | S07-02-8 | 51.0 | OK | |
| S07-02-1.008 | S07-02-9 | 62.7 | OK | |
| S07-02-1.009 | S07-02-10 | 66.6 | OK | |
| S07-02-1.010 | S07-02-11 | 66.5 | OK | |
| S07-02-1.011 | S07-02-12 | 66.5 | OK | |
| S07-02-2.000 | S07-02-13 | 28.0 | SURCHARGED | 4 |
| S07-02-2.001 | S07-02-14 | 32.8 | SURCHARGED | |
| S07-02-2.002 | S07-02-15 | 38.0 | OK | |
| S07-02-2.003 | S07-02-16 | 38.0 | OK | |
| S07-02-2.004 | S07-02-17 | 61.6 | OK | |
| S07-02-2.005 | S07-02-18 | 86.0 | OK | |
| S07-02-2.006 | S07-02-19 | 86.0 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for C02B

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S07-02-1.012 | S07-02-20 | 30 Winter | 5 | +20% | 100/15 Summer | | |
| S07-02-1.013 | S07-02-21 | 30 Winter | 5 | +20% | 100/15 Summer | | |
| S07-02-1.014 | S07-02-22 | 30 Winter | 5 | +20% | 100/15 Summer | | |
| S07-02-1.015 | S07-02-23 | 30 Winter | 5 | +20% | 100/15 Summer | | |
| S07-02-3.000 | S07-02-24 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| S07-02-3.001 | S07-02-25 | 15 Winter | 5 | +20% | 5/15 Winter | | |
| S07-02-3.002 | S07-02-26 | 15 Winter | 5 | +20% | 5/15 Summer | | |
| S07-02-3.003 | S07-02-27 | 15 Winter | 5 | +20% | 5/15 Summer | | |
| S07-02-3.004 | S07-02-28 | 30 Winter | 5 | +20% | 5/15 Summer | | |
| S07-02-3.005 | S07-02-29 | 30 Winter | 5 | +20% | 100/15 Summer | | |
| S07-02-3.006 | S07-02-30 | 30 Winter | 5 | +20% | 100/15 Summer | | |
| S07-02-3.007 | S07-02-31 | 30 Winter | 5 | +20% | 100/15 Summer | | |
| S07-02-1.016 | S07-02-32 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S07-02-1.017 | S07-02-33 | 30 Winter | 5 | +20% | 100/15 Summer | | |
| S07-02-1.018 | S07-02-34 | 240 Winter | 5 | +20% | | | |

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S07-02-1.012 | S07-02-20 | | 281.467 | -0.233 | 0.000 | 0.47 | | |
| S07-02-1.013 | S07-02-21 | | 281.286 | -0.021 | 0.000 | 0.84 | | |
| S07-02-1.014 | S07-02-22 | | 281.223 | -0.019 | 0.000 | 0.78 | | |
| S07-02-1.015 | S07-02-23 | | 281.159 | -0.003 | 0.000 | 0.79 | | |
| S07-02-3.000 | S07-02-24 | | 282.690 | -0.110 | 0.000 | 0.47 | | |
| S07-02-3.001 | S07-02-25 | | 282.242 | 0.037 | 0.000 | 0.93 | | |
| S07-02-3.002 | S07-02-26 | | 281.990 | 0.171 | 0.000 | 0.98 | | |
| S07-02-3.003 | S07-02-27 | | 281.755 | 0.176 | 0.000 | 1.11 | | |
| S07-02-3.004 | S07-02-28 | | 281.606 | 0.157 | 0.000 | 1.41 | | |
| S07-02-3.005 | S07-02-29 | | 281.227 | -0.058 | 0.000 | 0.75 | | |
| S07-02-3.006 | S07-02-30 | | 281.151 | -0.001 | 0.000 | 1.00 | | |
| S07-02-3.007 | S07-02-31 | | 281.125 | -0.001 | 0.000 | 0.97 | | |
| S07-02-1.016 | S07-02-32 | | 281.095 | 0.000 | 0.000 | 1.11 | | |
| S07-02-1.017 | S07-02-33 | | 281.000 | -0.047 | 0.000 | 1.00 | | |
| S07-02-1.018 | S07-02-34 | | 280.615 | -0.285 | 0.000 | 0.23 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S07-02-1.012 | S07-02-20 | 146.1 | OK | |
| S07-02-1.013 | S07-02-21 | 140.6 | OK | |
| S07-02-1.014 | S07-02-22 | 134.6 | OK | |
| S07-02-1.015 | S07-02-23 | 133.9 | OK | |
| S07-02-3.000 | S07-02-24 | 19.9 | OK | 6 |
| S07-02-3.001 | S07-02-25 | 31.3 | SURCHARGED | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for C02B

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S07-02-3.002 | S07-02-26 | 32.6 | SURCHARGED | |
| S07-02-3.003 | S07-02-27 | 35.6 | SURCHARGED | |
| S07-02-3.004 | S07-02-28 | 40.2 | SURCHARGED | |
| S07-02-3.005 | S07-02-29 | 44.5 | OK | |
| S07-02-3.006 | S07-02-30 | 47.6 | OK | |
| S07-02-3.007 | S07-02-31 | 47.6 | OK | |
| S07-02-1.016 | S07-02-32 | 169.2 | OK | |
| S07-02-1.017 | S07-02-33 | 175.2 | OK | |
| S07-02-1.018 | S07-02-34 | 37.6 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for C02B

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 1
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.300
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 17.200 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S07-02-1.000 | S07-02-1 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S07-02-1.001 | S07-02-2 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S07-02-1.002 | S07-02-3 | 30 Winter | 100 | +40% | 5/15 Winter | | |
| S07-02-1.003 | S07-02-4 | 30 Winter | 100 | +40% | 5/15 Winter | | |
| S07-02-1.004 | S07-02-5 | 30 Winter | 100 | +40% | 5/15 Summer | | |
| S07-02-1.005 | S07-02-6 | 30 Winter | 100 | +40% | 5/15 Summer | | |
| S07-02-1.006 | S07-02-7 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S07-02-1.007 | S07-02-8 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S07-02-1.008 | S07-02-9 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S07-02-1.009 | S07-02-10 | 30 Summer | 100 | +40% | | | |
| S07-02-1.010 | S07-02-11 | 30 Winter | 100 | +40% | | | |
| S07-02-1.011 | S07-02-12 | 30 Winter | 100 | +40% | | | |
| S07-02-2.000 | S07-02-13 | 15 Winter | 100 | +40% | 5/15 Winter | 100/15 Summer | |
| S07-02-2.001 | S07-02-14 | 15 Winter | 100 | +40% | 5/15 Summer | | |
| S07-02-2.002 | S07-02-15 | 30 Winter | 100 | +40% | | | |
| S07-02-2.003 | S07-02-16 | 30 Winter | 100 | +40% | | | |
| S07-02-2.004 | S07-02-17 | 15 Winter | 100 | +40% | | | |
| S07-02-2.005 | S07-02-18 | 30 Winter | 100 | +40% | 100/30 Winter | | |
| S07-02-2.006 | S07-02-19 | 30 Winter | 100 | +40% | 100/15 Summer | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for C02B

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S07-02-1.000 | S07-02-1 | | 286.091 | 1.616 | 0.000 | 0.64 | | |
| S07-02-1.001 | S07-02-2 | | 285.961 | 1.828 | 0.000 | 1.20 | | |
| S07-02-1.002 | S07-02-3 | | 285.441 | 1.667 | 0.000 | 1.42 | | |
| S07-02-1.003 | S07-02-4 | | 285.355 | 1.627 | 0.000 | 1.53 | | |
| S07-02-1.004 | S07-02-5 | | 284.972 | 1.411 | 0.000 | 1.74 | | |
| S07-02-1.005 | S07-02-6 | | 284.543 | 1.134 | 0.000 | 2.15 | | |
| S07-02-1.006 | S07-02-7 | | 283.660 | 0.445 | 0.000 | 1.20 | | |
| S07-02-1.007 | S07-02-8 | | 283.612 | 0.444 | 0.000 | 1.58 | | |
| S07-02-1.008 | S07-02-9 | | 283.000 | 0.048 | 0.000 | 1.17 | | |
| S07-02-1.009 | S07-02-10 | | 282.819 | 0.000 | 0.000 | 1.04 | | |
| S07-02-1.010 | S07-02-11 | | 282.697 | -0.097 | 0.000 | 0.96 | | |
| S07-02-1.011 | S07-02-12 | | 282.483 | -0.273 | 0.000 | 0.33 | | |
| S07-02-2.000 | S07-02-13 | | 289.005 | 1.205 | 4.958 | 1.39 | | |
| S07-02-2.001 | S07-02-14 | | 288.820 | 1.349 | 0.000 | 1.88 | | |
| S07-02-2.002 | S07-02-15 | | 287.035 | -0.075 | 0.000 | 0.77 | | |
| S07-02-2.003 | S07-02-16 | | 284.546 | -0.054 | 0.000 | 0.93 | | |
| S07-02-2.004 | S07-02-17 | | 284.113 | -0.187 | 0.000 | 0.48 | | |
| S07-02-2.005 | S07-02-18 | | 282.817 | 0.017 | 0.000 | 0.80 | | |
| S07-02-2.006 | S07-02-19 | | 282.498 | 0.598 | 0.000 | 0.93 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S07-02-1.000 | S07-02-1 | 25.9 | SURCHARGED | |
| S07-02-1.001 | S07-02-2 | 40.2 | SURCHARGED | |
| S07-02-1.002 | S07-02-3 | 41.1 | SURCHARGED | |
| S07-02-1.003 | S07-02-4 | 50.1 | SURCHARGED | |
| S07-02-1.004 | S07-02-5 | 56.5 | SURCHARGED | |
| S07-02-1.005 | S07-02-6 | 70.5 | SURCHARGED | |
| S07-02-1.006 | S07-02-7 | 69.8 | SURCHARGED | |
| S07-02-1.007 | S07-02-8 | 96.3 | SURCHARGED | |
| S07-02-1.008 | S07-02-9 | 122.3 | SURCHARGED | |
| S07-02-1.009 | S07-02-10 | 122.2 | OK | |
| S07-02-1.010 | S07-02-11 | 129.1 | OK | |
| S07-02-1.011 | S07-02-12 | 129.5 | OK | |
| S07-02-2.000 | S07-02-13 | 46.7 | FLOOD | 4 |
| S07-02-2.001 | S07-02-14 | 55.0 | FLOOD RISK | |
| S07-02-2.002 | S07-02-15 | 70.6 | OK | |
| S07-02-2.003 | S07-02-16 | 70.6 | OK | |
| S07-02-2.004 | S07-02-17 | 137.9 | OK | |
| S07-02-2.005 | S07-02-18 | 180.7 | SURCHARGED | |
| S07-02-2.006 | S07-02-19 | 162.1 | SURCHARGED | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for C02B

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S07-02-1.012 | S07-02-20 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S07-02-1.013 | S07-02-21 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S07-02-1.014 | S07-02-22 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S07-02-1.015 | S07-02-23 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S07-02-3.000 | S07-02-24 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| S07-02-3.001 | S07-02-25 | 15 Winter | 100 | +40% | 5/15 Winter | | |
| S07-02-3.002 | S07-02-26 | 30 Winter | 100 | +40% | 5/15 Summer | | |
| S07-02-3.003 | S07-02-27 | 30 Winter | 100 | +40% | 5/15 Summer | | |
| S07-02-3.004 | S07-02-28 | 30 Winter | 100 | +40% | 5/15 Summer | | |
| S07-02-3.005 | S07-02-29 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S07-02-3.006 | S07-02-30 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S07-02-3.007 | S07-02-31 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S07-02-1.016 | S07-02-32 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S07-02-1.017 | S07-02-33 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S07-02-1.018 | S07-02-34 | 180 Winter | 100 | +40% | | | |

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S07-02-1.012 | S07-02-20 | | 282.389 | 0.689 | 0.000 | 0.83 | | |
| S07-02-1.013 | S07-02-21 | | 282.127 | 0.820 | 0.000 | 1.53 | | |
| S07-02-1.014 | S07-02-22 | | 281.979 | 0.737 | 0.000 | 1.47 | | |
| S07-02-1.015 | S07-02-23 | | 281.807 | 0.645 | 0.000 | 1.51 | | |
| S07-02-3.000 | S07-02-24 | | 284.011 | 1.211 | 10.912 | 0.84 | | |
| S07-02-3.001 | S07-02-25 | | 284.234 | 2.029 | 0.000 | 1.19 | | |
| S07-02-3.002 | S07-02-26 | | 284.012 | 2.193 | 0.000 | 1.51 | | |
| S07-02-3.003 | S07-02-27 | | 283.532 | 1.953 | 0.000 | 1.76 | | |
| S07-02-3.004 | S07-02-28 | | 283.156 | 1.706 | 0.000 | 2.47 | | |
| S07-02-3.005 | S07-02-29 | | 282.146 | 0.861 | 0.000 | 1.41 | | |
| S07-02-3.006 | S07-02-30 | | 281.894 | 0.741 | 0.000 | 1.98 | | |
| S07-02-3.007 | S07-02-31 | | 281.773 | 0.647 | 0.000 | 1.90 | | |
| S07-02-1.016 | S07-02-32 | | 281.656 | 0.560 | 0.000 | 2.22 | | |
| S07-02-1.017 | S07-02-33 | | 281.420 | 0.373 | 0.000 | 1.90 | | |
| S07-02-1.018 | S07-02-34 | | 280.865 | -0.035 | 0.000 | 0.37 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S07-02-1.012 | S07-02-20 | 257.9 | SURCHARGED | |
| S07-02-1.013 | S07-02-21 | 256.6 | FLOOD RISK | |
| S07-02-1.014 | S07-02-22 | 254.9 | SURCHARGED | |
| S07-02-1.015 | S07-02-23 | 254.2 | SURCHARGED | |
| S07-02-3.000 | S07-02-24 | 35.8 | FLOOD | 6 |
| S07-02-3.001 | S07-02-25 | 40.0 | SURCHARGED | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for C02B

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S07-02-3.002 | S07-02-26 | 50.0 | SURCHARGED | |
| S07-02-3.003 | S07-02-27 | 56.6 | SURCHARGED | |
| S07-02-3.004 | S07-02-28 | 70.6 | SURCHARGED | |
| S07-02-3.005 | S07-02-29 | 83.6 | SURCHARGED | |
| S07-02-3.006 | S07-02-30 | 94.3 | SURCHARGED | |
| S07-02-3.007 | S07-02-31 | 93.2 | SURCHARGED | |
| S07-02-1.016 | S07-02-32 | 338.3 | SURCHARGED | |
| S07-02-1.017 | S07-02-33 | 334.5 | SURCHARGED | |
| S07-02-1.018 | S07-02-34 | 59.9 | OK | |

# STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for Storm

```
                    Pipe Sizes STANDARD Manhole Sizes STANDARD

                      FSR Rainfall Model - England and Wales
               Return Period (years)       1                       PIMP (%)   100
                         M5-60 (mm) 17.200        Add Flow / Climate Change (%)     0
                            Ratio R  0.300         Minimum Backdrop Height (m) 0.950
             Maximum Rainfall (mm/hr)      50         Maximum Backdrop Height (m) 1.500
Maximum Time of Concentration (mins)      30 Min Design Depth for Optimisation (m) 1.200
                 Foul Sewage (l/s/ha)  0.000     Min Vel for Auto Design only (m/s)  1.00
             Volumetric Runoff Coeff.  0.750       Min Slope for Optimisation (1:X)   500

                           Designed with Level Soffits
```

## Simulation Criteria for Storm

```
      Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 0.000
       Areal Reduction Factor 1.000       MADD Factor * 10m³/ha Storage 2.000
             Hot Start (mins)     0                 Inlet Coeffiecient 0.800
         Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
Manhole Headloss Coeff (Global) 0.500                     Run Time (mins)    60
  Foul Sewage per hectare (l/s) 0.000               Output Interval (mins)     1

    Number of Input Hydrographs 0 Number of Storage Structures 1
      Number of Online Controls 1 Number of Time/Area Diagrams 0
     Number of Offline Controls 0 Number of Real Time Controls 0
```

## Synthetic Rainfall Details

```
           Rainfall Model                FSR         Profile Type  Summer
    Return Period (years)                  1          Cv (Summer)   0.750
                   Region England and Wales           Cv (Winter)   0.840
               M5-60 (mm)             17.200 Storm Duration (mins)     30
                  Ratio R              0.300
```

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

```
                            Simulation Criteria
          Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 0.000
                Hot Start (mins)     0       MADD Factor * 10m³/ha Storage 2.000
              Hot Start Level (mm)     0                 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
  Foul Sewage per hectare (l/s) 0.000

          Number of Input Hydrographs 0 Number of Storage Structures 1
            Number of Online Controls 1 Number of Time/Area Diagrams 0
           Number of Offline Controls 0 Number of Real Time Controls 0

                        Synthetic Rainfall Details
                 Rainfall Model               FSR     Ratio R 0.300
                         Region England and Wales Cv (Summer) 0.750
                     M5-60 (mm)            17.200 Cv (Winter) 0.840

          Margin for Flood Risk Warning (mm) 300.0     DVD Status OFF
                          Analysis Timestep  Fine Inertia Status OFF
                                 DTS Status    ON


                    Profile(s)                        Summer and Winter
              Duration(s) (mins)     15, 30, 60, 120, 180, 240, 360, 480, 600,
                                      720, 960, 1440, 2160, 2880, 4320, 5760,
                                                            7200, 8640, 10080
          Return Period(s) (years)                                   5, 100
             Climate Change (%)                                      20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| C05 1.000 | S07-06-01 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| C05 1.001 | S07-06-02 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| C05 1.002 | S07-06-03 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| C05 1.003 | S07-06-04 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| C05 1.004 | S07-06-05 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| C05 1.005 | S07-06-06 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| C05 1.006 | S07-06-07 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| C05 1.007 | S07-06-08 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| C05 2.000 | S07-06-09A | 15 Winter | 5 | +20% | 100/15 Summer | | |
| C05 2.001 | S07-06-10A | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| C05 2.002 | S07-06-09 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| C05 2.003 | S07-06-10 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| C05 1.008 | S07-06-11 | 30 Winter | 5 | +20% | 5/15 Summer | | |
| C05 3.000 | S07-06-12 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| C05 4.000 | S07-06-13 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| C05 4.001 | S07-06-14 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| C05 4.002 | S07-06-15 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| C05 4.003 | S07-06-16 | 30 Winter | 5 | +20% | 100/15 Summer | | |
| C05 4.004 | S07-06-17 | 30 Winter | 5 | +20% | 100/15 Summer | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|
| C05 1.000 | S07-06-01 | | 265.780 | -0.179 | 0.000 | 0.33 | | | 36.8 |
| C05 1.001 | S07-06-02 | | 264.982 | -0.117 | 0.000 | 0.66 | | | 56.6 |
| C05 1.002 | S07-06-03 | | 264.513 | -0.077 | 0.000 | 0.86 | | | 71.9 |
| C05 1.003 | S07-06-04 | | 264.237 | 0.124 | 0.000 | 0.82 | | | 75.7 |
| C05 1.004 | S07-06-05 | | 263.963 | 0.428 | 0.000 | 1.51 | | | 78.3 |
| C05 1.005 | S07-06-06 | | 263.695 | 0.346 | 0.000 | 0.93 | | | 77.5 |
| C05 1.006 | S07-06-07 | | 263.347 | 0.474 | 0.000 | 0.90 | | | 77.9 |
| C05 1.007 | S07-06-08 | | 262.929 | 0.570 | 0.000 | 1.10 | | | 83.6 |
| C05 2.000 | S07-06-09A | | 263.388 | -0.129 | 0.000 | 0.36 | | | 13.8 |
| C05 2.001 | S07-06-10A | | 263.143 | -0.015 | 0.000 | 0.74 | | | 28.4 |
| C05 2.002 | S07-06-09 | | 263.021 | 0.222 | 0.000 | 1.12 | | | 43.2 |
| C05 2.003 | S07-06-10 | | 262.785 | 0.321 | 0.000 | 0.97 | | | 45.6 |
| C05 1.008 | S07-06-11 | | 262.463 | 0.500 | 0.000 | 1.22 | | | 116.1 |
| C05 3.000 | S07-06-12 | | 264.176 | -0.171 | 0.000 | 0.12 | | | 6.4 |
| C05 4.000 | S07-06-13 | | 266.279 | -0.034 | 0.000 | 0.76 | | | 39.0 |
| C05 4.001 | S07-06-14 | | 266.006 | 0.673 | 0.000 | 1.12 | | | 44.6 |
| C05 4.002 | S07-06-15 | | 265.327 | 0.580 | 0.000 | 1.38 | | | 55.0 |
| C05 4.003 | S07-06-16 | | 264.058 | -0.100 | 0.000 | 0.77 | | | 64.0 |
| C05 4.004 | S07-06-17 | | 263.492 | -0.092 | 0.000 | 0.65 | | | 63.1 |

| PN | US/MH Name | Status | Level Exceeded |
|---|---|---|---|
| C05 1.000 | S07-06-01 | OK | |
| C05 1.001 | S07-06-02 | OK | 4 |
| C05 1.002 | S07-06-03 | OK | 6 |
| C05 1.003 | S07-06-04 | SURCHARGED | 9 |
| C05 1.004 | S07-06-05 | SURCHARGED | 9 |
| C05 1.005 | S07-06-06 | SURCHARGED | 11 |
| C05 1.006 | S07-06-07 | SURCHARGED | 11 |
| C05 1.007 | S07-06-08 | SURCHARGED | 11 |
| C05 2.000 | S07-06-09A | OK | |
| C05 2.001 | S07-06-10A | OK | 6 |
| C05 2.002 | S07-06-09 | SURCHARGED | 11 |
| C05 2.003 | S07-06-10 | SURCHARGED | 9 |
| C05 1.008 | S07-06-11 | SURCHARGED | |
| C05 3.000 | S07-06-12 | OK | |
| C05 4.000 | S07-06-13 | OK | 5 |
| C05 4.001 | S07-06-14 | SURCHARGED | 9 |
| C05 4.002 | S07-06-15 | SURCHARGED | 9 |
| C05 4.003 | S07-06-16 | OK | |
| C05 4.004 | S07-06-17 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| C05 3.001 | S07-06-18 | 30 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | |
| C05 3.002 | S07-06-19 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| C05 3.003 | S07-06-20 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| C05 5.000 | S07-06-23A | 15 Winter | 5 | +20% | 100/15 Summer | | |
| C05 5.001 | S07-06-24A | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| C05 5.002 | S07-06-21 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| C05 5.003 | S07-06-22 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| C05 1.009 | S07-06-23 | 30 Winter | 5 | +20% | 5/15 Summer | | |
| C05 1.010 | S07-06-24 | 30 Winter | 5 | +20% | 100/15 Summer | | |
| C05 1.011 | S07-06-25 | 60 Winter | 5 | +20% | 5/15 Summer | | |
| C05 1.012 | S07-06-30 | 60 Winter | 5 | +20% | | | |

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|
| C05 3.001 | S07-06-18 | | 263.431 | -0.004 | 0.000 | 0.81 | | | 78.8 |
| C05 3.002 | S07-06-19 | | 263.079 | 0.316 | 0.000 | 1.00 | | | 79.9 |
| C05 3.003 | S07-06-20 | | 262.659 | 0.353 | 0.000 | 0.96 | | | 84.7 |
| C05 5.000 | S07-06-23A | | 263.368 | -0.128 | 0.000 | 0.37 | | | 14.1 |
| C05 5.001 | S07-06-24A | | 263.295 | 0.154 | 0.000 | 0.68 | | | 26.4 |
| C05 5.002 | S07-06-21 | | 263.184 | 0.397 | 0.000 | 1.27 | | | 48.8 |
| C05 5.003 | S07-06-22 | | 262.741 | 0.292 | 0.000 | 0.99 | | | 55.2 |
| C05 1.009 | S07-06-23 | | 262.137 | 0.394 | 0.000 | 1.35 | | | 250.1 |
| C05 1.010 | S07-06-24 | | 260.367 | -0.158 | 0.000 | 0.83 | | | 264.5 |
| C05 1.011 | S07-06-25 | | 260.069 | 0.026 | 0.000 | 0.71 | | | 168.7 |
| C05 1.012 | S07-06-30 | | 259.704 | -0.849 | 0.000 | 0.07 | | | 168.5 |

| PN | US/MH Name | Status | Level Exceeded |
|---|---|---|---|
| C05 3.001 | S07-06-18 | OK | 5 |
| C05 3.002 | S07-06-19 | SURCHARGED | 9 |
| C05 3.003 | S07-06-20 | SURCHARGED | 6 |
| C05 5.000 | S07-06-23A | OK | |
| C05 5.001 | S07-06-24A | SURCHARGED | 7 |
| C05 5.002 | S07-06-21 | SURCHARGED | 11 |
| C05 5.003 | S07-06-22 | SURCHARGED | 6 |
| C05 1.009 | S07-06-23 | SURCHARGED | |
| C05 1.010 | S07-06-24 | OK | |
| C05 1.011 | S07-06-25 | SURCHARGED | |
| C05 1.012 | S07-06-30 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

### Simulation Criteria

Areal Reduction Factor 1.000
Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0
MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0
Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500
Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0
Number of Storage Structures 1
Number of Online Controls 1
Number of Time/Area Diagrams 0
Number of Offline Controls 0
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
Ratio R 0.300
Region England and Wales
Cv (Summer) 0.750
M5-60 (mm) 17.200
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
DVD Status OFF
Analysis Timestep Fine
Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| C05 1.000 | S07-06-01 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| C05 1.001 | S07-06-02 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| C05 1.002 | S07-06-03 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| C05 1.003 | S07-06-04 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| C05 1.004 | S07-06-05 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| C05 1.005 | S07-06-06 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| C05 1.006 | S07-06-07 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| C05 1.007 | S07-06-08 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| C05 2.000 | S07-06-09A | 15 Winter | 100 | +40% | 100/15 Summer | | |
| C05 2.001 | S07-06-10A | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| C05 2.002 | S07-06-09 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| C05 2.003 | S07-06-10 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| C05 1.008 | S07-06-11 | 15 Winter | 100 | +40% | 5/15 Summer | | |
| C05 3.000 | S07-06-12 | 30 Summer | 100 | +40% | 100/15 Summer | | |
| C05 4.000 | S07-06-13 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| C05 4.001 | S07-06-14 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| C05 4.002 | S07-06-15 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| C05 4.003 | S07-06-16 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| C05 4.004 | S07-06-17 | 30 Winter | 100 | +40% | 100/15 Summer | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|
| C05 1.000 | S07-06-01 | | 266.557 | 0.598 | 0.000 | 0.62 | | | 70.0 |
| C05 1.001 | S07-06-02 | | 266.226 | 1.127 | 2.130 | 0.99 | | | 85.2 |
| C05 1.002 | S07-06-03 | | 265.726 | 1.136 | 10.935 | 0.99 | | | 82.8 |
| C05 1.003 | S07-06-04 | | 265.269 | 1.156 | 31.438 | 0.78 | | | 72.2 |
| C05 1.004 | S07-06-05 | | 264.958 | 1.423 | 7.242 | 1.59 | | | 82.8 |
| C05 1.005 | S07-06-06 | | 264.496 | 1.147 | 21.989 | 1.00 | | | 83.6 |
| C05 1.006 | S07-06-07 | | 264.019 | 1.146 | 20.552 | 1.00 | | | 87.0 |
| C05 1.007 | S07-06-08 | | 263.506 | 1.147 | 22.316 | 1.53 | | | 116.4 |
| C05 2.000 | S07-06-09A | | 264.299 | 0.782 | 0.000 | 0.70 | | | 27.2 |
| C05 2.001 | S07-06-10A | | 264.083 | 0.925 | 4.509 | 1.06 | | | 41.0 |
| C05 2.002 | S07-06-09 | | 263.689 | 0.890 | 28.622 | 1.19 | | | 46.0 |
| C05 2.003 | S07-06-10 | | 263.424 | 0.960 | 6.193 | 1.18 | | | 55.9 |
| C05 1.008 | S07-06-11 | | 263.199 | 1.236 | 0.000 | 1.48 | | | 140.5 |
| C05 3.000 | S07-06-12 | | 264.685 | 0.338 | 0.000 | 0.22 | | | 11.6 |
| C05 4.000 | S07-06-13 | | 267.519 | 1.206 | 5.819 | 0.99 | | | 51.0 |
| C05 4.001 | S07-06-14 | | 266.565 | 1.232 | 32.343 | 1.14 | | | 45.3 |
| C05 4.002 | S07-06-15 | | 265.964 | 1.217 | 17.092 | 1.58 | | | 63.0 |
| C05 4.003 | S07-06-16 | | 265.360 | 1.202 | 0.000 | 0.96 | | | 79.9 |
| C05 4.004 | S07-06-17 | | 264.741 | 1.157 | 0.000 | 0.83 | | | 80.2 |

| PN | US/MH Name | Status | Level Exceeded |
|---|---|---|---|
| C05 1.000 | S07-06-01 | SURCHARGED | |
| C05 1.001 | S07-06-02 | FLOOD | 4 |
| C05 1.002 | S07-06-03 | FLOOD | 6 |
| C05 1.003 | S07-06-04 | FLOOD | 9 |
| C05 1.004 | S07-06-05 | FLOOD | 9 |
| C05 1.005 | S07-06-06 | FLOOD | 11 |
| C05 1.006 | S07-06-07 | FLOOD | 11 |
| C05 1.007 | S07-06-08 | FLOOD | 11 |
| C05 2.000 | S07-06-09A | SURCHARGED | |
| C05 2.001 | S07-06-10A | FLOOD | 6 |
| C05 2.002 | S07-06-09 | FLOOD | 11 |
| C05 2.003 | S07-06-10 | FLOOD | 9 |
| C05 1.008 | S07-06-11 | FLOOD RISK | |
| C05 3.000 | S07-06-12 | SURCHARGED | |
| C05 4.000 | S07-06-13 | FLOOD | 5 |
| C05 4.001 | S07-06-14 | FLOOD | 9 |
| C05 4.002 | S07-06-15 | FLOOD | 9 |
| C05 4.003 | S07-06-16 | FLOOD RISK | |
| C05 4.004 | S07-06-17 | FLOOD RISK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| C05 3.001 | S07-06-18 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | |
| C05 3.002 | S07-06-19 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| C05 3.003 | S07-06-20 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| C05 5.000 | S07-06-23A | 15 Winter | 100 | +40% | 100/15 Summer | | |
| C05 5.001 | S07-06-24A | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| C05 5.002 | S07-06-21 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| C05 5.003 | S07-06-22 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| C05 1.009 | S07-06-23 | 15 Winter | 100 | +40% | 5/15 Summer | | |
| C05 1.010 | S07-06-24 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| C05 1.011 | S07-06-25 | 120 Winter | 100 | +40% | 5/15 Summer | | |
| C05 1.012 | S07-06-30 | 120 Winter | 100 | +40% | | | |

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|---|
| C05 3.001 | S07-06-18 | | 264.639 | 1.204 | 4.344 | 0.99 | | | 96.5 |
| C05 3.002 | S07-06-19 | | 263.985 | 1.222 | 22.132 | 1.26 | | | 100.9 |
| C05 3.003 | S07-06-20 | | 263.510 | 1.204 | 3.612 | 1.29 | | | 113.4 |
| C05 5.000 | S07-06-23A | | 264.283 | 0.787 | 0.000 | 0.75 | | | 28.8 |
| C05 5.001 | S07-06-24A | | 264.048 | 0.907 | 7.769 | 1.03 | | | 39.9 |
| C05 5.002 | S07-06-21 | | 263.689 | 0.902 | 44.662 | 1.36 | | | 52.5 |
| C05 5.003 | S07-06-22 | | 263.420 | 0.971 | 4.644 | 1.28 | | | 71.7 |
| C05 1.009 | S07-06-23 | | 262.701 | 0.958 | 0.000 | 1.70 | | | 313.7 |
| C05 1.010 | S07-06-24 | | 260.797 | 0.272 | 0.000 | 1.23 | | | 393.8 |
| C05 1.011 | S07-06-25 | | 260.206 | 0.163 | 0.000 | 0.91 | | | 216.7 |
| C05 1.012 | S07-06-30 | | 259.747 | -0.806 | 0.000 | 0.08 | | | 216.7 |

| PN | US/MH Name | Status | Level Exceeded |
|---|---|---|---|
| C05 3.001 | S07-06-18 | FLOOD | 5 |
| C05 3.002 | S07-06-19 | FLOOD | 9 |
| C05 3.003 | S07-06-20 | FLOOD | 6 |
| C05 5.000 | S07-06-23A | SURCHARGED | |
| C05 5.001 | S07-06-24A | FLOOD | 7 |
| C05 5.002 | S07-06-21 | FLOOD | 11 |
| C05 5.003 | S07-06-22 | FLOOD | 6 |
| C05 1.009 | S07-06-23 | SURCHARGED | |
| C05 1.010 | S07-06-24 | SURCHARGED | |
| C05 1.011 | S07-06-25 | SURCHARGED | |
| C05 1.012 | S07-06-30 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for Storm

```
                 Pipe Sizes STANDARD Manhole Sizes STANDARD

                  FSR Rainfall Model - England and Wales
              Return Period (years)      1                          PIMP (%)    100
                      M5-60 (mm) 17.000        Add Flow / Climate Change (%)      0
                         Ratio R  0.300          Minimum Backdrop Height (m)  0.200
            Maximum Rainfall (mm/hr)     50          Maximum Backdrop Height (m)  1.500
 Maximum Time of Concentration (mins)     30 Min Design Depth for Optimisation (m)  1.200
               Foul Sewage (l/s/ha)  0.000     Min Vel for Auto Design only (m/s)   0.58
            Volumetric Runoff Coeff.  0.750       Min Slope for Optimisation (1:X)    500

                        Designed with Level Soffits
```

### Simulation Criteria for Storm

```
           Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 0.000
            Areal Reduction Factor 1.000      MADD Factor * 10m³/ha Storage 2.000
                   Hot Start (mins)     0               Inlet Coeffiecient 0.800
               Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
      Manhole Headloss Coeff (Global) 0.500                   Run Time (mins)    60
        Foul Sewage per hectare (l/s) 0.000            Output Interval (mins)     1

            Number of Input Hydrographs 0 Number of Storage Structures 0
              Number of Online Controls 1 Number of Time/Area Diagrams 0
             Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
               Rainfall Model                  FSR           Profile Type  Summer
          Return Period (years)                  1            Cv (Summer)   0.750
                           Region England and Wales            Cv (Winter)   0.840
                     M5-60 (mm)             17.000 Storm Duration (mins)       30
                        Ratio R              0.300
```

## Summary of Critical Results by Maximum Level (Rank 1) for Storm

```
                                 Simulation Criteria
           Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 0.000
                  Hot Start (mins)     0       MADD Factor * 10m³/ha Storage 2.000
              Hot Start Level (mm)     0                  Inlet Coeffiecient 0.800
  Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
    Foul Sewage per hectare (l/s) 0.000

           Number of Input Hydrographs 0 Number of Storage Structures 0
             Number of Online Controls 1 Number of Time/Area Diagrams 0
            Number of Offline Controls 0 Number of Real Time Controls 0

                              Synthetic Rainfall Details
                 Rainfall Model                FSR      Ratio R 0.300
                         Region England and Wales Cv (Summer) 0.750
                     M5-60 (mm)             17.000 Cv (Winter) 0.840

            Margin for Flood Risk Warning (mm) 300.0     DVD Status OFF
                             Analysis Timestep  Fine Inertia Status OFF
                                    DTS Status    ON


                      Profile(s)                         Summer and Winter
                Duration(s) (mins)     15, 30, 60, 120, 180, 240, 360, 480, 600,
                                         720, 960, 1440, 2160, 2880, 4320, 5760,
                                                                     7200, 8640
          Return Period(s) (years)                                      5, 100
                Climate Change (%)                                      20, 40


          US/MH            Return Climate  First (X)     First (Y)     First (Z) Overflow
     PN   Name     Storm   Period Change   Surcharge       Flood       Overflow    Act.

   S1.000    S14 15 Winter    100     +40%
   S1.001    S15 15 Winter    100     +40%
   S1.002    S16 15 Winter    100     +40%
   S1.003    S17 30 Summer    100     +40%
   S1.004    S18 60 Winter    100     +40% 5/15 Winter 100/120 Summer
   S1.005    S19 60 Winter    100     +40% 5/15 Summer  100/15 Summer


                 Water  Surcharged Flooded                    Half Drain  Pipe
          US/MH  Level    Depth    Volume  Flow / Overflow       Time     Flow
     PN   Name    (m)      (m)      (m³)    Cap.    (l/s)       (mins)   (l/s)     Status

   S1.000    S14 270.626   -0.174   0.000   0.12                          14.1          OK
   S1.001    S15 268.567   -0.150   0.000   0.24                          29.5          OK
   S1.002    S16 267.162   -0.124   0.000   0.41                          44.2          OK
   S1.003    S17 265.424   -0.376   0.000   0.05                          55.3          OK
   S1.004    S18 265.416    1.003   0.000   0.13                          41.4  SURCHARGED
   S1.005    S19 265.414    1.432  13.687   0.51                          16.3       FLOOD
```

## Summary of Critical Results by Maximum Level (Rank 1) for Storm

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| S1.000 | S14 | |
| S1.001 | S15 | |
| S1.002 | S16 | |
| S1.003 | S17 | |
| S1.004 | S18 | |
| S1.005 | S19 | 11 |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for S08-01

```
                    Pipe Sizes STANDARD Manhole Sizes STANDARD

                      FSR Rainfall Model - England and Wales
               Return Period (years)       5                          PIMP (%)    100
                          M5-60 (mm)  17.000         Add Flow / Climate Change (%)      0
                             Ratio R   0.328          Minimum Backdrop Height (m)  0.000
             Maximum Rainfall (mm/hr)      50          Maximum Backdrop Height (m)  0.000
  Maximum Time of Concentration (mins)      30 Min Design Depth for Optimisation (m)  1.200
                Foul Sewage (l/s/ha)   0.000     Min Vel for Auto Design only (m/s)   0.50
             Volumetric Runoff Coeff.   0.750       Min Slope for Optimisation (1:X)    500

                            Designed with Level Soffits
```

### Simulation Criteria for S08-01

```
             Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 0.000
              Areal Reduction Factor 1.000       MADD Factor * 10m³/ha Storage 2.000
                    Hot Start (mins)     0                   Inlet Coeffiecient 0.800
                  Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
        Manhole Headloss Coeff (Global) 0.500                     Run Time (mins)    60
          Foul Sewage per hectare (l/s) 0.000                Output Interval (mins)     1

              Number of Input Hydrographs 0 Number of Storage Structures 1
                Number of Online Controls 1 Number of Time/Area Diagrams 0
               Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
                 Rainfall Model                FSR          Profile Type  Summer
            Return Period (years)                  5            Cv (Summer)   0.750
                         Region England and Wales            Cv (Winter)   0.840
                     M5-60 (mm)              17.000 Storm Duration (mins)      30
                        Ratio R               0.328
```

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-01

### Simulation Criteria

```
         Areal Reduction Factor 1.000    Additional Flow - % of Total Flow 0.000
               Hot Start (mins)     0        MADD Factor * 10m³/ha Storage 2.000
             Hot Start Level (mm)   0                 Inlet Coeffiecient 0.800
  Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
    Foul Sewage per hectare (l/s) 0.000

         Number of Input Hydrographs 0 Number of Storage Structures 1
           Number of Online Controls 1 Number of Time/Area Diagrams 0
          Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
          Rainfall Model               FSR     Ratio R 0.328
                  Region England and Wales Cv (Summer) 0.750
              M5-60 (mm)            17.000 Cv (Winter) 0.840

         Margin for Flood Risk Warning (mm) 300.0     DVD Status OFF
                        Analysis Timestep  Fine Inertia Status OFF
                               DTS Status    ON


                Profile(s)                          Summer and Winter
           Duration(s) (mins)     15, 30, 60, 120, 180, 240, 360, 480, 600,
                                    720, 960, 1440, 2160, 2880, 4320, 5760,
                                                           7200, 8640, 10080
        Return Period(s) (years)                                     5, 100
           Climate Change (%)                                        20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| C01 1.000 | 1 | 15 Summer | 5 | +20% | | | | |
| C01 1.001 | 2 | 15 Winter | 5 | +20% | 100/15 Summer | | | |
| C01 1.002 | 3 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | |
| C01 1.003 | 4 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| C01 2.000 | 5 | 15 Winter | 5 | +20% | | | | |
| C01 2.001 | 6 | 15 Winter | 5 | +20% | | | | |
| C01 2.002 | 7 | 15 Winter | 5 | +20% | | | | |
| C01 2.003 | 8 | 15 Winter | 5 | +20% | 100/15 Summer | | | |
| C01 2.004 | 9 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | |
| C01 2.005 | 10 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | |
| C01 1.004 | 11 | 15 Winter | 5 | +20% | 100/15 Summer | | | |
| C01 3.000 | 12 | 15 Winter | 5 | +20% | | | | |
| C01 3.001 | 13 | 15 Winter | 5 | +20% | | | | |
| C01 3.002 | 14 | 15 Winter | 5 | +20% | 100/15 Summer | | | |
| C01 3.003 | 15 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | |
| C01 3.004 | 16 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Summer | | |
| C01 3.005 | 17 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | |
| C01 1.005 | 18 | 15 Winter | 5 | +20% | 100/15 Summer | | | |
| C01 1.006 | 19 | 15 Winter | 5 | +20% | 100/15 Summer | | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-01

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| C01 1.000 | 1 | 216.450 | -0.150 | 0.000 | 0.00 | | | 0.0 | OK |
| C01 1.001 | 2 | 214.920 | -0.083 | 0.000 | 0.41 | | | 19.9 | OK |
| C01 1.002 | 3 | 209.830 | 0.085 | 0.000 | 0.99 | | | 34.2 | SURCHARGED |
| C01 1.003 | 4 | 208.071 | 0.121 | 0.000 | 1.27 | | | 45.9 | SURCHARGED |
| C01 2.000 | 5 | 225.992 | -0.124 | 0.000 | 0.07 | | | 3.3 | OK |
| C01 2.001 | 6 | 221.434 | -0.109 | 0.000 | 0.16 | | | 7.9 | OK |
| C01 2.002 | 7 | 218.151 | -0.089 | 0.000 | 0.35 | | | 16.1 | OK |
| C01 2.003 | 8 | 214.710 | -0.083 | 0.000 | 0.41 | | | 16.1 | OK |
| C01 2.004 | 9 | 211.843 | -0.059 | 0.000 | 0.67 | | | 20.8 | OK |
| C01 2.005 | 10 | 209.754 | -0.039 | 0.000 | 0.88 | | | 26.3 | OK |
| C01 1.004 | 11 | 207.763 | 0.000 | 0.000 | 1.56 | | | 83.0 | OK |
| C01 3.000 | 12 | 226.099 | -0.124 | 0.000 | 0.07 | | | 3.4 | OK |
| C01 3.001 | 13 | 221.178 | -0.106 | 0.000 | 0.18 | | | 9.4 | OK |
| C01 3.002 | 14 | 217.587 | -0.091 | 0.000 | 0.33 | | | 15.8 | OK |
| C01 3.003 | 15 | 214.139 | -0.065 | 0.000 | 0.61 | | | 22.8 | OK |
| C01 3.004 | 16 | 211.836 | 0.018 | 0.000 | 0.93 | | | 28.1 | SURCHARGED |
| C01 3.005 | 17 | 210.312 | 0.479 | 0.000 | 1.15 | | | 29.9 | SURCHARGED |
| C01 1.005 | 18 | 207.630 | -0.108 | 0.000 | 0.92 | | | 121.0 | OK |
| C01 1.006 | 19 | 207.522 | -0.146 | 0.000 | 0.79 | | | 119.2 | OK |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| C01 1.000 | 1 | |
| C01 1.001 | 2 | |
| C01 1.002 | 3 | 6 |
| C01 1.003 | 4 | |
| C01 2.000 | 5 | |
| C01 2.001 | 6 | |
| C01 2.002 | 7 | |
| C01 2.003 | 8 | |
| C01 2.004 | 9 | 4 |
| C01 2.005 | 10 | 4 |
| C01 1.004 | 11 | |
| C01 3.000 | 12 | |
| C01 3.001 | 13 | |
| C01 3.002 | 14 | |
| C01 3.003 | 15 | 4 |
| C01 3.004 | 16 | 6 |
| C01 3.005 | 17 | 6 |
| C01 1.005 | 18 | |
| C01 1.006 | 19 | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-01

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| C01 1.007 | 20 | 600 Winter | 5 | +20% | 5/120 Winter | | | |

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| C01 1.007 | 20 | 207.174 | 0.024 | 0.000 | 0.34 | | | 9.2 | SURCHARGED |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| C01 1.007 | 20 | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-01

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 1 |
| Number of Online Controls | 1 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Ratio R | 0.328 |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 17.000 | Cv (Winter) | 0.840 |

| | | | |
|---|---|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 | DVD Status | OFF |
| Analysis Timestep | Fine | Inertia Status | OFF |
| DTS Status | ON | | |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| C01 1.000 | 1 | 15 Summer | 100 | +40% | | | | |
| C01 1.001 | 2 | 15 Winter | 100 | +40% | 100/15 Summer | | | |
| C01 1.002 | 3 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | |
| C01 1.003 | 4 | 15 Winter | 100 | +40% | 5/15 Summer | | | |
| C01 2.000 | 5 | 15 Winter | 100 | +40% | | | | |
| C01 2.001 | 6 | 15 Winter | 100 | +40% | | | | |
| C01 2.002 | 7 | 15 Winter | 100 | +40% | | | | |
| C01 2.003 | 8 | 15 Winter | 100 | +40% | 100/15 Summer | | | |
| C01 2.004 | 9 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | |
| C01 2.005 | 10 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | |
| C01 1.004 | 11 | 15 Winter | 100 | +40% | 100/15 Summer | | | |
| C01 3.000 | 12 | 15 Winter | 100 | +40% | | | | |
| C01 3.001 | 13 | 15 Winter | 100 | +40% | | | | |
| C01 3.002 | 14 | 15 Winter | 100 | +40% | 100/15 Summer | | | |
| C01 3.003 | 15 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | |
| C01 3.004 | 16 | 30 Winter | 100 | +40% | 5/15 Winter | 100/15 Summer | | |
| C01 3.005 | 17 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | |
| C01 1.005 | 18 | 15 Winter | 100 | +40% | 100/15 Summer | | | |
| C01 1.006 | 19 | 15 Winter | 100 | +40% | 100/15 Summer | | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-01

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| C01 1.000 | 1 | 216.450 | -0.150 | 0.000 | 0.00 | | | 0.0 | OK |
| C01 1.001 | 2 | 215.465 | 0.462 | 0.000 | 0.92 | | | 44.7 | SURCHARGED |
| C01 1.002 | 3 | 210.957 | 1.212 | 12.741 | 1.27 | | | 43.9 | FLOOD |
| C01 1.003 | 4 | 208.717 | 0.767 | 0.000 | 1.91 | | | 68.9 | SURCHARGED |
| C01 2.000 | 5 | 226.005 | -0.111 | 0.000 | 0.15 | | | 7.3 | OK |
| C01 2.001 | 6 | 221.461 | -0.082 | 0.000 | 0.42 | | | 19.8 | OK |
| C01 2.002 | 7 | 218.203 | -0.037 | 0.000 | 0.91 | | | 42.3 | OK |
| C01 2.003 | 8 | 215.466 | 0.673 | 0.000 | 0.90 | | | 35.5 | SURCHARGED |
| C01 2.004 | 9 | 213.103 | 1.202 | 2.660 | 1.03 | | | 31.8 | FLOOD |
| C01 2.005 | 10 | 210.994 | 1.201 | 0.529 | 1.27 | | | 38.1 | FLOOD |
| C01 1.004 | 11 | 208.051 | 0.287 | 0.000 | 2.47 | | | 131.2 | SURCHARGED |
| C01 3.000 | 12 | 226.112 | -0.111 | 0.000 | 0.15 | | | 7.5 | OK |
| C01 3.001 | 13 | 221.207 | -0.077 | 0.000 | 0.47 | | | 24.1 | OK |
| C01 3.002 | 14 | 217.714 | 0.036 | 0.000 | 0.82 | | | 39.6 | SURCHARGED |
| C01 3.003 | 15 | 215.405 | 1.202 | 2.568 | 1.00 | | | 37.3 | FLOOD |
| C01 3.004 | 16 | 213.026 | 1.208 | 8.111 | 1.02 | | | 30.8 | FLOOD |
| C01 3.005 | 17 | 211.035 | 1.202 | 2.117 | 1.33 | | | 34.8 | FLOOD |
| C01 1.005 | 18 | 207.936 | 0.197 | 0.000 | 1.46 | | | 190.9 | SURCHARGED |
| C01 1.006 | 19 | 207.779 | 0.111 | 0.000 | 1.20 | | | 182.0 | SURCHARGED |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| C01 1.000 | 1 | |
| C01 1.001 | 2 | |
| C01 1.002 | 3 | 6 |
| C01 1.003 | 4 | |
| C01 2.000 | 5 | |
| C01 2.001 | 6 | |
| C01 2.002 | 7 | |
| C01 2.003 | 8 | |
| C01 2.004 | 9 | 4 |
| C01 2.005 | 10 | 4 |
| C01 1.004 | 11 | |
| C01 3.000 | 12 | |
| C01 3.001 | 13 | |
| C01 3.002 | 14 | |
| C01 3.003 | 15 | 4 |
| C01 3.004 | 16 | 6 |
| C01 3.005 | 17 | 6 |
| C01 1.005 | 18 | |
| C01 1.006 | 19 | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-01

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| C01 1.007 | 20 | 600 Winter | 100 | +40% | 5/120 Winter | | | |

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume ($m^3$) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| C01 1.007 | 20 | 207.427 | 0.277 | 0.000 | 0.34 | | | 9.3 | SURCHARGED |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| C01 1.007 | 20 | |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for S08-02

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 2 | PIMP (%) | 100 |
| M5-60 (mm) | 18.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.328 | Minimum Backdrop Height (m) | 0.000 |
| Maximum Rainfall (mm/hr) | 50 | Maximum Backdrop Height (m) | 0.000 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

## Simulation Criteria for S08-02

| | | | |
|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Additional Flow - % of Total Flow | 0.000 |
| Areal Reduction Factor | 1.000 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start (mins) | 0 | Inlet Coeffiecient | 0.800 |
| Hot Start Level (mm) | 0 | Flow per Person per Day (l/per/day) | 0.000 |
| Manhole Headloss Coeff (Global) | 0.500 | Run Time (mins) | 60 |
| Foul Sewage per hectare (l/s) | 0.000 | Output Interval (mins) | 1 |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 1 |
| Number of Online Controls | 1 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

## Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Profile Type | Summer |
| Return Period (years) | 5 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 17.000 | Storm Duration (mins) | 30 |
| Ratio R | 0.328 | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-02

### Simulation Criteria

```
          Areal Reduction Factor 1.000    Additional Flow - % of Total Flow 0.000
               Hot Start (mins)      0        MADD Factor * 10m³/ha Storage 2.000
             Hot Start Level (mm)    0                  Inlet Coeffiecient 0.800
  Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
     Foul Sewage per hectare (l/s) 0.000

          Number of Input Hydrographs 0 Number of Storage Structures 1
            Number of Online Controls 1 Number of Time/Area Diagrams 0
           Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
         Rainfall Model             FSR     Ratio R 0.328
                Region England and Wales Cv (Summer) 0.750
            M5-60 (mm)            17.000 Cv (Winter) 0.840

   Margin for Flood Risk Warning (mm)  300.0     DVD Status OFF
                    Analysis Timestep  Fine Inertia Status OFF
                           DTS Status    ON


              Profile(s)                              Summer and Winter
          Duration(s) (mins)     15, 30, 60, 120, 180, 240, 360, 480, 600,
                                   720, 960, 1440, 2160, 2880, 4320, 5760,
                                                       7200, 8640, 10080
       Return Period(s) (years)                                   5, 100
          Climate Change (%)                                      20, 40
```

| **PN** | **US/MH Name** | **Storm** | **Return Period** | **Climate Change** | **First (X) Surcharge** | **First (Y) Flood** | **First (Z) Overflow** |
|---|---|---|---|---|---|---|---|
| S08-02-1.000 | S08-02-1 | 15 Winter | 5 | +20% | | | |
| S08-02-1.001 | S08-02-2 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-02-1.002 | S08-02-3 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| S08-02-1.003 | S08-02-4 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| S08-02-1.004 | S08-02-5 | 15 Winter | 5 | +20% | 5/15 Summer | | |
| S08-02-2.000 | S08-02-6 | 15 Winter | 5 | +20% | | | |
| S08-02-2.001 | S08-02-7 | 15 Winter | 5 | +20% | | | |
| S08-02-2.002 | S08-02-8 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-02-2.003 | S08-02-9 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-02-2.004 | S08-02-10 | 15 Winter | 5 | +20% | | | |
| S08-02-1.005 | S08-02-11 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-02-1.006 | S08-02-12 | 15 Winter | 5 | +20% | | | |
| S08-02-1.007 | S08-02-13 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-02-1.008 | S08-02-14 | 15 Winter | 5 | +20% | 5/15 Summer | | |
| S08-02-1.009 | S08-02-15 | 15 Winter | 5 | +20% | 5/15 Summer | | |
| S08-02-1.010 | S08-02-16 | 15 Winter | 5 | +20% | 5/15 Summer | | |
| S08-02-1.011 | S08-02-20 | 600 Winter | 5 | +20% | | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-02

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-02-1.000 | S08-02-1 | | 218.198 | -0.087 | 0.000 | 0.36 | | |
| S08-02-1.001 | S08-02-2 | | 217.169 | -0.078 | 0.000 | 0.47 | | |
| S08-02-1.002 | S08-02-3 | | 215.013 | -0.060 | 0.000 | 0.66 | | |
| S08-02-1.003 | S08-02-4 | | 212.839 | -0.038 | 0.000 | 0.90 | | |
| S08-02-1.004 | S08-02-5 | | 210.902 | 0.173 | 0.000 | 1.09 | | |
| S08-02-2.000 | S08-02-6 | | 210.942 | -0.108 | 0.000 | 0.17 | | |
| S08-02-2.001 | S08-02-7 | | 210.517 | -0.095 | 0.000 | 0.29 | | |
| S08-02-2.002 | S08-02-8 | | 210.315 | -0.077 | 0.000 | 0.47 | | |
| S08-02-2.003 | S08-02-9 | | 210.184 | -0.068 | 0.000 | 0.58 | | |
| S08-02-2.004 | S08-02-10 | | 209.973 | -0.091 | 0.000 | 0.32 | | |
| S08-02-1.005 | S08-02-11 | | 209.716 | -0.080 | 0.000 | 0.74 | | |
| S08-02-1.006 | S08-02-12 | | 209.481 | -0.115 | 0.000 | 0.48 | | |
| S08-02-1.007 | S08-02-13 | | 207.813 | -0.103 | 0.000 | 0.56 | | |
| S08-02-1.008 | S08-02-14 | | 206.598 | 0.188 | 0.000 | 1.42 | | |
| S08-02-1.009 | S08-02-15 | | 206.296 | 0.039 | 0.000 | 1.03 | | |
| S08-02-1.010 | S08-02-16 | | 206.220 | 0.034 | 0.000 | 1.25 | | |
| S08-02-1.011 | S08-02-20 | | 205.909 | -0.191 | 0.000 | 0.05 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S08-02-1.000 | S08-02-1 | 8.7 | OK | |
| S08-02-1.001 | S08-02-2 | 17.9 | OK | |
| S08-02-1.002 | S08-02-3 | 24.5 | OK | 4 |
| S08-02-1.003 | S08-02-4 | 31.9 | OK | 6 |
| S08-02-1.004 | S08-02-5 | 35.8 | SURCHARGED | |
| S08-02-2.000 | S08-02-6 | 3.7 | OK | |
| S08-02-2.001 | S08-02-7 | 5.6 | OK | |
| S08-02-2.002 | S08-02-8 | 7.7 | OK | |
| S08-02-2.003 | S08-02-9 | 10.1 | OK | |
| S08-02-2.004 | S08-02-10 | 10.1 | OK | |
| S08-02-1.005 | S08-02-11 | 45.3 | OK | |
| S08-02-1.006 | S08-02-12 | 50.8 | OK | |
| S08-02-1.007 | S08-02-13 | 57.1 | OK | |
| S08-02-1.008 | S08-02-14 | 58.8 | SURCHARGED | |
| S08-02-1.009 | S08-02-15 | 57.8 | SURCHARGED | |
| S08-02-1.010 | S08-02-16 | 57.5 | SURCHARGED | |
| S08-02-1.011 | S08-02-20 | 4.3 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-02

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 1 |
| Number of Online Controls | 1 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Ratio R | 0.328 |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 17.000 | Cv (Winter) | 0.840 |

| | | | |
|---|---|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 | DVD Status | OFF |
| Analysis Timestep | Fine | Inertia Status | OFF |
| DTS Status | ON | | |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S08-02-1.000 | S08-02-1 | 15 Winter | 100 | +40% | | | |
| S08-02-1.001 | S08-02-2 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-02-1.002 | S08-02-3 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| S08-02-1.003 | S08-02-4 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| S08-02-1.004 | S08-02-5 | 15 Winter | 100 | +40% | 5/15 Summer | | |
| S08-02-2.000 | S08-02-6 | 15 Winter | 100 | +40% | | | |
| S08-02-2.001 | S08-02-7 | 15 Winter | 100 | +40% | | | |
| S08-02-2.002 | S08-02-8 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-02-2.003 | S08-02-9 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-02-2.004 | S08-02-10 | 15 Winter | 100 | +40% | | | |
| S08-02-1.005 | S08-02-11 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-02-1.006 | S08-02-12 | 15 Winter | 100 | +40% | | | |
| S08-02-1.007 | S08-02-13 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-02-1.008 | S08-02-14 | 15 Winter | 100 | +40% | 5/15 Summer | | |
| S08-02-1.009 | S08-02-15 | 15 Winter | 100 | +40% | 5/15 Summer | | |
| S08-02-1.010 | S08-02-16 | 15 Winter | 100 | +40% | 5/15 Summer | | |
| S08-02-1.011 | S08-02-20 | 600 Winter | 100 | +40% | | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-02

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-02-1.000 | S08-02-1 | | 218.284 | -0.001 | 0.000 | 0.76 | | |
| S08-02-1.001 | S08-02-2 | | 217.827 | 0.581 | 0.000 | 0.89 | | |
| S08-02-1.002 | S08-02-3 | | 216.274 | 1.201 | 1.271 | 1.00 | | |
| S08-02-1.003 | S08-02-4 | | 214.081 | 1.205 | 4.521 | 1.13 | | |
| S08-02-1.004 | S08-02-5 | | 211.848 | 1.120 | 0.000 | 1.46 | | |
| S08-02-2.000 | S08-02-6 | | 210.964 | -0.086 | 0.000 | 0.37 | | |
| S08-02-2.001 | S08-02-7 | | 210.589 | -0.023 | 0.000 | 0.64 | | |
| S08-02-2.002 | S08-02-8 | | 210.506 | 0.115 | 0.000 | 1.02 | | |
| S08-02-2.003 | S08-02-9 | | 210.361 | 0.109 | 0.000 | 1.26 | | |
| S08-02-2.004 | S08-02-10 | | 210.008 | -0.056 | 0.000 | 0.71 | | |
| S08-02-1.005 | S08-02-11 | | 209.849 | 0.053 | 0.000 | 1.15 | | |
| S08-02-1.006 | S08-02-12 | | 209.586 | -0.010 | 0.000 | 0.77 | | |
| S08-02-1.007 | S08-02-13 | | 208.647 | 0.730 | 0.000 | 0.90 | | |
| S08-02-1.008 | S08-02-14 | | 207.442 | 1.032 | 0.000 | 2.28 | | |
| S08-02-1.009 | S08-02-15 | | 206.644 | 0.388 | 0.000 | 1.68 | | |
| S08-02-1.010 | S08-02-16 | | 206.446 | 0.260 | 0.000 | 2.02 | | |
| S08-02-1.011 | S08-02-20 | | 206.053 | -0.047 | 0.000 | 0.06 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S08-02-1.000 | S08-02-1 | 18.4 | OK | |
| S08-02-1.001 | S08-02-2 | 34.0 | SURCHARGED | |
| S08-02-1.002 | S08-02-3 | 36.9 | FLOOD | 4 |
| S08-02-1.003 | S08-02-4 | 39.9 | FLOOD | 6 |
| S08-02-1.004 | S08-02-5 | 48.0 | FLOOD RISK | |
| S08-02-2.000 | S08-02-6 | 8.2 | OK | |
| S08-02-2.001 | S08-02-7 | 12.6 | OK | |
| S08-02-2.002 | S08-02-8 | 16.7 | SURCHARGED | |
| S08-02-2.003 | S08-02-9 | 22.0 | SURCHARGED | |
| S08-02-2.004 | S08-02-10 | 22.0 | OK | |
| S08-02-1.005 | S08-02-11 | 70.0 | SURCHARGED | |
| S08-02-1.006 | S08-02-12 | 81.5 | OK | |
| S08-02-1.007 | S08-02-13 | 90.9 | SURCHARGED | |
| S08-02-1.008 | S08-02-14 | 94.3 | FLOOD RISK | |
| S08-02-1.009 | S08-02-15 | 93.9 | SURCHARGED | |
| S08-02-1.010 | S08-02-16 | 93.1 | FLOOD RISK | |
| S08-02-1.011 | S08-02-20 | 4.9 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for S08-01

```
                Pipe Sizes STANDARD Manhole Sizes STANDARD

                  FSR Rainfall Model - England and Wales
             Return Period (years)       5                        PIMP (%)    100
                        M5-60 (mm)  17.000         Add Flow / Climate Change (%)      0
                           Ratio R   0.328          Minimum Backdrop Height (m)  0.000
          Maximum Rainfall (mm/hr)      50          Maximum Backdrop Height (m)  0.000
 Maximum Time of Concentration (mins)     30 Min Design Depth for Optimisation (m)  1.200
               Foul Sewage (l/s/ha)   0.000     Min Vel for Auto Design only (m/s)   0.50
          Volumetric Runoff Coeff.   0.750       Min Slope for Optimisation (1:X)    500

                         Designed with Level Soffits
```

## Simulation Criteria for S08-01

```
          Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 0.000
           Areal Reduction Factor 1.000       MADD Factor * 10m³/ha Storage 2.000
                  Hot Start (mins)     0                  Inlet Coeffiecient 0.800
              Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
      Manhole Headloss Coeff (Global) 0.500                      Run Time (mins)    60
        Foul Sewage per hectare (l/s) 0.000               Output Interval (mins)     1

            Number of Input Hydrographs 0 Number of Storage Structures 1
              Number of Online Controls 0 Number of Time/Area Diagrams 0
             Number of Offline Controls 0 Number of Real Time Controls 0
```

## Synthetic Rainfall Details

```
              Rainfall Model                 FSR          Profile Type  Summer
         Return Period (years)                 5            Cv (Summer)   0.750
                          Region England and Wales           Cv (Winter)   0.840
                     M5-60 (mm)            17.000 Storm Duration (mins)      30
                        Ratio R             0.328
```

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-01

### Simulation Criteria

Areal Reduction Factor 1.000
Hot Start (mins) 0
Hot Start Level (mm) 0
Manhole Headloss Coeff (Global) 0.500
Foul Sewage per hectare (l/s) 0.000
Additional Flow - % of Total Flow 0.000
MADD Factor * 10m³/ha Storage 2.000
Inlet Coeffiecient 0.800
Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0
Number of Online Controls 0
Number of Offline Controls 0
Number of Storage Structures 1
Number of Time/Area Diagrams 0
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
Region England and Wales
M5-60 (mm) 17.000
Ratio R 0.300
Cv (Summer) 0.750
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep Fine
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| C01 2.000 | 1 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | |
| C01 2.001 | 2 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | |
| C01 2.002 | 3 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | |
| C01 2.003 | 4 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Summer | | |
| C01 2.004 | 5 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | |
| C01 2.005 | 6 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | |
| C01 2.006 | 7 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Summer | | |
| C01 2.007 | 8 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | |
| C01 2.008 | 9 | 15 Winter | 5 | +20% | 5/15 Summer | | | |
| C01 2.009 | 10 | 15 Winter | 5 | +20% | 100/15 Summer | | | |
| C01 2.010 | 11 | 15 Winter | 5 | +20% | 100/15 Summer | | | |
| C01 2.011 | 12 | 15 Winter | 5 | +20% | 5/15 Winter | | | |
| C01 2.012 | 13 | 30 Winter | 5 | +20% | 100/15 Summer | | | |
| C01 2.013 | 14 | 30 Winter | 5 | +20% | 100/15 Summer | | | |
| C01 2.014 | 15 | 30 Winter | 5 | +20% | | | | |
| C01 2.015 | 16 | 30 Winter | 5 | +20% | | | | |
| C01 2.016 | 17 | 30 Winter | 5 | +20% | | | | |
| C01 2.017 | 18 | 30 Winter | 5 | +20% | 100/30 Summer | | | |
| C01 2.018 | 19 | 30 Winter | 5 | +20% | 100/15 Summer | | | |
| C01 3.000 | 20 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Summer | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-01

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| C01 2.000 | 1 | 229.321 | -0.089 | 0.000 | 0.65 | | | 58.8 | OK |
| C01 2.001 | 2 | 226.446 | 0.181 | 0.000 | 1.02 | | | 98.0 | SURCHARGED |
| C01 2.002 | 3 | 222.636 | -0.092 | 0.000 | 0.81 | | | 144.5 | OK |
| C01 2.003 | 4 | 220.096 | 0.108 | 0.000 | 1.02 | | | 183.2 | SURCHARGED |
| C01 2.004 | 5 | 216.789 | -0.129 | 0.000 | 0.75 | | | 226.9 | OK |
| C01 2.005 | 6 | 215.936 | -0.103 | 0.000 | 0.86 | | | 273.5 | OK |
| C01 2.006 | 7 | 213.860 | 0.060 | 0.000 | 0.96 | | | 303.8 | SURCHARGED |
| C01 2.007 | 8 | 211.842 | 0.385 | 0.000 | 1.02 | | | 324.5 | SURCHARGED |
| C01 2.008 | 9 | 209.040 | 0.267 | 0.000 | 1.05 | | | 335.3 | SURCHARGED |
| C01 2.009 | 10 | 205.889 | -0.162 | 0.000 | 0.73 | | | 347.4 | OK |
| C01 2.010 | 11 | 203.634 | -0.056 | 0.000 | 0.97 | | | 356.6 | OK |
| C01 2.011 | 12 | 202.303 | 0.022 | 0.000 | 1.03 | | | 363.9 | SURCHARGED |
| C01 2.012 | 13 | 201.547 | -0.141 | 0.000 | 0.88 | | | 371.8 | OK |
| C01 2.013 | 14 | 200.737 | -0.096 | 0.000 | 1.00 | | | 375.5 | OK |
| C01 2.014 | 15 | 200.050 | -0.187 | 0.000 | 0.74 | | | 375.4 | OK |
| C01 2.015 | 16 | 199.576 | -0.227 | 0.000 | 0.61 | | | 386.7 | OK |
| C01 2.016 | 17 | 197.659 | -0.244 | 0.000 | 0.56 | | | 395.5 | OK |
| C01 2.017 | 18 | 195.278 | -0.232 | 0.000 | 0.60 | | | 400.0 | OK |
| C01 2.018 | 19 | 194.395 | -0.141 | 0.000 | 0.69 | | | 400.3 | OK |
| C01 3.000 | 20 | 230.524 | 0.024 | 0.000 | 1.00 | | | 36.7 | SURCHARGED |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| C01 2.000 | 1 | 3 |
| C01 2.001 | 2 | 7 |
| C01 2.002 | 3 | 4 |
| C01 2.003 | 4 | 7 |
| C01 2.004 | 5 | 3 |
| C01 2.005 | 6 | 6 |
| C01 2.006 | 7 | 7 |
| C01 2.007 | 8 | 8 |
| C01 2.008 | 9 | |
| C01 2.009 | 10 | |
| C01 2.010 | 11 | |
| C01 2.011 | 12 | |
| C01 2.012 | 13 | |
| C01 2.013 | 14 | |
| C01 2.014 | 15 | |
| C01 2.015 | 16 | |
| C01 2.016 | 17 | |
| C01 2.017 | 18 | |
| C01 2.018 | 19 | |
| C01 3.000 | 20 | 5 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-01

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| C01 3.001 | 21 | 15 Winter | 5 | +20% | 100/15 Summer | | | |
| C01 3.002 | 22 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | |
| C01 3.003 | 23 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | |
| C01 3.004 | 24 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | | |
| C01 3.005 | 25 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | | |
| C01 3.006 | 26 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | | |
| C01 3.007 | 27 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Summer | | |
| C01 3.008 | 28 | 15 Winter | 5 | +20% | 100/15 Summer | | | |
| C01 3.009 | 29 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Winter | | |
| C01 3.010 | 30 | 15 Winter | 5 | +20% | 100/15 Summer | | | |
| C01 3.011 | 31 | 30 Winter | 5 | +20% | 5/15 Summer | | | |
| C01 3.012 | 32 | 30 Winter | 5 | +20% | 100/15 Winter | | | |
| C01 3.013 | 33 | 30 Winter | 5 | +20% | | | | |
| C01 3.014 | 34 | 30 Winter | 5 | +20% | | | | |
| C01 3.015 | 35 | 30 Winter | 5 | +20% | | | | |
| C01 3.016 | 36 | 30 Winter | 5 | +20% | 100/30 Winter | | | |
| C01 2.019 | 37 | 30 Winter | 5 | +20% | 5/15 Summer | | | |
| C01 2.020 | 38 | 120 Winter | 5 | +20% | 100/60 Summer | | | |
| C01 2.021 | 39 | 120 Winter | 5 | +20% | 100/60 Summer | | | |

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| C01 3.001 | 21 | 226.125 | -0.094 | 0.000 | 0.62 | | | 59.5 | OK |
| C01 3.002 | 22 | 222.658 | -0.054 | 0.000 | 0.91 | | | 76.9 | OK |
| C01 3.003 | 23 | 220.472 | 0.514 | 0.000 | 1.04 | | | 88.8 | SURCHARGED |
| C01 3.004 | 24 | 216.590 | 0.204 | 0.000 | 1.09 | | | 94.3 | SURCHARGED |
| C01 3.005 | 25 | 215.192 | -0.106 | 0.000 | 0.74 | | | 127.6 | OK |
| C01 3.006 | 26 | 213.243 | -0.087 | 0.000 | 0.84 | | | 148.3 | OK |
| C01 3.007 | 27 | 211.242 | 0.078 | 0.000 | 1.04 | | | 173.5 | SURCHARGED |
| C01 3.008 | 28 | 209.944 | -0.066 | 0.000 | 0.96 | | | 172.8 | OK |
| C01 3.009 | 29 | 207.419 | 0.160 | 0.000 | 1.03 | | | 181.6 | SURCHARGED |
| C01 3.010 | 30 | 204.463 | -0.134 | 0.000 | 0.74 | | | 192.8 | OK |
| C01 3.011 | 31 | 202.948 | 0.203 | 0.000 | 1.11 | | | 201.7 | SURCHARGED |
| C01 3.012 | 32 | 201.702 | -0.147 | 0.000 | 0.78 | | | 210.7 | OK |
| C01 3.013 | 33 | 200.900 | -0.184 | 0.000 | 0.65 | | | 219.5 | OK |
| C01 3.014 | 34 | 199.675 | -0.210 | 0.000 | 0.55 | | | 227.9 | OK |
| C01 3.015 | 35 | 197.877 | -0.223 | 0.000 | 0.51 | | | 236.3 | OK |
| C01 3.016 | 36 | 195.571 | -0.226 | 0.000 | 0.50 | | | 244.5 | OK |
| C01 2.019 | 37 | 194.123 | 0.161 | 0.000 | 1.37 | | | 640.7 | SURCHARGED |
| C01 2.020 | 38 | 193.496 | -0.247 | 0.000 | 0.65 | | | 180.3 | OK |
| C01 2.021 | 39 | 193.265 | -0.186 | 0.000 | 0.65 | | | 186.4 | OK |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-01

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| C01 3.001 | 21 | |
| C01 3.002 | 22 | 7 |
| C01 3.003 | 23 | 7 |
| C01 3.004 | 24 | 5 |
| C01 3.005 | 25 | 1 |
| C01 3.006 | 26 | 6 |
| C01 3.007 | 27 | 7 |
| C01 3.008 | 28 | |
| C01 3.009 | 29 | 4 |
| C01 3.010 | 30 | |
| C01 3.011 | 31 | |
| C01 3.012 | 32 | |
| C01 3.013 | 33 | |
| C01 3.014 | 34 | |
| C01 3.015 | 35 | |
| C01 3.016 | 36 | |
| C01 2.019 | 37 | |
| C01 2.020 | 38 | |
| C01 2.021 | 39 | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-01

### Simulation Criteria

```
           Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 0.000
                 Hot Start (mins)     0       MADD Factor * 10m³/ha Storage 2.000
               Hot Start Level (mm)     0             Inlet Coeffiecient 0.800
   Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
     Foul Sewage per hectare (l/s) 0.000

            Number of Input Hydrographs 0 Number of Storage Structures 1
              Number of Online Controls 0 Number of Time/Area Diagrams 0
             Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
                 Rainfall Model              FSR     Ratio R 0.300
                         Region England and Wales Cv (Summer) 0.750
                     M5-60 (mm)            17.000 Cv (Winter) 0.840

            Margin for Flood Risk Warning (mm)  300.0     DVD Status OFF
                             Analysis Timestep  Fine Inertia Status OFF
                                    DTS Status    ON


                    Profile(s)                         Summer and Winter
               Duration(s) (mins)   15, 30, 60, 120, 180, 240, 360, 480, 600,
                                                           720, 960, 1440
          Return Period(s) (years)                                  5, 100
               Climate Change (%)                                   20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| C01 2.000 | 1 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | |
| C01 2.001 | 2 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | |
| C01 2.002 | 3 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | |
| C01 2.003 | 4 | 30 Winter | 100 | +40% | 5/15 Winter | 100/15 Summer | | |
| C01 2.004 | 5 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | |
| C01 2.005 | 6 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | |
| C01 2.006 | 7 | 30 Winter | 100 | +40% | 5/15 Winter | 100/15 Summer | | |
| C01 2.007 | 8 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | |
| C01 2.008 | 9 | 15 Winter | 100 | +40% | 5/15 Summer | | | |
| C01 2.009 | 10 | 30 Winter | 100 | +40% | 100/15 Summer | | | |
| C01 2.010 | 11 | 30 Winter | 100 | +40% | 100/15 Summer | | | |
| C01 2.011 | 12 | 30 Winter | 100 | +40% | 5/15 Winter | | | |
| C01 2.012 | 13 | 30 Winter | 100 | +40% | 100/15 Summer | | | |
| C01 2.013 | 14 | 30 Winter | 100 | +40% | 100/15 Summer | | | |
| C01 2.014 | 15 | 30 Winter | 100 | +40% | | | | |
| C01 2.015 | 16 | 60 Winter | 100 | +40% | | | | |
| C01 2.016 | 17 | 30 Winter | 100 | +40% | | | | |
| C01 2.017 | 18 | 30 Winter | 100 | +40% | 100/30 Summer | | | |
| C01 2.018 | 19 | 30 Winter | 100 | +40% | 100/15 Summer | | | |
| C01 3.000 | 20 | 15 Winter | 100 | +40% | 5/15 Winter | 100/15 Summer | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-01

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| C01 2.000 | 1 | 230.612 | 1.202 | 2.328 | 1.00 | | | 90.1 | FLOOD |
| C01 2.001 | 2 | 227.501 | 1.235 | 35.503 | 1.16 | | | 111.1 | FLOOD |
| C01 2.002 | 3 | 223.934 | 1.206 | 5.564 | 1.00 | | | 178.4 | FLOOD |
| C01 2.003 | 4 | 221.223 | 1.235 | 34.807 | 1.18 | | | 213.2 | FLOOD |
| C01 2.004 | 5 | 218.118 | 1.201 | 0.950 | 0.99 | | | 299.1 | FLOOD |
| C01 2.005 | 6 | 217.257 | 1.217 | 17.084 | 1.00 | | | 317.6 | FLOOD |
| C01 2.006 | 7 | 215.040 | 1.240 | 39.655 | 1.00 | | | 316.4 | FLOOD |
| C01 2.007 | 8 | 212.691 | 1.234 | 34.014 | 1.11 | | | 352.8 | FLOOD |
| C01 2.008 | 9 | 209.895 | 1.122 | 0.000 | 1.16 | | | 370.8 | FLOOD RISK |
| C01 2.009 | 10 | 206.374 | 0.323 | 0.000 | 0.84 | | | 399.6 | SURCHARGED |
| C01 2.010 | 11 | 204.754 | 1.064 | 0.000 | 1.15 | | | 423.4 | FLOOD RISK |
| C01 2.011 | 12 | 202.948 | 0.667 | 0.000 | 1.25 | | | 438.9 | SURCHARGED |
| C01 2.012 | 13 | 202.055 | 0.366 | 0.000 | 1.06 | | | 448.0 | SURCHARGED |
| C01 2.013 | 14 | 201.094 | 0.260 | 0.000 | 1.21 | | | 456.4 | SURCHARGED |
| C01 2.014 | 15 | 200.101 | -0.135 | 0.000 | 0.90 | | | 456.4 | OK |
| C01 2.015 | 16 | 199.628 | -0.175 | 0.000 | 0.77 | | | 488.3 | OK |
| C01 2.016 | 17 | 197.722 | -0.181 | 0.000 | 0.75 | | | 534.0 | OK |
| C01 2.017 | 18 | 195.780 | 0.270 | 0.000 | 0.82 | | | 546.6 | SURCHARGED |
| C01 2.018 | 19 | 195.128 | 0.592 | 0.000 | 0.94 | | | 545.6 | SURCHARGED |
| C01 3.000 | 20 | 231.707 | 1.207 | 7.224 | 1.13 | | | 41.6 | FLOOD |

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| C01 2.000 | 1 | 3 |
| C01 2.001 | 2 | 7 |
| C01 2.002 | 3 | 4 |
| C01 2.003 | 4 | 7 |
| C01 2.004 | 5 | 3 |
| C01 2.005 | 6 | 6 |
| C01 2.006 | 7 | 7 |
| C01 2.007 | 8 | 8 |
| C01 2.008 | 9 | |
| C01 2.009 | 10 | |
| C01 2.010 | 11 | |
| C01 2.011 | 12 | |
| C01 2.012 | 13 | |
| C01 2.013 | 14 | |
| C01 2.014 | 15 | |
| C01 2.015 | 16 | |
| C01 2.016 | 17 | |
| C01 2.017 | 18 | |
| C01 2.018 | 19 | |
| C01 3.000 | 20 | 5 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-01

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| C01 3.001 | 21 | 15 Winter | 100 | +40% | 100/15 Summer | | | |
| C01 3.002 | 22 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | |
| C01 3.003 | 23 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | |
| C01 3.004 | 24 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | | |
| C01 3.005 | 25 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | | |
| C01 3.006 | 26 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | | |
| C01 3.007 | 27 | 30 Winter | 100 | +40% | 5/15 Winter | 100/15 Summer | | |
| C01 3.008 | 28 | 15 Winter | 100 | +40% | 100/15 Summer | | | |
| C01 3.009 | 29 | 30 Winter | 100 | +40% | 5/15 Winter | 100/15 Winter | | |
| C01 3.010 | 30 | 30 Winter | 100 | +40% | 100/15 Summer | | | |
| C01 3.011 | 31 | 30 Winter | 100 | +40% | 5/15 Summer | | | |
| C01 3.012 | 32 | 30 Winter | 100 | +40% | 100/15 Winter | | | |
| C01 3.013 | 33 | 30 Winter | 100 | +40% | | | | |
| C01 3.014 | 34 | 30 Winter | 100 | +40% | | | | |
| C01 3.015 | 35 | 30 Winter | 100 | +40% | | | | |
| C01 3.016 | 36 | 30 Winter | 100 | +40% | 100/30 Winter | | | |
| C01 2.019 | 37 | 30 Winter | 100 | +40% | 5/15 Summer | | | |
| C01 2.020 | 38 | 120 Winter | 100 | +40% | 100/60 Summer | | | |
| C01 2.021 | 39 | 120 Winter | 100 | +40% | 100/60 Summer | | | |

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status |
|---|---|---|---|---|---|---|---|---|---|
| C01 3.001 | 21 | 227.023 | 0.804 | 0.000 | 0.93 | | | 89.0 | SURCHARGED |
| C01 3.002 | 22 | 223.925 | 1.213 | 13.497 | 1.00 | | | 84.3 | FLOOD |
| C01 3.003 | 23 | 221.183 | 1.226 | 25.751 | 1.13 | | | 96.2 | FLOOD |
| C01 3.004 | 24 | 217.589 | 1.203 | 2.564 | 1.28 | | | 110.1 | FLOOD |
| C01 3.005 | 25 | 216.499 | 1.200 | 0.460 | 0.99 | | | 172.4 | FLOOD |
| C01 3.006 | 26 | 214.537 | 1.208 | 8.120 | 1.00 | | | 176.4 | FLOOD |
| C01 3.007 | 27 | 212.390 | 1.227 | 26.728 | 1.17 | | | 196.3 | FLOOD |
| C01 3.008 | 28 | 211.111 | 1.102 | 0.000 | 1.07 | | | 191.3 | FLOOD RISK |
| C01 3.009 | 29 | 208.462 | 1.203 | 2.896 | 1.17 | | | 205.6 | FLOOD |
| C01 3.010 | 30 | 205.202 | 0.605 | 0.000 | 0.87 | | | 228.8 | SURCHARGED |
| C01 3.011 | 31 | 203.800 | 1.055 | 0.000 | 1.43 | | | 260.0 | FLOOD RISK |
| C01 3.012 | 32 | 201.951 | 0.103 | 0.000 | 1.07 | | | 288.4 | SURCHARGED |
| C01 3.013 | 33 | 200.981 | -0.103 | 0.000 | 0.94 | | | 317.8 | OK |
| C01 3.014 | 34 | 199.757 | -0.128 | 0.000 | 0.85 | | | 350.4 | OK |
| C01 3.015 | 35 | 197.965 | -0.135 | 0.000 | 0.83 | | | 386.0 | OK |
| C01 3.016 | 36 | 195.840 | 0.043 | 0.000 | 0.83 | | | 411.5 | SURCHARGED |
| C01 2.019 | 37 | 194.622 | 0.660 | 0.000 | 2.04 | | | 955.2 | SURCHARGED |
| C01 2.020 | 38 | 193.852 | 0.109 | 0.000 | 1.31 | | | 363.5 | FLOOD RISK |
| C01 2.021 | 39 | 193.612 | 0.161 | 0.000 | 1.30 | | | 374.9 | SURCHARGED |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-01

| PN | US/MH Name | Level Exceeded |
|---|---|---|
| C01 3.001 | 21 | |
| C01 3.002 | 22 | 7 |
| C01 3.003 | 23 | 7 |
| C01 3.004 | 24 | 5 |
| C01 3.005 | 25 | 1 |
| C01 3.006 | 26 | 6 |
| C01 3.007 | 27 | 7 |
| C01 3.008 | 28 | |
| C01 3.009 | 29 | 4 |
| C01 3.010 | 30 | |
| C01 3.011 | 31 | |
| C01 3.012 | 32 | |
| C01 3.013 | 33 | |
| C01 3.014 | 34 | |
| C01 3.015 | 35 | |
| C01 3.016 | 36 | |
| C01 2.019 | 37 | |
| C01 2.020 | 38 | |
| C01 2.021 | 39 | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for S08-03

```
                        Pipe Sizes STANDARD Manhole Sizes STANDARD

                          FSR Rainfall Model - England and Wales
              Return Period (years)       5                    PIMP (%)    100
                         M5-60 (mm)  17.000       Add Flow / Climate Change (%)      0
                            Ratio R   0.328         Minimum Backdrop Height (m)  0.000
            Maximum Rainfall (mm/hr)      50         Maximum Backdrop Height (m)  0.000
 Maximum Time of Concentration (mins)      30 Min Design Depth for Optimisation (m)  1.200
               Foul Sewage (l/s/ha)   0.000     Min Vel for Auto Design only (m/s)   0.55
            Volumetric Runoff Coeff.   0.750       Min Slope for Optimisation (1:X)    500

                               Designed with Level Soffits
```

### Simulation Criteria for S08-03

```
            Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 0.000
             Areal Reduction Factor 1.000        MADD Factor * 10m³/ha Storage 2.000
                   Hot Start (mins)     0                    Inlet Coeffiecient 0.800
                 Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
       Manhole Headloss Coeff (Global) 0.500                      Run Time (mins)    60
         Foul Sewage per hectare (l/s) 0.000               Output Interval (mins)     1

               Number of Input Hydrographs 0 Number of Storage Structures 1
                 Number of Online Controls 1 Number of Time/Area Diagrams 0
                Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
                Rainfall Model                   FSR          Profile Type  Summer
           Return Period (years)                   5            Cv (Summer)   0.750
                                Region England and Wales        Cv (Winter)   0.840
                    M5-60 (mm)                17.000 Storm Duration (mins)      30
                       Ratio R                 0.328
```

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-03

### Simulation Criteria

```
         Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 0.000
               Hot Start (mins)     0        MADD Factor * 10m³/ha Storage 2.000
             Hot Start Level (mm)     0                  Inlet Coeffiecient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
   Foul Sewage per hectare (l/s) 0.000

          Number of Input Hydrographs 0 Number of Storage Structures 1
            Number of Online Controls 1 Number of Time/Area Diagrams 0
           Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
               Rainfall Model             FSR      Ratio R 0.328
                       Region England and Wales Cv (Summer) 0.750
                  M5-60 (mm)            17.000 Cv (Winter) 0.840

          Margin for Flood Risk Warning (mm)  300.0      DVD Status OFF
                          Analysis Timestep  Fine Inertia Status OFF
                                 DTS Status    ON


                  Profile(s)                          Summer and Winter
             Duration(s) (mins)    15, 30, 60, 120, 180, 240, 360, 480, 600,
                                     720, 960, 1440, 2160, 2880, 4320, 5760,
                                                          7200, 8640, 10080
        Return Period(s) (years)                                     5, 100
             Climate Change (%)                                      20, 40
```

```
                 US/MH                Return Climate   First (X)      First (Y)    First (Z)
       PN         Name      Storm     Period  Change   Surcharge        Flood      Overflow

  S08-04-1.000  S08-04-1  15 Winter      5     +20%  100/15 Winter
  S08-04-1.001  S08-04-2  15 Winter      5     +20%  100/15 Summer
  S08-04-1.002  S08-04-3  15 Winter      5     +20%  100/15 Summer
  S08-04-2.000  S08-04-4  15 Winter      5     +20%  100/15 Summer
  S08-04-2.001  S08-04-5  15 Winter      5     +20%  100/15 Summer 100/15 Summer
  S08-04-2.002  S08-04-6  15 Winter      5     +20%  100/15 Summer 100/15 Summer
  S08-04-2.003  S08-04-7  15 Winter      5     +20%    5/15 Summer 100/15 Summer
  S08-04-2.004  S08-04-8  15 Winter      5     +20%    5/15 Summer 100/15 Winter
  S08-04-2.005  S08-04-9  15 Winter      5     +20%  100/15 Summer
  S08-04-3.000 S08-04-10  15 Winter      5     +20%  100/15 Summer 100/15 Summer
  S08-04-3.001 S08-04-11  15 Winter      5     +20%  100/15 Summer 100/15 Winter
  S08-04-3.002 S08-04-12  15 Winter      5     +20%  100/15 Summer
  S08-04-3.003 S08-04-13  15 Winter      5     +20%  100/15 Summer 100/15 Winter
  S08-04-2.006 S08-04-14  15 Winter      5     +20%    5/15 Winter
  S08-04-4.000 S08-04-15  15 Winter      5     +20%    5/15 Summer 100/15 Summer
  S08-04-4.001 S08-04-16  15 Winter      5     +20%  100/15 Summer 100/15 Summer
  S08-04-4.002 S08-04-17  15 Winter      5     +20%    5/15 Winter 100/15 Summer
  S08-04-4.003 S08-04-18  15 Winter      5     +20%  100/15 Summer
  S08-04-4.004 S08-04-19  15 Winter      5     +20%  100/15 Summer
```

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-03

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-04-1.000 | S08-04-1 | | 193.442 | -0.084 | 0.000 | 0.38 | | |
| S08-04-1.001 | S08-04-2 | | 191.484 | -0.100 | 0.000 | 0.56 | | |
| S08-04-1.002 | S08-04-3 | | 190.447 | -0.113 | 0.000 | 0.65 | | |
| S08-04-2.000 | S08-04-4 | | 193.210 | -0.083 | 0.000 | 0.39 | | |
| S08-04-2.001 | S08-04-5 | | 191.197 | -0.047 | 0.000 | 0.68 | | |
| S08-04-2.002 | S08-04-6 | | 191.165 | -0.011 | 0.000 | 0.88 | | |
| S08-04-2.003 | S08-04-7 | | 190.923 | 0.078 | 0.000 | 1.39 | | |
| S08-04-2.004 | S08-04-8 | | 190.858 | 0.028 | 0.000 | 1.10 | | |
| S08-04-2.005 | S08-04-9 | | 190.609 | -0.052 | 0.000 | 0.92 | | |
| S08-04-3.000 | S08-04-10 | | 191.871 | -0.016 | 0.000 | 0.93 | | |
| S08-04-3.001 | S08-04-11 | | 191.353 | -0.025 | 0.000 | 0.96 | | |
| S08-04-3.002 | S08-04-12 | | 190.921 | -0.076 | 0.000 | 0.86 | | |
| S08-04-3.003 | S08-04-13 | | 190.640 | -0.097 | 0.000 | 0.77 | | |
| S08-04-2.006 | S08-04-14 | | 190.337 | 0.001 | 0.000 | 1.08 | | |
| S08-04-4.000 | S08-04-15 | | 192.424 | 0.073 | 0.000 | 1.07 | | |
| S08-04-4.001 | S08-04-16 | | 192.044 | -0.074 | 0.000 | 0.75 | | |
| S08-04-4.002 | S08-04-17 | | 191.704 | 0.020 | 0.000 | 1.02 | | |
| S08-04-4.003 | S08-04-18 | | 191.047 | -0.120 | 0.000 | 0.66 | | |
| S08-04-4.004 | S08-04-19 | | 190.564 | -0.092 | 0.000 | 0.81 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S08-04-1.000 | S08-04-1 | 9.5 | OK | |
| S08-04-1.001 | S08-04-2 | 29.7 | OK | |
| S08-04-1.002 | S08-04-3 | 38.0 | OK | |
| S08-04-2.000 | S08-04-4 | 10.5 | OK | |
| S08-04-2.001 | S08-04-5 | 24.1 | OK | 4 |
| S08-04-2.002 | S08-04-6 | 37.4 | OK | 4 |
| S08-04-2.003 | S08-04-7 | 36.2 | SURCHARGED | 6 |
| S08-04-2.004 | S08-04-8 | 36.0 | SURCHARGED | 1 |
| S08-04-2.005 | S08-04-9 | 57.1 | OK | |
| S08-04-3.000 | S08-04-10 | 13.2 | OK | 4 |
| S08-04-3.001 | S08-04-11 | 34.3 | OK | 1 |
| S08-04-3.002 | S08-04-12 | 53.6 | OK | |
| S08-04-3.003 | S08-04-13 | 59.3 | OK | 2 |
| S08-04-2.006 | S08-04-14 | 151.4 | SURCHARGED | |
| S08-04-4.000 | S08-04-15 | 10.3 | SURCHARGED | 4 |
| S08-04-4.001 | S08-04-16 | 30.7 | OK | 4 |
| S08-04-4.002 | S08-04-17 | 48.3 | SURCHARGED | 4 |
| S08-04-4.003 | S08-04-18 | 65.0 | OK | |
| S08-04-4.004 | S08-04-19 | 74.1 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-03

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S08-04-1.003 | S08-04-20 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-04-1.004 | S08-04-21 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-04-1.005 | S08-04-22 | 240 Winter | 5 | +20% | 100/30 Winter | | |
| S08-04-1.006 | S08-04-23 | 240 Winter | 5 | +20% | | | |

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume ($m^3$) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-04-1.003 | S08-04-20 | | 190.281 | -0.006 | 0.000 | 1.00 | | |
| S08-04-1.004 | S08-04-21 | | 190.158 | -0.060 | 0.000 | 1.00 | | |
| S08-04-1.005 | S08-04-22 | | 189.841 | -0.130 | 0.000 | 0.38 | | |
| S08-04-1.006 | S08-04-23 | | 189.642 | -0.293 | 0.000 | 0.27 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S08-04-1.003 | S08-04-20 | 255.0 | OK | |
| S08-04-1.004 | S08-04-21 | 267.3 | OK | |
| S08-04-1.005 | S08-04-22 | 36.4 | OK | |
| S08-04-1.006 | S08-04-23 | 36.3 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-03

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 1 |
| Number of Online Controls | 1 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Ratio R | 0.328 |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 17.000 | Cv (Winter) | 0.840 |

| | | | |
|---|---|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 | DVD Status | OFF |
| Analysis Timestep | Fine | Inertia Status | OFF |
| DTS Status | ON | | |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S08-04-1.000 | S08-04-1 | 15 Winter | 100 | +40% | 100/15 Winter | | |
| S08-04-1.001 | S08-04-2 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-04-1.002 | S08-04-3 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-04-2.000 | S08-04-4 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-04-2.001 | S08-04-5 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| S08-04-2.002 | S08-04-6 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| S08-04-2.003 | S08-04-7 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S08-04-2.004 | S08-04-8 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Winter | |
| S08-04-2.005 | S08-04-9 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-04-3.000 | S08-04-10 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| S08-04-3.001 | S08-04-11 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | |
| S08-04-3.002 | S08-04-12 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-04-3.003 | S08-04-13 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | |
| S08-04-2.006 | S08-04-14 | 15 Winter | 100 | +40% | 5/15 Winter | | |
| S08-04-4.000 | S08-04-15 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S08-04-4.001 | S08-04-16 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| S08-04-4.002 | S08-04-17 | 15 Winter | 100 | +40% | 5/15 Winter | 100/15 Summer | |
| S08-04-4.003 | S08-04-18 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-04-4.004 | S08-04-19 | 15 Winter | 100 | +40% | 100/15 Summer | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-03

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-04-1.000 | S08-04-1 | | 193.558 | 0.032 | 0.000 | 0.78 | | |
| S08-04-1.001 | S08-04-2 | | 192.478 | 0.894 | 0.000 | 1.10 | | |
| S08-04-1.002 | S08-04-3 | | 191.229 | 0.669 | 0.000 | 1.26 | | |
| S08-04-2.000 | S08-04-4 | | 193.570 | 0.277 | 0.000 | 0.71 | | |
| S08-04-2.001 | S08-04-5 | | 192.504 | 1.260 | 0.646 | 1.36 | | |
| S08-04-2.002 | S08-04-6 | | 192.379 | 1.203 | 2.728 | 1.48 | | |
| S08-04-2.003 | S08-04-7 | | 191.659 | 0.814 | 12.636 | 2.34 | | |
| S08-04-2.004 | S08-04-8 | | 191.665 | 0.835 | 0.047 | 1.97 | | |
| S08-04-2.005 | S08-04-9 | | 191.692 | 1.031 | 0.000 | 1.37 | | |
| S08-04-3.000 | S08-04-10 | | 193.090 | 1.203 | 3.191 | 1.53 | | |
| S08-04-3.001 | S08-04-11 | | 192.912 | 1.534 | 0.841 | 1.46 | | |
| S08-04-3.002 | S08-04-12 | | 192.263 | 1.267 | 0.000 | 1.43 | | |
| S08-04-3.003 | S08-04-13 | | 191.647 | 0.910 | 0.590 | 1.31 | | |
| S08-04-2.006 | S08-04-14 | | 191.042 | 0.705 | 0.000 | 2.02 | | |
| S08-04-4.000 | S08-04-15 | | 193.553 | 1.202 | 2.293 | 1.86 | | |
| S08-04-4.001 | S08-04-16 | | 193.340 | 1.222 | 2.228 | 1.02 | | |
| S08-04-4.002 | S08-04-17 | | 192.888 | 1.203 | 3.068 | 1.61 | | |
| S08-04-4.003 | S08-04-18 | | 191.957 | 0.790 | 0.000 | 1.03 | | |
| S08-04-4.004 | S08-04-19 | | 191.413 | 0.756 | 0.000 | 1.30 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S08-04-1.000 | S08-04-1 | 19.7 | SURCHARGED | |
| S08-04-1.001 | S08-04-2 | 58.6 | SURCHARGED | |
| S08-04-1.002 | S08-04-3 | 74.0 | SURCHARGED | |
| S08-04-2.000 | S08-04-4 | 19.1 | SURCHARGED | |
| S08-04-2.001 | S08-04-5 | 48.1 | FLOOD | 4 |
| S08-04-2.002 | S08-04-6 | 63.0 | FLOOD | 4 |
| S08-04-2.003 | S08-04-7 | 61.3 | FLOOD | 6 |
| S08-04-2.004 | S08-04-8 | 64.3 | FLOOD | 1 |
| S08-04-2.005 | S08-04-9 | 84.7 | FLOOD RISK | |
| S08-04-3.000 | S08-04-10 | 21.8 | FLOOD | 4 |
| S08-04-3.001 | S08-04-11 | 51.9 | FLOOD | 1 |
| S08-04-3.002 | S08-04-12 | 88.8 | FLOOD RISK | |
| S08-04-3.003 | S08-04-13 | 100.8 | FLOOD | 2 |
| S08-04-2.006 | S08-04-14 | 283.6 | FLOOD RISK | |
| S08-04-4.000 | S08-04-15 | 17.8 | FLOOD | 4 |
| S08-04-4.001 | S08-04-16 | 41.6 | FLOOD | 4 |
| S08-04-4.002 | S08-04-17 | 76.1 | FLOOD | 4 |
| S08-04-4.003 | S08-04-18 | 101.6 | SURCHARGED | |
| S08-04-4.004 | S08-04-19 | 118.6 | SURCHARGED | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-03

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S08-04-1.003 | S08-04-20 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-04-1.004 | S08-04-21 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-04-1.005 | S08-04-22 | 180 Winter | 100 | +40% | 100/30 Winter | | |
| S08-04-1.006 | S08-04-23 | 180 Winter | 100 | +40% | | | |

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m$^3$) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-04-1.003 | S08-04-20 | | 190.771 | 0.484 | 0.000 | 1.93 | | |
| S08-04-1.004 | S08-04-21 | | 190.503 | 0.286 | 0.000 | 2.00 | | |
| S08-04-1.005 | S08-04-22 | | 190.163 | 0.193 | 0.000 | 0.85 | | |
| S08-04-1.006 | S08-04-23 | | 189.737 | -0.198 | 0.000 | 0.60 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S08-04-1.003 | S08-04-20 | 491.6 | SURCHARGED | |
| S08-04-1.004 | S08-04-21 | 534.4 | SURCHARGED | |
| S08-04-1.005 | S08-04-22 | 82.0 | SURCHARGED | |
| S08-04-1.006 | S08-04-23 | 82.0 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for S08-05

```
                 Pipe Sizes STANDARD Manhole Sizes STANDARD

                   FSR Rainfall Model - England and Wales
              Return Period (years)       1                   PIMP (%)    100
                     M5-60 (mm)  17.000         Add Flow / Climate Change (%)      0
                        Ratio R   0.328          Minimum Backdrop Height (m)  0.000
           Maximum Rainfall (mm/hr)      50          Maximum Backdrop Height (m)  0.000
 Maximum Time of Concentration (mins)      30 Min Design Depth for Optimisation (m)  1.200
              Foul Sewage (l/s/ha)   0.000     Min Vel for Auto Design only (m/s)   0.58
           Volumetric Runoff Coeff.   0.750       Min Slope for Optimisation (1:X)    500

                        Designed with Level Soffits
```

### Simulation Criteria for S08-05

```
         Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 0.000
          Areal Reduction Factor 1.000       MADD Factor * 10m³/ha Storage 2.000
                Hot Start (mins)     0                   Inlet Coeffiecient 0.800
             Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
    Manhole Headloss Coeff (Global) 0.500                      Run Time (mins)    60
     Foul Sewage per hectare (l/s) 0.000                Output Interval (mins)     1

            Number of Input Hydrographs 0 Number of Storage Structures 1
             Number of Online Controls 1 Number of Time/Area Diagrams 0
            Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
               Rainfall Model                FSR          Profile Type  Summer
         Return Period (years)                 1           Cv (Summer)   0.750
                      Region England and Wales           Cv (Winter)   0.840
                   M5-60 (mm)             17.000 Storm Duration (mins)      30
                      Ratio R              0.328
```

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-05

### Simulation Criteria

```
           Areal Reduction Factor 1.000    Additional Flow - % of Total Flow 0.000
                  Hot Start (mins)     0       MADD Factor * 10m³/ha Storage 2.000
                Hot Start Level (mm)     0                   Inlet Coeffiecient 0.800
  Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
     Foul Sewage per hectare (l/s) 0.000

           Number of Input Hydrographs 0 Number of Storage Structures 1
             Number of Online Controls 1 Number of Time/Area Diagrams 0
            Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
          Rainfall Model                 FSR      Ratio R 0.328
                  Region England and Wales Cv (Summer) 0.750
               M5-60 (mm)             17.000 Cv (Winter) 0.840

         Margin for Flood Risk Warning (mm)  300.0     DVD Status OFF
                          Analysis Timestep  Fine Inertia Status OFF
                                 DTS Status    ON


                Profile(s)                              Summer and Winter
            Duration(s) (mins)     15, 30, 60, 120, 180, 240, 360, 480, 600,
                                     720, 960, 1440, 2160, 2880, 4320, 5760,
                                                          7200, 8640, 10080
         Return Period(s) (years)                                     5, 100
            Climate Change (%)                                          0, 0
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S08-05-1.000 | S08-05-1 | 15 Winter | 5 | +0% | | | |
| S08-05-1.001 | S08-05-2 | 15 Winter | 5 | +0% | 100/15 Winter | | |
| S08-05-1.002 | S08-05-3 | 15 Winter | 5 | +0% | 5/15 Winter | 100/15 Summer | |
| S08-05-1.003 | S08-05-4 | 15 Winter | 5 | +0% | 5/15 Summer | 100/15 Summer | |
| S08-05-1.004 | S08-05-5 | 15 Winter | 5 | +0% | 5/15 Summer | | |
| S08-05-2.000 | S08-05-6 | 15 Winter | 5 | +0% | 5/15 Summer | 100/15 Summer | |
| S08-05-2.001 | S08-05-7 | 15 Winter | 5 | +0% | 5/15 Summer | | |
| S08-05-2.002 | S08-05-8 | 15 Winter | 5 | +0% | 5/15 Summer | | |
| S08-05-2.003 | S08-05-9 | 15 Winter | 5 | +0% | 5/15 Summer | | |
| S08-05-2.004 | S08-05-10 | 15 Winter | 5 | +0% | 5/15 Summer | | |
| S08-05-2.005 | S08-05-11 | 15 Winter | 5 | +0% | 5/15 Summer | | |
| S08-05-2.006 | S08-05-12 | 15 Winter | 5 | +0% | 100/15 Summer | | |
| S08-05-2.007 | S08-05-13 | 15 Winter | 5 | +0% | 100/15 Summer | | |
| S08-05-2.008 | S08-05-14 | 15 Winter | 5 | +0% | 5/15 Summer | | |
| S08-05-2.009 | S08-05-15 | 15 Winter | 5 | +0% | 5/15 Summer | | |
| S08-05-2.010 | S08-05-16 | 15 Winter | 5 | +0% | 5/15 Summer | | |
| S08-05-3.000 | S08-05-17 | 15 Winter | 5 | +0% | | | |
| S08-05-3.001 | S08-05-18 | 15 Winter | 5 | +0% | | | |
| S08-05-3.002 | S08-05-19 | 15 Winter | 5 | +0% | | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-05

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-05-1.000 | S08-05-1 | | 178.855 | -0.090 | 0.000 | 0.31 | | |
| S08-05-1.001 | S08-05-2 | | 177.758 | -0.078 | 0.000 | 0.45 | | |
| S08-05-1.002 | S08-05-3 | | 173.157 | 0.034 | 0.000 | 0.87 | | |
| S08-05-1.003 | S08-05-4 | | 172.841 | 0.307 | 0.000 | 1.25 | | |
| S08-05-1.004 | S08-05-5 | | 172.575 | 0.238 | 0.000 | 1.28 | | |
| S08-05-2.000 | S08-05-6 | | 176.579 | 0.333 | 0.000 | 0.93 | | |
| S08-05-2.001 | S08-05-7 | | 176.554 | 0.394 | 0.000 | 1.07 | | |
| S08-05-2.002 | S08-05-8 | | 176.532 | 0.430 | 0.000 | 1.64 | | |
| S08-05-2.003 | S08-05-9 | | 176.507 | 0.436 | 0.000 | 1.45 | | |
| S08-05-2.004 | S08-05-10 | | 176.487 | 0.434 | 0.000 | 1.25 | | |
| S08-05-2.005 | S08-05-11 | | 176.449 | 0.453 | 0.000 | 1.13 | | |
| S08-05-2.006 | S08-05-12 | | 174.327 | -0.068 | 0.000 | 0.82 | | |
| S08-05-2.007 | S08-05-13 | | 172.860 | -0.096 | 0.000 | 0.80 | | |
| S08-05-2.008 | S08-05-14 | | 172.458 | 0.095 | 0.000 | 1.09 | | |
| S08-05-2.009 | S08-05-15 | | 172.327 | 0.074 | 0.000 | 1.46 | | |
| S08-05-2.010 | S08-05-16 | | 172.253 | 0.041 | 0.000 | 1.33 | | |
| S08-05-3.000 | S08-05-17 | | 177.611 | -0.075 | 0.000 | 0.48 | | |
| S08-05-3.001 | S08-05-18 | | 177.550 | -0.096 | 0.000 | 0.28 | | |
| S08-05-3.002 | S08-05-19 | | 177.443 | -0.077 | 0.000 | 0.47 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S08-05-1.000 | S08-05-1 | 6.6 | OK | |
| S08-05-1.001 | S08-05-2 | 17.6 | OK | |
| S08-05-1.002 | S08-05-3 | 16.6 | SURCHARGED | 5 |
| S08-05-1.003 | S08-05-4 | 13.7 | SURCHARGED | 6 |
| S08-05-1.004 | S08-05-5 | 14.1 | SURCHARGED | |
| S08-05-2.000 | S08-05-6 | 9.1 | SURCHARGED | 6 |
| S08-05-2.001 | S08-05-7 | 10.2 | SURCHARGED | |
| S08-05-2.002 | S08-05-8 | 14.9 | SURCHARGED | |
| S08-05-2.003 | S08-05-9 | 23.4 | SURCHARGED | |
| S08-05-2.004 | S08-05-10 | 26.9 | SURCHARGED | |
| S08-05-2.005 | S08-05-11 | 85.6 | SURCHARGED | |
| S08-05-2.006 | S08-05-12 | 91.7 | OK | |
| S08-05-2.007 | S08-05-13 | 91.6 | OK | |
| S08-05-2.008 | S08-05-14 | 89.8 | SURCHARGED | |
| S08-05-2.009 | S08-05-15 | 99.0 | SURCHARGED | |
| S08-05-2.010 | S08-05-16 | 102.3 | SURCHARGED | |
| S08-05-3.000 | S08-05-17 | 4.5 | OK | |
| S08-05-3.001 | S08-05-18 | 4.5 | OK | |
| S08-05-3.002 | S08-05-19 | 4.5 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-05

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S08-05-3.003 | S08-05-20 | 15 Winter | 5 | +0% | | | |
| S08-05-3.004 | S08-05-21 | 15 Winter | 5 | +0% | 100/15 Summer | | |
| S08-05-3.005 | S08-05-22 | 15 Winter | 5 | +0% | 100/15 Summer | | |
| S08-05-2.011 | S08-05-23 | 30 Winter | 5 | +0% | 100/15 Summer | | |
| S08-05-1.005 | S08-05-24 | 30 Winter | 5 | +0% | 5/15 Winter | | |
| S08-05-1.006 | S08-05-25 | 30 Winter | 5 | +0% | 5/30 Winter | | |
| S08-05-1.007 | S08-05-26 | 30 Winter | 5 | +0% | 100/15 Summer | | |
| S08-05-1.008 | S08-05-27 | 30 Winter | 5 | +0% | 100/15 Summer | | |
| S08-05-1.009 | S08-05-28 | 30 Winter | 5 | +0% | 100/15 Summer | | |
| S08-05-1.010 | S08-05-29 | 30 Winter | 5 | +0% | 100/15 Summer | | |
| S08-05-1.011 | S08-05-30 | 30 Winter | 5 | +0% | | | |
| S08-05-4.000 | S08-05-31 | 15 Winter | 5 | +0% | 5/15 Summer | 100/15 Summer | |
| S08-05-4.001 | S08-05-32 | 15 Winter | 5 | +0% | 5/15 Summer | 100/15 Summer | |
| S08-05-4.002 | S08-05-33 | 15 Winter | 5 | +0% | 5/15 Summer | 100/15 Summer | |
| S08-05-4.003 | S08-05-34 | 15 Winter | 5 | +0% | 5/15 Summer | 100/15 Summer | |
| S08-05-4.004 | S08-05-35 | 15 Winter | 5 | +0% | 100/15 Summer | | |
| S08-05-4.005 | S08-05-36 | 15 Winter | 5 | +0% | 100/15 Summer | | |
| S08-05-4.006 | S08-05-37 | 15 Winter | 5 | +0% | 100/15 Summer | | |
| S08-05-4.007 | S08-05-38 | 15 Winter | 5 | +0% | 5/15 Winter | | |
| S08-05-4.008 | S08-05-39 | 15 Winter | 5 | +0% | | | |
| S08-05-4.009 | S08-05-40 | 15 Winter | 5 | +0% | | | |
| S08-05-4.010 | S08-05-41 | 15 Winter | 5 | +0% | | | |
| S08-05-4.011 | S08-05-42 | 15 Winter | 5 | +0% | 100/15 Summer | | |
| S08-05-5.000 | S08-05-43 | 15 Winter | 5 | +0% | 100/15 Summer | | |
| S08-05-5.001 | S08-05-44 | 15 Winter | 5 | +0% | 100/15 Summer | | |
| S08-05-5.002 | S08-05-45 | 15 Winter | 5 | +0% | 100/15 Summer | | |
| S08-05-5.003 | S08-05-46 | 15 Winter | 5 | +0% | 100/15 Summer | 100/15 Winter | |
| S08-05-5.004 | S08-05-47 | 15 Winter | 5 | +0% | 5/15 Winter | 100/15 Summer | |
| S08-05-5.005 | S08-05-48 | 15 Winter | 5 | +0% | 5/15 Summer | 100/15 Summer | |
| S08-05-5.006 | S08-05-49 | 15 Winter | 5 | +0% | 5/15 Summer | 100/15 Summer | |
| S08-05-5.007 | S08-05-50 | 30 Winter | 5 | +0% | 5/15 Winter | | |
| S08-05-5.008 | S08-05-51 | 30 Winter | 5 | +0% | 5/15 Summer | 100/15 Summer | |
| S08-05-5.009 | S08-05-52 | 30 Winter | 5 | +0% | 5/15 Summer | 100/15 Summer | |
| S08-05-5.010 | S08-05-53 | 30 Winter | 5 | +0% | 5/15 Summer | 100/15 Summer | |
| S08-05-5.011 | S08-05-54 | 15 Winter | 5 | +0% | 100/15 Summer | | |
| S08-05-5.012 | S08-05-55 | 15 Winter | 5 | +0% | 100/15 Summer | | |
| S08-05-5.013 | S08-05-56 | 60 Winter | 5 | +0% | 100/15 Summer | | |
| S08-05-4.012 | S08-05-57 | 15 Winter | 5 | +0% | 100/15 Summer | | |
| S08-05-4.013 | S08-05-58 | 15 Winter | 5 | +0% | 5/15 Summer | | |
| S08-05-4.014 | S08-05-59 | 15 Winter | 5 | +0% | 5/15 Summer | | |
| S08-05-1.012 | S08-05-60 | 720 Winter | 5 | +0% | | | |
| S08-05-1.013 | S08-05-61 | 720 Winter | 5 | +0% | | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-05

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-05-3.003 | S08-05-20 | | 177.372 | -0.101 | 0.000 | 0.23 | | |
| S08-05-3.004 | S08-05-21 | | 176.581 | -0.074 | 0.000 | 0.50 | | |
| S08-05-3.005 | S08-05-22 | | 175.590 | -0.044 | 0.000 | 0.83 | | |
| S08-05-2.011 | S08-05-23 | | 172.160 | 0.000 | 0.000 | 1.48 | | |
| S08-05-1.005 | S08-05-24 | | 172.048 | 0.020 | 0.000 | 1.10 | | |
| S08-05-1.006 | S08-05-25 | | 171.952 | 0.001 | 0.000 | 1.34 | | |
| S08-05-1.007 | S08-05-26 | | 171.886 | -0.024 | 0.000 | 0.98 | | |
| S08-05-1.008 | S08-05-27 | | 171.694 | -0.033 | 0.000 | 0.91 | | |
| S08-05-1.009 | S08-05-28 | | 171.603 | 0.000 | 0.000 | 0.94 | | |
| S08-05-1.010 | S08-05-29 | | 171.550 | 0.000 | 0.000 | 1.08 | | |
| S08-05-1.011 | S08-05-30 | | 171.224 | -0.277 | 0.000 | 0.31 | | |
| S08-05-4.000 | S08-05-31 | | 192.093 | 0.163 | 0.000 | 1.06 | | |
| S08-05-4.001 | S08-05-32 | | 191.892 | 0.225 | 0.000 | 0.97 | | |
| S08-05-4.002 | S08-05-33 | | 191.128 | 0.285 | 0.000 | 0.96 | | |
| S08-05-4.003 | S08-05-34 | | 190.005 | 0.418 | 0.000 | 1.10 | | |
| S08-05-4.004 | S08-05-35 | | 187.606 | -0.127 | 0.000 | 0.62 | | |
| S08-05-4.005 | S08-05-36 | | 185.261 | -0.111 | 0.000 | 0.70 | | |
| S08-05-4.006 | S08-05-37 | | 182.468 | -0.101 | 0.000 | 0.77 | | |
| S08-05-4.007 | S08-05-38 | | 181.289 | 0.006 | 0.000 | 1.72 | | |
| S08-05-4.008 | S08-05-39 | | 180.973 | -0.278 | 0.000 | 0.31 | | |
| S08-05-4.009 | S08-05-40 | | 179.973 | -0.268 | 0.000 | 0.34 | | |
| S08-05-4.010 | S08-05-41 | | 176.624 | -0.236 | 0.000 | 0.45 | | |
| S08-05-4.011 | S08-05-42 | | 174.138 | -0.211 | 0.000 | 0.55 | | |
| S08-05-5.000 | S08-05-43 | | 192.294 | -0.059 | 0.000 | 0.75 | | |
| S08-05-5.001 | S08-05-44 | | 191.983 | -0.073 | 0.000 | 0.75 | | |
| S08-05-5.002 | S08-05-45 | | 191.109 | -0.078 | 0.000 | 0.73 | | |
| S08-05-5.003 | S08-05-46 | | 189.897 | -0.057 | 0.000 | 0.89 | | |
| S08-05-5.004 | S08-05-47 | | 188.303 | 0.050 | 0.000 | 0.95 | | |
| S08-05-5.005 | S08-05-48 | | 186.908 | 0.238 | 0.000 | 0.98 | | |
| S08-05-5.006 | S08-05-49 | | 184.601 | 0.338 | 0.000 | 1.59 | | |
| S08-05-5.007 | S08-05-50 | | 184.194 | 0.095 | 0.000 | 0.97 | | |
| S08-05-5.008 | S08-05-51 | | 181.413 | 0.502 | 0.000 | 0.99 | | |
| S08-05-5.009 | S08-05-52 | | 180.563 | 0.512 | 0.000 | 0.99 | | |
| S08-05-5.010 | S08-05-53 | | 179.088 | 0.565 | 0.000 | 1.12 | | |
| S08-05-5.011 | S08-05-54 | | 176.181 | -0.116 | 0.000 | 0.68 | | |
| S08-05-5.012 | S08-05-55 | | 173.812 | -0.085 | 0.000 | 0.85 | | |
| S08-05-5.013 | S08-05-56 | | 172.234 | 0.000 | 0.000 | 1.14 | | |
| S08-05-4.012 | S08-05-57 | | 171.983 | -0.212 | 0.000 | 0.55 | | |
| S08-05-4.013 | S08-05-58 | | 170.976 | 0.190 | 0.000 | 1.64 | | |
| S08-05-4.014 | S08-05-59 | | 170.843 | 0.102 | 0.000 | 1.28 | | |
| S08-05-1.012 | S08-05-60 | | 170.173 | -0.214 | 0.000 | 0.30 | | |
| S08-05-1.013 | S08-05-61 | | 169.972 | -0.369 | 0.000 | 0.08 | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-05

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S08-05-3.003 | S08-05-20 | 6.3 | OK | |
| S08-05-3.004 | S08-05-21 | 17.6 | OK | |
| S08-05-3.005 | S08-05-22 | 24.5 | OK | |
| S08-05-2.011 | S08-05-23 | 123.3 | OK | |
| S08-05-1.005 | S08-05-24 | 140.3 | SURCHARGED | |
| S08-05-1.006 | S08-05-25 | 140.3 | SURCHARGED | |
| S08-05-1.007 | S08-05-26 | 133.5 | OK | |
| S08-05-1.008 | S08-05-27 | 121.0 | OK | |
| S08-05-1.009 | S08-05-28 | 113.8 | OK | |
| S08-05-1.010 | S08-05-29 | 113.2 | OK | |
| S08-05-1.011 | S08-05-30 | 113.1 | OK | |
| S08-05-4.000 | S08-05-31 | 29.3 | SURCHARGED | 6 |
| S08-05-4.001 | S08-05-32 | 44.7 | SURCHARGED | 6 |
| S08-05-4.002 | S08-05-33 | 59.9 | SURCHARGED | 6 |
| S08-05-4.003 | S08-05-34 | 77.8 | SURCHARGED | 6 |
| S08-05-4.004 | S08-05-35 | 102.9 | OK | |
| S08-05-4.005 | S08-05-36 | 127.1 | OK | |
| S08-05-4.006 | S08-05-37 | 137.1 | OK | |
| S08-05-4.007 | S08-05-38 | 152.0 | SURCHARGED | |
| S08-05-4.008 | S08-05-39 | 152.2 | OK | |
| S08-05-4.009 | S08-05-40 | 192.0 | OK | |
| S08-05-4.010 | S08-05-41 | 222.3 | OK | |
| S08-05-4.011 | S08-05-42 | 237.1 | OK | |
| S08-05-5.000 | S08-05-43 | 20.7 | OK | |
| S08-05-5.001 | S08-05-44 | 35.5 | OK | |
| S08-05-5.002 | S08-05-45 | 45.9 | OK | |
| S08-05-5.003 | S08-05-46 | 62.5 | OK | 2 |
| S08-05-5.004 | S08-05-47 | 72.7 | SURCHARGED | 6 |
| S08-05-5.005 | S08-05-48 | 81.9 | SURCHARGED | 6 |
| S08-05-5.006 | S08-05-49 | 81.9 | SURCHARGED | 7 |
| S08-05-5.007 | S08-05-50 | 92.2 | SURCHARGED | |
| S08-05-5.008 | S08-05-51 | 90.7 | SURCHARGED | 7 |
| S08-05-5.009 | S08-05-52 | 94.1 | SURCHARGED | 7 |
| S08-05-5.010 | S08-05-53 | 101.7 | SURCHARGED | 6 |
| S08-05-5.011 | S08-05-54 | 114.3 | OK | |
| S08-05-5.012 | S08-05-55 | 129.6 | OK | |
| S08-05-5.013 | S08-05-56 | 116.0 | OK | |
| S08-05-4.012 | S08-05-57 | 367.6 | OK | |
| S08-05-4.013 | S08-05-58 | 363.9 | SURCHARGED | |
| S08-05-4.014 | S08-05-59 | 364.8 | SURCHARGED | |
| S08-05-1.012 | S08-05-60 | 35.5 | OK | |
| S08-05-1.013 | S08-05-61 | 35.5 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-05

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 1 |
| Number of Online Controls | 1 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Ratio R | 0.328 |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 17.000 | Cv (Winter) | 0.840 |

| | | | |
|---|---|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 | DVD Status | OFF |
| Analysis Timestep | Fine | Inertia Status | OFF |
| DTS Status | ON | | |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 0, 0 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S08-05-1.000 | S08-05-1 | 15 Winter | 100 | +0% | | | |
| S08-05-1.001 | S08-05-2 | 15 Winter | 100 | +0% | 100/15 Winter | | |
| S08-05-1.002 | S08-05-3 | 15 Winter | 100 | +0% | 5/15 Winter | 100/15 Summer | |
| S08-05-1.003 | S08-05-4 | 30 Winter | 100 | +0% | 5/15 Summer | 100/15 Summer | |
| S08-05-1.004 | S08-05-5 | 30 Winter | 100 | +0% | 5/15 Summer | | |
| S08-05-2.000 | S08-05-6 | 30 Winter | 100 | +0% | 5/15 Summer | 100/15 Summer | |
| S08-05-2.001 | S08-05-7 | 15 Winter | 100 | +0% | 5/15 Summer | | |
| S08-05-2.002 | S08-05-8 | 15 Winter | 100 | +0% | 5/15 Summer | | |
| S08-05-2.003 | S08-05-9 | 15 Winter | 100 | +0% | 5/15 Summer | | |
| S08-05-2.004 | S08-05-10 | 15 Winter | 100 | +0% | 5/15 Summer | | |
| S08-05-2.005 | S08-05-11 | 15 Winter | 100 | +0% | 5/15 Summer | | |
| S08-05-2.006 | S08-05-12 | 30 Winter | 100 | +0% | 100/15 Summer | | |
| S08-05-2.007 | S08-05-13 | 30 Winter | 100 | +0% | 100/15 Summer | | |
| S08-05-2.008 | S08-05-14 | 30 Winter | 100 | +0% | 5/15 Summer | | |
| S08-05-2.009 | S08-05-15 | 30 Winter | 100 | +0% | 5/15 Summer | | |
| S08-05-2.010 | S08-05-16 | 30 Winter | 100 | +0% | 5/15 Summer | | |
| S08-05-3.000 | S08-05-17 | 15 Winter | 100 | +0% | | | |
| S08-05-3.001 | S08-05-18 | 15 Winter | 100 | +0% | | | |
| S08-05-3.002 | S08-05-19 | 15 Winter | 100 | +0% | | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-05

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-05-1.000 | S08-05-1 | | 178.881 | -0.064 | 0.000 | 0.59 | | |
| S08-05-1.001 | S08-05-2 | | 177.884 | 0.048 | 0.000 | 0.90 | | |
| S08-05-1.002 | S08-05-3 | | 174.324 | 1.202 | 1.920 | 1.29 | | |
| S08-05-1.003 | S08-05-4 | | 173.736 | 1.202 | 2.131 | 1.62 | | |
| S08-05-1.004 | S08-05-5 | | 173.434 | 1.097 | 0.000 | 1.69 | | |
| S08-05-2.000 | S08-05-6 | | 177.463 | 1.217 | 16.722 | 2.71 | | |
| S08-05-2.001 | S08-05-7 | | 178.110 | 1.949 | 0.000 | 2.77 | | |
| S08-05-2.002 | S08-05-8 | | 178.506 | 2.404 | 0.000 | 3.08 | | |
| S08-05-2.003 | S08-05-9 | | 178.666 | 2.596 | 0.000 | 2.19 | | |
| S08-05-2.004 | S08-05-10 | | 178.687 | 2.634 | 0.000 | 1.84 | | |
| S08-05-2.005 | S08-05-11 | | 178.720 | 2.725 | 0.000 | 1.51 | | |
| S08-05-2.006 | S08-05-12 | | 175.284 | 0.889 | 0.000 | 1.03 | | |
| S08-05-2.007 | S08-05-13 | | 173.786 | 0.829 | 0.000 | 0.99 | | |
| S08-05-2.008 | S08-05-14 | | 173.210 | 0.847 | 0.000 | 1.38 | | |
| S08-05-2.009 | S08-05-15 | | 173.004 | 0.750 | 0.000 | 1.88 | | |
| S08-05-2.010 | S08-05-16 | | 172.883 | 0.671 | 0.000 | 1.74 | | |
| S08-05-3.000 | S08-05-17 | | 177.650 | -0.037 | 0.000 | 0.90 | | |
| S08-05-3.001 | S08-05-18 | | 177.574 | -0.072 | 0.000 | 0.52 | | |
| S08-05-3.002 | S08-05-19 | | 177.480 | -0.040 | 0.000 | 0.89 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S08-05-1.000 | S08-05-1 | 12.3 | OK | |
| S08-05-1.001 | S08-05-2 | 35.3 | SURCHARGED | |
| S08-05-1.002 | S08-05-3 | 24.6 | FLOOD | 5 |
| S08-05-1.003 | S08-05-4 | 17.7 | FLOOD | 6 |
| S08-05-1.004 | S08-05-5 | 18.6 | SURCHARGED | |
| S08-05-2.000 | S08-05-6 | 26.5 | FLOOD | 6 |
| S08-05-2.001 | S08-05-7 | 26.5 | SURCHARGED | |
| S08-05-2.002 | S08-05-8 | 28.0 | SURCHARGED | |
| S08-05-2.003 | S08-05-9 | 35.3 | SURCHARGED | |
| S08-05-2.004 | S08-05-10 | 39.6 | SURCHARGED | |
| S08-05-2.005 | S08-05-11 | 114.3 | SURCHARGED | |
| S08-05-2.006 | S08-05-12 | 115.0 | SURCHARGED | |
| S08-05-2.007 | S08-05-13 | 113.6 | SURCHARGED | |
| S08-05-2.008 | S08-05-14 | 113.9 | SURCHARGED | |
| S08-05-2.009 | S08-05-15 | 126.9 | SURCHARGED | |
| S08-05-2.010 | S08-05-16 | 134.2 | SURCHARGED | |
| S08-05-3.000 | S08-05-17 | 8.4 | OK | |
| S08-05-3.001 | S08-05-18 | 8.5 | OK | |
| S08-05-3.002 | S08-05-19 | 8.4 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-05

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S08-05-3.003 | S08-05-20 | 15 Winter | 100 | +0% | | | |
| S08-05-3.004 | S08-05-21 | 15 Winter | 100 | +0% | 100/15 Summer | | |
| S08-05-3.005 | S08-05-22 | 15 Winter | 100 | +0% | 100/15 Summer | | |
| S08-05-2.011 | S08-05-23 | 30 Winter | 100 | +0% | 100/15 Summer | | |
| S08-05-1.005 | S08-05-24 | 30 Winter | 100 | +0% | 5/15 Winter | | |
| S08-05-1.006 | S08-05-25 | 30 Winter | 100 | +0% | 5/30 Winter | | |
| S08-05-1.007 | S08-05-26 | 30 Winter | 100 | +0% | 100/15 Summer | | |
| S08-05-1.008 | S08-05-27 | 30 Winter | 100 | +0% | 100/15 Summer | | |
| S08-05-1.009 | S08-05-28 | 30 Winter | 100 | +0% | 100/15 Summer | | |
| S08-05-1.010 | S08-05-29 | 30 Winter | 100 | +0% | 100/15 Summer | | |
| S08-05-1.011 | S08-05-30 | 30 Winter | 100 | +0% | | | |
| S08-05-4.000 | S08-05-31 | 15 Winter | 100 | +0% | 5/15 Summer | 100/15 Summer | |
| S08-05-4.001 | S08-05-32 | 30 Winter | 100 | +0% | 5/15 Summer | 100/15 Summer | |
| S08-05-4.002 | S08-05-33 | 30 Winter | 100 | +0% | 5/15 Summer | 100/15 Summer | |
| S08-05-4.003 | S08-05-34 | 30 Winter | 100 | +0% | 5/15 Summer | 100/15 Summer | |
| S08-05-4.004 | S08-05-35 | 15 Winter | 100 | +0% | 100/15 Summer | | |
| S08-05-4.005 | S08-05-36 | 15 Winter | 100 | +0% | 100/15 Summer | | |
| S08-05-4.006 | S08-05-37 | 15 Winter | 100 | +0% | 100/15 Summer | | |
| S08-05-4.007 | S08-05-38 | 15 Winter | 100 | +0% | 5/15 Winter | | |
| S08-05-4.008 | S08-05-39 | 15 Winter | 100 | +0% | | | |
| S08-05-4.009 | S08-05-40 | 15 Winter | 100 | +0% | | | |
| S08-05-4.010 | S08-05-41 | 15 Winter | 100 | +0% | | | |
| S08-05-4.011 | S08-05-42 | 15 Winter | 100 | +0% | 100/15 Summer | | |
| S08-05-5.000 | S08-05-43 | 15 Winter | 100 | +0% | 100/15 Summer | | |
| S08-05-5.001 | S08-05-44 | 15 Winter | 100 | +0% | 100/15 Summer | | |
| S08-05-5.002 | S08-05-45 | 30 Winter | 100 | +0% | 100/15 Summer | | |
| S08-05-5.003 | S08-05-46 | 30 Winter | 100 | +0% | 100/15 Summer | 100/15 Winter | |
| S08-05-5.004 | S08-05-47 | 30 Winter | 100 | +0% | 5/15 Winter | 100/15 Summer | |
| S08-05-5.005 | S08-05-48 | 30 Winter | 100 | +0% | 5/15 Summer | 100/15 Summer | |
| S08-05-5.006 | S08-05-49 | 30 Winter | 100 | +0% | 5/15 Summer | 100/15 Summer | |
| S08-05-5.007 | S08-05-50 | 15 Winter | 100 | +0% | 5/15 Winter | | |
| S08-05-5.008 | S08-05-51 | 60 Winter | 100 | +0% | 5/15 Summer | 100/15 Summer | |
| S08-05-5.009 | S08-05-52 | 30 Winter | 100 | +0% | 5/15 Summer | 100/15 Summer | |
| S08-05-5.010 | S08-05-53 | 30 Winter | 100 | +0% | 5/15 Summer | 100/15 Summer | |
| S08-05-5.011 | S08-05-54 | 15 Winter | 100 | +0% | 100/15 Summer | | |
| S08-05-5.012 | S08-05-55 | 15 Winter | 100 | +0% | 100/15 Summer | | |
| S08-05-5.013 | S08-05-56 | 15 Winter | 100 | +0% | 100/15 Summer | | |
| S08-05-4.012 | S08-05-57 | 15 Winter | 100 | +0% | 100/15 Summer | | |
| S08-05-4.013 | S08-05-58 | 15 Winter | 100 | +0% | 5/15 Summer | | |
| S08-05-4.014 | S08-05-59 | 15 Winter | 100 | +0% | 5/15 Summer | | |
| S08-05-1.012 | S08-05-60 | 480 Winter | 100 | +0% | | | |
| S08-05-1.013 | S08-05-61 | 480 Winter | 100 | +0% | | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-05

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume ($m^3$) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-05-3.003 | S08-05-20 | | 177.395 | -0.078 | 0.000 | 0.46 | | |
| S08-05-3.004 | S08-05-21 | | 177.104 | 0.448 | 0.000 | 0.86 | | |
| S08-05-3.005 | S08-05-22 | | 176.346 | 0.712 | 0.000 | 1.41 | | |
| S08-05-2.011 | S08-05-23 | | 172.732 | 0.572 | 0.000 | 2.18 | | |
| S08-05-1.005 | S08-05-24 | | 172.665 | 0.636 | 0.000 | 1.66 | | |
| S08-05-1.006 | S08-05-25 | | 172.506 | 0.555 | 0.000 | 1.99 | | |
| S08-05-1.007 | S08-05-26 | | 172.394 | 0.484 | 0.000 | 1.47 | | |
| S08-05-1.008 | S08-05-27 | | 172.035 | 0.308 | 0.000 | 1.46 | | |
| S08-05-1.009 | S08-05-28 | | 171.770 | 0.167 | 0.000 | 1.59 | | |
| S08-05-1.010 | S08-05-29 | | 171.636 | 0.086 | 0.000 | 1.82 | | |
| S08-05-1.011 | S08-05-30 | | 171.286 | -0.216 | 0.000 | 0.53 | | |
| S08-05-4.000 | S08-05-31 | | 193.136 | 1.206 | 6.102 | 0.99 | | |
| S08-05-4.001 | S08-05-32 | | 192.878 | 1.210 | 9.892 | 1.03 | | |
| S08-05-4.002 | S08-05-33 | | 192.052 | 1.208 | 8.244 | 1.19 | | |
| S08-05-4.003 | S08-05-34 | | 190.792 | 1.205 | 5.140 | 1.29 | | |
| S08-05-4.004 | S08-05-35 | | 187.847 | 0.115 | 0.000 | 0.91 | | |
| S08-05-4.005 | S08-05-36 | | 186.070 | 0.697 | 0.000 | 1.03 | | |
| S08-05-4.006 | S08-05-37 | | 183.073 | 0.504 | 0.000 | 1.14 | | |
| S08-05-4.007 | S08-05-38 | | 181.405 | 0.122 | 0.000 | 2.64 | | |
| S08-05-4.008 | S08-05-39 | | 181.021 | -0.230 | 0.000 | 0.48 | | |
| S08-05-4.009 | S08-05-40 | | 180.045 | -0.197 | 0.000 | 0.59 | | |
| S08-05-4.010 | S08-05-41 | | 176.735 | -0.125 | 0.000 | 0.85 | | |
| S08-05-4.011 | S08-05-42 | | 174.463 | 0.114 | 0.000 | 1.00 | | |
| S08-05-5.000 | S08-05-43 | | 193.039 | 0.687 | 0.000 | 1.14 | | |
| S08-05-5.001 | S08-05-44 | | 192.784 | 0.728 | 0.000 | 0.95 | | |
| S08-05-5.002 | S08-05-45 | | 192.070 | 0.883 | 0.000 | 0.88 | | |
| S08-05-5.003 | S08-05-46 | | 191.154 | 1.201 | 0.530 | 1.00 | | |
| S08-05-5.004 | S08-05-47 | | 189.457 | 1.205 | 4.584 | 1.00 | | |
| S08-05-5.005 | S08-05-48 | | 187.876 | 1.206 | 6.137 | 1.01 | | |
| S08-05-5.006 | S08-05-49 | | 185.469 | 1.206 | 5.880 | 1.76 | | |
| S08-05-5.007 | S08-05-50 | | 185.290 | 1.190 | 0.000 | 0.99 | | |
| S08-05-5.008 | S08-05-51 | | 182.115 | 1.204 | 4.214 | 1.10 | | |
| S08-05-5.009 | S08-05-52 | | 181.254 | 1.203 | 2.575 | 1.09 | | |
| S08-05-5.010 | S08-05-53 | | 179.727 | 1.203 | 3.241 | 1.24 | | |
| S08-05-5.011 | S08-05-54 | | 176.443 | 0.146 | 0.000 | 0.89 | | |
| S08-05-5.012 | S08-05-55 | | 174.724 | 0.827 | 0.000 | 1.11 | | |
| S08-05-5.013 | S08-05-56 | | 172.775 | 0.541 | 0.000 | 1.78 | | |
| S08-05-4.012 | S08-05-57 | | 172.694 | 0.499 | 0.000 | 0.86 | | |
| S08-05-4.013 | S08-05-58 | | 171.658 | 0.872 | 0.000 | 2.58 | | |
| S08-05-4.014 | S08-05-59 | | 171.330 | 0.588 | 0.000 | 1.99 | | |
| S08-05-1.012 | S08-05-60 | | 170.352 | -0.035 | 0.000 | 0.61 | | |
| S08-05-1.013 | S08-05-61 | | 170.008 | -0.333 | 0.000 | 0.15 | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-05

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S08-05-3.003 | S08-05-20 | 12.4 | OK | |
| S08-05-3.004 | S08-05-21 | 30.2 | SURCHARGED | |
| S08-05-3.005 | S08-05-22 | 41.5 | SURCHARGED | |
| S08-05-2.011 | S08-05-23 | 181.4 | SURCHARGED | |
| S08-05-1.005 | S08-05-24 | 210.7 | SURCHARGED | |
| S08-05-1.006 | S08-05-25 | 209.2 | SURCHARGED | |
| S08-05-1.007 | S08-05-26 | 200.4 | SURCHARGED | |
| S08-05-1.008 | S08-05-27 | 193.7 | SURCHARGED | |
| S08-05-1.009 | S08-05-28 | 193.0 | SURCHARGED | |
| S08-05-1.010 | S08-05-29 | 191.5 | SURCHARGED | |
| S08-05-1.011 | S08-05-30 | 191.6 | OK | |
| S08-05-4.000 | S08-05-31 | 27.4 | FLOOD | 6 |
| S08-05-4.001 | S08-05-32 | 47.7 | FLOOD | 6 |
| S08-05-4.002 | S08-05-33 | 74.3 | FLOOD | 6 |
| S08-05-4.003 | S08-05-34 | 90.6 | FLOOD | 6 |
| S08-05-4.004 | S08-05-35 | 151.6 | SURCHARGED | |
| S08-05-4.005 | S08-05-36 | 186.7 | SURCHARGED | |
| S08-05-4.006 | S08-05-37 | 203.0 | SURCHARGED | |
| S08-05-4.007 | S08-05-38 | 233.4 | SURCHARGED | |
| S08-05-4.008 | S08-05-39 | 233.1 | OK | |
| S08-05-4.009 | S08-05-40 | 335.8 | OK | |
| S08-05-4.010 | S08-05-41 | 415.4 | OK | |
| S08-05-4.011 | S08-05-42 | 432.6 | SURCHARGED | |
| S08-05-5.000 | S08-05-43 | 31.3 | SURCHARGED | |
| S08-05-5.001 | S08-05-44 | 45.3 | SURCHARGED | |
| S08-05-5.002 | S08-05-45 | 54.8 | SURCHARGED | |
| S08-05-5.003 | S08-05-46 | 70.3 | FLOOD | 2 |
| S08-05-5.004 | S08-05-47 | 76.2 | FLOOD | 6 |
| S08-05-5.005 | S08-05-48 | 83.8 | FLOOD | 6 |
| S08-05-5.006 | S08-05-49 | 90.6 | FLOOD | 7 |
| S08-05-5.007 | S08-05-50 | 94.2 | FLOOD RISK | |
| S08-05-5.008 | S08-05-51 | 99.8 | FLOOD | 7 |
| S08-05-5.009 | S08-05-52 | 104.0 | FLOOD | 7 |
| S08-05-5.010 | S08-05-53 | 112.8 | FLOOD | 6 |
| S08-05-5.011 | S08-05-54 | 149.6 | SURCHARGED | |
| S08-05-5.012 | S08-05-55 | 169.3 | SURCHARGED | |
| S08-05-5.013 | S08-05-56 | 181.3 | SURCHARGED | |
| S08-05-4.012 | S08-05-57 | 574.8 | SURCHARGED | |
| S08-05-4.013 | S08-05-58 | 571.9 | SURCHARGED | |
| S08-05-4.014 | S08-05-59 | 569.7 | SURCHARGED | |
| S08-05-1.012 | S08-05-60 | 72.0 | OK | |
| S08-05-1.013 | S08-05-61 | 72.0 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for S08-07

```
                   Pipe Sizes STANDARD Manhole Sizes STANDARD

                       FSR Rainfall Model - England and Wales
                 Return Period (years)        2                      PIMP (%)    100
                           M5-60 (mm)  17.000         Add Flow / Climate Change (%)      0
                              Ratio R   0.328           Minimum Backdrop Height (m)  0.000
              Maximum Rainfall (mm/hr)       50           Maximum Backdrop Height (m)  0.000
 Maximum Time of Concentration (mins)       30 Min Design Depth for Optimisation (m)  1.200
                  Foul Sewage (l/s/ha)   0.000     Min Vel for Auto Design only (m/s)   1.00
              Volumetric Runoff Coeff.   0.750       Min Slope for Optimisation (1:X)    500

                            Designed with Level Soffits
```

### Simulation Criteria for S08-07

```
              Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 0.000
               Areal Reduction Factor 1.000         MADD Factor * 10m³/ha Storage 2.000
                     Hot Start (mins)     0                    Inlet Coeffiecient 0.800
                 Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
          Manhole Headloss Coeff (Global) 0.500                     Run Time (mins)    60
           Foul Sewage per hectare (l/s) 0.000               Output Interval (mins)     1

               Number of Input Hydrographs 0 Number of Storage Structures 0
                 Number of Online Controls 1 Number of Time/Area Diagrams 0
                Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
                 Rainfall Model                FSR          Profile Type  Summer
          Return Period (years)                  5           Cv (Summer)   0.750
                        Region England and Wales           Cv (Winter)   0.840
                     M5-60 (mm)             17.000 Storm Duration (mins)      30
                        Ratio R              0.328
```

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-07

### Simulation Criteria

Areal Reduction Factor 1.000
Hot Start (mins) 0
Hot Start Level (mm) 0
Manhole Headloss Coeff (Global) 0.500
Foul Sewage per hectare (l/s) 0.000
Additional Flow - % of Total Flow 0.000
MADD Factor * 10m³/ha Storage 2.000
Inlet Coeffiecient 0.800
Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0
Number of Online Controls 1
Number of Offline Controls 0
Number of Storage Structures 0
Number of Time/Area Diagrams 0
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
Region England and Wales
M5-60 (mm) 17.000
Ratio R 0.300
Cv (Summer) 0.750
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep Fine
DTS Status ON
DVD Status OFF
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| S08-07-1.000 | S08-07-1 | 15 Winter | 5 | +20% | | | | |
| S08-07-1.001 | S08-07-2 | 30 Winter | 5 | +20% | 100/30 Winter | | | |
| S08-07-1.002 | S08-07-3 | 30 Winter | 5 | +20% | 5/15 Summer | | | |

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|
| S08-07-1.000 | S08-07-1 | 212.631 | -0.118 | 0.000 | 0.10 | | | 5.3 |
| S08-07-1.001 | S08-07-2 | 209.516 | -0.511 | 0.000 | 0.02 | | | 9.1 |
| S08-07-1.002 | S08-07-3 | 209.516 | 0.191 | 0.000 | 0.08 | | | 3.4 |

| PN | US/MH Name | Status | Level Exceeded |
|---|---|---|---|
| S08-07-1.000 | S08-07-1 | OK | |
| S08-07-1.001 | S08-07-2 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-07

| PN | US/MH Name | Status | Level Exceeded |
|---|---|---|---|
| S08-07-1.002 | S08-07-3 | SURCHARGED |  |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-07

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 0
Number of Online Controls 1 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.300
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 17.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow | Overflow Act. |
|---|---|---|---|---|---|---|---|---|
| S08-07-1.000 | S08-07-1 | 15 Winter | 100 | +40% | | | | |
| S08-07-1.001 | S08-07-2 | 60 Winter | 100 | +40% | 100/30 Winter | | | |
| S08-07-1.002 | S08-07-3 | 60 Winter | 100 | +40% | 5/15 Summer | | | |

| PN | US/MH Name | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) |
|---|---|---|---|---|---|---|---|---|
| S08-07-1.000 | S08-07-1 | 212.646 | -0.103 | 0.000 | 0.22 | | | 11.6 |
| S08-07-1.001 | S08-07-2 | 210.439 | 0.412 | 0.000 | 0.02 | | | 14.8 |
| S08-07-1.002 | S08-07-3 | 210.439 | 1.114 | 0.000 | 0.08 | | | 3.4 |

| PN | US/MH Name | Status | Level Exceeded |
|---|---|---|---|
| S08-07-1.000 | S08-07-1 | OK | |
| S08-07-1.001 | S08-07-2 | SURCHARGED | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-07

| PN | US/MH Name | Status | Level Exceeded |
|---|---|---|---|
| S08-07-1.002 | S08-07-3 | SURCHARGED |  |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for S08-06

```
                    Pipe Sizes STANDARD Manhole Sizes STANDARD

                       FSR Rainfall Model - England and Wales
              Return Period (years)       2                    PIMP (%)    100
                        M5-60 (mm)  17.000      Add Flow / Climate Change (%)      0
                          Ratio R    0.328       Minimum Backdrop Height (m)  0.000
           Maximum Rainfall (mm/hr)       50       Maximum Backdrop Height (m)  0.000
Maximum Time of Concentration (mins)       30 Min Design Depth for Optimisation (m)  1.200
              Foul Sewage (l/s/ha)    0.000    Min Vel for Auto Design only (m/s)   1.00
           Volumetric Runoff Coeff.    0.750      Min Slope for Optimisation (1:X)    500

                          Designed with Level Soffits
```

## Simulation Criteria for S08-06

```
         Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 0.000
          Areal Reduction Factor 1.000       MADD Factor * 10m³/ha Storage 2.000
                Hot Start (mins)     0                 Inlet Coeffiecient 0.800
              Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
     Manhole Headloss Coeff (Global) 0.500                    Run Time (mins)    60
       Foul Sewage per hectare (l/s) 0.000             Output Interval (mins)     1

           Number of Input Hydrographs 0 Number of Storage Structures 1
             Number of Online Controls 1 Number of Time/Area Diagrams 0
            Number of Offline Controls 0 Number of Real Time Controls 0
```

## Synthetic Rainfall Details

```
           Rainfall Model              FSR          Profile Type  Summer
      Return Period (years)                 5           Cv (Summer)   0.750
                        Region England and Wales           Cv (Winter)   0.840
                 M5-60 (mm)           17.000 Storm Duration (mins)      30
                    Ratio R            0.328
```

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-06

### Simulation Criteria

Areal Reduction Factor 1.000
Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0
MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0
Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500
Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0
Number of Storage Structures 1
Number of Online Controls 1
Number of Time/Area Diagrams 0
Number of Offline Controls 0
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
Ratio R 0.328
Region England and Wales
Cv (Summer) 0.750
M5-60 (mm) 17.000
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
DVD Status OFF
Analysis Timestep Fine
Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S08-06-1.000 | S08-06-1 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Summer | |
| S08-06-1.001 | S08-06-2 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-06-1.002 | S08-06-3 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| S08-06-1.003 | S08-06-4 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S08-06-2.000 | S08-06-5 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S08-06-2.001 | S08-06-6 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-06-2.002 | S08-06-7 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-06-1.004 | S08-06-8 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S08-06-1.005 | S08-06-9 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S08-06-1.006 | S08-06-10 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-06-1.007 | S08-06-11 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | |
| S08-06-1.008 | S08-06-12 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| S08-06-1.009 | S08-06-13 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-06-1.010 | S08-06-14 | 15 Winter | 5 | +20% | 5/15 Winter | | |
| S08-06-1.011 | S08-06-15 | 15 Winter | 5 | +20% | 5/15 Summer | | |
| S08-06-3.000 | S08-06-16 | 15 Winter | 5 | +20% | | | |
| S08-06-3.001 | S08-06-17 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S08-06-3.002 | S08-06-18 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-06-3.003 | S08-06-19 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-06

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-06-1.000 | S08-06-1 | | 171.816 | 0.030 | 0.000 | 1.00 | | |
| S08-06-1.001 | S08-06-2 | | 169.077 | -0.107 | 0.000 | 0.53 | | |
| S08-06-1.002 | S08-06-3 | | 165.928 | -0.092 | 0.000 | 0.64 | | |
| S08-06-1.003 | S08-06-4 | | 164.874 | 1.110 | 0.000 | 1.16 | | |
| S08-06-2.000 | S08-06-5 | | 172.321 | 0.376 | 0.000 | 1.06 | | |
| S08-06-2.001 | S08-06-6 | | 169.190 | -0.102 | 0.000 | 0.57 | | |
| S08-06-2.002 | S08-06-7 | | 166.125 | -0.097 | 0.000 | 0.61 | | |
| S08-06-1.004 | S08-06-8 | | 164.756 | 1.089 | 0.000 | 1.06 | | |
| S08-06-1.005 | S08-06-9 | | 161.912 | 0.798 | 0.000 | 1.20 | | |
| S08-06-1.006 | S08-06-10 | | 159.201 | -0.116 | 0.000 | 0.69 | | |
| S08-06-1.007 | S08-06-11 | | 157.375 | -0.085 | 0.000 | 0.86 | | |
| S08-06-1.008 | S08-06-12 | | 156.246 | -0.066 | 0.000 | 0.95 | | |
| S08-06-1.009 | S08-06-13 | | 154.695 | -0.044 | 0.000 | 0.95 | | |
| S08-06-1.010 | S08-06-14 | | 153.506 | 0.094 | 0.000 | 0.96 | | |
| S08-06-1.011 | S08-06-15 | | 152.814 | 0.155 | 0.000 | 1.22 | | |
| S08-06-3.000 | S08-06-16 | | 168.520 | -0.088 | 0.000 | 0.34 | | |
| S08-06-3.001 | S08-06-17 | | 166.052 | 0.117 | 0.000 | 1.02 | | |
| S08-06-3.002 | S08-06-18 | | 163.035 | -0.102 | 0.000 | 0.57 | | |
| S08-06-3.003 | S08-06-19 | | 160.522 | -0.066 | 0.000 | 0.83 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S08-06-1.000 | S08-06-1 | 28.3 | SURCHARGED | 4 |
| S08-06-1.001 | S08-06-2 | 48.2 | OK | |
| S08-06-1.002 | S08-06-3 | 57.1 | OK | 4 |
| S08-06-1.003 | S08-06-4 | 46.6 | FLOOD RISK | 9 |
| S08-06-2.000 | S08-06-5 | 29.9 | SURCHARGED | 6 |
| S08-06-2.001 | S08-06-6 | 51.0 | OK | |
| S08-06-2.002 | S08-06-7 | 57.5 | OK | |
| S08-06-1.004 | S08-06-8 | 102.9 | FLOOD RISK | 9 |
| S08-06-1.005 | S08-06-9 | 107.4 | SURCHARGED | 6 |
| S08-06-1.006 | S08-06-10 | 115.8 | OK | |
| S08-06-1.007 | S08-06-11 | 124.7 | OK | 3 |
| S08-06-1.008 | S08-06-12 | 138.1 | OK | 6 |
| S08-06-1.009 | S08-06-13 | 147.0 | OK | |
| S08-06-1.010 | S08-06-14 | 149.5 | SURCHARGED | |
| S08-06-1.011 | S08-06-15 | 149.6 | SURCHARGED | |
| S08-06-3.000 | S08-06-16 | 11.6 | OK | |
| S08-06-3.001 | S08-06-17 | 34.8 | SURCHARGED | 6 |
| S08-06-3.002 | S08-06-18 | 55.8 | OK | |
| S08-06-3.003 | S08-06-19 | 73.7 | OK | 6 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-06

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S08-06-3.004 | S08-06-20 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S08-06-3.005 | S08-06-21 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-06-3.006 | S08-06-22 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-06-3.007 | S08-06-23 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-06-3.008 | S08-06-24 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-06-1.012 | S08-06-25 | 15 Winter | 5 | +20% | 5/15 Summer | | |
| S08-06-1.013 | S08-06-26 | 30 Summer | 5 | +20% | 100/15 Summer | | |
| S08-06-1.014 | S08-06-27 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-06-1.015 | S08-06-28 | 960 Winter | 5 | +20% | | | |

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-06-3.004 | S08-06-20 | | 159.250 | 0.387 | 0.000 | 1.10 | | |
| S08-06-3.005 | S08-06-21 | | 156.928 | -0.111 | 0.000 | 0.71 | | |
| S08-06-3.006 | S08-06-22 | | 155.804 | -0.091 | 0.000 | 0.82 | | |
| S08-06-3.007 | S08-06-23 | | 154.241 | -0.086 | 0.000 | 0.85 | | |
| S08-06-3.008 | S08-06-24 | | 152.961 | -0.016 | 0.000 | 0.97 | | |
| S08-06-1.012 | S08-06-25 | | 152.382 | 0.012 | 0.000 | 1.09 | | |
| S08-06-1.013 | S08-06-26 | | 152.310 | 0.000 | 0.000 | 1.61 | | |
| S08-06-1.014 | S08-06-27 | | 152.172 | -0.121 | 0.000 | 1.00 | | |
| S08-06-1.015 | S08-06-28 | | 151.645 | -0.230 | 0.000 | 0.17 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S08-06-3.004 | S08-06-20 | 88.1 | SURCHARGED | 6 |
| S08-06-3.005 | S08-06-21 | 103.3 | OK | |
| S08-06-3.006 | S08-06-22 | 119.6 | OK | |
| S08-06-3.007 | S08-06-23 | 131.6 | OK | |
| S08-06-3.008 | S08-06-24 | 136.9 | OK | |
| S08-06-1.012 | S08-06-25 | 283.9 | SURCHARGED | |
| S08-06-1.013 | S08-06-26 | 271.5 | OK | |
| S08-06-1.014 | S08-06-27 | 283.6 | FLOOD RISK | |
| S08-06-1.015 | S08-06-28 | 18.2 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-06

```
                              Simulation Criteria
          Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 0.000
                Hot Start (mins)     0       MADD Factor * 10m³/ha Storage 2.000
              Hot Start Level (mm)   0                  Inlet Coeffiecient 0.800
  Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
    Foul Sewage per hectare (l/s) 0.000

           Number of Input Hydrographs 0 Number of Storage Structures 1
             Number of Online Controls 1 Number of Time/Area Diagrams 0
            Number of Offline Controls 0 Number of Real Time Controls 0

                            Synthetic Rainfall Details
                Rainfall Model              FSR      Ratio R 0.328
                        Region England and Wales Cv (Summer) 0.750
                    M5-60 (mm)            17.000 Cv (Winter) 0.840

           Margin for Flood Risk Warning (mm)  300.0     DVD Status OFF
                            Analysis Timestep  Fine Inertia Status OFF
                                   DTS Status    ON


                    Profile(s)                          Summer and Winter
              Duration(s) (mins)     15, 30, 60, 120, 180, 240, 360, 480, 600,
                                       720, 960, 1440, 2160, 2880, 4320, 5760,
                                                            7200, 8640, 10080
         Return Period(s) (years)                                      5, 100
              Climate Change (%)                                       20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S08-06-1.000 | S08-06-1 | 15 Winter | 100 | +40% | 5/15 Winter | 100/15 Summer | |
| S08-06-1.001 | S08-06-2 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-06-1.002 | S08-06-3 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| S08-06-1.003 | S08-06-4 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S08-06-2.000 | S08-06-5 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S08-06-2.001 | S08-06-6 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-06-2.002 | S08-06-7 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-06-1.004 | S08-06-8 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S08-06-1.005 | S08-06-9 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S08-06-1.006 | S08-06-10 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-06-1.007 | S08-06-11 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | |
| S08-06-1.008 | S08-06-12 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| S08-06-1.009 | S08-06-13 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S08-06-1.010 | S08-06-14 | 30 Winter | 100 | +40% | 5/15 Winter | | |
| S08-06-1.011 | S08-06-15 | 30 Winter | 100 | +40% | 5/15 Summer | | |
| S08-06-3.000 | S08-06-16 | 15 Winter | 100 | +40% | | | |
| S08-06-3.001 | S08-06-17 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S08-06-3.002 | S08-06-18 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-06-3.003 | S08-06-19 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-06

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-06-1.000 | S08-06-1 | | 172.991 | 1.205 | 4.720 | 1.21 | | |
| S08-06-1.001 | S08-06-2 | | 169.545 | 0.361 | 0.000 | 0.87 | | |
| S08-06-1.002 | S08-06-3 | | 167.222 | 1.201 | 0.973 | 1.00 | | |
| S08-06-1.003 | S08-06-4 | | 164.993 | 1.230 | 29.564 | 2.29 | | |
| S08-06-2.000 | S08-06-5 | | 173.156 | 1.211 | 10.574 | 1.21 | | |
| S08-06-2.001 | S08-06-6 | | 169.717 | 0.425 | 0.000 | 0.92 | | |
| S08-06-2.002 | S08-06-7 | | 167.285 | 1.062 | 0.000 | 0.97 | | |
| S08-06-1.004 | S08-06-8 | | 164.896 | 1.229 | 29.156 | 1.09 | | |
| S08-06-1.005 | S08-06-9 | | 162.318 | 1.204 | 3.558 | 1.28 | | |
| S08-06-1.006 | S08-06-10 | | 159.827 | 0.509 | 0.000 | 0.84 | | |
| S08-06-1.007 | S08-06-11 | | 158.661 | 1.201 | 1.035 | 1.00 | | |
| S08-06-1.008 | S08-06-12 | | 157.517 | 1.205 | 4.805 | 1.11 | | |
| S08-06-1.009 | S08-06-13 | | 155.783 | 1.043 | 0.000 | 1.11 | | |
| S08-06-1.010 | S08-06-14 | | 154.175 | 0.762 | 0.000 | 1.14 | | |
| S08-06-1.011 | S08-06-15 | | 153.212 | 0.553 | 0.000 | 1.44 | | |
| S08-06-3.000 | S08-06-16 | | 168.594 | -0.014 | 0.000 | 0.73 | | |
| S08-06-3.001 | S08-06-17 | | 167.147 | 1.212 | 12.086 | 1.20 | | |
| S08-06-3.002 | S08-06-18 | | 163.828 | 0.691 | 0.000 | 0.88 | | |
| S08-06-3.003 | S08-06-19 | | 161.798 | 1.209 | 9.155 | 1.00 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S08-06-1.000 | S08-06-1 | 34.4 | FLOOD | 4 |
| S08-06-1.001 | S08-06-2 | 79.4 | SURCHARGED | |
| S08-06-1.002 | S08-06-3 | 88.6 | FLOOD | 4 |
| S08-06-1.003 | S08-06-4 | 92.3 | FLOOD | 9 |
| S08-06-2.000 | S08-06-5 | 34.1 | FLOOD | 6 |
| S08-06-2.001 | S08-06-6 | 82.5 | SURCHARGED | |
| S08-06-2.002 | S08-06-7 | 91.2 | FLOOD RISK | |
| S08-06-1.004 | S08-06-8 | 105.9 | FLOOD | 9 |
| S08-06-1.005 | S08-06-9 | 114.5 | FLOOD | 6 |
| S08-06-1.006 | S08-06-10 | 142.0 | SURCHARGED | |
| S08-06-1.007 | S08-06-11 | 145.4 | FLOOD | 3 |
| S08-06-1.008 | S08-06-12 | 160.4 | FLOOD | 6 |
| S08-06-1.009 | S08-06-13 | 171.3 | FLOOD RISK | |
| S08-06-1.010 | S08-06-14 | 177.5 | SURCHARGED | |
| S08-06-1.011 | S08-06-15 | 175.9 | SURCHARGED | |
| S08-06-3.000 | S08-06-16 | 24.7 | OK | |
| S08-06-3.001 | S08-06-17 | 40.9 | FLOOD | 6 |
| S08-06-3.002 | S08-06-18 | 85.8 | SURCHARGED | |
| S08-06-3.003 | S08-06-19 | 88.4 | FLOOD | 6 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-06

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S08-06-3.004 | S08-06-20 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S08-06-3.005 | S08-06-21 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-06-3.006 | S08-06-22 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-06-3.007 | S08-06-23 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-06-3.008 | S08-06-24 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S08-06-1.012 | S08-06-25 | 30 Winter | 100 | +40% | 5/15 Summer | | |
| S08-06-1.013 | S08-06-26 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S08-06-1.014 | S08-06-27 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S08-06-1.015 | S08-06-28 | 480 Winter | 100 | +40% | | | |

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-06-3.004 | S08-06-20 | | 160.078 | 1.216 | 15.391 | 1.29 | | |
| S08-06-3.005 | S08-06-21 | | 157.800 | 0.762 | 0.000 | 0.90 | | |
| S08-06-3.006 | S08-06-22 | | 157.000 | 1.105 | 0.000 | 1.06 | | |
| S08-06-3.007 | S08-06-23 | | 155.232 | 0.905 | 0.000 | 1.11 | | |
| S08-06-3.008 | S08-06-24 | | 153.583 | 0.607 | 0.000 | 1.28 | | |
| S08-06-1.012 | S08-06-25 | | 152.615 | 0.245 | 0.000 | 1.36 | | |
| S08-06-1.013 | S08-06-26 | | 152.491 | 0.181 | 0.000 | 2.09 | | |
| S08-06-1.014 | S08-06-27 | | 152.367 | 0.074 | 0.000 | 1.23 | | |
| S08-06-1.015 | S08-06-28 | | 151.777 | -0.098 | 0.000 | 0.46 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S08-06-3.004 | S08-06-20 | 103.6 | FLOOD | 6 |
| S08-06-3.005 | S08-06-21 | 130.6 | SURCHARGED | |
| S08-06-3.006 | S08-06-22 | 154.5 | FLOOD RISK | |
| S08-06-3.007 | S08-06-23 | 172.8 | FLOOD RISK | |
| S08-06-3.008 | S08-06-24 | 179.5 | SURCHARGED | |
| S08-06-1.012 | S08-06-25 | 352.6 | SURCHARGED | |
| S08-06-1.013 | S08-06-26 | 352.4 | SURCHARGED | |
| S08-06-1.014 | S08-06-27 | 350.9 | FLOOD RISK | |
| S08-06-1.015 | S08-06-28 | 49.6 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for S08-08

```
                  Pipe Sizes STANDARD Manhole Sizes STANDARD

                       FSR Rainfall Model - England and Wales
              Return Period (years)        2                    PIMP (%)    100
                          M5-60 (mm)  17.000      Add Flow / Climate Change (%)      0
                             Ratio R   0.328        Minimum Backdrop Height (m)  0.000
            Maximum Rainfall (mm/hr)      50        Maximum Backdrop Height (m)  0.000
Maximum Time of Concentration (mins)      30 Min Design Depth for Optimisation (m)  1.200
              Foul Sewage (l/s/ha)   0.000     Min Vel for Auto Design only (m/s)   1.00
            Volumetric Runoff Coeff.   0.750       Min Slope for Optimisation (1:X)    500

                           Designed with Level Soffits
```

### Simulation Criteria for S08-08

```
         Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 0.000
          Areal Reduction Factor 1.000       MADD Factor * 10m³/ha Storage 2.000
                Hot Start (mins)     0                  Inlet Coeffiecient 0.800
              Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
    Manhole Headloss Coeff (Global) 0.500                     Run Time (mins)    60
     Foul Sewage per hectare (l/s) 0.000               Output Interval (mins)     1

         Number of Input Hydrographs 0 Number of Storage Structures 0
           Number of Online Controls 1 Number of Time/Area Diagrams 0
          Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
              Rainfall Model                FSR          Profile Type  Summer
         Return Period (years)                5           Cv (Summer)   0.750
                          Region England and Wales           Cv (Winter)   0.840
                  M5-60 (mm)             17.000 Storm Duration (mins)      30
                     Ratio R              0.328
```

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-08

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 1 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Ratio R | 0.328 |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 17.000 | Cv (Winter) | 0.840 |

| | |
|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 |
| Analysis Timestep | 2.5 Second Increment (Extended) |
| DTS Status | ON |
| DVD Status | ON |
| Inertia Status | ON |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S08-08-1.000 | S08-08-1 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-08-1.001 | S08-08-2 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-08-1.002 | S08-08-3 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-08-1.003 | S08-08-4 | 120 Winter | 5 | +20% | | | |
| S08-08-1.004 | S08-08-5 | 120 Winter | 5 | +20% | 100/60 Winter | | |
| S08-08-1.005 | S08-08-6 | 120 Winter | 5 | +20% | 5/15 Summer | | |
| S08-08-1.006 | S08-08-7 | 480 Summer | 5 | +20% | | | |
| S08-08-1.007 | S08-08-8 | 480 Winter | 5 | +20% | | | |
| S08-08-1.008 | S08-08-9 | 480 Winter | 5 | +20% | | | |

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-08-1.000 | S08-08-1 | | 217.273 | -0.055 | 0.000 | 0.70 | | |
| S08-08-1.001 | S08-08-2 | | 216.932 | -0.056 | 0.000 | 0.71 | | |
| S08-08-1.002 | S08-08-3 | | 216.587 | -0.034 | 0.000 | 0.96 | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-08

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-08-1.003 | S08-08-4 | | 213.769 | -0.911 | 0.000 | 0.00 | | |
| S08-08-1.004 | S08-08-5 | | 213.769 | -0.327 | 0.000 | 0.01 | | |
| S08-08-1.005 | S08-08-6 | | 213.769 | 0.264 | 0.000 | 0.27 | | |
| S08-08-1.006 | S08-08-7 | | 213.307 | -0.096 | 0.000 | 0.28 | | |
| S08-08-1.007 | S08-08-8 | | 213.230 | -0.098 | 0.000 | 0.26 | | |
| S08-08-1.008 | S08-08-9 | | 213.144 | -0.098 | 0.000 | 0.26 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S08-08-1.000 | S08-08-1 | 14.6 | OK | |
| S08-08-1.001 | S08-08-2 | 14.7 | OK | |
| S08-08-1.002 | S08-08-3 | 24.6 | OK | |
| S08-08-1.003 | S08-08-4 | 14.2 | OK | |
| S08-08-1.004 | S08-08-5 | 11.1 | OK | |
| S08-08-1.005 | S08-08-6 | 3.5 | SURCHARGED | |
| S08-08-1.006 | S08-08-7 | 3.5 | OK | |
| S08-08-1.007 | S08-08-8 | 3.5 | OK | |
| S08-08-1.008 | S08-08-9 | 3.5 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-08

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m$^3$/ha Storage | 2.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 1 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Ratio R | 0.328 |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 17.000 | Cv (Winter) | 0.840 |

| | |
|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 |
| Analysis Timestep | 2.5 Second Increment (Extended) |
| DTS Status | ON |
| DVD Status | ON |
| Inertia Status | ON |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S08-08-1.000 | S08-08-1 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-08-1.001 | S08-08-2 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-08-1.002 | S08-08-3 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-08-1.003 | S08-08-4 | 240 Winter | 100 | +40% | | | |
| S08-08-1.004 | S08-08-5 | 240 Winter | 100 | +40% | 100/60 Winter | | |
| S08-08-1.005 | S08-08-6 | 240 Winter | 100 | +40% | 5/15 Summer | | |
| S08-08-1.006 | S08-08-7 | 240 Winter | 100 | +40% | | | |
| S08-08-1.007 | S08-08-8 | 240 Winter | 100 | +40% | | | |
| S08-08-1.008 | S08-08-9 | 240 Winter | 100 | +40% | | | |

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m$^3$) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-08-1.000 | S08-08-1 | | 218.251 | 0.923 | 0.000 | 1.09 | | |
| S08-08-1.001 | S08-08-2 | | 217.836 | 0.848 | 0.000 | 1.13 | | |
| S08-08-1.002 | S08-08-3 | | 217.441 | 0.820 | 0.000 | 1.48 | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-08

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-08-1.003 | S08-08-4 | | 214.383 | -0.297 | 0.000 | 0.00 | | |
| S08-08-1.004 | S08-08-5 | | 214.383 | 0.287 | 0.000 | 0.01 | | |
| S08-08-1.005 | S08-08-6 | | 214.399 | 0.894 | 0.000 | 0.27 | | |
| S08-08-1.006 | S08-08-7 | | 213.307 | -0.096 | 0.000 | 0.28 | | |
| S08-08-1.007 | S08-08-8 | | 213.230 | -0.098 | 0.000 | 0.26 | | |
| S08-08-1.008 | S08-08-9 | | 213.144 | -0.098 | 0.000 | 0.26 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S08-08-1.000 | S08-08-1 | 22.5 | FLOOD RISK | |
| S08-08-1.001 | S08-08-2 | 23.5 | SURCHARGED | |
| S08-08-1.002 | S08-08-3 | 38.0 | SURCHARGED | |
| S08-08-1.003 | S08-08-4 | 19.3 | OK | |
| S08-08-1.004 | S08-08-5 | 11.0 | SURCHARGED | |
| S08-08-1.005 | S08-08-6 | 3.5 | FLOOD RISK | |
| S08-08-1.006 | S08-08-7 | 3.5 | OK | |
| S08-08-1.007 | S08-08-8 | 3.5 | OK | |
| S08-08-1.008 | S08-08-9 | 3.5 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for S08-09

```
                  Pipe Sizes STANDARD Manhole Sizes STANDARD

                    FSR Rainfall Model - England and Wales
          Return Period (years)       2                      PIMP (%)    100
                     M5-60 (mm)  17.000        Add Flow / Climate Change (%)      0
                        Ratio R   0.328          Minimum Backdrop Height (m)  0.000
       Maximum Rainfall (mm/hr)      50          Maximum Backdrop Height (m)  0.000
Maximum Time of Concentration (mins)      30 Min Design Depth for Optimisation (m)  1.200
           Foul Sewage (l/s/ha)   0.000     Min Vel for Auto Design only (m/s)   1.00
        Volumetric Runoff Coeff.   0.750       Min Slope for Optimisation (1:X)    500

                         Designed with Level Soffits
```

### Simulation Criteria for S08-09

```
        Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 0.000
         Areal Reduction Factor 1.000         MADD Factor * 10m³/ha Storage 2.000
                Hot Start (mins)     0                     Inlet Coeffiecient 0.800
             Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
    Manhole Headloss Coeff (Global) 0.500                      Run Time (mins)    60
     Foul Sewage per hectare (l/s) 0.000                Output Interval (mins)     1

           Number of Input Hydrographs 0 Number of Storage Structures 0
            Number of Online Controls 1 Number of Time/Area Diagrams 0
           Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
              Rainfall Model                FSR          Profile Type  Summer
          Return Period (years)                5            Cv (Summer)   0.750
                        Region England and Wales            Cv (Winter)   0.840
                    M5-60 (mm)            17.000 Storm Duration (mins)      30
                       Ratio R             0.328
```

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-09

### Simulation Criteria

```
          Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 0.000
                Hot Start (mins)     0        MADD Factor * 10m³/ha Storage 2.000
              Hot Start Level (mm)     0                 Inlet Coeffiecient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
   Foul Sewage per hectare (l/s) 0.000

        Number of Input Hydrographs 0 Number of Storage Structures 0
          Number of Online Controls 1 Number of Time/Area Diagrams 0
         Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
       Rainfall Model                FSR      Ratio R 0.328
               Region England and Wales Cv (Summer) 0.750
           M5-60 (mm)             17.000 Cv (Winter) 0.840

        Margin for Flood Risk Warning (mm) 300.0     DVD Status OFF
                         Analysis Timestep  Fine Inertia Status OFF
                                DTS Status    ON


                Profile(s)                          Summer and Winter
           Duration(s) (mins)     15, 30, 60, 120, 180, 240, 360, 480, 600,
                                    720, 960, 1440, 2160, 2880, 4320, 5760,
                                                          7200, 8640, 10080
     Return Period(s) (years)                                        5, 100
           Climate Change (%)                                        20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S08-09-1.000 | S08-09-1 | 15 Winter | 5 | +20% | | | |
| S08-09-1.001 | S08-09-2 | 15 Winter | 5 | +20% | | | |
| S08-09-1.002 | S08-09-3 | 15 Winter | 5 | +20% | | | |
| S08-09-1.003 | S08-09-4 | 15 Winter | 5 | +20% | | | |
| S08-09-1.004 | S08-09-5 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-09-1.005 | S08-09-6 | 15 Winter | 5 | +20% | | | |
| S08-09-1.006 | S08-09-7 | 15 Winter | 5 | +20% | | | |
| S08-09-1.007 | S08-09-8 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-09-1.008 | S08-09-9 | 30 Winter | 5 | +20% | 100/30 Winter | | |
| S08-09-1.009 | S08-09-10 | 30 Winter | 5 | +20% | 100/30 Winter | | |
| S08-09-1.010 | S08-09-11 | 30 Winter | 5 | +20% | 100/30 Summer | | |
| S08-09-1.011 | S08-09-12 | 30 Winter | 5 | +20% | 100/15 Winter | | |
| S08-09-1.012 | S08-09-13 | 30 Winter | 5 | +20% | 5/15 Summer | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-09

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-09-1.000 | S08-09-1 | | 212.507 | -0.104 | 0.000 | 0.21 | | |
| S08-09-1.001 | S08-09-2 | | 211.972 | -0.106 | 0.000 | 0.18 | | |
| S08-09-1.002 | S08-09-3 | | 210.984 | -0.100 | 0.000 | 0.23 | | |
| S08-09-1.003 | S08-09-4 | | 209.603 | -0.095 | 0.000 | 0.29 | | |
| S08-09-1.004 | S08-09-5 | | 208.704 | -0.074 | 0.000 | 0.52 | | |
| S08-09-1.005 | S08-09-6 | | 208.456 | -0.098 | 0.000 | 0.26 | | |
| S08-09-1.006 | S08-09-7 | | 207.030 | -0.088 | 0.000 | 0.36 | | |
| S08-09-1.007 | S08-09-8 | | 205.750 | -0.081 | 0.000 | 0.43 | | |
| S08-09-1.008 | S08-09-9 | | 201.551 | -0.571 | 0.000 | 0.04 | | |
| S08-09-1.009 | S08-09-10 | | 201.545 | -0.477 | 0.000 | 0.06 | | |
| S08-09-1.010 | S08-09-11 | | 201.544 | -0.405 | 0.000 | 0.06 | | |
| S08-09-1.011 | S08-09-12 | | 201.542 | -0.356 | 0.000 | 0.03 | | |
| S08-09-1.012 | S08-09-13 | | 201.541 | 0.418 | 0.000 | 0.51 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S08-09-1.000 | S08-09-1 | 7.2 | OK | |
| S08-09-1.001 | S08-09-2 | 7.1 | OK | |
| S08-09-1.002 | S08-09-3 | 10.0 | OK | |
| S08-09-1.003 | S08-09-4 | 12.4 | OK | |
| S08-09-1.004 | S08-09-5 | 12.5 | OK | |
| S08-09-1.005 | S08-09-6 | 12.5 | OK | |
| S08-09-1.006 | S08-09-7 | 17.1 | OK | |
| S08-09-1.007 | S08-09-8 | 19.0 | OK | |
| S08-09-1.008 | S08-09-9 | 19.7 | OK | |
| S08-09-1.009 | S08-09-10 | 21.1 | OK | |
| S08-09-1.010 | S08-09-11 | 19.2 | OK | |
| S08-09-1.011 | S08-09-12 | 17.9 | OK | |
| S08-09-1.012 | S08-09-13 | 11.7 | SURCHARGED | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-09

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 1 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Ratio R | 0.328 |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 17.000 | Cv (Winter) | 0.840 |

| | | | |
|---|---|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 | DVD Status | OFF |
| Analysis Timestep | Fine | Inertia Status | OFF |
| DTS Status | ON | | |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| **PN** | **US/MH Name** | **Storm** | **Return Period** | **Climate Change** | **First (X) Surcharge** | **First (Y) Flood** | **First (Z) Overflow** |
|---|---|---|---|---|---|---|---|
| S08-09-1.000 | S08-09-1 | 15 Winter | 100 | +40% | | | |
| S08-09-1.001 | S08-09-2 | 15 Winter | 100 | +40% | | | |
| S08-09-1.002 | S08-09-3 | 15 Winter | 100 | +40% | | | |
| S08-09-1.003 | S08-09-4 | 15 Winter | 100 | +40% | | | |
| S08-09-1.004 | S08-09-5 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-09-1.005 | S08-09-6 | 15 Winter | 100 | +40% | | | |
| S08-09-1.006 | S08-09-7 | 15 Winter | 100 | +40% | | | |
| S08-09-1.007 | S08-09-8 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-09-1.008 | S08-09-9 | 60 Winter | 100 | +40% | 100/30 Winter | | |
| S08-09-1.009 | S08-09-10 | 60 Winter | 100 | +40% | 100/30 Winter | | |
| S08-09-1.010 | S08-09-11 | 60 Winter | 100 | +40% | 100/30 Summer | | |
| S08-09-1.011 | S08-09-12 | 60 Winter | 100 | +40% | 100/15 Winter | | |
| S08-09-1.012 | S08-09-13 | 60 Winter | 100 | +40% | 5/15 Summer | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-09

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-09-1.000 | S08-09-1 | | 212.532 | -0.079 | 0.000 | 0.45 | | |
| S08-09-1.001 | S08-09-2 | | 211.995 | -0.083 | 0.000 | 0.40 | | |
| S08-09-1.002 | S08-09-3 | | 211.015 | -0.070 | 0.000 | 0.54 | | |
| S08-09-1.003 | S08-09-4 | | 209.641 | -0.057 | 0.000 | 0.69 | | |
| S08-09-1.004 | S08-09-5 | | 208.884 | 0.106 | 0.000 | 1.22 | | |
| S08-09-1.005 | S08-09-6 | | 208.490 | -0.064 | 0.000 | 0.62 | | |
| S08-09-1.006 | S08-09-7 | | 207.078 | -0.040 | 0.000 | 0.87 | | |
| S08-09-1.007 | S08-09-8 | | 205.895 | 0.063 | 0.000 | 1.01 | | |
| S08-09-1.008 | S08-09-9 | | 202.748 | 0.626 | 0.000 | 0.07 | | |
| S08-09-1.009 | S08-09-10 | | 202.747 | 0.725 | 0.000 | 0.08 | | |
| S08-09-1.010 | S08-09-11 | | 202.746 | 0.797 | 0.000 | 0.06 | | |
| S08-09-1.011 | S08-09-12 | | 202.744 | 0.846 | 0.000 | 0.02 | | |
| S08-09-1.012 | S08-09-13 | | 202.743 | 1.620 | 0.000 | 0.51 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S08-09-1.000 | S08-09-1 | 15.8 | OK | |
| S08-09-1.001 | S08-09-2 | 15.6 | OK | |
| S08-09-1.002 | S08-09-3 | 23.2 | OK | |
| S08-09-1.003 | S08-09-4 | 29.7 | OK | |
| S08-09-1.004 | S08-09-5 | 29.5 | SURCHARGED | |
| S08-09-1.005 | S08-09-6 | 29.5 | OK | |
| S08-09-1.006 | S08-09-7 | 40.9 | OK | |
| S08-09-1.007 | S08-09-8 | 44.6 | SURCHARGED | |
| S08-09-1.008 | S08-09-9 | 30.9 | SURCHARGED | |
| S08-09-1.009 | S08-09-10 | 27.0 | SURCHARGED | |
| S08-09-1.010 | S08-09-11 | 18.6 | SURCHARGED | |
| S08-09-1.011 | S08-09-12 | 14.5 | SURCHARGED | |
| S08-09-1.012 | S08-09-13 | 11.7 | FLOOD RISK | |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for S08-10

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 2 | PIMP (%) | 100 |
| M5-60 (mm) | 17.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.328 | Minimum Backdrop Height (m) | 0.000 |
| Maximum Rainfall (mm/hr) | 50 | Maximum Backdrop Height (m) | 0.000 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

## Simulation Criteria for S08-10

| | | | |
|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Additional Flow - % of Total Flow | 0.000 |
| Areal Reduction Factor | 1.000 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start (mins) | 0 | Inlet Coeffiecient | 0.800 |
| Hot Start Level (mm) | 0 | Flow per Person per Day (l/per/day) | 0.000 |
| Manhole Headloss Coeff (Global) | 0.500 | Run Time (mins) | 60 |
| Foul Sewage per hectare (l/s) | 0.000 | Output Interval (mins) | 1 |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

## Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Profile Type | Summer |
| Return Period (years) | 5 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 17.000 | Storm Duration (mins) | 30 |
| Ratio R | 0.328 | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-10

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 0 |
| Number of Online Controls | 0 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Ratio R | 0.328 |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 17.000 | Cv (Winter) | 0.840 |

| | | | |
|---|---|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 | DVD Status | OFF |
| Analysis Timestep | Fine | Inertia Status | OFF |
| DTS Status | ON | | |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S08-10-1.000 | S08-10-1 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| S08-10-2.000 | S08-10-2 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-10-2.001 | S08-10-3 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-10-2.002 | S08-10-4 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-10-2.003 | S08-10-5 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-10-1.001 | S08-10-6 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-10-3.000 | S08-10-7 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S08-10-3.001 | S08-10-8 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| S08-10-3.002 | S08-10-9 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S08-10-3.003 | S08-10-10 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S08-10-1.002 | S08-10-11 | 15 Winter | 5 | +20% | 5/15 Summer | | |

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-10-1.000 | S08-10-1 | | 152.260 | -0.033 | 0.000 | 0.93 | | |
| S08-10-2.000 | S08-10-2 | | 152.323 | -0.059 | 0.000 | 0.66 | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-10

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-10-2.001 | S08-10-3 |  | 151.925 | -0.056 | 0.000 | 0.72 |  |  |
| S08-10-2.002 | S08-10-4 |  | 151.848 | -0.037 | 0.000 | 0.89 |  |  |
| S08-10-2.003 | S08-10-5 |  | 150.850 | -0.071 | 0.000 | 0.54 |  |  |
| S08-10-1.001 | S08-10-6 |  | 150.187 | -0.072 | 0.000 | 0.79 |  |  |
| S08-10-3.000 | S08-10-7 |  | 152.156 | -0.071 | 0.000 | 0.52 |  |  |
| S08-10-3.001 | S08-10-8 |  | 150.793 | -0.039 | 0.000 | 0.89 |  |  |
| S08-10-3.002 | S08-10-9 |  | 149.700 | 0.331 | 0.000 | 1.03 |  |  |
| S08-10-3.003 | S08-10-10 |  | 148.456 | 0.304 | 0.000 | 1.03 |  |  |
| S08-10-1.002 | S08-10-11 |  | 148.389 | 0.334 | 0.000 | 1.08 |  |  |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S08-10-1.000 | S08-10-1 | 26.9 | OK | 4 |
| S08-10-2.000 | S08-10-2 | 11.2 | OK |  |
| S08-10-2.001 | S08-10-3 | 11.3 | OK |  |
| S08-10-2.002 | S08-10-4 | 20.7 | OK |  |
| S08-10-2.003 | S08-10-5 | 20.8 | OK |  |
| S08-10-1.001 | S08-10-6 | 69.8 | OK |  |
| S08-10-3.000 | S08-10-7 | 14.9 | OK |  |
| S08-10-3.001 | S08-10-8 | 26.8 | OK | 5 |
| S08-10-3.002 | S08-10-9 | 31.6 | SURCHARGED | 6 |
| S08-10-3.003 | S08-10-10 | 36.6 | SURCHARGED | 5 |
| S08-10-1.002 | S08-10-11 | 94.2 | SURCHARGED |  |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-10

### Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0 Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0 Number of Storage Structures 0
Number of Online Controls 0 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.328
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 17.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S08-10-1.000 | S08-10-1 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| S08-10-2.000 | S08-10-2 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-10-2.001 | S08-10-3 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-10-2.002 | S08-10-4 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-10-2.003 | S08-10-5 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-10-1.001 | S08-10-6 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-10-3.000 | S08-10-7 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S08-10-3.001 | S08-10-8 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| S08-10-3.002 | S08-10-9 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S08-10-3.003 | S08-10-10 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S08-10-1.002 | S08-10-11 | 15 Winter | 100 | +40% | 5/15 Summer | | |

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-10-1.000 | S08-10-1 | | 153.497 | 1.204 | 3.606 | 1.13 | | |
| S08-10-2.000 | S08-10-2 | | 153.353 | 0.971 | 0.000 | 0.91 | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S08-10

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S08-10-2.001 | S08-10-3 | | 153.042 | 1.061 | 0.000 | 1.16 | | |
| S08-10-2.002 | S08-10-4 | | 152.960 | 1.074 | 0.000 | 1.16 | | |
| S08-10-2.003 | S08-10-5 | | 151.674 | 0.753 | 0.000 | 0.82 | | |
| S08-10-1.001 | S08-10-6 | | 151.399 | 1.139 | 0.000 | 1.04 | | |
| S08-10-3.000 | S08-10-7 | | 153.109 | 0.881 | 0.000 | 0.86 | | |
| S08-10-3.001 | S08-10-8 | | 152.035 | 1.204 | 3.773 | 1.00 | | |
| S08-10-3.002 | S08-10-9 | | 150.577 | 1.208 | 8.219 | 1.40 | | |
| S08-10-3.003 | S08-10-10 | | 149.355 | 1.203 | 3.010 | 1.59 | | |
| S08-10-1.002 | S08-10-11 | | 149.330 | 1.276 | 0.000 | 1.28 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S08-10-1.000 | S08-10-1 | 32.8 | FLOOD | 4 |
| S08-10-2.000 | S08-10-2 | 15.6 | FLOOD RISK | |
| S08-10-2.001 | S08-10-3 | 18.2 | FLOOD RISK | |
| S08-10-2.002 | S08-10-4 | 26.9 | SURCHARGED | |
| S08-10-2.003 | S08-10-5 | 31.6 | SURCHARGED | |
| S08-10-1.001 | S08-10-6 | 92.1 | FLOOD RISK | |
| S08-10-3.000 | S08-10-7 | 24.6 | SURCHARGED | |
| S08-10-3.001 | S08-10-8 | 30.2 | FLOOD | 5 |
| S08-10-3.002 | S08-10-9 | 43.0 | FLOOD | 6 |
| S08-10-3.003 | S08-10-10 | 56.6 | FLOOD | 5 |
| S08-10-1.002 | S08-10-11 | 111.4 | FLOOD RISK | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for S09-01

```
                   Pipe Sizes STANDARD Manhole Sizes STANDARD

                     FSR Rainfall Model - England and Wales
              Return Period (years)       2                        PIMP (%)    100
                        M5-60 (mm)  17.000         Add Flow / Climate Change (%)      0
                           Ratio R   0.300          Minimum Backdrop Height (m)  0.000
           Maximum Rainfall (mm/hr)     200          Maximum Backdrop Height (m)  0.000
 Maximum Time of Concentration (mins)      30 Min Design Depth for Optimisation (m)  1.200
              Foul Sewage (l/s/ha)   0.000     Min Vel for Auto Design only (m/s)   1.00
           Volumetric Runoff Coeff.   0.750       Min Slope for Optimisation (1:X)    500

                         Designed with Level Soffits
```

### Simulation Criteria for S09-01

```
           Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 0.000
            Areal Reduction Factor 1.000       MADD Factor * 10m³/ha Storage 2.000
                   Hot Start (mins)     0                   Inlet Coeffiecient 0.800
               Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
      Manhole Headloss Coeff (Global) 0.500                      Run Time (mins)    60
        Foul Sewage per hectare (l/s) 0.000                Output Interval (mins)     1

            Number of Input Hydrographs 0 Number of Storage Structures 1
              Number of Online Controls 1 Number of Time/Area Diagrams 0
             Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
               Rainfall Model                FSR          Profile Type  Summer
          Return Period (years)                2           Cv (Summer)   0.750
                      Region England and Wales           Cv (Winter)   0.840
                   M5-60 (mm)             17.000 Storm Duration (mins)      30
                      Ratio R              0.400
```

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-01

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 1 |
| Number of Online Controls | 1 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Ratio R | 0.300 |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 17.000 | Cv (Winter) | 0.840 |

| | |
|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 |
| Analysis Timestep | 2.5 Second Increment (Extended) |
| DTS Status | ON |
| DVD Status | ON |
| Inertia Status | OFF |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S09-01-1.000 | S09-01-1 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| S09-01-1.001 | S09-01-2 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Summer | |
| S09-01-1.002 | S09-01-3 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Winter | |
| S09-01-1.003 | S09-01-4 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-01-1.004 | S09-01-5 | 30 Winter | 5 | +20% | 5/15 Winter | | |
| S09-01-1.005 | S09-01-6 | 30 Winter | 5 | +20% | 100/15 Winter | | |
| S09-01-1.006 | S09-01-7 | 30 Winter | 5 | +20% | 100/15 Summer | | |
| S09-01-1.007 | S09-01-8 | 30 Winter | 5 | +20% | 100/15 Summer | | |
| S09-01-1.008 | S09-01-9 | 30 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| S09-01-1.009 | S09-01-10 | 30 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| S09-01-1.010 | S09-01-11 | 30 Winter | 5 | +20% | 5/15 Winter | 100/15 Summer | |
| S09-01-1.011 | S09-01-12 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-01-2.000 | S09-01-13 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-01-2.001 | S09-01-14 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Winter | |
| S09-01-2.002 | S09-01-15 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Winter | |
| S09-01-2.003 | S09-01-16 | 15 Winter | 5 | +20% | 5/15 Summer | | |
| S09-01-2.004 | S09-01-17 | 30 Winter | 5 | +20% | 5/15 Summer | | |
| S09-01-2.005 | S09-01-18 | 30 Winter | 5 | +20% | 5/15 Summer | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-01

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S09-01-1.000 | S09-01-1 | | 177.513 | -0.028 | 0.000 | 0.95 | | |
| S09-01-1.001 | S09-01-2 | | 176.945 | 0.033 | 0.000 | 0.84 | | |
| S09-01-1.002 | S09-01-3 | | 176.564 | 0.246 | 0.000 | 1.17 | | |
| S09-01-1.003 | S09-01-4 | | 175.647 | -0.076 | 0.000 | 0.87 | | |
| S09-01-1.004 | S09-01-5 | | 175.325 | 0.015 | 0.000 | 1.02 | | |
| S09-01-1.005 | S09-01-6 | | 174.755 | -0.142 | 0.000 | 0.54 | | |
| S09-01-1.006 | S09-01-7 | | 172.786 | -0.140 | 0.000 | 0.55 | | |
| S09-01-1.007 | S09-01-8 | | 170.175 | -0.133 | 0.000 | 0.59 | | |
| S09-01-1.008 | S09-01-9 | | 167.137 | -0.112 | 0.000 | 0.70 | | |
| S09-01-1.009 | S09-01-10 | | 164.362 | -0.099 | 0.000 | 0.77 | | |
| S09-01-1.010 | S09-01-11 | | 161.944 | 0.416 | 0.000 | 0.83 | | |
| S09-01-1.011 | S09-01-12 | | 161.318 | 0.700 | 0.000 | 1.48 | | |
| S09-01-2.000 | S09-01-13 | | 177.860 | 0.329 | 0.000 | 1.12 | | |
| S09-01-2.001 | S09-01-14 | | 176.590 | 0.017 | 0.000 | 0.81 | | |
| S09-01-2.002 | S09-01-15 | | 176.374 | 0.168 | 0.000 | 1.08 | | |
| S09-01-2.003 | S09-01-16 | | 175.958 | 0.118 | 0.000 | 1.37 | | |
| S09-01-2.004 | S09-01-17 | | 175.863 | 0.086 | 0.000 | 0.83 | | |
| S09-01-2.005 | S09-01-18 | | 175.695 | 0.165 | 0.000 | 1.02 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S09-01-1.000 | S09-01-1 | 16.6 | OK | 6 |
| S09-01-1.001 | S09-01-2 | 32.8 | SURCHARGED | 4 |
| S09-01-1.002 | S09-01-3 | 45.6 | SURCHARGED | 1 |
| S09-01-1.003 | S09-01-4 | 60.1 | OK | |
| S09-01-1.004 | S09-01-5 | 70.4 | SURCHARGED | |
| S09-01-1.005 | S09-01-6 | 81.7 | OK | |
| S09-01-1.006 | S09-01-7 | 96.4 | OK | |
| S09-01-1.007 | S09-01-8 | 111.3 | OK | |
| S09-01-1.008 | S09-01-9 | 127.1 | OK | 6 |
| S09-01-1.009 | S09-01-10 | 143.4 | OK | 7 |
| S09-01-1.010 | S09-01-11 | 141.4 | SURCHARGED | 9 |
| S09-01-1.011 | S09-01-12 | 142.9 | SURCHARGED | 10 |
| S09-01-2.000 | S09-01-13 | 19.8 | SURCHARGED | 7 |
| S09-01-2.001 | S09-01-14 | 31.2 | SURCHARGED | 2 |
| S09-01-2.002 | S09-01-15 | 41.7 | SURCHARGED | 2 |
| S09-01-2.003 | S09-01-16 | 46.0 | SURCHARGED | |
| S09-01-2.004 | S09-01-17 | 56.5 | SURCHARGED | |
| S09-01-2.005 | S09-01-18 | 58.7 | SURCHARGED | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-01

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood |
|---|---|---|---|---|---|---|
| S09-01-2.006 | S09-01-19 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S09-01-2.007 | S09-01-20 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S09-01-2.008 | S09-01-21 | 30 Winter | 5 | +20% | 100/15 Summer | |
| S09-01-2.009 | S09-01-22 | 30 Winter | 5 | +20% | 100/15 Summer | |
| S09-01-2.010 | S09-01-23 | 30 Winter | 5 | +20% | 100/15 Summer | |
| S09-01-2.011 | S09-01-24 | 30 Winter | 5 | +20% | 5/15 Winter | |
| S09-01-3.000 | S09-01-25 | 15 Winter | 5 | +20% | | |
| S09-01-3.001 | S09-01-26 | 15 Winter | 5 | +20% | | |
| S09-01-3.002 | S09-01-27 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-01-3.003 | S09-01-28 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-01-2.012 | S09-01-29 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S09-01-4.000 | S09-01-30 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer |
| S09-01-4.001 | S09-01-31 | 15 Winter | 5 | +20% | 5/15 Summer | |
| S09-01-2.013 | S09-01-32 | 30 Winter | 5 | +20% | 100/15 Summer | |
| S09-01-2.014 | S09-01-33 | 30 Winter | 5 | +20% | 100/15 Summer | |
| S09-01-2.015 | S09-01-34 | 30 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter |
| S09-01-2.016 | S09-01-35 | 30 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer |
| S09-01-1.012 | S09-01-36 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S09-01-1.013 | S09-01-37 | 30 Winter | 5 | +20% | | |
| S09-01-1.014 | S09-01-38 | 30 Winter | 5 | +20% | | |
| S09-01-1.015 | S09-01-39 | 30 Winter | 5 | +20% | | |
| S09-01-1.016 | S09-01-40 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S09-01-1.017 | S09-01-41 | 30 Winter | 5 | +20% | 100/15 Summer | |
| S09-01-1.018 | S09-01-42 | 30 Winter | 5 | +20% | 5/30 Winter | 100/15 Winter |
| S09-01-1.019 | S09-01-43 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S09-01-1.020 | S09-01-44 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S09-01-1.021 | S09-01-Pond Inlet | 30 Winter | 5 | +20% | 5/15 Winter | |
| S09-01-1.022 | S09-01-Pond Outlet | 360 Winter | 5 | +20% | | |
| S09-01-1.023 | S09-01-45 | 360 Winter | 5 | +20% | | |

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-01-2.006 | S09-01-19 | | | 175.619 | 0.139 | 0.000 | 1.18 |
| S09-01-2.007 | S09-01-20 | | | 175.271 | 0.061 | 0.000 | 1.12 |
| S09-01-2.008 | S09-01-21 | | | 174.824 | -0.117 | 0.000 | 0.68 |
| S09-01-2.009 | S09-01-22 | | | 173.479 | -0.135 | 0.000 | 0.58 |
| S09-01-2.010 | S09-01-23 | | | 171.029 | -0.132 | 0.000 | 0.60 |
| S09-01-2.011 | S09-01-24 | | | 168.569 | 0.052 | 0.000 | 1.38 |
| S09-01-3.000 | S09-01-25 | | | 170.810 | -0.118 | 0.000 | 0.10 |
| S09-01-3.001 | S09-01-26 | | | 170.417 | -0.106 | 0.000 | 0.19 |
| S09-01-3.002 | S09-01-27 | | | 170.049 | -0.082 | 0.000 | 0.40 |
| S09-01-3.003 | S09-01-28 | | | 168.805 | -0.071 | 0.000 | 0.52 |
| S09-01-2.012 | S09-01-29 | | | 167.667 | 0.046 | 0.000 | 1.54 |
| S09-01-4.000 | S09-01-30 | | | 170.595 | -0.046 | 0.000 | 0.75 |
| S09-01-4.001 | S09-01-31 | | | 169.033 | 0.102 | 0.000 | 1.04 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-01

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-01-2.013 | S09-01-32 | | | 167.414 | -0.176 | 0.000 | 0.55 |
| S09-01-2.014 | S09-01-33 | | | 165.905 | -0.172 | 0.000 | 0.56 |
| S09-01-2.015 | S09-01-34 | | | 163.686 | -0.155 | 0.000 | 0.65 |
| S09-01-2.016 | S09-01-35 | | | 162.005 | -0.146 | 0.000 | 0.68 |
| S09-01-1.012 | S09-01-36 | | | 160.605 | 0.324 | 0.000 | 1.19 |
| S09-01-1.013 | S09-01-37 | | | 159.319 | -0.141 | 0.000 | 0.71 |
| S09-01-1.014 | S09-01-38 | | | 157.503 | -0.176 | 0.000 | 0.55 |
| S09-01-1.015 | S09-01-39 | | | 146.947 | -0.153 | 0.000 | 0.66 |
| S09-01-1.016 | S09-01-40 | | | 142.058 | 0.158 | 0.000 | 1.38 |
| S09-01-1.017 | S09-01-41 | | | 141.533 | -0.167 | 0.000 | 0.72 |
| S09-01-1.018 | S09-01-42 | | | 140.606 | 0.006 | 0.000 | 0.95 |
| S09-01-1.019 | S09-01-43 | | | 139.710 | 0.110 | 0.000 | 1.22 |
| S09-01-1.020 | S09-01-44 | | | 139.596 | 0.073 | 0.000 | 2.02 |
| S09-01-1.021 | S09-01-Pond Inlet | | | 139.522 | 0.028 | 0.000 | 1.19 |
| S09-01-1.022 | S09-01-Pond Outlet | | | 139.041 | -0.314 | 0.000 | 0.20 |
| S09-01-1.023 | S09-01-45 | | | 138.829 | -0.211 | 0.000 | 0.19 |

| PN | US/MH Name | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|
| S09-01-2.006 | S09-01-19 | | | 80.0 | SURCHARGED | |
| S09-01-2.007 | S09-01-20 | | | 76.2 | SURCHARGED | |
| S09-01-2.008 | S09-01-21 | | | 84.5 | OK | |
| S09-01-2.009 | S09-01-22 | | | 97.5 | OK | |
| S09-01-2.010 | S09-01-23 | | | 111.4 | OK | |
| S09-01-2.011 | S09-01-24 | | | 111.6 | SURCHARGED | |
| S09-01-3.000 | S09-01-25 | | | 2.3 | OK | |
| S09-01-3.001 | S09-01-26 | | | 4.2 | OK | |
| S09-01-3.002 | S09-01-27 | | | 9.1 | OK | |
| S09-01-3.003 | S09-01-28 | | | 11.9 | OK | |
| S09-01-2.012 | S09-01-29 | | | 121.2 | SURCHARGED | |
| S09-01-4.000 | S09-01-30 | | | 17.3 | OK | 4 |
| S09-01-4.001 | S09-01-31 | | | 23.9 | SURCHARGED | |
| S09-01-2.013 | S09-01-32 | | | 147.6 | OK | |
| S09-01-2.014 | S09-01-33 | | | 184.4 | OK | |
| S09-01-2.015 | S09-01-34 | | | 203.9 | OK | 5 |
| S09-01-2.016 | S09-01-35 | | | 218.9 | OK | 6 |
| S09-01-1.012 | S09-01-36 | | | 347.6 | SURCHARGED | |
| S09-01-1.013 | S09-01-37 | | | 347.2 | OK | |
| S09-01-1.014 | S09-01-38 | | | 347.5 | OK | |
| S09-01-1.015 | S09-01-39 | | | 347.6 | OK | |
| S09-01-1.016 | S09-01-40 | | | 347.6 | SURCHARGED | |
| S09-01-1.017 | S09-01-41 | | | 347.3 | OK | |
| S09-01-1.018 | S09-01-42 | | | 343.8 | SURCHARGED | 5 |
| S09-01-1.019 | S09-01-43 | | | 342.1 | SURCHARGED | |
| S09-01-1.020 | S09-01-44 | | | 341.9 | SURCHARGED | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-01

| PN | US/MH Name | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|
| S09-01-1.021 | S09-01-Pond Inlet | | | 339.8 | SURCHARGED | |
| S09-01-1.022 | S09-01-Pond Outlet | | | 40.5 | OK | |
| S09-01-1.023 | S09-01-45 | | | 40.5 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-01

### Simulation Criteria

```
           Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 0.000
                 Hot Start (mins)     0        MADD Factor * 10m³/ha Storage 2.000
               Hot Start Level (mm)     0                 Inlet Coeffiecient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
    Foul Sewage per hectare (l/s) 0.000

            Number of Input Hydrographs 0 Number of Storage Structures 1
              Number of Online Controls 1 Number of Time/Area Diagrams 0
             Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
                 Rainfall Model                 FSR      Ratio R 0.300
                         Region England and Wales Cv (Summer) 0.750
                     M5-60 (mm)              17.000 Cv (Winter) 0.840

          Margin for Flood Risk Warning (mm)                            300.0
                        Analysis Timestep 2.5 Second Increment (Extended)
                               DTS Status                                 ON
                               DVD Status                                 ON
                           Inertia Status                                OFF


                      Profile(s)                           Summer and Winter
                  Duration(s) (mins)     15, 30, 60, 120, 180, 240, 360, 480, 600,
                                                              720, 960, 1440
            Return Period(s) (years)                                  5, 100
                  Climate Change (%)                                  20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S09-01-1.000 | S09-01-1 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| S09-01-1.001 | S09-01-2 | 15 Winter | 100 | +40% | 5/15 Winter | 100/15 Summer | |
| S09-01-1.002 | S09-01-3 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Winter | |
| S09-01-1.003 | S09-01-4 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S09-01-1.004 | S09-01-5 | 30 Winter | 100 | +40% | 5/15 Winter | | |
| S09-01-1.005 | S09-01-6 | 30 Winter | 100 | +40% | 100/15 Winter | | |
| S09-01-1.006 | S09-01-7 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S09-01-1.007 | S09-01-8 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S09-01-1.008 | S09-01-9 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| S09-01-1.009 | S09-01-10 | 60 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| S09-01-1.010 | S09-01-11 | 60 Winter | 100 | +40% | 5/15 Winter | 100/15 Summer | |
| S09-01-1.011 | S09-01-12 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S09-01-2.000 | S09-01-13 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S09-01-2.001 | S09-01-14 | 15 Winter | 100 | +40% | 5/15 Winter | 100/15 Winter | |
| S09-01-2.002 | S09-01-15 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Winter | |
| S09-01-2.003 | S09-01-16 | 30 Winter | 100 | +40% | 5/15 Summer | | |
| S09-01-2.004 | S09-01-17 | 30 Winter | 100 | +40% | 5/15 Summer | | |
| S09-01-2.005 | S09-01-18 | 30 Winter | 100 | +40% | 5/15 Summer | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-01

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S09-01-1.000 | S09-01-1 | | 178.754 | 1.213 | 13.275 | 1.66 | | |
| S09-01-1.001 | S09-01-2 | | 179.077 | 2.165 | 3.981 | 0.92 | | |
| S09-01-1.002 | S09-01-3 | | 179.161 | 2.843 | 0.072 | 1.65 | | |
| S09-01-1.003 | S09-01-4 | | 177.397 | 1.674 | 0.000 | 1.45 | | |
| S09-01-1.004 | S09-01-5 | | 176.475 | 1.165 | 0.000 | 1.84 | | |
| S09-01-1.005 | S09-01-6 | | 175.096 | 0.199 | 0.000 | 0.93 | | |
| S09-01-1.006 | S09-01-7 | | 173.526 | 0.600 | 0.000 | 0.91 | | |
| S09-01-1.007 | S09-01-8 | | 171.395 | 1.087 | 0.000 | 0.98 | | |
| S09-01-1.008 | S09-01-9 | | 168.464 | 1.216 | 15.570 | 1.00 | | |
| S09-01-1.009 | S09-01-10 | | 165.678 | 1.217 | 17.234 | 1.00 | | |
| S09-01-1.010 | S09-01-11 | | 162.763 | 1.235 | 34.925 | 1.00 | | |
| S09-01-1.011 | S09-01-12 | | 161.881 | 1.262 | 62.458 | 2.16 | | |
| S09-01-2.000 | S09-01-13 | | 178.750 | 1.219 | 19.321 | 1.50 | | |
| S09-01-2.001 | S09-01-14 | | 179.155 | 2.582 | 0.523 | 0.86 | | |
| S09-01-2.002 | S09-01-15 | | 179.066 | 2.860 | 0.599 | 1.39 | | |
| S09-01-2.003 | S09-01-16 | | 178.652 | 2.812 | 0.000 | 1.62 | | |
| S09-01-2.004 | S09-01-17 | | 178.517 | 2.739 | 0.000 | 1.28 | | |
| S09-01-2.005 | S09-01-18 | | 178.159 | 2.629 | 0.000 | 1.53 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S09-01-1.000 | S09-01-1 | 28.9 | FLOOD | 6 |
| S09-01-1.001 | S09-01-2 | 36.2 | FLOOD | 4 |
| S09-01-1.002 | S09-01-3 | 64.4 | FLOOD | 1 |
| S09-01-1.003 | S09-01-4 | 99.8 | SURCHARGED | |
| S09-01-1.004 | S09-01-5 | 126.5 | SURCHARGED | |
| S09-01-1.005 | S09-01-6 | 141.5 | SURCHARGED | |
| S09-01-1.006 | S09-01-7 | 159.5 | SURCHARGED | |
| S09-01-1.007 | S09-01-8 | 184.9 | FLOOD RISK | |
| S09-01-1.008 | S09-01-9 | 180.5 | FLOOD | 6 |
| S09-01-1.009 | S09-01-10 | 185.1 | FLOOD | 7 |
| S09-01-1.010 | S09-01-11 | 170.8 | FLOOD | 9 |
| S09-01-1.011 | S09-01-12 | 209.3 | FLOOD | 10 |
| S09-01-2.000 | S09-01-13 | 26.5 | FLOOD | 7 |
| S09-01-2.001 | S09-01-14 | 33.4 | FLOOD | 2 |
| S09-01-2.002 | S09-01-15 | 53.6 | FLOOD | 2 |
| S09-01-2.003 | S09-01-16 | 54.4 | FLOOD RISK | |
| S09-01-2.004 | S09-01-17 | 86.4 | FLOOD RISK | |
| S09-01-2.005 | S09-01-18 | 88.3 | FLOOD RISK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-01

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood |
|---|---|---|---|---|---|---|
| S09-01-2.006 | S09-01-19 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-01-2.007 | S09-01-20 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-01-2.008 | S09-01-21 | 30 Winter | 100 | +40% | 100/15 Summer | |
| S09-01-2.009 | S09-01-22 | 30 Winter | 100 | +40% | 100/15 Summer | |
| S09-01-2.010 | S09-01-23 | 30 Summer | 100 | +40% | 100/15 Summer | |
| S09-01-2.011 | S09-01-24 | 30 Winter | 100 | +40% | 5/15 Winter | |
| S09-01-3.000 | S09-01-25 | 15 Winter | 100 | +40% | | |
| S09-01-3.001 | S09-01-26 | 15 Winter | 100 | +40% | | |
| S09-01-3.002 | S09-01-27 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-01-3.003 | S09-01-28 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-01-2.012 | S09-01-29 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-01-4.000 | S09-01-30 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer |
| S09-01-4.001 | S09-01-31 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-01-2.013 | S09-01-32 | 30 Winter | 100 | +40% | 100/15 Summer | |
| S09-01-2.014 | S09-01-33 | 30 Winter | 100 | +40% | 100/15 Summer | |
| S09-01-2.015 | S09-01-34 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter |
| S09-01-2.016 | S09-01-35 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer |
| S09-01-1.012 | S09-01-36 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-01-1.013 | S09-01-37 | 30 Winter | 100 | +40% | | |
| S09-01-1.014 | S09-01-38 | 30 Winter | 100 | +40% | | |
| S09-01-1.015 | S09-01-39 | 30 Winter | 100 | +40% | | |
| S09-01-1.016 | S09-01-40 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-01-1.017 | S09-01-41 | 30 Winter | 100 | +40% | 100/15 Summer | |
| S09-01-1.018 | S09-01-42 | 30 Winter | 100 | +40% | 5/30 Winter | 100/15 Winter |
| S09-01-1.019 | S09-01-43 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-01-1.020 | S09-01-44 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-01-1.021 | S09-01-Pond Inlet | 30 Winter | 100 | +40% | 5/15 Winter | |
| S09-01-1.022 | S09-01-Pond Outlet | 360 Winter | 100 | +40% | | |
| S09-01-1.023 | S09-01-45 | 360 Winter | 100 | +40% | | |

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m$^3$) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-01-2.006 | S09-01-19 | | | 178.037 | 2.557 | 0.000 | 2.05 |
| S09-01-2.007 | S09-01-20 | | | 177.041 | 1.830 | 0.000 | 1.93 |
| S09-01-2.008 | S09-01-21 | | | 176.037 | 1.096 | 0.000 | 1.23 |
| S09-01-2.009 | S09-01-22 | | | 174.029 | 0.414 | 0.000 | 1.01 |
| S09-01-2.010 | S09-01-23 | | | 171.582 | 0.421 | 0.000 | 1.03 |
| S09-01-2.011 | S09-01-24 | | | 168.878 | 0.362 | 0.000 | 2.38 |
| S09-01-3.000 | S09-01-25 | | | 170.827 | -0.101 | 0.000 | 0.22 |
| S09-01-3.001 | S09-01-26 | | | 170.444 | -0.078 | 0.000 | 0.45 |
| S09-01-3.002 | S09-01-27 | | | 170.266 | 0.134 | 0.000 | 0.91 |
| S09-01-3.003 | S09-01-28 | | | 169.510 | 0.634 | 0.000 | 0.98 |
| S09-01-2.012 | S09-01-29 | | | 168.646 | 1.025 | 0.000 | 2.70 |
| S09-01-4.000 | S09-01-30 | | | 171.842 | 1.201 | 1.213 | 0.95 |
| S09-01-4.001 | S09-01-31 | | | 170.454 | 1.523 | 0.000 | 1.37 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-01

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-01-2.013 | S09-01-32 | | | 168.366 | 0.776 | 0.000 | 0.94 |
| S09-01-2.014 | S09-01-33 | | | 167.080 | 1.003 | 0.000 | 0.95 |
| S09-01-2.015 | S09-01-34 | | | 165.048 | 1.208 | 8.153 | 1.00 |
| S09-01-2.016 | S09-01-35 | | | 163.355 | 1.204 | 4.310 | 1.03 |
| S09-01-1.012 | S09-01-36 | | | 161.374 | 1.093 | 0.000 | 1.53 |
| S09-01-1.013 | S09-01-37 | | | 159.365 | -0.095 | 0.000 | 0.91 |
| S09-01-1.014 | S09-01-38 | | | 157.539 | -0.140 | 0.000 | 0.71 |
| S09-01-1.015 | S09-01-39 | | | 146.990 | -0.110 | 0.000 | 0.85 |
| S09-01-1.016 | S09-01-40 | | | 143.073 | 1.173 | 0.000 | 1.78 |
| S09-01-1.017 | S09-01-41 | | | 142.441 | 0.741 | 0.000 | 0.92 |
| S09-01-1.018 | S09-01-42 | | | 141.505 | 0.905 | 4.780 | 1.21 |
| S09-01-1.019 | S09-01-43 | | | 140.037 | 0.437 | 0.000 | 1.57 |
| S09-01-1.020 | S09-01-44 | | | 139.844 | 0.321 | 0.000 | 2.60 |
| S09-01-1.021 | S09-01-Pond Inlet | | | 139.651 | 0.158 | 0.000 | 1.53 |
| S09-01-1.022 | S09-01-Pond Outlet | | | 139.293 | -0.061 | 0.000 | 0.41 |
| S09-01-1.023 | S09-01-45 | | | 138.870 | -0.170 | 0.000 | 0.39 |

| PN | US/MH Name | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|
| S09-01-2.006 | S09-01-19 | | | 138.9 | FLOOD RISK | |
| S09-01-2.007 | S09-01-20 | | | 131.4 | SURCHARGED | |
| S09-01-2.008 | S09-01-21 | | | 153.1 | SURCHARGED | |
| S09-01-2.009 | S09-01-22 | | | 170.8 | SURCHARGED | |
| S09-01-2.010 | S09-01-23 | | | 193.0 | SURCHARGED | |
| S09-01-2.011 | S09-01-24 | | | 192.7 | SURCHARGED | |
| S09-01-3.000 | S09-01-25 | | | 5.0 | OK | |
| S09-01-3.001 | S09-01-26 | | | 9.9 | OK | |
| S09-01-3.002 | S09-01-27 | | | 20.8 | SURCHARGED | |
| S09-01-3.003 | S09-01-28 | | | 22.5 | SURCHARGED | |
| S09-01-2.012 | S09-01-29 | | | 212.7 | SURCHARGED | |
| S09-01-4.000 | S09-01-30 | | | 21.9 | FLOOD | 4 |
| S09-01-4.001 | S09-01-31 | | | 31.4 | SURCHARGED | |
| S09-01-2.013 | S09-01-32 | | | 253.3 | SURCHARGED | |
| S09-01-2.014 | S09-01-33 | | | 310.4 | FLOOD RISK | |
| S09-01-2.015 | S09-01-34 | | | 316.4 | FLOOD | 5 |
| S09-01-2.016 | S09-01-35 | | | 332.4 | FLOOD | 6 |
| S09-01-1.012 | S09-01-36 | | | 448.0 | FLOOD RISK | |
| S09-01-1.013 | S09-01-37 | | | 448.0 | OK | |
| S09-01-1.014 | S09-01-38 | | | 448.0 | OK | |
| S09-01-1.015 | S09-01-39 | | | 448.0 | OK | |
| S09-01-1.016 | S09-01-40 | | | 447.9 | FLOOD RISK | |
| S09-01-1.017 | S09-01-41 | | | 448.0 | SURCHARGED | |
| S09-01-1.018 | S09-01-42 | | | 440.7 | FLOOD | 5 |
| S09-01-1.019 | S09-01-43 | | | 439.9 | SURCHARGED | |
| S09-01-1.020 | S09-01-44 | | | 439.9 | SURCHARGED | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-01

| PN | US/MH Name | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|
| S09-01-1.021 | S09-01-Pond Inlet | | | 439.9 | SURCHARGED | |
| S09-01-1.022 | S09-01-Pond Outlet | | | 82.0 | OK | |
| S09-01-1.023 | S09-01-45 | | | 82.0 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for S09-02

```
                    Pipe Sizes STANDARD Manhole Sizes STANDARD

                      FSR Rainfall Model - England and Wales
               Return Period (years)      2                      PIMP (%)    100
                         M5-60 (mm)  17.000        Add Flow / Climate Change (%)      0
                            Ratio R   0.300        Minimum Backdrop Height (m)  0.000
            Maximum Rainfall (mm/hr)    200        Maximum Backdrop Height (m)  0.000
Maximum Time of Concentration (mins)     30 Min Design Depth for Optimisation (m)  1.200
               Foul Sewage (l/s/ha)   0.000    Min Vel for Auto Design only (m/s)   1.00
             Volumetric Runoff Coeff.   0.750      Min Slope for Optimisation (1:X)    500

                           Designed with Level Soffits
```

### Simulation Criteria for S09-02

```
        Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 0.000
         Areal Reduction Factor 1.000     MADD Factor * 10m³/ha Storage 2.000
              Hot Start (mins)     0              Inlet Coeffiecient 0.800
            Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
   Manhole Headloss Coeff (Global) 0.500                    Run Time (mins)    60
     Foul Sewage per hectare (l/s) 0.000             Output Interval (mins)     1

          Number of Input Hydrographs 0 Number of Storage Structures 1
            Number of Online Controls 1 Number of Time/Area Diagrams 0
           Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
           Rainfall Model                FSR          Profile Type Summer
       Return Period (years)                2            Cv (Summer)  0.750
                        Region England and Wales            Cv (Winter)  0.840
                 M5-60 (mm)           17.000 Storm Duration (mins)     30
                    Ratio R            0.400
```

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-02

```
                              Simulation Criteria
             Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 0.000
                   Hot Start (mins)     0       MADD Factor * 10m³/ha Storage 2.000
                 Hot Start Level (mm)     0                 Inlet Coeffiecient 0.800
  Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
     Foul Sewage per hectare (l/s) 0.000

              Number of Input Hydrographs 0 Number of Storage Structures 1
                Number of Online Controls 1 Number of Time/Area Diagrams 0
               Number of Offline Controls 0 Number of Real Time Controls 0

                           Synthetic Rainfall Details
                    Rainfall Model                FSR      Ratio R 0.300
                           Region England and Wales Cv (Summer) 0.750
                   M5-60 (mm)               17.000 Cv (Winter) 0.840

           Margin for Flood Risk Warning (mm)                        300.0
                           Analysis Timestep 2.5 Second Increment (Extended)
                                  DTS Status                            ON
                                  DVD Status                            ON
                              Inertia Status                           OFF


                        Profile(s)                        Summer and Winter
                  Duration(s) (mins)    15, 30, 60, 120, 180, 240, 360, 480, 600,
                                                               720, 960, 1440
             Return Period(s) (years)                                   5, 100
                  Climate Change (%)                                    20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S09-02-1.000 | S09-02-1 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| S09-02-1.001 | S09-02-2 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-02-1.002 | S09-02-3 | 15 Winter | 5 | +20% | 5/15 Summer | | |
| S09-02-1.003 | S09-02-4 | 15 Winter | 5 | +20% | 5/15 Summer | | |
| S09-02-2.000 | S09-02-5 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-02-2.001 | S09-02-6 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-02-2.002 | S09-02-7 | 15 Winter | 5 | +20% | 5/15 Summer | | |
| S09-02-1.004 | S09-02-8 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-02-1.005 | S09-02-9 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-02-1.006 | S09-02-10 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-02-1.007 | S09-02-11 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-02-1.008 | S09-02-12 | 15 Winter | 5 | +20% | 100/30 Winter | | |
| S09-02-1.009 | S09-02-13 | 15 Winter | 5 | +20% | 5/15 Winter | | |
| S09-02-1.010 | S09-02-14 | 30 Winter | 5 | +20% | | | |
| S09-02-1.011 | S09-02-15 | 30 Winter | 5 | +20% | | | |
| S09-02-1.012 | S09-02-16 | 30 Winter | 5 | +20% | | | |
| S09-02-1.013 | S09-02-17 | 30 Winter | 5 | +20% | | | |
| S09-02-1.014 | S09-02-18 | 30 Winter | 5 | +20% | | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-02

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume ($m^3$) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S09-02-1.000 | S09-02-1 | | 172.241 | -0.043 | 0.000 | 0.75 | | |
| S09-02-1.001 | S09-02-2 | | 171.217 | -0.077 | 0.000 | 0.72 | | |
| S09-02-1.002 | S09-02-3 | | 170.353 | 0.050 | 0.000 | 1.07 | | |
| S09-02-1.003 | S09-02-4 | | 170.139 | 0.022 | 0.000 | 1.24 | | |
| S09-02-2.000 | S09-02-5 | | 172.345 | 0.067 | 0.000 | 0.89 | | |
| S09-02-2.001 | S09-02-6 | | 171.660 | 0.372 | 0.000 | 1.11 | | |
| S09-02-2.002 | S09-02-7 | | 170.419 | 0.122 | 0.000 | 1.19 | | |
| S09-02-1.004 | S09-02-8 | | 169.916 | -0.082 | 0.000 | 0.88 | | |
| S09-02-1.005 | S09-02-9 | | 169.822 | -0.087 | 0.000 | 0.85 | | |
| S09-02-1.006 | S09-02-10 | | 169.683 | -0.088 | 0.000 | 0.84 | | |
| S09-02-1.007 | S09-02-11 | | 169.545 | -0.091 | 0.000 | 0.83 | | |
| S09-02-1.008 | S09-02-12 | | 169.338 | -0.152 | 0.000 | 0.49 | | |
| S09-02-1.009 | S09-02-13 | | 168.479 | 0.009 | 0.000 | 1.00 | | |
| S09-02-1.010 | S09-02-14 | | 167.901 | -0.156 | 0.000 | 0.47 | | |
| S09-02-1.011 | S09-02-15 | | 165.858 | -0.174 | 0.000 | 0.37 | | |
| S09-02-1.012 | S09-02-16 | | 162.206 | -0.184 | 0.000 | 0.32 | | |
| S09-02-1.013 | S09-02-17 | | 160.944 | -0.174 | 0.000 | 0.37 | | |
| S09-02-1.014 | S09-02-18 | | 159.389 | -0.194 | 0.000 | 0.27 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S09-02-1.000 | S09-02-1 | 13.1 | OK | 3 |
| S09-02-1.001 | S09-02-2 | 36.5 | OK | |
| S09-02-1.002 | S09-02-3 | 40.0 | SURCHARGED | |
| S09-02-1.003 | S09-02-4 | 41.3 | SURCHARGED | |
| S09-02-2.000 | S09-02-5 | 15.6 | SURCHARGED | 6 |
| S09-02-2.001 | S09-02-6 | 19.3 | SURCHARGED | 6 |
| S09-02-2.002 | S09-02-7 | 20.2 | SURCHARGED | |
| S09-02-1.004 | S09-02-8 | 62.7 | OK | |
| S09-02-1.005 | S09-02-9 | 64.1 | OK | |
| S09-02-1.006 | S09-02-10 | 65.2 | OK | |
| S09-02-1.007 | S09-02-11 | 66.1 | OK | |
| S09-02-1.008 | S09-02-12 | 68.2 | OK | |
| S09-02-1.009 | S09-02-13 | 68.9 | SURCHARGED | |
| S09-02-1.010 | S09-02-14 | 71.6 | OK | |
| S09-02-1.011 | S09-02-15 | 75.6 | OK | |
| S09-02-1.012 | S09-02-16 | 76.8 | OK | |
| S09-02-1.013 | S09-02-17 | 78.6 | OK | |
| S09-02-1.014 | S09-02-18 | 78.5 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-02

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood |
|---|---|---|---|---|---|---|
| S09-02-1.015 | S09-02-19 | 30 Winter | 5 | +20% | | |
| S09-02-1.016 | S09-02-20 | 30 Winter | 5 | +20% | | |
| S09-02-1.017 | S09-02-21 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S09-02-1.018 | S09-02-22 | 30 Winter | 5 | +20% | 100/30 Winter | |
| S09-02-1.019 | S09-02-23 | 30 Winter | 5 | +20% | 100/15 Summer | 100/30 Winter |
| S09-02-1.020 | S09-02-24 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S09-02-1.021 | S09-02-Pond Inlet | 30 Winter | 5 | +20% | 5/15 Winter | |
| S09-02-1.022 | S09-02-Pond Outlet | 180 Winter | 5 | +20% | 100/60 Summer | |
| S09-02-1.023 | S09-02-25 | 180 Winter | 5 | +20% | | |

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-02-1.015 | S09-02-19 | | | 157.209 | -0.205 | 0.000 | 0.22 |
| S09-02-1.016 | S09-02-20 | | | 146.774 | -0.196 | 0.000 | 0.26 |
| S09-02-1.017 | S09-02-21 | | | 142.010 | 0.030 | 0.000 | 1.32 |
| S09-02-1.018 | S09-02-22 | | | 141.752 | -0.167 | 0.000 | 0.40 |
| S09-02-1.019 | S09-02-23 | | | 140.421 | -0.109 | 0.000 | 0.73 |
| S09-02-1.020 | S09-02-24 | | | 139.745 | 0.109 | 0.000 | 1.50 |
| S09-02-1.021 | S09-02-Pond Inlet | | | 139.651 | 0.043 | 0.000 | 1.17 |
| S09-02-1.022 | S09-02-Pond Outlet | | | 139.340 | -0.110 | 0.000 | 0.37 |
| S09-02-1.023 | S09-02-25 | | | 139.174 | -0.250 | 0.000 | 0.07 |

| PN | US/MH Name | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|
| S09-02-1.015 | S09-02-19 | | | 78.5 | OK | |
| S09-02-1.016 | S09-02-20 | | | 78.5 | OK | |
| S09-02-1.017 | S09-02-21 | | | 78.5 | SURCHARGED | |
| S09-02-1.018 | S09-02-22 | | | 78.4 | OK | |
| S09-02-1.019 | S09-02-23 | | | 77.9 | OK | 2 |
| S09-02-1.020 | S09-02-24 | | | 77.3 | SURCHARGED | |
| S09-02-1.021 | S09-02-Pond Inlet | | | 77.1 | SURCHARGED | |
| S09-02-1.022 | S09-02-Pond Outlet | | | 18.5 | OK | |
| S09-02-1.023 | S09-02-25 | | | 18.5 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-02

### Simulation Criteria

```
         Areal Reduction Factor 1.000    Additional Flow - % of Total Flow 0.000
                Hot Start (mins)     0       MADD Factor * 10m³/ha Storage 2.000
              Hot Start Level (mm)     0                  Inlet Coeffiecient 0.800
  Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
     Foul Sewage per hectare (l/s) 0.000

          Number of Input Hydrographs 0 Number of Storage Structures 1
            Number of Online Controls 1 Number of Time/Area Diagrams 0
           Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
     Rainfall Model                FSR      Ratio R 0.300
             Region England and Wales Cv (Summer) 0.750
        M5-60 (mm)              17.000 Cv (Winter) 0.840

  Margin for Flood Risk Warning (mm)                          300.0
                 Analysis Timestep 2.5 Second Increment (Extended)
                        DTS Status                              ON
                        DVD Status                              ON
                    Inertia Status                             OFF


                Profile(s)                            Summer and Winter
            Duration(s) (mins)     15, 30, 60, 120, 180, 240, 360, 480, 600,
                                                           720, 960, 1440
         Return Period(s) (years)                                  5, 100
            Climate Change (%)                                     20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S09-02-1.000 | S09-02-1 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| S09-02-1.001 | S09-02-2 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S09-02-1.002 | S09-02-3 | 30 Winter | 100 | +40% | 5/15 Summer | | |
| S09-02-1.003 | S09-02-4 | 30 Winter | 100 | +40% | 5/15 Summer | | |
| S09-02-2.000 | S09-02-5 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S09-02-2.001 | S09-02-6 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S09-02-2.002 | S09-02-7 | 30 Winter | 100 | +40% | 5/15 Summer | | |
| S09-02-1.004 | S09-02-8 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S09-02-1.005 | S09-02-9 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S09-02-1.006 | S09-02-10 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S09-02-1.007 | S09-02-11 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S09-02-1.008 | S09-02-12 | 30 Winter | 100 | +40% | 100/30 Winter | | |
| S09-02-1.009 | S09-02-13 | 30 Winter | 100 | +40% | 5/15 Winter | | |
| S09-02-1.010 | S09-02-14 | 30 Winter | 100 | +40% | | | |
| S09-02-1.011 | S09-02-15 | 30 Winter | 100 | +40% | | | |
| S09-02-1.012 | S09-02-16 | 30 Winter | 100 | +40% | | | |
| S09-02-1.013 | S09-02-17 | 30 Winter | 100 | +40% | | | |
| S09-02-1.014 | S09-02-18 | 30 Winter | 100 | +40% | | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-02

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S09-02-1.000 | S09-02-1 | | 173.486 | 1.201 | 0.711 | 1.14 | | |
| S09-02-1.001 | S09-02-2 | | 172.571 | 1.277 | 0.000 | 1.23 | | |
| S09-02-1.002 | S09-02-3 | | 171.080 | 0.777 | 0.000 | 1.67 | | |
| S09-02-1.003 | S09-02-4 | | 170.572 | 0.454 | 0.000 | 1.91 | | |
| S09-02-2.000 | S09-02-5 | | 173.482 | 1.204 | 4.331 | 1.03 | | |
| S09-02-2.001 | S09-02-6 | | 172.878 | 1.591 | 1.151 | 1.41 | | |
| S09-02-2.002 | S09-02-7 | | 171.037 | 0.741 | 0.000 | 1.59 | | |
| S09-02-1.004 | S09-02-8 | | 170.353 | 0.355 | 0.000 | 1.28 | | |
| S09-02-1.005 | S09-02-9 | | 170.208 | 0.299 | 0.000 | 1.23 | | |
| S09-02-1.006 | S09-02-10 | | 169.998 | 0.227 | 0.000 | 1.23 | | |
| S09-02-1.007 | S09-02-11 | | 169.793 | 0.157 | 0.000 | 1.21 | | |
| S09-02-1.008 | S09-02-12 | | 169.579 | 0.089 | 0.000 | 0.72 | | |
| S09-02-1.009 | S09-02-13 | | 169.054 | 0.584 | 0.000 | 1.55 | | |
| S09-02-1.010 | S09-02-14 | | 167.951 | -0.106 | 0.000 | 0.74 | | |
| S09-02-1.011 | S09-02-15 | | 165.903 | -0.129 | 0.000 | 0.61 | | |
| S09-02-1.012 | S09-02-16 | | 162.248 | -0.142 | 0.000 | 0.54 | | |
| S09-02-1.013 | S09-02-17 | | 160.993 | -0.125 | 0.000 | 0.64 | | |
| S09-02-1.014 | S09-02-18 | | 159.428 | -0.155 | 0.000 | 0.47 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S09-02-1.000 | S09-02-1 | 19.9 | FLOOD | 3 |
| S09-02-1.001 | S09-02-2 | 62.2 | SURCHARGED | |
| S09-02-1.002 | S09-02-3 | 62.4 | SURCHARGED | |
| S09-02-1.003 | S09-02-4 | 63.8 | SURCHARGED | |
| S09-02-2.000 | S09-02-5 | 18.0 | FLOOD | 6 |
| S09-02-2.001 | S09-02-6 | 24.5 | FLOOD | 6 |
| S09-02-2.002 | S09-02-7 | 26.9 | SURCHARGED | |
| S09-02-1.004 | S09-02-8 | 91.6 | SURCHARGED | |
| S09-02-1.005 | S09-02-9 | 93.5 | SURCHARGED | |
| S09-02-1.006 | S09-02-10 | 95.3 | SURCHARGED | |
| S09-02-1.007 | S09-02-11 | 97.1 | SURCHARGED | |
| S09-02-1.008 | S09-02-12 | 100.7 | SURCHARGED | |
| S09-02-1.009 | S09-02-13 | 107.0 | SURCHARGED | |
| S09-02-1.010 | S09-02-14 | 113.8 | OK | |
| S09-02-1.011 | S09-02-15 | 126.2 | OK | |
| S09-02-1.012 | S09-02-16 | 130.1 | OK | |
| S09-02-1.013 | S09-02-17 | 135.7 | OK | |
| S09-02-1.014 | S09-02-18 | 135.8 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-02

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood |
|---|---|---|---|---|---|---|
| S09-02-1.015 | S09-02-19 | 30 Winter | 100 | +40% | | |
| S09-02-1.016 | S09-02-20 | 30 Winter | 100 | +40% | | |
| S09-02-1.017 | S09-02-21 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-02-1.018 | S09-02-22 | 30 Winter | 100 | +40% | 100/30 Winter | |
| S09-02-1.019 | S09-02-23 | 30 Winter | 100 | +40% | 100/15 Summer | 100/30 Winter |
| S09-02-1.020 | S09-02-24 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-02-1.021 | S09-02-Pond Inlet | 30 Winter | 100 | +40% | 5/15 Winter | |
| S09-02-1.022 | S09-02-Pond Outlet | 180 Winter | 100 | +40% | 100/60 Summer | |
| S09-02-1.023 | S09-02-25 | 180 Winter | 100 | +40% | | |

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-02-1.015 | S09-02-19 | | | 157.242 | -0.171 | 0.000 | 0.38 |
| S09-02-1.016 | S09-02-20 | | | 146.811 | -0.159 | 0.000 | 0.45 |
| S09-02-1.017 | S09-02-21 | | | 142.330 | 0.350 | 0.000 | 2.27 |
| S09-02-1.018 | S09-02-22 | | | 142.047 | 0.128 | 0.000 | 0.67 |
| S09-02-1.019 | S09-02-23 | | | 141.430 | 0.900 | 0.448 | 1.17 |
| S09-02-1.020 | S09-02-24 | | | 140.239 | 0.603 | 0.000 | 2.41 |
| S09-02-1.021 | S09-02-Pond Inlet | | | 139.993 | 0.386 | 0.000 | 1.88 |
| S09-02-1.022 | S09-02-Pond Outlet | | | 139.568 | 0.118 | 0.000 | 0.60 |
| S09-02-1.023 | S09-02-25 | | | 139.189 | -0.235 | 0.000 | 0.11 |

| PN | US/MH Name | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|
| S09-02-1.015 | S09-02-19 | | | 135.7 | OK | |
| S09-02-1.016 | S09-02-20 | | | 135.6 | OK | |
| S09-02-1.017 | S09-02-21 | | | 134.9 | SURCHARGED | |
| S09-02-1.018 | S09-02-22 | | | 130.1 | SURCHARGED | |
| S09-02-1.019 | S09-02-23 | | | 125.7 | FLOOD | 2 |
| S09-02-1.020 | S09-02-24 | | | 124.2 | FLOOD RISK | |
| S09-02-1.021 | S09-02-Pond Inlet | | | 124.1 | SURCHARGED | |
| S09-02-1.022 | S09-02-Pond Outlet | | | 29.8 | SURCHARGED | |
| S09-02-1.023 | S09-02-25 | | | 29.8 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for S09-03

```
                  Pipe Sizes STANDARD Manhole Sizes STANDARD

                    FSR Rainfall Model - England and Wales
              Return Period (years)       2                         PIMP (%)    100
                         M5-60 (mm)  17.000         Add Flow / Climate Change (%)     0
                            Ratio R   0.300          Minimum Backdrop Height (m)  0.000
           Maximum Rainfall (mm/hr)     200          Maximum Backdrop Height (m)  0.000
 Maximum Time of Concentration (mins)     30 Min Design Depth for Optimisation (m)  1.200
               Foul Sewage (l/s/ha)   0.000     Min Vel for Auto Design only (m/s)   1.00
           Volumetric Runoff Coeff.   0.750       Min Slope for Optimisation (1:X)    500

                          Designed with Level Soffits
```

### Simulation Criteria for S09-03

```
           Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 0.000
            Areal Reduction Factor 1.000         MADD Factor * 10m³/ha Storage 2.000
                  Hot Start (mins)     0                     Inlet Coeffiecient 0.800
                Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
       Manhole Headloss Coeff (Global) 0.500                     Run Time (mins)    60
         Foul Sewage per hectare (l/s) 0.000               Output Interval (mins)     1

           Number of Input Hydrographs 0 Number of Storage Structures 1
             Number of Online Controls 1 Number of Time/Area Diagrams 0
            Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
              Rainfall Model                  FSR          Profile Type  Summer
         Return Period (years)                  2           Cv (Summer)   0.750
                     Region England and Wales              Cv (Winter)   0.840
                  M5-60 (mm)               17.000 Storm Duration (mins)      30
                     Ratio R                0.400
```

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-03

### Simulation Criteria

```
          Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 0.000
                Hot Start (mins)     0      MADD Factor * 10m³/ha Storage 2.000
              Hot Start Level (mm)     0                 Inlet Coeffiecient 0.800
  Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
    Foul Sewage per hectare (l/s) 0.000

           Number of Input Hydrographs 0 Number of Storage Structures 1
             Number of Online Controls 1 Number of Time/Area Diagrams 0
            Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
                 Rainfall Model                FSR      Ratio R 0.300
                         Region England and Wales Cv (Summer) 0.750
                  M5-60 (mm)                17.000 Cv (Winter) 0.840

        Margin for Flood Risk Warning (mm)                        300.0
                      Analysis Timestep 2.5 Second Increment (Extended)
                             DTS Status                              ON
                             DVD Status                              ON
                          Inertia Status                            OFF


                   Profile(s)                          Summer and Winter
               Duration(s) (mins)     15, 30, 60, 120, 180, 240, 360, 480, 600,
                                                          720, 960, 1440
          Return Period(s) (years)                                  5, 100
               Climate Change (%)                                   20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S09-03-1.000 | S09-03-1 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-03-1.001 | S09-03-2 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-03-1.002 | S09-03-3 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-03-1.003 | S09-03-4 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| S09-03-1.004 | S09-03-5 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-03-1.005 | S09-03-6 | 15 Winter | 5 | +20% | 5/15 Winter | | |
| S09-03-1.006 | S09-03-7 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-03-1.007 | S09-03-8 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-03-1.008 | S09-03-9 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-03-1.009 | S09-03-10 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-03-1.010 | S09-03-11 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-03-1.011 | S09-03-12 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| S09-03-1.012 | S09-03-13 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| S09-03-1.013 | S09-03-14 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-03-1.014 | S09-03-15 | 30 Winter | 5 | +20% | 5/15 Summer | 100/30 Summer | |
| S09-03-2.000 | S09-03-16 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-03-2.001 | S09-03-17 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Summer | |
| S09-03-2.002 | S09-03-18 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-03

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S09-03-1.000 | S09-03-1 | | 177.503 | 0.057 | 0.000 | 1.02 | | |
| S09-03-1.001 | S09-03-2 | | 176.616 | -0.105 | 0.000 | 0.54 | | |
| S09-03-1.002 | S09-03-3 | | 175.646 | -0.092 | 0.000 | 0.65 | | |
| S09-03-1.003 | S09-03-4 | | 174.607 | -0.065 | 0.000 | 0.83 | | |
| S09-03-1.004 | S09-03-5 | | 173.791 | 0.299 | 0.000 | 1.66 | | |
| S09-03-1.005 | S09-03-6 | | 173.630 | 0.204 | 0.000 | 0.92 | | |
| S09-03-1.006 | S09-03-7 | | 172.140 | 0.741 | 0.000 | 1.32 | | |
| S09-03-1.007 | S09-03-8 | | 171.834 | 0.613 | 0.000 | 1.00 | | |
| S09-03-1.008 | S09-03-9 | | 170.099 | 0.603 | 0.000 | 1.04 | | |
| S09-03-1.009 | S09-03-10 | | 168.070 | 0.485 | 0.000 | 1.07 | | |
| S09-03-1.010 | S09-03-11 | | 163.926 | -0.129 | 0.000 | 0.61 | | |
| S09-03-1.011 | S09-03-12 | | 160.382 | -0.104 | 0.000 | 0.75 | | |
| S09-03-1.012 | S09-03-13 | | 156.841 | -0.072 | 0.000 | 0.88 | | |
| S09-03-1.013 | S09-03-14 | | 154.433 | 1.104 | 0.000 | 1.13 | | |
| S09-03-1.014 | S09-03-15 | | 151.529 | 0.454 | 0.000 | 1.08 | | |
| S09-03-2.000 | S09-03-16 | | 153.401 | 0.263 | 0.000 | 1.08 | | |
| S09-03-2.001 | S09-03-17 | | 152.187 | 0.048 | 0.000 | 0.88 | | |
| S09-03-2.002 | S09-03-18 | | 151.832 | 0.287 | 0.000 | 0.88 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S09-03-1.000 | S09-03-1 | 17.8 | SURCHARGED | 4 |
| S09-03-1.001 | S09-03-2 | 32.0 | OK | |
| S09-03-1.002 | S09-03-3 | 44.2 | OK | |
| S09-03-1.003 | S09-03-4 | 60.1 | OK | 6 |
| S09-03-1.004 | S09-03-5 | 57.7 | SURCHARGED | 7 |
| S09-03-1.005 | S09-03-6 | 78.6 | SURCHARGED | |
| S09-03-1.006 | S09-03-7 | 75.0 | SURCHARGED | 9 |
| S09-03-1.007 | S09-03-8 | 84.1 | SURCHARGED | 7 |
| S09-03-1.008 | S09-03-9 | 91.5 | SURCHARGED | 9 |
| S09-03-1.009 | S09-03-10 | 102.4 | SURCHARGED | 7 |
| S09-03-1.010 | S09-03-11 | 124.3 | OK | |
| S09-03-1.011 | S09-03-12 | 152.4 | OK | 5 |
| S09-03-1.012 | S09-03-13 | 179.3 | OK | 7 |
| S09-03-1.013 | S09-03-14 | 183.9 | FLOOD RISK | 11 |
| S09-03-1.014 | S09-03-15 | 189.2 | SURCHARGED | 4 |
| S09-03-2.000 | S09-03-16 | 18.9 | SURCHARGED | 7 |
| S09-03-2.001 | S09-03-17 | 34.3 | SURCHARGED | 4 |
| S09-03-2.002 | S09-03-18 | 39.7 | SURCHARGED | 7 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-03

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood |
|---|---|---|---|---|---|---|
| S09-03-1.015 | S09-03-19 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Winter |
| S09-03-3.000 | S09-03-20 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer |
| S09-03-3.001 | S09-03-21 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer |
| S09-03-3.002 | S09-03-22 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-03-3.003 | S09-03-23 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-03-3.004 | S09-03-24 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-03-4.000 | S09-03-25 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer |
| S09-03-4.001 | S09-03-26 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-03-4.002 | S09-03-27 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Winter |
| S09-03-1.016 | S09-03-28 | 15 Winter | 5 | +20% | 5/15 Summer | |
| S09-03-5.000 | S09-03-29 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer |
| S09-03-5.001 | S09-03-30 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-03-5.002 | S09-03-31 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer |
| S09-03-5.003 | S09-03-32 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Summer |
| S09-03-5.004 | S09-03-33 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer |
| S09-03-5.005 | S09-03-34 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer |
| S09-03-5.006 | S09-03-35 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer |
| S09-03-5.007 | S09-03-36 | 30 Winter | 5 | +20% | | |
| S09-03-5.008 | S09-03-37 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-03-5.009 | S09-03-38 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-03-5.010 | S09-03-39 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-03-1.017 | S09-03-40 | 15 Winter | 5 | +20% | 5/15 Summer | |
| S09-03-1.018 | S09-03-41 | 30 Winter | 5 | +20% | 5/30 Winter | |
| S09-03-1.019 | S09-03-42 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S09-03-1.020 | S09-03-43 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S09-03-1.021 | S09-03-44 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S09-03-1.022 | S09-03-Pond Inlet | 30 Winter | 5 | +20% | 5/15 Summer | |
| S09-03-1.023 | S09-03-Pond Outlet | 1440 Winter | 5 | +20% | | |
| S09-03-1.024 | S09-03-45 | 1440 Winter | 5 | +20% | | |

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-03-1.015 | S09-03-19 | | | 151.365 | 0.430 | 0.000 | 1.80 |
| S09-03-3.000 | S09-03-20 | | | 160.212 | -0.039 | 0.000 | 0.85 |
| S09-03-3.001 | S09-03-21 | | | 156.954 | 0.268 | 0.000 | 1.07 |
| S09-03-3.002 | S09-03-22 | | | 154.669 | -0.111 | 0.000 | 0.51 |
| S09-03-3.003 | S09-03-23 | | | 152.456 | -0.067 | 0.000 | 0.83 |
| S09-03-3.004 | S09-03-24 | | | 151.423 | -0.079 | 0.000 | 0.89 |
| S09-03-4.000 | S09-03-25 | | | 153.593 | 0.131 | 0.000 | 1.04 |
| S09-03-4.001 | S09-03-26 | | | 152.494 | -0.061 | 0.000 | 0.83 |
| S09-03-4.002 | S09-03-27 | | | 152.087 | 0.047 | 0.000 | 1.03 |
| S09-03-1.016 | S09-03-28 | | | 151.205 | 0.311 | 0.000 | 2.25 |
| S09-03-5.000 | S09-03-29 | | | 177.789 | 0.353 | 0.000 | 1.12 |
| S09-03-5.001 | S09-03-30 | | | 176.298 | -0.094 | 0.000 | 0.62 |
| S09-03-5.002 | S09-03-31 | | | 174.745 | -0.065 | 0.000 | 0.82 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-03

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-03-5.003 | S09-03-32 | | | 172.731 | 0.043 | 0.000 | 0.95 |
| S09-03-5.004 | S09-03-33 | | | 170.606 | 0.578 | 0.000 | 0.96 |
| S09-03-5.005 | S09-03-34 | | | 167.777 | 0.966 | 0.000 | 1.00 |
| S09-03-5.006 | S09-03-35 | | | 164.169 | 0.926 | 0.000 | 1.12 |
| S09-03-5.007 | S09-03-36 | | | 159.539 | -0.127 | 0.000 | 0.62 |
| S09-03-5.008 | S09-03-37 | | | 156.508 | -0.122 | 0.000 | 0.65 |
| S09-03-5.009 | S09-03-38 | | | 153.098 | -0.084 | 0.000 | 0.86 |
| S09-03-5.010 | S09-03-39 | | | 151.822 | -0.096 | 0.000 | 0.90 |
| S09-03-1.017 | S09-03-40 | | | 151.025 | 0.162 | 0.000 | 1.26 |
| S09-03-1.018 | S09-03-41 | | | 150.555 | 0.003 | 0.000 | 0.76 |
| S09-03-1.019 | S09-03-42 | | | 150.319 | 0.220 | 0.000 | 1.44 |
| S09-03-1.020 | S09-03-43 | | | 150.089 | 0.107 | 0.000 | 0.70 |
| S09-03-1.021 | S09-03-44 | | | 149.882 | 0.319 | 0.000 | 2.15 |
| S09-03-1.022 | S09-03-Pond Inlet | | | 149.707 | 0.161 | 0.000 | 1.31 |
| S09-03-1.023 | S09-03-Pond Outlet | | | 148.830 | -0.445 | 0.000 | 0.10 |
| S09-03-1.024 | S09-03-45 | | | 148.633 | -0.250 | 0.000 | 0.07 |

| PN | US/MH Name | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|
| S09-03-1.015 | S09-03-19 | | | 231.1 | SURCHARGED | 5 |
| S09-03-3.000 | S09-03-20 | | | 28.5 | OK | 4 |
| S09-03-3.001 | S09-03-21 | | | 35.0 | SURCHARGED | 6 |
| S09-03-3.002 | S09-03-22 | | | 46.8 | OK | |
| S09-03-3.003 | S09-03-23 | | | 57.2 | OK | |
| S09-03-3.004 | S09-03-24 | | | 66.6 | OK | |
| S09-03-4.000 | S09-03-25 | | | 18.0 | SURCHARGED | 6 |
| S09-03-4.001 | S09-03-26 | | | 32.3 | OK | |
| S09-03-4.002 | S09-03-27 | | | 46.3 | SURCHARGED | 3 |
| S09-03-1.016 | S09-03-28 | | | 326.3 | SURCHARGED | |
| S09-03-5.000 | S09-03-29 | | | 20.1 | SURCHARGED | 6 |
| S09-03-5.001 | S09-03-30 | | | 39.6 | OK | |
| S09-03-5.002 | S09-03-31 | | | 61.2 | OK | 6 |
| S09-03-5.003 | S09-03-32 | | | 79.3 | SURCHARGED | 7 |
| S09-03-5.004 | S09-03-33 | | | 88.1 | SURCHARGED | 9 |
| S09-03-5.005 | S09-03-34 | | | 97.0 | FLOOD RISK | 11 |
| S09-03-5.006 | S09-03-35 | | | 108.5 | FLOOD RISK | 11 |
| S09-03-5.007 | S09-03-36 | | | 117.5 | OK | |
| S09-03-5.008 | S09-03-37 | | | 130.9 | OK | |
| S09-03-5.009 | S09-03-38 | | | 137.4 | OK | |
| S09-03-5.010 | S09-03-39 | | | 142.9 | OK | |
| S09-03-1.017 | S09-03-40 | | | 461.6 | SURCHARGED | |
| S09-03-1.018 | S09-03-41 | | | 440.4 | SURCHARGED | |
| S09-03-1.019 | S09-03-42 | | | 428.3 | SURCHARGED | |
| S09-03-1.020 | S09-03-43 | | | 419.2 | SURCHARGED | |
| S09-03-1.021 | S09-03-44 | | | 418.8 | SURCHARGED | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-03

| PN | US/MH Name | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|
| S09-03-1.022 | S09-03-Pond Inlet | | | 419.0 | SURCHARGED | |
| S09-03-1.023 | S09-03-Pond Outlet | | | 24.8 | OK | |
| S09-03-1.024 | S09-03-45 | | | 24.8 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-03

### Simulation Criteria

```
           Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 0.000
                  Hot Start (mins)     0       MADD Factor * 10m³/ha Storage 2.000
                Hot Start Level (mm)     0                  Inlet Coeffiecient 0.800
  Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
     Foul Sewage per hectare (l/s) 0.000

          Number of Input Hydrographs 0 Number of Storage Structures 1
            Number of Online Controls 1 Number of Time/Area Diagrams 0
           Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
     Rainfall Model                FSR      Ratio R 0.300
             Region England and Wales Cv (Summer) 0.750
         M5-60 (mm)              17.000 Cv (Winter) 0.840

  Margin for Flood Risk Warning (mm)                          300.0
                  Analysis Timestep 2.5 Second Increment (Extended)
                         DTS Status                              ON
                         DVD Status                              ON
                     Inertia Status                             OFF


                Profile(s)                          Summer and Winter
           Duration(s) (mins)     15, 30, 60, 120, 180, 240, 360, 480, 600,
                                                         720, 960, 1440
       Return Period(s) (years)                                  5, 100
           Climate Change (%)                                    20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S09-03-1.000 | S09-03-1 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S09-03-1.001 | S09-03-2 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S09-03-1.002 | S09-03-3 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S09-03-1.003 | S09-03-4 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| S09-03-1.004 | S09-03-5 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S09-03-1.005 | S09-03-6 | 15 Winter | 100 | +40% | 5/15 Winter | | |
| S09-03-1.006 | S09-03-7 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S09-03-1.007 | S09-03-8 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S09-03-1.008 | S09-03-9 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S09-03-1.009 | S09-03-10 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S09-03-1.010 | S09-03-11 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S09-03-1.011 | S09-03-12 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| S09-03-1.012 | S09-03-13 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| S09-03-1.013 | S09-03-14 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S09-03-1.014 | S09-03-15 | 60 Winter | 100 | +40% | 5/15 Summer | 100/30 Summer | |
| S09-03-2.000 | S09-03-16 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S09-03-2.001 | S09-03-17 | 15 Winter | 100 | +40% | 5/15 Winter | 100/15 Summer | |
| S09-03-2.002 | S09-03-18 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-03

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume ($m^3$) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S09-03-1.000 | S09-03-1 | | 178.647 | 1.202 | 1.841 | 1.44 | | |
| S09-03-1.001 | S09-03-2 | | 177.521 | 0.800 | 0.000 | 0.85 | | |
| S09-03-1.002 | S09-03-3 | | 176.899 | 1.161 | 0.000 | 0.96 | | |
| S09-03-1.003 | S09-03-4 | | 175.878 | 1.206 | 6.133 | 1.00 | | |
| S09-03-1.004 | S09-03-5 | | 174.711 | 1.219 | 18.897 | 2.25 | | |
| S09-03-1.005 | S09-03-6 | | 174.730 | 1.304 | 0.000 | 1.01 | | |
| S09-03-1.006 | S09-03-7 | | 172.630 | 1.230 | 30.047 | 1.48 | | |
| S09-03-1.007 | S09-03-8 | | 172.426 | 1.205 | 4.581 | 1.04 | | |
| S09-03-1.008 | S09-03-9 | | 170.709 | 1.213 | 12.707 | 1.15 | | |
| S09-03-1.009 | S09-03-10 | | 168.793 | 1.208 | 7.529 | 1.16 | | |
| S09-03-1.010 | S09-03-11 | | 164.286 | 0.231 | 0.000 | 0.85 | | |
| S09-03-1.011 | S09-03-12 | | 161.692 | 1.206 | 6.323 | 1.00 | | |
| S09-03-1.012 | S09-03-13 | | 158.139 | 1.226 | 26.308 | 1.00 | | |
| S09-03-1.013 | S09-03-14 | | 154.619 | 1.290 | 90.492 | 1.22 | | |
| S09-03-1.014 | S09-03-15 | | 152.277 | 1.202 | 1.779 | 1.15 | | |
| S09-03-2.000 | S09-03-16 | | 154.346 | 1.209 | 8.748 | 1.16 | | |
| S09-03-2.001 | S09-03-17 | | 153.892 | 1.753 | 0.627 | 1.25 | | |
| S09-03-2.002 | S09-03-18 | | 152.886 | 1.342 | 9.051 | 1.32 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S09-03-1.000 | S09-03-1 | 25.1 | FLOOD | 4 |
| S09-03-1.001 | S09-03-2 | 50.1 | SURCHARGED | |
| S09-03-1.002 | S09-03-3 | 65.9 | FLOOD RISK | |
| S09-03-1.003 | S09-03-4 | 71.8 | FLOOD | 6 |
| S09-03-1.004 | S09-03-5 | 78.5 | FLOOD | 7 |
| S09-03-1.005 | S09-03-6 | 86.2 | FLOOD RISK | |
| S09-03-1.006 | S09-03-7 | 84.1 | FLOOD | 9 |
| S09-03-1.007 | S09-03-8 | 87.3 | FLOOD | 7 |
| S09-03-1.008 | S09-03-9 | 101.2 | FLOOD | 9 |
| S09-03-1.009 | S09-03-10 | 111.4 | FLOOD | 7 |
| S09-03-1.010 | S09-03-11 | 174.0 | SURCHARGED | |
| S09-03-1.011 | S09-03-12 | 204.2 | FLOOD | 5 |
| S09-03-1.012 | S09-03-13 | 204.5 | FLOOD | 7 |
| S09-03-1.013 | S09-03-14 | 198.0 | FLOOD | 11 |
| S09-03-1.014 | S09-03-15 | 201.1 | FLOOD | 4 |
| S09-03-2.000 | S09-03-16 | 20.3 | FLOOD | 7 |
| S09-03-2.001 | S09-03-17 | 48.8 | FLOOD | 4 |
| S09-03-2.002 | S09-03-18 | 59.7 | FLOOD | 7 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-03

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood |
|---|---|---|---|---|---|---|
| S09-03-1.015 | S09-03-19 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Winter |
| S09-03-3.000 | S09-03-20 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer |
| S09-03-3.001 | S09-03-21 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer |
| S09-03-3.002 | S09-03-22 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-03-3.003 | S09-03-23 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-03-3.004 | S09-03-24 | 30 Winter | 100 | +40% | 100/15 Summer | |
| S09-03-4.000 | S09-03-25 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer |
| S09-03-4.001 | S09-03-26 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-03-4.002 | S09-03-27 | 30 Winter | 100 | +40% | 5/15 Winter | 100/15 Winter |
| S09-03-1.016 | S09-03-28 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-03-5.000 | S09-03-29 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer |
| S09-03-5.001 | S09-03-30 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-03-5.002 | S09-03-31 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer |
| S09-03-5.003 | S09-03-32 | 30 Winter | 100 | +40% | 5/15 Winter | 100/15 Summer |
| S09-03-5.004 | S09-03-33 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer |
| S09-03-5.005 | S09-03-34 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer |
| S09-03-5.006 | S09-03-35 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer |
| S09-03-5.007 | S09-03-36 | 15 Winter | 100 | +40% | | |
| S09-03-5.008 | S09-03-37 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-03-5.009 | S09-03-38 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-03-5.010 | S09-03-39 | 30 Winter | 100 | +40% | 100/15 Summer | |
| S09-03-1.017 | S09-03-40 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-03-1.018 | S09-03-41 | 30 Winter | 100 | +40% | 5/30 Winter | |
| S09-03-1.019 | S09-03-42 | 15 Winter | 100 | +40% | 5/15 Summer | |
| S09-03-1.020 | S09-03-43 | 15 Winter | 100 | +40% | 5/15 Summer | |
| S09-03-1.021 | S09-03-44 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-03-1.022 | S09-03-Pond Inlet | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-03-1.023 | S09-03-Pond Outlet | 1440 Winter | 100 | +40% | | |
| S09-03-1.024 | S09-03-45 | 1440 Winter | 100 | +40% | | |

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-03-1.015 | S09-03-19 | | | 152.149 | 1.214 | 13.807 | 2.12 |
| S09-03-3.000 | S09-03-20 | | | 161.455 | 1.203 | 3.472 | 1.00 |
| S09-03-3.001 | S09-03-21 | | | 157.890 | 1.204 | 3.613 | 1.28 |
| S09-03-3.002 | S09-03-22 | | | 154.917 | 0.137 | 0.000 | 0.80 |
| S09-03-3.003 | S09-03-23 | | | 153.704 | 1.181 | 0.000 | 1.26 |
| S09-03-3.004 | S09-03-24 | | | 152.415 | 0.913 | 0.000 | 1.25 |
| S09-03-4.000 | S09-03-25 | | | 154.667 | 1.205 | 5.367 | 1.31 |
| S09-03-4.001 | S09-03-26 | | | 154.256 | 1.701 | 0.000 | 1.12 |
| S09-03-4.002 | S09-03-27 | | | 153.490 | 1.451 | 1.912 | 1.46 |
| S09-03-1.016 | S09-03-28 | | | 152.079 | 1.184 | 0.000 | 2.71 |
| S09-03-5.000 | S09-03-29 | | | 178.643 | 1.207 | 6.992 | 1.44 |
| S09-03-5.001 | S09-03-30 | | | 177.392 | 1.000 | 0.000 | 0.91 |
| S09-03-5.002 | S09-03-31 | | | 176.017 | 1.207 | 6.564 | 1.00 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-03

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-03-5.003 | S09-03-32 | | | 173.903 | 1.215 | 14.608 | 1.00 |
| S09-03-5.004 | S09-03-33 | | | 171.248 | 1.220 | 20.007 | 1.00 |
| S09-03-5.005 | S09-03-34 | | | 168.044 | 1.233 | 32.714 | 1.00 |
| S09-03-5.006 | S09-03-35 | | | 164.459 | 1.215 | 15.496 | 1.16 |
| S09-03-5.007 | S09-03-36 | | | 159.576 | -0.091 | 0.000 | 0.81 |
| S09-03-5.008 | S09-03-37 | | | 157.029 | 0.398 | 0.000 | 0.92 |
| S09-03-5.009 | S09-03-38 | | | 154.167 | 0.985 | 0.000 | 1.24 |
| S09-03-5.010 | S09-03-39 | | | 152.518 | 0.600 | 0.000 | 1.27 |
| S09-03-1.017 | S09-03-40 | | | 151.911 | 1.048 | 0.000 | 1.54 |
| S09-03-1.018 | S09-03-41 | | | 151.311 | 0.759 | 0.000 | 0.93 |
| S09-03-1.019 | S09-03-42 | | | 150.945 | 0.846 | 0.000 | 1.79 |
| S09-03-1.020 | S09-03-43 | | | 150.584 | 0.601 | 0.000 | 0.89 |
| S09-03-1.021 | S09-03-44 | | | 150.253 | 0.691 | 0.000 | 2.71 |
| S09-03-1.022 | S09-03-Pond Inlet | | | 149.977 | 0.431 | 0.000 | 1.64 |
| S09-03-1.023 | S09-03-Pond Outlet | | | 149.087 | -0.188 | 0.000 | 0.13 |
| S09-03-1.024 | S09-03-45 | | | 148.643 | -0.240 | 0.000 | 0.09 |

| PN | US/MH Name | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|
| S09-03-1.015 | S09-03-19 | | | 272.1 | FLOOD | 5 |
| S09-03-3.000 | S09-03-20 | | | 33.3 | FLOOD | 4 |
| S09-03-3.001 | S09-03-21 | | | 42.0 | FLOOD | 6 |
| S09-03-3.002 | S09-03-22 | | | 73.8 | SURCHARGED | |
| S09-03-3.003 | S09-03-23 | | | 86.9 | FLOOD RISK | |
| S09-03-3.004 | S09-03-24 | | | 94.1 | FLOOD RISK | |
| S09-03-4.000 | S09-03-25 | | | 22.8 | FLOOD | 6 |
| S09-03-4.001 | S09-03-26 | | | 43.5 | FLOOD RISK | |
| S09-03-4.002 | S09-03-27 | | | 65.6 | FLOOD | 3 |
| S09-03-1.016 | S09-03-28 | | | 392.9 | SURCHARGED | |
| S09-03-5.000 | S09-03-29 | | | 25.9 | FLOOD | 6 |
| S09-03-5.001 | S09-03-30 | | | 58.5 | FLOOD RISK | |
| S09-03-5.002 | S09-03-31 | | | 74.2 | FLOOD | 6 |
| S09-03-5.003 | S09-03-32 | | | 83.2 | FLOOD | 7 |
| S09-03-5.004 | S09-03-33 | | | 91.6 | FLOOD | 9 |
| S09-03-5.005 | S09-03-34 | | | 97.0 | FLOOD | 11 |
| S09-03-5.006 | S09-03-35 | | | 112.0 | FLOOD | 11 |
| S09-03-5.007 | S09-03-36 | | | 153.1 | OK | |
| S09-03-5.008 | S09-03-37 | | | 183.9 | SURCHARGED | |
| S09-03-5.009 | S09-03-38 | | | 196.6 | FLOOD RISK | |
| S09-03-5.010 | S09-03-39 | | | 201.5 | SURCHARGED | |
| S09-03-1.017 | S09-03-40 | | | 566.3 | SURCHARGED | |
| S09-03-1.018 | S09-03-41 | | | 540.7 | SURCHARGED | |
| S09-03-1.019 | S09-03-42 | | | 531.5 | SURCHARGED | |
| S09-03-1.020 | S09-03-43 | | | 527.2 | SURCHARGED | |
| S09-03-1.021 | S09-03-44 | | | 527.0 | SURCHARGED | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-03

| PN | US/MH Name | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|
| S09-03-1.022 | S09-03-Pond Inlet | | | 527.3 | SURCHARGED | |
| S09-03-1.023 | S09-03-Pond Outlet | | | 32.8 | OK | |
| S09-03-1.024 | S09-03-45 | | | 32.8 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for S09-04

```
                       Pipe Sizes STANDARD Manhole Sizes STANDARD

                          FSR Rainfall Model - England and Wales
                Return Period (years)       2                         PIMP (%)    100
                           M5-60 (mm)  17.000         Add Flow / Climate Change (%)     0
                              Ratio R   0.300          Minimum Backdrop Height (m)  0.000
             Maximum Rainfall (mm/hr)     200          Maximum Backdrop Height (m)  0.000
 Maximum Time of Concentration (mins)      30 Min Design Depth for Optimisation (m)  1.200
                 Foul Sewage (l/s/ha)   0.000    Min Vel for Auto Design only (m/s)   1.00
             Volumetric Runoff Coeff.   0.750      Min Slope for Optimisation (1:X)    500

                              Designed with Level Soffits
```

### Simulation Criteria for S09-04

```
             Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 0.000
              Areal Reduction Factor 1.000       MADD Factor * 10m³/ha Storage 2.000
                    Hot Start (mins)     0                   Inlet Coeffiecient 0.800
                  Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
          Manhole Headloss Coeff (Global) 0.500                      Run Time (mins)    60
           Foul Sewage per hectare (l/s) 0.000               Output Interval (mins)     1

               Number of Input Hydrographs 0 Number of Storage Structures 0
                 Number of Online Controls 0 Number of Time/Area Diagrams 0
                Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
                 Rainfall Model                 FSR          Profile Type  Summer
           Return Period (years)                  2            Cv (Summer)   0.750
                         Region England and Wales            Cv (Winter)   0.840
                     M5-60 (mm)              17.000 Storm Duration (mins)      30
                        Ratio R               0.400
```

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-04

### Simulation Criteria

```
         Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 0.000
               Hot Start (mins)     0        MADD Factor * 10m³/ha Storage 2.000
             Hot Start Level (mm)     0                Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
  Foul Sewage per hectare (l/s) 0.000

         Number of Input Hydrographs 0 Number of Storage Structures 0
           Number of Online Controls 0 Number of Time/Area Diagrams 0
          Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
Rainfall Model                FSR      Ratio R 0.300
       Region England and Wales Cv (Summer) 0.750
   M5-60 (mm)              17.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)                           300.0
                 Analysis Timestep 2.5 Second Increment (Extended)
                        DTS Status                              ON
                        DVD Status                              ON
                    Inertia Status                             OFF


               Profile(s)                           Summer and Winter
          Duration(s) (mins)     15, 30, 60, 120, 180, 240, 360, 480, 600,
                                                         720, 960, 1440
     Return Period(s) (years)                                   5, 100
          Climate Change (%)                                    20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S09-04-1.000 | S09-04-1 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-04-1.001 | S09-04-2 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-04-1.002 | S09-04-3 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-04-1.003 | S09-04-4 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-04-1.004 | S09-04-5 | 15 Winter | 5 | +20% | 100/15 Winter | | |
| S09-04-1.005 | S09-04-6 | 15 Winter | 5 | +20% | 100/15 Winter | | |
| S09-04-1.006 | S09-04-7 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-04-1.007 | S09-04-8 | 30 Winter | 5 | +20% | | | |
| S09-04-1.008 | S09-04-9 | 30 Winter | 5 | +20% | | | |
| S09-04-1.009 | S09-04-10 | 30 Winter | 5 | +20% | | | |
| S09-04-1.010 | S09-04-11 | 30 Winter | 5 | +20% | 100/30 Winter | | |
| S09-04-1.011 | S09-04-12 | 30 Winter | 5 | +20% | 100/15 Winter | | |
| S09-04-1.012 | S09-04-13 | 30 Winter | 5 | +20% | 100/15 Summer | | |
| S09-04-2.000 | S09-04-14 | 15 Winter | 5 | +20% | | | |
| S09-04-2.001 | S09-04-15 | 15 Winter | 5 | +20% | | | |
| S09-04-2.002 | S09-04-16 | 15 Winter | 5 | +20% | | | |
| S09-04-2.003 | S09-04-17 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-04-2.004 | S09-04-18 | 15 Winter | 5 | +20% | 100/15 Summer | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-04

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S09-04-1.000 | S09-04-1 | | 173.678 | 0.234 | 0.000 | 1.36 | | |
| S09-04-1.001 | S09-04-2 | | 173.133 | -0.062 | 0.000 | 0.95 | | |
| S09-04-1.002 | S09-04-3 | | 172.123 | -0.100 | 0.000 | 0.77 | | |
| S09-04-1.003 | S09-04-4 | | 170.984 | 0.604 | 0.000 | 1.38 | | |
| S09-04-1.004 | S09-04-5 | | 169.680 | -0.094 | 0.000 | 0.80 | | |
| S09-04-1.005 | S09-04-6 | | 167.748 | -0.105 | 0.000 | 0.74 | | |
| S09-04-1.006 | S09-04-7 | | 165.423 | -0.104 | 0.000 | 0.75 | | |
| S09-04-1.007 | S09-04-8 | | 163.028 | -0.128 | 0.000 | 0.62 | | |
| S09-04-1.008 | S09-04-9 | | 159.424 | -0.138 | 0.000 | 0.57 | | |
| S09-04-1.009 | S09-04-10 | | 156.616 | -0.146 | 0.000 | 0.52 | | |
| S09-04-1.010 | S09-04-11 | | 151.483 | -0.139 | 0.000 | 0.56 | | |
| S09-04-1.011 | S09-04-12 | | 149.876 | -0.133 | 0.000 | 0.60 | | |
| S09-04-1.012 | S09-04-13 | | 148.625 | -0.122 | 0.000 | 0.66 | | |
| S09-04-2.000 | S09-04-14 | | 173.506 | -0.119 | 0.000 | 0.09 | | |
| S09-04-2.001 | S09-04-15 | | 172.230 | -0.104 | 0.000 | 0.19 | | |
| S09-04-2.002 | S09-04-16 | | 170.530 | -0.094 | 0.000 | 0.28 | | |
| S09-04-2.003 | S09-04-17 | | 168.823 | -0.092 | 0.000 | 0.32 | | |
| S09-04-2.004 | S09-04-18 | | 168.087 | -0.035 | 0.000 | 0.79 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S09-04-1.000 | S09-04-1 | 91.8 | SURCHARGED | 6 |
| S09-04-1.001 | S09-04-2 | 100.7 | OK | |
| S09-04-1.002 | S09-04-3 | 112.5 | OK | |
| S09-04-1.003 | S09-04-4 | 115.8 | SURCHARGED | 6 |
| S09-04-1.004 | S09-04-5 | 119.7 | OK | |
| S09-04-1.005 | S09-04-6 | 122.6 | OK | |
| S09-04-1.006 | S09-04-7 | 124.5 | OK | |
| S09-04-1.007 | S09-04-8 | 127.1 | OK | |
| S09-04-1.008 | S09-04-9 | 133.9 | OK | |
| S09-04-1.009 | S09-04-10 | 137.5 | OK | |
| S09-04-1.010 | S09-04-11 | 137.9 | OK | |
| S09-04-1.011 | S09-04-12 | 137.8 | OK | |
| S09-04-1.012 | S09-04-13 | 138.3 | OK | |
| S09-04-2.000 | S09-04-14 | 2.0 | OK | |
| S09-04-2.001 | S09-04-15 | 4.4 | OK | |
| S09-04-2.002 | S09-04-16 | 6.4 | OK | |
| S09-04-2.003 | S09-04-17 | 7.2 | OK | |
| S09-04-2.004 | S09-04-18 | 14.0 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-04

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S09-04-2.005 | S09-04-19 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-04-2.006 | S09-04-20 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | |
| S09-04-2.007 | S09-04-21 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | |
| S09-04-2.008 | S09-04-22 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | |
| S09-04-2.009 | S09-04-23 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | |
| S09-04-2.010 | S09-04-24 | 30 Winter | 5 | +20% | 5/15 Winter | 100/15 Summer | |
| S09-04-2.011 | S09-04-25 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-04-2.012 | S09-04-26 | 30 Winter | 5 | +20% | 5/15 Summer | | |
| S09-04-1.013 | S09-04-27 | 30 Winter | 5 | +20% | 5/30 Winter | | |

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S09-04-2.005 | S09-04-19 | | 166.312 | -0.033 | 0.000 | 0.93 | | |
| S09-04-2.006 | S09-04-20 | | 164.633 | -0.033 | 0.000 | 0.95 | | |
| S09-04-2.007 | S09-04-21 | | 162.610 | -0.036 | 0.000 | 0.93 | | |
| S09-04-2.008 | S09-04-22 | | 161.529 | -0.034 | 0.000 | 0.94 | | |
| S09-04-2.009 | S09-04-23 | | 157.004 | -0.036 | 0.000 | 0.92 | | |
| S09-04-2.010 | S09-04-24 | | 153.407 | 0.354 | 0.000 | 0.90 | | |
| S09-04-2.011 | S09-04-25 | | 150.889 | 0.952 | 0.000 | 1.19 | | |
| S09-04-2.012 | S09-04-26 | | 147.898 | 0.056 | 0.000 | 1.38 | | |
| S09-04-1.013 | S09-04-27 | | 147.787 | 0.004 | 0.000 | 1.14 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S09-04-2.005 | S09-04-19 | 21.1 | OK | |
| S09-04-2.006 | S09-04-20 | 26.3 | OK | 5 |
| S09-04-2.007 | S09-04-21 | 29.1 | OK | 5 |
| S09-04-2.008 | S09-04-22 | 35.4 | OK | 4 |
| S09-04-2.009 | S09-04-23 | 39.6 | OK | 2 |
| S09-04-2.010 | S09-04-24 | 40.1 | SURCHARGED | 9 |
| S09-04-2.011 | S09-04-25 | 45.7 | FLOOD RISK | 11 |
| S09-04-2.012 | S09-04-26 | 45.8 | SURCHARGED | |
| S09-04-1.013 | S09-04-27 | 184.1 | SURCHARGED | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-04

### Simulation Criteria

```
              Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 0.000
                    Hot Start (mins)     0       MADD Factor * 10m³/ha Storage 2.000
                  Hot Start Level (mm)     0                 Inlet Coeffiecient 0.800
   Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
     Foul Sewage per hectare (l/s) 0.000

              Number of Input Hydrographs 0 Number of Storage Structures 0
                Number of Online Controls 0 Number of Time/Area Diagrams 0
               Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
                     Rainfall Model          FSR      Ratio R 0.300
                             Region England and Wales Cv (Summer) 0.750
                         M5-60 (mm)            17.000 Cv (Winter) 0.840

            Margin for Flood Risk Warning (mm)                          300.0
                            Analysis Timestep 2.5 Second Increment (Extended)
                                   DTS Status                              ON
                                   DVD Status                              ON
                               Inertia Status                             OFF


                         Profile(s)                           Summer and Winter
                    Duration(s) (mins)    15, 30, 60, 120, 180, 240, 360, 480, 600,
                                                                  720, 960, 1440
               Return Period(s) (years)                                   5, 100
                    Climate Change (%)                                    20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S09-04-1.000 | S09-04-1 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S09-04-1.001 | S09-04-2 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S09-04-1.002 | S09-04-3 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S09-04-1.003 | S09-04-4 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S09-04-1.004 | S09-04-5 | 30 Winter | 100 | +40% | 100/15 Winter | | |
| S09-04-1.005 | S09-04-6 | 30 Winter | 100 | +40% | 100/15 Winter | | |
| S09-04-1.006 | S09-04-7 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S09-04-1.007 | S09-04-8 | 30 Winter | 100 | +40% | | | |
| S09-04-1.008 | S09-04-9 | 30 Summer | 100 | +40% | | | |
| S09-04-1.009 | S09-04-10 | 30 Summer | 100 | +40% | | | |
| S09-04-1.010 | S09-04-11 | 30 Winter | 100 | +40% | 100/30 Winter | | |
| S09-04-1.011 | S09-04-12 | 30 Winter | 100 | +40% | 100/15 Winter | | |
| S09-04-1.012 | S09-04-13 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S09-04-2.000 | S09-04-14 | 15 Winter | 100 | +40% | | | |
| S09-04-2.001 | S09-04-15 | 15 Winter | 100 | +40% | | | |
| S09-04-2.002 | S09-04-16 | 15 Winter | 100 | +40% | | | |
| S09-04-2.003 | S09-04-17 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S09-04-2.004 | S09-04-18 | 30 Winter | 100 | +40% | 100/15 Summer | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-04

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S09-04-1.000 | S09-04-1 | | 174.741 | 1.296 | 21.880 | 1.81 | | |
| S09-04-1.001 | S09-04-2 | | 174.397 | 1.202 | 0.000 | 1.22 | | |
| S09-04-1.002 | S09-04-3 | | 173.363 | 1.140 | 0.000 | 0.96 | | |
| S09-04-1.003 | S09-04-4 | | 171.589 | 1.209 | 9.432 | 1.73 | | |
| S09-04-1.004 | S09-04-5 | | 169.978 | 0.204 | 0.000 | 1.02 | | |
| S09-04-1.005 | S09-04-6 | | 168.034 | 0.181 | 0.000 | 0.99 | | |
| S09-04-1.006 | S09-04-7 | | 165.775 | 0.247 | 0.000 | 1.05 | | |
| S09-04-1.007 | S09-04-8 | | 163.082 | -0.074 | 0.000 | 0.92 | | |
| S09-04-1.008 | S09-04-9 | | 159.490 | -0.072 | 0.000 | 0.91 | | |
| S09-04-1.009 | S09-04-10 | | 156.683 | -0.079 | 0.000 | 0.88 | | |
| S09-04-1.010 | S09-04-11 | | 151.688 | 0.066 | 0.000 | 0.94 | | |
| S09-04-1.011 | S09-04-12 | | 150.262 | 0.254 | 0.000 | 1.00 | | |
| S09-04-1.012 | S09-04-13 | | 149.007 | 0.260 | 0.000 | 1.11 | | |
| S09-04-2.000 | S09-04-14 | | 173.521 | -0.104 | 0.000 | 0.19 | | |
| S09-04-2.001 | S09-04-15 | | 172.260 | -0.074 | 0.000 | 0.47 | | |
| S09-04-2.002 | S09-04-16 | | 170.601 | -0.023 | 0.000 | 0.66 | | |
| S09-04-2.003 | S09-04-17 | | 170.350 | 1.435 | 0.000 | 0.49 | | |
| S09-04-2.004 | S09-04-18 | | 170.189 | 2.067 | 0.000 | 1.06 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S09-04-1.000 | S09-04-1 | 122.4 | FLOOD | 6 |
| S09-04-1.001 | S09-04-2 | 129.7 | SURCHARGED | |
| S09-04-1.002 | S09-04-3 | 140.9 | FLOOD RISK | |
| S09-04-1.003 | S09-04-4 | 145.0 | FLOOD | 6 |
| S09-04-1.004 | S09-04-5 | 153.3 | SURCHARGED | |
| S09-04-1.005 | S09-04-6 | 162.8 | SURCHARGED | |
| S09-04-1.006 | S09-04-7 | 175.1 | SURCHARGED | |
| S09-04-1.007 | S09-04-8 | 188.0 | OK | |
| S09-04-1.008 | S09-04-9 | 216.3 | OK | |
| S09-04-1.009 | S09-04-10 | 232.4 | OK | |
| S09-04-1.010 | S09-04-11 | 231.7 | SURCHARGED | |
| S09-04-1.011 | S09-04-12 | 230.5 | SURCHARGED | |
| S09-04-1.012 | S09-04-13 | 231.9 | SURCHARGED | |
| S09-04-2.000 | S09-04-14 | 4.4 | OK | |
| S09-04-2.001 | S09-04-15 | 10.7 | OK | |
| S09-04-2.002 | S09-04-16 | 15.3 | OK | |
| S09-04-2.003 | S09-04-17 | 11.0 | SURCHARGED | |
| S09-04-2.004 | S09-04-18 | 18.8 | SURCHARGED | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-04

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S09-04-2.005 | S09-04-19 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S09-04-2.006 | S09-04-20 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | |
| S09-04-2.007 | S09-04-21 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | |
| S09-04-2.008 | S09-04-22 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | |
| S09-04-2.009 | S09-04-23 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | |
| S09-04-2.010 | S09-04-24 | 60 Winter | 100 | +40% | 5/15 Winter | 100/15 Summer | |
| S09-04-2.011 | S09-04-25 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S09-04-2.012 | S09-04-26 | 30 Winter | 100 | +40% | 5/15 Summer | | |
| S09-04-1.013 | S09-04-27 | 30 Winter | 100 | +40% | 5/30 Winter | | |

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S09-04-2.005 | S09-04-19 | | 168.190 | 1.845 | 0.000 | 1.17 | | |
| S09-04-2.006 | S09-04-20 | | 165.869 | 1.202 | 2.175 | 1.11 | | |
| S09-04-2.007 | S09-04-21 | | 163.847 | 1.201 | 1.069 | 1.10 | | |
| S09-04-2.008 | S09-04-22 | | 162.922 | 1.360 | 0.729 | 1.01 | | |
| S09-04-2.009 | S09-04-23 | | 158.404 | 1.364 | 0.298 | 1.02 | | |
| S09-04-2.010 | S09-04-24 | | 154.258 | 1.205 | 4.348 | 1.00 | | |
| S09-04-2.011 | S09-04-25 | | 151.151 | 1.214 | 13.929 | 1.25 | | |
| S09-04-2.012 | S09-04-26 | | 148.054 | 0.212 | 0.000 | 1.44 | | |
| S09-04-1.013 | S09-04-27 | | 147.939 | 0.156 | 0.000 | 1.72 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S09-04-2.005 | S09-04-19 | 26.5 | FLOOD RISK | |
| S09-04-2.006 | S09-04-20 | 31.0 | FLOOD | 5 |
| S09-04-2.007 | S09-04-21 | 34.4 | FLOOD | 5 |
| S09-04-2.008 | S09-04-22 | 37.9 | FLOOD | 4 |
| S09-04-2.009 | S09-04-23 | 43.9 | FLOOD | 2 |
| S09-04-2.010 | S09-04-24 | 44.3 | FLOOD | 9 |
| S09-04-2.011 | S09-04-25 | 47.8 | FLOOD | 11 |
| S09-04-2.012 | S09-04-26 | 48.0 | SURCHARGED | |
| S09-04-1.013 | S09-04-27 | 278.4 | SURCHARGED | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for S09-05

```
                 Pipe Sizes STANDARD Manhole Sizes STANDARD

                   FSR Rainfall Model - England and Wales
             Return Period (years)        2                    PIMP (%)    100
                        M5-60 (mm)   17.000          Add Flow / Climate Change (%)      0
                           Ratio R    0.300           Minimum Backdrop Height (m)  0.000
          Maximum Rainfall (mm/hr)      200           Maximum Backdrop Height (m)  0.000
 Maximum Time of Concentration (mins)     30 Min Design Depth for Optimisation (m)  1.200
               Foul Sewage (l/s/ha)   0.000     Min Vel for Auto Design only (m/s)   1.00
          Volumetric Runoff Coeff.    0.750       Min Slope for Optimisation (1:X)    500

                        Designed with Level Soffits
```

### Simulation Criteria for S09-05

```
          Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 0.000
           Areal Reduction Factor 1.000        MADD Factor * 10m³/ha Storage 2.000
                 Hot Start (mins)     0                  Inlet Coeffiecient 0.800
               Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
      Manhole Headloss Coeff (Global) 0.500                     Run Time (mins)    60
        Foul Sewage per hectare (l/s) 0.000              Output Interval (mins)     1

          Number of Input Hydrographs 0 Number of Storage Structures 1
            Number of Online Controls 1 Number of Time/Area Diagrams 0
           Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
            Rainfall Model                  FSR          Profile Type  Summer
        Return Period (years)                 2            Cv (Summer)   0.750
                        Region England and Wales           Cv (Winter)   0.840
                  M5-60 (mm)             17.000 Storm Duration (mins)      30
                     Ratio R              0.400
```

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-05

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 1 |
| Number of Online Controls | 1 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Ratio R | 0.300 |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 17.000 | Cv (Winter) | 0.840 |

| | |
|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 |
| Analysis Timestep | 2.5 Second Increment (Extended) |
| DTS Status | ON |
| DVD Status | ON |
| Inertia Status | OFF |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S09-05-1.000 | S09-05-1 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Summer | |
| S09-05-1.001 | S09-05-2 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-05-1.002 | S09-05-3 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | |
| S09-05-1.003 | S09-05-4 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Winter | |
| S09-05-1.004 | S09-05-5 | 15 Winter | 5 | +20% | 5/15 Summer | | |
| S09-05-2.000 | S09-05-6 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-05-2.001 | S09-05-7 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-05-2.002 | S09-05-8 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-05-2.003 | S09-05-9 | 15 Winter | 5 | +20% | 5/15 Winter | | |
| S09-05-2.004 | S09-05-10 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-05-1.005 | S09-05-11 | 15 Winter | 5 | +20% | 5/15 Summer | | |
| S09-05-1.006 | S09-05-12 | 30 Winter | 5 | +20% | 100/15 Summer | | |
| S09-05-1.007 | S09-05-13 | 30 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| S09-05-1.008 | S09-05-14 | 30 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | |
| S09-05-1.009 | S09-05-15 | 30 Winter | 5 | +20% | 100/15 Summer | | |
| S09-05-3.000 | S09-05-16 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-05-4.000 | S09-05-17 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-05-4.001 | S09-05-18 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-05

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S09-05-1.000 | S09-05-1 | | 153.178 | 0.041 | 0.000 | 0.86 | | |
| S09-05-1.001 | S09-05-2 | | 152.720 | 0.299 | 0.000 | 1.25 | | |
| S09-05-1.002 | S09-05-3 | | 151.866 | -0.045 | 0.000 | 0.80 | | |
| S09-05-1.003 | S09-05-4 | | 151.650 | 0.128 | 0.000 | 0.91 | | |
| S09-05-1.004 | S09-05-5 | | 151.417 | 0.174 | 0.000 | 1.10 | | |
| S09-05-2.000 | S09-05-6 | | 153.596 | 0.135 | 0.000 | 0.88 | | |
| S09-05-2.001 | S09-05-7 | | 153.070 | 0.396 | 0.000 | 1.23 | | |
| S09-05-2.002 | S09-05-8 | | 151.870 | -0.046 | 0.000 | 0.86 | | |
| S09-05-2.003 | S09-05-9 | | 151.706 | 0.024 | 0.000 | 1.06 | | |
| S09-05-2.004 | S09-05-10 | | 151.576 | -0.068 | 0.000 | 0.81 | | |
| S09-05-1.005 | S09-05-11 | | 151.334 | 0.170 | 0.000 | 1.18 | | |
| S09-05-1.006 | S09-05-12 | | 150.655 | -0.095 | 0.000 | 0.80 | | |
| S09-05-1.007 | S09-05-13 | | 149.421 | -0.086 | 0.000 | 0.84 | | |
| S09-05-1.008 | S09-05-14 | | 147.583 | -0.078 | 0.000 | 0.89 | | |
| S09-05-1.009 | S09-05-15 | | 145.439 | -0.025 | 0.000 | 1.00 | | |
| S09-05-3.000 | S09-05-16 | | 145.012 | -0.056 | 0.000 | 0.70 | | |
| S09-05-4.000 | S09-05-17 | | 146.470 | 0.082 | 0.000 | 0.86 | | |
| S09-05-4.001 | S09-05-18 | | 145.929 | 0.419 | 0.000 | 1.24 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S09-05-1.000 | S09-05-1 | 15.0 | SURCHARGED | 6 |
| S09-05-1.001 | S09-05-2 | 21.6 | SURCHARGED | 6 |
| S09-05-1.002 | S09-05-3 | 30.9 | OK | 3 |
| S09-05-1.003 | S09-05-4 | 34.7 | SURCHARGED | 1 |
| S09-05-1.004 | S09-05-5 | 38.0 | SURCHARGED | |
| S09-05-2.000 | S09-05-6 | 15.4 | SURCHARGED | 6 |
| S09-05-2.001 | S09-05-7 | 23.5 | SURCHARGED | 6 |
| S09-05-2.002 | S09-05-8 | 32.6 | OK | |
| S09-05-2.003 | S09-05-9 | 31.6 | SURCHARGED | |
| S09-05-2.004 | S09-05-10 | 31.2 | OK | |
| S09-05-1.005 | S09-05-11 | 81.3 | SURCHARGED | |
| S09-05-1.006 | S09-05-12 | 96.1 | OK | |
| S09-05-1.007 | S09-05-13 | 123.8 | OK | 6 |
| S09-05-1.008 | S09-05-14 | 142.9 | OK | 5 |
| S09-05-1.009 | S09-05-15 | 145.7 | OK | |
| S09-05-3.000 | S09-05-16 | 18.1 | OK | |
| S09-05-4.000 | S09-05-17 | 44.2 | SURCHARGED | 6 |
| S09-05-4.001 | S09-05-18 | 59.4 | SURCHARGED | 7 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-05

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood |
|---|---|---|---|---|---|---|
| S09-05-4.002 | S09-05-19 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-05-4.003 | S09-05-20 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter |
| S09-05-4.004 | S09-05-21 | 30 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer |
| S09-05-3.001 | S09-05-22 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S09-05-1.010 | S09-05-23 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S09-05-5.000 | S09-05-24 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-05-5.001 | S09-05-25 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer |
| S09-05-5.002 | S09-05-26 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer |
| S09-05-5.003 | S09-05-27 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-05-5.004 | S09-05-28 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-05-5.005 | S09-05-29 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-05-5.006 | S09-05-30 | 15 Winter | 5 | +20% | | |
| S09-05-1.011 | S09-05-31 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S09-05-6.000 | S09-05-32 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter |
| S09-05-6.001 | S09-05-33 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter |
| S09-05-6.002 | S09-05-34 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter |
| S09-05-6.003 | S09-05-35 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer |
| S09-05-6.004 | S09-05-36 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer |
| S09-05-6.005 | S09-05-37 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Winter |
| S09-05-6.006 | S09-05-38 | 15 Winter | 5 | +20% | 5/15 Summer | |
| S09-05-1.012 | S09-05-39 | 30 Winter | 5 | +20% | | |
| S09-05-1.013 | S09-05-40 | 30 Winter | 5 | +20% | 100/15 Summer | |
| S09-05-1.014 | S09-05-Pond Inlet | 30 Winter | 5 | +20% | 100/15 Summer | |
| S09-05-1.015 | S09-05-Pond Outlet | 1440 Winter | 5 | +20% | 100/720 Winter | |
| S09-05-1.016 | S09-05-41 | 1440 Winter | 5 | +20% | | |

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-05-4.002 | S09-05-19 | | | 144.680 | -0.102 | 0.000 | 0.76 |
| S09-05-4.003 | S09-05-20 | | | 144.529 | -0.027 | 0.000 | 0.79 |
| S09-05-4.004 | S09-05-21 | | | 144.050 | 0.388 | 0.000 | 1.22 |
| S09-05-3.001 | S09-05-22 | | | 143.423 | 0.175 | 0.000 | 0.94 |
| S09-05-1.010 | S09-05-23 | | | 143.338 | 0.141 | 0.000 | 1.60 |
| S09-05-5.000 | S09-05-24 | | | 153.311 | -0.064 | 0.000 | 0.57 |
| S09-05-5.001 | S09-05-25 | | | 151.986 | 0.136 | 0.000 | 0.93 |
| S09-05-5.002 | S09-05-26 | | | 150.158 | 0.593 | 0.000 | 1.23 |
| S09-05-5.003 | S09-05-27 | | | 148.331 | -0.107 | 0.000 | 0.53 |
| S09-05-5.004 | S09-05-28 | | | 147.067 | -0.074 | 0.000 | 0.76 |
| S09-05-5.005 | S09-05-29 | | | 145.257 | -0.107 | 0.000 | 0.73 |
| S09-05-5.006 | S09-05-30 | | | 144.872 | -0.144 | 0.000 | 0.52 |
| S09-05-1.011 | S09-05-31 | | | 143.276 | 0.112 | 0.000 | 1.58 |
| S09-05-6.000 | S09-05-32 | | | 146.400 | -0.073 | 0.000 | 0.51 |
| S09-05-6.001 | S09-05-33 | | | 146.276 | -0.099 | 0.000 | 0.59 |
| S09-05-6.002 | S09-05-34 | | | 145.978 | -0.098 | 0.000 | 0.60 |
| S09-05-6.003 | S09-05-35 | | | 145.447 | -0.090 | 0.000 | 0.79 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-05

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-05-6.004 | S09-05-36 | | | 144.910 | -0.083 | 0.000 | 0.85 |
| S09-05-6.005 | S09-05-37 | | | 144.198 | 0.055 | 0.000 | 0.98 |
| S09-05-6.006 | S09-05-38 | | | 143.449 | 0.078 | 0.000 | 1.28 |
| S09-05-1.012 | S09-05-39 | | | 142.793 | -0.280 | 0.000 | 0.44 |
| S09-05-1.013 | S09-05-40 | | | 141.584 | -0.124 | 0.000 | 0.94 |
| S09-05-1.014 | S09-05-Pond Inlet | | | 141.241 | -0.161 | 0.000 | 0.89 |
| S09-05-1.015 | S09-05-Pond Outlet | | | 140.621 | -0.329 | 0.000 | 0.02 |
| S09-05-1.016 | S09-05-41 | | | 139.679 | -0.211 | 0.000 | 0.19 |

| PN | US/MH Name | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|
| S09-05-4.002 | S09-05-19 | | | 65.5 | OK | |
| S09-05-4.003 | S09-05-20 | | | 80.2 | OK | 4 |
| S09-05-4.004 | S09-05-21 | | | 84.2 | SURCHARGED | 6 |
| S09-05-3.001 | S09-05-22 | | | 93.8 | SURCHARGED | |
| S09-05-1.010 | S09-05-23 | | | 235.7 | SURCHARGED | |
| S09-05-5.000 | S09-05-24 | | | 12.3 | OK | |
| S09-05-5.001 | S09-05-25 | | | 24.7 | SURCHARGED | 7 |
| S09-05-5.002 | S09-05-26 | | | 29.6 | SURCHARGED | 7 |
| S09-05-5.003 | S09-05-27 | | | 37.5 | OK | |
| S09-05-5.004 | S09-05-28 | | | 51.6 | OK | |
| S09-05-5.005 | S09-05-29 | | | 59.0 | OK | |
| S09-05-5.006 | S09-05-30 | | | 71.9 | OK | |
| S09-05-1.011 | S09-05-31 | | | 305.3 | SURCHARGED | |
| S09-05-6.000 | S09-05-32 | | | 8.0 | OK | 1 |
| S09-05-6.001 | S09-05-33 | | | 28.4 | OK | 1 |
| S09-05-6.002 | S09-05-34 | | | 29.6 | OK | 1 |
| S09-05-6.003 | S09-05-35 | | | 66.6 | OK | 4 |
| S09-05-6.004 | S09-05-36 | | | 88.2 | OK | 5 |
| S09-05-6.005 | S09-05-37 | | | 97.5 | SURCHARGED | 2 |
| S09-05-6.006 | S09-05-38 | | | 97.5 | SURCHARGED | |
| S09-05-1.012 | S09-05-39 | | | 398.8 | OK | |
| S09-05-1.013 | S09-05-40 | | | 398.5 | OK | |
| S09-05-1.014 | S09-05-Pond Inlet | | | 398.2 | OK | |
| S09-05-1.015 | S09-05-Pond Outlet | | | 15.9 | OK | |
| S09-05-1.016 | S09-05-41 | | | 15.9 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-05

### Simulation Criteria

Areal Reduction Factor 1.000
Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0
MADD Factor * 10m³/ha Storage 2.000
Hot Start Level (mm) 0
Inlet Coeffiecient 0.800
Manhole Headloss Coeff (Global) 0.500
Flow per Person per Day (l/per/day) 0.000
Foul Sewage per hectare (l/s) 0.000

Number of Input Hydrographs 0
Number of Storage Structures 1
Number of Online Controls 1
Number of Time/Area Diagrams 0
Number of Offline Controls 0
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
Ratio R 0.300
Region England and Wales
Cv (Summer) 0.750
M5-60 (mm) 17.000
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status ON
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S09-05-1.000 | S09-05-1 | 30 Winter | 100 | +40% | 5/15 Winter | 100/15 Summer | |
| S09-05-1.001 | S09-05-2 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S09-05-1.002 | S09-05-3 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | |
| S09-05-1.003 | S09-05-4 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Winter | |
| S09-05-1.004 | S09-05-5 | 30 Winter | 100 | +40% | 5/15 Summer | | |
| S09-05-2.000 | S09-05-6 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S09-05-2.001 | S09-05-7 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S09-05-2.002 | S09-05-8 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S09-05-2.003 | S09-05-9 | 30 Winter | 100 | +40% | 5/15 Winter | | |
| S09-05-2.004 | S09-05-10 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S09-05-1.005 | S09-05-11 | 30 Winter | 100 | +40% | 5/15 Summer | | |
| S09-05-1.006 | S09-05-12 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S09-05-1.007 | S09-05-13 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| S09-05-1.008 | S09-05-14 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | |
| S09-05-1.009 | S09-05-15 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S09-05-3.000 | S09-05-16 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S09-05-4.000 | S09-05-17 | 15 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S09-05-4.001 | S09-05-18 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-05

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S09-05-1.000 | S09-05-1 | | 154.344 | 1.208 | 7.803 | 1.28 | | |
| S09-05-1.001 | S09-05-2 | | 154.284 | 1.863 | 2.874 | 1.42 | | |
| S09-05-1.002 | S09-05-3 | | 154.056 | 2.145 | 0.753 | 0.87 | | |
| S09-05-1.003 | S09-05-4 | | 153.877 | 2.355 | 1.048 | 1.17 | | |
| S09-05-1.004 | S09-05-5 | | 153.647 | 2.404 | 0.000 | 1.37 | | |
| S09-05-2.000 | S09-05-6 | | 154.672 | 1.210 | 10.376 | 1.29 | | |
| S09-05-2.001 | S09-05-7 | | 154.636 | 1.962 | 1.785 | 1.44 | | |
| S09-05-2.002 | S09-05-8 | | 154.060 | 2.144 | 0.000 | 1.03 | | |
| S09-05-2.003 | S09-05-9 | | 153.867 | 2.185 | 0.000 | 1.17 | | |
| S09-05-2.004 | S09-05-10 | | 153.795 | 2.151 | 0.000 | 0.96 | | |
| S09-05-1.005 | S09-05-11 | | 153.555 | 2.391 | 0.000 | 1.59 | | |
| S09-05-1.006 | S09-05-12 | | 152.496 | 1.746 | 0.000 | 1.18 | | |
| S09-05-1.007 | S09-05-13 | | 150.724 | 1.216 | 16.451 | 1.09 | | |
| S09-05-1.008 | S09-05-14 | | 148.865 | 1.205 | 4.690 | 1.08 | | |
| S09-05-1.009 | S09-05-15 | | 146.428 | 0.964 | 0.000 | 1.22 | | |
| S09-05-3.000 | S09-05-16 | | 145.930 | 0.862 | 0.000 | 1.10 | | |
| S09-05-4.000 | S09-05-17 | | 147.599 | 1.210 | 10.463 | 1.00 | | |
| S09-05-4.001 | S09-05-18 | | 146.729 | 1.219 | 19.281 | 1.54 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S09-05-1.000 | S09-05-1 | 22.2 | FLOOD | 6 |
| S09-05-1.001 | S09-05-2 | 24.5 | FLOOD | 6 |
| S09-05-1.002 | S09-05-3 | 33.8 | FLOOD | 3 |
| S09-05-1.003 | S09-05-4 | 44.5 | FLOOD | 1 |
| S09-05-1.004 | S09-05-5 | 47.5 | FLOOD RISK | |
| S09-05-2.000 | S09-05-6 | 22.4 | FLOOD | 6 |
| S09-05-2.001 | S09-05-7 | 27.6 | FLOOD | 6 |
| S09-05-2.002 | S09-05-8 | 39.1 | SURCHARGED | |
| S09-05-2.003 | S09-05-9 | 34.9 | FLOOD RISK | |
| S09-05-2.004 | S09-05-10 | 36.9 | FLOOD RISK | |
| S09-05-1.005 | S09-05-11 | 109.7 | FLOOD RISK | |
| S09-05-1.006 | S09-05-12 | 141.6 | FLOOD RISK | |
| S09-05-1.007 | S09-05-13 | 159.6 | FLOOD | 6 |
| S09-05-1.008 | S09-05-14 | 173.4 | FLOOD | 5 |
| S09-05-1.009 | S09-05-15 | 177.8 | FLOOD RISK | |
| S09-05-3.000 | S09-05-16 | 28.4 | SURCHARGED | |
| S09-05-4.000 | S09-05-17 | 51.1 | FLOOD | 6 |
| S09-05-4.001 | S09-05-18 | 73.5 | FLOOD | 7 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-05

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood |
|---|---|---|---|---|---|---|
| S09-05-4.002 | S09-05-19 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-05-4.003 | S09-05-20 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter |
| S09-05-4.004 | S09-05-21 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer |
| S09-05-3.001 | S09-05-22 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-05-1.010 | S09-05-23 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-05-5.000 | S09-05-24 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-05-5.001 | S09-05-25 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer |
| S09-05-5.002 | S09-05-26 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer |
| S09-05-5.003 | S09-05-27 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-05-5.004 | S09-05-28 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-05-5.005 | S09-05-29 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-05-5.006 | S09-05-30 | 15 Winter | 100 | +40% | | |
| S09-05-1.011 | S09-05-31 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-05-6.000 | S09-05-32 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter |
| S09-05-6.001 | S09-05-33 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter |
| S09-05-6.002 | S09-05-34 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter |
| S09-05-6.003 | S09-05-35 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer |
| S09-05-6.004 | S09-05-36 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer |
| S09-05-6.005 | S09-05-37 | 30 Winter | 100 | +40% | 5/15 Winter | 100/15 Winter |
| S09-05-6.006 | S09-05-38 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-05-1.012 | S09-05-39 | 30 Winter | 100 | +40% | | |
| S09-05-1.013 | S09-05-40 | 30 Winter | 100 | +40% | 100/15 Summer | |
| S09-05-1.014 | S09-05-Pond Inlet | 30 Winter | 100 | +40% | 100/15 Summer | |
| S09-05-1.015 | S09-05-Pond Outlet | 1440 Winter | 100 | +40% | 100/720 Winter | |
| S09-05-1.016 | S09-05-41 | 1440 Summer | 100 | +40% | | |

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-05-4.002 | S09-05-19 | | | 145.961 | 1.179 | 0.000 | 0.93 |
| S09-05-4.003 | S09-05-20 | | | 145.772 | 1.216 | 1.950 | 1.00 |
| S09-05-4.004 | S09-05-21 | | | 144.871 | 1.208 | 8.293 | 1.70 |
| S09-05-3.001 | S09-05-22 | | | 143.833 | 0.584 | 0.000 | 1.37 |
| S09-05-1.010 | S09-05-23 | | | 143.714 | 0.517 | 0.000 | 2.14 |
| S09-05-5.000 | S09-05-24 | | | 154.395 | 1.019 | 0.000 | 0.90 |
| S09-05-5.001 | S09-05-25 | | | 153.057 | 1.208 | 7.899 | 1.00 |
| S09-05-5.002 | S09-05-26 | | | 150.769 | 1.204 | 3.976 | 1.44 |
| S09-05-5.003 | S09-05-27 | | | 148.819 | 0.381 | 0.000 | 0.78 |
| S09-05-5.004 | S09-05-28 | | | 148.109 | 0.967 | 0.000 | 1.20 |
| S09-05-5.005 | S09-05-29 | | | 145.528 | 0.165 | 0.000 | 1.21 |
| S09-05-5.006 | S09-05-30 | | | 144.980 | -0.037 | 0.000 | 0.95 |
| S09-05-1.011 | S09-05-31 | | | 143.550 | 0.386 | 0.000 | 2.34 |
| S09-05-6.000 | S09-05-32 | | | 147.673 | 1.200 | 0.121 | 0.84 |
| S09-05-6.001 | S09-05-33 | | | 147.626 | 1.251 | 0.053 | 0.99 |
| S09-05-6.002 | S09-05-34 | | | 147.375 | 1.299 | 0.199 | 0.88 |
| S09-05-6.003 | S09-05-35 | | | 146.954 | 1.417 | 2.840 | 1.20 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-05

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-05-6.004 | S09-05-36 | | | 146.202 | 1.208 | 8.499 | 1.17 |
| S09-05-6.005 | S09-05-37 | | | 145.343 | 1.200 | 0.099 | 1.45 |
| S09-05-6.006 | S09-05-38 | | | 143.718 | 0.347 | 0.000 | 1.88 |
| S09-05-1.012 | S09-05-39 | | | 142.875 | -0.199 | 0.000 | 0.66 |
| S09-05-1.013 | S09-05-40 | | | 142.285 | 0.577 | 0.000 | 1.39 |
| S09-05-1.014 | S09-05-Pond Inlet | | | 141.696 | 0.294 | 0.000 | 1.31 |
| S09-05-1.015 | S09-05-Pond Outlet | | | 140.994 | 0.045 | 0.000 | 0.02 |
| S09-05-1.016 | S09-05-41 | | | 139.679 | -0.211 | 0.000 | 0.19 |

| PN | US/MH Name | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|
| S09-05-4.002 | S09-05-19 | | | 79.8 | FLOOD RISK | |
| S09-05-4.003 | S09-05-20 | | | 102.1 | FLOOD | 4 |
| S09-05-4.004 | S09-05-21 | | | 117.2 | FLOOD | 6 |
| S09-05-3.001 | S09-05-22 | | | 135.8 | SURCHARGED | |
| S09-05-1.010 | S09-05-23 | | | 315.1 | SURCHARGED | |
| S09-05-5.000 | S09-05-24 | | | 19.5 | FLOOD RISK | |
| S09-05-5.001 | S09-05-25 | | | 26.6 | FLOOD | 7 |
| S09-05-5.002 | S09-05-26 | | | 34.6 | FLOOD | 7 |
| S09-05-5.003 | S09-05-27 | | | 55.0 | SURCHARGED | |
| S09-05-5.004 | S09-05-28 | | | 81.5 | FLOOD RISK | |
| S09-05-5.005 | S09-05-29 | | | 98.1 | SURCHARGED | |
| S09-05-5.006 | S09-05-30 | | | 131.2 | OK | |
| S09-05-1.011 | S09-05-31 | | | 451.2 | SURCHARGED | |
| S09-05-6.000 | S09-05-32 | | | 13.2 | FLOOD | 1 |
| S09-05-6.001 | S09-05-33 | | | 47.9 | FLOOD | 1 |
| S09-05-6.002 | S09-05-34 | | | 43.7 | FLOOD | 1 |
| S09-05-6.003 | S09-05-35 | | | 100.9 | FLOOD | 4 |
| S09-05-6.004 | S09-05-36 | | | 122.1 | FLOOD | 5 |
| S09-05-6.005 | S09-05-37 | | | 143.7 | FLOOD | 2 |
| S09-05-6.006 | S09-05-38 | | | 142.6 | SURCHARGED | |
| S09-05-1.012 | S09-05-39 | | | 589.4 | OK | |
| S09-05-1.013 | S09-05-40 | | | 589.3 | SURCHARGED | |
| S09-05-1.014 | S09-05-Pond Inlet | | | 587.5 | FLOOD RISK | |
| S09-05-1.015 | S09-05-Pond Outlet | | | 15.9 | SURCHARGED | |
| S09-05-1.016 | S09-05-41 | | | 15.9 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

## Design Criteria for S09-06

```
                   Pipe Sizes STANDARD Manhole Sizes STANDARD

                     FSR Rainfall Model - England and Wales
           Return Period (years)       2                         PIMP (%)    100
                     M5-60 (mm)   17.000          Add Flow / Climate Change (%)    0
                        Ratio R    0.300           Minimum Backdrop Height (m) 0.000
        Maximum Rainfall (mm/hr)     200           Maximum Backdrop Height (m) 0.000
Maximum Time of Concentration (mins)   30 Min Design Depth for Optimisation (m) 1.200
            Foul Sewage (l/s/ha)   0.000    Min Vel for Auto Design only (m/s)  1.00
          Volumetric Runoff Coeff. 0.750      Min Slope for Optimisation (1:X)   500

                          Designed with Level Soffits
```

## Simulation Criteria for S09-06

```
      Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 0.000
       Areal Reduction Factor 1.000      MADD Factor * 10m³/ha Storage 2.000
             Hot Start (mins)     0                 Inlet Coeffiecient 0.800
           Hot Start Level (mm)   0 Flow per Person per Day (l/per/day) 0.000
  Manhole Headloss Coeff (Global) 0.500                   Run Time (mins)    60
    Foul Sewage per hectare (l/s) 0.000            Output Interval (mins)     1

         Number of Input Hydrographs 0 Number of Storage Structures 1
           Number of Online Controls 1 Number of Time/Area Diagrams 0
          Number of Offline Controls 0 Number of Real Time Controls 0
```

## Synthetic Rainfall Details

```
            Rainfall Model                  FSR          Profile Type Summer
        Return Period (years)                 2           Cv (Summer)  0.750
                     Region England and Wales           Cv (Winter)  0.840
                  M5-60 (mm)             17.000 Storm Duration (mins)     30
                     Ratio R              0.400
```

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-06

### Simulation Criteria

```
               Areal Reduction Factor 1.000    Additional Flow - % of Total Flow 0.000
                     Hot Start (mins)     0       MADD Factor * 10m³/ha Storage 2.000
                 Hot Start Level (mm)     0                  Inlet Coeffiecient 0.800
     Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
       Foul Sewage per hectare (l/s) 0.000

               Number of Input Hydrographs 0 Number of Storage Structures 1
                 Number of Online Controls 1 Number of Time/Area Diagrams 0
                Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
                    Rainfall Model               FSR      Ratio R 0.300
                            Region England and Wales Cv (Summer) 0.750
                        M5-60 (mm)             17.000 Cv (Winter) 0.840

            Margin for Flood Risk Warning (mm)                         300.0
                            Analysis Timestep 2.5 Second Increment (Extended)
                                   DTS Status                             ON
                                   DVD Status                             ON
                               Inertia Status                            OFF


                           Profile(s)                      Summer and Winter
                   Duration(s) (mins)    15, 30, 60, 120, 180, 240, 360, 480, 600,
                                                                720, 960, 1440
              Return Period(s) (years)                                  5, 100
                   Climate Change (%)                                   20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S09-06-1.000 | S09-06-1 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-06-1.001 | S09-06-2 | 15 Winter | 5 | +20% | 5/15 Winter | | |
| S09-06-1.002 | S09-06-3 | 15 Winter | 5 | +20% | 5/15 Summer | | |
| S09-06-1.003 | S09-06-4 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-06-1.004 | S09-06-5 | 30 Winter | 5 | +20% | 100/15 Summer | | |
| S09-06-2.000 | S09-06-6 | 15 Winter | 5 | +20% | | | |
| S09-06-2.001 | S09-06-7 | 15 Winter | 5 | +20% | 100/30 Winter | | |
| S09-06-2.002 | S09-06-8 | 15 Winter | 5 | +20% | 100/30 Summer | | |
| S09-06-1.005 | S09-06-9 | 30 Winter | 5 | +20% | 5/15 Winter | | |
| S09-06-1.006 | S09-06-10 | 30 Winter | 5 | +20% | 5/15 Winter | | |
| S09-06-1.007 | S09-06-11 | 30 Winter | 5 | +20% | 5/30 Summer | | |
| S09-06-1.008 | S09-06-12 | 30 Winter | 5 | +20% | 100/15 Summer | | |
| S09-06-1.009 | S09-06-13 | 30 Winter | 5 | +20% | 100/15 Summer | | |
| S09-06-3.000 | S09-06-14 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-06-3.001 | S09-06-15 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-06-3.002 | S09-06-16 | 15 Winter | 5 | +20% | 5/15 Summer | 100/30 Winter | |
| S09-06-3.003 | S09-06-17 | 15 Winter | 5 | +20% | 5/15 Summer | | |
| S09-06-3.004 | S09-06-18 | 30 Winter | 5 | +20% | 100/15 Summer | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-06

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S09-06-1.000 | S09-06-1 | | 150.319 | 0.345 | 0.000 | 1.16 | | |
| S09-06-1.001 | S09-06-2 | | 149.261 | 0.063 | 0.000 | 0.82 | | |
| S09-06-1.002 | S09-06-3 | | 148.997 | 0.197 | 0.000 | 1.14 | | |
| S09-06-1.003 | S09-06-4 | | 148.114 | -0.091 | 0.000 | 0.80 | | |
| S09-06-1.004 | S09-06-5 | | 147.767 | -0.025 | 0.000 | 0.87 | | |
| S09-06-2.000 | S09-06-6 | | 151.132 | -0.119 | 0.000 | 0.09 | | |
| S09-06-2.001 | S09-06-7 | | 150.555 | -0.106 | 0.000 | 0.18 | | |
| S09-06-2.002 | S09-06-8 | | 149.882 | -0.106 | 0.000 | 0.19 | | |
| S09-06-1.005 | S09-06-9 | | 147.564 | 0.051 | 0.000 | 0.97 | | |
| S09-06-1.006 | S09-06-10 | | 147.232 | 0.074 | 0.000 | 1.06 | | |
| S09-06-1.007 | S09-06-11 | | 146.817 | 0.028 | 0.000 | 1.06 | | |
| S09-06-1.008 | S09-06-12 | | 146.354 | -0.118 | 0.000 | 0.79 | | |
| S09-06-1.009 | S09-06-13 | | 146.081 | -0.101 | 0.000 | 0.88 | | |
| S09-06-3.000 | S09-06-14 | | 150.286 | 0.333 | 0.000 | 1.11 | | |
| S09-06-3.001 | S09-06-15 | | 148.947 | -0.015 | 0.000 | 0.83 | | |
| S09-06-3.002 | S09-06-16 | | 148.664 | 0.195 | 0.000 | 0.94 | | |
| S09-06-3.003 | S09-06-17 | | 148.336 | 0.239 | 0.000 | 1.17 | | |
| S09-06-3.004 | S09-06-18 | | 147.394 | -0.096 | 0.000 | 0.79 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S09-06-1.000 | S09-06-1 | 20.2 | SURCHARGED | 8 |
| S09-06-1.001 | S09-06-2 | 31.8 | SURCHARGED | |
| S09-06-1.002 | S09-06-3 | 44.5 | SURCHARGED | |
| S09-06-1.003 | S09-06-4 | 55.0 | OK | |
| S09-06-1.004 | S09-06-5 | 59.2 | OK | |
| S09-06-2.000 | S09-06-6 | 1.5 | OK | |
| S09-06-2.001 | S09-06-7 | 3.1 | OK | |
| S09-06-2.002 | S09-06-8 | 3.1 | OK | |
| S09-06-1.005 | S09-06-9 | 66.8 | SURCHARGED | |
| S09-06-1.006 | S09-06-10 | 72.7 | SURCHARGED | |
| S09-06-1.007 | S09-06-11 | 76.9 | SURCHARGED | |
| S09-06-1.008 | S09-06-12 | 83.7 | OK | |
| S09-06-1.009 | S09-06-13 | 94.2 | OK | |
| S09-06-3.000 | S09-06-14 | 19.4 | SURCHARGED | 9 |
| S09-06-3.001 | S09-06-15 | 32.4 | OK | |
| S09-06-3.002 | S09-06-16 | 36.4 | SURCHARGED | 2 |
| S09-06-3.003 | S09-06-17 | 46.1 | SURCHARGED | |
| S09-06-3.004 | S09-06-18 | 53.7 | OK | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-06

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood |
|---|---|---|---|---|---|---|
| S09-06-3.005 | S09-06-19 | 30 Winter | 5 | +20% | 5/30 Winter | |
| S09-06-3.006 | S09-06-20 | 30 Winter | 5 | +20% | 5/15 Winter | 100/30 Winter |
| S09-06-3.007 | S09-06-21 | 30 Winter | 5 | +20% | 5/15 Summer | 100/60 Winter |
| S09-06-3.008 | S09-06-22 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S09-06-3.009 | S09-06-23 | 60 Winter | 5 | +20% | 5/15 Winter | |
| S09-06-3.010 | S09-06-24 | 60 Winter | 5 | +20% | 5/15 Summer | |
| S09-06-1.010 | S09-06-25 | 60 Winter | 5 | +20% | 5/15 Winter | |
| S09-06-1.011 | S09-06-26 | 60 Winter | 5 | +20% | 5/30 Summer | |
| S09-06-1.012 | S09-06-27 | 60 Winter | 5 | +20% | 5/30 Summer | |
| S09-06-4.000 | S09-06-28 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-06-1.013 | S09-06-29 | 60 Winter | 5 | +20% | 5/30 Summer | |
| S09-06-5.000 | S09-06-30 | 15 Winter | 5 | +20% | | |
| S09-06-5.001 | S09-06-31 | 15 Winter | 5 | +20% | | |
| S09-06-5.002 | S09-06-32 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-06-5.003 | S09-06-33 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-06-5.004 | S09-06-34 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-06-5.005 | S09-06-35 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-06-5.006 | S09-06-36 | 15 Winter | 5 | +20% | 5/15 Winter | |
| S09-06-6.000 | S09-06-37 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-06-1.014 | S09-06-38 | 30 Winter | 5 | +20% | 5/30 Winter | |
| S09-06-1.015 | S09-06-39 | 30 Winter | 5 | +20% | 100/15 Summer | |
| S09-06-1.016 | S09-06-40 | 60 Winter | 5 | +20% | | |
| S09-06-1.017 | S09-06-Pond Inlet | 60 Winter | 5 | +20% | | |
| S09-06-1.018 | S09-06-Pond Outlet | 1440 Winter | 5 | +20% | | |
| S09-06-1.019 | S09-06-41 | 1440 Winter | 5 | +20% | | |

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-06-3.005 | S09-06-19 | | | 147.214 | 0.001 | 0.000 | 0.88 |
| S09-06-3.006 | S09-06-20 | | | 146.967 | 0.113 | 0.000 | 0.98 |
| S09-06-3.007 | S09-06-21 | | | 146.665 | 0.164 | 0.000 | 0.99 |
| S09-06-3.008 | S09-06-22 | | | 146.389 | 0.173 | 0.000 | 1.04 |
| S09-06-3.009 | S09-06-23 | | | 146.021 | 0.174 | 0.000 | 1.00 |
| S09-06-3.010 | S09-06-24 | | | 145.555 | 0.184 | 0.000 | 1.28 |
| S09-06-1.010 | S09-06-25 | | | 145.465 | 0.162 | 0.000 | 1.09 |
| S09-06-1.011 | S09-06-26 | | | 145.161 | 0.134 | 0.000 | 1.07 |
| S09-06-1.012 | S09-06-27 | | | 144.841 | 0.096 | 0.000 | 1.09 |
| S09-06-4.000 | S09-06-28 | | | 146.949 | -0.056 | 0.000 | 0.91 |
| S09-06-1.013 | S09-06-29 | | | 144.506 | 0.043 | 0.000 | 1.52 |
| S09-06-5.000 | S09-06-30 | | | 147.987 | -0.116 | 0.000 | 0.12 |
| S09-06-5.001 | S09-06-31 | | | 147.561 | -0.101 | 0.000 | 0.23 |
| S09-06-5.002 | S09-06-32 | | | 147.078 | -0.078 | 0.000 | 0.45 |
| S09-06-5.003 | S09-06-33 | | | 146.551 | -0.080 | 0.000 | 0.44 |
| S09-06-5.004 | S09-06-34 | | | 146.085 | -0.067 | 0.000 | 0.54 |
| S09-06-5.005 | S09-06-35 | | | 144.966 | -0.082 | 0.000 | 0.67 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-06

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-06-5.006 | S09-06-36 | | | 144.500 | 0.048 | 0.000 | 1.02 |
| S09-06-6.000 | S09-06-37 | | | 146.778 | -0.061 | 0.000 | 0.86 |
| S09-06-1.014 | S09-06-38 | | | 143.895 | 0.022 | 0.000 | 1.77 |
| S09-06-1.015 | S09-06-39 | | | 143.851 | 0.000 | 0.000 | 1.04 |
| S09-06-1.016 | S09-06-40 | | | 143.393 | -0.354 | 0.000 | 0.23 |
| S09-06-1.017 | S09-06-Pond Inlet | | | 142.110 | -0.301 | 0.000 | 0.50 |
| S09-06-1.018 | S09-06-Pond Outlet | | | 141.569 | -0.339 | 0.000 | 0.05 |
| S09-06-1.019 | S09-06-41 | | | 141.315 | -0.261 | 0.000 | 0.04 |

| PN | US/MH Name | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|
| S09-06-3.005 | S09-06-19 | | | 60.4 | SURCHARGED | |
| S09-06-3.006 | S09-06-20 | | | 67.1 | SURCHARGED | 2 |
| S09-06-3.007 | S09-06-21 | | | 67.4 | SURCHARGED | 1 |
| S09-06-3.008 | S09-06-22 | | | 71.7 | SURCHARGED | |
| S09-06-3.009 | S09-06-23 | | | 74.2 | SURCHARGED | |
| S09-06-3.010 | S09-06-24 | | | 81.3 | SURCHARGED | |
| S09-06-1.010 | S09-06-25 | | | 175.0 | SURCHARGED | |
| S09-06-1.011 | S09-06-26 | | | 173.9 | SURCHARGED | |
| S09-06-1.012 | S09-06-27 | | | 176.5 | SURCHARGED | |
| S09-06-4.000 | S09-06-28 | | | 28.9 | OK | |
| S09-06-1.013 | S09-06-29 | | | 180.6 | SURCHARGED | |
| S09-06-5.000 | S09-06-30 | | | 2.0 | OK | |
| S09-06-5.001 | S09-06-31 | | | 3.9 | OK | |
| S09-06-5.002 | S09-06-32 | | | 7.8 | OK | |
| S09-06-5.003 | S09-06-33 | | | 7.6 | OK | |
| S09-06-5.004 | S09-06-34 | | | 10.0 | OK | |
| S09-06-5.005 | S09-06-35 | | | 26.2 | OK | |
| S09-06-5.006 | S09-06-36 | | | 40.0 | SURCHARGED | |
| S09-06-6.000 | S09-06-37 | | | 26.9 | OK | |
| S09-06-1.014 | S09-06-38 | | | 204.8 | SURCHARGED | |
| S09-06-1.015 | S09-06-39 | | | 201.2 | OK | |
| S09-06-1.016 | S09-06-40 | | | 206.6 | OK | |
| S09-06-1.017 | S09-06-Pond Inlet | | | 206.6 | OK | |
| S09-06-1.018 | S09-06-Pond Outlet | | | 11.9 | OK | |
| S09-06-1.019 | S09-06-41 | | | 11.9 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-06

```
                             Simulation Criteria
       Areal Reduction Factor 1.000    Additional Flow - % of Total Flow 0.000
             Hot Start (mins)     0        MADD Factor * 10m³/ha Storage 2.000
           Hot Start Level (mm)     0                 Inlet Coeffiecient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
   Foul Sewage per hectare (l/s) 0.000

         Number of Input Hydrographs 0 Number of Storage Structures 1
           Number of Online Controls 1 Number of Time/Area Diagrams 0
          Number of Offline Controls 0 Number of Real Time Controls 0

                          Synthetic Rainfall Details
                Rainfall Model              FSR      Ratio R 0.300
                       Region England and Wales Cv (Summer) 0.750
                    M5-60 (mm)            17.000 Cv (Winter) 0.840

          Margin for Flood Risk Warning (mm)                        300.0
                         Analysis Timestep 2.5 Second Increment (Extended)
                                DTS Status                             ON
                                DVD Status                             ON
                            Inertia Status                            OFF


                     Profile(s)                         Summer and Winter
                Duration(s) (mins)     15, 30, 60, 120, 180, 240, 360, 480, 600,
                                                          720, 960, 1440
           Return Period(s) (years)                                5, 100
                Climate Change (%)                                 20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S09-06-1.000 | S09-06-1 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S09-06-1.001 | S09-06-2 | 30 Winter | 100 | +40% | 5/15 Winter | | |
| S09-06-1.002 | S09-06-3 | 30 Winter | 100 | +40% | 5/15 Summer | | |
| S09-06-1.003 | S09-06-4 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S09-06-1.004 | S09-06-5 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S09-06-2.000 | S09-06-6 | 15 Winter | 100 | +40% | | | |
| S09-06-2.001 | S09-06-7 | 60 Winter | 100 | +40% | 100/30 Winter | | |
| S09-06-2.002 | S09-06-8 | 60 Winter | 100 | +40% | 100/30 Summer | | |
| S09-06-1.005 | S09-06-9 | 30 Winter | 100 | +40% | 5/15 Winter | | |
| S09-06-1.006 | S09-06-10 | 60 Winter | 100 | +40% | 5/15 Winter | | |
| S09-06-1.007 | S09-06-11 | 60 Winter | 100 | +40% | 5/30 Summer | | |
| S09-06-1.008 | S09-06-12 | 60 Winter | 100 | +40% | 100/15 Summer | | |
| S09-06-1.009 | S09-06-13 | 60 Winter | 100 | +40% | 100/15 Summer | | |
| S09-06-3.000 | S09-06-14 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer | |
| S09-06-3.001 | S09-06-15 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S09-06-3.002 | S09-06-16 | 30 Winter | 100 | +40% | 5/15 Summer | 100/30 Winter | |
| S09-06-3.003 | S09-06-17 | 30 Winter | 100 | +40% | 5/15 Summer | | |
| S09-06-3.004 | S09-06-18 | 30 Winter | 100 | +40% | 100/15 Summer | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-06

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S09-06-1.000 | S09-06-1 | | 151.200 | 1.225 | 25.126 | 1.60 | | |
| S09-06-1.001 | S09-06-2 | | 152.066 | 2.868 | 0.000 | 0.90 | | |
| S09-06-1.002 | S09-06-3 | | 152.043 | 3.242 | 0.000 | 1.47 | | |
| S09-06-1.003 | S09-06-4 | | 151.560 | 3.354 | 0.000 | 1.06 | | |
| S09-06-1.004 | S09-06-5 | | 151.268 | 3.476 | 0.000 | 1.19 | | |
| S09-06-2.000 | S09-06-6 | | 151.147 | -0.104 | 0.000 | 0.19 | | |
| S09-06-2.001 | S09-06-7 | | 150.936 | 0.274 | 0.000 | 0.38 | | |
| S09-06-2.002 | S09-06-8 | | 150.917 | 0.929 | 0.000 | 0.90 | | |
| S09-06-1.005 | S09-06-9 | | 150.934 | 3.421 | 0.000 | 1.33 | | |
| S09-06-1.006 | S09-06-10 | | 150.443 | 3.285 | 0.000 | 1.43 | | |
| S09-06-1.007 | S09-06-11 | | 149.707 | 2.918 | 0.000 | 1.53 | | |
| S09-06-1.008 | S09-06-12 | | 148.979 | 2.507 | 0.000 | 1.19 | | |
| S09-06-1.009 | S09-06-13 | | 148.572 | 2.390 | 0.000 | 1.33 | | |
| S09-06-3.000 | S09-06-14 | | 151.188 | 1.235 | 34.830 | 1.49 | | |
| S09-06-3.001 | S09-06-15 | | 152.482 | 3.520 | 0.000 | 0.86 | | |
| S09-06-3.002 | S09-06-16 | | 152.384 | 3.915 | 5.595 | 0.96 | | |
| S09-06-3.003 | S09-06-17 | | 152.469 | 4.372 | 0.000 | 1.37 | | |
| S09-06-3.004 | S09-06-18 | | 152.146 | 4.656 | 0.000 | 0.89 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S09-06-1.000 | S09-06-1 | 27.8 | FLOOD | 8 |
| S09-06-1.001 | S09-06-2 | 34.9 | SURCHARGED | |
| S09-06-1.002 | S09-06-3 | 57.6 | SURCHARGED | |
| S09-06-1.003 | S09-06-4 | 72.8 | SURCHARGED | |
| S09-06-1.004 | S09-06-5 | 81.0 | SURCHARGED | |
| S09-06-2.000 | S09-06-6 | 3.3 | OK | |
| S09-06-2.001 | S09-06-7 | 6.6 | SURCHARGED | |
| S09-06-2.002 | S09-06-8 | 14.5 | SURCHARGED | |
| S09-06-1.005 | S09-06-9 | 91.6 | SURCHARGED | |
| S09-06-1.006 | S09-06-10 | 98.6 | SURCHARGED | |
| S09-06-1.007 | S09-06-11 | 110.4 | SURCHARGED | |
| S09-06-1.008 | S09-06-12 | 126.2 | SURCHARGED | |
| S09-06-1.009 | S09-06-13 | 141.5 | SURCHARGED | |
| S09-06-3.000 | S09-06-14 | 26.0 | FLOOD | 9 |
| S09-06-3.001 | S09-06-15 | 33.7 | FLOOD RISK | |
| S09-06-3.002 | S09-06-16 | 37.2 | FLOOD | 2 |
| S09-06-3.003 | S09-06-17 | 54.1 | SURCHARGED | |
| S09-06-3.004 | S09-06-18 | 60.4 | FLOOD RISK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-06

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood |
|---|---|---|---|---|---|---|
| S09-06-3.005 | S09-06-19 | 30 Winter | 100 | +40% | 5/30 Winter | |
| S09-06-3.006 | S09-06-20 | 60 Winter | 100 | +40% | 5/15 Winter | 100/30 Winter |
| S09-06-3.007 | S09-06-21 | 60 Winter | 100 | +40% | 5/15 Summer | 100/60 Winter |
| S09-06-3.008 | S09-06-22 | 60 Winter | 100 | +40% | 5/15 Summer | |
| S09-06-3.009 | S09-06-23 | 60 Winter | 100 | +40% | 5/15 Winter | |
| S09-06-3.010 | S09-06-24 | 60 Winter | 100 | +40% | 5/15 Summer | |
| S09-06-1.010 | S09-06-25 | 60 Winter | 100 | +40% | 5/15 Winter | |
| S09-06-1.011 | S09-06-26 | 60 Winter | 100 | +40% | 5/30 Summer | |
| S09-06-1.012 | S09-06-27 | 60 Winter | 100 | +40% | 5/30 Summer | |
| S09-06-4.000 | S09-06-28 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-06-1.013 | S09-06-29 | 60 Winter | 100 | +40% | 5/30 Summer | |
| S09-06-5.000 | S09-06-30 | 15 Winter | 100 | +40% | | |
| S09-06-5.001 | S09-06-31 | 15 Winter | 100 | +40% | | |
| S09-06-5.002 | S09-06-32 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-06-5.003 | S09-06-33 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-06-5.004 | S09-06-34 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-06-5.005 | S09-06-35 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-06-5.006 | S09-06-36 | 15 Winter | 100 | +40% | 5/15 Winter | |
| S09-06-6.000 | S09-06-37 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-06-1.014 | S09-06-38 | 30 Winter | 100 | +40% | 5/30 Winter | |
| S09-06-1.015 | S09-06-39 | 30 Winter | 100 | +40% | 100/15 Summer | |
| S09-06-1.016 | S09-06-40 | 60 Winter | 100 | +40% | | |
| S09-06-1.017 | S09-06-Pond Inlet | 30 Winter | 100 | +40% | | |
| S09-06-1.018 | S09-06-Pond Outlet | 1440 Winter | 100 | +40% | | |
| S09-06-1.019 | S09-06-41 | 240 Summer | 100 | +40% | | |

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-06-3.005 | S09-06-19 | | | 151.999 | 4.786 | 0.000 | 1.06 |
| S09-06-3.006 | S09-06-20 | | | 151.617 | 4.763 | 1.340 | 1.26 |
| S09-06-3.007 | S09-06-21 | | | 151.155 | 4.654 | 0.323 | 1.42 |
| S09-06-3.008 | S09-06-22 | | | 150.653 | 4.437 | 0.000 | 1.62 |
| S09-06-3.009 | S09-06-23 | | | 149.716 | 3.869 | 0.000 | 1.73 |
| S09-06-3.010 | S09-06-24 | | | 148.291 | 2.920 | 0.000 | 2.01 |
| S09-06-1.010 | S09-06-25 | | | 148.020 | 2.717 | 0.000 | 1.85 |
| S09-06-1.011 | S09-06-26 | | | 147.061 | 2.034 | 0.000 | 1.92 |
| S09-06-1.012 | S09-06-27 | | | 146.012 | 1.267 | 0.000 | 1.99 |
| S09-06-4.000 | S09-06-28 | | | 147.800 | 0.795 | 0.000 | 1.72 |
| S09-06-1.013 | S09-06-29 | | | 144.891 | 0.428 | 0.000 | 2.89 |
| S09-06-5.000 | S09-06-30 | | | 148.005 | -0.098 | 0.000 | 0.25 |
| S09-06-5.001 | S09-06-31 | | | 147.660 | -0.002 | 0.000 | 0.55 |
| S09-06-5.002 | S09-06-32 | | | 147.622 | 0.466 | 0.000 | 0.96 |
| S09-06-5.003 | S09-06-33 | | | 147.463 | 0.832 | 0.000 | 0.89 |
| S09-06-5.004 | S09-06-34 | | | 147.376 | 1.224 | 0.000 | 1.06 |
| S09-06-5.005 | S09-06-35 | | | 147.220 | 2.172 | 0.000 | 1.08 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-06

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-06-5.006 | S09-06-36 | | | 146.416 | 1.964 | 0.000 | 1.90 |
| S09-06-6.000 | S09-06-37 | | | 147.494 | 0.655 | 0.000 | 1.64 |
| S09-06-1.014 | S09-06-38 | | | 144.528 | 0.655 | 0.000 | 3.67 |
| S09-06-1.015 | S09-06-39 | | | 144.221 | 0.370 | 0.000 | 2.17 |
| S09-06-1.016 | S09-06-40 | | | 143.477 | -0.270 | 0.000 | 0.48 |
| S09-06-1.017 | S09-06-Pond Inlet | | | 142.411 | 0.000 | 0.000 | 1.00 |
| S09-06-1.018 | S09-06-Pond Outlet | | | 141.907 | -0.001 | 0.000 | 0.05 |
| S09-06-1.019 | S09-06-41 | | | 141.315 | -0.261 | 0.000 | 0.04 |

| PN | US/MH Name | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|
| S09-06-3.005 | S09-06-19 | | | 72.7 | FLOOD RISK | |
| S09-06-3.006 | S09-06-20 | | | 86.4 | FLOOD | 2 |
| S09-06-3.007 | S09-06-21 | | | 96.5 | FLOOD | 1 |
| S09-06-3.008 | S09-06-22 | | | 111.0 | FLOOD RISK | |
| S09-06-3.009 | S09-06-23 | | | 127.8 | SURCHARGED | |
| S09-06-3.010 | S09-06-24 | | | 128.0 | SURCHARGED | |
| S09-06-1.010 | S09-06-25 | | | 297.7 | SURCHARGED | |
| S09-06-1.011 | S09-06-26 | | | 311.3 | SURCHARGED | |
| S09-06-1.012 | S09-06-27 | | | 323.1 | SURCHARGED | |
| S09-06-4.000 | S09-06-28 | | | 55.0 | SURCHARGED | |
| S09-06-1.013 | S09-06-29 | | | 343.5 | SURCHARGED | |
| S09-06-5.000 | S09-06-30 | | | 4.3 | OK | |
| S09-06-5.001 | S09-06-31 | | | 9.5 | OK | |
| S09-06-5.002 | S09-06-32 | | | 16.7 | SURCHARGED | |
| S09-06-5.003 | S09-06-33 | | | 15.5 | SURCHARGED | |
| S09-06-5.004 | S09-06-34 | | | 19.5 | SURCHARGED | |
| S09-06-5.005 | S09-06-35 | | | 42.5 | SURCHARGED | |
| S09-06-5.006 | S09-06-36 | | | 74.2 | SURCHARGED | |
| S09-06-6.000 | S09-06-37 | | | 51.4 | FLOOD RISK | |
| S09-06-1.014 | S09-06-38 | | | 425.0 | SURCHARGED | |
| S09-06-1.015 | S09-06-39 | | | 420.9 | SURCHARGED | |
| S09-06-1.016 | S09-06-40 | | | 422.1 | OK | |
| S09-06-1.017 | S09-06-Pond Inlet | | | 414.2 | OK | |
| S09-06-1.018 | S09-06-Pond Outlet | | | 11.9 | OK | |
| S09-06-1.019 | S09-06-41 | | | 12.0 | OK | |

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Summer | 145.974 | 0.292 | 22.1 | 69.6 | Flood Risk |
| 30 min Summer | 146.053 | 0.371 | 22.1 | 91.9 | Flood Risk |
| 60 min Summer | 146.112 | 0.430 | 22.1 | 109.5 | Flood Risk |
| 120 min Summer | 146.138 | 0.456 | 22.1 | 117.9 | Flood Risk |
| 180 min Summer | 146.131 | 0.449 | 22.1 | 115.6 | Flood Risk |
| 240 min Summer | 146.111 | 0.429 | 22.1 | 109.5 | Flood Risk |
| 360 min Summer | 146.059 | 0.377 | 22.1 | 93.6 | Flood Risk |
| 480 min Summer | 146.010 | 0.328 | 22.1 | 79.6 | Flood Risk |
| 600 min Summer | 145.968 | 0.286 | 22.1 | 67.9 | Flood Risk |
| 720 min Summer | 145.934 | 0.252 | 22.0 | 58.8 | Flood Risk |
| 960 min Summer | 145.889 | 0.207 | 21.4 | 47.0 | Flood Risk |
| 1440 min Summer | 145.852 | 0.170 | 17.1 | 38.0 | O K |
| 2160 min Summer | 145.824 | 0.142 | 13.1 | 31.3 | O K |
| 2880 min Summer | 145.808 | 0.126 | 10.7 | 27.4 | O K |
| 4320 min Summer | 145.788 | 0.106 | 8.0 | 22.8 | O K |
| 5760 min Summer | 145.776 | 0.094 | 6.5 | 20.1 | O K |
| 7200 min Summer | 145.767 | 0.085 | 5.4 | 18.2 | O K |
| 8640 min Summer | 145.761 | 0.079 | 4.8 | 16.8 | O K |
| 10080 min Summer | 145.756 | 0.074 | 4.2 | 15.7 | O K |
| 15 min Winter | 146.008 | 0.326 | 22.1 | 78.9 | Flood Risk |
| 30 min Winter | 146.097 | 0.415 | 22.1 | 105.0 | Flood Risk |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 104.373 | 0.0 | 85.5 | 22 |
| 30 min Summer | 72.185 | 0.0 | 118.5 | 33 |
| 60 min Summer | 47.821 | 0.0 | 157.5 | 54 |
| 120 min Summer | 30.679 | 0.0 | 202.2 | 88 |
| 180 min Summer | 23.321 | 0.0 | 230.6 | 124 |
| 240 min Summer | 19.055 | 0.0 | 251.2 | 156 |
| 360 min Summer | 14.198 | 0.0 | 280.8 | 222 |
| 480 min Summer | 11.527 | 0.0 | 304.0 | 282 |
| 600 min Summer | 9.797 | 0.0 | 322.9 | 340 |
| 720 min Summer | 8.572 | 0.0 | 339.1 | 398 |
| 960 min Summer | 6.935 | 0.0 | 365.8 | 508 |
| 1440 min Summer | 5.133 | 0.0 | 406.0 | 744 |
| 2160 min Summer | 3.788 | 0.0 | 449.8 | 1108 |
| 2880 min Summer | 3.049 | 0.0 | 482.6 | 1472 |
| 4320 min Summer | 2.239 | 0.0 | 531.6 | 2204 |
| 5760 min Summer | 1.796 | 0.0 | 568.9 | 2928 |
| 7200 min Summer | 1.516 | 0.0 | 600.2 | 3672 |
| 8640 min Summer | 1.320 | 0.0 | 627.1 | 4360 |
| 10080 min Summer | 1.174 | 0.0 | 650.6 | 5056 |
| 15 min Winter | 104.373 | 0.0 | 95.8 | 22 |
| 30 min Winter | 72.185 | 0.0 | 132.8 | 34 |

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 60 min Winter | 146.160 | 0.478 | 22.1 | 124.8 | Flood Risk |
| 120 min Winter | 146.179 | 0.497 | 22.1 | 131.1 | Flood Risk |
| 180 min Winter | 146.162 | 0.480 | 22.1 | 125.5 | Flood Risk |
| 240 min Winter | 146.130 | 0.448 | 22.1 | 115.2 | Flood Risk |
| 360 min Winter | 146.044 | 0.362 | 22.1 | 89.2 | Flood Risk |
| 480 min Winter | 145.970 | 0.288 | 22.1 | 68.2 | Flood Risk |
| 600 min Winter | 145.914 | 0.232 | 21.8 | 53.5 | Flood Risk |
| 720 min Winter | 145.883 | 0.201 | 20.9 | 45.5 | Flood Risk |
| 960 min Winter | 145.854 | 0.172 | 17.4 | 38.5 | O K |
| 1440 min Winter | 145.824 | 0.142 | 13.1 | 31.3 | O K |
| 2160 min Winter | 145.801 | 0.119 | 9.8 | 25.8 | O K |
| 2880 min Winter | 145.787 | 0.105 | 7.9 | 22.6 | O K |
| 4320 min Winter | 145.770 | 0.088 | 5.8 | 18.9 | O K |
| 5760 min Winter | 145.760 | 0.078 | 4.7 | 16.6 | O K |
| 7200 min Winter | 145.754 | 0.072 | 4.0 | 15.2 | O K |
| 8640 min Winter | 145.748 | 0.066 | 3.4 | 14.1 | O K |
| 10080 min Winter | 145.745 | 0.063 | 3.1 | 13.2 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 60 min Winter | 47.821 | 0.0 | 176.4 | 58 |
| 120 min Winter | 30.679 | 0.0 | 226.5 | 94 |
| 180 min Winter | 23.321 | 0.0 | 258.3 | 132 |
| 240 min Winter | 19.055 | 0.0 | 281.4 | 170 |
| 360 min Winter | 14.198 | 0.0 | 314.5 | 234 |
| 480 min Winter | 11.527 | 0.0 | 340.5 | 292 |
| 600 min Winter | 9.797 | 0.0 | 361.7 | 344 |
| 720 min Winter | 8.572 | 0.0 | 379.8 | 392 |
| 960 min Winter | 6.935 | 0.0 | 409.7 | 510 |
| 1440 min Winter | 5.133 | 0.0 | 454.7 | 750 |
| 2160 min Winter | 3.788 | 0.0 | 503.8 | 1108 |
| 2880 min Winter | 3.049 | 0.0 | 540.6 | 1476 |
| 4320 min Winter | 2.239 | 0.0 | 595.4 | 2208 |
| 5760 min Winter | 1.796 | 0.0 | 637.2 | 2936 |
| 7200 min Winter | 1.516 | 0.0 | 672.3 | 3624 |
| 8640 min Winter | 1.320 | 0.0 | 702.3 | 4408 |
| 10080 min Winter | 1.174 | 0.0 | 728.7 | 5120 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 17.000 | Shortest Storm (mins) | 15 |
| Ratio R | 0.300 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 0.440

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 0.147 | 4 | 8 | 0.147 | 8 | 12 | 0.147 |

## Model Details

Storage is Online Cover Level (m) 146.182

## Tank or Pond Structure

Invert Level (m) 145.682

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 204.0 | 0.500 | 329.0 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0214-2210-0500-2210 |
| Design Head (m) | 0.500 |
| Design Flow (l/s) | 22.1 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 214 |
| Invert Level (m) | 145.682 |
| Minimum Outlet Pipe Diameter (mm) | 300 |
| Suggested Manhole Diameter (mm) | 1200 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 0.500 | 22.1 |
| Flush-Flo™ | 0.293 | 22.1 |
| Kick-Flo® | 0.435 | 20.7 |
| Mean Flow over Head Range | - | 16.4 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.100 | 7.2 | 1.200 | 33.6 | 3.000 | 52.3 | 7.000 | 78.7 |
| 0.200 | 20.8 | 1.400 | 36.2 | 3.500 | 56.4 | 7.500 | 81.5 |
| 0.300 | 22.1 | 1.600 | 38.6 | 4.000 | 60.1 | 8.000 | 84.2 |
| 0.400 | 21.3 | 1.800 | 40.8 | 4.500 | 63.7 | 8.500 | 86.9 |
| 0.500 | 22.1 | 2.000 | 43.0 | 5.000 | 67.0 | 9.000 | 89.4 |
| 0.600 | 24.1 | 2.200 | 45.0 | 5.500 | 69.6 | 9.500 | 91.9 |
| 0.800 | 27.7 | 2.400 | 46.9 | 6.000 | 72.8 | | |
| 1.000 | 30.8 | 2.600 | 48.8 | 6.500 | 75.8 | | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for S09-10

```
                   Pipe Sizes STANDARD Manhole Sizes STANDARD

                     FSR Rainfall Model - England and Wales
              Return Period (years)       2                      PIMP (%)    100
                         M5-60 (mm)  17.000        Add Flow / Climate Change (%)      0
                            Ratio R   0.300          Minimum Backdrop Height (m)  0.000
             Maximum Rainfall (mm/hr)    200          Maximum Backdrop Height (m)  0.000
 Maximum Time of Concentration (mins)     30 Min Design Depth for Optimisation (m)  1.200
                Foul Sewage (l/s/ha)  0.000     Min Vel for Auto Design only (m/s)   1.00
             Volumetric Runoff Coeff.  0.750      Min Slope for Optimisation (1:X)    500

                           Designed with Level Soffits
```

### Simulation Criteria for S09-10

```
             Volumetric Runoff Coeff 0.750   Additional Flow - % of Total Flow 0.000
              Areal Reduction Factor 1.000       MADD Factor * 10m³/ha Storage 2.000
                    Hot Start (mins)     0                   Inlet Coeffiecient 0.800
                  Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
        Manhole Headloss Coeff (Global) 0.500                      Run Time (mins)    60
         Foul Sewage per hectare (l/s) 0.000                Output Interval (mins)     1

               Number of Input Hydrographs 0 Number of Storage Structures 1
                 Number of Online Controls 1 Number of Time/Area Diagrams 0
                Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
                 Rainfall Model                 FSR          Profile Type  Summer
             Return Period (years)                2           Cv (Summer)   0.750
                              Region England and Wales          Cv (Winter)   0.840
                        M5-60 (mm)            17.000 Storm Duration (mins)      30
                           Ratio R             0.400
```

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-10

### Simulation Criteria

```
              Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 0.000
                    Hot Start (mins)     0       MADD Factor * 10m³/ha Storage 2.000
                  Hot Start Level (mm)     0                  Inlet Coeffiecient 0.800
  Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
    Foul Sewage per hectare (l/s) 0.000

            Number of Input Hydrographs 0 Number of Storage Structures 1
              Number of Online Controls 1 Number of Time/Area Diagrams 0
             Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
                  Rainfall Model                 FSR      Ratio R 0.300
                          Region England and Wales Cv (Summer) 0.750
                      M5-60 (mm)              17.000 Cv (Winter) 0.840

          Margin for Flood Risk Warning (mm)                         300.0
                          Analysis Timestep 2.5 Second Increment (Extended)
                                 DTS Status                             ON
                                 DVD Status                             ON
                             Inertia Status                            OFF


                   Profile(s)                              Summer and Winter
               Duration(s) (mins)     15, 30, 60, 120, 180, 240, 360, 480, 600,
                                                             720, 960, 1440
           Return Period(s) (years)                                    5, 100
               Climate Change (%)                                      20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S09-10-1.000 | S09-10-1 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-10-1.001 | S09-10-2 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-10-1.002 | S09-10-3 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-10-1.003 | S09-10-4 | 15 Winter | 5 | +20% | 5/15 Winter | | |
| S09-10-1.004 | S09-10-5 | 15 Winter | 5 | +20% | 5/15 Summer | | |
| S09-10-1.005 | S09-10-6 | 15 Winter | 5 | +20% | 5/15 Summer | | |
| S09-10-1.006 | S09-10-7 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-10-2.000 | S09-10-8 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| S09-10-2.001 | S09-10-9 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | |
| S09-10-2.002 | S09-10-10 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Winter | |
| S09-10-2.003 | S09-10-11 | 15 Winter | 5 | +20% | 5/15 Summer | 100/30 Winter | |
| S09-10-2.004 | S09-10-12 | 30 Winter | 5 | +20% | 5/15 Summer | 100/30 Winter | |
| S09-10-2.005 | S09-10-13 | 30 Winter | 5 | +20% | 5/15 Summer | 100/60 Winter | |
| S09-10-2.006 | S09-10-14 | 30 Winter | 5 | +20% | 5/15 Winter | | |
| S09-10-2.007 | S09-10-15 | 30 Winter | 5 | +20% | 5/15 Winter | | |
| S09-10-2.008 | S09-10-16 | 30 Winter | 5 | +20% | 5/30 Summer | | |
| S09-10-2.009 | S09-10-17 | 30 Winter | 5 | +20% | 5/30 Winter | | |
| S09-10-2.010 | S09-10-18 | 30 Winter | 5 | +20% | 5/15 Winter | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-10

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S09-10-1.000 | S09-10-1 | | 147.218 | -0.076 | 0.000 | 0.42 | | |
| S09-10-1.001 | S09-10-2 | | 146.611 | -0.058 | 0.000 | 0.65 | | |
| S09-10-1.002 | S09-10-3 | | 146.298 | -0.035 | 0.000 | 0.78 | | |
| S09-10-1.003 | S09-10-4 | | 146.227 | 0.046 | 0.000 | 0.86 | | |
| S09-10-1.004 | S09-10-5 | | 146.082 | 0.107 | 0.000 | 0.98 | | |
| S09-10-1.005 | S09-10-6 | | 145.922 | 0.118 | 0.000 | 1.23 | | |
| S09-10-1.006 | S09-10-7 | | 145.475 | -0.094 | 0.000 | 0.62 | | |
| S09-10-2.000 | S09-10-8 | | 148.472 | -0.037 | 0.000 | 0.89 | | |
| S09-10-2.001 | S09-10-9 | | 148.210 | -0.072 | 0.000 | 0.74 | | |
| S09-10-2.002 | S09-10-10 | | 147.641 | -0.027 | 0.000 | 0.92 | | |
| S09-10-2.003 | S09-10-11 | | 147.162 | 0.096 | 0.000 | 1.07 | | |
| S09-10-2.004 | S09-10-12 | | 146.664 | 0.047 | 0.000 | 1.02 | | |
| S09-10-2.005 | S09-10-13 | | 146.460 | 0.051 | 0.000 | 1.04 | | |
| S09-10-2.006 | S09-10-14 | | 146.340 | 0.047 | 0.000 | 1.02 | | |
| S09-10-2.007 | S09-10-15 | | 146.168 | 0.043 | 0.000 | 1.02 | | |
| S09-10-2.008 | S09-10-16 | | 145.962 | 0.036 | 0.000 | 1.04 | | |
| S09-10-2.009 | S09-10-17 | | 145.747 | 0.021 | 0.000 | 0.93 | | |
| S09-10-2.010 | S09-10-18 | | 145.525 | 0.055 | 0.000 | 1.09 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S09-10-1.000 | S09-10-1 | 6.2 | OK | |
| S09-10-1.001 | S09-10-2 | 9.0 | OK | |
| S09-10-1.002 | S09-10-3 | 10.4 | OK | |
| S09-10-1.003 | S09-10-4 | 11.6 | SURCHARGED | |
| S09-10-1.004 | S09-10-5 | 13.3 | SURCHARGED | |
| S09-10-1.005 | S09-10-6 | 16.5 | SURCHARGED | |
| S09-10-1.006 | S09-10-7 | 22.0 | OK | |
| S09-10-2.000 | S09-10-8 | 12.4 | OK | 4 |
| S09-10-2.001 | S09-10-9 | 30.6 | OK | 3 |
| S09-10-2.002 | S09-10-10 | 38.0 | OK | 5 |
| S09-10-2.003 | S09-10-11 | 38.2 | SURCHARGED | 3 |
| S09-10-2.004 | S09-10-12 | 35.6 | SURCHARGED | 2 |
| S09-10-2.005 | S09-10-13 | 34.9 | SURCHARGED | 1 |
| S09-10-2.006 | S09-10-14 | 35.2 | SURCHARGED | |
| S09-10-2.007 | S09-10-15 | 35.6 | SURCHARGED | |
| S09-10-2.008 | S09-10-16 | 36.0 | SURCHARGED | |
| S09-10-2.009 | S09-10-17 | 36.6 | SURCHARGED | |
| S09-10-2.010 | S09-10-18 | 37.3 | SURCHARGED | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-10

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood |
|---|---|---|---|---|---|---|
| S09-10-3.000 | S09-10-19 | 15 Winter | 5 | +20% | 100/15 Winter | |
| S09-10-3.001 | S09-10-20 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-10-2.011 | S09-10-21 | 30 Winter | 5 | +20% | 5/15 Winter | |
| S09-10-1.007 | S09-10-22 | 30 Winter | 5 | +20% | 5/15 Winter | |
| S09-10-1.008 | S09-10-23 | 30 Winter | 5 | +20% | 5/30 Winter | |
| S09-10-1.009 | S09-10-24 | 30 Winter | 5 | +20% | 100/15 Summer | |
| S09-10-1.010 | S09-10-Pond Inlet | 30 Winter | 5 | +20% | 100/15 Summer | |
| S09-10-1.011 | S09-10-Pond Outlet | 720 Winter | 5 | +20% | 100/60 Summer | |
| S09-10-1.012 | S09-10-25 | 180 Winter | 5 | +20% | | |

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-10-3.000 | S09-10-19 | | | 147.019 | -0.079 | 0.000 | 0.44 |
| S09-10-3.001 | S09-10-20 | | | 146.497 | -0.075 | 0.000 | 0.50 |
| S09-10-2.011 | S09-10-21 | | | 145.360 | 0.032 | 0.000 | 0.64 |
| S09-10-1.007 | S09-10-22 | | | 145.277 | 0.054 | 0.000 | 1.04 |
| S09-10-1.008 | S09-10-23 | | | 145.197 | 0.013 | 0.000 | 1.10 |
| S09-10-1.009 | S09-10-24 | | | 145.122 | 0.000 | 0.000 | 1.08 |
| S09-10-1.010 | S09-10-Pond Inlet | | | 144.957 | -0.093 | 0.000 | 0.81 |
| S09-10-1.011 | S09-10-Pond Outlet | | | 144.743 | -0.057 | 0.000 | 0.09 |
| S09-10-1.012 | S09-10-25 | | | 144.493 | -0.121 | 0.000 | 0.08 |

| PN | US/MH Name | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|
| S09-10-3.000 | S09-10-19 | | | 7.9 | OK | |
| S09-10-3.001 | S09-10-20 | | | 12.9 | OK | |
| S09-10-2.011 | S09-10-21 | | | 39.5 | SURCHARGED | |
| S09-10-1.007 | S09-10-22 | | | 60.5 | SURCHARGED | |
| S09-10-1.008 | S09-10-23 | | | 60.4 | SURCHARGED | |
| S09-10-1.009 | S09-10-24 | | | 60.3 | OK | |
| S09-10-1.010 | S09-10-Pond Inlet | | | 59.9 | OK | |
| S09-10-1.011 | S09-10-Pond Outlet | | | 5.0 | OK | |
| S09-10-1.012 | S09-10-25 | | | 5.0 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-10

### Simulation Criteria

Areal Reduction Factor 1.000
Hot Start (mins) 0
Hot Start Level (mm) 0
Manhole Headloss Coeff (Global) 0.500
Foul Sewage per hectare (l/s) 0.000
Additional Flow - % of Total Flow 0.000
MADD Factor * 10m³/ha Storage 2.000
Inlet Coeffiecient 0.800
Flow per Person per Day (l/per/day) 0.000

Number of Input Hydrographs 0
Number of Online Controls 1
Number of Offline Controls 0
Number of Storage Structures 1
Number of Time/Area Diagrams 0
Number of Real Time Controls 0

### Synthetic Rainfall Details

Rainfall Model FSR
Region England and Wales
M5-60 (mm) 17.000
Ratio R 0.300
Cv (Summer) 0.750
Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status ON
DVD Status ON
Inertia Status OFF

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440
Return Period(s) (years) 5, 100
Climate Change (%) 20, 40

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S09-10-1.000 | S09-10-1 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S09-10-1.001 | S09-10-2 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S09-10-1.002 | S09-10-3 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S09-10-1.003 | S09-10-4 | 30 Winter | 100 | +40% | 5/15 Winter | | |
| S09-10-1.004 | S09-10-5 | 30 Winter | 100 | +40% | 5/15 Summer | | |
| S09-10-1.005 | S09-10-6 | 30 Winter | 100 | +40% | 5/15 Summer | | |
| S09-10-1.006 | S09-10-7 | 30 Winter | 100 | +40% | 100/15 Summer | | |
| S09-10-2.000 | S09-10-8 | 15 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer | |
| S09-10-2.001 | S09-10-9 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | |
| S09-10-2.002 | S09-10-10 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Winter | |
| S09-10-2.003 | S09-10-11 | 60 Winter | 100 | +40% | 5/15 Summer | 100/30 Winter | |
| S09-10-2.004 | S09-10-12 | 60 Winter | 100 | +40% | 5/15 Summer | 100/30 Winter | |
| S09-10-2.005 | S09-10-13 | 60 Winter | 100 | +40% | 5/15 Summer | 100/60 Winter | |
| S09-10-2.006 | S09-10-14 | 60 Winter | 100 | +40% | 5/15 Winter | | |
| S09-10-2.007 | S09-10-15 | 60 Winter | 100 | +40% | 5/15 Winter | | |
| S09-10-2.008 | S09-10-16 | 60 Winter | 100 | +40% | 5/30 Summer | | |
| S09-10-2.009 | S09-10-17 | 60 Winter | 100 | +40% | 5/30 Winter | | |
| S09-10-2.010 | S09-10-18 | 30 Winter | 100 | +40% | 5/15 Winter | | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-10

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S09-10-1.000 | S09-10-1 | | 147.726 | 0.432 | 0.000 | 0.73 | | |
| S09-10-1.001 | S09-10-2 | | 147.610 | 0.941 | 0.000 | 0.80 | | |
| S09-10-1.002 | S09-10-3 | | 147.444 | 1.111 | 0.000 | 0.91 | | |
| S09-10-1.003 | S09-10-4 | | 147.331 | 1.150 | 0.000 | 1.12 | | |
| S09-10-1.004 | S09-10-5 | | 147.101 | 1.126 | 0.000 | 1.35 | | |
| S09-10-1.005 | S09-10-6 | | 146.844 | 1.040 | 0.000 | 1.74 | | |
| S09-10-1.006 | S09-10-7 | | 146.145 | 0.576 | 0.000 | 0.98 | | |
| S09-10-2.000 | S09-10-8 | | 149.710 | 1.201 | 1.323 | 1.22 | | |
| S09-10-2.001 | S09-10-9 | | 149.562 | 1.280 | 0.865 | 1.05 | | |
| S09-10-2.002 | S09-10-10 | | 149.081 | 1.413 | 4.101 | 1.23 | | |
| S09-10-2.003 | S09-10-11 | | 148.594 | 1.528 | 2.216 | 1.22 | | |
| S09-10-2.004 | S09-10-12 | | 148.110 | 1.493 | 0.300 | 1.25 | | |
| S09-10-2.005 | S09-10-13 | | 147.857 | 1.448 | 0.002 | 1.30 | | |
| S09-10-2.006 | S09-10-14 | | 147.686 | 1.393 | 0.000 | 1.31 | | |
| S09-10-2.007 | S09-10-15 | | 147.418 | 1.293 | 0.000 | 1.35 | | |
| S09-10-2.008 | S09-10-16 | | 147.062 | 1.136 | 0.000 | 1.43 | | |
| S09-10-2.009 | S09-10-17 | | 146.651 | 0.925 | 0.000 | 1.34 | | |
| S09-10-2.010 | S09-10-18 | | 146.192 | 0.722 | 0.000 | 1.56 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S09-10-1.000 | S09-10-1 | 10.7 | SURCHARGED | |
| S09-10-1.001 | S09-10-2 | 11.2 | FLOOD RISK | |
| S09-10-1.002 | S09-10-3 | 12.1 | FLOOD RISK | |
| S09-10-1.003 | S09-10-4 | 15.1 | FLOOD RISK | |
| S09-10-1.004 | S09-10-5 | 18.3 | FLOOD RISK | |
| S09-10-1.005 | S09-10-6 | 23.3 | FLOOD RISK | |
| S09-10-1.006 | S09-10-7 | 34.7 | SURCHARGED | |
| S09-10-2.000 | S09-10-8 | 17.0 | FLOOD | 4 |
| S09-10-2.001 | S09-10-9 | 43.3 | FLOOD | 3 |
| S09-10-2.002 | S09-10-10 | 51.0 | FLOOD | 5 |
| S09-10-2.003 | S09-10-11 | 43.5 | FLOOD | 3 |
| S09-10-2.004 | S09-10-12 | 43.4 | FLOOD | 2 |
| S09-10-2.005 | S09-10-13 | 43.7 | FLOOD | 1 |
| S09-10-2.006 | S09-10-14 | 45.0 | FLOOD RISK | |
| S09-10-2.007 | S09-10-15 | 46.8 | FLOOD RISK | |
| S09-10-2.008 | S09-10-16 | 49.7 | FLOOD RISK | |
| S09-10-2.009 | S09-10-17 | 52.6 | SURCHARGED | |
| S09-10-2.010 | S09-10-18 | 53.0 | SURCHARGED | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-10

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood |
|---|---|---|---|---|---|---|
| S09-10-3.000 | S09-10-19 | 15 Winter | 100 | +40% | 100/15 Winter | |
| S09-10-3.001 | S09-10-20 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-10-2.011 | S09-10-21 | 30 Winter | 100 | +40% | 5/15 Winter | |
| S09-10-1.007 | S09-10-22 | 30 Winter | 100 | +40% | 5/15 Winter | |
| S09-10-1.008 | S09-10-23 | 30 Winter | 100 | +40% | 5/30 Winter | |
| S09-10-1.009 | S09-10-24 | 30 Winter | 100 | +40% | 100/15 Summer | |
| S09-10-1.010 | S09-10-Pond Inlet | 30 Winter | 100 | +40% | 100/15 Summer | |
| S09-10-1.011 | S09-10-Pond Outlet | 960 Winter | 100 | +40% | 100/60 Summer | |
| S09-10-1.012 | S09-10-25 | 360 Winter | 100 | +40% | | |

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-10-3.000 | S09-10-19 | | | 147.111 | 0.013 | 0.000 | 0.92 |
| S09-10-3.001 | S09-10-20 | | | 146.673 | 0.101 | 0.000 | 1.05 |
| S09-10-2.011 | S09-10-21 | | | 145.924 | 0.596 | 0.000 | 1.05 |
| S09-10-1.007 | S09-10-22 | | | 145.841 | 0.618 | 0.000 | 1.74 |
| S09-10-1.008 | S09-10-23 | | | 145.683 | 0.499 | 0.000 | 1.83 |
| S09-10-1.009 | S09-10-24 | | | 145.477 | 0.355 | 0.000 | 1.79 |
| S09-10-1.010 | S09-10-Pond Inlet | | | 145.246 | 0.196 | 0.000 | 1.35 |
| S09-10-1.011 | S09-10-Pond Outlet | | | 145.090 | 0.290 | 0.000 | 0.09 |
| S09-10-1.012 | S09-10-25 | | | 144.493 | -0.121 | 0.000 | 0.08 |

| PN | US/MH Name | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|
| S09-10-3.000 | S09-10-19 | | | 16.4 | SURCHARGED | |
| S09-10-3.001 | S09-10-20 | | | 27.1 | SURCHARGED | |
| S09-10-2.011 | S09-10-21 | | | 64.1 | SURCHARGED | |
| S09-10-1.007 | S09-10-22 | | | 101.4 | SURCHARGED | |
| S09-10-1.008 | S09-10-23 | | | 100.6 | SURCHARGED | |
| S09-10-1.009 | S09-10-24 | | | 100.1 | SURCHARGED | |
| S09-10-1.010 | S09-10-Pond Inlet | | | 99.6 | SURCHARGED | |
| S09-10-1.011 | S09-10-Pond Outlet | | | 5.0 | SURCHARGED | |
| S09-10-1.012 | S09-10-25 | | | 5.0 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for S09-11

```
                    Pipe Sizes STANDARD Manhole Sizes STANDARD

                      FSR Rainfall Model - England and Wales
              Return Period (years)       2                    PIMP (%)    100
                         M5-60 (mm)  17.000       Add Flow / Climate Change (%)      0
                            Ratio R   0.300         Minimum Backdrop Height (m)  0.000
           Maximum Rainfall (mm/hr)     200         Maximum Backdrop Height (m)  0.000
Maximum Time of Concentration (mins)      30 Min Design Depth for Optimisation (m)  1.200
               Foul Sewage (l/s/ha)   0.000     Min Vel for Auto Design only (m/s)   1.00
            Volumetric Runoff Coeff.   0.750       Min Slope for Optimisation (1:X)    500

                           Designed with Level Soffits
```

### Simulation Criteria for S09-11

```
           Volumetric Runoff Coeff 0.750  Additional Flow - % of Total Flow 0.000
            Areal Reduction Factor 1.000      MADD Factor * 10m³/ha Storage 2.000
                  Hot Start (mins)     0                  Inlet Coeffiecient 0.800
                Hot Start Level (mm)     0 Flow per Person per Day (l/per/day) 0.000
      Manhole Headloss Coeff (Global) 0.500                      Run Time (mins)    60
        Foul Sewage per hectare (l/s) 0.000                Output Interval (mins)     1

              Number of Input Hydrographs 0 Number of Storage Structures 1
                Number of Online Controls 1 Number of Time/Area Diagrams 0
               Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
              Rainfall Model                 FSR         Profile Type  Summer
         Return Period (years)                 2          Cv (Summer)   0.750
                      Region England and Wales          Cv (Winter)   0.840
                  M5-60 (mm)              17.000 Storm Duration (mins)     30
                     Ratio R               0.400
```

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-11

### Simulation Criteria

| | | | |
|---|---|---|---|
| Areal Reduction Factor | 1.000 | Additional Flow - % of Total Flow | 0.000 |
| Hot Start (mins) | 0 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start Level (mm) | 0 | Inlet Coeffiecient | 0.800 |
| Manhole Headloss Coeff (Global) | 0.500 | Flow per Person per Day (l/per/day) | 0.000 |
| Foul Sewage per hectare (l/s) | 0.000 | | |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 1 |
| Number of Online Controls | 1 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Ratio R | 0.300 |
| Region | England and Wales | Cv (Summer) | 0.750 |
| M5-60 (mm) | 17.000 | Cv (Winter) | 0.840 |

| | |
|---|---|
| Margin for Flood Risk Warning (mm) | 300.0 |
| Analysis Timestep | 2.5 Second Increment (Extended) |
| DTS Status | ON |
| DVD Status | ON |
| Inertia Status | OFF |

| | |
|---|---|
| Profile(s) | Summer and Winter |
| Duration(s) (mins) | 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440 |
| Return Period(s) (years) | 5, 100 |
| Climate Change (%) | 20, 40 |

| **PN** | **US/MH Name** | **Storm** | **Return Period** | **Climate Change** | **First (X) Surcharge** | **First (Y) Flood** |
|---|---|---|---|---|---|---|
| S09-11-1.000 | S09-11-1 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-11-1.001 | S09-11-2 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer |
| S09-11-1.002 | S09-11-3 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer |
| S09-11-1.003 | S09-11-4 | 15 Winter | 5 | +20% | 5/15 Summer | |
| S09-11-2.000 | S09-11-5 | 15 Winter | 5 | +20% | | |
| S09-11-1.004 | S09-11-6 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-11-1.005 | S09-11-13 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-11-1.006 | S09-11-14 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-11-1.007 | S09-11-15 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-11-1.008 | S09-11-Pond Inlet | 15 Winter | 5 | +20% | 100/60 Summer | |
| S09-11-1.009 | S09-11-Pond Outlet | 180 Winter | 5 | +20% | 100/30 Winter | |
| S09-11-3.000 | S09-11-16 | 15 Winter | 5 | +20% | | |
| S09-11-4.000 | S09-11-17 | 15 Winter | 5 | +20% | | |
| S09-11-3.001 | S09-11-18 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-11-5.000 | S09-11-19 | 15 Winter | 5 | +20% | | |
| S09-11-6.000 | S09-11-20 | 15 Winter | 5 | +20% | | |
| S09-11-3.002 | S09-11-21 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-11-1.010 | S09-11-22 | 15 Winter | 5 | +20% | 5/15 Winter | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-11

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-11-1.000 | S09-11-1 | | | 146.966 | -0.070 | 0.000 | 0.54 |
| S09-11-1.001 | S09-11-2 | | | 146.568 | -0.023 | 0.000 | 0.84 |
| S09-11-1.002 | S09-11-3 | | | 146.318 | 0.220 | 0.000 | 1.01 |
| S09-11-1.003 | S09-11-4 | | | 145.986 | 0.225 | 0.000 | 1.18 |
| S09-11-2.000 | S09-11-5 | | | 145.036 | -0.114 | 0.000 | 0.13 |
| S09-11-1.004 | S09-11-6 | | | 144.840 | -0.096 | 0.000 | 0.63 |
| S09-11-1.005 | S09-11-13 | | | 144.793 | -0.079 | 0.000 | 0.75 |
| S09-11-1.006 | S09-11-14 | | | 144.754 | -0.079 | 0.000 | 0.75 |
| S09-11-1.007 | S09-11-15 | | | 144.720 | -0.074 | 0.000 | 0.79 |
| S09-11-1.008 | S09-11-Pond Inlet | | | 144.674 | -0.089 | 0.000 | 0.68 |
| S09-11-1.009 | S09-11-Pond Outlet | | | 144.593 | -0.087 | 0.000 | 0.15 |
| S09-11-3.000 | S09-11-16 | | | 146.963 | -0.116 | 0.000 | 0.12 |
| S09-11-4.000 | S09-11-17 | | | 145.048 | -0.097 | 0.000 | 0.26 |
| S09-11-3.001 | S09-11-18 | | | 144.936 | -0.087 | 0.000 | 0.37 |
| S09-11-5.000 | S09-11-19 | | | 146.987 | -0.118 | 0.000 | 0.10 |
| S09-11-6.000 | S09-11-20 | | | 145.123 | -0.103 | 0.000 | 0.21 |
| S09-11-3.002 | S09-11-21 | | | 144.895 | -0.063 | 0.000 | 0.63 |
| S09-11-1.010 | S09-11-22 | | | 144.631 | 0.015 | 0.000 | 0.13 |

| PN | US/MH Name | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|
| S09-11-1.000 | S09-11-1 | | | 9.3 | OK | |
| S09-11-1.001 | S09-11-2 | | | 14.8 | OK | 4 |
| S09-11-1.002 | S09-11-3 | | | 17.5 | SURCHARGED | 5 |
| S09-11-1.003 | S09-11-4 | | | 21.0 | SURCHARGED | |
| S09-11-2.000 | S09-11-5 | | | 2.5 | OK | |
| S09-11-1.004 | S09-11-6 | | | 22.0 | OK | |
| S09-11-1.005 | S09-11-13 | | | 22.0 | OK | |
| S09-11-1.006 | S09-11-14 | | | 22.0 | OK | |
| S09-11-1.007 | S09-11-15 | | | 22.0 | OK | |
| S09-11-1.008 | S09-11-Pond Inlet | | | 22.0 | OK | |
| S09-11-1.009 | S09-11-Pond Outlet | | | 5.1 | OK | |
| S09-11-3.000 | S09-11-16 | | | 2.6 | OK | |
| S09-11-4.000 | S09-11-17 | | | 2.8 | OK | |
| S09-11-3.001 | S09-11-18 | | | 5.5 | OK | |
| S09-11-5.000 | S09-11-19 | | | 2.2 | OK | |
| S09-11-6.000 | S09-11-20 | | | 2.4 | OK | |
| S09-11-3.002 | S09-11-21 | | | 10.1 | OK | |
| S09-11-1.010 | S09-11-22 | | | 5.0 | SURCHARGED | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-11

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S09-11-1.011 | S09-11-23 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-11-1.012 | S09-11-24 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-11-1.013 | S09-11-25 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-11-1.014 | S09-11-26 | 15 Winter | 5 | +20% | | | |

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S09-11-1.011 | S09-11-23 | | 144.306 | -0.174 | 0.000 | 0.12 | | |
| S09-11-1.012 | S09-11-24 | | 144.226 | -0.095 | 0.000 | 0.61 | | |
| S09-11-1.013 | S09-11-25 | | 143.997 | -0.101 | 0.000 | 0.58 | | |
| S09-11-1.014 | S09-11-26 | | 143.717 | -0.162 | 0.000 | 0.18 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S09-11-1.011 | S09-11-23 | 5.0 | OK | |
| S09-11-1.012 | S09-11-24 | 22.2 | OK | |
| S09-11-1.013 | S09-11-25 | 21.9 | OK | |
| S09-11-1.014 | S09-11-26 | 21.9 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-11

### Simulation Criteria

```
          Areal Reduction Factor 1.000    Additional Flow - % of Total Flow 0.000
                Hot Start (mins)     0        MADD Factor * 10m³/ha Storage 2.000
             Hot Start Level (mm)    0                  Inlet Coeffiecient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
   Foul Sewage per hectare (l/s) 0.000

          Number of Input Hydrographs 0 Number of Storage Structures 1
            Number of Online Controls 1 Number of Time/Area Diagrams 0
           Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
Rainfall Model                 FSR      Ratio R 0.300
        Region England and Wales Cv (Summer) 0.750
M5-60 (mm)                  17.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)                       300.0
            Analysis Timestep 2.5 Second Increment (Extended)
                   DTS Status                               ON
                   DVD Status                               ON
               Inertia Status                              OFF


            Profile(s)                         Summer and Winter
       Duration(s) (mins)     15, 30, 60, 120, 180, 240, 360, 480, 600,
                                                    720, 960, 1440
  Return Period(s) (years)                                   5, 100
       Climate Change (%)                                    20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood |
|---|---|---|---|---|---|---|
| S09-11-1.000 | S09-11-1 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-11-1.001 | S09-11-2 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer |
| S09-11-1.002 | S09-11-3 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer |
| S09-11-1.003 | S09-11-4 | 15 Winter | 100 | +40% | 5/15 Summer | |
| S09-11-2.000 | S09-11-5 | 60 Winter | 100 | +40% | | |
| S09-11-1.004 | S09-11-6 | 60 Winter | 100 | +40% | 100/15 Summer | |
| S09-11-1.005 | S09-11-13 | 60 Winter | 100 | +40% | 100/15 Summer | |
| S09-11-1.006 | S09-11-14 | 120 Winter | 100 | +40% | 100/15 Summer | |
| S09-11-1.007 | S09-11-15 | 120 Winter | 100 | +40% | 100/15 Summer | |
| S09-11-1.008 | S09-11-Pond Inlet | 240 Winter | 100 | +40% | 100/60 Summer | |
| S09-11-1.009 | S09-11-Pond Outlet | 240 Winter | 100 | +40% | 100/30 Winter | |
| S09-11-3.000 | S09-11-16 | 15 Winter | 100 | +40% | | |
| S09-11-4.000 | S09-11-17 | 15 Winter | 100 | +40% | | |
| S09-11-3.001 | S09-11-18 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-11-5.000 | S09-11-19 | 15 Winter | 100 | +40% | | |
| S09-11-6.000 | S09-11-20 | 15 Winter | 100 | +40% | | |
| S09-11-3.002 | S09-11-21 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-11-1.010 | S09-11-22 | 240 Winter | 100 | +40% | 5/15 Winter | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-11

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-11-1.000 | S09-11-1 | | | 148.121 | 1.086 | 0.000 | 0.80 |
| S09-11-1.001 | S09-11-2 | | | 147.791 | 1.201 | 0.756 | 1.00 |
| S09-11-1.002 | S09-11-3 | | | 147.301 | 1.202 | 2.127 | 1.46 |
| S09-11-1.003 | S09-11-4 | | | 146.936 | 1.175 | 0.000 | 1.74 |
| S09-11-2.000 | S09-11-5 | | | 145.074 | -0.076 | 0.000 | 0.17 |
| S09-11-1.004 | S09-11-6 | | | 145.069 | 0.133 | 0.000 | 0.90 |
| S09-11-1.005 | S09-11-13 | | | 144.986 | 0.115 | 0.000 | 1.09 |
| S09-11-1.006 | S09-11-14 | | | 144.928 | 0.095 | 0.000 | 0.86 |
| S09-11-1.007 | S09-11-15 | | | 144.877 | 0.083 | 0.000 | 0.89 |
| S09-11-1.008 | S09-11-Pond Inlet | | | 144.842 | 0.079 | 0.000 | 0.55 |
| S09-11-1.009 | S09-11-Pond Outlet | | | 144.836 | 0.156 | 0.000 | 0.20 |
| S09-11-3.000 | S09-11-16 | | | 146.981 | -0.098 | 0.000 | 0.25 |
| S09-11-4.000 | S09-11-17 | | | 145.082 | -0.064 | 0.000 | 0.56 |
| S09-11-3.001 | S09-11-18 | | | 145.048 | 0.025 | 0.000 | 0.73 |
| S09-11-5.000 | S09-11-19 | | | 147.003 | -0.102 | 0.000 | 0.22 |
| S09-11-6.000 | S09-11-20 | | | 145.148 | -0.078 | 0.000 | 0.45 |
| S09-11-3.002 | S09-11-21 | | | 145.016 | 0.058 | 0.000 | 1.25 |
| S09-11-1.010 | S09-11-22 | | | 144.850 | 0.234 | 0.000 | 0.13 |

| PN | US/MH Name | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|
| S09-11-1.000 | S09-11-1 | | | 13.7 | FLOOD RISK | |
| S09-11-1.001 | S09-11-2 | | | 17.7 | FLOOD | 4 |
| S09-11-1.002 | S09-11-3 | | | 25.3 | FLOOD | 5 |
| S09-11-1.003 | S09-11-4 | | | 30.9 | FLOOD RISK | |
| S09-11-2.000 | S09-11-5 | | | 3.2 | OK | |
| S09-11-1.004 | S09-11-6 | | | 31.7 | SURCHARGED | |
| S09-11-1.005 | S09-11-13 | | | 31.9 | SURCHARGED | |
| S09-11-1.006 | S09-11-14 | | | 25.2 | SURCHARGED | |
| S09-11-1.007 | S09-11-15 | | | 25.0 | SURCHARGED | |
| S09-11-1.008 | S09-11-Pond Inlet | | | 17.8 | SURCHARGED | |
| S09-11-1.009 | S09-11-Pond Outlet | | | 6.7 | SURCHARGED | |
| S09-11-3.000 | S09-11-16 | | | 5.7 | OK | |
| S09-11-4.000 | S09-11-17 | | | 6.1 | OK | |
| S09-11-3.001 | S09-11-18 | | | 10.9 | SURCHARGED | |
| S09-11-5.000 | S09-11-19 | | | 4.8 | OK | |
| S09-11-6.000 | S09-11-20 | | | 5.2 | OK | |
| S09-11-3.002 | S09-11-21 | | | 20.0 | SURCHARGED | |
| S09-11-1.010 | S09-11-22 | | | 5.0 | SURCHARGED | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-11

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S09-11-1.011 | S09-11-23 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S09-11-1.012 | S09-11-24 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S09-11-1.013 | S09-11-25 | 15 Winter | 100 | +40% | 100/15 Summer | | |
| S09-11-1.014 | S09-11-26 | 15 Winter | 100 | +40% | | | |

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S09-11-1.011 | S09-11-23 | | 144.508 | 0.028 | 0.000 | 0.24 | | |
| S09-11-1.012 | S09-11-24 | | 144.500 | 0.179 | 0.000 | 1.27 | | |
| S09-11-1.013 | S09-11-25 | | 144.158 | 0.060 | 0.000 | 1.14 | | |
| S09-11-1.014 | S09-11-26 | | 143.745 | -0.134 | 0.000 | 0.35 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S09-11-1.011 | S09-11-23 | 10.6 | SURCHARGED | |
| S09-11-1.012 | S09-11-24 | 46.3 | SURCHARGED | |
| S09-11-1.013 | S09-11-25 | 43.3 | SURCHARGED | |
| S09-11-1.014 | S09-11-26 | 43.4 | OK | |

## STORM SEWER DESIGN by the Modified Rational Method

### Design Criteria for S09-12

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

| | | | |
|---|---|---|---|
| Return Period (years) | 2 | PIMP (%) | 100 |
| M5-60 (mm) | 17.000 | Add Flow / Climate Change (%) | 0 |
| Ratio R | 0.300 | Minimum Backdrop Height (m) | 0.000 |
| Maximum Rainfall (mm/hr) | 200 | Maximum Backdrop Height (m) | 0.000 |
| Maximum Time of Concentration (mins) | 30 | Min Design Depth for Optimisation (m) | 1.200 |
| Foul Sewage (l/s/ha) | 0.000 | Min Vel for Auto Design only (m/s) | 1.00 |
| Volumetric Runoff Coeff. | 0.750 | Min Slope for Optimisation (1:X) | 500 |

Designed with Level Soffits

### Simulation Criteria for S09-12

| | | | |
|---|---|---|---|
| Volumetric Runoff Coeff | 0.750 | Additional Flow - % of Total Flow | 0.000 |
| Areal Reduction Factor | 1.000 | MADD Factor * 10m³/ha Storage | 2.000 |
| Hot Start (mins) | 0 | Inlet Coeffiecient | 0.800 |
| Hot Start Level (mm) | 0 | Flow per Person per Day (l/per/day) | 0.000 |
| Manhole Headloss Coeff (Global) | 0.500 | Run Time (mins) | 60 |
| Foul Sewage per hectare (l/s) | 0.000 | Output Interval (mins) | 1 |

| | | | |
|---|---|---|---|
| Number of Input Hydrographs | 0 | Number of Storage Structures | 1 |
| Number of Online Controls | 1 | Number of Time/Area Diagrams | 0 |
| Number of Offline Controls | 0 | Number of Real Time Controls | 0 |

### Synthetic Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Profile Type | Summer |
| Return Period (years) | 2 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 17.000 | Storm Duration (mins) | 30 |
| Ratio R | 0.400 | | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-12

### Simulation Criteria

```
          Areal Reduction Factor 1.000   Additional Flow - % of Total Flow 0.000
                Hot Start (mins)     0       MADD Factor * 10m³/ha Storage 2.000
              Hot Start Level (mm)   0                   Inlet Coeffiecient 0.800
 Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
   Foul Sewage per hectare (l/s) 0.000

       Number of Input Hydrographs 0 Number of Storage Structures 1
         Number of Online Controls 1 Number of Time/Area Diagrams 0
        Number of Offline Controls 0 Number of Real Time Controls 0
```

### Synthetic Rainfall Details

```
     Rainfall Model                FSR     Ratio R 0.300
             Region England and Wales Cv (Summer) 0.750
         M5-60 (mm)             17.000 Cv (Winter) 0.840

   Margin for Flood Risk Warning (mm)                    300.0
                   Analysis Timestep 2.5 Second Increment (Extended)
                          DTS Status                        ON
                          DVD Status                        ON
                      Inertia Status                       OFF


              Profile(s)                      Summer and Winter
          Duration(s) (mins)     15, 30, 60, 120, 180, 240, 360, 480, 600,
                                                          720, 960, 1440
        Return Period(s) (years)                               5, 100
          Climate Change (%)                                   20, 40
```

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood | First (Z) Overflow |
|---|---|---|---|---|---|---|---|
| S09-12-1.000 | S09-12-1 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-12-1.001 | S09-12-2 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-12-1.002 | S09-12-3 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| S09-12-1.003 | S09-12-4 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-12-1.004 | S09-12-5 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-12-2.000 | S09-12-6 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-12-2.001 | S09-12-7 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-12-2.002 | S09-12-8 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| S09-12-1.005 | S09-12-9 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-12-3.000 | S09-12-10 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer | |
| S09-12-3.001 | S09-12-11 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Summer | |
| S09-12-3.002 | S09-12-12 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |
| S09-12-3.003 | S09-12-13 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-12-1.006 | S09-12-14 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Winter | |
| S09-12-1.007 | S09-12-15 | 15 Winter | 5 | +20% | 5/15 Summer | | |
| S09-12-1.008 | S09-12-16 | 15 Winter | 5 | +20% | 5/15 Summer | | |
| S09-12-4.000 | S09-12-17 | 15 Winter | 5 | +20% | 100/15 Summer | | |
| S09-12-4.001 | S09-12-18 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer | |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-12

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S09-12-1.000 | S09-12-1 | | 145.606 | -0.058 | 0.000 | 0.66 | | |
| S09-12-1.001 | S09-12-2 | | 145.088 | -0.062 | 0.000 | 0.63 | | |
| S09-12-1.002 | S09-12-3 | | 142.715 | -0.039 | 0.000 | 0.88 | | |
| S09-12-1.003 | S09-12-4 | | 140.644 | 0.491 | 0.000 | 1.11 | | |
| S09-12-1.004 | S09-12-5 | | 139.405 | 0.263 | 0.000 | 0.96 | | |
| S09-12-2.000 | S09-12-6 | | 143.228 | -0.084 | 0.000 | 0.39 | | |
| S09-12-2.001 | S09-12-7 | | 142.836 | -0.079 | 0.000 | 0.45 | | |
| S09-12-2.002 | S09-12-8 | | 140.741 | -0.035 | 0.000 | 0.92 | | |
| S09-12-1.005 | S09-12-9 | | 139.322 | 0.254 | 0.000 | 1.24 | | |
| S09-12-3.000 | S09-12-10 | | 145.631 | -0.043 | 0.000 | 0.84 | | |
| S09-12-3.001 | S09-12-11 | | 145.466 | 0.044 | 0.000 | 0.96 | | |
| S09-12-3.002 | S09-12-12 | | 142.963 | 0.549 | 0.000 | 1.09 | | |
| S09-12-3.003 | S09-12-13 | | 139.473 | -0.075 | 0.000 | 0.78 | | |
| S09-12-1.006 | S09-12-14 | | 139.059 | 0.184 | 0.000 | 0.99 | | |
| S09-12-1.007 | S09-12-15 | | 138.870 | 0.192 | 0.000 | 1.23 | | |
| S09-12-1.008 | S09-12-16 | | 138.563 | 0.092 | 0.000 | 1.31 | | |
| S09-12-4.000 | S09-12-17 | | 144.906 | -0.088 | 0.000 | 0.35 | | |
| S09-12-4.001 | S09-12-18 | | 144.597 | 0.117 | 0.000 | 0.89 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S09-12-1.000 | S09-12-1 | 12.6 | OK | |
| S09-12-1.001 | S09-12-2 | 21.1 | OK | |
| S09-12-1.002 | S09-12-3 | 30.8 | OK | 6 |
| S09-12-1.003 | S09-12-4 | 31.9 | SURCHARGED | 8 |
| S09-12-1.004 | S09-12-5 | 33.4 | SURCHARGED | 7 |
| S09-12-2.000 | S09-12-6 | 8.8 | OK | |
| S09-12-2.001 | S09-12-7 | 14.4 | OK | |
| S09-12-2.002 | S09-12-8 | 26.4 | OK | 6 |
| S09-12-1.005 | S09-12-9 | 55.7 | SURCHARGED | 7 |
| S09-12-3.000 | S09-12-10 | 14.1 | OK | 5 |
| S09-12-3.001 | S09-12-11 | 39.5 | SURCHARGED | 6 |
| S09-12-3.002 | S09-12-12 | 43.7 | SURCHARGED | 7 |
| S09-12-3.003 | S09-12-13 | 51.9 | OK | |
| S09-12-1.006 | S09-12-14 | 103.7 | SURCHARGED | 5 |
| S09-12-1.007 | S09-12-15 | 128.9 | SURCHARGED | |
| S09-12-1.008 | S09-12-16 | 128.0 | SURCHARGED | |
| S09-12-4.000 | S09-12-17 | 7.4 | OK | |
| S09-12-4.001 | S09-12-18 | 19.2 | SURCHARGED | 6 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-12

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood |
|---|---|---|---|---|---|---|
| S09-12-4.002 | S09-12-19 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer |
| S09-12-4.003 | S09-12-20 | 15 Winter | 5 | +20% | 5/15 Summer | |
| S09-12-5.000 | S09-12-21 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-12-5.001 | S09-12-22 | 15 Winter | 5 | +20% | 100/15 Summer | 100/15 Summer |
| S09-12-5.002 | S09-12-23 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer |
| S09-12-5.003 | S09-12-24 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer |
| S09-12-4.004 | S09-12-25 | 15 Winter | 5 | +20% | 5/15 Summer | |
| S09-12-1.009 | S09-12-26 | 15 Winter | 5 | +20% | 5/15 Summer | |
| S09-12-6.000 | S09-12-27 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-12-6.001 | S09-12-28 | 15 Winter | 5 | +20% | 100/15 Summer | |
| S09-12-6.002 | S09-12-29 | 15 Winter | 5 | +20% | 5/15 Winter | 100/15 Summer |
| S09-12-6.003 | S09-12-30 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer |
| S09-12-6.004 | S09-12-31 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer |
| S09-12-6.005 | S09-12-32 | 15 Winter | 5 | +20% | 5/15 Summer | 100/15 Summer |
| S09-12-6.006 | S09-12-33 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S09-12-6.007 | S09-12-34 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S09-12-6.008 | S09-12-35 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S09-12-6.009 | S09-12-36 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S09-12-1.010 | S09-12-37 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S09-12-1.011 | S09-12-38 | 30 Winter | 5 | +20% | 5/15 Summer | |
| S09-12-1.012 | S09-12-39 | 30 Winter | 5 | +20% | 5/15 Winter | |
| S09-12-1.013 | S09-12-40 | 30 Winter | 5 | +20% | | |
| S09-12-1.014 | S09-12-Pond Inlet | 30 Winter | 5 | +20% | | |
| S09-12-1.015 | S09-12-Pond Outlet | 360 Winter | 5 | +20% | 100/120 Winter | |
| S09-12-1.016 | S09-12-41 | 360 Winter | 5 | +20% | | |
| S09-12-1.017 | S09-12-42 | 360 Winter | 5 | +20% | | |
| S09-12-1.018 | S09-12-43 | 360 Winter | 5 | +20% | | |

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume ($m^3$) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-12-4.002 | S09-12-19 | | | 144.054 | 0.463 | 0.000 | 1.14 |
| S09-12-4.003 | S09-12-20 | | | 142.293 | 0.054 | 0.000 | 0.72 |
| S09-12-5.000 | S09-12-21 | | | 144.799 | -0.080 | 0.000 | 0.43 |
| S09-12-5.001 | S09-12-22 | | | 144.456 | -0.032 | 0.000 | 0.90 |
| S09-12-5.002 | S09-12-23 | | | 143.879 | 0.240 | 0.000 | 0.87 |
| S09-12-5.003 | S09-12-24 | | | 143.726 | 0.295 | 0.000 | 1.16 |
| S09-12-4.004 | S09-12-25 | | | 142.222 | 0.048 | 0.000 | 1.35 |
| S09-12-1.009 | S09-12-26 | | | 138.405 | 0.026 | 0.000 | 1.26 |
| S09-12-6.000 | S09-12-27 | | | 143.252 | -0.112 | 0.000 | 0.14 |
| S09-12-6.001 | S09-12-28 | | | 142.998 | -0.077 | 0.000 | 0.46 |
| S09-12-6.002 | S09-12-29 | | | 141.292 | 0.003 | 0.000 | 0.95 |
| S09-12-6.003 | S09-12-30 | | | 139.611 | 0.302 | 0.000 | 1.15 |
| S09-12-6.004 | S09-12-31 | | | 139.259 | 0.234 | 0.000 | 1.18 |
| S09-12-6.005 | S09-12-32 | | | 138.890 | 0.137 | 0.000 | 0.83 |
| S09-12-6.006 | S09-12-33 | | | 138.706 | 0.223 | 0.000 | 1.15 |

## 5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-12

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-12-6.007 | S09-12-34 | | | 138.430 | 0.262 | 0.000 | 1.13 |
| S09-12-6.008 | S09-12-35 | | | 138.287 | 0.279 | 0.000 | 0.53 |
| S09-12-6.009 | S09-12-36 | | | 138.194 | 0.299 | 0.000 | 0.67 |
| S09-12-1.010 | S09-12-37 | | | 138.105 | 0.285 | 0.000 | 1.29 |
| S09-12-1.011 | S09-12-38 | | | 137.724 | 0.141 | 0.000 | 1.24 |
| S09-12-1.012 | S09-12-39 | | | 137.377 | 0.047 | 0.000 | 1.10 |
| S09-12-1.013 | S09-12-40 | | | 136.758 | -0.285 | 0.000 | 0.29 |
| S09-12-1.014 | S09-12-Pond Inlet | | | 135.620 | -0.223 | 0.000 | 0.51 |
| S09-12-1.015 | S09-12-Pond Outlet | | | 135.218 | -0.232 | 0.000 | 0.09 |
| S09-12-1.016 | S09-12-41 | | | 134.662 | -0.230 | 0.000 | 0.12 |
| S09-12-1.017 | S09-12-42 | | | 130.889 | -0.161 | 0.000 | 0.44 |
| S09-12-1.018 | S09-12-43 | | | 129.828 | -0.218 | 0.000 | 0.17 |

| PN | US/MH Name | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|
| S09-12-4.002 | S09-12-19 | | | 24.3 | SURCHARGED | 7 |
| S09-12-4.003 | S09-12-20 | | | 24.3 | SURCHARGED | |
| S09-12-5.000 | S09-12-21 | | | 7.9 | OK | |
| S09-12-5.001 | S09-12-22 | | | 16.7 | OK | 5 |
| S09-12-5.002 | S09-12-23 | | | 15.5 | SURCHARGED | 6 |
| S09-12-5.003 | S09-12-24 | | | 21.6 | SURCHARGED | 6 |
| S09-12-4.004 | S09-12-25 | | | 46.1 | SURCHARGED | |
| S09-12-1.009 | S09-12-26 | | | 175.4 | SURCHARGED | |
| S09-12-6.000 | S09-12-27 | | | 2.7 | OK | |
| S09-12-6.001 | S09-12-28 | | | 13.3 | OK | |
| S09-12-6.002 | S09-12-29 | | | 28.3 | SURCHARGED | 6 |
| S09-12-6.003 | S09-12-30 | | | 26.5 | SURCHARGED | 8 |
| S09-12-6.004 | S09-12-31 | | | 29.4 | SURCHARGED | 8 |
| S09-12-6.005 | S09-12-32 | | | 29.3 | SURCHARGED | 8 |
| S09-12-6.006 | S09-12-33 | | | 40.6 | SURCHARGED | |
| S09-12-6.007 | S09-12-34 | | | 38.9 | SURCHARGED | |
| S09-12-6.008 | S09-12-35 | | | 36.5 | SURCHARGED | |
| S09-12-6.009 | S09-12-36 | | | 44.2 | SURCHARGED | |
| S09-12-1.010 | S09-12-37 | | | 198.3 | SURCHARGED | |
| S09-12-1.011 | S09-12-38 | | | 190.6 | SURCHARGED | |
| S09-12-1.012 | S09-12-39 | | | 179.4 | SURCHARGED | |
| S09-12-1.013 | S09-12-40 | | | 179.4 | OK | |
| S09-12-1.014 | S09-12-Pond Inlet | | | 179.2 | OK | |
| S09-12-1.015 | S09-12-Pond Outlet | | | 34.1 | OK | |
| S09-12-1.016 | S09-12-41 | | | 34.1 | OK | |
| S09-12-1.017 | S09-12-42 | | | 34.1 | OK | |
| S09-12-1.018 | S09-12-43 | | | 34.1 | OK | |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-12

```
                              Simulation Criteria
           Areal Reduction Factor 1.000    Additional Flow - % of Total Flow 0.000
                 Hot Start (mins)     0        MADD Factor * 10m³/ha Storage 2.000
               Hot Start Level (mm)     0                 Inlet Coeffiecient 0.800
   Manhole Headloss Coeff (Global) 0.500 Flow per Person per Day (l/per/day) 0.000
     Foul Sewage per hectare (l/s) 0.000

            Number of Input Hydrographs 0 Number of Storage Structures 1
              Number of Online Controls 1 Number of Time/Area Diagrams 0
             Number of Offline Controls 0 Number of Real Time Controls 0

                           Synthetic Rainfall Details
                 Rainfall Model               FSR      Ratio R 0.300
                         Region England and Wales Cv (Summer) 0.750
                     M5-60 (mm)             17.000 Cv (Winter) 0.840

          Margin for Flood Risk Warning (mm)                         300.0
                             Analysis Timestep 2.5 Second Increment (Extended)
                                    DTS Status                          ON
                                    DVD Status                          ON
                                Inertia Status                         OFF


                     Profile(s)                         Summer and Winter
                Duration(s) (mins)     15, 30, 60, 120, 180, 240, 360, 480, 600,
                                                          720, 960, 1440
           Return Period(s) (years)                                  5, 100
                Climate Change (%)                                   20, 40


                 US/MH             Return Climate   First (X)     First (Y)    First (Z)
       PN        Name      Storm   Period  Change   Surcharge       Flood      Overflow

S09-12-1.000  S09-12-1  15 Winter    100     +40% 100/15 Summer
S09-12-1.001  S09-12-2  15 Winter    100     +40% 100/15 Summer
S09-12-1.002  S09-12-3  30 Winter    100     +40% 100/15 Summer 100/15 Summer
S09-12-1.003  S09-12-4  30 Winter    100     +40%   5/15 Summer 100/15 Summer
S09-12-1.004  S09-12-5  60 Winter    100     +40%   5/15 Summer 100/15 Summer
S09-12-2.000  S09-12-6  15 Winter    100     +40% 100/15 Summer
S09-12-2.001  S09-12-7  15 Winter    100     +40% 100/15 Summer
S09-12-2.002  S09-12-8  30 Winter    100     +40% 100/15 Summer 100/15 Summer
S09-12-1.005  S09-12-9  60 Winter    100     +40%   5/15 Summer 100/15 Summer
S09-12-3.000 S09-12-10  15 Winter    100     +40% 100/15 Summer 100/15 Summer
S09-12-3.001 S09-12-11  30 Winter    100     +40%   5/15 Winter 100/15 Summer
S09-12-3.002 S09-12-12  30 Winter    100     +40%   5/15 Summer 100/15 Summer
S09-12-3.003 S09-12-13  15 Winter    100     +40% 100/15 Summer
S09-12-1.006 S09-12-14  30 Winter    100     +40%   5/15 Summer 100/15 Winter
S09-12-1.007 S09-12-15  30 Winter    100     +40%   5/15 Summer
S09-12-1.008 S09-12-16  60 Winter    100     +40%   5/15 Summer
S09-12-4.000 S09-12-17  15 Winter    100     +40% 100/15 Summer
S09-12-4.001 S09-12-18  30 Winter    100     +40%   5/15 Summer 100/15 Summer
```

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-12

| PN | US/MH Name | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. | Overflow (l/s) | Half Drain Time (mins) |
|---|---|---|---|---|---|---|---|---|
| S09-12-1.000 | S09-12-1 | | 146.573 | 0.909 | 0.000 | 0.98 | | |
| S09-12-1.001 | S09-12-2 | | 146.072 | 0.922 | 0.000 | 0.93 | | |
| S09-12-1.002 | S09-12-3 | | 143.959 | 1.205 | 4.183 | 1.00 | | |
| S09-12-1.003 | S09-12-4 | | 141.365 | 1.212 | 11.392 | 1.31 | | |
| S09-12-1.004 | S09-12-5 | | 140.346 | 1.204 | 4.029 | 1.61 | | |
| S09-12-2.000 | S09-12-6 | | 143.527 | 0.215 | 0.000 | 0.77 | | |
| S09-12-2.001 | S09-12-7 | | 143.343 | 0.429 | 0.000 | 0.79 | | |
| S09-12-2.002 | S09-12-8 | | 141.981 | 1.206 | 5.977 | 1.04 | | |
| S09-12-1.005 | S09-12-9 | | 140.277 | 1.209 | 8.303 | 1.58 | | |
| S09-12-3.000 | S09-12-10 | | 146.876 | 1.202 | 2.117 | 0.99 | | |
| S09-12-3.001 | S09-12-11 | | 146.633 | 1.211 | 8.946 | 1.00 | | |
| S09-12-3.002 | S09-12-12 | | 143.622 | 1.208 | 7.979 | 1.16 | | |
| S09-12-3.003 | S09-12-13 | | 140.628 | 1.080 | 0.000 | 0.91 | | |
| S09-12-1.006 | S09-12-14 | | 140.084 | 1.209 | 9.128 | 1.24 | | |
| S09-12-1.007 | S09-12-15 | | 140.073 | 1.394 | 0.000 | 1.82 | | |
| S09-12-1.008 | S09-12-16 | | 139.683 | 1.212 | 0.000 | 1.75 | | |
| S09-12-4.000 | S09-12-17 | | 145.935 | 0.941 | 0.000 | 0.67 | | |
| S09-12-4.001 | S09-12-18 | | 145.685 | 1.205 | 5.049 | 1.00 | | |

| PN | US/MH Name | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|
| S09-12-1.000 | S09-12-1 | 18.6 | FLOOD RISK | |
| S09-12-1.001 | S09-12-2 | 31.4 | FLOOD RISK | |
| S09-12-1.002 | S09-12-3 | 35.1 | FLOOD | 6 |
| S09-12-1.003 | S09-12-4 | 37.6 | FLOOD | 8 |
| S09-12-1.004 | S09-12-5 | 56.0 | FLOOD | 7 |
| S09-12-2.000 | S09-12-6 | 17.2 | SURCHARGED | |
| S09-12-2.001 | S09-12-7 | 25.5 | SURCHARGED | |
| S09-12-2.002 | S09-12-8 | 29.9 | FLOOD | 6 |
| S09-12-1.005 | S09-12-9 | 71.2 | FLOOD | 7 |
| S09-12-3.000 | S09-12-10 | 16.6 | FLOOD | 5 |
| S09-12-3.001 | S09-12-11 | 41.0 | FLOOD | 6 |
| S09-12-3.002 | S09-12-12 | 46.2 | FLOOD | 7 |
| S09-12-3.003 | S09-12-13 | 60.9 | FLOOD RISK | |
| S09-12-1.006 | S09-12-14 | 129.1 | FLOOD | 5 |
| S09-12-1.007 | S09-12-15 | 190.8 | SURCHARGED | |
| S09-12-1.008 | S09-12-16 | 171.2 | SURCHARGED | |
| S09-12-4.000 | S09-12-17 | 14.2 | FLOOD RISK | |
| S09-12-4.001 | S09-12-18 | 21.7 | FLOOD | 6 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-12

| PN | US/MH Name | Storm | Return Period | Climate Change | First (X) Surcharge | First (Y) Flood |
|---|---|---|---|---|---|---|
| S09-12-4.002 | S09-12-19 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer |
| S09-12-4.003 | S09-12-20 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-12-5.000 | S09-12-21 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-12-5.001 | S09-12-22 | 30 Winter | 100 | +40% | 100/15 Summer | 100/15 Summer |
| S09-12-5.002 | S09-12-23 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer |
| S09-12-5.003 | S09-12-24 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer |
| S09-12-4.004 | S09-12-25 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-12-1.009 | S09-12-26 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-12-6.000 | S09-12-27 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-12-6.001 | S09-12-28 | 15 Winter | 100 | +40% | 100/15 Summer | |
| S09-12-6.002 | S09-12-29 | 30 Winter | 100 | +40% | 5/15 Winter | 100/15 Summer |
| S09-12-6.003 | S09-12-30 | 30 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer |
| S09-12-6.004 | S09-12-31 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer |
| S09-12-6.005 | S09-12-32 | 60 Winter | 100 | +40% | 5/15 Summer | 100/15 Summer |
| S09-12-6.006 | S09-12-33 | 30 Summer | 100 | +40% | 5/15 Summer | |
| S09-12-6.007 | S09-12-34 | 60 Winter | 100 | +40% | 5/15 Summer | |
| S09-12-6.008 | S09-12-35 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-12-6.009 | S09-12-36 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-12-1.010 | S09-12-37 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-12-1.011 | S09-12-38 | 30 Winter | 100 | +40% | 5/15 Summer | |
| S09-12-1.012 | S09-12-39 | 30 Winter | 100 | +40% | 5/15 Winter | |
| S09-12-1.013 | S09-12-40 | 60 Winter | 100 | +40% | | |
| S09-12-1.014 | S09-12-Pond Inlet | 60 Winter | 100 | +40% | | |
| S09-12-1.015 | S09-12-Pond Outlet | 240 Winter | 100 | +40% | 100/120 Winter | |
| S09-12-1.016 | S09-12-41 | 480 Winter | 100 | +40% | | |
| S09-12-1.017 | S09-12-42 | 120 Winter | 100 | +40% | | |
| S09-12-1.018 | S09-12-43 | 720 Summer | 100 | +40% | | |

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume (m³) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-12-4.002 | S09-12-19 | | | 144.796 | 1.205 | 4.784 | 1.34 |
| S09-12-4.003 | S09-12-20 | | | 142.382 | 0.143 | 0.000 | 0.86 |
| S09-12-5.000 | S09-12-21 | | | 145.908 | 1.029 | 0.000 | 0.71 |
| S09-12-5.001 | S09-12-22 | | | 145.691 | 1.202 | 1.679 | 0.99 |
| S09-12-5.002 | S09-12-23 | | | 144.856 | 1.217 | 1.416 | 1.36 |
| S09-12-5.003 | S09-12-24 | | | 144.639 | 1.208 | 1.070 | 1.55 |
| S09-12-4.004 | S09-12-25 | | | 142.300 | 0.125 | 0.000 | 1.70 |
| S09-12-1.009 | S09-12-26 | | | 139.473 | 1.094 | 0.000 | 1.80 |
| S09-12-6.000 | S09-12-27 | | | 143.742 | 0.377 | 0.000 | 0.33 |
| S09-12-6.001 | S09-12-28 | | | 143.727 | 0.652 | 0.000 | 0.82 |
| S09-12-6.002 | S09-12-29 | | | 142.496 | 1.208 | 7.829 | 1.06 |
| S09-12-6.003 | S09-12-30 | | | 140.516 | 1.207 | 6.543 | 1.08 |
| S09-12-6.004 | S09-12-31 | | | 140.228 | 1.203 | 3.496 | 1.40 |
| S09-12-6.005 | S09-12-32 | | | 139.962 | 1.208 | 8.143 | 1.11 |
| S09-12-6.006 | S09-12-33 | | | 139.997 | 1.514 | 0.000 | 1.74 |

## 100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for S09-12

| PN | US/MH Name | First (Z) Overflow | Overflow Act. | Water Level (m) | Surcharged Depth (m) | Flooded Volume ($m^3$) | Flow / Cap. |
|---|---|---|---|---|---|---|---|
| S09-12-6.007 | S09-12-34 | | | 139.684 | 1.516 | 0.000 | 1.53 |
| S09-12-6.008 | S09-12-35 | | | 139.456 | 1.449 | 0.000 | 0.85 |
| S09-12-6.009 | S09-12-36 | | | 139.374 | 1.479 | 0.000 | 0.86 |
| S09-12-1.010 | S09-12-37 | | | 139.298 | 1.478 | 0.000 | 1.89 |
| S09-12-1.011 | S09-12-38 | | | 138.618 | 1.035 | 0.000 | 1.76 |
| S09-12-1.012 | S09-12-39 | | | 137.812 | 0.482 | 0.000 | 1.59 |
| S09-12-1.013 | S09-12-40 | | | 136.797 | -0.246 | 0.000 | 0.42 |
| S09-12-1.014 | S09-12-Pond Inlet | | | 135.682 | -0.160 | 0.000 | 0.74 |
| S09-12-1.015 | S09-12-Pond Outlet | | | 135.491 | 0.042 | 0.000 | 0.13 |
| S09-12-1.016 | S09-12-41 | | | 134.675 | -0.217 | 0.000 | 0.17 |
| S09-12-1.017 | S09-12-42 | | | 130.919 | -0.131 | 0.000 | 0.61 |
| S09-12-1.018 | S09-12-43 | | | 129.844 | -0.203 | 0.000 | 0.23 |

| PN | US/MH Name | Overflow (l/s) | Half Drain Time (mins) | Pipe Flow (l/s) | Status | Level Exceeded |
|---|---|---|---|---|---|---|
| S09-12-4.002 | S09-12-19 | | | 28.7 | FLOOD | 7 |
| S09-12-4.003 | S09-12-20 | | | 29.0 | SURCHARGED | |
| S09-12-5.000 | S09-12-21 | | | 12.9 | FLOOD RISK | |
| S09-12-5.001 | S09-12-22 | | | 18.5 | FLOOD | 5 |
| S09-12-5.002 | S09-12-23 | | | 24.1 | FLOOD | 6 |
| S09-12-5.003 | S09-12-24 | | | 28.9 | FLOOD | 6 |
| S09-12-4.004 | S09-12-25 | | | 58.2 | SURCHARGED | |
| S09-12-1.009 | S09-12-26 | | | 249.9 | SURCHARGED | |
| S09-12-6.000 | S09-12-27 | | | 6.4 | SURCHARGED | |
| S09-12-6.001 | S09-12-28 | | | 23.4 | SURCHARGED | |
| S09-12-6.002 | S09-12-29 | | | 31.4 | FLOOD | 6 |
| S09-12-6.003 | S09-12-30 | | | 24.9 | FLOOD | 8 |
| S09-12-6.004 | S09-12-31 | | | 34.8 | FLOOD | 8 |
| S09-12-6.005 | S09-12-32 | | | 39.1 | FLOOD | 8 |
| S09-12-6.006 | S09-12-33 | | | 61.7 | SURCHARGED | |
| S09-12-6.007 | S09-12-34 | | | 52.5 | SURCHARGED | |
| S09-12-6.008 | S09-12-35 | | | 58.6 | SURCHARGED | |
| S09-12-6.009 | S09-12-36 | | | 56.6 | SURCHARGED | |
| S09-12-1.010 | S09-12-37 | | | 289.8 | SURCHARGED | |
| S09-12-1.011 | S09-12-38 | | | 271.3 | SURCHARGED | |
| S09-12-1.012 | S09-12-39 | | | 260.2 | SURCHARGED | |
| S09-12-1.013 | S09-12-40 | | | 261.8 | OK | |
| S09-12-1.014 | S09-12-Pond Inlet | | | 261.9 | OK | |
| S09-12-1.015 | S09-12-Pond Outlet | | | 47.0 | SURCHARGED | |
| S09-12-1.016 | S09-12-41 | | | 47.0 | OK | |
| S09-12-1.017 | S09-12-42 | | | 47.0 | OK | |
| S09-12-1.018 | S09-12-43 | | | 47.0 | OK | |

## Summary of Results for 100 year Return Period (+40%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Control (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Summer | 8.834 | 0.834 | 30.5 | 10.0 | OK |
| 30 min Summer | 8.771 | 0.771 | 30.4 | 9.3 | OK |
| 60 min Summer | 8.432 | 0.432 | 29.8 | 5.2 | OK |
| 120 min Summer | 8.019 | 0.019 | 29.1 | 0.2 | OK |
| 180 min Summer | 8.000 | 0.000 | 23.6 | 0.0 | OK |
| 240 min Summer | 8.000 | 0.000 | 19.2 | 0.0 | OK |
| 360 min Summer | 8.000 | 0.000 | 14.0 | 0.0 | OK |
| 480 min Summer | 8.000 | 0.000 | 11.2 | 0.0 | OK |
| 600 min Summer | 8.000 | 0.000 | 9.3 | 0.0 | OK |
| 720 min Summer | 8.000 | 0.000 | 8.1 | 0.0 | OK |
| 960 min Summer | 8.000 | 0.000 | 6.4 | 0.0 | OK |
| 1440 min Summer | 8.000 | 0.000 | 4.7 | 0.0 | OK |
| 2160 min Summer | 8.000 | 0.000 | 3.4 | 0.0 | OK |
| 2880 min Summer | 8.000 | 0.000 | 2.7 | 0.0 | OK |
| 4320 min Summer | 8.000 | 0.000 | 1.9 | 0.0 | OK |
| 5760 min Summer | 8.000 | 0.000 | 1.5 | 0.0 | OK |
| 7200 min Summer | 8.000 | 0.000 | 1.3 | 0.0 | OK |
| 8640 min Summer | 8.000 | 0.000 | 1.1 | 0.0 | OK |
| 10080 min Summer | 8.000 | 0.000 | 1.0 | 0.0 | OK |
| 15 min Winter | 8.970 | 0.970 | 30.7 | 11.6 | OK |
| 30 min Winter | 8.796 | 0.796 | 30.4 | 9.6 | OK |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 115.584 | 0.0 | 29.3 | 16 |
| 30 min Summer | 76.054 | 0.0 | 38.1 | 25 |
| 60 min Summer | 47.821 | 0.0 | 47.9 | 40 |
| 120 min Summer | 29.168 | 0.0 | 58.8 | 68 |
| 180 min Summer | 21.604 | 0.0 | 65.6 | 0 |
| 240 min Summer | 17.380 | 0.0 | 70.4 | 0 |
| 360 min Summer | 12.705 | 0.0 | 77.2 | 0 |
| 480 min Summer | 10.119 | 0.0 | 82.0 | 0 |
| 600 min Summer | 8.477 | 0.0 | 85.8 | 0 |
| 720 min Summer | 7.340 | 0.0 | 89.2 | 0 |
| 960 min Summer | 5.844 | 0.0 | 94.7 | 0 |
| 1440 min Summer | 4.232 | 0.0 | 102.8 | 0 |
| 2160 min Summer | 3.059 | 0.0 | 111.5 | 0 |
| 2880 min Summer | 2.428 | 0.0 | 118.0 | 0 |
| 4320 min Summer | 1.751 | 0.0 | 127.6 | 0 |
| 5760 min Summer | 1.387 | 0.0 | 134.8 | 0 |
| 7200 min Summer | 1.157 | 0.0 | 140.6 | 0 |
| 8640 min Summer | 0.998 | 0.0 | 145.4 | 0 |
| 10080 min Summer | 0.880 | 0.0 | 149.6 | 0 |
| 15 min Winter | 115.584 | 0.0 | 32.1 | 17 |
| 30 min Winter | 76.054 | 0.0 | 43.0 | 26 |

## Summary of Results for 100 year Return Period (+40%)

| **Storm Event** | **Max Level (m)** | **Max Depth (m)** | **Max Control (l/s)** | **Max Volume (m³)** | **Status** |
|---|---|---|---|---|---|
| 60 min Winter | 8.258 | 0.258 | 29.5 | 3.1 | O K |
| 120 min Winter | 8.000 | 0.000 | 23.1 | 0.0 | O K |
| 180 min Winter | 8.000 | 0.000 | 17.2 | 0.0 | O K |
| 240 min Winter | 8.000 | 0.000 | 13.8 | 0.0 | O K |
| 360 min Winter | 8.000 | 0.000 | 10.1 | 0.0 | O K |
| 480 min Winter | 8.000 | 0.000 | 8.1 | 0.0 | O K |
| 600 min Winter | 8.000 | 0.000 | 6.8 | 0.0 | O K |
| 720 min Winter | 8.000 | 0.000 | 5.8 | 0.0 | O K |
| 960 min Winter | 8.000 | 0.000 | 4.7 | 0.0 | O K |
| 1440 min Winter | 8.000 | 0.000 | 3.4 | 0.0 | O K |
| 2160 min Winter | 8.000 | 0.000 | 2.4 | 0.0 | O K |
| 2880 min Winter | 8.000 | 0.000 | 1.9 | 0.0 | O K |
| 4320 min Winter | 8.000 | 0.000 | 1.4 | 0.0 | O K |
| 5760 min Winter | 8.000 | 0.000 | 1.1 | 0.0 | O K |
| 7200 min Winter | 8.000 | 0.000 | 0.9 | 0.0 | O K |
| 8640 min Winter | 8.000 | 0.000 | 0.8 | 0.0 | O K |
| 10080 min Winter | 8.000 | 0.000 | 0.7 | 0.0 | O K |

| **Storm Event** | **Rain (mm/hr)** | **Flooded Volume (m³)** | **Discharge Volume (m³)** | **Time-Peak (mins)** |
|---|---|---|---|---|
| 60 min Winter | 47.821 | 0.0 | 53.4 | 42 |
| 120 min Winter | 29.168 | 0.0 | 66.2 | 0 |
| 180 min Winter | 21.604 | 0.0 | 73.5 | 0 |
| 240 min Winter | 17.380 | 0.0 | 78.8 | 0 |
| 360 min Winter | 12.705 | 0.0 | 86.4 | 0 |
| 480 min Winter | 10.119 | 0.0 | 91.8 | 0 |
| 600 min Winter | 8.477 | 0.0 | 96.1 | 0 |
| 720 min Winter | 7.340 | 0.0 | 99.9 | 0 |
| 960 min Winter | 5.844 | 0.0 | 106.0 | 0 |
| 1440 min Winter | 4.232 | 0.0 | 115.2 | 0 |
| 2160 min Winter | 3.059 | 0.0 | 124.9 | 0 |
| 2880 min Winter | 2.428 | 0.0 | 132.2 | 0 |
| 4320 min Winter | 1.751 | 0.0 | 143.0 | 0 |
| 5760 min Winter | 1.387 | 0.0 | 151.0 | 0 |
| 7200 min Winter | 1.157 | 0.0 | 157.5 | 0 |
| 8640 min Winter | 0.998 | 0.0 | 162.9 | 0 |
| 10080 min Winter | 0.880 | 0.0 | 167.6 | 0 |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.750 |
| Region | England and Wales | Cv (Winter) | 0.840 |
| M5-60 (mm) | 17.000 | Shortest Storm (mins) | 15 |
| Ratio R | 0.400 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +40 |

## Time Area Diagram

Total Area (ha) 0.135

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|
| 0 | 4 | 0.000 | 4 | 8 | 0.135 |

## Model Details

Storage is Online Cover Level (m) 10.000

## Tank or Pond Structure

Invert Level (m) 8.000

| Depth (m) | Area (m²) | Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|---|---|
| 0.000 | 12.0 | 1.000 | 12.0 | 1.001 | 0.0 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0151-1080-1000-1080 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 10.8 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 151 |
| Invert Level (m) | 0.000 |
| Minimum Outlet Pipe Diameter (mm) | 225 |
| Suggested Manhole Diameter (mm) | 1200 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 1.000 | 10.8 |
| Flush-Flo™ | 0.309 | 10.8 |
| Kick-Flo® | 0.682 | 9.0 |
| Mean Flow over Head Range | - | 9.2 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.100 | 5.4 | 1.200 | 11.7 | 3.000 | 18.1 | 7.000 | 27.3 |
| 0.200 | 10.4 | 1.400 | 12.6 | 3.500 | 19.5 | 7.500 | 28.2 |
| 0.300 | 10.8 | 1.600 | 13.5 | 4.000 | 20.8 | 8.000 | 29.1 |
| 0.400 | 10.7 | 1.800 | 14.2 | 4.500 | 22.0 | 8.500 | 29.9 |
| 0.500 | 10.4 | 2.000 | 15.0 | 5.000 | 23.2 | 9.000 | 30.8 |
| 0.600 | 9.9 | 2.200 | 15.7 | 5.500 | 24.3 | 9.500 | 31.6 |
| 0.800 | 9.7 | 2.400 | 16.3 | 6.000 | 25.3 | | |
| 1.000 | 10.8 | 2.600 | 16.9 | 6.500 | 26.3 | | |

## Summary of Results for 100 year Return Period (+40%)

| **Storm Event** | **Max Level (m)** | **Max Depth (m)** | **Max Control (l/s)** | **Max Volume (m³)** | **Status** |
|---|---|---|---|---|---|
| 15 min Summer | 8.831 | 0.831 | 14.5 | 5.8 | O K |
| 30 min Summer | 8.789 | 0.789 | 14.5 | 5.5 | O K |
| 60 min Summer | 8.487 | 0.487 | 14.3 | 3.4 | O K |
| 120 min Summer | 8.081 | 0.081 | 13.9 | 0.6 | O K |
| 180 min Summer | 8.000 | 0.000 | 12.4 | 0.0 | O K |
| 240 min Summer | 8.000 | 0.000 | 10.1 | 0.0 | O K |
| 360 min Summer | 8.000 | 0.000 | 7.4 | 0.0 | O K |
| 480 min Summer | 8.000 | 0.000 | 5.9 | 0.0 | O K |
| 600 min Summer | 8.000 | 0.000 | 4.9 | 0.0 | O K |
| 720 min Summer | 8.000 | 0.000 | 4.3 | 0.0 | O K |
| 960 min Summer | 8.000 | 0.000 | 3.4 | 0.0 | O K |
| 1440 min Summer | 8.000 | 0.000 | 2.5 | 0.0 | O K |
| 2160 min Summer | 8.000 | 0.000 | 1.8 | 0.0 | O K |
| 2880 min Summer | 8.000 | 0.000 | 1.4 | 0.0 | O K |
| 4320 min Summer | 8.000 | 0.000 | 1.0 | 0.0 | O K |
| 5760 min Summer | 8.000 | 0.000 | 0.8 | 0.0 | O K |
| 7200 min Summer | 8.000 | 0.000 | 0.7 | 0.0 | O K |
| 8640 min Summer | 8.000 | 0.000 | 0.6 | 0.0 | O K |
| 10080 min Summer | 8.000 | 0.000 | 0.5 | 0.0 | O K |
| 15 min Winter | 8.973 | 0.973 | 14.7 | 6.8 | O K |
| 30 min Winter | 8.841 | 0.841 | 14.5 | 5.9 | O K |

| **Storm Event** | **Rain (mm/hr)** | **Flooded Volume (m³)** | **Discharge Volume (m³)** | **Time-Peak (mins)** |
|---|---|---|---|---|
| 15 min Summer | 115.584 | 0.0 | 15.0 | 17 |
| 30 min Summer | 76.054 | 0.0 | 19.9 | 25 |
| 60 min Summer | 47.821 | 0.0 | 24.9 | 40 |
| 120 min Summer | 29.168 | 0.0 | 30.8 | 70 |
| 180 min Summer | 21.604 | 0.0 | 34.5 | 0 |
| 240 min Summer | 17.380 | 0.0 | 37.0 | 0 |
| 360 min Summer | 12.705 | 0.0 | 40.6 | 0 |
| 480 min Summer | 10.119 | 0.0 | 43.1 | 0 |
| 600 min Summer | 8.477 | 0.0 | 45.1 | 0 |
| 720 min Summer | 7.340 | 0.0 | 46.9 | 0 |
| 960 min Summer | 5.844 | 0.0 | 49.8 | 0 |
| 1440 min Summer | 4.232 | 0.0 | 54.1 | 0 |
| 2160 min Summer | 3.059 | 0.0 | 58.6 | 0 |
| 2880 min Summer | 2.428 | 0.0 | 62.1 | 0 |
| 4320 min Summer | 1.751 | 0.0 | 67.1 | 0 |
| 5760 min Summer | 1.387 | 0.0 | 70.9 | 0 |
| 7200 min Summer | 1.157 | 0.0 | 73.9 | 0 |
| 8640 min Summer | 0.998 | 0.0 | 76.5 | 0 |
| 10080 min Summer | 0.880 | 0.0 | 78.7 | 0 |
| 15 min Winter | 115.584 | 0.0 | 17.2 | 17 |
| 30 min Winter | 76.054 | 0.0 | 22.5 | 26 |

## Summary of Results for 100 year Return Period (+40%)

| **Storm Event** | **Max Level (m)** | **Max Depth (m)** | **Max Control (l/s)** | **Max Volume (m³)** | **Status** |
|---|---|---|---|---|---|
| 60 min Winter | 8.369 | 0.369 | 14.2 | 2.6 | O K |
| 120 min Winter | 8.000 | 0.000 | 12.2 | 0.0 | O K |
| 180 min Winter | 8.000 | 0.000 | 9.0 | 0.0 | O K |
| 240 min Winter | 8.000 | 0.000 | 7.3 | 0.0 | O K |
| 360 min Winter | 8.000 | 0.000 | 5.3 | 0.0 | O K |
| 480 min Winter | 8.000 | 0.000 | 4.2 | 0.0 | O K |
| 600 min Winter | 8.000 | 0.000 | 3.6 | 0.0 | O K |
| 720 min Winter | 8.000 | 0.000 | 3.1 | 0.0 | O K |
| 960 min Winter | 8.000 | 0.000 | 2.4 | 0.0 | O K |
| 1440 min Winter | 8.000 | 0.000 | 1.8 | 0.0 | O K |
| 2160 min Winter | 8.000 | 0.000 | 1.3 | 0.0 | O K |
| 2880 min Winter | 8.000 | 0.000 | 1.0 | 0.0 | O K |
| 4320 min Winter | 8.000 | 0.000 | 0.7 | 0.0 | O K |
| 5760 min Winter | 8.000 | 0.000 | 0.6 | 0.0 | O K |
| 7200 min Winter | 8.000 | 0.000 | 0.5 | 0.0 | O K |
| 8640 min Winter | 8.000 | 0.000 | 0.4 | 0.0 | O K |
| 10080 min Winter | 8.000 | 0.000 | 0.4 | 0.0 | O K |

| **Storm Event** | **Rain (mm/hr)** | **Flooded Volume (m³)** | **Discharge Volume (m³)** | **Time-Peak (mins)** |
|---|---|---|---|---|
| 60 min Winter | 47.821 | 0.0 | 28.5 | 42 |
| 120 min Winter | 29.168 | 0.0 | 34.8 | 0 |
| 180 min Winter | 21.604 | 0.0 | 38.7 | 0 |
| 240 min Winter | 17.380 | 0.0 | 41.5 | 0 |
| 360 min Winter | 12.705 | 0.0 | 45.5 | 0 |
| 480 min Winter | 10.119 | 0.0 | 48.3 | 0 |
| 600 min Winter | 8.477 | 0.0 | 50.6 | 0 |
| 720 min Winter | 7.340 | 0.0 | 52.5 | 0 |
| 960 min Winter | 5.844 | 0.0 | 55.8 | 0 |
| 1440 min Winter | 4.232 | 0.0 | 60.6 | 0 |
| 2160 min Winter | 3.059 | 0.0 | 65.7 | 0 |
| 2880 min Winter | 2.428 | 0.0 | 69.5 | 0 |
| 4320 min Winter | 1.751 | 0.0 | 75.2 | 0 |
| 5760 min Winter | 1.387 | 0.0 | 79.4 | 0 |
| 7200 min Winter | 1.157 | 0.0 | 82.8 | 0 |
| 8640 min Winter | 0.998 | 0.0 | 85.7 | 0 |
| 10080 min Winter | 0.880 | 0.0 | 88.1 | 0 |

## Rainfall Details

```
                Rainfall Model                 FSR          Winter Storms    Yes
          Return Period (years)                100           Cv (Summer)  0.750
                         Region England and Wales           Cv (Winter)  0.840
                      M5-60 (mm)            17.000 Shortest Storm (mins)     15
                         Ratio R             0.400  Longest Storm (mins)  10080
                  Summer Storms                Yes      Climate Change %    +40
```

## Time Area Diagram

Total Area (ha) 0.071

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|
| 0 | 4 | 0.000 | 4 | 8 | 0.071 |

## Model Details

Storage is Online Cover Level (m) 10.000

## Tank or Pond Structure

Invert Level (m) 8.000

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|---|---|
| 0.000 | 7.0 | 1.000 | 7.0 | 1.001 | 0.0 |

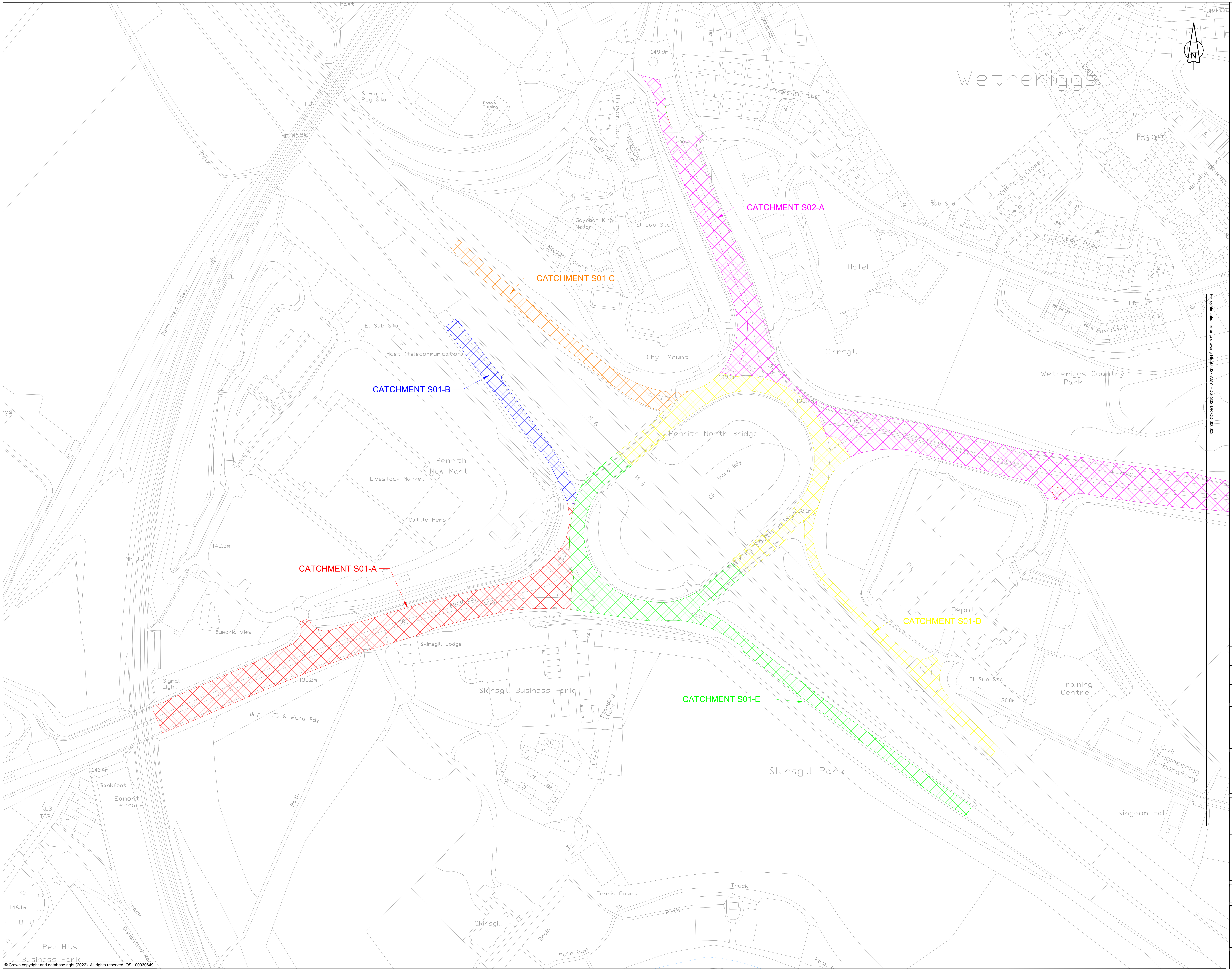
## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0108-5200-1000-5200 |
| Design Head (m) | 1.000 |
| Design Flow (l/s) | 5.2 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 108 |
| Invert Level (m) | 0.000 |
| Minimum Outlet Pipe Diameter (mm) | 150 |
| Suggested Manhole Diameter (mm) | 1200 |

| **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|
| Design Point (Calculated) | 1.000 | 5.2 |
| Flush-Flo™ | 0.296 | 5.2 |
| Kick-Flo® | 0.641 | 4.2 |
| Mean Flow over Head Range | - | 4.5 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|
| 0.100 | 3.7 | 1.200 | 5.7 | 3.000 | 8.7 | 7.000 | 13.0 |
| 0.200 | 5.1 | 1.400 | 6.1 | 3.500 | 9.4 | 7.500 | 13.4 |
| 0.300 | 5.2 | 1.600 | 6.5 | 4.000 | 10.0 | 8.000 | 13.9 |
| 0.400 | 5.1 | 1.800 | 6.8 | 4.500 | 10.5 | 8.500 | 14.3 |
| 0.500 | 4.9 | 2.000 | 7.2 | 5.000 | 11.1 | 9.000 | 14.7 |
| 0.600 | 4.5 | 2.200 | 7.5 | 5.500 | 11.6 | 9.500 | 15.1 |
| 0.800 | 4.7 | 2.400 | 7.8 | 6.000 | 12.1 | | |
| 1.000 | 5.2 | 2.600 | 8.1 | 6.500 | 12.6 | | |



For continuation refer to drawing HE565627-AMY-HDG-S02-DR-CD-000003

## NOTES

1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed drainage design designed in accordance with the Standards for Highways Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, as-built drawings, OS, JBA culvert surveys, site walk overs and topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   - No surcharging in 1yr storm event
   - No flooding in 1 or 5yr storm event
   - Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope
10. Ponds to have minimum 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

## KEY

| | |
|---|---|
| 🟥 | CATCHMENT S01-A |
| 🟦 | CATCHMENT S01-B |
| 🟧 | CATCHMENT S01-C |
| 🟨 | CATCHMENT S01-D |
| 🟩 | CATCHMENT S01-E |
| 🟪 | CATCHMENT S02-A |

| | | | | | |
|---|---|---|---|---|---|
| --- | --- | | | | |
| | --- | --- | --- | --- | --- |
| | --- | --- | --- | --- | --- |
| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 25/04/22 | 25/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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national highways

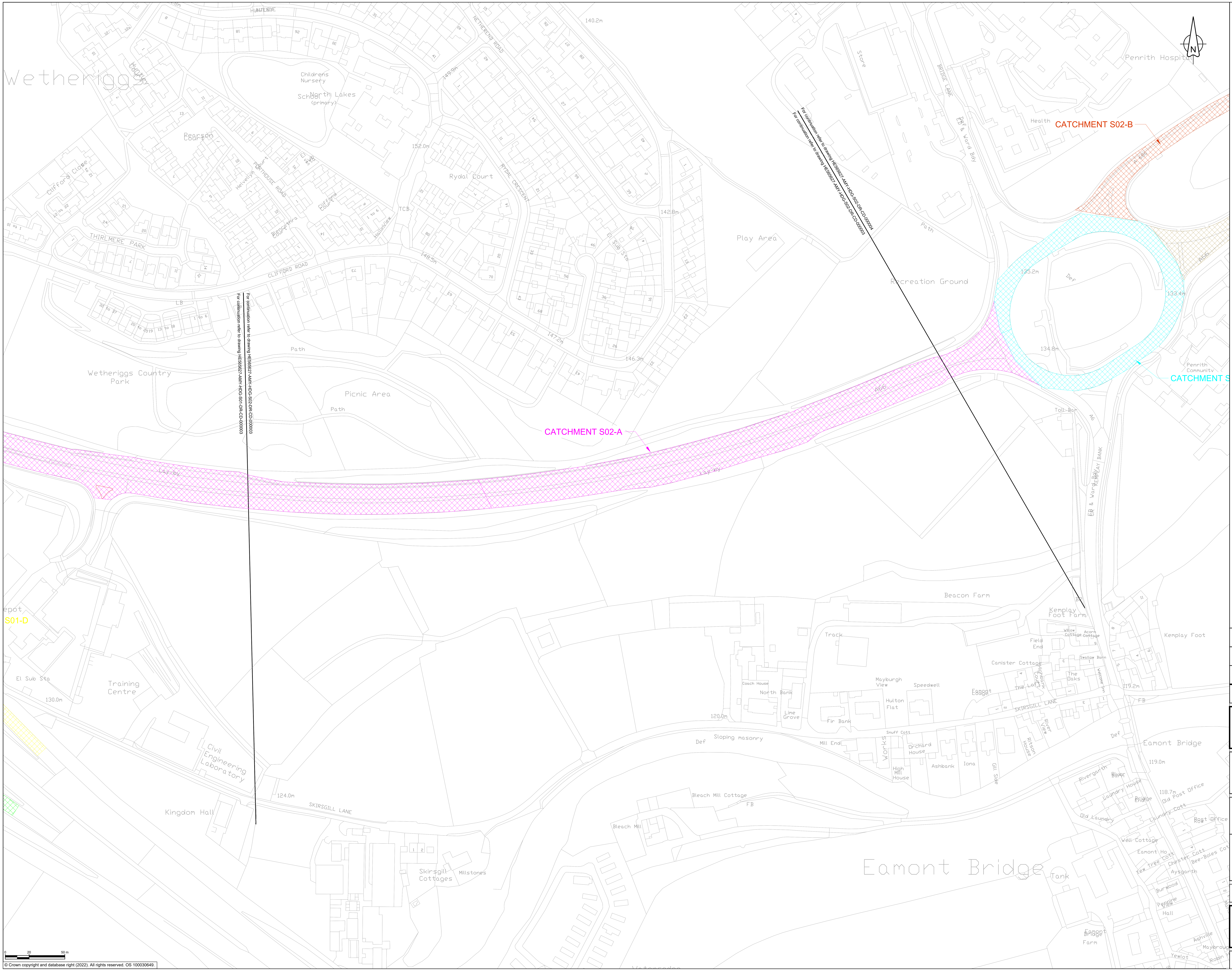
Project Name
A66 Northern Trans-Pennine

Drawing Title
Existing M6 J40 to Kemplay Bank
Drainage Catchment Areas
Sheet 1 of 3

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S01 -DR-CD- 000003
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |



## NOTES

1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed drainage design designed in accordance with the Standards for Highways Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, as-built drawings, OS, JBA culvert surveys, site walk overs and topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   - No surcharging in 1yr storm event
   - No flooding in 1 or 5yr storm event
   - Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope
10. Ponds to have minimum 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

## KEY

▨ CATCHMENT S02-A

| Revision | Revision details | | | | |
|---|---|---|---|---|---|
| --- | --- | | | | |
| | --- | --- | --- | --- | --- |
| | --- | --- | --- | --- | --- |
| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 25/04/22 | 25/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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national highways

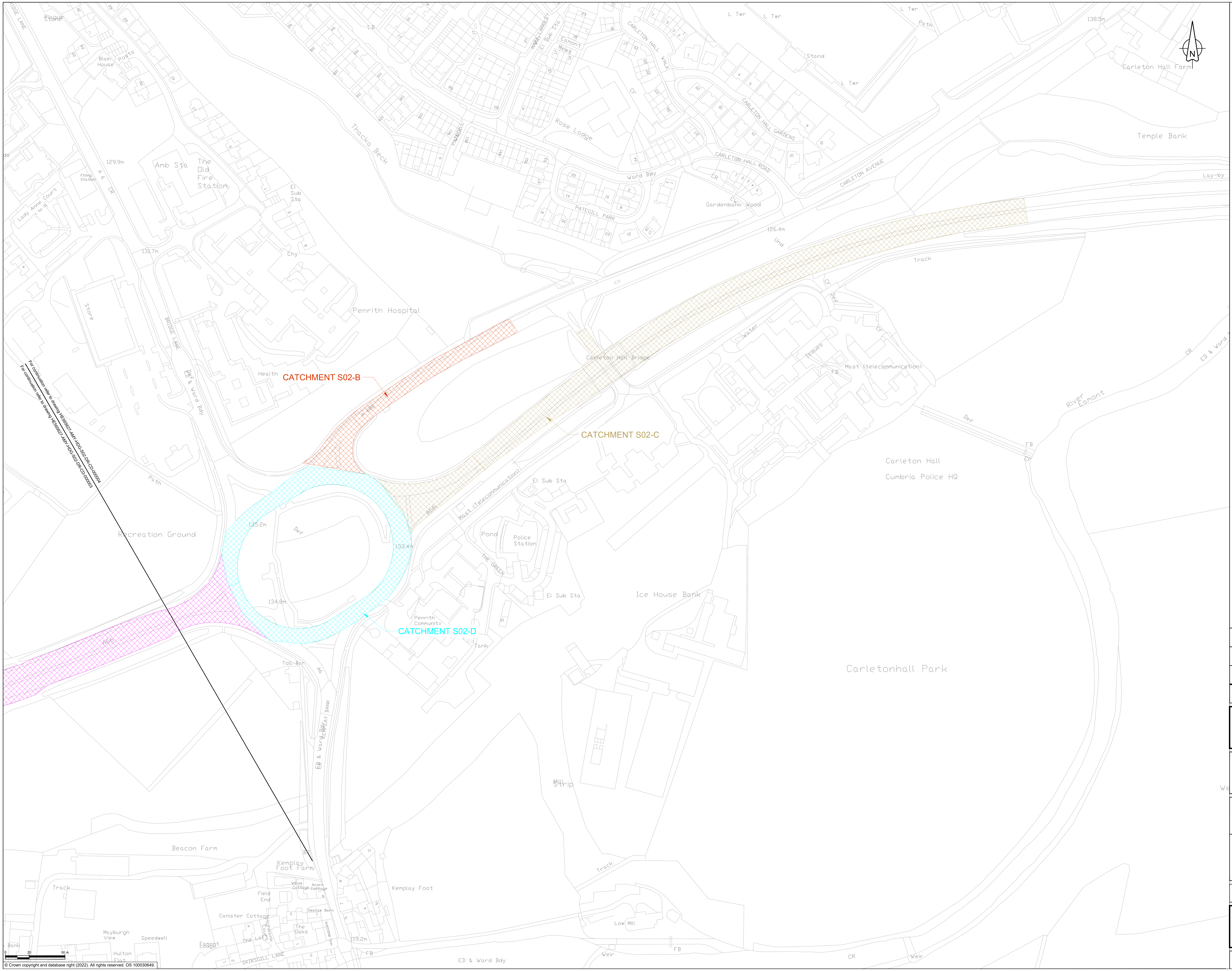
Project Name
A66 Northern Trans-Pennine

Drawing Title
Existing M6 J40 to Kemplay Bank
Drainage Catchment Areas
Sheet 2 of 3

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S02 -DR-CD- 000003
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |



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## NOTES

1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed drainage design designed in accordance with the Standards for Highways Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, as-built drawings, OS, JBA culvert surveys, site walk overs and topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   - No surcharging in 1yr storm event
   - No flooding in 1 or 5yr storm event
   - Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope
10. Ponds to have minimum 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

## KEY

| | |
|---|---|
| ▨ | CATCHMENT S02-A |
| ▨ | CATCHMENT S02-B |
| ▨ | CATCHMENT S02-C |
| ▨ | CATCHMENT S02-D |

| | | | | | |
|---|---|---|---|---|---|
| --- | --- | | | | |
| | --- | --- | --- | --- | --- |
| | --- | --- | --- | --- | --- |
| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 25/04/22 | 25/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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national highways

Project Name
A66 Northern Trans-Pennine

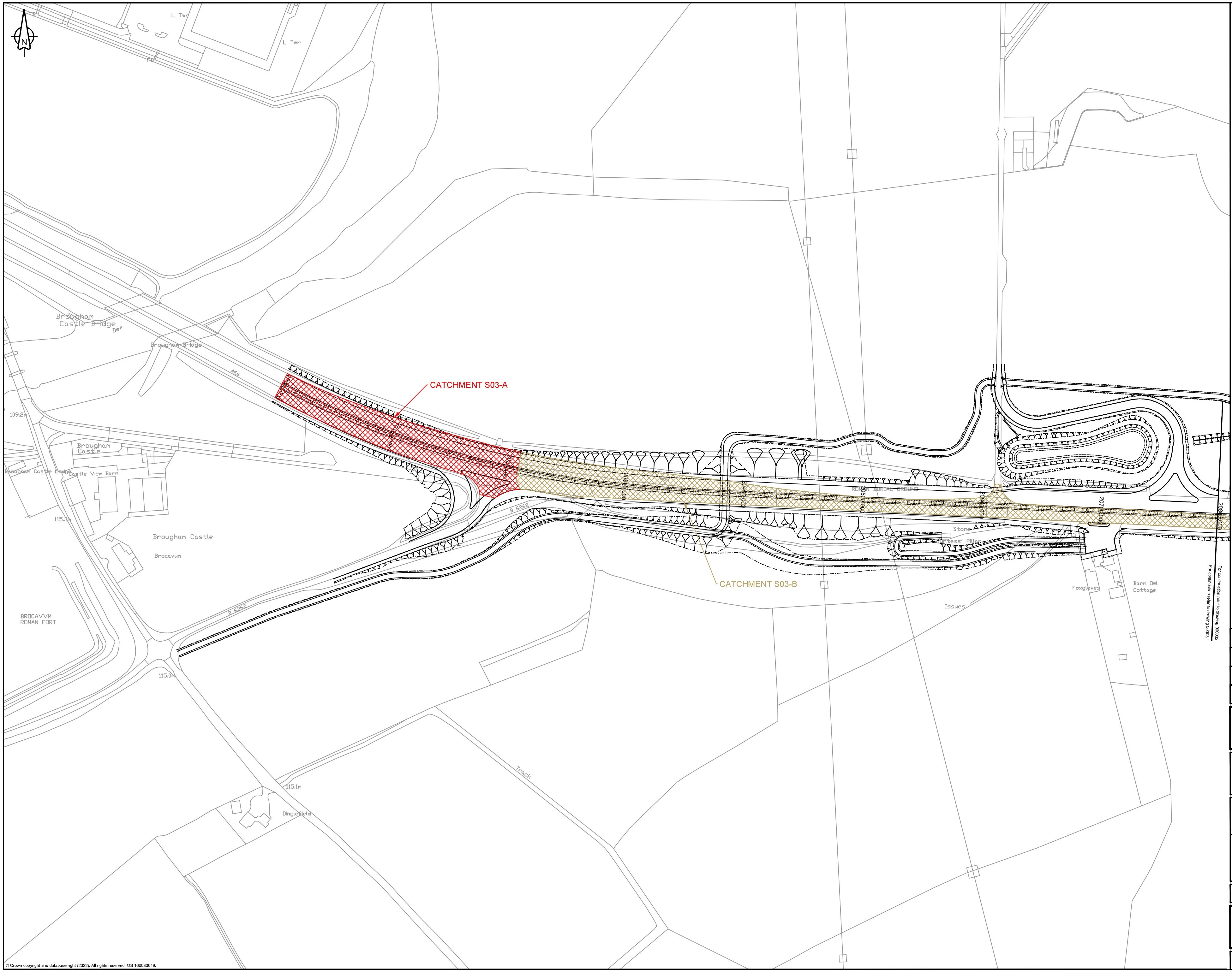
Drawing Title
Existing M6 J40 to Kemplay Bank
Drainage Catchment Areas
Sheet 3 of 3

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number

| Project | Originator | Volume | Location | Type | Role | Number |
|---|---|---|---|---|---|---|
| HE565627 | AMY | HDG | S02 | DR | CD | 000004 |

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |



For continuation refer to drawing 000032

For continuation refer to drawing 000031

## NOTES

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## KEY

| | |
|---|---|
| ▨ | CATCHMENT S03-A |
| ▨ | CATCHMENT S03-B |
| ▨ | CATCHMENT S03-C |
| ▨ | CATCHMENT S03-D |
| ▨ | CATCHMENT S03-E |
| ▨ | CATCHMENT S03-F |
| ▨ | CATCHMENT S03-G |
| ▨ | CATCHMENT S03-H |

| Revision | Revision details | | | | |
|---|---|---|---|---|---|
| — | — | | | | |
| | — | — | — | — | — |
| | — | — | — | — | — |
| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 25/04/22 | 25/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
Amey OW Limited
Chancery Exchange
10 Furnival Street
London, EC4A 1AB

Client
3 Piccadilly Place
Manchester
M1 3BN

national highways

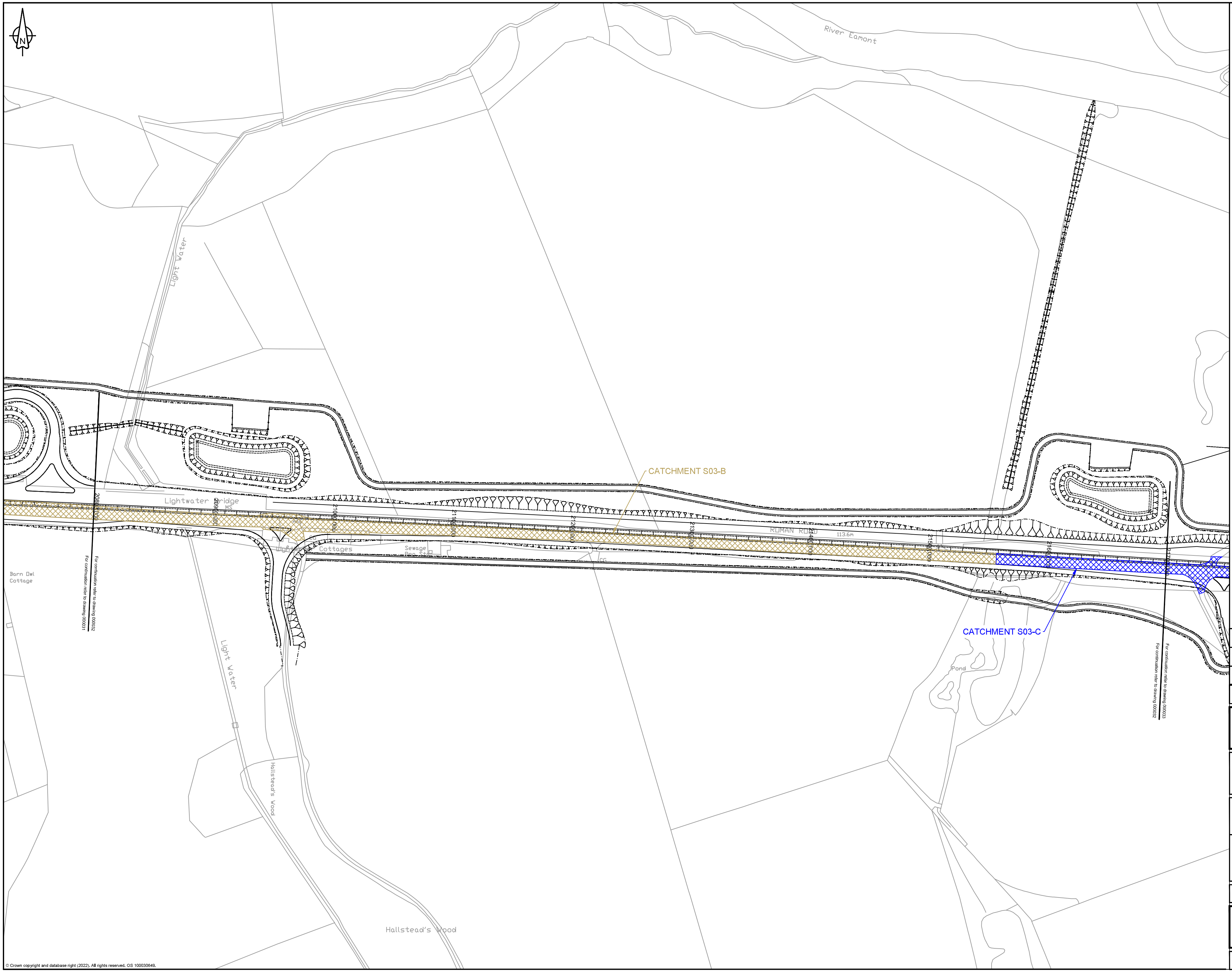
Project Name
A66 Northern Trans-Pennine

Drawing Title
Existing Center Parcs
Drainage Catchment Areas
Sheet 1 of 6

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| — | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S03 -DR-CD- 000031
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |



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## KEY

| | |
|---|---|
| ▨ | CATCHMENT S03-A |
| ▨ | CATCHMENT S03-B |
| ▨ | CATCHMENT S03-C |
| ▨ | CATCHMENT S03-D |
| ▨ | CATCHMENT S03-E |
| ▨ | CATCHMENT S03-F |
| ▨ | CATCHMENT S03-G |
| ▨ | CATCHMENT S03-H |

| Revision | Revision details | | | | |
|---|---|---|---|---|---|
| — | — | | | | |
| | — | — | — | — | — |
| | — | — | — | — | — |
| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 25/04/22 | 25/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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Amey OW Limited
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10 Furnival Street
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Manchester
M1 3BN
national highways

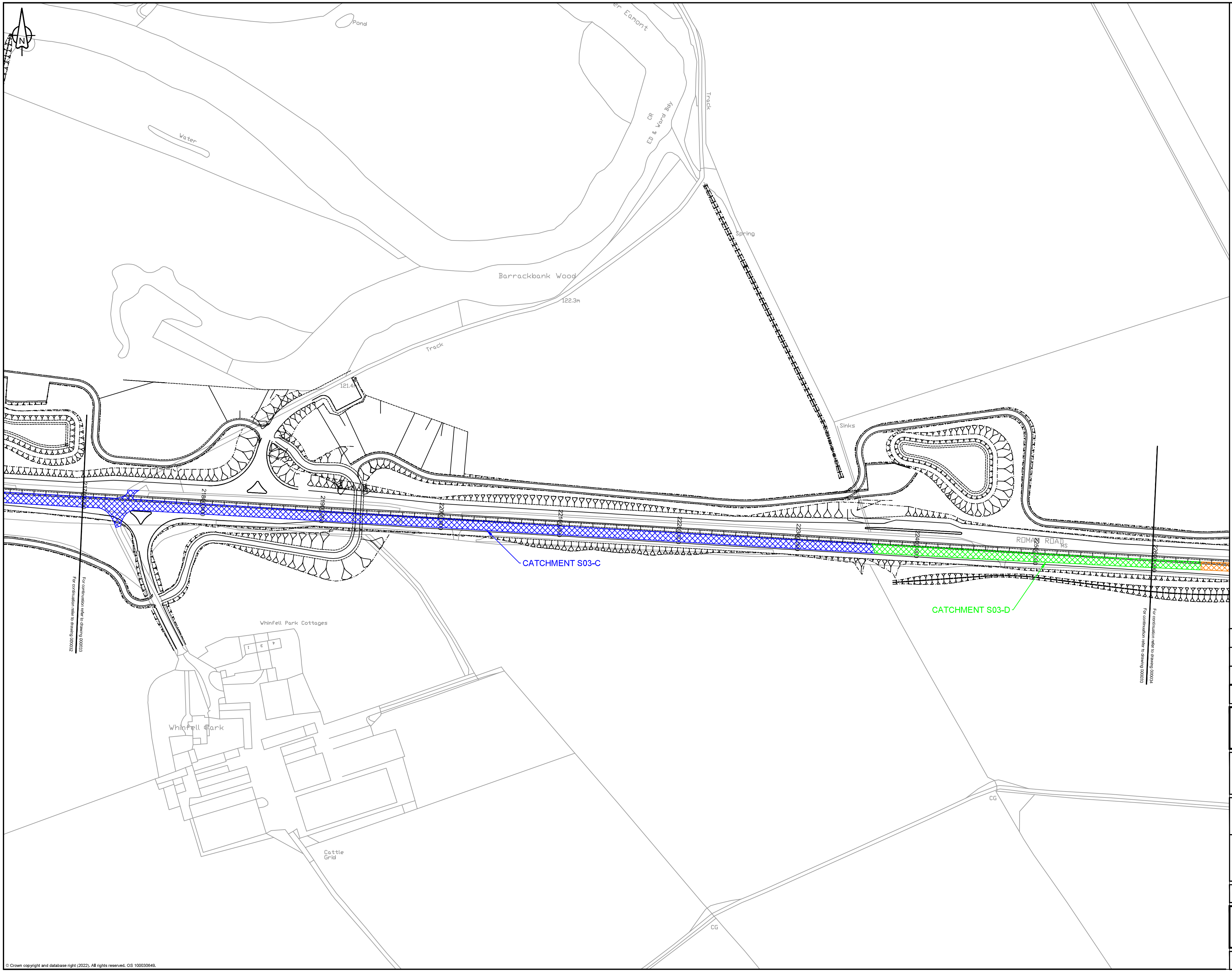
Project Name
A66 Northern Trans-Pennine

Drawing Title
Existing Center Parcs
Drainage Catchment Areas
Sheet 2 of 6

| Project Ref. No. | Stage | Scale / Dimensions |
|---|---|---|
| — | PCF3 | Scale : 1:1000 @ A0<br>Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S03 -DR-CD- 000032
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |



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## KEY

| | |
|---|---|
| 🟥 | CATCHMENT S03-A |
| ▨ | CATCHMENT S03-B |
| 🟦 | CATCHMENT S03-C |
| 🟩 | CATCHMENT S03-D |
| 🟧 | CATCHMENT S03-E |
| 🟪 | CATCHMENT S03-F |
| 🟨 | CATCHMENT S03-G |
| 🟪 | CATCHMENT S03-H |

| Revision | Revision details | | | | |
|---|---|---|---|---|---|
| — | — | | | | |
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| | — | — | — | — | — |
| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 25/04/22 | 25/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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Manchester
M1 3BN

national highways

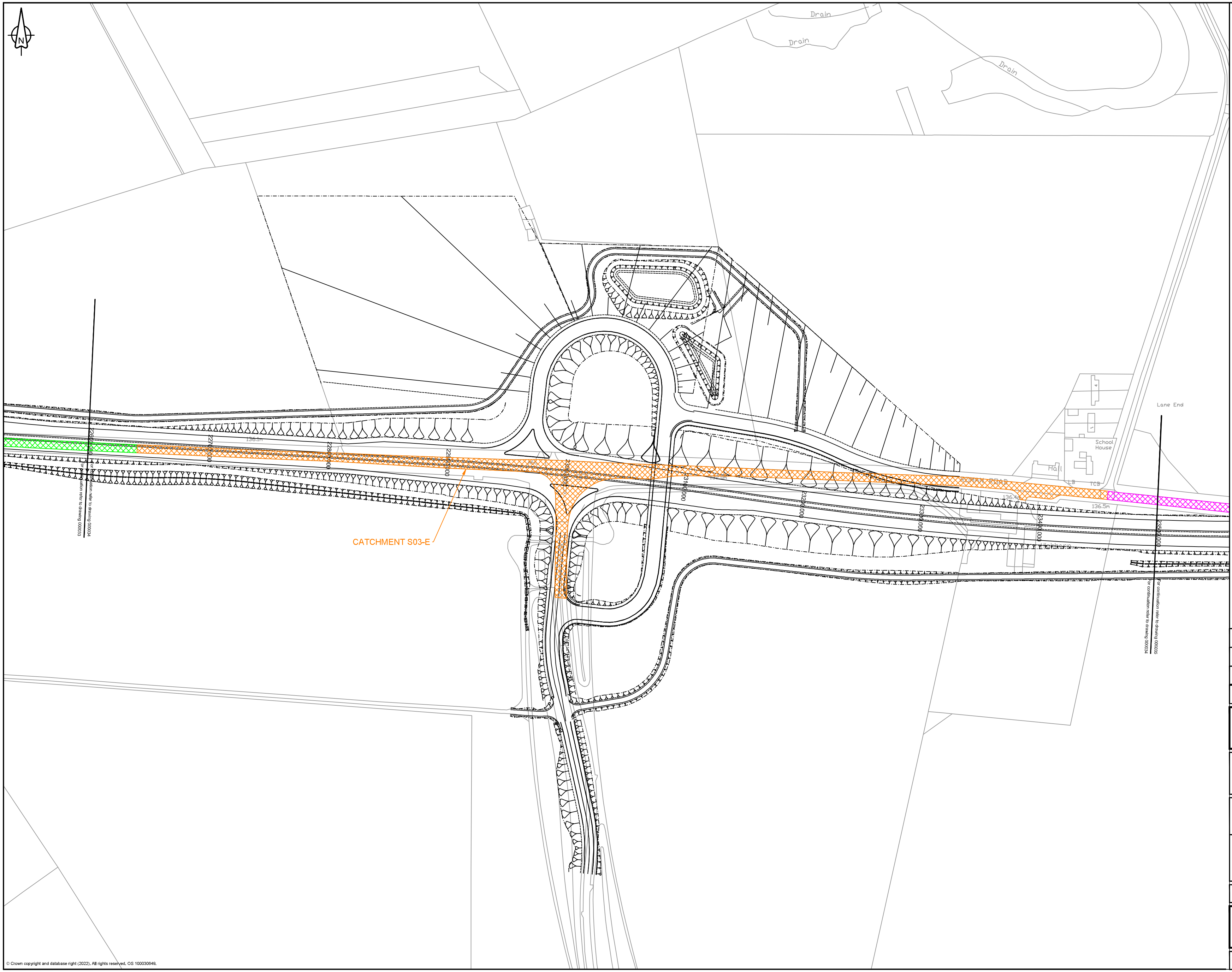
Project Name
A66 Northern Trans-Pennine

Drawing Title
Existing Center Parcs
Drainage Catchment Areas
Sheet 3 of 6

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| — | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S03 -DR-CD- 000033
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |



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## KEY

| | |
|---|---|
| ▨ | CATCHMENT S03-A |
| ▨ | CATCHMENT S03-B |
| ▨ | CATCHMENT S03-C |
| ▨ | CATCHMENT S03-D |
| ▨ | CATCHMENT S03-E |
| ▨ | CATCHMENT S03-F |
| ▨ | CATCHMENT S03-G |
| ▨ | CATCHMENT S03-H |

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| | — | — | — | — | — |
| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 25/04/22 | 25/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
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3 Piccadilly Place
Manchester
M1 3BN

national highways

Project Name
A66 Northern Trans-Pennine

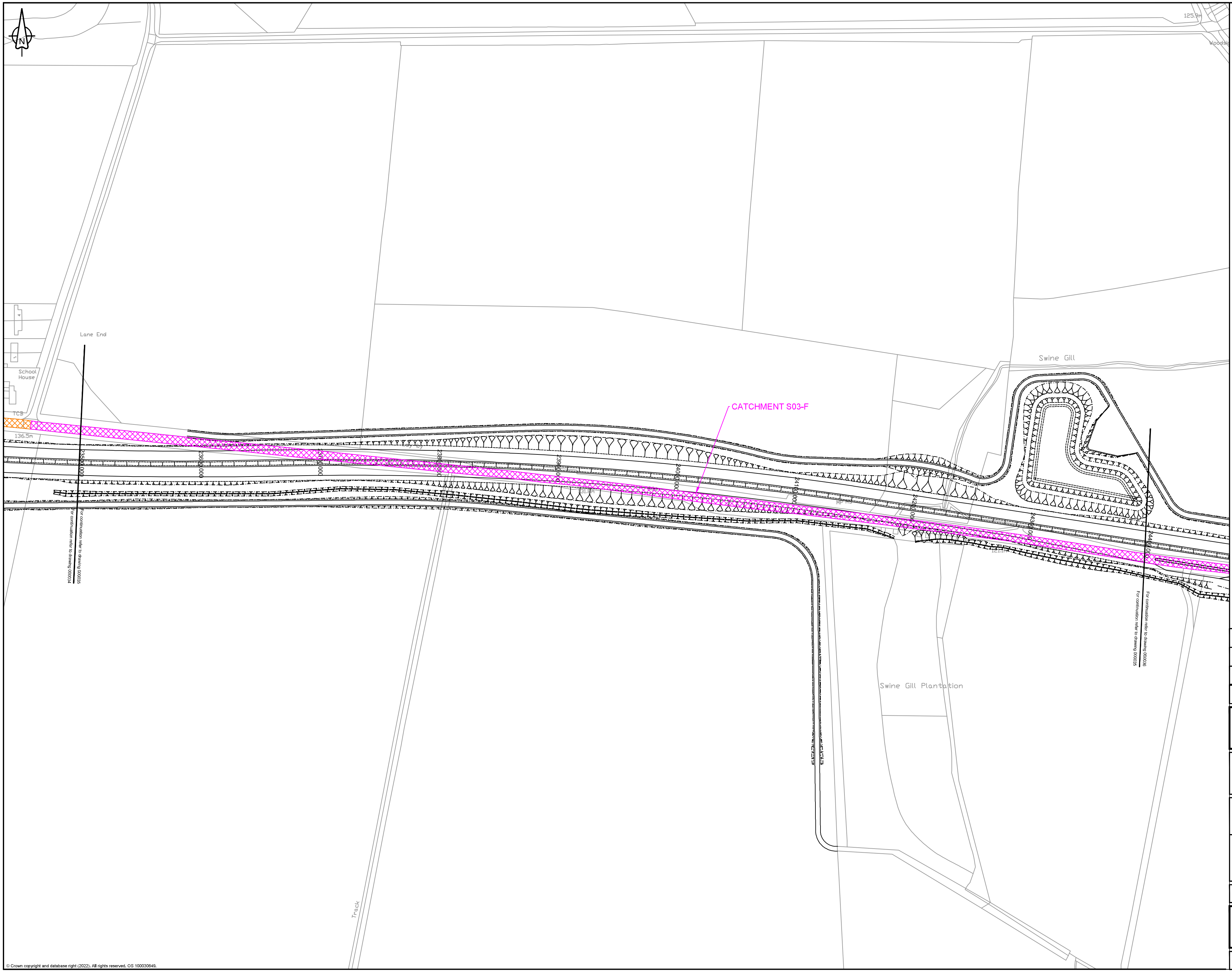
Drawing Title
Existing Center Parcs
Drainage Catchment Areas
Sheet 4 of 6

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| — | PCF3 | Dimensions : M |

Drawing Number

| Project | Originator | Volume | Location | Type | Role | Number |
|---|---|---|---|---|---|---|
| HE565627 | AMY | HDG | S03 | DR | CD | 000034 |

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |



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## KEY

| | |
|---|---|
| ▨ | CATCHMENT S03-A |
| ▨ | CATCHMENT S03-B |
| ▨ | CATCHMENT S03-C |
| ▨ | CATCHMENT S03-D |
| ▨ | CATCHMENT S03-E |
| ▨ | CATCHMENT S03-F |
| ▨ | CATCHMENT S03-G |
| ▨ | CATCHMENT S03-H |

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| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 25/04/22 | 25/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
Amey OW Limited
Chancery Exchange
10 Furnival Street
London, EC4A 1AB

Client
3 Piccadilly Place
Manchester
M1 3BN
national highways

Project Name
A66 Northern Trans-Pennine

Drawing Title
Existing Center Parcs
Drainage Catchment Areas
Sheet 5 of 6

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| — | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S03 -DR-CD- 000035
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |

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## KEY

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|---|---|
| 🟥 | CATCHMENT S03-A |
| ▨ | CATCHMENT S03-B |
| 🟦 | CATCHMENT S03-C |
| 🟩 | CATCHMENT S03-D |
| 🟧 | CATCHMENT S03-E |
| 🟪 | CATCHMENT S03-F |
| 🟨 | CATCHMENT S03-G |
| 🟪 | CATCHMENT S03-H |

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| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 25/04/22 | 25/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
Amey OW Limited
Chancery Exchange
10 Furnival Street
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Client
3 Piccadilly Place
Manchester
M1 3BN

Project Name
A66 Northern Trans-Pennine

Drawing Title
Existing Center Parcs
Drainage Catchment Areas
Sheet 6 of 6

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| — | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S03 -DR-CD- 000036
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |

For continuation refer to drawing HE565627-AMY-HDG-S0405-DR-CD-000221

For continuation refer to drawing HE565627-AMY-HDG-S0405-DR-CD-000222

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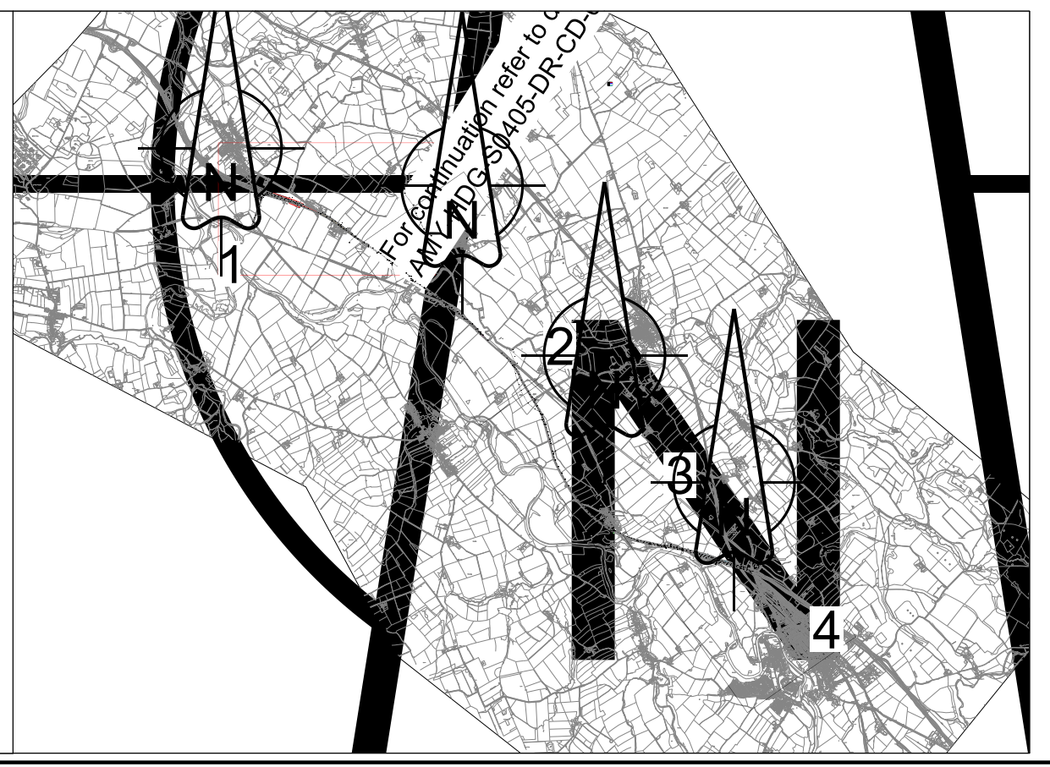
### Drainage key plan

Existing Drainage Catchments

| Catchment | |
|---|---|
| A | 🟥 |
| B | 🟨 |
| C | 🟩 |
| D | 🟦 |
| E | 🟪 |
| F | 🟪 |
| G | ▨ |
| H | ▨ |
| I | ▨ |
| J | 🟧 |
| K | ▨ |
| L | ▨ |
| M | 🟦 |
| N | 🟩 |

### Site key plan



| | | | | | |
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| P01 | SGAR3 | | | | |
| | JMOR | JMOR | ASHI | KCRO | KCRO |
| | 09/05/22 | 09/05/22 | 09/05/22 | 09/05/22 | 09/05/22 |
| P02 | SGAR3 | | | | |
| | CMAR | CMAR | ASHI | KCRO | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
Amey OW Limited
Chancery Exchange
10 Furnival Street
London, EC4A 1AB

Client
3 Piccadilly Place
Manchester
M1 3BN

Project Name
A66 Northern Trans-Pennine

Drawing Title
Existing Draiange Catchment Plan
Sheet 1 of 4

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume
HE565627 - AMY - HDG
S0405 -DR-CD-000221
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |

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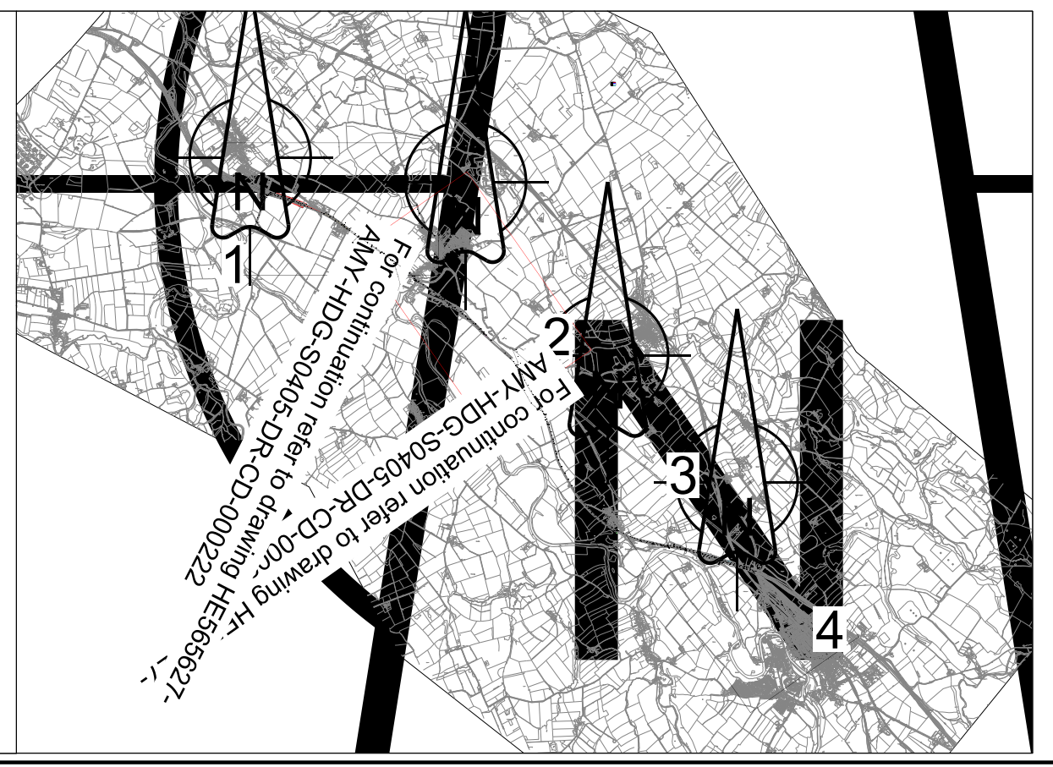
## Drainage key plan

| Existing Drainage Catchments | |
|---|---|
| Catchment | |
| A | 🟥 |
| B | 🟨 |
| C | 🟩 |
| D | 🟦 |
| E | 🟪 |
| F | 🟪 |
| G | 🟪 |
| H | ⬜ |
| I | ⬜ |
| J | 🟧 |
| K | ⬜ |
| L | ⬜ |
| M | 🟦 |
| N | 🟩 |

## Site key plan



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| P01 | SGAR3 | | | | |
| | JMOR | JMOR | ASHI | KCRO | KCRO |
| | 09/05/22 | 09/05/22 | 09/05/22 | 09/05/22 | 09/05/22 |
| P02 | SGAR3 | | | | |
| | CMAR | CMAR | ASHI | KCRO | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
Amey OW Limited
Chancery Exchange
10 Furnival Street
London, EC4A 1AB

Client
3 Piccadilly Place
Manchester
M1 3BN

Project Name
A66 Northern Trans-Pennine

Drawing Title
Existing Drainage Catchment Plan
Sheet 2 of 4

| Project Ref. No. | Stage | Scale : 1:2500 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume
HE565627 - AMY - HDG
S0405 -DR-CD- 000222
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |

For continuation refer to drawing HE565627-AMY-HDG-S0405-DR-CD-000223

For continuation refer to drawing HE565627-AMY-HDG-S0405-DR-CD-000222

For continuation refer to drawing HE565627-AMY-HDG-S0405-DR-CD-000224

For continuation refer to drawing HE565627-AMY-HDG-S0405-DR-CD-000223

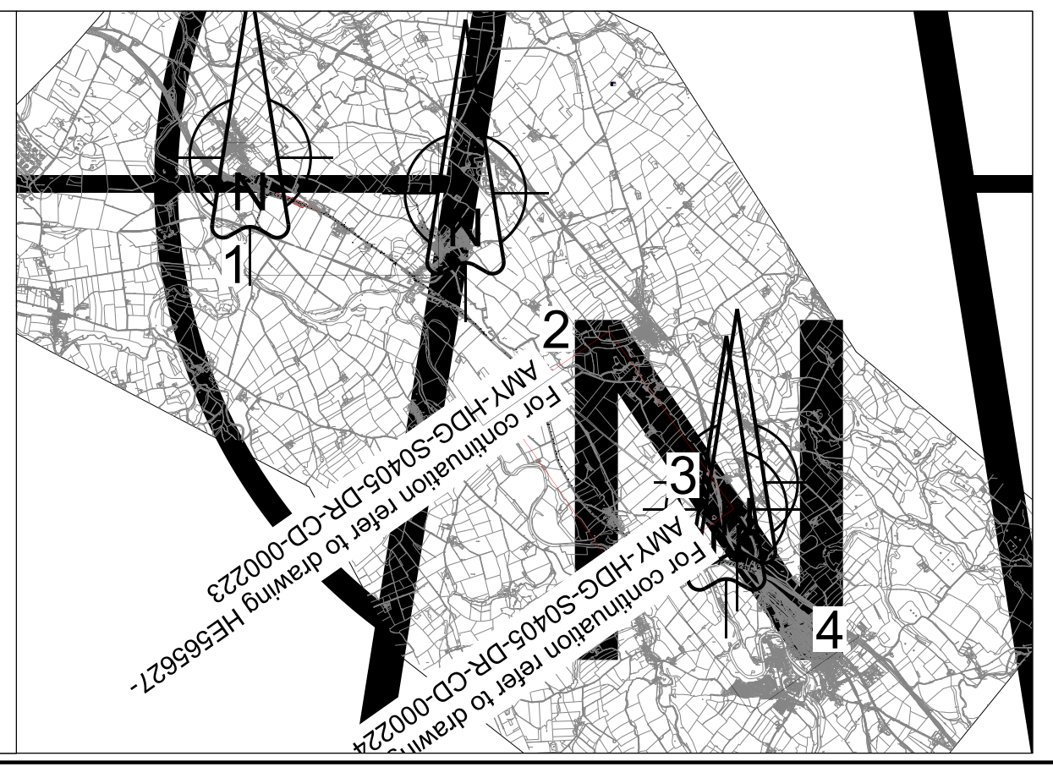
## NOTES

1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed drainage design designed in accordance with the Standards for Highways Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, as-built drawings, OS, JBA culvert surveys, site walk overs and topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   - No surcharging in 1yr storm event
   - No flooding in 1 or 5yr storm event
   - Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope
10. Ponds to have minimum 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

## Drainage key plan

| Existing Drainage Catchments | |
|---|---|
| Catchment | |
| A | 🟥 |
| B | 🟨 |
| C | 🟩 |
| D | 🟦 |
| E | 🟪 |
| F | 🟪 |
| G | ▨ |
| H | ⬜ |
| I | ⬜ |
| J | 🟧 |
| K | ▨ |
| L | ⬜ |
| M | 🟦 |
| N | 🟩 |

## Site key plan



| Revision | Revision details | | | | |
|---|---|---|---|---|---|
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| | --- | --- | --- | --- | --- |
| | --- | --- | --- | --- | --- |
| P01 | SGAR3 | | | | |
| | JMOR | JMOR | ASHI | KCRO | KCRO |
| | 09/05/22 | 09/05/22 | 09/05/22 | 09/05/22 | 09/05/22 |
| P02 | SGAR3 | | | | |
| | CMAR | CMAR | ASHI | KCRO | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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Project Name
A66 Northern Trans-Pennine

Drawing Title
Existing Drainage Catchment Plan
Sheet 3 of 4

| Project Ref. No. | Stage | Scale : 1:2500 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume
HE565627 - AMY - HDG
S0405 -DR-CD- 000223
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |

## NOTES

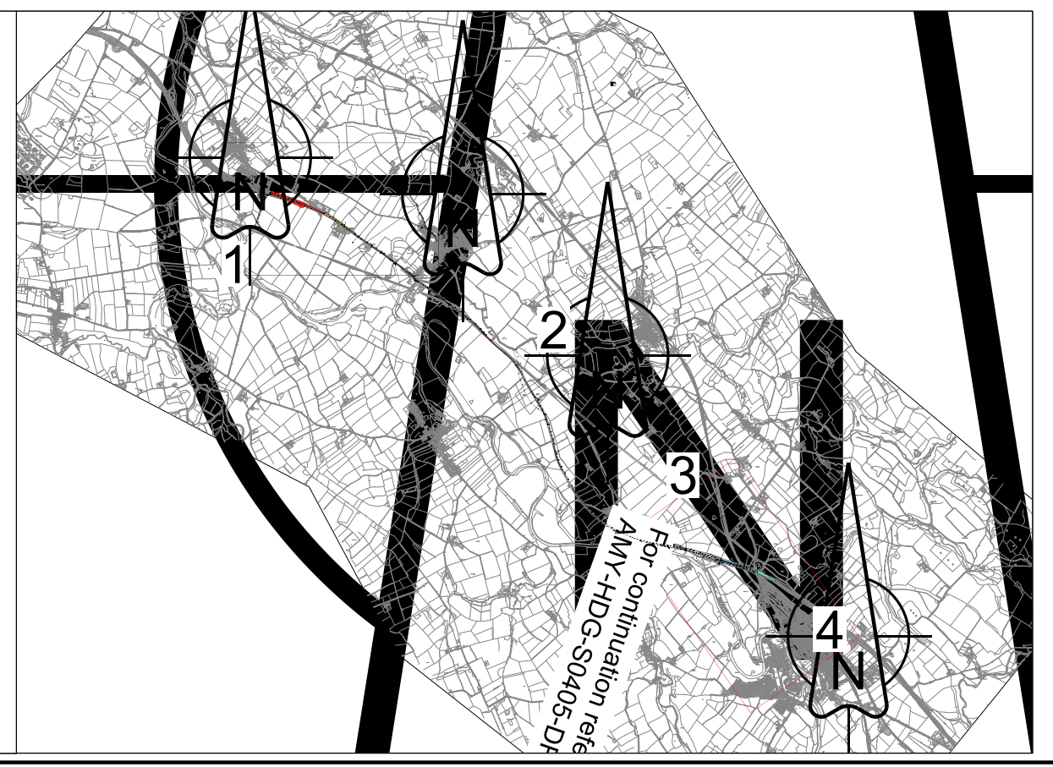
1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed drainage design designed in accordance with the Standards for Highways Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, as-built drawings, OS, JBA culvert surveys, site walk overs and topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   - •No surcharging in 1yr storm event
   - •No flooding in 1 or 5yr storm event
   - •Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope
10. Ponds to have minimum 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

### Drainage key plan

Existing Drainage Catchments

| Catchment | |
| --- | --- |
| A | 🟥 |
| B | 🟨 |
| C | 🟩 |
| D | 🟦 |
| E | 🟪 |
| F | 🟪 |
| G | ▨ |
| H | ⬜ |
| I | ▨ |
| J | 🟧 |
| K | ▨ |
| L | ▨ |
| M | 🟦 |
| N | 🟩 |

### Site key plan



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| P01 | SGAR3 | | | | |
| | JMOR | JMOR | ASHI | KCRO | KCRO |
| | 09/05/22 | 09/05/22 | 09/05/22 | 09/05/22 | 09/05/22 |
| P02 | SGAR3 | | | | |
| | CMAR | CMAR | ASHI | KCRO | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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national highways

Project Name
A66 Northern Trans-Pennine

Drawing Title
Existing Drainage Catchment Plan
Sheet 4 of 4

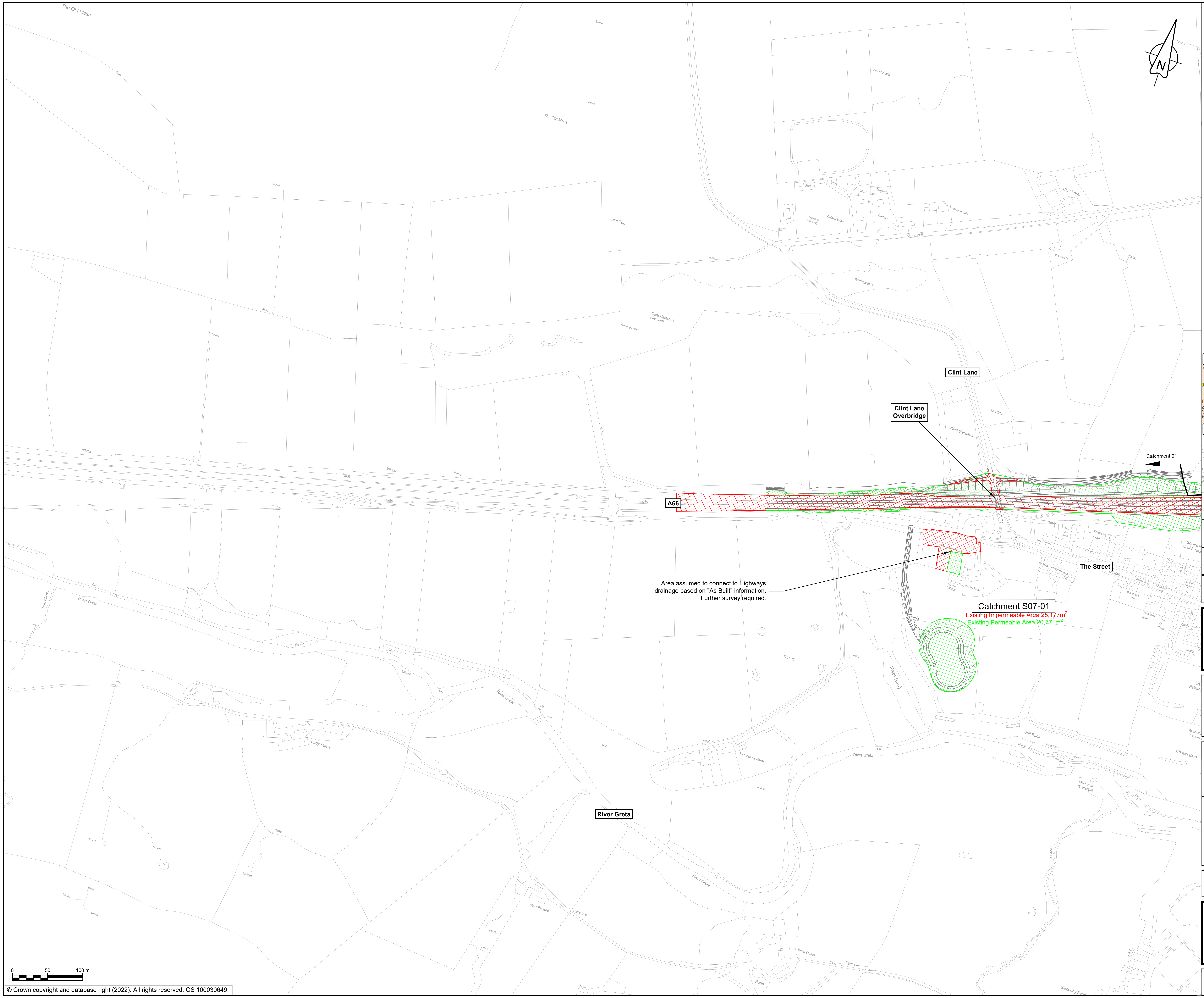
| Project Ref. No. | Stage | Scale : 1:2500 @ A0 |
| --- | --- | --- |
| --- | PCF3 | Dimensions : M |

Drawing Number

| Project | Originator | Volume |
| --- | --- | --- |
| HE565627 - | AMY - | HDG |

| Location | Type | Role | Number |
| --- | --- | --- | --- |
| S0405 | - DR - | CD - | 000224 |

| Suitability | Suitability Description | Revision |
| --- | --- | --- |
| S4 | Fit for Stage Approval | P02 |



Area assumed to connect to Highways drainage based on "As Built" information. Further survey required.

**Catchment S07-01**
Existing Impermeable Area 25,177m$^2$
Existing Permeable Area 20,771m$^2$

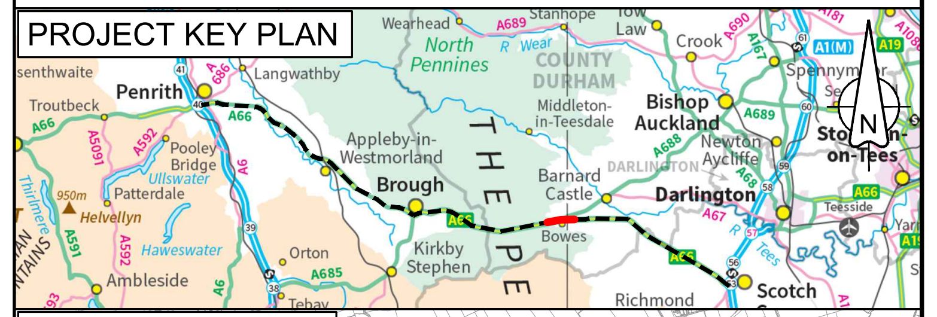
## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. AREAS BASED ON ASSESSMENT OF EXISTING SURFACE AND ORDINANCE SURVEY MAP.
3. AREA BENEATH PROPOSED ALIGNMENT THAT DRAINS TOWARDS OUTFALL HAS BEEN INCLUDED. OTHER AREA DISCOUNTED.

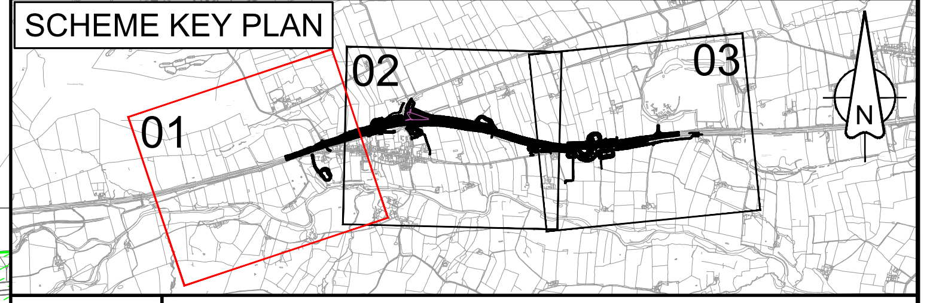
## KEY

| | |
|---|---|
| 🟥 | EXISTING IMPERMEABLE |
| 🟩 | EXISTING PERMEABLE |

PROJECT KEY PLAN



SCHEME KEY PLAN



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| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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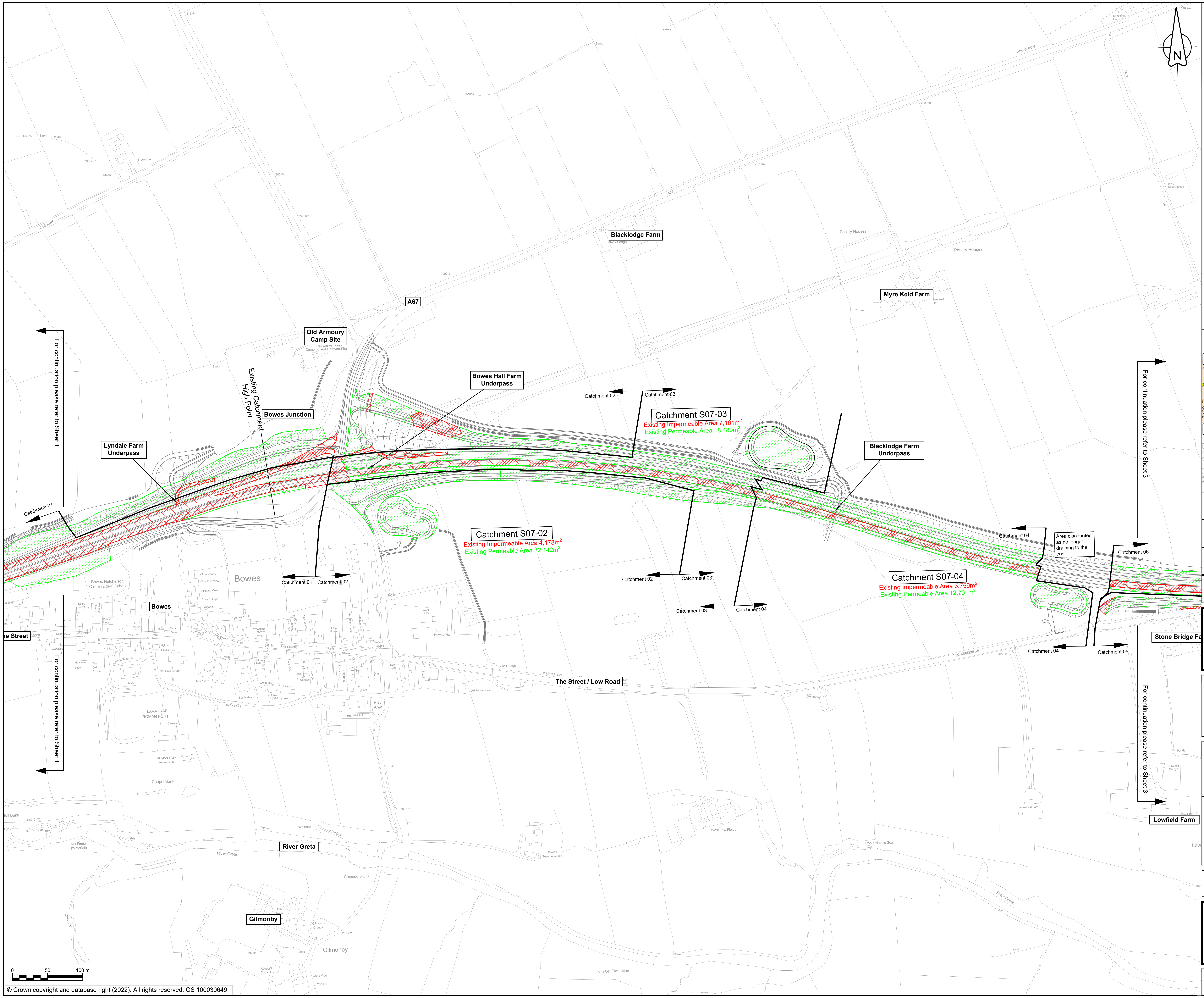
Project Name
A66 Northern Trans-Pennine Project

Drawing Title
Bowes Bypass
Existing Catchment Plan
Sheet 1 of 3

| Project Ref. No. | Stage | Scale : 1:2500 @ A1 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S07 -DR-CD-000101
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S0 | Initial non-contractual code | P01.1 |



## NOTES

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## KEY

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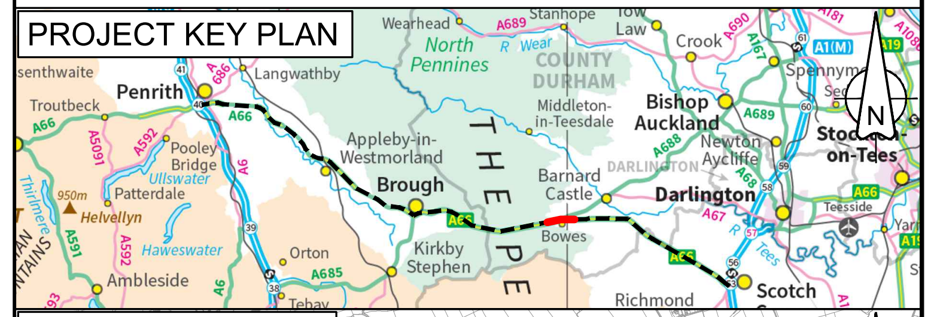
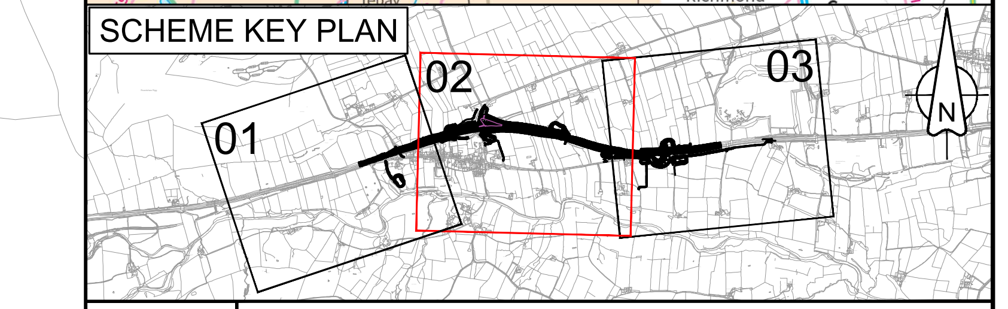
| 🟥 | EXISTING IMPERMEABLE |
| 🟩 | EXISTING PERMEABLE |

PROJECT KEY PLAN



SCHEME KEY PLAN



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| C01 | SGAR3 | | | | |
| | ATUN | ATUN | JHAR | THAL | SSCO |
| | 07/06/22 | 07/06/22 | 08/06/22 | 08/06/22 | 08/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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national highways

Project Name
A66 Northern Trans-Pennine

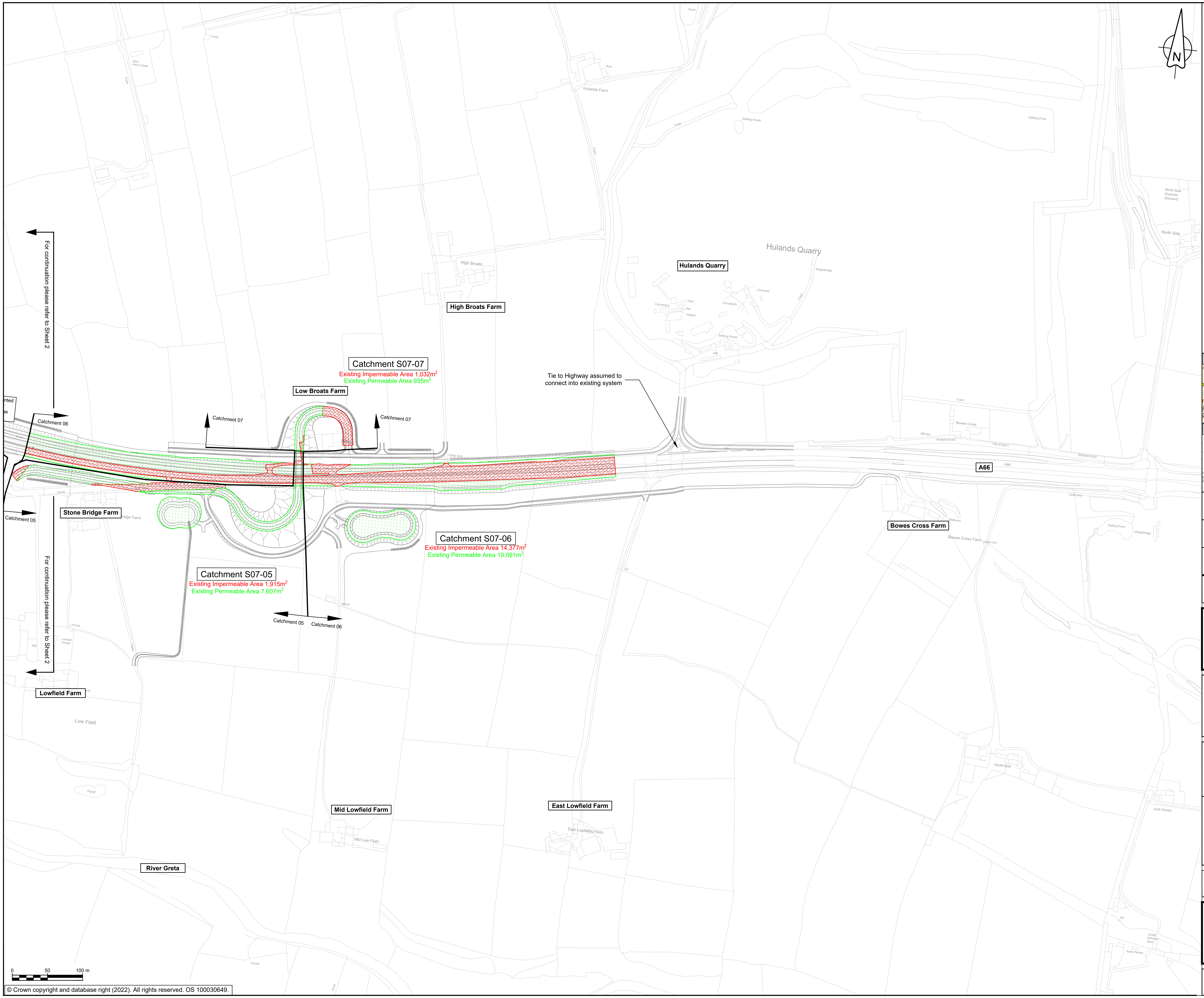
Drawing Title
Bowes Bypass
Existing Catchment Plan
Sheet 2 of 3

| Project Ref. No. | Stage | Scale : 1:2500 @ A1 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number

| Project | Originator | Volume | Location | Type | Role | Number |
|---|---|---|---|---|---|---|
| HE565627 | AMY | HDG | S07 | DR | CD | 000102 |

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |



## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. AREAS BASED ON ASSESSMENT OF EXISTING SURFACE AND ORDINANCE SURVEY MAP.
3. AREA BENEATH PROPOSED ALIGNMENT THAT DRAINS TOWARDS OUTFALL HAS BEEN INCLUDED. OTHER AREA DISCOUNTED.

## KEY

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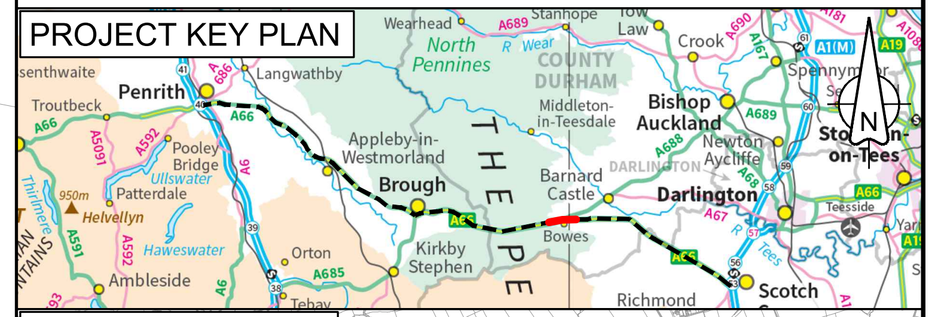
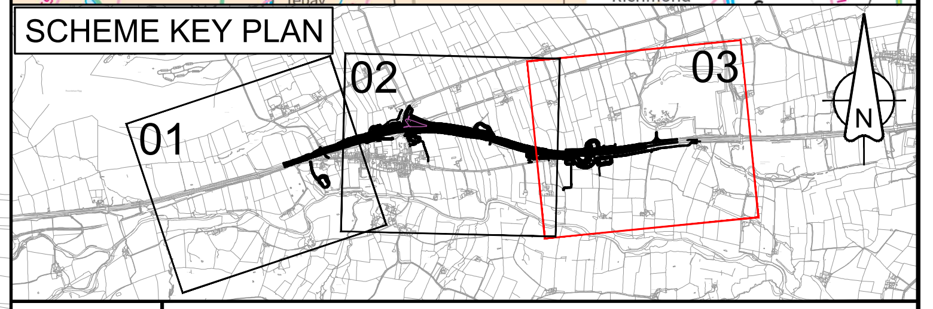
|---|---|
| 🟥 | EXISTING IMPERMEABLE |
| 🟩 | EXISTING PERMEABLE |

PROJECT KEY PLAN



SCHEME KEY PLAN



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| C01 | SGAR3 | | | | |
| | ATUN | ATUN | JHAR | THAL | SSCO |
| | 07/06/22 | 07/06/22 | 08/06/22 | 08/06/22 | 08/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
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M1 3BN

national highways

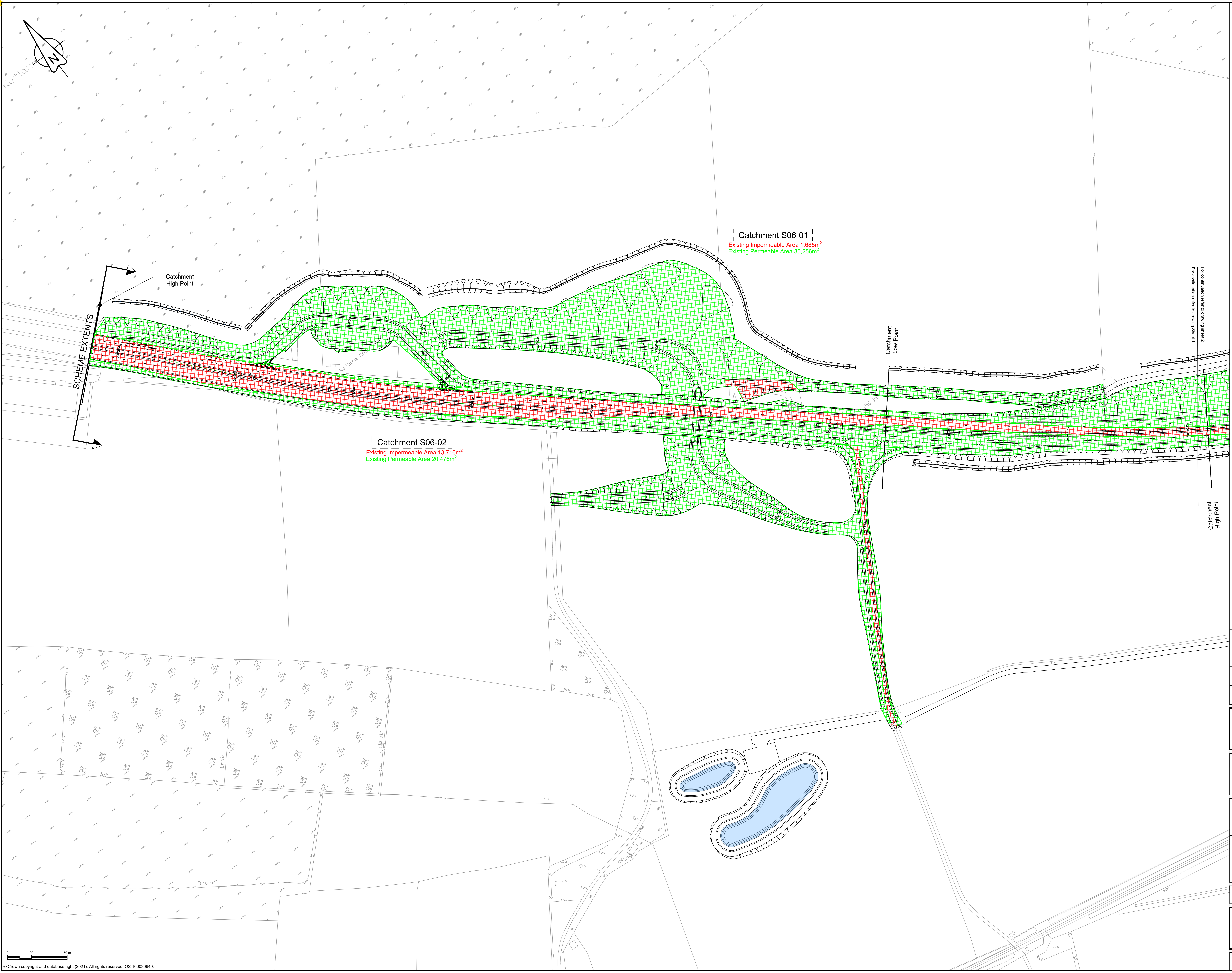
Project Name
A66 Northern Trans-Pennine

Drawing Title
Bowes Bypass
Existing Catchment Plan
Sheet 3 of 3

| Project Ref. No. | Stage | Scale : 1:2500 @ A1 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S07 -DR-CD-000103
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |



## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. AREAS BASED ON ASSESSMENT OF EXISTING SURFACE.

## KEY

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| 🟥 | EXISTING IMPERMEABLE AREA |
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| P01.1 | SGAR3 | | | | |
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| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
Amey OW Limited
Chancery Exchange
10 Furnival Street
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Client
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Manchester
M1 3BN
national highways

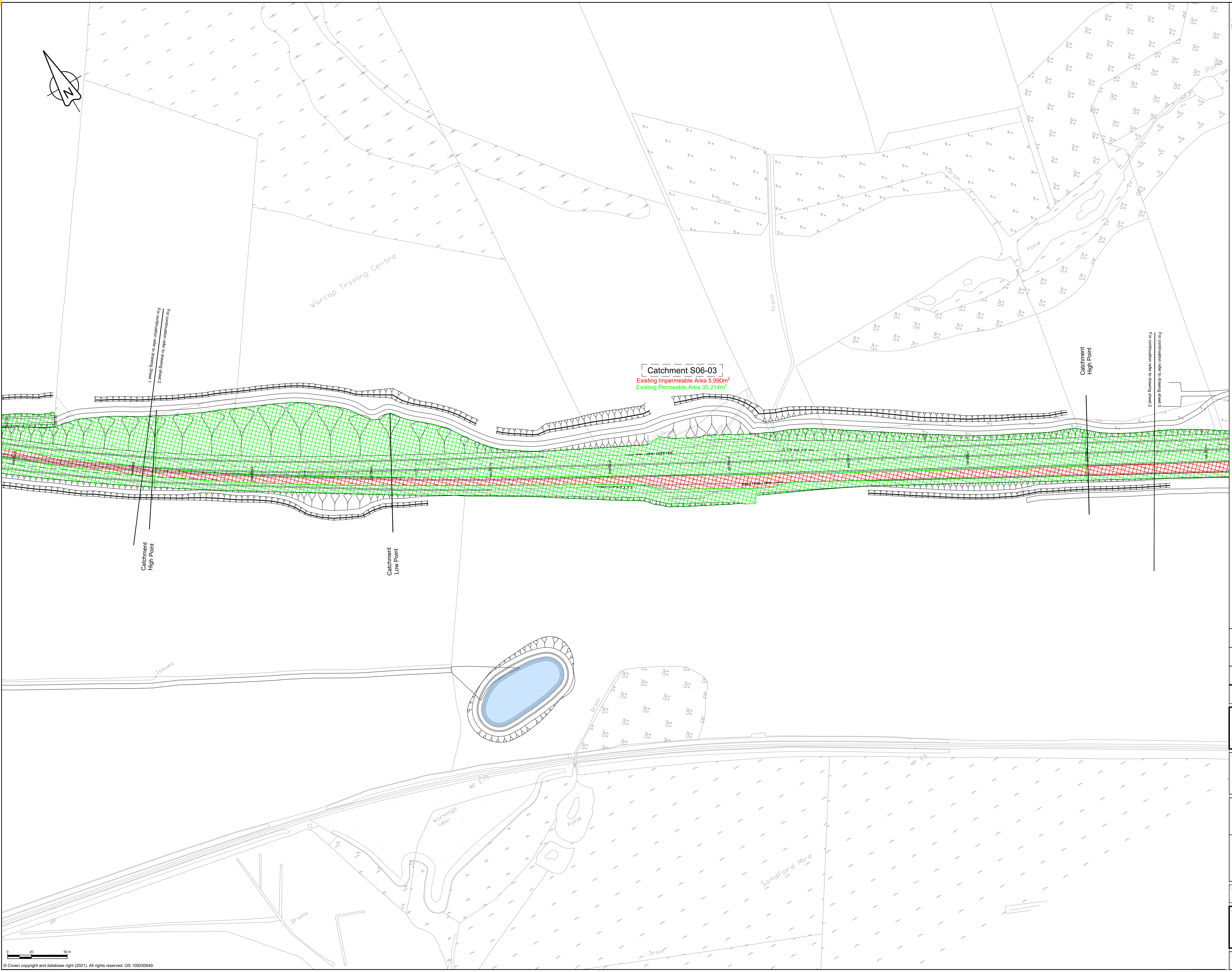
Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Existing Catchment Areas
Sheet 1 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 -DR-CD-476031
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S0 | Initial non-contractual code | P01.1 |



## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. AREAS BASED ON ASSESSMENT OF EXISTING SURFACE.

## KEY

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| 🟥 | EXISTING IMPERMEABLE AREA |
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| Revision | Revision details | | | | |
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| P01.1 | SGAR3 | | | | |
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| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
Amey OW Limited
Chancery Exchange
10 Furnival Street
London, EC4A 1AB

Client
3 Piccadilly Place
Manchester
M1 3BN

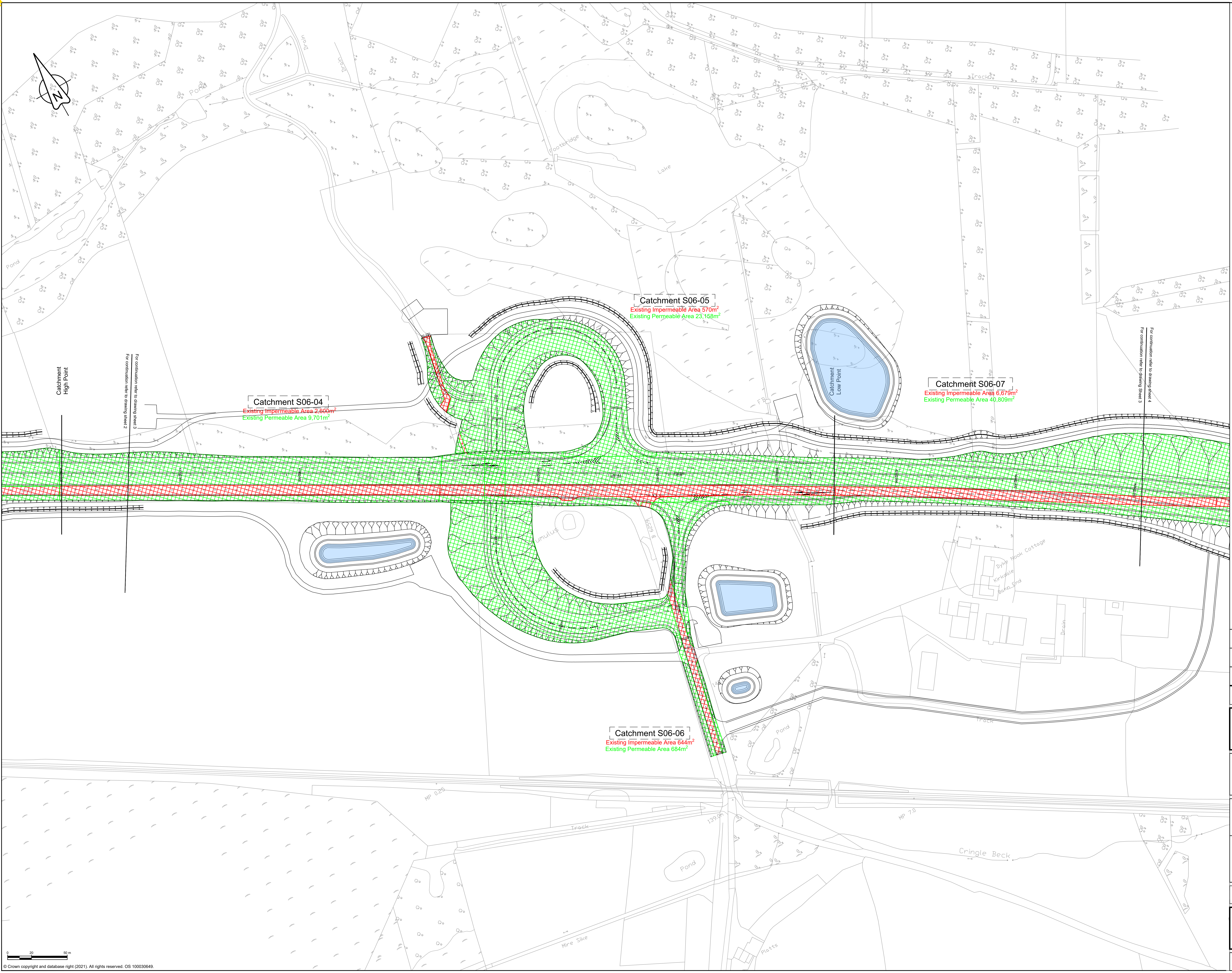
Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Existing Catchment Areas
Sheet 2 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 -DR-CD-476032
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S0 | Initial non-contractual code | P01.1 |



## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. AREAS BASED ON ASSESSMENT OF EXISTING SURFACE.

## KEY

| | |
|---|---|
| 🟥 | EXISTING IMPERMEABLE AREA |
| 🟩 | EXISTING PERMEABLE AREA |

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| P01.1 | SGAR3 | | | | |
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| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
Amey OW Limited
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Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Existing Catchment Areas
Sheet 3 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : |

Drawing Number

| Project | Originator | Volume | Location | Type | Role | Number |
|---|---|---|---|---|---|---|
| HE565627 | AMY | HDG | S06 | DR | CD | 476033 |

| Suitability | Suitability Description | Revision |
|---|---|---|
| S0 | Initial non-contractual code | P01.1 |

## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. AREAS BASED ON ASSESSMENT OF EXISTING SURFACE.

## KEY

| | |
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| 🟥 | EXISTING IMPERMEABLE AREA |
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| Revision | Revision details | | | | |
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| Revision | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
Amey OW Limited
Chancery Exchange
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London, EC4A 1AB

Client
3 Piccadilly Place
Manchester
M1 3BN

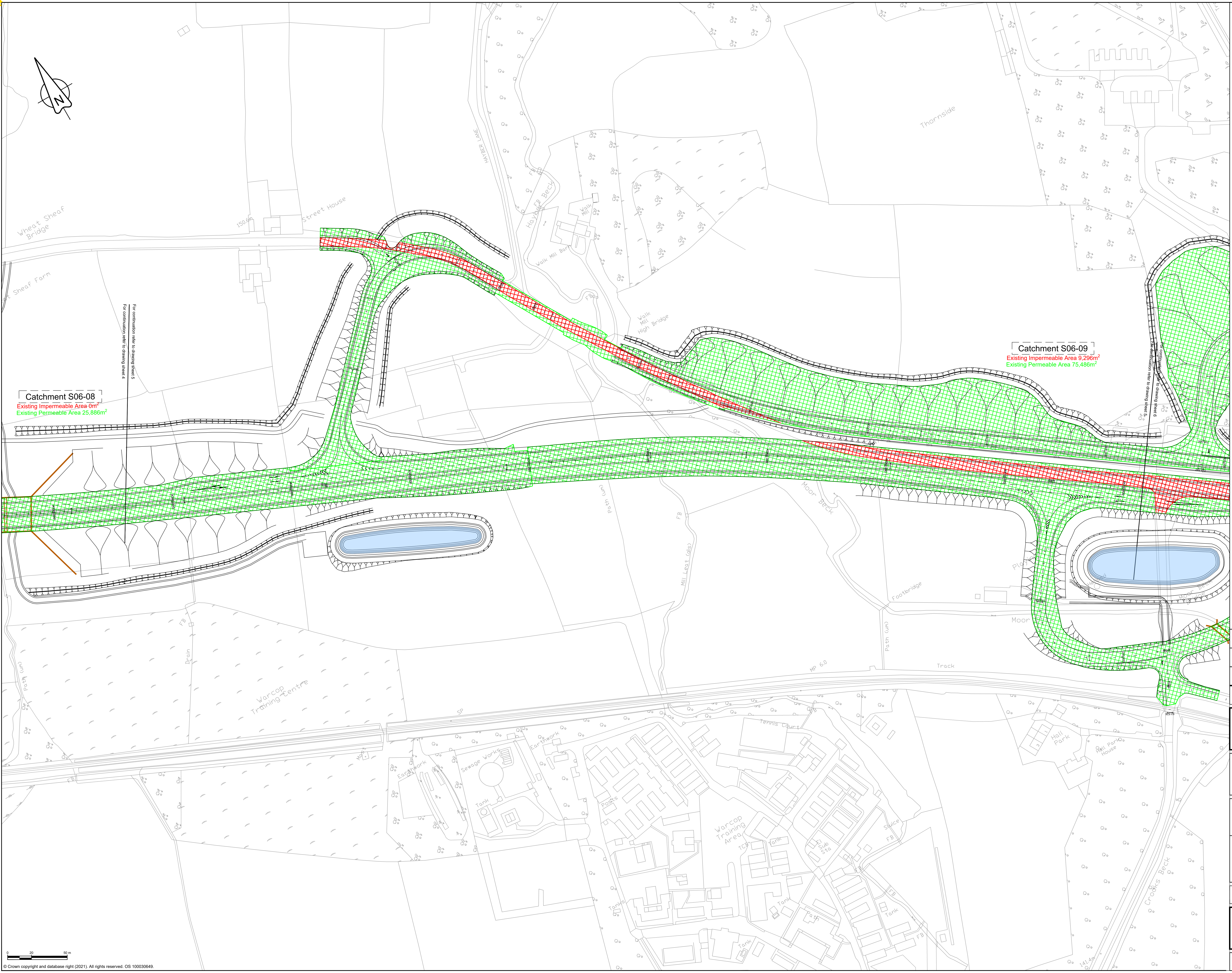
Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Existing Catchment Areas
Sheet 4 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 -DR-CD-476034
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S0 | Initial non-contractual code | P01.1 |



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## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. AREAS BASED ON ASSESSMENT OF EXISTING SURFACE.

## KEY

| | |
|---|---|
| 🟥 | EXISTING IMPERMEABLE AREA |
| 🟩 | EXISTING PERMEABLE AREA |

| Revision | | | | | |
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| P01.1 | SGAR3 | | | | |
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| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Existing Catchment Areas
Sheet 5 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : |

Drawing Number

| Project | Originator | Volume | Location | Type | Role | Number |
|---|---|---|---|---|---|---|
| HE565627 | AMY | HDG | S06 | DR | CD | 476035 |

| Suitability | Suitability Description | Revision |
|---|---|---|
| S0 | Initial non-contractual code | P01.1 |

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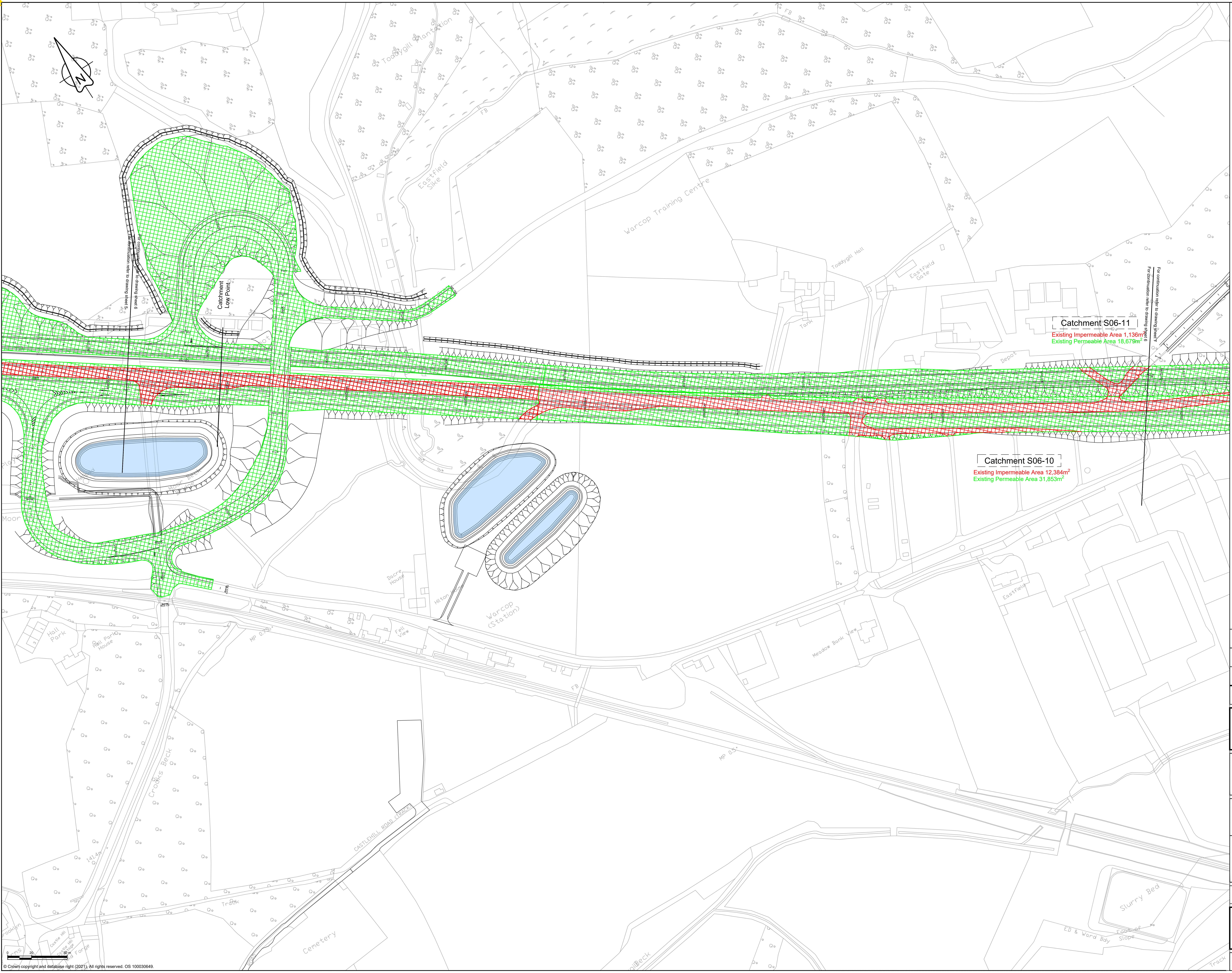

## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. AREAS BASED ON ASSESSMENT OF EXISTING SURFACE.

## KEY

| | |
|---|---|
| 🟥 | EXISTING IMPERMEABLE AREA |
| 🟩 | EXISTING PERMEABLE AREA |

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| P01.1 | SGAR3 | | | | |
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| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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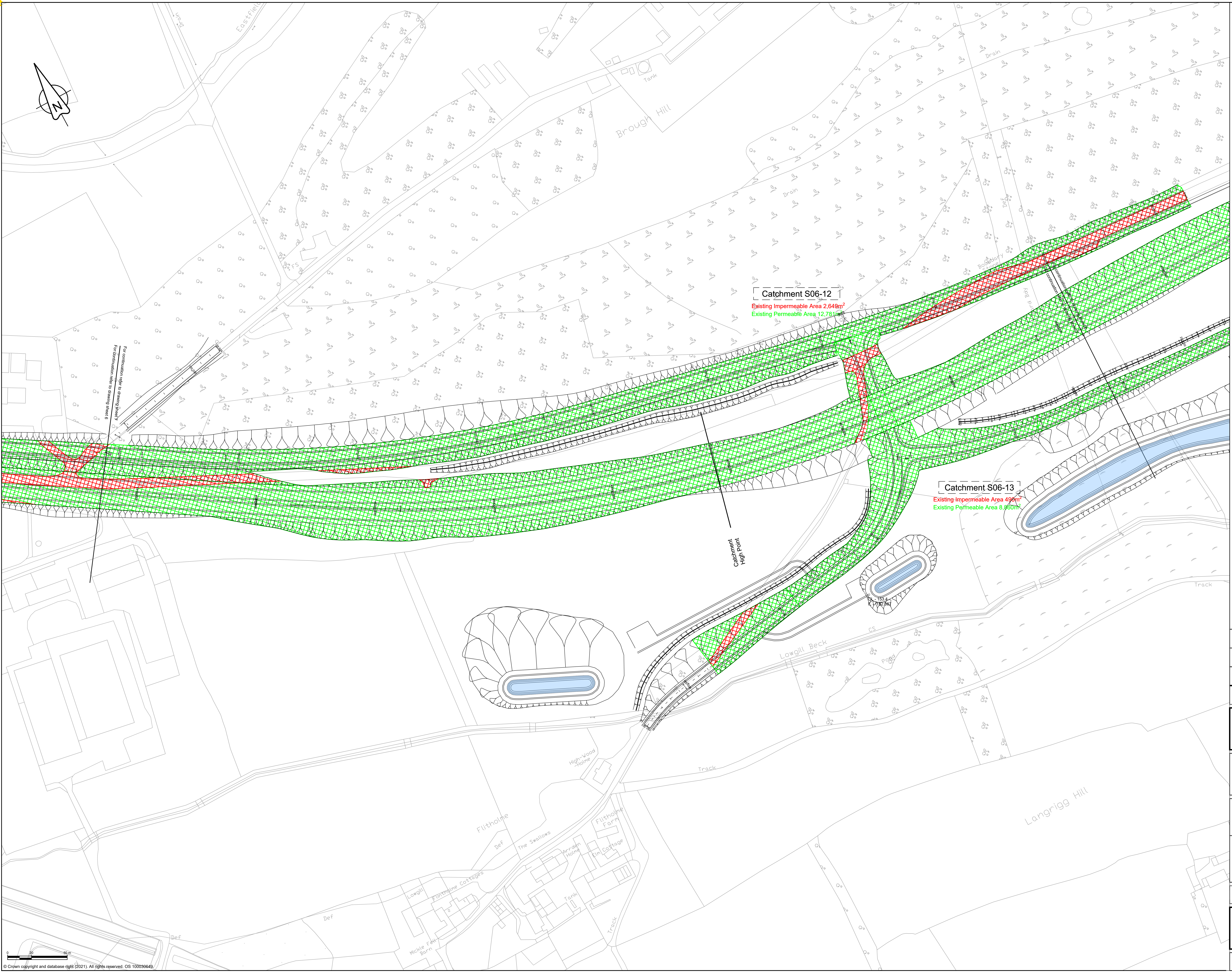
Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Existing Catchment Areas
Sheet 6 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 -DR-CD-476036
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S0 | Initial non-contractual code | P01.1 |



## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. AREAS BASED ON ASSESSMENT OF EXISTING SURFACE.

## KEY

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| 🟥 | EXISTING IMPERMEABLE AREA |
| 🟩 | EXISTING PERMEABLE AREA |

| Revision | Revision details | | | | |
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| P01.1 | SGAR3 | | | | |
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| Revision | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Existing Catchment Areas
Sheet 7 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | | Dimensions : M |

Drawing Number

| Project | Originator | Volume | Location | Type | Role | Number |
|---|---|---|---|---|---|---|
| HE565627 | AMY | HDG | S06 | DR | CD | 476037 |

HE565627 - AMY - HDG - S06 -DR-CD-476037

| Suitability | Suitability Description | Revision |
|---|---|---|
| S0 | Initial non-contractual code | P01.1 |

## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. AREAS BASED ON ASSESSMENT OF EXISTING SURFACE.

## KEY

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| 🟥 | EXISTING IMPERMEABLE AREA |
| 🟩 | EXISTING PERMEABLE AREA |

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| P01.1 | SGAR3 | | | | |
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| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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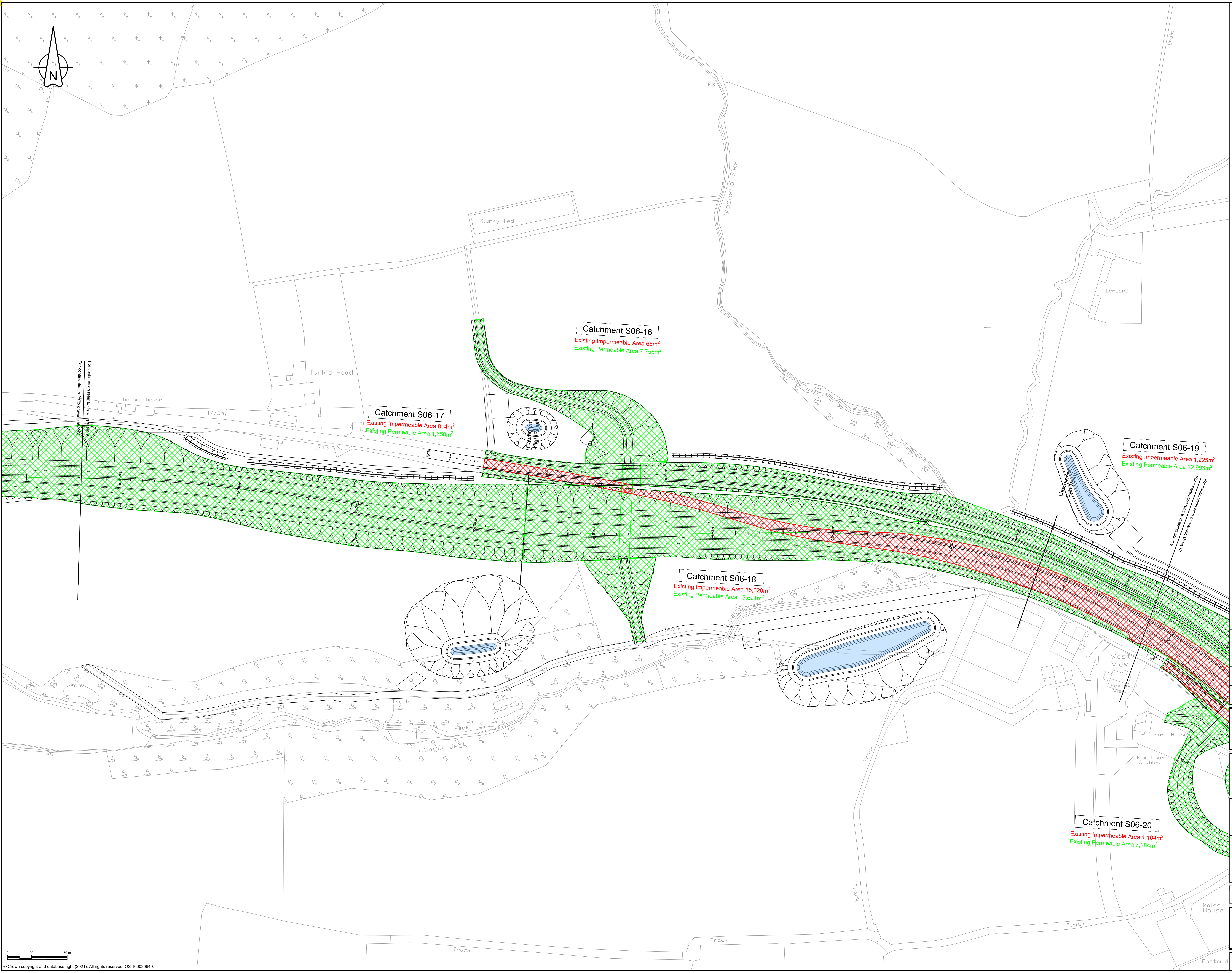
Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Existing Catchment Areas
Sheet 8 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 -DR-CD-476038
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S0 | Initial non-contractual code | P01.1 |



## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
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## KEY

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| 🟥 | EXISTING IMPERMEABLE AREA |
| 🟩 | EXISTING PERMEABLE AREA |

| Revision | Revision details | | | | |
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| P01.1 | SGAR3 | | | | |
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| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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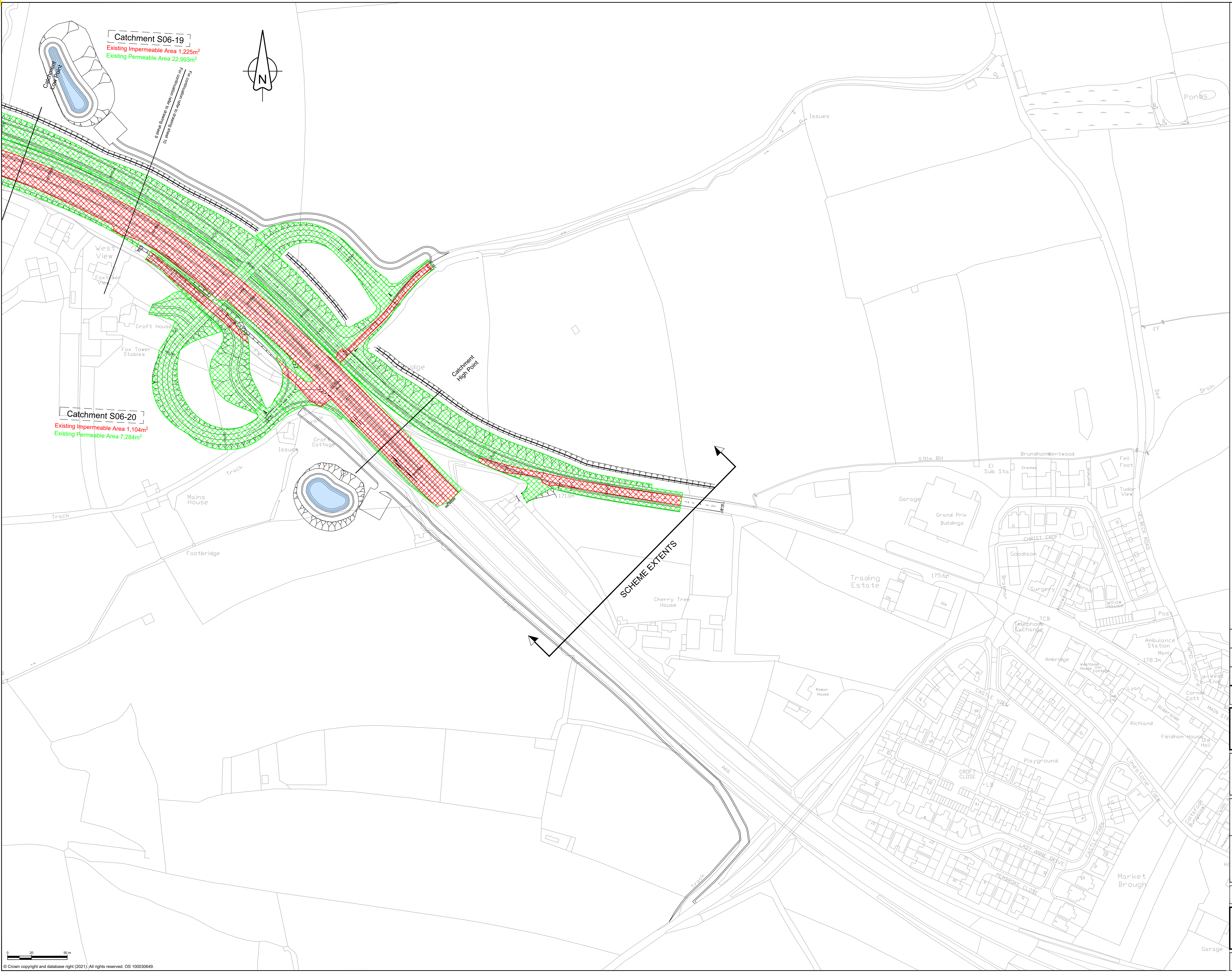
Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Existing Catchment Areas
Sheet 9 of 10

Project Ref. No. ---
Stage
Scale : 1:1000 @ A0
Dimensions : M

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 -DR-CD-476039
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S0 | Initial non-contractual code | P01.1 |



## NOTES

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## KEY

| | |
|---|---|
| 🟥 | EXISTING IMPERMEABLE AREA |
| 🟩 | EXISTING PERMEABLE AREA |

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| P01.1 | SGAR3 | | | | |
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| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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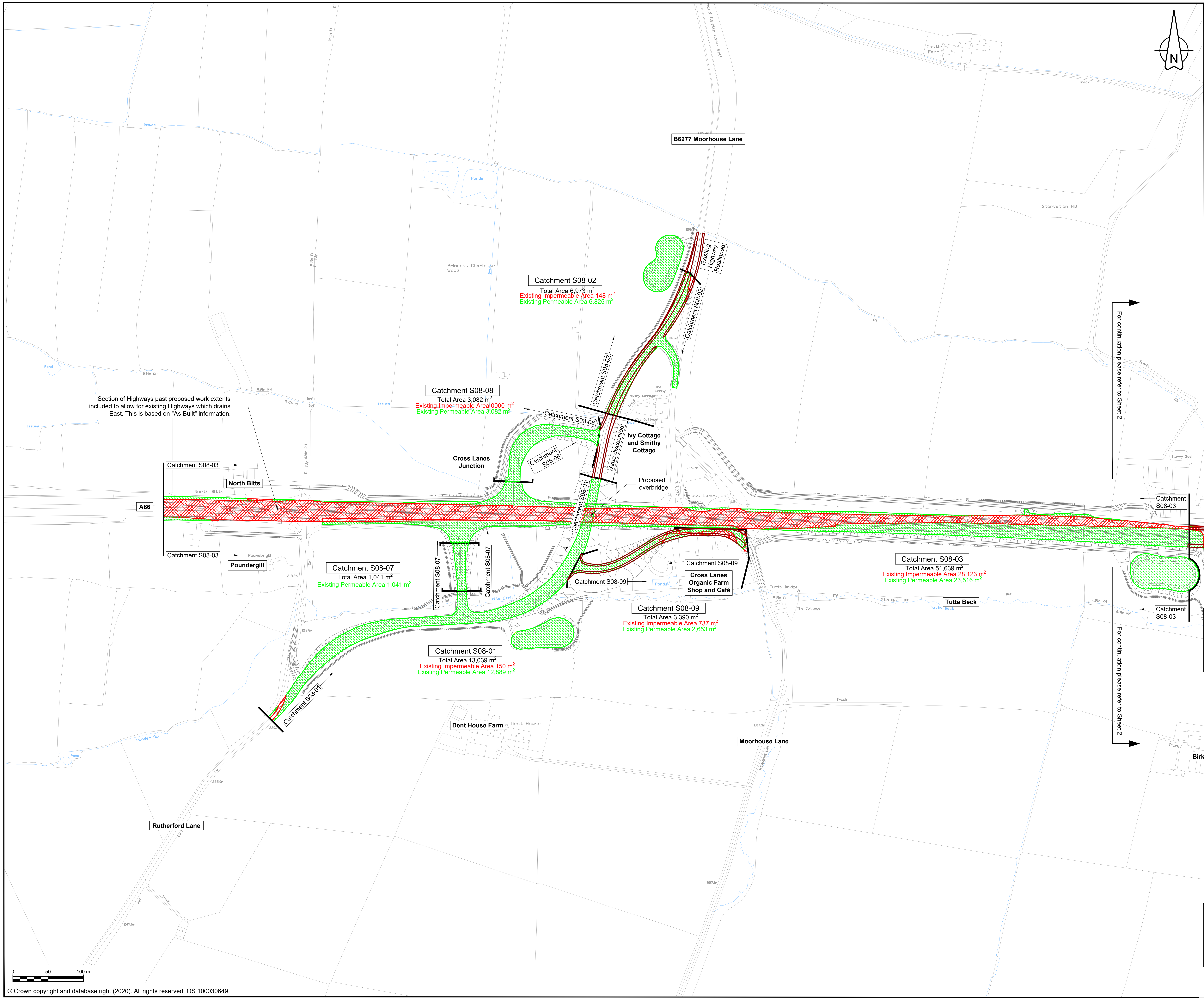
Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Existing Catchment Areas
Sheet 10 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 -DR-CD-476040
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S0 | Initial non-contractual code | P01.1 |



Section of Highways past proposed work extents included to allow for existing Highways which drains East. This is based on "As Built" information.

Catchment S08-02
Total Area 6,973 m$^2$
Existing Impermeable Area 148 m$^2$
Existing Permeable Area 6,825 m$^2$

Catchment S08-08
Total Area 3,082 m$^2$
Existing Impermeable Area 0000 m$^2$
Existing Permeable Area 3,082 m$^2$

Catchment S08-07
Total Area 1,041 m$^2$
Existing Permeable Area 1,041 m$^2$

Catchment S08-01
Total Area 13,039 m$^2$
Existing Impermeable Area 150 m$^2$
Existing Permeable Area 12,889 m$^2$

Catchment S08-09
Total Area 3,390 m$^2$
Existing Impermeable Area 737 m$^2$
Existing Permeable Area 2,653 m$^2$

Catchment S08-03
Total Area 51,639 m$^2$
Existing Impermeable Area 28,123 m$^2$
Existing Permeable Area 23,516 m$^2$

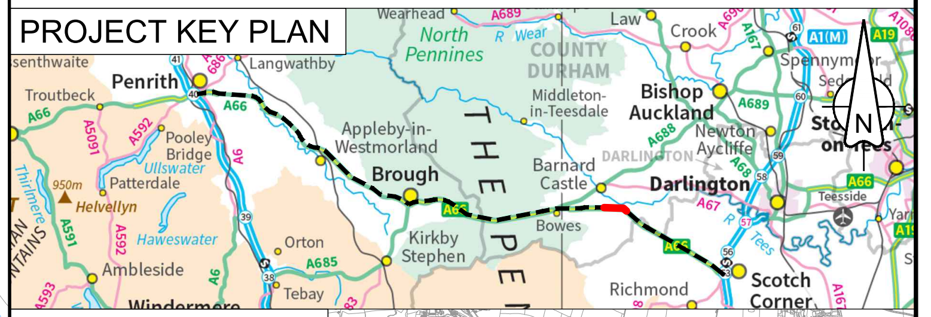
## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. AREAS BASED ON ORDINANCE SURVEY (OS) MAP.
3. PROPOSED HIGHWAYS SCHEME IS SHOWN TO JUSTIFY EXTENT OF GREENFIELD AND BROWNFIELD CATCHMENTS

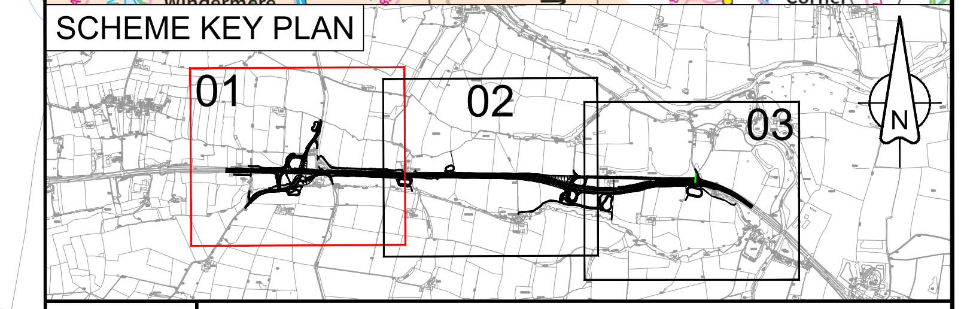
## KEY

| | |
|---|---|
| 🟥 | EXISTING IMPERMEABLE |
| 🟩 | EXISTING PERMEABLE |
| ▬ | CATCHMENT BOUNDARY |

PROJECT KEY PLAN



SCHEME KEY PLAN



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| C01 | SGAR3 | | | | |
| | ATUN | ATUN | JHAR | THAL | SSCO |
| | 07/06/22 | 07/06/22 | 08/06/22 | 08/06/22 | 08/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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Project Name
A66 Northern Trans-Pennine

Drawing Title
Cross Lanes to Rokeby
Existing Catchment Plan
Sheet 1 of 3

| Project Ref. No. | Stage | Scale : 1:2500 @ A1 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S08 -DR-CD-000101
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |

Catchment S08-04
Total Area 26,254 m$^2$
Existing Impermeable Area 5,169 m$^2$
Existing Permeable Area 21,085 m$^2$

Catchment S08-05
Total Area 67,806 m$^2$
Existing Impermeable Area 5,125 m$^2$
Existing Permeable Area 62,681 m$^2$

## NOTES

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3. PROPOSED HIGHWAYS SCHEME IS SHOWN TO JUSTIFY EXTENT OF GREENFIELD AND BROWNFIELD CATCHMENTS

## KEY

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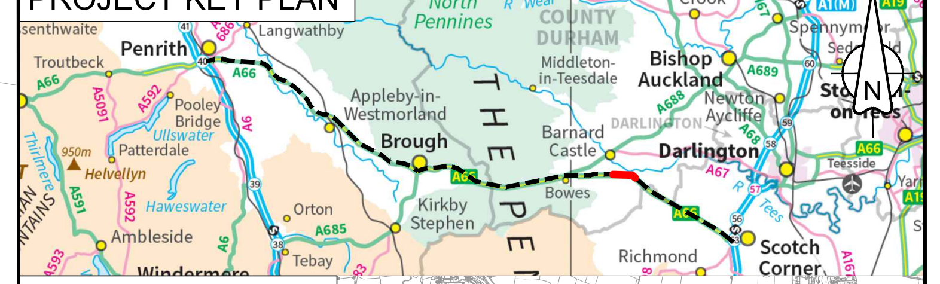
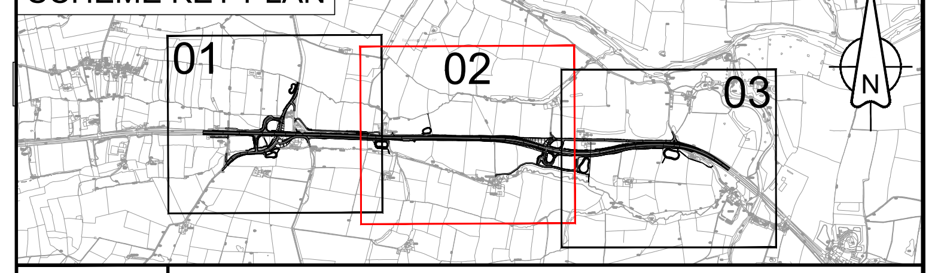
|---|---|
| 🟥 | EXISTING IMPERMEABLE |
| 🟩 | EXISTING PERMEABLE |
| — | CATCHMENT BOUNDARY |

PROJECT KEY PLAN



SCHEME KEY PLAN



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| C01 | SGAR3 | | | | |
| | ATUN | ATUN | JHAR | THAL | SSCO |
| | 07/06/22 | 07/06/22 | 08/06/22 | 08/06/22 | 08/06/22 |
| Revision | Revision details | | | | |
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| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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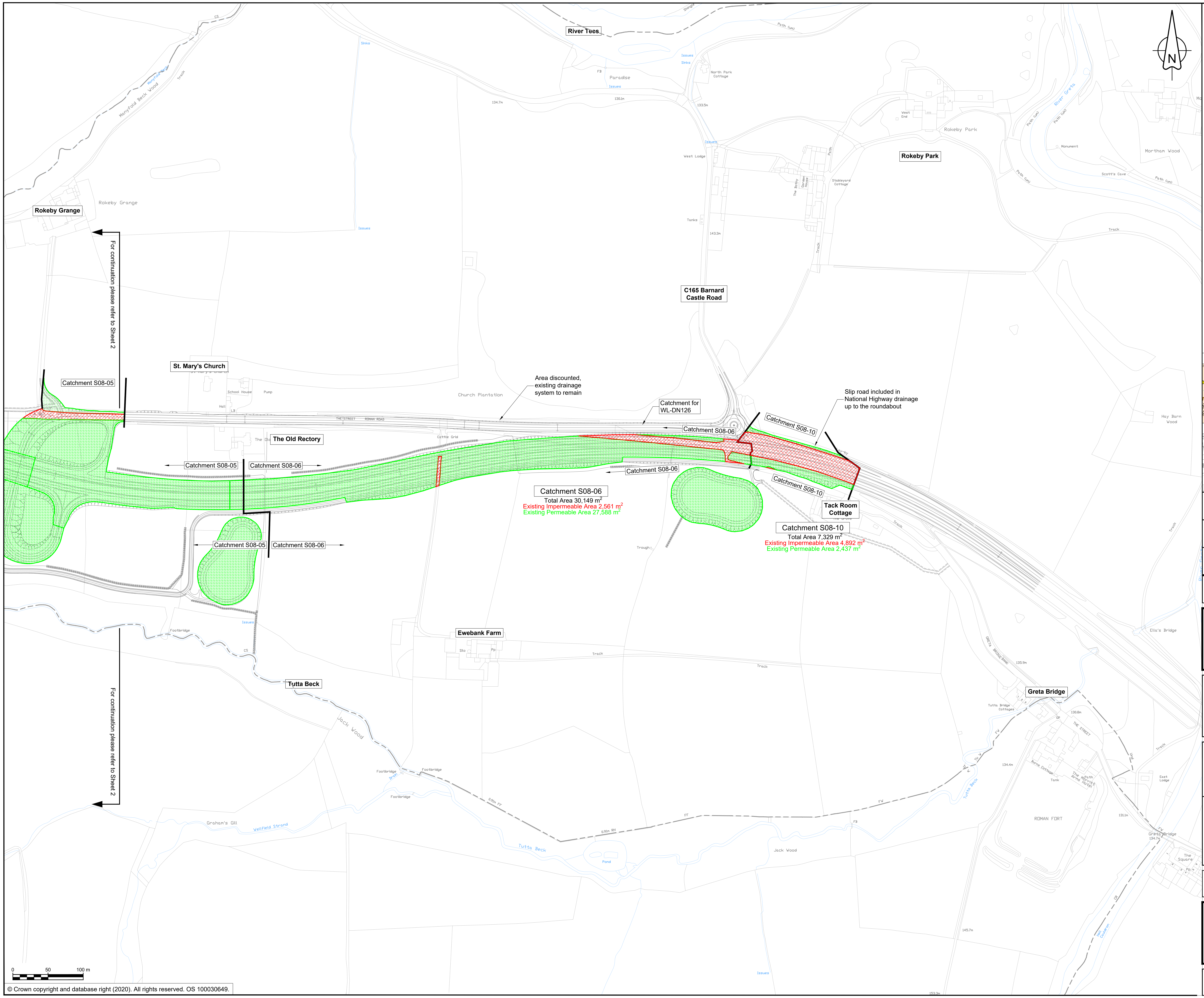
Project Name
A66 Northern Trans-Pennine

Drawing Title
Cross Lanes to Rokeby
Existing Catchment Plan
Sheet 2 of 3

| Project Ref. No. | Stage | Scale : 1:2500 @ A1 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S08 -DR-CD-000102
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |



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## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
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## KEY

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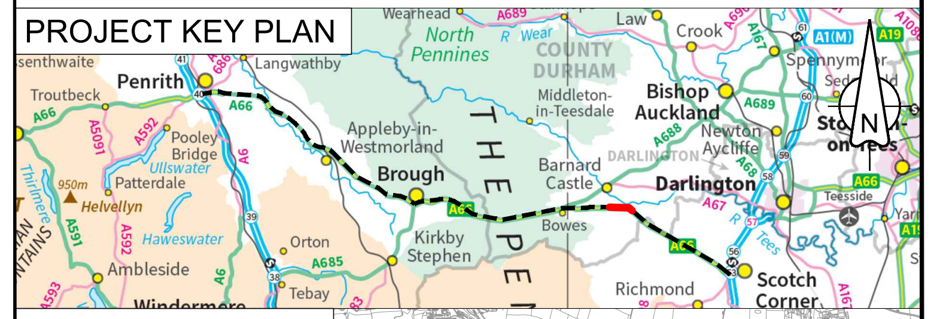
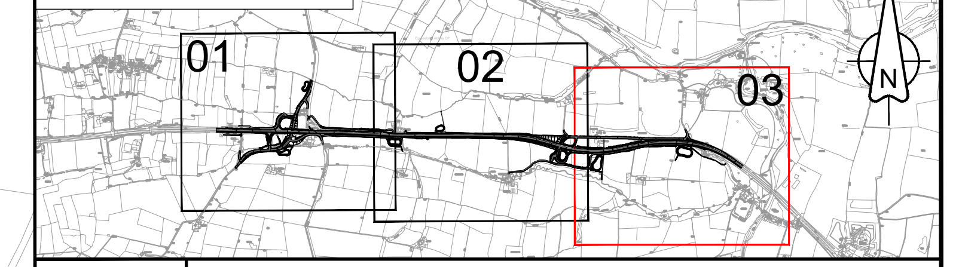
|---|---|
| 🟥 | EXISTING IMPERMEABLE |
| 🟩 | EXISTING PERMEABLE |
| ━ | CATCHMENT BOUNDARY |

PROJECT KEY PLAN



SCHEME KEY PLAN



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| C01 | SGAR3 | | | | | |
| | ATUN | ATUN | JHAR | THAL | SSCO | |
| | 07/06/22 | 07/06/22 | 08/06/22 | 08/06/22 | 08/06/22 | |
| Revision | Revision details | | | | | |
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Project Name
A66 Northern Trans-Pennine

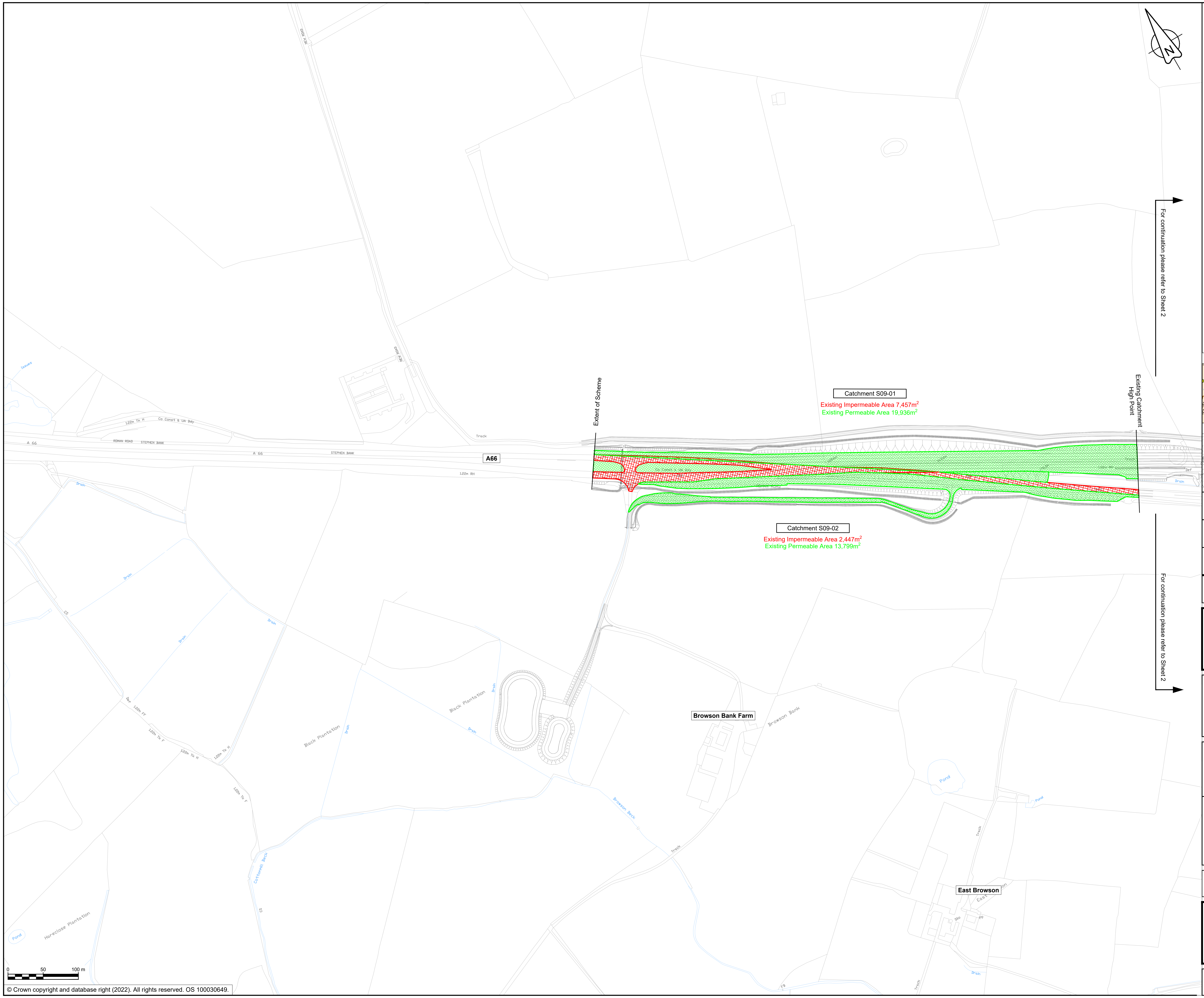
Drawing Title
Cross Lanes to Rokeby
Existing Catchment Plan
Sheet 3 of 3

| Project Ref. No. | Stage | Scale : 1:2500 @ A1 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number

| Project | Originator | Volume | Location | Type | Role | Number |
|---|---|---|---|---|---|---|
| HE565627 | AMY | HDG | S08 | DR | CD | 000103 |

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |



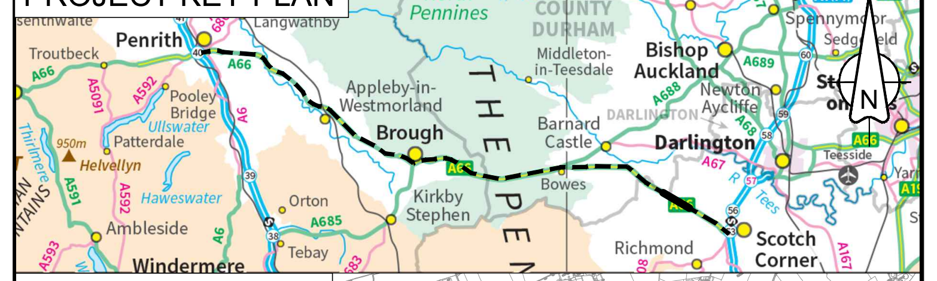
## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. AREAS BASED ON ASSESSMENT OF EXISTING SURFACE.
3. AREA BENEATH PROPOSED ALIGNMENT THAT DRAINS TOWARDS OUTFALL HAS BEEN INCLUDED. OTHER AREA DISCOUNTED.

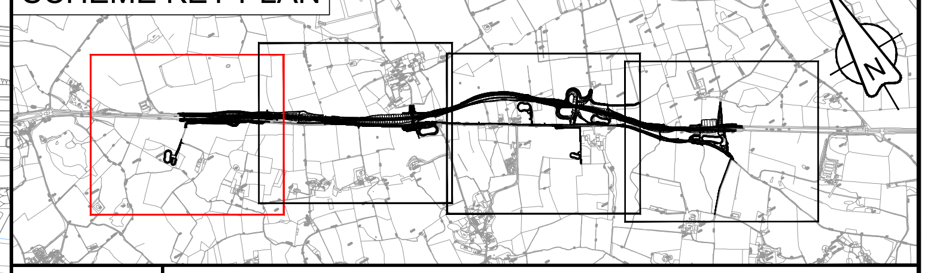
## KEY

| | |
|---|---|
| 🟥 | EXISTING IMPERMEABLE AREA |
| 🟩 | EXISTING PERMEABLE AREA |

PROJECT KEY PLAN



SCHEME KEY PLAN



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| P01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | FMOL |
| | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 |
| C01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | SSCO |
| | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 |
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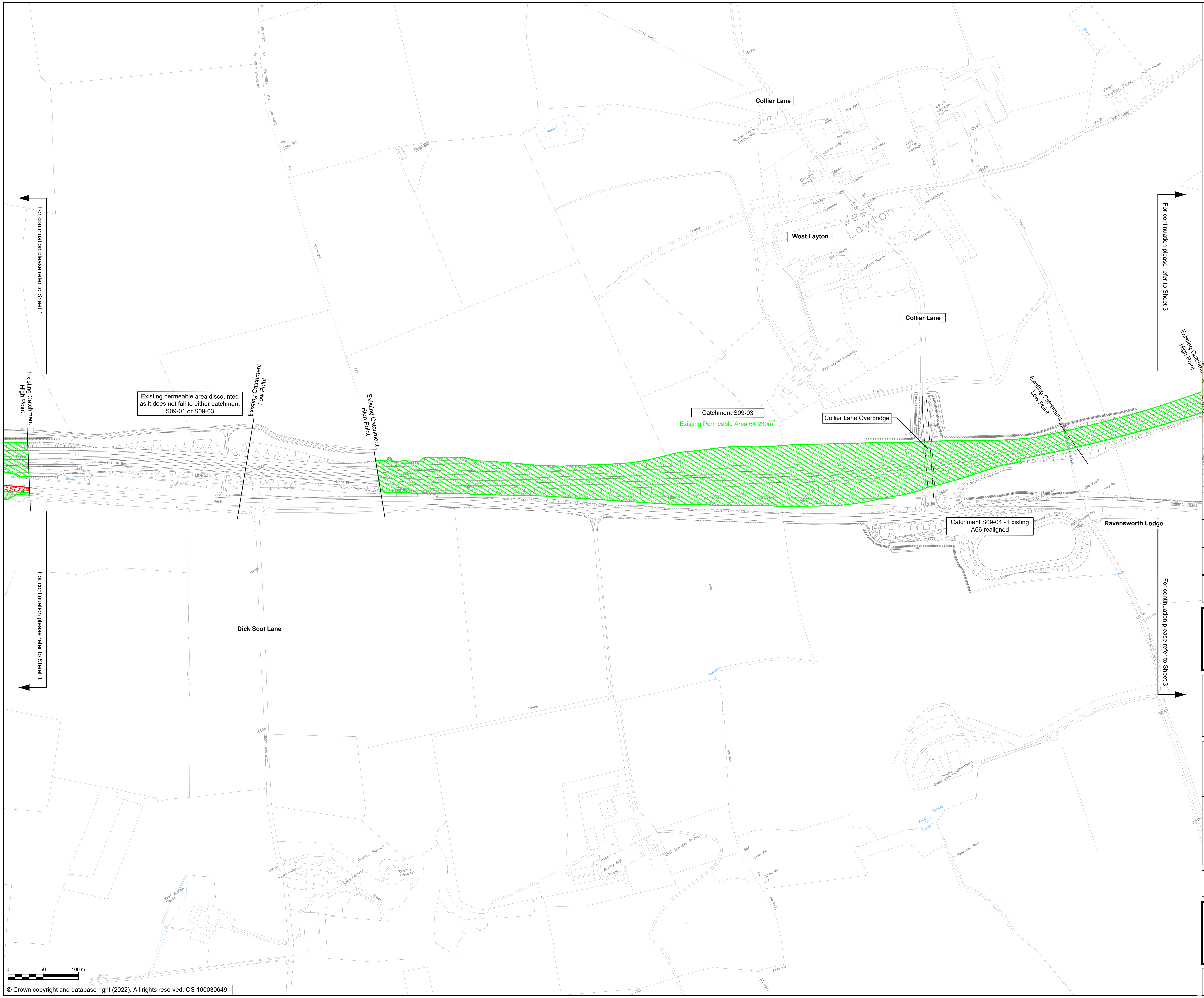
Project Name
A66 Northern Trans-Pennine

Drawing Title
Stephen Bank to Carkin Moor
Existing Catchment Plan
Sheet 1 of 4

| Project Ref. No. | Stage | Scale : 1:2500 @ A1 |
|---|---|---|
| --- | PCF3 | Dimensions : N/A |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S09 -DR-CD-000101
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |



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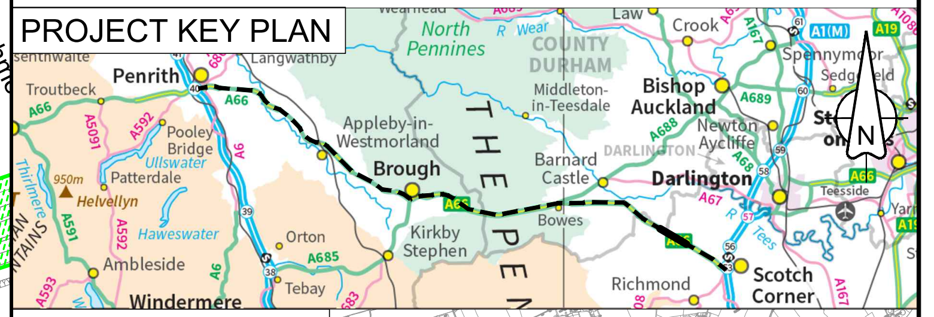
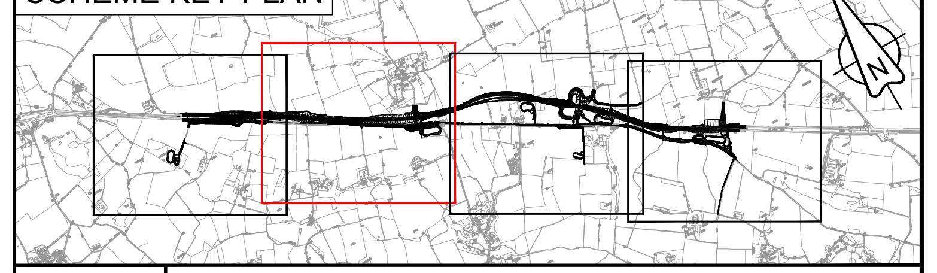
## KEY

🟥 EXISTING IMPERMEABLE AREA
🟩 EXISTING PERMEABLE AREA

PROJECT KEY PLAN



SCHEME KEY PLAN



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| P01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | FMOL |
| | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 |
| C01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | SSCO |
| | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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Manchester
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national highways

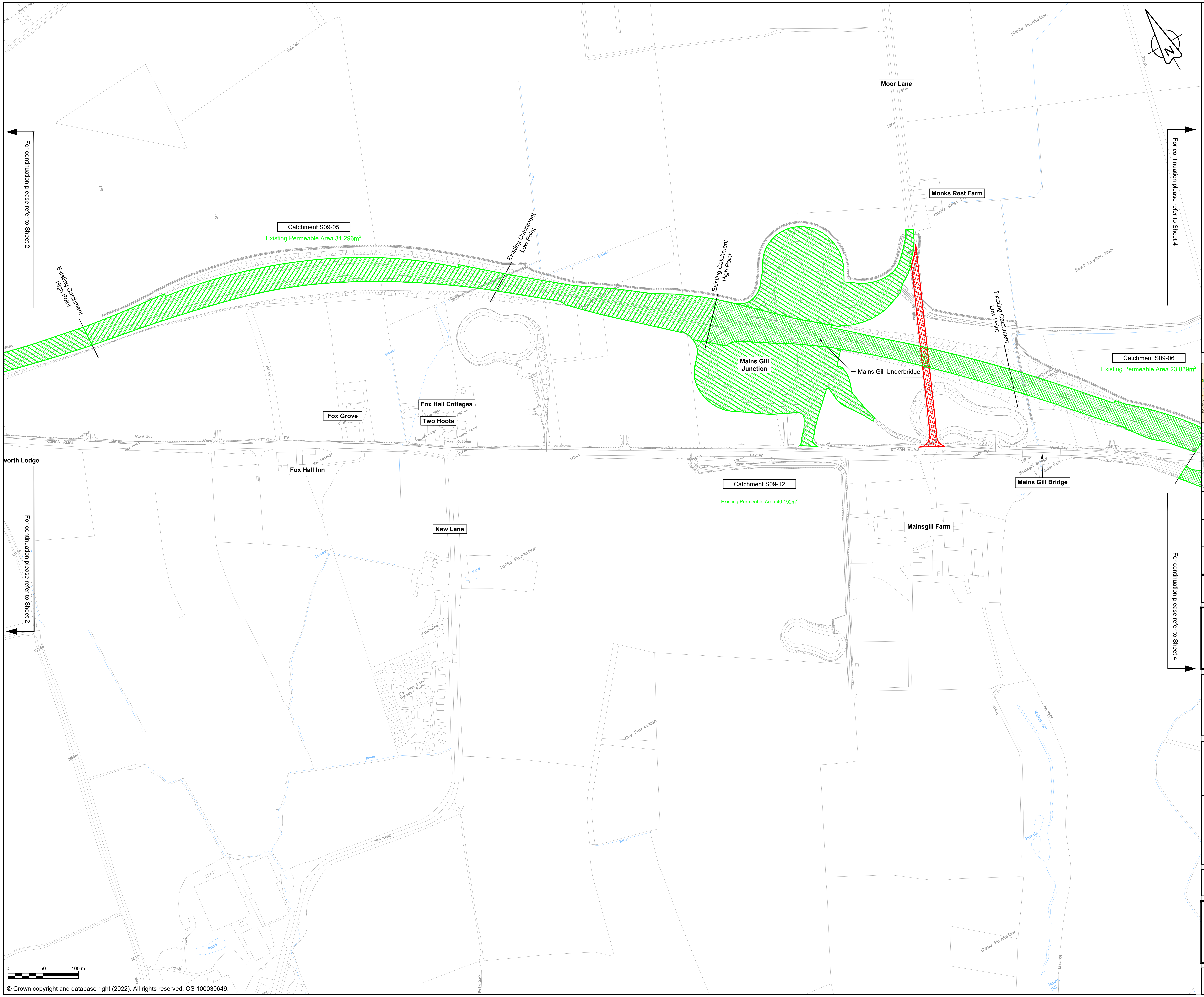
Project Name
A66 Northern Trans-Pennine

Drawing Title
Stephen Bank to Carkin Moor
Existing Catchment Plan
Sheet 2 of 4

| Project Ref. No. | Stage | Scale : 1:2500 @ A1 |
|---|---|---|
| --- | PCF3 | Dimensions : N/A |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S09 -DR-CD-000102
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |



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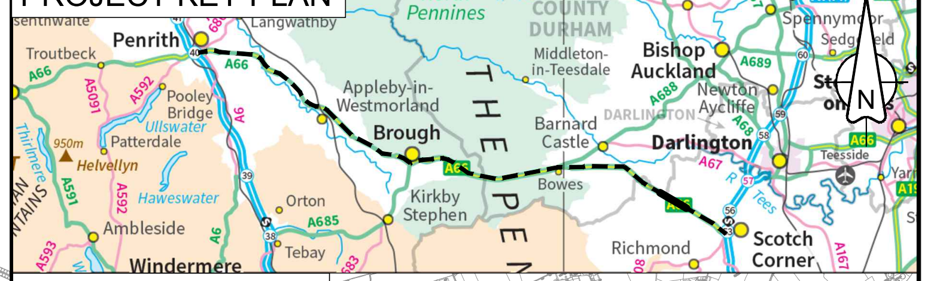
## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. AREAS BASED ON ASSESSMENT OF EXISTING SURFACE.
3. AREA BENEATH PROPOSED ALIGNMENT THAT DRAINS TOWARDS OUTFALL HAS BEEN INCLUDED. OTHER AREA DISCOUNTED.

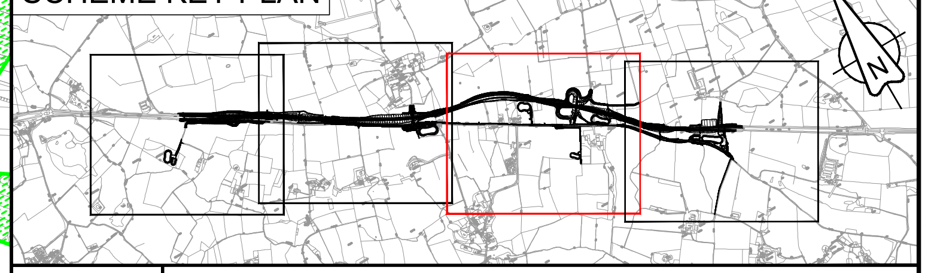
## KEY

| | |
|---|---|
| 🟥 | EXISTING IMPERMEABLE AREA |
| 🟩 | EXISTING PERMEABLE AREA |

PROJECT KEY PLAN



SCHEME KEY PLAN



| Revision | Created | Checked | Reviewed | Approved | Authorised |
|---|---|---|---|---|---|
| --- | ---<br>--- | ---<br>--- | ---<br>--- | ---<br>--- | ---<br>--- |
| P01 | SGAR3<br>JHAR<br>10/05/22 | JHAR<br>10/05/22 | CHEA<br>10/05/22 | TEGG<br>10/05/22 | FMOL<br>10/05/22 |
| C01 | SGAR3<br>JHAR<br>07/06/22 | JHAR<br>07/06/22 | CHEA<br>07/06/22 | TEGG<br>07/06/22 | SSCO<br>07/06/22 |
| Revision | Revision details<br>Created<br>dd/mm/yy | Checked<br>dd/mm/yy | Reviewed<br>dd/mm/yy | Approved<br>dd/mm/yy | Authorised<br>dd/mm/yy |

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Project Name
A66 Northern Trans-Pennine

Drawing Title
Stephen Bank to Carkin Moor
Existing Catchment Plan
Sheet 3 of 4

| Project Ref. No. | Stage | Scale : 1:2500 @ A1 |
|---|---|---|
| --- | PCF3 | Dimensions : N/A |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S09 -DR-CD-000103
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |

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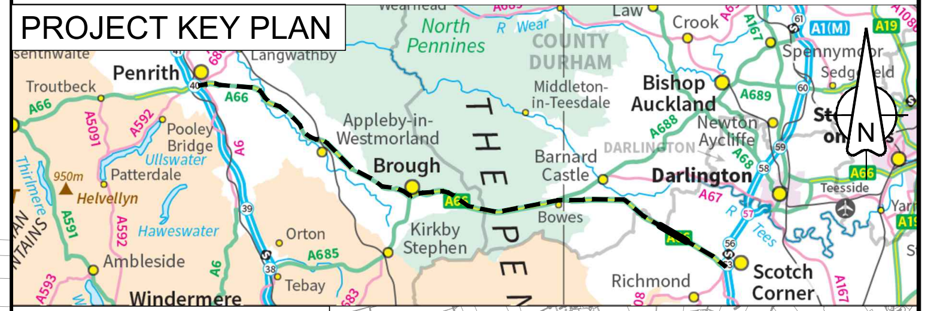
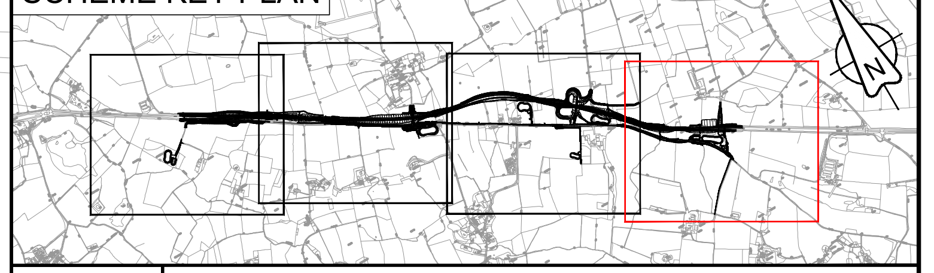
## KEY

| | |
|---|---|
| 🟥 | EXISTING IMPERMEABLE AREA |
| 🟩 | EXISTING PERMEABLE AREA |

PROJECT KEY PLAN



SCHEME KEY PLAN



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| P01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | FMOL |
| | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 |
| C01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | SSCO |
| | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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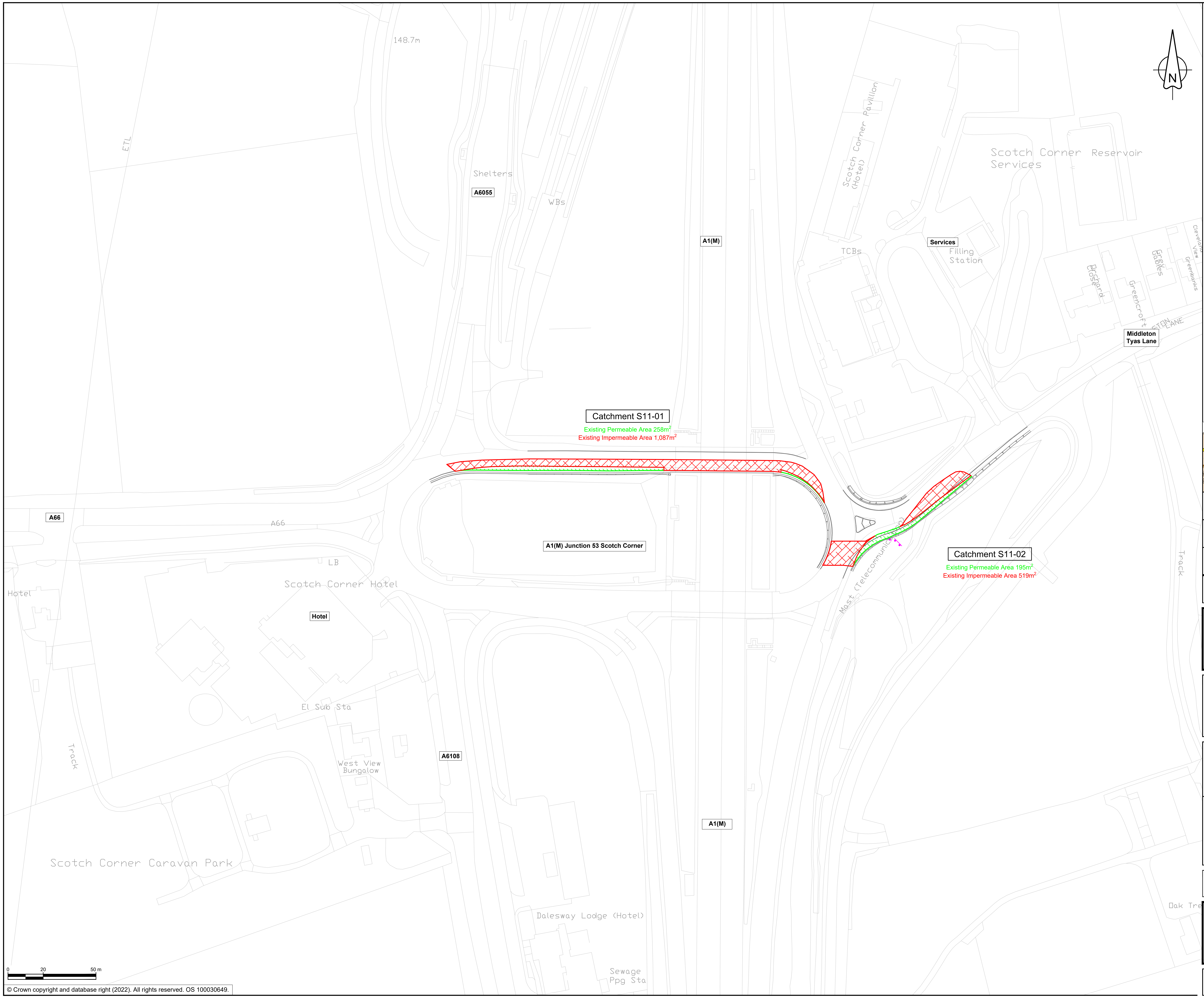
Project Name
A66 Northern Trans-Pennine

Drawing Title
Stephen Bank to Carkin Moor
Existing Catchment Plan
Sheet 4 of 4

| Project Ref. No. | Stage | Scale : 1:2500 @ A1 |
|---|---|---|
| --- | PCF3 | Dimensions : N/A |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S09 -DR-CD-000104
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |



## NOTES

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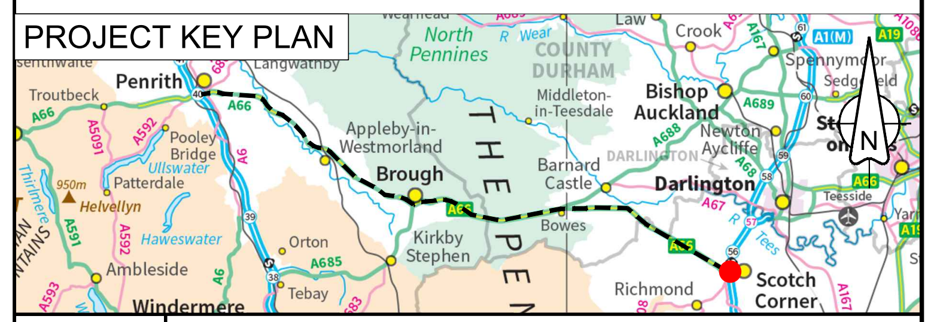
2. AREAS BASED ON ASSESSMENT OF EXISTING SURFACE.

## KEY

| | |
|---|---|
| 🟥 | EXISTING IMPERMEABLE AREA |
| 🟩 | EXISTING PERMEABLE AREA |

PROJECT KEY PLAN



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| | | --- | --- | --- | --- | --- |
| P01 | SGAR3 | JHAR<br>10/05/22 | JHAR<br>10/05/22 | CHEA<br>10/05/22 | TEGG<br>10/05/22 | FMOL<br>10/05/22 |
| C01 | SGAR3 | JHAR<br>07/06/22 | JHAR<br>07/06/22 | CHEA<br>07/06/22 | TEGG<br>07/06/22 | SSCO<br>07/06/22 |
| Revision | Revision details | Created<br>dd/mm/yy | Checked<br>dd/mm/yy | Reviewed<br>dd/mm/yy | Approved<br>dd/mm/yy | Authorised<br>dd/mm/yy |

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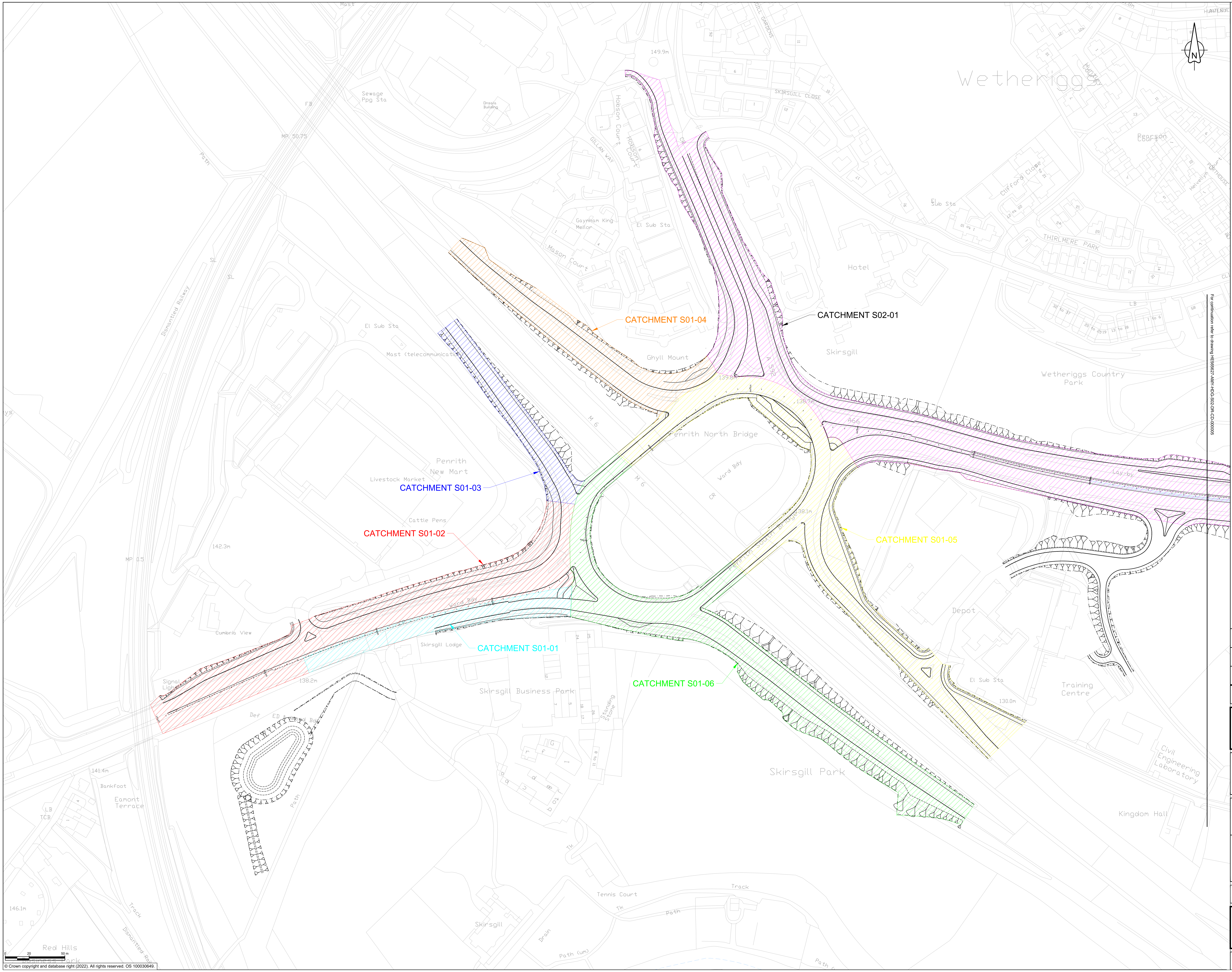
Project Name
A66 Northern Trans-Pennine

Drawing Title
A1(M) Junction 53 Scotch Corner
Existing Catchment Plan

| Project Ref. No. | Stage | Scale : 1:1000 @ A1 |
|---|---|---|
| --- | PCF3 | Dimensions : |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S11 -DR-CD-000101
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |



For continuation refer to drawing HE565627-AMY-HDG-S02-DR-CD-000005

## NOTES

1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed drainage design designed in accordance with the Standards for Highways Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, as-built drawings, OS, JBA culvert surveys, site walk overs and topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   - No surcharging in 1yr storm event
   - No flooding in 1 or 5yr storm event
   - Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope
10. Ponds to have minimum 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

## KEY

| | |
|---|---|
| ▨ | CATCHMENT S01-01 |
| ▨ | CATCHMENT S01-02 |
| ▨ | CATCHMENT S01-03 |
| ▨ | CATCHMENT S01-04 |
| ▨ | CATCHMENT S01-05 |
| ▨ | CATCHMENT S01-06 |
| ▨ | CATCHMENT S02-01 |
| ▨ | CATCHMENT S02-02 |
| ▨ | CATCHMENT S02-03 |
| ▨ | CATCHMENT S02-04 |
| ▨ | CATCHMENT S02-05 |

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| | --- | --- | --- | --- | --- |
| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 25/04/22 | 25/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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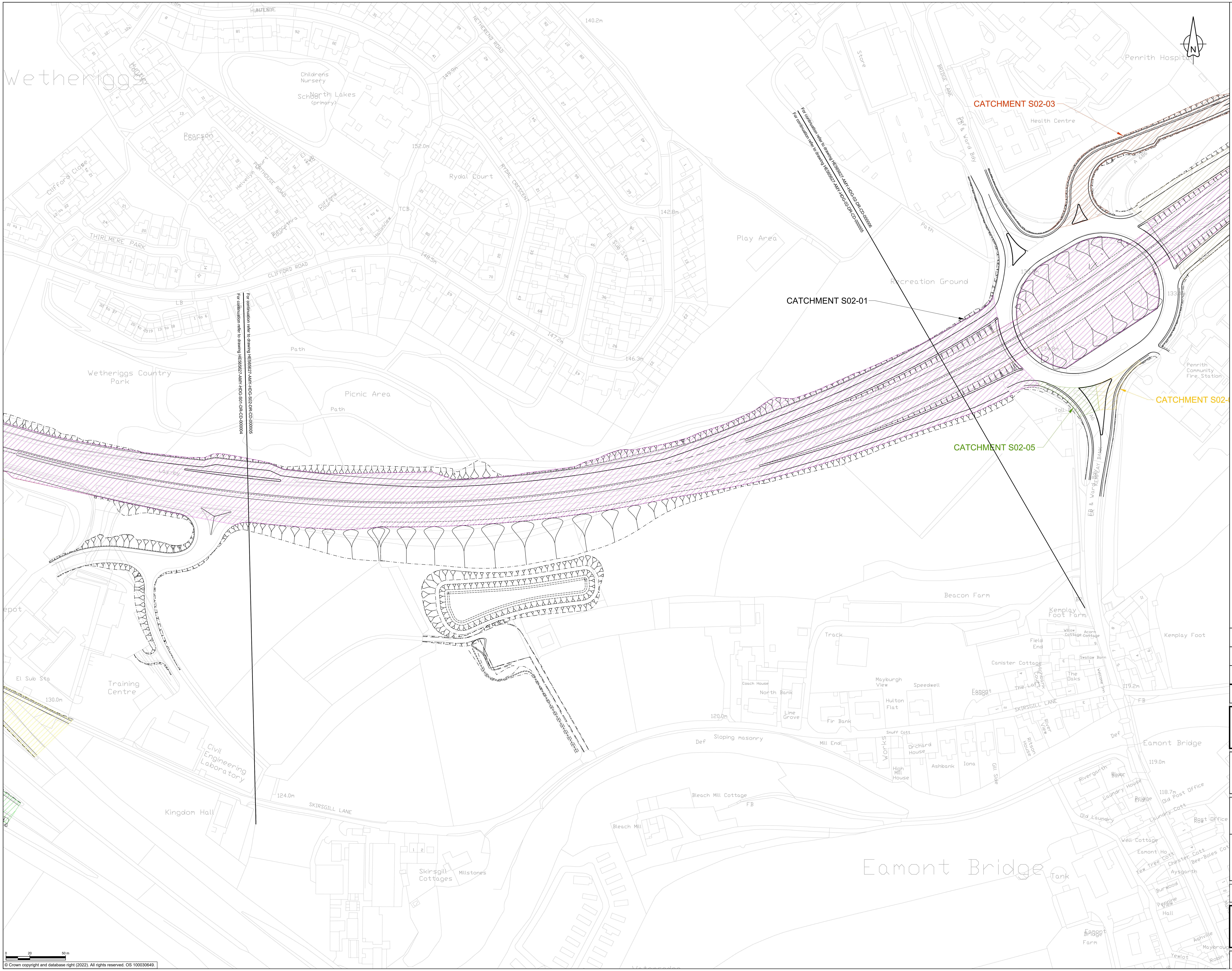
Project Name
A66 Northern Trans-Pennine

Drawing Title
Proposed M6 J40 to Kemplay Bank
Drainage Catchment Areas
Sheet 1 of 3

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S01 -DR-CD-000004
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |



## NOTES

1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
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6. Proposed drainage design designed in accordance with the Standards for Highways Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, as-built drawings, OS, JBA culvert surveys, site walk overs and topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   - No surcharging in 1yr storm event
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## KEY

| | |
|---|---|
| ▨ | CATCHMENT S01-01 |
| ▨ | CATCHMENT S01-02 |
| ▨ | CATCHMENT S01-03 |
| ▨ | CATCHMENT S01-04 |
| ▨ | CATCHMENT S01-05 |
| ▨ | CATCHMENT S01-06 |
| ▨ | CATCHMENT S02-01 |
| ▨ | CATCHMENT S02-02 |
| ▨ | CATCHMENT S02-03 |
| ▨ | CATCHMENT S02-04 |
| ▨ | CATCHMENT S02-05 |

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| | --- | --- | --- | --- | --- |
| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 25/04/22 | 25/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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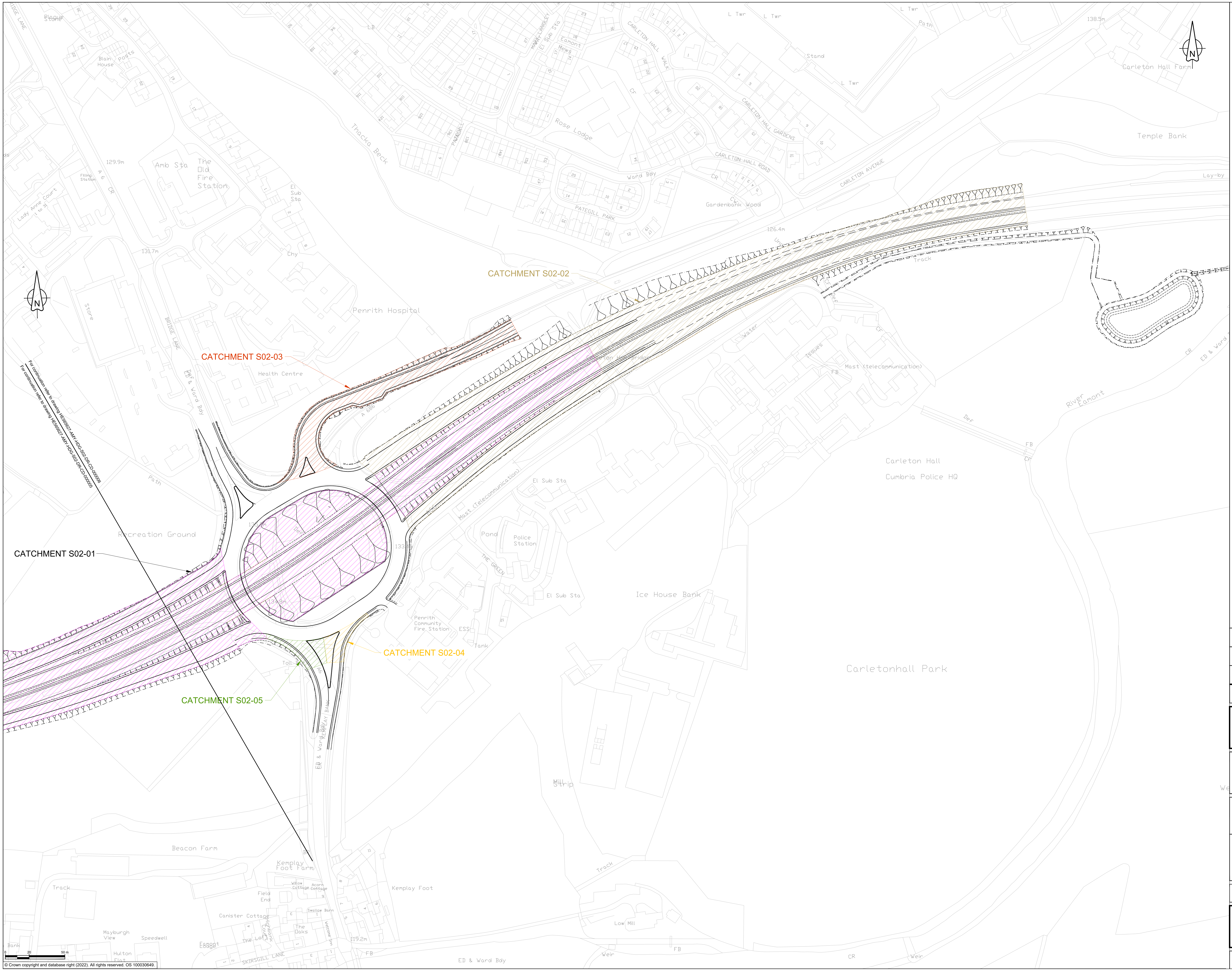
Project Name
A66 Northern Trans-Pennine

Drawing Title
Proposed M6 J40 to Kemplay Bank
Drainage Catchment Areas
Sheet 2 of 3

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
| Project | Originator | Volume |
HE565627 - AMY - HDG -
S02 - DR - CD - 000005
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |



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## NOTES

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## KEY

| | |
|---|---|
| ▨ | CATCHMENT S01-01 |
| ▨ | CATCHMENT S01-02 |
| ▨ | CATCHMENT S01-03 |
| ▨ | CATCHMENT S01-04 |
| ▨ | CATCHMENT S01-05 |
| ▨ | CATCHMENT S01-06 |
| ▨ | CATCHMENT S02-01 |
| ▨ | CATCHMENT S02-02 |
| ▨ | CATCHMENT S02-03 |
| ▨ | CATCHMENT S02-04 |
| ▨ | CATCHMENT S02-05 |

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| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 25/04/22 | 25/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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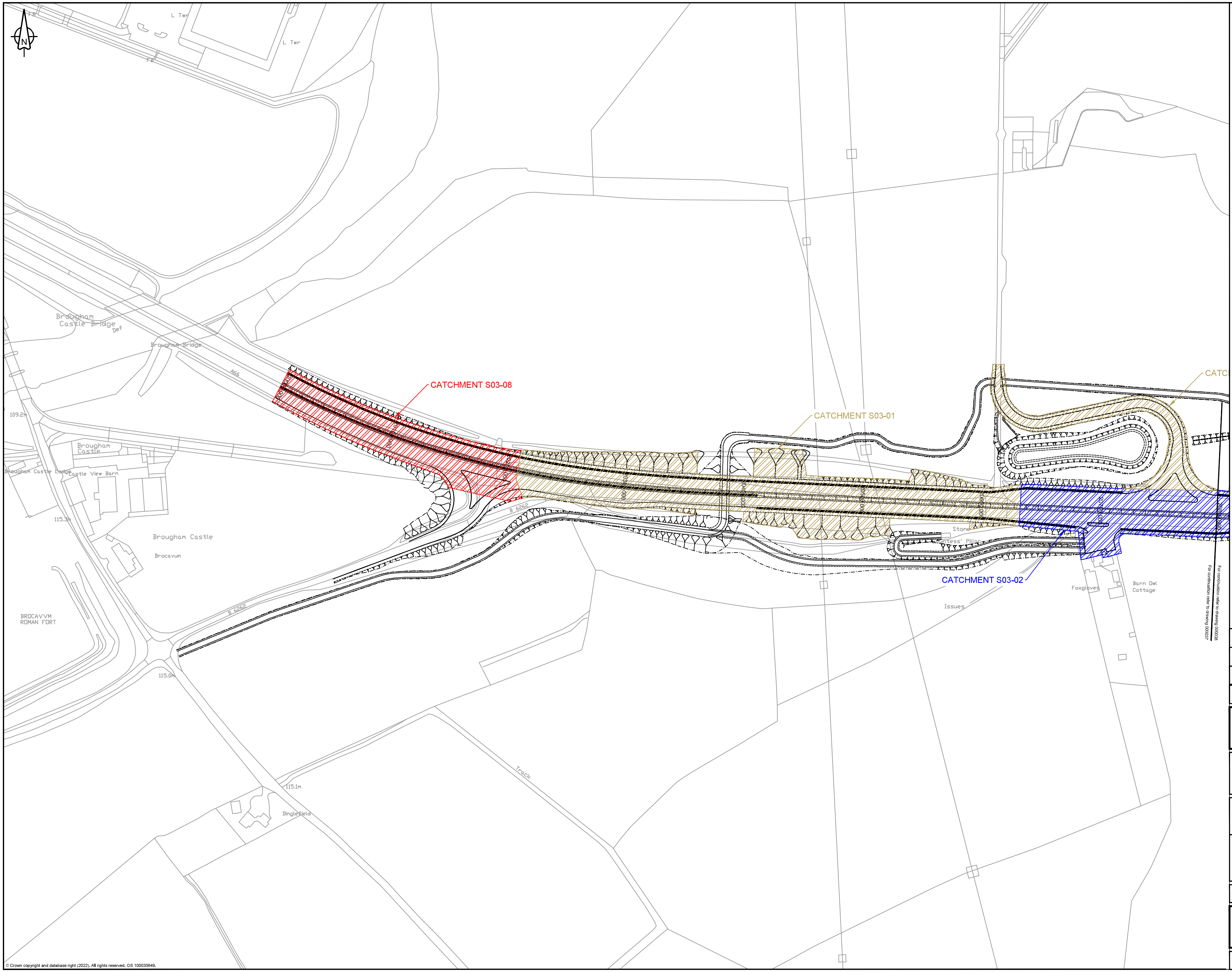
Project Name
A66 Northern Trans-Pennine

Drawing Title
Proposed M6 J40 to Kemplay Bank
Drainage Catchment Areas
Sheet 3 of 3

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S02 -DR-CD- 000006
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |



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## KEY

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| 🟫 | CATCHMENT S03-01 |
| 🟦 | CATCHMENT S03-02 |
| 🟩 | CATCHMENT S03-03 |
| 🟧 | CATCHMENT S03-04 |
| 🟦 | CATCHMENT S03-05 |
| 🟩 | CATCHMENT S03-06 |
| 🟪 | CATCHMENT S03-07 |
| 🟥 | CATCHMENT S03-08 into existing system |
| 🟨 | CATCHMENT S03-09 into existing system |
| 🟪 | CATCHMENT S03-10 into existing system |

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| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 25/04/22 | 25/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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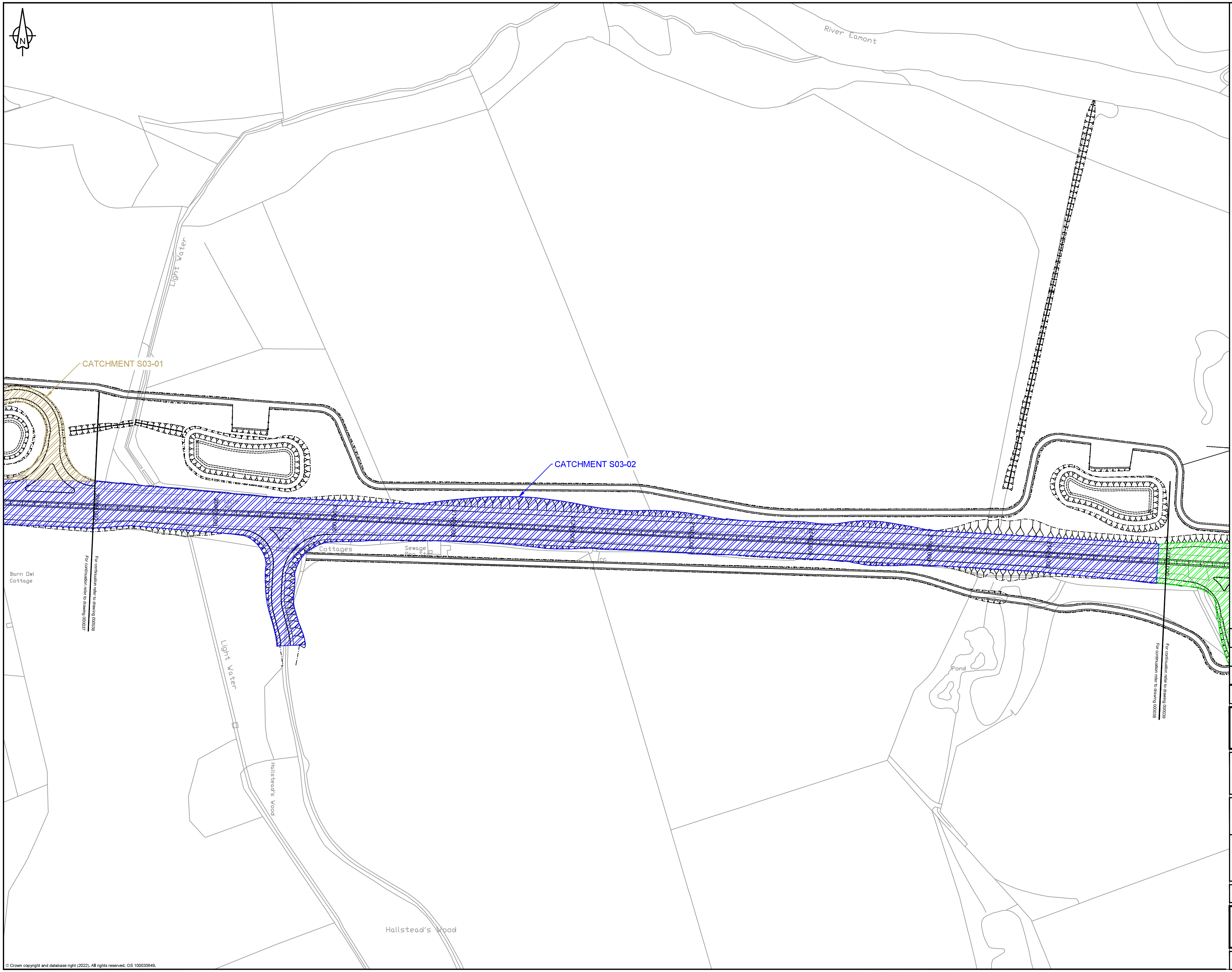
Project Name
A66 Northern Trans-Pennine

Drawing Title
Proposed Center Parcs
Drainage Catchment Areas
Sheet 1 of 6

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| — | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S03 -DR-CD- 000037
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |



## NOTES

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## KEY

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|---|---|
| ▨ | CATCHMENT S03-01 |
| ▨ | CATCHMENT S03-02 |
| ▨ | CATCHMENT S03-03 |
| ▨ | CATCHMENT S03-04 |
| ▨ | CATCHMENT S03-05 |
| ▨ | CATCHMENT S03-06 |
| ▨ | CATCHMENT S03-07 |
| ▨ | CATCHMENT S03-08 into existing system |
| ▨ | CATCHMENT S03-09 into existing system |
| ▨ | CATCHMENT S03-10 into existing system |

| Revision | Revision details | | | | |
|---|---|---|---|---|---|
| — | — | | | | |
| | — | — | — | — | — |
| | — | — | — | — | — |
| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 25/04/22 | 25/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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national highways

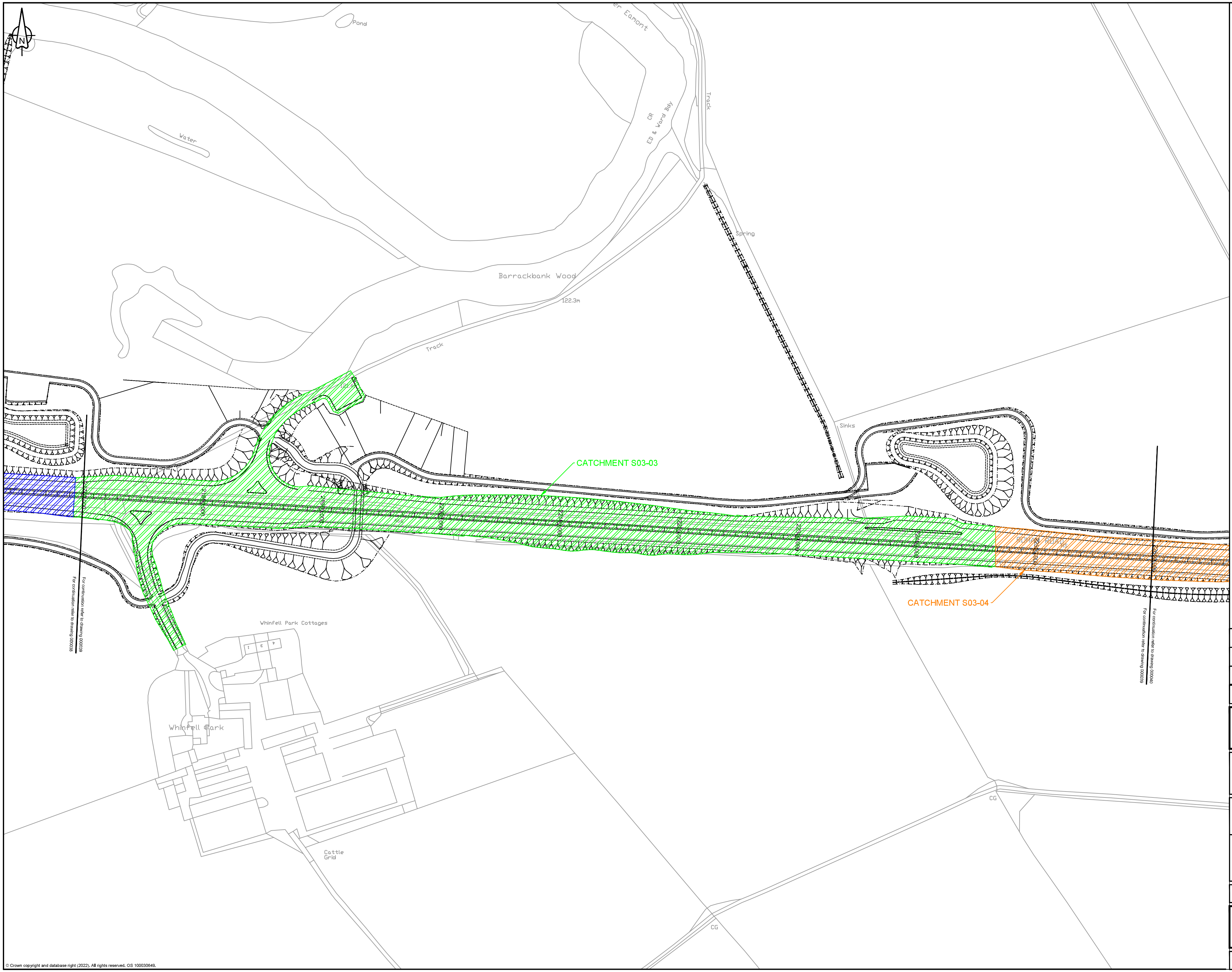
Project Name
A66 Northern Trans-Pennine

Drawing Title
Proposed Center Parcs
Drainage Catchment Areas
Sheet 2 of 6

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| — | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S03 -DR-CD- 000038
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |



## NOTES

1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
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7. Existing drainage information based on HADDMS, as-built drawings, OS, JBA culvert surveys, site walk overs and topographical survey information. Existing drainage is omitted from this drawing.
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   - No flooding in 1 or 5yr storm event
   - Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
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11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

## KEY

| | |
|---|---|
| ▨ | CATCHMENT S03-01 |
| ▨ | CATCHMENT S03-02 |
| ▨ | CATCHMENT S03-03 |
| ▨ | CATCHMENT S03-04 |
| ▨ | CATCHMENT S03-05 |
| ▨ | CATCHMENT S03-06 |
| ▨ | CATCHMENT S03-07 |
| ▨ | CATCHMENT S03-08 into existing system |
| ▨ | CATCHMENT S03-09 into existing system |
| ▨ | CATCHMENT S03-10 into existing system |

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|---|---|---|---|---|---|
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| | — | — | — | — | — |
| | — | — | — | — | — |
| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 25/04/22 | 25/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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A66 NTP Integrated Project Team

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national highways

Project Name
A66 Northern Trans-Pennine

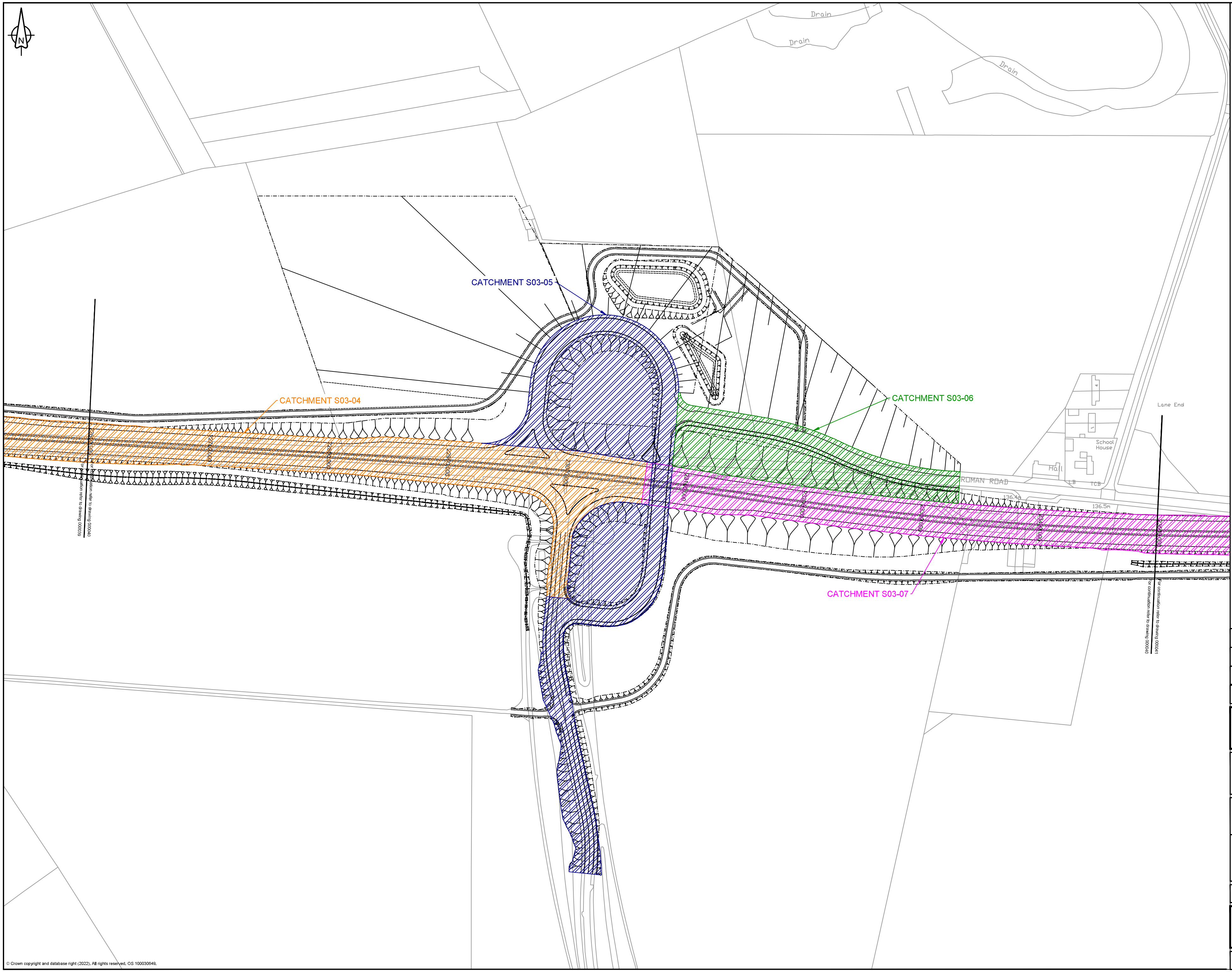
Drawing Title
Proposed Center Parcs
Drainage catchment Areas
Sheet 3 of 6

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| — | PCF3 | Dimensions : M |

Drawing Number

| Project | Originator | Volume | Location | Type | Role | Number |
|---|---|---|---|---|---|---|
| HE565627 | AMY | HDG | S03 | DR | CD | 000039 |

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |



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| | |
|---|---|
| ▨ | CATCHMENT S03-01 |
| ▨ | CATCHMENT S03-02 |
| ▨ | CATCHMENT S03-03 |
| ▨ | CATCHMENT S03-04 |
| ▨ | CATCHMENT S03-05 |
| ▨ | CATCHMENT S03-06 |
| ▨ | CATCHMENT S03-07 |
| ▨ | CATCHMENT S03-08 into existing system |
| ▨ | CATCHMENT S03-09 into existing system |
| ▨ | CATCHMENT S03-10 into existing system |

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|---|---|---|---|---|---|
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| | — | — | — | — | — |
| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 25/04/22 | 25/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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national highways

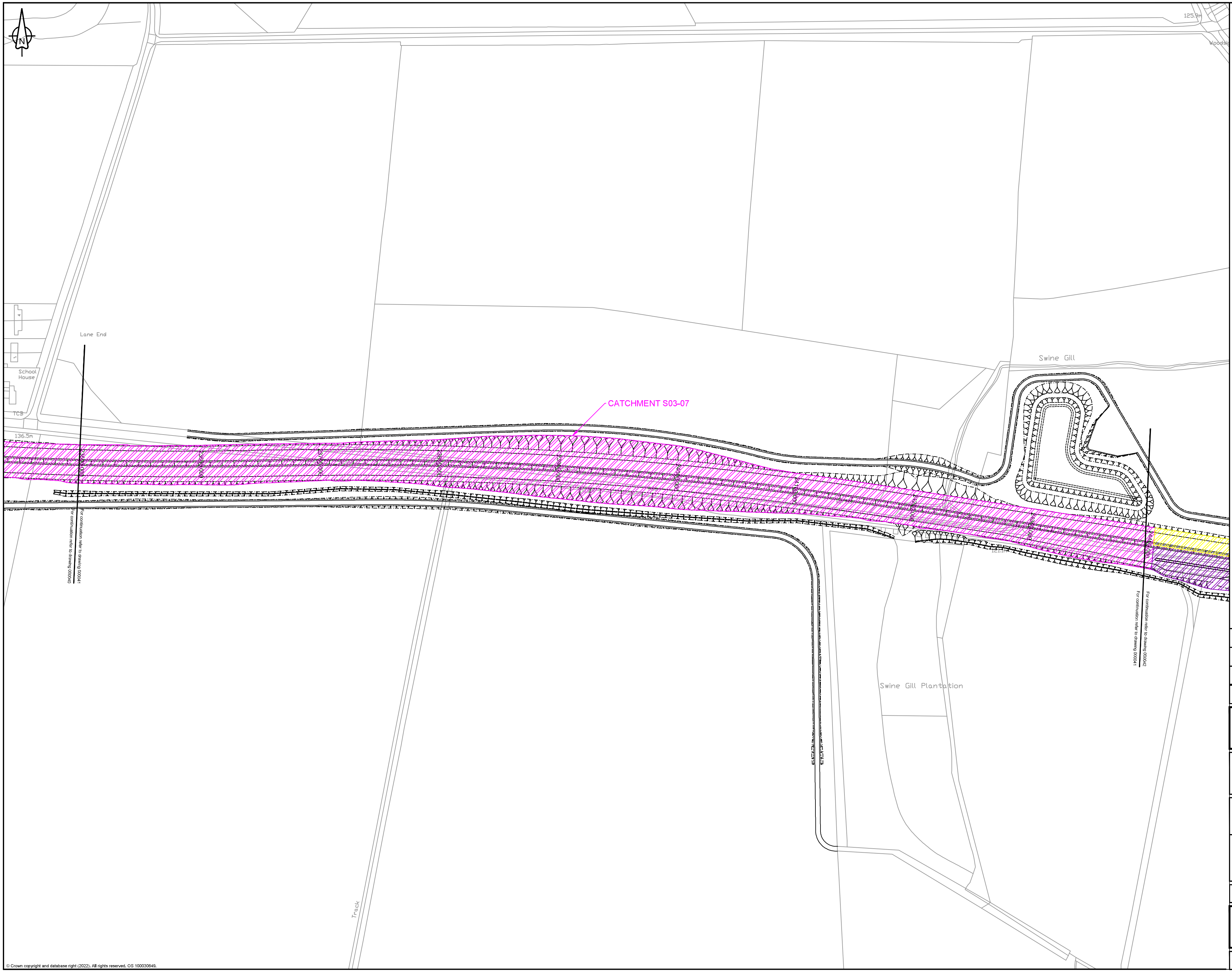
Project Name
A66 Northern Trans-Pennine

Drawing Title
Proposed Center Parcs
Drainage Catchment Areas
Sheet 4 of 6

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| — | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S03 -DR-CD- 000040
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |



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## KEY

| | |
|---|---|
| ▨ | CATCHMENT S03-01 |
| ▨ | CATCHMENT S03-02 |
| ▨ | CATCHMENT S03-03 |
| ▨ | CATCHMENT S03-04 |
| ▨ | CATCHMENT S03-05 |
| ▨ | CATCHMENT S03-06 |
| ▨ | CATCHMENT S03-07 |
| ▨ | CATCHMENT S03-08 into existing system |
| ▨ | CATCHMENT S03-09 into existing system |
| ▨ | CATCHMENT S03-10 into existing system |

| | | | | | |
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| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 25/04/22 | 25/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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M1 3BN
national highways

Project Name
A66 Northern Trans-Pennine

Drawing Title
Proposed Center Parcs
Drainage Catchment Areas
Sheet 5 of 6

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| — | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S03 -DR-CD- 000041
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |

## NOTES

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## KEY

| | |
|---|---|
| ▨ | CATCHMENT S03-01 |
| ▨ | CATCHMENT S03-02 |
| ▨ | CATCHMENT S03-03 |
| ▨ | CATCHMENT S03-04 |
| ▨ | CATCHMENT S03-05 |
| ▨ | CATCHMENT S03-06 |
| ▨ | CATCHMENT S03-07 |
| ▨ | CATCHMENT S03-08 into existing system |
| ▨ | CATCHMENT S03-09 into existing system |
| ▨ | CATCHMENT S03-10 into existing system |

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| P01 | SGAR3 | | | | |
| | MAND | MAND | JMCC | WBOA | KCRO |
| | 25/04/22 | 25/04/22 | 25/04/22 | 25/04/22 | 26/04/22 |
| P02 | SGAR3 | | | | |
| | PMOR | MAND | ASCR | WBOA | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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national highways

Project Name
A66 Northern Trans-Pennine

Drawing Title
Proposed Center Parcs
Drainage Catchment Areas
Sheet 6 of 6

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| — | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S03 -DR-CD- 000042
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P02 |

## NOTES

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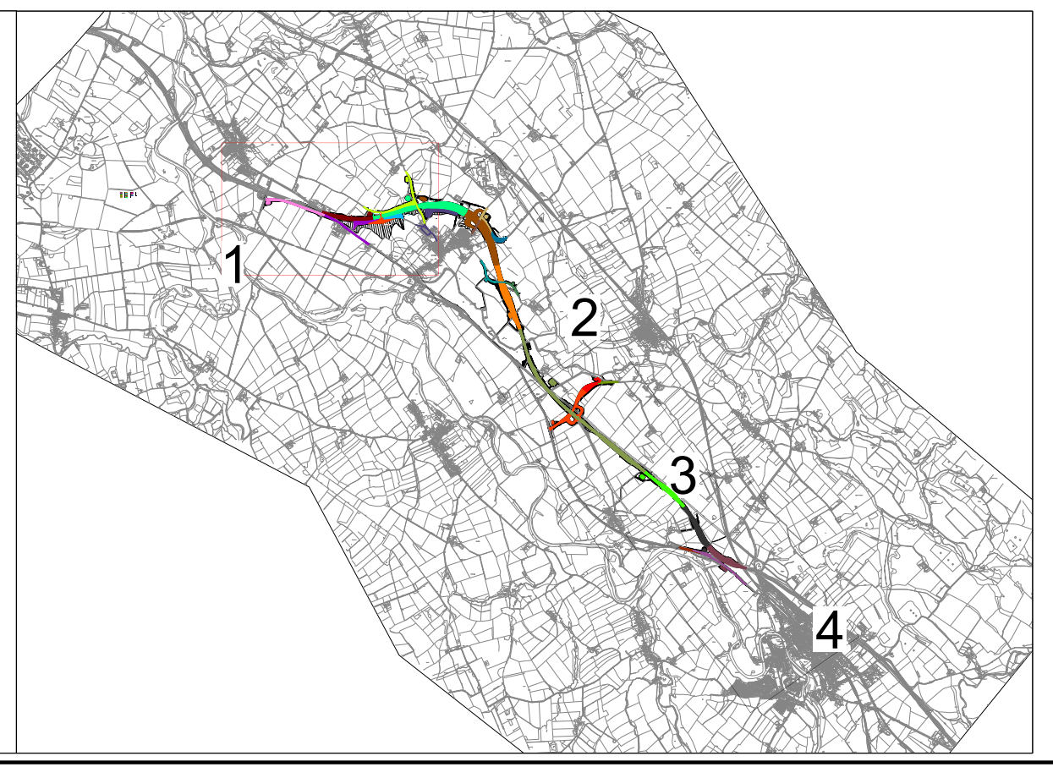
## Drainage key plan

### KEY

| | | | | | |
|---|---|---|---|---|---|
| ▨ | CATCHMENT S0405-01 | ▨ | CATCHMENT S0405-009 | ▨ | CATCHMENT S0405-016 |
| ▨ | CATCHMENT S0405-02 | ▨ | CATCHMENT S0405-010 | ▨ | CATCHMENT S0405-017 |
| ▨ | CATCHMENT S0405-03 | ▨ | CATCHMENT S0405-011 | ▨ | CATCHMENT S0405-018 |
| ▨ | CATCHMENT S0405-04 | ▨ | CATCHMENT S0405-012 | ▨ | CATCHMENT S0405-019 |
| ▨ | CATCHMENT S0405-05 | ▨ | CATCHMENT S0405-012a | ▨ | CATCHMENT S0405-020 |
| ▨ | CATCHMENT S0405-06 | ▨ | CATCHMENT S0405-012b | ▨ | CATCHMENT S0405-EX-D |
| ▨ | CATCHMENT S0405-6b | ▨ | CATCHMENT S0405-013 | | |
| ▨ | CATCHMENT S0405-07 | ▨ | CATCHMENT S0405-014 | | |
| ▨ | CATCHMENT S0405-08 | ▨ | CATCHMENT S0405-015 | | |

## Site key plan



| | | | | | |
|---|---|---|---|---|---|
| P01 | | | | | |
| | GCOO | GCOO | ASHI | KCRO | --- |
| | 04/03/22 | 04/03/22 | 04/03/22 | 04/03/22 | --- |
| P02 | SGAR3 | | | | |
| | JMOR | JMOR | ASHI | KCRO | KCRO |
| | 19/04/22 | 19/04/22 | 09/05/22 | 09/05/22 | 09/05/22 |
| P03 | SGAR3 | | | | |
| | CMAR | CMAR | ASHI | KCRO | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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3 Piccadilly Place
Manchester
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Project Name
A66 Northern Trans-Pennine

Drawing Title
Proposed Drainage Catchment Plan
Sheet 1 of 4

| Project Ref. No. | Stage | Scale : 1:2500 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number

| Project | Originator | Volume | Location | Type | Role | Number |
|---|---|---|---|---|---|---|
| HE565627 | AMY | HDG | S0405 | DR | CD | 000217 |

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P03 |

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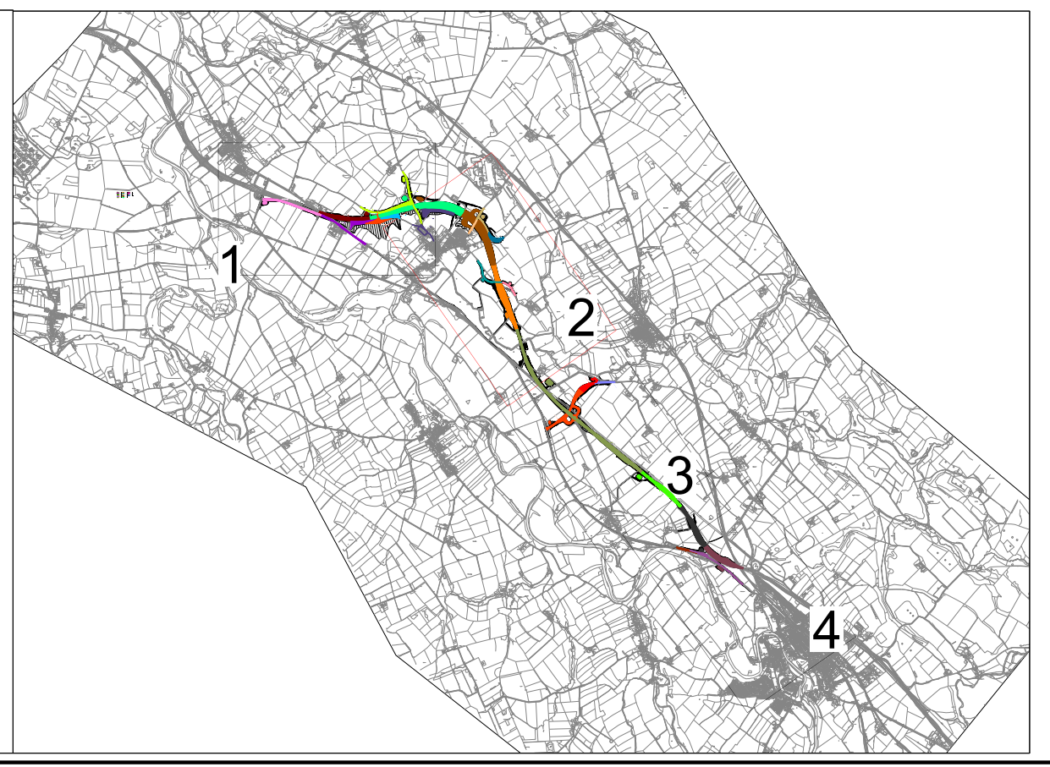
## Drainage key plan

### KEY

| | | | | | |
|---|---|---|---|---|---|
| ▨ | CATCHMENT S0405-01 | ▨ | CATCHMENT S0405-009 | ▨ | CATCHMENT S0405-016 |
| ▨ | CATCHMENT S0405-02 | ▨ | CATCHMENT S0405-010 | ▨ | CATCHMENT S0405-017 |
| ▨ | CATCHMENT S0405-03 | ▨ | CATCHMENT S0405-011 | ▨ | CATCHMENT S0405-018 |
| ▨ | CATCHMENT S0405-04 | ▨ | CATCHMENT S0405-012 | ▨ | CATCHMENT S0405-019 |
| ▨ | CATCHMENT S0405-05 | ▨ | CATCHMENT S0405-012a | ▨ | CATCHMENT S0405-020 |
| ▨ | CATCHMENT S0405-06 | ▨ | CATCHMENT S0405-012b | ▨ | CATCHMENT S0405-EX-D |
| ▨ | CATCHMENT S0405-6b | ▨ | CATCHMENT S0405-013 | | |
| ▨ | CATCHMENT S0405-07 | ▨ | CATCHMENT S0405-014 | | |
| ▨ | CATCHMENT S0405-08 | ▨ | CATCHMENT S0405-015 | | |

## Site key plan



| | | | | | |
|---|---|---|---|---|---|
| P01 | | | | | |
| | GCOO | GCOO | ASHI | KCRO | --- |
| | 04/03/22 | 04/03/22 | 04/03/22 | 04/03/22 | --- |
| P02 | SGAR3 | | | | |
| | JMOR | JMOR | ASHI | KCRO | KCRO |
| | 19/04/22 | 19/04/22 | 09/05/22 | 09/05/22 | 09/05/22 |
| P03 | SGAR3 | | | | |
| | CMAR | CMAR | ASHI | KCRO | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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national highways

Project Name
A66 Northern Trans-Pennine

Drawing Title
Proposed Drainage Catchment Plan
Sheet 2 of 4

| Project Ref. No. | Stage | Scale : 1:2500 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number

| Project | Originator | Volume | | | |
|---|---|---|---|---|---|
| HE565627 - | AMY - | HDG | | | |
| S0405 | | | -DR- | CD- | 000218 |
| Location | | | Type | Role | Number |

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P03 |

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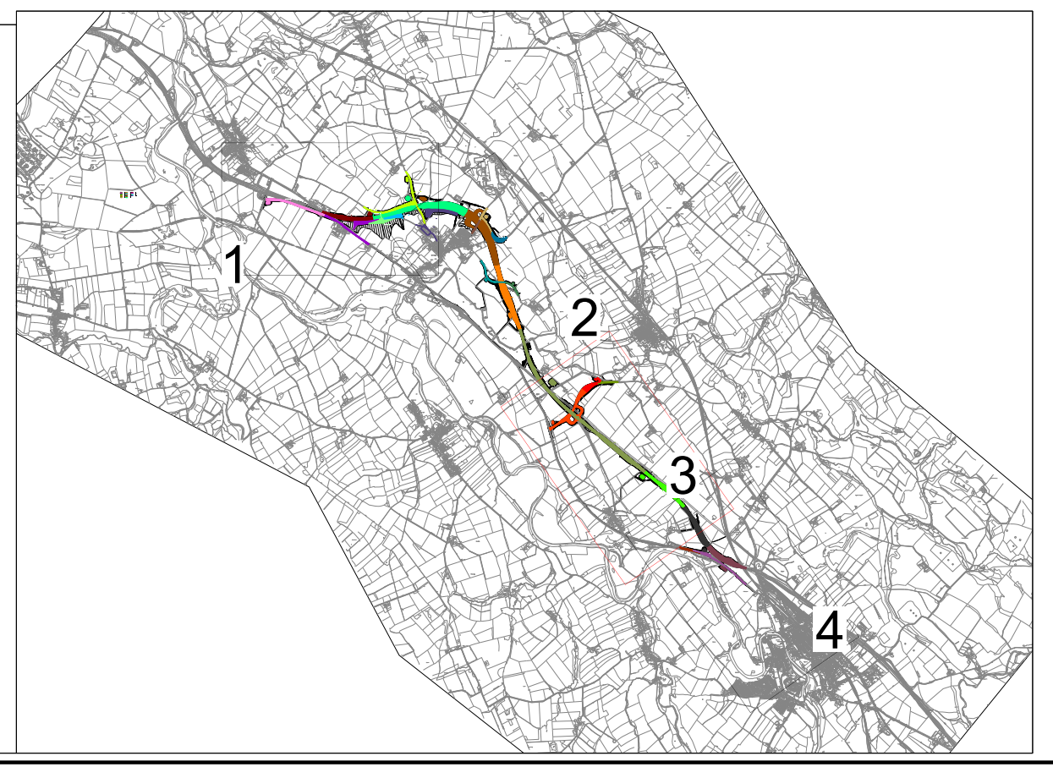
## Drainage key plan

### KEY

| | | | | | |
|---|---|---|---|---|---|
| ▨ | CATCHMENT S0405-01 | ▨ | CATCHMENT S0405-009 | ▨ | CATCHMENT S0405-016 |
| ▨ | CATCHMENT S0405-02 | ▨ | CATCHMENT S0405-010 | ▨ | CATCHMENT S0405-017 |
| ▨ | CATCHMENT S0405-03 | ▨ | CATCHMENT S0405-011 | ▨ | CATCHMENT S0405-018 |
| ▨ | CATCHMENT S0405-04 | ▨ | CATCHMENT S0405-012 | ▨ | CATCHMENT S0405-019 |
| ▨ | CATCHMENT S0405-05 | ▨ | CATCHMENT S0405-012a | ▨ | CATCHMENT S0405-020 |
| ▨ | CATCHMENT S0405-06 | ▨ | CATCHMENT S0405-012b | ▨ | CATCHMENT S0405-EX-D |
| ▨ | CATCHMENT S0405-6b | ▨ | CATCHMENT S0405-013 | | |
| ▨ | CATCHMENT S0405-07 | ▨ | CATCHMENT S0405-014 | | |
| ▨ | CATCHMENT S0405-08 | ▨ | CATCHMENT S0405-015 | | |

## Site key plan



| | | | | | | |
|---|---|---|---|---|---|---|
| P01 | | | | | | |
| | | GCOO | GCOO | ASHI | KCRO | --- |
| | | 04/03/22 | 04/03/22 | 04/03/22 | 04/03/22 | --- |
| P02 | SGAR3 | | | | | |
| | | JMOR | JMOR | ASHI | KCRO | KCRO |
| | | 19/04/22 | 19/04/22 | 09/05/22 | 09/05/22 | 09/05/22 |
| P03 | SGAR3 | | | | | |
| | | CMAR | CMAR | ASHI | KCRO | KCRO |
| | | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | | |
| | | Created | Checked | Reviewed | Approved | Authorised |
| | | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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national highways

Project Name
A66 Northern Trans-Pennine

Drawing Title
Proposed Drainage Catchment Plan
Sheet 3 of 4

| Project Ref. No. | Stage | Scale : 1:2500 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number

| Project | Originator | Volume | Location | Type | Role | Number |
|---|---|---|---|---|---|---|
| HE565627 | AMY | HDG | S0405 | DR | CD | 000219 |

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P03 |

For continuation refer to drawing HE565627-AMY-HDG-S0405-DR-CD-000220

For continuation refer to drawing HE565627-AMY-HDG-S0405-DR-CD-000219

## NOTES

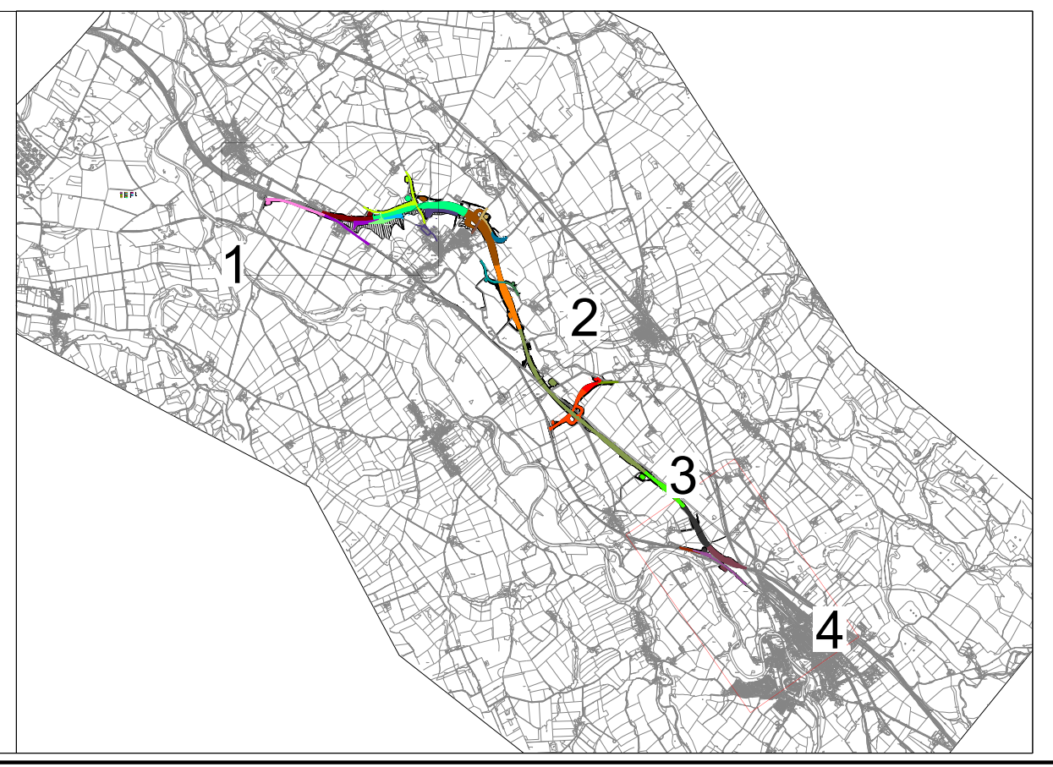
1. All levels are in metres above Ordnance Datum.
2. All dimensions are in millimetres unless otherwise stated.
3. The drainage design is of a sufficient level of detail to advise land take requirements and early stage design feasibility. Further design development to be undertaken.
4. Road markings and structures are indicative only and require further design development.
5. Fencing and gate locations subject to agreement with landowners.
6. Proposed drainage design designed in accordance with the Standards for Highways Design Manual for Roads and Bridges (DMRB) and Local Authority Guidance.
7. Existing drainage information based on HADDMS, as-built drawings, OS, JBA culvert surveys, site walk overs and topographical survey information. Existing drainage is omitted from this drawing.
8. Drainage design has been completed based on the 1, 5, and 100yr + 40%cc storm events and adheres to the below requirements:
   •No surcharging in 1yr storm event
   •No flooding in 1 or 5yr storm event
   •Water not to exceed pond storage layer in 1 in 100yr + 40% climate change storm event.
9. Ditches have a 1:2 side slope
10. Ponds to have minimum 0.3 freeboard, 0.5m of standing water. Stored water level not to exceed 1.5m in accordance with CD532. Ponds to have internal side slopes of 1:4.
11. Fencing and gate to be erected around pond and associated access track, subject to adopting authority requirements.

## Drainage key plan

### KEY

▨ CATCHMENT S0405-01
▨ CATCHMENT S0405-02
▨ CATCHMENT S0405-03
▨ CATCHMENT S0405-04
▨ CATCHMENT S0405-05
▨ CATCHMENT S0405-06
▨ CATCHMENT S0405-6b
▨ CATCHMENT S0405-07
▨ CATCHMENT S0405-08
▨ CATCHMENT S0405-009
▨ CATCHMENT S0405-010
▨ CATCHMENT S0405-011
▨ CATCHMENT S0405-012
▨ CATCHMENT S0405-012a
▨ CATCHMENT S0405-012b
▨ CATCHMENT S0405-013
▨ CATCHMENT S0405-014
▨ CATCHMENT S0405-015
▨ CATCHMENT S0405-016
▨ CATCHMENT S0405-017
▨ CATCHMENT S0405-018
▨ CATCHMENT S0405-019
▨ CATCHMENT S0405-020
▨ CATCHMENT S0405-EX-D

## Site key plan



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| P01 | | | | | |
| | GCOO | GCOO | ASHI | KCRO | --- |
| | 04/03/22 | 04/03/22 | 04/03/22 | 04/03/22 | --- |
| P02 | SGAR3 | | | | |
| | JMOR | JMOR | ASHI | KCRO | KCRO |
| | 19/04/22 | 19/04/22 | 09/05/22 | 09/05/22 | 09/05/22 |
| P03 | SGAR3 | | | | |
| | CMAR | CMAR | ASHI | KCRO | KCRO |
| | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 | 06/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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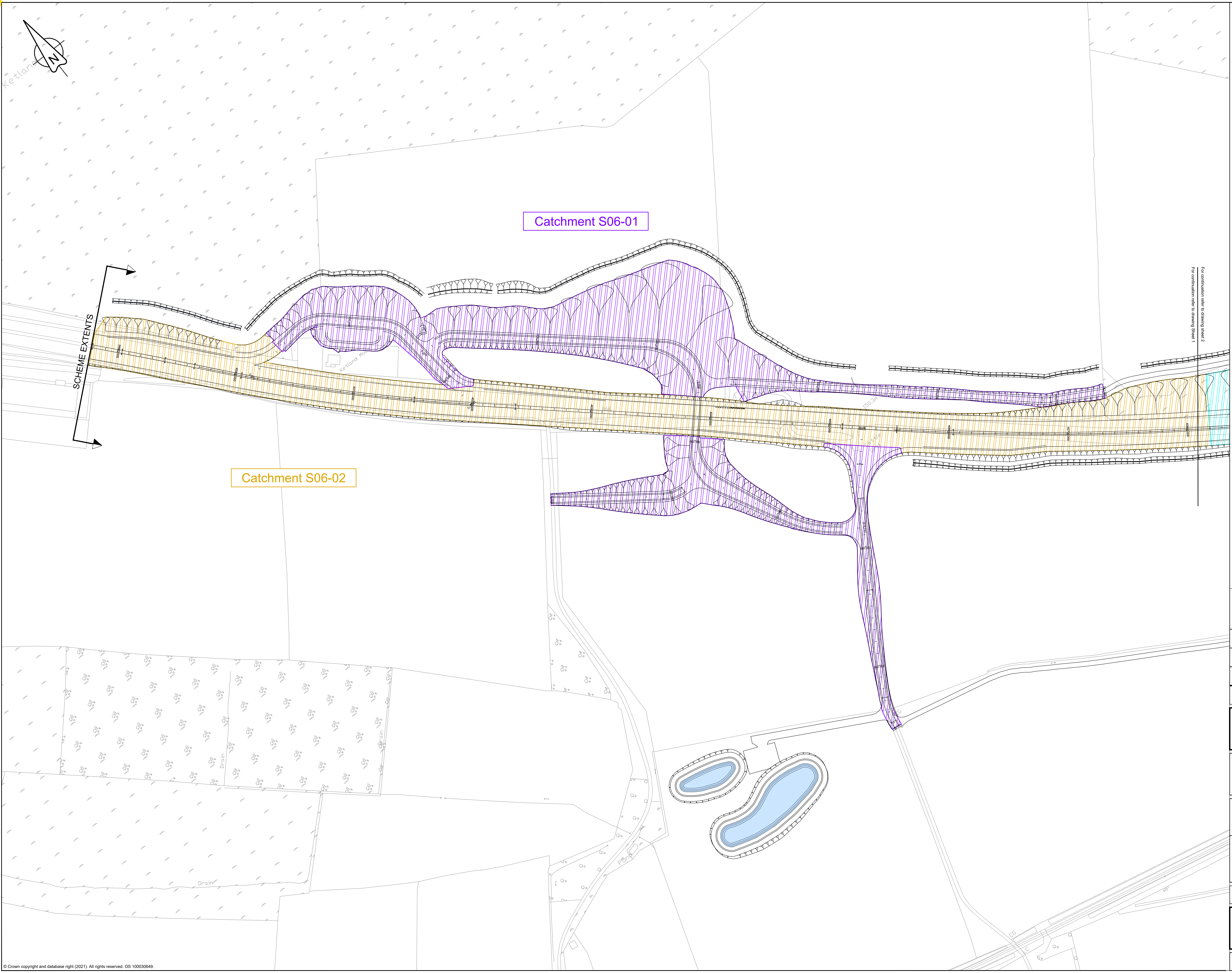
Project Name
A66 Northern Trans-Pennine

Drawing Title
Proposed Drainage Catchment Plan
Sheet 4 of 4

| Project Ref. No. | Stage | Scale : 1:2500 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume
HE565627 - AMY - HDG
S0405 -DR-CD- 000220
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P03 |



## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. TO BE READ IN CONJUNCTION WITH THE EXISTING CATCHMENT DRAWINGS.

## KEY

| | |
|---|---|
| ▨ | CATCHMENT S06-01 |
| ▨ | CATCHMENT S06-02 |
| ▨ | CATCHMENT S06-03 |
| ▨ | CATCHMENT S06-04 |
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| ▨ | CATCHMENT S06-06 |
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| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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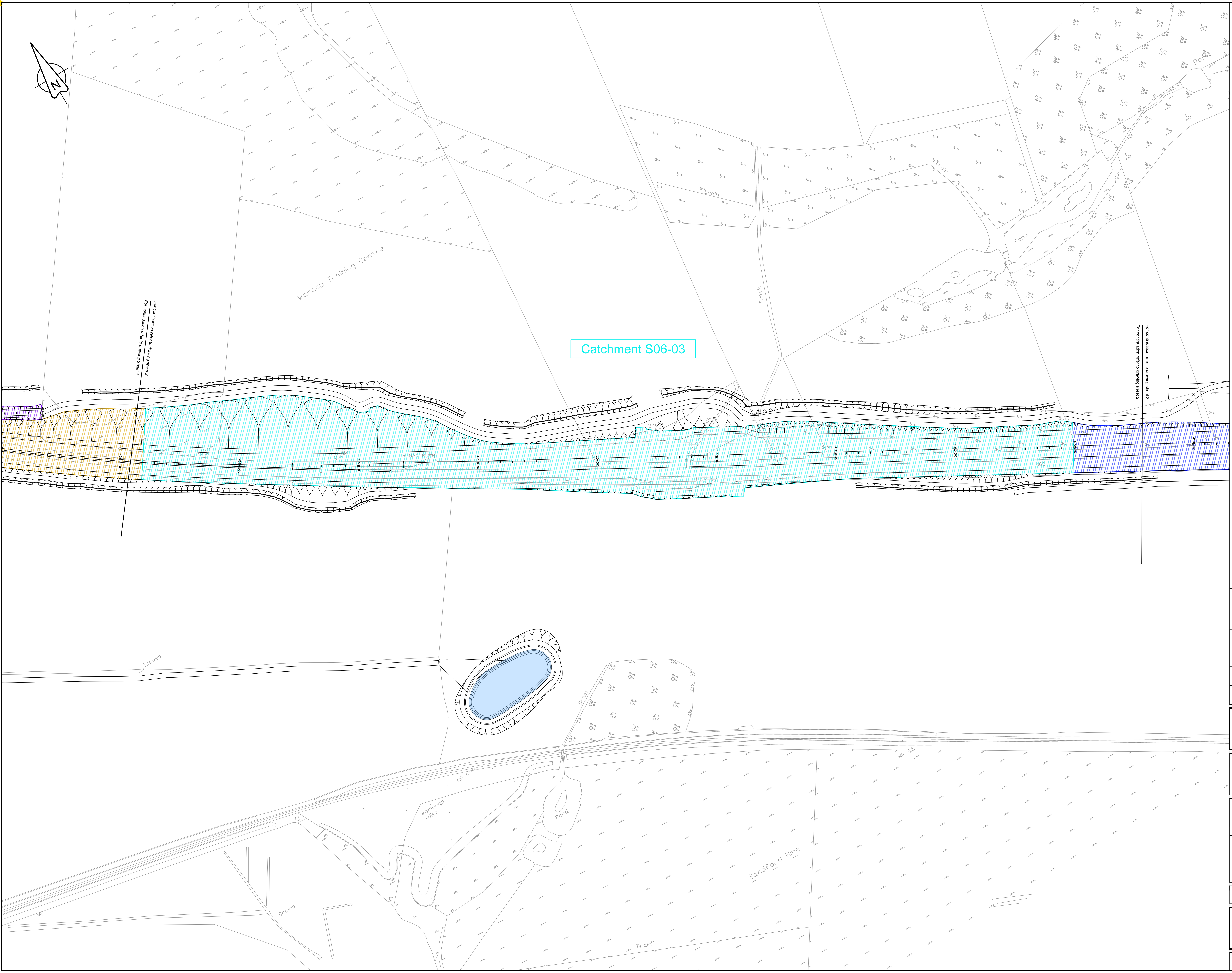
Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Proposed Catchment Areas
Sheet 1 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 -DR-CD-476050
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P01 |



## NOTES

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## KEY

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| ▨ | CATCHMENT S06-01 |
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| P01 | SGAR3 | | | | |
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| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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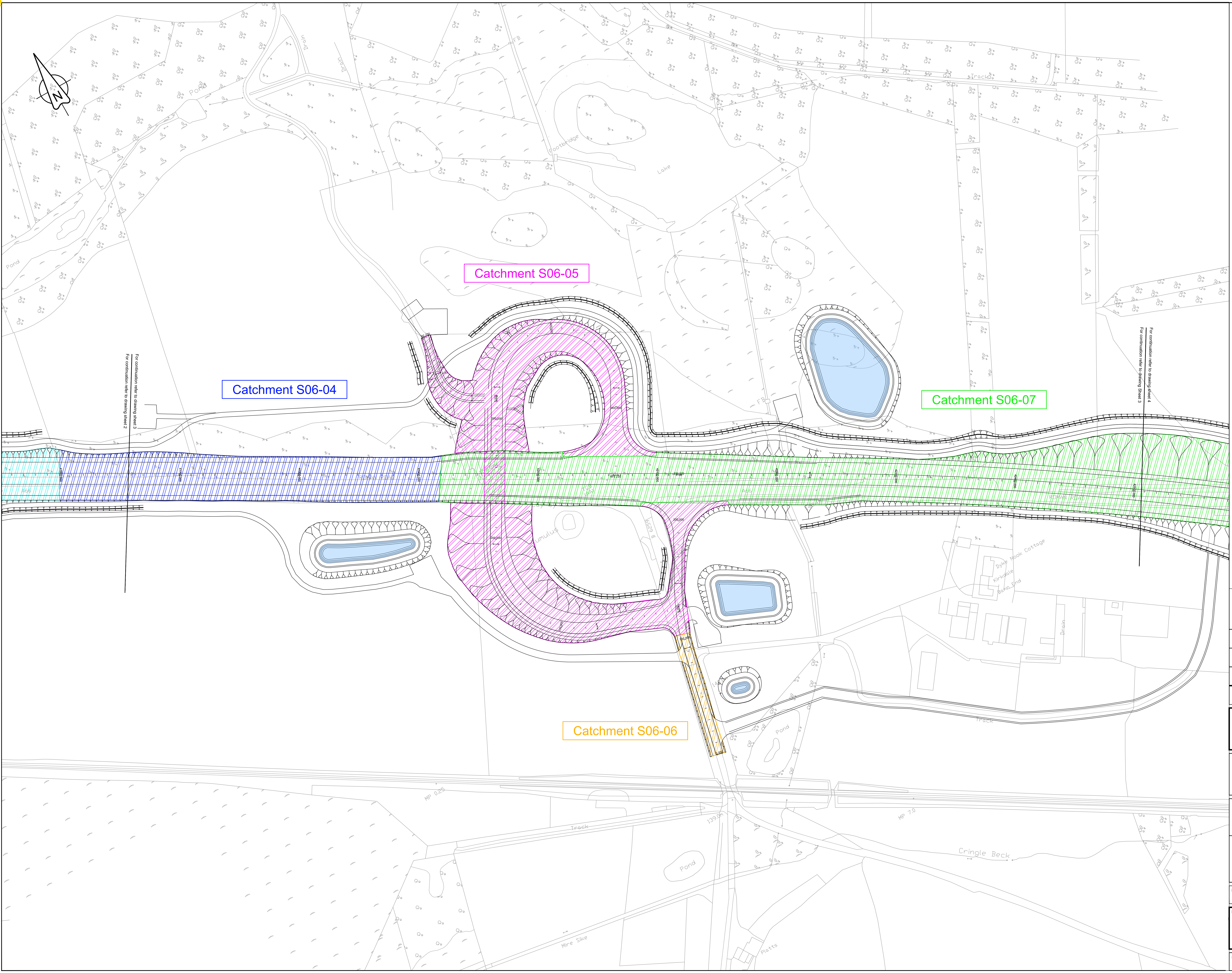
Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Proposed Catchment Areas
Sheet 2 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 -DR-CD- 476051
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P01 |



## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. TO BE READ IN CONJUNCTION WITH THE EXISTING CATCHMENT DRAWINGS.

## KEY

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| ▨ | CATCHMENT S06-01 |
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| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Proposed Catchment Areas
Sheet 3 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 -DR-CD- 476052
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P01 |

## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. TO BE READ IN CONJUNCTION WITH THE EXISTING CATCHMENT DRAWINGS.

## KEY

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| ▨ | CATCHMENT S06-01 |
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| P01 | SGAR3 | | | | |
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| Revision | Revision details | | | | |
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| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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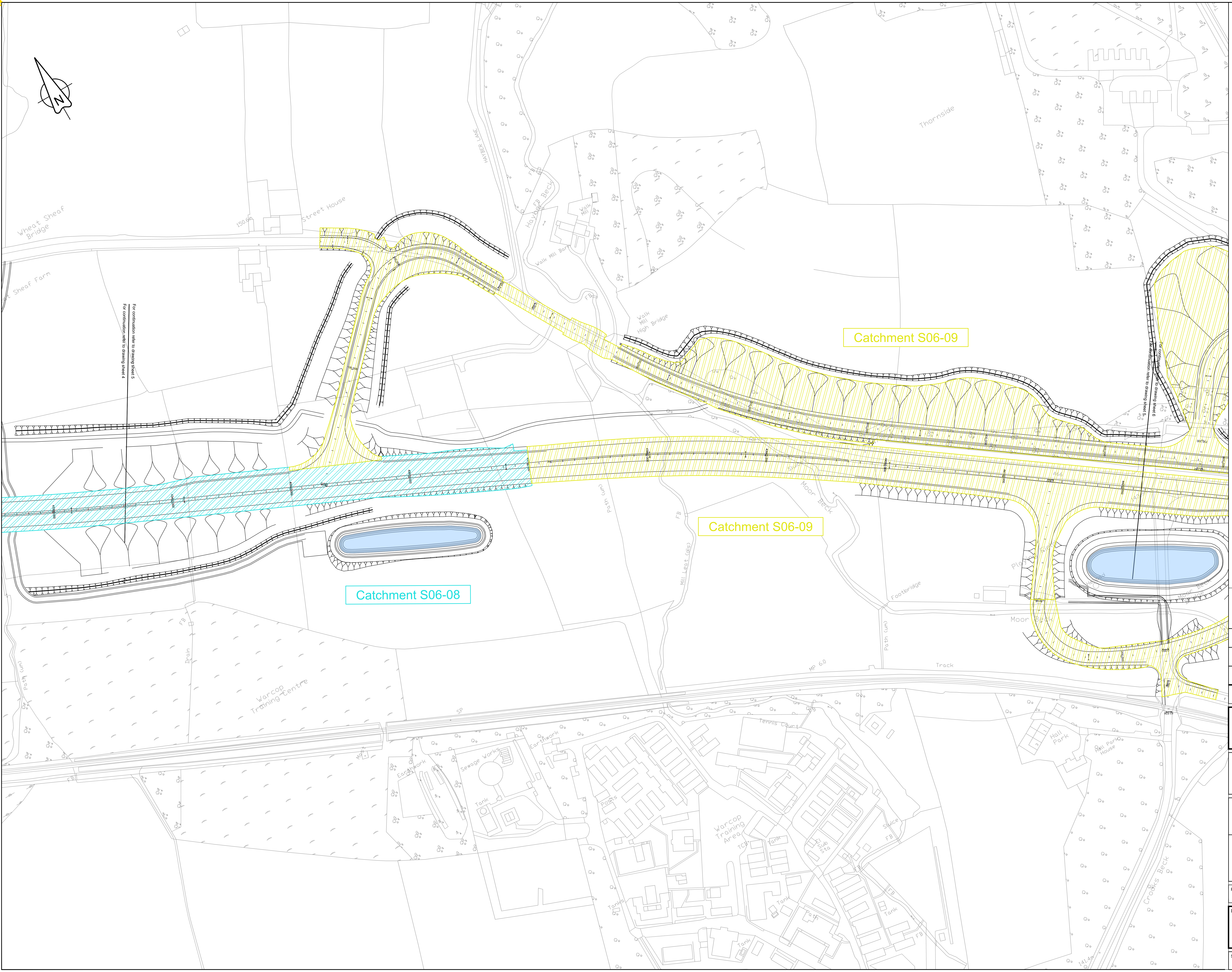
Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Proposed Catchment Areas
Sheet 4 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 -DR-CD-476053
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P01 |



## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. TO BE READ IN CONJUNCTION WITH THE EXISTING CATCHMENT DRAWINGS.

## KEY

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| ▨ | CATCHMENT S06-01 |
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| P01 | SGAR3 | | | | |
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| Revision | Revision details | | | | |
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| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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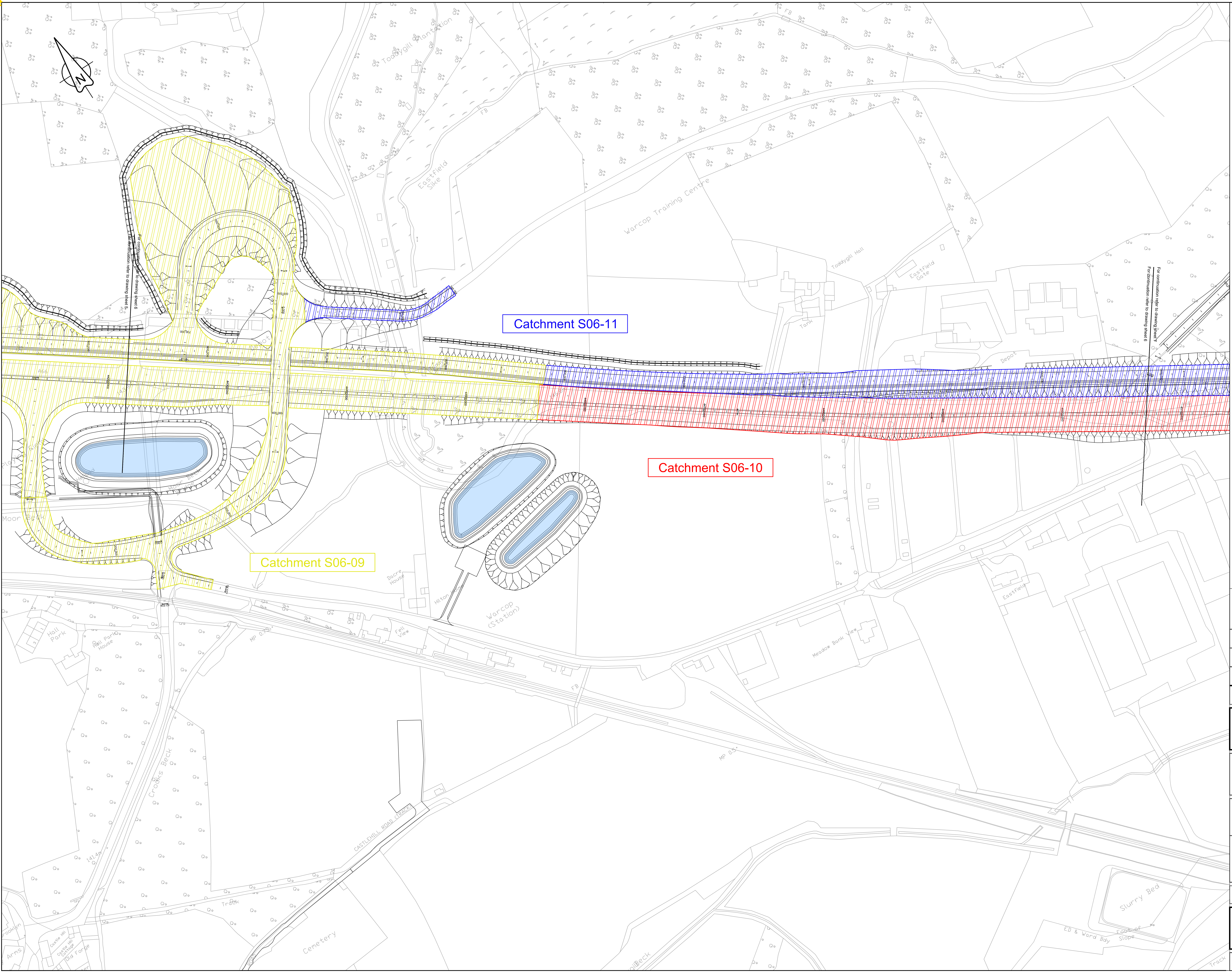
Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Proposed Catchment Areas
Sheet 5 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 -DR-CD-476054
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P01 |



## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. TO BE READ IN CONJUNCTION WITH THE EXISTING CATCHMENT DRAWINGS.

## KEY

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| P01 | SGAR3 | | | | |
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| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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national highways

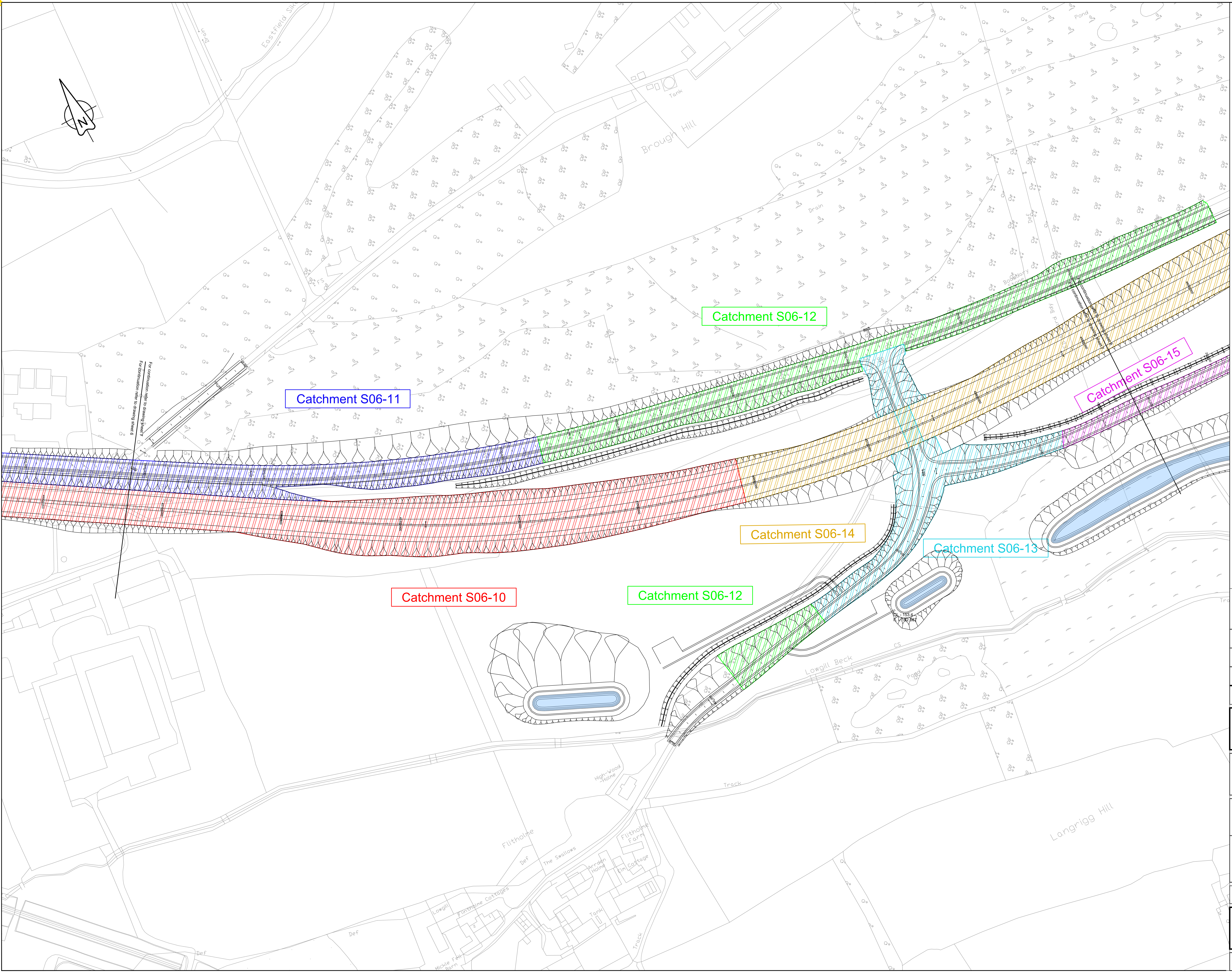
Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Proposed Catchment Areas
Sheet 6 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 -DR-CD-476055
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P01 |



## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. TO BE READ IN CONJUNCTION WITH THE EXISTING CATCHMENT DRAWINGS.

## KEY

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| ▨ | CATCHMENT S06-01 |
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| P01 | SGAR3 | | | | |
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| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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Project Name
A66 Northern Trans-Pennine

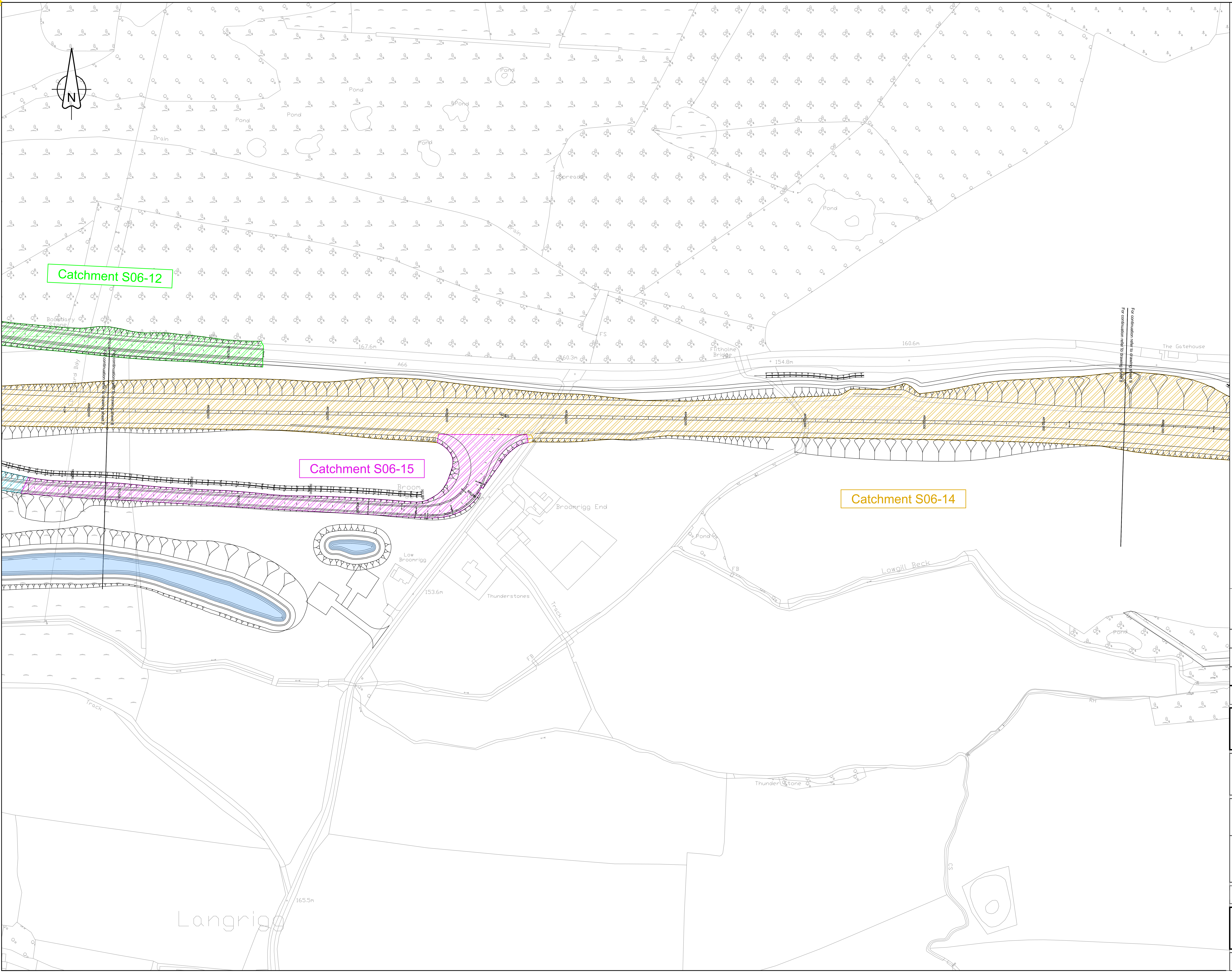
Drawing Title
Appleby to Brough
Proposed Catchment Areas
Sheet 7 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number

| Project | Originator | Volume | Location | Type | Role | Number |
|---|---|---|---|---|---|---|
| HE565627 | AMY | HDG | S06 | DR | CD | 476056 |

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P01 |



## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. TO BE READ IN CONJUNCTION WITH THE EXISTING CATCHMENT DRAWINGS.

## KEY

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| ▨ | CATCHMENT S06-01 |
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| ▨ | CATCHMENT S06-10 |
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| ▨ | CATCHMENT S06-12 |
| ▨ | CATCHMENT S06-13 |
| ▨ | CATCHMENT S06-14 |
| ▨ | CATCHMENT S06-15 |
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| P01 | SGAR3 | | | | |
| | UHUS | UHUS | WBOA | WBOA | KCRO |
| | 06/05/22 | 06/05/22 | 09/05/22 | 09/05/22 | 09/05/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
Amey OW Limited
Chancery Exchange
10 Furnival Street
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Client
3 Piccadilly Place
Manchester
M1 3BN

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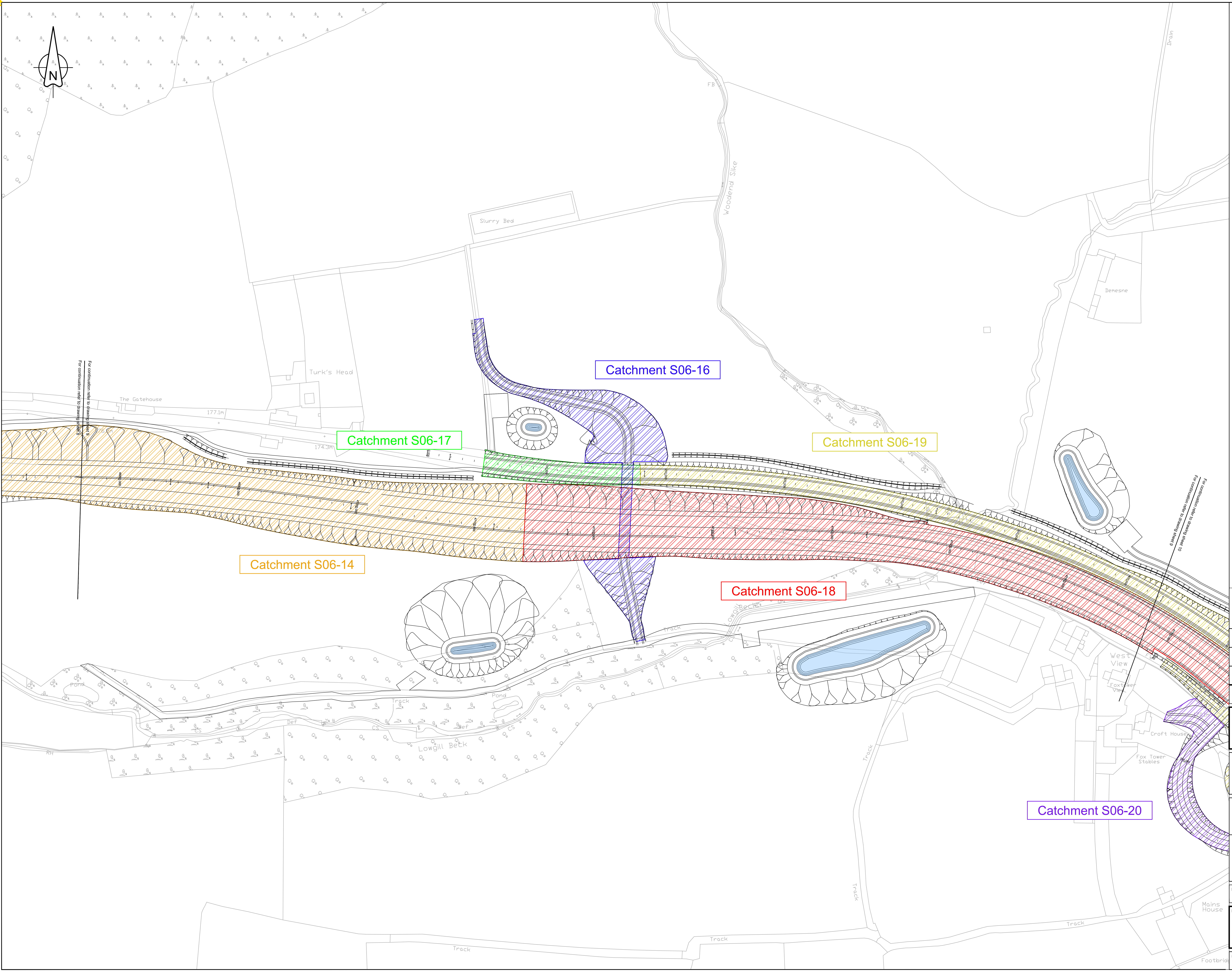
Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Proposed Catchment Areas
Sheet 8 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 -DR-CD- 476057
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P01 |



## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. TO BE READ IN CONJUNCTION WITH THE EXISTING CATCHMENT DRAWINGS.

## KEY

| | |
|---|---|
| ▨ | CATCHMENT S06-01 |
| ▨ | CATCHMENT S06-02 |
| ▨ | CATCHMENT S06-03 |
| ▨ | CATCHMENT S06-04 |
| ▨ | CATCHMENT S06-05 |
| ▨ | CATCHMENT S06-06 |
| ▨ | CATCHMENT S06-07 |
| ▨ | CATCHMENT S06-08 |
| ▨ | CATCHMENT S06-09 |
| ▨ | CATCHMENT S06-10 |
| ▨ | CATCHMENT S06-11 |
| ▨ | CATCHMENT S06-12 |
| ▨ | CATCHMENT S06-13 |
| ▨ | CATCHMENT S06-14 |
| ▨ | CATCHMENT S06-15 |
| ▨ | CATCHMENT S06-16 |
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| ▨ | CATCHMENT S06-18 |
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| ▨ | CATCHMENT S06-20 |

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| P01 | SGAR3 | | | | |
| | UHUS | UHUS | WBOA | WBOA | KCRO |
| | 06/05/22 | 06/05/22 | 09/05/22 | 09/05/22 | 09/05/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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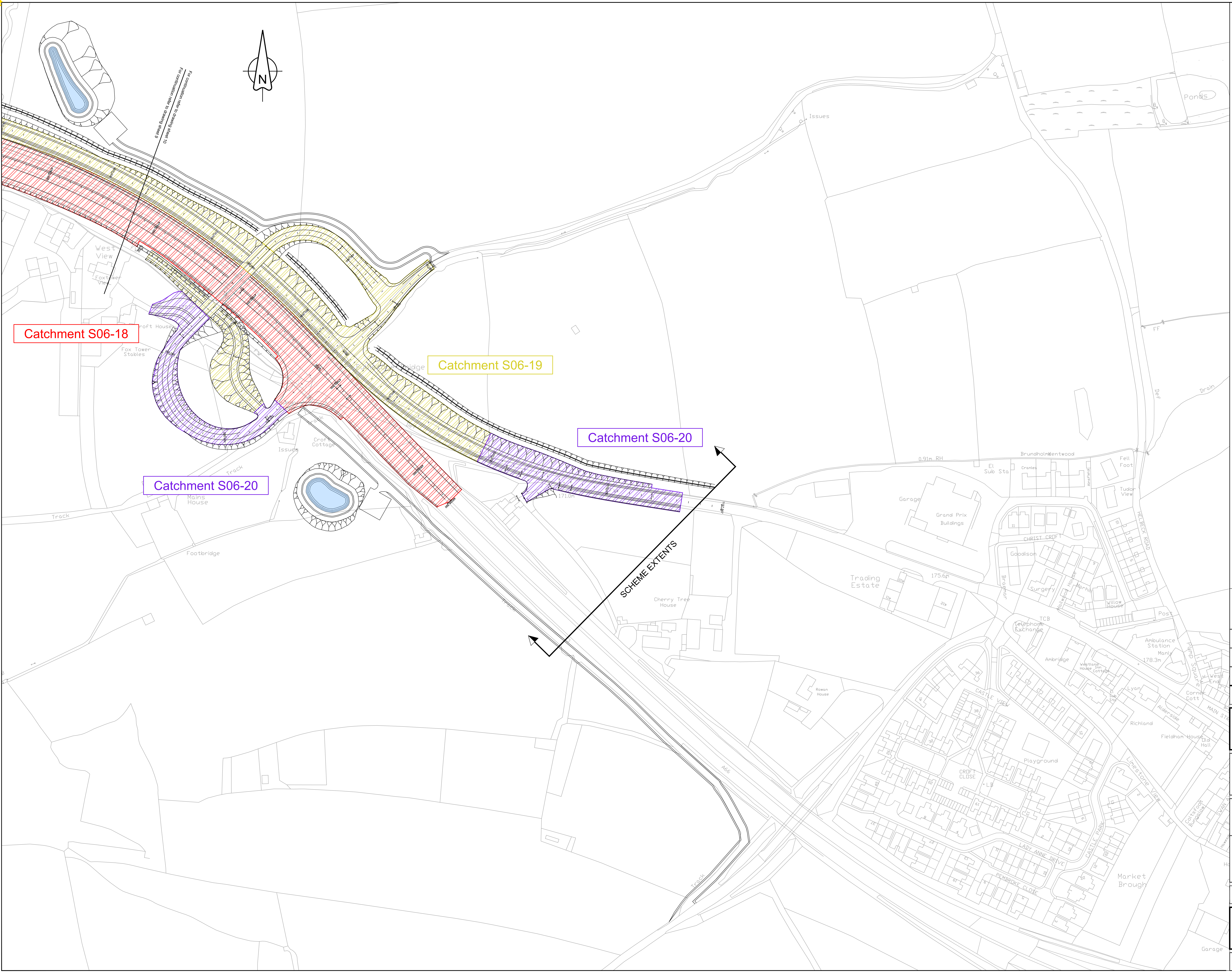
Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Proposed Catchment Areas
Sheet 9 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S06 -DR-CD- 476058
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P01 |



## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. TO BE READ IN CONJUNCTION WITH THE EXISTING CATCHMENT DRAWINGS.

## KEY

| | |
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| ▨ | CATCHMENT S06-01 |
| ▨ | CATCHMENT S06-02 |
| ▨ | CATCHMENT S06-03 |
| ▨ | CATCHMENT S06-04 |
| ▨ | CATCHMENT S06-05 |
| ▨ | CATCHMENT S06-06 |
| ▨ | CATCHMENT S06-07 |
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| ▨ | CATCHMENT S06-09 |
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| ▨ | CATCHMENT S06-16 |
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| P01 | SGAR3 | | | | |
| | UHUS | UHUS | WBOA | WBOA | KCRO |
| | 06/05/22 | 06/05/22 | 09/05/22 | 09/05/22 | 09/05/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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Project Name
A66 Northern Trans-Pennine

Drawing Title
Appleby to Brough
Proposed Catchment Areas
Sheet 10 of 10

| Project Ref. No. | Stage | Scale : 1:1000 @ A0 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number

| Project | Originator | Volume | Location | Type | Role | Number |
|---|---|---|---|---|---|---|
| HE565627 | AMY | HDG | S06 | DR | CD | 476059 |

HE565627 - AMY - HDG - S06 -DR-CD-476059

| Suitability | Suitability Description | Revision |
|---|---|---|
| S4 | Fit for Stage Approval | P01 |

Area assumed to connect to Highways drainage based on "as built" information. Further survey required.

# NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. AREAS INCLUDED HAVE BEEN ASSESSED BASED ON HADAMS AND AS-BUILT RECORDS.
3. PROPOSED PONDS ASSUMED TO BE LINED AND IMPERMEABLE.

# KEY

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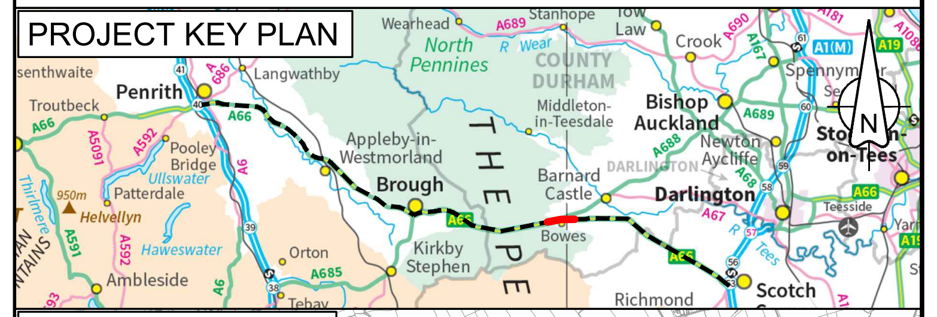
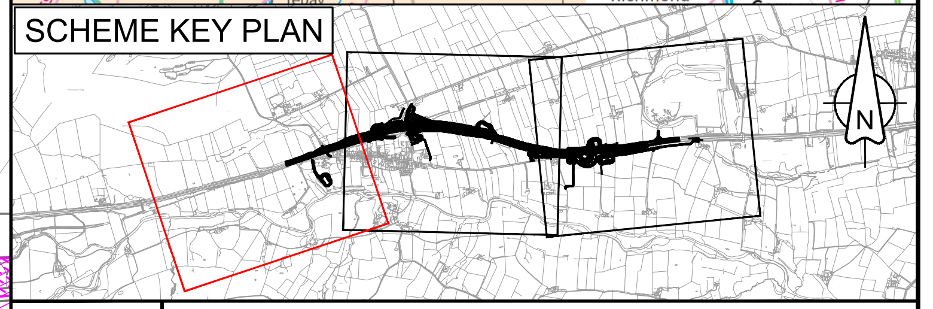
| ▨ | CATCHMENT S07-01 |
| ▨ | CATCHMENT S07-02 |
| ▨ | CATCHMENT S07-03 |
| ▨ | CATCHMENT S07-04 |
| ▨ | CATCHMENT S07-05 |
| ▨ | CATCHMENT S07-06 |
| ▨ | CATCHMENT S07-07 |

PROJECT KEY PLAN



SCHEME KEY PLAN



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| C01 | SGAR3 | | | | |
| | ATUN | ATUN | JHAR | THAL | SSCO |
| | 07/06/22 | 07/06/22 | 08/06/22 | 08/06/22 | 08/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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Project Name
A66 Northern Trans-Pennine

Drawing Title
Bowes Bypass
Proposed Catchment Plan
Sheet 1 of 3

| Project Ref. No. | Stage | Scale : 1:2500 @ A1 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S07 -DR-CD-000201
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |

## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
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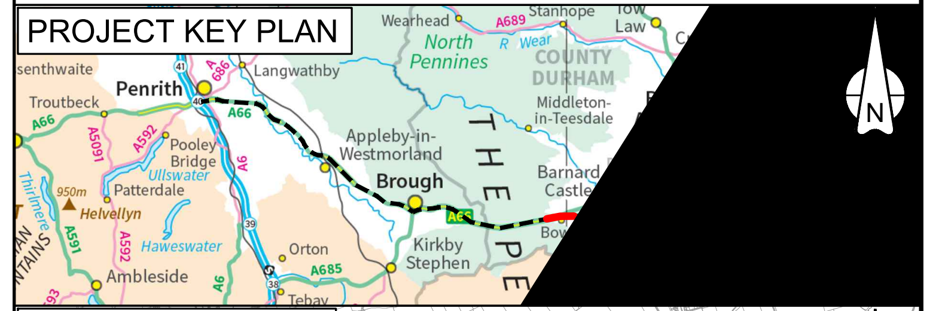
3. PROPOSED PONDS ASSUMED TO BE LINED AND IMPERMEABLE.

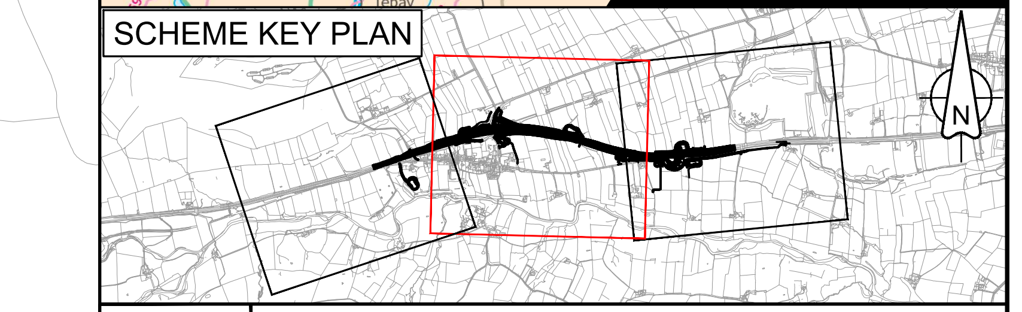
## KEY

| | |
|---|---|
| ▨ | CATCHMENT S07-01 |
| ▨ | CATCHMENT S07-02 |
| ▨ | CATCHMENT S07-03 |
| ▨ | CATCHMENT S07-04 |
| ▨ | CATCHMENT S07-05 |
| ▨ | CATCHMENT S07-06 |
| ▨ | CATCHMENT S07-07 |

PROJECT KEY PLAN



SCHEME KEY PLAN



| Revision | Created | Checked | Reviewed | Approved | Authorised |
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| C01 | SGAR3 | | | | |
| | ATUN | ATUN | JHAR | THAL | SSCO |
| | 07/06/22 | 07/06/22 | 08/06/22 | 08/06/22 | 08/06/22 |
| Revision | Revision details | | | | |
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| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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Project Name
A66 Northern Trans-Pennine

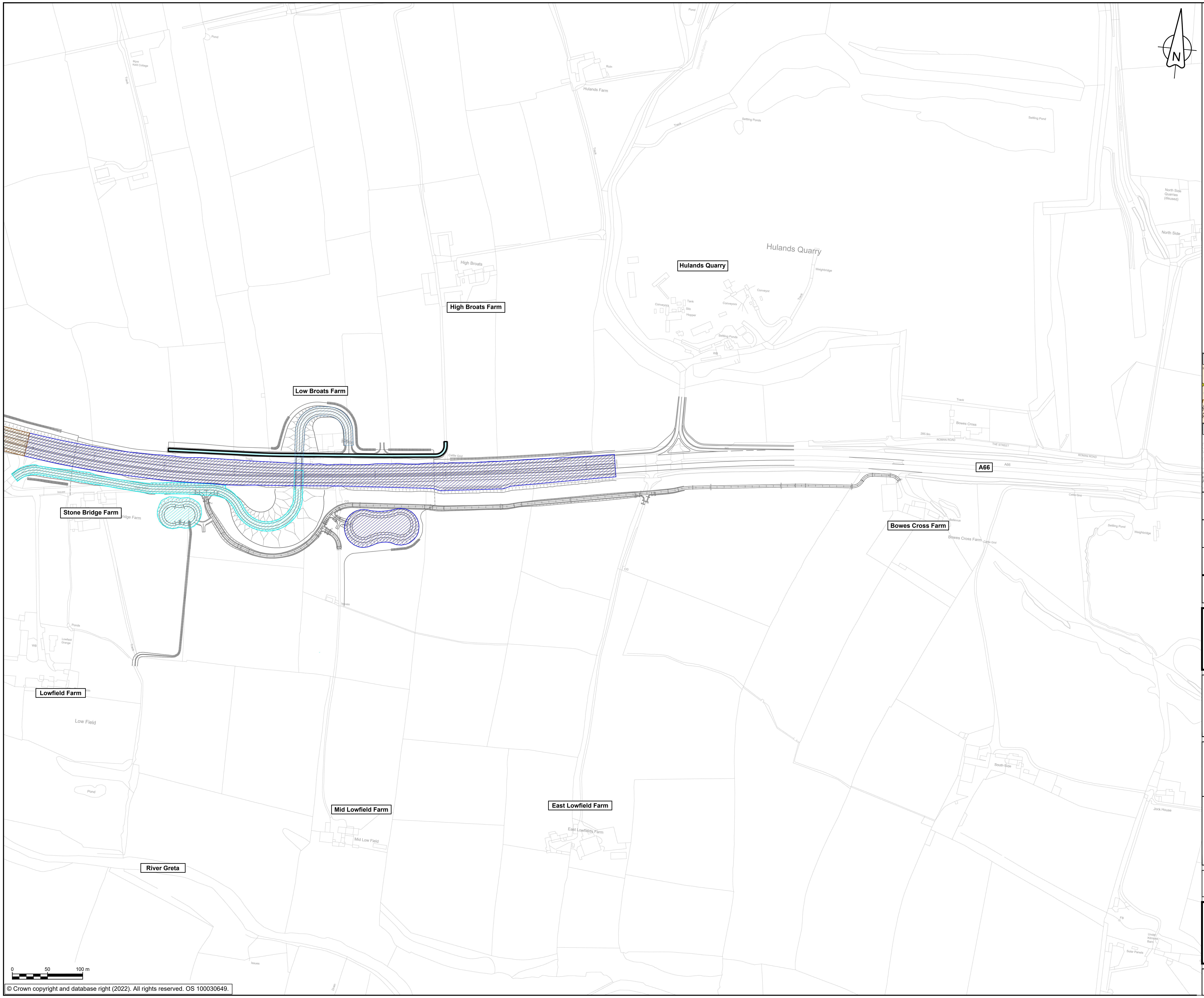
Drawing Title
Bowes Bypass
Proposed Catchment Plan
Sheet 2 of 3

| Project Ref. No. | Stage | Scale : 1:2500 @ A1 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number

| Project | Originator | Volume | Location | Type | Role | Number |
|---|---|---|---|---|---|---|
| HE565627 | AMY | HDG | S07 | DR | CD | 000202 |

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |



# NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. AREAS INCLUDED HAVE BEEN ASSESSED BASED ON HADAMS AND AS-BUILT RECORDS.
3. PROPOSED PONDS ASSUMED TO BE LINED AND IMPERMEABLE.

# KEY

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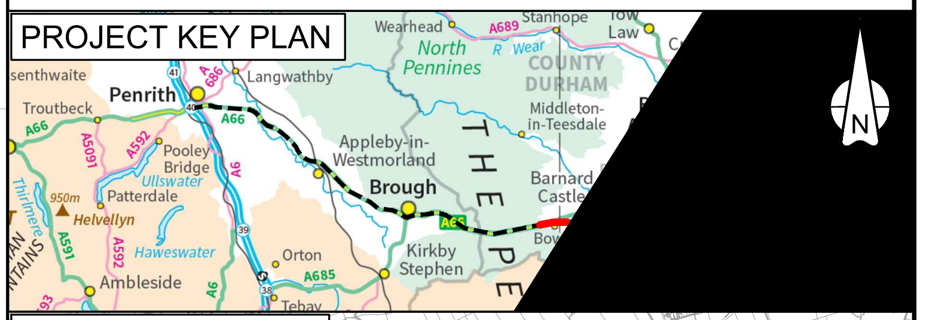
|---|---|
| ▨ | CATCHMENT S07-01 |
| ▨ | CATCHMENT S07-02 |
| ▨ | CATCHMENT S07-03 |
| ▨ | CATCHMENT S07-04 |
| ▨ | CATCHMENT S07-05 |
| ▨ | CATCHMENT S07-06 |
| ▨ | CATCHMENT S07-07 |

PROJECT KEY PLAN



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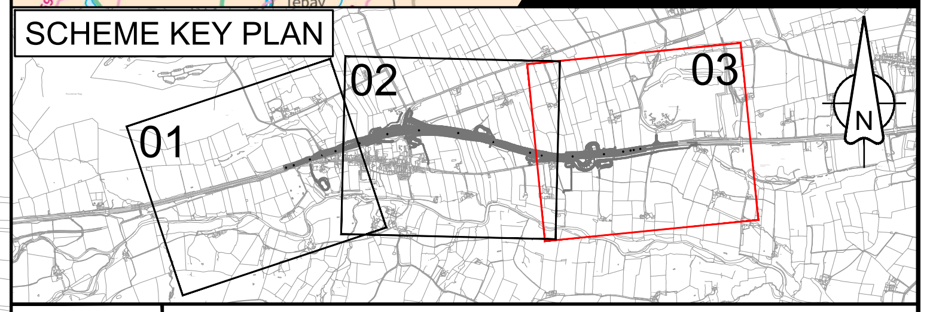

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| C01 | SGAR3 | | | | |
| | ATUN | ATUN | JHAR | THAL | SSCO |
| | 07/06/22 | 07/06/22 | 08/06/22 | 08/06/22 | 08/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
Amey OW Limited
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10 Furnival Street
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Client
3 Piccadilly Place
Manchester
M1 3BN

national highways

Project Name
A66 Northern Trans-Pennine

Drawing Title
Bowes Bypass
Proposed Catchment Plan
Sheet 3 of 3

| Project Ref. No. | Stage | Scale : 1:2500 @ A1 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S07 -DR-CD-000203
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |

Section of Highways past proposed work extents included to allow for existing Highways which drains East. This is based on As Built information.

For continuation please refer to Sheet 2

For continuation please refer to Sheet 2

## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
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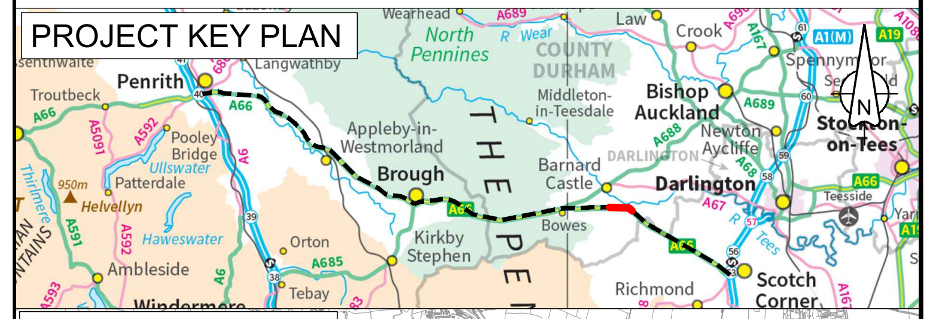
3. PROPOSED PONDS ASSUMED TO BE LINED AND IMPERMEABLE

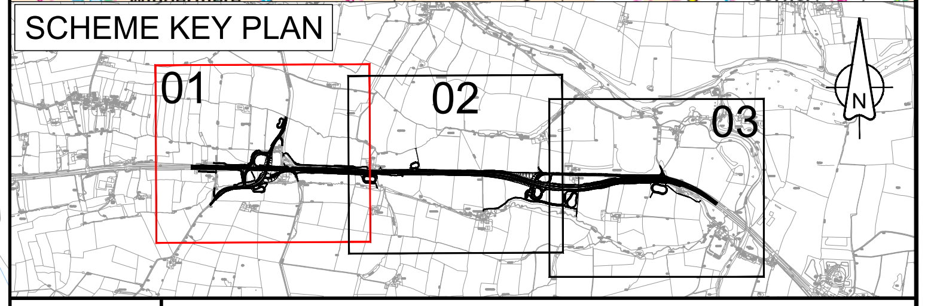
## KEY

▨ CATCHMENT S08-01
▨ CATCHMENT S08-02
▨ CATCHMENT S08-03
▨ CATCHMENT S08-04
▨ CATCHMENT S08-05
▨ CATCHMENT S08-06
▨ CATCHMENT S08-07
▨ CATCHMENT S08-08
▨ CATCHMENT S08-09
▨ CATCHMENT S08-10

PROJECT KEY PLAN



SCHEME KEY PLAN



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| C01 | SGAR3 | | | | |
| | ATUN | ATUN | JHAR | THAL | SSCO |
| | 07/06/22 | 07/06/22 | 08/06/22 | 08/06/22 | 08/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

Designer
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Manchester
M1 3BN

national highways

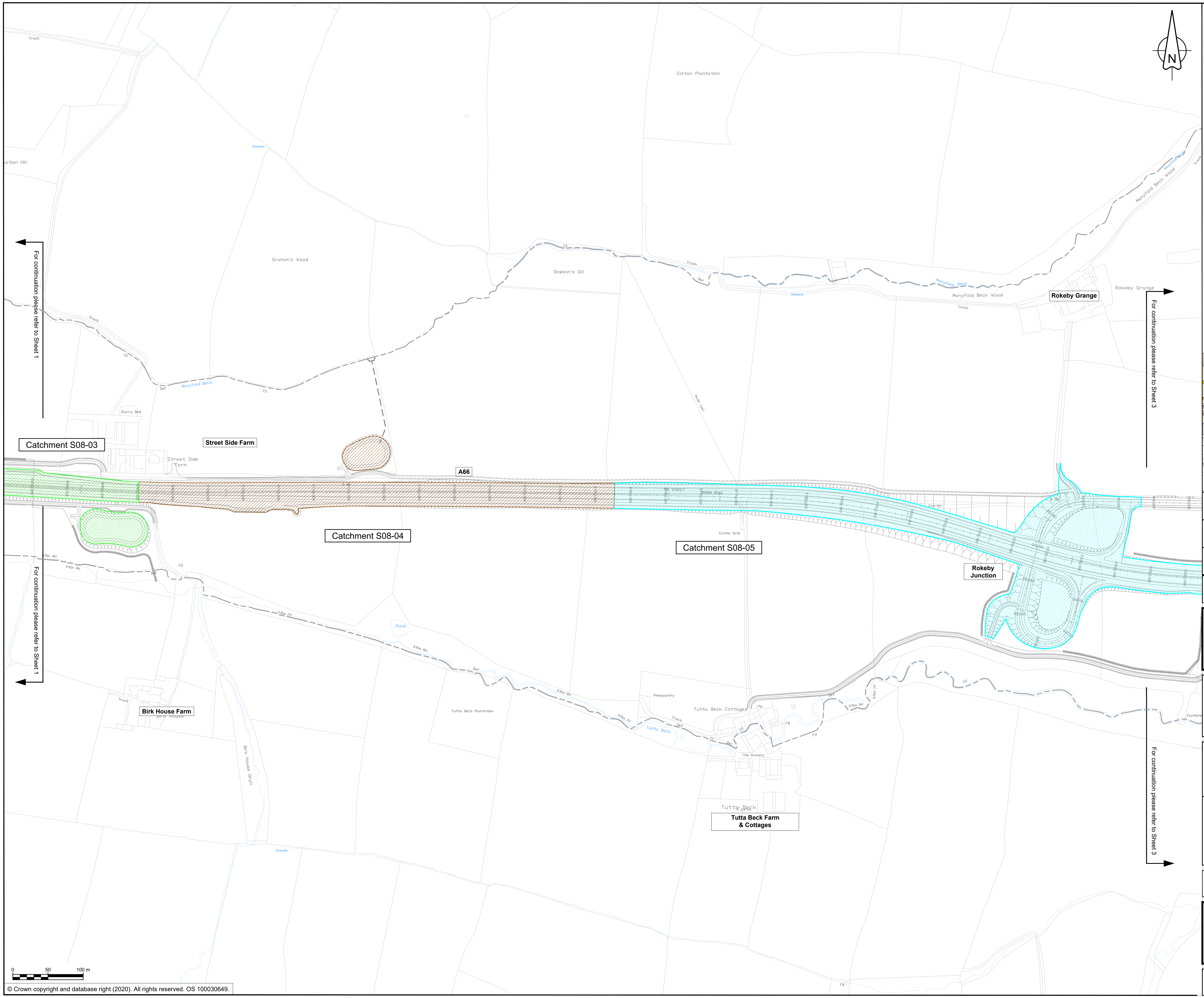
Project Name
A66 Northern Trans-Pennine

Drawing Title
Cross Lanes to Rokeby
Proposed Catchment Plan
Sheet 1 of 3

| Project Ref. No. | Stage | Scale : 1:2500 @ A1 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S08 -DR-CD- 000201
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |



## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
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3. PROPOSED PONDS ASSUMED TO BE LINED AND IMPERMEABLE

## KEY

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| 🟥 | CATCHMENT S08-01 |
| ▨ | CATCHMENT S08-02 |
| 🟩 | CATCHMENT S08-03 |
| 🟫 | CATCHMENT S08-04 |
| ▨ | CATCHMENT S08-05 |
| 🟦 | CATCHMENT S08-06 |
| ▨ | CATCHMENT S08-07 |
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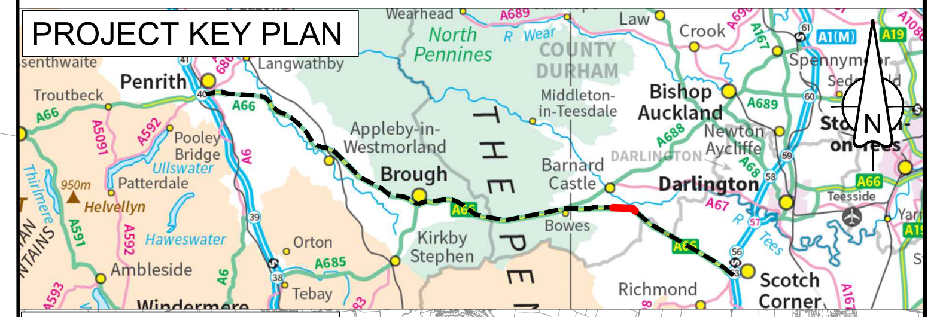
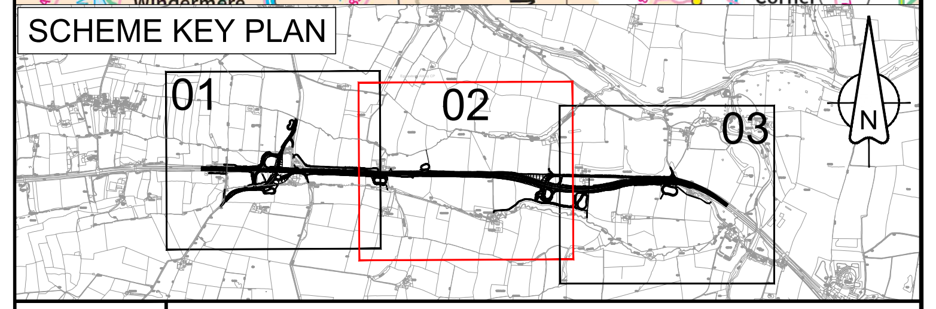
| 🟩 | CATCHMENT S08-10 |

PROJECT KEY PLAN



SCHEME KEY PLAN



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| C01 | SGAR3 | | | | |
| | ATUN | ATUN | JHAR | THAL | SSCO |
| | 07/06/22 | 07/06/22 | 08/06/22 | 08/06/22 | 08/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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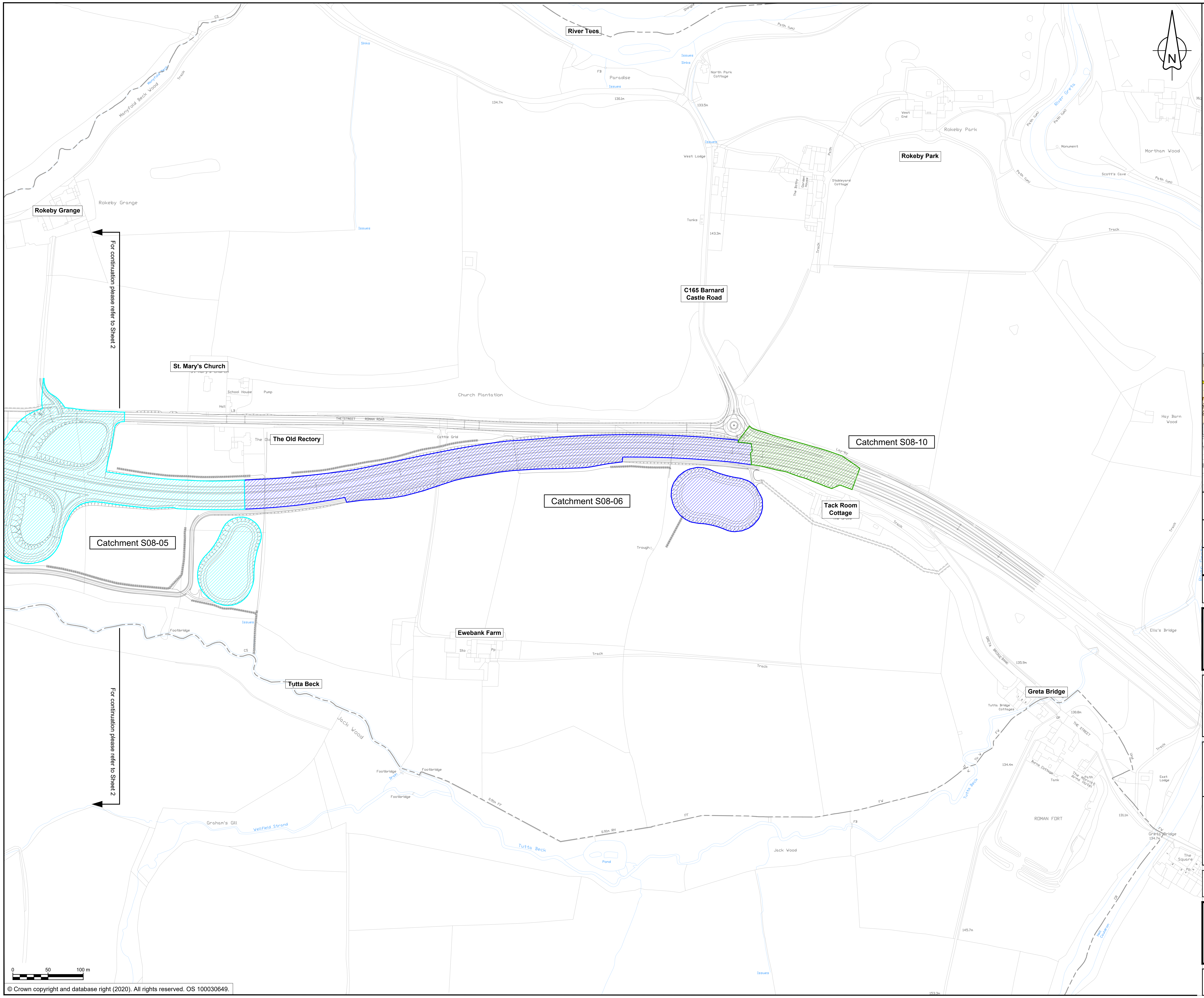
Project Name
A66 Northern Trans-Pennine

Drawing Title
Cross Lanes to Rokeby
Proposed Catchment Plan
Sheet 2 of 3

| Project Ref. No. | Stage | Scale : 1:2500 @ A1 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S08 -DR-CD- 000202
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |



For continuation please refer to Sheet 2

For continuation please refer to Sheet 2

## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. AREAS INCLUDED HAVE BEEN ASSESSED BASED ON HADAMS AND AS-BUILT RECORDS.
3. PROPOSED PONDS ASSUMED TO BE LINED AND IMPERMEABLE

## KEY

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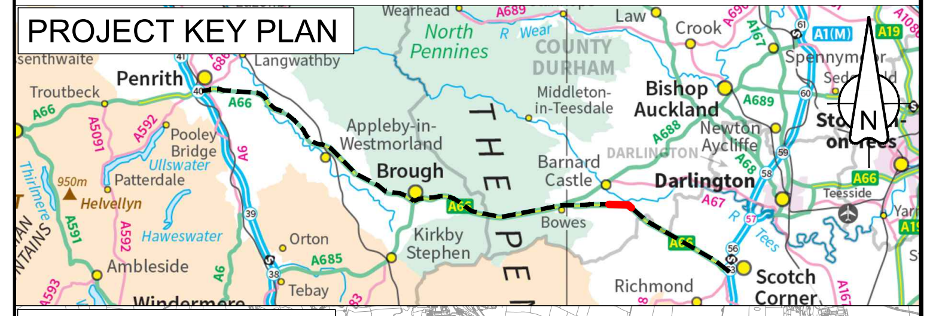
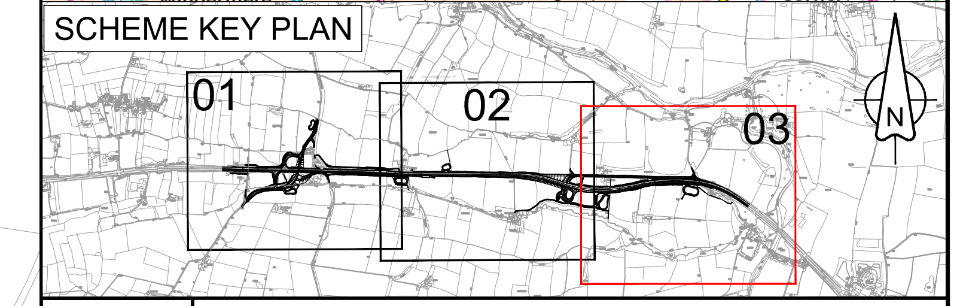
| ▨ | CATCHMENT S08-01 |
| ▨ | CATCHMENT S08-02 |
| ▨ | CATCHMENT S08-03 |
| ▨ | CATCHMENT S08-04 |
| ▨ | CATCHMENT S08-05 |
| ▨ | CATCHMENT S08-06 |
| ▨ | CATCHMENT S08-07 |
| ▨ | CATCHMENT S08-08 |
| ▨ | CATCHMENT S08-09 |
| ▨ | CATCHMENT S08-10 |

PROJECT KEY PLAN



SCHEME KEY PLAN



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| C01 | SGAR3 | | | | |
| | ATUN | ATUN | JHAR | THAL | SSCO |
| | 07/06/22 | 07/06/22 | 08/06/22 | 08/06/22 | 08/06/22 |
| Revision | Revision details | | | | |
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national highways

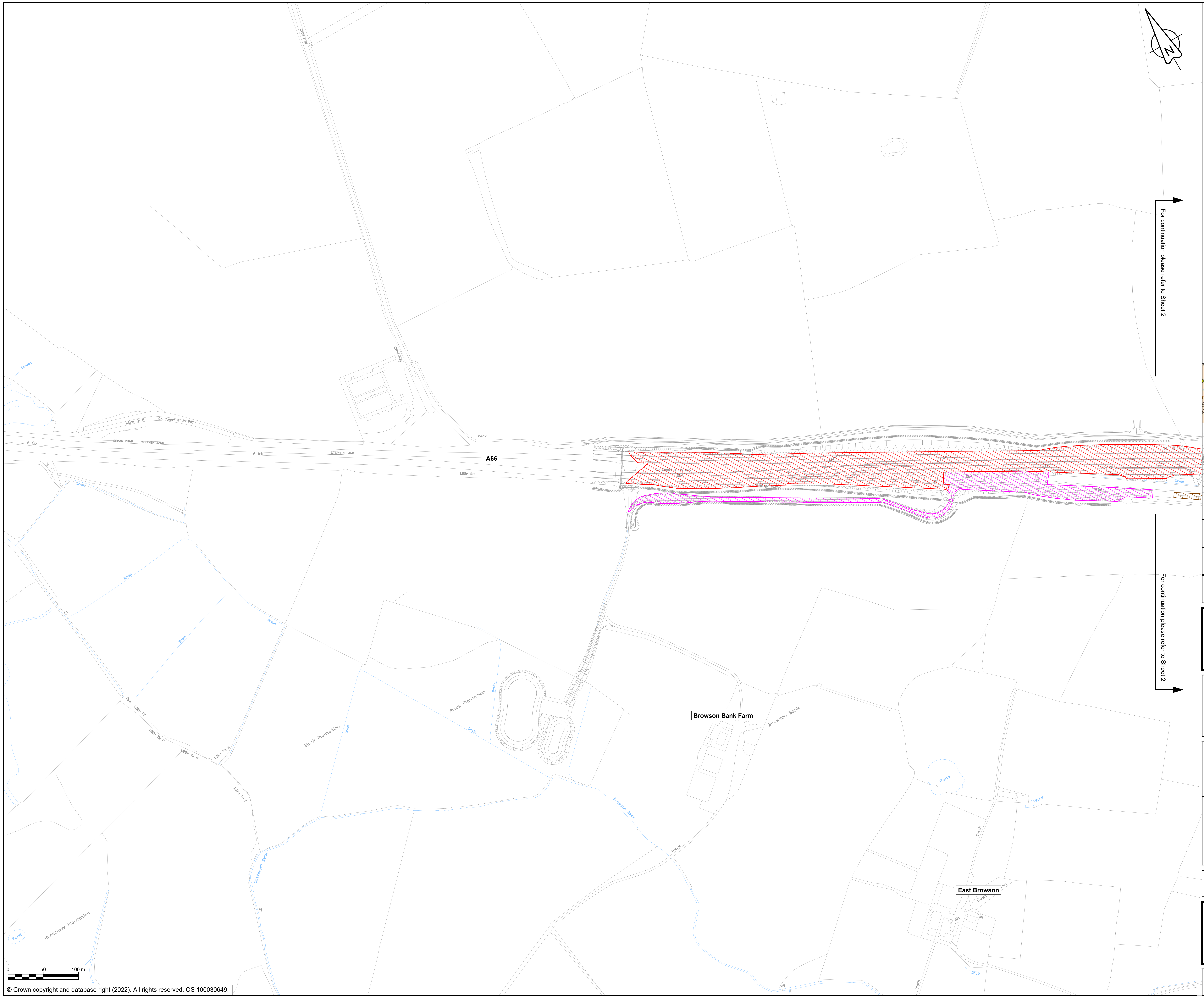
Project Name
A66 Northern Trans-Pennine

Drawing Title
Cross Lanes to Rokeby
Proposed Catchment Plan
Sheet 3 of 3

| Project Ref. No. | Stage | Scale : 1:2500 @ A1 |
|---|---|---|
| --- | PCF3 | Dimensions : M |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S08 -DR-CD-000203
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |



For continuation please refer to Sheet 2

For continuation please refer to Sheet 2

# NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.

# KEY

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| ▨ | CATCHMENT S09-01 |
| ▨ | CATCHMENT S09-02 |
| ▨ | CATCHMENT S09-03 |
| ▨ | CATCHMENT S09-04 |
| ▨ | CATCHMENT S09-05 |
| ▨ | CATCHMENT S09-06 |
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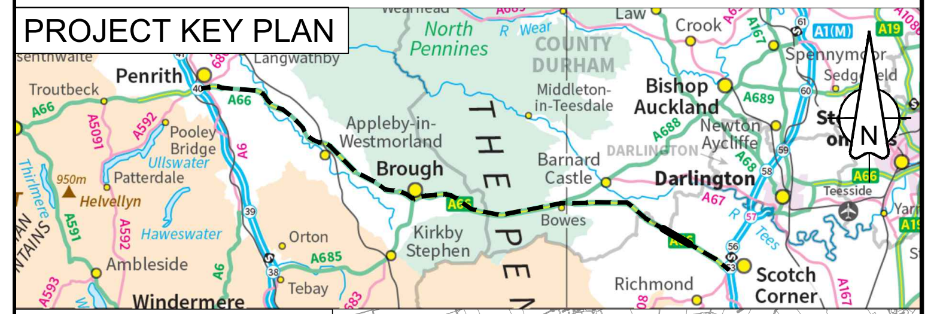
| ▨ | CATCHMENT S09-11 |
| ▨ | CATCHMENT S09-12 |

PROJECT KEY PLAN



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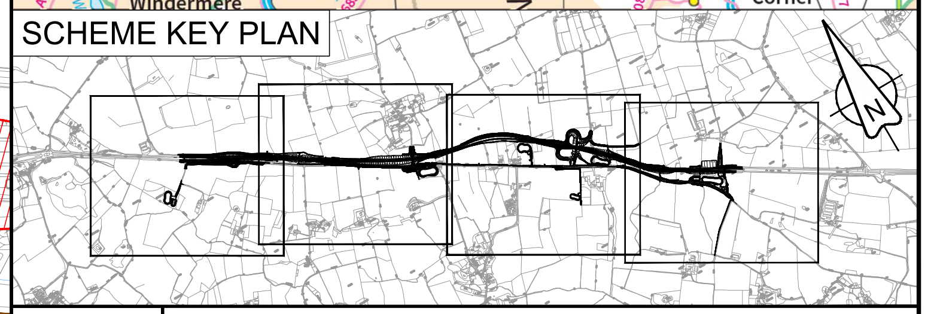

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| P01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | FMOL |
| | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 |
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| | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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Project Name
A66 Northern Trans-Pennine

Drawing Title
Stephen Bank to Carkin Moor
Proposed Catchment Plan
Sheet 1 of 4

| Project Ref. No. | Stage | Scale : 1:2500 @ A1 |
|---|---|---|
| --- | PCF3 | Dimensions : N/A |

Drawing Number

| Project | Originator | Volume | Location | Type | Role | Number |
|---|---|---|---|---|---|---|
| HE565627 | AMY | HDG | S09 | DR | CD | 000201 |

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |

## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.

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- ▨ CATCHMENT S09-05
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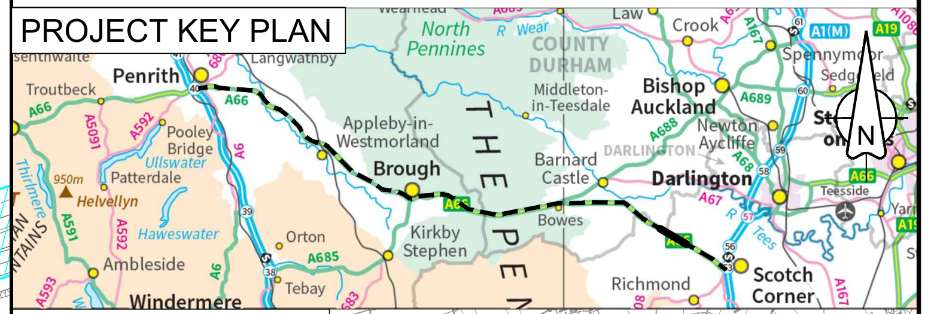
- ▨ CATCHMENT S09-11
- 🟧 CATCHMENT S09-12

PROJECT KEY PLAN



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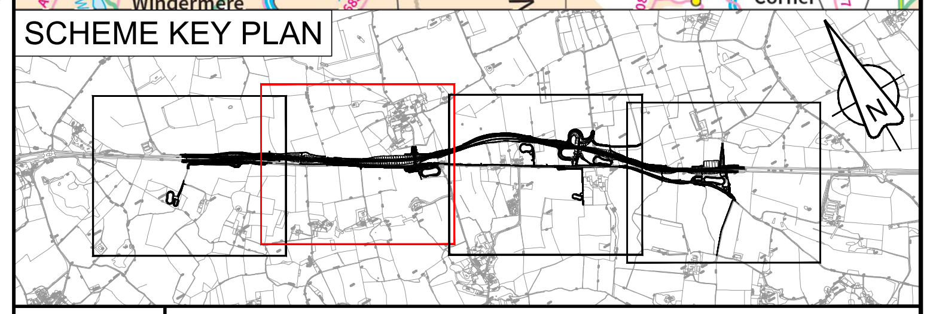

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Project Name
A66 Northern Trans-Pennine

Drawing Title
Stephen Bank to Carkin Moor
Proposed Catchment Plan
Sheet 2 of 4

| Project Ref. No. | Stage | Scale : 1:2500 @ A1 |
|---|---|---|
| --- | PCF3 | Dimensions : N/A |

Drawing Number

| Project | Originator | Volume |
|---|---|---|
| HE565627 - | AMY - | HDG - |

| Location | Type | Role | Number |
|---|---|---|---|
| S09 | -DR- | CD- | 000202 |

| Suitability | Suitability Description | Revision |
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| A | Approved for Stage Complete | C01 |

For continuation please refer to Sheet 2

For continuation please refer to Sheet 2

For continuation please refer to Sheet 4

For continuation please refer to Sheet 4

# NOTES

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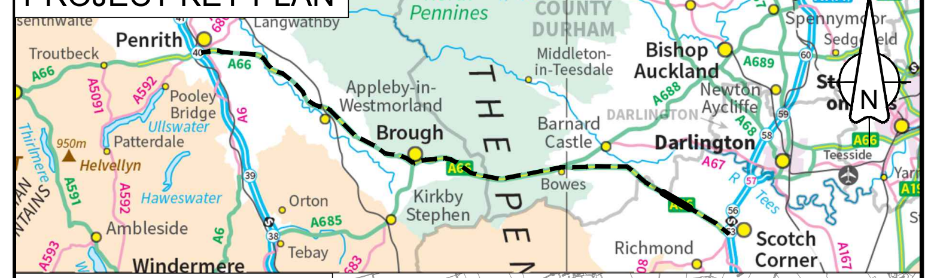

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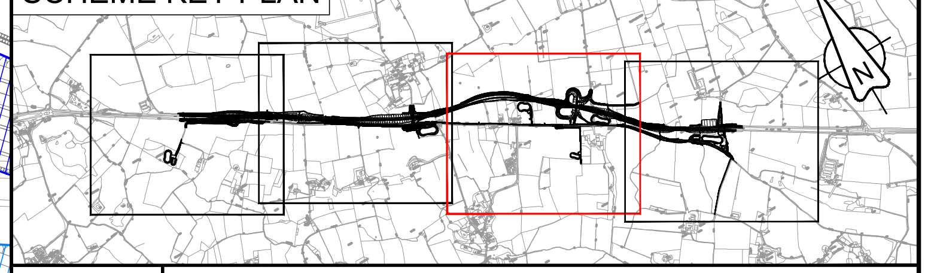

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| | JHAR | JHAR | CHEA | TEGG | FMOL |
| | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 |
| C01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | SSCO |
| | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 |
| Revision | Revision details | | | | |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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Project Name
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Drawing Title
Stephen Bank to Carkin Moor
Proposed Catchment Plan
Sheet 3 of 4

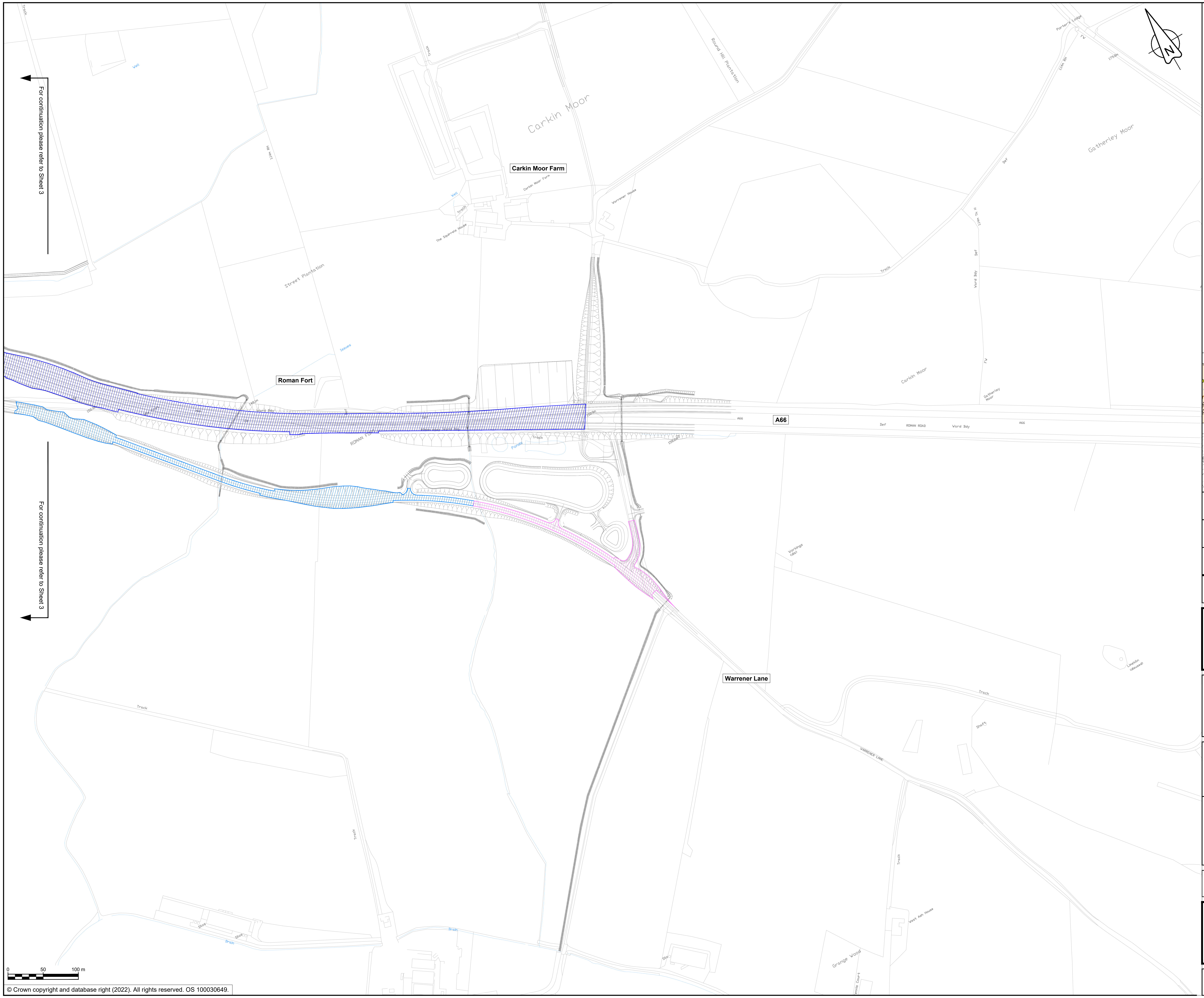
| Project Ref. No. | Stage | Scale : 1:2500 @ A1 |
|---|---|---|
| --- | PCF3 | Dimensions : N/A |

Drawing Number

| Project | Originator | Volume | | | |
|---|---|---|---|---|---|
| HE565627 - | AMY - | HDG - | | | |
| S09 | | - DR - | CD - | 000203 | |
| Location | | Type | Role | Number | |

| Suitability | Suitability Description | Revision |
|---|---|---|
| A | Approved for Stage Complete | C01 |

For continuation please refer to Sheet 3



For continuation please refer to Sheet 3

## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.

## KEY

▨ CATCHMENT S09-01
▨ CATCHMENT S09-02
▨ CATCHMENT S09-03
▨ CATCHMENT S09-04
▨ CATCHMENT S09-05
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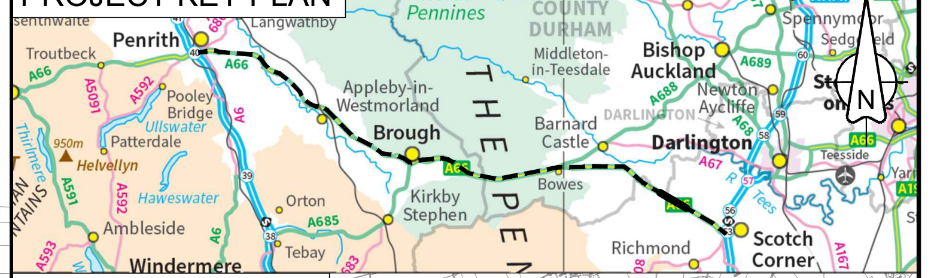
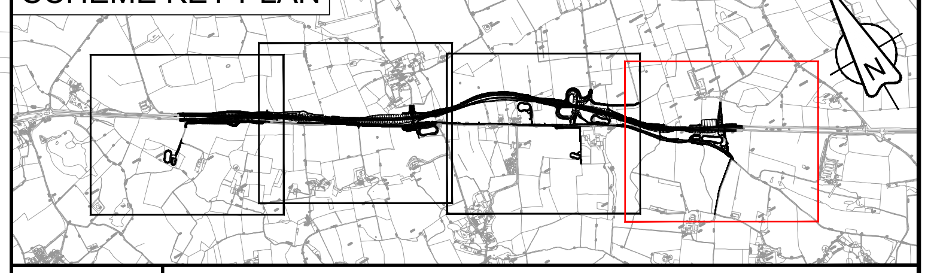
PROJECT KEY PLAN



SCHEME KEY PLAN



| Revision | Revision details | | | | |
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| P01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | FMOL |
| | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 |
| C01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | SSCO |
| | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 |
| | Created | Checked | Reviewed | Approved | Authorised |
| | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy | dd/mm/yy |

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Project Name
A66 Northern Trans-Pennine

Drawing Title
Stephen Bank to Carkin Moor
Proposed Catchment Plan
Sheet 4 of 4

| Project Ref. No. | Stage | Scale : 1:2500 @ A1 |
|---|---|---|
| --- | PCF3 | Dimensions : N/A |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S09 -DR-CD-000204
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
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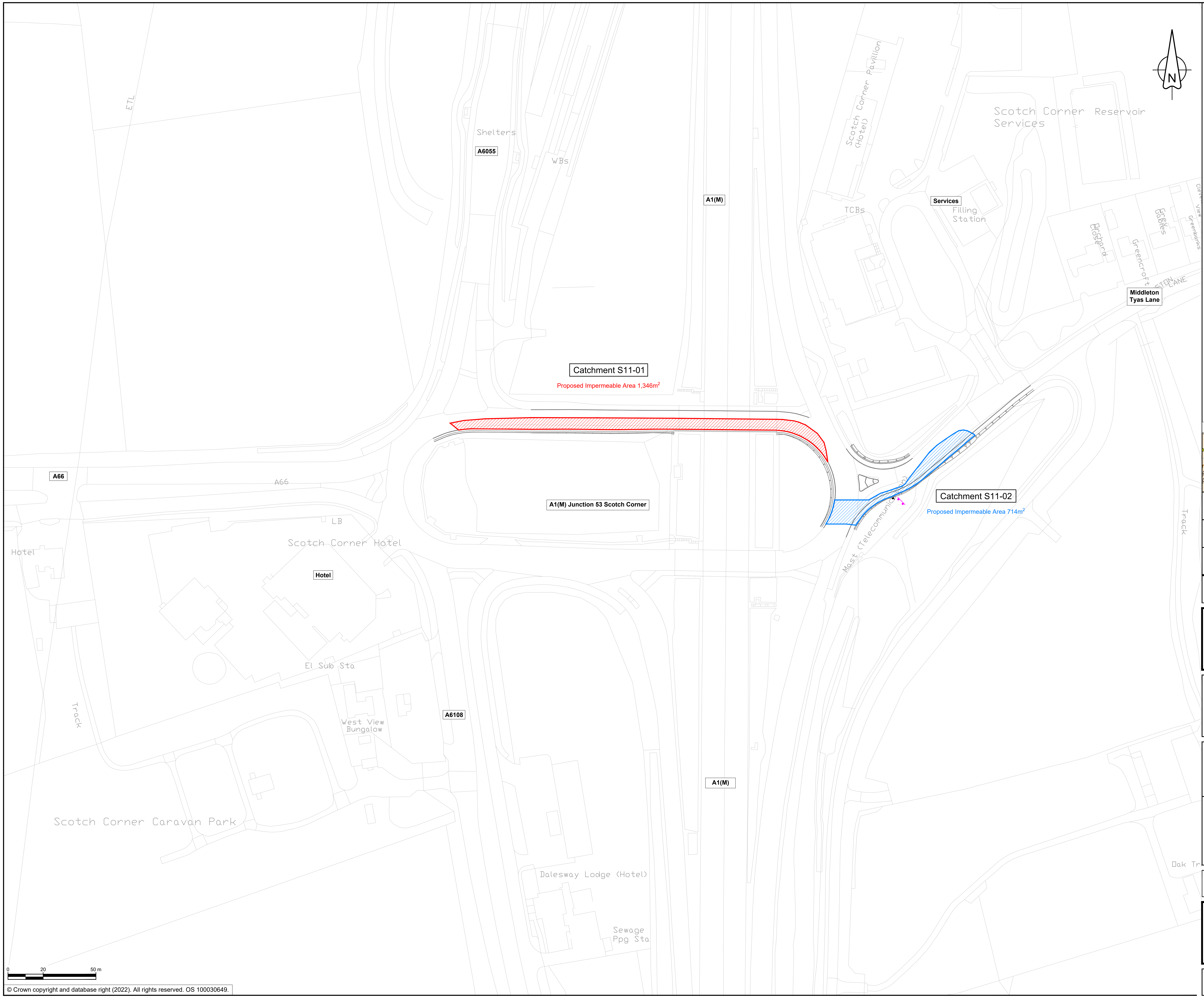
| A | Approved for Stage Complete | C01 |



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## NOTES

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.

## KEY

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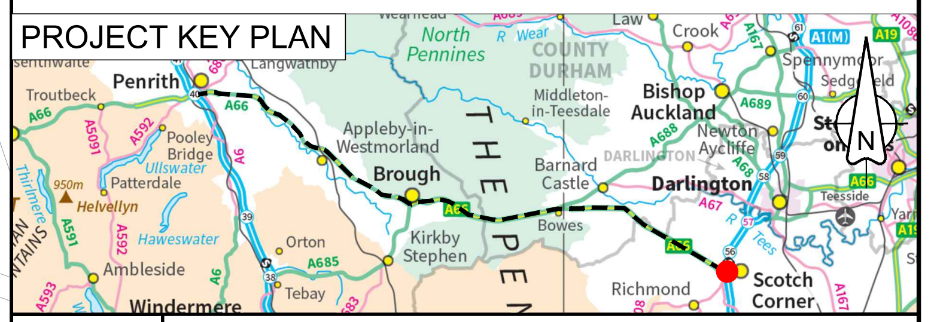
PROJECT KEY PLAN



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| P01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | FMOL |
| | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 | 10/05/22 |
| C01 | SGAR3 | | | | |
| | JHAR | JHAR | CHEA | TEGG | SSCO |
| | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 | 07/06/22 |
| Revision | Revision details | | | | |
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Project Name
A66 Northern Trans-Pennine

Drawing Title
A1(M) Junction 53 Scotch Corner
Proposed Catchment Plan

| Project Ref. No. | Stage | Scale : 1:1000 @ A1 |
|---|---|---|
| --- | PCF3 | Dimensions : |

Drawing Number
Project | Originator | Volume |
HE565627 - AMY - HDG -
S11 -DR-CD-000201
Location | Type | Role | Number

| Suitability | Suitability Description | Revision |
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| A | Approved for Stage Complete | C01 |

A66 Northern Trans-Pennine

# M6 Junction 40 to Kemplay Bank Hydraulic Modelling Report

M6 Junction 40 to Kemplay Bank

| Document Verification | |
|---|---|
| **Project Title** | **A66 Northern Trans-Pennine**<br>M6 Junction 40 Penrith |
| **Document Title** | M6 Junction 40 to Kemplay Bank Hydraulic Modelling Report |
| **Document Ref** | HE565627-JBAU-XX-01-RP-HM-S3-P02-0001-Scheme1_Modelling_Report |

**Note:** The contents of the Cover Page and Document Verification page are managed by ProjectWise. Users should not edit these fields manually.

| Rev | Suit. Code | Suitability | | Purpose of Issue | | |
|---|---|---|---|---|---|---|
| P01 | S3 | Shared for Review | | | | |
| | | Created | Checked | Reviewed | Approved | Authorised |
| | **Name** | A. Blanchard - | C. Mbigha | C. Mbigha | C. Mbigha | --- |
| | **Date** | 26.01.2022 | 28.01.2022 | 28.01.2022 | 28.01.2022 | --- |

| Rev | Suit. Code | Suitability | | Purpose of Issue | | |
|---|---|---|---|---|---|---|
| P02 | S3 | Shared for Review | | --- | | |
| | | Created | Checked | Reviewed | Approved | Authorised |
| | Name | A. Blanchard | C. Mbigha | C. Mbigha | C. Mbigha | --- |
| | Date | 14.04.2022 | 14.04.2022 | 14.04.2022 | 14.04.2022 | --- |

| Rev | Suit. Code | Suitability | | Purpose of Issue | | |
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| | | Created | Checked | Reviewed | Approved | Authorised |
| | Name | --- | --- | --- | --- | --- |
| | Date | --- | --- | --- | --- | --- |

| **Fluvial Hydraulic Modelling Report – Scheme 1** | | |
|---|---|---|
| 1 Basic Model Information | | |
| Model Name | Scheme 1 model (Eamont) | |
| Primary Watercourses / Water Bodies | River Eamont | |
| Designation | Main River | |
| Model ID | The following table presents information regarding the model scenarios carried out as part of this study. | |
| Model Scenario ID | Scenario | Annual Probability |
| Eamont Bridge | | |
| EAM_030_DM_2017.dat<br>A66_Eamont_Bridge_(Q25).ief<br>A66_Eamont_Bridge_(Q25).tcf | Existing situation model for Eamont Bridge | 4% (1 in 25-years) |
| EAM_030_DM_2017.dat<br>A66_Eamont_Bridge_(Q100).ief<br>A66_Eamont_Bridge_(Q100).tcf | | 1% (1 in 100-years) |
| EAM_030_DM_2017.dat<br>A66_Eamont_Bridge_(Q100p47%).ief<br>A66_Eamont_Bridge_(Q100p47%).tcf | | 1% + 47% climate change (1 in 100-years + 47% climate change) |
| EAM_030_DM_2017.dat<br>A66_Eamont_Bridge_(Q100p61%).ief<br>A66_Eamont_Bridge_(Q100p61%).tcf | | 1% + 61% climate change (1 in 100-years +61% climate change) |
| EAM_030_DM_2017.dat<br>A66_Eamont_Bridge_(Q100p94%).ief<br>A66_Eamont_Bridge_(Q100p94%).tcf | | 1% + 94% climate change (1 in 100-years plus 94% climate change) |
| EAM_030_DM_2017.dat<br>A66_Eamont_Bridge_(Q1000)ief<br>A66_Eamont_Bridge_(Q1000).tcf | | 0.1% (1 in 1000-years) |
| Not required – scheme does not encroach on Eamont floodplain and no changes made to model | Sensitivity tests | |
| Not required – scheme does not encroach on Eamont floodplain | With-Scheme Situation Model | |

| **2 Model Input Data** | |
|---|---|
| Incoming Models | 2018 Eamont Bridge Appraisal Model |
| DTM for 2D Model Domain | Lidar flown in 2019 |
| River channel/Structure survey | No new channel survey data collected – 2018 Eamont Bridge Appraisal model includes new survey data dated 2017. |
| Additional Data | Proposed route alignments. |

| **3 Model Build Overview** | | | |
|---|---|---|---|
| Software | 1D domain: FM | | |
| | 2D domain(s): TUFLOW | | |
| Model Reference | HE565627-JBAU-01-MO-HM-0001-Scheme01_Hydraulic_Model | | |
| Model Schematisation | Figure 3.1 shows the schematisation of the hydraulic models for Scheme 1 | | |
| Model Reaches | The table below shows the watercourse reaches defined in the model. They are also shown in Figure 3.1. | | |
| Watercourse Name | Upstream model node | Downstream model node | Total Reach length (km) |
| Eamont | EAMT02_2188 | EAMT01_0010 | 12 |
| River Lowther | LWTH01_02430 | LWTH01_44 | 2.4 |

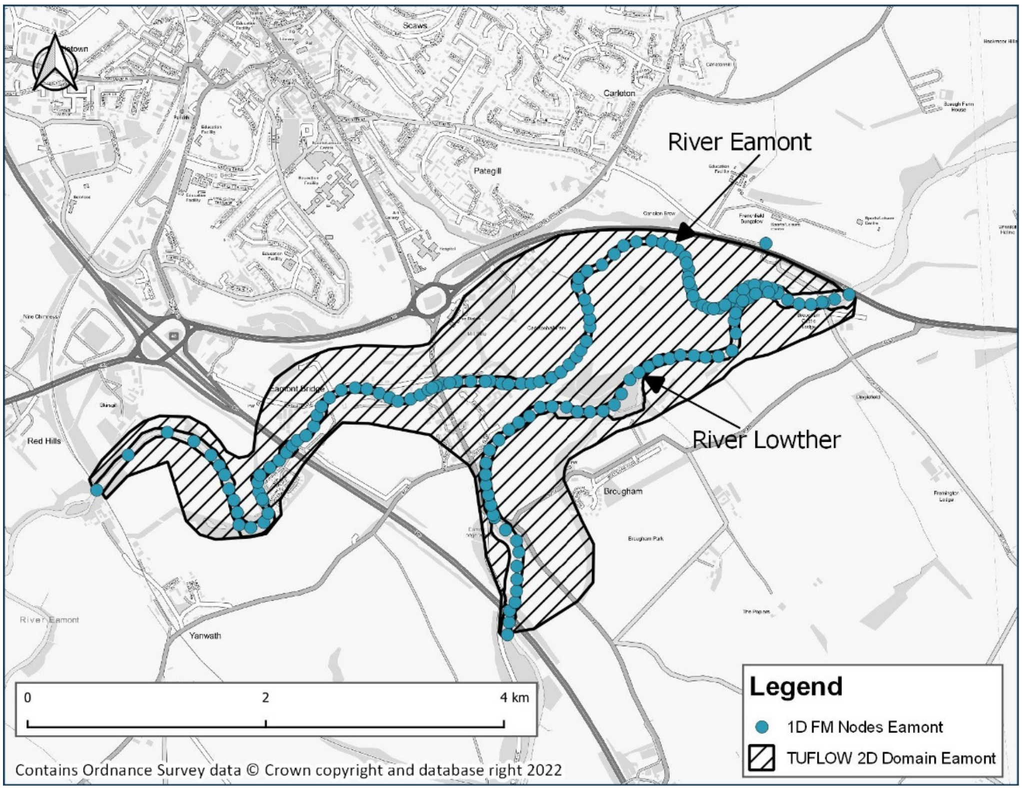

Figure 3.1: Model extent, River Eamont

| **4 Baseline model schematisation** | |
|---|---|
| 4.1 1D Domain | |
| Overview | The 2018 Eamont Bridge Appraisal model was used for the purposes of this study. A review of the model was carried out by JBA Consulting in December 2020 to assess its suitability for assessing the baseline fluvial flood risk in relation to the proposed A66 scheme.<br>Key findings of the model review were:<br>• The 2018 model incorporates updated hydrological estimates and takes account of the December 2015 flood event<br>• The 2018 model incorporates new survey data collected in 2017 |

| | | | |
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| | • The 2018 model uses a 2m grid cell size and well defined materials layers based on OS MasterMap<br>• The model results generally appear reasonably stable<br>• The 2018 model does not include model results for the 100-year plus climate change event in accordance with the Environment Agency July 2021 climate change guidance<br>Therefore, for the purposes of the assessment, the 2018 Eamont Bridge Appraisal model was deemed suitable for use for the study, with no updates to the model geometry or hydrology proposed, other than to update the flow estimates for the latest EA climate change allowances. | | |
| Channel representation | No updates to the channel representation carried out – please refer to the Eamont Bridge Appraisal model report. | | |
| Structure representation | No updates to the structure representation carried out – please refer to the Eamont Bridge Appraisal model report. | | |
| Inflow boundaries | No updates to the inflow boundaries carried out – please refer to the Eamont Bridge Appraisal model report. | | |
| Climate Change | Climate change uplifts applied for the central, higher central and upper end allowances for the Eden and Esk Management Catchment using the Environment Agency's July 2021 allowances. | | |
| Downstream boundary | No updates to the downstream boundary representation carried out – please refer to the Eamont Bridge Appraisal model report. | | |
| Hydraulic roughness values used | No updates to the Manning's n representation carried out – please refer to the Eamont Bridge Appraisal model report. | | |
| 4.2 2D Domain | | | |
| Area of 2D Domains | 1km2 | DTM data source | LIDAR |
| Resolution of grid | 2m | DTM Resolution | 1m and 2m |
| Modifications to topography and reasons | 2d_zsh_Buildings_027.shp | Outline of buildings based on OS | |
| | 2d_zln_EAM_bank_levels_P_028.shp<br>2d_zln_EAM_bank_levels_L_028.shp | MasterMap data – no updates<br>Crest Levels of Eamont and Lowther river banks– no updates | |
| | 2d_zln_EAM_WALL_LB_P_030.shp<br>2d_zln_EAM_WALL_LB_L_030.shp | Walls and embankments on 2d domain – no updates | |
| | 2d_zln_EAM_Eamont_Park_Embank_P_030.shp<br>2d_zln_EAM_Eamont_Park_Embank_L_030.shp | Embankment surrounding Eamont Park – no updates | |
| | 2d_zln_EAM_AIMS_33752_removal_P_022.shp<br>2d_zln_EAM_AIMS_33752_removal_L_022.shp | Embankment failure as per do minimum/do nothing | |

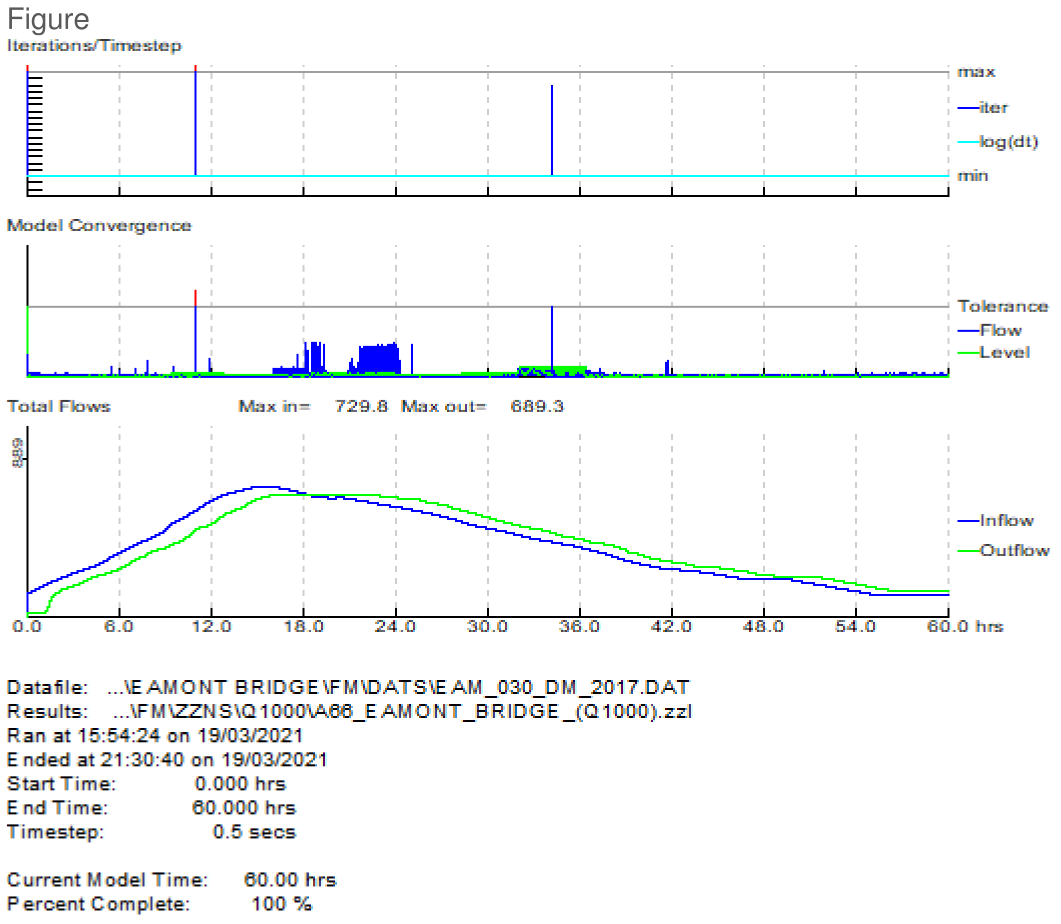
| | | |
|---|---|---|
| | | assumptions – no updates |

| | |
|---|---|
| Hydraulic roughness values used | Manning's 'n' values used to represent hydraulic roughness in the 2D domain. A review of the materials layer indicates no significant changes within the catchment and therefore no updates carried out.<br>There are three stability patches in the model to enable it run to completion. A Manning's 'n' value of 0.075 is used in the patches. |
| 4.3 1D-2D Linking | |
| No updates to the 1D-2D linking carried out – please refer to the Eamont Bridge Appraisal model report. | |
| Model Boundaries – Downstream Conditions | No updates to the downstream boundaries carried out – please refer to the Eamont Bridge Appraisal model report. |
| 4.4 Representation of Defences | |
| Defences | No updates to the representation of defences carried out – please refer to the Eamont Bridge Appraisal model report. |

| **5 Structures** |
|---|
| No updates to the representation of structures carried out – please refer to the Eamont Bridge Appraisal model report. |

# 6 Model Proving

## 6.1 Model Performance



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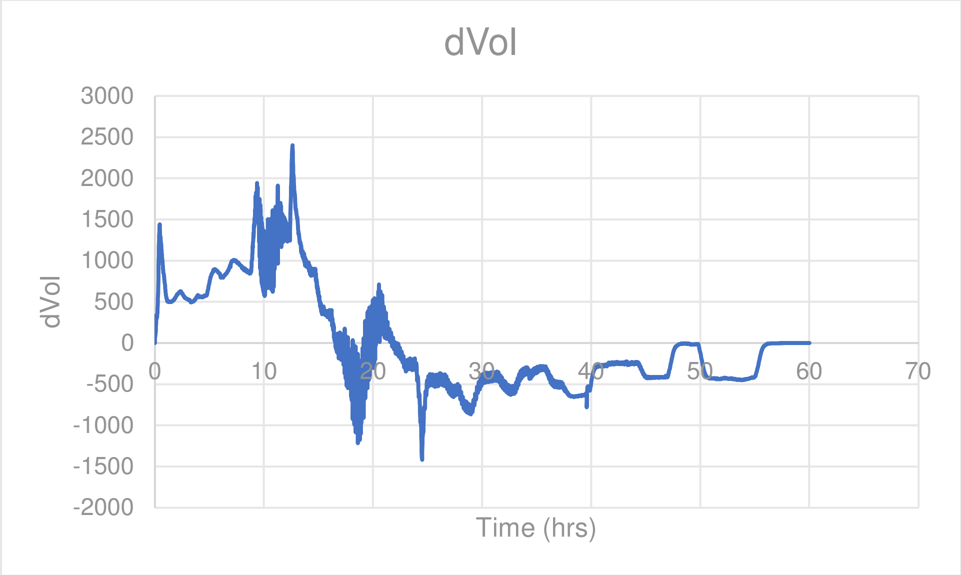
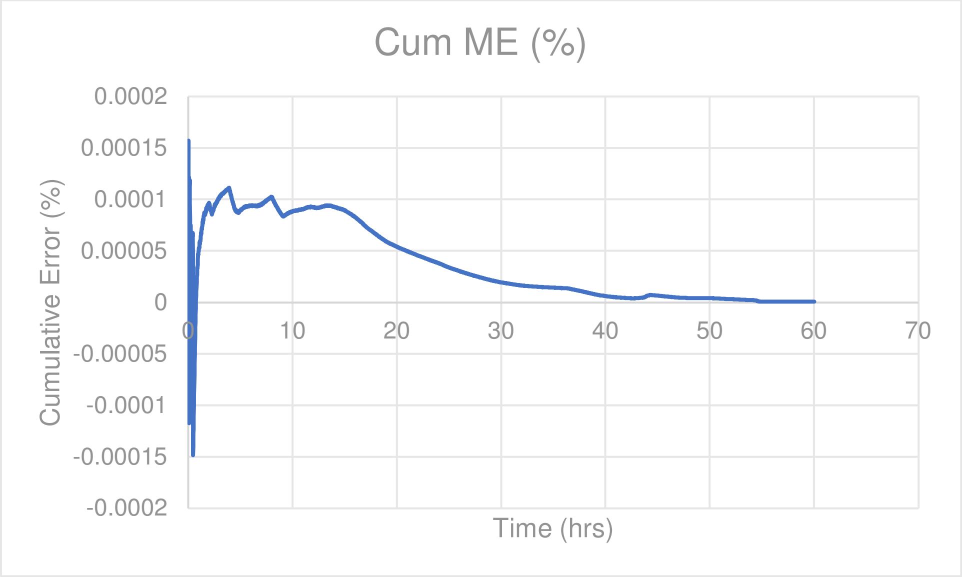
Results: ...\FM\ZZNS\Q1000\A66_EAMONT_BRIDGE_(Q1000).zzl
Ran at 15:54:24 on 19/03/2021
Ended at 21:30:40 on 19/03/2021
Start Time: 0.000 hrs
End Time: 60.000 hrs
Timestep: 0.5 secs

Current Model Time: 60.00 hrs
Percent Complete: 100 %

Figure 6.1: Flood Modeller Convergence Plot Eamont model



6.2: dVol plot for Eamont model, 1000-year



6.3: Cumulative Mass Error for Eamont model, 1000-year

The Flood modeller convergence plot shows smooth inflows to and outflows from the model with no instances of poor convergence. Whilst the dVol plot shows a moderate amount of oscillation, the 2D outputs do not indicate any particularly unstable elements. Flow and stage profiles have been checked within the area of interest and are smooth with minimal oscillations, indicating the model is performing well. The cumulative mass error is within the tolerable limits of + or – 1% throughout the entire simulation.

| 6.2 Model Verification | |
|---|---|
| Calibration | The Eamont Bridge hydraulic model was calibrated against the December 2015 event and compares well against the recorded flood outline provided by the EA and gauge data, where available. Further calibration has not been carried out as part of this study. |
| Flood Zone Comparison | Figure 6.4 shows a comparison of the modelled 1,000-year River Eamont flood extent compared to Flood Zone 2.<br>This shows that generally, the 1,000-year modelled flood extent compares well to Flood Zone 2. However, there is a dry island included within the 1,000-year flood extent which is not shown in Flood Zone 2. It is understood that in this area Flood Zone 2 has been derived based on the River Eamont hydraulic modelling results combined with recorded flood outlines based on the 2015 event. Further consultation with the Environment Agency found that this area remained dry during the 2015 flood event, as shown in Figure 6.5. Therefore, it is considered that there is an error in the EA Flood Zones within this location as a result of the historic flood outline. |

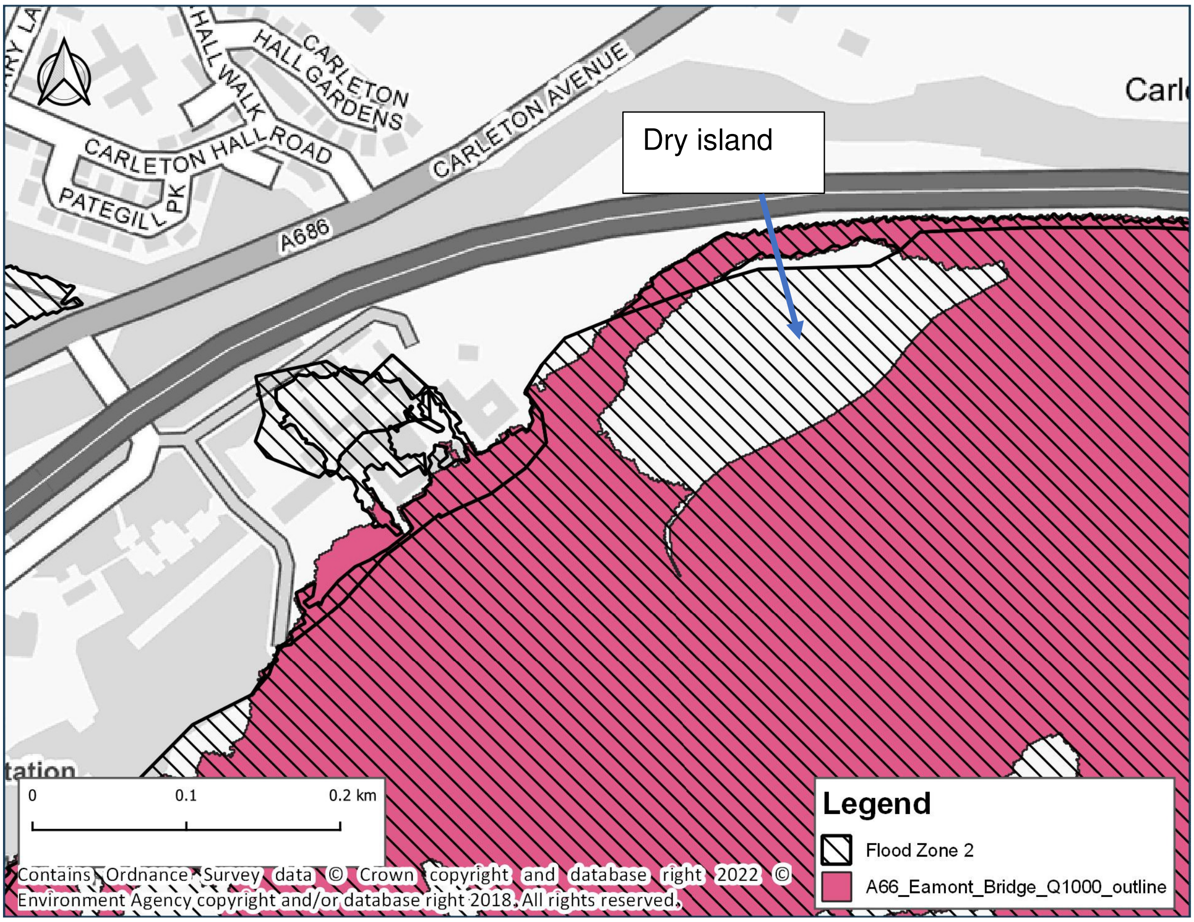


Figure 6.4: Modelled 1,000-year outline vs EA Flood Zone 2

Figure 6:5: Aerial photograph of 2015 flood extent, provided by the Environment Agency

## 6.3 Sensitivity Analysis

Sensitivity tests have not been carried out for the Eamont model for the following reasons:

- Sensitivity analysis was carried out as part of the 2018 Eamont Bridge appraisal study
- The model was found to be most sensitive to flow
- The model was found to be relatively insensitive to other parameters such as increased in-channel roughness and grid cell size
- The hydraulic model has been re-run for a 47%, 61% and 94% uplift for climate change. - The indication is of a minimal difference the 100-year and the 100-year plus 47% climate change in flood extents in the vicinity of the proposed A66 route.
- The downstream boundary is a significant distance (>7.5km) from the proposed development.

## 7 Model Build – With-Scheme Situation Model

Not required – scheme does not encroach on Eamont floodplain

## 8 Key Model Assumptions and Limitations

During any hydraulic modelling study, there will always be associated limitations, for example, with uncertainty and data availability etc. The representation of any complex system by a model requires several assumptions to be made. In the case of the Eamont Bridge hydraulic model it has been assumed that:

- Cross sections accurately represent the shape and variation of the river.
- Model parameters have been determined appropriately.
- Design flows are an accurate representation of flows of a given AEP.
- The surveyed cross-sections of hydraulic structures and the units used to represent them in the model are appropriate and adequate.
- LIDAR accurately reflects bank heights and particularly that the filtered LIDAR has appropriately removed the influence of vegetation.

A66 Northern Trans-Pennine

# M6 Junction 40 to Kemplay Bank Hydraulic Modelling Report

M6 Junction 40 to Kemplay Bank

| **Document Verification** | |
|---|---|
| **Project Title** | **A66 Northern Trans-Pennine**<br>M6 Junction 40 to Kemplay Bank |
| **Document Title** | M6 Junction 40 to Kemplay Bank Hydraulic Modelling Report |
| **Document Ref** | HE565627-JBAU-XX-02-RP-HM-S3-P02-0001-Scheme2_Modelling_Report |

**Note:** The contents of the Cover Page and Document Verification page are managed by ProjectWise. Users should not edit these fields manually.

| Rev | Suit. Code | Suitability | | Purpose of Issue | | |
|---|---|---|---|---|---|---|
| P01 | S3 | Shared for Review | | | | |
| | | Created | Checked | Reviewed | Approved | Authorised |
| | **Name** | A. Blanchard | C. Mbigha | C. Mbigha | C. Mbigha | --- |
| | **Date** | 28.01.2022 | 01.02.2022 | 01.02.2022 | 01.02.2022 | --- |

| Rev | Suit. Code | Suitability | | Purpose of Issue | | |
|---|---|---|---|---|---|---|
| P02 | S3 | Shared for Review | | --- | | |
| | | Created | Checked | Reviewed | Approved | Authorised |
| | Name | A. Blanchard | C. Mbigha | C. Mbigha | C. Mbigha | --- |
| | Date | 14.04.2022 | 14.04.2022 | 14.04.2022 | 14.04.2022 | --- |

| Rev | Suit. Code | Suitability | | Purpose of Issue | | |
|---|---|---|---|---|---|---|
| --- | --- | --- | | --- | | |
| | | Created | Checked | Reviewed | Approved | Authorised |
| | Name | --- | --- | --- | --- | --- |
| | Date | --- | --- | --- | --- | --- |

| **Fluvial Hydraulic Modelling Report – Scheme 2** | | |
|---|---|---|
| 1 Basic Model Information | | |
| Model Name | Scheme 2 model (Thacka Beck) | |
| Primary Watercourses / Water Bodies | Thacka Beck | |
| Designation | Main River | |
| Model ID | The following table presents information regarding the model scenarios carried out as part of this study. | |
| Model Scenario ID | Scenario | Annual Probability |
| Thacka Beck | | |
| THB_014.dat<br>A66_Thacka_Beck_AB_014_(Q20).ief<br>A66_THB_AB_014_(Q20).tcf | Existing situation model for Thacka Beck | 5% (1 in 20-years) |
| THB_014.dat<br>A66_Thacka_Beck_AB_014_(Q100).ief<br>A66_THB_AB_014_(Q100).tcf | | 1% (1 in 100-years) |
| THB_014.dat<br>A66_Thacka_Beck_AB_014_(Q100p47%).ief<br>A66_THB_AB_014_(Q100p47%).tcf | | 1% + 47% climate change (1 in 100-years + 47% climate change) |
| THB_014.dat<br>A66_Thacka_Beck_AB_014_(Q100p61%).ief<br>A66_THB_AB_014_(Q100p61%).tcf | | 1% + 61% climate change (1 in 100-years +61% climate change) |
| THB_014.dat<br>A66_Thacka_Beck_AB_014_(Q100p94%).ief<br>A66_THB_AB_014_(Q100p94%).tcf | | 1% + 94% climate change (1 in 100-years plus 94% climate change) |
| THB_014.dat<br>A66_Thacka_Beck_AB_014_(Q1000).ief<br>A66_THB_AB_014_(Q1000).tcf | | 0.1% (1 in 1000-years) |
| THB_014_Nplus20pc.dat<br>A66_Thacka_Beck_AB_014_(Q100)_Nplus20pc.ief<br>A66_THB_AB_014_(Q100)_Nplus20pc.tcf | Sensitivity tests for model Thacka Beck | 1% AEP with +20% roughness |
| THB_014_Nmin20pc.dat<br>A66_Thacka_Beck_AB_014_(Q100)_Nmin20pc.ief<br>A66_THB_AB_014_(Q100)_Nmin20pc.tcf | | 1% AEP with –20% roughness |
| THB_014.dat<br>A66_Thacka_Beck_AB_014_(Q100)_Qplus20pc.ief<br>A66_THB_AB_014_(Q100)_Qplus20pc.tcf | | 1% AEP with +20% flow |
| THB_014_DSBDY250.dat<br>A66_Thacka_Beck_AB_014_(Q100)_DSBDY250.ief<br>A66_THB_AB_014_(Q100)_DSBDY250.tcf | | 1% with 250mm increase in downstream boundary |

| | | |
|---|---|---|
| No with-scheme modelling carried out | With-Scheme Situation Model | |
| | | |
| | | |

| 2 Model Input Data | |
|---|---|
| Incoming Models | 2014 JBA Consulting Thacka Beck Model |
| DTM for 2D Model Domain | 1m resolution LIDAR flown in June 2011 |
| River channel/Structure survey | Channel survey data within 2014 Thacka Beck model last surveyed in 2011.<br>Spot checks of survey data carried out by JBA Consulting between November 2020 and June 2021 |
| Additional Data | MasterMap data, as -built drawings of existing A66 where available, proposed route alignments. |

| 3 Model Build Overview | | | |
|---|---|---|---|
| Software | 1D domain: FM and ESTRY | | |
| | 2D domain(s): TUFLOW | | |
| Model Reference | HE565627-JBAU-02-MO-HM-0001-Scheme02_Hydraulic_Model | | |
| Model Schematisation | Figure 3.1 shows the schematisation of the hydraulic model for Scheme 2. Figure 3.2 shows the location of new survey data collected for the purposes of this study. | | |
| Model Reaches | The table below shows the watercourse reaches defined in the model. They are also shown in Figure 3.1. | | |
| Watercourse Name | Upstream model node | Downstream model node | Total Reach length (km) |
| Thacka Beck | TBE_2042<br>TBW_1700 | THBE01_0007 | 7.3 |
| Dog Beck | MYER01_1882 | MYER01_0480 | 1.7 |

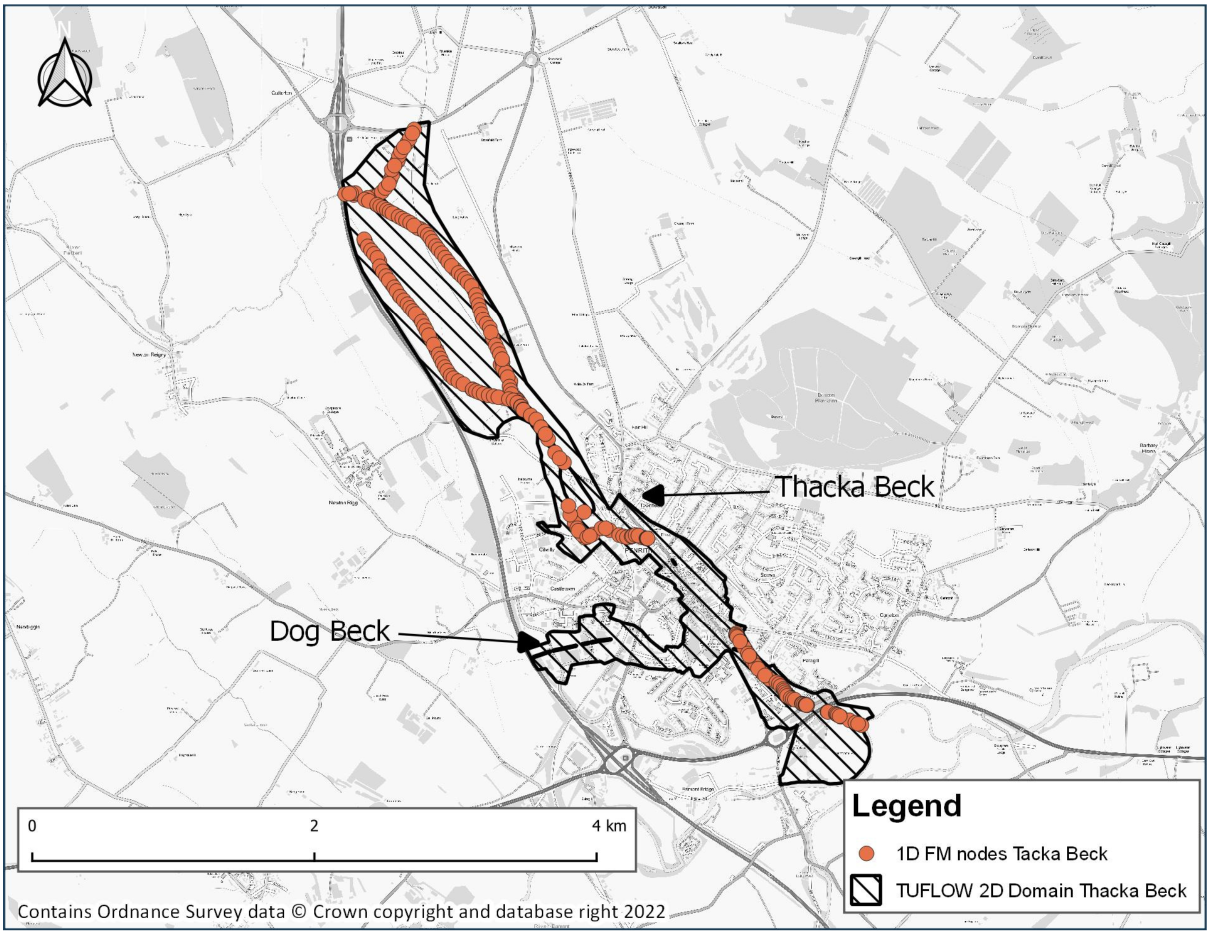


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Figure 3.1: Thacka Beck model extent

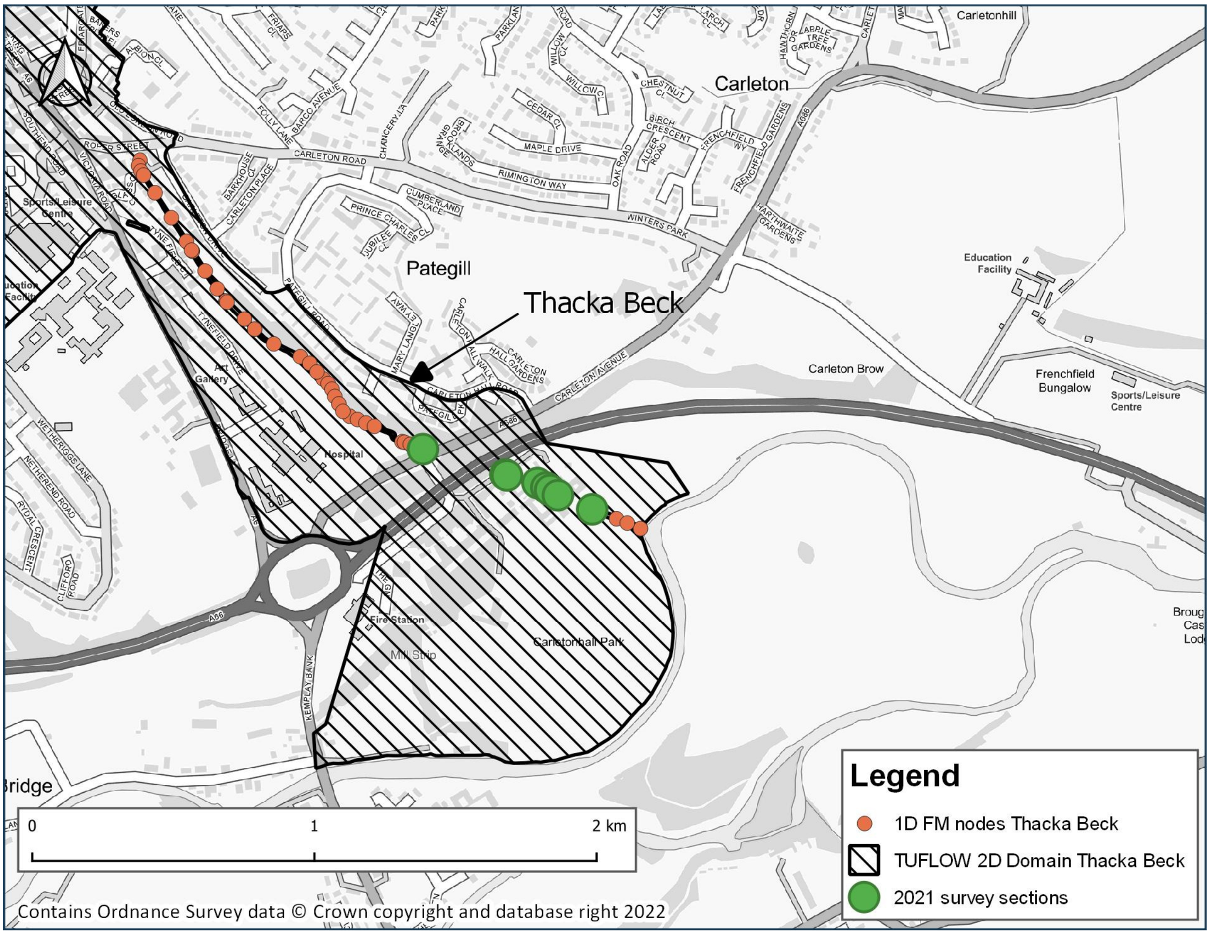

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Figure 3.2: Location of new survey cross sections Thacka Beck

## 4 Baseline model schematisation

### 4.1 1D Domain

| | |
|---|---|
| Overview | The 2014 Thacka Beck hydraulic model was supplied by the Environment Agency for use in this study. A review of the model was carried out by JBA Consulting in December 2020 to assess its suitability for assessing the baseline fluvial flood risk in relation to the proposed A66 scheme.<br>Key findings of the model review were:<br>• Channel cross sections were last surveyed along the lower end of the Thacka Beck in 2011. Whilst unlikely to have seen any significant change in the time (given the engineered nature of the channel), the model would benefit from a confirmatory/check survey.<br>• The hydrology currently driving the Thacka Beck model dates back to 2014 and does not take account of the December 2015 flood event. Therefore, a check on the hydrology is necessary, to see if new flow estimates are likely to be higher than the 2014 equivalents. |

| | |
|---|---|
| | • The 2014 model does not include model results for the 100-year plus climate change event in accordance with the current Environment Agency July 2021 climate change guidance.<br>Therefore, having adopted the 2014 Thacka beck model for the purposes of the present study, the updates as outlined above were required. |
| Channel representation | The channel system for the majority of the hydraulic model is based on the 2014 Thacka Beck model, using survey dated 2011. Additional check survey was collected by JBA Consulting in January 2020 and added to the model at the locations shown in Figure 3.2. |
| Structure representation | Existing structures are based on the existing 2014 hydraulic model, except where new survey from January 2020 is added. Modelling assumptions for changes to any structures from the 2014 model are documented within this report (Section 5). |
| Inflow boundaries | Flow is applied with ReFH boundary units and flow-time (QT) boundary units at upstream nodes of each watercourse. A check was carried out on the inflows to establish whether these may have increased since 2014. Further information can be found in the FEH calculation record.<br>As the hydrological estimation found that there will be no increases to the Thacka Beck inflows, the flow estimates from the 2014 study were retained for the purposes of this study. The exception is the River Petteril inflows which have been adjusted upwards following update of its FEH statistical flood estimates carried out as part of the above-mentioned check. Note: the River Petteril and Thacka Beck are not directly connected but the former can overspill into the latter during flood. |
| Climate Change | Climate change uplifts are applied for the central, higher central and upper end allowances for the Eden and Esk Management Catchment using the Environment Agency July 2021 allowances. |
| Downstream boundary | Stage-time (HT) hydrographs are applied at the downstream extent of Thacka Beck, with levels extracted from the River Eamont hydraulic model, supplied by the Environment Agency for use in this study. |
| Hydraulic roughness values used | A review of channel roughness values was carried out where new survey data added to the model. At these locations, updates were made to Manning's 'n' values based on photographic evidence collected during site visits and survey collection as a reference alongside application of the method published by Cowan (1956). |
| Labelling/naming convention used | No change to model naming conventions from 2014 study. |

| | | | |
|---|---|---|---|
| 4.2 2D Domain | | | |
| Area of 2D Domains | 2.95km2 | DTM data source | LIDAR |
| Resolution of grid | 2m | DTM Resolution | 1m |
| Modifications to topography and reasons | 2d_zsh_Thack_Holes_001.MIF | Fills in areas of no data within the active model domain – no updates carried out | |

| | | |
|---|---|---|
| | 2d_zsh_Myers_TopoM_001.MIF | Topographic modifications (bridge decks) on Myers Beck – no updates carried out |
| | 2d_zln_zpt_TB_Banks_002.MIF | Banks on right bank of Thacka Beck downstream of town – no updates carried out. |
| | 2d_zln_zpt_MB_002.MIF | Topo mods in floodplain in vicinity of Myers Beck + Left bank near the confluence of MB and TB – no updates carried out |
| | 2d_zln_zpt_RBanks_UTB_003 | Topo mods for banks upstream of the retention pond – no updates carried out |

| | |
|---|---|
| Hydraulic roughness values used | Manning's n values are used to represent hydraulic roughness in the 2D domain. A review of the materials layer against new OS MasterMap data indicates no significant changes within the catchment and for this reason, no updates have been carried out.<br>A stability patch, with a Manning's 'n' of 0.100, was added to the hydraulic model to improve stability near the River Petteril. |
| 4.3 1D-2D Linking | |
| A HX boundary is used to link the 1D and 2D domains along the top of banks. No updates to the location of the HX lines was carried out. | |
| Model Boundaries – Downstream Conditions | Stage-time (HT) hydrographs are applied at the downstream extent of Thacka Beck, with levels extracted from the River Eamont hydraulic model, supplied by the Environment Agency for use in this study. |
| 4.4 Representation of Defences | |
| Defences | The representation of defences within the hydraulic model is unchanged from the 2014 model. The main flood defences within the catchment are those erected as part of the Thacka Beck Flood Alleviation Scheme. For the purposes of the present study, the scheme is retained within the hydraulic model. As such, all model runs are considered to be defended. |

## 5 Structures

### General Approach

The representation of structures at the lower end of the Thacka Beck were reviewed against new survey data collected in January 2020. The differences between the cross sections from the January 2020 survey and those from 2011 already in the model are minimal. However, for completeness the 2011 cross sections were replaced by those from January 2020 where the two coincided.

### Thacka Beck

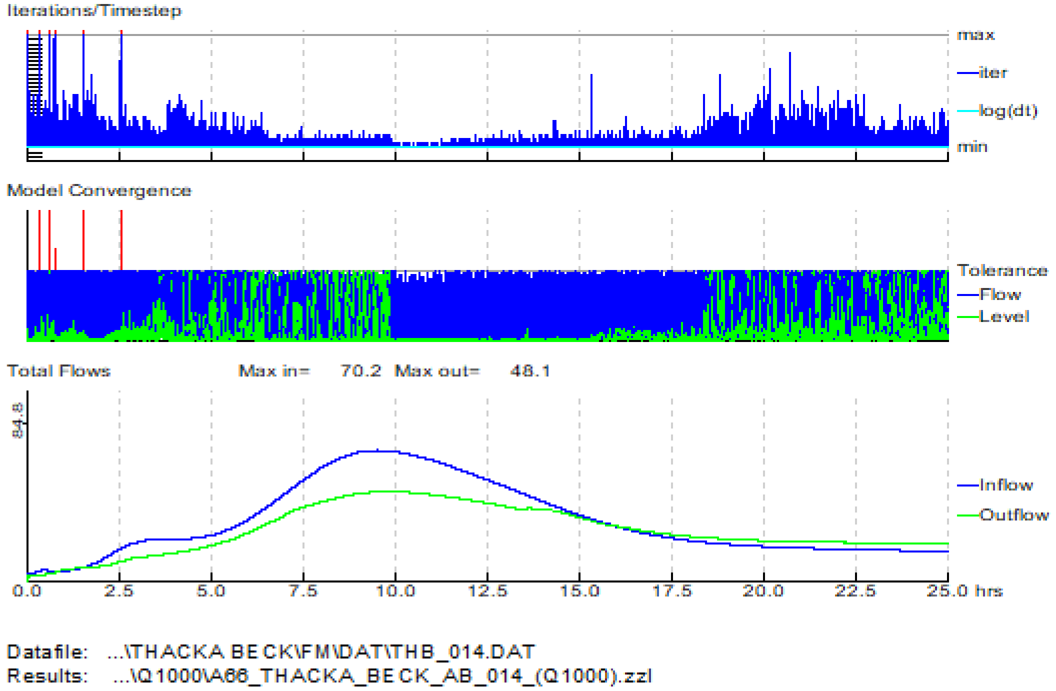
| ID | Structure | How has this structure been modelled? | Photo (view of upstream face unless specified) |
|---|---|---|---|
| Survey ID – THA001_0433<br>Model ID THBE01_0418i | A66 bridge | This structure is modelled with a rectangular conduit unit in Flood Modeller. The trash screen has been included within the model. Overtopping flow is represented in the 2D domain. |  Upstream face looking downstream  Downstream face looking upstream |

| | | | |
|---|---|---|---|
| Survey ID – THA001_0278<br>Model ID THBE01_0263 | Culvert beneath police station | This structure is modelled with a sprung arch conduit unit in Flood Modeller. Overtopping is represented in the 2D domain |  Upstream face looking downstream  Downstream face looking upstream |
| Survey ID – THA001_0205<br>Model ID THBE_BR0190u | Footbridge | This structure is modelled using a USBPR Bridge unit in Flood Modeller. Overtopping is represented in the 1D domain. |  Upstream face looking downstream |

| | | | |
|---|---|---|---|
| Survey ID – THA001_0180<br>Model ID – THBE01_0165c | Culvert beneath police station | This structure is modelled using a rectangular conduit unit connected to a sprung arch conduit unit in Flood Modeller. Overtopping is represented in the 2d Domain |  Upstream face looking downstream  Downstream face looking upstream |

# 6 Model Proving

## 6.1 Model Performance



Datafile: ...\THACKA BECK\FM\DAT\THB_014.DAT
Results: ...\Q1000\A66_THACKA_BECK_AB_014_(Q1000).zzl

Figure 6.1: Thacka Beck Flood Modeller convergence plot

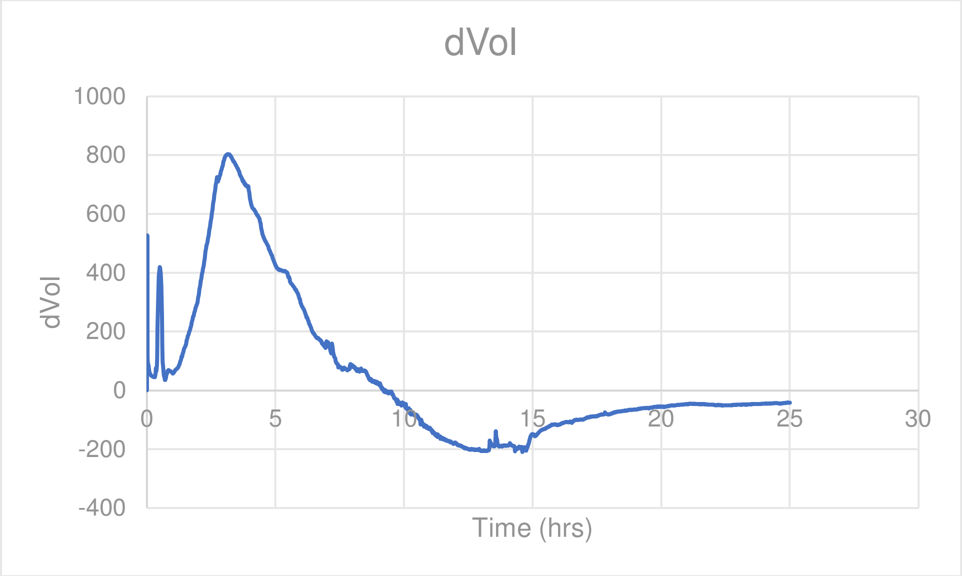


Figure 6.2: Thacka Beck dVol

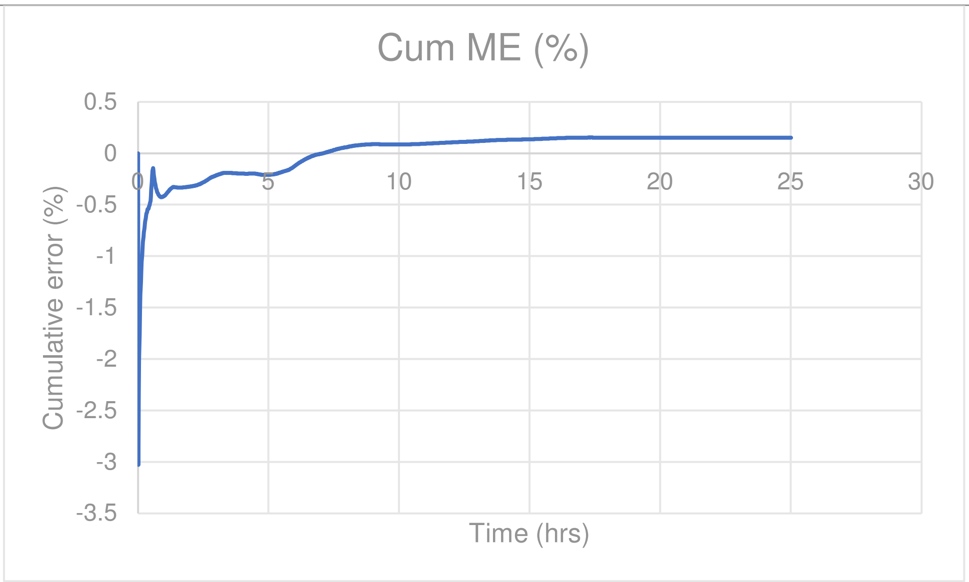
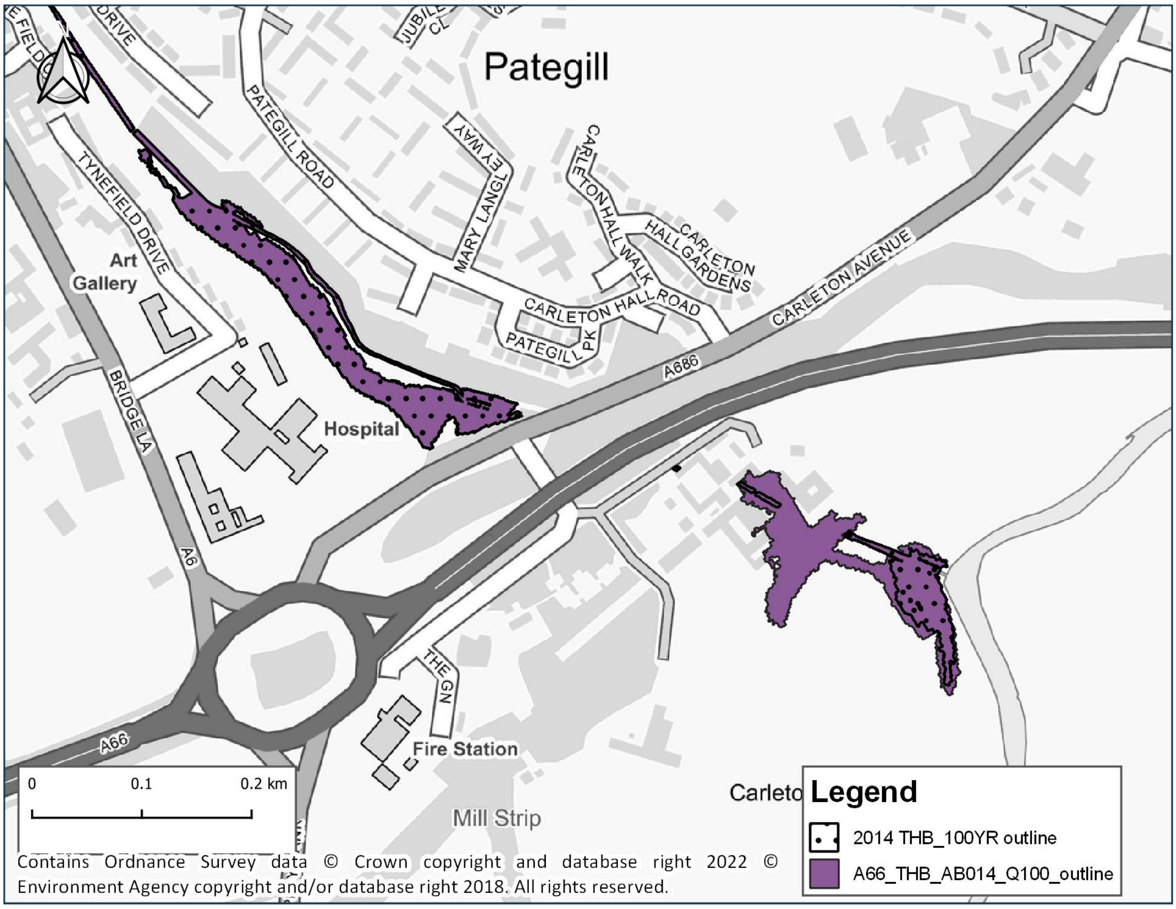
<table>
<tr><td colspan="2">

Figure 6.3: Thacka Beck cumulative mass error<br>The Flood modeller convergence plot shows smooth inflows to and outflows from the model with only isolated and short-lived instances of poor convergence . Flow and stage profiles have been checked at the lower end of the Thacka Beck and are smooth with minimal oscillations, indicating the model is performing well. The dVol and cumulative mass error plots shows a spike at the beginning of the model run. However, this is not unusual as the model settles down to steady state. Throughout the simulation the dVol is smooth and the cumulative mass error is within a range of +1 to -1%.</td></tr>
<tr><td colspan="2">6.2 Model Verification</td></tr>
<tr><td>Calibration</td><td>As part of JBA 2014 study, the Thacka Beck model was calibrated against the high flow events of 3, 6 and 9 December 1999 and verified against that of 28 October 1999. The November 2009 flood event was the next largest flood event available during the 2014 study, but the model could not be calibrated against this as the Thacka Beck FAS post dates the November 2009 event.<br>Given the minimal updates to the hydraulic model and hydrology, further calibration has not been carried out as part of this study.<br>To validate the model outputs, the Environment Agency recorded flood outline dataset was reviewed but no flood outlines following the implementation of the Thacka Beck FAS were recorded. Consultation with the Local Authority identified that flooding had occurred along the Dog Beck in 2016, just before the watercourse joins the Thacka Beck. Whilst information on the causes of the flooding could not be provided (e.g, blockage, bank overtopping etc), modelled flood extents show this area flooding from the 100-year plus climate change event.</td></tr>
<tr><td>Previous Model Comparison</td><td>A comparison of the 100-year flood extents from the 2014 study against those from this study is shown in Figure 6.4. The indication is of that</td></tr>
</table>

| | |
|---|---|
| | comparable flood extents across the majority of the study area, and increased flood extents just upstream of the Eamont confluence. |
| Flood Zone Comparison | A comparison between the modelled 100-year flood extents and the environment Agency's Flood Zone 3 is shown in Figure 6.5. The indication is that upstream of the A66, flood extents compare well but diverge at the Thacka Beck / River Eamont confluence. The latter observation can be attributed to the River Eamont floodplain, which is represented in a separate hydraulic model. |
|  Contains Ordnance Survey data © Crown copyright and database right 2022 © Environment Agency copyright and/or database right 2018. All rights reserved.<br>Figure 6.4: 1% fluvial flood extents from the 2014 and 2020 modelling studies | |

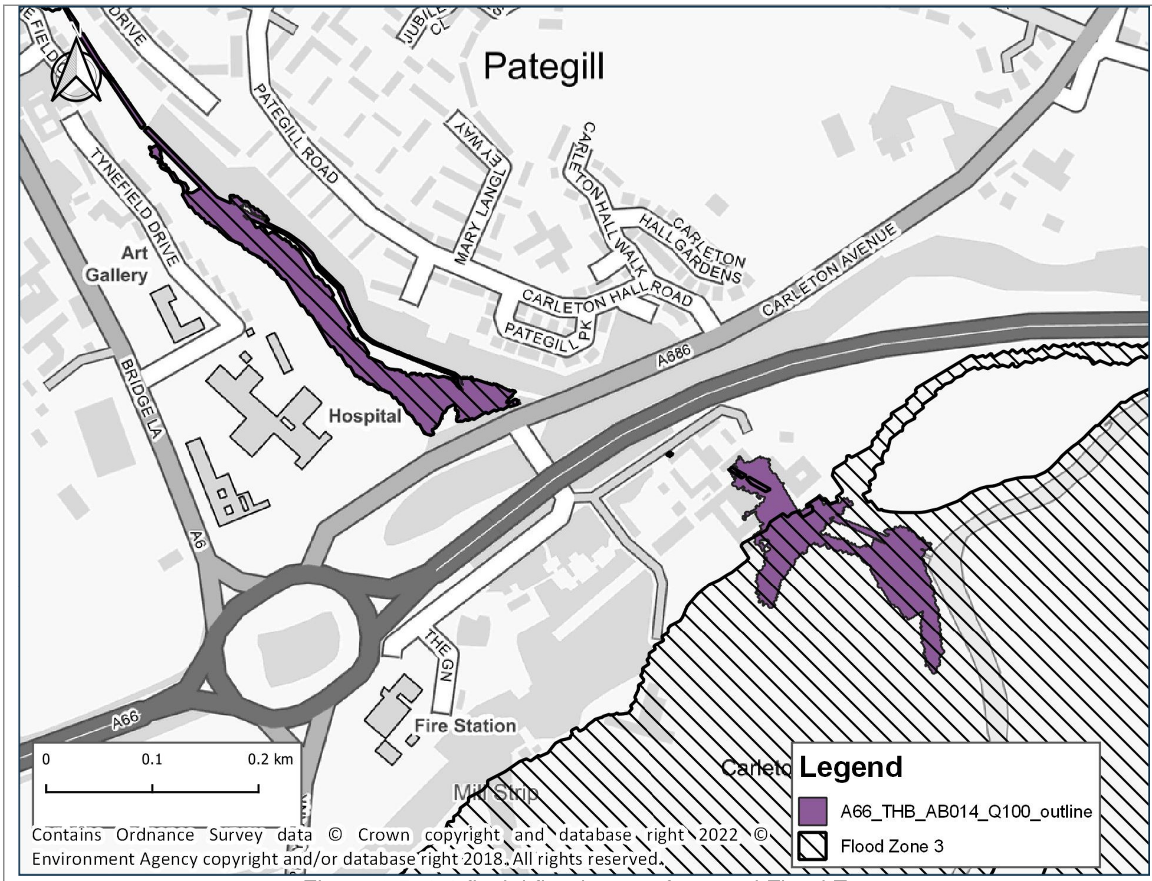


Figure 6.5: 1% fluvial flood extent from and Flood Zone 3

## 6.3 Sensitivity Analysis

Sensitivity tests were carried out for the 1% AEP existing situation model to assess the model response to the change in:

- Flow: Model inflows increased by 20%
- Roughness coefficient: In-channel and roughness values changed by +20% and -20%
- Downstream boundary: Increased by 250mm

The hydraulic model results showed a maximum increase of 0.38m in water levels due to a 20% increase in flow.
The downstream boundary sensitivity test showed a maximum increase in peak water levels of 0.25m at node TBE0_0007. Increases in water levels greater than 0.01m extend approximately 120m upstream of the Eamont confluence.

The sensitivity tests for increased and decreased Manning’s ‘n’ did not start due to an instability issue. Attempts were made to run the model in ISIS, which did allows the model for the Manning’s ‘n’ minus 20% roughness to complete, but a fair results comparison could not be made due to differences in model software. As a result, sensitivity to these parameters could not be tested within the model. However, sensitivity testing was carried out as part of the 2014 modelling study. This showed that the model was not unduly sensitive to channel hydraulic roughness. The study concluded that Thacka Beck exhibits little sensitivity to hydraulic roughness by virtue of its steepness.

## 7 Model Build – With-Scheme Situation Model

With-scheme hydraulic modelling had not been carried out as the proposals do not include any changes to structures along the watercourse or within the floodplain of the Thacka Beck.

## 8 Key Model Assumptions and Limitations

During any hydraulic modelling study, there will always be associated limitations, for example, with uncertainty and data availability etc. The representation of any complex system by a model requires several assumptions to be made. In the case of the Thacka Beck hydraulic model it has been assumed that:

- Cross sections accurately represent the shape and variation of the river.
- Model parameters have been determined appropriately.
- Design flows are an accurate representation of flows of a given AEP.
- The surveyed cross-sections of hydraulic structures and the units used to represent them in the model are appropriate and adequate.
- LIDAR accurately reflects bank heights and particularly that the filtered LIDAR has appropriately removed the influence of vegetation.

A66 Northern Trans-Pennine

# Penrith to Temple Sowerby Hydraulic Modelling Report

Penrith to Temple Sowerby

| **Document Verification** | |
|---|---|
| **Project Title** | **A66 Northern Trans-Pennine**<br>Penrith to Temple Sowerby |
| **Document Title** | Hydraulic Modelling Report |
| **Document Ref** | HE565627-JBAU-XX-03-RP-HM-S3-P02-0001-Scheme3_Modelling_Report |

**Note:** The contents of the Cover Page and Document Verification page are managed by ProjectWise. Users should not edit these fields manually.

| Rev | Suit. Code | Suitability | | Purpose of Issue | | |
|---|---|---|---|---|---|---|
| P01 | S01 | Shared for review | | | | |
| | | Created | Checked | Reviewed | Approved | Authorised |
| | **Name** | A. Blanchard | D. Kearney | D. Kearney | D. Kearney | --- |
| | **Date** | 10.10.2021 | 03.11.2021 | 03.11.2021 | 03.11.2021 | --- |

| Rev | Suit. Code | Suitability | | Purpose of Issue | | |
|---|---|---|---|---|---|---|
| P02 | S3 | Shared for review | | --- | | |
| | | Created | Checked | Reviewed | Approved | Authorised |
| | Name | A. Blanchard | A Waite | A. Waite | A. Waite | --- |
| | Date | 30.03.2022 | 14.04.2022 | 14.04.2022 | 14.04.2022 | --- |

| Rev | Suit. Code | Suitability | | Purpose of Issue | | |
|---|---|---|---|---|---|---|
| --- | --- | --- | | --- | | |
| | | Created | Checked | Reviewed | Approved | Authorised |
| | Name | --- | --- | --- | --- | --- |
| | Date | --- | --- | --- | --- | --- |

| **Fluvial Hydraulic Modelling Report – Scheme 3** | | |
|---|---|---|
| 1 Basic Model Information | | |
| Model Name | Scheme 3 model | |
| Primary Watercourses / Water Bodies | Lightwater<br>Unnamed Tributary of Lightwater 3.1<br>Unnamed Tributary of River Eamont 3.3<br>Unnamed Tributary of River Eamont 3.5<br>Swine Gill | |
| Designation | Ordinary Watercourse | |
| Model ID | The following table presents information regarding the model scenarios carried out as part of this study. | |
| Model Scenario ID | Scenario | Annual Probability |
| Lightwater, Unnamed tributary of Lightwater 3.1, Unnamed tributary of River Eamont 3.3 | | |
| Scheme3_LIG_UNN301_004.dat<br>Scheme3_LIGH_UNN301_Q20_004.ief<br>LIGH_UNN301_Q20_004.tcf | Existing situation model for Lightwater, Unnamed tributary of Lightwater and Unnamed Tributary of River Eamont 3.3 | 5% (1 in 20-years) |
| Scheme3_LIG_UNN301_004.dat<br>Scheme3_LIGH_UNN301_Q100_004.ief<br>LIGH_UNN301_Q100_004.tcf | | 1% (1 in 100-years) |
| Scheme3_LIG_UNN301_004.dat<br>Scheme3_LIGH_UNN301_Q100CC47_004.ief<br>LIGH_UNN301_Q100CC47_004.tcf | | 1% + 47% climate change (1 in 100-years + 47% climate change) |
| Scheme3_LIG_UNN301_004.dat<br>Scheme3_LIGH_UNN301_Q100CC61_004.ief<br>LIGH_UNN301_Q100CC61_004.tcf | | 1% + 61% climate change (1 in 100-years +61% climate change) |
| Scheme3_LIG_UNN301_004.dat<br>Scheme3_LIGH_UNN301_Q100CC94_004.ief<br>LIGH_UNN301_Q100CC94_004.tcf | | 1% + 94% climate change (1 in 100-years plus 94% climate change) |
| Scheme3_LIG_UNN301_004.dat<br>Scheme3_LIGH_UNN301_Q1000_004.ief<br>LIGH_UNN301_Q1000_004.tcf | | 0.1% (1 in 1000-years) |
| Scheme3_LIG_UNN301_004_Nplus20pct.dat<br>Scheme3_LIGH_UNN301_Q100_004_Nplus20pct.ief<br>LIGH_UNN301_Q100_004_Nplus20pct.tcf | Sensitivity tests for model of Lightwater, Unnamed tributary of Lightwater and | 1% AEP with +20% roughness |
| Scheme3_LIG_UNN301_004_Nmin20pct.dat<br>Scheme3_LIGH_UNN301_Q100_004_Nminus20pct.ief | | 1% AEP with –20% roughness |

| | | |
|---|---|---|
| LIGH_UNN301_Q100_004_Nmin20pct.tcf | Unnamed Tributary of River Eamont 3.3 | |
| Scheme3_LIG_UNN301_004.dat<br>Scheme3_LIGH_UNN301_Q100_004_Qplus20pct.ief<br>LIGH_UNN301_Q100_004_Qplus20pct.tcf | | 1% AEP with +20% flow |
| Scheme3_LIG_UNN301_004_DSBDY.dat<br>Scheme3_LIGH_UNN301_Q100_004_DSBDY5.ief<br>LIGH_UNN301_Q100_004_DSBDY5yr.tcf | | 1% with 5-year downstream boundary |
| Swine Gill | | |
| Scheme3_SWG_006.dat<br>Scheme3_SWG_Q20_003.ief<br>SWG001_Q20_002.tcf | Existing situation for Swine Gill | 5% (1 in 20-years) |
| Scheme3_SWG_006.dat<br>Scheme3_SWG_Q100_003.ief<br>SWG001_Q100_002.tcf | | 1% (1 in 100-years) |
| Scheme3_SWG_006.dat<br>Scheme3_SWG_Q100CC47_003.ief<br>SWG001_Q100CC47_002.tcf | | 1% + 47% climate change (1 in 100-years + 47% climate change) |
| Scheme3_SWG_006.dat<br>Scheme3_SWG_Q100CC61_003.ief<br>SWG001_Q100CC61_002.tcf | | 1% + 61% climate change (1 in 100-years +61% climate change) |
| Scheme3_SWG_006.dat<br>Scheme3_SWG_Q100CC94_003.ief<br>SWG001_Q100CC94_002.tcf | | 1% + 94% climate change (1 in 100-years plus 94% climate change) |
| Scheme3_SWG_006.dat<br>Scheme3_SWG_Q1000_003.ief<br>SWG001_Q1000_002.tcf | | 0.1% (1 in 1000-years) |
| Scheme3_SWG_006_Nplus20pct.dat<br>Scheme3_SWG_Q100_003_Nplus20pct.ief<br>SWG001_Q100_002_Nplus20pct.tcf | Sensitivity tests for Swine Gill | 1% AEP with +20% roughness |
| Scheme3_SWG_006_Nminus20pct.dat<br>Scheme3_SWG_Q100_003_Nmin20pct.ief<br>SWG001_Q100_002_Nmin20pct.tcf | | 1% AEP with –20% roughness |
| Scheme3_SWG_006.dat<br>Scheme3_SWG_Q100_003_Qplus20pct.ief<br>SWG001_Q100_002_Qplus20pct.tcf | | 1% AEP with +20% flow |
| Scheme3_SWG_006_Dmin20pct.dat<br>Scheme3_SWG_Q100_003_Dmin20pct.ief<br>SWG001_Q100_002_Dmin20pct.tcf | | 1% with -20% gradient downstream boundary |
| Unnamed tributary of River Eamont 3.5 | | |

| | | |
|---|---|---|
| UNN302_Q20_003.tcf<br>UNN302_Q20_003.ecf | Existing situation for Unnamed tributary of River Eamont 3.5 | 5% (1 in 20-years) |
| UNN302_Q100_003.tcf<br>UNN302_Q100_003.ecf | | 1% (1 in 100-years) |
| UNN302_Q100CC47_003.tcf<br>UNN302_Q100CC47_003.ecf | | 1% + 47% climate change (1 in 100-years + 47% climate change) |
| UNN302_Q100CC61_003.tcf<br>UNN302_Q100CC61_003.ecf | | 1% + 61% climate change (1 in 100-years +61% climate change) |
| UNN302_Q100CC94_003.tcf<br>UNN302_Q100CC94_003.ecf | | 1% + 94% climate change (1 in 100-years plus 94% climate change) |
| UNN302_Q1000_003.tcf<br>UNN302_Q1000_003.ecf | | 0.1% (1 in 1000-years) |
| UNN302_Q100_003_Nplus20pct.tcf<br>UNN302_Q100_003_Nplus20pct.ecf | Sensitivity tests | 1% AEP with +20% roughness |
| UNN302_Q100_003_Nmin20pct.tcf<br>UNN302_Q100_003_Nmin20pct.ecf | | 1% AEP with –20% roughness |
| UNN302_Q100_003_Qplus20pct.tcf<br>UNN302_Q100_003_Qplus20pct.ecf | | 1% AEP with +20% flow |
| UNN302_Q100_003_DSBDY1m.tfc<br>UNN302_Q100_003_DSBDY1m.ecf | | 1% with 1m increase on downstream boundary |
| Scheme3_LIG_UNN301_004_PD002.dat<br>Scheme3_LIGH_UNN301_Q20_004_PD005.ief<br>LIGH_UNN301_Q20_004_PD005.tcf | With-Scheme Situation Model for Lightwater, Unnamed tributary of Lightwater and Unnamed Tributary of River Eamont 3.3 | 5% (1 in 20-years) |
| Scheme3_LIG_UNN301_004_PD002.dat<br>Scheme3_LIGH_UNN301_Q100_004_PD005.ief<br>LIGH_UNN301_Q100_004_PD005.tcf | | 1% (1 in 100-years) |
| Scheme3_LIG_UNN301_004_PD002.dat<br>Scheme3_LIGH_UNN301_Q100CC94_004_PD005.ief<br>LIGH_UNN301_Q100CC94_004_PD005.tcf | | 1% + 94% climate change (1 in 100-years plus 94% climate change) |
| Scheme3_SWG_006_PD001.dat<br>Scheme3_SWG_Q20_003_PD001.ief<br>SWG001_Q20_002_PD001.tcf | With-Scheme Situation for Swine Gill | 5% (1 in 20-years) |

| | | |
|---|---|---|
| Scheme3_SWG_006_PD001.dat<br>Scheme3_SWG_Q100_003_PD001.ief<br>SWG001_Q100_002_PD001.tcf | | 1% (1 in 100-years) |
| Scheme3_SWG_006_PD001.dat<br>Scheme3_SWG_Q100CC94_003_PD001.ief<br>SWG001_Q100CC94_002_PD001.tcf | | 1% + 94% climate change (1 in 100-years plus 94% climate change) |
| UNN302_Q20_003_PD001.tcf<br>UNN302_Q20_003_PD001.ecf | With Scheme model for Unnamed tributary of River Eamont 3.5 | 5% (1 in 20-years) |
| UNN302_Q100_003_PD001.tcf<br>UNN302_Q100_003_PD001.ecf | | 1% (1 in 100-years) |
| UNN302_Q100CC94_003_PD001.tcf<br>UNN302_Q100CC94_003_PD001.ecf | | 1% + 94% climate change (1 in 100-years plus 94% climate change) |

| **2 Model Input Data** | |
|---|---|
| Incoming Models | 2018 Eamont Bridge Appraisal Model – used to inform downstream boundary water levels |
| DTM for 2D Model Domain | 1m resolution LIDAR flown in 2013<br>For Swine Gill, the area upstream of the A66 crossing has been represented using a reservoir unit with ground levels derived from 1m LiDAR data and 5m photogrammetric data dated 2018. |
| River channel/Structure survey | Channel survey collected by JBA Consulting between November 2020-June 2021 |
| Additional Data | Mastermap data, As built drawings of existing A66 where available, proposed route alignments. |

| **3 Model Build Overview** | | | |
|---|---|---|---|
| Software | 1D domain: FM for Lightwater, Unnamed tributary of Lightwater and Unnamed tributary of River Eamont 3.3<br>FM for Swine Gill<br>ESTRY for Unnamed tributary of River Eamont 3.5 | | |
| | 2D domain(s): TUFLOW for all three models | | |
| Model Reference | HE565627-JBAU-03-MO-HM-0001-Scheme03_Hydraulic_Model | | |
| Model Schematisation | Figure 3.1 to 3.3 show the schematisation of the hydraulic models for Scheme 3 | | |
| Model Reaches | The table below shows the watercourse reaches defined in the model. They are also shown in Figure 3.1 to 3.3. | | |
| Watercourse Name | Upstream model node | Downstream model node | Total Reach length (km) |

| | | | |
|---|---|---|---|
| Lightwater | LIG1_1190 | LIG1_0063 | 1.12 |
| Unnamed tributary of Lightwater | UNN303_0282 | UNN303_000C | 0.28 |
| Unnamed tributary of River Eamont 3.3 | UNN301_652u | UNN301_22 | 0.71 |
| Unnamed tributary of River Eamont 3.5 | UNN302_0401 | UNN302_020 | 0.39 |
| Swine Gill | SWG001_2257 | SWG001_1337 | 0.78 |

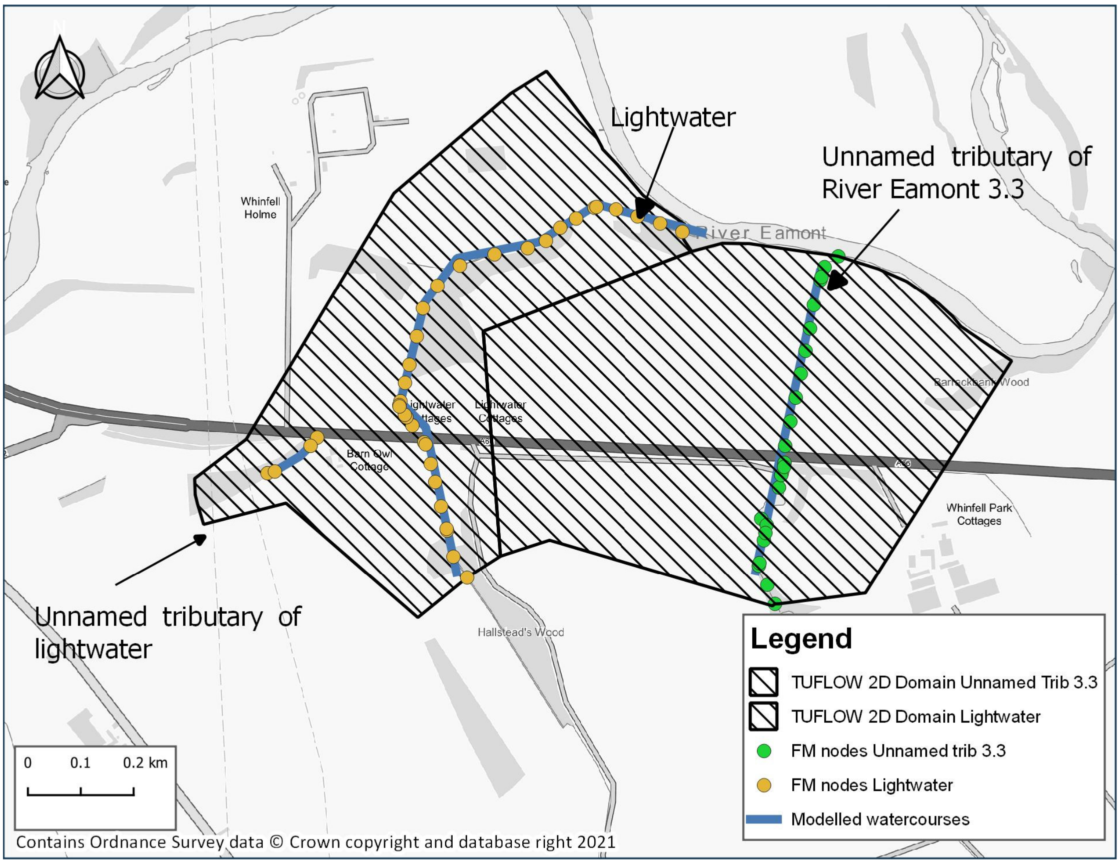


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Figure 3.1: Model extent, Lightwater, tributary of Lightwater and Unnamed tributary 3.3

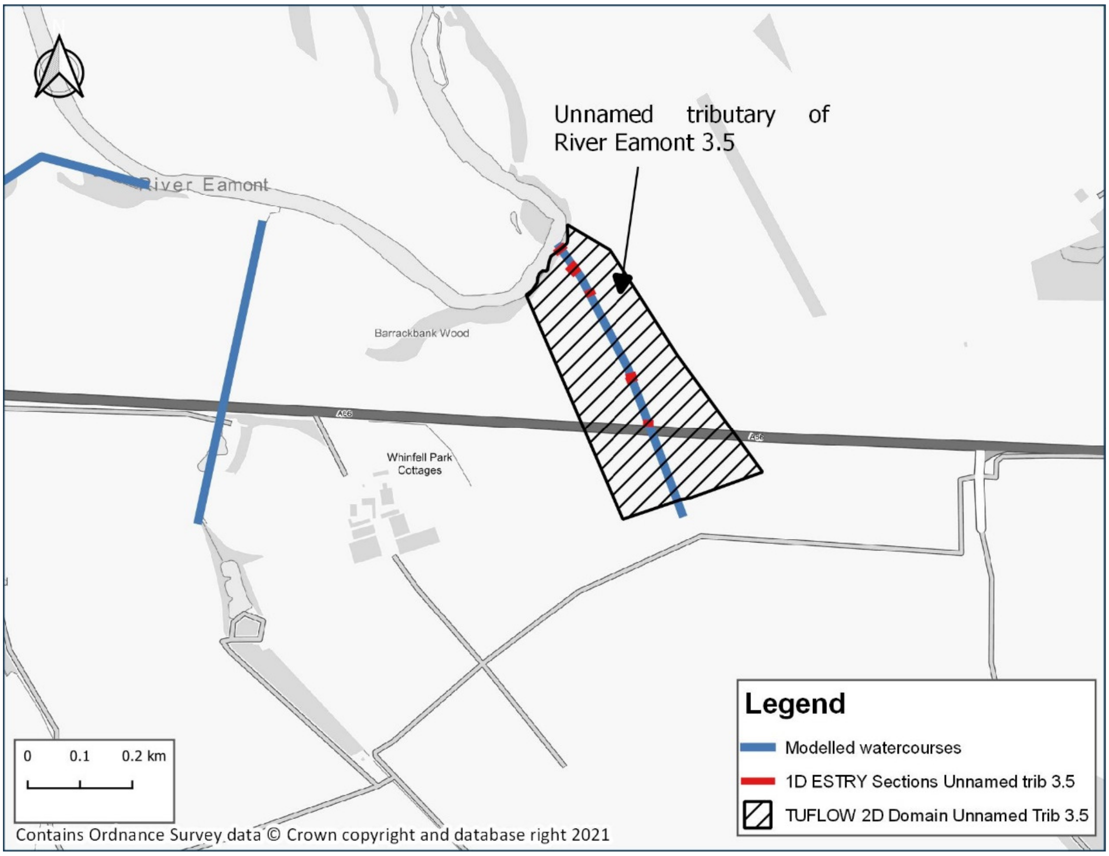

Figure 3.2: Model extent, Unnamed tributary of River Eamont 3.5

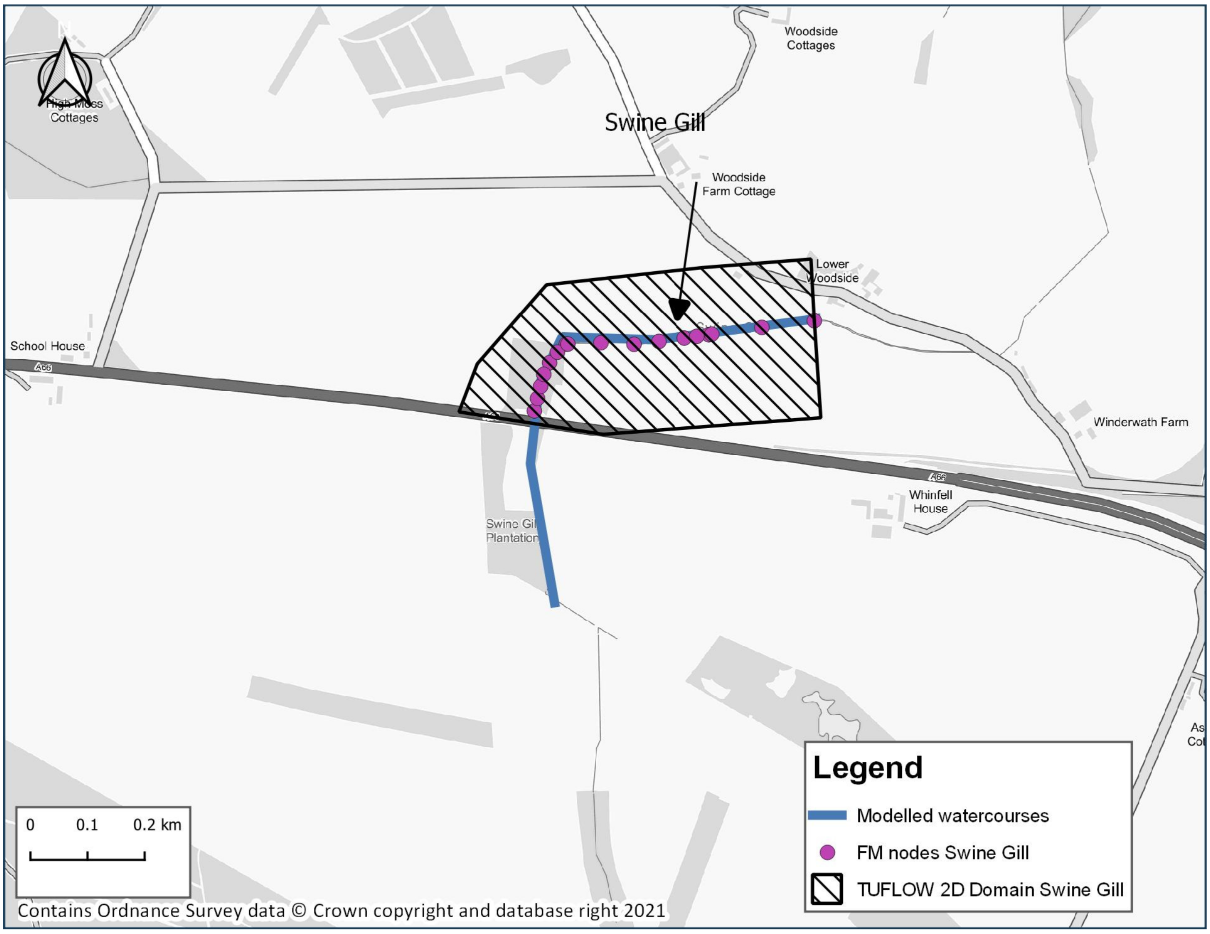

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Figure 3.3: Model extent, Swine Gill

| **4 Baseline model schematisation** | |
|---|---|
| 4.1 1D Domain | |
| Channel representation | The channel system has been based upon the most recent survey data set available for the area. The channels have been represented within the 1D domain across the study reach. |
| Structure representation | Existing structures have been based upon the most recent survey data set available. All significant structures within the study area have any modelling assumptions documented within this report (Section 5). Additionally, any structures which were not included within the hydraulic model based on the assumption that they were not deemed to be hydraulically significant are also recorded. |
| Inflow boundaries | Lightwater/ Tributary of Lightwater and Unnamed tributary of River Eamont 3.3<br>Flow has been applied with a flow-time (QT) boundary at a point for the upstream nodes of each watercourse. No lateral inflows have been applied due to the negligible catchment area between the existing and proposed A66 alignments. Further information can be found in the FEH calculation record. |

| | |
|---|---|
| | Unnamed tributary of River Eamont 3.5<br>Flow has been applied to the 2D domain with a 2D boundary condition line to allow water to route towards the structure beneath the A66. No upstream channel sections could be found upstream of the existing A66. No lateral inflows have been applied due to the negligible catchment area between the existing and proposed A66 alignments. Further information can be found in the FEH calculation record.<br><br>Swine Gill<br>Flow has been applied with a flow-time (QT) boundary at the upstream extent of the model. No lateral inflows have been applied due to the negligible catchment area between the existing and proposed A66 alignments. Further information can be found in the FEH calculation record. |
| Climate Change | Climate change uplifts have been applied for the central, higher central and upper end allowances for the Eden and Esk Management Catchment using the Environment Agency July 2021 allowances. |
| Downstream boundary | Lightwater/ Tributary of Lightwater and Unnamed tributary of River Eamont 3.3<br>Stage-time (HT) hydrographs have been applied at the downstream extent of the Lightwater and the Unnamed tributary of the River Eamont. Levels have been extracted from the River Eamont hydraulic model, supplied by the Environment Agency for use in this study. The 2-year peak water level has been used in the baseline model runs.<br><br>Unnamed tributary of River Eamont 3.5<br>Stage-time (HT) hydrographs have been applied at the downstream extent of the tributary of the River Eamont. No hydraulic model information was available for this part of the River Eamont. Water levels have therefore been estimated from the River Eamont bank top levels<br><br>Swine Gill<br>A normal depth downstream boundary has been applied at the downstream end of the Swine Gill model. This was because no existing model was available at the downstream boundary location to accurately extract water level data for a given AEP event. |
| Hydraulic roughness values used | Channel roughness values have been represented in the model by Manning's 'n' values, defined on a reach basis. In order to determine the roughness of channel cross sections, photographic evidence collected during site visits and survey collection were used as a reference alongside application of the method published by Cowan (1956).<br>Channel roughness values range from 0.040-0.070.<br>Structure roughness values range from 0.015-0.025.<br>To understand the implications of using these manning's n values, sensitivity testing has been conducted to quantify the impacts in changing these parameters. |
| Labelling/naming convention used | All nodes have an ID of NNN001_XXXXX where NNN is the watercourse reference and XXXXX is the chainage upstream.<br>The following suffixes have been used: |

| | | | |
|---|---|---|---|
| | C or CU Culvert<br>J Junction<br>W Weir<br>SP Spill<br>B Bridge<br>i, i2, i3 Interpolate<br>u or d Upstream or downstream node | | |
| 4.2 2D Domain | | | |
| Area of 2D Domains | Lightwater/ Tributary of Lightwater and Unnamed tributary of River Eamont 3.3<br>0.89 m2<br>Unnamed tributary of River Eamont 3.5<br>0.1 km2<br>Swine Gill<br>0.15km2 | DTM data source | LIDAR |
| Resolution of grid | 2m | DTM Resolution | 1m |
| Modifications to topography and reasons | 2d_zsh_LIGH_L.shp<br>2d_zsh_LIGH_P_002.shp<br><br>2d_zsh_banks_L_SWG_002.shp<br>2d_zsh_banks_P_SWG_004.shp<br><br>2d_zsh_UNN301_L_001.shp<br>2d_zsh_UNN301_P_005.shp<br><br>2d_zsh_UNN302_L_001.shp<br>2d_zsh_UNN302_P_002.shp | The top of bank elevations have been stamped using Z shapes. Elevations are based on surveyed channel sections and LIDAR. | |

<table>
<tr>
<td>Hydraulic roughness values used</td>
<td>Manning’s n values have been used to represent hydraulic roughness in the 2D domain. The following roughness values were used in the model and are based on land cover types recorded in the Ordnance Survey MasterMap Topographic Area layer dataset.
<table>
<tr><th>Land Cover</th><th>Manning’s ‘n’ value</th></tr>
<tr><td>Generic floodplain roughness values</td><td>0.050</td></tr>
<tr><td>Boulders</td><td>0.065</td></tr>
<tr><td>Coniferous trees</td><td>0.120</td></tr>
<tr><td>Coniferous trees – scattered / Orchard</td><td>0.070</td></tr>
<tr><td>Coppice or osiers</td><td>0.090</td></tr>
<tr><td>Marsh Reeds or Saltmarsh</td><td>0.060</td></tr>
<tr><td>Non coniferous trees</td><td>0.090</td></tr>
<tr><td>Non-coniferous trees – scattered</td><td>0.060</td></tr>
<tr><td>Rough grassland</td><td>0.060</td></tr>
<tr><td>Scrub</td><td>0.070</td></tr>
</table>
</td>
</tr>
</table>

| | | |
|---|---|---|
| | Rock | 0.070 |
| | Heath | 0.090 |
| | Building | 0.300 |
| | General surface – multi surface | 0.050 |
| | General surface – step | 0.050 |
| | General surface - manmade | 0.050 |
| | General surface - natural | 0.060 |
| | Glasshouse | 0.200 |
| | Inland water | 0.045 |
| | Landform | 0.060 |
| | Landform – slope | 0.060 |
| | Landform – cliff | 0.060 |
| | Path – step | 0.050 |
| | Path | 0.050 |
| | Rail | 0.045 |
| | Road | 0.035 |
| | Roadside | 0.050 |
| | Structure | 0.300 |
| | Structure – upper level of communication | 0.300 |
| | Structure – pylon | 0.060 |
| | Tidal water – foreshore | 0.055 |
| | Tidal water | 0.055 |
| | Unclassified | 0.060 |
| | Stability value | 0.300 |
| 4.3 1D-2D Linking | | |
| A HX boundary is used to link the 1D and 2D domains along the top of banks. Elevations of HX cells are set using Z shapes outlined in Section 4.2. | | |
| Model Boundaries – Downstream Conditions | Lightwater/ Tributary of Lightwater and Unnamed tributary of River Eamont 3.3<br>A 2D HT boundary is used at the downstream extent of the 2D domain using the 2-year water level from the Eamont Bridge 2018 hydraulic model<br><br>Unnamed tributary of River Eamont 3.5<br>A 2D HT boundary is used at the downstream extent of the 2D domain using an approximated bank-full level based on LiDAR data<br><br>Swine Gill<br>A 2D HQ boundary is used at the downstream extent of the 2D domain based on slope values derived from LIDAR. | |
| 4.4 Representation of Defences | | |
| Defences | There are no formal defences within the study area. As such, all model runs are considered to be undefended.<br><br>A number of drystone walls are present within the study area that may impede flow during particular fluvial flood events. These have not been represented | |

| | |
|---|---|
| | within the model due to lack of data on these structures, and in parts, the integrity of these walls. |

| **5 Structures** | | | |
|---|---|---|---|
| General Assumptions | | | |
| At structures where only one face has been surveyed, a copy of the surveyed upstream face was used to represent the downstream face.<br>Bridge decks have been represented using spill units where it is likely there would be no complex overland flows which potentially would take water away from the channel.<br>Modelled structures have been schematised using the most recent channel survey taken by JBA Consulting between November 2020 and June 2021. | | | |
| Lightwater | | | |
| ID | Structure | How has this structure been modelled? | Photo (view of upstream face unless specified) |
| LIG1_1092C1u | Access bridge | This structure has been modelled with twin circular conduit units in Flood Modeller. Overtopping flow is represented in the 1D domain using a spill unit. | <br>Upstream face looking downstream |
| LIG1_0919Ci | Existing A66 structure | This structure has been modelled with a rectangular conduit unit in Flood Modeller. Overtopping flow is represented with in the 2D domain. The width has been adjusted | <br>Upstream face looking downstream |

| | | | |
|---|---|---|---|
| | | within the unit to account for the 37 degree skew. |  Downstream face looking upstream |
| LIG1_0860Cu | Access bridge | This structure has been modelled with an orifice unit in Flood Modeller to allow the wooden board at the face of the structure to be represented. Overtopping flow is represented in the 1D domain using a spill unit. |  Upstream face looking downstream |
| LIG1_0247CUu | Access bridge | This structure has been modelled with a circular conduit unit in Flood Modeller. Overtopping flow is represented in the 1D domain using a spill unit. |  Upstream face looking downstream |
| Tributary of Lightwater | | | |

| ID | Structure | How has this structure been modelled? | Photo (view of upstream face unless specified) |
|---|---|---|---|
| U303_0165CU | Circular pipe beneath A66 | This structure has been modelled with a circular conduit unit in Flood Modeller. Overtopping flow is represented in the 2D domain. The route of this structure has been inferred using as built drawings |  Upstream face  Downstream face looking upstream |
| Unnamed tributary of River Eamont 3.3 (UNN301) | | | |
| ID | Structure | How has this structure been modelled? | Photo (view of upstream face unless specified) |

| | | | |
|---|---|---|---|
| U301_652Cu | Circular culvert under access track | This structure has been modelled with a circular conduit unit in Flood Modeller. Overtopping has been represented in the 2D domain. | <br>Upstream face |
| UNN301_465C | Circular culvert under access track | This structure has been modelled with a circular conduit unit in Flood Modeller. Overtopping flow is represented with in the 2D domain. | <br>Upstream face |
| UNN301_441C1 | Existing A66 structure | This structure has been modelled with a rectangular conduit unit. Overtopping of flow is represented in the 2D domain. A circular outfall was identified at the downstream end, | <br>Upstream face looking downstream |

| | | | |
|---|---|---|---|
| | | understood to be from the surface water network. This has not been included in the hydraulic model. | <br>Downstream face looking upstream |
| UNN301_84C1 | Circular pipe | This structure has been modelled with a circular conduit unit in Flood Modeller. Overtopping flow is represented with in the 2D domain. | <br>Upstream face |
| Unnamed tributary to River Eamont 3.5 (UNN302) | | | |
| ID | Structure | How has this structure been modelled? | Photo (view of upstream face unless specified) |
| UNN302_0431C | Culvert under A66 | This structure has been modelled using a circular culvert in ESTRY. Overtopping has been represented in the 2D domain. A surface water outfall pipe identified at the upstream face of the | <br>Upstream face |

| | | | |
|---|---|---|---|
| | | structure was not modelled. |  Downstream face |
| UNN302_0310C | Circular culvert at farm crossing | This structure has been modelled using a circular culvert in ESTRY. Overtopping has been represented in the 2D domain. As the upstream inlet could not be found during the survey, dimensions for the upstream face are assumed based on the downstream. |  Downstream face |

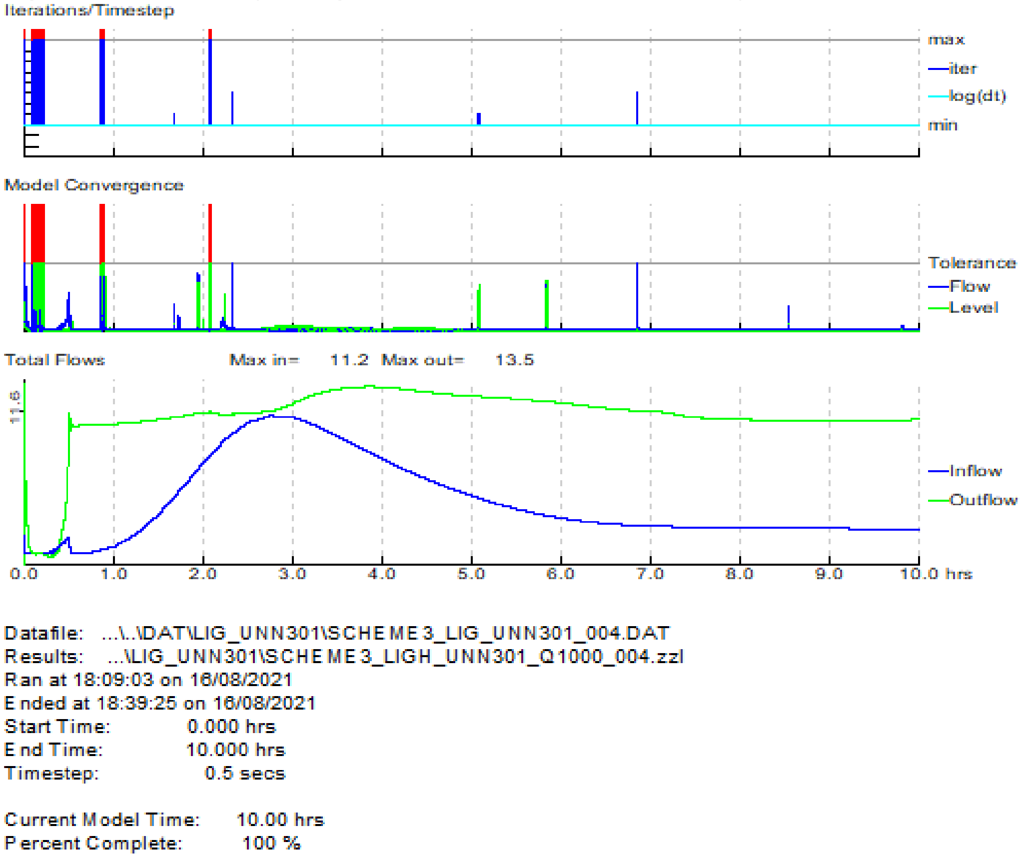
| | | | |
|---|---|---|---|
| UNN302_073C | Culvert at farm crossing | This structure has been modelled using a rectangular culvert in ESTRY. Overtopping has been represented in the 2D domain. | <br>Upstream face |
| Swine Gill | | | |
| SWG001_1941 | Culvert under A66 | The culvert inlets have been modelled using an orifice unit. A 1m drop in bed level has been assumed from photos and channel survey data. The culvert outlet has been modelled with a circular conduit unit. Overtopping is modelling in the 2D domain. | <br>Upstream face<br><br>Downstream face |

| | | | |
|---|---|---|---|
| SWG_1776Cu | Short culverted section | This structure was modelled using an orifice unit in Flood Modeller. Overtopping was modelled in the 1D domain using a spill unit |  Upstream face |
| SWG001_1524 | Farm crossing culvert | This structure was modelled using a circular culvert. Overtopping was represented in the 1D domain with a spill unit. |  Upstream face |

# 6 Model Proving

## 6.1 Model Performance

### Lightwater/ Tributary of Lightwater and Unnamed tributary of River Eamont 3.3



```
Datafile:   ...\..\DAT\LIG_UNN301\SCHEME3_LIG_UNN301_004.DAT
Results:    ...\LIG_UNN301\SCHEME3_LIGH_UNN301_Q1000_004.zzl
Ran at 18:09:03 on 16/08/2021
Ended at 18:39:25 on 16/08/2021
Start Time:           0.000 hrs
End Time:            10.000 hrs
Timestep:               0.5 secs

Current Model Time:      10.00 hrs
Percent Complete:         100 %
```

Figure 6.1: Lightwater model Flood Modeller convergence plot

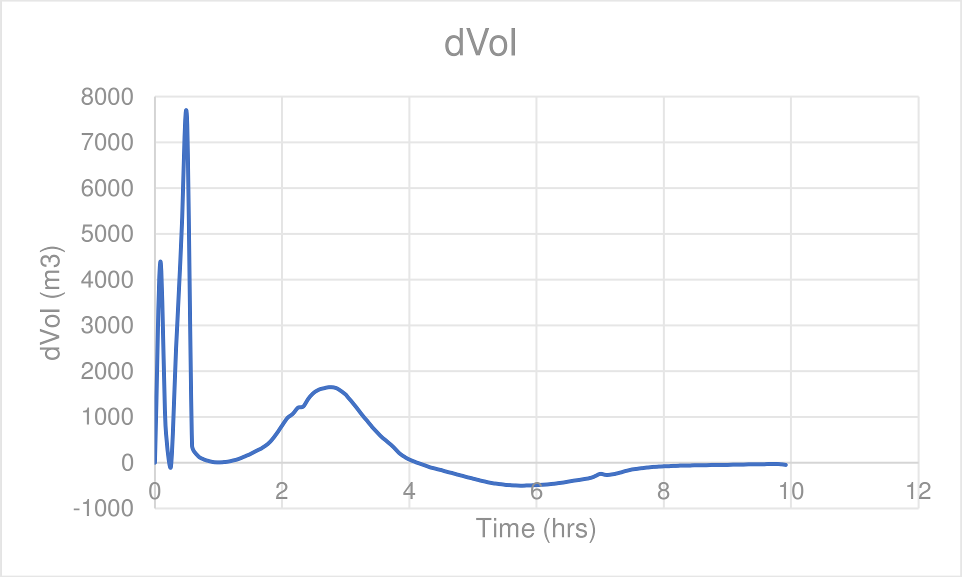


Figure 6.2: Lightwater model dVol

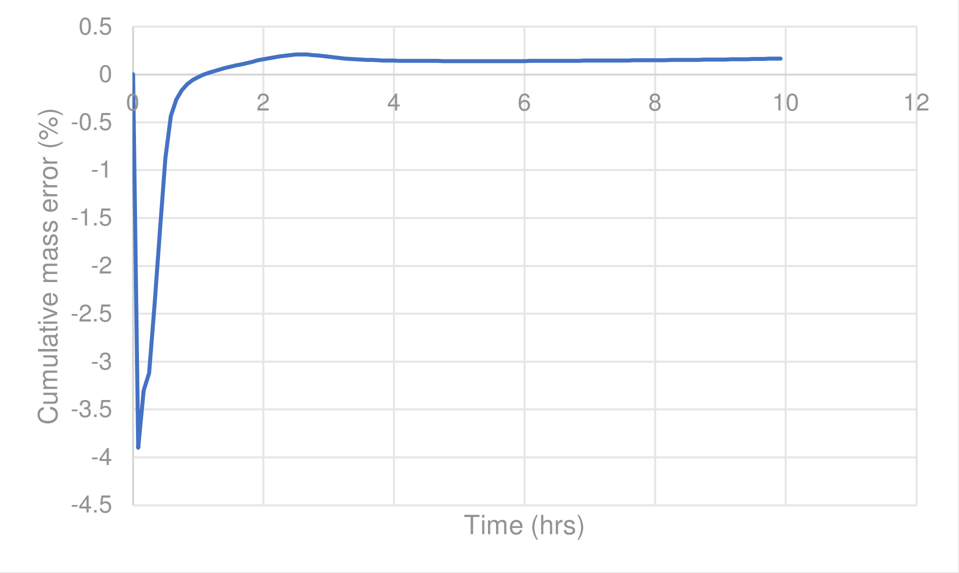


Figure 6.3: Lightwater model cumulative mass error

The Flood modeller convergence plot show smooth inflow an outflows into the model with only isolated incidences of poor convergences.  Flow and stage profiles have been checked throughout the model and are smooth with minimal oscillations, indicating the model is performing well. The dVol plot shows a spike at the beginning of the model run, associated with the HT boundary at the downstream end of the model. However, throughout the rest of the simulation the dvol is shown to be smooth and the cumulative mass error is within a range of +1 to -1 for the majority of the simulation.

Unnamed tributary of River Eamont 3.5

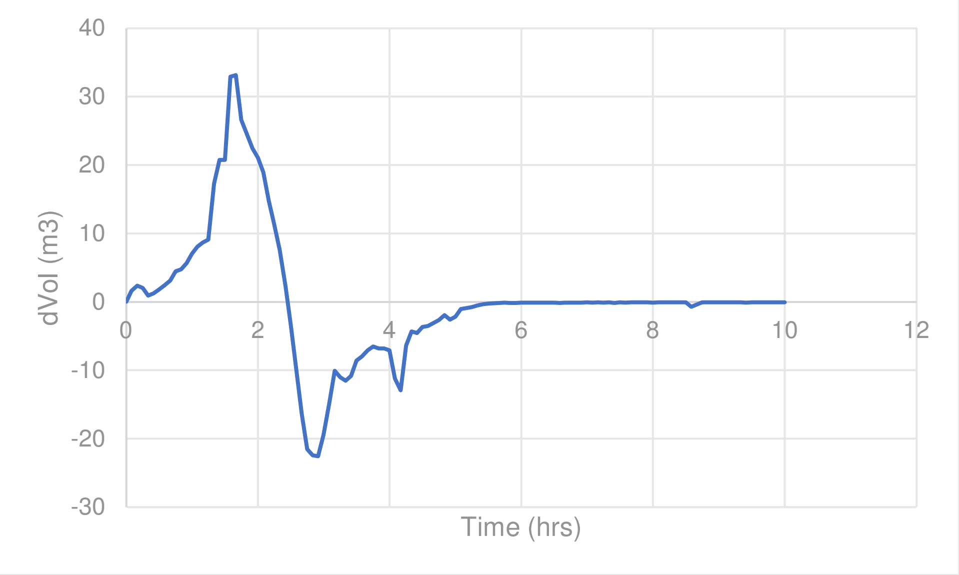


Figure 6.4: Unnamed tributary of River Eamont 3.5 dVol

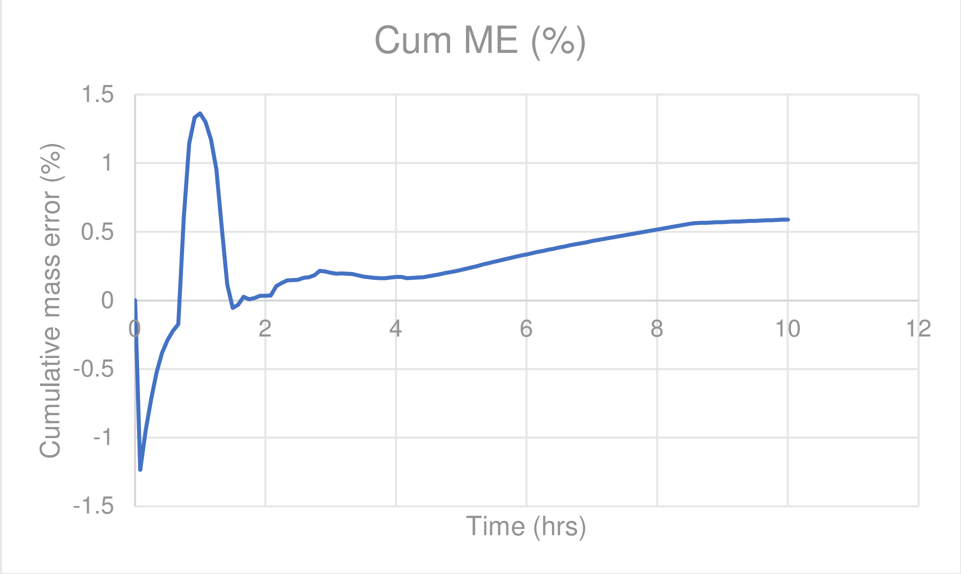
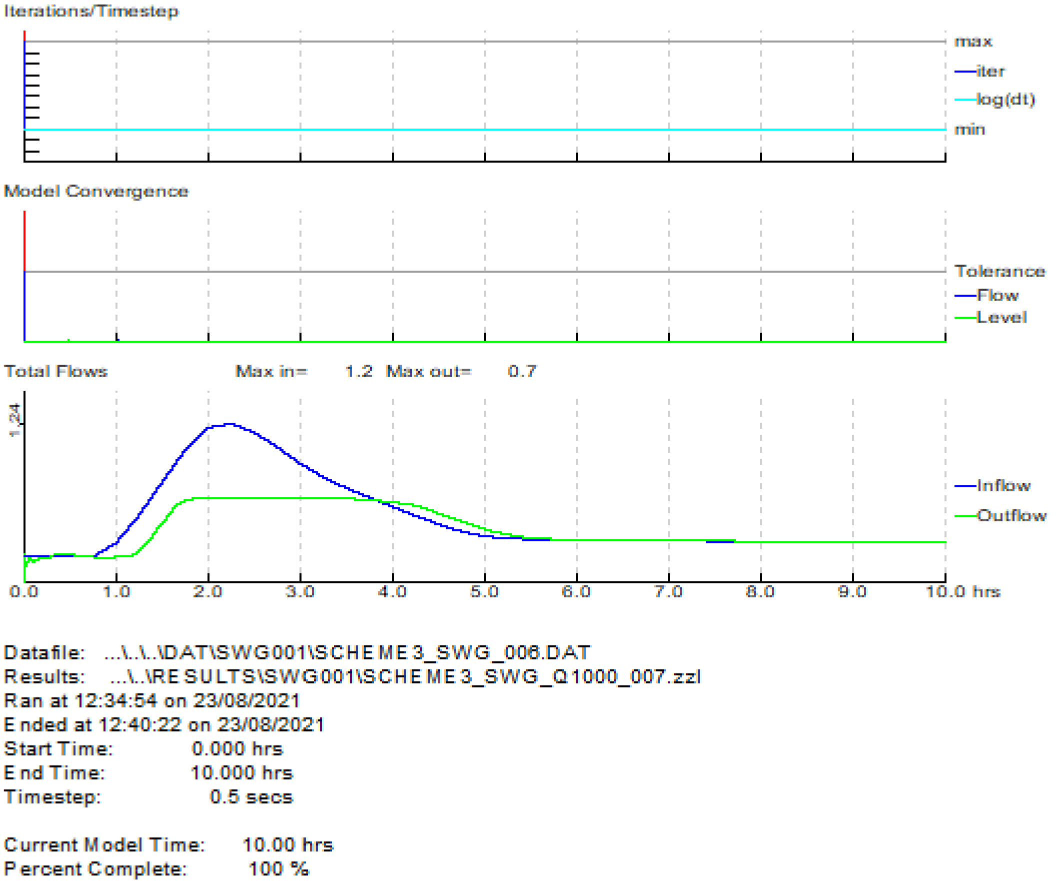


Figure 6.5: Unnamed tributary of River Eamont 3.5 cumulative mass error

Flow and stage profiles have been checked throughout the model and are smooth with minimal oscillations, indicating the model is performing well. The dVol plot is generally smooth and the cumulative mass error is within a range of +1 to -1 for the majority of the simulation.

## Swine Gill



```
Datafile:   ...\..\..\DAT\SWG001\SCHEME3_SWG_006.DAT
Results:    ...\..\RESULTS\SWG001\SCHEME3_SWG_Q1000_007.zzl
Ran at 12:34:54 on 23/08/2021
Ended at 12:40:22 on 23/08/2021
Start Time:          0.000 hrs
End Time:           10.000 hrs
Timestep:              0.5 secs

Current Model Time:      10.00 hrs
Percent Complete:         100 %
```

Figure 6.6: Swine Gill Flood Modeller convergence plot

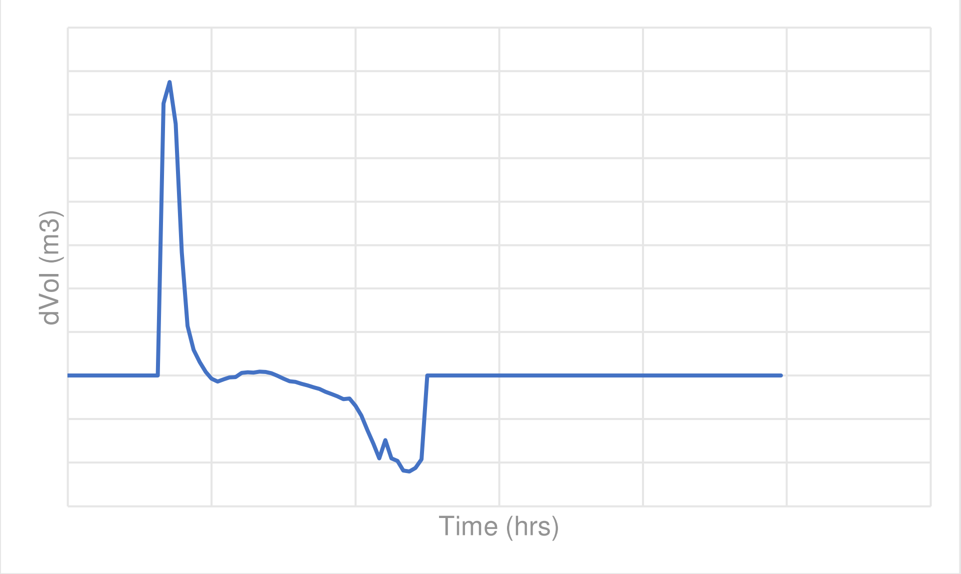


Figure 6.7: Swine gill model dVol

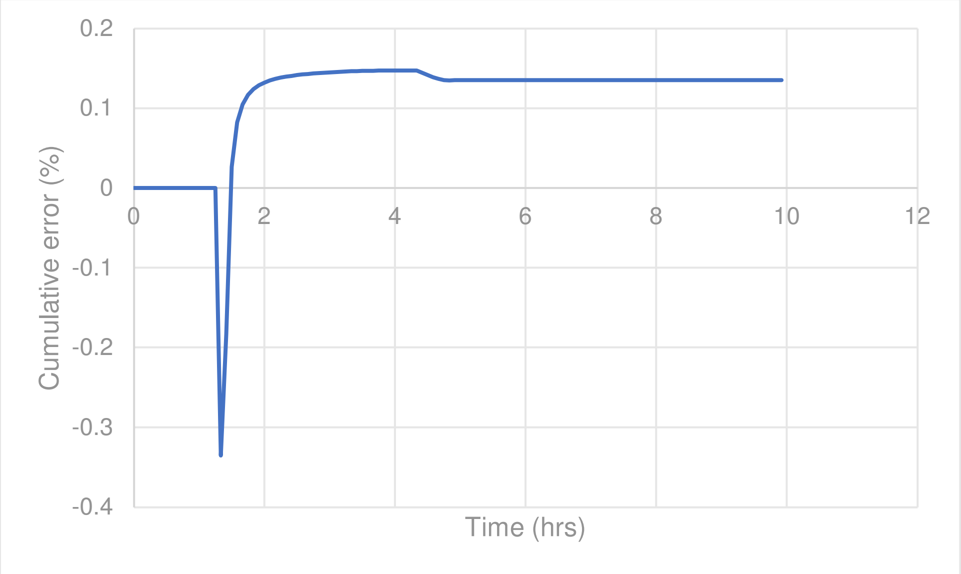


Figure 6.8: Swine gill model cumulative mass error

The Flood modeller convergence plot show smooth inflow an outflows into the model with no incidences of poor convergences. Flow and stage profiles have been checked throughout the model and are smooth with minimal oscillations, indicating the model is performing well. The dVol plot is shown to be smooth and the cumulative mass error is within a range of +1 to -1 for the entire simulation.

| 6.2 Model Verification | |
|---|---|
| Calibration | No gauge data was available for the study area to allow the model to be calibrated to. Information on historical flood risk was requested from the Lead Local Flood Authority but no information was provided. It is understood from anecdotal evidence that the Llama Karma Café has experienced |

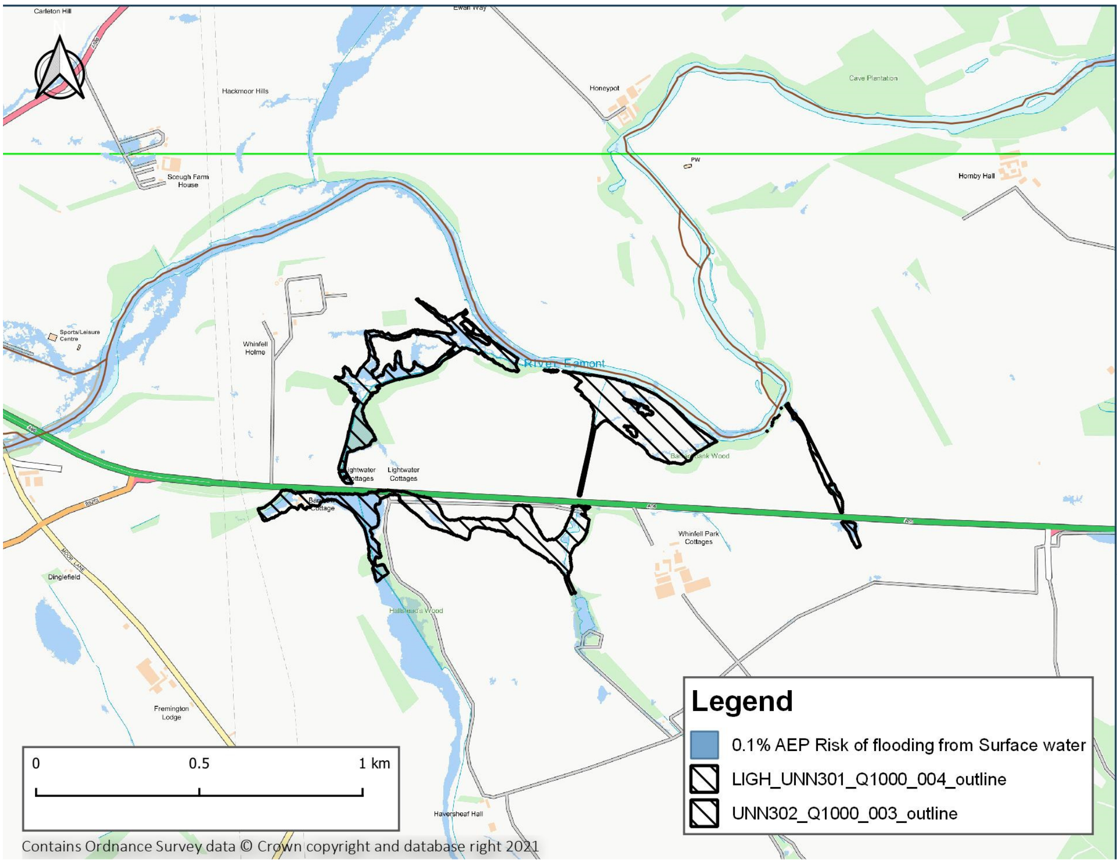
<table>
<tr><td></td><td>flooding in the past, and model results reconcile with this.</td></tr>
<tr><td>Previous Model Comparison</td><td>No previous hydraulic model results are available for the study area for comparison.</td></tr>
<tr><td>Flood Zone Comparison</td><td>Fluvial Flood Zone data is unavailable for the model extent. Surface water flood maps have therefore been used as a comparison and show that generally the modelled 0.1% fluvial flood extent are slightly larger than the 0.1% surface water flood extent, particularly at the confluence with the River Eamont, where the surface water extents do not take into account high water levels on the River Eamont.</td></tr>
<tr><td colspan="2">


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Figure 6.9: 0.1% surface water flood extent and 0.1% fluvial modelled flood extent
</td></tr>
</table>

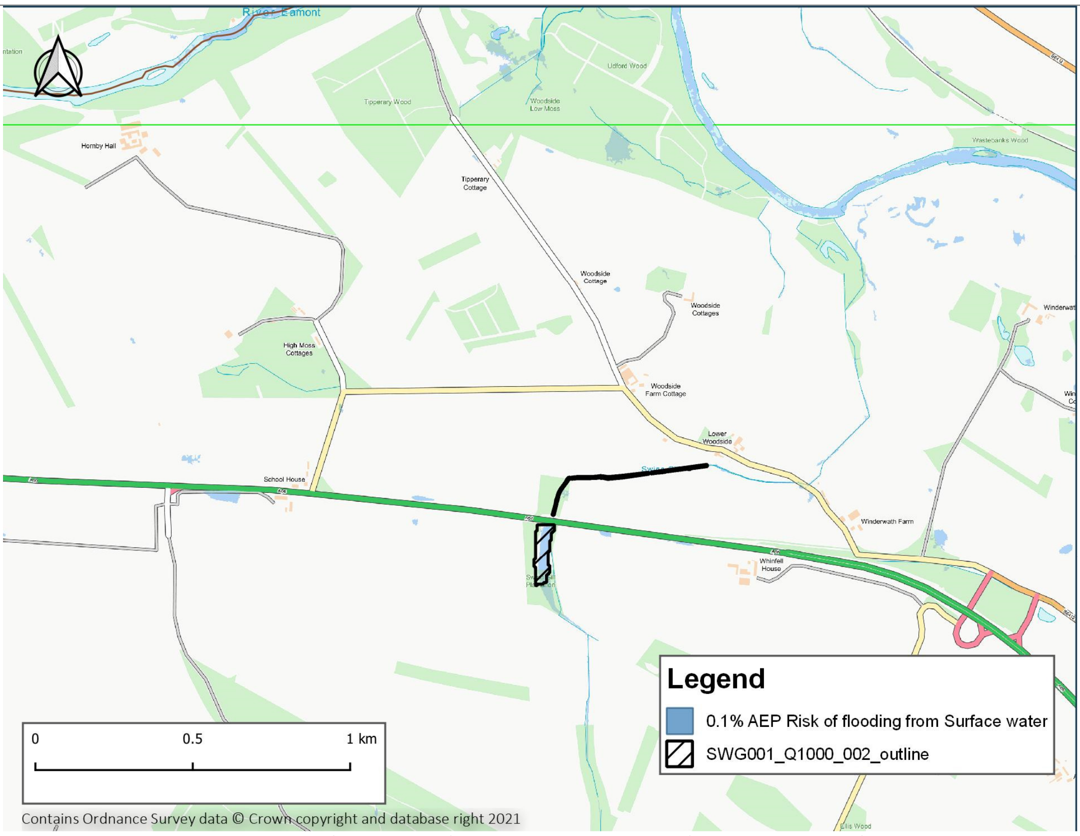

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Figure 6.10: 0.1% surface water flood extent and 0.1% fluvial modelled flood extent

## 6.3 Sensitivity Analysis

Sensitivity tests were carried out for the 1% AEP existing situation model to assess the model response to the change in:

- Flow: Model inflows increased by 20%
- Roughness coefficient: In-channel and roughness values changed by +20% and -20%
- Downstream boundary:
- Lightwater model – 5year downstream boundary used
- Unnamed tributary of River Eamont 3.5 – Downstream water level increased by 1m
- Swine Gill - Slope decreased by -20%

The table below shows the maximum, minimum and average change in in-channel water levels relative to the existing situation model for each modelled reach with increase in flow and increase and decrease in roughness coefficients.

- The downstream boundary sensitivity test showed a maximum increase in water levels at the most downstream node on all watercourses. Changes in peak water level compared to the baseline extend approximately 60m on the unnamed tributary of the River Eamont 3.3, approximately 150m on the Lightwater and approximately 180m on the Swine Gill.

| | | | |
|---|---|---|---|
| Watercourse | Lightwater and tributary of Lightwater | | |
| Node | Change in peak water level (m) | | |
| Sensitivity | Maximum | Minimum | Average |

| | | | |
|---|---|---|---|
| +20% Flow | 0.447 | 0 | 0.133 |
| +20% Roughness | 0.099 | -0.025 | 0.042 |
| -20% Roughness | Model did not run | | |
| | | | |
| Watercourse | Unnamed tributary of River Eamont 3.3 | | |
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.065 | 0 | 0.026 |
| +20% Roughness | 0.071 | -0.082 | 0.0078 |
| -20% Roughness | Model did not run | | |
| | | | |
| Watercourse | Swine Gill | | |
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.057 | 0 | 0.0127 |
| +20% Roughness | 0.047 | -0.063 | -0.00422 |
| -20% Roughness | 0.067 | -0.046 | -0.0008 |

## 7 Model Build – With-Scheme Situation Model

| | |
|---|---|
| Scenario Definition | Figure 7-1 to Figure 7-4 show the proposed features of the A66 scheme within the extent of the Scheme 3 hydraulic models. The following sections explain how the features were incorporated into the model. |

1D Domain

Lightwater, Unnamed tributary of Lightwater and Unnamed tributary of River Eamont 3.3
The following updates were made to the Flood Modeller model to represent design features:

- Lightwater culvert (node LIG1_0191Cu to LIG1_0880Cu) extended to 69m length with dimensions set to 3.658m wide and 2.362m height. Invert levels based on estimated levels between nearest surveyed cross sections
- An additional culvert added at LIG1_0796C of 3.658m width and 2.362m height. Invert levels based on estimated levels between nearest surveyed cross sections.
- Lightwater tributary culvert (node U303_0165CU to U303_0000C) extended to 200m in length. Modelled as a 0.675m diameter circular pipe for the entire length. Upstream invert level based on design drawing.
- Un-named tributary of River Eamont 3.3 culvert (node UNN301_441C1 to UNN301_0366) extended to 75m length culvert. Existing culvert section modelled as per baseline (0.76m * 1.11m rectangular culvert) and extension section modelled as a 0.9m circular pipe). Downstream invert level based on estimated levels between nearest surveyed cross sections.

Swine Gill
The following updates were made to the Flood Modeller model to represent the design features:

- Swine Gill culvert (node SWG_1938Cu to SWG_1912C2) extended to 64m length with extended section modelled at a 1.5m diameter circular pipe. Downstream invert level based on estimated levels between nearest surveyed cross sections.

Unnamed tributary of River Eamont 3.5
The following updates were made to the ESTRY model to represent the design features:

| | |
|---|---|
| - 1D network line (ref: UN302_0431C) extended to 83m, modelled as a 0.6m diameter pipe. Downstream invert level based on proposed 3D surface nearest the existing watercourse. | |
| TUFLOW 2D model | |
| Lightwater, Unnamed tributary of Lightwater and Unnamed tributary of River Eamont 3.3<br>The following updates were made to the TUFLOW model to represent design features:<br>- 3D surface of proposed scheme added to set elevations of the proposed road<br>- Proposed swale between access road and A66 modelled using a z-shape lowering ground levels by 0.5m.<br>- Open channel removed where culvert extensions are proposed.<br><br>Swine Gill<br>The following updates were made to the TUFLOW model to represent the design features:<br>- 3D surface of proposed scheme added to set elevations of the proposed road.<br>- Open channel removed where culvert extensions are proposed.<br><br>Unnamed tributary of River Eamont 3.5<br>The following updates were made to the TUFLOW model to represent the design features:<br>- 3D surface of proposed scheme added to set elevations of the proposed road.<br>- Open channel removed where culvert extensions are proposed. | |
| Design Detail Sources | In addition to direct communication with the design team, the following sources of information were utilised:<br><br>Design drawings:<br>HE565627-AMY-SGN-S03-DR-CB-000041 A3<br>HE565627-AMY-SGN-S03-DR-CB-000032 A3<br>HE565627-AMY-HDG-S03-DR-CD-000020-A1V Frame<br>HE565627-AMY-HDG-S03-DR-CD-000021-A1V Frame<br>HE565627-AMY-HDG-S03-DR-CD-000023-A1V Frame<br><br>Proposed surface:<br>ACAD-HE565627-AMY-HDG-S03-M3-CD-000004-Model |

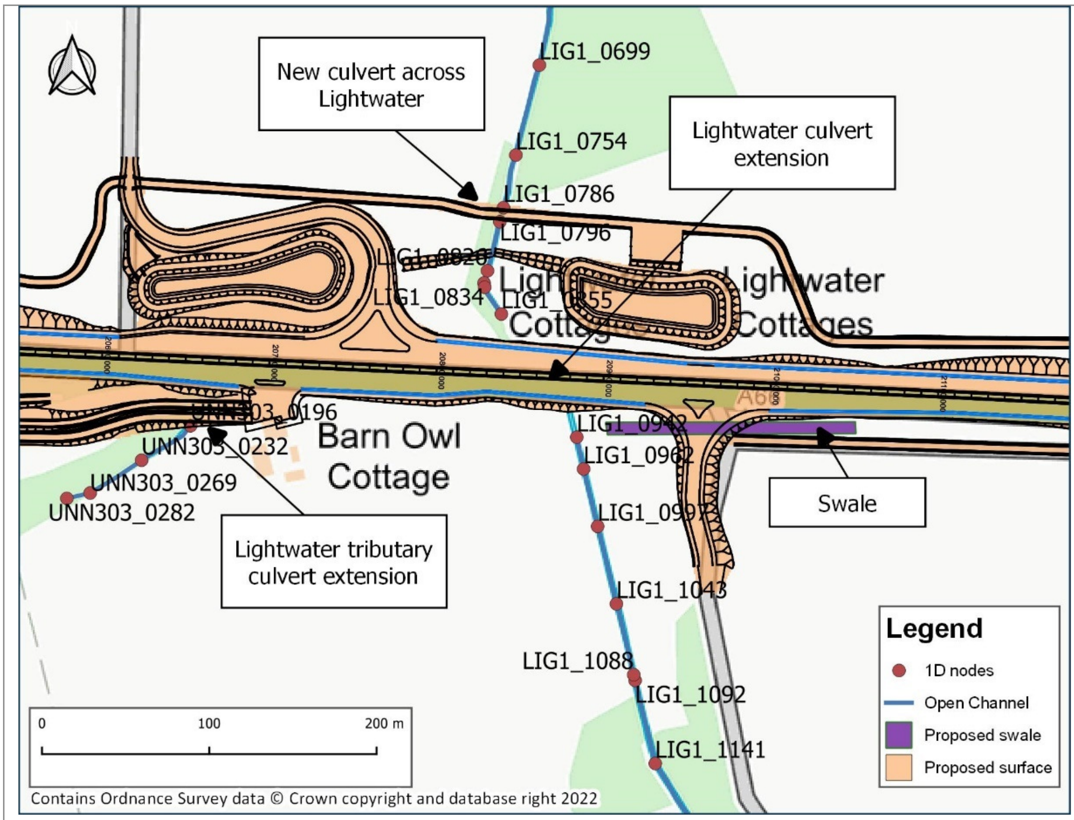

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Figure 7-1: With-scheme model schematisation, Lightwater and Unnamed tributary of Lightwater

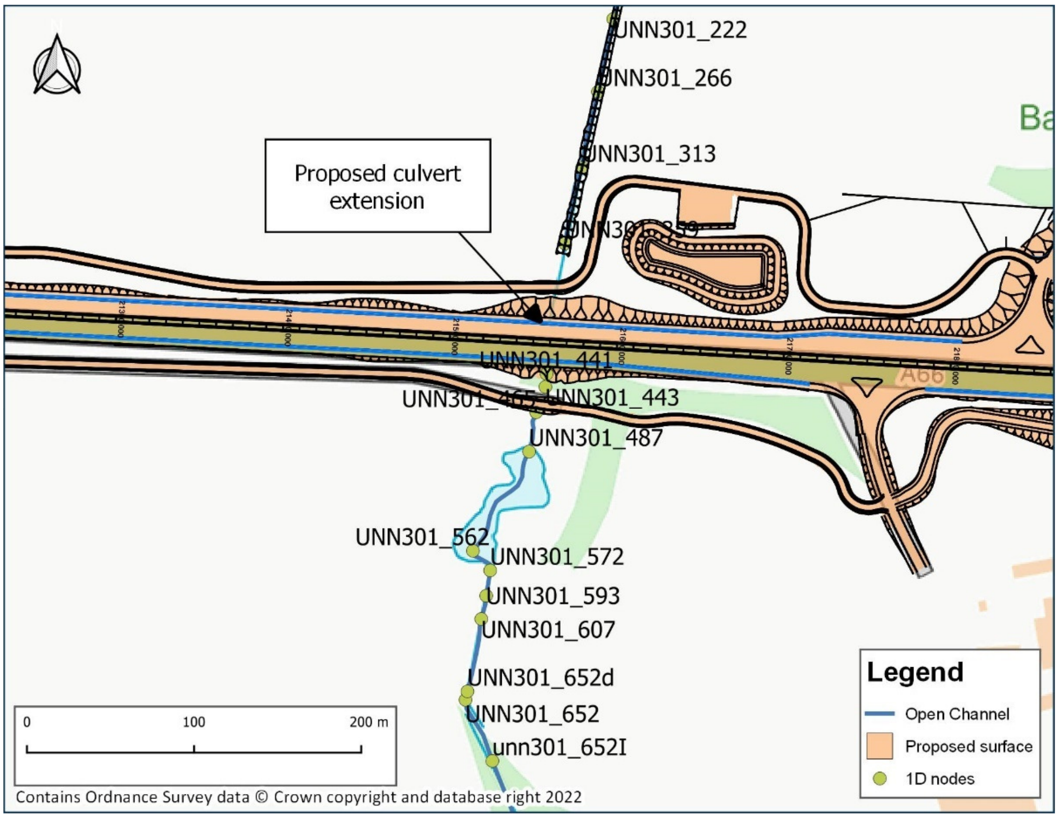

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Figure 7-2: With-scheme model, Unnamed tributary of River Eamont 3.3

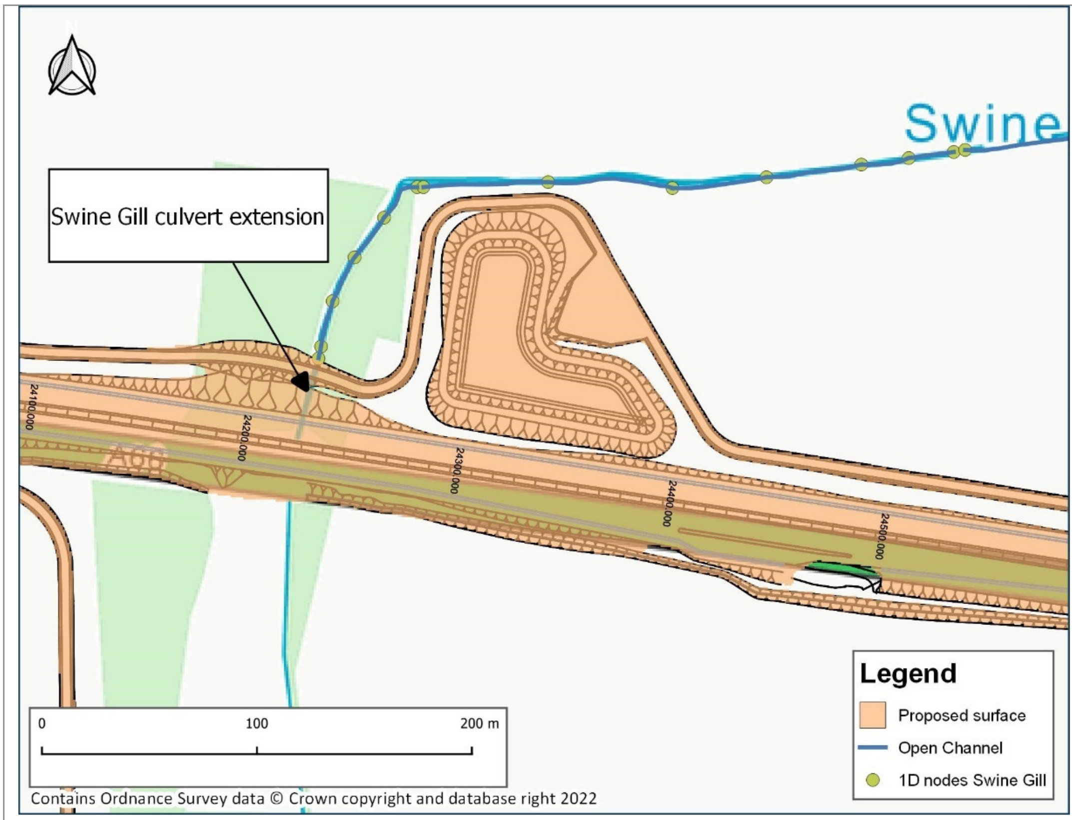

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Figure 7-3: With-scheme model schematisation, Swine Gill

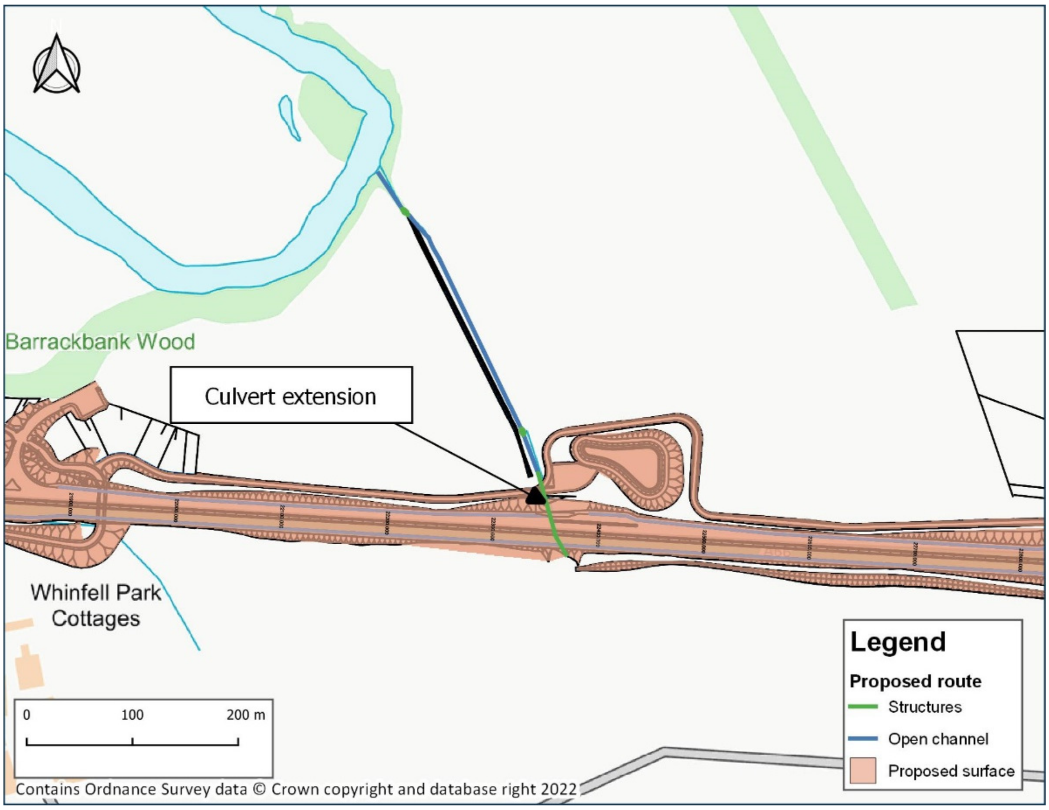

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Figure7-4: With-scheme model schematisation, Unnamed tributary of River Eamont 3.5

## 8 With-Scheme Model outputs

Water level, flow and depth outputs were extracted for the existing situation and with-scheme situation model at key locations and compared. The changes are presented below.

Change in 1D peak water levels

| Location | Model node | Change in peak water level (m) | | |
|---|---|---|---|---|
| | | 5% AEP | 1% AEP | 1% AEP plus 94% climate change |
| Upstream of Lightwater culvert | LIG1_0962 | -0.29 | -0.43 | -0.55 |
| Downstream of Lightwater culvert | LIG1_0855 | +0.03 | +0.03 | +0.05 |
| Upstream of Lightwater tributary | UNN303_0269 | +0.09 | +0.16 | +0.08 |
| Downstream of Lightwater tributary | LIG1_0834 | +0.04 | +0.04 | +0.06 |
| Upstream of unnamed tributary of River Eamont 3.3 | UNN301_441 | -0.15 | -0.02 | -0.02 |
| Downstream of unnamed tributary of River Eamont 3.3 | UNN301_359 | +0.0 | +0.03 | +0.01 |
| Downstream of unnamed tributary of River Eamont 3.5 | UNN302_030.1 | +0.01 | +0.01 | +0.01 |
| Upstream of Swine Gill | SWG_1941 | +0.0 | +0.0 | +0.0 |
| Downstream of Swine Gill | SWG_1868 | +0.04 | +0.03 | -0.03 |

### 8.2 Pass forward flow

The pass forward flow downstream of each culvert extension or new culvert has been assessed to see what the likely effect will be for downstream flood risk. The table below shows the changes between the existing situation and with-scheme scenarios. This shows that there is negligible change in pass-forward flow as a result of the scheme.

| Model Assessed | Peak Flow (m3/s) | | |
|---|---|---|---|
| | 5% AEP | 1% AEP | 1% AEP plus 94% climate change |
| Lightwater existing situation (node LIG1_286) | 2.3 | 3.5 | 5.8 |
| Lightwater with-scheme (node LIG1_286) | 2.3 | 3.5 | 5.9 |
| Swine Gill existing situation (node SWG001_1824) | 0.4 | 0.5 | 0.6 |
| Swine Gill with-scheme (node SWG001_1824) | 0.4 | 0.5 | 0.6 |
| Unnamed tributary of River Eamont 3.5 | 0.3 | 0.4 | 0.7 |

| | | | |
|---|---|---|---|
| existing situation (node UNN_076) | | | |
| Unnamed tributary of River Eamont 3.5 with-scheme (node UNN_076) | 0.3 | 0.4 | 0.7 |

## 8.3 2D flood depth change

Figure 8.1 to Figure 8.9 show the changes in flood depth for the existing situation and with-scheme situation for each event

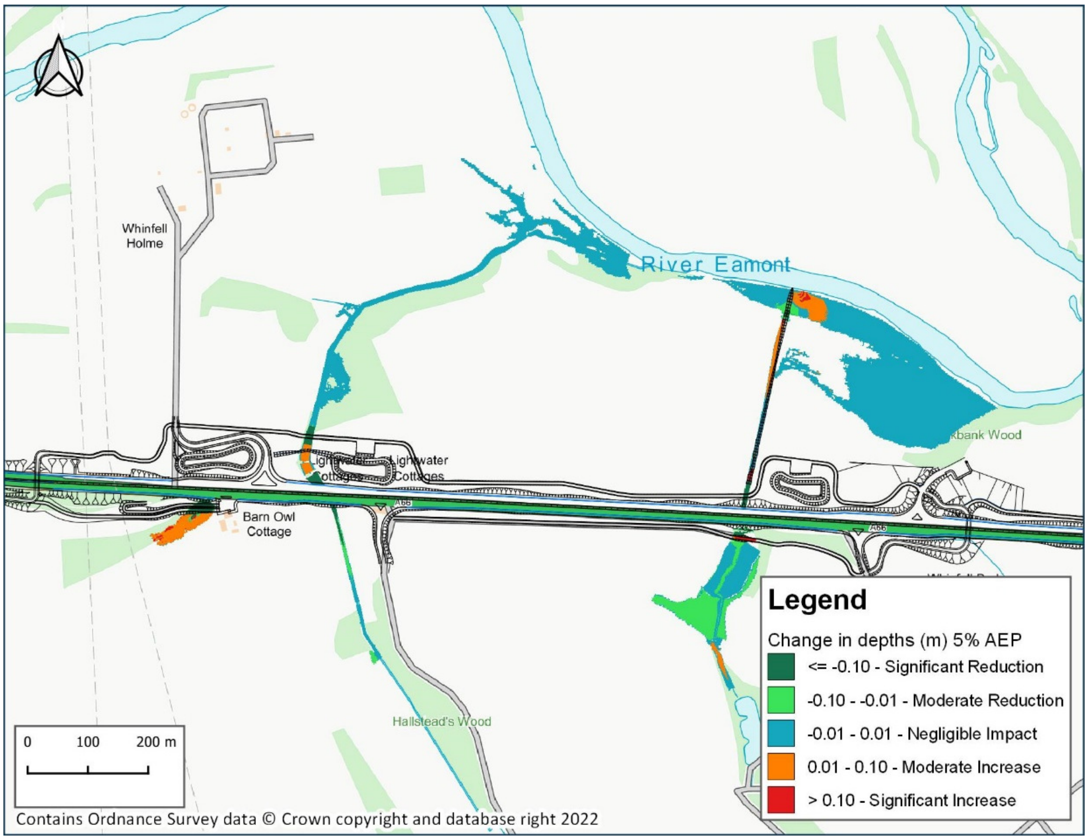

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Figure 8-1: Lightwater change in depths, 5% AEP

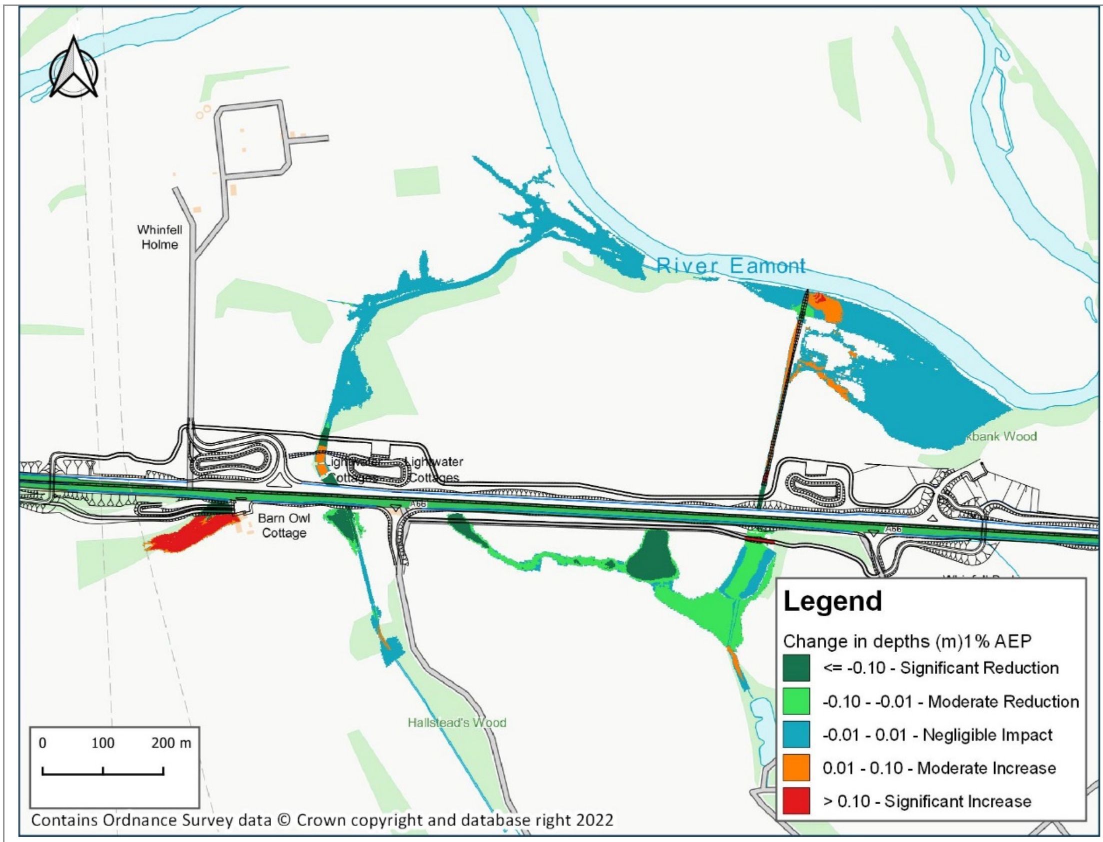

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Figure 8-2: Lightwater change in depths, 1% AEP

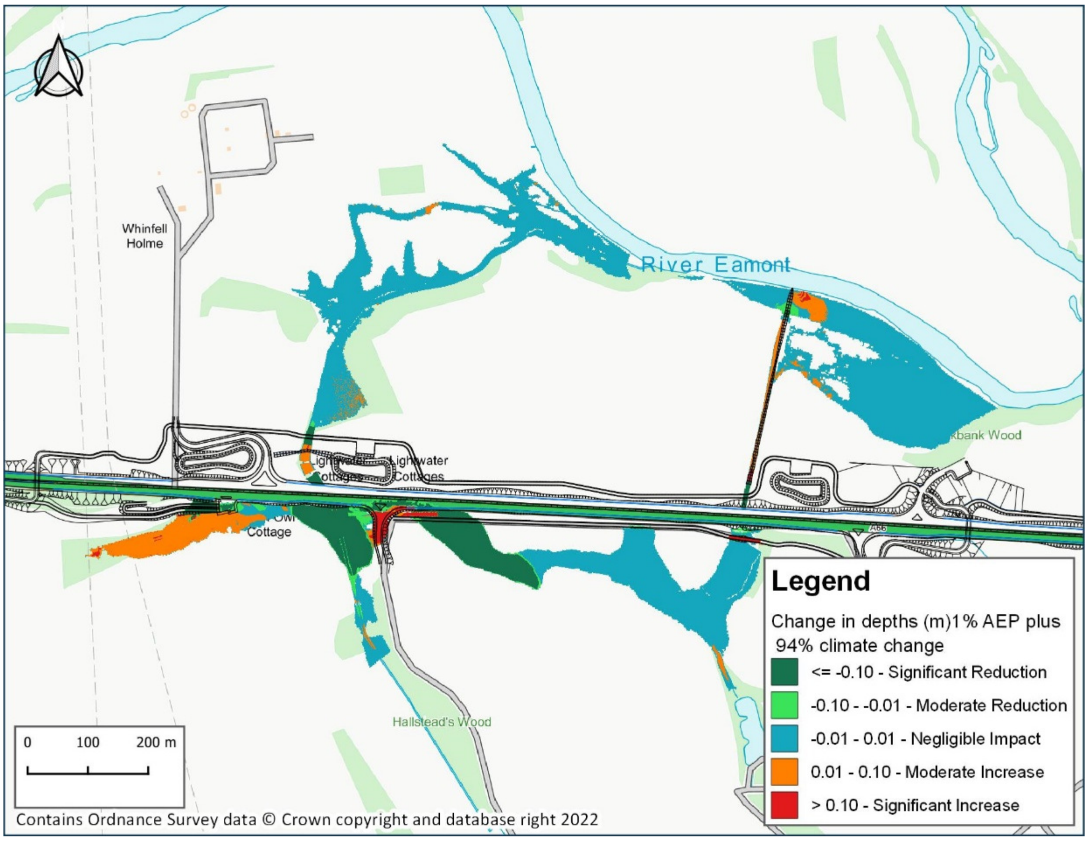

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Figure 8-3: Lightwater change in depths, 1% AEP plus 94% climate change

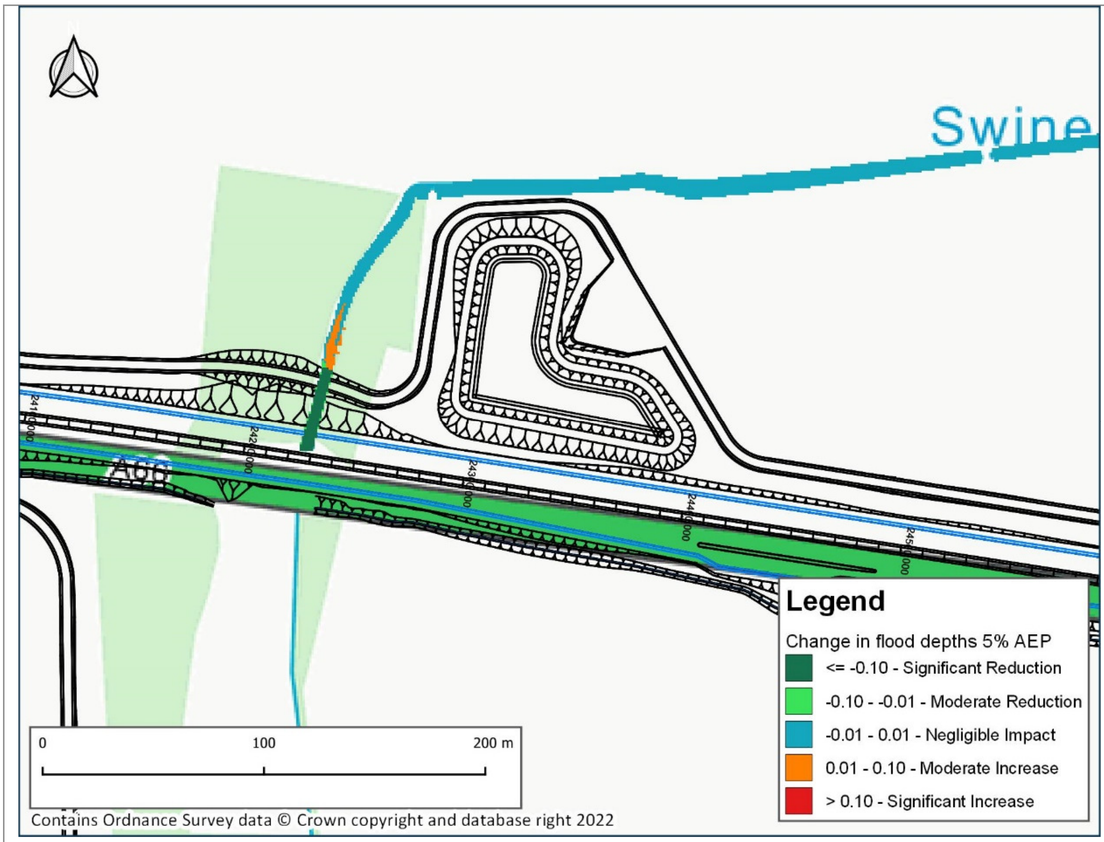

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Figure 8-4: Swine Gill change in depths, 5% AEP

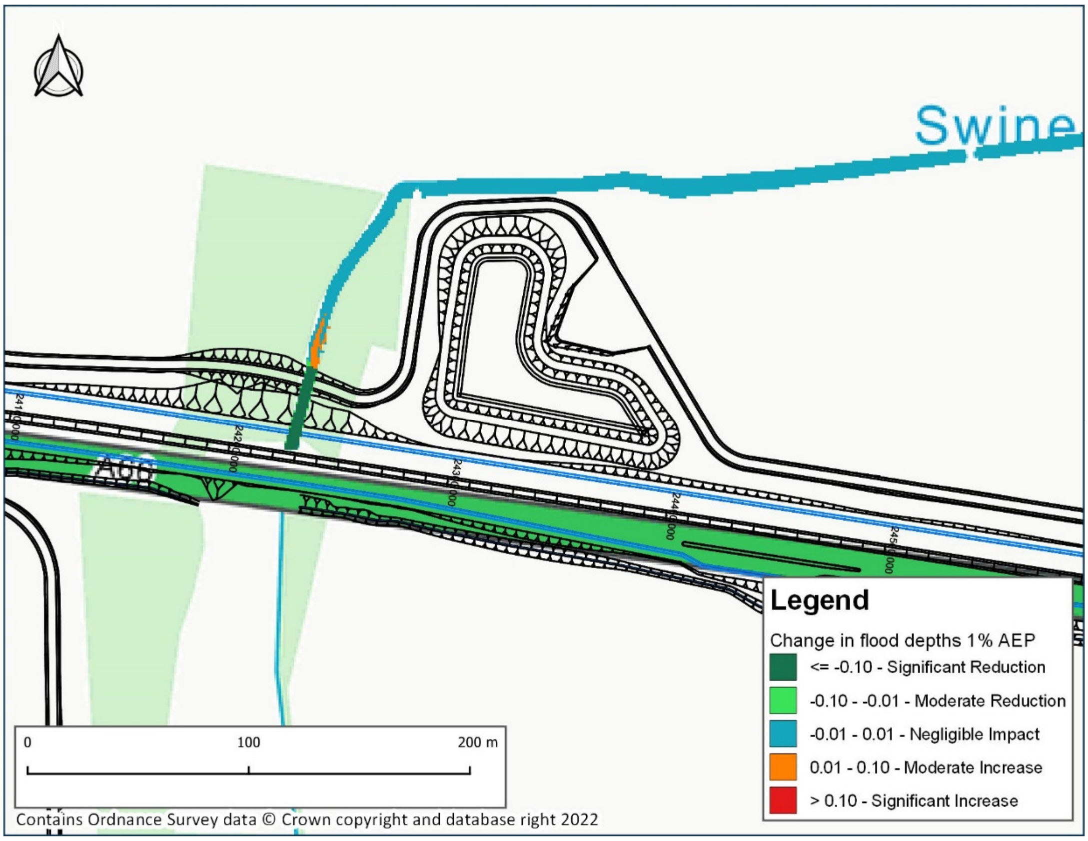

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Figure 8-5: Swine Gill change in depths, 1% AEP

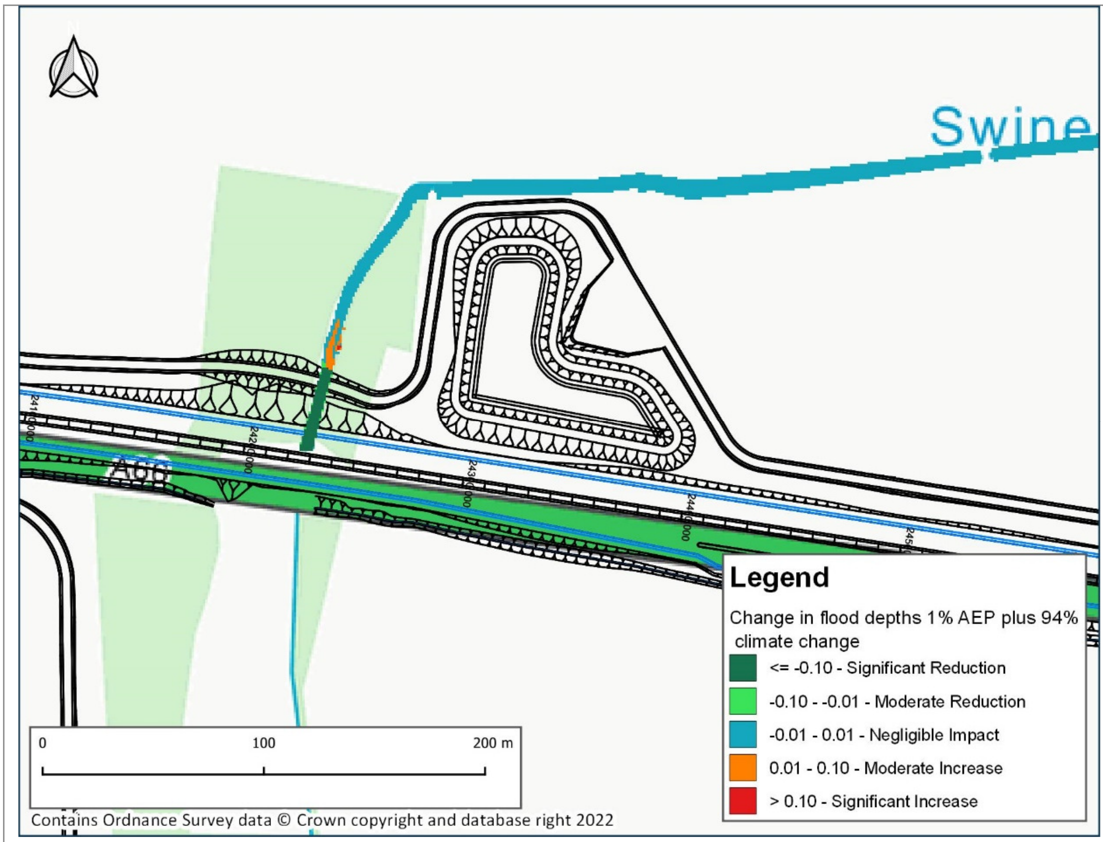

Figure 8-6: Swine Gill change in depths, 1% AEP plus 94% climate change

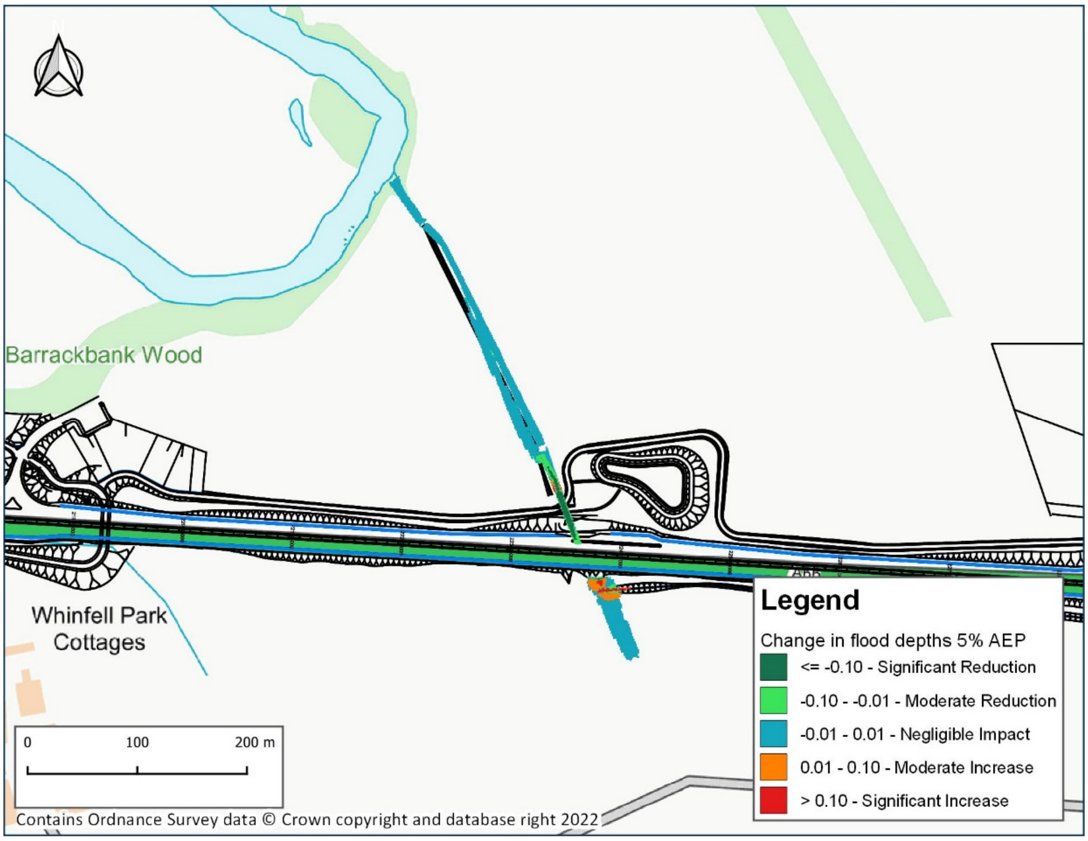

Figure 8-7: Unnamed tributary of River Eamont 3.5 change in depths 5% AEP

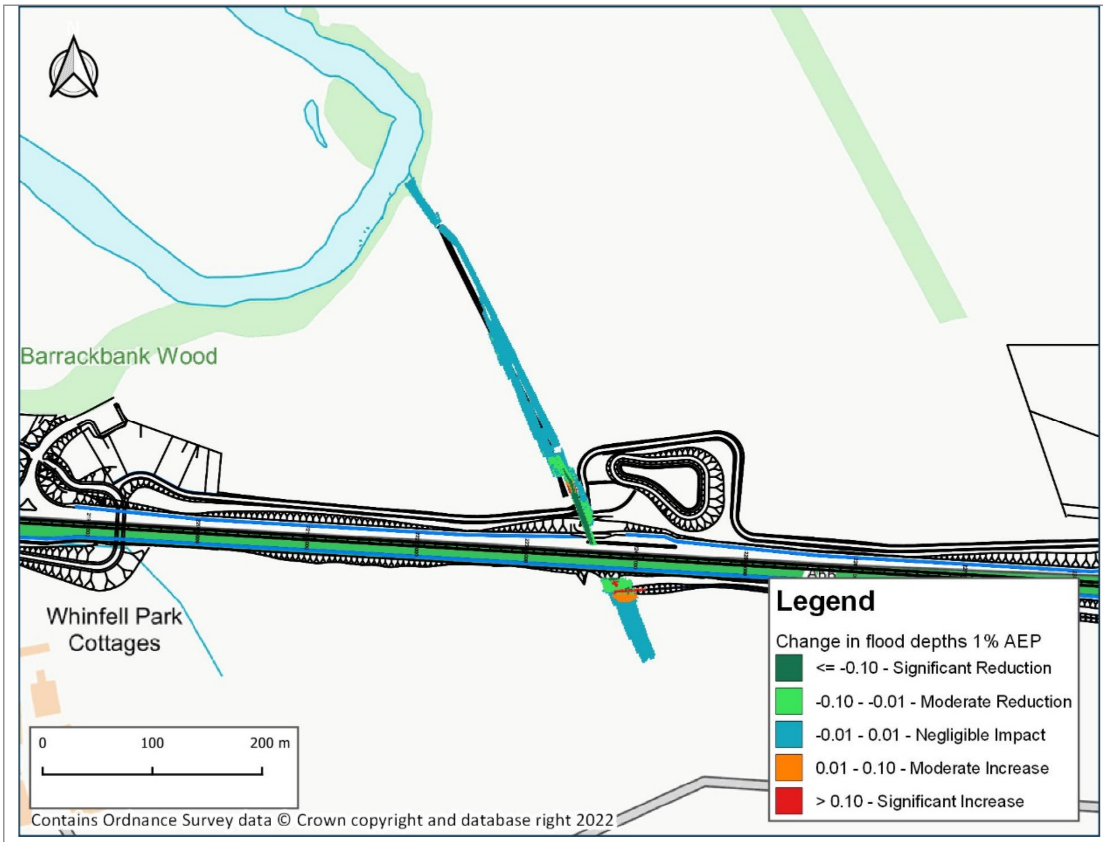

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Figure 8-8: Unnamed tributary of River Eamont 3.5 change in depths 1% AEP

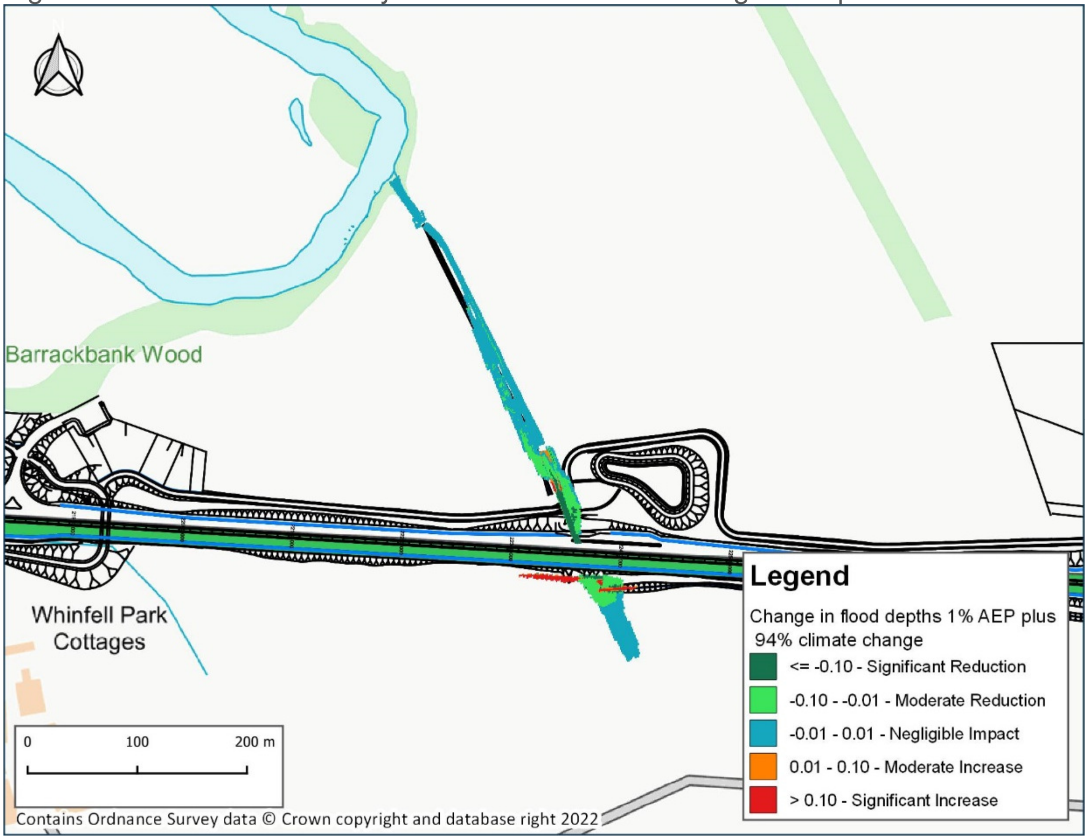

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Figure 8-7: Unnamed tributary of River Eamont 3.5 change in depths 1% AEP plus 94% climate change

8.4 Effect of proposed scheme

**In-channel**

On the Lightwater watercourse, significant decreases in water level are predicted upstream of the existing A66 culvert, as a result of the removal of the small footbridge downstream of the existing A66 structure. Minor increases are predicted downstream of the existing A66, although water in the immediate downstream vicinity is in bank.

On the Lightwater tributary watercourse, moderate increases in water level are predicted, up to 0.16m during the 1% AEP event. Downstream, minor increases are predicted, up to 0.06m during the 1% plus 94% AEP climate change event.

On Unnamed tributary of River Eamont 3.3, model results predict decreases in water in-channel water level upstream of the existing A66 and minor increases (up to 0.03m) downstream of the culvert extension.

On Unnamed tributary of River Eamont 3.5, negligible change in peak water level is predicted downstream of the proposed culvert extension.

On Swine Gill, no change in peak water level is predicted upstream of the existing A66 structure, and up to 0.04m increase predicted downstream.

**Floodplain**

Lightwater, Unnamed tributary of Lightwater and Unnamed tributary of River Eamont 3.3
During the 5% AEP event, there is negligible change in water levels across the majority of the floodplain. Moderate increases are predicted upstream of the Lighwater tributary culvert and downstream of the Unnamed tributary of the River Eamont 3.3. However, the later increases are within the River Eamont floodplain, and given the distance from the proposed culvert extension, may be related to model stability. During the 1% AEP event, predicted changes in water level are similar, although significant increases are predicted upstream of the Lightwater tributary culvert. During the 1% AEP plus 94% climate change scenario, the proposed swale is utilised, reducing flood depths on the existing A66 during this event. Moderate increases in water levels are predicted upstream of the Lightwater tributary culvert and again downstream of the Unnamed tributary of the River Eamont 3.3 within the Eamont floodplain.

Swine Gill
During all modelled return period events, water remains in-bank during both the existing and with-scheme model scenarios.

Unnamed tributary of River Eamont 3.5
During all scenarios assessed, there is negligible change or reduction in flood depths downstream of the A66 along the Unnamed tributary of the River Eamont 3.5. Upstream some localised increases in water levels are observed, although this is likely due to minor ground alterations in this area of the proposed scheme.

## 9 Key Model Assumptions and Limitations

During any hydraulic modelling study, there will always be associated limitations, for example, with uncertainty and data availability etc. The representation of any complex system by a model requires several assumptions to be made. In the case of the hydraulic model it has been assumed that:

- Cross sections accurately represent the shape and variation of the river.
- Model parameters have been determined appropriately.
- Design flows are an accurate representation of flows of a given AEP.
- The surveyed cross-sections of hydraulic structures and the units used to represent them in the model provide an adequate representation of the situation.
- LIDAR accurately reflects bank heights and particularly that the filtered LIDAR has appropriately removed the influence of vegetation.

Other specific limitations and assumptions are detailed below:

- The watercourses in the study area are ungagged and therefore no calibration of the hydraulic model has been carried out.
- A number of drystone walls are present within the study area that may impede flow during particular fluvial flood events. These have not been represented within the model due to lack of data on these structures, and in parts, the integrity of these walls.
- At Swine Gill the photographs and as built drawings suggest a drop in invert level through the existing A66 structure. The exact location and levels which this occurs has been inferred using photographs and channel survey data.
- At the tributary to the Lightwater, the alignment of the culverted section of watercourse beneath the A66 has been inferred using as built drawings. The culvert inlet and outlet have been modelled using channel survey data and the capacity of the culverted network between the inlet and outlet inferred from the survey data.
- Surface water, sewer flooding and groundwater flooding have not been included in this assessment. The hydraulic model results demonstrate the potential flood risk from the mechanism of the modelled watercourses overtopping only.

A66 Northern Trans-Pennine

# Temple Sowerby to Appleby Hydraulic Modelling Report

Temple Sowerby to Appleby

| **Document Verification** | |
|---|---|
| **Project Title** | **A66 Northern Trans-Pennine**<br>Temple Sowerby to Appleby |
| **Document Title** | Hydraulic Modelling Report |
| **Document Ref** | HE565627-JBAU-XX-04-RP-HM-0001-S3_P02-Scheme4_ModellingReport |

**Note:** The contents of the Cover Page and Document Verification page are managed by ProjectWise. Users should not edit these fields manually.

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|---|---|---|---|---|---|---|
| P01 | S3 | Shared for Review | | | | |
| | | Created | Checked | Reviewed | Approved | Authorised |
| | **Name** | D. Bloomfield | A. Blanchard | A. Blanchard | A. Blanchard | --- |
| | **Date** | 02.11.2021 | 03.11.2021 | 03.11.2021 | 03.11.2021 | --- |

| Rev | Suit. Code | Suitability | | Purpose of Issue | | |
|---|---|---|---|---|---|---|
| P02 | S3 | Shared for Review | | --- | | |
| | | Created | Checked | Reviewed | Approved | Authorised |
| | Name | D. Bloomfield | A. Blanchard | A. Blanchard | A. Blanchard | --- |
| | Date | 29.03.2022 | 13.04.2022 | 13.04.2022 | 13.04.2022 | --- |

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| | | Created | Checked | Reviewed | Approved | Authorised |
| | Name | --- | --- | --- | --- | --- |
| | Date | --- | --- | --- | --- | --- |

| **Fluvial Hydraulic Modelling Report – Scheme 4** | | |
|---|---|---|
| 1 Basic Model Information | | |
| Model Name | Kirby Thore | |
| Primary Watercourses / Water Bodies | River Eden<br>Trout Beck<br>Keld Sike | |
| Designation | Eden/Trout Beck – Main River<br>Keld Sike - Ordinary Watercourse | |
| Model ID | The following table presents information regarding the model scenarios carried out as part of this study. | |
| Model Scenario ID | Scenario | Annual Probability |
| EDEN_TBK_007.dat<br>EDEN_Q20_TBK_Q2_10pt5hr_005.ief<br>EDEN_Q20_TBK_Q2_10pt5hr_005.tcf | Existing Situation Model | Eden 5% (1 in 20-years)<br>Trout Beck 50% (1 in 2-years) |
| EDEN_TBK_007.dat<br>EDEN_Q100_TBK_Q20_10pt5hr_005.ief<br>EDEN_Q100_TBK_Q20_10pt5hr_005.tcf | | Eden 1% (1 in 100-years)<br>Trout Beck 5% (1 in 20-years) |
| EDEN_TBK_007.dat<br>EDEN_Q100cc47_TBK_Q20cc47_10pt5hr_005.ief<br>EDEN_Q100cc47_TBK_Q20cc47_10pt5hr_005.tcf | | Eden 1% + 47% climate change (1 in 100-years+47% climate change)<br>Trout Beck 5% + 47% climate change (1 in 20-years+47% climate change) |
| EDEN_TBK_007.dat<br>EDEN_Q100cc61_TBK_Q20cc61_10pt5hr_005.ief<br>EDEN_Q100cc61_TBK_Q20cc61_10pt5hr_005.tcf | | Eden 1% + 61% climate change (1 in 100-years+61% climate change)<br>Trout Beck 5% + 61% climate change (1 in 20-years+61% climate change) |
| EDEN_TBK_007.dat<br>EDEN_Q100cc94_TBK_Q20cc94_10pt5hr_005.ief<br>EDEN_Q100cc94_TBK_Q20cc94_10pt5hr_005.tcf | | Eden 1% + 94% climate change (1 in 100-years+94% climate change)<br>Trout Beck 5% + 94% climate change (1 in 20-years+94% climate change) |
| EDEN_TBK_007.dat<br>EDEN_Q1000_TBK_Q100_10pt5hr_005.ief | | Eden 0.1% (1 in 1000-years)<br>Trout Beck 1% (1 in 100-years) |

| | | |
|---|---|---|
| EDEN_Q1000_TBK_Q100_10pt5hr_005.tcf | | |
| EDEN_TBK_007.dat<br>EDEN_Q2_TBK_Q10_4pt5hr_005.ief<br>EDEN_Q2_TBK_Q10_4pt5hr_005.tcf | | Eden 50% (1 in 2-years)<br>Trout Beck 10% (1 in 10-years) |
| EDEN_TBK_007.dat<br>EDEN_Q20_TBK_Q100_4pt5hr_005.ief<br>EDEN_Q20_TBK_Q100_4pt5hr_005.tcf | | Eden 5% (1 in 20-years)<br>Trout Beck 1% (1 in 100-years) |
| EDEN_TBK_007.dat<br>EDEN_Q20cc47_TBK_Q100cc47_4pt5hr_005.ief<br>EDEN_Q20cc47_TBK_Q100cc47_4pt5hr_005.tcf | | Eden 5% + 47% climate change (1 in 20-years+47% climate change)<br>Trout Beck 1% + 47% climate change (1 in 100-years+47% climate change) |
| EDEN_TBK_007.dat<br>EDEN_Q20cc61_TBK_Q100cc61_4pt5hr_005.ief<br>EDEN_Q20cc61_TBK_Q100cc61_4pt5hr_005.tcf | | Eden 5% + 61% climate change (1 in 20-years+61% climate change)<br>Trout Beck 1% + 61% climate change (1 in 100-years+61% climate change) |
| EDEN_TBK_007.dat<br>EDEN_Q20cc94_TBK_Q100cc94_4pt5hr_005.ief<br>EDEN_Q20cc94_TBK_Q100cc94_4pt5hr_005.tcf | | Eden 5% + 94% climate change (1 in 20-years+94% climate change)<br>Trout Beck 1% + 94% climate change (1 in 100-years+94% climate change) |
| EDEN_TBK_007.dat<br>EDEN_Q100_TBK_Q1000_4pt5hr_005.ief<br>EDEN_Q100_TBK_Q1000_4pt5hr_005.tcf | | Eden 1% (1 in 100-years)<br>Trout Beck 0.1% (1 in 1000-years) |
| EDEN_TBK_007.dat<br>EDEN_Q2_TBK_Q10_4pt5hr_005.ief<br>EDEN_Q2_TBK_Q10_4pt5hr_005.tcf | | Eden 50% (1 in 2-years)<br>Trout Beck 10% (1 in 10-years) |
| EDEN_TBK_007.dat<br>EDEN_Q2_TBK_Q2_4pt5hr_005.ief<br>EDEN_Q2_TBK_Q2_4pt5hr_005.tcf | | Eden 50% (1 in 2-years)<br>Trout Beck 50% (1 in 2-years) |
| EDEN_TBK_007_nplus20.dat<br>EDEN_Q20_TBK_Q100_4pt5hr_005_SAnplus20.ief<br>EDEN_Q20_TBK_Q100_4pt5hr_005_SA_nplus20.tcf | Sensitivity tests | Eden 5% (1 in 20-years)<br>Trout Beck 1% (1 in 100-years)<br>With +20% roughness |
| EDEN_TBK_007_nmin20.dat<br>EDEN_Q20_TBK_Q100_4pt5hr_005_SAnmin20.ief | | Eden 5% (1 in 20-years)<br>Trout Beck 1% (1 in 100-years) |

| | | |
|---|---|---|
| EDEN_Q20_TBK_Q100_4pt5hr_005_SA_nmin20.tcf | | With -20% roughness |
| EDEN_TBK_007.dat<br>EDEN_Q100_TBK_Q100_4pt5hr_005_SA_DSBDY.ief<br>EDEN_Q100_TBK_Q100_4pt5hr_005_SA_DSBY.tcf | | Eden 1% (1 in 100-years)<br>Trout Beck 1% (1 in 100-years)<br>(Increased downstream boundary) |
| EDEN_TBK_007.dat<br>EDEN_Q20_TBK_Q100_4pt5hr_005_SAQplus20.ief<br>EDEN_Q20_TBK_Q100_4pt5hr_005_SA_Qplus20.tcf | | Eden 5% (1 in 20-years)<br>Trout Beck 1% + 20% (1 in 100-years) with +20% inflow |
| EDEN_TBK_007.dat<br>PD001_EDEN_Q2_TBK_Q2_4pt5hr_007.ief<br>PD001_EDEN_Q2_TBK_Q2_4pt5hr_006.tcf | With-scheme situation model | Eden 50% (1 in 2-years)<br>Trout Beck 50% (1 in 2-years) |
| EDEN_TBK_007.dat<br>PD001_EDEN_Q2_TBK_Q10_4pt5hr_007.ief<br>PD001_EDEN_Q2_TBK_Q10_4pt5hr_006.tcf | | Eden 50% (1 in 2-years)<br>Trout Beck 10% (1 in 10-years) |
| EDEN_TBK_007.dat<br>PD001_EDEN_Q2_TBK_Q20_4pt5hr_006.ief<br>PD001_EDEN_Q2_TBK_Q20_4pt5hr_006.tcf | | Eden 50% (1 in 2-years)<br>Trout Beck 5% (1 in 20-years) |
| EDEN_TBK_007.dat<br>PD001_EDEN_Q20_TBK_Q100_4pt5hr_006.ief<br>PD001_EDEN_Q20_TBK_Q100_4pt5hr_006.tcf | | Eden 5% (1 in 20-years)<br>Trout Beck 1% (1 in 100-years) |
| EDEN_TBK_007.dat<br>PD001_EDEN_Q20cc94_TBK_Q100cc94_4pt5hr_006.ief<br>PD001_EDEN_Q20cc94_TBK_Q100cc94_4pt5hr_006.tcf | | Eden 5% + 94% climate change (1 in 20-years+94% climate change)<br>Trout Beck 1% + 94% climate change (1 in 100-years+94% climate change) |

| **2 Model Input Data** | |
|---|---|
| Incoming Models | 'Trout Beck' Arcadis 1D-2D Flood Modeller TUFLOW hydraulic model |
| DTM for 2D Model Domain | 1m resolution LIDAR flown in 2020 |
| River channel/Structure survey | Channel survey collected by JBA Consulting between November 2020-June 2021 |
| Additional Data | Mastermap data, As built drawings of existing A66 where available, proposed route alignments, AIMS data. |

| **3 Model Build Overview** | | | |
|---|---|---|---|
| Software | 1D domain: FM and ESTRY | | |
| | 2D domain(s): TUFLOW | | |
| Model Reference | HE565627-JBAU-XX-04-MD-HM-0001-S3-P01-Scheme4_HydraulicModel | | |
| Model Schematisation | Figure 3-1 shows the schematisation of the hydraulic model for Scheme 4 | | |
| Model Reaches | The table below shows the watercourse reaches defined in the model. They are also shown in Figure 3-1. | | |
| Watercourse Name | Upstream model node | Downstream model node | Total Reach length (km) |
| River Eden | EDEN_4327_d | EDEN_0005_d | 4.49 |
| Trout Beck | TRO001_4233 | TRO001_0023 | 4.20 |
| Keld Sike | KEL001_1066 | KEL001_0011 | 1.05 |

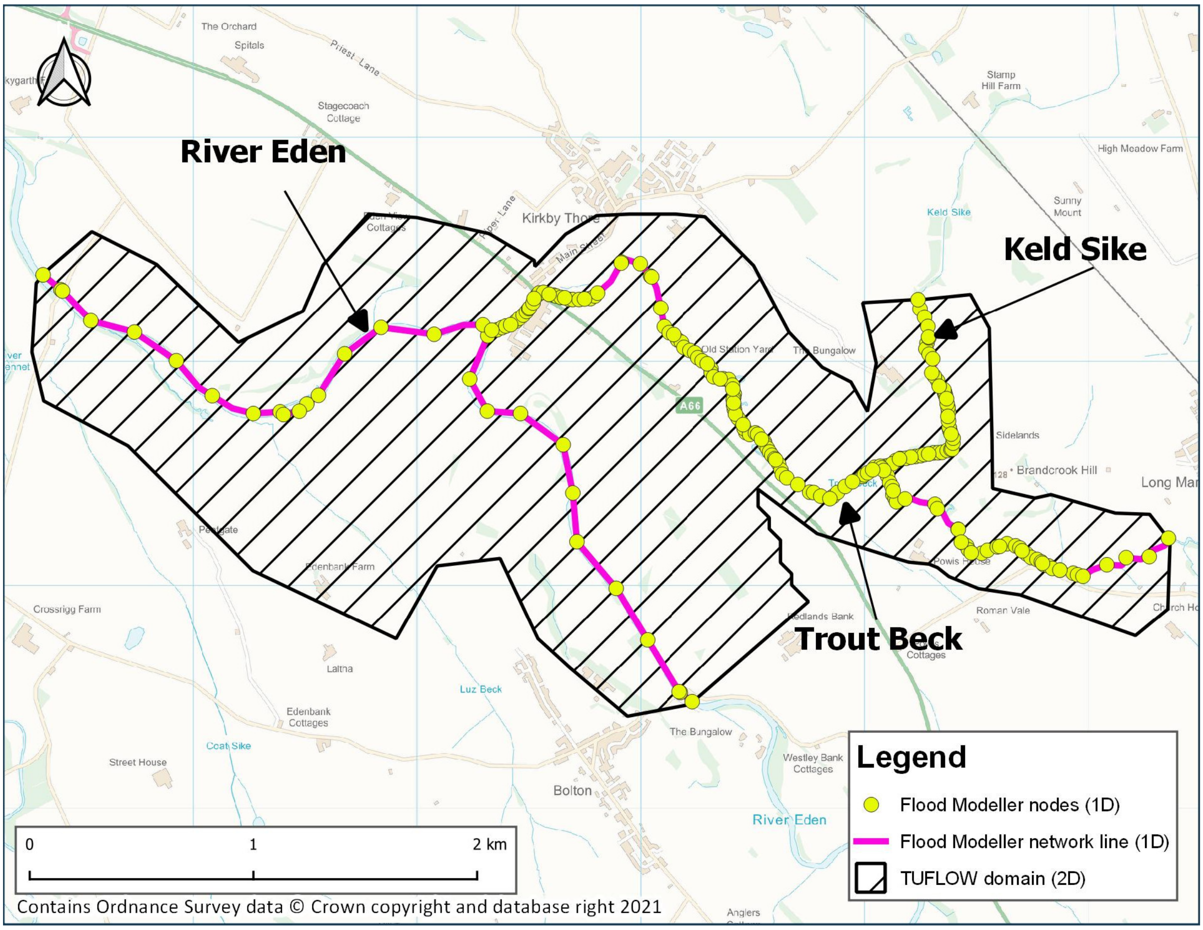

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Figure 3-1: Model overview

## 4 Baseline model schematisation

### 4.1 1D Domain

| | |
|---|---|
| Channel representation | The channel system has been based upon the most recent survey data set available for the area. The channels have been represented within the 1D domain across the study reach. |
| Structure representation | Existing structures have been based upon the most recent survey data set available. All significant structures within the study area have any modelling assumptions documented within this report (Section 5). Additionally, any structures which were not included within the hydraulic model based on the assumption that they were not deemed to be hydraulically significant are also recorded.<br>Gaps in the railway embankment that is situated to the south of the existing A66 have been modelled using ESTRY rectangular conduit units and based on survey data. |
| Inflow boundaries | Flow has been applied with a flow-time (QT) boundary at a point for the upstream nodes of each watercourse, and with lateral inflow nodes for the intervening catchment. Joint probability analysis has |

| | |
|---|---|
| | been carried out to determine suitable scenarios for use in the modelling during Trout Beck and River Eden dominating events. Further information can be found in the FEH calculation record. |
| Climate Change | Climate change uplifts have been applied for the central, higher central and upper end allowances for the Eden and Esk Management Catchment using the Environment Agency July 2021 allowances. |
| Downstream boundary | A normal depth boundary has been used at the downstream extent of the River Eden in the 1D domain. The reason for this choice of boundary was that no existing model was available at the downstream boundary locations to accurately extract water level data for a given AEP event. As the focus of the model build is on the blue-route proposed alignment, sensitivity tests have been carried out to understand the impact of a higher water level on the River Eden during an event on the Trout Beck. |
| Hydraulic roughness values used | Channel roughness values have been represented in the model by Manning's 'n' values, defined on a reach basis. In order to determine the roughness of channel cross sections, photographic evidence collected during site visits and survey collection were used as a reference alongside application of the method published by Cowan (1956).<br>Bed roughness values range from 0.030-0.060 with a value of 0.060 for all banks.<br>Structure roughness values range from 0.015-0.030.<br>To understand the implications of using these manning's n values, sensitivity testing has been conducted to quantify the impacts in changing these parameters. |
| Labelling/naming convention used | All nodes have an ID of NNN_XXXXX where NNN is prefix the reference of the water course and XXXXX is the chainage upstream. The following prefixes have been used:<br>TRO001 Trout Beck<br>EDEN River Eden<br>KEL001 Keld Sike<br>The following suffixes have been used:<br>C or CU Culvert<br>J Junction<br>W Weir<br>SP Spill<br>B Bridge<br>i, i2, i3 Interpolate<br>u or d Upstream or downstream node |
| 4.2 2D Domain | |

| | | | |
|---|---|---|---|
| Area of 2D Domains | 6.29km2 | DTM data source | LIDAR |

| | | | |
|---|---|---|---|
| Resolution of grid | 2m | DTM Resolution | 1m |
| Modifications to topography and reasons | 2d_zsh_EDEN_TBK_004_L.shp<br>2d_zsh_EDEN_TBK_006_P.shp | The top of bank elevations have been stamped using Z shapes. Elevations are based on surveyed channel sections and LIDAR. | |
| | 2d_zsh_EDEN_TBK_BridgeRoad_R.shp<br>2d_zsh_EDEN_TBK_BridgeRoad_P.shp<br>2d_zsh_EDEN_TBK_BridgeWall_L.shp<br>2d_zsh_EDEN_TBK_BridgeWall_P.shp | Elevations of bridge decks and bridge walls along the River Eden have been stamped in based on structure survey. | |
| | 2d_zsh_railway_002_R.shp<br>2d_zsh_railway_003_R.shp<br>2d_zsh_railway_003_P.shp | Elevations of openings in the railway embankment, that crosses the flood plain, have been stamped in based on survey. | |
| | 2d_zsh_TBK_BridgeWall_002_L.shp<br>2d_zsh_TBK_BridgeWall_002_P.shp<br>2d_zsh_TBK_flood_defence_009_L.shp<br>2d_zsh_TBK_flood_defence_009_P.shp | Elevations of bridge decks and walls along the River Eden have been stamped in based on structure survey. | |

<table>
<tr>
<td>Hydraulic roughness values used</td>
<td>Manning’s n values have been used to represent hydraulic roughness in the 2D domain. The following roughness values were used in the model and are based on land cover types recorded in the Ordnance Survey MasterMap Topographic Area layer dataset.
<table>
<tr><th>Land Cover</th><th>Manning’s ‘n’</th></tr>
<tr><td>Building</td><td>0.300</td></tr>
<tr><td>General surface</td><td>0.050</td></tr>
<tr><td>General surface</td><td>0.050</td></tr>
<tr><td>General surface</td><td>0.050</td></tr>
<tr><td>General surface</td><td>0.060</td></tr>
<tr><td>Glasshouse</td><td>0.200</td></tr>
<tr><td>Inland water</td><td>0.045</td></tr>
<tr><td>Landform</td><td>0.060</td></tr>
<tr><td>Landform</td><td>0.060</td></tr>
<tr><td>Landform</td><td>0.060</td></tr>
<tr><td>Boulders</td><td>0.065</td></tr>
<tr><td>Coniferous trees</td><td>0.120</td></tr>
<tr><td>Coniferous trees</td><td>0.070</td></tr>
<tr><td>Coppice or osiers</td><td>0.090</td></tr>
<tr><td>Marsh reeds or saltmarsh</td><td>0.060</td></tr>
<tr><td>Non coniferous trees</td><td>0.090</td></tr>
<tr><td>Non-coniferous trees</td><td>0.060</td></tr>
<tr><td>Rough grassland</td><td>0.060</td></tr>
<tr><td>Scrub</td><td>0.070</td></tr>
<tr><td>Path step</td><td>0.050</td></tr>
<tr><td>Path</td><td>0.050</td></tr>
<tr><td>Rail</td><td>0.045</td></tr>
<tr><td>Road</td><td>0.035</td></tr>
<tr><td>Roadside</td><td>0.050</td></tr>
<tr><td>Structure</td><td>0.300</td></tr>
<tr><td>Structure (upper level of communication)</td><td>0.300</td></tr>
<tr><td>Structure pylon</td><td>0.060</td></tr>
<tr><td>Tidal water foreshore</td><td>0.055</td></tr>
<tr><td>Tidal water</td><td>0.055</td></tr>
<tr><td>Unclassified</td><td>0.060</td></tr>
<tr><td>Rock</td><td>0.070</td></tr>
<tr><td>Heath</td><td>0.090</td></tr>
</table>
</td>
</tr>
<tr><td colspan="2">4.3 1D-2D Linking</td></tr>
<tr><td colspan="2">A HX boundary is used to link the 1D and 2D domains along the top of banks. Elevations of HX cells are set using Z shapes outlined in Section 4.2.</td></tr>
</table>

| | |
|---|---|
| An SX boundary is used to link the 1D and 2D domains at each end of the ESTRY conduit units. | |
| Model Boundaries – Downstream Conditions | A 2D HQ boundary is used at the downstream extent of the 2D domain based on slope values derived from LIDAR. |
| 4.4 Representation of Defences | |
| Defences | A flood wall is represented on the right bank of the Trout Beck. A Z-shape is used to enforce the height of the defence based on survey data. |

## 5 Structures

General Assumptions

- At structures where only one face has been surveyed, a copy of the surveyed upstream face was used to represent the downstream face.
- Bridge decks have been represented using spill units where it is likely there would be no complex overland flows which potentially would take water away from the channel.
- Modelled structures have been schematised using the most recent channel survey taken by JBA Consulting between November 2020 and June 2021.

Trout Beck

| Model ID (Survey ID) | Structure | How has this structure been modelled? | Photo (view of upstream face unless specified) |
|---|---|---|---|
| TRO01_3101B (TRO001_3101) | Wooden footbridge | This structure has been modelled with a USBPR Bridge unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |
| TRO01_1991B (TRO001_1991) | Bridge | This structure has been modelled with a USBPR Bridge unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |
| TRO01_0923B (TRO001_0923) | Wooden footbridge | This structure has been modelled with a USBPR Bridge unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |

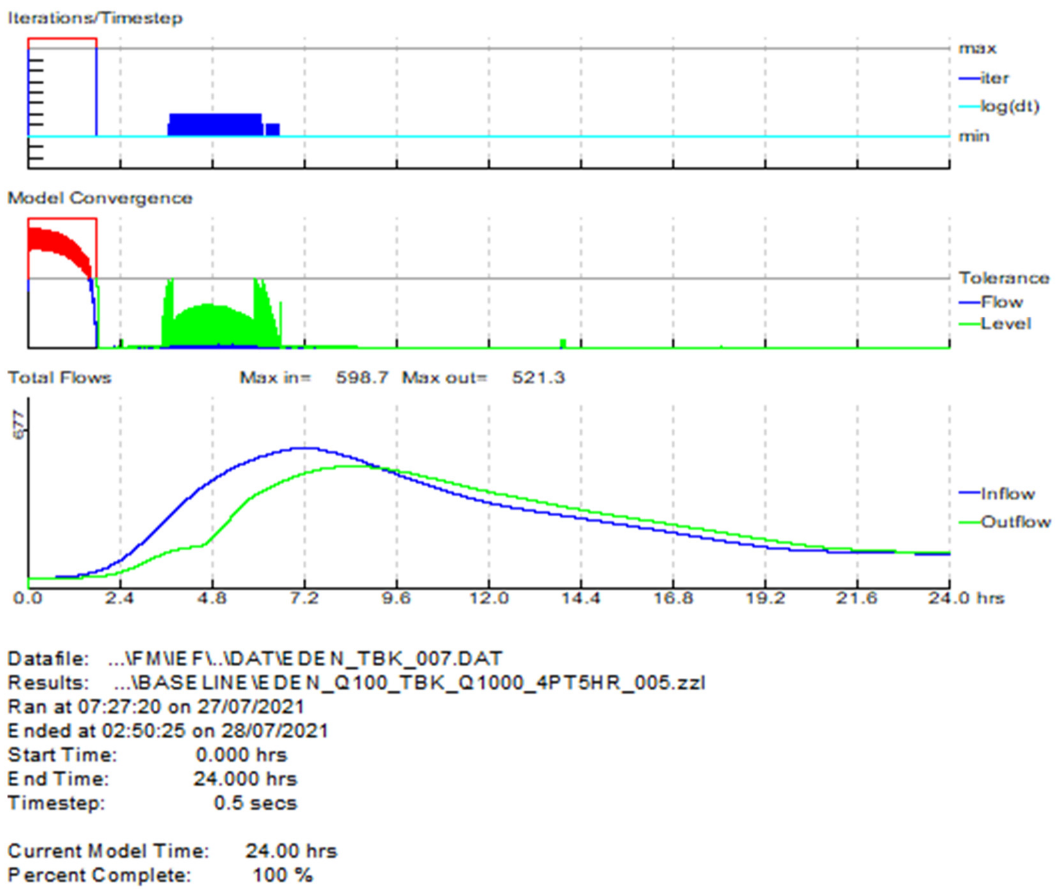
| | | | |
|---|---|---|---|
| TRO1_0754wu (TRO001_0754) | Weir | This weir was modelled as a Broad Crested Weir unit using Flood Modeller. |  |
| TRO01_0304B (TRO001_0304) | Bridge | This bridge was modelled as an Arch Bridge, using Flood Modeller. Overtopping of the bridge was represented within the 2D domain. |  |
| TRO01_0222B (TRO001_0222) | Wooden bridge | This bridge was modelled as a USBPR Bridge, using Flood Modeller. Overtopping flow is represented with a spill unit. |  |
| Keld Sike | | | |
| ID | Structure | How has this structure been modelled? | Photo (view of upstream face unless specified) |

| | | | |
|---|---|---|---|
| KEL1_0882cu (KEL001_0882) | Circular culvert | This structure has been modelled with a circular conduit unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |
| KEL01_597cu (KEL001_0597) | Circular culvert | This structure has been modelled with a circular conduit unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |
| KEL01_0436cu (KEL001_0436) | Rectangular culvert | This structure has been modelled with a Rectangular conduit unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |
| KEL01_0334cu (KEL001_0334) | Circular culvert | This structure has been modelled with a circular conduit unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |

| | | | |
|---|---|---|---|
| KEL01_0098cu (KEL001_0098) | Circular culvert | This structure has been modelled with a circular conduit unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |
| River Eden | | | |
| ID | Structure | How has this structure been modelled? | Photo (view of upstream face unless specified) |
| EDEN_4327B (EDEN_4327) | Bridge | This bridge was modelled as an Arch Bridge, using Flood Modeller. Overtopping of the bridge was represented within the 2D domain. |  |
| EDEN_0005B (EDEN_0005) | Bridge | This bridge was modelled as an Arch Bridge, using Flood Modeller. Overtopping of the bridge was represented within the 2D domain. |  |

# 6 Model Proving

## 6.1 Model Performance



```
Datafile:   ...\FM\IEF\..\DAT\EDEN_TBK_007.DAT
Results:    ...\BASELINE\EDEN_Q100_TBK_Q1000_4PT5HR_005.zzl
Ran at 07:27:20 on 27/07/2021
Ended at 02:50:25 on 28/07/2021
Start Time:        0.000 hrs
End Time:         24.000 hrs
Timestep:            0.5 secs

Current Model Time:     24.00 hrs
Percent Complete:        100 %
```

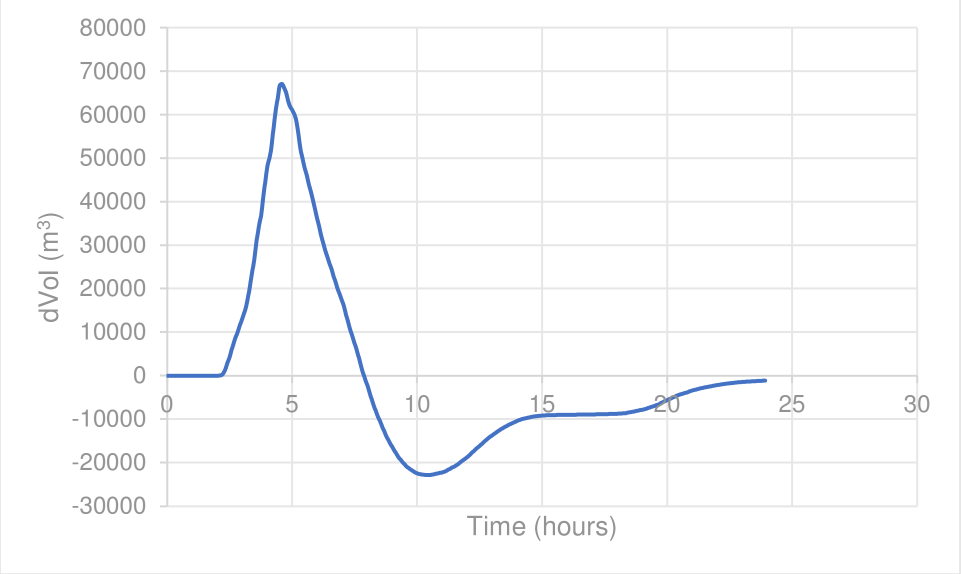


Figure: dVol

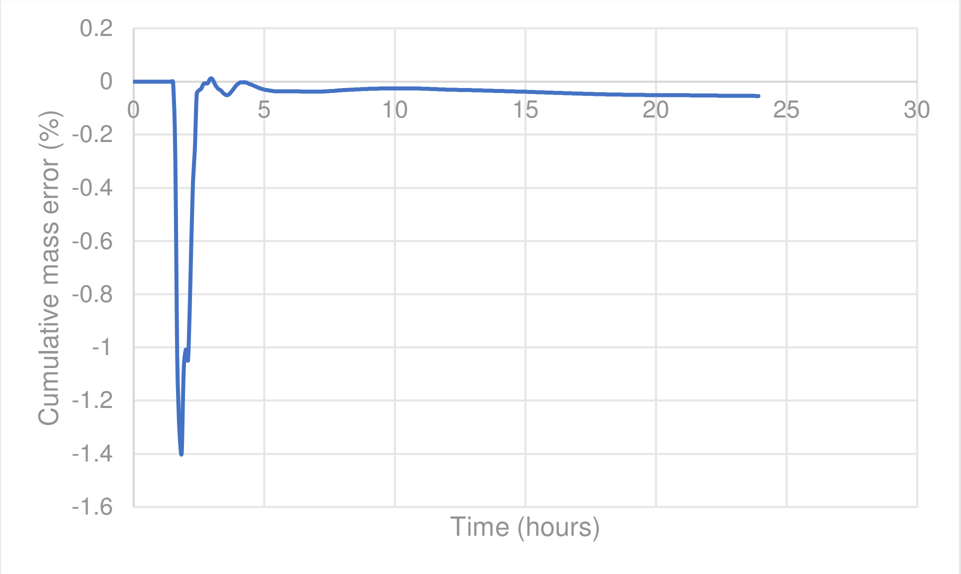


Figure: cumulative mass error

The Flood Modeller convergence plot show smooth inflow and outflows into the model with only isolated incidences of poor convergences. Flow and stage profiles have been checked throughout the model and are smooth with minimal oscillations, indicating the model is performing well. The dVol plot is shown to be smooth and the cumulative mass error is within a range of +1 to -1 for the majority of the simulation, and in particular the peak of the event (approximately 7 hours into the simulation with a 4.5hr storm duration). Whilst there is a spike in the mass error at the beginning of the model, this occurs when the volume in the model is low and therefore considered acceptable.

6.2 Model Verification

| | |
|---|---|
| Calibration | No gauge data was available for the study area to allow the model to be calibrated to. Information on historical flood risk was available in the Environment Agency's Historic Flood Outline dataset, this showed historic flooding within the flood extent modelled in this study. It is understood from anecdotal evidence that the cow shed near TRO01_0222B has experienced flooding in the past. The hydraulic model results obtained in this study reconcile with this. |
| Previous Model Comparison | No previous hydraulic model results are available for the study area for comparison. |
| Flood Zone Comparison | Fluvial Flood Zone 3 was compared to the 0.1% AEP Eden dominated event and showed good correlation with the modelled outline, shown in Figure 6-1. |

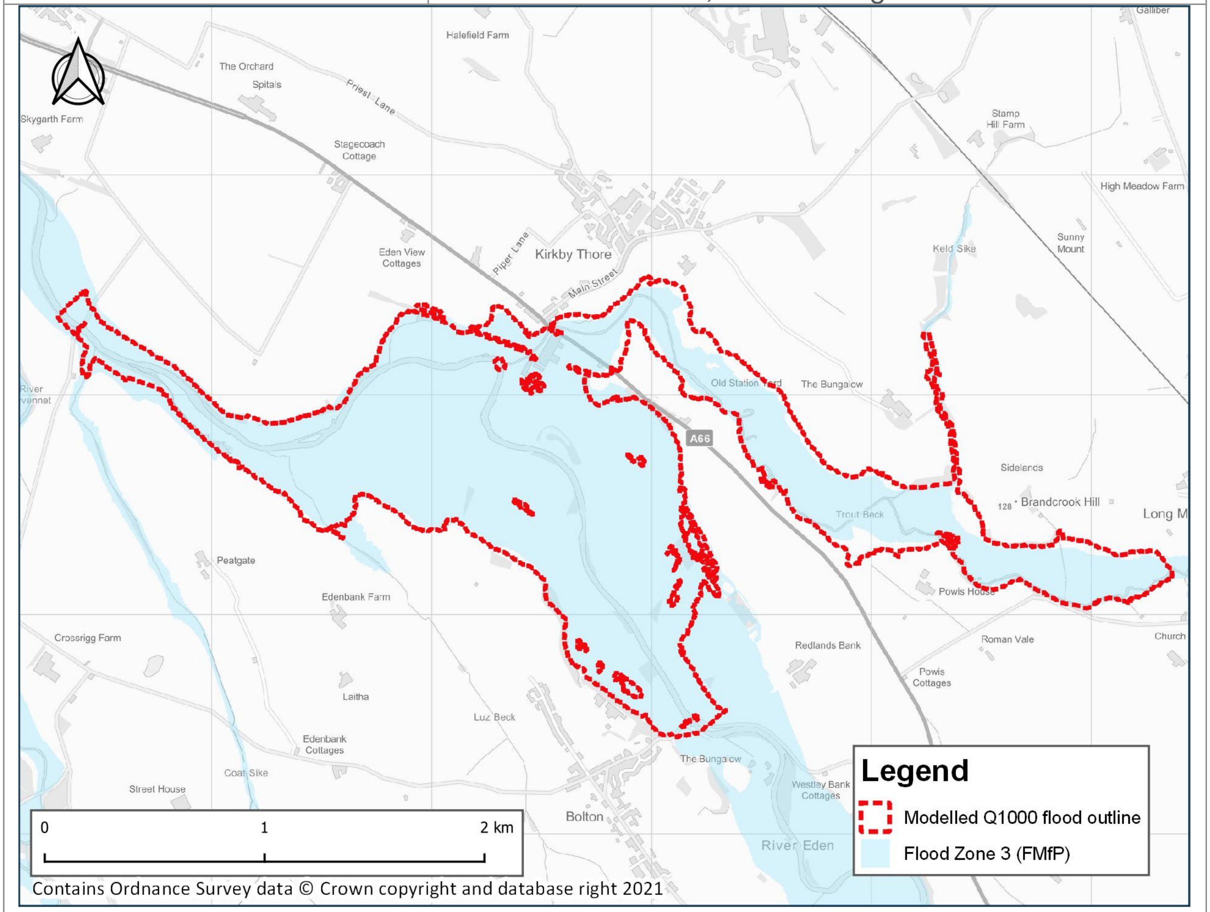


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Figure 6-1: Comparison of modelled flood extent to Flood Zone 3

## 6.3 Sensitivity Analysis

Sensitivity tests were carried out for the 1% AEP existing situation model to assess the model response to the change in:

- Flow: Model inflows increased by 20%
- Roughness coefficient: In-channel and roughness values changed by +20% and -20%
- Downstream boundary: Increased flow on the Eden to test the impact on the Trout Beck

The table below shows the maximum, minimum and average change in in-channel water levels relative to the existing situation model for each modelled reach with increase in flow and increase and decrease in roughness coefficients.

- The downstream boundary sensitivity test showed a maximum increase in water levels at the most downstream node the Trout Beck. Changes in peak water level compared to the baseline extend approximately 368m upstream on the Trout Beck.

| Watercourse | River Eden | | |
|---|---|---|---|
| | Change in peak water level (m) | | |
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.06 | 0.00 | 0.02 |
| +20% Roughness | 0.30 | 0.05 | 0.19 |
| -20% Roughness | -0.05 | -0.49 | -0.24 |

| Watercourse | Trout Beck | | |
|---|---|---|---|
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.17 | 0.01 | 0.06 |
| +20% Roughness | 0.05 | -0.03 | 0.00 |
| -20% Roughness | 0.02 | -0.18 | -0.06 |

| Watercourse | Trout Beck (100m upstream and downstream of proposed Blue alignment) | | |
|---|---|---|---|
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.07 | 0.03 | 0.04 |
| +20% Roughness | 0.06 | 0.02 | 0.05 |
| -20% Roughness | -0.02 | -0.09 | -0.06 |

| Watercourse | Keld Sike | | |
|---|---|---|---|
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.07 | 0.03 | 0.04 |
| +20% Roughness | 0.06 | 0.02 | 0.05 |
| -20% Roughness | -0.02 | -0.09 | -0.06 |

## 7 Model Build – With-Scheme Situation Model

| | |
|---|---|
| 7.1 Scenario Definition | Figure 7-1 shows the proposed features of the A66 improvement scheme within the extent of the Scheme 4 Trout Beck hydraulic model.<br>The following sections explain how the features were incorporated into the model. |

### Flood Modeller 1D Model

The positioning of the features relating to the proposed bridge structure is on the flood plain and not in the channel of the Trout Beck, as the soffit level of the bridge is higher than the modelled flood level of the 1% AEP with (+94%) climate change event (plus freeboard). Therefore, there were no changes made to the 1D component of the model.

### TUFLOW 2D Model

The following updates were made to the TUFLOW model to represent design features:

- An ascii grid of the proposed surface levels was used in the model to overwrite the DTM with new levels in the flood plain to represent the following features of the proposed bridge structure:
    - Embankments
    - Abutments
    - Ditches
    - Flood plain attenuation pond
- The proposed bridge piers were added to the floodplain using 2D Flow Constriction (FC) polygons using a blockage factor to represent the proposed width of the columns as shown on the design drawings (0.75 for 1.5m and 0.9 for 1.9m)

| | |
|---|---|
| 7.2 Design Detail Sources | In addition to direct communication with the design team, the following sources of information were utilised:<br><br>Design drawings:<br>HE565627-AMY-SGN-S0405-DR-CB-000029.dwg<br><br>Proposed surface:<br>HE565627-AMY-HDG-S0405-M3-CD-000234.dwg |

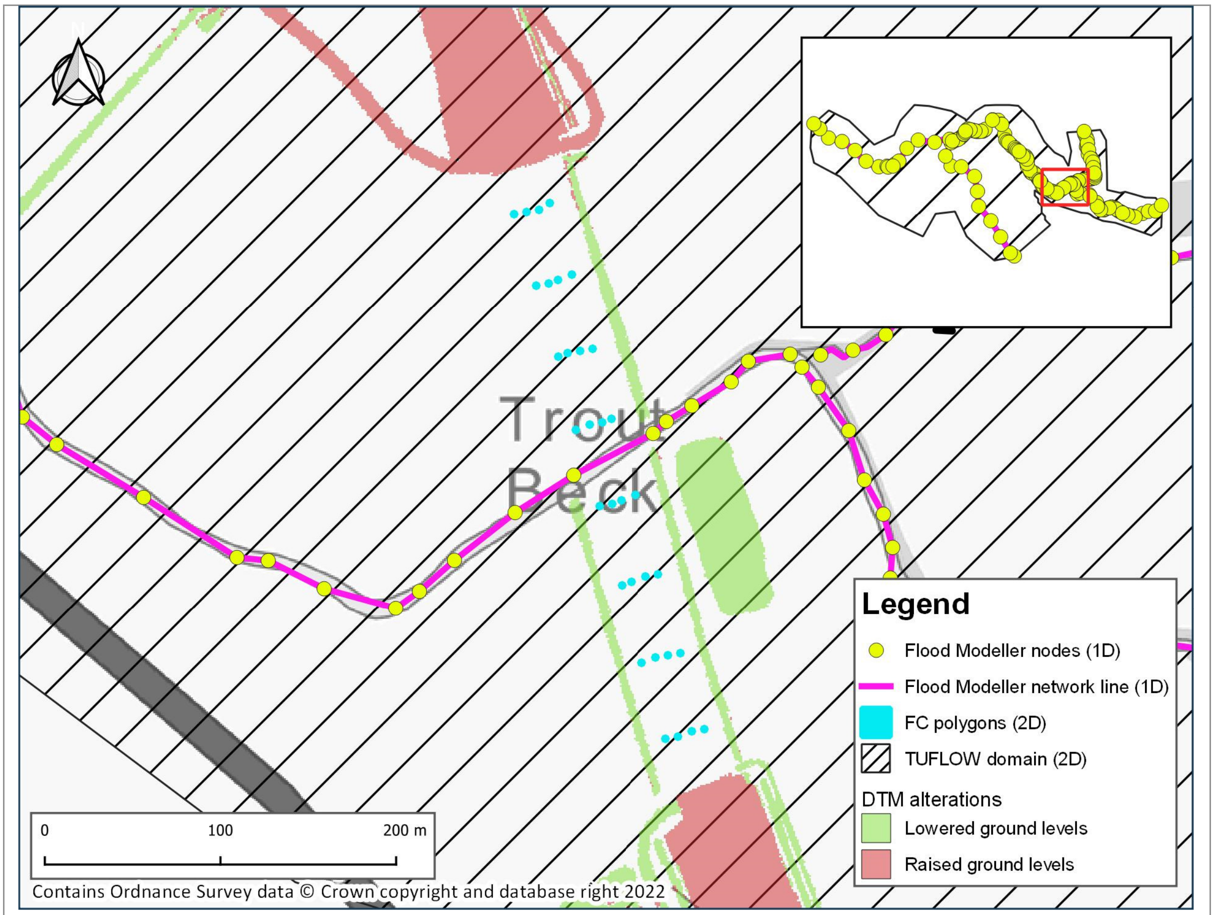

Figure 7-1: With-Scheme Situation Model Schematisation

## 8 With-scheme Model Outputs

Water level outputs were extracted for the existing situation and with-scheme situation model at key locations and compared, the changes in water levels are presented below.

### 8.1 Change in 1D peak water levels

| Watercourse | Trout Beck | | | |
|---|---|---|---|---|
| Location | Model node | Change in Peak Water Level (m) | | |
| | | 5% AEP | 1% AEP | 1% AEP with (+94%) CC |
| Upstream of proposed structure | TRO001_2498 | -0.012 | -0.041 | -0.047 |
| Downstream of proposed structure | TRO001_2438 | -0.008 | -0.013 | 0.009 |
| 100m upstream of proposed structure (Confluence with Keld Sike) | TRO001_2581 | -0.022 | -0.018 | -0.006 |
| 300m downstream of proposed structure | TRO001_2152 | 0.022 | 0.008 | -0.001 |

### 8.3 Pass-Forward Flow

The pass-forward flow at the downstream end of the Trout Beck in the hydraulic model has been assessed to see what the likely effect will be for flood risk downstream. The table below shows the flow changes between the existing situation and with-scheme scenarios. It shows that for all events, the pass-forward flow is reduced as a result of the scheme.

| Model Assessed | Peak Flow (m3/s) at Node TRO001_0023 | | |
|---|---|---|---|
| | 5% AEP Event | 1% AEP Event | 1% AEP with (+94%) CC Event |
| Existing situation | 53.82 | 61.49 | 72.92 |
| With-scheme | 53.78 | 61.49 | 72.92 |

### 8.4 2D Flood Depth Change

Figure 8-1 to Figure 8-3 show the changes in flood depth for the existing situation and with-scheme situation for each event.

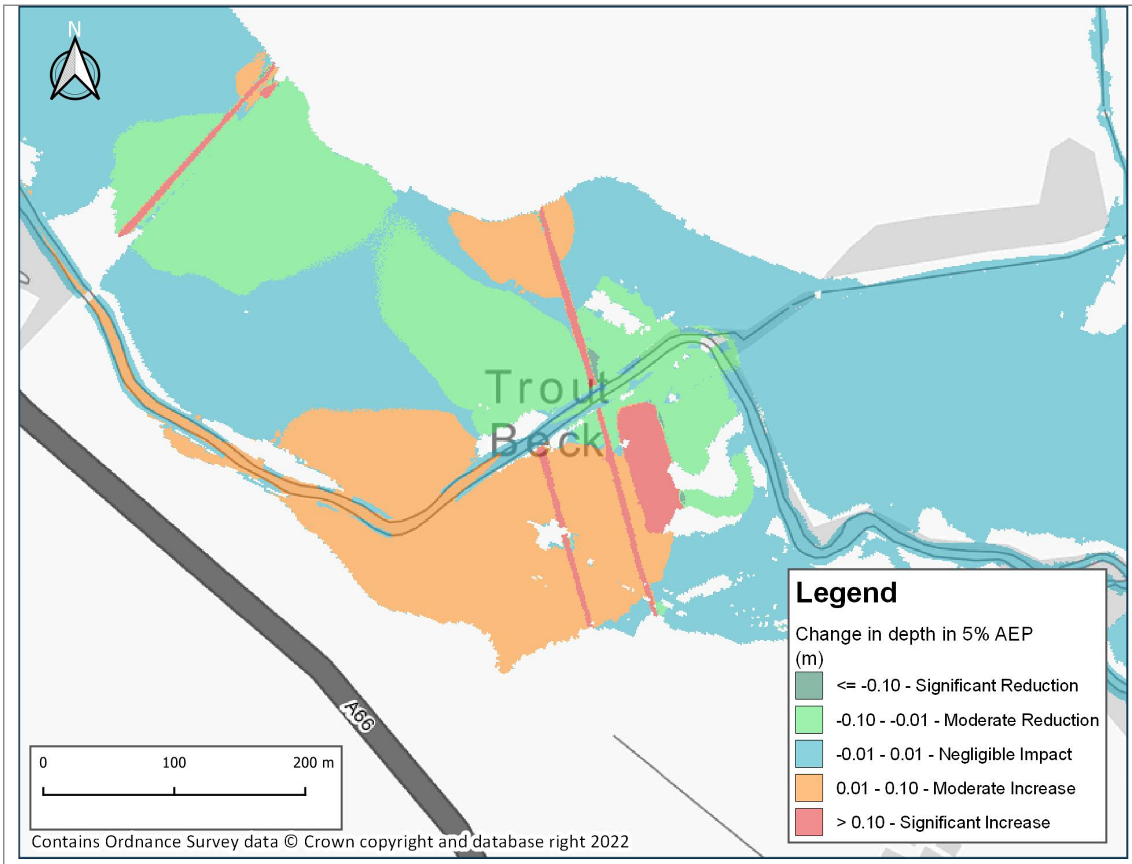

Figure 8-1: 5% AEP event flood depth comparison

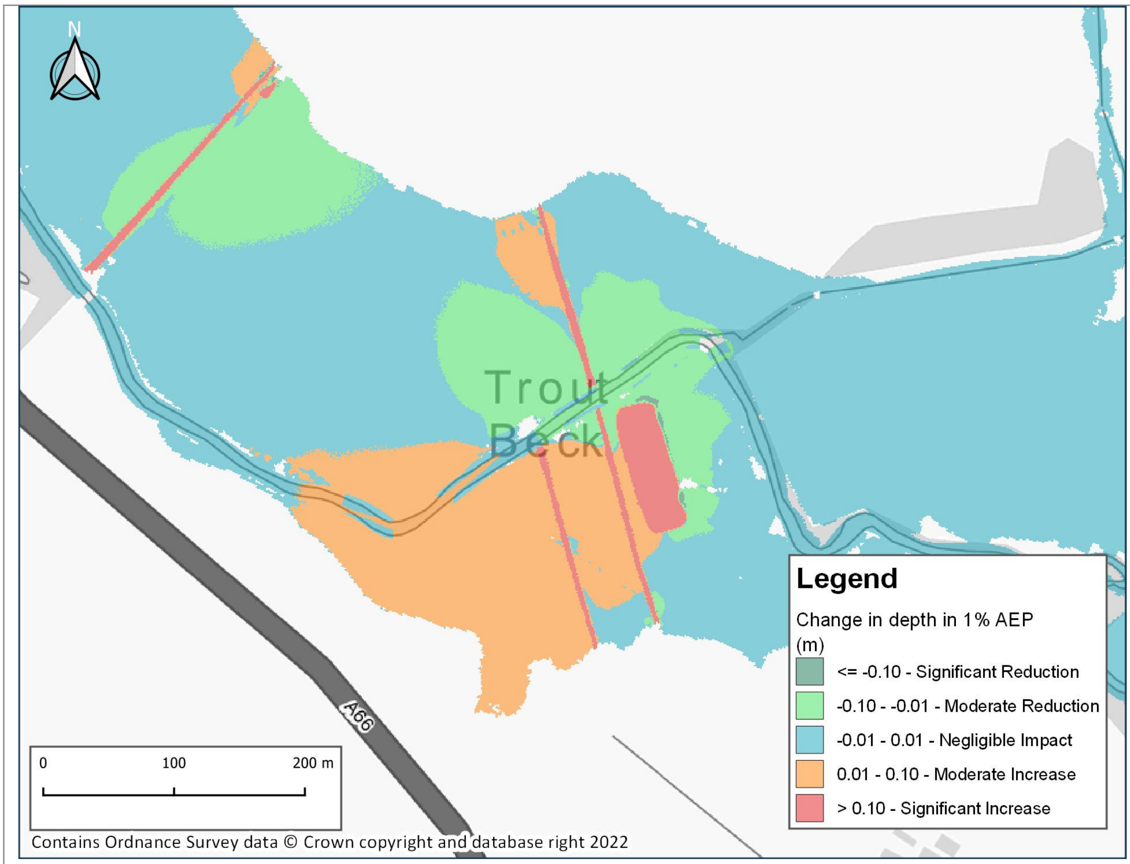

Figure 8-2: 1% AEP event flood depth comparison

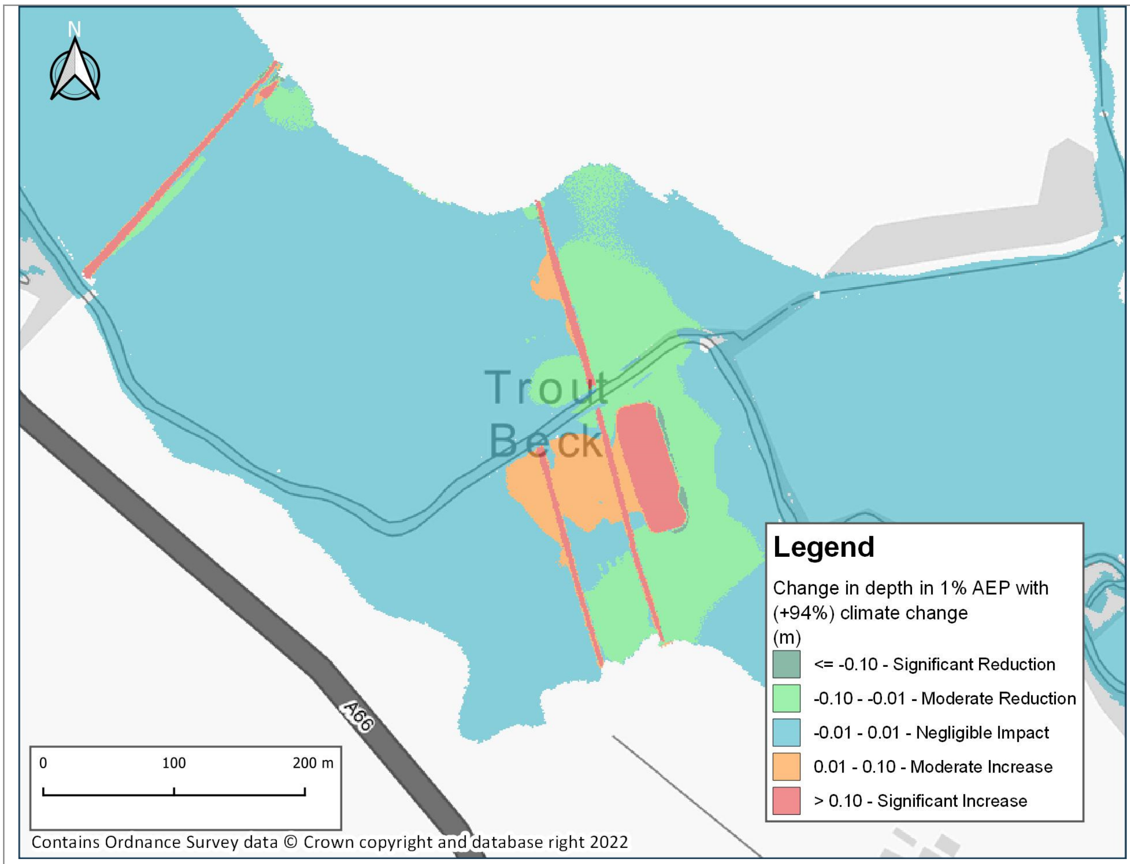

Figure 8-3: 1% AEP with (+94%) climate change event flood depth comparison

## 8.6 Effect of proposed scheme

### In-Channel

For the 4.5 hour critical storm events model results predict a change in water level around the proposed bridge structure. In the 1% AEP with (+94%) climate change events, water levels reduce upstream of the proposed structure by -0.047m and increase downstream of the proposed structure by less than 0.01m. This is likely to be the impact of lowered ground levels for ditches and the flood attenuation pond.

### Floodplain

For the 4.5 hour critical storm events model results predict a general reduction in water level is for the with-scheme situation upstream of the proposed bridge structure. There are moderate increased levels predicted downstream of the proposed ditches and the proposed flood plain attenuation pond. The comparison figures (Figure 8-1 to Figure 8-3) indicate these increases are likely to be an impact of the ground alterations on flow i.e. the floodplain compensation area and drainage ditches drawing more water towards lower ground and redirecting flow. The increase in water levels caused by these alterations is predicted to be between 0.01m and 0.10m.

### Key Model Assumptions and Limitations

During any hydraulic modelling study, there will always be associated limitations, for example, with uncertainty and data availability etc. The representation of any complex system by a model requires several assumptions to be made. In the case of the hydraulic model it has been assumed that:

- Cross sections accurately represent the shape and variation of the river.
- Model parameters have been determined appropriately.
- Design flows are an accurate representation of flows of a given AEP.
- The surveyed cross-sections of hydraulic structures and the units used to represent them in the model provide an adequate representation of the situation.
- LIDAR accurately reflects bank heights and particularly that the filtered LIDAR has appropriately removed the influence of vegetation.

Other specific limitations and assumptions are detailed below:

- The watercourses in the study area are ungauged and therefore no calibration of the hydraulic model has been carried out.
- Surface water, sewer flooding and groundwater flooding have not been included in this assessment. The hydraulic model results demonstrate the potential flood risk from the mechanism of the modelled watercourses overtopping only.

A66 Northern Trans-Pennine

# Temple Sowerby to Appleby Hydraulic Modelling Report

Temple Sowerby to Appleby

| **Document Verification** | |
|---|---|
| **Project Title** | **A66 Northern Trans-Pennine**<br>Temple Sowerby to Appleby |
| **Document Title** | Hydraulic Modelling Report |
| **Document Ref** | HE565627-JBAU-XX-05-RP-HM-S3-P02-0001-Scheme5_Modelling_Report |

**Note:** The contents of the Cover Page and Document Verification page are managed by ProjectWise. Users should not edit these fields manually.

| **Rev** | **Suit. Code** | **Suitability** | | **Purpose of Issue** | | |
|---|---|---|---|---|---|---|
| P01 | S3 | Shared for review | | | | |
| | | **Created** | **Checked** | **Reviewed** | **Approved** | **Authorised** |
| | **Name** | E. Albrighton | A. Blanchard | A. Blanchard | A. Blanchard | --- |
| | **Date** | 30.11.2021 | 17.01.2022 | 17.01.2022 | 17.01.2022 | --- |

| **Rev** | **Suit. Code** | **Suitability** | | **Purpose of Issue** | | |
|---|---|---|---|---|---|---|
| P02 | S3 | Shared for review | | --- | | |
| | | **Created** | **Checked** | **Reviewed** | **Approved** | **Authorised** |
| | Name | E. Albrighton | A. Blanchard | A. Blanchard | A. Blanchard | --- |
| | Date | 14.04.2022 | 14.04.2022 | 14.04.2022 | 14.04.2022 | --- |

| **Rev** | **Suit. Code** | **Suitability** | | **Purpose of Issue** | | |
|---|---|---|---|---|---|---|
| --- | --- | --- | | --- | | |
| | | **Created** | **Checked** | **Reviewed** | **Approved** | **Authorised** |
| | Name | --- | --- | --- | --- | --- |
| | Date | --- | --- | --- | --- | --- |

| **Fluvial Hydraulic Modelling Report – Scheme 5** | | |
|---|---|---|
| 1 Basic Model Information | | |
| Model Name | Scheme 5 Model | |
| Primary Watercourses / Water Bodies | Model UNN05: Unnamed tributary of Trout Beck 4.2, 4.5 and 4.6 | |
| Designation | Ordinary Watercourse | |
| Model ID | The following table presents information regarding the model scenarios carried out as part of this study. | |
| Model Scenario ID | Scenario | Annual Probability |
| UNN05_Baseline_Q20_008.tcf | Existing Situation Model | 5% (1 in 20-years) |
| UNN05_Baseline_Q100_008.tcf | | 1% (1 in 100-years) |
| UNN05_Baseline_Q100CC47_008.tcf | | 1% + 47% climate change (1 in 100-years +47% climate change) |
| UNN05_Baseline_Q100CC61_008.tcf | | 1% + 61% climate change (1 in 100-years +61% climate change) |
| UNN05_Baseline_Q100CC94_008.tcf | | 1% + 94% climate change (1 in 100-years plus 94% climate change) |
| UNN05_Baseline_Q1000_008.tcf | | 0.1% (1 in 1,000-years) |
| UNN05_FLOW_SENS_Q100_008.tcf | Sensitivity tests | 1% AEP with +20% flow |
| UNN05_ROUGH_SENS_P_Q100_008.tcf | | 1% AEP with +20% roughness |
| UNN05_ROUGH_SENS_M_Q100_008.tcf | | 1% AEP with -20% roughness |
| UNN05_DSBDY_SENS_Q100_008.tcf | | 1% AEP with +250mm at downstream boundary |
| UNN05_~s1~_~e1~_017_PD1.tcf | With-Scheme Situation Model | 5% (1 in 20-years) |
| UNN05_~s1~_~e1~_017_PD1.tcf | | 1% (1 in 100-years) |
| UNN05_~s1~_~e1~_017_PD1.tcf | | 1% + 94% climate change (1 in 100-years plus 94% climate change) |

| 2 Model Input Data | |
|---|---|
| Incoming Models | No existing hydraulic model was available for this study area. |
| DTM for 2D Model Domain | 1m resolution LiDAR last flown in 2013 and 5m photogrammetric data dated 2018. |
| River channel/Structure survey | Channel survey collected by JBA Consulting between November 2020 and June 2021. |
| Additional Data | Mastermap data, As built drawings of existing structures where available, proposed route alignments. |

| 3 Model Build Overview | | | |
|---|---|---|---|
| Software | 1D domain: ESTRY | | |
| | 2D domain(s): TUFLOW | | |
| Model Reference | HE565627-JBAU-XX-05-MD-HM-0001-Scheme5_HydraulicModel | | |
| Model reaches | The table below shows the watercourse reaches defined in the model. | | |
| Model Schematisation | Figure 3.1 shows the schematisation of the hydraulic models. | | |
| Watercourse Name | Upstream model node | Downstream model node | Total Reach length (km) |
| Unnamed tributary of Trout Beck 4.2 and 4.5 | R1_1408_1 | R1_0186C3 | 1.42 |
| Unnamed tributary of Trout Beck 4.6 | R2_1417 | R2_0257C4 | 1.42 |

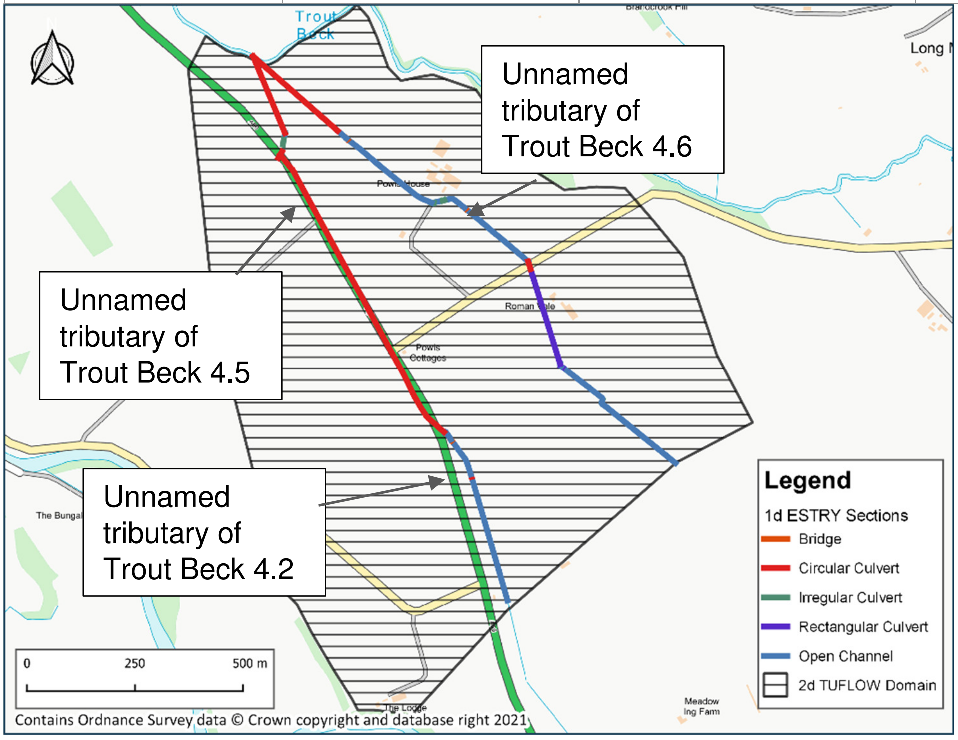

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Figure 5.1: Model UNN501: Unnamed Tributary of Trout Beck 4.2, 4.5 and 4.6

<table>
<tr><th colspan="4">4 Baseline model schematisation</th></tr>
<tr><td colspan="4">4.1 1D Model</td></tr>
<tr><td>Inflow boundaries</td><td colspan="3">Flow has been applied with a flow-time (QT) boundary at a point for the upstream nodes of each watercourse, and with lateral inflow nodes for the intervening catchment. Further information can be found in the FEH calculation record.</td></tr>
<tr><td>Downstream boundary</td><td colspan="3">A stage-flow (HQ) boundaries has been applied at the downstream extents of the watercourse in the 1D domain, using a relationship curve from the 2-year event in the Trout Beck. Along the 2D downstream boundary a stage-time boundary has been used, with water levels from the 2-year Trout Beck event applied.</td></tr>
<tr><td>Climate Change</td><td colspan="3">Climate change uplifts have been applied for the central, higher central and upper end allowances for the Eden and Esk Management Catchment using the Environment Agency July 2021 allowances.</td></tr>
<tr><td>Hydraulic roughness values used</td><td colspan="3">Channel roughness values have been represented in the model by Manning’s ‘n’ values, defined on a reach basis. In order to determine the roughness of channel cross sections, photographic evidence collected during site visits and survey collection were used as a reference alongside application of the method published by Cowan (1956).<br>Bed roughness values range from 0.035-0.060 with a value of 0.060 for all banks.<br>Structure roughness values range from 0.025-0.035.<br>To understand the implications of using these manning’s n values, sensitivity testing has been conducted to quantify the impacts in changing these parameters.</td></tr>
<tr><td rowspan="3">Labelling/naming convention used</td><td colspan="3">All nodes have an ID of S5_RX_XXXX where RX donates the watercourse and XXXX is the chainage upstream.<br>The following suffixes have been used:</td></tr>
<tr><td colspan="2">C, R or I<br>W<br>B<br>i, i2, i3<br>MH</td><td>Culvert<br>Weir or ESTRY Spill<br>Bridge<br>Interpolate<br>Manhole</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="4">4.2 2D Model</td></tr>
<tr><td>Area of 2D Domains</td><td>1.26km2</td><td>DTM data source</td><td>LiDAR, Photogrammetric data</td></tr>
<tr><td>Resolution of grid</td><td>2m</td><td>DTM Resolution</td><td>1m LiDAR, 5m Photogrammetric</td></tr>
<tr><td rowspan="3">Modifications to topography and reasons</td><td>2d_zsh_LiDAR_Feathering_R_001</td><td colspan="2">Used to smooth the transition between the two DTM files.</td></tr>
<tr><td>2d_zsh_UNN05_Banks_L_002<br>2d_zsh_UNN05_Banks_P_002</td><td colspan="2">The top of bank elevations have been stamped using Z shapes. Elevations are based on surveyed channel sections and LIDAR.</td></tr>
<tr><td>2d_zsh_UNN05_ManholeCover_R</td><td colspan="2">Used to set the soffit level of the manhole cover for stability.</td></tr>
</table>

| | | |
|---|---|---|
| | 2d_zsh_BridgeDecks_R<br>2d_zsh_BridgeDecks_P | Bridge decks have been set as per the survey levels using Z shapes. |

| | |
|---|---|
| Hydraulic roughness values used | Manning's n values have been used to represent hydraulic roughness in the 2D domain. The following roughness values were used in the model and are based on land cover types recorded in the Ordnance Survey MasterMap Topographic Area layer dataset. |

| Land Cover | Manning's 'n' value |
|---|---|
| Generic floodplain roughness values | 0.050 |
| Boulders | 0.065 |
| Coniferous trees | 0.120 |
| Coniferous trees – scattered / Orchard | 0.070 |
| Coppice or osiers | 0.090 |
| Marsh Reeds or Saltmarsh | 0.060 |
| Non coniferous trees | 0.090 |
| Non-coniferous trees – scattered | 0.060 |
| Rough grassland | 0.060 |
| Scrub | 0.070 |
| Rock | 0.070 |
| Heath | 0.090 |
| Building | 0.300 |
| General surface – multi surface | 0.050 |
| General surface – step | 0.050 |
| General surface - manmade | 0.050 |
| General surface - natural | 0.060 |
| Glasshouse | 0.200 |
| Inland water | 0.045 |
| Landform | 0.060 |
| Landform – slope | 0.060 |
| Landform – cliff | 0.060 |
| Path – step | 0.050 |
| Path | 0.050 |
| Rail | 0.045 |
| Road | 0.035 |
| Roadside | 0.050 |
| Structure | 0.300 |
| Structure – upper level of communication | 0.300 |
| Structure – pylon | 0.060 |
| Tidal water – foreshore | 0.055 |
| Tidal water | 0.055 |
| Unclassified | 0.060 |
| Stability value | 0.300 |

| 4.3 1D-2D Linking |
|---|
| A HX boundary is used to link the 1D and 2D domains along the top of banks. Elevations of HX cells are set using Z shapes outlined in Section 4.2. |

| | |
|---|---|
| Model Boundaries – Downstream Conditions | A 2D HT boundary is used at the downstream extent of the 2D domain using the 2-year water level from the Scheme 4 Trout Beck 2021 hydraulic model. |

## 5 Structures

General Assumptions

- At structures where only one face has been surveyed, a copy of the surveyed upstream face was used to represent the downstream face.
- Bridge decks have been represented using spill units where it is likely there would be no complex overland flows which potentially would take water away from the channel.
- Modelled structures have been schematised using the most recent channel survey taken by JBA Consulting in June 2021.

There are no formal defences within the study area. As such, all model runs are considered to be undefended. A number of drystone walls are present within the study area that may impede flow during particular fluvial flood events. These have not been represented within the model due to lack of data on these structures, and in parts, the integrity of these walls.

| ID | Structure | How has this structure been modelled? | Photo (view of upstream face unless specified) |
|---|---|---|---|
| R1_1106C | Access bridge | This structure has been modelled as a circular culvert unit in ESTRY. Overtopping flow has been modelled in the 2D. |  |
| R1_1009B | Wooden footbridge | This structure has been modelled as a BB Bridge unit in ESTRY. Overtopping flow has been modelled in the 1D using an ESTRY weir unit. |  |
| R1_0983C1 | Culvert beneath existing A66 | This structure has been modelled as a circular culvert unit in ESTRY. Overtopping flow has been modelled in the 2D. Due to the short section of open channel at the downstream, the open channel has been represented as a manhole with the same opening area as the open channel. |  |

| | | | |
|---|---|---|---|
| R1_0929C -<br>R1_0929C13<br><br>Downstream<br>R1_00227C1<br>R1_0227C2 | Culvert running alongside A66. | This structure has been modelled as a circular culvert unit in ESTRY. Overtopping flow has been modelled in the 2D. Upstream of culvert has been modelled as connected to the manhole representing the open channel for stability. |  Upstream face looking downstream<br> Downstream face looking upstream |
| R1_0212I | Culvert through railway embankment | This structure has been modelled as an irregular culvert unit in ESTRY. Overtopping flow has been modelled in the 2D. |  Upstream face looking downstream<br> Downstream face looking upstream |

| | | | |
|---|---|---|---|
| R1_0186C - R1_0186C3 | Field culvert | This structure has been modelled as a circular culvert unit in ESTRY. Overtopping flow has been modelled in the 2D. | <br>Upstream face looking downstream<br><br>Downstream face looking upstream |
| R2_1194I1 | Field drain culvert | The upstream of structure has been modelled as an irregular culvert unit in ESTRY. Overtopping flow has been modelled in the 1D as an ESTRY weir unit. | <br>Upstream face looking downstream<br><br>Downstream face looking upstream |

| | | | |
|---|---|---|---|
| R2_1067R | Field access culvert | This structure has been modelled as a rectangular culvert unit in ESTRY. Overtopping flow has been modelled in the 1D using an ESTRY weir unit. |  |
| R2_1056R -<br>R2_1056R4,<br>R2_1056C5 | Field drain culvert | This structure has been modelled as a rectangular culvert unit in ESTRY, with the final 18m being represented by a circular culvert . Overtopping flow has been modelled in the 2D. |  |
| R2_0618B | Wooden footbridge | This structure has been modelled as a BB Bridge unit in ESTRY. Overtopping flow has been modelled in the 1D using an ESTRY weir unit. |  |
| R2_0557I1 -<br>R2_0557I4 | Opening through a wall | This structure has been modelled as four irregular culvert units in ESTRY. Overtopping flow has been modelled in the 1D as an ESTRY weir unit. |  |
| R2_0535IU<br>R2_0535ID | Access culvert | This structure has been modelled as two irregular culvert units in ESTRY. Overtopping flow has been modelled in the 1D as an ESTRY weir unit |  |

| | | | |
|---|---|---|---|
| R2_0285B | Concrete access bridge | This structure has been modelled as a BB Bridge unit in ESTRY. Overtopping flow has been modelled in the 1D using an ESTRY weir unit |  |
| R2_0257C - R2_0257C4 | Field drain culvert | This structure has been modelled as a circular culvert unit in ESTRY. Overtopping flow has been modelled in the 2D | <br>Upstream face looking downstream<br><br>Downstream face |

# 6 Model Proving

## 6.1 Model Performance

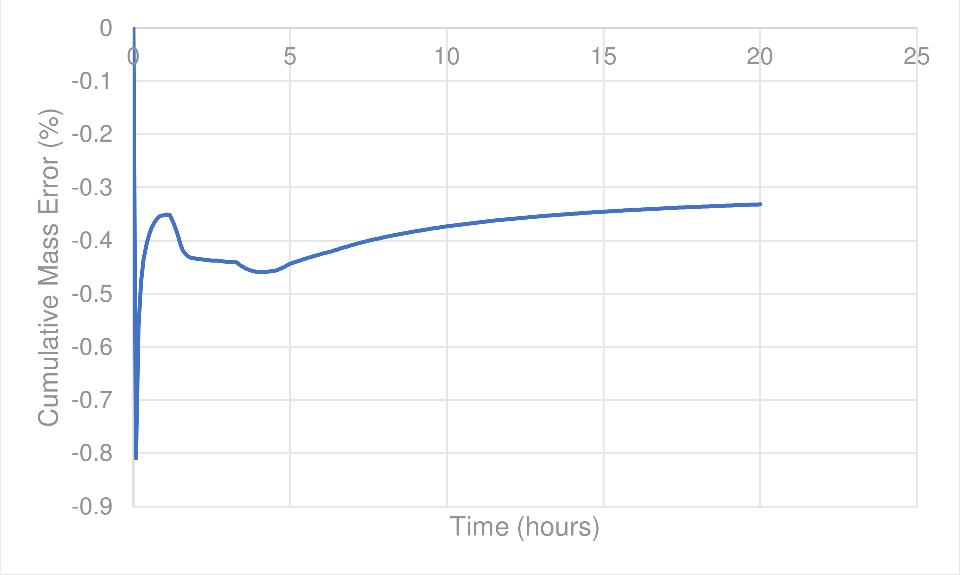

Figure 6-1: TUFLOW Cumulative Mass Error (0.1% AEP)

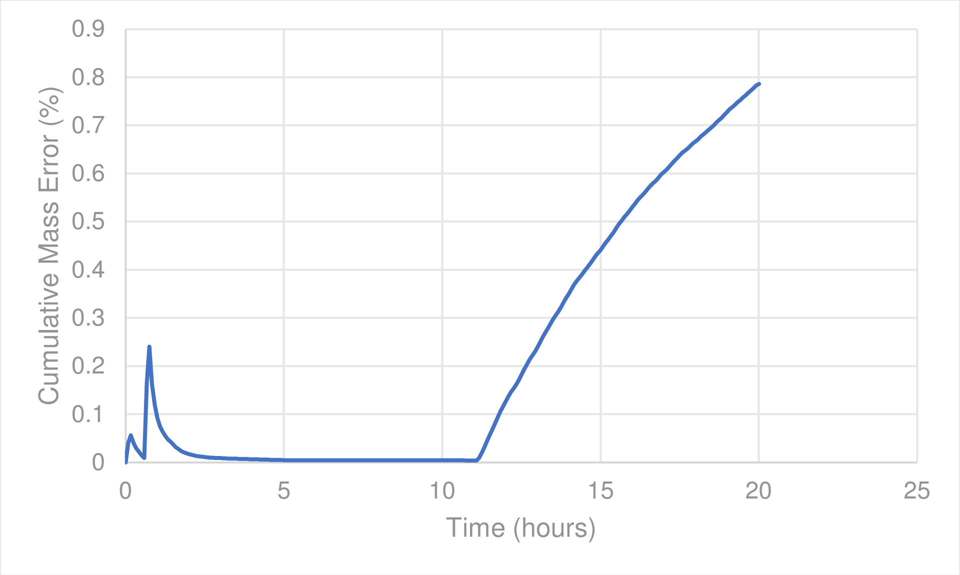

Figure 6-2: ESTRY Cumulative Mass Error (0.1% AEP)

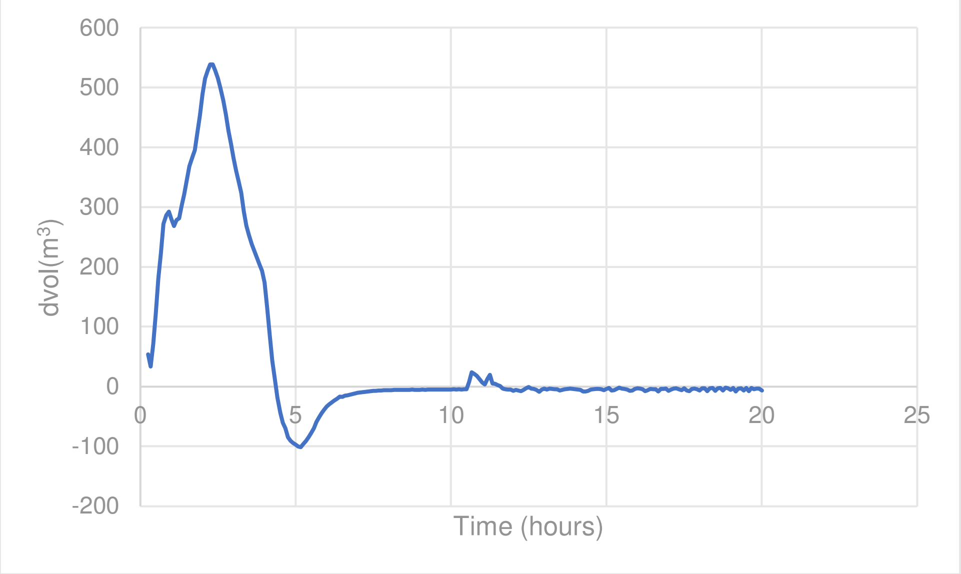

Figure 6-3: dVOl plot (0.1% AEP)

Flow and stage profiles have been checked throughout the model and are smooth with minimal oscillations, indicating the model is performing well. The dVol plot is shown to be smooth and the cumulative mass error is within a range of +1 to -1 for the entire simulation in the 1D and 2D domains.

| 6.2 Model Verification | |
|---|---|
| Calibration | No gauge data was available for the study area to allow the model to be calibrated to. |
| Previous Model Comparison | No previous hydraulic model results are available for the study area for comparison. |
| Flood Zone Comparison | Fluvial Flood Zone data is unavailable for the model extent. Surface water flood maps have therefore been used as a comparison and show that generally the modelled 0.1% flood extent are slightly larger than the 0.1% surface water flood extent, particularly at the confluence with the Trout Beck, where the surface water extents do not take into account water levels on the Trout Beck. |

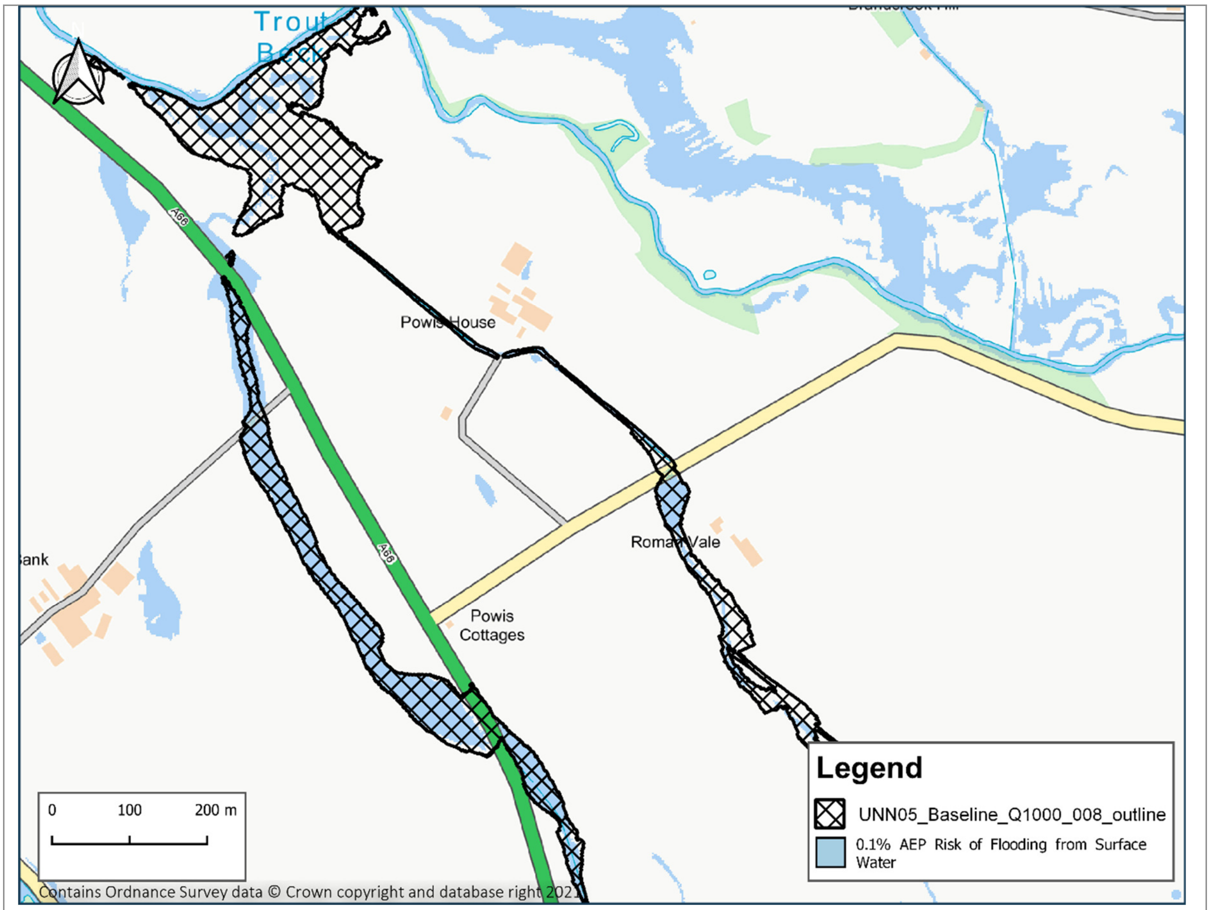

Figure 6-3: 0.1% surface water flood extent and 0.1% modelled flood extent

## 6.3 Sensitivity Analysis

Sensitivity tests were carried out for the 1% AEP existing situation model to assess the model response to the change in:

- Flow: Model inflows increased by 20%
- Roughness coefficient: In-channel and roughness values changed by +20% and -20%
- Downstream boundary: Water levels in the Trout Beck increased by 250mm.

The table below shows the maximum, minimum and average change in in-channel water levels relative to the existing situation model for each modelled reach with increase in flow and increase and decrease in roughness coefficients.

| Watercourse | UNN05 | | |
|---|---|---|---|
| | Change in peak water level (m) | | |
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.13 | -0.08 | 0.02 |
| +20% Roughness | 1.37 | -0.53 | 0.09 |
| -20% Roughness | 0.38 | -0.10 | 0.01 |
| +250mm DSBDY | 0.38 | 0 | 0.01 |

## 7 Model Build – With-Scheme Situation Model

| | |
|---|---|
| Scenario Definition | Figure 7-1 and Figure 7-2 show the proposed features of the A66 improvement scheme within the extent of the Scheme 5 hydraulic model.<br>The following sections explain how the features were incorporated into the model. |

### ESTRY 1D Model

The positioning of the features relating to the proposed bridge structure is on the flood plain and across some of the channel within Scheme 5. The proposed new culverts and realigned watercourse are shown in Figure 7-1 below.

Where new open channel sections are proposed, cross section profiles were taken from the proposed surface DTM and incorporated into the 1D domain of the model. Several new culverts were also added to the model as per design drawing HE565627-AMY-HDG-S0405-M3-CD-000203-Model.

Two underpass structures at the junction in the vicinity of Unnamed tributary of Trout Beck 4.6 were added into the model using z-shapes and ESTRY network lines.

At the downstream end of Unnamed tributary of Trout Beck 4.6, de-culverting is proposed. In the with-scheme model, the culvert discharging to the Trout Beck has been removed and replaced with open channel, based on dimensions shown in the proposed surface DTM.

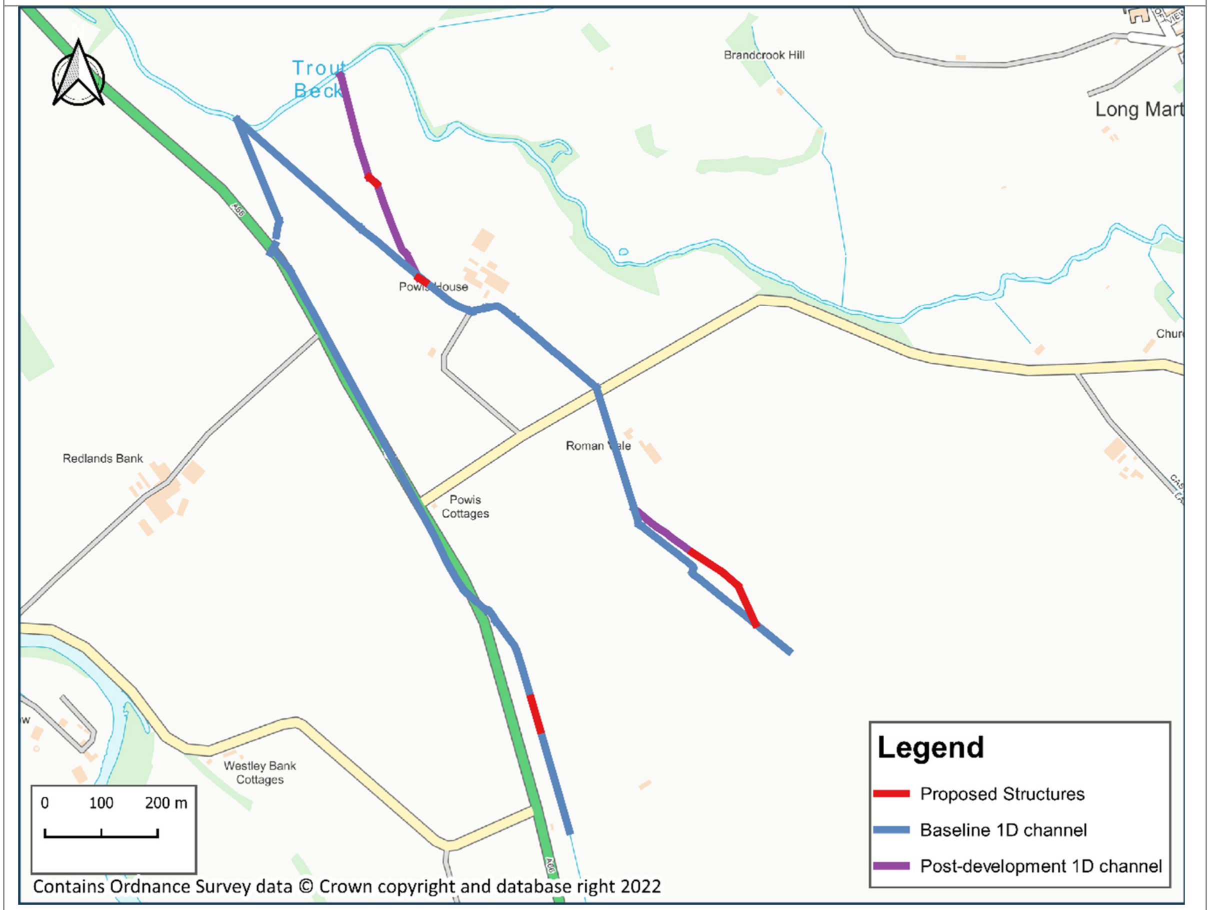

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Figure 7-1: With-scheme 1D schematisation

### TUFLOW 2D Model

The following updates were made to the TUFLOW model to represent design features:

- An ascii grid of the proposed surface levels was used in the model to overwrite the DTM with new levels in the flood plain to represent the following features of the proposed bridge structure:
    - Embankments
    - Abutments
    - Ditches
    - Flood plain attenuation pond
- The proposed bridge piers were added to the floodplain using 2D Flow Constriction (FC) polygons using a blockage factor to represent the proposed width of the columns as shown on the design drawings (0.75 for 1.5m and 0.9 for 1.9m)

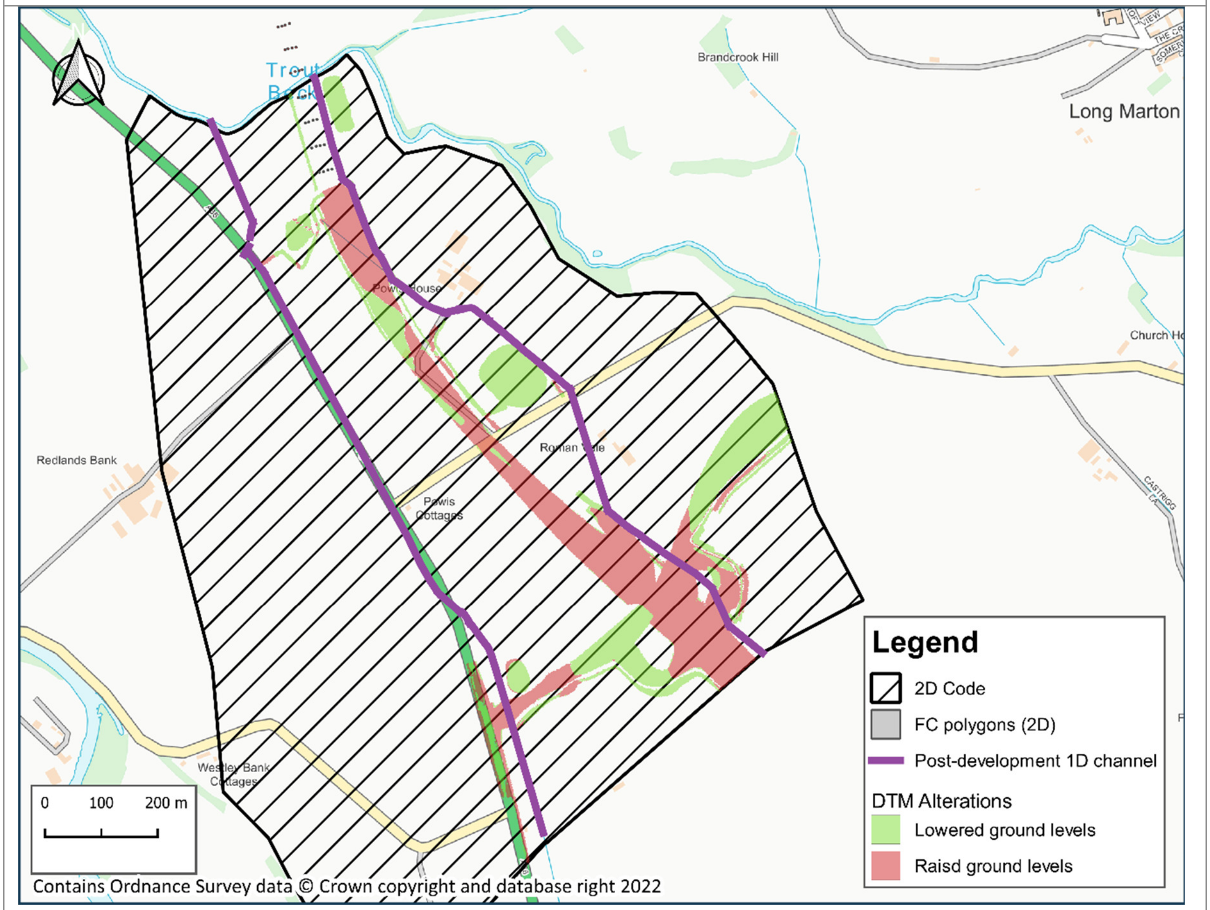

Figure 7-2: With-scheme 2D schematisation

| | |
|---|---|
| Design Detail Sources | In addition to direct communication with the design team, the following sources of information were utilised:<br>Design drawings:<br>HE565627-AMY-SGN-S0405-DR-CB-000029.dwg<br>Proposed structures:<br>HE565627-AMY-HDG-S0405-M3-CD-000203-Model<br>Proposed surface:<br>HE565627-AMY-HDG-S0405-M3-CD-000234.dwg |

## 8 With-scheme Model Outputs

Water level outputs were extracted for the existing situation and with-scheme situation model at key locations and compared, the changes in water levels are presented below.

### 8.1 Change in 1D peak water levels

| Watercourse | Unnamed tributary of Trout Beck 4.2, 4.5 and 4.6 | | | |
|---|---|---|---|---|
| Location | Model node | Change in Peak Water Level (m) | | |
| | | 5% AEP | 1% AEP | 1% AEP with (+94%) CC |
| Unnamed tributary of Trout Beck 4.6 - 400m upstream of Trout Beck confluence and upstream of upstream of new channel | Rs_0453 | 0.078 | 0.124 | 0.157 |
| Unnamed tributary of Trout Beck 4.5 - 50m upstream of Trout Beck confluence | R1_0186C3 | 0.000 | 0.000 | 0.000 |
| Unnamed tributary of Trout Beck 4.6 - downstream of proposed structure | R2_1056R | -0.005 | -0.350 | -0.406 |
| Unnamed tributary of Trout Beck 4.6 - upstream of proposed structure | R2_1417_1 | 0.000 | 0.000 | 0.075 |
| Unnamed tributary of Trout Beck 4.2 - downstream of proposed structure | R1_1106C | -0.004 | -0.004 | -0.003 |
| Unnamed tributary of Trout Beck 4.2 - upstream of proposed structure | R1_1408_2 | 0.301 | 0.233 | 0.093 |

### 8.3 Pass-Forward Flow

The pass-forward flows at the downstream end of the unnamed tributaries of Trout Beck in the hydraulic model have been assessed to see what the likely effect will be for flood risk downstream. The table below shows the flow changes between the existing situation and with-scheme scenarios. It shows that for the 5% AEP and 1% AEP events on the unnamed tributary of the Trout Beck 4.6, the pass-forward flow is predicted to reduce as a result of the scheme. A minor increase is predicted during the 1% AEP with (+94%) climate change event. For all events on the unnamed tributary of the Trout Beck 4.5, there is no predicted change in the pass-forward flow as a result of the scheme.

| Model Assessed | Peak Flow (m3/s) at Node R2_0453 (Unnamed tributary of Trout Beck 4.6) | | |
|---|---|---|---|
| | 5% AEP Event | 1% AEP Event | 1% AEP with (+94%) CC Event |
| Existing situation | 0.28 | 0.34 | 0.66 |
| With-scheme | 0.26 | 0.32 | 0.69 |

| Model Assessed | Peak Flow (m3/s) at Node R1_0186C3 (Unnamed tributary of Trout Beck 4.5) | | |
|---|---|---|---|
| | 5% AEP Event | 1% AEP Event | 1% AEP with (+94%) CC Event |
| Existing situation | 0.06 | 0.06 | 0.07 |
| With-scheme | 0.06 | 0.06 | 0.07 |

## 8.4 2D Flood Depth Change

Figure 8-1 to Figure 8-3 show the changes in flood depth for the existing situation and with-scheme situation for each event.

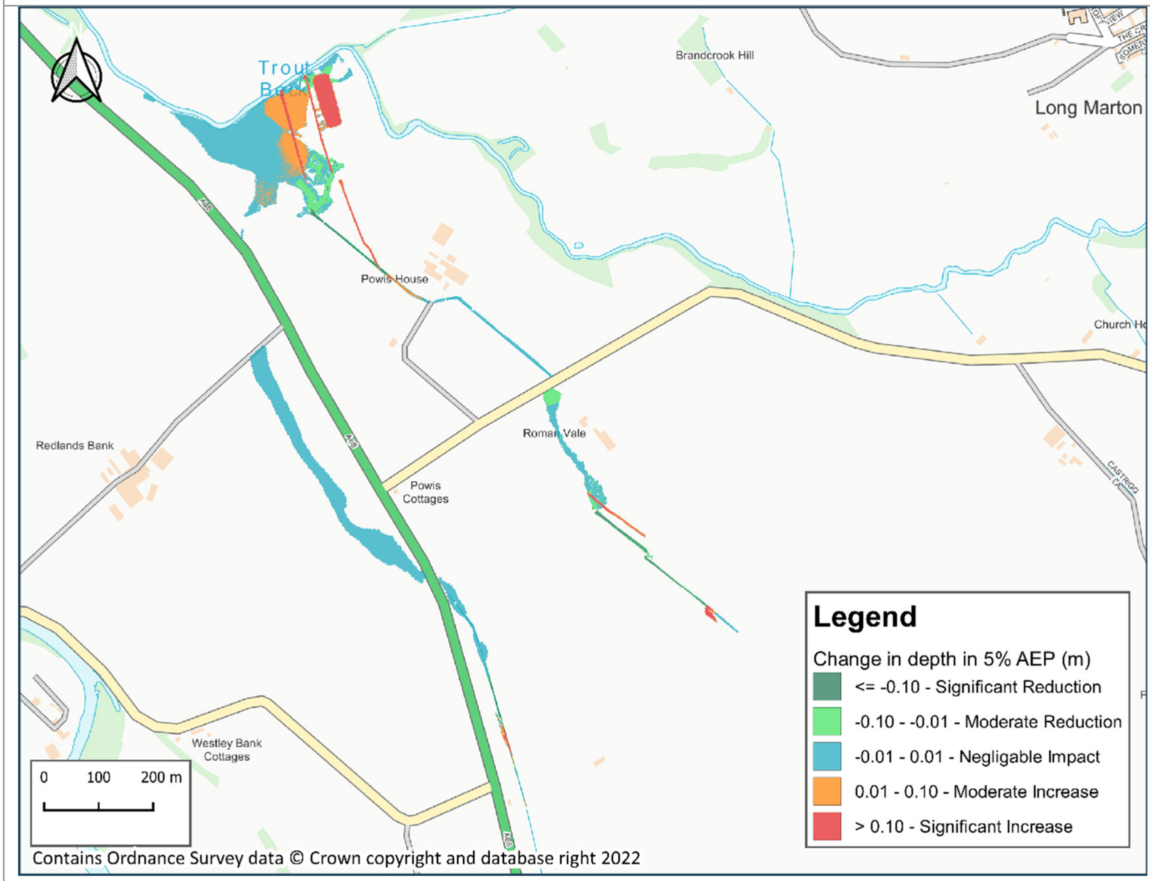

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Figure 8-1: 5% AEP event flood depth comparison

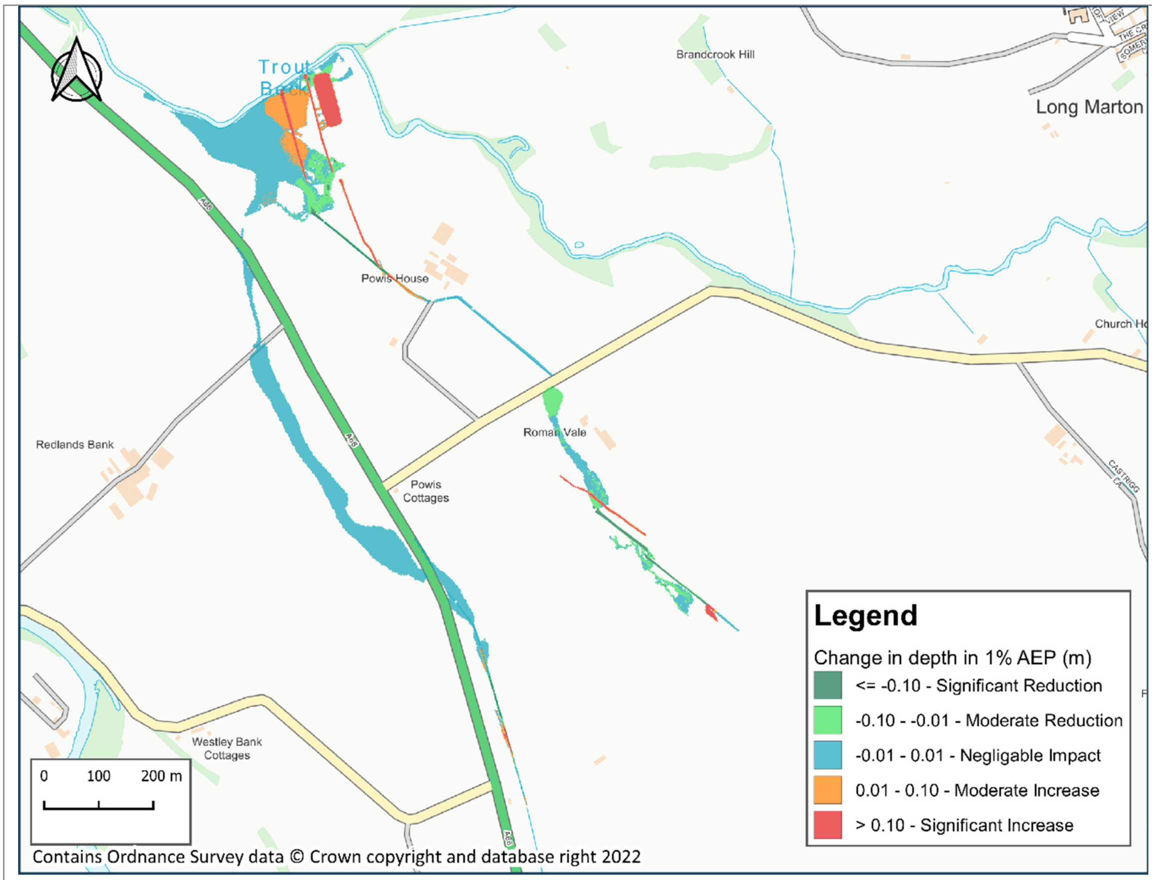

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Figure 8-2: 1% AEP event flood depth comparison

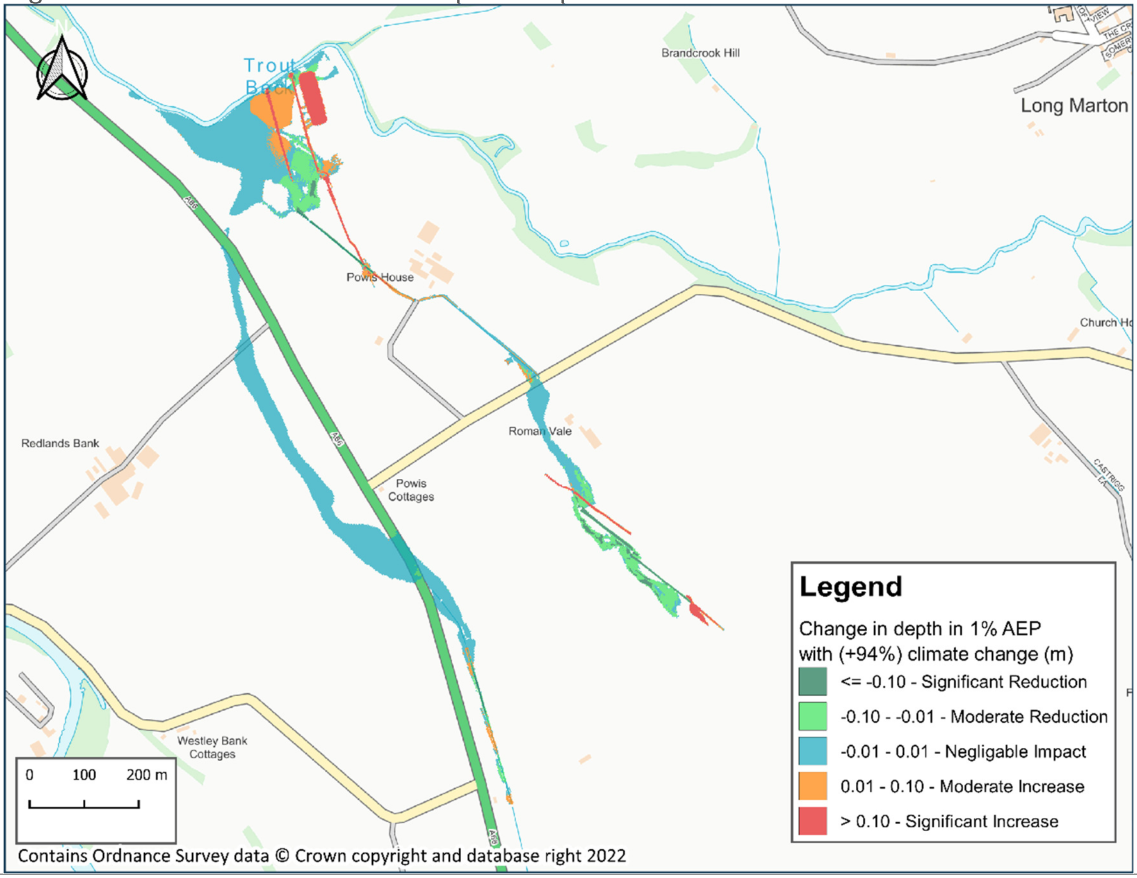

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Figure 8-3: 1% AEP with (+94%) climate change event flood depth comparison

## 8.6 Effect of proposed scheme

### In-Channel

Model results predict changes in in-channel water level around the proposed bridge structure, around the proposed alignment of unnamed tributary 4.6 and around proposed structures along both unnamed tributaries. In the 1% AEP with (+94%) climate change events, the greatest increase in water levels is predicted to be upstream of the proposed alignment of unnamed tributary 4.6 where modelled water levels increase by up to 0.157m. The greatest reduction in levels is predicted to be downstream of the proposed structure, upstream of Roman Vale, on unnamed tributary 4.6 where modelled flood levels change by -0.406m.

### Floodplain

Generally, changes in flood depths predicted are within the vicinity of the proposed scheme. Model results predict a change in water level around the proposed bridge structure on the flood plain of the Trout Beck, likely due to proposed ground level changes located here (e.g. new ditches and floodplain compensation scheme). Other increases in flood depths are generally confined to new proposed ditches, or their immediate vicinity. There is a moderate reduction in flood levels (between -0.10m and -0.01m) predicted around the proposed alignment upstream of Roman Vale.

## 9 Key Model Assumptions and Limitations

During any hydraulic modelling study, there will always be associated limitations, for example, with uncertainty and data availability etc. The representation of any complex system by a model requires several assumptions to be made. In the case of the hydraulic model, it has been assumed that:

- Cross sections accurately represent the shape and variation of the river.
- Model parameters have been determined appropriately.
- Design flows are an accurate representation of flows of a given AEP.
- The surveyed cross-sections of hydraulic structures and the units used to represent them in the model provide an adequate representation of the situation.
- LIDAR accurately reflects bank heights and particularly that the filtered LIDAR has appropriately removed the influence of vegetation.

Other specific limitations and assumptions are detailed below:

- The watercourses in the study area are ungauged and therefore no calibration of the hydraulic model has been carried out.
- The modelled watercourses include some long sections of culverted watercourses. Changes in shape and size, manholes, gullies or blockages which may be present along these culverted sections have not been represented due to lack of data.
- To aid stability, a simplified approach was taken to modelling the short section of open channel between the existing A66 and the railway embankment (between R1_0227C2 and R1_0212I). This section of open channel has been modelled in the 2D domain with the bed levels of the watercourse represented using a Z-line.
- The connection between the unnamed tributary of Trout Beck 4.2 and unnamed tributary of Trout Beck 4.5 was confirmed using dye tracing. The exact alignment of the culverted watercourse and connections to the surface water network between these two watercourses is not known.
- Surface water, sewer flooding and groundwater flooding have not been included in this assessment. The hydraulic model results demonstrate the potential flood risk from the mechanism of the modelled watercourses overtopping only.

A66 Northern Trans-Pennine

# Appleby to Brough Hydraulic Modelling Report

Appleby to Brough

| **Document Verification** | |
|---|---|
| **Project Title** | **A66 Northern Trans-Pennine**<br>Appleby to Brough (Warcop) |
| **Document Title** | Hydraulic Modelling Report |
| **Document Ref** | HE565627-JBAU-XX-06-RP-HM-S3-P02-0001-Scheme6_Modelling_Report |

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| Rev | Suit. Code | Suitability | | Purpose of Issue | | |
|---|---|---|---|---|---|---|
| P01 | S3 | Shared for Review | | | | |
| | | Created | Checked | Reviewed | Approved | Authorised |
| | **Name** | Jack Richardson-- | Alice Blanchard--- | --Alice Blanchard- | Alice Blanchard--- | |
| | **Date** | 30/11/2021 | 30/11/2021 - | 30/11/2021 | 30/11/2021 | |

| Rev | Suit. Code | Suitability | | Purpose of Issue | | |
|---|---|---|---|---|---|---|
| P02 | S3 | Shared for Review | | --- | | |
| | | Created | Checked | Reviewed | Approved | Authorised |
| | Name | Jack Richardson | Alice Blanchard | David Kearney | David Kearney | |
| | Date | 14/04/2022 | 14/04/2022 | 14/04/2022 | 14/04/2022 | |

| Rev | Suit. Code | Suitability | | Purpose of Issue | | |
|---|---|---|---|---|---|---|
| P03 | S3 | Shared for Review | | --- | | |
| | | Created | Checked | Reviewed | Approved | Authorised |
| | Name | Jack Richardson | Alice Blanchard | Alice Blanchard | Alice Blanchard - | --- |
| | Date | 06.05.2022 | 10.05.2022 | 10.05.2022 | 10.05.2022 | --- |

| Fluvial Hydraulic Modelling Report – Scheme 6 | | |
|---|---|---|
| 1 Basic Model Information | | |
| Model Name | Warcop model (existing model)<br>UNN607 model<br>UNN605 model | |
| Primary Watercourses / Water Bodies | Warcop Model<br>Lowgill Beck (MR)<br>Woodend Sike (OW)<br>Yosgill Sike (OW)<br>Crooks Beck (MR)<br>Moor Beck (MR)<br>Eastfield Sike (OW)<br>Unnamed Tributary of Lowgill Beck 6.1 (OW)<br>Cringle Beck (OW)<br>Unnamed Tributary of Cringle Beck 6.1 (OW)<br>Unnamed Tributary of Cringle Beck 6.2 (OW)<br>Unnamed Tributary of Cringle Beck 6.3 (OW)<br>UNN607 model<br>Unnamed Tributary of Lowgill Beck 6.7 (OW)<br>UNN605 model<br>Unnamed Tributary of Mire Sike 6.12 (OW) | |
| Designation | As indicated above:<br>Main River (MR)<br>Ordinary Watercourse (OW) | |
| Model ID | The following table presents information regarding the model scenarios carried out as part of this study. | |
| Model Scenario ID | Scenario | Annual Probability |
| WAR_Scheme6_Baseline_034.dat<br>WAR_Scheme6_Q2_036.ief<br>Scheme6_WAR_Baseline_Q2_036.tcf | Existing Situation Model | 5% (1 in 20-years) |
| Scheme6_UNN607_Q20_005.tcf | | |
| Scheme6_UNN605_Q20_005.tcf | | |
| WAR_Scheme6_Baseline_034.dat<br>WAR_Scheme6_Q10_036.ief<br>Scheme6_WAR_Baseline_Q10_036.tcf | | 1% (1 in 100-years) |
| Scheme6_UNN607_Q100_005.tcf | | |
| Scheme6_UNN605_Q100_005.tcf | | |
| WAR_Scheme6_Baseline_034.dat<br>WAR_Scheme6_Q20_036.ief<br>Scheme6_WAR_Baseline_Q20_036.tcf | | 1% + 47% climate change |
| Scheme6_UNN607_Q100_CC47_005.tcf | | |
| Scheme6_UNN605_Q100_CC47_005.tcf | | |
| WAR_Scheme6_Baseline_034.dat | | |

| | | |
|---|---|---|
| WAR_Scheme6_Q100_036.ief<br>Scheme6_WAR_Baseline_Q100_036.tcf | | 1% + 61% climate change |
| Scheme6_UNN607_Q100_CC61_005.tcf | | |
| Scheme6_UNN605_Q100_CC61_005.tcf | | |
| WAR_Scheme6_Baseline_034.dat<br>WAR_Scheme6_Q100_CC47_036.ief<br>Scheme6_WAR_Baseline_ Q100_CC47_036.tcf | | 1% + 94% climate change |
| Scheme6_UNN607_Q100_CC94_005.tcf | | |
| Scheme6_UNN605_Q100_CC94_005.tcf | | |
| WAR_Scheme6_Baseline_034.dat<br>WAR_Scheme6_Q100_CC61_036.ief<br>Scheme6_WAR_Baseline_ Q100_CC61_036.tcf | | 0.1% (1 in 1000-years) |
| Scheme6_UNN607_Q1000_005.tcf | | |
| Scheme6_UNN605_Q1000_005.tcf | | |
| WAR_Scheme6_Nplus20pct_020.dat<br>Nplus20pct_Q100_025.ief<br>Scheme6_WAR_Nplus20pct_Q100_025.tcf | Sensitivity tests | 1% AEP with +20% roughness |
| UNN607_Nplus20pctQ100_005.tcf | | |
| UNN605_Nplus20pct_Q100_005.tcf | | |
| Scheme6_Nmin20pct_020.dat<br>Nmin20pct_025.ief<br>Scheme6_WAR_Nmin20pct_Q100_025.tcf | | 1% AEP with –20% roughness |
| UNN607_Nmin20pctQ100_005.tcf | | |
| UNN605_Nmin20pct_Q100_005.tcf | | |
| WAR_Scheme6_Baseline_020.dat<br>Qplus20pct_Q100_025.ief<br>Scheme6_WAR_Baseline_Q100plus20pct_025.tcf | | 1% AEP with +20% flow |
| Scheme6_UNN607_Q100plus20pct_005.tcf | | |
| Scheme6_UNN605_Q100plus20pct_005.tcf | | |
| WAR_Scheme6_Dplus1m_020.dat<br>Dplus1m_Q100_025.ief<br>Scheme6_WAR_Dplus1m_Q100_025.tcf | | 1% AEP with -20% downstream boundary |
| UNN607_dsbdy_Q100_005.tcf | | |
| UNN605_dsbdy_Q100_005.tcf | | |
| WAR_Scheme6_PostDev_025.dat<br>WAR_Scheme6_Q2_030.ief<br>Scheme6_WAR_PostDev_Q2_030.tcf | With-Scheme Situation Model | 50% (1 in 2-years) |
| Scheme6_UNN607_PostDev_Q2_001.tcf | | |
| Scheme6_UNN605_PostDev_Q2_001.tcf | | |
| WAR_Scheme6_PostDev_025.dat<br>WAR_Scheme6_Q10_030.ief<br>Scheme6_WAR_PostDev_Q10_030.tcf | | 10% (1 in 10-years) |
| Scheme6_UNN607_PostDev_Q10_001.tcf | | |
| Scheme6_UNN605_PostDev_Q10_001.tcf | | |
| WAR_Scheme6_PostDev_025.dat<br>WAR_Scheme6_Q20_030.ief<br>Scheme6_WAR_PostDev_Q20_030.tcf | | 5% (1 in 20-years) |
| Scheme6_UNN607_PostDev_Q20_001.tcf | | |
| Scheme6_UNN605_PostDev_Q20_001.tcf | | |
| WAR_Scheme6_PostDev_025.dat<br>WAR_Scheme6_Q100_030.ief | | 1% (1 in 100-years) |

| | | |
|---|---|---|
| Scheme6_WAR_PostDev_Q100_030.tcf | | |
| Scheme6_UNN607_PostDev_Q20_001.tcf | | |
| Scheme6_UNN605_PostDev_Q20_001.tcf | | |
| WAR_Scheme6_PostDev_025.dat<br>WAR_Scheme6_Q100_CC94_030.ief<br>Scheme6_WAR_PostDev_Q100_CC94_030.tcf | | 1% + 94% climate change |
| Scheme6_UNN607_PostDev_Q100_CC94_001.tcf | | |
| Scheme6_UNN605_PostDev_Q100_CC94_001.tcf | | |

| **2 Model Input Data** | |
|---|---|
| Incoming Models | Warcop Model: Environment Agency FM-TUFLOW model for Warcop (2018) |
| DTM for 2D Model Domain | 1m resolution LIDAR flown in 2019 |
| River channel/Structure survey | Channel survey collected by JBA Consulting between November 2021-July 2021 has been used to extend the existing Environment Agency Warcop model for Lowgill Beck, Toddygill Sike, tributary of Lowgill Beck 6.1, Woodend Sike, Yosgill Sike and Cringle Beck. Channel survey has also been used to construct two new models for the Unnamed Tributary of Lowgill Beck 6.7 (UNN607 model) and Unnamed Tributary of Mire Sike 6.12 (UNN605 model). |
| Additional Data | Mastermap data, as built drawings of existing A66 where available, HADDAMS information, proposed route alignments. |

| **3 Model Build Overview** | | | |
|---|---|---|---|
| Software | 1D domain: FM and ESTRY | | |
| | 2D domain(s): TUFLOW | | |
| Model Reference | HE565627-JBAU-XX-06-M2-HM-0001-Scheme6_Warcop_Model | | |
| Model Schematisation | Figure 3-1, Figure 3-2 and Figure 3-3 shows the schematisation of the hydraulic models for Scheme 6. | | |
| Model Reaches | The table below shows the watercourse reaches defined in the model. They are also shown in Figure 3-1. | | |
| Watercourse Name | Upstream model node | Downstream model node | Total Reach length (km) |
| Warcop model | | | |
| Woodend Sike | WOO001_0651 | WOO001_0000 | 0.65 |
| Yosgill Sike | YOS001_0205 | YOS001_0000 | 0.21 |
| Lowgill Beck * | LOW_03874 | LOWB_00013 | 3.86 |
| Moor Beck * | CROO_02656 | CROO_1629U | 1.03 |
| Crooks Beck * | CROO_01629D | CROO_00009 | 1.62 |
| Warcop Millstream * | CROK_00846 | CROO_001321 | 0.85 |
| Toddygill Sike * | TODY_00446 | TODY_00055 | 0.45 |
| Unnamed 606 | UNN606_0375 | UNN606_0007 | 0.38 |
| Cringle Beck | CRI_657 | CRI_8 | 0.66 |
| Unnamed 601 | U601_576 | U601_19 | 0.58 |
| *These watercourses were represented by the existing Warcop hydraulic model which has been incorporated into this model. Further information on existing models can be found in relevant modelling reports (Warcop 1D-2D Model Final Report v1.4.pdf). | | | |

| | | | |
|---|---|---|---|
| Updates to existing Warcop Model | | | |
| The existing Warcop model has been updated with the following:<br>• Extended with new channel survey to include the as outlined in Section 2 and shown in Figure 3-1.<br>• Within the existing domain of the Warcop model, three new cross sections for the Mill Leat and the Moor Beck have been added in key locations relating to the proposed highway alignment (CROK_00790, UNN604_0515 and UNN604_0240)<br>• New climate change allowances are higher than previous allowances. In order to stabilise the model for higher allowances, some minor changes have been made to the existing model sections including changing the orifice flow transition distances at CROK_00731B and CROO_01321B.<br>• Materials layer produced from latest OS Mastermap data.<br>• Latest composite LIDAR data from 2020 with existing model LIDAR used where new data is unavailable.<br>• TUFLOW build: 2020-01-AB-iDP-w64, Flood Modeller version: 4.5.7110.17678<br>• As the model was completed and signed off by the Environment Agency in 2019 it is not deemed necessary to update other model parameters or inputs. Therefore the vast majority of the model remains unchanged including to the hydrological inflows being applied. It is assumed that best practice guidelines have been adhered to in the previous modelling study. | | | |
| UNN607 model | | | |
| Unnamed 607 (U607) | U607_547** | U607_DS_100** | 0.65 |
| **Model UNN607 was extended by 100-200m upstream and downstream using interpolated cross section information in order to cover changes in the extent of the proposed A66 alignments. A site visit was conducted and determined no significant changes in channel geometry over the extended reaches. It was deemed appropriate to use the nearest surveyed cross section and make changes to the elevation values based on LIDAR data. | | | |
| UNN605 model | | | |
| Unnamed 605 (U605) | U605_608Sp (pond outfall) | U605_00d | 0.61 |

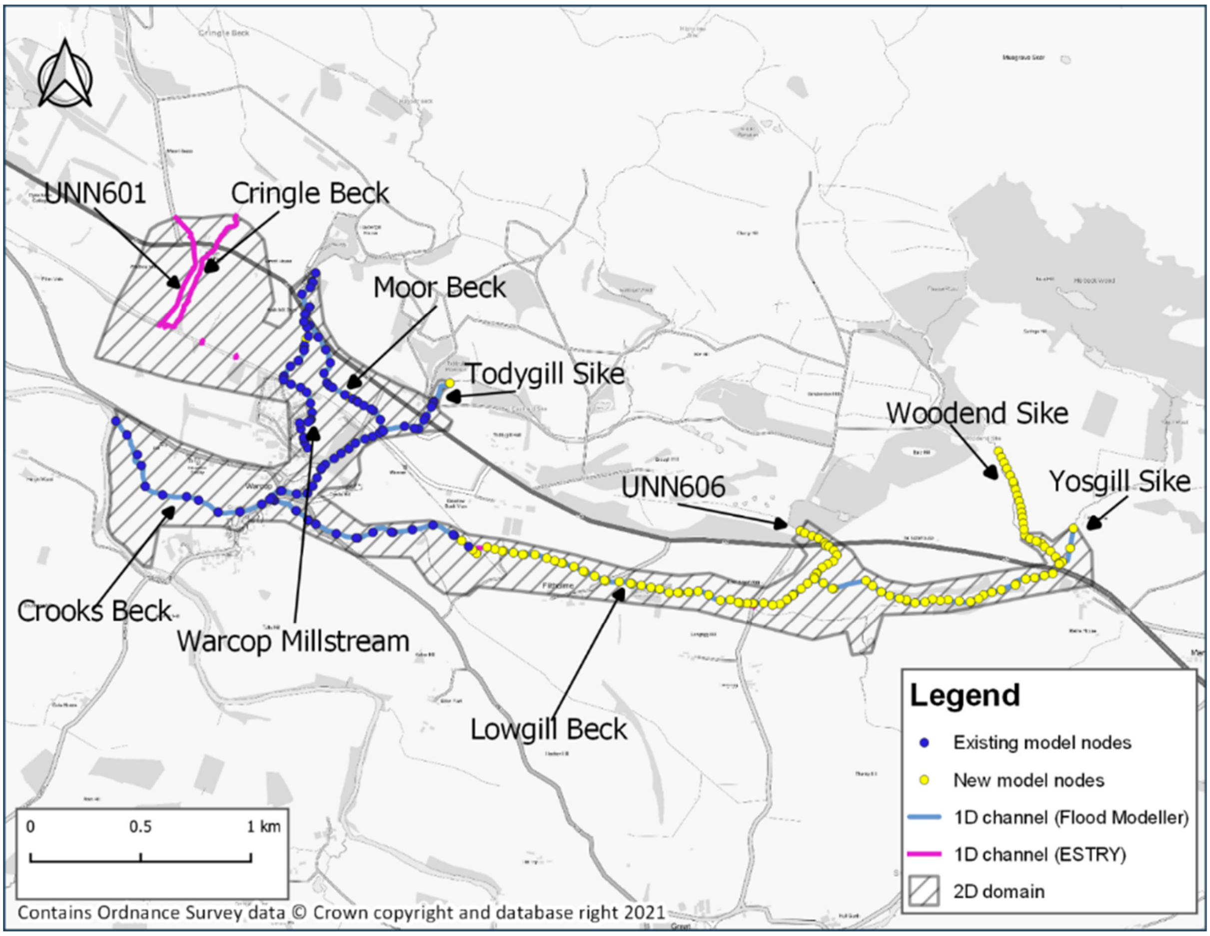


Figure 3-1: Warcop model overview

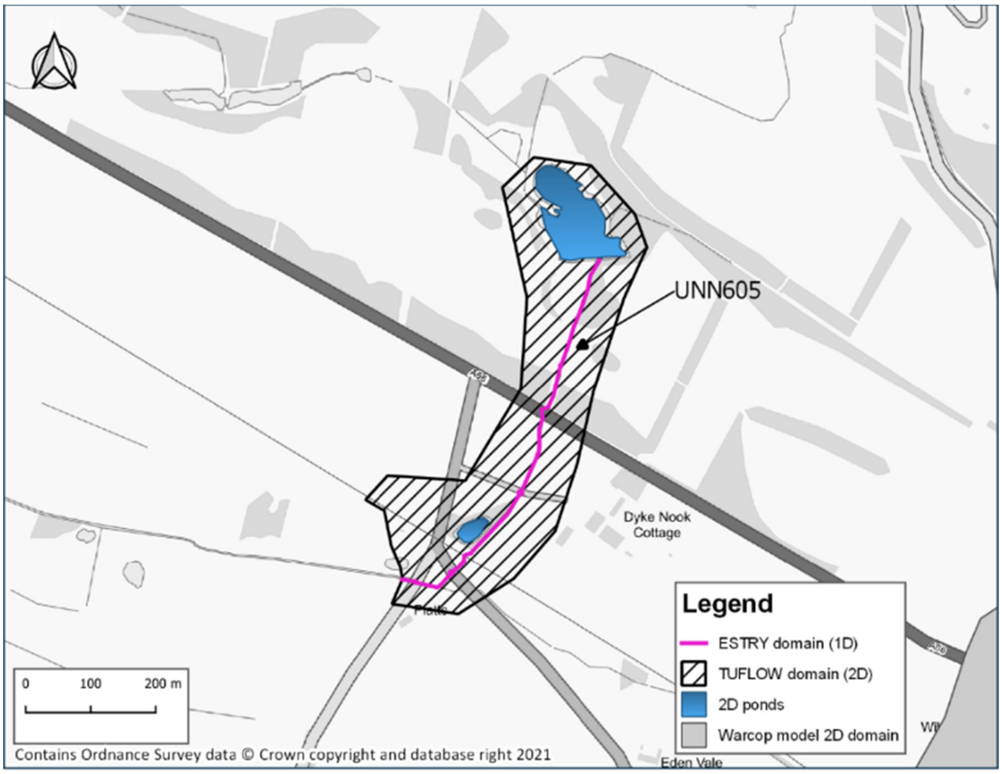


Figure 3-2: UNN607 model overview

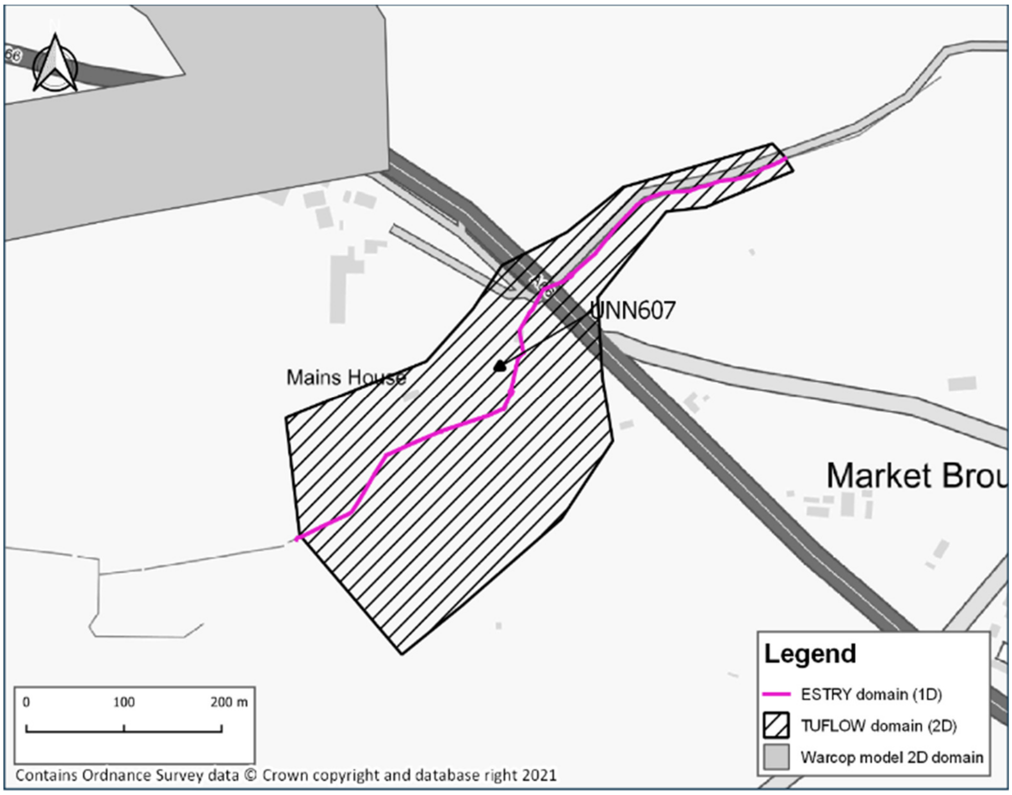


Figure 3-3: UNN605 model overview

| **4 Baseline model schematisation** | |
|---|---|
| 4.1 1D Domain | |
| Channel representation | Warcop model<br>The channel system has been based upon the existing 1D-2D 2018 Warcop model for the Crooks Beck, Moor Beck, Toddygill Beck, Warcop Millstream and Lowgill Beck (LOWB) watercourses and on new survey data collected for the Lowgill Beck (LOW), Cringle Beck, Woodend Sike, Yosgill Sike, Unnamed Tributary of Lowgill Beck 6.1 watercourses. The channels have been represented within the 1D domain across the study reach.<br>UNN607 and UNN605<br>The channel system has been based upon the most recent survey data set available for the area. The channels have been represented within the 1D domain across the study reach. |
| Structure representation | Warcop model<br>Structures along Crooks Beck, Moor Beck, Toddygill Beck, Warcop Millstream and Lowgill Beck (LOWB) watercourses are based on the existing 1D-2D 2018 Warcop model. Structures along the Lowgill Beck (LOW), Cringle Beck, Woodend Sike, Yosgill Sike, Unnamed Tributary of Lowgill Beck 6.1 watercourses have been based upon the most recent survey dataset available.<br>All significant structures within the study area have any modelling assumptions documented within this report (Section 5). Additionally, any structures which were not included within the hydraulic model based on the assumption that they were not deemed to be hydraulically significant are also recorded. Structures in the floodplain, such as culverts through railway embankments, have been represented in the 2D domain using ESTRY culverts and SX boundaries. These are shown in Figure 3-1.<br>UNN607 and UNN605<br>Existing structures have been based upon the most recent survey dataset available. All significant structures within the study area have any modelling assumptions documented within this report (Section 5). Additionally, any structures which were not included within the hydraulic model based on the assumption that they were not deemed to be hydraulically significant are also recorded. |
| Inflow boundaries | Flow has been applied with a flow-time (QT) boundary at a point for the upstream nodes of each watercourse, and with lateral inflow nodes for the intervening catchment.<br>Model inflows to the Warcop model for the Crooks Beck, Moor Beck, Toddygill Beck and Lowgill Beck (lateral flow in Warcop) watercourses remain unchanged from the 2018 Warcop modelling study. For the Warcop model, new inflows were derived for the Yosgill Sike, Woodend Sike, Unnamed Tributary of Lowgill Beck 6.1, Cringle Beck and Lowgill Beck (lateral flow upstream of Warcop) watercourses.<br>For models UNN607 and UNN605, new hydrological inflows have been derived. Further information can be found in the FEH calculation record. |
| Climate Change | Climate change uplifts have been applied for the central, higher central and upper end allowances for the Tees Management Catchment using the Environment Agency July 2021 allowances. |

<table>
<tr><td>Downstream boundary</td><td>Warcop model: The downstream boundary to the Crooks Beck is set using a head-time boundary at above bank full of the River Eden. A 2D stage-discharge boundary is used for the Cringle Beck based on floodplain gradients.<br>UNN607 and UNN605: a stage-discharge (HQ) relationship based on the channel gradient at the downstream reach of the model. A 2D stage-discharge boundary is used based on floodplain gradients.</td></tr>
<tr><td>Hydraulic roughness values used</td><td>Channel roughness values have been represented in the model by Manning's 'n' values, defined on a reach basis. In order to determine the roughness of channel cross sections, photographic evidence collected during site visits and survey collection were used as a reference alongside application of the method published by Cowan (1956).<br>Bed and bank roughness values range from 0.035-0.060.<br>Structure roughness values range from 0.015-0.020.<br>Roughness values for the existing modelled reaches in Warcop have been spot-checked against site visit photographs and remain unchanged. To understand the implications of using these manning's n values, sensitivity testing has been conducted to quantify the impacts in changing these parameters.</td></tr>
<tr><td>Labelling/naming convention used</td><td>All nodes have an ID of NNN001_XXXXX where XXXXX is the chainage upstream.<br>The following suffixes have been used:
<table>
<tr><td>C or CU</td><td>Culvert</td></tr>
<tr><td>J</td><td>Junction</td></tr>
<tr><td>W</td><td>Weir</td></tr>
<tr><td>SP</td><td>Spill</td></tr>
<tr><td>B</td><td>Bridge</td></tr>
<tr><td>i, i2, i3</td><td>Interpolate</td></tr>
<tr><td>u or d</td><td>Upstream or downstream node</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><td colspan="4">4.2 2D Domain</td></tr>
<tr><td>Area of 2D Domains</td><td>Warcop model: 1.96km2<br>UNN607 model: 0.091km2<br>UNN605 model: 0.12km2</td><td>DTM data source</td><td>LIDAR</td></tr>
<tr><td>Resolution of grid</td><td>2m</td><td>DTM Resolution</td><td>1m</td></tr>
<tr><td rowspan="4">Modifications to topography and reasons</td><td colspan="3">Warcop model</td></tr>
<tr><td>2d_zsh_WAR_Banks_L_004.shp<br>2d_zsh_WAR_Banks_P_004.shp</td><td colspan="2">The top of bank elevations have been stamped using Z shapes. Elevations are based on surveyed cross sections and LIDAR.</td></tr>
<tr><td>2d_zsh_WAR_R_119.shp<br>2d_zsh_WAR_P_119.shp</td><td colspan="2">The elevation of structure decks have been stamped using Z shapes. Elevations are based on surveyed cross sections.</td></tr>
<tr><td>2d_zsh_WAR_CROK_TOB_R_119.shp<br>2d_zsh_WAR_CROK_TOB_P_119.shp</td><td colspan="2">Millstream topography modification to ensure channel is represented</td></tr>
</table>

| | | |
|---|---|---|
| | | appropriately in the 2D domain. |
| | 2d_zsh_BridgeDecks_Scheme6_R_002.shp | The elevation of structure decks have been stamped using Z shapes. Elevations are based on surveyed cross sections. |
| | 2d_zsh_DTMEdits_Scheme6_R_001.shp | The 2D levels at SX boundaries have been stamped using Z shapes in order to improve model stability. Elevations are based on surveyed cross sections and LIDAR. |
| | 2d_zsh_MireSike_L_001.shp<br>2d_zsh_MireSike_P_001.shp | Mire Sike topography modification to ensure channel is represented appropriately in the 2D domain. |
| | 2d_zsh_LOW002_L_001.shp<br>2d_zsh_LOW002_P_001.shp | Railway overflow channel on Lowgill Beck topography modification to ensure overland flow is represented appropriately in the 2D domain. |
| | UNN607 model | |
| | 2d_zsh_Banks_UNN607_L_002.shp<br>2d_zsh_Banks_UNN607_P_002.shp | The top of bank elevations have been stamped using Z shapes. Elevations are based on surveyed cross sections and LIDAR. |
| | UNN605 model | |
| | 2d_zsh_Banks_UNN605_L_001.shp<br>2d_zsh_Banks_UNN605_P_001.shp | The top of bank elevations have been stamped using Z shapes. Elevations are based on surveyed cross sections and LIDAR. |
| | 2d_zsh_BridgeDecks_UNN605_R_001.shp | The elevation of structure decks have been stamped using Z shapes. Elevations are based on surveyed cross sections. |
| | 2d_zsh_UNN605_spill_L_001.shp<br>2d_zsh_UNN605_spill_P_001.shp | The elevation of the pond outfall. |
| | 2d_zsh_UNN605_Pond_R_001.shp<br>2d_iwl_UNN605_R_001.shp | The elevation of pond bed levels.<br>Initial water levels of ponds set at survey level / LIDAR level if no survey. |
| Hydraulic roughness values used | Manning's n values have been used to represent hydraulic roughness in the 2D domain. The following roughness values were used in the model and are | |

based on land cover types recorded in the Ordnance Survey MasterMap Topographic Area layer dataset. Two stability patches have been used in the Warcop model and these are at structures on the Cringle Beck and for a railway embankment culvert. Stability patches were used to improve model stability on several boundary (HX and SX) cells.

| Land Cover | Manning's 'n' value |
|---|---|
| Generic floodplain roughness values | 0.050 |
| Boulders | 0.065 |
| Coniferous trees | 0.120 |
| Coniferous trees – scattered / Orchard | 0.070 |
| Coppice or osiers | 0.090 |
| Marsh Reeds or Saltmarsh | 0.060 |
| Non coniferous trees | 0.090 |
| Non-coniferous trees – scattered | 0.060 |
| Rough grassland | 0.060 |
| Scrub | 0.070 |
| Rock | 0.070 |
| Heath | 0.090 |
| Building | 0.300 |
| General surface – multi surface | 0.050 |
| General surface – step | 0.050 |
| General surface - manmade | 0.050 |
| General surface - natural | 0.060 |
| Glasshouse | 0.200 |
| Inland water | 0.045 |
| Landform | 0.060 |
| Landform – slope | 0.060 |
| Landform – cliff | 0.060 |
| Path – step | 0.050 |
| Path | 0.050 |
| Rail | 0.045 |
| Road | 0.035 |
| Roadside | 0.050 |
| Stability Patch | 0.300 |
| Structure | 0.300 |
| Structure – upper level of communication | 0.300 |
| Structure – pylon | 0.060 |
| Tidal water – foreshore | 0.055 |
| Tidal water | 0.055 |
| Unclassified | 0.060 |

4.3 1D-2D Linking

A HX boundary is used to link the 1D and 2D domains along the top of banks. SX boundaries are applied to link the 1D and 2D domains at structures. Elevations of HX and SX cells are set using Z shapes outlined in Section 4.2.

| | |
|---|---|
| Model Boundaries – Downstream Conditions | A 2D HQ boundary is used at the edge of the 2D domain in some locations based on slope values derived from LIDAR.  SX boundaries are used at structures represented in the 2D domain. |
| 4.4 Representation of Defences | |
| Defences | There are no formal defences within the study area. As such, all model runs are considered to be undefended. |

| **5 Structures** | | | |
|---|---|---|---|
| General Assumptions | | | |
| - At structures where only one face has been surveyed, a copy of the surveyed upstream face was used to represent the downstream face.<br>- Bridge decks have been represented using spill units where it is likely there would be no complex overland flows which potentially would take water away from the channel.<br>- New modelled structures have been schematised using the most recent channel survey taken by JBA Consulting between November 2020 and June 2021.<br>- For structures along the Moor Beck, Warcop Millstream, Todygill Sike and Crooks Beck, please refer to the 2018 Warcop 1D-2D Model Final Report v1.4 | | | |
| Yosgill Sike | | | |
| ID | Structure | How has this structure been modelled? | Photo (view of upstream face unless specified) |
| YOS001_0325 | Wooden Footbridge | The model starts downstream of this structure. |  |
| YOS001_0309 | Trash screen | The model starts downstream of this structure. |  |
| Woodend Sike | | | |
| ID | Structure | How has this structure been modelled? | Photo (view of upstream face unless specified) |

| | | | |
|---|---|---|---|
| WOO001_0485 | Wooden bridge | This structure has been modelled with an arch bridge unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |
| WOO001_0003 | Wooden trash screen | This structure has not been modelled as it is not deemed hydraulically significant. |  |
| Lowgill Beck | | | |
| ID | Structure | How has this structure been modelled? | Photo (view of upstream face unless specified) |
| LOW_03926 | A66 culvert | This structure has been modelled with a rectangular culvert unit in Flood Modeller. Overtopping flow is represented in the 2D domain. | <br>Upstream face:<br><br>Downstream face: |

| | | | |
|---|---|---|---|
| LOW_03693 | Circular, concrete culvert | This structure has been modelled with an orifice unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |
| LOW_03160 | Circular, concrete culvert | This structure has been modelled with a circular culvert unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |
| LOW_02787 | Wooden trash screen | This structure has not been modelled as it is not deemed hydraulically significant. |  |
| LOW_02780 | Wooden trash screen | This structure has not been modelled as it is not deemed hydraulically significant. |  |

| | | | |
|---|---|---|---|
| LOW_02563 | Circular, stone culvert | This structure has been modelled with a circular culvert unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |
| LOW_02527 | Wooden bridge | This structure has been modelled with an arch bridge unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |
| LOW_02366 | Bridge | This structure has been modelled with an arch bridge unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |
| LOW_02366LB | Stone culvert (in floodplain on left bank of LOW_02366 bridge) | This structure has been represented with a rectangular culvert unit in ESTRY. An SX boundary is used to connect the 1D and 2D domains upstream and downstream. |  |

| | | | |
|---|---|---|---|
| LOW_02301 | Circular, concrete culvert | This structure has been modelled with a circular culvert unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |
| LOW_02013 | Circular, concrete culvert | This structure has been modelled with a circular culvert unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |
| LOW_01792 | Circular, concrete culvert | This structure has been modelled with a circular culvert unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |
| LOW_01672 | Road Bridge | This structure has been modelled with an arch bridge unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |

| | | | |
|---|---|---|---|
| LOW_01566 | Circular, concrete culvert | This structure has been modelled with a circular culvert unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |
| LOW_01460 | Circular, concrete culvert | This structure has been modelled with a circular culvert unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |
| LOW_01277 | Circular, concrete culvert | This structure has been modelled with a circular culvert unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |
| LOW_01182 | Circular, concrete culvert | This structure has been modelled with a circular culvert unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |

| | | | |
|---|---|---|---|
| LOW_01108 | Plastic culvert underneath railway | This structure has been modelled with a circular culvert unit in Flood Modeller. Overtopping flow has been represented in the 2D domain (see below). | <br>Upstream face:<br><br>Downstream face: |
| LOW002_0057 | Footbridge (in floodplain adjacent to railway) | This structure has not been modelled. It is not deemed hydraulically significant for overtopping flows. |  |
| LOW002_CU | Railway culvert (in floodplain adjacent to railway) | This structure has been represented with an irregular culvert unit in ESTRY. An SX boundary is used to connect the 1D and 2D domains upstream and downstream. |  |

<table>
<tr><td>LOW002_0038</td><td>Railway bridge (in floodplain adjacent to railway)</td><td>This structure has been represented by stamping the ground levels with a Z shape to allow flow through the railway embankment.</td><td></td></tr>
<tr><td colspan="4">The Lowgill Beck between the railway crossing and the confluence with the Crooks Beck was represented in an existing Environment Agency model. For details of the structures modelled please refer to the modelling report (Hydraulic model user report v1.3.pdf).</td></tr>
<tr><td colspan="4">Unnamed 601 (U601)</td></tr>
<tr><td>ID</td><td>Structure</td><td>How has this structure been modelled?</td><td>Photo (view of upstream face unless specified)</td></tr>
<tr><td>U601_601</td><td>Twin-pipe, concrete culvert</td><td>The model starts downstream of this structure.</td><td></td></tr>
<tr><td>U601_436</td><td>A66 Culvert</td><td>This structure has been modelled with a circular culvert unit in ESTRY. Overtopping flow is represented in the 2D domain.</td><td><br>Upstream face:</td></tr>
</table>

| | | | |
|---|---|---|---|
| | | | <br>Downstream face: |
| U601_411 | Circular culvert | This structure has been modelled with a circular culvert unit in ESTRY. Overtopping flow is represented in the 2D domain. |  |
| U601_313 | Circular culvert | This structure has been modelled with a circular culvert unit in ESTRY. Overtopping flow is represented with a weir unit. |  |

| | | | |
|---|---|---|---|
| U601_19 | Railway culvert | This structure has been modelled with a circular culvert unit in ESTRY. Overtopping flow is represented in the 2D domain. | <br>Upstream face:<br><br>Downstream face: |
| Cringle Beck | | | |
| ID | Structure | How has this structure been modelled? | Photo (view of upstream face unless specified) |
| CRI_583 | Stone wall and trash screen | This structure has not been included in the model. |  |

| | | | |
|---|---|---|---|
| CRI_475 | A66 bridge | This structure has been modelled with a bridge unit in ESTRY. Overtopping flow is represented in the 2D domain. | <br>Upstream face:<br><br>Downstream face: |
| CRI_183 | Concrete bridge | This structure has been modelled with a bridge unit in ESTRY. Overtopping flow is represented with a weir unit. |  |

| | | | |
|---|---|---|---|
| CRI_8 | Railway culvert | This structure has been modelled with a rectangular culvert unit in ESTRY. Overtopping flow is represented in the 2D domain. | <br>Upstream face:<br><br>Downstream face: |
| STR_601 | Railway bridge (in floodplain adjacent to Cringle Beck) | This structure has been represented with a rectangular culvert unit in ESTRY. An SX boundary is used to connect the 1D and 2D domains upstream and downstream. |  |

| | | | |
|---|---|---|---|
| U603_0000C | Railway culvert (in floodplain adjacent to Cringle Beck) | This structure has been represented with a rectangular culvert unit in ESTRY. An SX boundary is used to connect the 1D and 2D domains upstream and downstream. |  |
| Unnamed 606 (U606) | | | |
| ID | Structure | How has this structure been modelled? | Photo (view of upstream face unless specified) |
| UNN606_0417 | Plastic culvert | The model starts downstream of this structure. |  |
| UNN606_0375 | Culvert | The model starts downstream of this structure. |  |

| | | | |
|---|---|---|---|
| UNN606_0240 | A66 Culvert | This structure has been modelled with an orifice unit in Flood Modeller. Overtopping flow is represented in the 2D domain. | <br>Upstream face:<br><br>Downstream face: |
| UNN606_0030 | Stone bridge | This structure has been modelled with an arch bridge unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |
| UNN607 | | | |
| U607_291 | Circular, concrete culvert | This structure has been modelled with a circular culvert (C) unit in ESTRY. Overtopping flow has been modelled with a weir (WW) unit. |  |

| | | | |
|---|---|---|---|
| U607_279 | A66 concrete culvert. | This structure has been modelled with a circular culvert (C) unit in ESTRY. Overtopping flow has been modelled in the 2D domain. |  Upstream face:  Downstream face: |
| U607_233 | Culvert | This structure has been modelled with a circular culvert (C) unit in ESTRY. Overtopping flow has been modelled in the 2D domain. |  |

| | | | |
|---|---|---|---|
| U607_152 | | This structure has been modelled with a circular culvert (C) unit in ESTRY. Overtopping flow has been modelled with a weir (WW) unit. |  |
| U607_62 | Wooden footbridge | This structure has been modelled with a bridge (BB) unit in ESTRY. Overtopping flow has been modelled with a weir (WW) unit. |  |

| **UNN605** | | | |
|---|---|---|---|
| U605_608 | Pond outfall | This structure has been modelled with a weir (WW) unit in ESTRY. The pond has been modelled in the 2D domain and connected to the weir with an SX boundary. |  |

| | | | |
|---|---|---|---|
| U605_437 | Wooden bridge | This structure has been modelled with a bridge (BB) unit in ESTRY. Overtopping flow has been modelled with a weir (WW) unit. |  |
| U605_365 | A66 culvert | This structure has been modelled with an irregular culvert (I) unit in ESTRY. Overtopping flow has been modelled in the 2D domain. | <br>Upstream face:<br><br>Downstream face: |

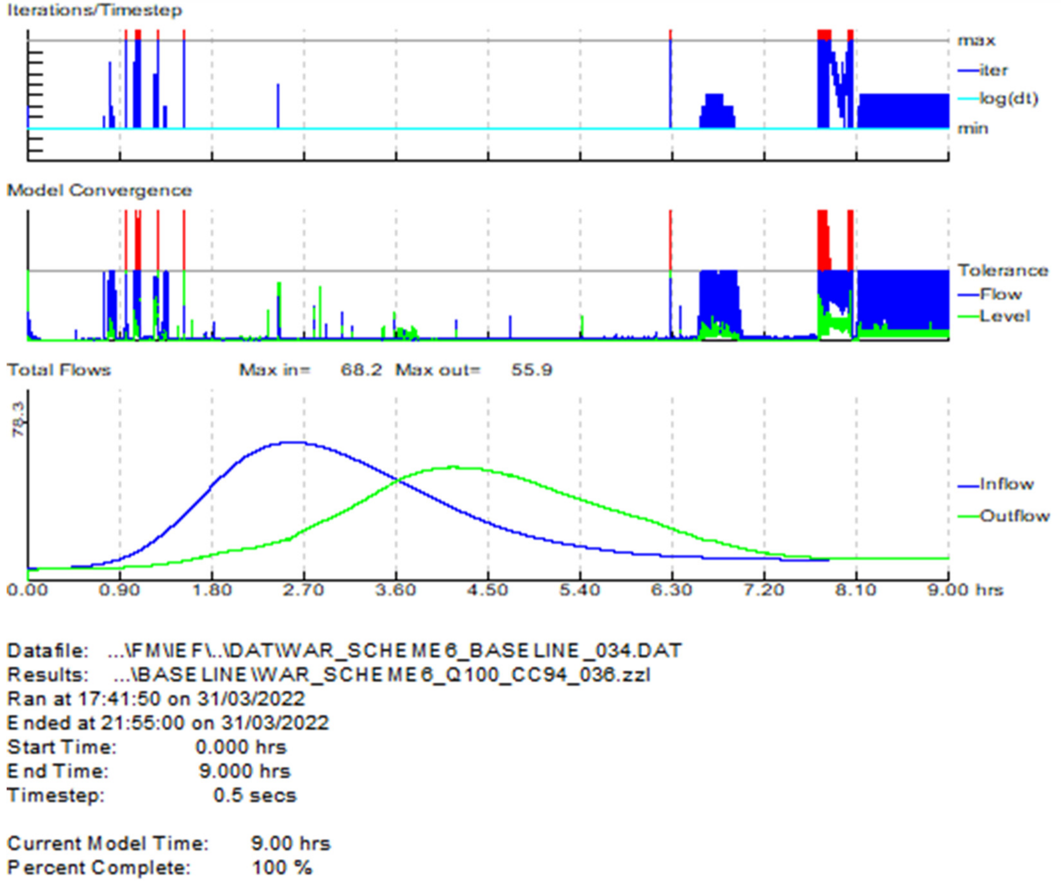
| | | | |
|---|---|---|---|
| U605_291 | Concrete culvert | This structure has been modelled with a circular culvert (C) unit in ESTRY. Overtopping flow has been modelled in the 2D domain. |  |
| U605_229 | Concrete culvert | This structure has been modelled with a circular culvert (C) unit in ESTRY. Overtopping flow has been modelled with a weir (WW) unit. |  |
| U605_103 | Railway culvert | This structure has been modelled with an irregular culvert (I) unit in ESTRY. Overtopping flow has been modelled in the 2D domain. |  |

| | | | |
|---|---|---|---|
| U605_66 | Road bridge | This structure has been modelled with a bridge (BB) unit in ESTRY. Overtopping flow has been modelled with a weir (WW) unit. |  |
| U605_00 | Road bridge | This structure has been modelled with a bridge (BB) unit in ESTRY. Overtopping flow has been modelled with a weir (WW) unit. |  |

# 6 Model Proving

## 6.1 Model Performance

### Warcop Model



Datafile: ...\FM\IEF\..\DAT\WAR_SCHEME6_BASELINE_034.DAT
Results: ...\BASELINE\WAR_SCHEME6_Q100_CC94_036.zzl
Ran at 17:41:50 on 31/03/2022
Ended at 21:55:00 on 31/03/2022
Start Time: 0.000 hrs
End Time: 9.000 hrs
Timestep: 0.5 secs

Current Model Time: 9.00 hrs
Percent Complete: 100 %

Figure 6-1: Flood Modeller model performance (1% AEP + climate change)

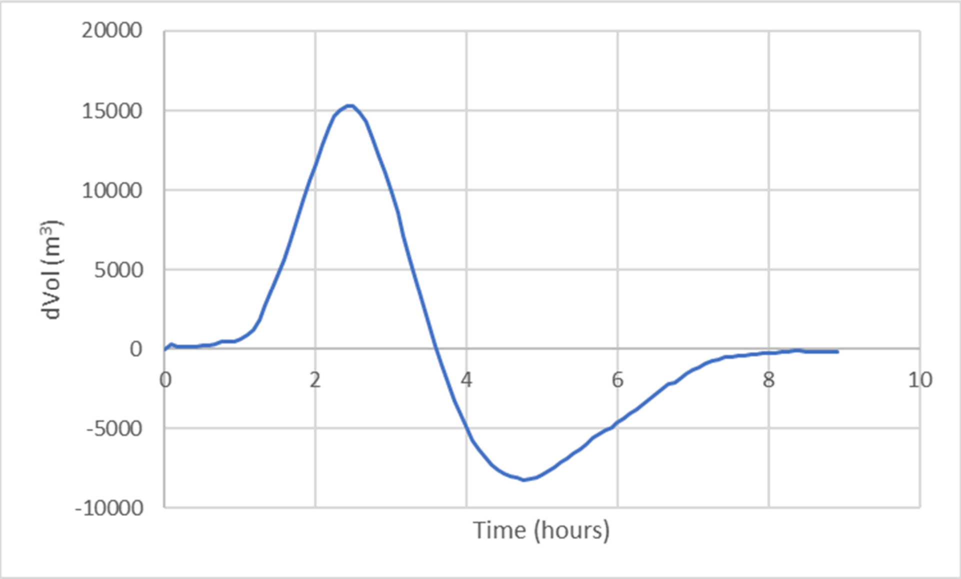


Figure 6-2: dVol plot for the TUFLOW domain (1% AEP + climate change )

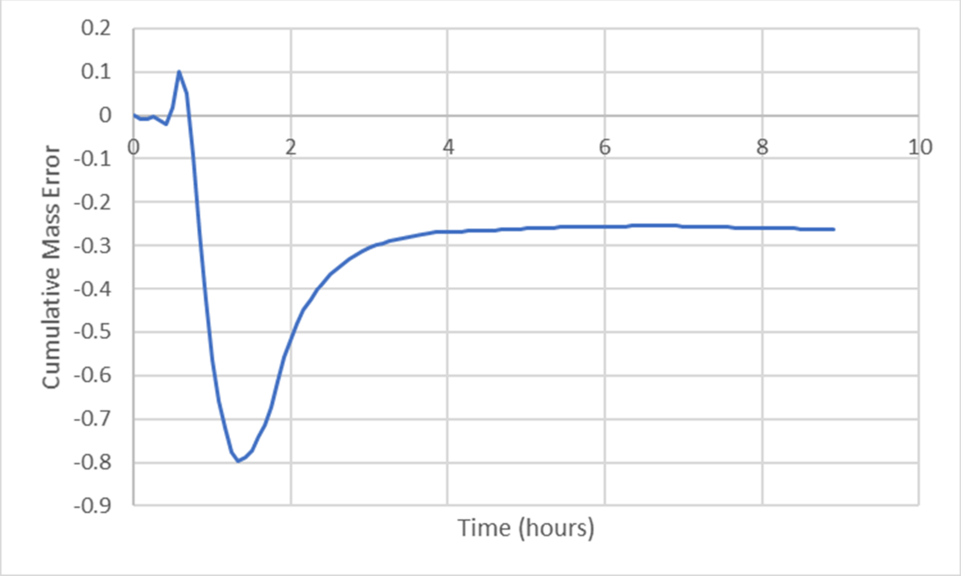


Figure 6-3: TUFLOW Cumulative Mass Error (1% AEP + climate change )

The Flood modeller convergence plot show smooth inflow and outflows into the model with only isolated incidences of poor convergences.  Flow and stage profiles have been checked throughout the model and are smooth with minimal oscillations, indicating the model is performing well. The dVol plot is shown to be smooth and the cumulative mass error is within a range of +1 to -1 for the majority of the simulation, with a short peak at -1.01%.

UNN607 model

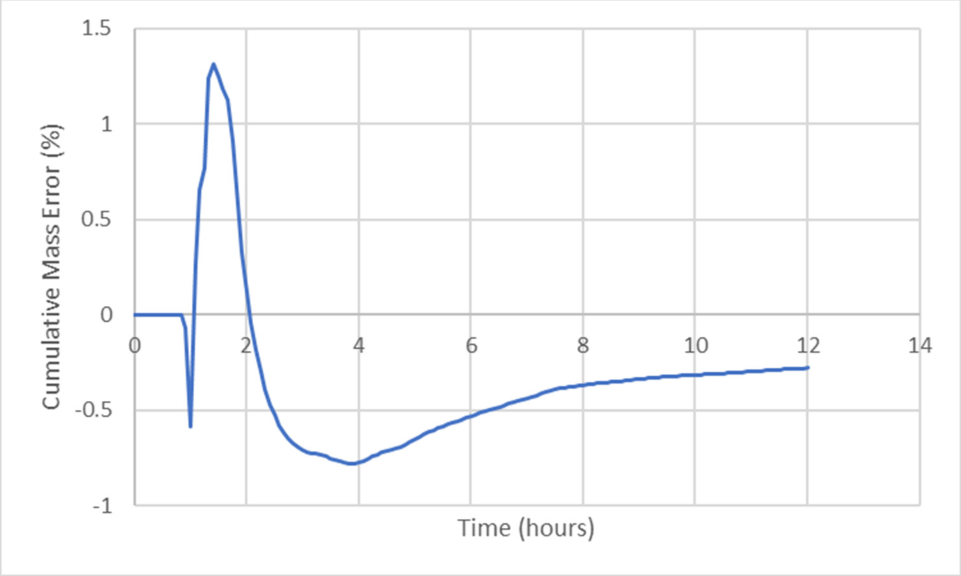


Figure 6-4: TUFLOW Cumulative Mass Error (0.1% AEP)

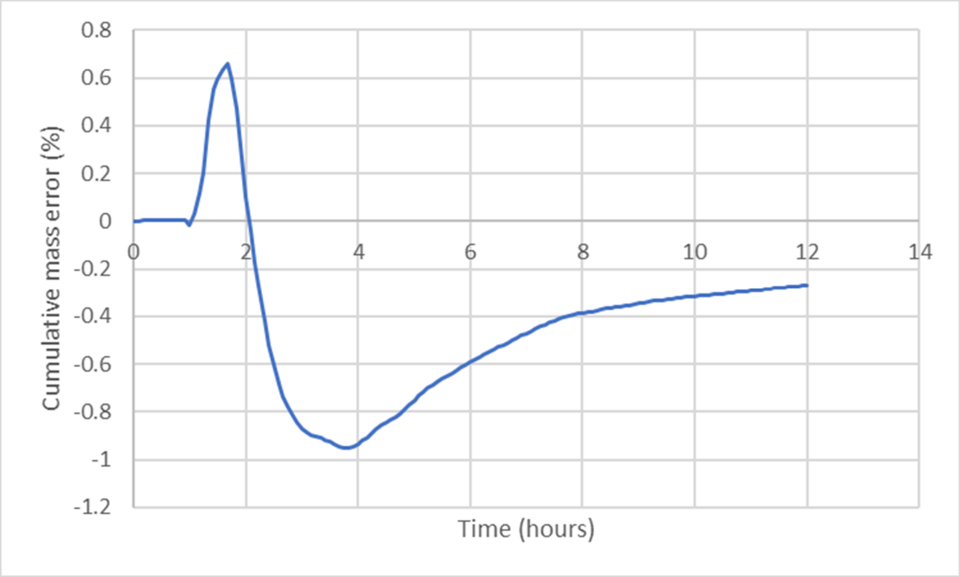


Figure 6-5: ESTRY Cumulative Mass Error (0.1% AEP)

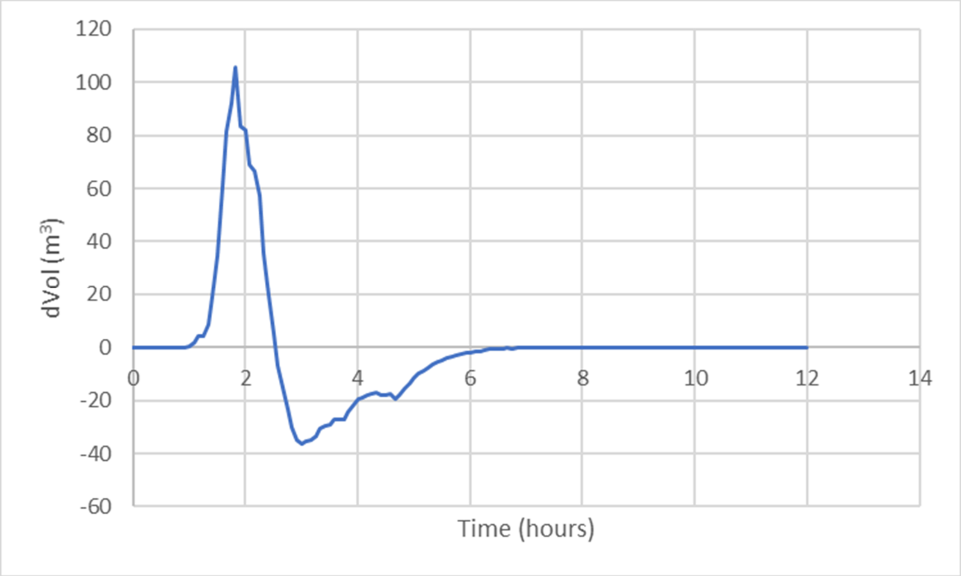


Figure 6-6: dVol plot (0.1% AEP)

Flow and stage profiles have been checked throughout the model and are smooth with minimal oscillations, indicating the model is performing well. The dVol plot is shown to be smooth and the cumulative mass error is within a range of +1 to -1 for the majority of the simulation in the 1D and 2D domains, with a short peak at -1.25% in the 2D domain, but this occurs before the peak of the event.

## UNN605 model

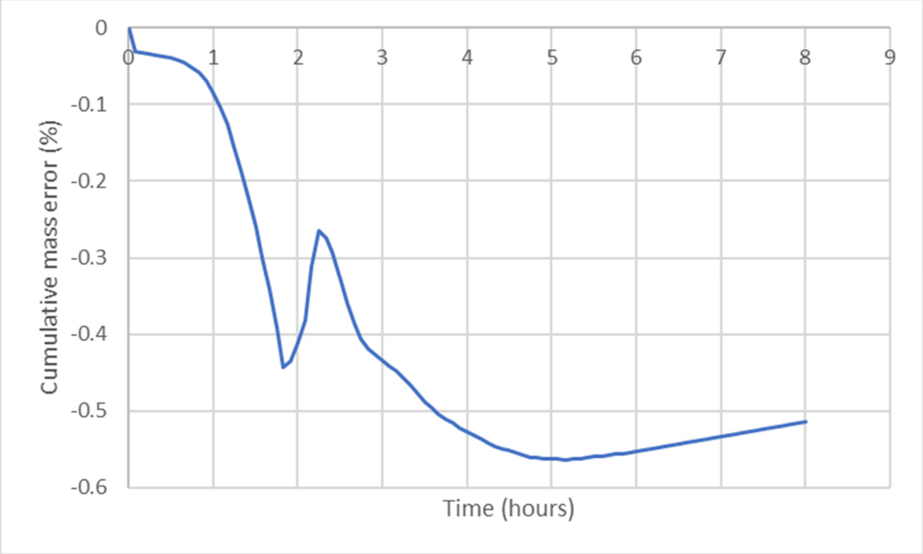


Figure 6-4: TUFLOW Cumulative Mass Error (0.1% AEP)

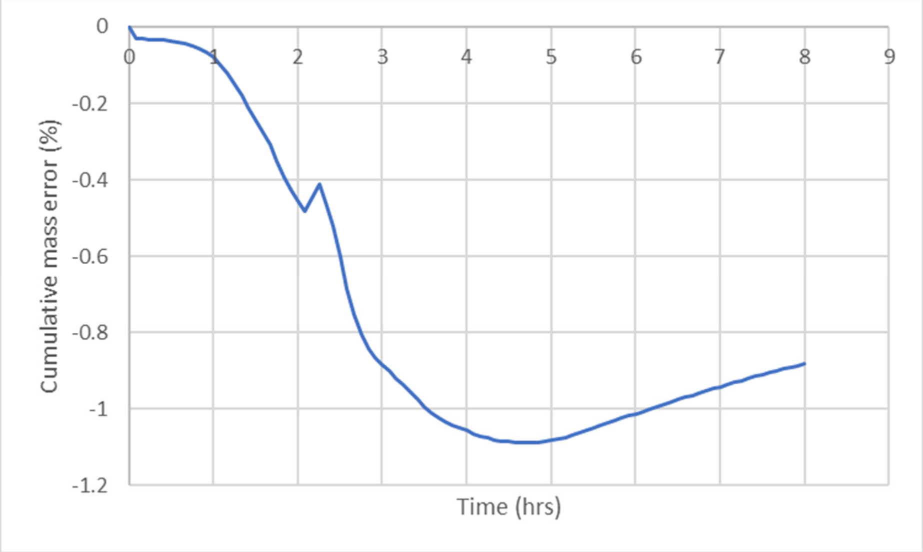


Figure 6-5: ESTRY Cumulative Mass Error (0.1% AEP)

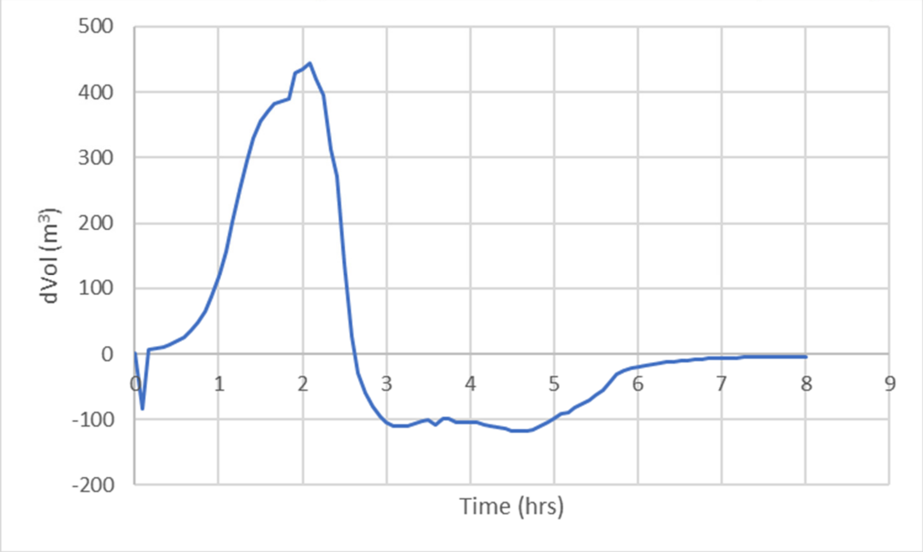


Figure 6-6: dVol plot (0.1% AEP)

| | |
|---|---|
| Flow and stage profiles have been checked throughout the model and are generally smooth with minimal oscillations, indicating the model is performing well. The dVol plot is shown to be smooth for the majority of the simulation with a small spike at the beginning of the simulation. This is associated with the 2D pond at the upstream extent of the model and is for a short time period. Cumulative mass error is within a range of +1 to -1 for the majority of the simulation in the 1D and 2D domains, with a peak at -1.1% in the 1D domain. | |
| **6.2 Model Verification** | |
| Calibration | No gauge data was available for the study area to allow the model to be calibrated to. Information on historical flood risk was requested from the Lead Local Flood Authority but no information was provided, other than the Section 19 report from the 2015 event in Warcop. It is understood from anecdotal evidence that the property along Moorhouse Lane has experienced flooding in the past. The hydraulic model results obtained in this study reconcile with this. Flood Data from the Warcop Section 19 report, published in December 2015 following the flood event in Warcop on 5th and 6th December has been used to sense-check the outputs of the model. Previous flood outlines generated by the modelling study conducted in 2018 have also been used to check the latest extents. |
| Previous Model Comparison | Hydraulic model results have been compared to the previous modelled flood outlines from the 2018 Warcop model. This comparison is shown in Figure 6-7. |
| Flood Zone Comparison | Flood Zone data has been used as a comparison and show that modelled results compare well to flood zone extents. This comparison is shown in Figure 6-8 and Figure 6-9.<br>Flood Zone data is not available for the UNN605 and UNN607 watercourses. Risk of Flooding from Surface Water (RoFSW) data has been used instead to compare to modelled outputs for UNN605. For UNN605, modelled extents are generally a good match to RoFSW data but do show a greater extent in some locations. This comparison is shown in Figure 6-10. UNN607 RoFSW data is limited and therefore a comparison has not been made for this model. |

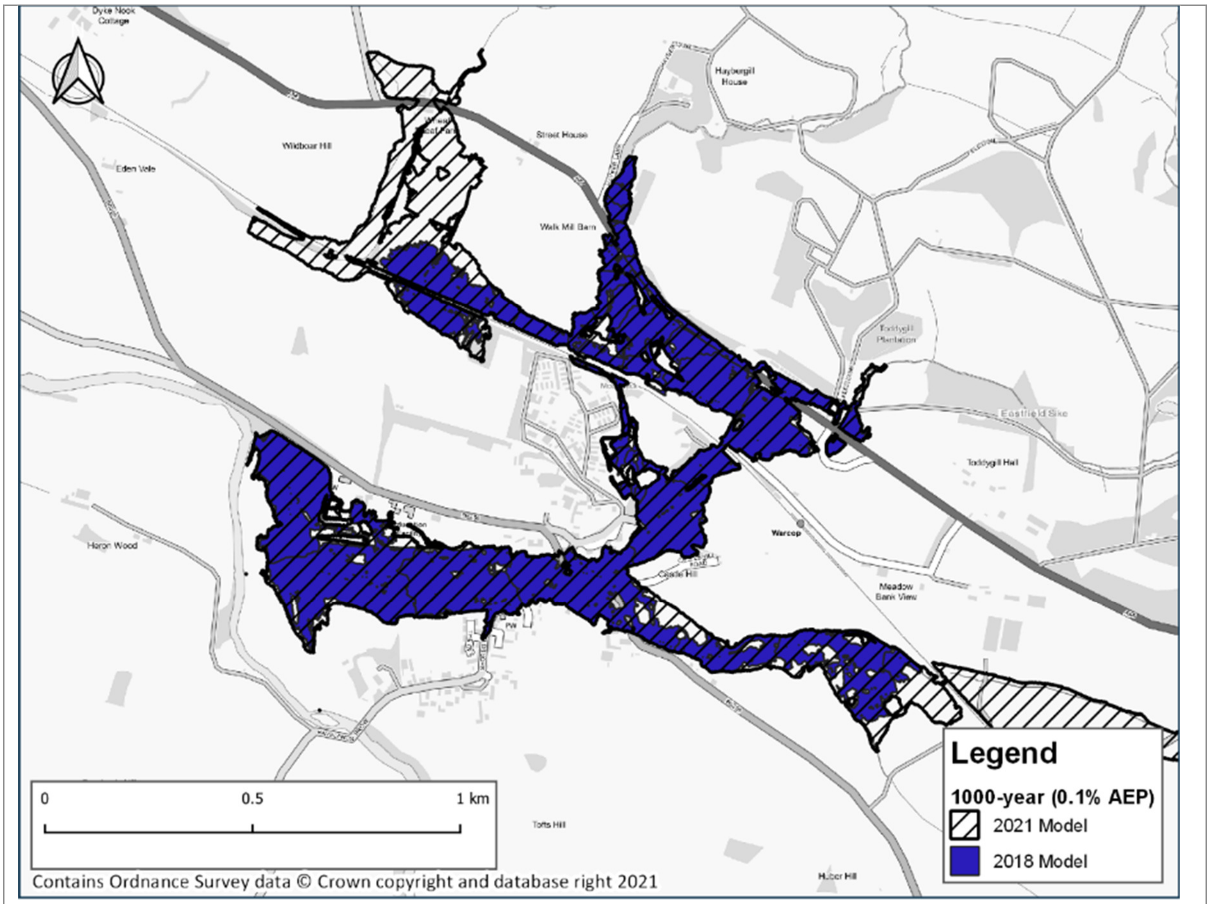


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Figure 6-7: Previous modelled flood extent comparison

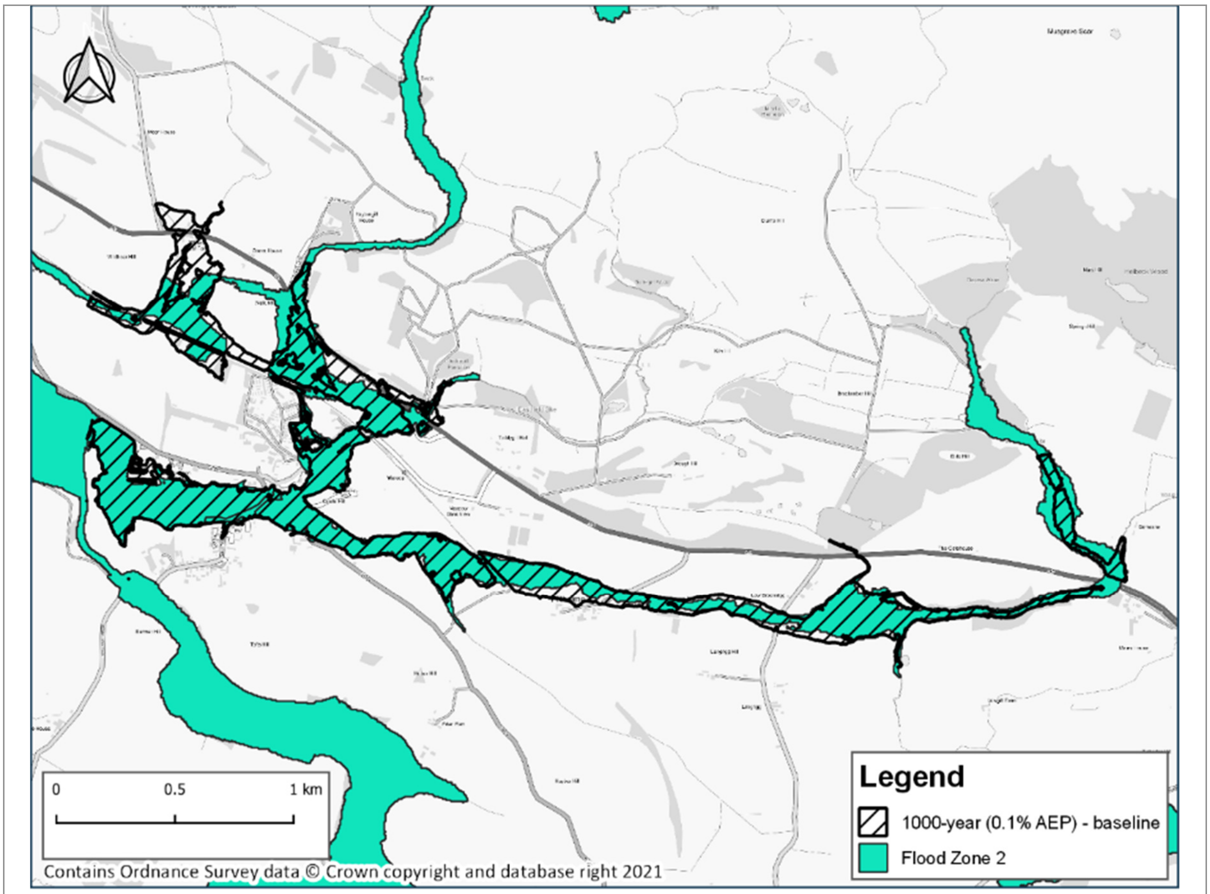

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Figure 6-8: Flood Zone 2 comparison

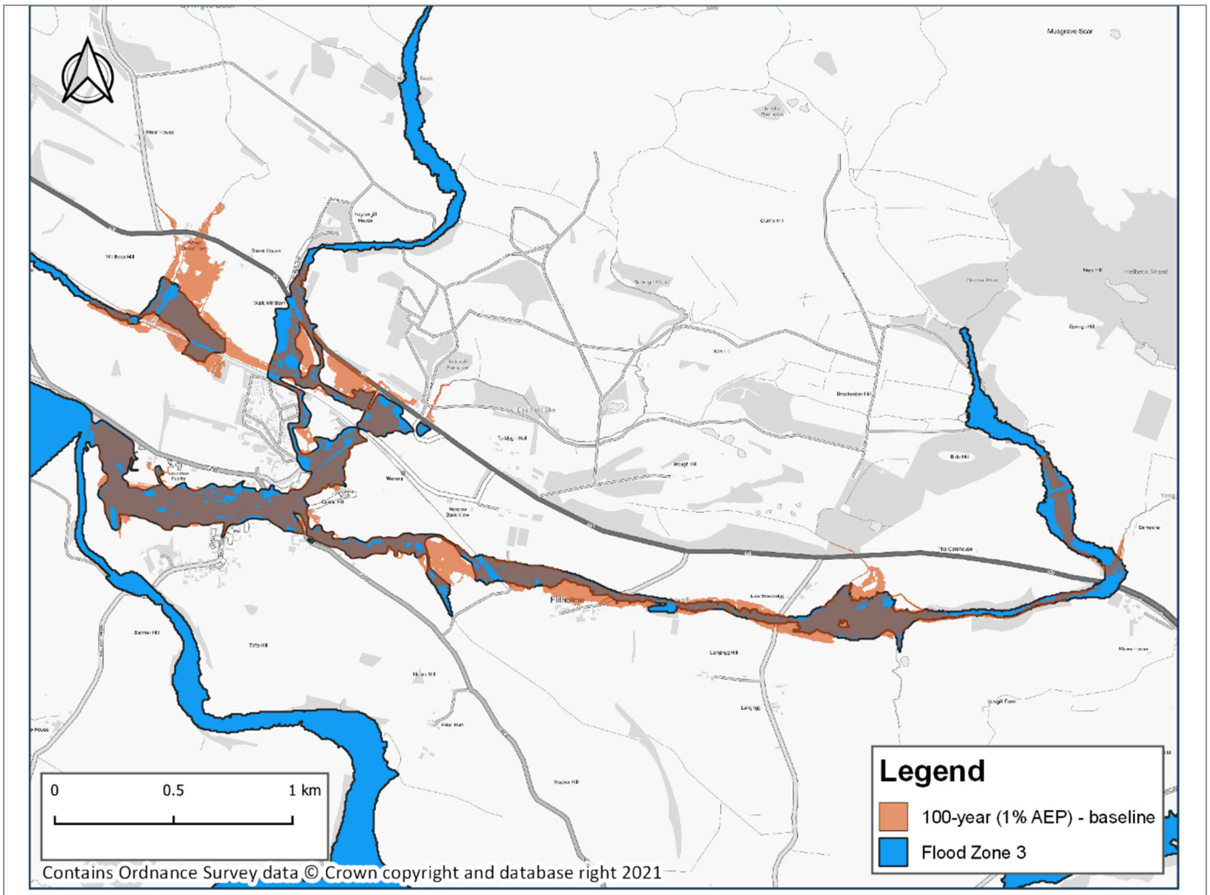

Figure 6-9: Flood Zone 3 comparison

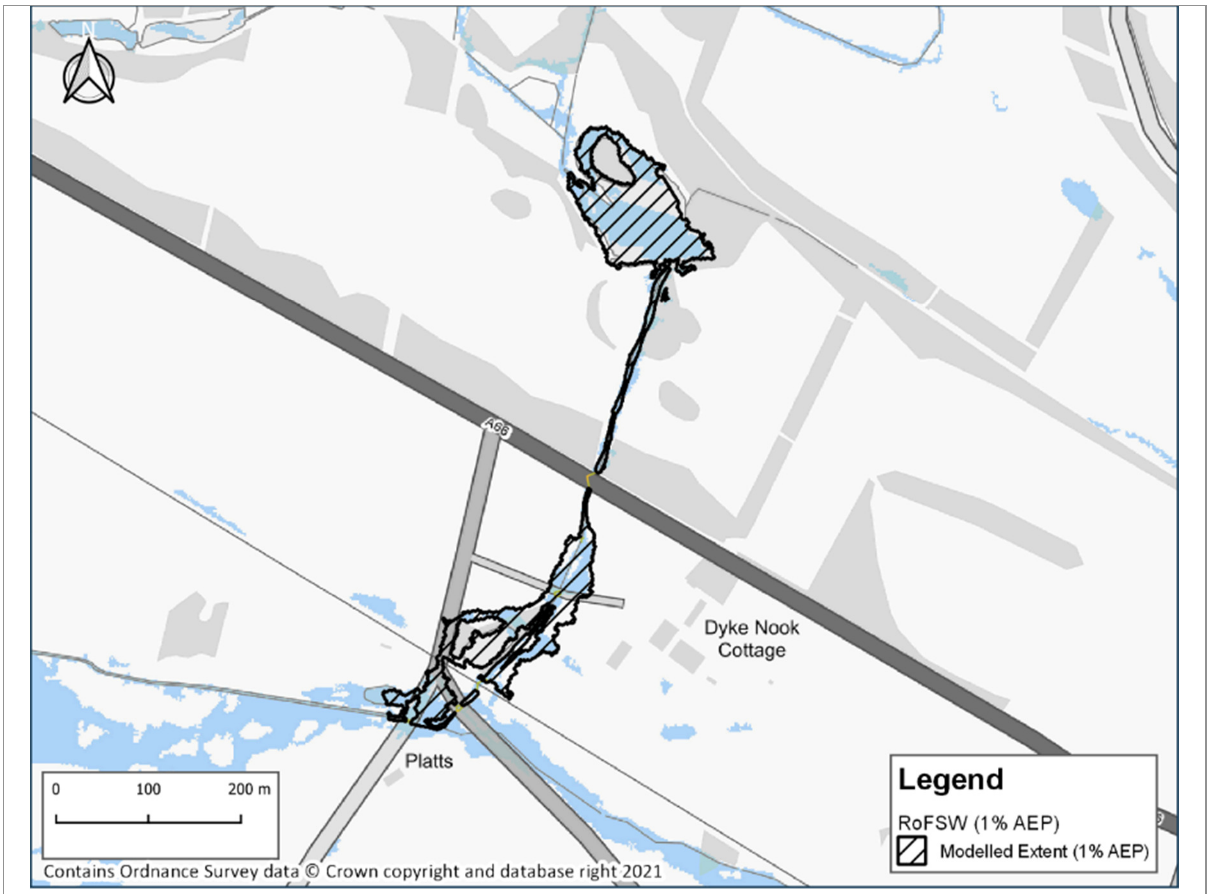

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Figure 6-10: RoFSW comparison (1% AEP)

## 6.3 Sensitivity Analysis

Sensitivity tests were carried out for the 1% AEP existing situation model to assess the model response to the change in:

- Flow: Model inflows increased by 20%
- Roughness coefficient: In-channel and roughness values changed by +20% and -20%
- Downstream boundary: Outflow decreased by 20% for UNN605 and UNN607. For the Warcop model the stage at the downstream boundary has been increased by 1m and the slope has been increased by 20% for the 2D boundary.

The table below shows the maximum, minimum and average change in in-channel water levels relative to the existing situation model for each modelled reach with increase in flow and increase and decrease in roughness coefficients.

- Warcop model: downstream boundary sensitivity test results in an increase in water levels approximately 500m upstream of the downstream boundary. This is away from the proposed A66 alignment and therefore the conclusions of the study will not be impacted. Flood extents and flood depths for the Cringle Beck are insensitive to changes in the downstream boundary with a maximum change of 0.04m.
- UNN605 model: the downstream boundary sensitivity test showed a maximum increase in water levels at the most downstream node on all watercourses. Changes in peak water level compared to the baseline do not extend upstream beyond the most downstream node on UNN605.
- UNN607 model: the downstream boundary sensitivity test showed a maximum increase in water levels at the most downstream node on all watercourses. Changes in peak water level compared to the baseline extend 12m upstream on UNN607.

| Watercourse | Crooks Beck | | |
|---|---|---|---|
| | Change in peak water level (m) | | |
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.15 | 0.00 | 0.07 |
| +20% Roughness | 0.06 | -0.16 | -0.03 |
| -20% Roughness | 0.01 | -0.03 | -0.01 |

| Watercourse | Lowgill Beck | | |
|---|---|---|---|
| | Change in peak water level (m) | | |
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.25 | 0.00 | 0.09 |
| +20% Roughness | 0.03 | -0.15 | -0.03 |
| -20% Roughness | 0.01 | -0.02 | -0.00 |

| Watercourse | Warcop Millstream | | |
|---|---|---|---|
| | Change in peak water Level (mAOD) | | |
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.06 | 0.00 | 0.01 |
| +20% Roughness | 0.03 | -0.03 | 0.00 |
| -20% Roughness | 0.01 | -0.01 | 0.00 |

| Watercourse | Woodend Sike | | |
|---|---|---|---|
| | Change in peak water Level (mAOD) | | |
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.18 | -0.01 | 0.05 |
| +20% Roughness | 0.03 | -0.17 | -0.07 |

| | | | |
|---|---|---|---|
| -20% Roughness | 0.01 | -0.03 | -0.01 |
| Watercourse | Todygill Sike | | |
| | Change in peak water Level (mAOD) | | |
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.27 | 0.07 | 0.14 |
| +20% Roughness | 0.00 | -0.14 | -0.05 |
| -20% Roughness | 0.00 | -0.02 | -0.01 |
| | | | |
| Watercourse | Yosgill Sike | | |
| | Change in peak water Level (mAOD) | | |
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.18 | 0.02 | 0.09 |
| +20% Roughness | 0.03 | -0.20 | -0.09 |
| -20% Roughness | 0.01 | -0.01 | -0.04 |
| | | | |
| Watercourse | Cringle Beck | | |
| | Change in peak water Level (mAOD) | | |
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.12 | -0.02 | 0.03 |
| +20% Roughness | 0.01 | -0.06 | -0.01 |
| -20% Roughness | 0.04 | -0.05 | -0.01 |
| | | | |
| Watercourse | UNN606 | | |
| | Change in peak water Level (mAOD) | | |
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.08 | 0.015 | 0.05 |
| +20% Roughness | 0.00 | -0.07 | -0.03 |
| -20% Roughness | 0.00 | -0.02 | -0.01 |
| | | | |
| Watercourse | UNN601 | | |
| | Change in peak water Level (mAOD) | | |
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.14 | -0.03 | 0.03 |
| +20% Roughness | 0.00 | -0.4 | -0.01 |
| -20% Roughness | 0.01 | -0.05 | -0.01 |
| | | | |
| Watercourse | UNN605 | | |
| | Change in peak water Level (mAOD) | | |
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.12 | 0.05 | 0.01 |
| +20% Roughness | 0.08 | -0.06 | -0.02 |
| -20% Roughness | 0.02 | -0.10 | -0.03 |
| | | | |
| Watercourse | UNN607 | | |
| | Change in peak water Level (mAOD) | | |
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.14 | 0.00 | 0.04 |
| +20% Roughness | 0.07 | -0.02 | 0.02 |

| | | | |
|---|---|---|---|
| -20% Roughness | 0.02 | -0.07 | -0.02 |

**Mill Leat sensitivity test**

In order to understand the connection between the Moor Beck (CROO) and Mill Leat (CROK), testing has been undertaken to simulate a scenario where connectivity between these two channels is reduced. The elevation of the spill unit, which is included in the model to join these two channels and transfer flow from the Moor Beck to the Mill Leat, has been raised by approximately 150mm. This is the highest level before the model crashed in Flood Modeller and would not run.

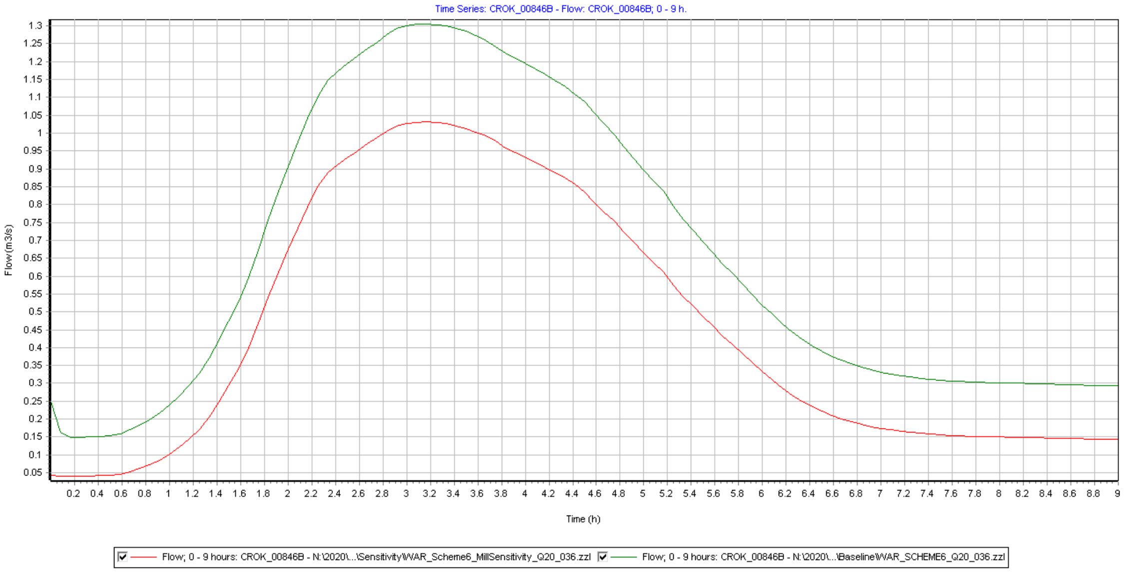

Figure 6-11: Flow comparison in Mill Leat (CROK_00846B)

Figure 6-11 shows the flows in the Mill Leat in the baseline scenario and in the sensitivity scenario with levels increased by 150mm. Flows are reduced by around 0.3 cumecs when the connection between the two watercourses is reduced.

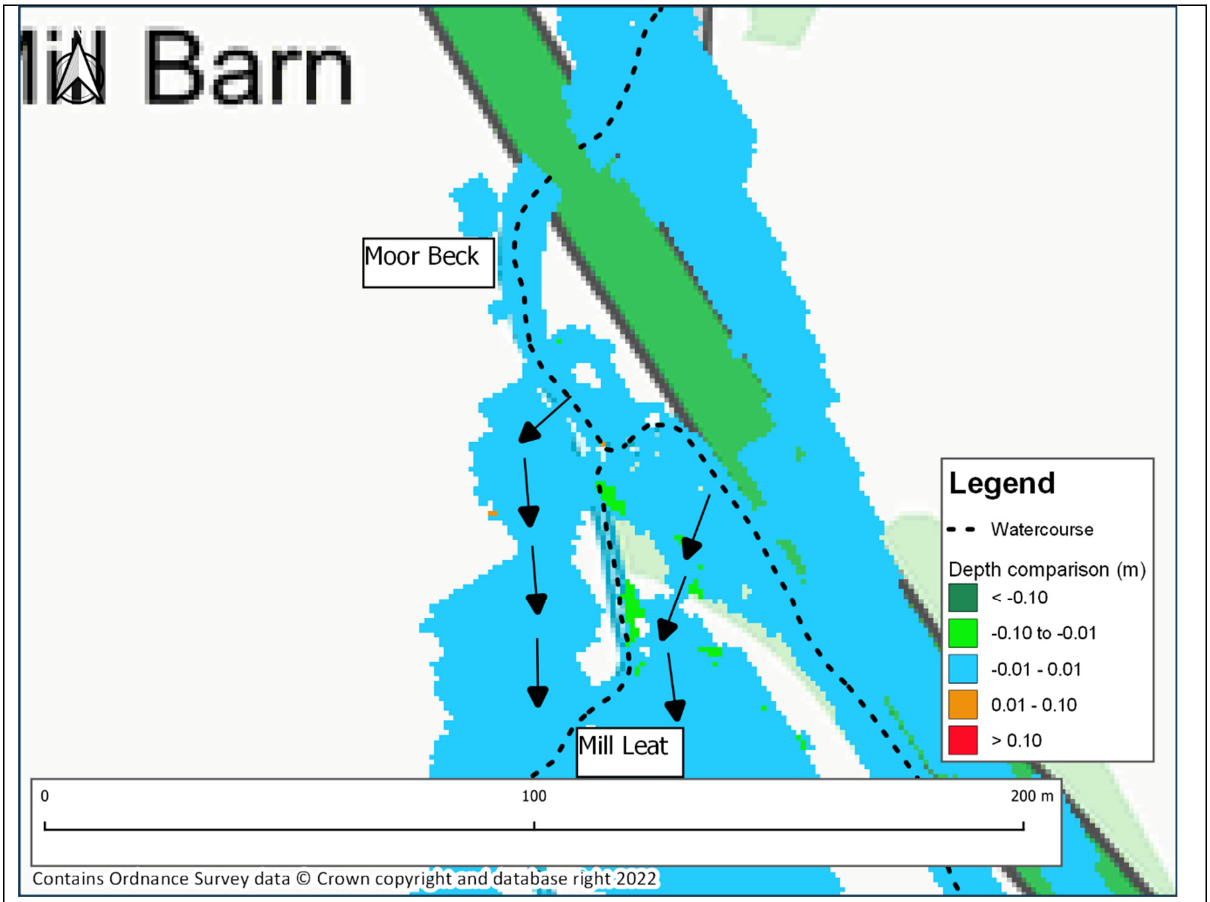

Figure 6-12: Depth impact analysis - Mill Leat sensitivity

Figure 6-12 shows that flooding converging towards the Mill Leat originates from upstream and downstream of the junction with the Moor Beck, represented by the flow direction arrows in the diagram. This shows that uncertainty associated with the connection between the Mill Leat and Moor Beck is not likely to be the controlling factor to determine flood extents in this location.

Figure 6-12 also shows that when the connection between the two watercourses is reduced, the impact on 20-year flood depths is negligible with only localised impacts on flood depths in the floodplain.

## 7 Model Build – With-Scheme Situation Model

| **Scenario Definition** | The proposed scenario model incorporates changes outlined in the Scheme 6 design between Brough, Warcop and Sandford.<br>Figures 7-1 to 7-6 show the proposed features of the A66 NTP scheme within the Warcop model area.<br>The following sections explain how the features were incorporated into the model. |
|---|---|

**Flood Modeller 1D Model**

Warcop Model:

- Culvert removed at TODY_00247 and replaced with open channel sections for proposed A66 underbridge.
- Culvert removed at UNN606_0156 and replaced by a portal culvert of 50m length through proposed A66 embankment.
- New sections added at U606_0226i2 and U606_0156i – generated using HEC-RAS interpolating between nearest existing channel cross sections.
- Culvert extended at LOW_03942 to 67m length from 52m length. Opening area changed from 5.89m2 to 5.06m2.
- Channel realigned upstream of LOW_03942 in Woodend Sike and Yosgill Sike. Cross sections WOO001_0003, WOO001_0127 and YOS001_0016 elevations changed to tie in with proposed embankment.

**TUFLOW 1D Model (ESTRY)**

Warcop Model:

- Cringle Beck flood alleviation culvert – located to the right of the Cringle Beck – has been represented with an ESTRY culvert connected to the 2D floodplain with SX connectors.

UNN605 Model:

- Culvert U605_365 extended upstream and downstream with a total length of 60m, increased from 20m in the existing situation.

UNN607 Model:

- Culvert U607_279C extended upstream from 42m length to 66m length and diameter changed from 1.05m to 1.10m. Culvert U607_291C and spill U607_291Sp removed.

**TUFLOW 2D Model**

Warcop Model:

- 3D surface of proposed scheme added to set elevations of the proposed road alignment - supplied by Amey.
- Floodplain compensation proposals included for the Lowgill Beck, Eastfield Sike, Moor Beck and Cringle Beck – 3D surfaces supplied by Amey.
- Underbridges at Cringle Beck, Moor Beck, Warcop east and Warcop west junctions and Eastfield Sike – proposed surface has been clipped in these locations to allow the passage of flows. Peak flood levels do not reach the proposed soffit of these underbridges and there are not inlet losses. Therefore this representation is sufficient.
- Underbridge piers at Cringle Beck and Moor Beck represented with flow constriction applied to individual cells. Piers of 1.2m diameter at Moor Beck viaduct and 1.6m width piers at Cringle Beck.

UNN605 Model:

- 3D surface of proposed scheme added to set elevations of the proposed road alignment.

- Floodplain compensation proposal including for UNN605 – 3D surfaces supplied by Amey.

UNN607 Model:

- 3D surface of proposed scheme added to set elevations of the proposed road alignment - supplied by Amey.

**Design Detail Sources**

In addition to direct communication with the design team the following sources of information were utilised:

Structures

- A66 - Scheme 06 - Structures List v4.xlsx
- A66 - Scheme 06 - Structures Draft GAs.pdf
- HE565627-AMY-SGN-S06-DR-CB-000004-4.pdf
- 1_PDFsam2_2022-02-08 - Cringle Beck.pdf
- 2022-02-08 - Moor Beck.pdf
- Bullistone Bridge Culvert - Extension Option 1.pdf
- Low Gill Culvert - Extension Option 1.pdf
- HE565627-AMY-SGN-S06-DR-CB-000036.pdf
- HE565627-AMY-SGN-S06-DR-CB-000032.pdf
- HE565627-AMY-SGN-S06-DR-CB-000034.pdf
- HE565627-AMY-HAC-S06-DR-CH-400003 General Arrangement Drawings Sheet 3.pdf
- HE565627-AMY-HAC-S06-DR-CH-400004 General Arrangement Drawings Sheet 4.pdf

Topography

- Moor Beck Flood Compensation 3D Surface V3.dwg
- Warcop Beck Flood Compensation LFL 3D Surface V1.dwg
- Sandford and Lowgill Beck Flood Compensation V1.dwg
- HE565627-AMY-HGN-S06-M3-CH-400023 03.02.22.dwg
- Warcop S2AP corridor triangles amended to JBA surface.dwg

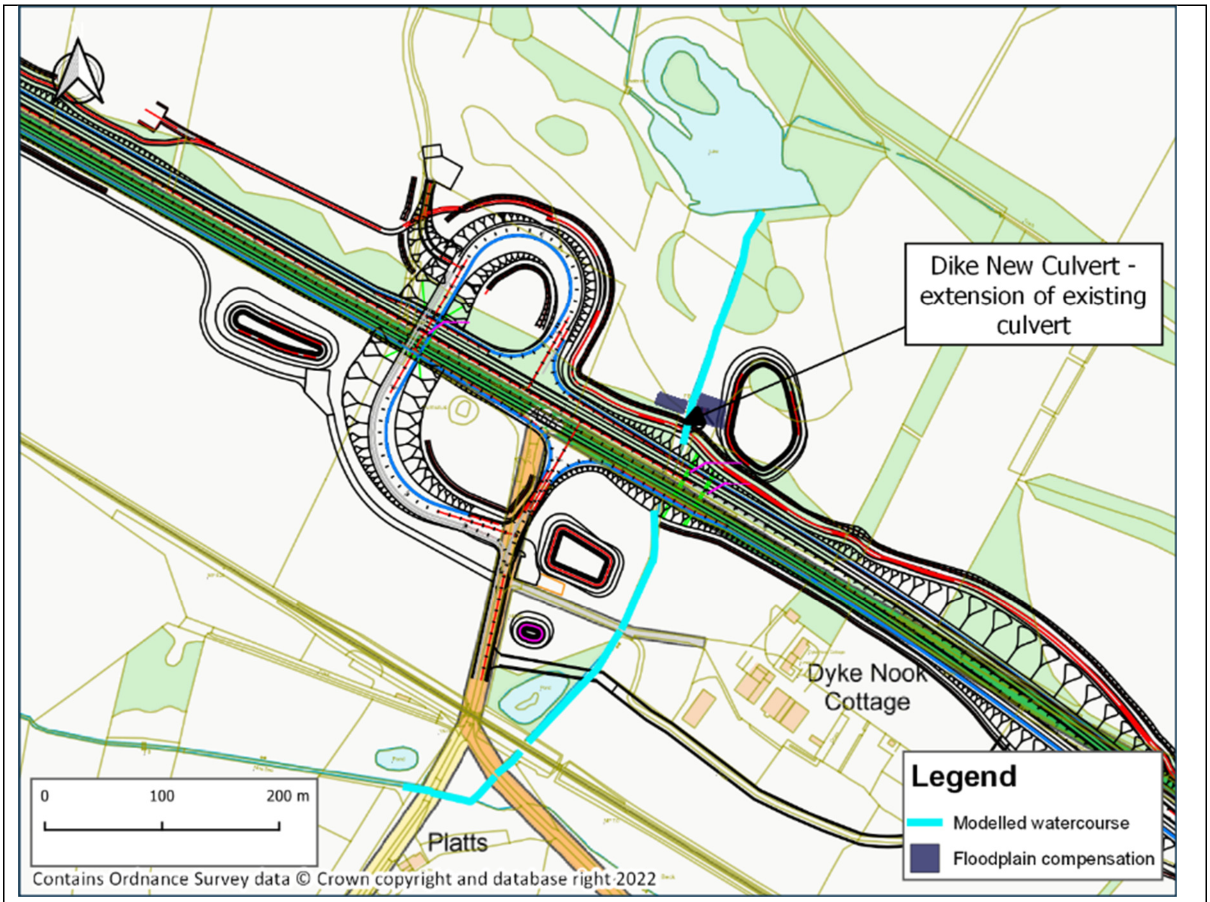

Figure 7-1: Scheme 6 proposal at Sandford junction (UNN605 model)

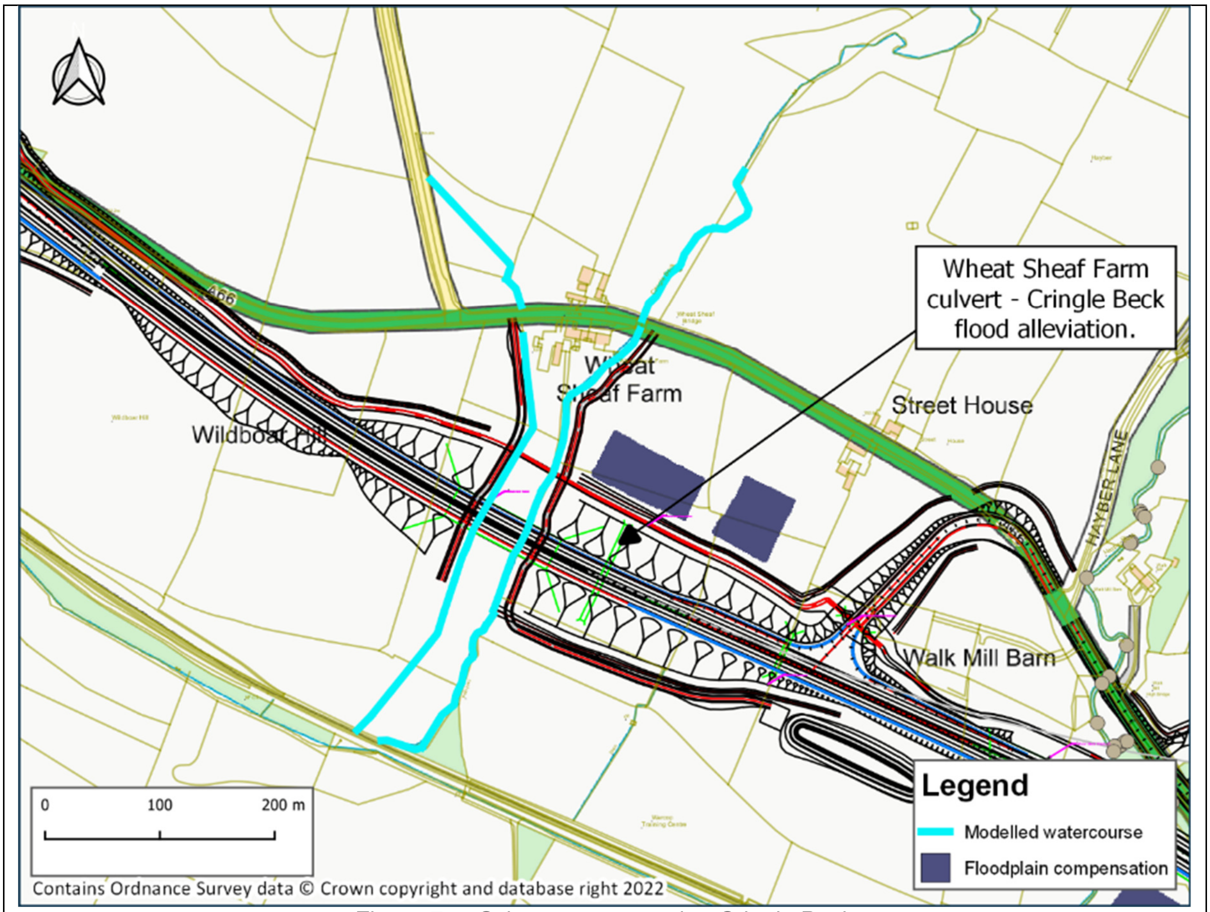

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Figure 7-2: Scheme 6 proposal at Cringle Beck

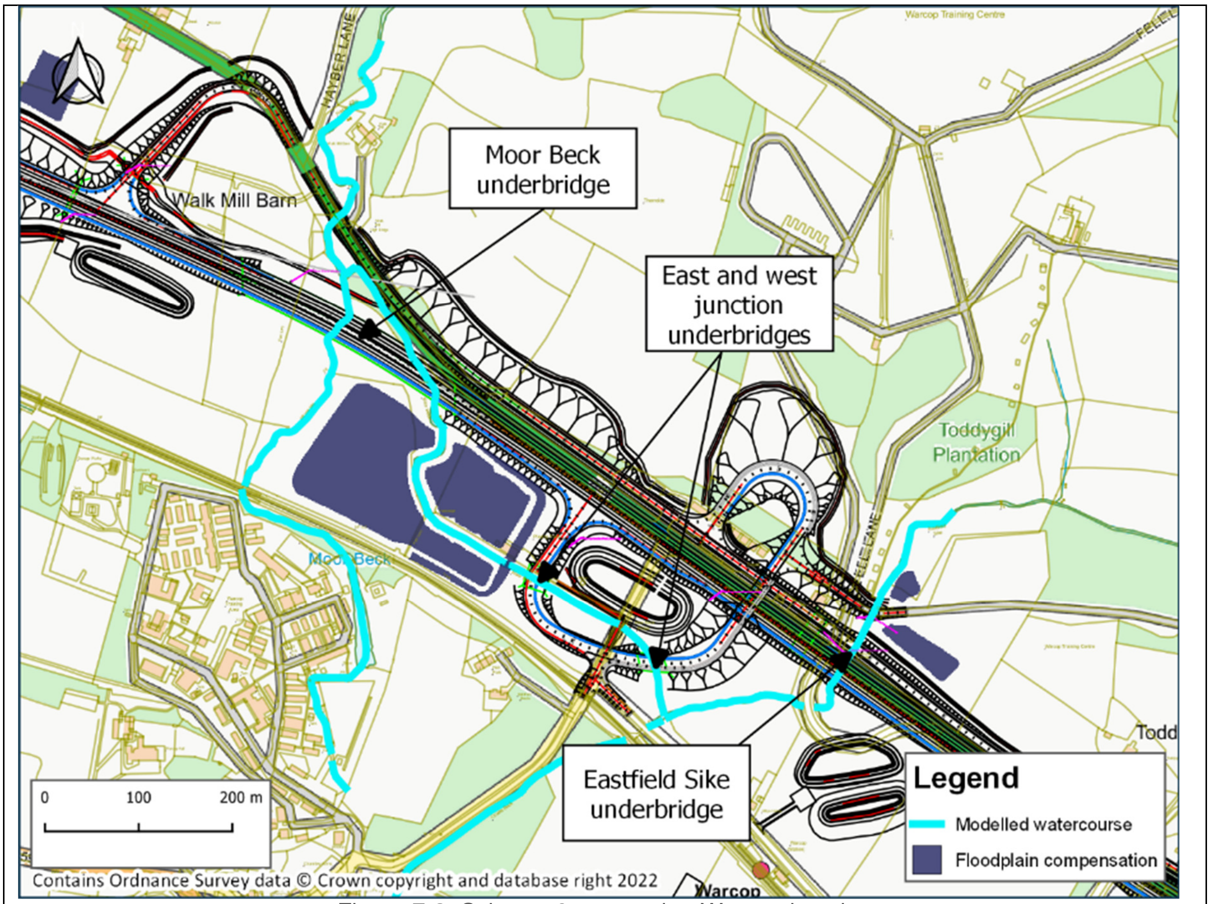

Figure 7-3: Scheme 6 proposal at Warcop junction

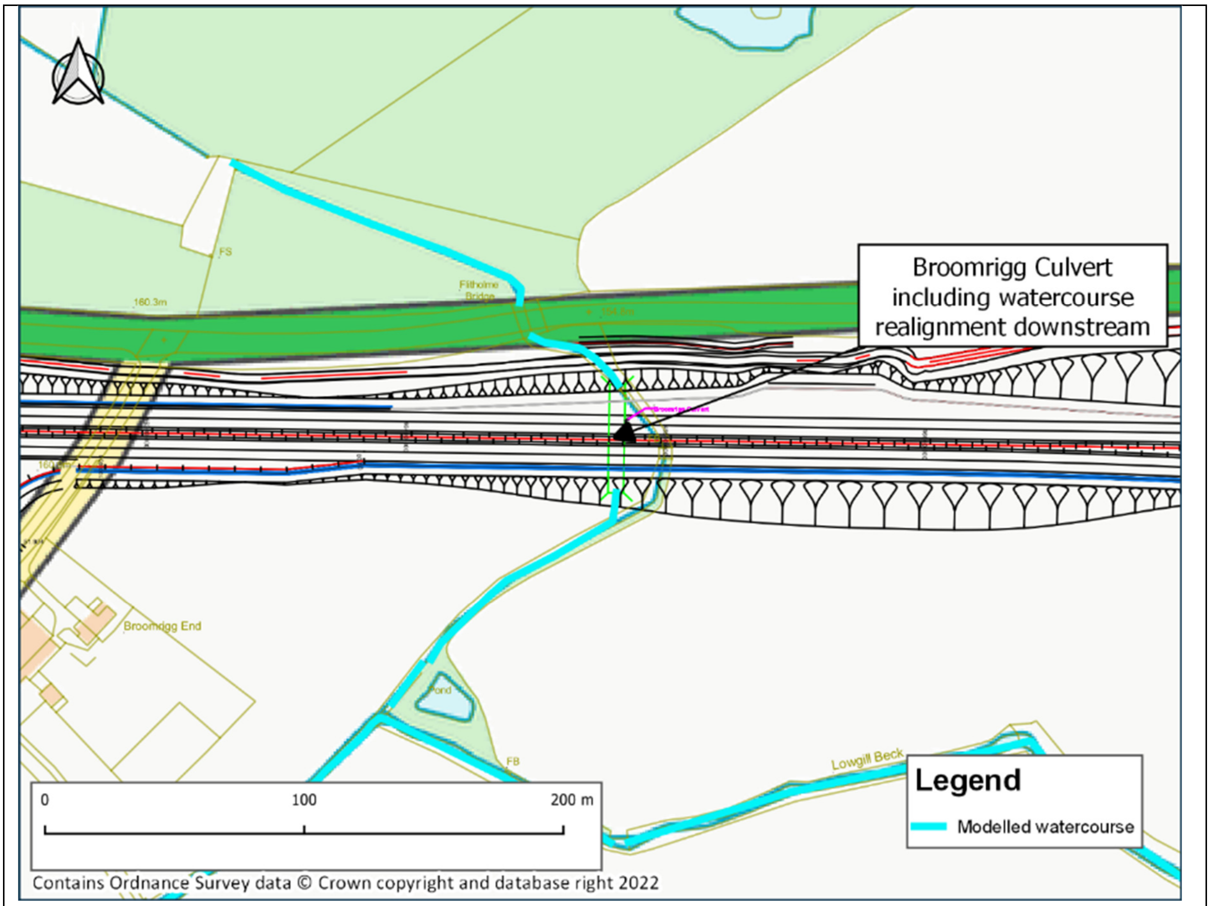

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Figure 7-4: Scheme 6 proposal at Broomrigg

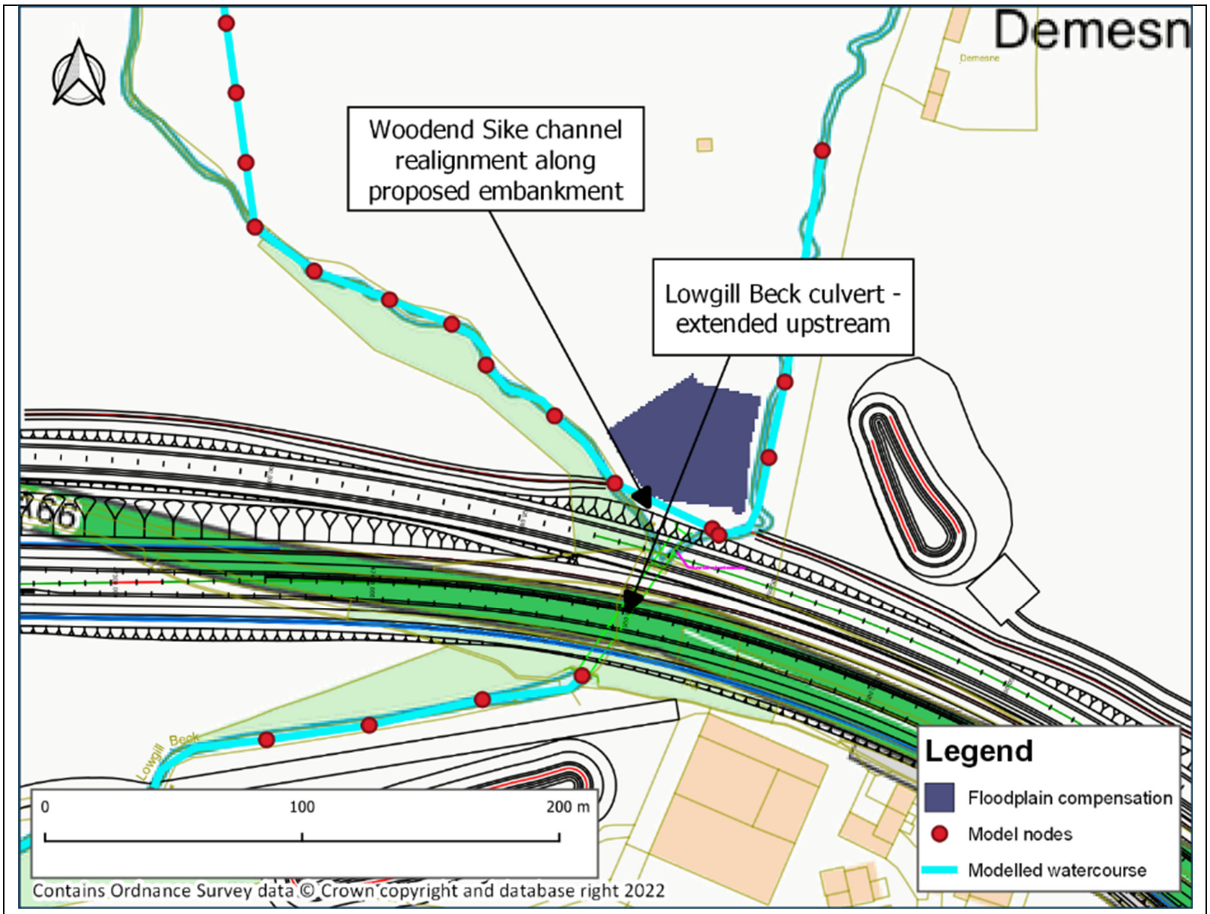

Figure 7-5: Scheme 6 proposal at Lowgill Beck

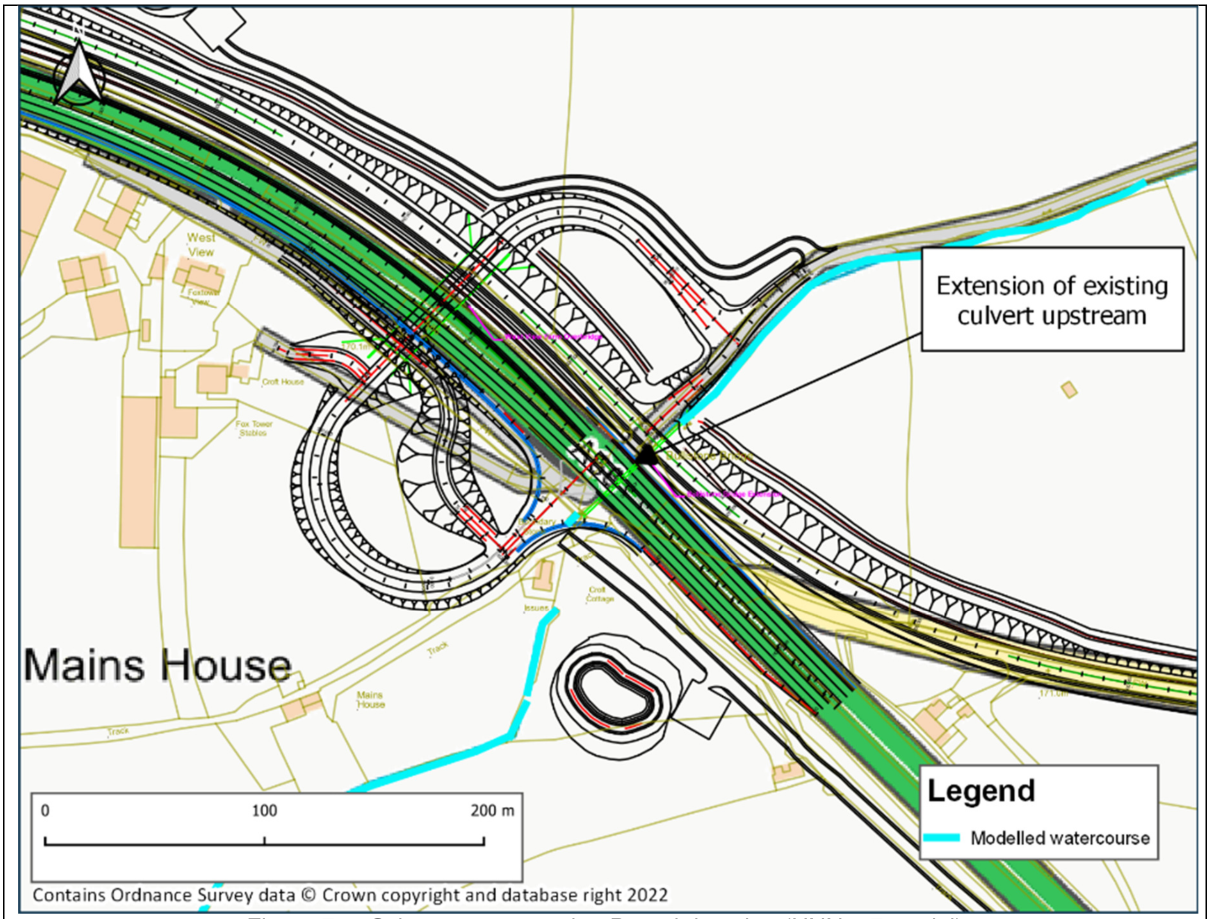

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Figure 7-6: Scheme 6 proposal at Brough junction (UNN607 model)

## 8 Impact of proposed scheme

### Change in peak water level

Changes in peak water level between the existing situation and with scheme situation are provided in the table below for the 50% AEP, 5% AEP and 1% AEP with climate change events.

| Location | Model Node | Change in Peak Water Level (m) | | | |
|---|---|---|---|---|---|
| | | 50% AEP | 5% AEP | 1% AEP | 1% AEP + 94% climate change |
| Downstream of Broomrigg culvert | U606_0156i2 | +0.06 | +0.06 | +0.09 | +0.18 |
| Downstream of Moor Beck underbridge | CROK_00750 | +0.00 | +0.00 | +0.00 | +0.00 |
| Downstream of Moor Beck underbridge | CROO_02112 | -0.04 | -0.02 | -0.08 | -0.36 |
| Downstream of Warcop junction | CROO_01629 | -0.03 | -0.00 | -0.01 | -0.03 |
| Downstream of Eastfield Sike underbridge | TODY_00104 | -0.05 | -0.00 | +0.06 | +0.09 |
| Upstream of Lowgill Beck crossing* | YOS001_0105i | +0.67 | +0.49 | +0.39 | +1.25 |
| Upstream of Lowgill Beck crossing* | W001_0127i3 | -0.16 | +0.03 | +0.11 | +1.25 |
| Downstream of Lowgill Beck crossing | LOW_03874i | +0.01 | +0.00 | -0.00 | -0.05 |
| Downstream of Cringle Beck underbridge | CRI_167i1 | +0.00 | +0.00 | +0.03 | +0.07 |
| Downstream of Cringle Beck underbridge | U601_147 | +0.00 | +0.00 | +0.00 | +0.01 |
| Upstream of Sandford junction | U605_500 | NA | -0.00 | +0.00 | -0.02 |
| Downstream of Sandford junction | U605_291i | NA | -0.00 | +0.00 | -0.00 |
| Upstream of Brough junction | U607_387i2 | NA | +0.00 | +0.00 | +0.00 |
| Downstream of Brough junction | U607_237 | NA | +0.00 | +0.00 | +0.25 |

*Peak water level shows a +1.25m change at this location in the 1% AEP plus 94% climate change. This is a result of impounded flows upstream of the proposed embankment and bed elevation changes in the channel where the watercourse has been realigned.

### Pass-Forward Flow

The pass-forward flow at the downstream end of the model has been assessed to see what the likely effect will be for flood risk downstream of the existing A66. The table below shows the flow changes between the existing situation and with-scheme scenarios, at locations immediately downstream from the scheme.

| Location | Model Node | Change in Peak Flow (m3/s) | | | |
|---|---|---|---|---|---|
| | | 50% AEP | 5% AEP | 1% AEP | 1% AEP + 94% climate change |
| Downstream of Broomrigg culvert | U606_0156i2 | +0.1 | +0.1 | +0.3 | +0.8 |
| Downstream of Moor Beck underbridge | CROK_00750 | +0.0 | +0.0 | +0.0 | -0.0 |
| Downstream of Crooks Beck railway culvert** | CROO_01629 | -0.3 | -0.1 | +0.7 | +1.2 |
| Railway bridge (NGR: 375200, 515788)** | STR602 | 0.0 | 0.0 | -0.9 | -3.0 |
| Downstream of railway crossing** | CROO_01473 | -0.2 | -0.0 | -0.1 | -0.3 |
| Downstream of Eastfield Sike underbridge | TODY_00104 | +0.0 | +0.0 | -0.0 | +0.2 |
| Downstream of Lowgill Beck crossing | LOW_03874i | +0.1 | +0.1 | -0.1 | -2.5 |
| Downstream of Cringle Beck underbridge | CRI_167i1 | +0.0 | +0.0 | +0.1 | +0.8 |
| Downstream of Cringle Beck underbridge | U601_147 | +0.0 | +0.0 | +0.0 | +0.1 |
| Upstream of Sandford junction | U605_500 | NA | +0.0 | +0.0 | +0.0 |
| Downstream of Sandford junction | U605_291i | NA | +0.0 | +0.0 | -0.0 |
| Upstream of Brough junction | U607_387i2 | NA | +0.0 | +0.0 | -0.0 |
| Downstream of Brough junction | U607_237 | NA | +0.0 | +0.0 | +0.0 |

**Flows through the railway culvert at CROO_01629 show an increase with the proposal, however, flows through the railway bridge (along the existing road into Warcop) show a significant decrease. Overall, pass-forward flows downstream of the railway at CROO_01473 show a decrease with the proposal.

**Depth Impact Analysis**

Figures 8-1 to 8-18 show the depth impact analysis for the Scheme 6 proposal. Peak flood depths have been compared between the existing situation and with-scheme models for the 5% AEP, 1% AEP and 1% AEP plus 94% climate change event. Areas with red shading show an increase in flood depth, and areas of green show a decrease in flood depth. Areas in blue show no significant change.

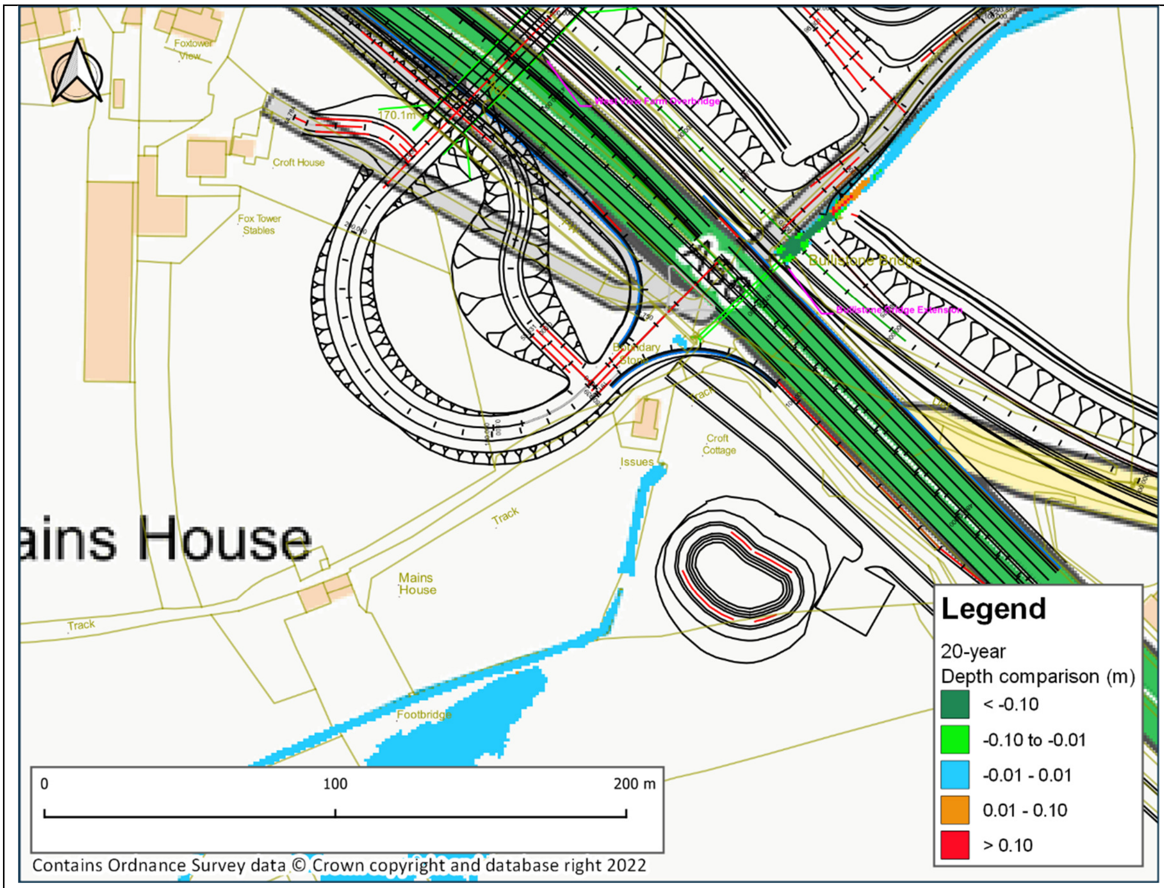

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Figure 8-1: UNN607 model impact analysis - 20-year

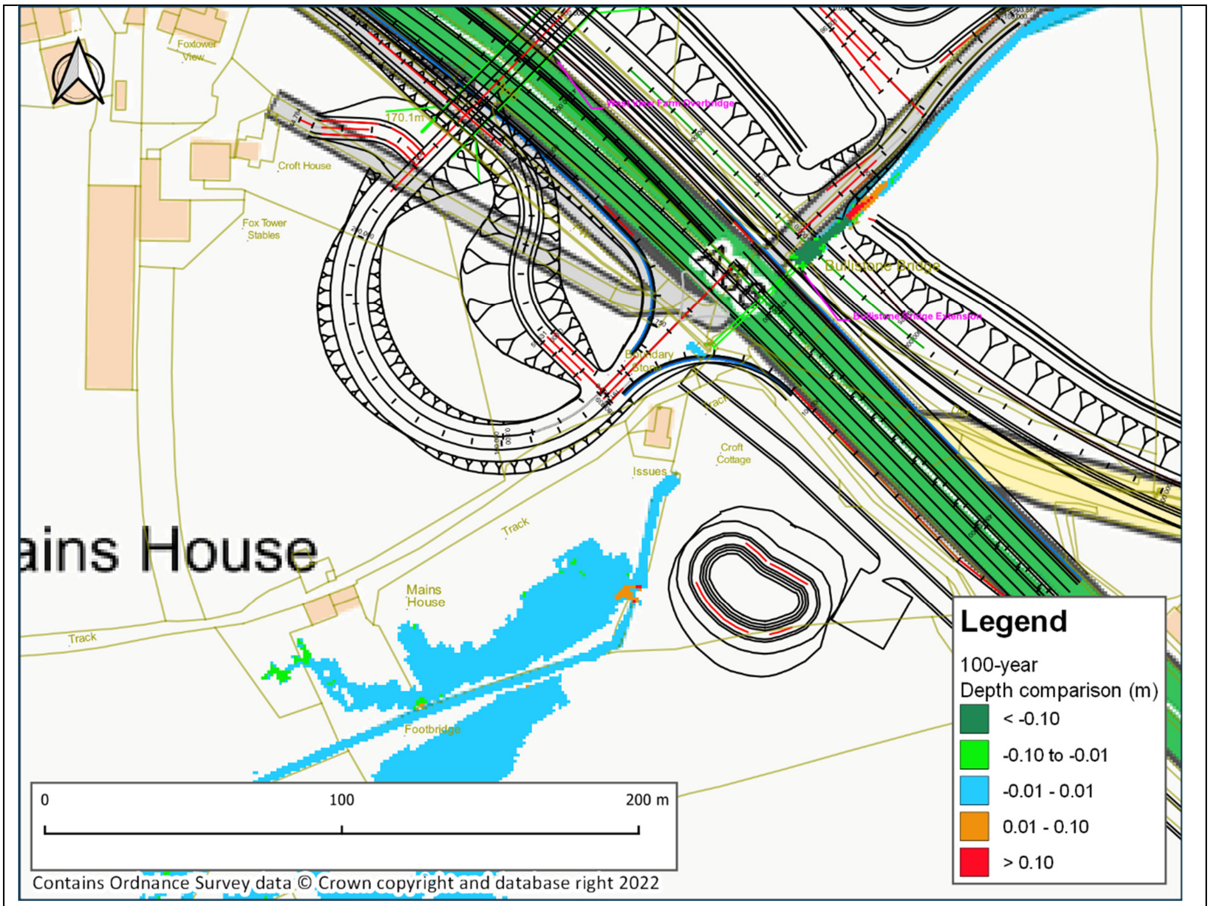

Figure 8-2: UNN607 model impact analysis - 100-year

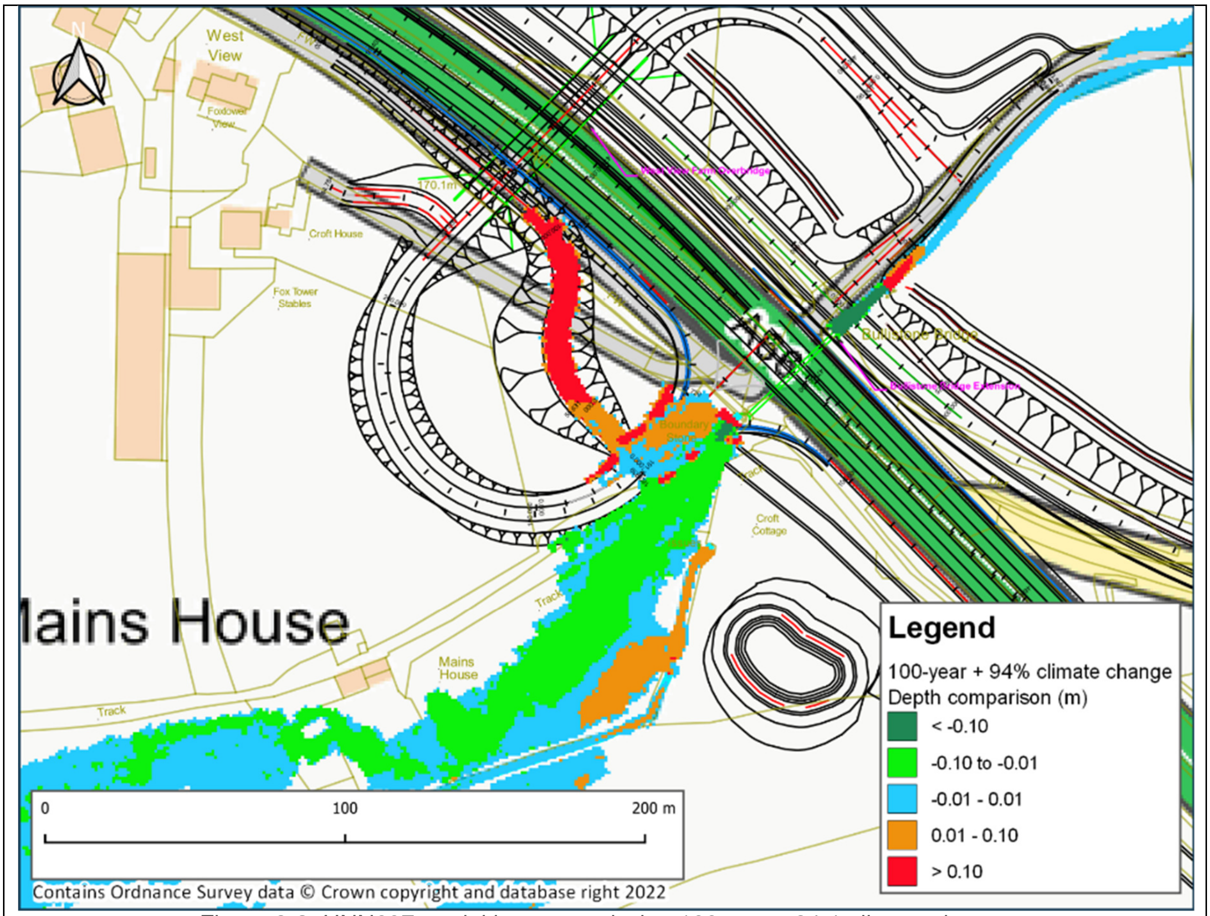

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Figure 8-3: UNN607 model impact analysis - 100-year +94% climate change

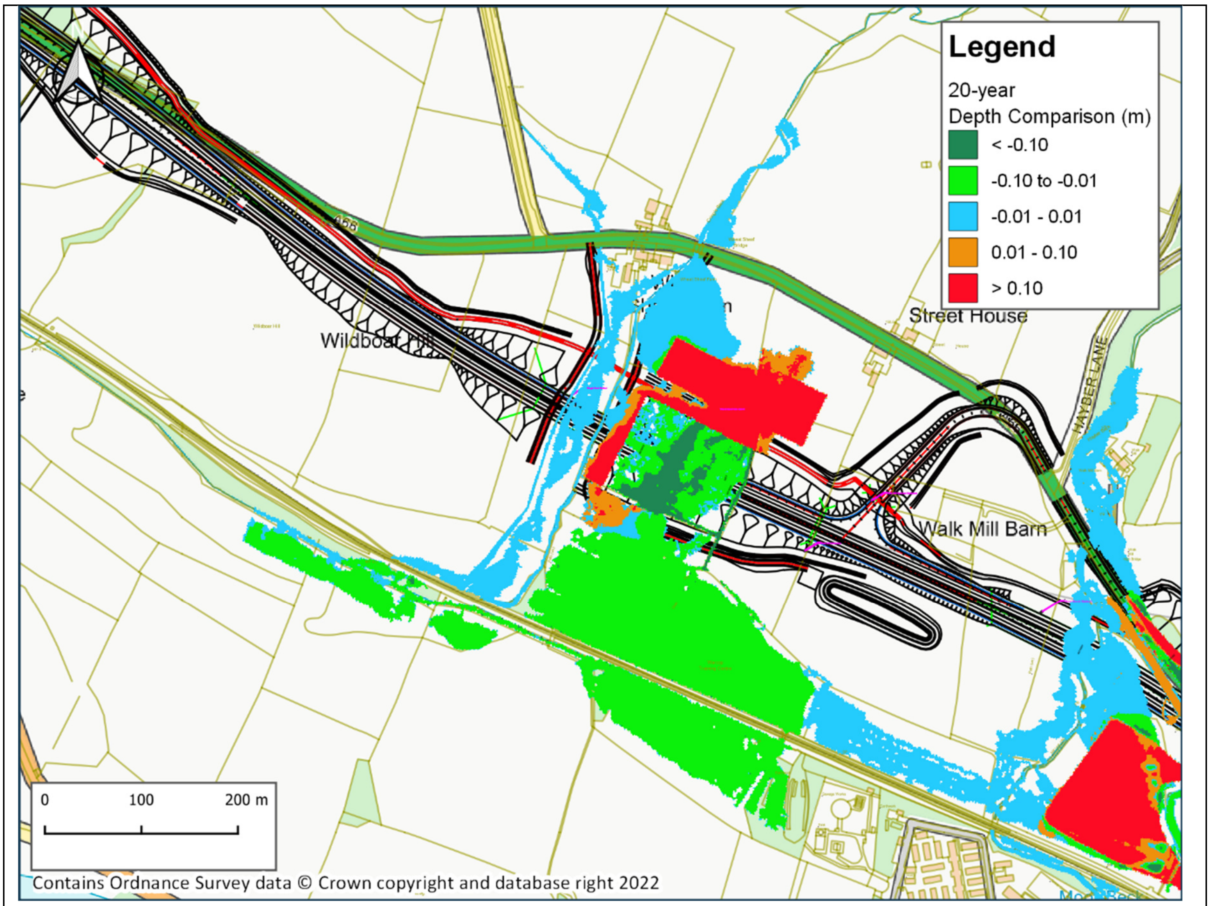

Figure 8-4: Cringle Beck impact analysis - 20-year

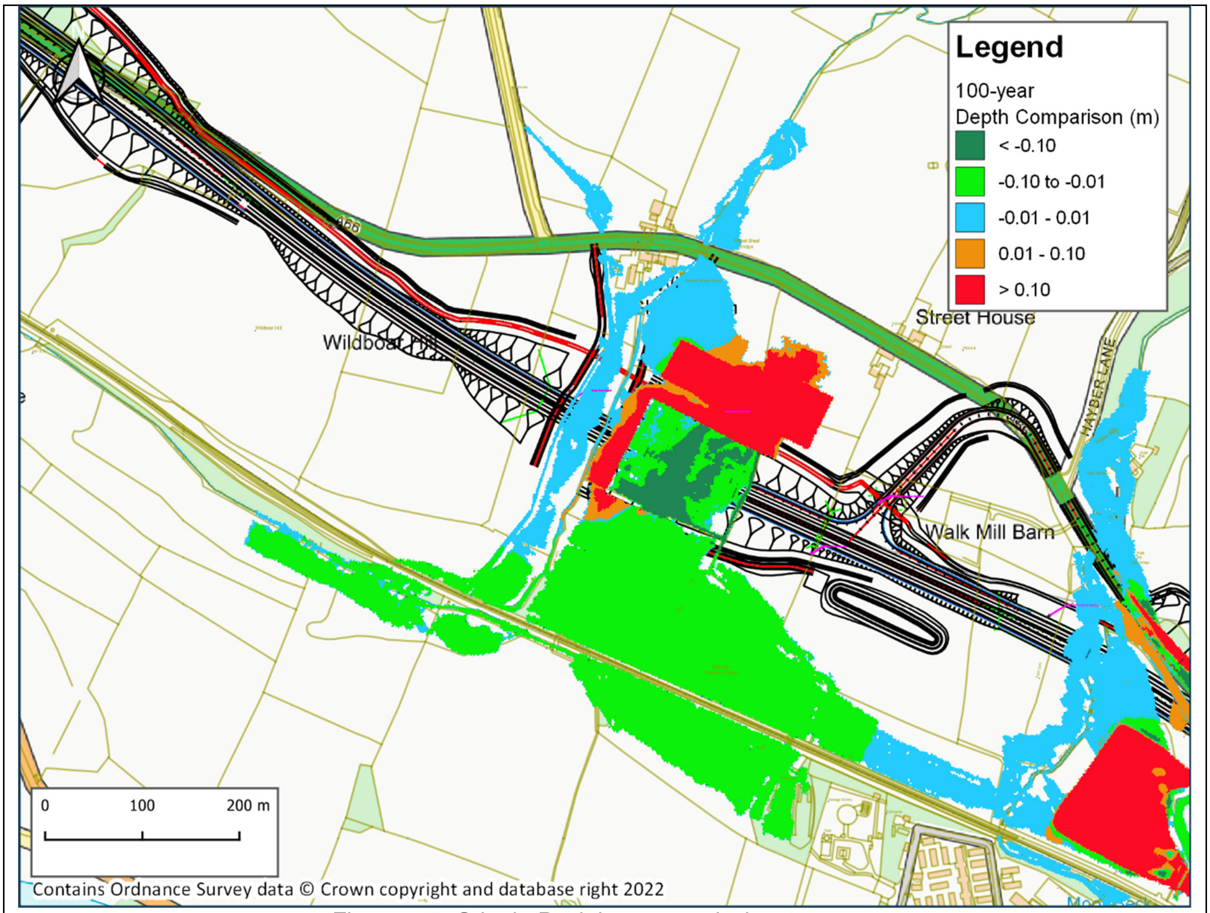

Figure 8-5: Cringle Beck impact analysis - 100-year

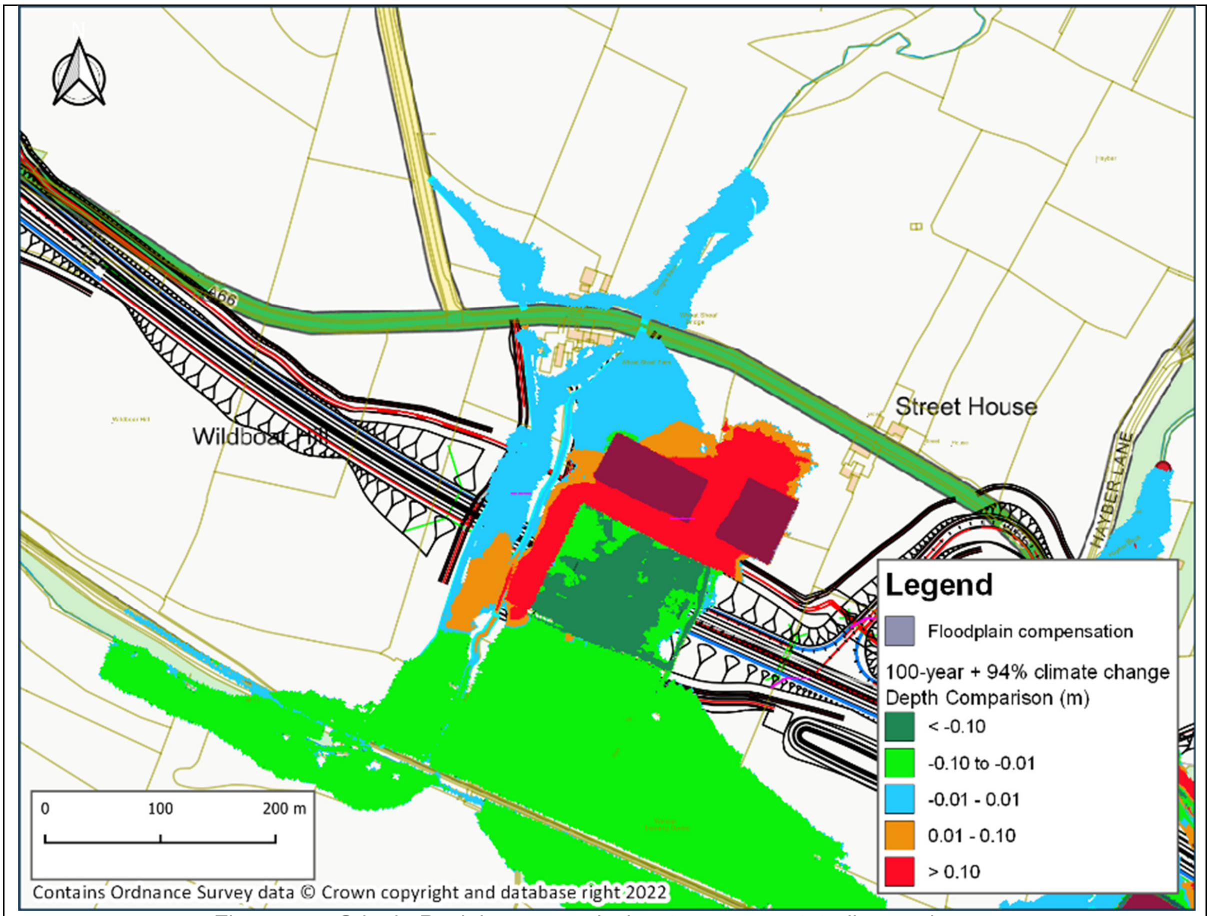

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Figure 8-6: Cringle Beck impact analysis - 100-year +94% climate change

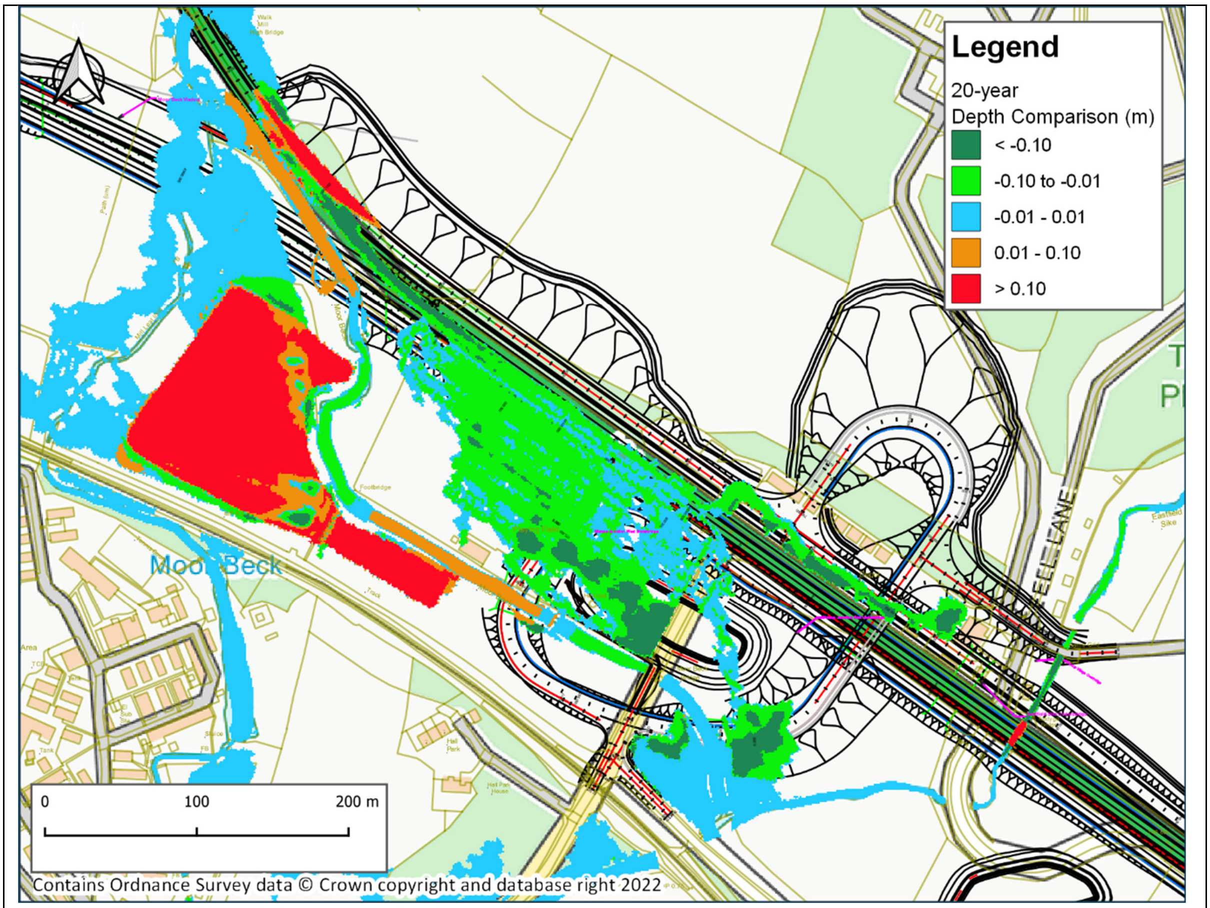

Figure 8-7: Warcop impact analysis - 20-year

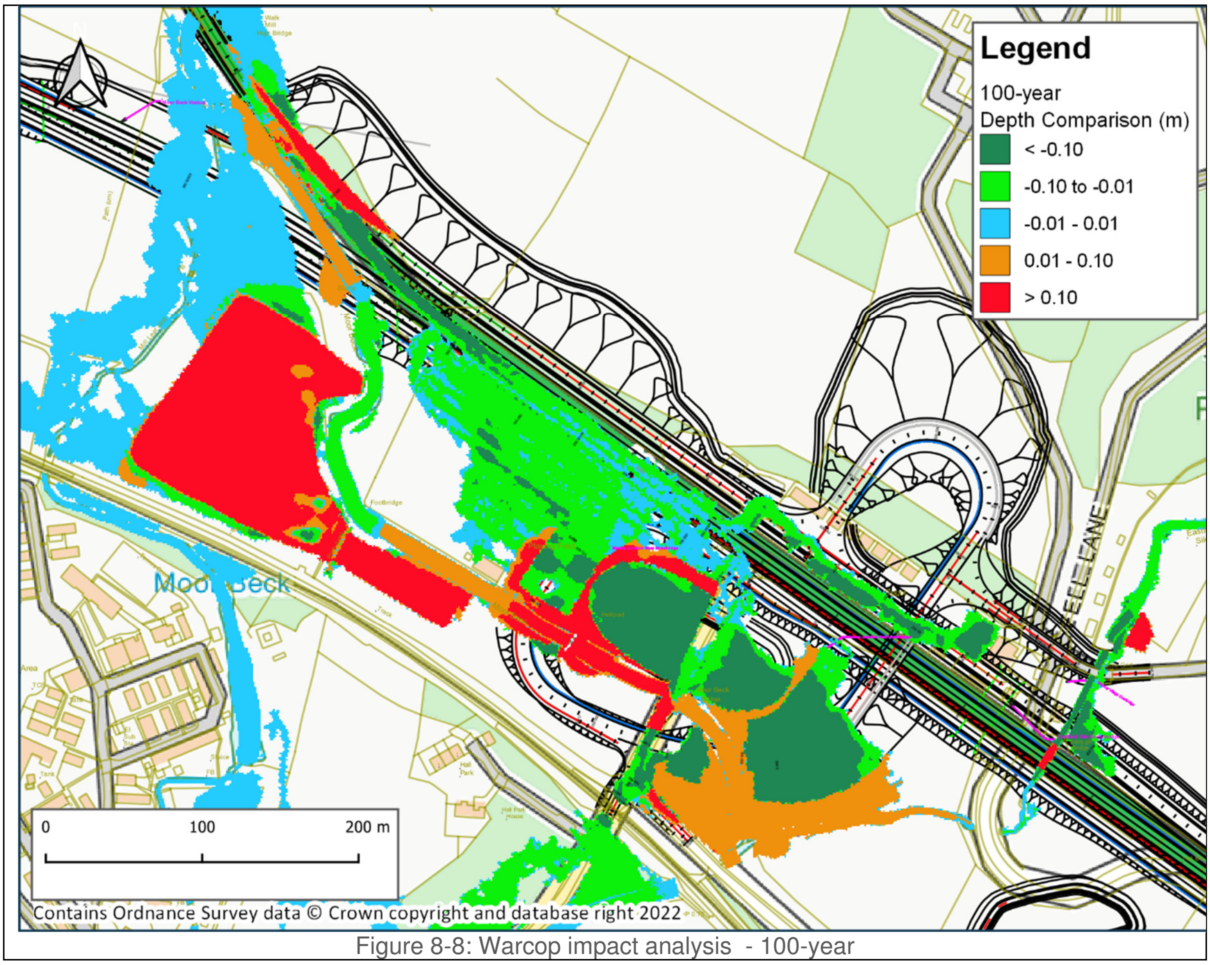

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Figure 8-8: Warcop impact analysis - 100-year

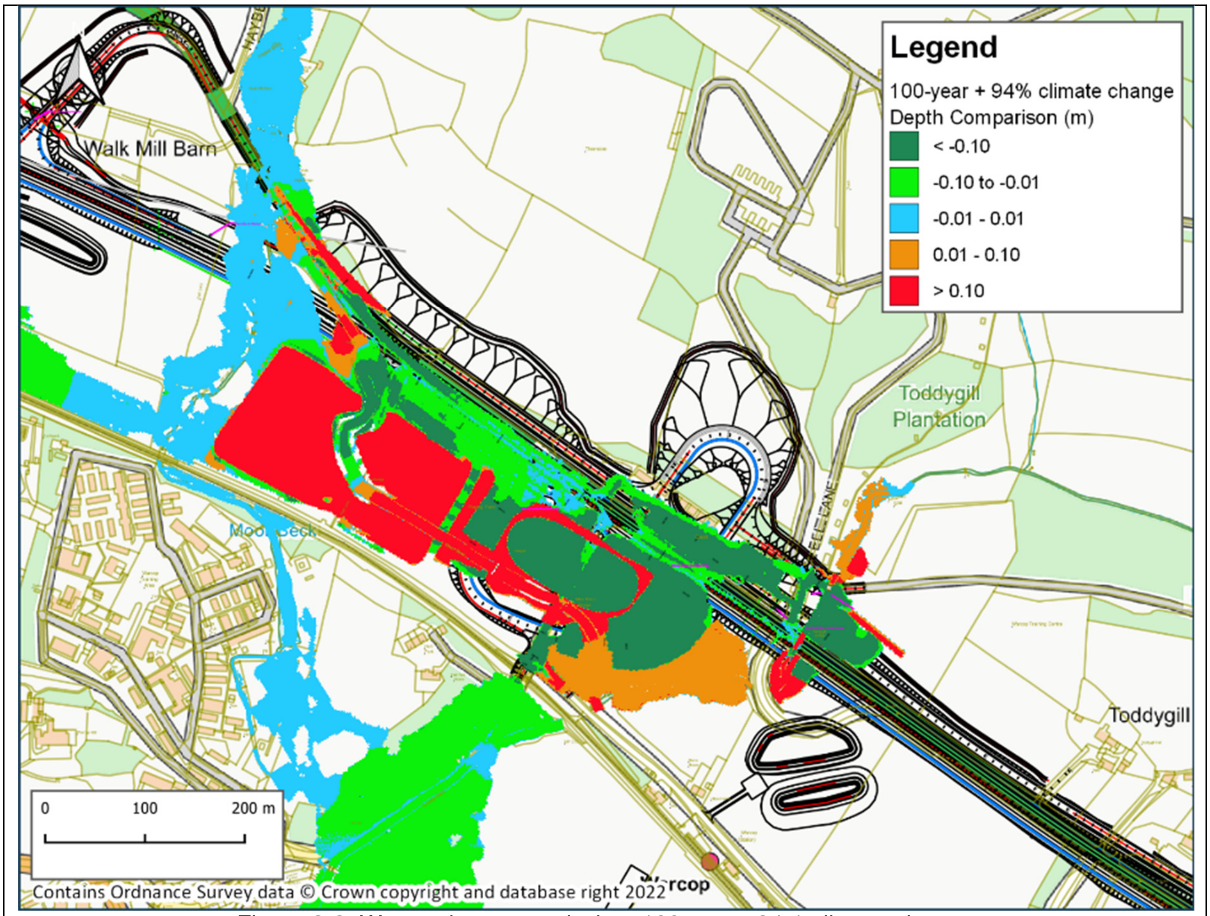

Figure 8-9: Warcop impact analysis - 100-year +94% climate change

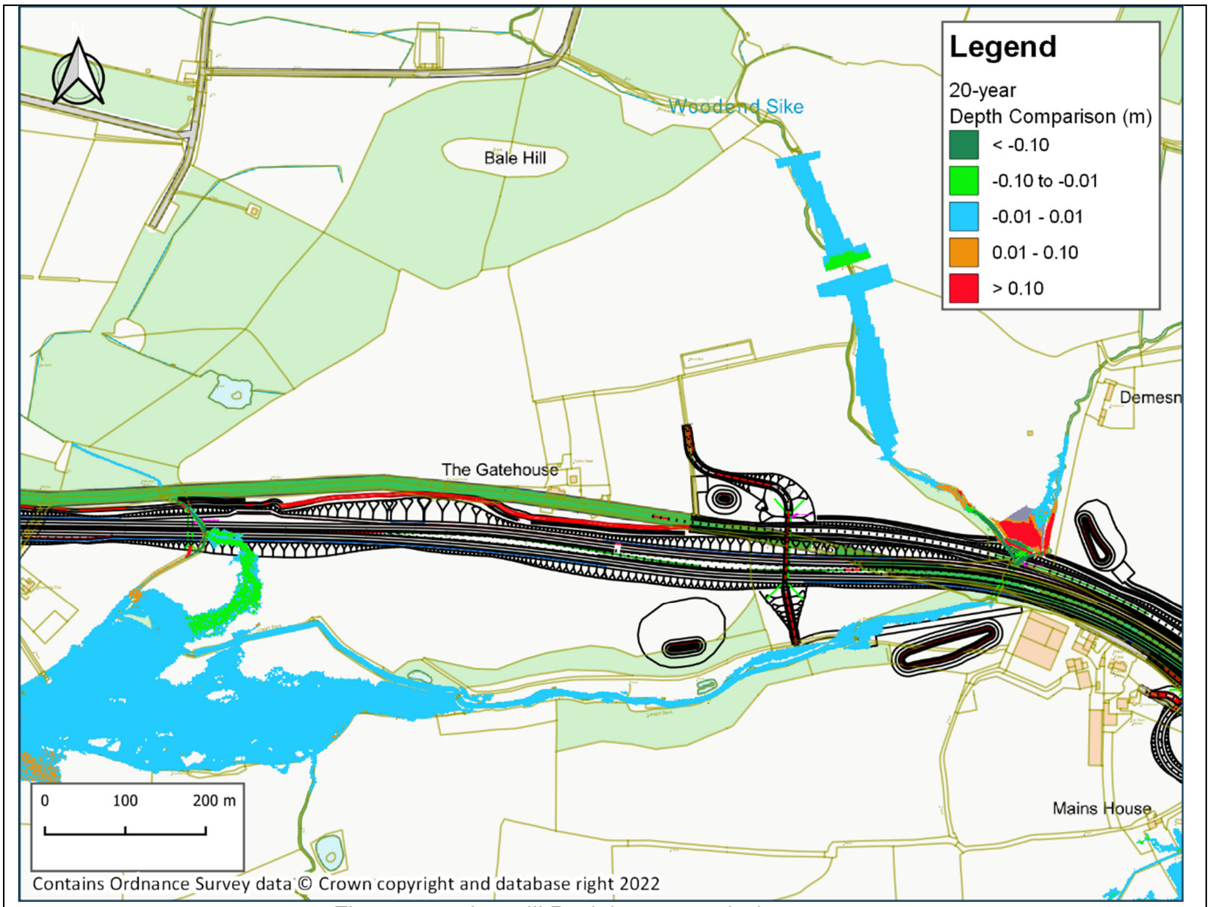

Figure 8-10: Lowgill Beck impact analysis - 20-year

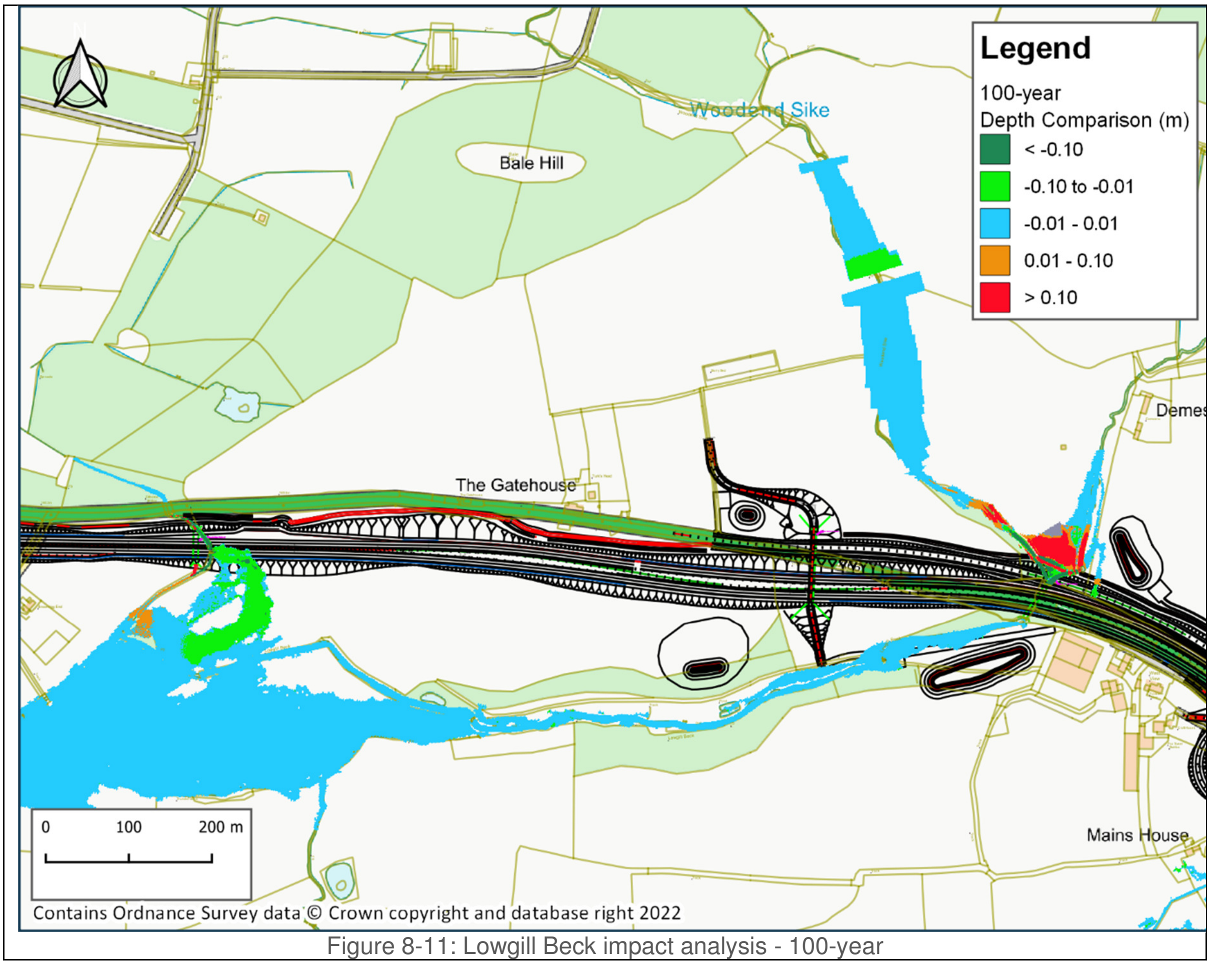

Figure 8-11: Lowgill Beck impact analysis - 100-year

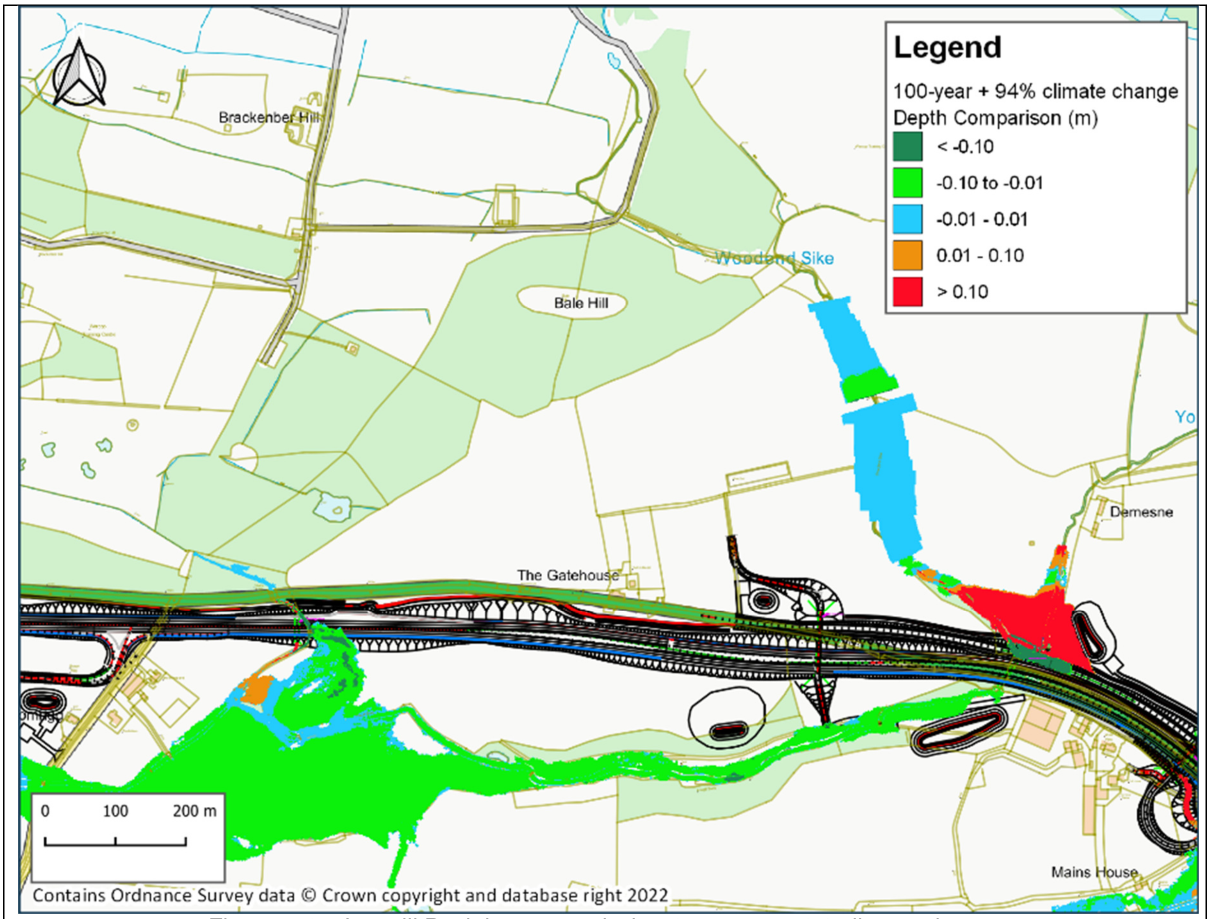

Figure 8-12: Lowgill Beck impact analysis - 100-year +94% climate change

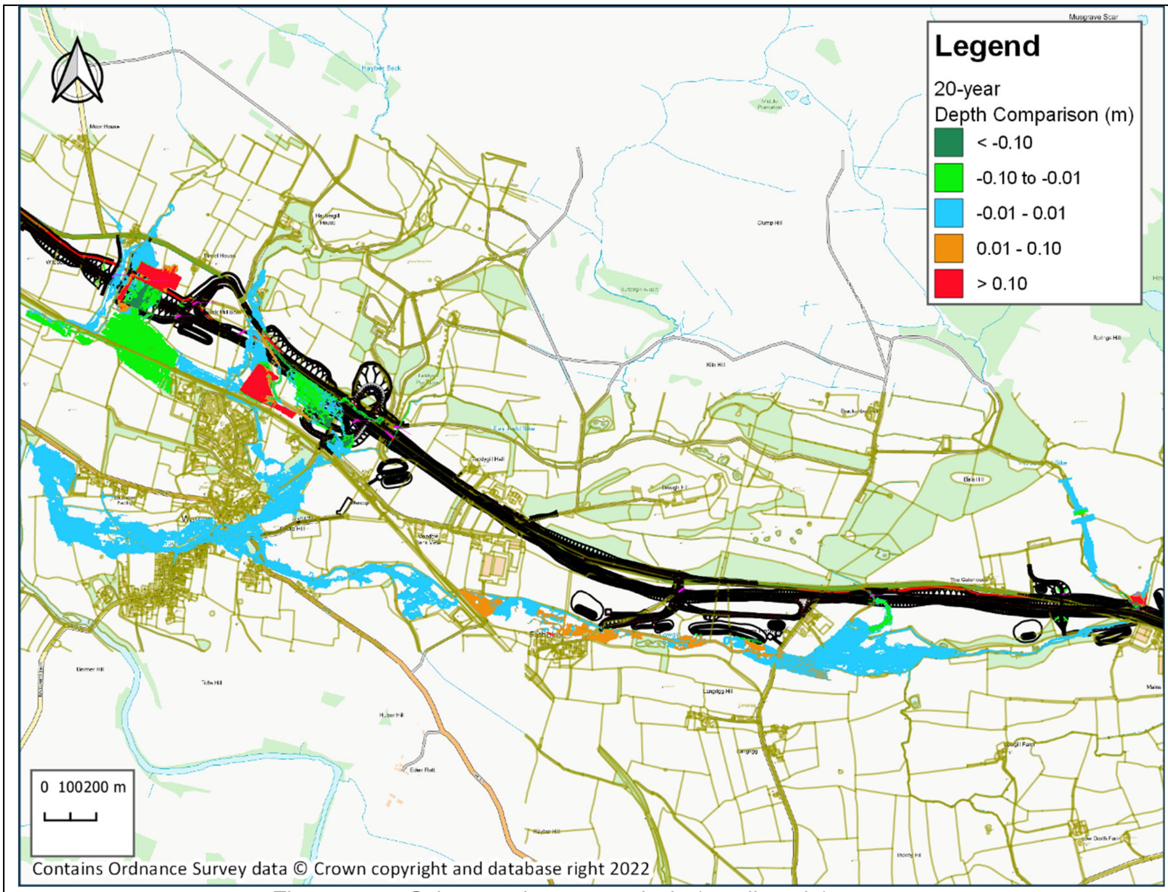

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Figure 8-13: Scheme 6 impact analysis (small-scale) – 20-year

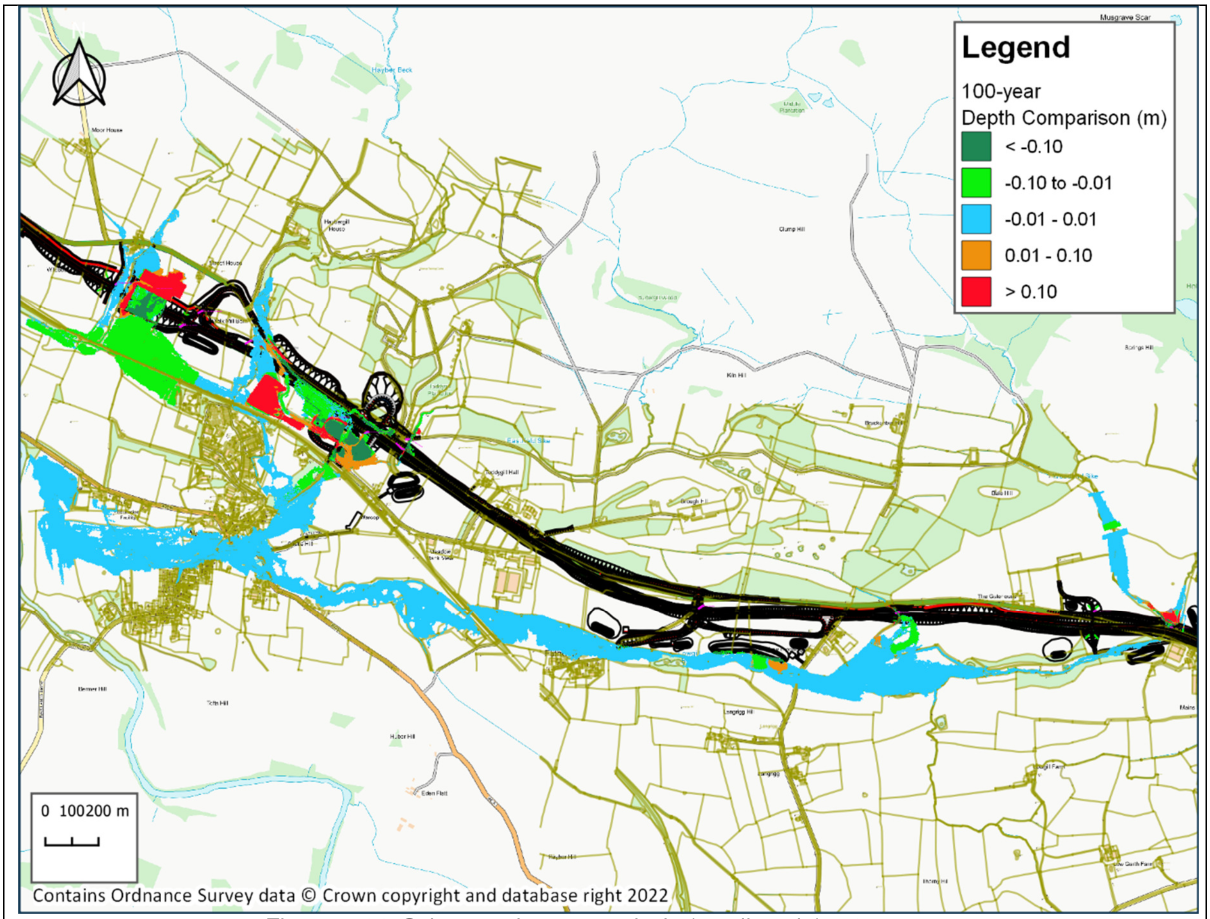

Figure 8-14: Scheme 6 impact analysis (small-scale) – 100-year

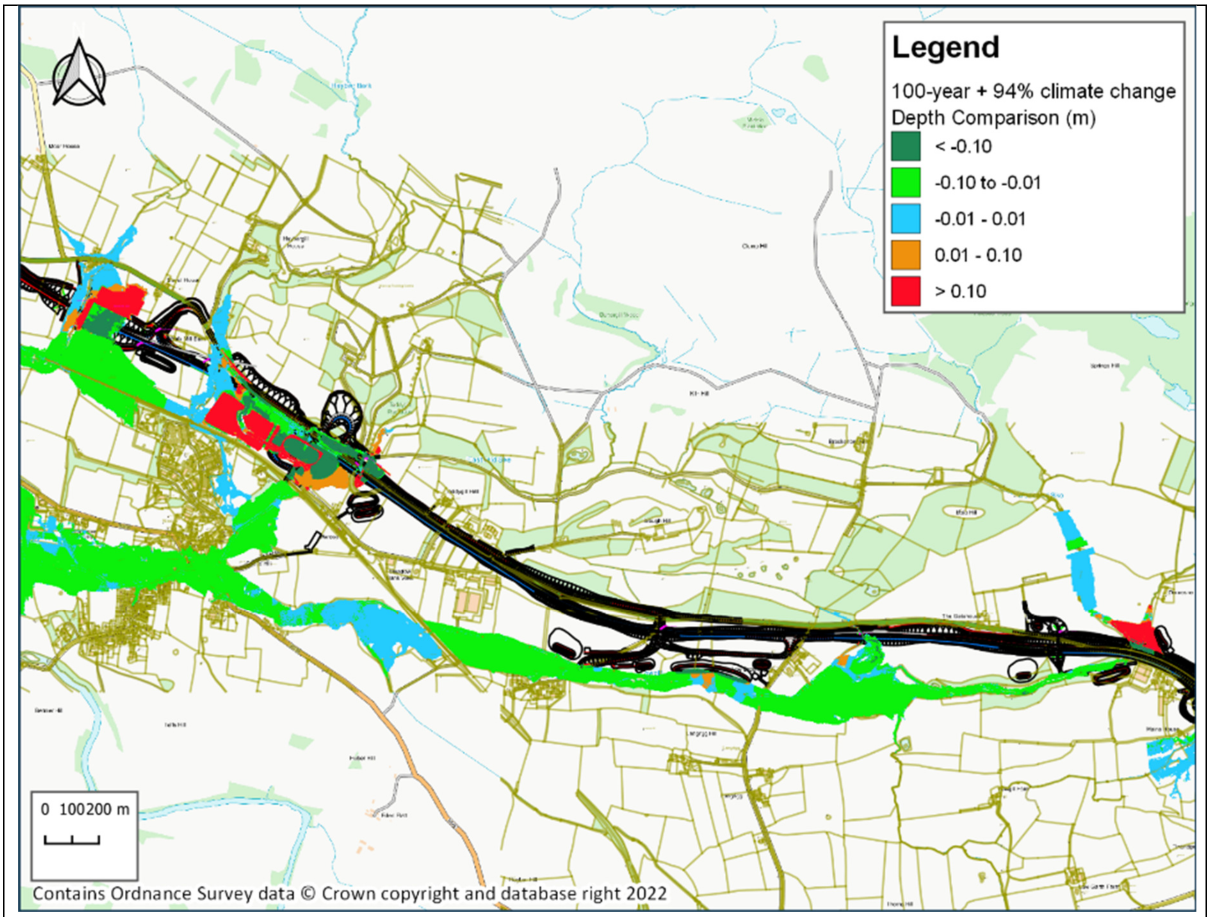

Figure 8-15: Scheme 6 impact analysis (small-scale) – 100-year +94% climate change

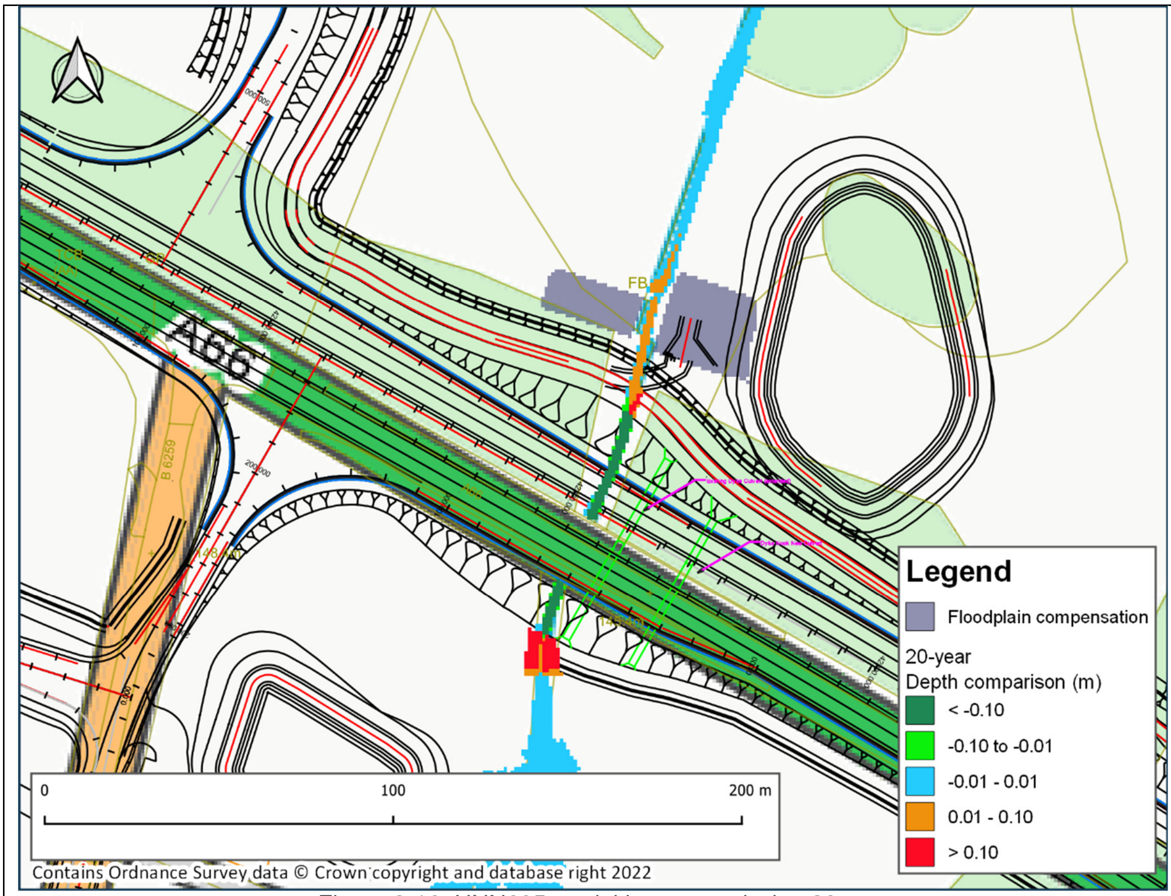

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Figure 8-16: UNN605 model impact analysis - 20-year

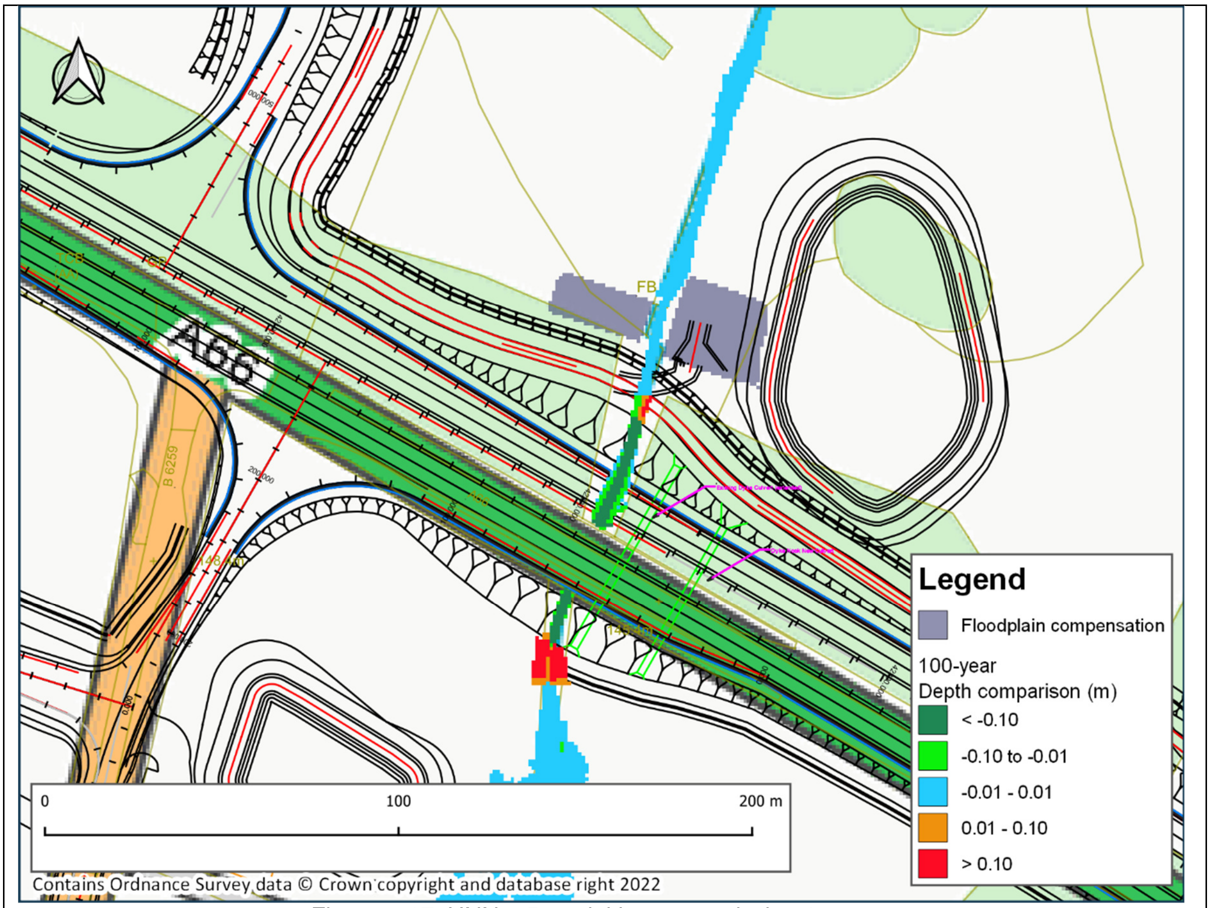

Figure 8-17: UNN605 model impact analysis - 100-year

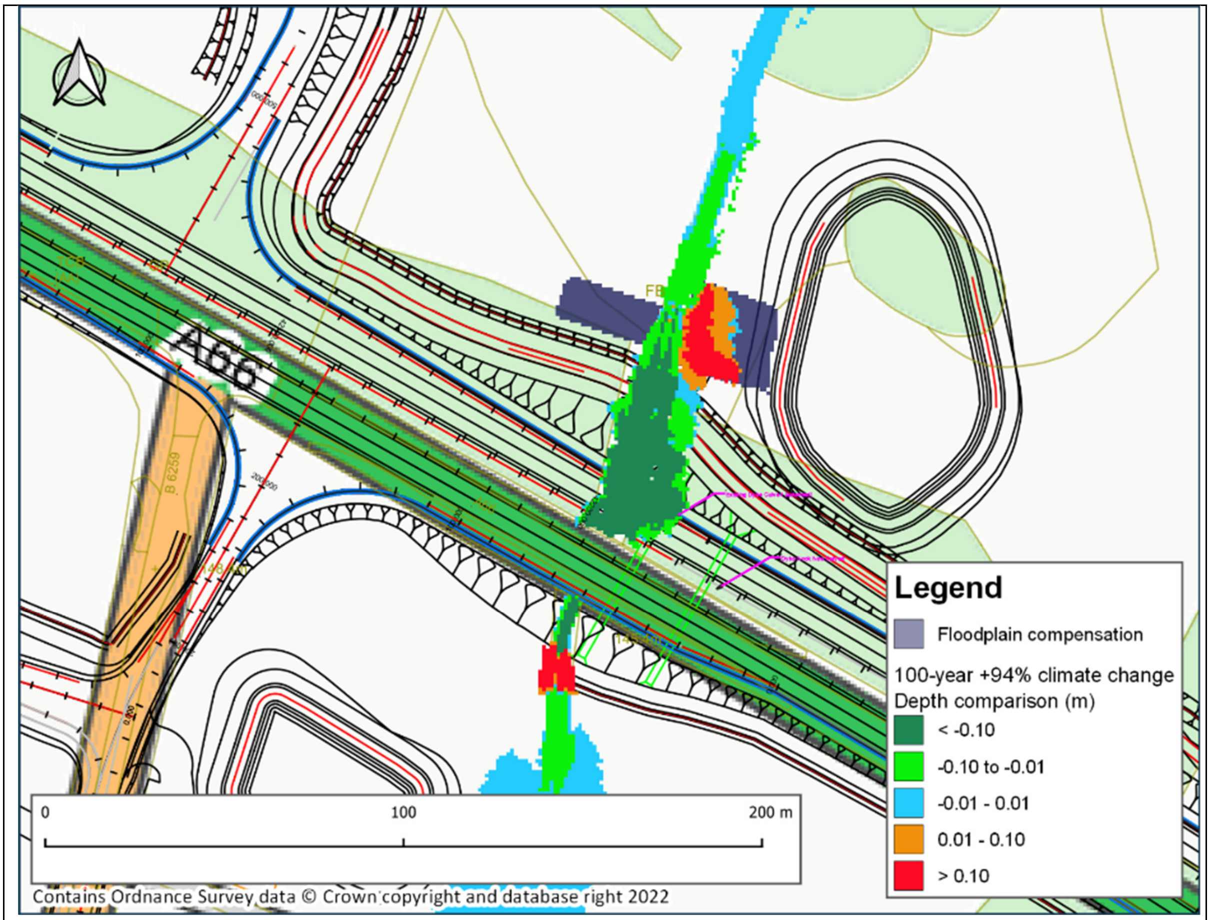

Figure 8-18: UNN605 model impact analysis - 100-year +94% climate change

## Impact of proposed scheme - summary

**In-Channel**

The results show that generally the impacts of the proposal are located within the vicinity of the new A66 scheme. Where changes in peak water level or peak flow occur these are within the immediate vicinity of proposed structures and as expected, where the most significant changes are proposed, the most significant impact is noted. Firstly, peak water levels upstream of the Lowgill Beck crossing within the Woodend and Yosgill Sike channels will increase with the proposed scheme as a result of flood water impounding behind the new embankment. In addition, downstream of the proposed Broomrigg Culvert, peak water level will increase in the channel. This is a consequence of attenuated flows through the A66 structure compared to the existing situation where flows are restricted and flow across the left bank floodplain further upstream.

Depths in the channel immediately downstream of the Sandford junction / Dike Nook culvert increase with the proposal, however, this is likely due to a change in the elevation of the bed in this section caused by the model representation rather than an impact associated with the proposed changes. The culvert in this location has been extended rather than replaced in the model and therefore the existing flow control is still in place.

Overall there is a decrease in pass-forward flow along Moor Beck downstream of the railway and into Warcop village.

Increases in flood depths for models UNN605 and UNN607 are largely confined to the channel for the 20-year and 100-year events.

**Floodplain**

Depth impact analysis shows that flood depths immediately upstream of the Cringle Beck and Lowgill Beck crossings increase as a result of impounding water against the proposed embankment in the 100-year plus 94% climate change event. Downstream, flood depths are generally shown to decrease during the 100-year plus 94% climate change event.

Other areas where there are increases in water depths (shown in red), are located in relation to the floodplain compensation areas where floodplain levels have been lowered and hence it is expected that depths would increase.

Flood depths downstream of the Brough junction are shown to increase during the 100-year plus 94% climate change event on the slip road and on the right bank floodplain. These impacts are within the proposed red line boundary.

In general, Figures 8-13 to 8-15 demonstrate that flood depths in Warcop, and other areas south of the proposed scheme, have reduced flood depths with the proposal in the 100-year and 100-year plus 94% climate change events. In the 20-year event, there are some areas of increased flood depth along the Lowgill Beck shown in orange (increases up to 0.1m). It is likely that these increases are associated with areas of ground level changes in the proposed scheme.

## 9 Key Model Assumptions and Limitations

During any hydraulic modelling study, there will always be associated limitations, for example, with uncertainty and data availability etc. The representation of any complex system by a model requires several assumptions to be made. In the case of the hydraulic model it has been assumed that:

- Cross sections accurately represent the shape and variation of the river.
- Model parameters have been determined appropriately.
- Design flows are an accurate representation of flows of a given AEP.
- The surveyed cross-sections of hydraulic structures and the units used to represent them in the model provide an adequate representation of the situation.
- LIDAR accurately reflects bank heights and particularly that the filtered LIDAR has appropriately removed the influence of vegetation.

Other specific limitations and assumptions are detailed below:

- The watercourses in the study area are ungagged and therefore no calibration of the hydraulic model has been carried out.
- Model UNN607 was extended by 100-200m upstream and downstream using interpolated cross section information in order to cover changes in the extent of the proposed A66 alignments. A site visit was conducted and determined no significant changes in channel geometry over the extended reaches. It was deemed appropriate to use the nearest surveyed cross section and make changes to the elevation values based on LIDAR data. Surface water, sewer flooding and groundwater flooding have not been included in this assessment. The hydraulic model results demonstrate the potential flood risk from the mechanism of the modelled watercourses overtopping only.

A66 Northern Trans-Pennine

# Appleby to Brough Rainfall Runoff Hydraulic Modelling Report

Appleby to Brough

| **Document Verification** | |
|---|---|
| **Project Title** | **A66 Northern Trans-Pennine**<br>Appleby to Brough |
| **Document Title** | Appleby to Brough Rainfall Runoff Hydraulic Modelling Report |
| **Document Ref** | HE565627-JBAU-XX-06-RP-HM-S3-P02-0002-Scheme6_Modelling_Report |

**Note:** The contents of the Cover Page and Document Verification page are managed by ProjectWise. Users should not edit these fields manually.

| Rev | Suit. Code | Suitability | | Purpose of Issue | | |
|---|---|---|---|---|---|---|
| P01 | S3 | Shared for Review | | | | |
| | | Created | Checked | Reviewed | Approved | Authorised |
| | **Name** | E. Persson-- | A. Blanchard--- | --A. Blanchard- | A. Blanchard--- | |
| | **Date** | 30/11/2021 | 30/11/2021 - | 30/11/2021 | 30/11/2021 | |

| Rev | Suit. Code | Suitability | | Purpose of Issue | | |
|---|---|---|---|---|---|---|
| P02 | S3 | Shared for Review | | --- | | |
| | | Created | Checked | Reviewed | Approved | Authorised |
| | Name | E. Persson | A. Blanchard | A. Blanchard | A. Blanchard | |
| | Date | 21/04/2022 | 21/04/2022 | 21/04/2022 | 21/04/2022 | |

| Rev | Suit. Code | Suitability | | Purpose of Issue | | |
|---|---|---|---|---|---|---|
| --- | --- | --- | | --- | | |
| | | Created | Checked | Reviewed | Approved | Authorised |
| | Name | --- | --- | --- | --- | --- |
| | Date | --- | --- | --- | --- | --- |

| **Direct Rainfall Hydraulic Modelling Report – Scheme 6** | | |
|---|---|---|
| 1 Basic Model Information | | |
| Model Name | New Hall Direct Rainfall model | |
| Primary Watercourses / Water Bodies | Unnamed tributary of Mire Sike 6.1<br>Unnamed tributary of Mire Sike 6.4 | |
| Designation | Ordinary Watercourse | |
| Model ID | The following table presents information regarding the model scenarios carried out as part of this study. | |
| Model Scenario ID | Scenario | Annual Probability |
| UNN6_~s1~_~e1~_007.tcf<br>UNN6_~s1~_~e1~_007.ecf | Existing Situation Model | 3.33% (1 in 30-years)<br>1% (1 in 100-years)<br>1% + 40% climate change (1 in 100-years) |
| UNN6_~s1~_~e1~_007.tcf<br>UNN6_~s1~_~e1~_007.ecf | | 0.1% (1 in 1000-years)<br>3.33% (1 in 30-years)<br>1% (1 in 100-years) |
| UNN6_~s1~_~e1~_007.tcf<br>UNN6_~s1~_~e1~_007.ecf | | 1% + 40% climate change (1 in 100-years)<br>3.33% (1 in 30-years) |
| UNN6_~s1~_~e1~_007.tcf<br>UNN6_~s1~_~e1~_007.ecf | | 1% (1 in 100-years) |
| UNN6_~s1~_~e1~_007_SENS_ROUGH_1.2.tcf<br>UNN6_~s1~_~e1~_007_SENS_ROUGH_1.2.ecf | Sensitivity tests | 1% AEP with +20% roughness<br>1% AEP with -20% roughness<br>1% AEP with +20% flow |
| UNN6_~s1~_~e1~_007_SENS_ROUGH_0.8.tcf<br>UNN6_~s1~_~e1~_007_SENS_ROUGH_0.8.ecf | | 1% AEP with -20% gradient downstream boundary<br>1% AEP with +20% roughness<br>1% AEP with -20% roughness |
| UNN6_~s1~_~e1~_007_SENS_FLOW.tcf<br>UNN6_~s1~_~e1~_007_SENS_FLOW.ecf | | 1% AEP with +20% flow<br>1% AEP with +20% roughness |

| | | |
|---|---|---|
| UNN6_~s1~_~e1~_007_SENS_DSBDY.tcf<br>UNN6_~s1~_~e1~_007_SENS_DSBDY.ecf | | 1% AEP with -20% roughness |

| **2 Model Input Data** | |
|---|---|
| Incoming Models | No existing hydraulic model was available for this study area |
| DTM for 2D Model Domain | 1m resolution LIDAR flown in 2020 |
| River channel/Structure survey | Channel survey collected by JBA Consulting between November 2020-June 2021 |
| Additional Data | OS Mastermap data |

| **3 Model Build Overview** | | | |
|---|---|---|---|
| Software | 1D domain: ESTRY | | |
| | 2D domain(s): TUFLOW | | |
| Model Reference | HE565627-JBAU-XX-06-M2-HM-0002 Scheme6_RainfallRunoff_Model | | |
| Model overview | The purpose of the modelling exercise was to carry out a rainfall-runoff model for the catchment shown in Figure 3-1. This was to estimate surface water flood extents for a range of flood events. | | |
| Model Reaches | The table below shows the watercourse reaches defined in the model. They are also shown in Figure 3-1. | | |
| Watercourse Name | Upstream model node | Downstream model node | Total Reach length (km) |
| Unnamed tributary of Mire Sike 6.1 (UNN608, UNN612) | UNN608_0242 | UNN612_0046 | 0.622 |
| Unnamed tributary of Mire Sike 6.4 (UNN613, UNN611, UNN610, UNN609) | UNN611_0000 | UNN609_0004 | 0.989 |

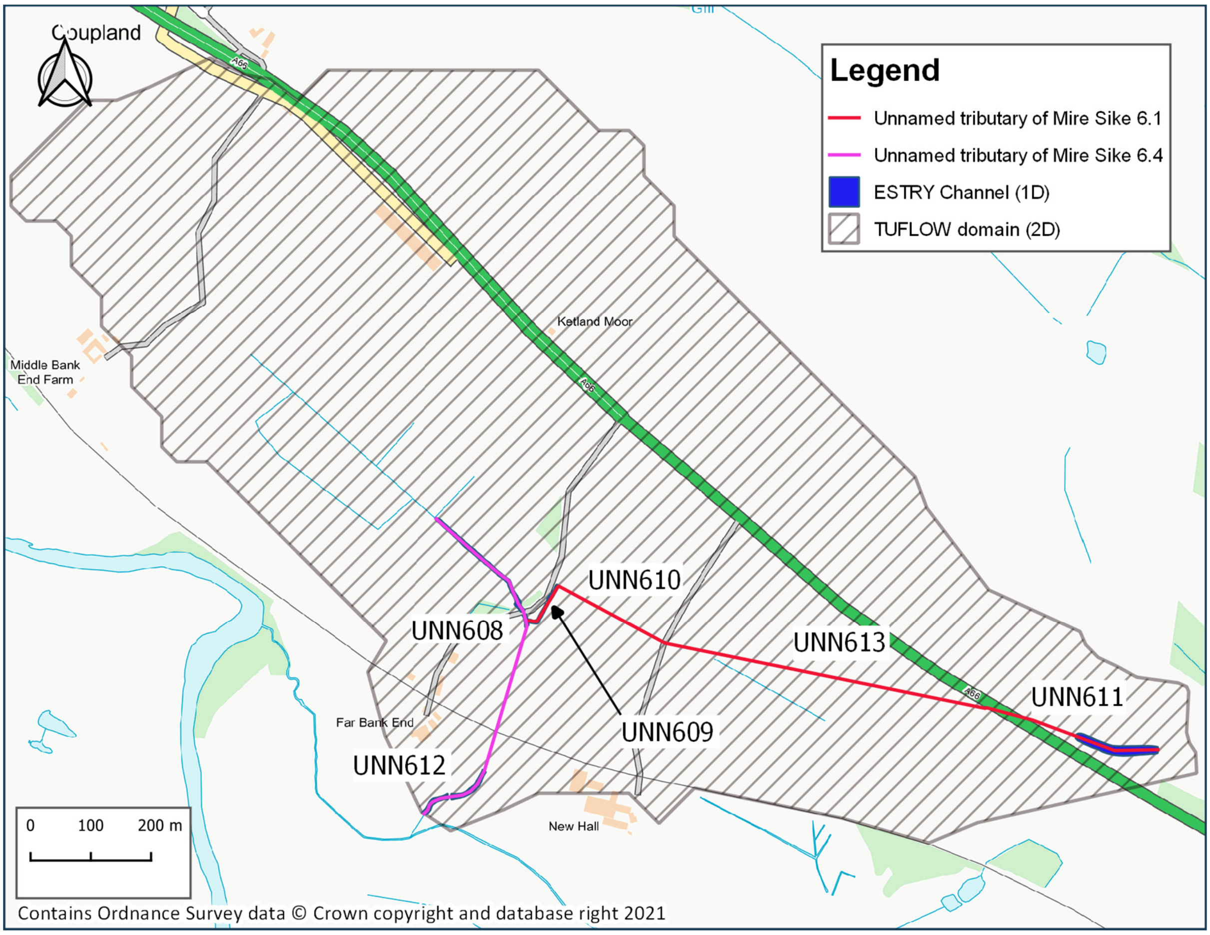

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Figure 3-1: Rainfall-runoff model overview

| **Baseline model schematisation** | |
|---|---|
| 4.1 1D Domain | |
| Channel representation | The channel system has been based upon the most recent survey data set available for the area. The channels have been represented within the 1D domain across the study area. |
| Structure representation | Existing structures have been based upon the most recent survey data set available. All significant structures within the study area have any modelling assumptions documented within this report (Section 5). |
| Inflow boundaries | Rainfall hyetographs were used to provide flow to the rainfall runoff model. |
| Climate Change | Climate change uplifts of 40% were applied using the Environment Agency July 2021 allowances. |
| Downstream boundary | A HQ downstream boundary is applied at the downstream extent of the Unnamed tributary of Mire Sike 6.4 in the 1D domain. |
| Hydraulic roughness values used | Channel roughness values have been represented in the model by Manning’s ‘n’ values, defined on a reach basis. In order to determine the roughness of channel cross sections, photographic evidence collected during site visits and survey collection were used as a reference alongside application of the method published by Cowan (1956).<br>Bed and bank roughness values range from 0.04-0.060. |

<table>
<tr><td></td><td colspan="3">Structure roughness values range from 0.020-0.025.</td></tr>
<tr><td>Labelling/naming convention used</td><td colspan="3">All nodes have an ID of UNN600_XXXXX where XXXXX is the chainage upstream.<br>The following suffixes have been used:
<table>
<tr><td>C or CU</td><td>Culvert</td></tr>
<tr><td>J</td><td>Junction</td></tr>
<tr><td>W</td><td>Weir</td></tr>
<tr><td>SP</td><td>Spill</td></tr>
<tr><td>B</td><td>Bridge</td></tr>
<tr><td>i, i2, i3</td><td>Interpolate</td></tr>
<tr><td>u or d</td><td>Upstream or downstream node</td></tr>
</table></td></tr>
<tr><td colspan="4">4.2 2D Domain</td></tr>
<tr><td>Area of 2D Domains</td><td>1.365 km2</td><td>DTM data source</td><td>LIDAR</td></tr>
<tr><td>Resolution of grid</td><td>2m</td><td>DTM Resolution</td><td>1m</td></tr>
<tr><td>Modifications to topography and reasons</td><td>2d_zsh_UNN6_banks_L_002.shp<br>2d_zsh_UNN6_banks_P_002.shp</td><td colspan="2">The top of bank elevations has been stamped using Z shapes. Elevations are based on surveyed channel sections and LIDAR.</td></tr>
<tr><td>Hydraulic roughness values used</td><td colspan="3">Manning’s n values have been used to represent hydraulic roughness in the 2D domain. The following roughness values were used in the model and are based on land cover types recorded in the Ordnance Survey MasterMap Topographic Area layer dataset.
<table>
<tr><th>Land Cover</th><th>Manning’s ‘n’ value</th></tr>
<tr><td>Generic floodplain roughness values</td><td>0.050</td></tr>
<tr><td>Boulders</td><td>0.065</td></tr>
<tr><td>Coniferous trees</td><td>0.120</td></tr>
<tr><td>Coniferous trees – scattered / Orchard</td><td>0.070</td></tr>
<tr><td>Coppice or osiers</td><td>0.090</td></tr>
<tr><td>Marsh Reeds or Saltmarsh</td><td>0.060</td></tr>
<tr><td>Non coniferous trees</td><td>0.090</td></tr>
<tr><td>Non-coniferous trees – scattered</td><td>0.060</td></tr>
<tr><td>Rough grassland</td><td>0.060</td></tr>
<tr><td>Scrub</td><td>0.070</td></tr>
<tr><td>Rock</td><td>0.070</td></tr>
<tr><td>Heath</td><td>0.090</td></tr>
<tr><td>Building</td><td>0.300</td></tr>
<tr><td>General surface – multi surface</td><td>0.050</td></tr>
<tr><td>General surface – step</td><td>0.050</td></tr>
<tr><td>General surface - manmade</td><td>0.050</td></tr>
<tr><td>General surface - natural</td><td>0.060</td></tr>
<tr><td>Glasshouse</td><td>0.200</td></tr>
</table></td></tr>
</table>

<table>
<tr><td></td><td>
<table>
<tr><td>Inland water</td><td>0.045</td></tr>
<tr><td>Landform</td><td>0.060</td></tr>
<tr><td>Landform – slope</td><td>0.060</td></tr>
<tr><td>Landform – cliff</td><td>0.060</td></tr>
<tr><td>Path – step</td><td>0.050</td></tr>
<tr><td>Path</td><td>0.050</td></tr>
<tr><td>Rail</td><td>0.045</td></tr>
<tr><td>Road</td><td>0.035</td></tr>
<tr><td>Roadside</td><td>0.050</td></tr>
<tr><td>Stability Patch</td><td>0.300</td></tr>
<tr><td>Structure</td><td>0.300</td></tr>
<tr><td>Structure – upper level of communication</td><td>0.300</td></tr>
<tr><td>Structure – pylon</td><td>0.060</td></tr>
<tr><td>Tidal water – foreshore</td><td>0.055</td></tr>
<tr><td>Tidal water</td><td>0.055</td></tr>
<tr><td>Unclassified</td><td>0.060</td></tr>
</table>
</td></tr>
<tr><td colspan="2">4.3 1D-2D Linking</td></tr>
<tr><td colspan="2">A HX boundary is used to link the 1D and 2D domains along the top of banks. Elevations of HX cells are set using Z shapes outlined in Section 4.2.</td></tr>
<tr><td>Model Boundaries – Downstream Conditions</td><td>A 2D HQ boundary is used at the downstream extent of the 2D domain based on slope values derived from LIDAR. To understand the implications of a HQ boundary conditions, sensitivity testing has been conducted to quantify the impacts in changing the boundary parameters.</td></tr>
</table>

| **5 Structures** | | | |
|---|---|---|---|
| General Assumptions | | | |
| • Modelled structures have been schematised using the most recent channel survey taken by JBA Consulting between November 2020 and June 2021.<br>• Invert level for the out of culvert UNN613_0002 has been assumed due to not being stated in the survey drawing | | | |
| ID | Structure | How has this structure been modelled? | Photo (view of upstream face unless specified) |
| UNN613_0002 | Road culvert | This structure has been modelled as a circular culvert exit unit (C) in ESTRY. |  Downstream face |

| | | | |
|---|---|---|---|
| UNN613_0000 | Culvert | This structure has been modelled as a circular culvert unit (C) in ESTRY. | <br>Upstream face<br><br>Downstream face |

| | | | |
|---|---|---|---|
| UNN610_0002 | Culvert | This structure has been modelled as an irregular culvert unit (I) in ESTRY. |  |
| UNN610_0000 | Culvert | This structure has been modelled as a circular culvert unit (C) in ESTRY. | <br>Upstream face<br><br>Downstream face |

| | | | |
|---|---|---|---|
| UNN609_0055 | Culvert | This structure has been modelled as a circular culvert unit (C) in ESTRY. |  Upstream face |
| UNN608_0028 | Culvert | This structure has been modelled as a circular culvert unit (C) in ESTRY. |  Upstream face<br> Downstream face |

| | | | |
|---|---|---|---|
| UNN608_0000 | Culvert | This structure has been modelled as a circular culvert unit (C) in ESTRY. |  Upstream face  Downstream face |
| UNN612_0140 | Culvert | This structure has been modelled as a circular culvert unit (C) in ESTRY. Overtopping of the structure has been represented as a 1D ESTRY weir (W) unit. |  Upstream face |

| | | | |
|---|---|---|---|
| | | | <br>Downstream face |
| 001_0000C | Culvert | This structure has been modelled as an irregular culvert unit (I) in ESTRY.<br>To link the 1D/2D domains and to control the number of 2D cells connected to the culvert inlet and outlet, 2D SX cells were applied. | <br>Upstream face<br><br>Downstream face |

# 6 Model Proving

## 6.1 Model Performance

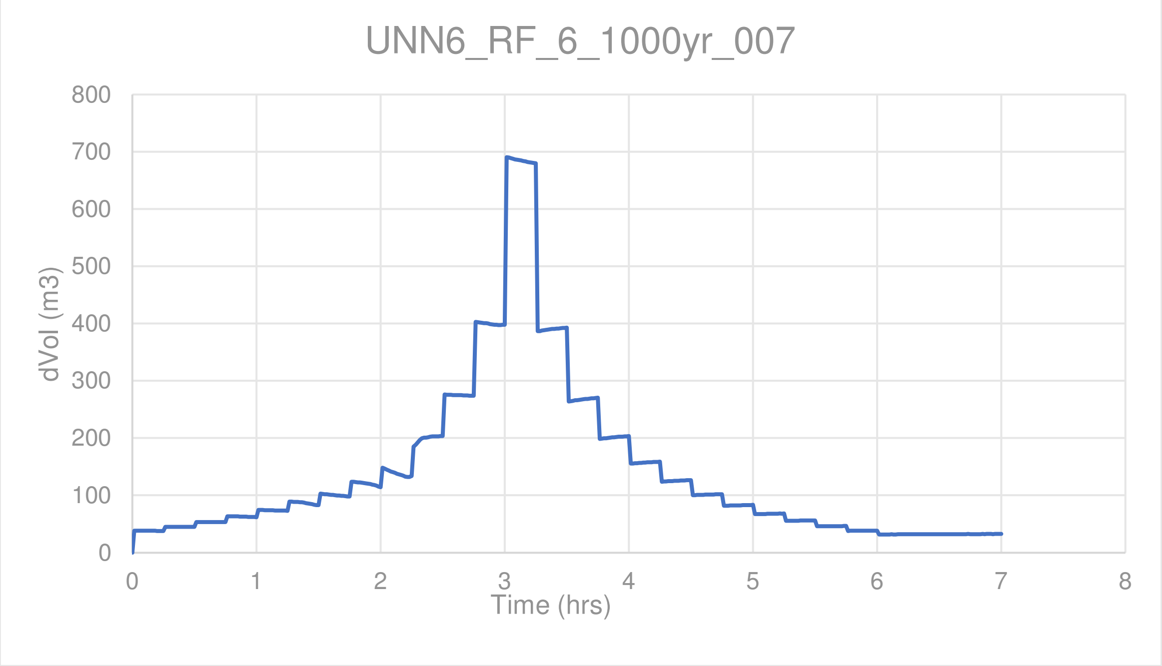

Figure 6-1: TUFLOW dVol plot

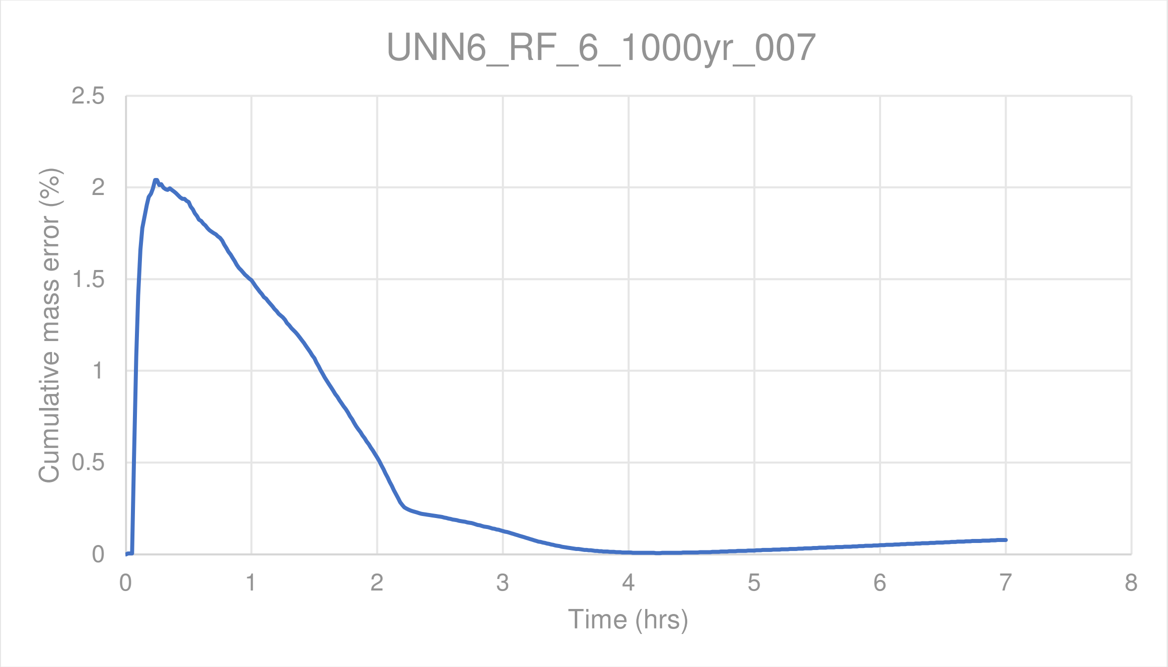

Figure 6-2: TUFLOW cumulative mass error

Flow and stage profiles have been checked throughout the model and are smooth with minimal oscillations, indicating the model is performing well. The dVol plot is shown to be smooth and the cumulative mass error is within a range of +1 to -1 for the majority of the simulation. Whilst there is a spike in the mass error at the beginning of the model, this occurs when the volume in the model is low and therefore considered acceptable.

## 6.2 Model Verification

| | |
|---|---|
| Calibration | No gauge data was available for the study area to allow the model to be calibrated to. |
| Previous Model Comparison | No previous hydraulic model results are available for the study area for comparison. |
| Flood Zone Comparison | Surface water flood maps has been used as a comparison and shows the maximum modelled extents compare well to the 1000-year flood extents in the Risk of Flooding from Surface Water RoFSW) data. |

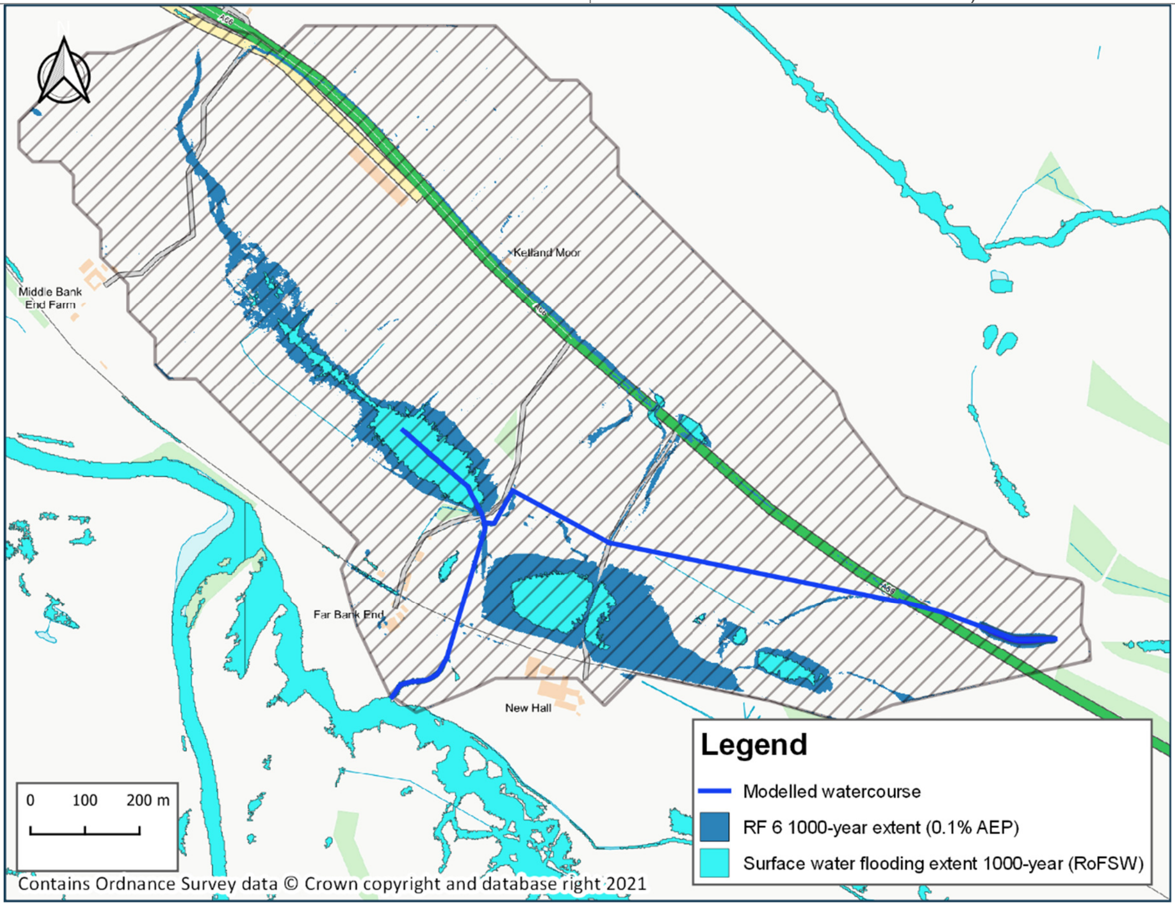

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Figure 6-3: Comparison to surface water flood maps

## 6.3 Sensitivity Analysis

Sensitivity tests were carried out for the 1% AEP existing situation model to assess the model response to the change in:

- Flow: Model inflows increased by 20%
- Roughness coefficient: In-channel and roughness values changed by +20% and -20%
- Downstream boundary: Slope decreased by -20%

The figures below show the change in in-channel water levels relative to the existing situation model for the model with increase in flow and increase and decrease in roughness coefficients.

- The increase in flow sensitivity test shown in Figure 6-4 shows minor changes in the peak flood extent of the baseline 100-year event and that there is a negligible impact on the model results at the site when flows are increased by 20%. As a result, the model results are relatively insensitive to changes in an increase in flow values.

- Figure 6-5 shows that the model is relatively insensitive to changes in roughness values applied in the 1D and 2D domain.
- The downstream boundary sensitivity test shown in Figure 6-6 show a negligible increase in water levels at the most downstream node on the watercourses.

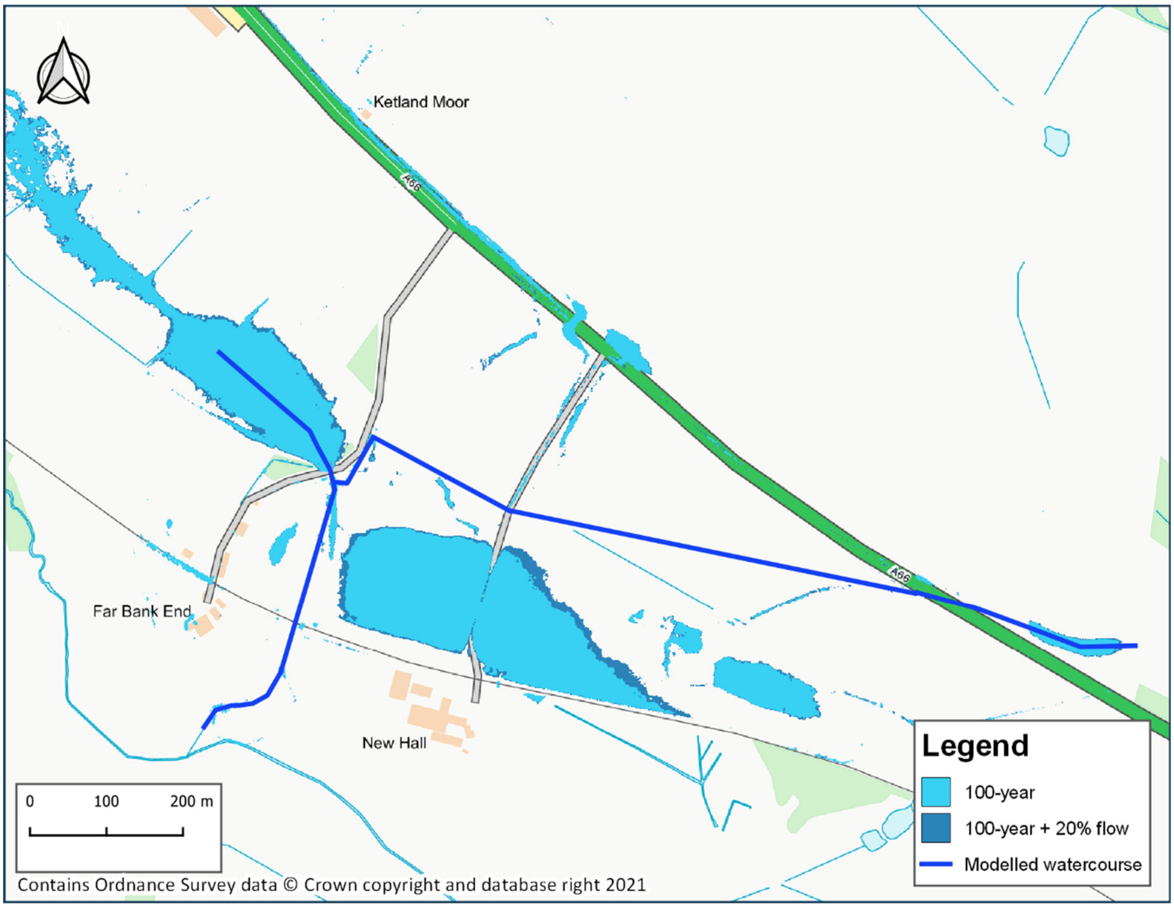

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Figure 6-4: Sensitivity analysis for +20% flow

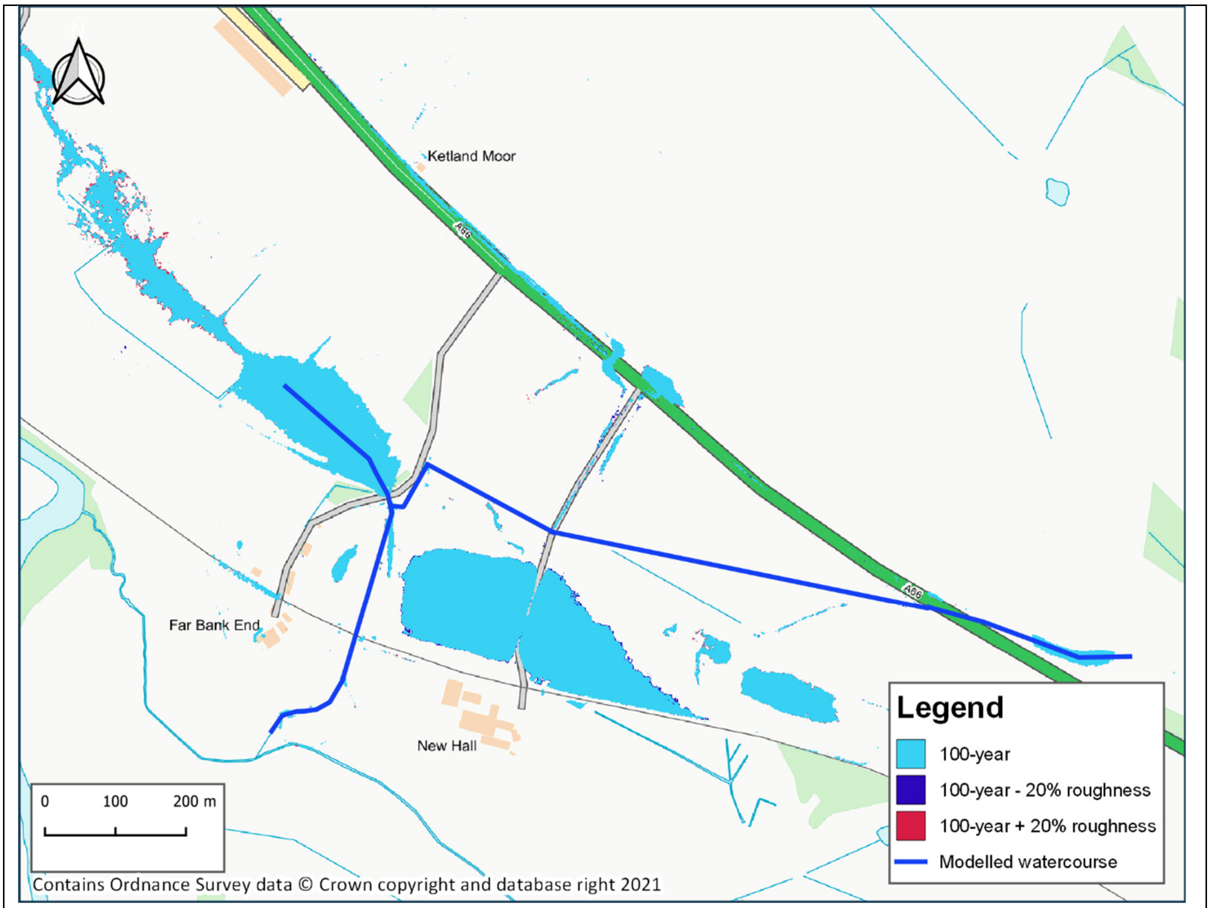

Figure 6-5: Sensitivity analysis for changes in + / - 20% roughness

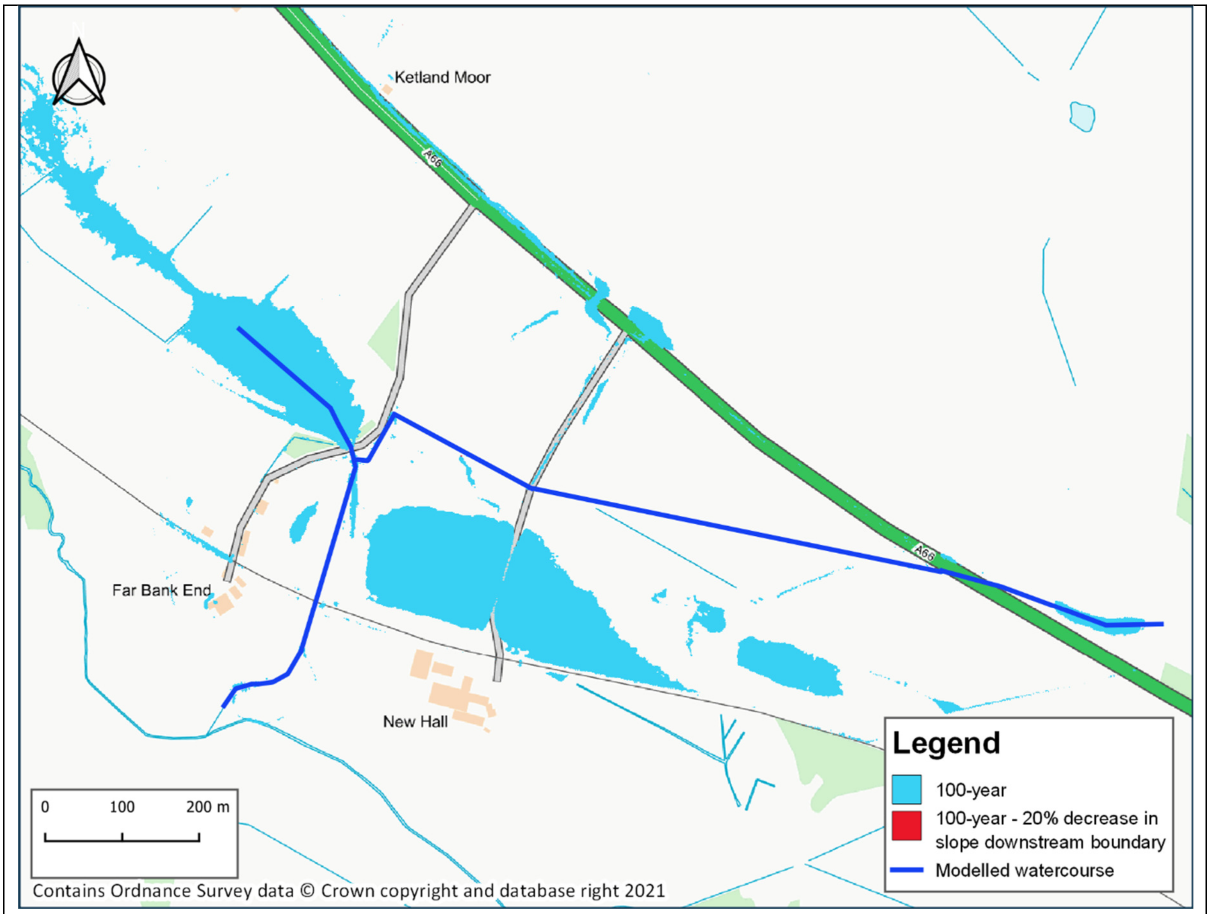

Figure 6-6: Sensitivity analysis for - 20% in bed slope value for downstream boundary

## 8 Key Model Assumptions and Limitations

During any hydraulic modelling study, there will always be associated limitations, for example, with uncertainty and data availability etc. The representation of any complex system by a model requires several assumptions to be made. In the case of the hydraulic model, it has been assumed that:

- Cross sections accurately represent the shape and variation of the river.
- Model parameters have been determined appropriately.
- Design hyetographs are an accurate representation of rainfall of a given AEP.
- The surveyed cross-sections of hydraulic structures and the units used to represent them in the model provide an adequate representation of the situation.
- LIDAR accurately reflects bank heights and particularly that the filtered LIDAR has appropriately removed the influence of vegetation.

A66 Northern Trans-Pennine

# Bowes Bypass Hydraulic Modelling Report

Bowes Bypass

| **Document Verification** | |
|---|---|
| **Project Title** | **A66 Northern Trans-Pennine**<br>Bowes Bypass |
| **Document Title** | Hydraulic Modelling Report |
| **Document Ref** | HE565627-JBAU-XX-07-RP-HM-S3-P02-0001-Scheme7_Modelling_Report |

**Note:** The contents of the Cover Page and Document Verification page are managed by ProjectWise. Users should not edit these fields manually.

| **Rev** | **Suit. Code** | **Suitability** | | **Purpose of Issue** | | |
|---|---|---|---|---|---|---|
| P01 | S3 | Shared for review | | | | |
| | | **Created** | **Checked** | **Reviewed** | **Approved** | **Authorised** |
| | **Name** | Jack Richardson- | Alice Blanchard | Alice Blanchard | Alice Blanchard | |
| | **Date** | 03/11/2021 | 03/11/2021 | 03/11/2021 | 03/11/2021 | |

| **Rev** | **Suit. Code** | **Suitability** | | **Purpose of Issue** | | |
|---|---|---|---|---|---|---|
| P02 | S3 | Shared for review | | --- | | |
| | | **Created** | **Checked** | **Reviewed** | **Approved** | **Authorised** |
| | Name | Jack Richardson | David Kearney | David Kearney | David Kearney | |
| | Date | 14/04/2022 | 14/04/2022 | 14/04/2022 | 14/04/2022 | |

| **Rev** | **Suit. Code** | **Suitability** | | **Purpose of Issue** | | |
|---|---|---|---|---|---|---|
| --- | --- | --- | | --- | | |
| | | **Created** | **Checked** | **Reviewed** | **Approved** | **Authorised** |
| | Name | --- | --- | --- | --- | --- |
| | Date | --- | --- | --- | --- | --- |

| **Fluvial Hydraulic Modelling Report – Scheme 7** | | |
|---|---|---|
| 1 Basic Model Information | | |
| Model Name | Armoury Model<br>Bowes Bypass Model | |
| Primary Watercourses / Water Bodies | Unnamed Tributary of River Greta 7.3<br>Unnamed Tributary of River Greta 7.4<br>Unnamed Tributary of River Greta 7.5 | |
| Designation | Ordinary Watercourse | |
| Model ID | The following table presents information regarding the model scenarios carried out as part of this study. | |
| Armoury Model | | |
| Model Scenario ID | Scenario | Annual Probability |
| Scheme7_UNN704_Q20_014.tcf | Existing Situation Model | 5% |
| Scheme7_UNN704_Q100_014.tcf | | 1% |
| Scheme7_UNN704_Q100_32CC_014.tcf | | 1% + 32% climate change |
| Scheme7_UNN704_ Q100_40CC _014.tcf | | 1% + 40% climate change |
| Scheme7_UNN704_ Q100_61CC _014.tcf | | 1% + 61% climate change |
| Scheme7_UNN704_ Q1000 _014.tcf | | 0.1% |
| Scheme7_UNN704_Q100plus20pct_014.tcf | Sensitivity tests | 1% AEP with +20% flow |
| Scheme7_UNN704_Nplus20pct_Q100_014.tcf | | 1% AEP with + 20% roughness |
| Scheme7_UNN704_Nmin20pct_Q100_014.tcf | | 1% AEP with -20% roughness |
| Scheme7_UNN704_DSBDYmin20pct _Q100_014.tcf | | 1% AEP with -20% flow at downstream boundary |
| Scheme7_UNN704_PostDev_Q20_002.tcf | With-Scheme Situation Model | 5% |
| Scheme7_UNN704_PostDev_ Q100_002.tcf | | 1% |
| Scheme7_UNN704_PostDev_ Q100_61CC _002.tcf | | 1% + 61% climate change |
| Bowes Bypass Model | | |
| Model Scenario ID | Scenario | Annual Probability |
| HE565627-JBAU-XX-07-M2-G-0001-UNN701_FM_017.dat<br>Scheme7_Bowes_Q20_0004.ief<br>Scheme7_Bowes_Q20_0003.tcf | Existing Situation Model | 5% |
| Scheme7_Bowes_Q100_0004.ief<br>Scheme7_Bowes_Q100_0004.tcf | | 1% |
| Scheme7_Bowes_Q100_32CC_0004.ief<br>Scheme7_Bowes_Q100_32CC_0004.tcf | | 1% + 32% climate change |
| Scheme7_Bowes_Q100_40CC_0004.ief<br>Scheme7_Bowes_Q100_40CC_0004.tcf | | 1% + 40% climate change |
| Scheme7_Bowes_Q100_61CC_0004.ief<br>Scheme7_Bowes_Q100_61CC_0004.tcf | | 1% + 61% climate change |
| Scheme7_Bowes_Q1000_0003.ief<br>Scheme7_Bowes_Q1000_0003.tcf | | 0.1% |

| | | |
|---|---|---|
| Scheme7_Bowes_Nplus20pct_Q100_0004.ief<br>UNN701_FM_017_Nplus20pct.dat<br>Scheme7_Bowes_Nplus20pct_Q100_0004.tcf | Sensitivity tests | 1% AEP with +20% roughness |
| Scheme7_Bowes_Nmin20pct_Q100_0004.ief<br>UNN701_FM_017_Nmin20pct.dat<br>Scheme7_Bowes_Nmin20pct_Q100_0004.tcf | | 1% AEP with – 20% roughness |
| Scheme7_Bowes_Q100plus20pct_0004.ief<br>HE565627-JBAU-XX-07-M2-G-0001-UNN701_FM_017.dat<br>Scheme7_Bowes_Q100plus20pct_0004.tcf | | 1% AEP with +20% flow |
| Scheme7_Bowes_Dmin20pct_Q100_0004.ief<br>Scheme7_Bowes_Dmin20pct_Q100_0004.tcf | | 1% with -20% gradient downstream boundary |
| Scheme7_Bowes_PD_Q20_0001.ief<br>Scheme7_Bowes_PD_Q100_0001.ief<br>Bowes_PD_Q20_0001.tcf | With-Scheme Situation Model | 5% |
| Scheme7_Bowes_PD_Q100_0001.ief<br>Scheme7_Bowes_PD_Q100_0001.ief<br>Bowes_PD_Q100_0001.tcf | | 1% |
| Scheme7_Bowes_PD_Q100_61CC_0001.ief<br>Scheme7_Bowes_PD_Q100_0001.ief<br>Bowes_PD_Q100_61CC_0001.tcf | | 1% + 61% climate change |

| **2 Model Input Data** | |
|---|---|
| Incoming Models | No existing hydraulic model was available for this study area. |
| DTM for 2D Model Domain | Armoury Model: National LIDAR Programme DTM 2018-2019<br>Bowes Bypass Model: 1m resolution LIDAR flown in 2019 |
| River channel/Structure survey | Armoury Model: Channel survey collected by JBA Consulting in June 2021.<br>Bowes Bypass Model: Channel survey collected by JBA Consulting between November-December 2020 |
| Additional Data | Mastermap data, As built drawings of existing structures where available, proposed route alignments |

| **3 Model Build Overview** | | | |
|---|---|---|---|
| Software | Armoury Model 1D domain: ESTRY<br>Bowes Bypass 1D Domain: Flood Modeller | | |
| | 2D domains: TUFLOW | | |
| Model Reference | Armoury Model: HE565627-JBAU-XX-07-MO-HM-0002-Scheme7_Armoury_hydraulic_model<br>Bowes Bypass Model: HE565627-JBAU-XX-07-MO-HM-0001-Scheme7_BowesBypass_hydraulic_model | | |
| Model Schematisation | Figure 3-1 shows the schematisation of the Armoury Model.<br>Figure 3-2 shows the schematisation of the Bowes Bypass Model. | | |
| Model Reaches | The table below shows the watercourse reaches defined in the models. They are also shown in Figure 3-1 and Figure 3-2. | | |
| Watercourse Name | Upstream model node | Downstream model node | Total Reach length (km) |

| | | | |
|---|---|---|---|
| Armoury Model | | | |
| Unnamed Tributary of River Greta 7.3 (UNN704) | UNN704_1563 | U704_0157 | 1406 |
| Bowes Bypass Model | | | |
| Unnamed Tributary of River Greta 7.5 (UNN701) | UNN701_605 | UNN701_0042 | 0.56 |
| Unnamed Tributary of River Greta 7.4 (UNN702) | UNN702_0203 | UNN702_0000 | 0.20 |
| Unnamed Tributary of River Greta 7.4 (UNN703) | UNN703_0142 | UNN703_0000 | 0.14 |

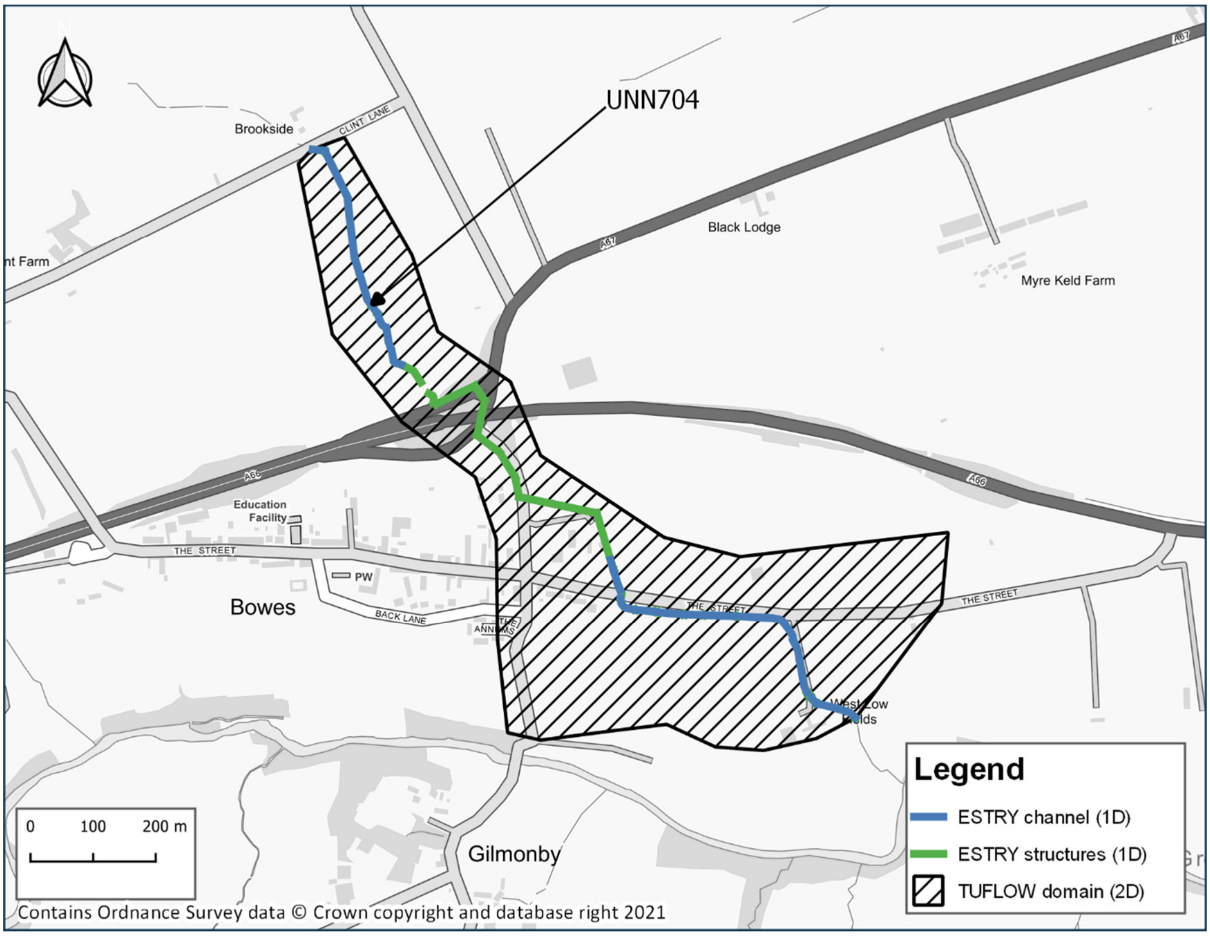

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Figure 3-1: Armoury model overview

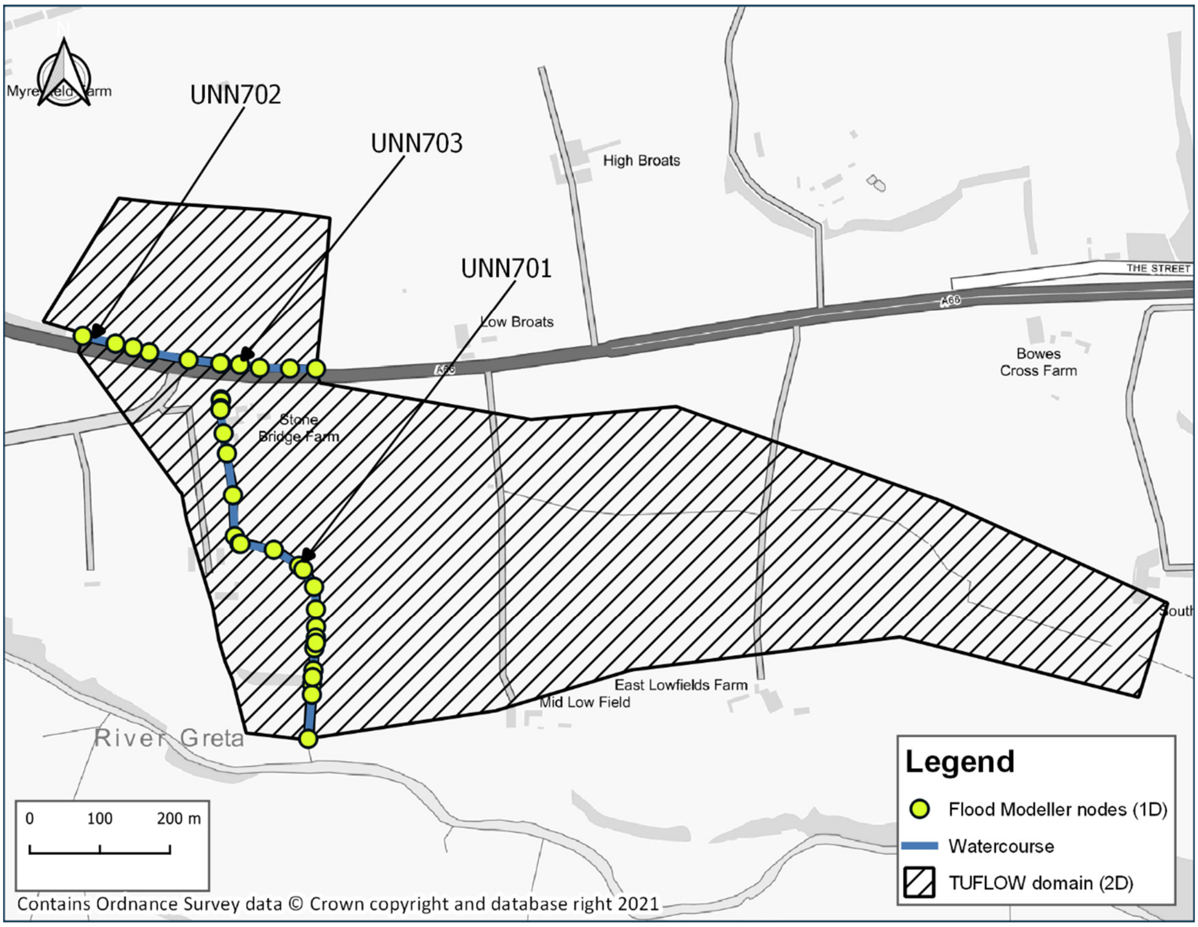


Figure 3-2: Bowes Bypass model overview

| **4 Baseline model schematisation** | |
|---|---|
| 4.1 1D Domain | |
| Channel representation | The channel system has been based upon the most recent survey data set available for the area. The channels have been represented within the 1D domain across the study reach. |
| Structure representation | Existing structures have been based upon the most recent survey data set available. All significant structures within the study area have any modelling assumptions documented within this report (Section 5). Additionally, any structures which were not included within the hydraulic model based on the assumption that they were not deemed to be hydraulically significant are also recorded. |
| Inflow boundaries | Flow has been applied with a flow-time (QT) boundary at a point for the upstream nodes of each watercourse, and with lateral inflow nodes for the intervening catchment. Further information can be found in the FEH calculation record. |
| Climate Change | Climate change uplifts have been applied for the central, higher central and upper end allowances for the Tees Management Catchment using the Environment Agency July 2021 allowances. |
| Downstream boundary | Armoury Model:<br>Stage-flow (HQ) boundaries are applied at the downstream extents of the watercourse in the 1D domain. The reason for this choice of boundary was that no existing model was available at the downstream boundary locations to accurately extract water level data for a given AEP event. To understand the implications of using a HQ boundary, sensitivity testing has been conducted to quantify the impacts in changing the boundary parameters.<br>Bowes Bypass Model:<br>Normal depth downstream boundary has been applied at the downstream extents of the watercourse in the 1D domain. The reason for this choice of boundary was that no existing model was available at the downstream boundary locations to accurately extract water level data for a given AEP event. To understand the implications of using a normal depth boundary, sensitivity testing has been conducted to quantify the impacts in changing the boundary parameters. |
| Hydraulic roughness values used | Channel roughness values have been represented in the model by Manning’s ‘n’ values, defined on a reach basis. In order to determine the roughness of channel cross sections, photographic evidence collected during site visits and survey collection were used as a reference alongside application of the method published by Cowan (1956).<br>Bed roughness values range from 0.040-0.060 with a value of 0.060 for all banks.<br>Structure roughness values range from 0.013-0.020.<br>To understand the implications of using these manning’s n values, sensitivity testing has been conducted to quantify the impacts in changing these parameters. |
| Labelling/naming convention used | All nodes have an ID of U704_XXXX where XXXX is the chainage upstream.<br>The following suffixes have been used: |

| | |
|---|---|
| C or CU | Culvert |
| W | Weir or ESTRY spill |
| J | Junction |
| Sp | Flood Modeller spill |
| B | Bridge |
| i, i2, i3 | Interpolate |
| MH | Manhole |
| Ofl | Overflow |
| u/d | Upstream of downstream node |

Culverted watercourse sections have been labelled according to drawings and levels supplied by Amey.

| | | | |
|---|---|---|---|
| 4.2 2D Domain | | | |
| Area of 2D Domains | Armoury Model: 0.3km2<br>Bowes Bypass Model: 0.55km2 | DTM data source | LIDAR |
| Resolution of grids | 2.0m | DTM Resolution | 1.0m |
| Modifications to topography and reasons | Armoury Model | | |
| | 2d_zsh_Banks_UNN704_L_004.shp<br>2d_zsh_Banks_UNN704_P_004.shp | The top of bank elevations have been stamped using Z shapes. Elevations are based on surveyed cross sections and LIDAR. | |
| | 2d_zsh_Spills_UNN704_L_002.shp<br>2d_zsh_Spills_UNN704_P_002.shp | The elevation of structure decks have been stamped using Z shapes. Elevations are based on surveyed cross sections. | |
| | 2d_zsh_DTMEdits_UNN704_L_002.shp | The 2D levels at SX boundaries and pit/manhole covers have been stamped using Z shapes in order to improve model stability. Elevations are based on surveyed cross sections and LIDAR. | |
| Modifications to topography and reasons | Bowes Bypass Model | | |
| | 2d_zsh_UNN7_Banks_L_002.shp<br>2d_zsh_UNN7_Banks_P_002.shp | The top of bank elevations have been stamped using Z shapes. Elevations are based on surveyed cross sections and LIDAR. | |

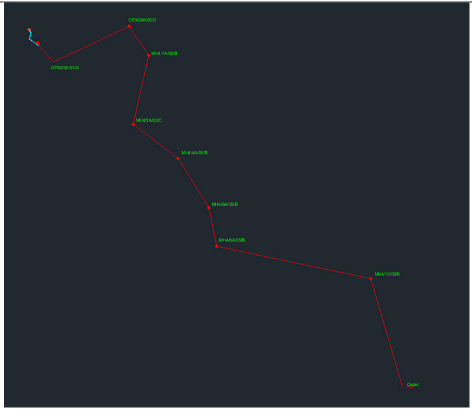
| | |
|---|---|
| Hydraulic roughness values used | Manning's n values have been used to represent hydraulic roughness in the 2D domain. The following roughness values were used in the model and are based on land cover types recorded in the Ordnance Survey MasterMap Topographic Area layer dataset.<br>Armoury Model: dry stone walls have been represented with a Manning's n value of 0.300. . |

| Land Cover | Manning's 'n' value |
|---|---|
| Generic floodplain roughness values | 0.050 |
| Boulders | 0.065 |
| Coniferous trees | 0.120 |
| Coniferous trees – scattered / Orchard | 0.070 |
| Coppice or osiers | 0.090 |
| Marsh Reeds or Saltmarsh | 0.060 |
| Non coniferous trees | 0.090 |
| Non-coniferous trees – scattered | 0.060 |
| Rough grassland | 0.060 |
| Scrub | 0.070 |
| Rock | 0.070 |
| Heath | 0.090 |
| Building | 0.300 |
| General surface – multi surface | 0.050 |
| General surface – step | 0.050 |
| General surface - manmade | 0.050 |
| General surface - natural | 0.060 |
| Glasshouse | 0.200 |
| Inland water | 0.045 |
| Landform | 0.060 |
| Landform – slope | 0.060 |
| Landform – cliff | 0.060 |
| Path – step | 0.050 |
| Path | 0.050 |
| Rail | 0.045 |
| Road | 0.035 |
| Roadside | 0.050 |
| Structure | 0.300 |
| Structure – upper level of communication | 0.300 |
| Structure – pylon | 0.060 |
| Tidal water – foreshore | 0.055 |
| Tidal water | 0.055 |
| Unclassified | 0.060 |

| | |
|---|---|
| 4.3 1D-2D Linking | |
| A HX boundary is used to link the 1D and 2D domains along the top of banks. SX boundaries are applied to link the 1D and 2D domains at structures. Elevations of HX and SX cells are set using Z shapes outlined in Section 4.2. | |
| Model Boundaries – Downstream Conditions | A 2D HQ boundary is used at the downstream extent of the 2D domain based on slope values derived from LIDAR. |
| 4.4 Representation of Defences | |
| Defences | There are no formal defences within the study area. As such, all model runs are considered to be undefended. |

| **5 Structures** | | | |
|---|---|---|---|
| General Assumptions | | | |
| At structures where only one face has been surveyed, a copy of the surveyed upstream face was used to represent the downstream face.<br>Bridge decks have been represented using spill units where it is likely there would be no complex overland flows which potentially would take water away from the channel.<br>Modelled structures have been schematised using the most recent channel survey taken by JBA Consulting between November 2020 and June 2021. | | | |
| Armoury Model | | | |
| Model/Survey ID | Structure | How has this structure been modelled? | Photo (view of upstream face unless specified) |
| U704_1544B | Concrete footbridge | This structure has been modelled as a BB bridge unit in ESTRY. Overtopping flow has been modelled with a WW weir unit. |  |
| U704_1281B | Concrete footbridge | This structure has been modelled as a BB bridge unit in ESTRY. Overtopping flow has been modelled with a WW weir unit. |  |
| U704_1265B | Dry stone wall over channel with opening | This structure has been modelled as a BB bridge unit in ESTRY. Overtopping flow has been modelled with a WW weir unit. |  |

| | | | |
|---|---|---|---|
| U704_1169C | Stone culvert | This structure has been modelled as a R (rectangular) culvert unit in ESTRY. Overtopping flow has been represented in the 2D domain. | <br>1.Location of culvert inlet indicated with arrow.<br><br>2.Culvert outlet (U704_1127) |
| U704_1105C | Stone culvert | This structure has been modelled as a R (rectangular) culvert unit in ESTRY. Overtopping flow has been represented in the 2D domain. |  |

| | | | |
|---|---|---|---|
| U704_1088C | Grated overflow structure with concrete wall and circular inlet and outlet pipes | This structure has been modelled as a C (circular) culvert unit in ESTRY. A network point (R) has been used to represent overflow through the trash screen. |  |
| CP_23A;<br>CP3_25A;<br>MH4_1A;<br>MH4_2A;<br>MH4_4A;<br>MH4_5A;<br>MH4_6A;<br>MH4_10 | Series of pipes and manholes | These structures have been modelled with C (circular) culverts and network point (R) units in ESTRY. Dimensions are based on information provided by Amey, with levels calibrated to most recent, available LiDAR data. Manhole chamber and cover dimensions are set to the maximum pipe diameter (0.6 x 0.3m) to |  Drawing supplied by Amey.<br>Images unavailable. |

| | | | |
|---|---|---|---|
| | | account for surface drainage through grates. | |
| U704_0711 | Pipe network outlet | |  Downstream face of outlet. |
| U704_0695W | Concrete weir | This structure has been modelled with a WW weir unit in ESTRY. |  1. Upstream face of weir  2. Downstream face of weir |
| UNN704_0699 | Concrete and stone wall with metal bar trash screen | Not included in the 1D model. Roughness increased in 2D domain (floodplain) to represent the stone wall adjacent to the channel. |  |

| | | | |
|---|---|---|---|
| U704_0657C | Concrete, arch-shaped culvert under "The Street" | This structure has been modelled as a I (irregular) culvert unit in ESTRY. Overtopping flow has been modelled with a WW weir unit. | <br>1. Upstream face of culvert inlet.<br><br>2. Downstream face or culvert outlet (U704_0644). |
| U704_0612B | Stone wall with plinth and wire trash screen | This structure has been modelled as a BB bridge unit in ESTRY. Overtopping flow has been modelled with a WW weir unit. The wire trash screen has been represented with an exit loss coefficient value of 1.5. |  |
| U704_0581C | Concrete circular culvert under farm track | This structure has been modelled as a C (circular) culvert unit in ESTRY. Overtopping flow has been modelled with a WW weir unit. |  |

| | | | |
|---|---|---|---|
| U704_0533B | Stone wall | This structure has been modelled as a BB bridge unit in ESTRY. Overtopping flow has been modelled with a WW weir unit. |  |
| U704_0504 | Wooden footbridge | This structure has been modelled as a BB bridge unit in ESTRY. Overtopping flow has been modelled with a WW weir unit. |  |
| U704_0449C | Concrete, circular pipe through stone wall | This structure has been modelled as a C (circular) culvert unit in ESTRY. Overtopping flow has been modelled with a WW weir unit. |  |
| U704_0251C | Stone circular culvert. | This structure has been modelled as a C (circular) culvert unit in ESTRY. Overtopping flow has been modelled with a WW weir unit. |  |
| U704_0229 | X2 stone pipes through stone wall in channel | This structure has been modelled as two C (circular) culverts unit in ESTRY. Overtopping flow has been modelled with a WW weir unit. | <br>1. Upstream face of inlets |

| | | | |
|---|---|---|---|
| | | | <br>2. Downstream face of outlets |
| Bowes Bypass Model | | | |
| Unnamed watercourse 701 | | | |
| ID | Structure | How has this structure been modelled? | Photo (view of upstream face unless specified) |
| UNN701_0655C | A66 concrete culvert | This structure has been modelled with a circular conduit unit in Flood Modeller. Overtopping flow has been represented in the 2D domain. | <br>Upstream face:<br><br>Downstream face: |
| UNN701_0603 | Arch culvert | This structure has been modelled as a sprung arch conduit (US) and a rectangular conduit (DS). Overtopping flow has been represented in the 2D domain. | <br>Upstream face: |

| | | | |
|---|---|---|---|
| | | |  Downstream face: |
| UNN701_0590 | Stone wall over channel | This structure has been modelled with an arch bridge unit in Flood Modeller. Overtopping flow has been represented with a spill unit. |  |
| UNN701_0390 | Wooden footbridge | This structure has been modelled with an arch bridge unit in Flood Modeller. Overtopping flow has been represented with a spill unit. |  |
| UNN701_0296 | Circular, concrete culvert | This structure has been modelled with a circular conduit unit in Flood Modeller. Overtopping flow has been represented with a spill unit. |  |

## 6 Model Proving

### 6.1 Model Performance

Armoury Model

Typically, during a stable model run, the cumulative mass error will have a value of ±1%. Measures were taken to improve cumulative mass error including applying alpha factors to HX lines, using Z shapes at SX cells, re-schematising sections upstream and adjusting downstream boundaries. These actions saw some improvement to the overall model stability, however, further re-schematisation to try to reduce the mass error would have fundamentally changed the flow mechanisms in the model. Water levels and flows have been checked throughout the hydraulic model for the 1% and 0.1% AEP events. There are minimal oscillations throughout the model and stage profiles are generally smooth. Therefore whilst the cumulative mass error is outside the typical range, the model is still considered to be stable.

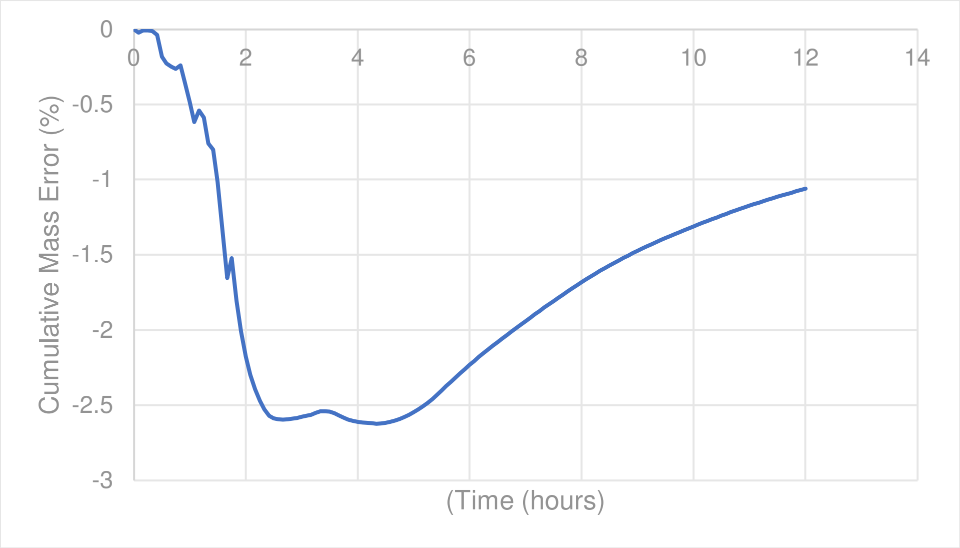


Figure 6-1: Cumulative mass error plot for 1000-year (0.1% AEP) event

The dVol plot is shown to be smooth with minimal oscillations and as such indicates that the model is stable.

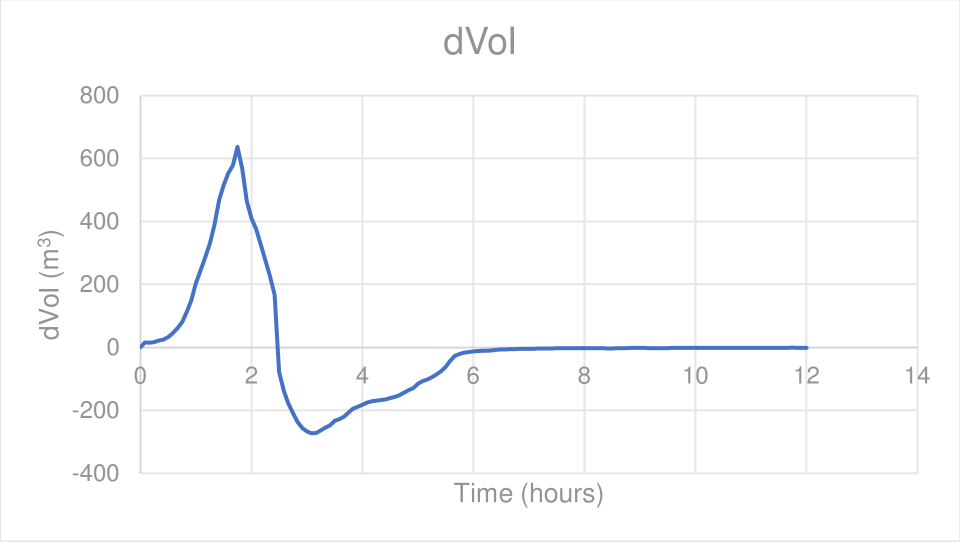
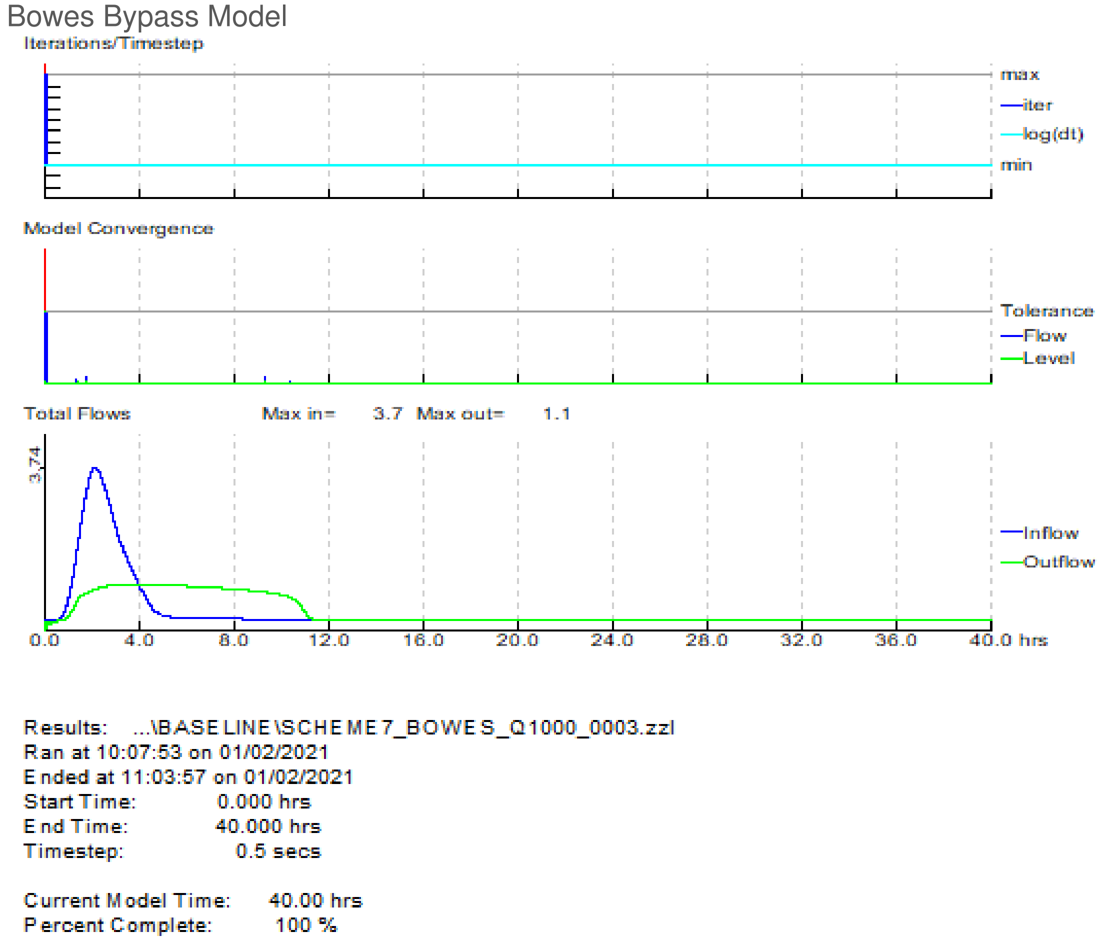


Figure 6-2: dVol plot for 1000-year (0.1% AEP) event



```
Results:    ...\BASELINE\SCHEME7_BOWES_Q1000_0003.zzl
Ran at 10:07:53 on 01/02/2021
Ended at 11:03:57 on 01/02/2021
Start Time:          0.000 hrs
End Time:           40.000 hrs
Timestep:              0.5 secs

Current Model Time:     40.00 hrs
Percent Complete:        100 %
```

Figure 6-3: Flood Modeller model performance

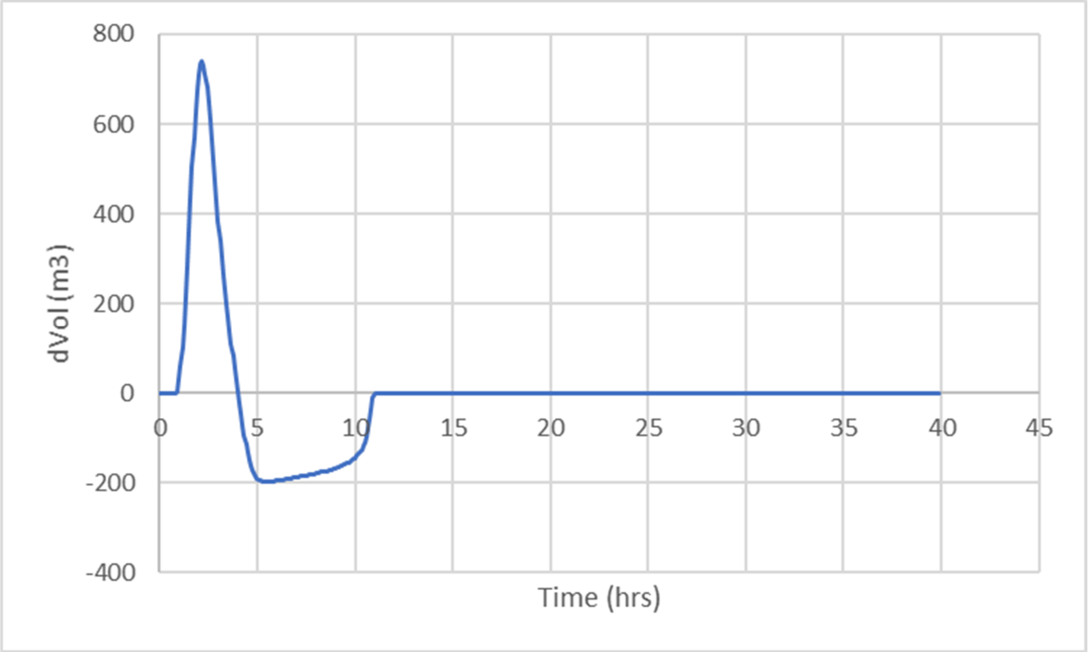


Figure 6-4: TUFLOW dVol plot

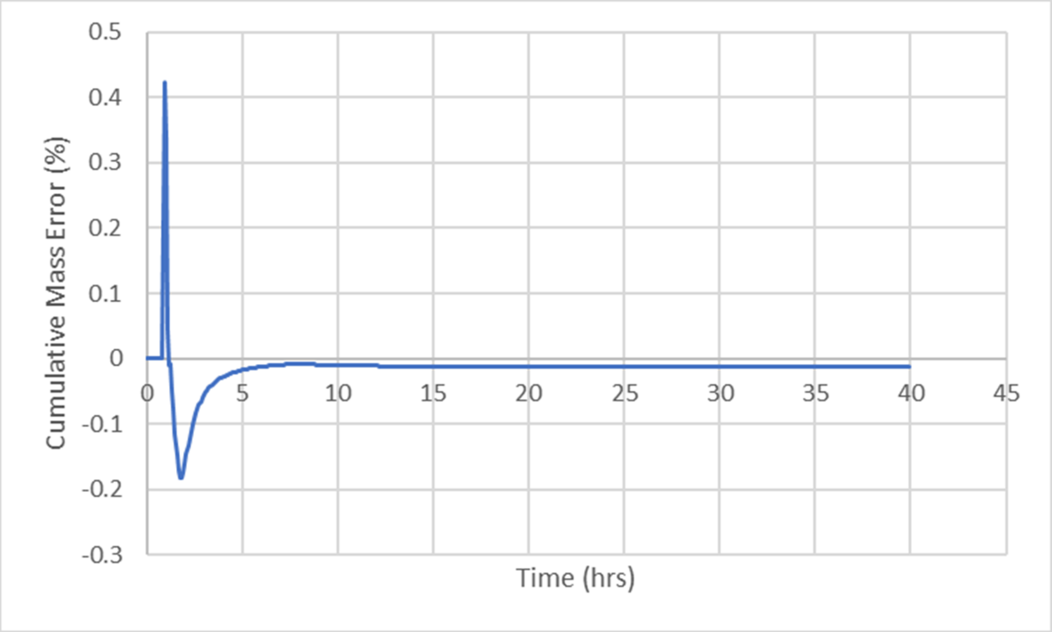
<table>
<tr><td colspan="2">

Figure 6-5: TUFLOW cumulative mass error<br>The Flood Modeller convergence plot shows smooth flows into and out of the model with no incidences of poor convergences. Flow and stage profiles have been checked in the model and are generally smooth with minimal oscillations, indicating the model is performing well. The dVol plot is shown to be smooth and the cumulative mass error is within a range of +1 to -1 for the entirety of the simulation.</td></tr>
<tr><td colspan="2">6.2 Model Verification</td></tr>
<tr><td>Calibration</td><td>No gauge data was available for the study area to allow the model to be calibrated to. Information on historical flood risk was requested from the Lead Local Flood Authority but no information was provided. Environment Agency Recorded Flood Outline does not show historic flooding in this location.</td></tr>
<tr><td>Previous Model Comparison</td><td>No previous hydraulic model results are available for the study area for comparison.</td></tr>
<tr><td>Flood Zone Comparison</td><td>Fluvial Flood Zone data is unavailable for the model extent. Surface water flood maps have therefore been used as a comparison.<br>Armoury Model:<br>Figure 6-6 shows that modelled extents generally show a good correlation to the Risk of Flooding from Surface Water (RoFSW) extents.<br>Bowes Bypass Model:<br>Figure 6-7 shows that modelled extents generally show a good correlation to the Risk of Flooding from Surface Water (RoFSW) extents, although the modelled extent is notably greater north of the A66.</td></tr>
</table>

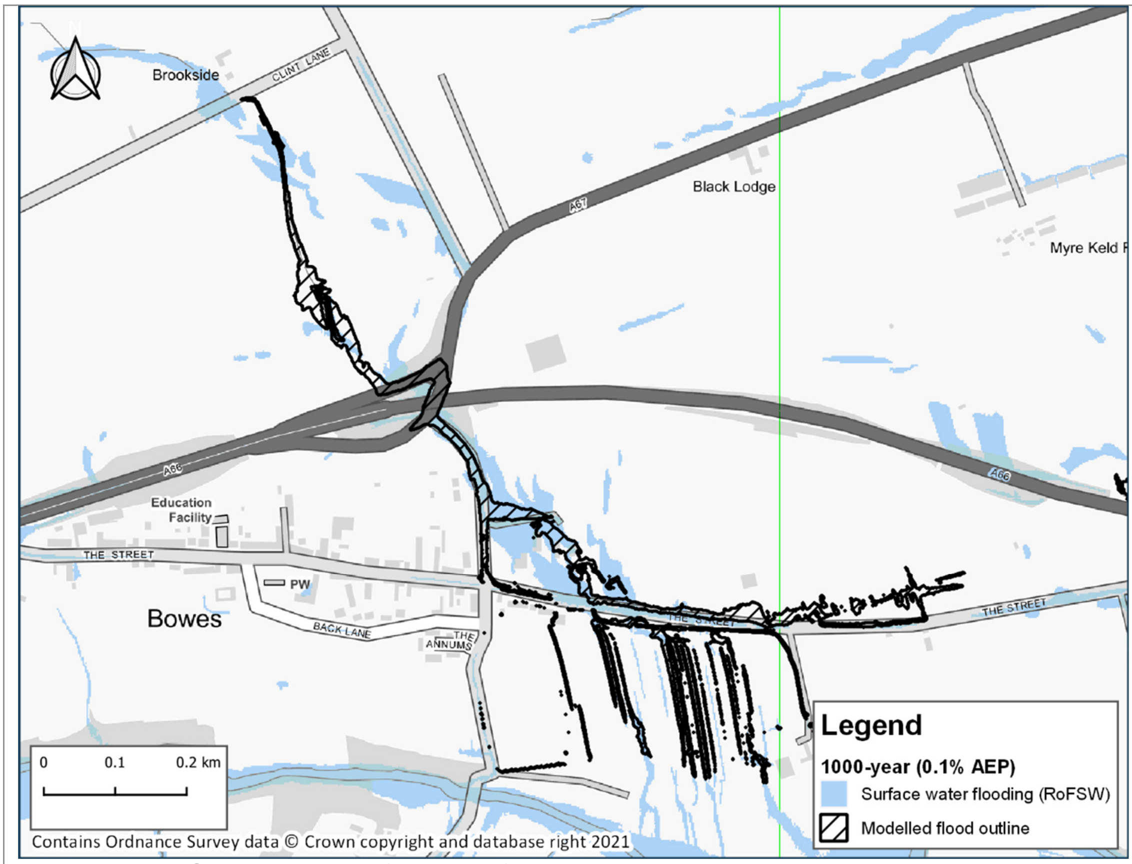


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Figure 6-6: Comparison to surface water flood maps in 1000-year (0.1% AEP) event – Armoury Model

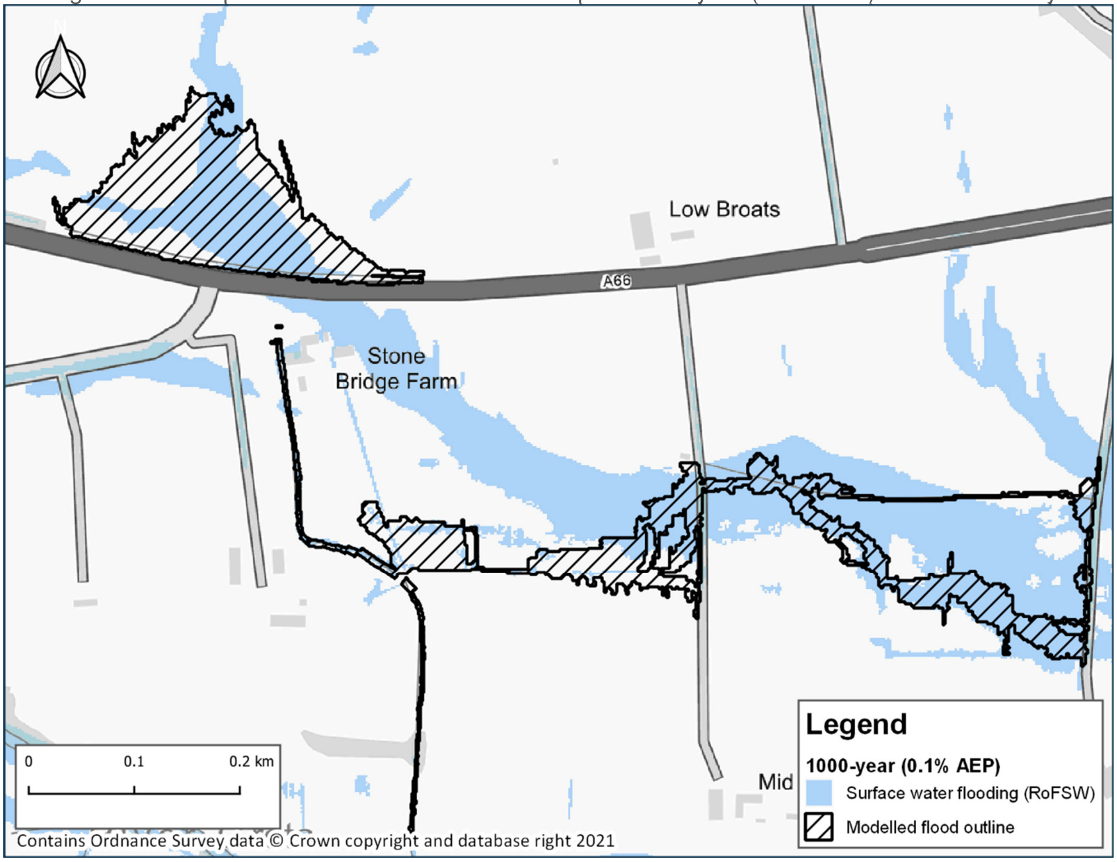

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Figure 6-7: Comparison to surface water flood maps in 1000-year (0.1% AEP) event – Bowes Bypass Model

## 6.3 Sensitivity Analysis

Sensitivity tests were carried out for the 1% AEP existing situation model to assess the model response to the change in:

- Flow: Model inflows increased by 20%
- Roughness coefficient: In-channel and roughness values changed by +20% and -20%
- Downstream boundary: Flow decreased by -20% (Armoury Model), gradient decreased by 20% (Bowes Bypass Model).

The table below shows the maximum, minimum and average change in in-channel water levels relative to the existing situation model for each modelled reach with increase in flow and increase and decrease in roughness coefficients.

Armoury model:

- The downstream boundary sensitivity test showed a maximum increase in water levels at the UNN704_657C. This is a result of a known instability in the model at this location caused by a sensitivity to roughness and downstream boundary. This instability does not exist in the baseline model and is approximately 450m downstream of the proposed alignment.

Bowes Bypass Model:

- The maximum sensitivity to downstream boundary condition occurs at the downstream node of the model. Sensitivity to downstream boundary extends approximately 140m upstream.

**Armoury Model**

| | | | |
|---|---|---|---|
| Watercourse | UNN704 | | |
| | Change in peak water level (m) | | |
| | Maximum | Minimum | Average |
| +20% Flow | 0.12 | -0.16 | 0.02 |
| +20% Roughness | 0.17 | -0.50*(-0.08) | -0.02 |
| -20% Roughness | 0.77* (0.09) | -0.19 | -0.01 |

*These values are a result of modelling instability at a single node during the sensitivity run. Values in brackets represent change if this node is excluded from calculations.

**Bowes Bypass Model**

| | | | |
|---|---|---|---|
| Watercourse | UNN701(includes short reaches for UNN702 and UNN703) | | |
| | Change in peak water level (m) | | |
| | Maximum | Minimum | Average |
| +20% Flow | 0.15 | 0.00 | 0.04 |
| +20% Roughness | 0.04 | -0.13 | -0.02 |
| -20% Roughness | 0.02 | -0.07 | -0.04 |

## 7 Model Build – With-Scheme Situation Model

| **Scenario Definition** | The proposed scenario model incorporates changes outlined in the Scheme 7 design at Bowes.<br>Figures 7-1 to 7-2 show the proposed features of the A66 NTP scheme within the model areas.<br>The following sections explain how the features were incorporated into the model. |
|---|---|

### Flood Modeller 1D Model

Bowes Bypass

- Extension of existing A66 culvert U701_0655 from 50m to 67m length.
- Adjustment of U702 and U703 open channel sections with proposed levels based on proposed 3D surface and existing LIDAR ground levels. The channel in this location, north of the proposed A66, will be realigned further north in the proposal.

### TUFLOW 1D Model (ESTRY)

Armoury

- Pipe network S7_C1_002 updated from inlet upstream of proposed A66 (in line with low point of drainage ditch) to MH_2AC. The pipe network from MH_2AC and downstream is unchanged.

Culvert U704_1105C removed.

### TUFLOW 2D Model

Bowes Bypass

- Inclusion of proposed scheme 3D surface

Armoury

- Inclusion of proposed scheme 3D surface
- Flows from outlet of existing culvert (U704_1169C) and proposed pipe network inlet (S7_C1_001) represented in the 2D domain with SX connections to transfer flows from the 1D to 2D, and then back into the 1D. This was previously represented in the 2D domain and with culvert U704_1105C.

### Design Detail Sources

In addition to direct communication with the design team the following sources of information were utilised:

Structures

- HE565627-AMY-HDG-S07-SH-CD-000001.xlsx

Topography

- ACAD-HE565627-AMY-HDG-S07-M3-CD-000002-Model.dwg

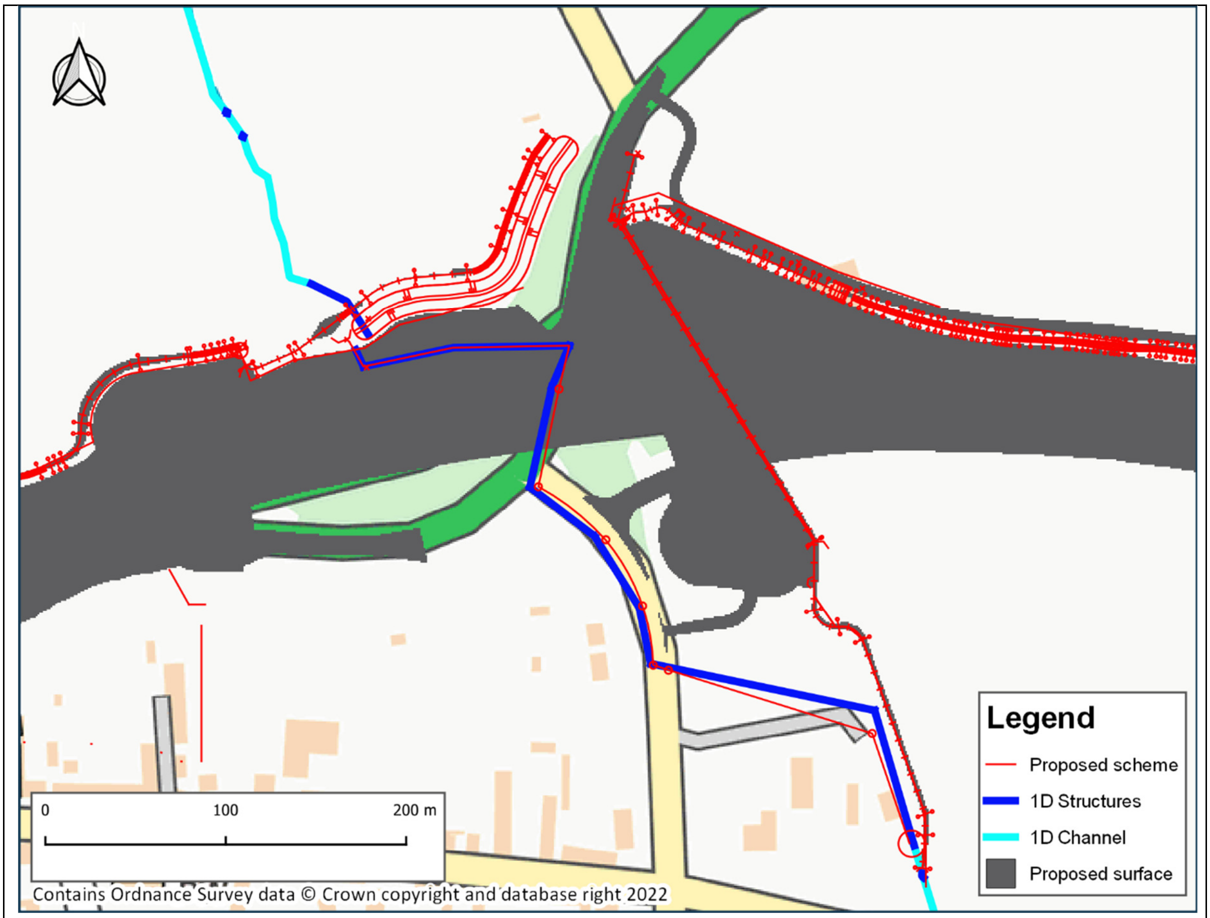

Figure 7-1: Scheme 7 proposal – Armoury model

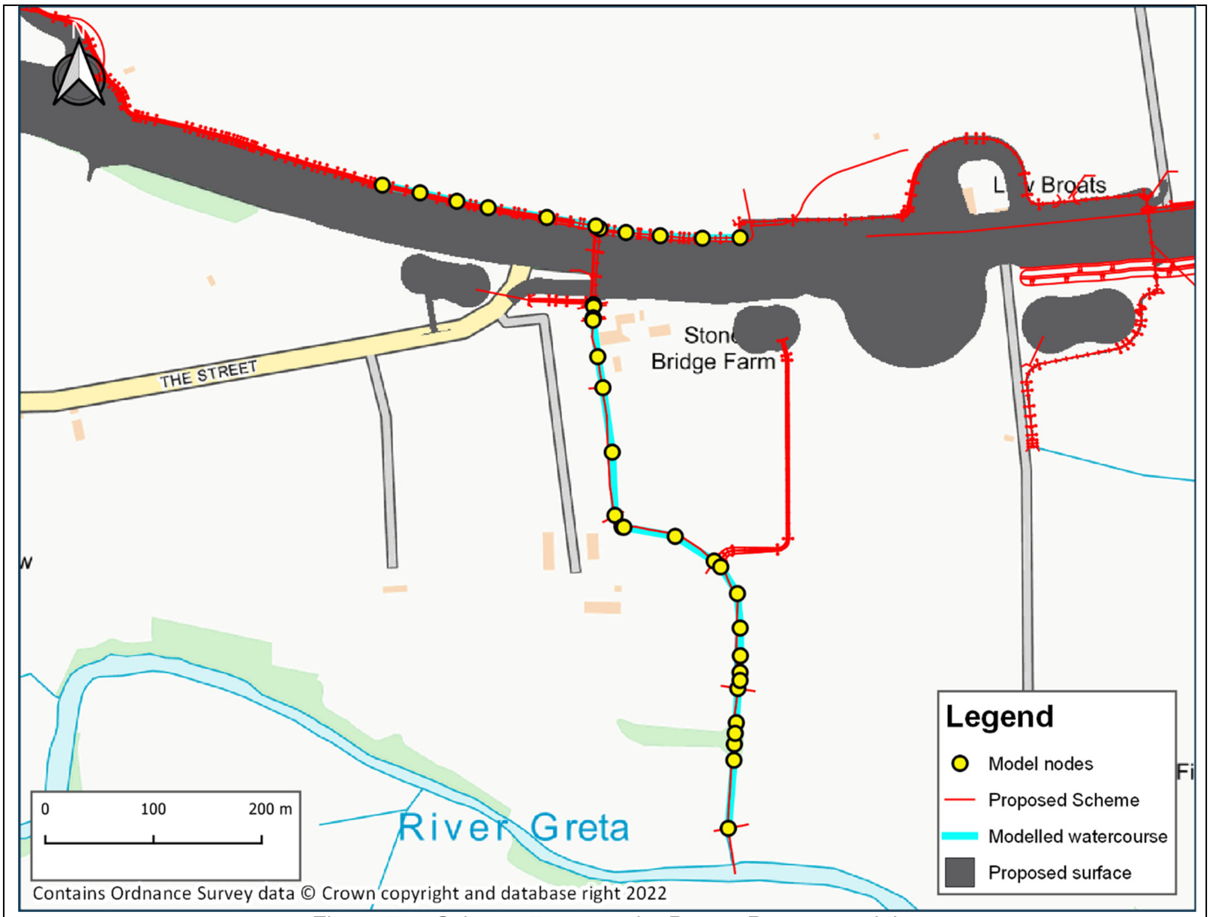

Figure 7-2: Scheme 7 proposal – Bowes Bypass model

## 8 Impact of proposed scheme

### Change in peak water level

Changes in peak water level between the existing situation and with scheme situation are provided in the table below for the 50% AEP, 5% AEP and 1% AEP with climate change events.

| Location | Model Node | Change in Peak Water Level (m) | | |
|---|---|---|---|---|
| | | 5% AEP | 1% AEP | 1% AEP + 61% climate change |
| Bowes Bypass model upstream of A66* | U702_0105 | +0.14 | +0.16 | +0.16 |
| Bowes Bypass model downstream of A66 | UNN701_0527 | -0.01 | -0.01 | -0.01 |
| Armoury model upstream of A66 | U704_1266 | -0.00 | -0.00 | -0.00 |
| Armoury model downstream of pipe network | U704_0695d | +0.01 | +0.00 | +0.03 |

*Changes in peak water level at this location relate to the bed elevation changes made in the proposed model.

### Pass-Forward Flow

The pass-forward flow at the downstream end of the model has been assessed to see what the likely effect will be for flood risk downstream of the existing A66. The table below shows the flow changes between the existing situation and with-scheme scenarios, at locations immediately downstream from the scheme.

| Location | Model Node | Change in Peak Flow (m3/s) | | |
|---|---|---|---|---|
| | | 5% AEP | 1% AEP | 1% AEP + 61% climate change |
| Bowes Bypass model, Downstream of A66 | UNN701_0527 | -0.0 | -0.0 | -0.0 |
| Armoury model, Downstream of pipe network | U704_0695d | +0.1 | +0.1 | +0.1 |

### Depth Impact Analysis

Figures 8-1 to 8-6 show the depth impact analysis for the Scheme 7 proposal. Peak flood depths have been compared between the existing situation and with-scheme models for the 20-year, 100-year and 100-year plus 61% climate change events. Areas with red shading show increases in flood depths, and areas of green show a reduction in flood depths. Areas in blue show no significant changes.

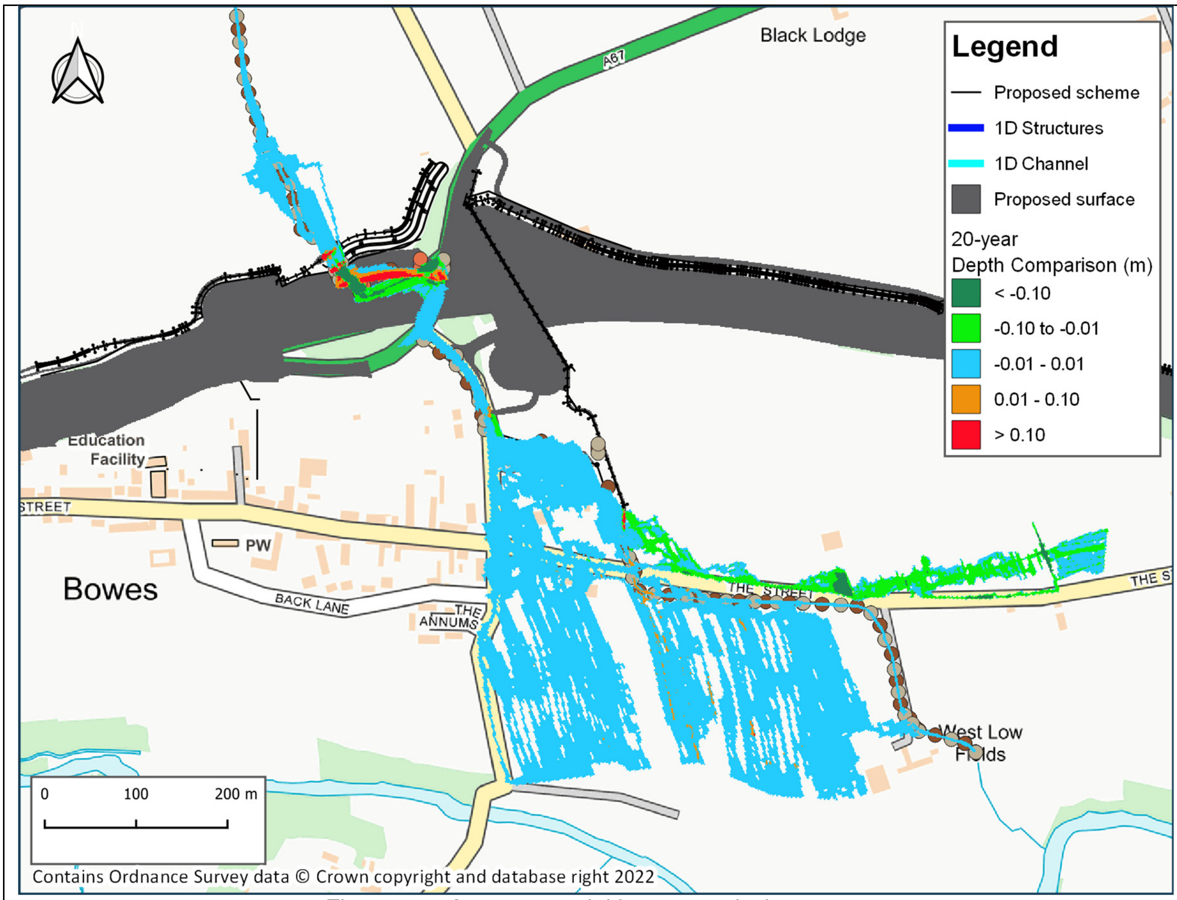

Figure 8-1: Armoury model impact analysis - 20-year

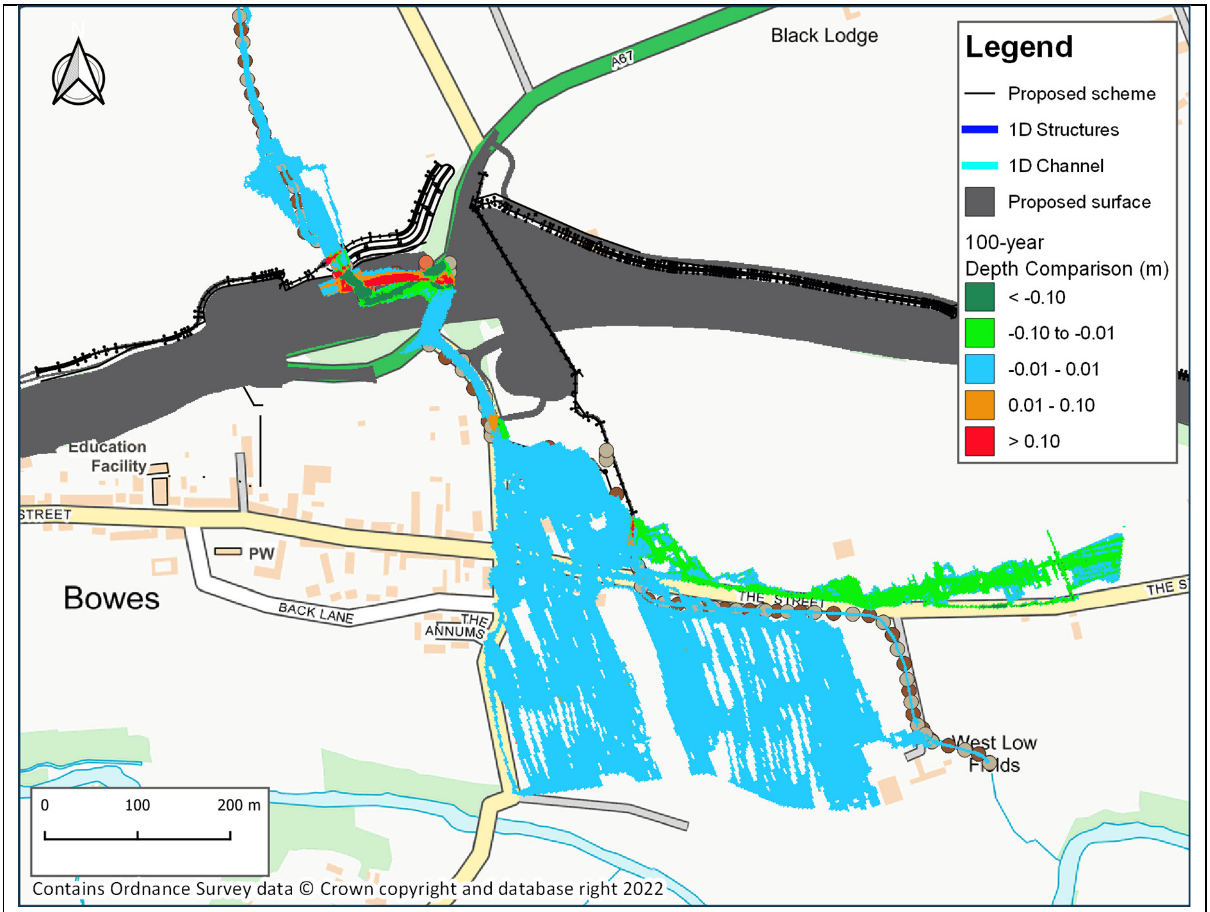

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Figure 8-2: Armoury model impact analysis - 100-year

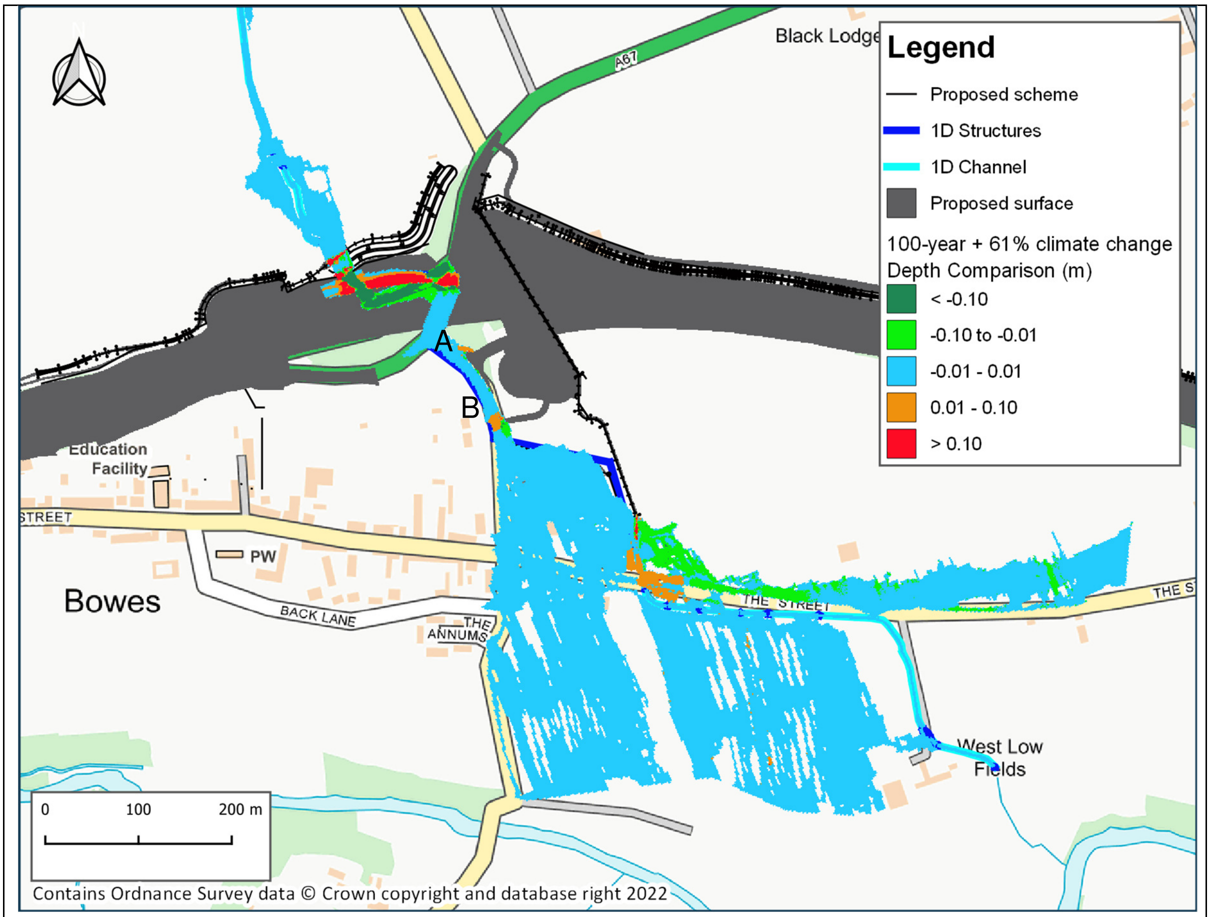

Figure 8-3: Armoury model impact analysis - 100-year + 61% climate change

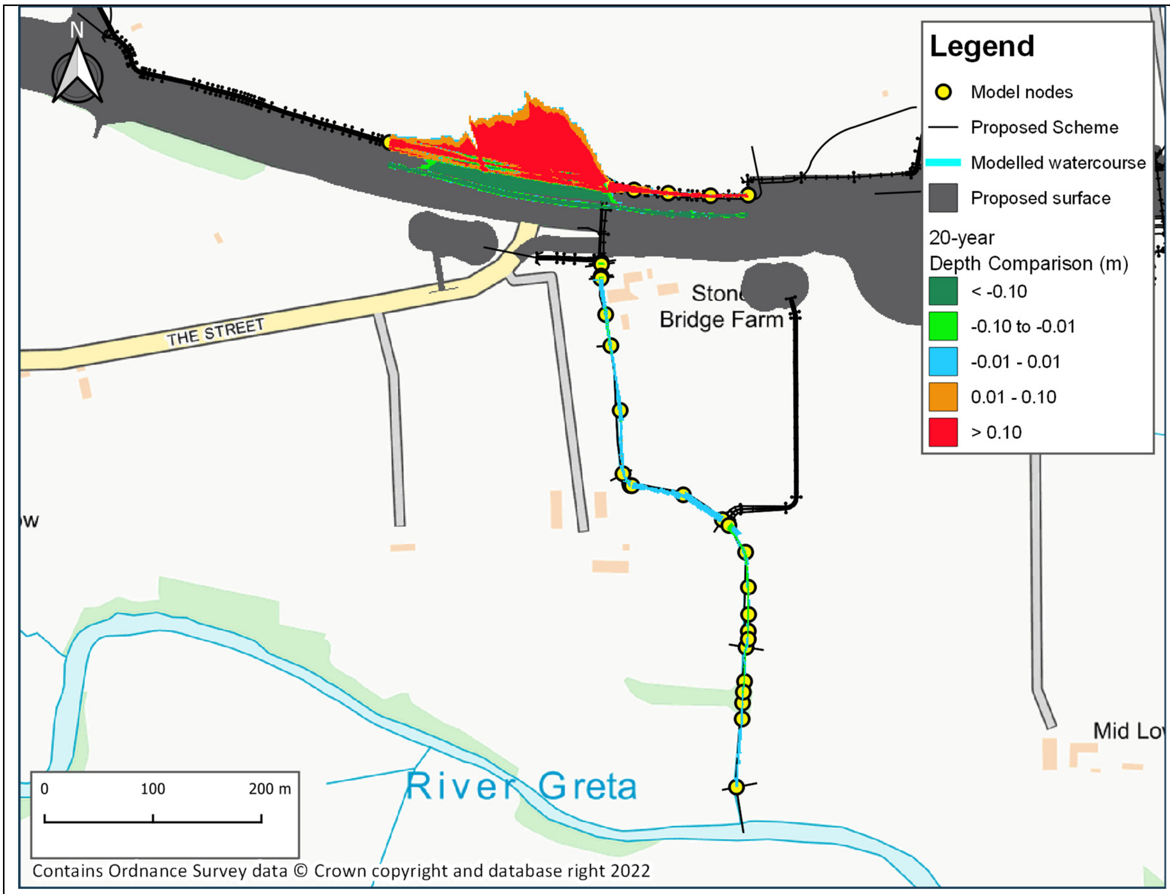

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Figure 8-4: Bowes Bypass model impact analysis - 20-year

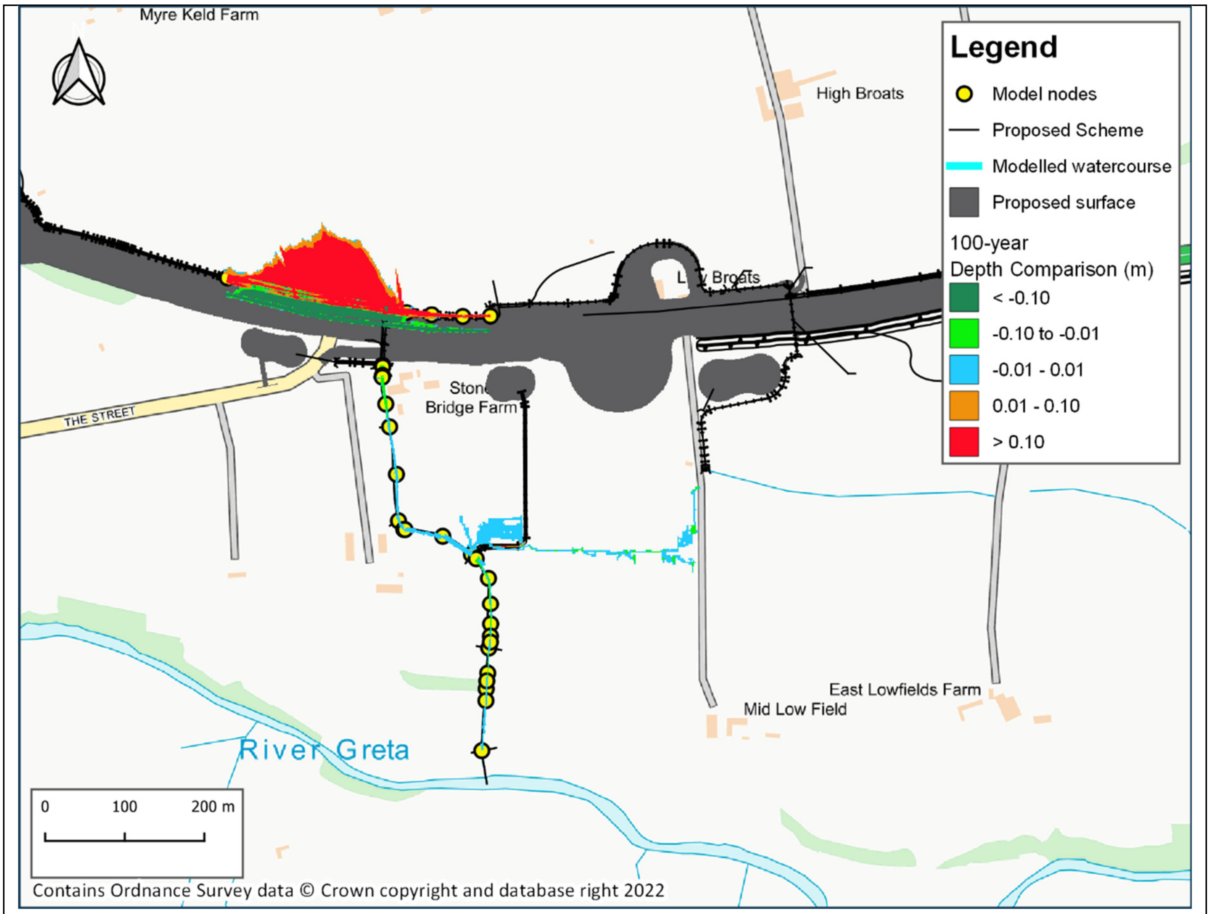

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Figure 8-5: Bowes Bypass model impact analysis - 100-year

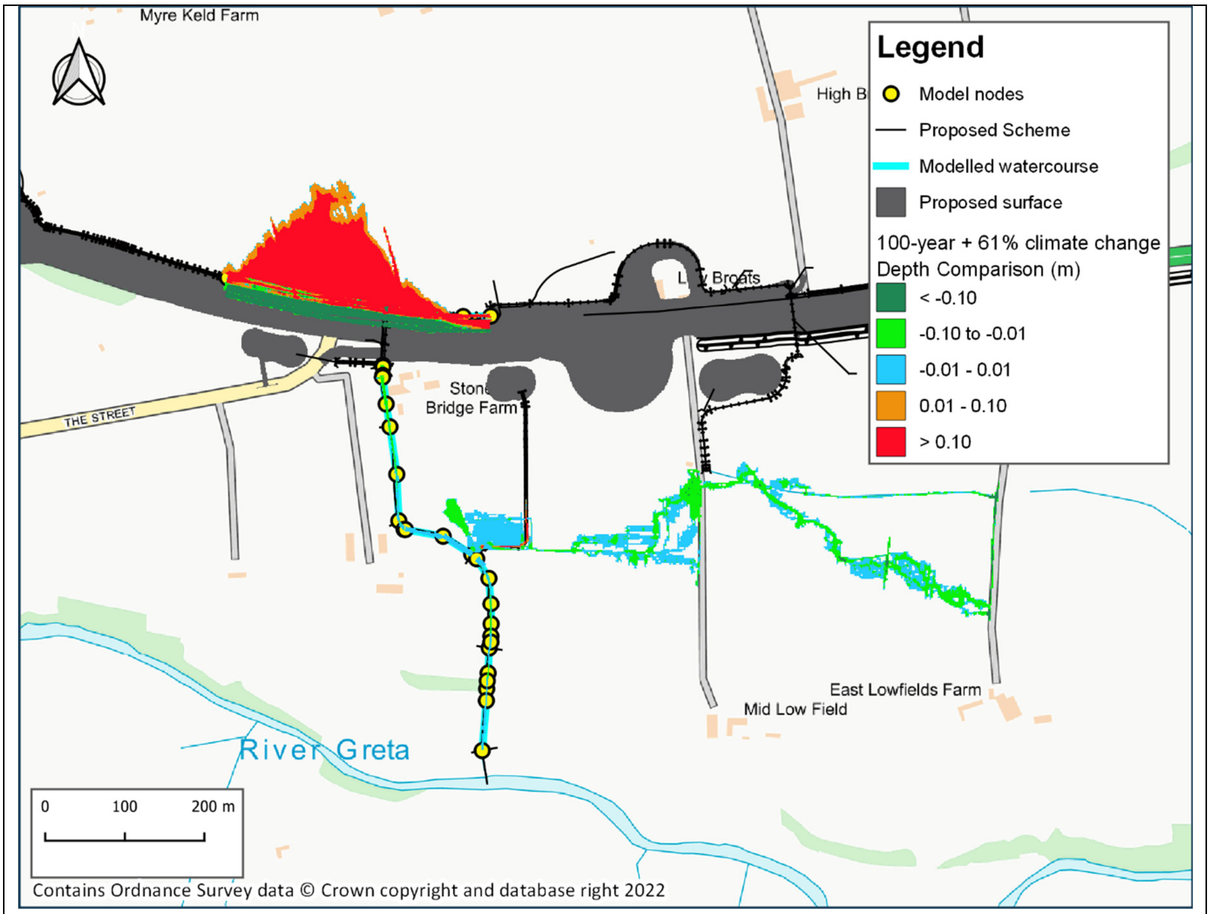

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Figure 8-6: Bowes Bypass model impact analysis - 100-year + 61% climate change

## Impact of proposed scheme - summary

**In-Channel**

The results show that generally the scheme has a negligible impact on water levels and pass-forward flows within the channel.

Peak water level and pass-forward flows downstream of the pipe network in Unnamed Tributary of River Greta 7.3 (UNN704) watercourse slightly increase, in addition to an increase in flood levels shown at this location in Figure 8-3. This is likely as a result of flows being attenuated by a proposed drainage ditch north of the existing channel (NGR: 399728, 513533), causing greater flow towards The Street.

**Floodplain**

Figures 8-1 to 8-3 show that generally there is negligible impact on flood depths due to the proposal. During the 100-year plus 61% event, there are a couple of isolated locations where an increase in flood risk is predicted (points A and B shown in Figure 8-3). Proposed ground levels are lower than existing ground levels at these locations causing flood depths to increase in the proposed model. Changes in ground elevation are determined by the 3D surface supplied by Amey, in these instances.

Figures 8-4 to 8-6 show that immediately upstream of the scheme at Stone Bridge Farm, flood depths show a significant increase as a result of impoundment against the embankment in all events. Downstream, there is negligible impact on flood depths.

## 9 Key Model Assumptions and Limitations

During any hydraulic modelling study, there will always be associated limitations, for example, with uncertainty and data availability etc. The representation of any complex system by a model requires several assumptions to be made. In the case of the hydraulic model, it has been assumed that:

- Cross sections accurately represent the shape and variation of the river.
- Model parameters have been determined appropriately.
- Design flows are an accurate representation of flows of a given AEP.
- The surveyed cross-sections of hydraulic structures and the units used to represent them in the model provide an adequate representation of the situation.
- LIDAR accurately reflects bank heights and particularly that the filtered LIDAR has appropriately removed the influence of vegetation.

Other specific limitations and assumptions are detailed below:

- The watercourses in the study area are ungauged and therefore no calibration of the hydraulic model has been carried out.
- The representation of the culverted network beneath Bowes Junction is based on as built drawings provided by Amey. CCTV data was not available to confirm the parameters used within the model to represent the culverted network.
- The watercourse network north of the A66 in the Armoury model is complex and has been represented using the best available survey data, and an understanding of the network gained from a site visit carried out by JBA Consulting.
- Surface water, sewer flooding and groundwater flooding have not been included in this assessment. The hydraulic model results demonstrate the potential flood risk from the mechanism of the modelled watercourses overtopping only.

A66 Northern Trans-Pennine

# Cross Lanes to Rokeby Hydraulic Modelling Report

Cross Lanes to Rokeby

| **Document Verification** | |
|---|---|
| **Project Title** | **A66 Northern Trans-Pennine**<br>Cross Lanes to Rokeby |
| **Document Title** | Cross Lanes to Rokeby Hydraulic Modelling Report |
| **Document Ref** | HE565627-JBAU-XX-08-RP-HM-S3-P02-0001-Scheme8_Modelling_Report |

**Note:** The contents of the Cover Page and Document Verification page are managed by ProjectWise. Users should not edit these fields manually.

| Rev | Suit. Code | Suitability | | Purpose of Issue | | |
|---|---|---|---|---|---|---|
| P01 | S3 | Shared for Review | | | | |
| | | Created | Checked | Reviewed | Approved | Authorised |
| | **Name** | Jack Richardson | Alice Blanchard | Alice Blanchard | Alice Blanchard | |
| | **Date** | 03/11/2021 | 03/11/2021 | 03/11/2021 | 03/11/2021 | |

| Rev | Suit. Code | Suitability | | Purpose of Issue | | |
|---|---|---|---|---|---|---|
| P02 | S3 | Shared for Review | | --- | | |
| | | Created | Checked | Reviewed | Approved | Authorised |
| | Name | Jack Richardson | Alice Blanchard | Alice Blanchard | Alice Blanchard | |
| | Date | 20/04/2022 | 20/04/2022 | 20/04/2022 | 20/04/2022 | |

| Rev | Suit. Code | Suitability | | Purpose of Issue | | |
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| | | Created | Checked | Reviewed | Approved | Authorised |
| | Name | --- | --- | --- | --- | --- |
| | Date | --- | --- | --- | --- | --- |

| **Fluvial Hydraulic Modelling Report – Scheme 8** | | |
|---|---|---|
| 1 Basic Model Information | | |
| Model Name | Rokeby model | |
| Primary Watercourses / Water Bodies (model name) | Punder Gill / Tutta Beck (TUT001)<br>Unnamed Tributary of Punder Gill 8.1 (UNN803)<br>Unnamed Tributary of Tutta Beck 8.1 (UNN802)<br>Unnamed Tributary of Manyfold Beck 8.3 / Manyfold Beck (UNN801) | |
| Designation | Ordinary Watercourse | |
| Model ID | The following table presents information regarding the model scenarios carried out as part of this study. | |
| Model Scenario ID | Scenario | Annual Probability |
| Scheme8_Rokeby_020.dat<br>Scheme8_Rokeby_Q20_025.ief<br>Scheme8_Rokeby_Q20_025.tcf | Existing Situation Model | 5% (1 in 20-years) |
| Scheme8_Rokeby_020.dat<br>Scheme8_Rokeby_Q100_025.ief<br>Scheme8_Rokeby_Q100_025.tcf | | 1% (1 in 100-years) |
| Scheme8_Rokeby_020.dat<br>Scheme8_Rokeby_Q100_CC32_025.ief<br>Scheme8_Rokeby_Q100_CC32_025.tcf | | 1% + 32% climate change (1 in 100-years + 32% climate change) |
| Scheme8_Rokeby_020.dat<br>Scheme8_Rokeby_Q100_CC40_025.ief<br>Scheme8_Rokeby_Q100_CC40_025.tcf | | 1% + 40% climate change (1 in 100-years +40% climate change) |
| Scheme8_Rokeby_020.dat<br>Scheme8_Rokeby_Q100_CC61_025.ief<br>Scheme8_Rokeby_Q100_CC61_025.tcf | | 1% + 61% climate change (1 in 100-years plus 61% climate change) |
| Scheme8_Rokeby_020.dat<br>Scheme8_Rokeby_Q1000_025.ief<br>Scheme8_Rokeby_Q1000_025.tcf | | 0.1% (1 in 1000-years) |
| Scheme8_Rokeby_Nplus20pct_020.dat<br>Scheme8_Rokeby_Q100_Nplus20pct_0025.ief<br>Scheme8_Rokeby_Nplus20pct_Q100_0025.tcf | Sensitivity tests | 1% AEP with +20% roughness |
| Scheme8_Rokeby_Nmin20pct_020.dat<br>Scheme8_Rokeby_Q100_Nmin20pct_0025.ief<br>Scheme8_Rokeby_Nmin20pct_Q100_0025.tcf | | 1% AEP with –20% roughness |
| Scheme8_Rokeby_020.dat<br>Scheme8_Rokeby_Q100_Qplus20pct_0025.ief<br>Scheme8_Rokeby_Q100plus20pct_0025.tcf | | 1% AEP with +20% flow |
| Scheme8_Rokeby_020.dat<br>Scheme8_Rokeby_Q100_Dmin20pct_0025.ief<br>Scheme8_Rokeby_Dmin20pct_Q100_0025.tcf | | 1% with -20% gradient downstream boundary |

| **2 Model Input Data** | |
|---|---|
| Incoming Models | No existing hydraulic model was available for this study area |
| DTM for 2D Model Domain | 1m resolution LIDAR flown in 2019 |
| River channel/Structure survey | Channel survey collected by JBA Consulting between November 2020-June 2021 |
| Additional Data | Mastermap data, As built drawing of A66 where available, proposed route alignments. |

| **3 Model Build Overview** | | | |
|---|---|---|---|
| Software | 1D domain: FM and ESTRY | | |
| | 2D domain(s): TUFLOW | | |
| Model Reference | HE565627-JBAU-XX-08-MO-HM-0001-Scheme8_Hydraulic_Model | | |
| Model Schematisation | Figure 3-1 shows the schematisation of the hydraulic model for Scheme 8 | | |
| Model Reaches | The table below shows the watercourse reaches defined in the model. They are also shown in Figure 3-1. | | |
| Watercourse Name | Upstream model node | Downstream model node | Total Reach length (km) |
| Tutta Beck / Punder Gill (TUT001) | TUT001_1467 | TUT001_0000i | 1.47 |
| Manyfold Beck / Unnamed tributary of Manyfold Beck 8.3 (UNN801) | UNN801_0498 | UNN801_0000 | 0.50 |
| Unnamed tributary of Tutta Beck 8.1 (UNN802) | UNN802_0503 | UNN802_0000 | 0.50 |
| Unnamed Tributary of Punder Gill 8.1 (UNN803) | U803_444 | U803_00 | 0.44 |

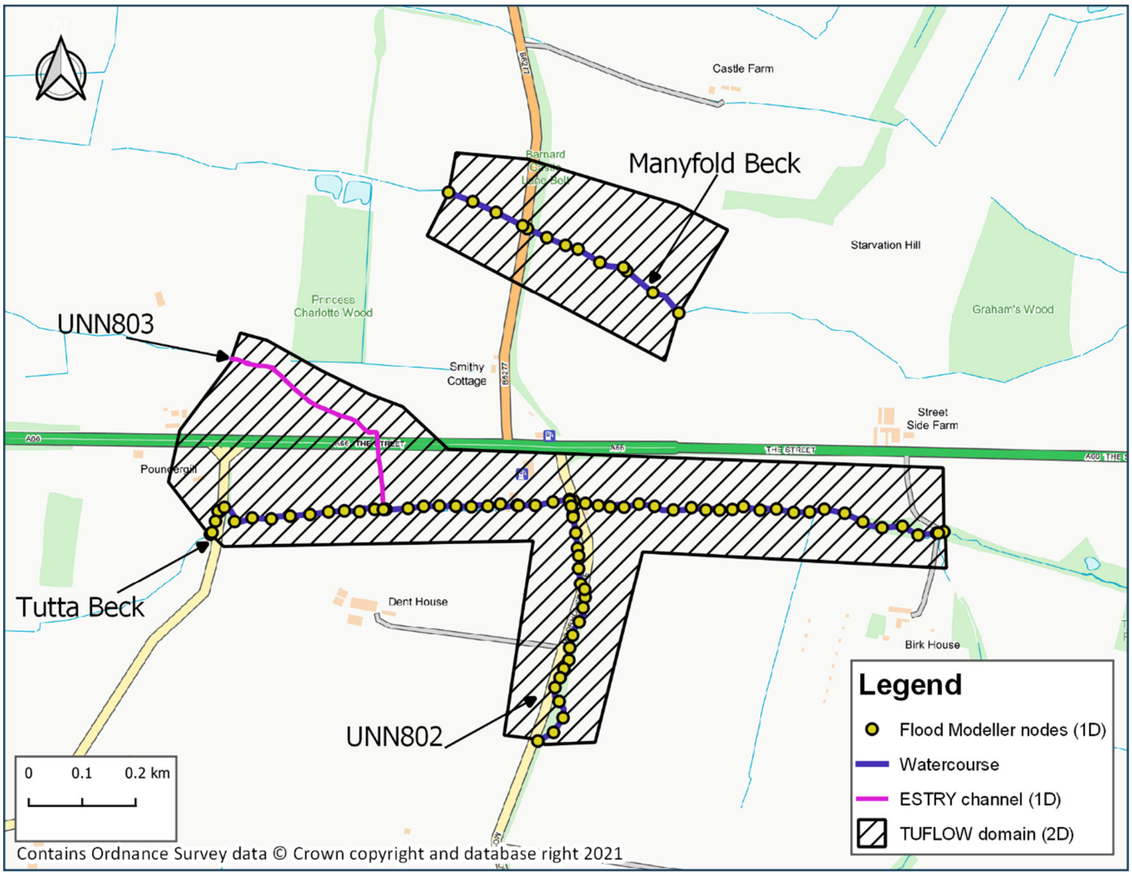


Figure 3-1: Model overview

| **4 Baseline model schematisation** | | | |
|---|---|---|---|
| 4.1 1D Domain | | | |
| Channel representation | The channel system has been based upon the most recent survey data set available for the area. The channels have been represented within the 1D domain across the study reach. | | |
| Structure representation | Existing structures have been based upon the most recent survey data set available. All significant structures within the study area have any modelling assumptions documented within this report (Section 5). Additionally, any structures which were not included within the hydraulic model based on the assumption that they were not deemed to be hydraulically significant are also recorded. | | |
| Inflow boundaries | Flow has been applied with a flow-time (QT) boundary at a point for the upstream nodes of each watercourse, and with lateral inflow nodes for the intervening catchment. Further information can be found in the FEH calculation record. | | |
| Climate Change | Climate change uplifts have been applied for the central, higher central and upper end allowances for the Tees Management Catchment using the Environment Agency July 2021 allowances. | | |
| Downstream boundary | Normal depth downstream boundaries are applied at the downstream extents of the Tutta Beck and Manyfold Beck in the 1D domain. The reason for this choice of boundary was that no existing model was available at the downstream boundary locations to accurately extract water level data for a given AEP event. To understand the implications of using a normal depth boundary, sensitivity testing has been conducted to quantify the impacts in changing the boundary parameters. | | |
| Hydraulic roughness values used | Channel roughness values have been represented in the model by Manning's 'n' values, defined on a reach basis. In order to determine the roughness of channel cross sections, photographic evidence collected during site visits and survey collection were used as a reference alongside application of the method published by Cowan (1956).<br>Bed roughness values range from 0.040-0.060 with a value of 0.060 for all banks. Structure roughness values range from 0.015-0.020. To understand the implications of using these manning's n values, sensitivity testing has been conducted to quantify the impacts in changing these parameters. | | |
| Labelling/naming convention used | All nodes have an ID of TUT001_XXXXX where XXXXX is the chainage upstream.<br>The following suffixes have been used:<br>C or CU Culvert<br>J Junction<br>W Weir<br>SP Spill<br>B Bridge<br>i, i2, i3 Interpolate<br>u or d Upstream or downstream node | | |
| 4.2 2D Domain | | | |
| Area of 2D Domains | 0.50km2 | DTM data source | LIDAR |

<table>
<tr><td>Resolution of grid</td><td>2m</td><td>DTM Resolution</td><td>1m</td></tr>
<tr><td>Modifications to topography and reasons</td><td>2d_zsh_Banks_Scheme8_L_002.shp<br>2d_zsh_Banks_Scheme8_P_002.shp</td><td colspan="2">The top of bank elevations have been stamped using Z shapes. Elevations are based on surveyed channel sections and LIDAR.</td></tr>
<tr><td colspan="2">Hydraulic roughness values used</td><td colspan="2">Manning’s n values have been used to represent hydraulic roughness in the 2D domain. The following roughness values were used in the model and are based on land cover types recorded in the Ordnance Survey MasterMap Topographic Area layer dataset.
<table>
<tr><th>Land Cover</th><th>Manning’s ‘n’ value</th></tr>
<tr><td>Generic floodplain roughness values</td><td>0.050</td></tr>
<tr><td>Boulders</td><td>0.065</td></tr>
<tr><td>Coniferous trees</td><td>0.120</td></tr>
<tr><td>Coniferous trees – scattered / Orchard</td><td>0.070</td></tr>
<tr><td>Coppice or osiers</td><td>0.090</td></tr>
<tr><td>Marsh Reeds or Saltmarsh</td><td>0.060</td></tr>
<tr><td>Non coniferous trees</td><td>0.090</td></tr>
<tr><td>Non-coniferous trees – scattered</td><td>0.060</td></tr>
<tr><td>Rough grassland</td><td>0.060</td></tr>
<tr><td>Scrub</td><td>0.070</td></tr>
<tr><td>Rock</td><td>0.070</td></tr>
<tr><td>Heath</td><td>0.090</td></tr>
<tr><td>Building</td><td>0.300</td></tr>
<tr><td>General surface – multi surface</td><td>0.050</td></tr>
<tr><td>General surface – step</td><td>0.050</td></tr>
<tr><td>General surface - manmade</td><td>0.050</td></tr>
<tr><td>General surface - natural</td><td>0.060</td></tr>
<tr><td>Glasshouse</td><td>0.200</td></tr>
<tr><td>Inland water</td><td>0.045</td></tr>
<tr><td>Landform</td><td>0.060</td></tr>
<tr><td>Landform – slope</td><td>0.060</td></tr>
<tr><td>Landform – cliff</td><td>0.060</td></tr>
<tr><td>Path – step</td><td>0.050</td></tr>
<tr><td>Path</td><td>0.050</td></tr>
<tr><td>Rail</td><td>0.045</td></tr>
<tr><td>Road</td><td>0.035</td></tr>
<tr><td>Roadside</td><td>0.050</td></tr>
<tr><td>Structure</td><td>0.300</td></tr>
<tr><td>Structure – upper level of communication</td><td>0.300</td></tr>
<tr><td>Structure – pylon</td><td>0.060</td></tr>
<tr><td>Tidal water – foreshore</td><td>0.055</td></tr>
<tr><td>Tidal water</td><td>0.055</td></tr>
<tr><td>Unclassified</td><td>0.060</td></tr>
</table></td></tr>
<tr><td colspan="4">4.3 1D-2D Linking</td></tr>
</table>

| | |
|---|---|
| A HX boundary is used to link the 1D and 2D domains along the top of banks. Elevations of HX cells are set using Z shapes outlined in Section 4.2. | |
| Model Boundaries – Downstream Conditions | A 2D HQ boundary is used at the downstream extent of the 2D domain based on slope values derived from LIDAR. |
| 4.4 Representation of Defences | |
| Defences | There are no formal defences within the study area. As such, all model runs are considered to be undefended. |

## 5 Structures

General Assumptions

- At structures where only one face has been surveyed, a copy of the surveyed upstream face was used to represent the downstream face.
- Bridge decks have been represented using spill units where it is likely there would be no complex overland flows which potentially would take water away from the channel.
- Modelled structures have been schematised using the most recent channel survey taken by JBA Consulting between November 2020 and June 2021.

Tutta Beck

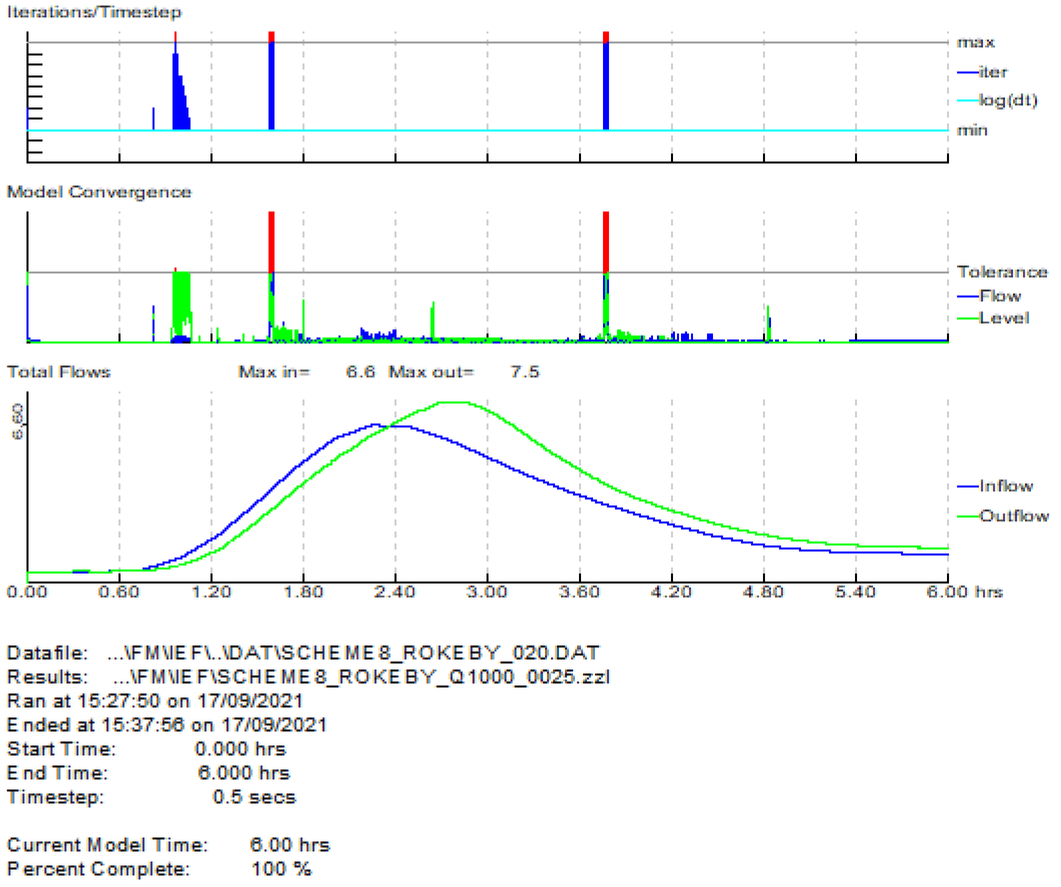
| Model/Survey ID | Structure | How has this structure been modelled? | Photo (view of upstream face unless specified) |
|---|---|---|---|
| TUT001_1420 | Road culvert | This structure has been modelled with a rectangular conduit unit in Flood Modeller. Overtopping flow is represented in the 2D domain. | <br>Upstream face:<br><br>Downstream face: |
| TUT001_0834 | Wooden footbridge | This structure has been modelled with an arch bridge unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |

| | | | |
|---|---|---|---|
| TUT001_0734 | Road culvert | This structure has been modelled with a sprung arch conduit unit in Flood Modeller. Overtopping flow is represented in the 2D domain. |  |
| TUT001_0000 | Wooden bridge | This structure has been modelled with an arch bridge unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |
| Manyfold Beck | | | |
| ID | Structure | How has this structure been modelled? | Photo (view of upstream face unless specified) |
| UNN801_0346 | Rectangular culvert, circular pipe | This structure has been modelled with a rectangular conduit unit and a circular conduit unit in Flood Modeller. Overtopping flow is represented with a spill unit. | <br>Upstream face:<br><br>Downstream face: |

| | | | |
|---|---|---|---|
| UNN801_0139 | Concrete footbridge | This structure has been modelled with an arch bridge unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |
| Unnamed 802 | | | |
| ID | Structure | How has this structure been modelled? | Photo (view of upstream face unless specified) |
| UNN802_0173 | X3 Pipes | These structures have been modelled with a circular conduit unit and two orifice units in Flood Modeller (the smaller pipes are often dry and therefore orifice units are the most appropriate schematisation). Overtopping flow is represented with a spill unit. |  |
| UNN802_0034 | Concrete culvert | This structure has been modelled with an orifice unit in Flood Modeller. Overtopping flow is represented with a spill unit. |  |

# 6 Model Proving

## 6.1 Model Performance



```
Datafile:   ...\FM\IEF\..\DAT\SCHEME8_ROKEBY_020.DAT
Results:    ...\FM\IEF\SCHEME8_ROKEBY_Q1000_0025.zzl
Ran at 15:27:50 on 17/09/2021
Ended at 15:37:56 on 17/09/2021
Start Time:          0.000 hrs
End Time:            6.000 hrs
Timestep:              0.5 secs

Current Model Time:        6.00 hrs
Percent Complete:          100 %
```

Figure 6-1: Flood Modeller model performance

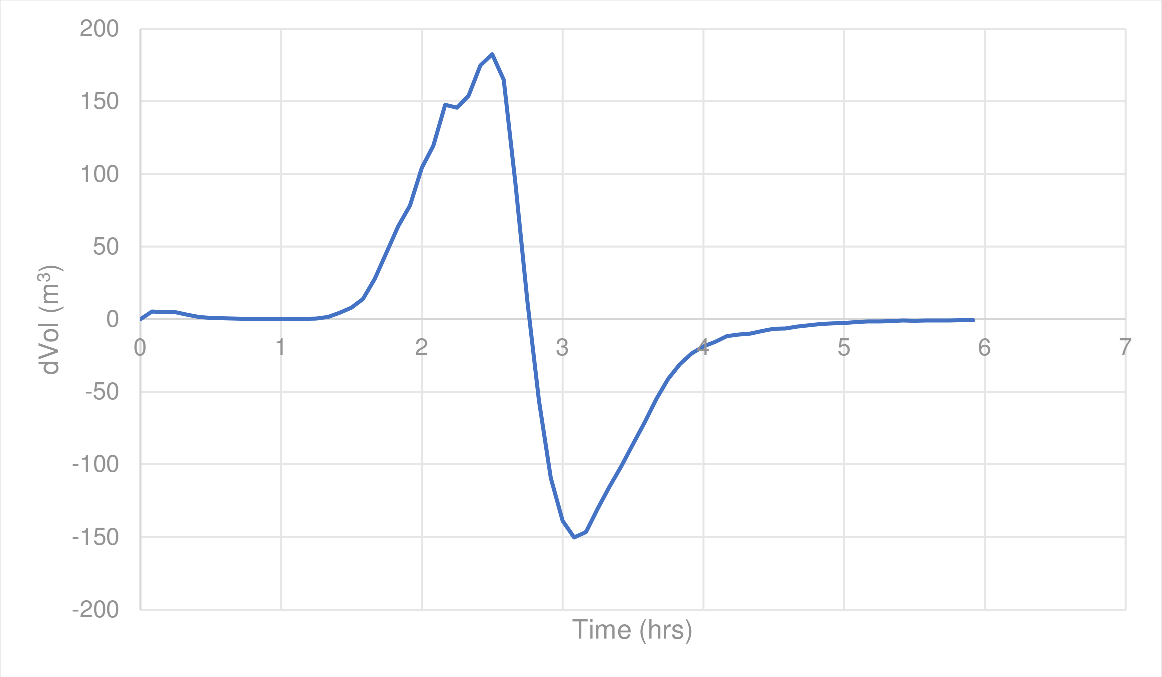


Figure 6-2: TUFLOW dVol plot

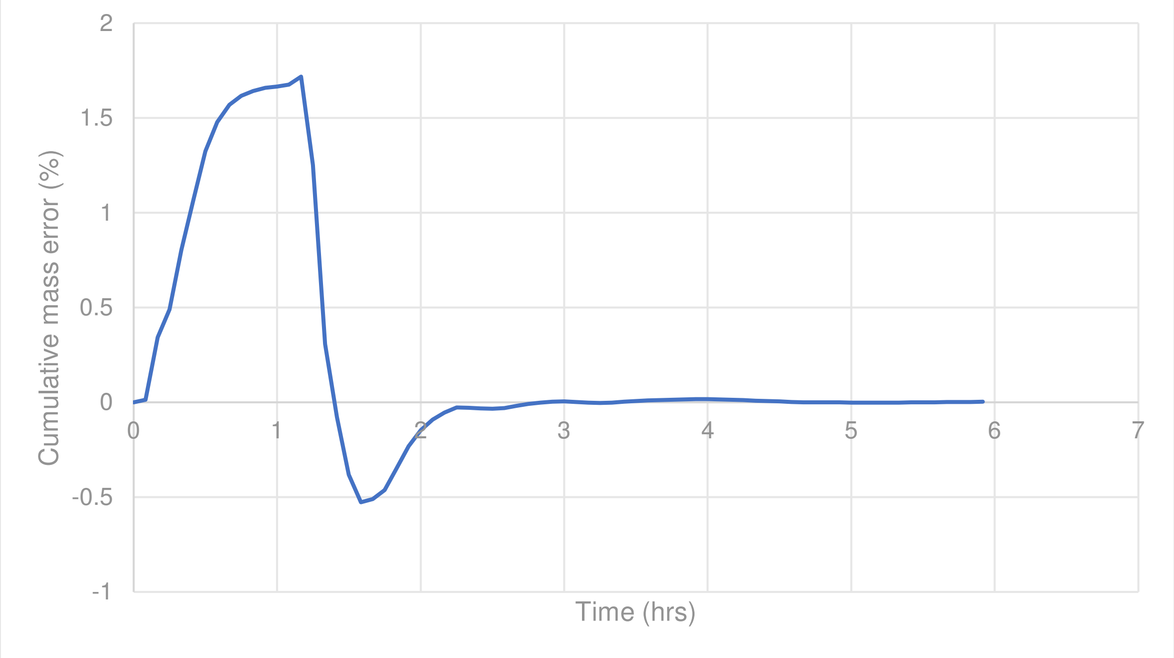
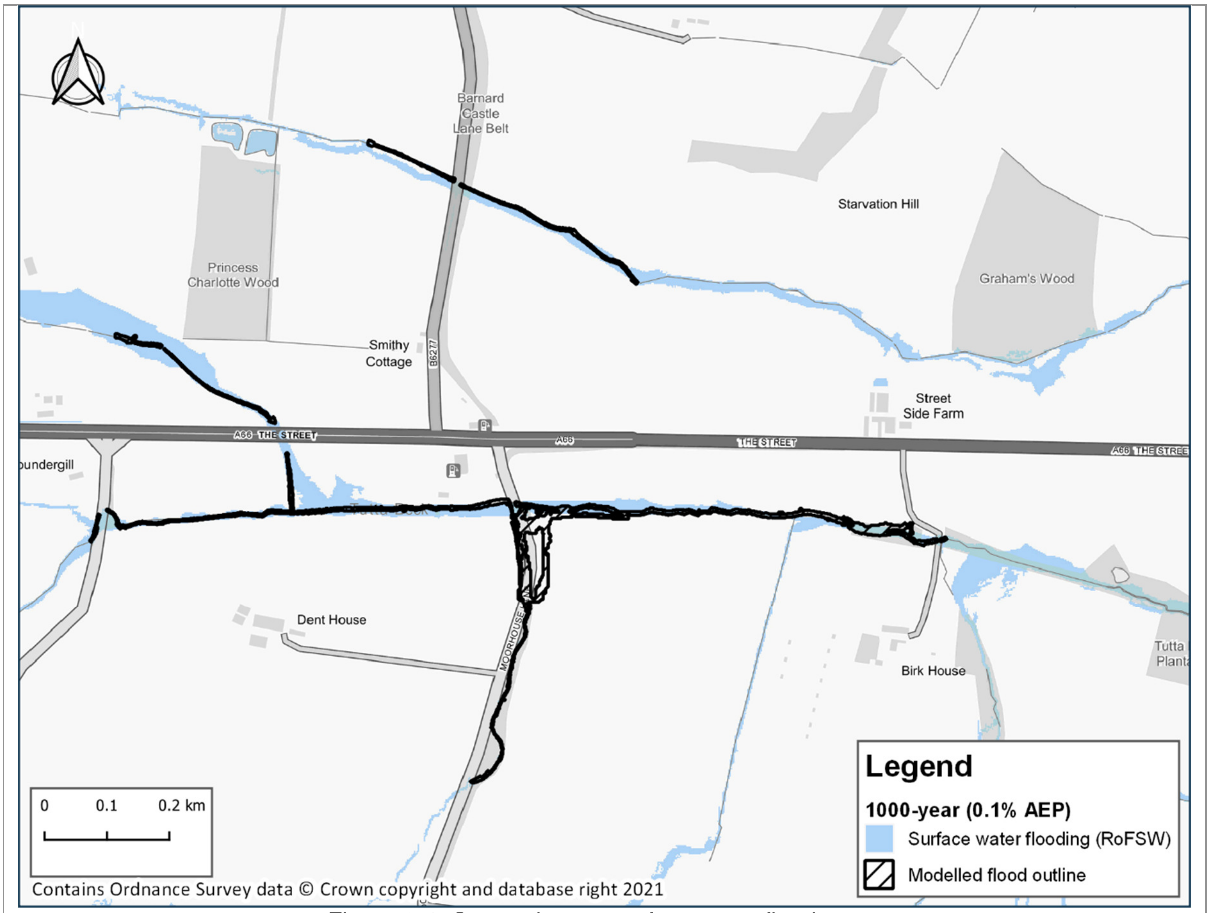


Figure 6-3: TUFLOW cumulative mass error

The Flood modeller convergence plot show smooth inflow an outflows into the model with only isolated incidences of poor convergences.  Flow and stage profiles have been checked throughout the model and are smooth with minimal oscillations, indicating the model is performing well. The dVol plot is shown to be smooth and the cumulative mass error is within a range of +1 to -1 for the majority of the simulation, and in particular the peak of the event (approximately 2hours into the simulation). Whilst there is a spike in the mass error at the beginning of the model, this occurs when the volume in the model is low and therefore considered acceptable.

| 6.2 Model Verification | |
|---|---|
| Calibration | No gauge data was available for the study area to allow the model to be calibrated to. Information on historical flood risk was requested from the Lead Local Flood Authority but no information was provided. It is understood from anecdotal evidence that the property along Moorhouse Lane has experienced flooding in the past. The hydraulic model results obtained in this study reconcile with this. |
| Previous Model Comparison | No previous hydraulic model results are available for the study area for comparison. |
| Flood Zone Comparison | Fluvial Flood Zone data is unavailable for the model extent. Surface water flood maps have therefore been used as a comparison and show that maximum modelled extents compare well to the 1,000-year flood extents in the Risk of Flooding from Surface Water (RoFSW) data. |



Contains Ordnance Survey data © Crown copyright and database right 2021

Figure 6-4: Comparison to surface water flood maps

### 6.3 Sensitivity Analysis

Sensitivity tests were carried out for the 1% AEP existing situation model to assess the model response to the change in:

- Flow: Model inflows increased by 20%
- Roughness coefficient: In-channel and roughness values changed by +20% and -20%
- Downstream boundary: Slope decreased by -20%

The table below shows the maximum, minimum and average change in in-channel water levels relative to the existing situation model for each modelled reach with increase in flow and increase and decrease in roughness coefficients.

- The downstream boundary sensitivity test showed a maximum increase in water levels at the most downstream node on all watercourses. Changes in peak water level compared to the baseline extend approximately 0-30m upstream on the Tutta Beck and 130m on the Manyfold Beck.

| Watercourse | Tutta Beck | | |
|---|---|---|---|
| | Change in peak water level (m) | | |
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.27 | 0.00 | 0.07 |
| +20% Roughness | 0.10 | -0.01 | 0.05 |
| -20% Roughness | 0.06 | -0.06 | -0.17 |

| Watercourse | Manyfold Beck | | |
|---|---|---|---|
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.10 | 0.01 | 0.05 |
| +20% Roughness | 0.057 | -0.054 | 0.03 |
| -20% Roughness | 0.15 | -0.09 | -0.01 |

| Watercourse | UNN802 | | |
|---|---|---|---|
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.09 | 0.01 | 0.03 |
| +20% Roughness | 0.19 | -0.01 | 0.02 |
| -20% Roughness | 0.06 | -0.24 | -0.03 |

| Watercourse | UNN803 | | |
|---|---|---|---|
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.12 | 0.01 | 0.04 |
| +20% Roughness | 0.10 | -0.11 | 0.01 |
| -20% Roughness | 0.00 | -0.03 | -0.05 |

## 7 With-Scheme situation model

No with-scheme situation modelled

## 8 Key Model Assumptions and Limitations

During any hydraulic modelling study, there will always be associated limitations, for example, with uncertainty and data availability etc. The representation of any complex system by a model requires several assumptions to be made. In the case of the hydraulic model, it has been assumed that:

- Cross sections accurately represent the shape and variation of the river.
- Model parameters have been determined appropriately.
- Design flows are an accurate representation of flows of a given AEP.
- The surveyed cross-sections of hydraulic structures and the units used to represent them in the model provide an adequate representation of the situation.
- LIDAR accurately reflects bank heights and particularly that the filtered LIDAR has appropriately removed the influence of vegetation.

Other specific limitations and assumptions are detailed below:

- The watercourses in the study area are ungauged and therefore no calibration of the hydraulic model has been carried out.
- The upstream boundary of the model is approximately 600m upstream of the proposed new alignment. The model could not be extended further than this due to land access not being granted.
- Surface water, sewer flooding and groundwater flooding have not been included in this assessment. The hydraulic model results demonstrate the potential flood risk from the mechanism of the modelled watercourses overtopping only.

A66 Northern Trans-Pennine

# Stephen Bank to Carkin Moor Hydraulic Modelling Report

Stephen Bank to Carkin Moor

| **Document Verification** | |
|---|---|
| **Project Title** | **A66 Northern Trans-Pennine**<br>Stephen Bank to Carkin Moor |
| **Document Title** | Stephen Bank to Carkin Moor Hydraulic Modelling Report |
| **Document Ref** | HE565627-JBAU-XX-09-RP-HM-S3-P02-0001-Scheme9_Modelling_Report |

**Note:** The contents of the Cover Page and Document Verification page are managed by ProjectWise. Users should not edit these fields manually.

| Rev | Suit. Code | Suitability | | Purpose of Issue | | |
|---|---|---|---|---|---|---|
| P01 | S3 | Shared for review | | | | |
| | | Created | Checked | Reviewed | Approved | Authorised |
| | **Name** | A. Blanchard - | D. Kearney | D. Kearney | D. Kearney | --- |
| | **Date** | 16.01.2022 | 17.01.2022 | 17.01.2022 | 17.01.2022 | --- |

| Rev | Suit. Code | Suitability | | Purpose of Issue | | |
|---|---|---|---|---|---|---|
| P02 | S3 | Shared for review | | --- | | |
| | | Created | Checked | Reviewed | Approved | Authorised |
| | Name | A. Blanchard | D. Kearney | D. Kearney | D. Kearney | --- |
| | Date | 14.04.2022 | 14.04.2022 | 14.04.2022 | 14.04.2022 | --- |

| Rev | Suit. Code | Suitability | | Purpose of Issue | | |
|---|---|---|---|---|---|---|
| --- | --- | --- | | --- | | |
| | | Created | Checked | Reviewed | Approved | Authorised |
| | Name | --- | --- | --- | --- | --- |
| | Date | --- | --- | --- | --- | --- |

| **Fluvial Hydraulic Modelling Report – Scheme 9** | | |
|---|---|---|
| 1 Basic Model Information | | |
| Model Name | Scheme 9 model | |
| Primary Watercourses / Water Bodies | Model UNN901: Unnamed Tributary of Holme Beck 9.2<br>Model UNN902: Unnamed Tributary of Holme Beck 9.1<br>Model UNN903: Mains Gill and Unnamed Tributaries of Mains Gill 9.1 and 9.3<br>Model UNN904: Unnamed Tributaries of Dalton Beck 9.3, 9.4 and 9.5<br>Model UNN906: Unnamed Tributary of Dalton Beck 9.1 and 9.2 | |
| Designation | Ordinary Watercourses | |
| Model ID | The following table presents information regarding the model scenarios carried out as part of this study. | |
| Model Scenario ID | Scenario | Annual Probability |
| Unnamed Tributary of Holme Beck 9.2 | | |
| S20_BL_UNN901_007.tcf<br>S20_BL_UNN901_007.ecf | Existing situation model Unnamed Tributary of Holme Beck 9.2 | 5% (1 in 20-years) |
| S100_BL_UNN901_007.tcf<br>S100_BL_UNN901_007.ecf | | 1% (1 in 100-years) |
| S100CC25_BL_UNN901_007.tcf<br>S100CC25_BL_UNN901_007.ecf | | 1% + 25% climate change (1 in 100-years + 25% climate change) |
| S100CC34_BL_UNN901_007.tcf<br>S100CC34_BL_UNN901_007.ecf | | 1% + 34% climate change (1 in 100-years +34% climate change) |
| S100CC53_BL_UNN901_007.tcf<br>S100CC53_BL_UNN901_007.ecf | | 1% + 53% climate change (1 in 100-years plus 53% climate change) |
| S1000_BL_UNN901_007.tcf<br>S1000_BL_UNN901_007.ecf | | 0.1% (1 in 1000-years) |
| S100_BL_UNN901_007_Nplus20pct.ecf<br>S100_BL_UNN901_007_Nplus20pct.tcf | Sensitivity tests for model of Unnamed Tributary of Holme Beck 9.2 | 1% AEP with +20% roughness |
| S100_BL_UNN901_007_Nmin20pct.ecf<br>S100_BL_UNN901_007_Nmin20pct.tcf | | 1% AEP with –20% roughness |
| S100_BL_UNN901_007_Qplus20pct.ecf<br>S100_BL_UNN901_007_Qplus20pct.tcf | | 1% AEP with +20% flow |

| | | |
|---|---|---|
| S100_BL_UNN901_007_DSBDYmin20pct.ecf<br>S100_BL_UNN901_007_DSBDYmin20pct.tcf | | 1% with -20% flow downstream boundary |
| Unnamed Tributary of Holme Beck 9.1 | | |
| HE565627-JBAU-XX-09-M2-G-0002-UNN902_XS_FM_006.dat<br>Scheme9_UNN902_Q20_010.ief<br>S20_UNN902_001.tcf | Existing situation for Unnamed Tributary of Holme Beck 9.1 | 5% (1 in 20-years) |
| HE565627-JBAU-XX-09-M2-G-0002-UNN902_XS_FM_006.dat<br>Scheme9_UNN902_Q100_010.ief<br>S100_UNN902_001.tcf | | 1% (1 in 100-years) |
| HE565627-JBAU-XX-09-M2-G-0002-UNN902_XS_FM_006.dat<br>Scheme9_UNN902_Q100CC25_010.ief<br>S100CC25_UNN902_001.tcf | | 1% + 25% climate change (1 in 100-years + 25% climate change) |
| HE565627-JBAU-XX-09-M2-G-0002-UNN902_XS_FM_006.dat<br>Scheme9_UNN902_Q100CC34_010.ief<br>S100CC34_UNN902_001.tcf | | 1% + 34% climate change (1 in 100-years +34% climate change) |
| HE565627-JBAU-XX-09-M2-G-0002-UNN902_XS_FM_006.dat<br>Scheme9_UNN902_Q100CC53_010.ief<br>S100CC53_UNN902_001.tcf | | 1% + 53% climate change (1 in 100-years plus 53% climate change) |
| HE565627-JBAU-XX-09-M2-G-0002-UNN902_XS_FM_006.dat<br>Scheme9_UNN902_Q1000_010.ief<br>S1000_UNN902_001.tcf | | 0.1% (1 in 1000-years) |
| HE565627-JBAU-XX-09-M2-G-0002-UNN902_XS_FM_006_Nplus20pct.dat<br>Scheme9_UNN902_Q100_010_Nplus20pct.ief<br>S100_UNN902_001_Nplus20pct.tcf | Sensitivity tests for Unnamed Tributary of Holme Beck 9.1 | 1% AEP with +20% roughness |
| HE565627-JBAU-XX-09-M2-G-0002-UNN902_XS_FM_006_Nmin20pct.dat<br>Scheme9_UNN902_Q100_010_Nmin20pct.ief<br>S100_UNN902_001_Nmin20pct.tcf | | 1% AEP with –20% roughness |
| HE565627-JBAU-XX-09-M2-G-0002-UNN902_XS_FM_006.dat<br>Scheme9_UNN902_Q100_010_Qplus20pct.ief<br>S100_UNN902_001_Qplus20pct.tcf | | 1% AEP with +20% flow |
| HE565627-JBAU-XX-09-M2-G-0002-UNN902_XS_FM_006_DSBDYmin20pct.dat<br>Scheme9_UNN902_Q100_010_DSBDYmin20pct.ief<br>S100_UNN902_001_DSBDYmin20pct.tcf | | 1% with -20% gradient downstream boundary |
| Mains Gill and Unnamed Tributaries of Mains Gill 9.1 and 9.3 | | |
| UNN903_006_0020-yr.tcf<br>UNN903_006_0020-yr.ecf | Existing situation for | 5% (1 in 20-years) |

| | | |
|---|---|---|
| UNN903_006_0100-yr.tcf<br>UNN903_006_0100-yr.ecf | Mains Gill and Unnamed Tributaries of Mains Gill 9.1 and 9.3 | 1% (1 in 100-years) |
| UNN903_006_0100-yr_CC25.tcf<br>UNN903_006_0100-yr_CC25.ecf | | 1% + 25% climate change (1 in 100-years + 25% climate change) |
| UNN903_006_0100-yr_CC34.tcf<br>UNN903_006_0100-yr_CC34.ecf | | 1% + 34% climate change (1 in 100-years +34% climate change) |
| UNN903_006_0100-yr_CC53.tcf<br>UNN903_006_0100-yr_CC53.ecf | | 1% + 53% climate change (1 in 100-years plus 53% climate change) |
| UNN903_006_1000-yr.tcf<br>UNN903_006_1000-yr.ecf | | 0.1% (1 in 1000-years) |
| UNN903_006_0100-yr_Nplus20pct.ecf<br>UNN903_006_0100-yr_Nplus20pct.tcf | Sensitivity tests for Mains Gill and Unnamed Tributaries of Mains Gill 9.1 and 9.3 | 1% AEP with +20% roughness |
| UNN903_006_0100-yr_Nmin20pct.ecf<br>UNN903_006_0100-yr_Nmin20pct.tcf | | 1% AEP with –20% roughness |
| UNN903_006_0100-yr_Qplus20pct.ecf<br>UNN903_006_0100-yr_Qplus20pct.tcf | | 1% AEP with +20% flow |
| UNN903_006_0100-yr_DSBDYmin20pct.ecf<br>UNN903_006_0100-yr_DSBDYmin20pct.tcf | | 1% with -20% flow downstream boundary |
| Unnamed Tributaries of Dalton Beck 9.3, 9.4 and 9.5 | | |
| UNN904_053.dat<br>S20_UNN904_004.ief<br>S20_UNN904_004.tcf | Existing situation for Unnamed Tributaries of Dalton Beck 9.3, 9.4 and 9.5 | 5% (1 in 20-years) |
| UNN904_053.dat<br>S100_UNN904_004.ief<br>S100_UNN904_004.tcf | | 1% (1 in 100-years) |
| UNN904_053.dat<br>S100CC25_UNN904_004.ief<br>S100CC25_UNN904_004.tcf | | 1% + 25% climate change (1 in 100-years + 25% climate change) |
| UNN904_053.dat<br>S100CC34_UNN904_004.ief<br>S100CC34_UNN904_004.tcf | | 1% + 34% climate change (1 in 100-years +34% climate change) |
| UNN904_053.dat<br>S100CC53_UNN904_004.ief<br>S100CC53_UNN904_004.tcf | | 1% + 53% climate change (1 in 100-years plus 53% climate change) |

| | | |
|---|---|---|
| UNN904_053.dat<br>S1000_UNN904_004.ief<br>S1000_UNN904_004.tcf | | 0.1% (1 in 1000-years) |
| UNN904_053_Nplus20pct.dat<br>S100_UNN904_004_Nplus20pct.ief<br>S100_UNN904_004_Nplus20pct.tcf | Sensitivity tests for Unnamed Tributaries of Dalton Beck 9.3, 9.4 and 9.5 | 1% AEP with +20% roughness |
| Did not run | | 1% AEP with –20% roughness |
| UNN904_053.dat<br>S100_UNN904_004_Qplus20pct.ief<br>S100_UNN904_004_Qplus20pct.tcf | | 1% AEP with +20% flow |
| UNN904_053_DSBDY_min20pct.dat<br>S100_UNN904_004_DSBDYmin20pct.ief<br>S100_UNN904_004_DSBDYmin20pct.tcf | | 1% with -20% gradient downstream boundary |
| Unnamed Tributary of Dalton Beck 9.1 and 9.2 | | |
| S20_BL_UNN906_003.ecf<br>S20_BL_UNN906_003.tcf | Existing situation for Unnamed Tributary of Dalton Beck 9.1 and 9.2 | 5% (1 in 20-years) |
| S100_BL_UNN906_003.ecf<br>S100_BL_UNN906_003.tcf | | 1% (1 in 100-years) |
| S100CC25_BL_UNN906_003.ecf<br>S100CC25_BL_UNN906_003.tcf | | 1% + 25% climate change (1 in 100-years + 25% climate change) |
| S100CC34_BL_UNN906_003.ecf<br>S100CC34_BL_UNN906_003.tcf | | 1% + 34% climate change (1 in 100-years +34% climate change) |
| S100CC53_BL_UNN906_003.ecf<br>S100CC53_BL_UNN906_003.tcf | | 1% + 53% climate change (1 in 100-years plus 53% climate change) |
| S1000_BL_UNN906_003.ecf<br>S1000_BL_UNN906_003.tcf | | 0.1% (1 in 1000-years) |
| S100_BL_UNN906_003_Nplus20pct.ecf<br>S100_BL_UNN906_003_Nplus20pct.tcf | Sensitivity tests for Unnamed Tributary of Dalton Beck 9.1 and 9.2 | 1% AEP with +20% roughness |
| S100_BL_UNN906_003_Nmin20pct.ecf<br>S100_BL_UNN906_003_Nmin20pct.tcf | | 1% AEP with –20% roughness |
| S100_BL_UNN906_003_Qplus20pct.ecf<br>S100_BL_UNN906_003_Qplus20pct.tcf | | 1% AEP with +20% flow |
| S100_BL_UNN906_003_DSBDYmin20pct.ecf<br>S100_BL_UNN906_003_DSBDYmin20pct.tcf | | 1% with -20% flow downstream boundary |

| **2 Model Input Data** | |
|---|---|
| Incoming Models | No existing hydraulic model information available |
| DTM for 2D Model Domain | 1m resolution LIDAR flown in 2018 |
| River channel/Structure survey | Channel survey collected by JBA Consulting between November 2020 - June 2021 |
| Additional Data | OS Mastermap data, As built drawings of existing A66 where available,  proposed route alignments. |

| **3 Model Build Overview** | | | |
|---|---|---|---|
| Software | 1D domain: Flood Modeller for models UNN902 and UNN904<br>ESTRY for UNN901, UNN903 and UNN906 | | |
| | 2D domain(s): TUFLOW for all five models | | |
| Model Reference | HE565627-JBAU-09-MO-HM-0001-Scheme09_Hydraulic_Model | | |
| Model Schematisation | Figure 3.1 to 3.5 show the schematisation of the hydraulic models for Scheme 9 | | |
| Model Reaches | The table below shows the watercourse reaches defined in the model. They are also shown in Figure 3.1 to 3.5. | | |
| Watercourse Name | Upstream model node | Downstream model node | Total Reach length (km) |
| Model UNN901 | | | |
| Unnamed tributary of Holme Beck 9.2 | UNN901_0329 | UNN901_0000 | 0.3 |
| Model UNN902 | | | |
| Unnamed Tributary of Holme Beck 9.1 | UNN902_0658 | UNN902_0_d2 | 0.7 |
| Model UNN903 | | | |
| Mains Gill and Unnamed Tributary of Mains Gill 9.1 | UNN903_0920 | UNN903_0010 | 0.9 |
| Unnamed Tributary of Mains Gill 9.3 | UNN909_0718 | UNN909_0262 | 0.5 |
| Model UNN904 | | | |
| Unnamed Tributary of Dalton Beck 9.3 | UNN904_0964 | UNN904_0000 | 1.0 |
| Unnamed Tributary of Dalton Beck 9.4 | UNN907_0086 | UNN907_0002 | 0.08 |
| Unnamed Tributary of Dalton Beck 9.5 | UNN908_0000 | UNN908_0000d | 0.09 |
| Model UNN906 | | | |
| Unnamed Tributary of Dalton Beck 9.1 | UNN905_0008 | UNN905_0000 | 0.008 |
| Unnamed Tributary of Dalton Beck 9.2 | UNN906_0643 | UNN906_0000 | 0.6 |

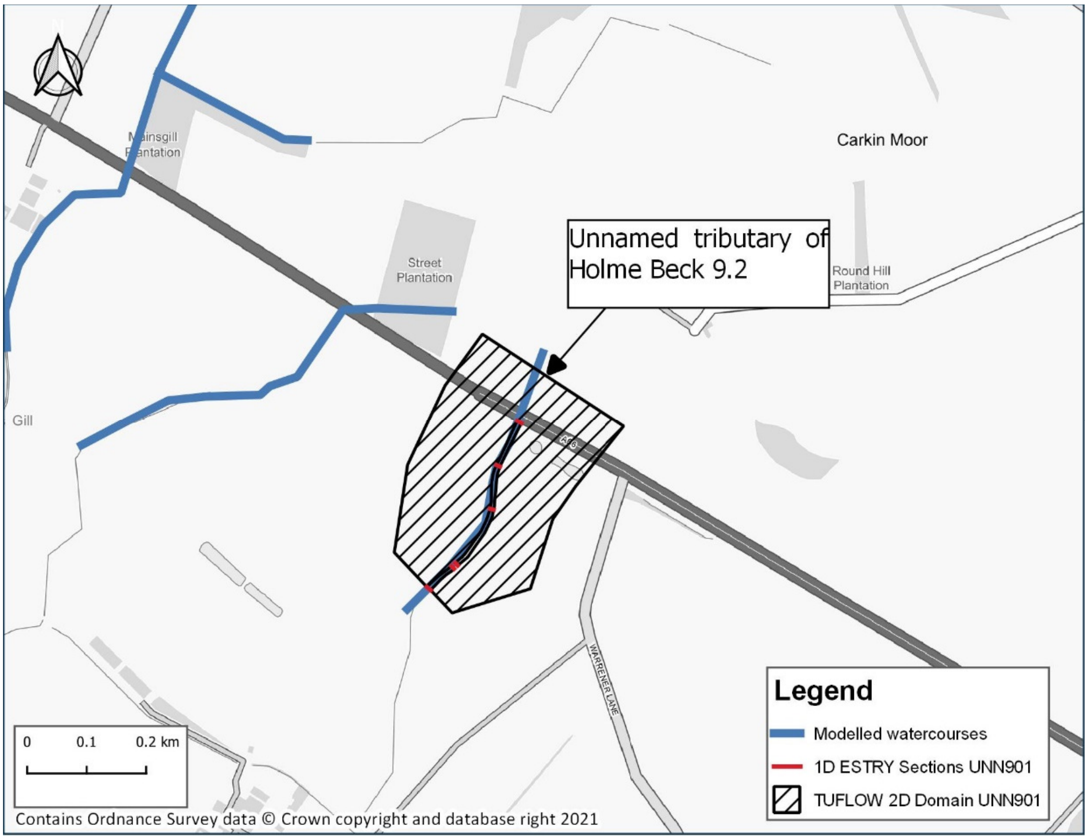


Figure 3.1: Model UNN901: Unnamed Tributary of Holme Beck 9.2

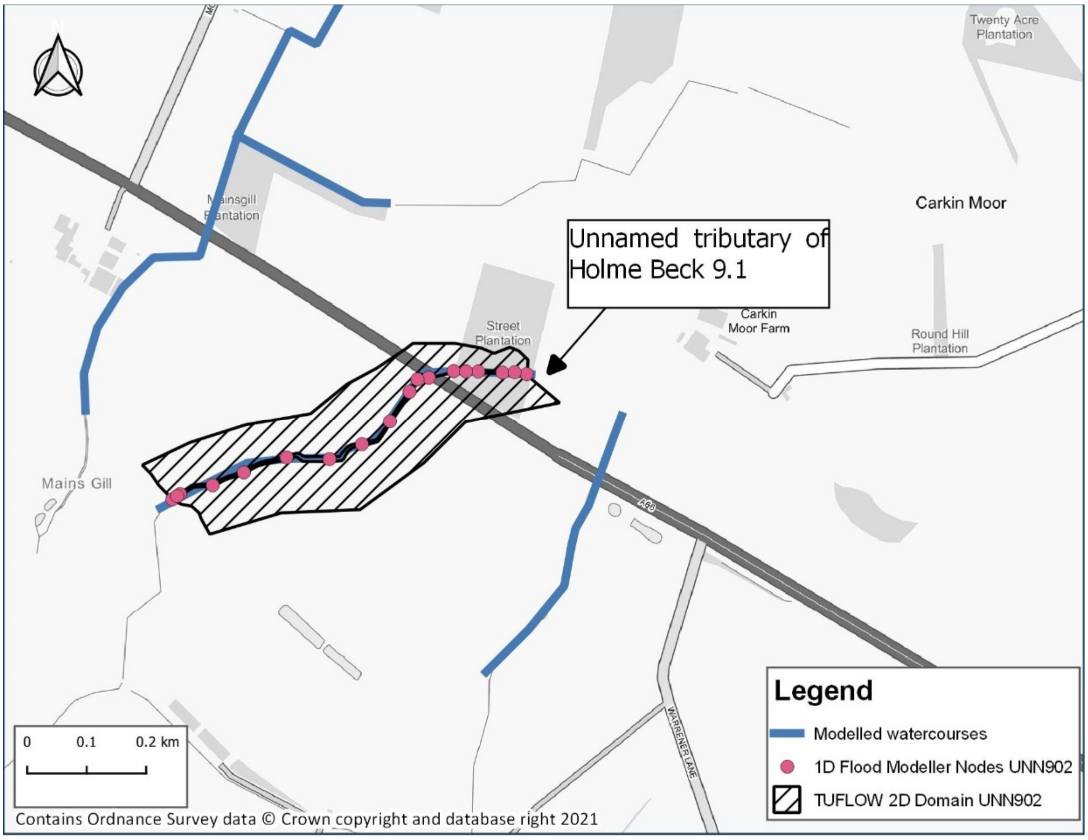


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Figure 3.2: Model UNN902: Unnamed Tributary of Holme Beck 9.1

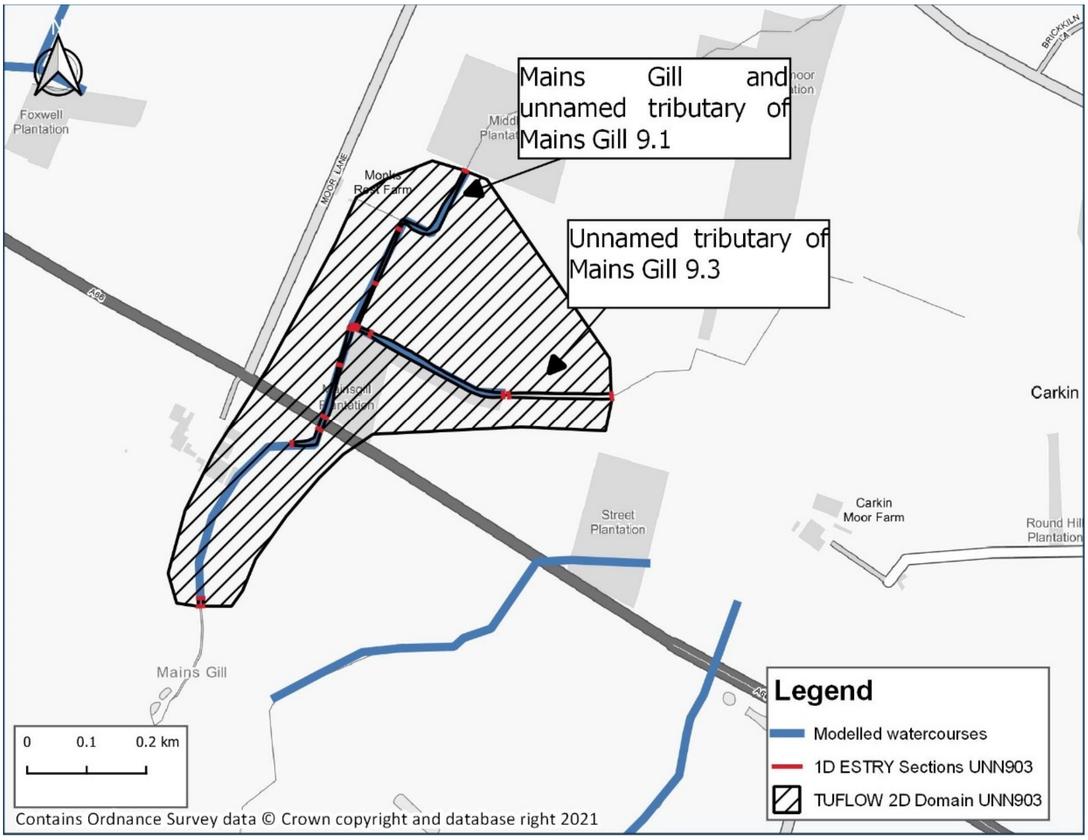

Figure 3.3: Model UNN903: Mains Gill and Unnamed Tributaries of Mains Gill 9.1 and 9.3

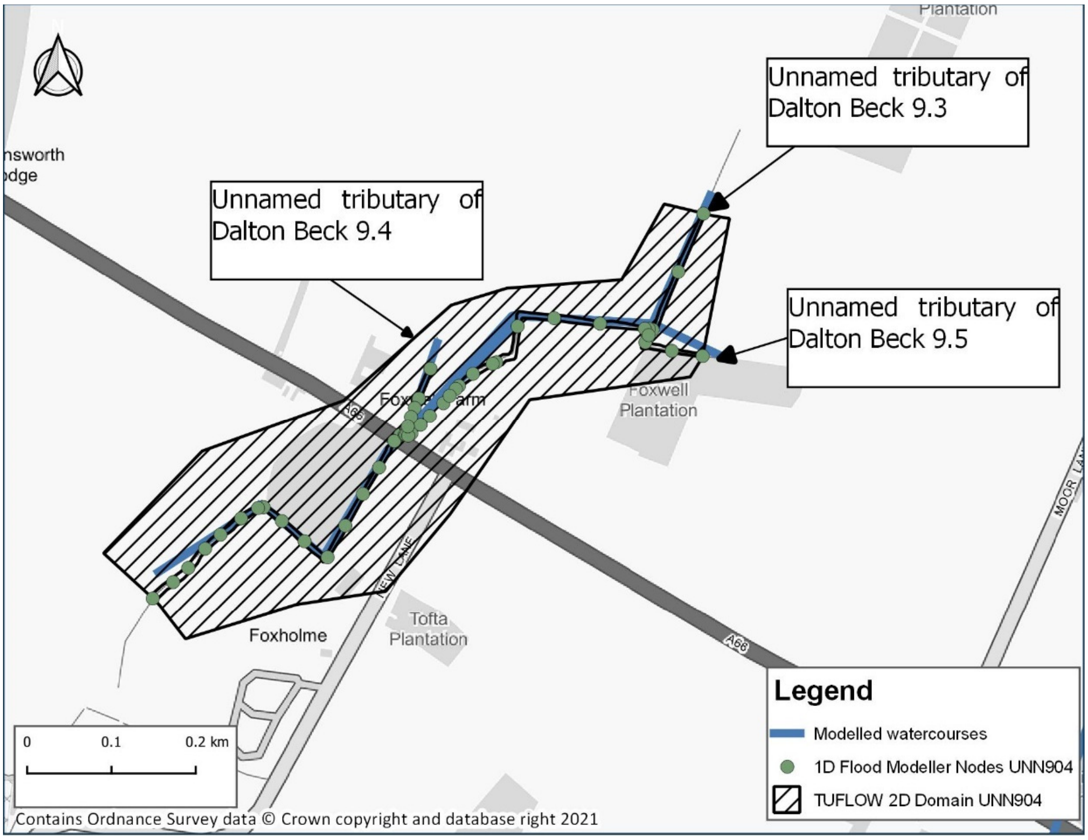

Figure 3.4: Model UNN904: Unnamed Tributaries of Dalton Beck 9.3, 9.4 and 9.5

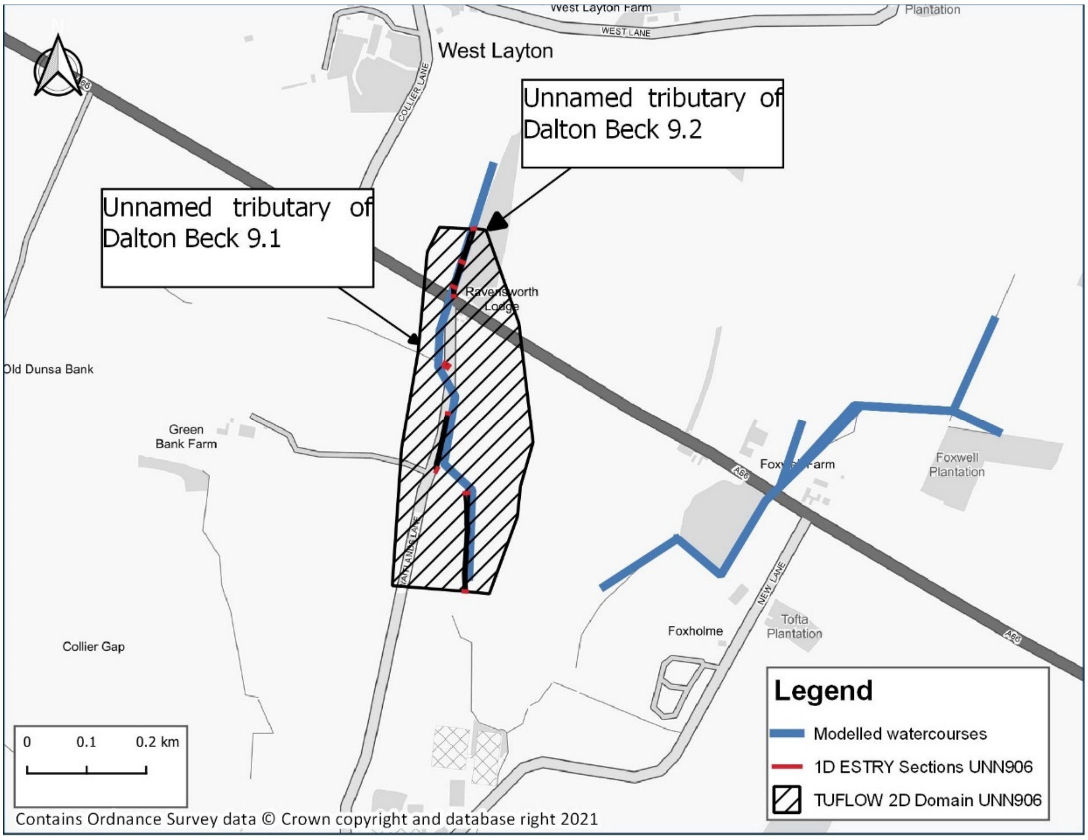

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Figure 3.5: Model UNN906: Unnamed Tributary of Dalton Beck 9.1 and 9.2

| **4 Baseline model schematisation** | |
|---|---|
| 4.1 1D Domain | |
| Channel representation | The channel system has been based upon the most recent survey data set available for the area. The channels have been represented within the 1D domain across the study reach. |
| Structure representation | Existing structures have been based upon the most recent survey data set available. All significant structures within the study area have any modelling assumptions documented within this report (Section 5). Additionally, any structures which were not included within the hydraulic model based on the assumption that they were not deemed to be hydraulically significant are also recorded. |
| Inflow boundaries | Model UNN901<br>Flow has been applied with a flow-time (QT) boundary in the 2D domain to allow water to route towards the structure beneath the A66. No formal upstream channel could be found upstream of the structure beneath the A66. A lateral inflow has been applied in the 1D domain to account for the intervening flow. Further information can be found in the FEH calculation record.<br><br>Model UNN902, UNN903, UNN904 and UNN906<br>Flow has been applied with a flow-time (QT) boundary at the upstream extent of the model. A lateral inflow has been applied to |

<table>
<tr><td></td><td colspan="3">account for the intervening area. Further information can be found in the FEH calculation record.</td></tr>
<tr><td>Climate Change</td><td colspan="3">Climate change uplifts have been applied for the central, higher central and upper end allowances for the Eden and Esk Management Catchment using the Environment Agency July 2021 allowances.</td></tr>
<tr><td>Downstream boundary</td><td colspan="3">A normal depth downstream boundary has been applied at the downstream end of each model. This was because no existing model was available at the downstream boundary location to accurately extract water level data for a given AEP event.</td></tr>
<tr><td>Hydraulic roughness values used</td><td colspan="3">Channel roughness values have been represented in the model by Manning’s ‘n’ values, defined on a reach basis.  In order to determine the roughness of channel cross sections, photographic evidence collected during site visits and survey collection were used as a reference alongside application of the method published by Cowan (1956).<br>Channel roughness values range from 0.035-0.070.<br>Structure roughness values range from 0.015-0.03.<br>To understand the implications of using these manning’s n values, sensitivity testing has been conducted to quantify the impacts in changing these parameters.</td></tr>
<tr><td>Labelling/naming convention used</td><td colspan="3">All nodes have an ID of NNN00X_XXXXX where NNN00X is the watercourse reference and XXXXX is the chainage upstream.<br>The following suffixes have been used:<br>C or CU  Culvert<br>W  Weir<br>SP  Spill<br>B  Bridge<br>i, i2, i3  Interpolate<br>u or d  Upstream or downstream node</td></tr>
<tr><td colspan="4">4.2 2D Domain</td></tr>
<tr><td>Area of 2D Domains</td><td>Model UNN901: 0.1km2<br>Model UNN902: 0.098km2<br>Model UNN903: 0.23km2<br>Model UNN904: 0.13km2<br>Model UNN906: 0.1km2</td><td>DTM data source</td><td>LIDAR</td></tr>
<tr><td>Resolution of grid</td><td>2m for all models at Scheme 9</td><td>DTM Resolution</td><td>1m</td></tr>
<tr><td>Modifications to topography and reasons</td><td>UNN901<br>2d_zsh_UNN901_banks_002_L<br>2d_zsh_UNN901_banks_002_P<br>2d_iwl_UNN901_R</td><td colspan="2">The top of bank elevations have been stamped using Z shapes. Elevations are based on surveyed channel sections and LIDAR.<br>Initial water level polygon, used to aid stability when applying flow to the 2D domain.</td></tr>
</table>

| | | |
|---|---|---|
| | UNN902<br>2d_zsh_UNN902_banks_001_L<br>2d_zsh_UNN902_banks_002_P | The top of bank elevations have been stamped using Z shapes. Elevations are based on surveyed channel sections and LIDAR. |
| | UNN903<br>2d_zsh_UNN903_L_002<br>2d_zsh_UNN903_P_002 | The top of bank elevations have been stamped using Z shapes. Elevations are based on surveyed channel sections and LIDAR. |
| | UNN904<br>2d_zsh_UNN904_banks_002_L<br>2d_zsh_UNN904_banks_004_P | The top of bank elevations have been stamped using Z shapes. Elevations are based on surveyed channel sections and LIDAR. |
| | UNN906<br>2d_zsh_UNN906_banks_002_L<br>2d_zsh_UNN906_banks_002_P<br>2d_zsh_UNN906_LiDAR_002_L<br>2d_zsh_UNN906_LiDAR_002_P | The top of bank elevations have been stamped using Z shapes. Elevations are based on surveyed channel sections and LIDAR.<br>Reinforcing the representation of the headwall at the upstream end of the A66 culvert using survey data. |
| Hydraulic roughness values used | Manning's n values have been used to represent hydraulic roughness in the 2D domain. The following roughness values were used in the model and are based on land cover types recorded in the Ordnance Survey MasterMap Topographic Area layer dataset. | |

| Land Cover | Manning's 'n' value |
|---|---|
| Generic floodplain roughness values | 0.050 |
| Boulders | 0.065 |
| Coniferous trees | 0.120 |
| Coniferous trees – scattered / Orchard | 0.070 |
| Coppice or osiers | 0.090 |
| Marsh Reeds or Saltmarsh | 0.060 |
| Non coniferous trees | 0.090 |
| Non-coniferous trees – scattered | 0.060 |
| Rough grassland | 0.060 |
| Scrub | 0.070 |
| Rock | 0.070 |
| Heath | 0.090 |
| Building | 0.300 |
| General surface – multi surface | 0.050 |
| General surface – step | 0.050 |
| General surface - manmade | 0.050 |
| General surface - natural | 0.060 |

| | | |
|---|---|---|
| | Glasshouse | 0.200 |
| | Inland water | 0.045 |
| | Landform | 0.060 |
| | Landform – slope | 0.060 |
| | Landform – cliff | 0.060 |
| | Path – step | 0.050 |
| | Path | 0.050 |
| | Rail | 0.045 |
| | Road | 0.035 |
| | Roadside | 0.050 |
| | Structure | 0.300 |
| | Structure – upper level of communication | 0.300 |
| | Structure – pylon | 0.060 |
| | Tidal water – foreshore | 0.055 |
| | Tidal water | 0.055 |
| | Unclassified | 0.060 |
| | Stability value | 0.300 |
| 4.3 1D-2D Linking | | |
| A HX boundary is used to link the 1D and 2D domains along the top of banks. Elevations of HX cells are set using Z shapes outlined in Section 4.2. | | |
| Model Boundaries – Downstream Conditions | A 2D HQ boundary is used at the downstream extent of the 2D domain based on slope values derived from LIDAR. | |
| 4.4 Representation of Defences | | |
| Defences | There are no formal defences within the study area. As such, all model runs are considered to be undefended.<br>A number of drystone walls are present within the study area that may impede flow during particular fluvial flood events. These have not been represented within the model due to lack of data on these structures, and in parts, the integrity of these walls. | |

## 5 Structures

General Assumptions

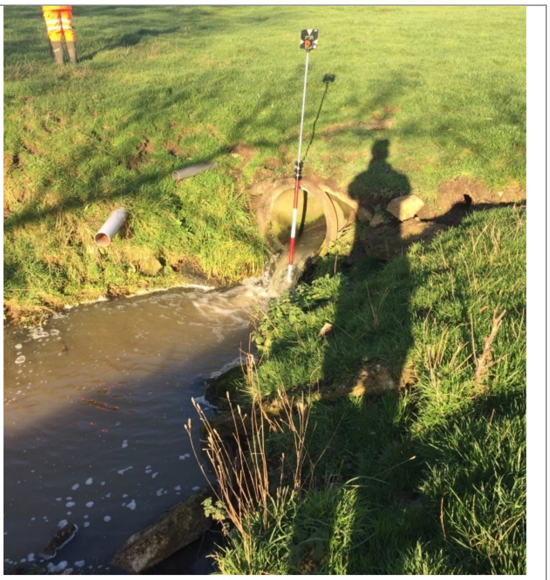
- At structures where only one face has been surveyed, a copy of the surveyed upstream face was used to represent the downstream face.
- Modelled structures have been schematised using the most recent channel survey taken by JBA Consulting between November 2020 and June 2021.

UNN901: Unnamed Tributary of Holme Beck 9.2

| ID | Structure | How has this structure been modelled? | Photo (view of upstream face unless specified) |
|---|---|---|---|
| UNN901_0352 | Existing A66 road culvert | This structure has been modelled in ESTRY with a rectangular culvert unit. Overtopping flow is represented in the 2D domain. | <br>Upstream face looking downstream<br><br>Downstream face looking upstream |

| | | | |
|---|---|---|---|
| U901_0065C | Farm access culvert | This structure has been modelled in ESTRY with a circular culvert unit. Overtopping flow is represented in the 2D domain. | <br>Upstream face looking downstream |
| UNN902: Unnamed Tributary of Holme Beck 9.1 | | | |
| UNN902_534 CU<br>UNN902_0490 | Structure under existing A66 | This structure has been modelled in Flood Modeller with a circular conduit unit connected to a rectangular conduit unit using an orifice unit. Due to lack of data, assumptions have been made as to where the culvert changes shape and size. Overtopping flow is represented in the 2D domain. | <br>Upstream face looking downstream<br><br>Downstream face looking upstream |

| | | | |
|---|---|---|---|
| UNN902_000 C | Culvert under farm access track | This structure has been modelled in Flood Modeller with a circular conduit unit. Overtopping flow is represented in the 2D domain. |  Upstream face looking downstream |
| UNN903: Mains Gill and Unnamed Tributaries of Mains Gill 9.1 and 9.3 | | | |
| UNN903_0385 | Existing A66 culvert | This structure has been modelled in ESTRY with a rectangular culvert unit. Overtopping flow is represented in the 1D domain. |  Upstream face looking downstream |
| UNN903_0301 _C1<br>UNN903_0301 _C2 | Circular culvert | This structure has been modelled in ESTRY with a circular culvert unit. Due to lack of data, assumptions have been made as to where the culvert changes size. Overtopping flow is |  Upstream face looking downstream |

| | | | |
|---|---|---|---|
| | | represented in the 2D domain. | <br>Downstream face looking upstream |
| UNN909_0545 C | Circular culvert | This structure has been modelled in ESTRY with a circular culvert unit. Overtopping flow is represented in the 2D domain. | <br>Upstream face looking downstream |
| UNN904: Unnamed Tributaries of Dalton Beck 9.3, 9.4 and 9.5 | | | |
| U908_0019cu | Farm access track culvert | This structure has been modelled with a rectangular conduit unit in Flood Modeller. Overtopping has been represented in the 1D domain. | <br>Upstream face looking downstream |

| | | | |
|---|---|---|---|
| U904_0812cu | Farm access track | This structure has been modelled with a rectangular conduit unit connected to an orifice unit to represent the circular culvert outlet in Flood Modeller. Overtopping has been represented in the 1D domain. |  Upstream face looking downstream  Downstream face looking upstream |
| U904_0589Ou | Corrugated conduit unit | This structure has been modelled with an orifice unit in Flood Modeller. Overtopping has been represented in the 1D domain. |  Upstream face looking downstream  Downstream face looking upstream |

| | | | |
|---|---|---|---|
| U904_0535cu | Farm access track | This structure has been modelled with a rectangular conduit unit linked to a circular conduit unit using an orifice unit in Flood Modeller. Due to lack of data, assumptions have been made as to where the culvert changes size. Overtopping has been represented in the 1D domain. |  Upstream face looking downstream<br> Downstream face looking upstream |
| U904_0508Cu | Circular culvert structure | This structure has been modelled with a circular conduit unit linked to an orifice unit to represent the culvert outlet in Flood Modeller to aid stability. Overtopping has been represented in the 2D domain |  Upstream face looking downstream<br> Downstream face looking upstream |

| | | | |
|---|---|---|---|
| UNN904_0440 | Bend | A bed loss has been applied to account for additional losses associated with the 90degree bend in the channel approaching the A66 culvert |  |
| U904_0440cu | A66 culvert | This structure has been modelled with a sprung arch culvert unit in Flood Modeller. Overtopping has been represented in the 2D domain. | <br>Upstream face looking downstream<br><br>Downstream face looking upstream |
| U904_0166cu | Culvert beneath track | This structure has been modelled with a circular culvert unit in Flood Modeller. Overtopping has been represented in the 1D domain. At the time of survey the upstream face was blocked. | <br>Upstream face looking downstream |

| | | | |
|---|---|---|---|
| | | | <br>Downstream face looking upstream |
| U907_0000Ou | Brick opening into channel U904. | This structure is modelled using an orifice unit in Flood modeller. Overtopping represented in the 2d domain. | <br>Upstream face looking downstream<br><br>Downstream face looking upstream |

| UNN906: Unnamed Tributary of Dalton Beck 9.1 and 9.2 | | | |
|---|---|---|---|
| U906_0525 to U906_0327 | A66 culvert | This structure has been modelled as a 1.05m x 1.1m rectangular culvert unit in ESTRY at the upstream extent, and a 0.48 x 0.46 rectangular culvert unit at the downstream point. The point at which the significant change in size occurs is unknown. Assumptions have been made on where this change occurs based on site photos and site walkover observations. Overtopping is modelled in the 2D domain. | <br>Upstream face looking downstream<br><br>Downstream face looking upstream |

| | | | |
|---|---|---|---|
| UNN906_0029 to UNN906_0167 | Circular culvert | This structure has been modelled using a circular conduit unit in ESTRY. Overtopping has been modelled in the 2D domain. |  Upstream face looking downstream<br> Downstream face looking upstream |

| | | | |
|---|---|---|---|
| U906_0000C (survey is from UNN905_0000 ) | Culvert beneath Waitlands Lane | This structure has been modelled using a circular conduit unit in ESTRY. Overtopping has been modelled in the 2D domain. |  |

# 6 Model Proving

## 6.1 Model Performance

### Model UNN901: Unnamed Tributary of Holme Beck 9.2

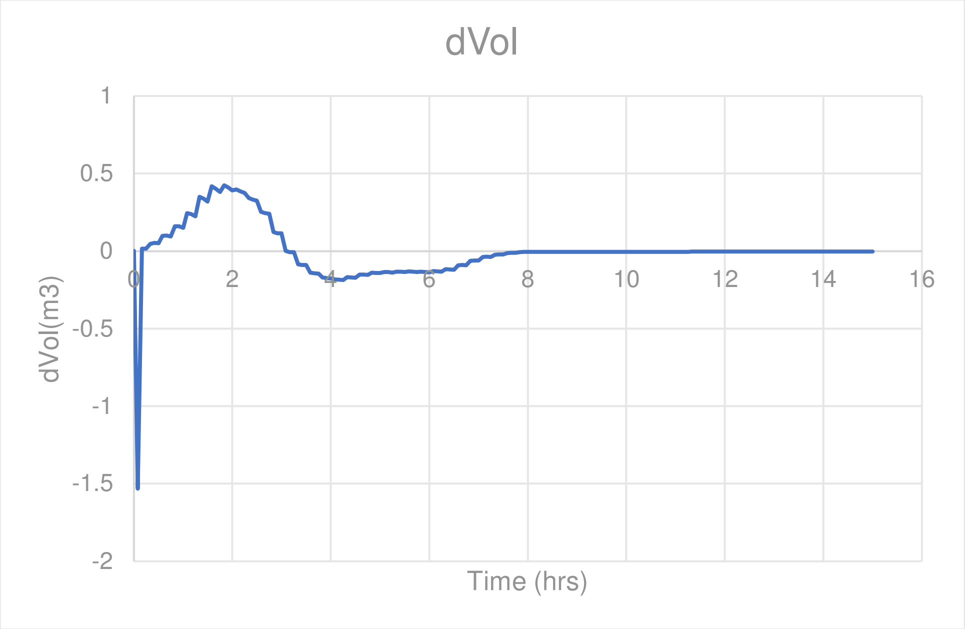


Figure 6.1: dVol for model UNN901

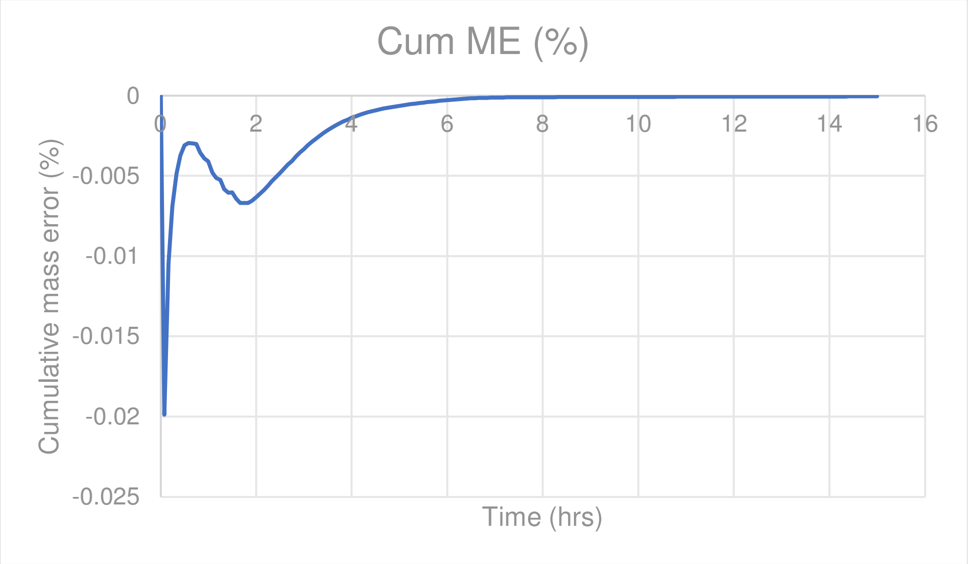


Figure 6.2: Cumulative mass error plot for UNN901

Flow and stage profiles have been checked throughout the model and are smooth with minimal oscillations, indicating the model is performing well.  The change in volume (dVol) plot is generally smooth after an initial spike and the cumulative mass error is within a range of +1 to -1 for the whole of the simulation.

## Model UNN902: Unnamed Tributary of Holme Beck 9.1

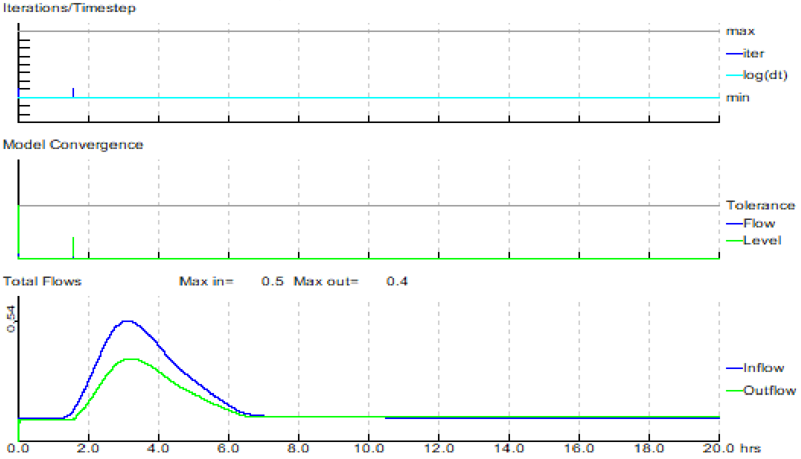


Figure 6.3: Flood Modeller convergence plot for Model UNN902

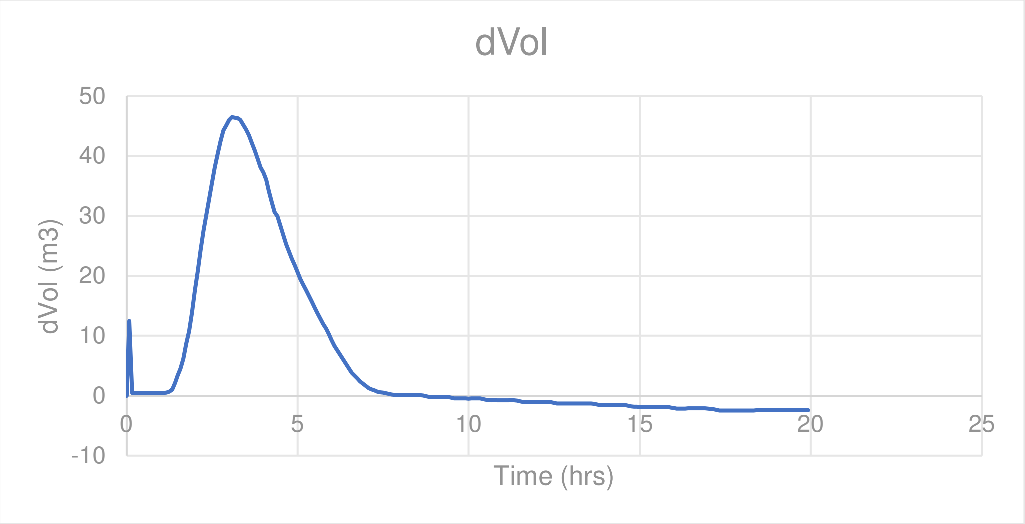


Figure 6.4: dVol for model UNN902

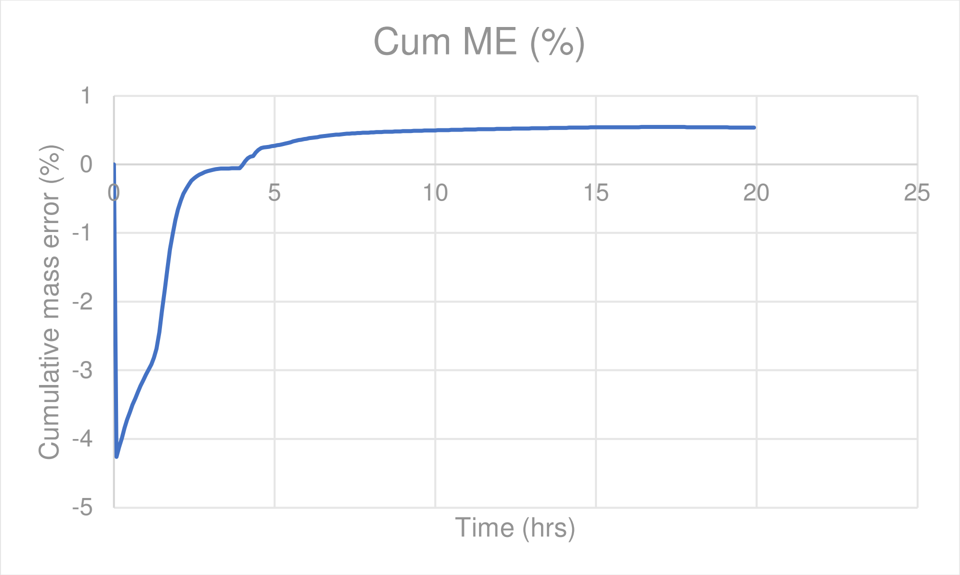


Figure 6.5: Cumulative mass error for model UNN902

The Flood modeller convergence plot show smooth inflow and outflows into the model with no incidences of poor convergences. Flow and stage profiles have been checked throughout the model and are smooth with minimal oscillations, indicating the model is performing well. The change in volume (dVol) plot shows a spike at the beginning of the model run, but is smooth through the majority of the simulation. The cumulative mass error shows an initial spike at the beginning of the simulation, however this occurs when the volume of water in the model is small and returns to within +1 to -1 for before the peak of the event.

Model UNN903: Mains Gill and Unnamed Tributaries of Mains Gill 9.1 and 9.3

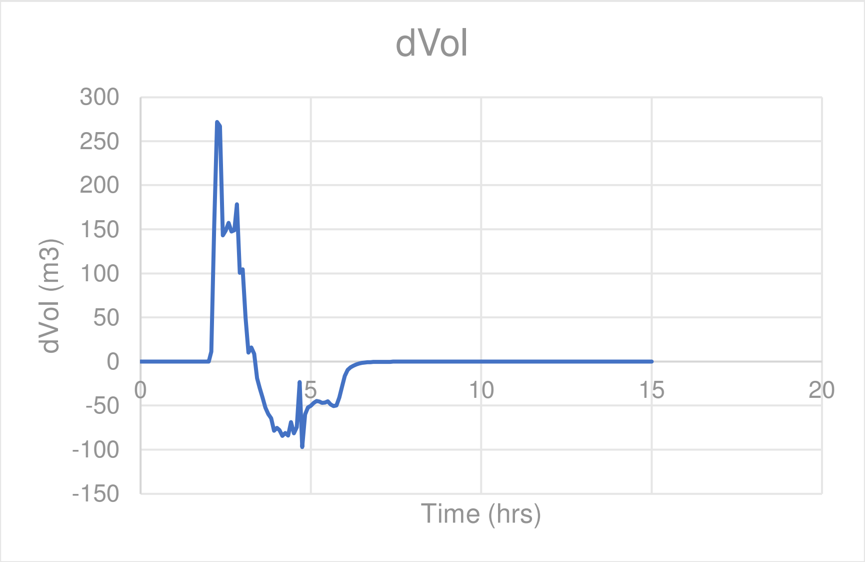


Figure 6.6: dVol for model UNN903

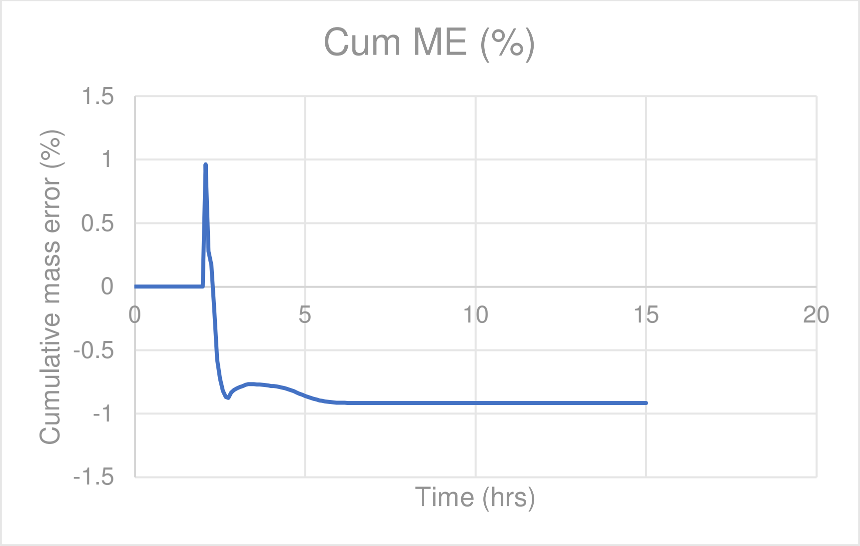


Figure 6.7: Cumulative mass error for model UNN903

Flow and stage profiles have been checked throughout the model and are smooth with minimal oscillations, indicating the model is performing well. The change in volume (dVol) plot shows some minor oscillations, although these occur after the peak of the event. After an initial spike the cumulative mass error is within a range of +1 to -1% for the majority of the simulation.

Model UNN904: Unnamed Tributaries of Dalton Beck 9.3, 9.4 and 9.5

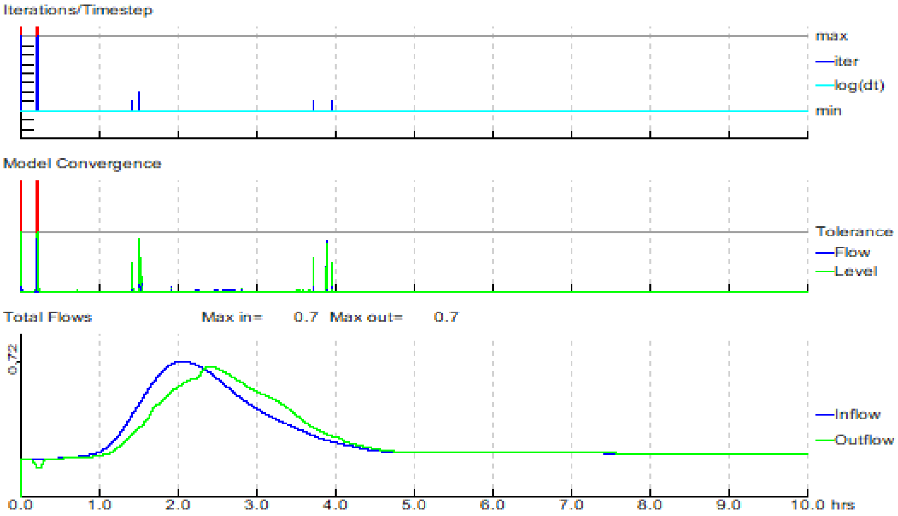


Figure 6.8: Flood Modeller convergence plot for Model UNN904

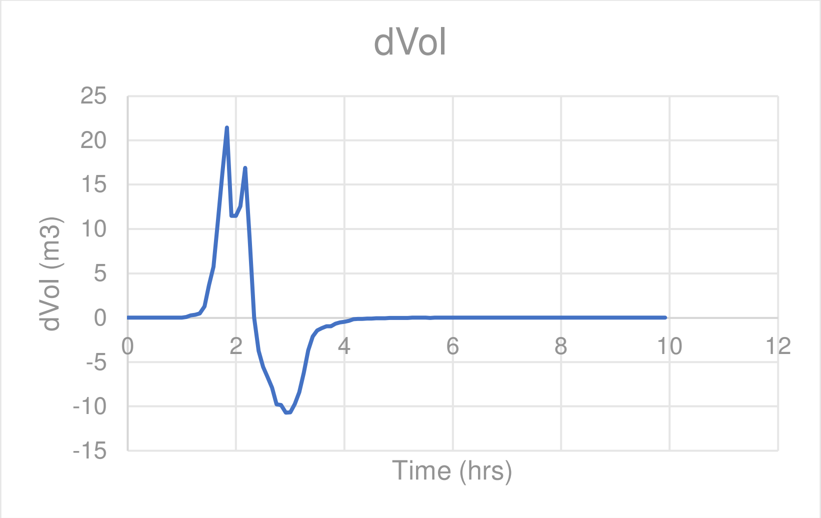


Figure 6.9: dVol plot for model UNN904

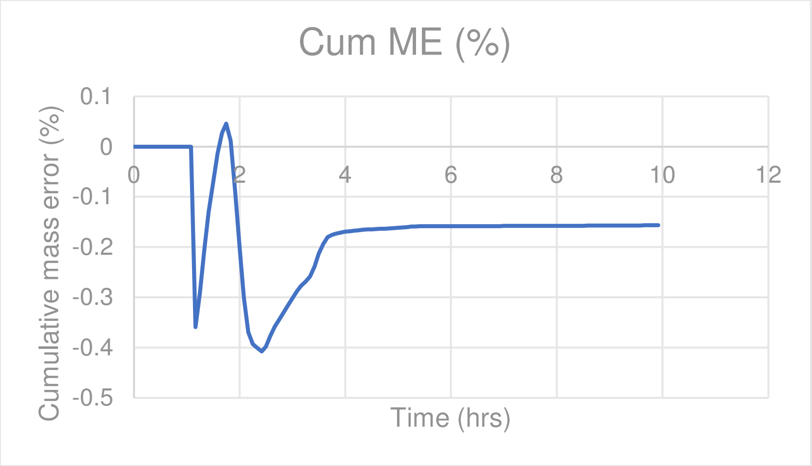


Figure 6.10: Cumulative mass error for model UNN904

The Flood modeller convergence plot show smooth inflow and outflows into the model with minimal incidences of poor convergences. Flow and stage profiles have been checked throughout the model and are smooth with minimal oscillations, indicating the model is performing well. The change in volume (dVol) plot is generally smooth and the cumulative mass error is within +1 to -1% for the entire simulation.

Model UNN906: Unnamed Tributary of Dalton Beck 9.1 and 9.2

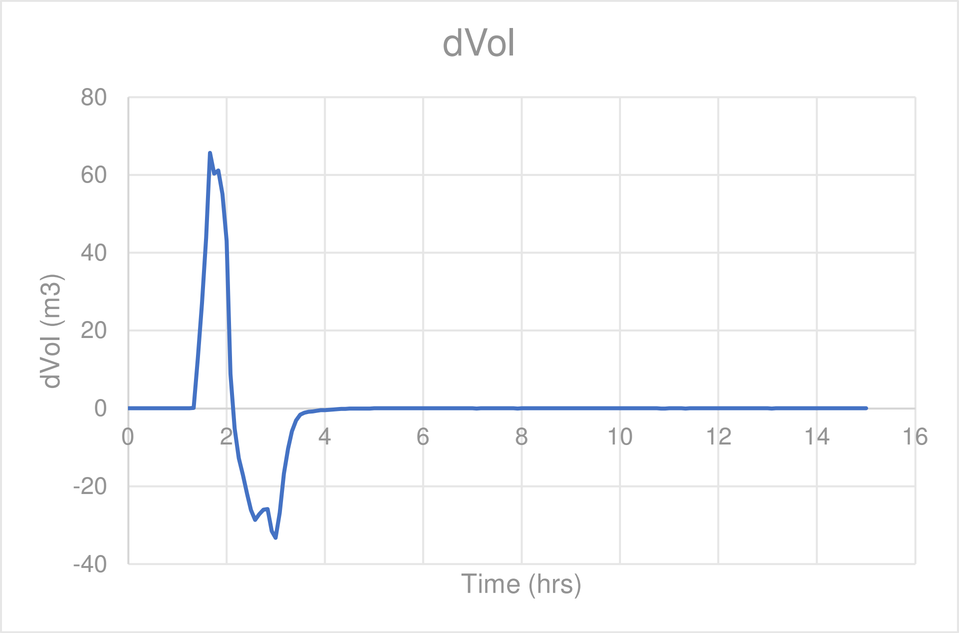


Figure 6.11: dVol plot for model UNN906

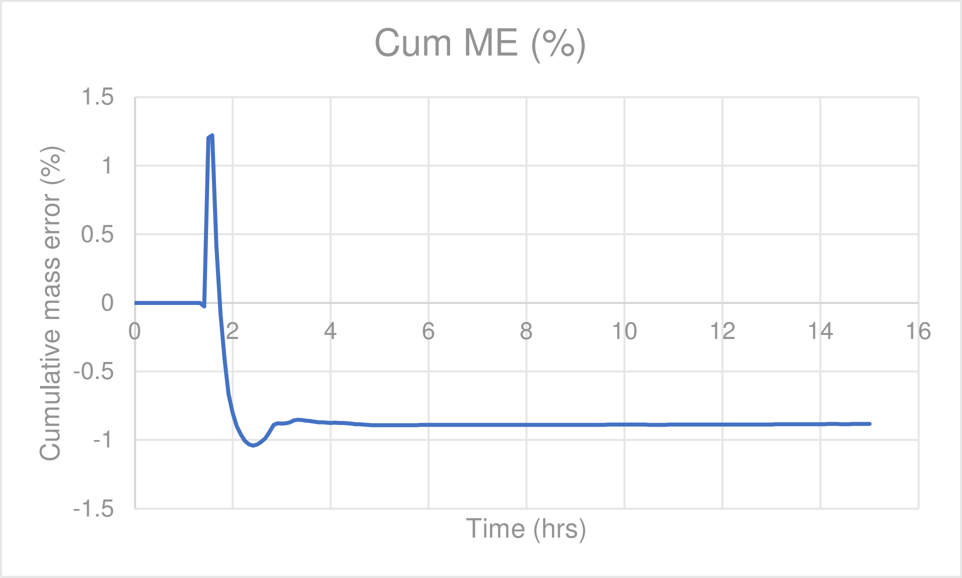


Figure 6.12: Cumulative mass error for model UNN906

Flow and stage profiles have been checked throughout the model and are smooth with minimal oscillations, indicating the model is performing well. The dVol plot is generally smooth and the cumulative mass error is within a range of +1 to -1% for the majority of the simulation.

| 6.2 Model Verification | |
|---|---|
| Calibration | No gauge data was available for the study area to allow the model to be calibrated to. Information on historical flood risk was requested from the Lead Local Flood Authority but no information was provided. |
| Previous Model Comparison | No previous hydraulic model results are available for the study area for comparison. |
| Flood Zone Comparison | Fluvial Flood Zone data is unavailable for the model extent.  Surface water flood maps have therefore been used as a comparison and show that generally the modelled 0.1% flood extent are slightly smaller than the EA's 0.1% Risk of Flooding from Surface Water maps for models UNN901, UNN903 and UNN904.  This may be as a result of detailed survey information being used to represent the channel capacity of the watercourses which are not included in the EA's surface water maps. For UNN902 and UNN904 and UNN904,  the detailed model results show larger flood extents that the EA's surface water flood maps. |

Figure 6.13: 0.1% surface water flood extent and 0.1% modelled flood extent for Model UNN901

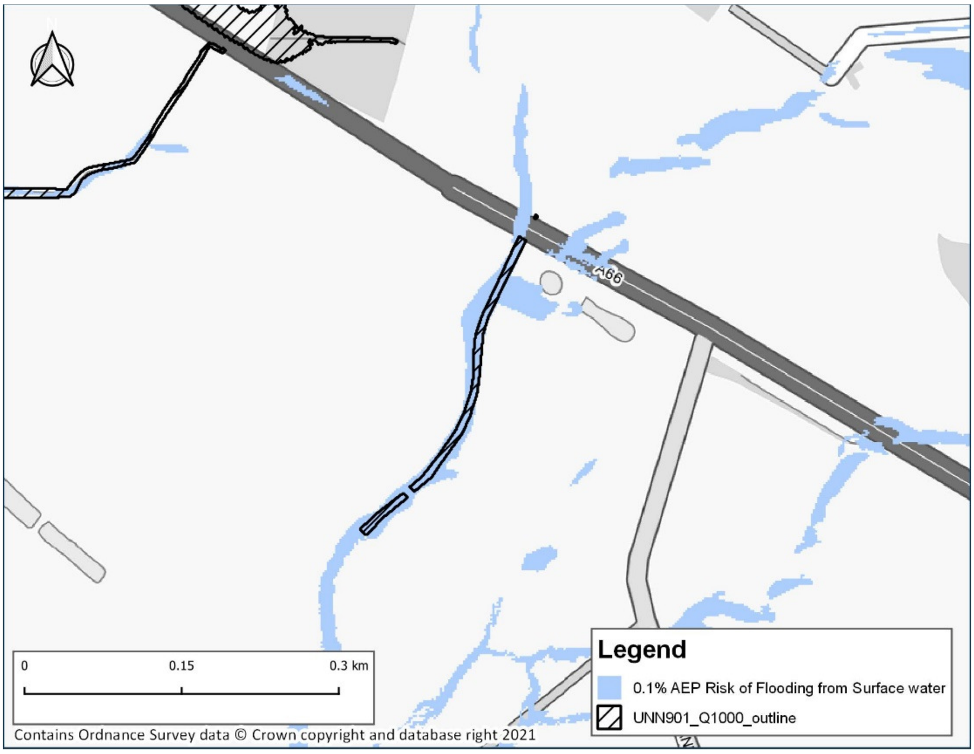


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Figure 6.14: 0.1% surface water flood extent and 0.1% modelled flood extent for Model UNN902 and UNN903

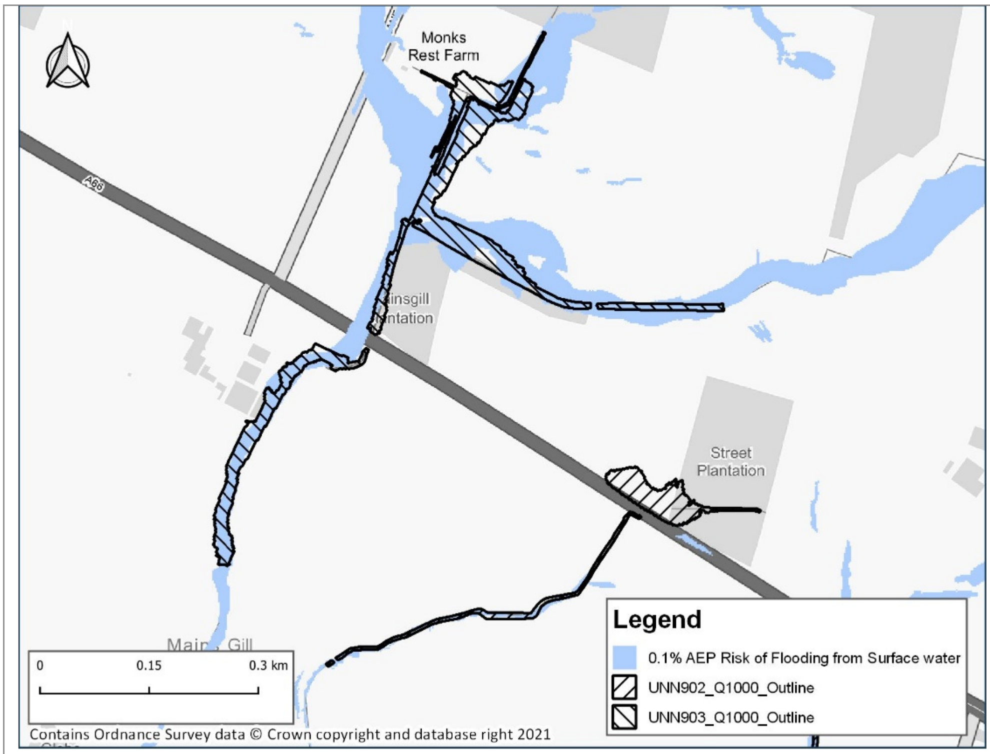

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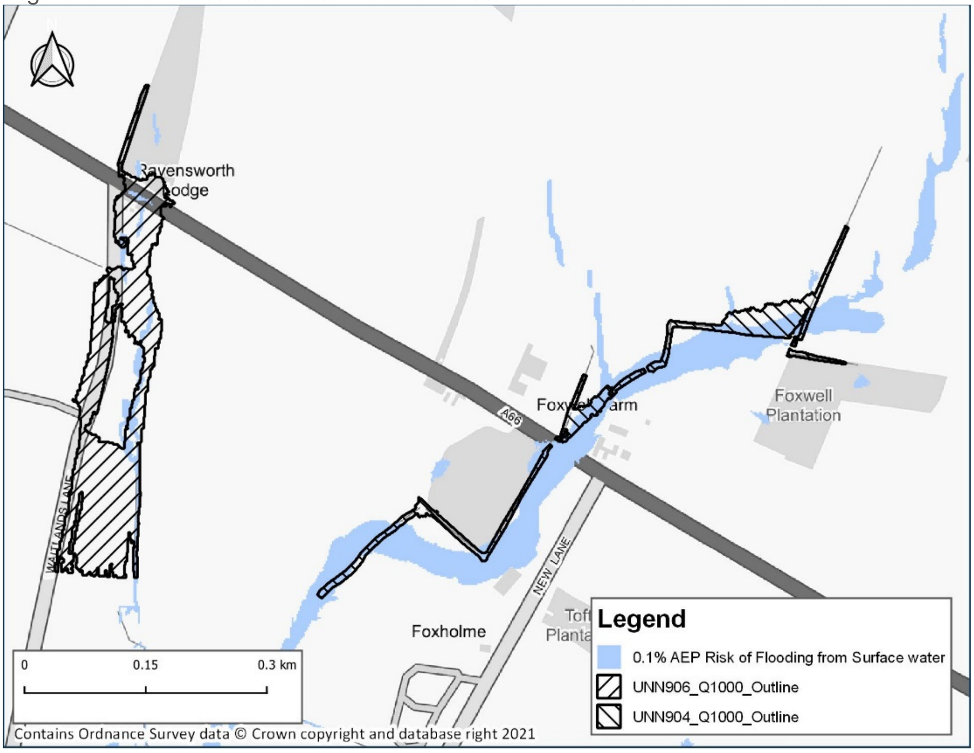
Figure 6.15: 0.1% surface water flood extent and 0.1% modelled flood extent for Model UNN904 and UNN906



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## 6.3 Sensitivity Analysis

Sensitivity tests were carried out for the 1% AEP existing situation model to assess the model response to the change in:

- Flow: Model inflows increased by 20%
- Roughness coefficient: In-channel and roughness values changed by +20% and -20%
- Downstream boundary: UNN901, UNN903 and UNN906 - Flow in the HQ boundary decreased by 20%. UNN902 and UNN904 – gradient decreased by 20%
- The table below shows the maximum, minimum and average change in in-channel water levels relative to the existing situation model for each modelled reach with increase in flow and increase and decrease in roughness coefficients.
- The downstream boundary sensitivity test showed a maximum increase in water levels at the most downstream node on all watercourses.  Changes in peak water level compared to the baseline extend approximately 65m in Model UNN901, 15m in Model UNN902, 0m in Model UNN903, 166m in Model UNN904 and 229m in UNN906.

| Watercourse | Model UNN901: Unnamed Tributary of Holme Beck 9.2 | | |
|---|---|---|---|
| Node | Change in peak water level (m) | | |
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.06 | 0.00 | 0.03 |
| +20% Roughness | 0.08 | -0.05 | 0.02 |
| -20% Roughness | 0.04 | -0.09 | 0.02 |

| Watercourse | Model UNN902: Unnamed Tributary of Holme Beck 9.1 | | |
|---|---|---|---|
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.03 | -0.01 | 0.07 |
| +20% Roughness | 0.04 | -0.22 | 0.01 |
| -20% Roughness | 0.04 | -0.22 | 0.01 |

| Watercourse | Model UNN903: Mains Gill and Unnamed Tributaries of Mains Gill 9.1 and 9.3 | | |
|---|---|---|---|
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.12 | 0 | 0.05 |
| +20% Roughness | 0.11 | -0.03 | 0.03 |
| -20% Roughness | 0.01 | -0.08 | -0.05 |

| Watercourse | Model UNN904: Unnamed Tributaries of Dalton Beck 9.3, 9.4 and 9.5 | | |
|---|---|---|---|
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.4 | -0.01 | 0.04 |
| +20% Roughness | 0.05 | -0.01 | 0.02 |
| -20% Roughness | Did not run | | |

| Watercourse | Model UNN906: Unnamed Tributary of Dalton Beck 9.1 and 9.2 | | |
|---|---|---|---|
| Sensitivity | Maximum | Minimum | Average |
| +20% Flow | 0.26 | 0.00 | 0.08 |
| +20% Roughness | 0.24 | -0.02 | 0.05 |
| -20% Roughness | 0.00 | -0.05 | -0.02 |

## 7 Model Build – With-Scheme Situation Model

No with scheme scenario modelled

## 8 Key Model Assumptions and Limitations

During any hydraulic modelling study, there will always be associated limitations, for example, with uncertainty and data availability etc. The representation of any complex system by a model requires several assumptions to be made. In the case of the hydraulic model it has been assumed that:

- Cross sections accurately represent the shape and variation of the river.
- Model parameters have been determined appropriately.
- Design flows are an accurate representation of flows of a given AEP.
- The surveyed cross-sections of hydraulic structures and the units used to represent them in the model provide an adequate representation of the situation.
- LIDAR accurately reflects bank heights and particularly that the filtered LIDAR has appropriately removed the influence of vegetation.

Other specific limitations and assumptions are detailed below:

- The watercourses in the study area are ungauged and therefore no calibration of the hydraulic model has been carried out.
- At UNN906, Unnamed Tributary of Dalton Beck 9.1 and 9.2, there is a significant change in the size of the structure beneath the A66 between the surveyed inlet and outlet (U906_0525C to U906_0327C).  The point at which this change in structure shape and size occurs is not known due to lack of as built drawings.
- Several other structures within the Scheme 9 A66 domains featured culverts where the inlet and outlet are different shapes/ sizes.  Due to lack of data, assumptions have been made as to where the change in structure shape and size occurs.
- Surface water, sewer flooding and groundwater flooding have not been included in this assessment.  The hydraulic model results demonstrate the potential flood risk from the mechanism of the modelled watercourses overtopping only.