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Roxhill (Junction 15 Ltd)
Northampton Gateway
Strategic Rail Freight Interchange

SUSTAINABLE DRAINAGE STATEMENT

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ENVIRONMENT

Roxhill (Junction 15 Ltd)
Northampton Gateway
Strategic Rail Freight
Interchange

SUSTAINABLE DRAINAGE STATEMENT

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1.0 INTRODUCTION

Site Details

1.1 This Sustainable Drainage Statement has been produced by BWB Consulting on behalf of Roxhill (Junction 15 Ltd) in respect of the site known as Northampton Gateway Strategic Rail Freight Interchange, adjacent Junction 15 of the M1 Motorway.

1.2 A Sustainable Drainage Statement sets out the principles of the drainage design for the development and summarises the reasoning behind the chosen design. This includes justification of specific flow rates, volumes of attenuation and the level of treatment provided to runoff.

1.3 This document forms an appendix to the Environmental Statement (ES) submitted in support of this application.

1.4 Separately to this, but also as appendices to the ES, is a Flood Risk Assessment and a Water Framework Directive Compliance Assessment.

1.5 The proposed development is to be submitted as a Nationally Significant Infrastructure Project (NSIP) for a Development Consent Order (DCO) and as such the details have been developed, commented on and reviewed by statutory bodies in advance of the application being made.

1.6 The Lead Local Flood Authority (LLFA) are Northamptonshire County Council. They have been formally consulted and have agreed a Statement of Common Ground (SoCG) in respect of surface water and ordinary watercourses, this is included as **Appendix 1.**

1.7 Anglian Water (AW) are responsible for waste water disposal and they have also been consulted, agreeing to enter into a SoCG which is included as **Appendix 2**.

1.8 The proposals for the development centre around a proposed rail served storage and distribution site adjacent to Junction 15 of the M1 Motorway. Throughout this document, this is referred to as the 'Main Site'.

1.9 A bypass is proposed around the village of Roade which lies south of the Main Site and also requires a surface water drainage strategy. There are no foul water requirements.

1.10 Traffic modelling has also identified a further seven junctions or areas of highway in the wider vicinity to which works are proposed, typically localised carriageway widening or realignment to provide betterment with the exception of M1 J15 itself where more significant works are proposed. Outline surface water drainage strategies are also proposed for these junctions.

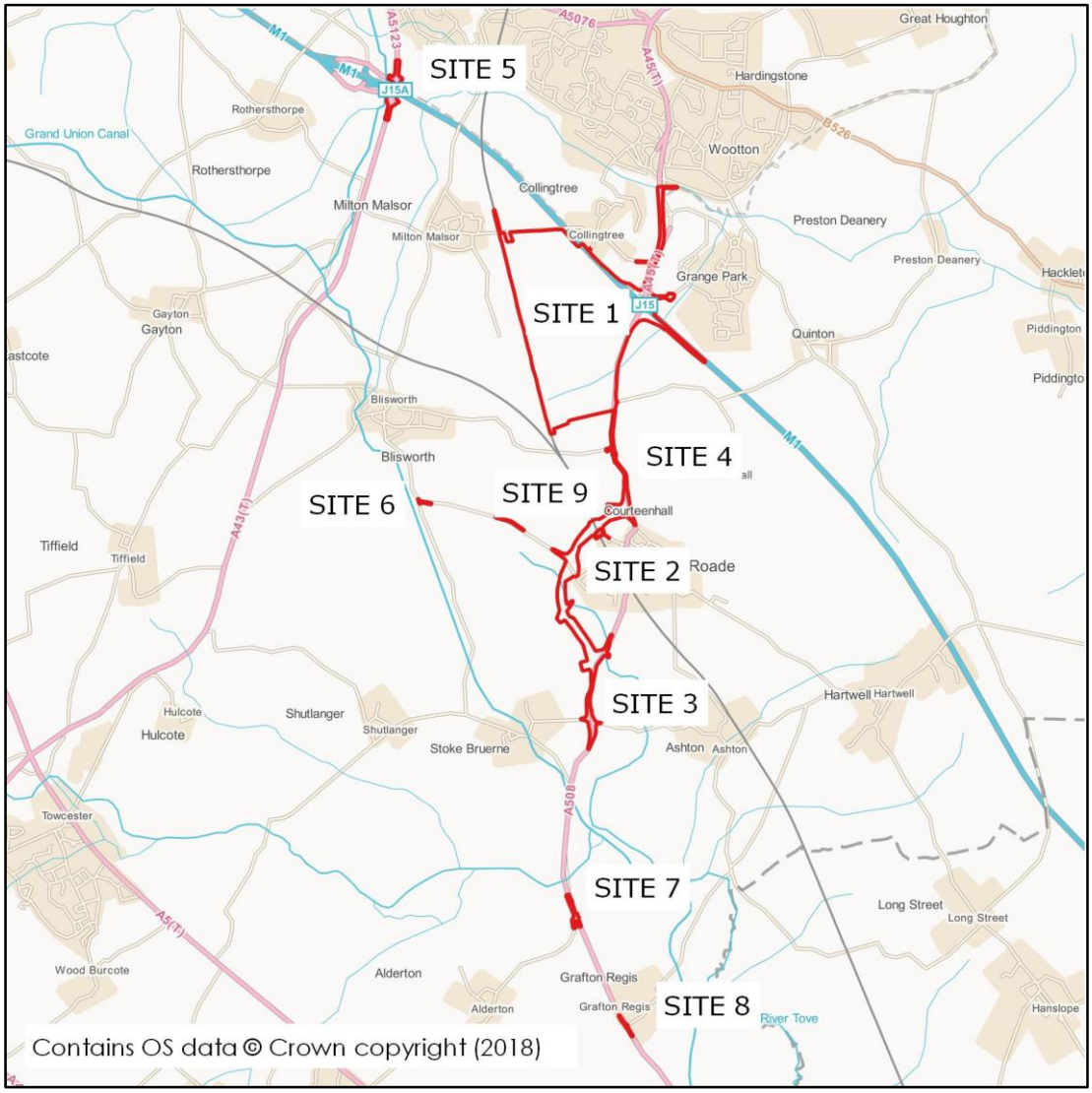

Figure 1.1 - Site Locations

SuDS Guidance

1.11 The LLFA have a website (www.floodtoolkit.com) which provides advice and guidance on new planning applications, and a document has also been produced (Local Standards and Guidance for Surface Water Drainage in Northamptonshire)[1]. A pre application meeting was also held with a representative on 1st December 2017 due to the scale and nature of the proposals.

1.12 In addition, the Non-Statutory Technical Standards for Sustainable Drainage Systems[2] as published by DEFRA have been utilised to inform the strategy.

[1] https://www.floodtoolkit.com/wp-content/uploads/2017/09/Local-Standards-for-publication-v1.3-September-2017.pdf
[2] 2015, DEFRA. Non-statutory technical standards for sustainable drainage systems

2.0 SURFACE WATER DRAINAGE STRATEGY

Drainage Hierarchy

2.1 A preferential hierarchy for discharge of surface water exists which states that surface water should be disposed of in the following order of preference;

- *Infiltration via soakaways*
- *Watercourse*
- *Surface Water Sewer*
- *Combined Water Sewer*

2.2 The existing runoff regime for the vast majority of land affected by the proposed development is Greenfield whereby small amounts of rainfall are infiltrated into the existing ground and the remainder runs off across, or just under the surface into a network of ditches and watercourses.

2.3 The nature of the underlying ground means that using infiltration as a single means of surface water disposal would not be feasible, it being typified by a gravelly clay. Therefore, whilst a degree of infiltration is likely in most instances, a formalised connection to either a watercourse/highway drain has been proposed within this document. This provides the security that were infiltration unable to deal with all post development flows, a suitable strategy is in place.

2.4 Preliminary soakaway tests were undertaken in unsupported shallow trial pits and were attempted in general accordance with the recommendation of BRE 365. The three tests, undertaken within TPs 5, 15 and 20 did not soakaway sufficiently to allow calculation of infiltration rates. The strata in which these tests were undertaken were predominantly cohesive and not considered to be conducive to soakaways and the testing undertaken has confirmed this. Refer to RSK Factual Ground Investigation Report (Ref 312598-02) for further details.

2.5 It may be appropriate to perform infiltration tests at the formation level of proposed sustainable drainage features during construction to better define infiltration characteristics however it is not thought that any rates achieved will be suitable as a single solution.

2.6 Therefore, discharge to watercourses has been proposed wherever possible with connection to existing highway drains (typically culverted watercourses) suggested elsewhere and this is in compliance with the aforementioned hierarchy.

Main Site

Introduction

2.7 The Main Site extends to approximately 215ha and is located on land west of the M1 Motorway, being comprised of farmland (including associated buildings) and wooded areas. It is divided into smaller parcels of land by hedgerows and ditches typical of farmland. An Illustrative Masterplan is included as **Appendix 3** for reference.

2.8 Topographically, the site has falls in all directions towards its boundaries, levels ranging between 102mAOD and 80mAOD which results in it being split into a number of catchments. For further details on these catchments refer to the Courteenhall Brook Modelling Report included within the Flood Risk Assessment (document reference NGW-BWB-EWE-XX-RP-YE-0005).

2.9 The site is within the Upper Nene catchment and in compliance with NCC/Environment Agency guidance attenuation should be provided on site to cater for all storms up to and including the 200 year plus climate change peak storm. For a development of this nature an allowance of 20% for climate change is appropriate.

Catchments and Outfalls

2.10 There are five main outfall locations for the Main Site shown in **Figure 1.2**, which are as follows;

1. Collingtree village via 300mm culvert under M1 (to Wooton Brook)
2. Wootton Brook (via existing ditch network in south of site)
3. Wootton Brook (via culvert under M1 roundabout)
4. Northampton Loop railway line (informal runoff to west of site)
5. Collingtree Rd (surface runoff towards north)

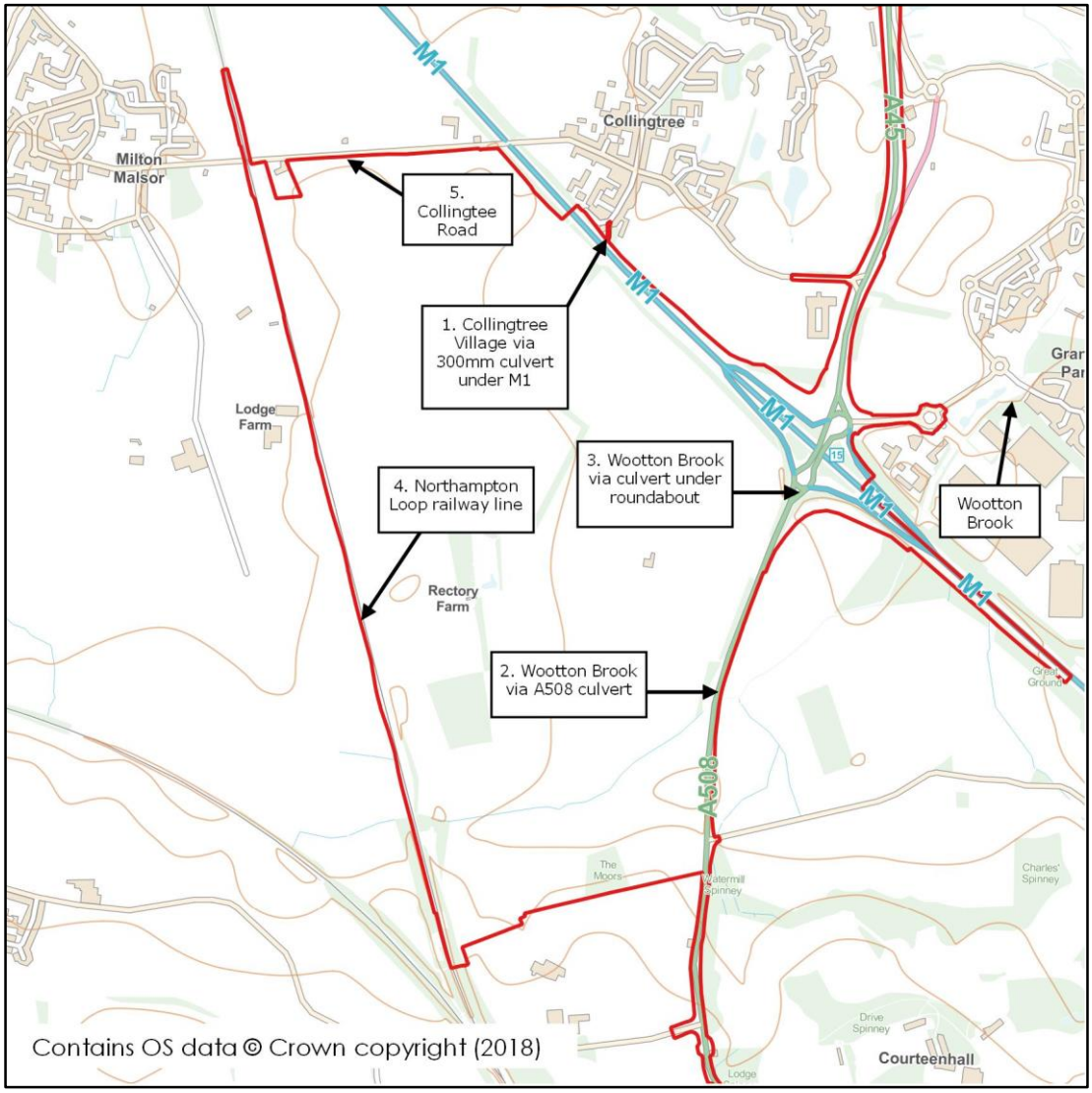

Figure 2.1 - Existing Outfall Locations

2.11 Of these outfalls, the proposed layout and most formal location of connections are those that can be traced towards Wootton Brook via smaller unnamed watercourses and therefore it is proposed that only these outlets are utilised (1,2 and 3).

2.12 The northernmost outfall (Outfall 1) is an existing 300mm diameter pipe which is approximately 45m south of the access bridge across the M1 from Collingtree. This culvert then becomes open channel within Collingtree and flows generally northwards towards Wootton Brook.

2.13 From assessment of the existing catchment it is apparent that this culvert is responsible for draining significantly more area than such a pipe would typically take and this leads to the potential for large volumes of surface water to sit behind it and create pluvial flooding during extreme events. By utilising the existing capacity of this outfall it is appropriate to assess what it may have been designed to take. In the absence of any further information and in the interest of being conservative, the pipe full capacity at a velocity of 1m/s (to achieve self-cleansing) has been calculated to be 80l/s.

2.14 In practice the pipe is likely to surcharge due to its under capacity, and the gradient is likely steeper than assumed, hence flow would increase. 80l/s represents a rate much lower than the likely flow leaving the site and restricting maximum flows through the culvert to 80l/s will ensure a betterment over the existing situation.

2.15 The proposed catchment draining to Outfall 1 is 29.14ha, therefore the pro rata runoff rate is 2.75l/s/ha which is lower than the remainder of the site.

2.16 Outfalls 2 and 3 are located along the south eastern boundary of the site, adjacent to the A508 Northampton Road. The Courteenhall Brook flows under the A508 and across an adjacent field whilst the remainder of this catchment passes under a large trapezoidal culvert (refer to **Figure 2.2**) which dog-legs under the adjacent roundabout and outfalls to an existing ditch west of the M1. Both watercourses meet at a culvert approximately 300m south of M1 Junction 15, where they combine and flow through the Grange Park development and into Wootton Brook. From the east of the M1, the watercourse is designated as Main River by the EA.

Figure 2.2 - Culvert Under M1 Roundabout

2.17 The remaining catchments drain to Outfalls 4 and 5. Whilst these are proposed to be built upon, the Outfalls are not intended to be utilised at this stage, and by removing these catchments from the drainage regime, uncontrolled flows will be significantly reduced.

Proposed Drainage

2.18 An assessment of the existing runoff rate has been undertaken using the ICP SUDS calculation method within Micro Drainage, and calculated to be vary between 4.0l/s/ha and 12.3l/s/ha, a copy of the simulation results are included in **Appendix 4**.

2.19 To comply with local and national guidance on restriction of runoff rates, and with the intention of providing betterment over the existing situation, it is proposed to restrict runoff to 4.0l/s/ha through Outfalls 2 and 3 for all storms up to and including the 200 year + 20% climate change storm, as summarised in **Table 2.1**.

Table 2.1 - Existing & Proposed Runoff Rates

Return Period (Yr.)	Existing Runoff Rate (l/s/ha)	Proposed Runoff Rate (l/s/ha)
1	4.0	4.0 *Outfall 1 limited to 80l/s total
QBAR	4.8	
30	9.4	
100	12.3	
100 + 20%	-	
200 + 20%	-	

2.20 The proposed development will increase the impermeable area of the site through the nature of its proposals, and this will subsequently increase the rate of runoff above the natural rate calculated. Therefore it will be necessary to provide attenuation within the development to allow rates to be restricted to the aforementioned 4.0l/s/ha.

2.21 The Illustrative Masterplan has been reviewed in light of the proposed outfall locations and split into proposed catchments, with detention basins proposed at strategic locations around the boundary. The proposed catchments and associated attenuation ponds are shown on BWB drawing reference NGW-BWB-GEN-XX-SK-C-SK44 which is included within **Appendix 5**.

2.22 Basin sizes have been based on an outfall rate of 4.0l/s/ha and impermeable area that drains to them with paved areas/roofs taken to be 100% impermeable and landscape bunds 20%. This allows the derivation of runoff rates based purely on proposed drained areas and ensures that any areas that were to remain undeveloped would not contribute towards the runoff rates to provide a true reflection.

2.23 Simulations have been run within Micro Drainage to define attenuation requirements for the Main Site based on the Illustrative Masterplan, with the site split into six discrete catchments A-F. Catchment A drains to Outfall 1 whilst B-F drain through the two southern Outfalls (2 and 3). A summary of these calculations is included as **Table 2.2.**

Table 2.2 - Main Site Attenuation Summary

	A*	B	C	D	E	F
Impermeable Catchment (ha)	23.743	13.054	24.952	11.878	26.700	15.292
Discharge Rate (l/s) @ 4.0l/s/ha	80.0	52.2	99.8	47.5	106.8	61.2
Pond Volume (m^3) @ 4.0l/s/ha	19868	10536	20330	8521	21861	12428
Max Pond Volume (m^3)	22026	10761	20820	11010	23503	13346
Catchment (ha) @ 100% imp	22.394	12.431	24.952	11.878	26.7	10.77
Catchment (ha) @ 20% imp	6.74	3.11	0.00	0.00	0.00	22.61
Total Catchment Size (ha)	29.14	15.55	24.95	11.88	26.70	33.38

*Note previous comment regarding Outfall 1 (Catchment A) where the pro rata runoff rate is 2.75l/s/ha.

2.24 In order to form the development plateaus required, changes to existing levels are required. A 3D earthworks ground model has been produced to show the proposed contours for the site, and within this the attenuation ponds have been included to ensure the required size and volume can be accommodated.

2.25 The attenuation requirements are large and it will be appropriate during the detailed design process to ensure that volumes of water are not impounded to the extent that a formal designation is required under the Reservoirs Act.

Summary – Main Site

2.26 Existing catchments and outfall points of the existing site have been considered and a runoff rate calculated which is designed to provide betterment in storms in excess of a 1 year return period, up to and including a 200 year + 20% event.

2.27 Suitable attenuation volumes have been provided within the Illustrative Masterplan in the form of ponds that can store excess water as necessary.

2.28 Connection to existing watercourses is the most appropriate form of discharge.

Roade Bypass

Introduction

2.29 The village of Roade is located to the south of the Main Site along the A508. A bypass is proposed to the west of the village, running for approximately 2.3km, generally through open fields but also requiring a bridge crossing over the West Coast Main Line (WCML) and culverting of a watercourse. A General Arrangement plan is included as **Appendix 6** for reference.

2.30 By its nature the site is linear and existing levels vary along its route, however there is a general fall from the northern end where levels are approximately 121mAOD to the southern tie in at approximately 100mAOD.

2.31 The alignment is intersected by existing field ditches and drains which capture runoff and convey it southwards, the most significant of which is an unnamed watercourse referred to as Roade Brook for the purposes of the application. A Roade Brook Modelling Report (document reference NGW-BWB-EWE-XX-RP-YE-0005) is included within the Flood Risk Assessment which details the hydraulic modelling undertaken to quantify the extent of fluvial flooding associated with the bypass. This watercourse also forms an outfall for much of the southern extent of the bypass.

2.32 The site is within the River Tove catchment and in compliance with NCC/Environment Agency guidance attenuation should be provided on site to cater for all storms up to and including the 100 year plus climate change peak storm. For a development of this nature an allowance of 20% for climate change is appropriate.

Catchments and Outfalls

2.33 There are two main outfall locations for the Roade Bypass which are as follows;

- Culverted watercourse flowing to Bailey Brooks Lane (Outfall 1)
- Roade Brook (three separate connection points), (Outfalls 2-4)

2.34 The alignment east of the WCML, and the fields immediately to the east do not drain to the Roade Brook, either because of the delineation provided by the railway or existing land drainage.

2.35 The eastern field has a network of land drainage which conveys flow to an existing culvert, before crossing the WCML perpendicularly and then turning southwards and becoming an open channel within the curtilage of a property on Bailey Brooks Lane.

2.36 The land to the east of the WCML naturally falls towards a low point between the railway and properties on Bailey Brooks Lane, within the catchment of the Bailey Brooks Lane watercourse, which for the purposes of this report is referred to as Bailey Brook.

Proposed Drainage

2.37 An assessment of the existing runoff rate has been undertaken using the ICP SUDS calculation method within Micro Drainage, and calculated to be vary between 3.3l/s/ha and 10.2l/s/ha, a copy of the simulations results are included in **Appendix 7**.

2.38 To comply with local and national guidance on restriction of runoff rates, and with the intention of providing betterment over the existing situation, it is proposed to restrict runoff to 3.3/s/ha for all storms up to and including the 100 year + 20% climate change storm, as summarised in **Table 2.3**.

Table 2.3 - Existing & Proposed Runoff Rates (Roade Bypass)

Return Period (Yr.)	Existing Runoff Rate (l/s/ha)	Proposed Runoff Rate (l/s/ha)
1	3.3	3.3
QBAR	4.0	
30	7.8	
100	10.2	
100 + 20%	-	

2.39 The proposed development will introduce a new impermeable area through the nature of its proposals, and this will subsequently increase the rate of runoff above the natural rate calculated. Therefore it will be necessary to provide attenuation within the development to allow rates to be restricted to the aforementioned 3.3l/s/ha.

2.40 The proposed alignment has been reviewed in light of the proposed outfall locations and split into proposed catchments, with attenuation ponds proposed at strategic locations along the alignment.

2.41 The proposed catchments and associated attenuation pond are shown on BWB drawing reference NGW-BWB-GEN-XX-SK-C-SK12 which is included within **Appendix 8**.

2.42 Attenuation pond sizes have been based on an outfall rate of 3.3/s/ha of impermeable area that drains to them with paved areas taken to be 100% impermeable and noise bunds, embankments etc as 20%. This allows the derivation of runoff rates based purely on proposed drained area and ensures that any areas that were to remain undeveloped would not contribute towards the runoff rates to provide a true reflection.

2.43 Simulations have been run within Micro Drainage to define attenuation requirements, with the alignment split into five discreet catchments A-E. Catchments A and B drain to Outfall 1 whilst B-E drain to Roade Brook (Outfalls 2-4). A summary of these calculations is included as **Table 2.4.**

Table 2.4 - Roade Bypass Attenuation Summary

	A	B	C	D	E
Impermeable Catchment (ha)	1.13	0.21	1.46	0.33	1.46
Discharge Rate (l/s) @ 3.3l/s/ha	3.7	0.7	4.8	1.1	4.8
Pond Volume (m3) @ 3.3l/s/ha	779.8	149.2	1011.8	236.2	1007.8
Max Pond Volume (m3)	884.1	250.3	1110.1	465.6	1059.2

2.44 In order to form the carriageway to acceptable standards, the alignment is in both cutting and on embankment and this defines the proposed drainage catchments. A 3D earthworks ground model has been produced for this, and within it the attenuation ponds have been included to ensure the required size and volume can be accommodated.

Summary – Roade Bypass

2.45 Existing catchments and outfall points of the existing site have been considered and a runoff rate calculated which is designed to provide betterment in storms in excess of a 1 year return period, up to and including a 100 year + 20% event.

2.46 Suitable attenuation volumes have been provided within the General Arrangement in the form of ponds that can store excess water as necessary.

2.47 Connection to existing watercourses is the most appropriate form of discharge and forms the basis of the drainage strategy.

Additional Sites (Highway Mitigation Works)

Introduction

2.48 Traffic modelling has identified that upgrade works are required on seven parts of the highway in the vicinity of the proposed SRFI development. These range from localised widening of carriageways to realignment of short sections with the exception of M1 J15 where more significant works are proposed.

2.49 All the development sites will be within or form part of the adopted highway, managed and maintained by Northamptonshire County Council as Local Highway Authority or Highways England in the case of Trunk Roads. Drawings showing the proposals are included within **Appendix 9**.

2.50 None of the proposals change the character or use of the existing highways, and the potential impact from a drainage perspective is limited when compared to the size of the existing catchments being drained. Nonetheless it is important to review the impact on the existing drainage regime and provide suitable mitigation wherever necessary.

2.51 As the new impermeable areas are comparatively small, the calculated greenfield runoff rates would also be similarly low (typically 0.5 – 1.0l/s) and as such the ability to separate flows and provide a restriction to such rates is impractical and a more holistic approach to the drainage strategy is necessary.

Proposed Drainage

2.52 Drawing references NGW-BWB-EWE-XX-DR-PD-0003 to 0010 included as **Appendix 10** are proposed strategies for the drainage amendments required for each site. Many of the sites currently drain to existing ditches adjacent the highway or pipe networks discharging to ditches.

2.53 The principle for each of the sites is therefore that the existing drainage networks will be upgraded wherever practical, to include for a suitable volume of attenuation to allow that created by the new impermeable area to be held, and to generally improve the condition of existing drainage ditches to provide betterment wherever possible. The drawings provided should be used as the basis for the final strategy, however assessment will be required on site to determine the form of the final detailed solution, potentially including additional surveys if necessary.

2.54 Final designs for the highway works will require approval from the relevant highway authority prior to construction and this principle has been agreed with the LLFA via the SoCG process.

3.0 FOUL WATER DRAINAGE STRATEGY

Main Site

3.1 Anglian Water were approached via their Pre Planning Enquiry process for waste water and provided a response in October 2016 (reference 00017125).

3.2 Further to this initial response, AW were commissioned to undertake hydraulic modelling of the existing sewer network. This resulted in an Addendum being produced (dated 09/03/17) which proposes a solution to upgrade a length of sewer north of the Main Site.

3.3 It will be necessary to pump flows from the Main Site, along the A45 towards Northampton to achieve a connection to the existing sewer network.

3.4 Drawing NGW-BWB-GEN-XX-SK-C-SK13 included as **Appendix 11** shows the proposed route of the rising main from the development and extent of works required to the existing sewer network.

3.5 A Statement of Common Ground has been agreed with Anglian Water on this basis with the detailed design to be taken forward in due course.

4.0 MAINTENANCE

Main Site

4.1 The proposed surface water features form a part of the wider landscape proposals, all of which will require ongoing management and maintenance. A development of this scale would be expected to have a permanent on site presence in the form of a Management Company who would be responsible for the ongoing maintenance of the site-wide landscape.

4.2 Requirements for ongoing maintenance of the drainage network for specific plots should form part of an Operation and Maintenance manual for that site and should be undertaken by the building management. Any specialist or proprietary products that are specified at detailed design will have a manufacturer specific maintenance regime which should be included within the document.

4.3 All drainage features should be located in open areas which are readily accessible.

4.4 A new pumping station is necessary to convey foul water to the existing adoped sewer network. It is likely this will be designed to adoptable standards but kept private with responsibility for maintenance kept by the on site Management Company.

Roade Bypass

4.5 The highway and drainage features will be designed in accordance with agreed standards and offered for adoption to the local highway authority who will retain ongoing responsibility for maintenance.

Additional Junctions

4.6 All areas form additions to the existing adopted highway and will be the responsibility of the local highway authority or Highways England.

5.0 SUMMARY

5.1 This Sustainable Drainage Statement demonstrates that the proposed development sites can be drained in a manner compliant with best practice standards and will wherever possible reduce downstream flood risk by restricting flows to the equivalent rate for low return period events.

5.2 Drainage strategies for all sites comply with local and national policy requirements.

5.3 Maintenance of proposed drainage features will be secured in perpetuity with an appropriate body, normally a Management Company or Highway Authority in the instance of drainage for adopted highways.

APPENDIX 1

Statement of Common Ground – Lead Local Flood Authority

NORTHAMPTON GATEWAY STRATEGIC RAIL FREIGHT INTERCHANGE

Statement of Common Ground between Roxhill (Junction 15) Ltd and Northamptonshire County Council as Lead Local Flood Authority

1 Introduction

1.1 This Statement summarises the agreement reached between Roxhill (Junction 15) Ltd and Northamptonshire County Council Lead Local Flood Authority (LLFA) in relation to the proposed development known as Northampton Gateway (the SRFI).

1.2 The LLFA is responsible for matters relating to surface water flood risk and drainage as well as consenting matters for Ordinary Watercourses within Northamptonshire.

1.3 Pre application advice was sought from the LLFA via a formal meeting held on 1st December 2017 where results of flood risk and drainage investigations were presented. Calculations and modelling results were subsequently provided for review.

2 Development Proposals

2.1 The SRFI consists of discreet areas of land forming the overall application which are;

- Main Site
- Roade Bypass
- Additional Junction works

The locations for the above are shown on plan reference NGW-BWB-GEN-XX-SK-X-SK35.

2.2 The Northampton Gateway Strategic Rail Freight Interchange (SRFI) scheme would, if consented, comprise the following;

- A rail freight terminal (and express freight facility) with the capacity to accommodate up to 16 trains per day
- 468,000m2 of rail-served warehousing
- Improvements to the local highways network including M1 Junctions 15 and 15a
- Bypass around Roade village

2.3 As a result of the development and increase in the impermeable area it will be necessary to provide surface water attenuation which is proposed in the form of basins as shown on the masterplan.

3 Basis of Agreement

3.1 The following information has been provided to the LLFA for review;

<u>DCO Application</u>

- Flood Risk Assessment (Document reference NGW-BWB-EWE-XX-RP-YE-0005)

<u>Main Site</u>

- Drainage Catchment Layout (Drawing reference NGW-BWB-GEN-XX-SK-C-SK33)
- Micro Drainage Calculations (Greenfield Runoff Rates)
- Micro Drainage Calculations (Attenuation Requirements Catchments A - F)
- Courteenhall Brook Fluvial Flood Modelling Technical Note (Document reference NGW-BWB-EWE-XX-RP-EN-0002)

<u>Roade Bypass</u>

- Drainage Strategy (Drawing reference NGW-BWB-GEN-XX-SK-C-SK12)
- Micro Drainage Calculations (Greenfield Runoff Rates)
- Micro Drainage Calculations (Attenuation Requirements Catchments A - E)

- Roade Brook Fluvial Flood Modelling Technical Note (Document reference NGW-BWB-EWE-XX-RP-EN-0003)

4 Agreement

4.1 The following points are agreed;

4.2 The Flood Risk Assessment and Drainage Strategy have been prepared in accordance with the National Policy Statement for National Networks (NPSNN).

4.3 Surface water runoff from the Main Site will not exceed 4l/s/ha (Greenfield Runoff) in all events up to and including the 200 year plus a 20% allowance for climate change event. A sensitivity test will be carried using 40% allowance for climate change.

4.4 Surface water runoff from the Roade Bypass will not exceed 4l/s/ha (Greenfield Runoff) in all events up to and including the 100 year plus a 20% allowance for climate change event. A sensitivity test will be carried by using a 40% allowance for climate change.

4.5 Surface water runoff from the additional junctions will be designed where possible to restrict to greenfield runoff rates based on any new impermeable areas added. Approval of the final design will rest with the relevant Highway Authority (Highways England or Northamptonshire County Council Highway Authority).

Dated 19/03/18

Signed

[redacted]

On behalf of Roxhill (Junction 15) Ltd

Name. CHRIS DODD Position. Associate (BWB Consulting)

Signed [redacted]

On behalf of Northamptonshire County Council as Lead Local Flood Authority

Name. MALCOLM BALL Position. TECHNICIAN.

APPENDIX 2

Statement of Common Ground – Anglian Water

APPENDIX 3

Illustrative Masterplan

FOOTPATH KEY

- Footpath existing (public)
- Footpath existing (to be diverted) (public)
- Footpath Proposed (public)
- Footpath & Cycleway Proposed (public)
- Footpath & Cycleway Proposed (private)

LANDSCAPING KEY

- Existing Landscaping
- Proposed New Landscaping

GROSS INTERNAL AREAS

	Square ft	(Square m)
UNIT 1		
Warehouse	500,000 ft²	
Office	30,000 ft²	
TOTAL	530,000 ft²	(49,238 sqm)
UNIT 2		
Warehouse	515,000 ft²	
Office	30,000 ft²	
TOTAL	545,000 ft²	(50,632 sqm)
UNIT 3		
Warehouse	653,000 ft²	
Office	30,000 ft²	
TOTAL	683,000 ft²	(63,452 sqm)
UNIT 4		
Warehouse	790,000 ft²	
Office	40,000 ft²	
TOTAL	830,000 ft²	(77,109 sqm)
UNIT 5		
Warehouse	510,000 ft²	
Office	37,000 ft²	
TOTAL	547,000 ft²	(50,817 sqm)
UNIT 6		
Warehouse	660,000 ft²	
Office	35,000 ft²	
TOTAL	695,000 ft²	(64,567 sqm)
UNIT 7		
Warehouse	1,150,000 ft²	
Office	41,000 ft²	
TOTAL	1,191,000 ft²	(110,648 sqm)
FREIGHT TERMINAL		
Offices	20,000 ft²	(1858 sqm)
GRAND TOTAL	5,041,000 ft²	(468,324 sqm)

Rev	Date	Details of issue / revision	Drw	Rev

ISSUES & REVISIONS

ROXHILL

NORTHAMPTON GATEWAY
STRATEGIC RAIL FREIGHT INTERCHANGE

THE NORTHAMPTON GATEWAY RAIL FREIGHT INTERCHANGE ORDER 201X

Drawing Title

ILLUSTRATIVE MASTERPLAN

Scale	1:2,500	Drawn	RM
Size	A0	Reviewed	SH

Regulation: **Reg 5(2)(o)**

Document: **2.11**

Drawing Status: **PRELIMINARY**

Drawing No.: **4054 - R001**

Revision: **P61**

APPENDIX 4

Main Site Calculations

Pond Calculations Summary

	A	B	C	D	E	F
Impermeable Catchment (ha)	23.743	13.054	24.952	11.878	26.700	15.292
Discharge Rate (l/s) @ 4.0l/s/ha	80.0	52.2	99.8	47.5	106.8	61.2
Pond Volume (m3) @ 4.0l/s/ha	19868	10536	20330	8521	21861	12428
Max Pond Volume (m3)	20020	10694	20656	9058	23413	13285
Catchment (ha) 100% imp	22.394	12.431	24.952	11.878	26.7	10.77
Catchment (ha) 20% imp	6.74	3.11	0.00	0.00	0.00	22.61
Total Catchment Size (ha)	29.14	15.55	24.95	11.88	26.70	33.38

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.500
Area (ha)	1.000	Urban	0.000
SAAR (mm)	620	Region Number	Region 4

Results l/s

QBAR Rural	4.8
QBAR Urban	4.8
Q100 years	12.3
Q1 year	4.0
Q30 years	9.4
Q100 years	12.3

Summary of Results for 200 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	84.094	1.094	80.0	9749.8	O K
30 min Summer	84.218	1.218	80.0	11032.2	O K
60 min Summer	84.350	1.350	80.0	12443.8	O K
120 min Summer	84.488	1.488	80.0	13961.1	O K
180 min Summer	84.568	1.568	80.0	14861.6	O K
240 min Summer	84.623	1.623	80.0	15487.3	O K
360 min Summer	84.694	1.694	80.0	16315.9	O K
480 min Summer	84.738	1.738	80.0	16832.7	Flood Risk
600 min Summer	84.766	1.766	80.0	17168.7	Flood Risk
720 min Summer	84.785	1.785	80.0	17387.0	Flood Risk
960 min Summer	84.792	1.792	80.0	17469.7	Flood Risk
1440 min Summer	84.767	1.767	80.0	17177.8	Flood Risk
2160 min Summer	84.699	1.699	80.0	16369.5	O K
2880 min Summer	84.635	1.635	80.0	15633.6	O K
4320 min Summer	84.488	1.488	80.0	13958.0	O K
5760 min Summer	84.342	1.342	80.0	12355.0	O K
7200 min Summer	84.204	1.204	80.0	10887.6	O K
8640 min Summer	84.080	1.080	80.0	9610.8	O K
10080 min Summer	83.968	0.968	80.0	8483.1	O K
15 min Winter	84.208	1.208	80.0	10931.0	O K
30 min Winter	84.344	1.344	79.9	12374.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.234	0.0	6754.3	31
30 min Summer	125.491	0.0	6674.1	45
60 min Summer	71.183	0.0	11611.4	76
120 min Summer	40.377	0.0	12593.8	134
180 min Summer	28.980	0.0	12748.9	194
240 min Summer	22.903	0.0	12637.5	252
360 min Summer	16.438	0.0	12419.3	372
480 min Summer	12.991	0.0	12235.5	490
600 min Summer	10.824	0.0	12077.6	610
720 min Summer	9.324	0.0	11936.2	728
960 min Summer	7.323	0.0	11674.9	966
1440 min Summer	5.209	0.0	11196.5	1442
2160 min Summer	3.705	0.0	22564.9	1848
2880 min Summer	2.910	0.0	22746.2	2224
4320 min Summer	2.036	0.0	20739.3	2992
5760 min Summer	1.580	0.0	26818.2	3808
7200 min Summer	1.298	0.0	27519.0	4544
8640 min Summer	1.105	0.0	28076.9	5280
10080 min Summer	0.965	0.0	28456.1	6056
15 min Winter	221.234	0.0	6711.1	31
30 min Winter	125.491	0.0	6524.5	45

Summary of Results for 200 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	84.489	1.489	80.0	13965.7	O K
120 min Winter	84.639	1.639	80.0	15674.4	O K
180 min Winter	84.727	1.727	80.0	16699.0	Flood Risk
240 min Winter	84.787	1.787	80.0	17417.5	Flood Risk
360 min Winter	84.867	1.867	79.9	18382.7	Flood Risk
480 min Winter	84.918	1.918	80.0	19000.1	Flood Risk
600 min Winter	84.951	1.951	80.0	19415.8	Flood Risk
720 min Winter	84.974	1.974	80.0	19698.8	Flood Risk
960 min Winter	84.988	1.988	80.0	19868.9	Flood Risk
1440 min Winter	84.974	1.974	80.0	19701.5	Flood Risk
2160 min Winter	84.908	1.908	80.0	18883.9	Flood Risk
2880 min Winter	84.828	1.828	80.0	17907.5	Flood Risk
4320 min Winter	84.650	1.650	80.0	15803.0	O K
5760 min Winter	84.470	1.470	80.0	13761.5	O K
7200 min Winter	84.268	1.268	80.0	11562.1	O K
8640 min Winter	84.082	1.082	80.0	9628.8	O K
10080 min Winter	83.915	0.915	80.0	7966.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	71.183	0.0	12552.1	74
120 min Winter	40.377	0.0	12792.6	132
180 min Winter	28.980	0.0	12651.8	190
240 min Winter	22.903	0.0	12537.3	248
360 min Winter	16.438	0.0	12372.0	366
480 min Winter	12.991	0.0	12252.5	482
600 min Winter	10.824	0.0	12155.9	598
720 min Winter	9.324	0.0	12073.6	714
960 min Winter	7.323	0.0	11919.2	944
1440 min Winter	5.209	0.0	11682.9	1396
2160 min Winter	3.705	0.0	24141.8	2036
2880 min Winter	2.910	0.0	23356.8	2316
4320 min Winter	2.036	0.0	21384.0	3240
5760 min Winter	1.580	0.0	30030.6	4152
7200 min Winter	1.298	0.0	30819.1	4976
8640 min Winter	1.105	0.0	31459.4	5712
10080 min Winter	0.965	0.0	31928.3	6456

Rainfall Details

Rainfall Model	FEH
Return Period (years)	200
Site Location	GB 475200 253950 SP 75200 53950
C (1km)	-0.027
D1 (1km)	0.325
D2 (1km)	0.303
D3 (1km)	0.262
E (1km)	0.304
F (1km)	2.473
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+20

Time Area Diagram

Total Area (ha) 23.744

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	5.936	4	8	5.936	8	12	5.936	12	16	5.936

Model Details

Storage is Online Cover Level (m) 85.000

Tank or Pond Structure

Invert Level (m) 83.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	7693.7	2.000	12521.6	2.001	0.0

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0347-8000-2000-8000
Design Head (m)	2.000
Design Flow (l/s)	80.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	347
Invert Level (m)	83.000
Minimum Outlet Pipe Diameter (mm)	375
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)	2.000	80.0	Kick-Flo®	1.389	67.0
Flush-Flo™	0.644	80.0	Mean Flow over Head Range	-	68.1

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	10.1	1.200	74.3	3.000	97.3	7.000	147.1
0.200	35.1	1.400	67.3	3.500	104.9	7.500	152.2
0.300	64.3	1.600	71.8	4.000	112.0	8.000	157.0
0.400	77.0	1.800	76.0	4.500	118.6	8.500	161.8
0.500	79.1	2.000	80.0	5.000	124.8	9.000	166.4
0.600	79.9	2.200	83.7	5.500	130.8	9.500	170.8
0.800	79.3	2.400	87.3	6.000	136.4		
1.000	77.6	2.600	90.8	6.500	141.9		

Summary of Results for 200 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	81.305	1.105	52.0	5358.5	O K
30 min Summer	81.432	1.232	52.0	6057.9	O K
60 min Summer	81.567	1.367	52.0	6823.8	O K
120 min Summer	81.706	1.506	52.0	7631.7	O K
180 min Summer	81.785	1.585	52.0	8101.6	O K
240 min Summer	81.838	1.638	52.0	8420.1	O K
360 min Summer	81.904	1.704	52.0	8825.6	Flood Risk
480 min Summer	81.942	1.742	52.0	9059.8	Flood Risk
600 min Summer	81.964	1.764	52.0	9195.9	Flood Risk
720 min Summer	81.976	1.776	52.0	9267.6	Flood Risk
960 min Summer	81.968	1.768	52.0	9220.8	Flood Risk
1440 min Summer	81.916	1.716	52.0	8895.3	Flood Risk
2160 min Summer	81.831	1.631	52.0	8377.4	O K
2880 min Summer	81.753	1.553	52.0	7909.9	O K
4320 min Summer	81.576	1.376	52.0	6873.2	O K
5760 min Summer	81.396	1.196	52.0	5855.5	O K
7200 min Summer	81.241	1.041	52.0	5008.3	O K
8640 min Summer	81.103	0.903	52.0	4280.3	O K
10080 min Summer	80.982	0.782	52.0	3656.8	O K
15 min Winter	81.423	1.223	52.0	6008.2	O K
30 min Winter	81.563	1.363	52.0	6796.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.234	0.0	4332.7	27
30 min Summer	125.491	0.0	4322.8	42
60 min Summer	71.183	0.0	6661.8	72
120 min Summer	40.377	0.0	7450.6	130
180 min Summer	28.980	0.0	7873.5	190
240 min Summer	22.903	0.0	8091.0	250
360 min Summer	16.438	0.0	8126.3	368
480 min Summer	12.991	0.0	8039.2	486
600 min Summer	10.824	0.0	7945.6	606
720 min Summer	9.324	0.0	7854.1	724
960 min Summer	7.323	0.0	7677.5	962
1440 min Summer	5.209	0.0	7334.7	1378
2160 min Summer	3.705	0.0	12819.4	1712
2880 min Summer	2.910	0.0	13331.9	2084
4320 min Summer	2.036	0.0	13467.0	2908
5760 min Summer	1.580	0.0	14793.5	3648
7200 min Summer	1.298	0.0	15184.0	4400
8640 min Summer	1.105	0.0	15494.2	5184
10080 min Summer	0.965	0.0	15723.8	5856
15 min Winter	221.234	0.0	4343.6	27
30 min Winter	125.491	0.0	4205.5	41

Summary of Results for 200 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	81.710	1.510	52.0	7657.9	O K
120 min Winter	81.863	1.663	52.0	8572.1	O K
180 min Winter	81.950	1.750	52.0	9110.1	Flood Risk
240 min Winter	82.010	1.810	52.0	9479.8	Flood Risk
360 min Winter	82.086	1.886	52.0	9960.2	Flood Risk
480 min Winter	82.131	1.931	52.0	10249.1	Flood Risk
600 min Winter	82.159	1.959	52.0	10428.0	Flood Risk
720 min Winter	82.175	1.975	52.0	10535.1	Flood Risk
960 min Winter	82.176	1.976	52.0	10536.1	Flood Risk
1440 min Winter	82.135	1.935	52.0	10275.6	Flood Risk
2160 min Winter	82.033	1.833	52.0	9625.2	Flood Risk
2880 min Winter	81.941	1.741	52.0	9053.5	Flood Risk
4320 min Winter	81.718	1.518	52.0	7704.8	O K
5760 min Winter	81.476	1.276	52.0	6304.6	O K
7200 min Winter	81.239	1.039	52.0	5000.1	O K
8640 min Winter	81.037	0.837	52.0	3937.9	O K
10080 min Winter	80.866	0.666	52.0	3071.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	71.183	0.0	7377.9	70
120 min Winter	40.377	0.0	8085.4	128
180 min Winter	28.980	0.0	8246.1	186
240 min Winter	22.903	0.0	8214.3	246
360 min Winter	16.438	0.0	8125.7	362
480 min Winter	12.991	0.0	8044.4	478
600 min Winter	10.824	0.0	7972.6	594
720 min Winter	9.324	0.0	7906.9	710
960 min Winter	7.323	0.0	7778.3	938
1440 min Winter	5.209	0.0	7546.0	1380
2160 min Winter	3.705	0.0	14273.2	1948
2880 min Winter	2.910	0.0	14717.0	2224
4320 min Winter	2.036	0.0	13926.1	3156
5760 min Winter	1.580	0.0	16570.7	4032
7200 min Winter	1.298	0.0	17011.6	4760
8640 min Winter	1.105	0.0	17366.2	5448
10080 min Winter	0.965	0.0	17636.0	6144

Rainfall Details

Rainfall Model	FEH
Return Period (years)	200
Site Location	GB 475200 253950 SP 75200 53950
C (1km)	-0.027
D1 (1km)	0.325
D2 (1km)	0.303
D3 (1km)	0.262
E (1km)	0.304
F (1km)	2.473
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+20

Time Area Diagram

Total Area (ha) 13.053

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	4.351	4	8	4.351	8	12	4.351

Model Details

Storage is Online Cover Level (m) 82.200

Tank or Pond Structure

Invert Level (m) 80.200

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	4273.9	2.000	6498.0	2.001	0.0

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0287-5220-2000-5220
Design Head (m)	2.000
Design Flow (l/s)	52.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	287
Invert Level (m)	80.200
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	52.1	Kick-Flo®	1.338	42.9
Flush-Flo™	0.615	52.0	Mean Flow over Head Range	-	44.8

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.9	1.200	47.2	3.000	63.3	7.000	95.6
0.200	29.5	1.400	43.9	3.500	68.2	7.500	98.8
0.300	47.9	1.600	46.8	4.000	72.8	8.000	102.0
0.400	50.4	1.800	49.5	4.500	77.1	8.500	105.1
0.500	51.7	2.000	52.1	5.000	81.1	9.000	108.0
0.600	52.0	2.200	54.5	5.500	85.0	9.500	110.9
0.800	51.5	2.400	56.9	6.000	88.7		
1.000	50.1	2.600	59.1	6.500	92.2		

Summary of Results for 200 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	81.170	1.070	99.4	10229.1	O K
30 min Summer	81.297	1.197	99.4	11569.6	O K
60 min Summer	81.434	1.334	99.4	13037.7	O K
120 min Summer	81.576	1.476	99.4	14604.2	O K
180 min Summer	81.658	1.558	99.4	15521.1	O K
240 min Summer	81.714	1.614	99.4	16149.3	O K
360 min Summer	81.785	1.685	99.4	16956.7	O K
480 min Summer	81.826	1.726	99.4	17435.5	Flood Risk
600 min Summer	81.851	1.751	99.4	17724.8	Flood Risk
720 min Summer	81.866	1.766	99.4	17889.6	Flood Risk
960 min Summer	81.862	1.762	99.4	17852.1	Flood Risk
1440 min Summer	81.816	1.716	99.4	17317.5	Flood Risk
2160 min Summer	81.738	1.638	99.4	16423.5	O K
2880 min Summer	81.664	1.564	99.4	15588.5	O K
4320 min Summer	81.484	1.384	99.4	13583.5	O K
5760 min Summer	81.312	1.212	99.4	11733.7	O K
7200 min Summer	81.164	1.064	99.4	10165.7	O K
8640 min Summer	81.031	0.931	99.4	8801.0	O K
10080 min Summer	80.915	0.815	99.4	7631.8	O K
15 min Winter	81.288	1.188	99.4	11469.7	O K
30 min Winter	81.428	1.328	99.4	12979.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.234	0.0	8068.6	31
30 min Summer	125.491	0.0	8324.8	45
60 min Summer	71.183	0.0	12430.3	74
120 min Summer	40.377	0.0	13905.5	134
180 min Summer	28.980	0.0	14724.3	194
240 min Summer	22.903	0.0	15214.4	252
360 min Summer	16.438	0.0	15564.2	370
480 min Summer	12.991	0.0	15427.7	490
600 min Summer	10.824	0.0	15231.2	608
720 min Summer	9.324	0.0	15031.0	726
960 min Summer	7.323	0.0	14635.8	964
1440 min Summer	5.209	0.0	13867.9	1382
2160 min Summer	3.705	0.0	24201.1	1716
2880 min Summer	2.910	0.0	25099.0	2088
4320 min Summer	2.036	0.0	25399.8	2900
5760 min Summer	1.580	0.0	28187.2	3640
7200 min Summer	1.298	0.0	28919.0	4400
8640 min Summer	1.105	0.0	29482.5	5184
10080 min Summer	0.965	0.0	29860.4	5856
15 min Winter	221.234	0.0	8355.4	31
30 min Winter	125.491	0.0	8246.1	45

Summary of Results for 200 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	81.579	1.479	99.4	14638.1	O K
120 min Winter	81.736	1.636	99.4	16402.5	O K
180 min Winter	81.827	1.727	99.4	17446.5	Flood Risk
240 min Winter	81.890	1.790	99.4	18167.8	Flood Risk
360 min Winter	81.970	1.870	99.4	19112.9	Flood Risk
480 min Winter	82.019	1.919	99.4	19691.1	Flood Risk
600 min Winter	82.050	1.950	99.4	20057.7	Flood Risk
720 min Winter	82.069	1.969	99.4	20285.5	Flood Risk
960 min Winter	82.073	1.973	99.4	20330.3	Flood Risk
1440 min Winter	82.037	1.937	99.4	19908.1	Flood Risk
2160 min Winter	81.940	1.840	99.4	18755.6	Flood Risk
2880 min Winter	81.852	1.752	99.4	17730.9	Flood Risk
4320 min Winter	81.630	1.530	99.4	15207.7	O K
5760 min Winter	81.386	1.286	99.4	12523.8	O K
7200 min Winter	81.163	1.063	99.4	10161.5	O K
8640 min Winter	80.970	0.870	99.4	8179.5	O K
10080 min Winter	80.806	0.706	99.4	6549.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	71.183	0.0	13771.9	74
120 min Winter	40.377	0.0	15174.2	132
180 min Winter	28.980	0.0	15730.7	190
240 min Winter	22.903	0.0	15816.6	248
360 min Winter	16.438	0.0	15646.7	364
480 min Winter	12.991	0.0	15467.4	480
600 min Winter	10.824	0.0	15299.9	596
720 min Winter	9.324	0.0	15142.7	712
960 min Winter	7.323	0.0	14834.4	940
1440 min Winter	5.209	0.0	14247.3	1382
2160 min Winter	3.705	0.0	26910.6	1944
2880 min Winter	2.910	0.0	27675.2	2224
4320 min Winter	2.036	0.0	26340.5	3160
5760 min Winter	1.580	0.0	31578.2	3984
7200 min Winter	1.298	0.0	32408.2	4752
8640 min Winter	1.105	0.0	33059.9	5448
10080 min Winter	0.965	0.0	33516.7	6152

Rainfall Details

Rainfall Model	FEH
Return Period (years)	200
Site Location	GB 475200 253950 SP 75200 53950
C (1km)	-0.027
D1 (1km)	0.325
D2 (1km)	0.303
D3 (1km)	0.262
E (1km)	0.304
F (1km)	2.473
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+20

Time Area Diagram

Total Area (ha) 24.952

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	6.238	4	8	6.238	8	12	6.238	12	16	6.238

Model Details

Storage is Online Cover Level (m) 82.100

Tank or Pond Structure

Invert Level (m) 80.100

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	8729.7	2.000	12013.1	2.001	0.0

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0382-9980-2000-9980
Design Head (m)	2.000
Design Flow (l/s)	99.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	382
Invert Level (m)	80.100
Minimum Outlet Pipe Diameter (mm)	450
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)	2.000	99.6	Kick-Flo®	1.416	84.2
Flush-Flo™	0.673	99.4	Mean Flow over Head Range	-	84.1

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	10.7	1.200	93.4	3.000	121.3	7.000	183.4
0.200	38.0	1.400	85.4	3.500	130.7	7.500	189.7
0.300	72.3	1.600	89.4	4.000	139.5	8.000	195.8
0.400	94.9	1.800	94.6	4.500	147.8	8.500	201.7
0.500	97.9	2.000	99.6	5.000	155.6	9.000	207.5
0.600	99.1	2.200	104.3	5.500	163.0	9.500	213.0
0.800	98.9	2.400	108.8	6.000	170.1		
1.000	96.9	2.600	113.1	6.500	176.9		

Summary of Results for 200 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	84.201	1.201	67.2	4814.4	O K
30 min Summer	84.326	1.326	68.2	5420.9	O K
60 min Summer	84.453	1.453	69.2	6059.9	O K
120 min Summer	84.573	1.573	70.1	6686.3	O K
180 min Summer	84.634	1.634	70.6	7008.5	O K
240 min Summer	84.669	1.669	70.8	7196.8	O K
360 min Summer	84.700	1.700	71.1	7364.3	O K
480 min Summer	84.703	1.703	71.1	7380.2	Flood Risk
600 min Summer	84.690	1.690	71.0	7309.6	O K
720 min Summer	84.666	1.666	70.8	7183.0	O K
960 min Summer	84.595	1.595	70.3	6801.9	O K
1440 min Summer	84.479	1.479	69.4	6196.0	O K
2160 min Summer	84.354	1.354	68.4	5559.1	O K
2880 min Summer	84.245	1.245	67.6	5025.3	O K
4320 min Summer	84.019	1.019	65.7	3970.3	O K
5760 min Summer	83.820	0.820	64.1	3095.1	O K
7200 min Summer	83.643	0.643	62.6	2360.4	O K
8640 min Summer	83.488	0.488	61.3	1745.9	O K
10080 min Summer	83.356	0.356	60.1	1246.9	O K
15 min Winter	84.322	1.322	68.2	5404.5	O K
30 min Winter	84.459	1.459	69.2	6093.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.234	0.0	4926.4	30
30 min Summer	125.491	0.0	5448.8	45
60 min Summer	71.183	0.0	6343.2	74
120 min Summer	40.377	0.0	7192.9	132
180 min Summer	28.980	0.0	7745.0	192
240 min Summer	22.903	0.0	8162.7	250
360 min Summer	16.438	0.0	8787.4	368
480 min Summer	12.991	0.0	9257.7	486
600 min Summer	10.824	0.0	9647.3	602
720 min Summer	9.324	0.0	9968.6	720
960 min Summer	7.323	0.0	10437.5	840
1440 min Summer	5.209	0.0	10798.6	1082
2160 min Summer	3.705	0.0	11888.4	1476
2880 min Summer	2.910	0.0	12448.5	1884
4320 min Summer	2.036	0.0	13057.3	2684
5760 min Summer	1.580	0.0	13506.9	3464
7200 min Summer	1.298	0.0	13869.2	4184
8640 min Summer	1.105	0.0	14187.0	4928
10080 min Summer	0.965	0.0	14445.6	5560
15 min Winter	221.234	0.0	5441.2	30
30 min Winter	125.491	0.0	5553.4	44

Summary of Results for 200 year Return Period (+20%)

	Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60	min Winter	84.600	1.600	70.3	6824.2	O K
120	min Winter	84.735	1.735	71.3	7557.7	Flood Risk
180	min Winter	84.806	1.806	71.8	7950.2	Flood Risk
240	min Winter	84.849	1.849	72.2	8191.7	Flood Risk
360	min Winter	84.892	1.892	72.5	8441.5	Flood Risk
480	min Winter	84.906	1.906	72.6	8521.1	Flood Risk
600	min Winter	84.903	1.903	72.6	8504.4	Flood Risk
720	min Winter	84.890	1.890	72.5	8427.0	Flood Risk
960	min Winter	84.831	1.831	72.0	8093.8	Flood Risk
1440	min Winter	84.694	1.694	71.0	7331.7	O K
2160	min Winter	84.531	1.531	69.8	6461.7	O K
2880	min Winter	84.383	1.383	68.6	5703.7	O K
4320	min Winter	84.066	1.066	66.1	4183.1	O K
5760	min Winter	83.781	0.781	63.8	2931.1	O K
7200	min Winter	83.531	0.531	61.6	1913.6	O K
8640	min Winter	83.318	0.318	59.8	1105.5	O K
10080	min Winter	83.146	0.146	58.2	494.2	O K

	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60	min Winter	71.183	0.0	7104.9	74
120	min Winter	40.377	0.0	8057.9	130
180	min Winter	28.980	0.0	8675.4	188
240	min Winter	22.903	0.0	9140.9	246
360	min Winter	16.438	0.0	9839.6	360
480	min Winter	12.991	0.0	10371.6	476
600	min Winter	10.824	0.0	10798.7	590
720	min Winter	9.324	0.0	11168.5	702
960	min Winter	7.323	0.0	11220.7	916
1440	min Winter	5.209	0.0	11093.8	1150
2160	min Winter	3.705	0.0	13314.0	1604
2880	min Winter	2.910	0.0	13934.7	2052
4320	min Winter	2.036	0.0	14625.6	2900
5760	min Winter	1.580	0.0	15144.4	3688
7200	min Winter	1.298	0.0	15548.5	4400
8640	min Winter	1.105	0.0	15880.2	5104
10080	min Winter	0.965	0.0	16178.5	5656

Rainfall Details

Rainfall Model	FEH
Return Period (years)	200
Site Location	GB 475200 253950 SP 75200 53950
C (1km)	-0.027
D1 (1km)	0.325
D2 (1km)	0.303
D3 (1km)	0.262
E (1km)	0.304
F (1km)	2.473
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+20

Time Area Diagram

Total Area (ha) 11.880

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	2.970	4	8	2.970	8	12	2.970	12	16	2.970

Model Details

Storage is Online Cover Level (m) 85.000

Tank or Pond Structure

Invert Level (m) 83.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	3298.2	2.000	5893.9	2.001	0.0

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0275-4750-2000-4750
Design Head (m)	2.000
Design Flow (l/s)	47.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	275
Invert Level (m)	80.100
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	47.5	Kick-Flo®	1.324	39.0
Flush-Flo™	0.606	47.5	Mean Flow over Head Range	-	40.9

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	8.7	1.200	42.7	3.000	57.8	7.000	87.1
0.200	28.3	1.400	40.0	3.500	62.2	7.500	90.1
0.300	43.8	1.600	42.7	4.000	66.4	8.000	93.0
0.400	46.1	1.800	45.2	4.500	70.3	8.500	95.8
0.500	47.2	2.000	47.5	5.000	74.0	9.000	98.5
0.600	47.5	2.200	49.7	5.500	77.5	9.500	101.1
0.800	46.9	2.400	51.9	6.000	80.8		
1.000	45.6	2.600	53.9	6.500	84.1		

Summary of Results for 200 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	86.014	1.014	106.5	10948.7	O K
30 min Summer	86.135	1.135	106.5	12382.9	O K
60 min Summer	86.265	1.265	106.5	13953.0	O K
120 min Summer	86.402	1.402	106.5	15629.2	O K
180 min Summer	86.481	1.481	106.5	16621.5	O K
240 min Summer	86.535	1.535	106.5	17303.7	O K
360 min Summer	86.604	1.604	106.5	18185.9	O K
480 min Summer	86.645	1.645	106.5	18715.0	O K
600 min Summer	86.670	1.670	106.5	19040.1	O K
720 min Summer	86.685	1.685	106.5	19231.4	O K
960 min Summer	86.684	1.684	106.5	19218.7	O K
1440 min Summer	86.643	1.643	106.5	18689.9	O K
2160 min Summer	86.570	1.570	106.5	17744.4	O K
2880 min Summer	86.499	1.499	106.5	16851.9	O K
4320 min Summer	86.321	1.321	106.5	14634.8	O K
5760 min Summer	86.164	1.164	106.5	12724.5	O K
7200 min Summer	86.025	1.025	106.5	11074.7	O K
8640 min Summer	85.900	0.900	106.5	9633.1	O K
10080 min Summer	85.792	0.792	106.5	8397.0	O K
15 min Winter	86.126	1.126	106.5	12276.0	O K
30 min Winter	86.260	1.260	106.5	13890.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.234	0.0	8534.9	31
30 min Summer	125.491	0.0	8927.0	45
60 min Summer	71.183	0.0	13192.3	74
120 min Summer	40.377	0.0	14777.1	134
180 min Summer	28.980	0.0	15656.3	194
240 min Summer	22.903	0.0	16194.1	252
360 min Summer	16.438	0.0	16635.5	370
480 min Summer	12.991	0.0	16530.0	490
600 min Summer	10.824	0.0	16304.0	608
720 min Summer	9.324	0.0	16072.1	726
960 min Summer	7.323	0.0	15617.9	964
1440 min Summer	5.209	0.0	14741.3	1406
2160 min Summer	3.705	0.0	25778.8	1728
2880 min Summer	2.910	0.0	26713.0	2108
4320 min Summer	2.036	0.0	27129.6	2864
5760 min Summer	1.580	0.0	30128.1	3640
7200 min Summer	1.298	0.0	30904.8	4400
8640 min Summer	1.105	0.0	31496.4	5112
10080 min Summer	0.965	0.0	31879.1	5856
15 min Winter	221.234	0.0	8941.1	31
30 min Winter	125.491	0.0	8912.1	45

Summary of Results for 200 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	86.405	1.405	106.5	15665.3	O K
120 min Winter	86.555	1.555	106.5	17563.9	O K
180 min Winter	86.643	1.643	106.5	18688.6	O K
240 min Winter	86.703	1.703	106.5	19467.8	Flood Risk
360 min Winter	86.782	1.782	106.5	20493.3	Flood Risk
480 min Winter	86.830	1.830	106.5	21125.9	Flood Risk
600 min Winter	86.860	1.860	106.5	21531.9	Flood Risk
720 min Winter	86.879	1.879	106.5	21788.8	Flood Risk
960 min Winter	86.885	1.885	106.5	21861.4	Flood Risk
1440 min Winter	86.854	1.854	106.5	21452.7	Flood Risk
2160 min Winter	86.764	1.764	106.5	20261.6	Flood Risk
2880 min Winter	86.680	1.680	106.5	19157.4	O K
4320 min Winter	86.465	1.465	106.5	16422.7	O K
5760 min Winter	86.231	1.231	106.5	13529.1	O K
7200 min Winter	86.024	1.024	106.5	11068.8	O K
8640 min Winter	85.844	0.844	106.5	8983.8	O K
10080 min Winter	85.691	0.691	106.5	7266.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	71.183	0.0	14633.5	74
120 min Winter	40.377	0.0	16140.8	132
180 min Winter	28.980	0.0	16779.4	190
240 min Winter	22.903	0.0	16939.2	248
360 min Winter	16.438	0.0	16747.0	364
480 min Winter	12.991	0.0	16528.6	480
600 min Winter	10.824	0.0	16322.8	596
720 min Winter	9.324	0.0	16130.2	712
960 min Winter	7.323	0.0	15762.0	942
1440 min Winter	5.209	0.0	15066.8	1384
2160 min Winter	3.705	0.0	28642.6	1972
2880 min Winter	2.910	0.0	29420.7	2232
4320 min Winter	2.036	0.0	28200.8	3164
5760 min Winter	1.580	0.0	33755.2	3976
7200 min Winter	1.298	0.0	34637.3	4752
8640 min Winter	1.105	0.0	35324.0	5448
10080 min Winter	0.965	0.0	35791.4	6144

Rainfall Details

Rainfall Model	FEH
Return Period (years)	200
Site Location	GB 475200 253950 SP 75200 53950
C (1km)	-0.027
D1 (1km)	0.325
D2 (1km)	0.303
D3 (1km)	0.262
E (1km)	0.304
F (1km)	2.473
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+20

Time Area Diagram

Total Area (ha) 26.704

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	6.676	4	8	6.676	8	12	6.676	12	16	6.676

Model Details

Storage is Online Cover Level (m) 87.000

Tank or Pond Structure

Invert Level (m) 85.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	9915.6	2.000	13593.7	2.001	0.0

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0393-1068-2000-1068
Design Head (m)	2.000
Design Flow (l/s)	106.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	393
Invert Level (m)	85.000
Minimum Outlet Pipe Diameter (mm)	450
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)	2.000	106.6	Kick-Flo®	1.429	90.6
Flush-Flo™	0.685	106.5	Mean Flow over Head Range	-	89.9

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	10.9	1.200	100.5	3.000	129.8	7.000	196.4
0.200	38.9	1.400	92.6	3.500	140.0	7.500	203.2
0.300	74.7	1.600	95.7	4.000	149.4	8.000	209.7
0.400	101.4	1.800	101.3	4.500	158.2	8.500	216.0
0.500	104.6	2.000	106.6	5.000	166.6	9.000	222.2
0.600	106.1	2.200	111.6	5.500	174.5	9.500	228.1
0.800	106.0	2.400	116.5	6.000	182.1		
1.000	104.1	2.600	121.1	6.500	189.4		

Summary of Results for 200 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	86.923	1.023	61.1	6267.2	O K
30 min Summer	87.045	1.145	61.1	7088.4	O K
60 min Summer	87.176	1.276	61.1	7986.4	O K
120 min Summer	87.313	1.413	61.1	8943.4	O K
180 min Summer	87.392	1.492	61.1	9502.2	O K
240 min Summer	87.445	1.545	61.1	9884.1	O K
360 min Summer	87.512	1.612	61.1	10373.3	O K
480 min Summer	87.552	1.652	61.1	10661.7	O K
600 min Summer	87.575	1.675	61.1	10834.2	O K
720 min Summer	87.588	1.688	61.1	10930.8	O K
960 min Summer	87.584	1.684	61.1	10899.8	O K
1440 min Summer	87.537	1.637	61.1	10556.7	O K
2160 min Summer	87.457	1.557	61.1	9971.0	O K
2880 min Summer	87.382	1.482	61.1	9432.4	O K
4320 min Summer	87.199	1.299	61.1	8147.1	O K
5760 min Summer	87.032	1.132	61.1	7001.9	O K
7200 min Summer	86.888	0.988	61.1	6035.2	O K
8640 min Summer	86.760	0.860	61.1	5195.4	O K
10080 min Summer	86.648	0.748	61.1	4476.0	O K
15 min Winter	87.036	1.136	61.1	7027.8	O K
30 min Winter	87.171	1.271	61.1	7952.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	221.234	0.0	5029.7	31
30 min Summer	125.491	0.0	5115.1	45
60 min Summer	71.183	0.0	7716.6	74
120 min Summer	40.377	0.0	8631.7	134
180 min Summer	28.980	0.0	9131.4	194
240 min Summer	22.903	0.0	9413.0	252
360 min Summer	16.438	0.0	9539.2	370
480 min Summer	12.991	0.0	9427.4	490
600 min Summer	10.824	0.0	9303.4	608
720 min Summer	9.324	0.0	9180.4	726
960 min Summer	7.323	0.0	8945.0	964
1440 min Summer	5.209	0.0	8494.0	1406
2160 min Summer	3.705	0.0	14923.7	1728
2880 min Summer	2.910	0.0	15496.6	2108
4320 min Summer	2.036	0.0	15761.6	2900
5760 min Summer	1.580	0.0	17304.7	3640
7200 min Summer	1.298	0.0	17757.6	4400
8640 min Summer	1.105	0.0	18112.0	5120
10080 min Summer	0.965	0.0	18361.8	5856
15 min Winter	221.234	0.0	5135.8	31
30 min Winter	125.491	0.0	5051.4	45

Summary of Results for 200 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	87.317	1.417	61.1	8968.1	O K
120 min Winter	87.467	1.567	61.1	10047.1	O K
180 min Winter	87.555	1.655	61.1	10684.3	O K
240 min Winter	87.614	1.714	61.1	11124.1	Flood Risk
360 min Winter	87.692	1.792	61.1	11698.9	Flood Risk
480 min Winter	87.738	1.838	61.1	12049.5	Flood Risk
600 min Winter	87.767	1.867	61.1	12270.5	Flood Risk
720 min Winter	87.785	1.885	61.1	12406.7	Flood Risk
960 min Winter	87.788	1.888	61.1	12427.7	Flood Risk
1440 min Winter	87.752	1.852	61.1	12157.0	Flood Risk
2160 min Winter	87.656	1.756	61.1	11431.6	Flood Risk
2880 min Winter	87.566	1.666	61.1	10767.6	O K
4320 min Winter	87.346	1.446	61.1	9179.7	O K
5760 min Winter	87.102	1.202	61.1	7477.5	O K
7200 min Winter	86.886	0.986	61.1	6020.0	O K
8640 min Winter	86.699	0.799	61.1	4801.7	O K
10080 min Winter	86.541	0.641	61.1	3803.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	71.183	0.0	8547.5	74
120 min Winter	40.377	0.0	9393.6	132
180 min Winter	28.980	0.0	9665.6	190
240 min Winter	22.903	0.0	9647.6	248
360 min Winter	16.438	0.0	9526.6	364
480 min Winter	12.991	0.0	9410.1	480
600 min Winter	10.824	0.0	9305.6	596
720 min Winter	9.324	0.0	9209.9	712
960 min Winter	7.323	0.0	9027.7	942
1440 min Winter	5.209	0.0	8689.7	1384
2160 min Winter	3.705	0.0	16597.1	1972
2880 min Winter	2.910	0.0	17078.0	2232
4320 min Winter	2.036	0.0	16226.1	3164
5760 min Winter	1.580	0.0	19385.2	3984
7200 min Winter	1.298	0.0	19897.6	4752
8640 min Winter	1.105	0.0	20304.9	5448
10080 min Winter	0.965	0.0	20602.7	6144

Rainfall Details

Rainfall Model	FEH
Return Period (years)	200
Site Location	GB 475200 253950 SP 75200 53950
C (1km)	-0.027
D1 (1km)	0.325
D2 (1km)	0.303
D3 (1km)	0.262
E (1km)	0.304
F (1km)	2.473
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+20

Time Area Diagram

Total Area (ha) 15.292

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	3.823	4	8	3.823	8	12	3.823	12	16	3.823

Model Details

Storage is Online Cover Level (m) 87.900

Tank or Pond Structure

Invert Level (m) 85.900

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	5615.3	2.000	7725.4	2.001	0.0

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0308-6120-2000-6120
Design Head (m)	2.000
Design Flow (l/s)	61.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	308
Invert Level (m)	85.900
Minimum Outlet Pipe Diameter (mm)	375
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)	2.000	61.2	Kick-Flo®	1.353	50.7
Flush-Flo™	0.620	61.1	Mean Flow over Head Range	-	52.4

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	9.3	1.200	55.9	3.000	74.5	7.000	112.4
0.200	31.6	1.400	51.5	3.500	80.2	7.500	116.3
0.300	54.5	1.600	54.9	4.000	85.6	8.000	120.0
0.400	59.2	1.800	58.2	4.500	90.7	8.500	123.6
0.500	60.6	2.000	61.2	5.000	95.4	9.000	127.1
0.600	61.1	2.200	64.1	5.500	100.0	9.500	130.5
0.800	60.5	2.400	66.8	6.000	104.3		
1.000	59.0	2.600	69.5	6.500	108.4		

APPENDIX 5

Main Site Drainage Strategy

Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in con junction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.

Key Plan

Legend

- Drainage Catchment A
- Drainage Catchment B
- Drainage Catchment C
- Drainage Catchment D
- Drainage Catchment E
- Drainage Catchment F
- Watercourses
- Outfall Routes

Rev	Date	Details of issue / revision	Drw	Rev
P1	05.12.17	Preliminary Issue	DF	CO

Issues & Revisions

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Client

ROXHILL

Project Title

NORTHAMPTON GATEWAY RAIL FREIGHT INTERCHANGE

Drawing Title

MAIN SITE DRAINAGE STRATEGY

Drawn:	D. Fraser	Reviewed:	C. Dodd
BWB Ref:	NTH 2315	Date:	05/12/17
Scale: : A0:	1:2500		

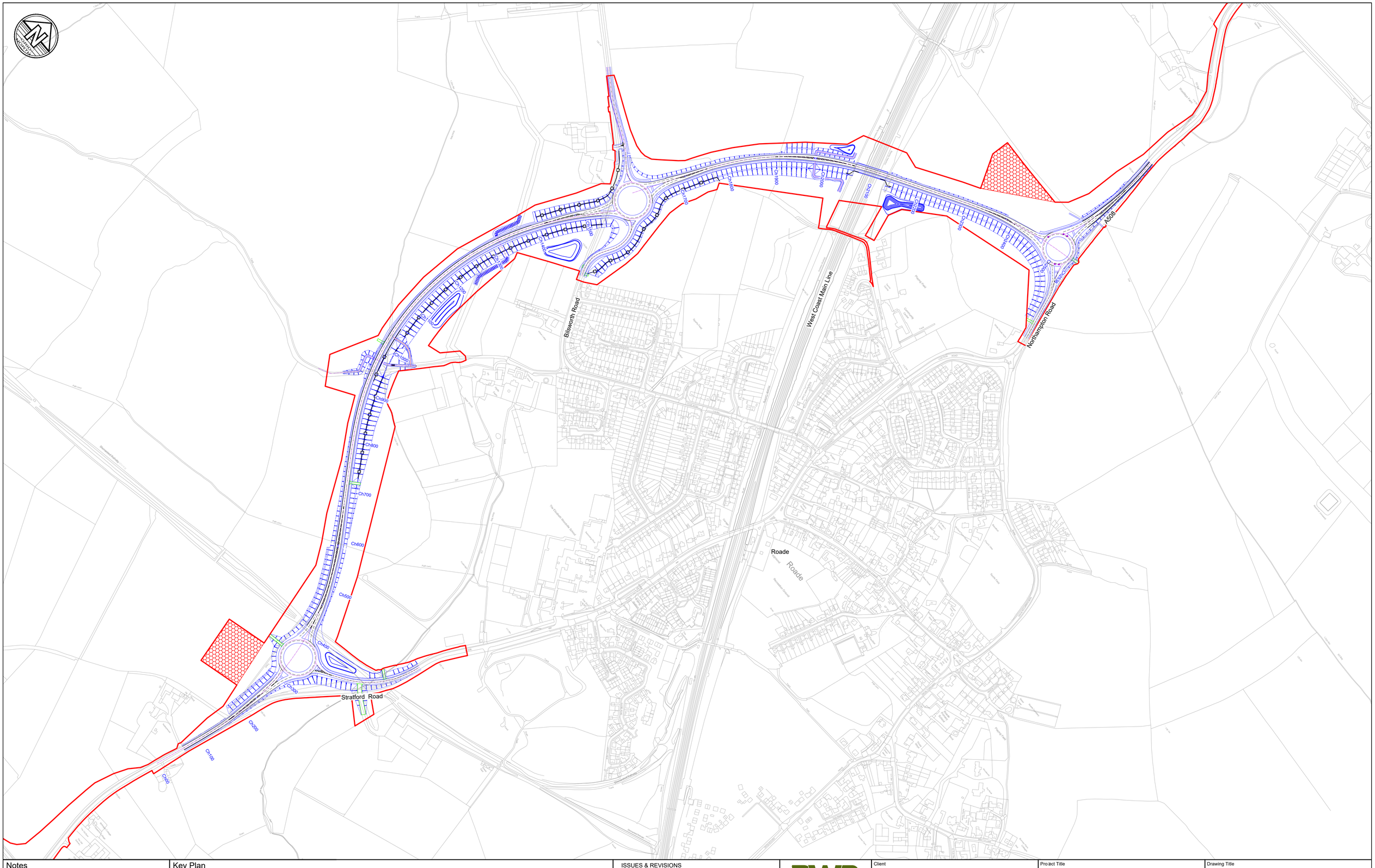
Drawing Status

PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
NTH-BWB-GEN-XX-SK-C-SK44	S2	P1

APPENDIX 6

Roade Bypass General Arrangement



Notes

1. Do not scale this drawing. All dimensions must be checked/ verified on site. If in doubt ask.
2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.

Key Plan

Site Compound

ISSUES & REVISIONS

Rev	Date	Details of issue / revision	Drw	Rev
P1	02.08.17	PRELIMINARY ISSUE	PG	DM
P2	31.08.17	BYPASS ALIGNMENT REVISED	PG	SRH
P3	12.12.17	REFUGE ISLAND'S & BUNDS ADDED	PG	SRH
P4	20.12.17	BUNDS & PONDS REVISED	PG	SRH
P5	21.02.18	SITE COMPOUNDS ADDED	PG	SRH

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Client: ROXHILL

Project Title: **NORTHAMPTON GATEWAY RAIL FREIGHT INTERCHANGE**

Drawing Title: **ROADE BYPASS GENERAL ARRANGEMENT**

Drawn:	P. Goodyear	Reviewed:	D. Mackrory		
BWB Ref:	NTH 2315	Date:	02.08.17	Scale: A1:	1:2500

Drawing Status: **PRELIMINARY**

Project - Originator - Zone - Level - Type - Role - Number: **NGW-BW-GEN-XX-S-C-S-21**

Status: **S** Rev: **P5**

Y:\NTH\NTH2315\M1 15 SRFI 02. Project Delivery 01. WIP Sketches\NGW-BWB-GEN-XX-SK-C-SK21_Roade Bypass GA.dwg

APPENDIX 7

Roade Bypass Calculations

Pond Calculations Summary

	A	B	C	D	E
Impermeable Catchment (ha)	1.13	0.21	1.46	0.33	1.46
Discharge Rate (l/s) @ 3.3l/s/ha	3.7	0.7	4.8	1.1	4.8
Pond Volume (m3) @ 3.3l/s/ha	779.8	149.2	1011.8	236.2	1007.8
Max Pond Volume (m3)	884.1	250.3	1110.1	465.6	1059.2

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	1.000	Urban	0.000
SAAR (mm)	644	Region Number	Region 4

Results l/s

QBAR Rural	4.0
QBAR Urban	4.0
Q100 years	10.2
Q1 year	3.3
Q30 years	7.8
Q100 years	10.2

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.493	0.493	3.7	365.7	O K
30 min Summer	0.555	0.555	3.7	418.6	O K
60 min Summer	0.622	0.622	3.7	477.5	O K
120 min Summer	0.693	0.693	3.7	540.9	O K
180 min Summer	0.733	0.733	3.7	578.5	Flood Risk
240 min Summer	0.761	0.761	3.7	604.5	Flood Risk
360 min Summer	0.796	0.796	3.7	638.6	Flood Risk
480 min Summer	0.818	0.818	3.7	659.3	Flood Risk
600 min Summer	0.831	0.831	3.7	672.4	Flood Risk
720 min Summer	0.839	0.839	3.7	680.4	Flood Risk
960 min Summer	0.841	0.841	3.7	681.7	Flood Risk
1440 min Summer	0.823	0.823	3.7	664.7	Flood Risk
2160 min Summer	0.787	0.787	3.7	630.1	Flood Risk
2880 min Summer	0.755	0.755	3.7	598.7	Flood Risk
4320 min Summer	0.681	0.681	3.7	530.0	O K
5760 min Summer	0.606	0.606	3.7	462.5	O K
7200 min Summer	0.534	0.534	3.7	400.4	O K
8640 min Summer	0.471	0.471	3.7	347.3	O K
10080 min Summer	0.414	0.414	3.7	301.0	O K
15 min Winter	0.545	0.545	3.7	410.0	O K
30 min Winter	0.614	0.614	3.7	469.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	174.522	0.0	306.5	27
30 min Summer	100.264	0.0	308.6	41
60 min Summer	57.603	0.0	473.7	72
120 min Summer	33.093	0.0	536.3	130
180 min Summer	23.929	0.0	567.4	190
240 min Summer	19.012	0.0	577.8	250
360 min Summer	13.748	0.0	574.0	368
480 min Summer	10.923	0.0	567.0	488
600 min Summer	9.138	0.0	560.2	606
720 min Summer	7.898	0.0	553.8	726
960 min Summer	6.236	0.0	542.3	964
1440 min Summer	4.469	0.0	521.4	1436
2160 min Summer	3.203	0.0	963.2	1772
2880 min Summer	2.529	0.0	1004.5	2140
4320 min Summer	1.786	0.0	971.2	2948
5760 min Summer	1.395	0.0	1132.7	3752
7200 min Summer	1.152	0.0	1169.0	4472
8640 min Summer	0.986	0.0	1198.8	5200
10080 min Summer	0.864	0.0	1222.6	5952
15 min Winter	174.522	0.0	309.9	27
30 min Winter	100.264	0.0	302.8	41

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.687	0.687	3.7	536.1	O K
120 min Winter	0.764	0.764	3.7	607.8	Flood Risk
180 min Winter	0.809	0.809	3.7	650.9	Flood Risk
240 min Winter	0.840	0.840	3.7	681.0	Flood Risk
360 min Winter	0.880	0.880	3.7	721.2	Flood Risk
480 min Winter	0.906	0.906	3.7	746.5	Flood Risk
600 min Winter	0.922	0.922	3.7	763.3	Flood Risk
720 min Winter	0.933	0.933	3.7	774.3	Flood Risk
960 min Winter	0.938	0.938	3.7	779.8	Flood Risk
1440 min Winter	0.928	0.928	3.7	769.0	Flood Risk
2160 min Winter	0.889	0.889	3.7	729.6	Flood Risk
2880 min Winter	0.849	0.849	3.7	689.7	Flood Risk
4320 min Winter	0.756	0.756	3.7	600.1	Flood Risk
5760 min Winter	0.661	0.661	3.7	512.2	O K
7200 min Winter	0.551	0.551	3.7	414.6	O K
8640 min Winter	0.455	0.455	3.7	334.1	O K
10080 min Winter	0.372	0.372	3.7	267.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	57.603	0.0	525.2	70
120 min Winter	33.093	0.0	577.2	128
180 min Winter	23.929	0.0	581.5	186
240 min Winter	19.012	0.0	578.1	246
360 min Winter	13.748	0.0	570.4	362
480 min Winter	10.923	0.0	564.2	478
600 min Winter	9.138	0.0	559.1	596
720 min Winter	7.898	0.0	554.9	712
960 min Winter	6.236	0.0	547.5	940
1440 min Winter	4.469	0.0	537.5	1386
2160 min Winter	3.203	0.0	1068.0	2000
2880 min Winter	2.529	0.0	1081.4	2256
4320 min Winter	1.786	0.0	997.3	3196
5760 min Winter	1.395	0.0	1268.6	4104
7200 min Winter	1.152	0.0	1309.4	4896
8640 min Winter	0.986	0.0	1343.2	5616
10080 min Winter	0.864	0.0	1370.6	6256

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
Site Location	GB 475250 250800 SP 75250 50800
C (1km)	-0.026
D1 (1km)	0.320
D2 (1km)	0.298
D3 (1km)	0.262
E (1km)	0.302
F (1km)	2.482
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+20

Time Area Diagram

Total Area (ha) 1.130

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.380	4	8	0.380	8	12	0.370

Model Details

Storage is Online Cover Level (m) 1.000

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	650.1	1.000	1054.3	1.300	1201.2

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0091-3700-1000-3700
Design Head (m)	1.000
Design Flow (l/s)	3.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	91
Invert Level (m)	0.000
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	3.7	Kick-Flo®	0.631	3.0
Flush-Flo™	0.299	3.7	Mean Flow over Head Range	-	3.2

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	2.9	1.200	4.0	3.000	6.2	7.000	9.2
0.200	3.6	1.400	4.3	3.500	6.6	7.500	9.5
0.300	3.7	1.600	4.6	4.000	7.1	8.000	9.8
0.400	3.6	1.800	4.9	4.500	7.5	8.500	10.1
0.500	3.5	2.000	5.1	5.000	7.8	9.000	10.4
0.600	3.2	2.200	5.3	5.500	8.2	9.500	10.6
0.800	3.3	2.400	5.6	6.000	8.6		
1.000	3.7	2.600	5.8	6.500	8.9		

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.354	0.354	0.5	68.1	O K
30 min Summer	0.398	0.398	0.5	78.1	O K
60 min Summer	0.445	0.445	0.5	89.1	O K
120 min Summer	0.494	0.494	0.5	101.0	O K
180 min Summer	0.523	0.523	0.5	108.3	O K
240 min Summer	0.543	0.543	0.5	113.3	O K
360 min Summer	0.570	0.570	0.5	120.2	O K
480 min Summer	0.586	0.586	0.6	124.5	O K
600 min Summer	0.597	0.597	0.6	127.5	O K
720 min Summer	0.605	0.605	0.6	129.4	O K
960 min Summer	0.609	0.609	0.6	130.6	O K
1440 min Summer	0.604	0.604	0.6	129.3	O K
2160 min Summer	0.584	0.584	0.6	123.8	O K
2880 min Summer	0.564	0.564	0.5	118.8	O K
4320 min Summer	0.521	0.521	0.5	107.7	O K
5760 min Summer	0.484	0.484	0.5	98.5	O K
7200 min Summer	0.449	0.449	0.5	90.2	O K
8640 min Summer	0.417	0.417	0.5	82.6	O K
10080 min Summer	0.385	0.385	0.5	75.3	O K
15 min Winter	0.390	0.390	0.5	76.4	O K
30 min Winter	0.438	0.438	0.5	87.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	174.522	0.0	43.0	27
30 min Summer	100.264	0.0	41.4	42
60 min Summer	57.603	0.0	83.6	72
120 min Summer	33.093	0.0	84.6	130
180 min Summer	23.929	0.0	84.4	190
240 min Summer	19.012	0.0	84.2	250
360 min Summer	13.748	0.0	84.0	368
480 min Summer	10.923	0.0	84.1	488
600 min Summer	9.138	0.0	84.3	606
720 min Summer	7.898	0.0	84.6	726
960 min Summer	6.236	0.0	85.1	964
1440 min Summer	4.469	0.0	84.6	1442
2160 min Summer	3.203	0.0	166.9	1864
2880 min Summer	2.529	0.0	162.3	2228
4320 min Summer	1.786	0.0	149.5	3028
5760 min Summer	1.395	0.0	210.6	3856
7200 min Summer	1.152	0.0	217.3	4680
8640 min Summer	0.986	0.0	222.9	5464
10080 min Summer	0.864	0.0	227.5	6344
15 min Winter	174.522	0.0	41.8	27
30 min Winter	100.264	0.0	40.7	41

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.490	0.490	0.5	99.9	O K
120 min Winter	0.544	0.544	0.5	113.5	O K
180 min Winter	0.576	0.576	0.5	121.8	O K
240 min Winter	0.598	0.598	0.6	127.6	O K
360 min Winter	0.628	0.628	0.6	135.7	O K
480 min Winter	0.647	0.647	0.6	140.9	O K
600 min Winter	0.660	0.660	0.6	144.6	O K
720 min Winter	0.670	0.670	0.6	147.2	O K
960 min Winter	0.677	0.677	0.6	149.2	O K
1440 min Winter	0.677	0.677	0.6	149.2	O K
2160 min Winter	0.660	0.660	0.6	144.3	O K
2880 min Winter	0.635	0.635	0.6	137.7	O K
4320 min Winter	0.584	0.584	0.6	123.9	O K
5760 min Winter	0.535	0.535	0.5	111.2	O K
7200 min Winter	0.488	0.488	0.5	99.5	O K
8640 min Winter	0.442	0.442	0.5	88.4	O K
10080 min Winter	0.396	0.396	0.5	77.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	57.603	0.0	84.9	70
120 min Winter	33.093	0.0	84.8	128
180 min Winter	23.929	0.0	84.9	188
240 min Winter	19.012	0.0	85.1	246
360 min Winter	13.748	0.0	85.9	362
480 min Winter	10.923	0.0	87.1	480
600 min Winter	9.138	0.0	88.1	596
720 min Winter	7.898	0.0	88.7	714
960 min Winter	6.236	0.0	89.1	944
1440 min Winter	4.469	0.0	88.3	1396
2160 min Winter	3.203	0.0	170.8	2040
2880 min Winter	2.529	0.0	166.8	2344
4320 min Winter	1.786	0.0	157.5	3244
5760 min Winter	1.395	0.0	235.9	4152
7200 min Winter	1.152	0.0	243.3	5048
8640 min Winter	0.986	0.0	249.5	5960
10080 min Winter	0.864	0.0	254.4	6856

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
Site Location	GB 475250 250800 SP 75250 50800
C (1km)	-0.026
D1 (1km)	0.320
D2 (1km)	0.298
D3 (1km)	0.262
E (1km)	0.302
F (1km)	2.482
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.210

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.070	4	8	0.070	8	12	0.070

Model Details

Storage is Online Cover Level (m) 1.000

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	165.1	1.000	346.7	1.300	419.8

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0039-7000-1000-7000
Design Head (m)	1.000
Design Flow (l/s)	0.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	39
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	0.7	Kick-Flo®	0.345	0.4
Flush-Flo™	0.172	0.5	Mean Flow over Head Range	-	0.5

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	0.5	1.200	0.8	3.000	1.1	7.000	1.7
0.200	0.5	1.400	0.8	3.500	1.2	7.500	1.7
0.300	0.5	1.600	0.9	4.000	1.3	8.000	1.8
0.400	0.5	1.800	0.9	4.500	1.4	8.500	1.8
0.500	0.5	2.000	1.0	5.000	1.4	9.000	1.9
0.600	0.6	2.200	1.0	5.500	1.5	9.500	1.9
0.800	0.6	2.400	1.0	6.000	1.6		
1.000	0.7	2.600	1.1	6.500	1.6		

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.470	0.470	4.8	472.5	O K
30 min Summer	0.531	0.531	4.8	541.0	O K
60 min Summer	0.598	0.598	4.8	617.0	O K
120 min Summer	0.669	0.669	4.8	699.4	O K
180 min Summer	0.711	0.711	4.8	748.5	Flood Risk
240 min Summer	0.739	0.739	4.8	782.5	Flood Risk
360 min Summer	0.776	0.776	4.8	827.3	Flood Risk
480 min Summer	0.799	0.799	4.8	854.8	Flood Risk
600 min Summer	0.813	0.813	4.8	872.3	Flood Risk
720 min Summer	0.822	0.822	4.8	883.3	Flood Risk
960 min Summer	0.824	0.824	4.8	886.0	Flood Risk
1440 min Summer	0.808	0.808	4.8	866.1	Flood Risk
2160 min Summer	0.773	0.773	4.8	823.2	Flood Risk
2880 min Summer	0.740	0.740	4.8	783.5	Flood Risk
4320 min Summer	0.665	0.665	4.8	694.2	O K
5760 min Summer	0.587	0.587	4.8	604.2	O K
7200 min Summer	0.518	0.518	4.8	526.3	O K
8640 min Summer	0.457	0.457	4.8	458.6	O K
10080 min Summer	0.402	0.402	4.8	399.2	O K
15 min Winter	0.521	0.521	4.8	529.8	O K
30 min Winter	0.590	0.590	4.8	607.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	174.522	0.0	393.5	27
30 min Summer	100.264	0.0	401.2	41
60 min Summer	57.603	0.0	606.6	72
120 min Summer	33.093	0.0	686.9	130
180 min Summer	23.929	0.0	728.6	190
240 min Summer	19.012	0.0	746.7	250
360 min Summer	13.748	0.0	744.7	368
480 min Summer	10.923	0.0	735.1	488
600 min Summer	9.138	0.0	725.4	606
720 min Summer	7.898	0.0	716.3	726
960 min Summer	6.236	0.0	699.7	964
1440 min Summer	4.469	0.0	669.4	1438
2160 min Summer	3.203	0.0	1238.5	1776
2880 min Summer	2.529	0.0	1289.5	2140
4320 min Summer	1.786	0.0	1253.6	2948
5760 min Summer	1.395	0.0	1462.1	3704
7200 min Summer	1.152	0.0	1508.7	4472
8640 min Summer	0.986	0.0	1546.8	5200
10080 min Summer	0.864	0.0	1576.3	5952
15 min Winter	174.522	0.0	402.3	27
30 min Winter	100.264	0.0	397.0	41

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.664	0.664	4.8	692.9	O K
120 min Winter	0.742	0.742	4.8	785.9	Flood Risk
180 min Winter	0.788	0.788	4.8	841.9	Flood Risk
240 min Winter	0.820	0.820	4.8	881.1	Flood Risk
360 min Winter	0.862	0.862	4.8	933.7	Flood Risk
480 min Winter	0.889	0.889	4.8	966.9	Flood Risk
600 min Winter	0.906	0.906	4.8	989.0	Flood Risk
720 min Winter	0.918	0.918	4.8	1003.8	Flood Risk
960 min Winter	0.924	0.924	4.8	1011.8	Flood Risk
1440 min Winter	0.915	0.915	4.8	999.5	Flood Risk
2160 min Winter	0.876	0.876	4.8	950.6	Flood Risk
2880 min Winter	0.836	0.836	4.8	900.2	Flood Risk
4320 min Winter	0.741	0.741	4.8	784.9	Flood Risk
5760 min Winter	0.643	0.643	4.8	668.0	O K
7200 min Winter	0.533	0.533	4.8	543.0	O K
8640 min Winter	0.441	0.441	4.8	441.0	O K
10080 min Winter	0.361	0.361	4.8	355.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	57.603	0.0	672.7	70
120 min Winter	33.093	0.0	743.3	128
180 min Winter	23.929	0.0	755.0	186
240 min Winter	19.012	0.0	750.7	246
360 min Winter	13.748	0.0	740.0	362
480 min Winter	10.923	0.0	730.9	478
600 min Winter	9.138	0.0	723.4	596
720 min Winter	7.898	0.0	716.9	712
960 min Winter	6.236	0.0	705.3	940
1440 min Winter	4.469	0.0	687.3	1388
2160 min Winter	3.203	0.0	1371.8	2008
2880 min Winter	2.529	0.0	1391.1	2256
4320 min Winter	1.786	0.0	1282.9	3200
5760 min Winter	1.395	0.0	1637.5	4104
7200 min Winter	1.152	0.0	1690.0	4832
8640 min Winter	0.986	0.0	1733.3	5544
10080 min Winter	0.864	0.0	1767.6	6256

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
Site Location	GB 475250 250800 SP 75250 50800
C (1km)	-0.026
D1 (1km)	0.320
D2 (1km)	0.298
D3 (1km)	0.262
E (1km)	0.302
F (1km)	2.482
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+20

Time Area Diagram

Total Area (ha) 1.460

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.487	4	8	0.487	8	12	0.486

Model Details

Storage is Online Cover Level (m) 1.000

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	920.0	1.000	1311.7	1.300	1452.2

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0103-4800-1000-4800
Design Head (m)	1.000
Design Flow (l/s)	4.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	0.000
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	4.8	Kick-Flo®	0.637	3.9
Flush-Flo™	0.295	4.8	Mean Flow over Head Range	-	4.2

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	3.5	1.200	5.2	3.000	8.0	7.000	12.0
0.200	4.7	1.400	5.6	3.500	8.6	7.500	12.4
0.300	4.8	1.600	6.0	4.000	9.2	8.000	12.8
0.400	4.7	1.800	6.3	4.500	9.7	8.500	13.2
0.500	4.6	2.000	6.6	5.000	10.2	9.000	13.5
0.600	4.2	2.200	6.9	5.500	10.7	9.500	13.9
0.800	4.3	2.400	7.2	6.000	11.1		
1.000	4.8	2.600	7.5	6.500	11.6		

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.291	0.291	0.9	107.0	O K
30 min Summer	0.329	0.329	0.9	122.5	O K
60 min Summer	0.370	0.370	0.9	139.8	O K
120 min Summer	0.413	0.413	0.9	158.7	O K
180 min Summer	0.439	0.439	0.9	170.2	O K
240 min Summer	0.458	0.458	0.9	178.3	O K
360 min Summer	0.482	0.482	0.9	189.4	O K
480 min Summer	0.498	0.498	0.9	196.5	O K
600 min Summer	0.508	0.508	0.9	201.3	O K
720 min Summer	0.515	0.515	0.9	204.7	O K
960 min Summer	0.520	0.520	0.9	207.0	O K
1440 min Summer	0.517	0.517	0.9	205.7	O K
2160 min Summer	0.499	0.499	0.9	197.4	O K
2880 min Summer	0.481	0.481	0.9	189.0	O K
4320 min Summer	0.438	0.438	0.9	169.4	O K
5760 min Summer	0.395	0.395	0.9	150.7	O K
7200 min Summer	0.358	0.358	0.9	134.8	O K
8640 min Summer	0.324	0.324	0.9	120.7	O K
10080 min Summer	0.293	0.293	0.9	108.0	O K
15 min Winter	0.322	0.322	0.9	119.9	O K
30 min Winter	0.364	0.364	0.9	137.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	174.522	0.0	77.7	27
30 min Summer	100.264	0.0	78.3	42
60 min Summer	57.603	0.0	135.0	72
120 min Summer	33.093	0.0	148.0	130
180 min Summer	23.929	0.0	149.5	190
240 min Summer	19.012	0.0	148.1	250
360 min Summer	13.748	0.0	145.0	368
480 min Summer	10.923	0.0	142.3	488
600 min Summer	9.138	0.0	140.1	608
720 min Summer	7.898	0.0	138.1	726
960 min Summer	6.236	0.0	134.8	964
1440 min Summer	4.469	0.0	129.1	1442
2160 min Summer	3.203	0.0	270.7	1968
2880 min Summer	2.529	0.0	266.4	2308
4320 min Summer	1.786	0.0	247.0	3076
5760 min Summer	1.395	0.0	330.4	3808
7200 min Summer	1.152	0.0	340.9	4552
8640 min Summer	0.986	0.0	349.6	5360
10080 min Summer	0.864	0.0	356.5	6064
15 min Winter	174.522	0.0	78.5	27
30 min Winter	100.264	0.0	77.9	41

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.409	0.409	0.9	156.9	O K
120 min Winter	0.458	0.458	0.9	178.4	O K
180 min Winter	0.487	0.487	0.9	191.5	O K
240 min Winter	0.507	0.507	0.9	200.8	O K
360 min Winter	0.534	0.534	0.9	213.6	O K
480 min Winter	0.552	0.552	0.9	222.0	O K
600 min Winter	0.564	0.564	0.9	227.9	O K
720 min Winter	0.573	0.573	0.9	232.2	O K
960 min Winter	0.580	0.580	0.9	235.7	O K
1440 min Winter	0.581	0.581	0.9	236.2	O K
2160 min Winter	0.567	0.567	0.9	229.2	O K
2880 min Winter	0.544	0.544	0.9	218.4	O K
4320 min Winter	0.494	0.494	0.9	194.8	O K
5760 min Winter	0.442	0.442	0.9	171.3	O K
7200 min Winter	0.384	0.384	0.9	146.1	O K
8640 min Winter	0.333	0.333	0.9	124.5	O K
10080 min Winter	0.287	0.287	0.9	105.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	57.603	0.0	146.6	70
120 min Winter	33.093	0.0	149.5	128
180 min Winter	23.929	0.0	147.3	188
240 min Winter	19.012	0.0	145.3	246
360 min Winter	13.748	0.0	142.3	364
480 min Winter	10.923	0.0	140.1	480
600 min Winter	9.138	0.0	138.4	598
720 min Winter	7.898	0.0	137.0	714
960 min Winter	6.236	0.0	134.8	946
1440 min Winter	4.469	0.0	132.0	1400
2160 min Winter	3.203	0.0	278.2	2056
2880 min Winter	2.529	0.0	269.6	2632
4320 min Winter	1.786	0.0	249.5	3288
5760 min Winter	1.395	0.0	370.0	4216
7200 min Winter	1.152	0.0	381.8	4984
8640 min Winter	0.986	0.0	391.5	5792
10080 min Winter	0.864	0.0	399.5	6552

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
Site Location	GB 475250 250800 SP 75250 50800
C (1km)	-0.026
D1 (1km)	0.320
D2 (1km)	0.298
D3 (1km)	0.262
E (1km)	0.302
F (1km)	2.482
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+20

Time Area Diagram

Total Area (ha) 0.330

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.110	4	8	0.110	8	12	0.110

Model Details

Storage is Online Cover Level (m) 1.000

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	332.1	1.000	613.3	1.300	719.7

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0049-1100-1000-1100
Design Head (m)	1.000
Design Flow (l/s)	1.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	49
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	1.1	Kick-Flo®	0.437	0.8
Flush-Flo™	0.215	0.9	Mean Flow over Head Range	-	0.9

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	0.8	1.200	1.2	3.000	1.8	7.000	2.7
0.200	0.9	1.400	1.3	3.500	1.9	7.500	2.8
0.300	0.9	1.600	1.4	4.000	2.1	8.000	2.8
0.400	0.8	1.800	1.4	4.500	2.2	8.500	2.9
0.500	0.8	2.000	1.5	5.000	2.3	9.000	3.0
0.600	0.9	2.200	1.6	5.500	2.4	9.500	3.1
0.800	1.0	2.400	1.6	6.000	2.5		
1.000	1.1	2.600	1.7	6.500	2.6		

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	0.498	0.498	4.8	472.5	O K
30 min Summer	0.562	0.562	4.8	541.0	O K
60 min Summer	0.632	0.632	4.8	617.1	O K
120 min Summer	0.704	0.704	4.8	699.1	Flood Risk
180 min Summer	0.746	0.746	4.8	747.8	Flood Risk
240 min Summer	0.775	0.775	4.8	781.5	Flood Risk
360 min Summer	0.812	0.812	4.8	825.6	Flood Risk
480 min Summer	0.834	0.834	4.8	852.5	Flood Risk
600 min Summer	0.848	0.848	4.8	869.4	Flood Risk
720 min Summer	0.857	0.857	4.8	879.8	Flood Risk
960 min Summer	0.858	0.858	4.8	881.5	Flood Risk
1440 min Summer	0.840	0.840	4.8	859.7	Flood Risk
2160 min Summer	0.804	0.804	4.8	816.1	Flood Risk
2880 min Summer	0.770	0.770	4.8	776.3	Flood Risk
4320 min Summer	0.695	0.695	4.8	688.4	O K
5760 min Summer	0.619	0.619	4.8	602.7	O K
7200 min Summer	0.544	0.544	4.8	521.7	O K
8640 min Summer	0.479	0.479	4.8	452.7	O K
10080 min Summer	0.421	0.421	4.8	392.5	O K
15 min Winter	0.552	0.552	4.8	529.8	O K
30 min Winter	0.622	0.622	4.8	607.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	174.522	0.0	395.6	27
30 min Summer	100.264	0.0	399.6	41
60 min Summer	57.603	0.0	609.1	72
120 min Summer	33.093	0.0	689.6	130
180 min Summer	23.929	0.0	731.1	190
240 min Summer	19.012	0.0	747.6	250
360 min Summer	13.748	0.0	744.4	368
480 min Summer	10.923	0.0	735.5	488
600 min Summer	9.138	0.0	726.7	606
720 min Summer	7.898	0.0	718.5	726
960 min Summer	6.236	0.0	703.4	964
1440 min Summer	4.469	0.0	675.7	1430
2160 min Summer	3.203	0.0	1241.9	1756
2880 min Summer	2.529	0.0	1294.6	2136
4320 min Summer	1.786	0.0	1253.9	2944
5760 min Summer	1.395	0.0	1462.7	3752
7200 min Summer	1.152	0.0	1509.6	4472
8640 min Summer	0.986	0.0	1547.8	5200
10080 min Summer	0.864	0.0	1577.9	5952
15 min Winter	174.522	0.0	401.2	27
30 min Winter	100.264	0.0	391.9	41

Summary of Results for 100 year Return Period (+20%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	0.699	0.699	4.8	692.8	O K
120 min Winter	0.778	0.778	4.8	785.5	Flood Risk
180 min Winter	0.825	0.825	4.8	841.2	Flood Risk
240 min Winter	0.857	0.857	4.8	880.1	Flood Risk
360 min Winter	0.899	0.899	4.8	932.1	Flood Risk
480 min Winter	0.926	0.926	4.8	964.8	Flood Risk
600 min Winter	0.943	0.943	4.8	986.4	Flood Risk
720 min Winter	0.954	0.954	4.8	1000.7	Flood Risk
960 min Winter	0.960	0.960	4.8	1007.8	Flood Risk
1440 min Winter	0.949	0.949	4.8	993.9	Flood Risk
2160 min Winter	0.908	0.908	4.8	943.1	Flood Risk
2880 min Winter	0.868	0.868	4.8	892.8	Flood Risk
4320 min Winter	0.772	0.772	4.8	777.7	Flood Risk
5760 min Winter	0.674	0.674	4.8	665.1	O K
7200 min Winter	0.561	0.561	4.8	539.5	O K
8640 min Winter	0.462	0.462	4.8	434.7	O K
10080 min Winter	0.377	0.377	4.8	347.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	57.603	0.0	675.3	70
120 min Winter	33.093	0.0	745.3	128
180 min Winter	23.929	0.0	754.6	186
240 min Winter	19.012	0.0	750.6	246
360 min Winter	13.748	0.0	741.2	362
480 min Winter	10.923	0.0	733.4	478
600 min Winter	9.138	0.0	727.0	596
720 min Winter	7.898	0.0	721.6	710
960 min Winter	6.236	0.0	712.0	940
1440 min Winter	4.469	0.0	698.3	1386
2160 min Winter	3.203	0.0	1377.4	1996
2880 min Winter	2.529	0.0	1400.1	2252
4320 min Winter	1.786	0.0	1290.7	3168
5760 min Winter	1.395	0.0	1638.3	4096
7200 min Winter	1.152	0.0	1690.8	4896
8640 min Winter	0.986	0.0	1734.4	5616
10080 min Winter	0.864	0.0	1769.2	6256

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
Site Location	GB 475250 250800 SP 75250 50800
C (1km)	-0.026
D1 (1km)	0.320
D2 (1km)	0.298
D3 (1km)	0.262
E (1km)	0.302
F (1km)	2.482
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+20

Time Area Diagram

Total Area (ha) 1.460

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.487	4	8	0.487	8	12	0.486

Model Details

Storage is Online Cover Level (m) 1.000

Tank or Pond Structure

Invert Level (m) 0.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	846.2	1.000	1287.5	1.300	1451.4

Hydro-Brake Optimum® Outflow Control

Unit Reference	MD-SHE-0103-4800-1000-4800
Design Head (m)	1.000
Design Flow (l/s)	4.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	0.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

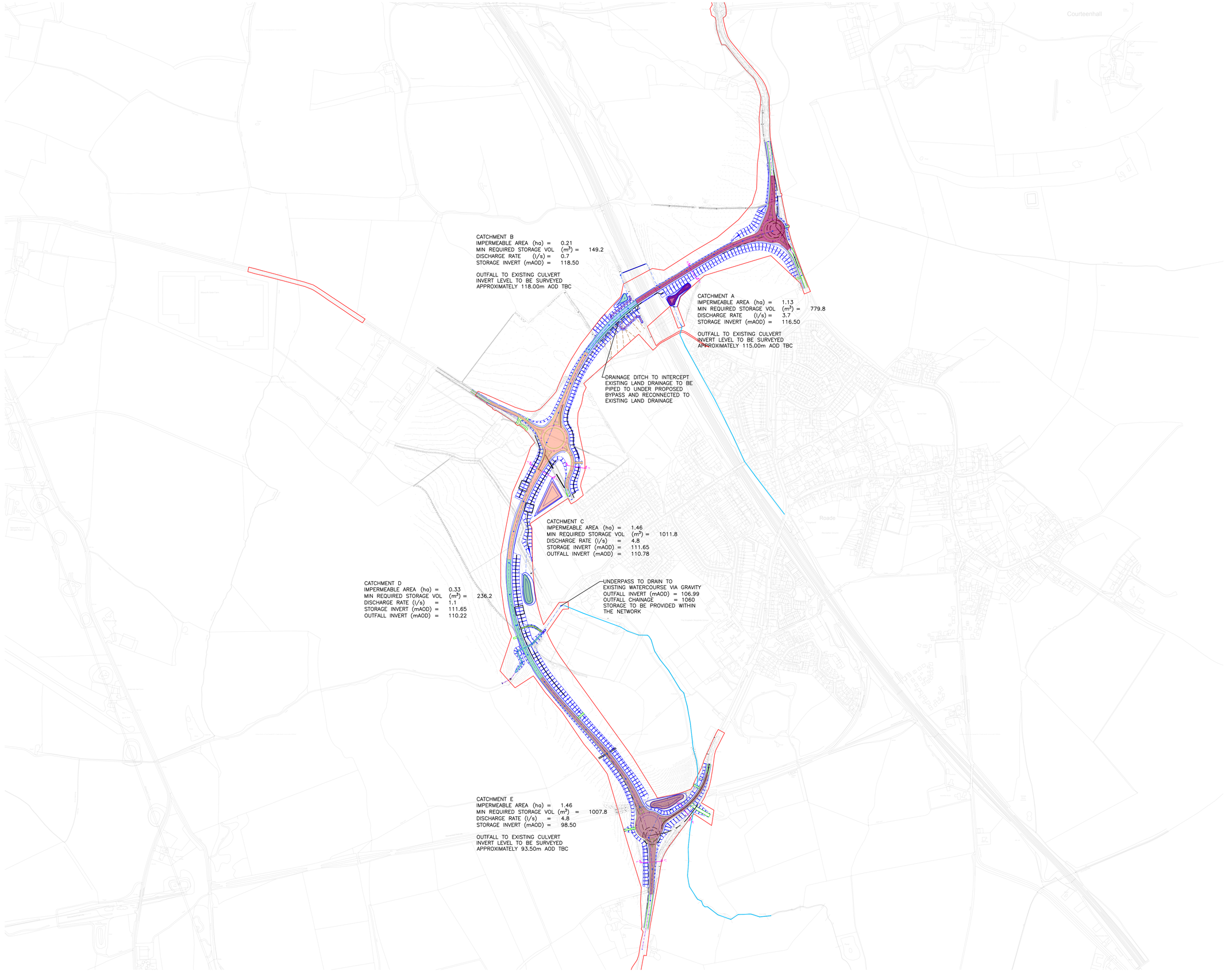
Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	4.8	Kick-Flo®	0.637	3.9
Flush-Flo™	0.295	4.8	Mean Flow over Head Range	-	4.2

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	3.5	1.200	5.2	3.000	8.0	7.000	12.0
0.200	4.7	1.400	5.6	3.500	8.6	7.500	12.4
0.300	4.8	1.600	6.0	4.000	9.2	8.000	12.8
0.400	4.7	1.800	6.3	4.500	9.7	8.500	13.2
0.500	4.6	2.000	6.6	5.000	10.2	9.000	13.5
0.600	4.2	2.200	6.9	5.500	10.7	9.500	13.9
0.800	4.3	2.400	7.2	6.000	11.1		
1.000	4.8	2.600	7.5	6.500	11.6		

APPENDIX 8

Roade Bypass Drainage Strategy



Notes

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2. This drawing is to be read in conjunction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.

Key

- Catchment A
- Catchment B
- Catchment C
- Catchment D
- Catchment E
- Existing Watercourses
- Existing Aqueduct
- Surface Water Drainage

Rev	Date	Details of issue / revision	Drw	Rev
P1	06.12.17	Preliminary Issue	DF	CD

Issues & Revisions

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Client

ROXHILL

Project Title

NORTHAMPTON GATEWAY RAIL FREIGHT INTERCHANGE

Drawing Title

ROADE BYPASS DRAINAGE STRATEGY

Drawn:	D. Fraser	Reviewed:	C. Dodd	
BWB Ref:	NTH 2315	Date:	06/12/17	Scale@A1: 1:5000

Drawing Status

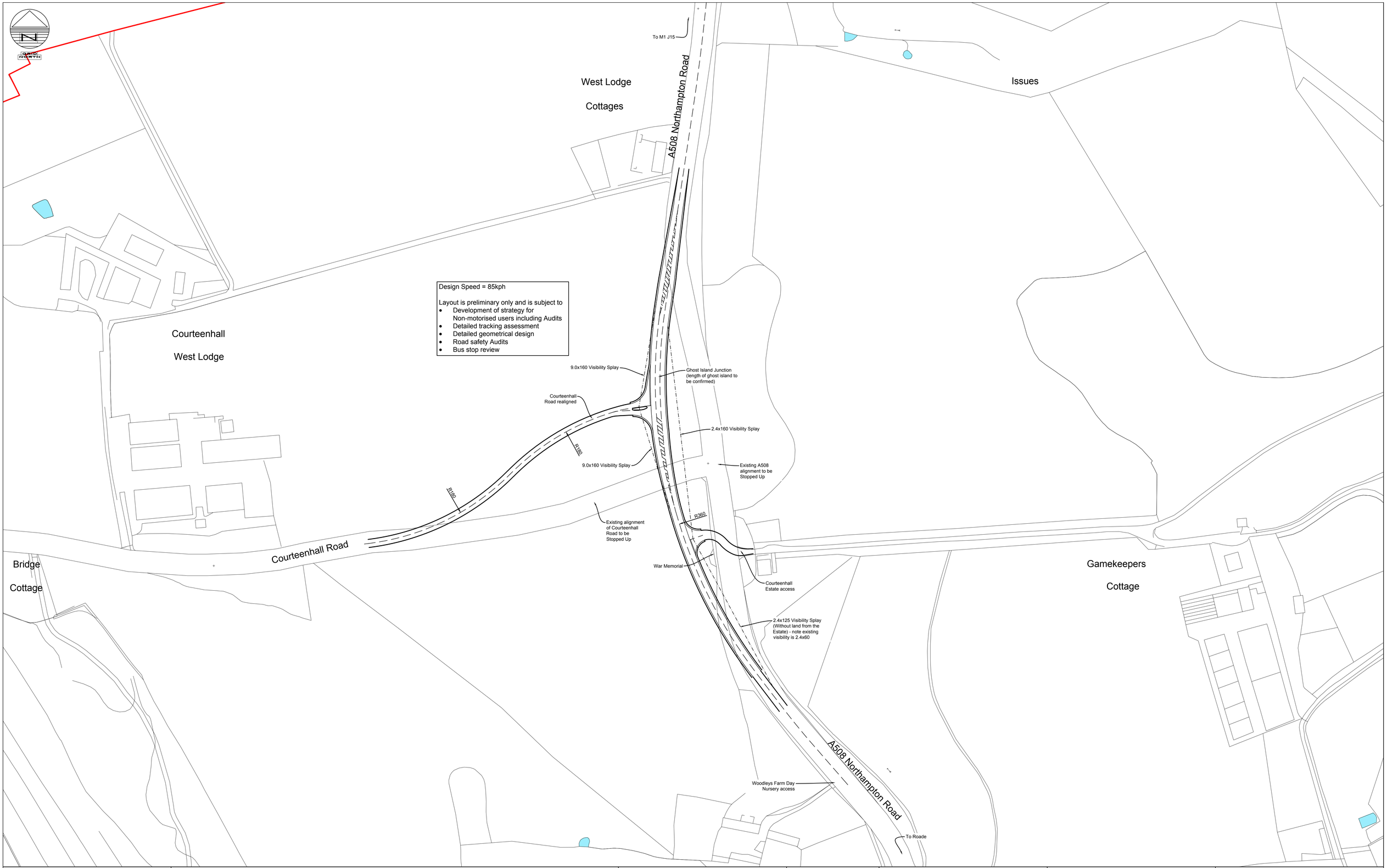
PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
NGW-BWB-GEN-XX-SK-C-SK12	S2	P1

Y:\NTH\NTH2315_M1 J15 SRFI\02. Project Delivery\01. WIP\Sketches\NGW-BWB-GEN-XX-SK-C-SK12_Roade Bypass Drainage Strategy.dwg

APPENDIX 9

Additional Sites General Arrangements



Notes

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3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. Refer to Appendix 7/1 of the contract specification for details of proposed Pavement Types and restrictions.

Legend

Order Limits

ISSUES & REVISIONS

Rev	Date	Details of issue / revision	Drw	Rev
P1	17.07.17	Preliminary Issue	SRH	SRH
P2	19.07.17	Minor realignment	SRH	SRH

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Client: ROXHILL

Project Title: **NORTHAMPTON GATEWAY RAIL FREIGHT INTERCHANGE**

Drawing Title: **A508 COURTEENHALL ROAD JUNCTION GENERAL ARRANGEMENT**

Drawn:	S. Hilditch	Reviewed:	S. Hilditch
BWB Ref:	NTH 2315	Date:	17.07.17
Scale@A1:	1:1250		

Drawing Status: **FOR COMMENT**

Project - Originator - Zone - Level - Type - Role - Number: **NGW-BWB-GEN-XX-SK-C-SK16**

Status: **S3** Rev: **P2**

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2. This drawing is to be read in con□unction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. Refer to Appendi□7/1 of the contract specification for details of proposed Pavement Types and restrictions.

Legend

Order Limits

ISSUES & REVISIONS

Rev	Date	Details of issue / revision	Drw	Rev
P1	20.07.17	Preliminary Issue	SRH	SRH
P2	16.08.17	Order limits shown	PG	PG
P3	26.01.18	Updated following topographical survey	PG	SRH

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Client: ROXHILL

Pro□ect Title: **NORTHAMPTON GATEWAY RAIL FREIGHT INTERCHANGE**

Drawing Title: **A50□ PURY ROAD □UNCTION GENERAL ARRANGEMENT**

Drawn:	S. Hilditch	Reviewed:	S. Hilditch
BWB Ref:	NTH 2315	Date:	20.07.17

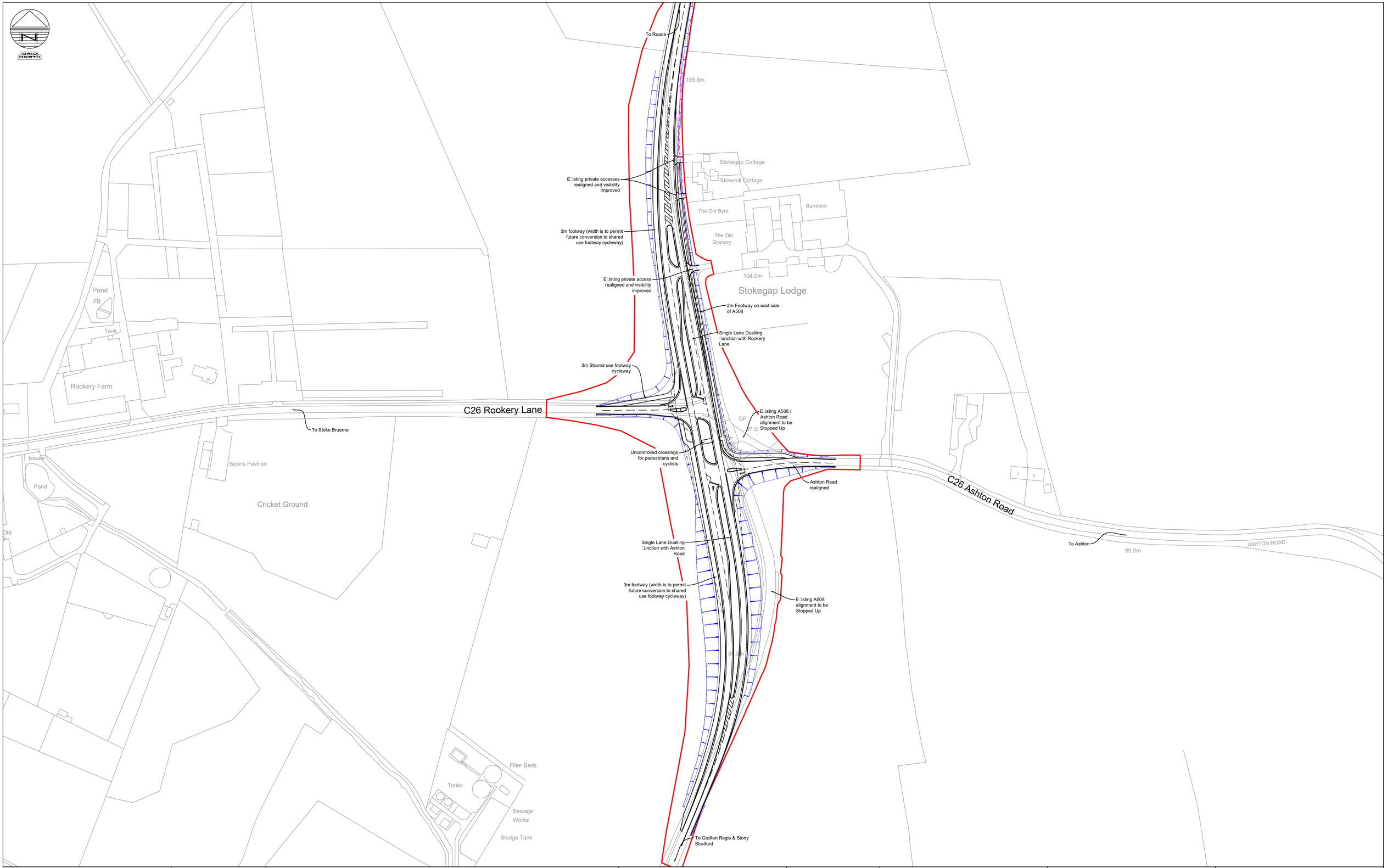
Scale□ A1: 1:1250

Drawing Status: **FOR COMMENT**

Pro□ect - Originator - Zone - Level - Type - Role - Number: **NGW-□W□-GEN-XX-S□-C-S□1□**

Status: **S□**

Rev: **P□**



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4. Any discrepancies noted on site are to be reported to the engineer immediately.

Legend

Order Limits

ISSUES & REVISIONS

Rev	Date	Details of issue / revision	Drw	Rev
P1	25.07.17	Preliminary Issue	SRH	SRH
P2	16.08.17	Order limits added	PG	PG
P3	20.10.17	Changed to single land dualling, NMU ings added	SRH	SRH
P4	26.01.18	Revised layout and extents of earthworks added	PG	SRH

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Client: ROXHILL

Project Title: **NORTHAMPTON GATEWAY RAIL FREIGHT INTERCHANGE**

Drawing Title: **A50 ROOKERY LANE ASHTON ROAD JUNCTION GENERAL ARRANGEMENT**

Drawn:	S. Hilditch	Reviewed:	S. Hilditch
BWB Ref:	NTH 2315	Date:	25.07.17

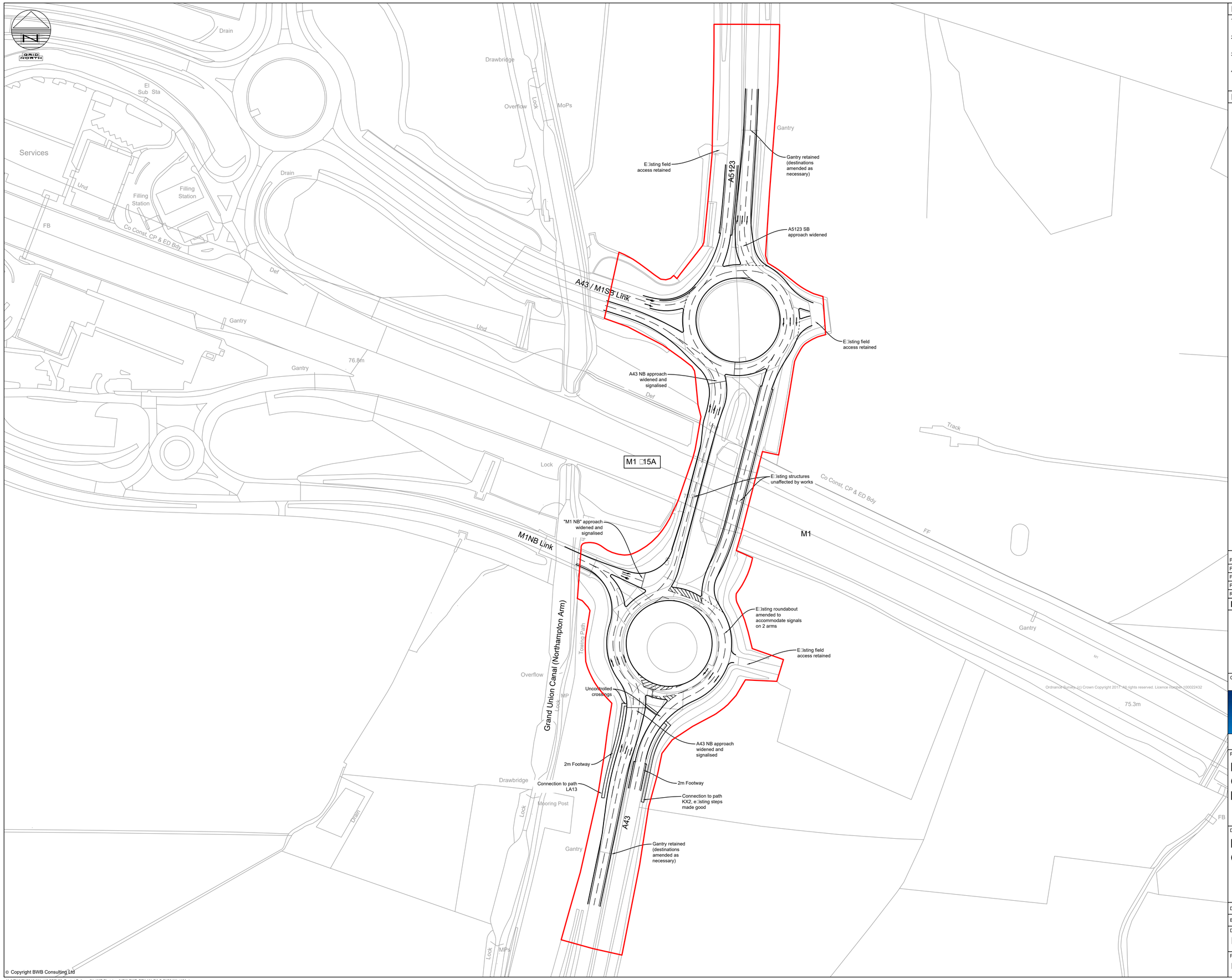
Scale: A1: 1:1250

Drawing Status: **FOR COMMENT**

Project - Originator - Zone - Level - Type - Role - Number: **NGW-BW-GEN-XX-S-C-S-1**

Status: **S**

Rev: **P4**



Notes

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4. Any discrepancies noted on site are to be reported to the engineer immediately.

Legend

Order Limits

Rev	Date	Details of issue / revision	Drw	Rev
P4	07.03.18	Southern roundabout geometry amended & footway and uncontrolled crossings added	PG	SRH
P3	21.12.17	Layout amended to reflect topographical survey	PG	SRH
P2	16.08.17	Order limits added	PG	PG
P1	26.07.17	Preliminary Issue	SRH	SRH

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Client

ROXHILL

Project Title

NORTHAMPTON GATEWAY RAIL FREIGHT INTERCHANGE

Drawing Title

M1 □15A (A4□A512□) GENERAL ARRANGEMENT

Drawn:	S. Hilditch		Reviewed:	S. Hilditch	
BWB Ref:	NTH 2315	Date:	26.07.17	Scale□ A1:	1:1250

Drawing Status

FOR COMMENT

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
NGW-□W□-GEN-XX-S□-C-S□20	S□	P4

Notes

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2. This drawing is to be read in con□unction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.

Legend

Order Limits

ISSUES & REVISIONS

Rev	Date	Details of issue / revision	Drw	Rev
P1	11.08.17	Preliminary Issue	PG	DM
P2	15.09.17	Bus stop added	PG	SRH
P3	20.10.17	Works to Woodleys Farm access shown	SRH	SRH
P4	07.11.17	Updated design geometry	SRH	SRH
P5	29.01.18	Footway e□tents and minor amendments	PG	SRH

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Client: ROXHILL

Pro□ect Title: **NORTHAMPTON GATEWAY RAIL FREIGHT INTERCHANGE**

Drawing Title: **A50□ □LISWORTH ROAD □UNCTION GENERAL ARRANGEMENT LEFT IN AND LEFT OUT**

Drawn:	P. Goodyear	Reviewed:	D. Mackrory
BWB Ref:	NTH 2315	Date:	11.08.17

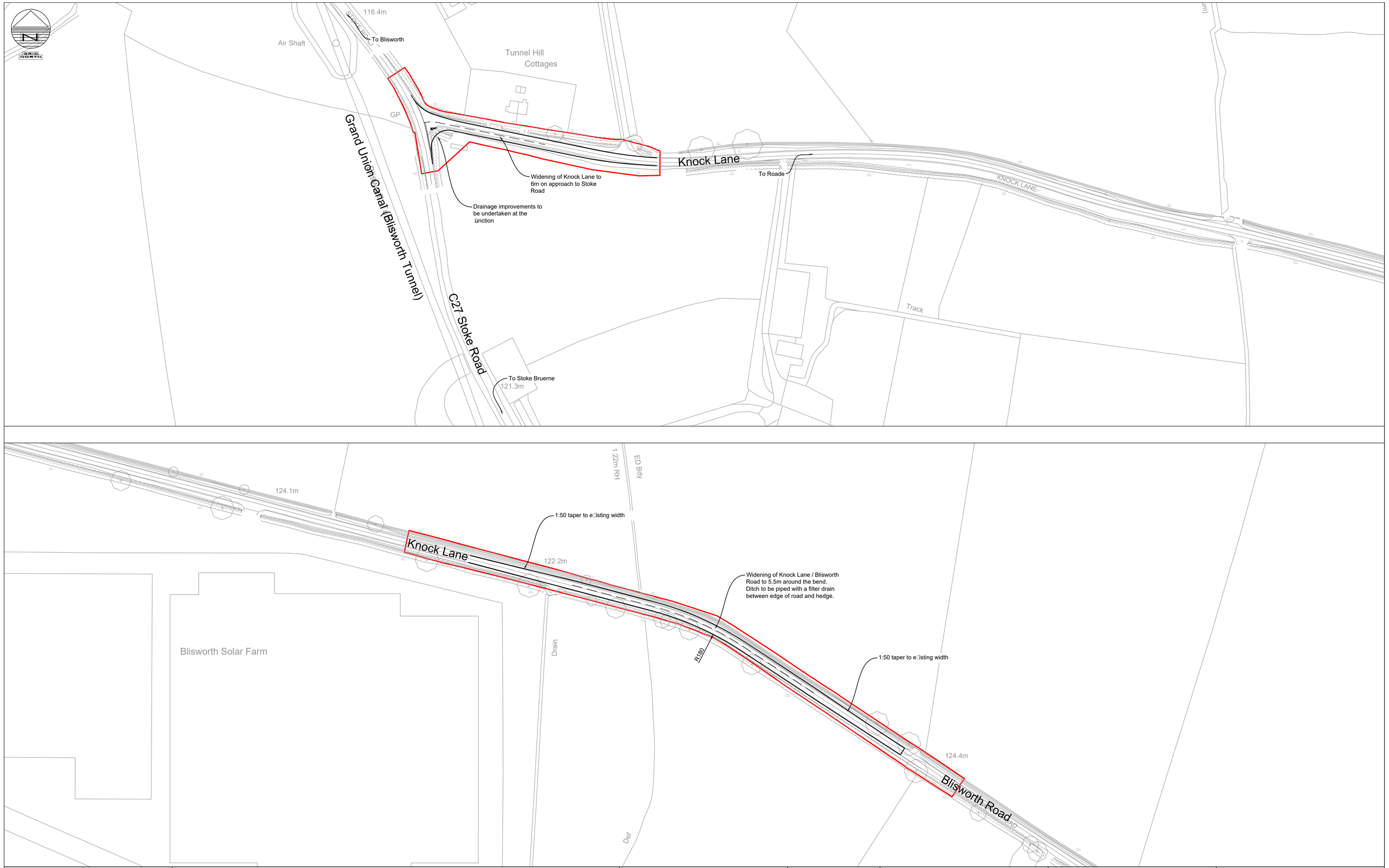
Scale□ A1: 1:1250

Drawing Status: **FOR COMMENT**

Pro□ect - Originator - Zone - Level - Type - Role - Number: **NGW-□W□-GEN-XX-S□-C-S□2□**

Status: **S□**

Rev: **P5**



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3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.

Legend

Order Limits

ISSUES & REVISIONS

Rev	Date	Details of issue / revision	Drw	Rev
P1	23.08.17	Preliminary Issue	SRH	SRH
P2	25.08.17	Proposals updated	SRH	SRH
P3	06.11.17	Proposals updated	SRH	SRH
P4	26.01.18	Proposals updated following 3d design	PG	SRH

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Client: ROXHILL

Project Title: **NORTHAMPTON GATEWAY RAIL FREIGHT INTERCHANGE**

Drawing Title: **NOC LANE LISWORTH ROAD IMPROVEMENTS GENERAL ARRANGEMENT**

Drawn:	S. Hilditch	Reviewed:	S. Hilditch
BWB Ref:	NTH 2315	Date:	23.08.17

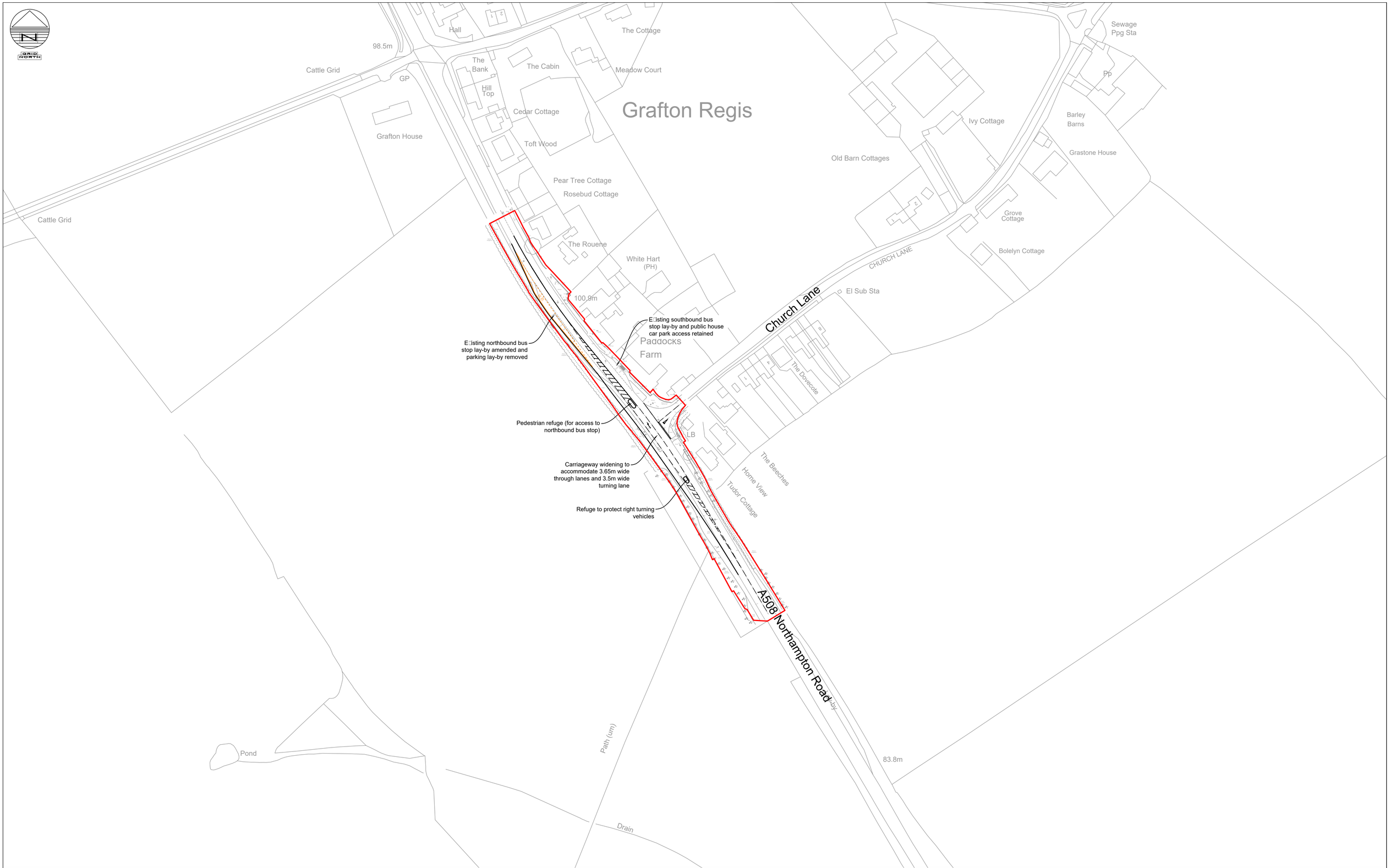
Scale: A1: 1:1000

Drawing Status: **FOR COMMENT**

Project - Originator - Zone - Level - Type - Role - Number: **NGW-WGEN-XX-SC-S2**

Status: **S**

Rev: **P4**



Notes

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3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.

Legend

Order Limits

ISSUES & REVISIONS

Rev	Date	Details of issue / revision	Drw	Rev
P1	07.09.17	Preliminary Issue	SRH	SRH
P2	26.01.18	Updated following topographical survey	PG	SRH

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Client: ROXHILL

Project Title: **NORTHAMPTON GATEWAY RAIL FREIGHT INTERCHANGE**

Drawing Title: **A50 CHURCH LANE GRAFTON REGIS GENERAL ARRANGEMENT**

Drawn:	S. Hilditch	Reviewed:	S. Hilditch		
BWB Ref:	NTH 2315	Date:	07.09.17	Scale: A1:	1:1000

Drawing Status: **FOR COMMENT**

Project - Originator - Zone - Level - Type - Role - Number: **NGW-XX-GEN-XX-S-C-S2**

Status: **S**

Rev: **P2**

APPENDIX 10

Additional Sites Drainage Schematics

APPROX

EXISTING GULLIES AND CONNECTIONS TO BE RELOCATED

EXISTING DRAINAGE DITCH TO BE RETAINED

1059M² OF EXISTING IMPERMEABLE AREA (A508 CARRIAGEWAY) TO BECOME PERMEABLE AREA DUE TO STOPPING UP WORKS

PROPOSED DITCH TO CONVEY REDIRECTED RUNOFF FROM CATCHMENT 3A. DISCHARGE TO PROPOSED ATTENUATION POND. CHECK DAMS TO CONTROL FLOW RATE DUE TO STEEP GRADIENT NORTH TO SOUTH

104.0m

EXISTING DRAINAGE DITCH TO BE RETAINED – FLOWS NORTH TO SOUTH

CATCHMENT 3A (NORTH OF ROOKERY LANE JUNCTION) – 3456M² OF NEW IMPERMEABLE AREA

ALL EXISTING GULLIES AND CONNECTIONS TO BE REMOVED DUE TO STOPPING UP WORKS

CULVERTED SECTION OF PROPOSED DRAINAGE DITCH REQUIRED TO CONVEY RUNOFF FROM DITCH TO ATTENUATION POND

PROPOSED ATTENUATION POND FOR CATCHMENT 3A. VOLUME = 105M³ DISCHARGE TO EXISTING DRAINAGE DITCH. POND LOCATED OFFLINE OF RETAINED DITCH

CATCHMENT 3B (SOUTH OF THE ROOKERY LANE JUNCTION) – 3122M² OF NEW IMPERMEABLE AREA. 1584M² TO BE OFFSET FROM STOPPING UP WORKS = 1583M² EFFECTIVE IMPERMEABLE AREA

EXISTING DRAINAGE DITCH – TO BE RETAINED

EXISTING DRAINAGE DITCH UNDER PROPOSED CARRIAGEWAY ALIGNMENT TO BE ABANDONED

PROPOSED SWALE TO CONVEY CATCHMENT 3B RUNOFF – CHECK DAMS TO CONTROL FLOW DUE TO STEEP GRADIENT. FLOWS SOUTHWARDS.

EXISTING DRAINAGE DITCH DISCHARGES TO PIPE – ASSUEMED TO FOLLOW ALIGNMENT OF EXISTING A508 CARRIAGEWAY. TO BE RETAINED

1584M² OF EXISTING IMPERMEABLE AREA (A508 CARRIAGEWAY) TO BECOME PERMEABLE AREA DUE TO STOPPING UP WORKS. CARRIAGEWAY RUNOFF CURRENTLY CAPTURED BY GULLIES WHICH DISCHARGE TO DRAINAGE DITCH

PROPOSED BASIN FEATURES WITHIN PROPOSED DRAINAGE DITCH TO PROVIDE COMBINED 195M³ OF STORAGE FOR CATCHMENT 3B. PROPOSED SWALE TO CONVEY FLOW BETWEEN PONDS

ASSUMED PIPED SECTION OF EXISTING DRAINAGE DITCH – LOCATION AND CONDITION TBC ON SITE. UPGRADING OR REINFORCEMENT WORKS MAY BE REQUIRED UNDER NEW CARRIAGEWAY CONSTRUCTION

99.0m

Cricket Ground

PROPOSED SWALE TO DISCHARGE TO EXISTING DRAINAGE DITCH

Filter Beds

Tanks

Sewage Works

EXISTING DRAINAGE DITCH

Notes

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2. This drawing is to be read in con unction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Net increase in impermeable area = 3450m²

Legend

Rev	Date	Details of issue / revision	Drw	Rev
P1	an 18	Preliminary Issue	RW	CD

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Client

ROXHILL

Project Title

NORTHAMPTON GATEWAY ADDITIONAL JUNCTIONS

Drawing Title

DRAINAGE STRATEGY - ROOKERY LANE / ASHTON ROAD (SITE 3)

Drawn:	R. WARD		Reviewed:	C. DODD	
BWB Ref:	NTH2315	Date:	05.01.18	Scale: A1:	1:1000

Drawing Status

FOR INFORMATION

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
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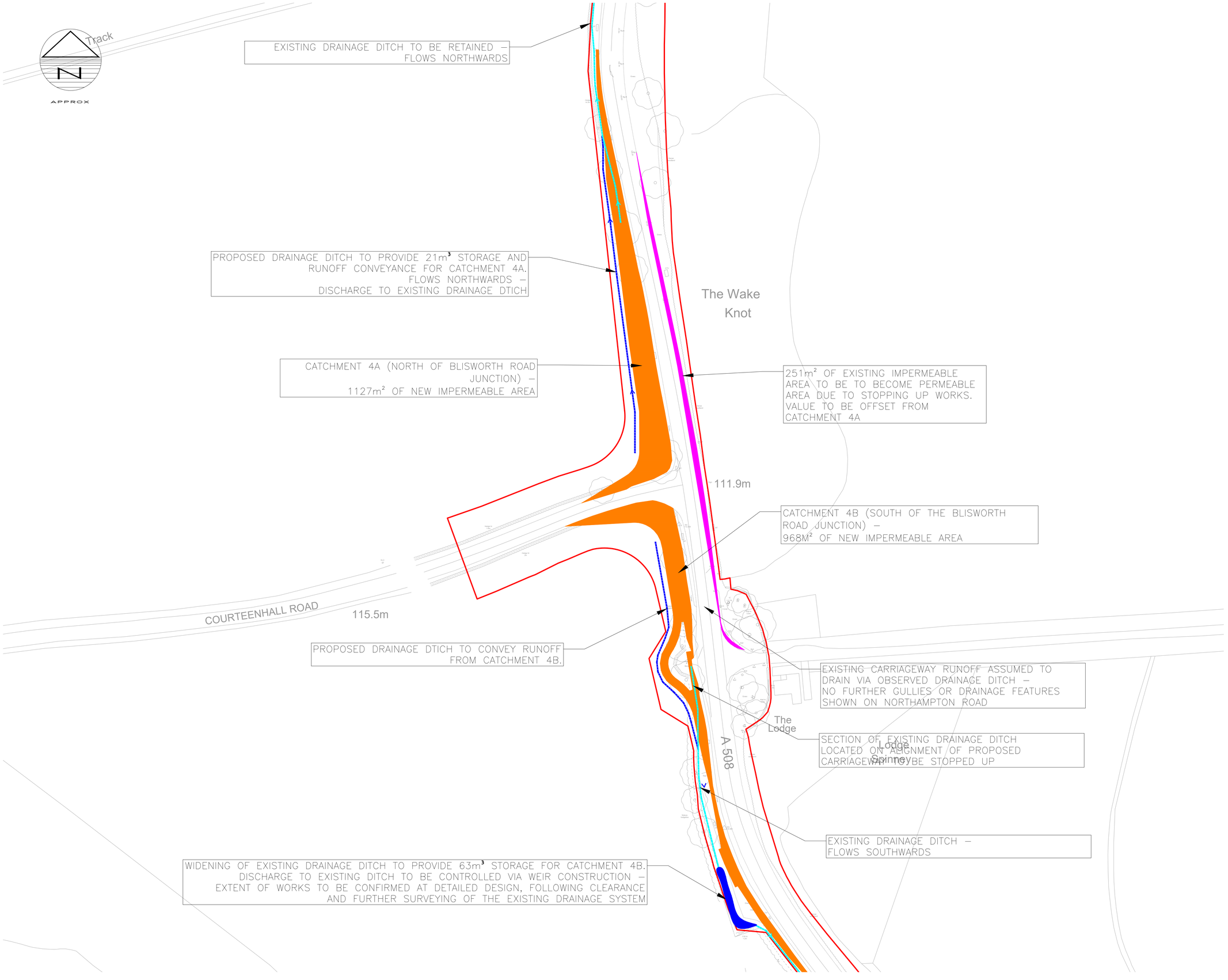

Notes

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2. This drawing is to be read in con□unction with all relevant architects, engineers and specialists drawings and specifications.
3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.
5. Net increase in impermeable area = 1844m².

Legend

Rev	Date	Details of issue / revision	Drw	Rev
P1	□an 18	Preliminary Issue	RW	CD

Issues & Revisions

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Client

ROXHILL

Pro□ect Title

NORTHAMPTON GATEWAY ADDITIONAL JUNCTIONS

Drawing Title

DRAINAGE STRATEGY - COURTEENHALL ROAD JUNCTION (SITE 4)

Drawn:	R. WARD		Reviewed:	C. DODD		
BWB Ref:	NTH2315	Date:	05.01.18	Scale□ A1:	1:750	

Drawing Status

FOR INFORMATION

Pro□ect - Originator - Zone - Level - Type - Role - Number	Status	Rev
NGW-BWB-EWE-XX-DR-PD-0004	**S2**	**P1**

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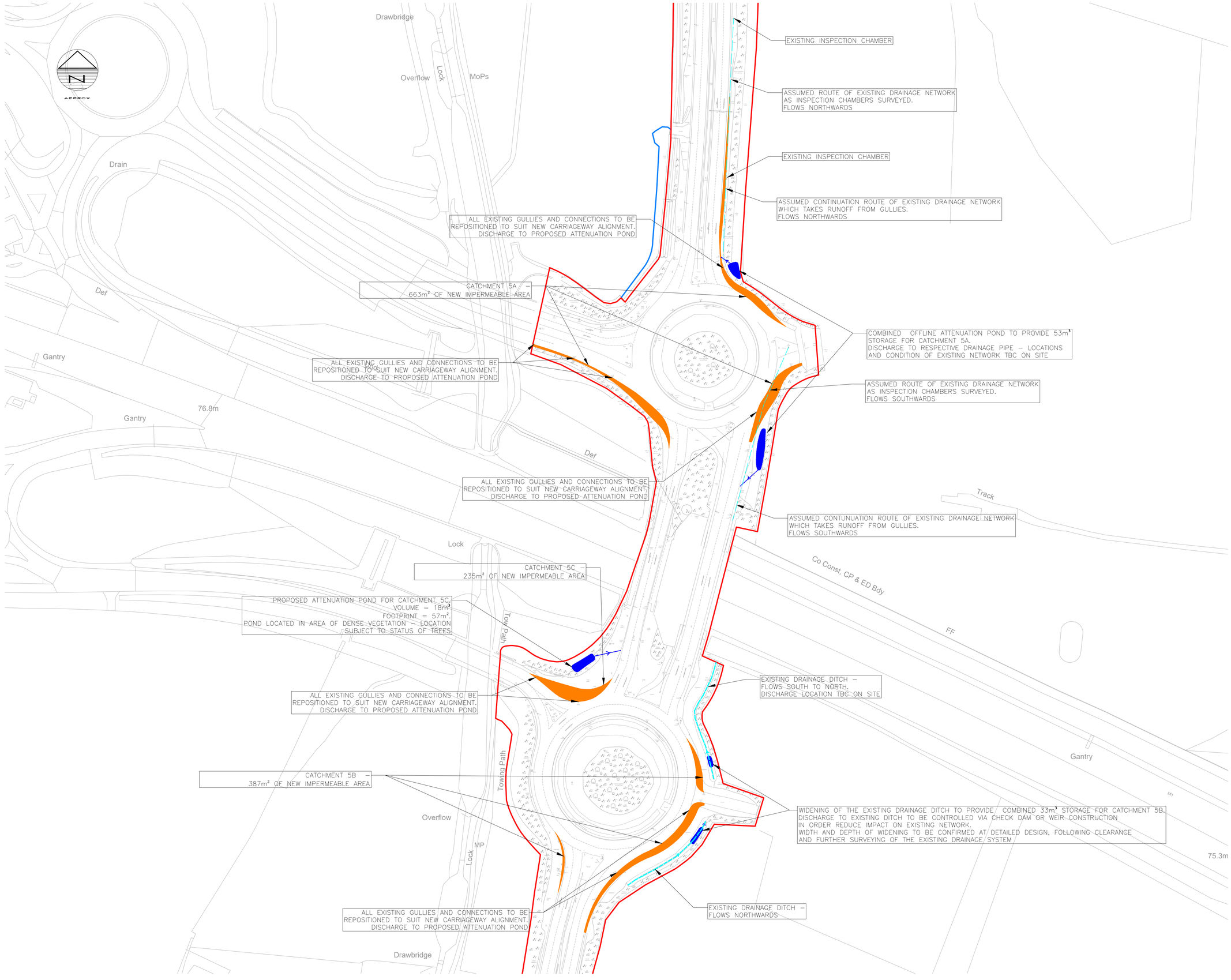

Notes

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4. Any discrepancies noted on site are to be reported to the engineer immediately.

Legend

Rev	Date	Details of issue / revision	Drw	Rev
P1	an 18	Preliminary Issue	RW	CD

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www.bwbconsulting.com

Client

ROXHILL

Project Title

NORTHAMPTON GATEWAY ADDITIONAL JUNCTIONS

Drawing Title

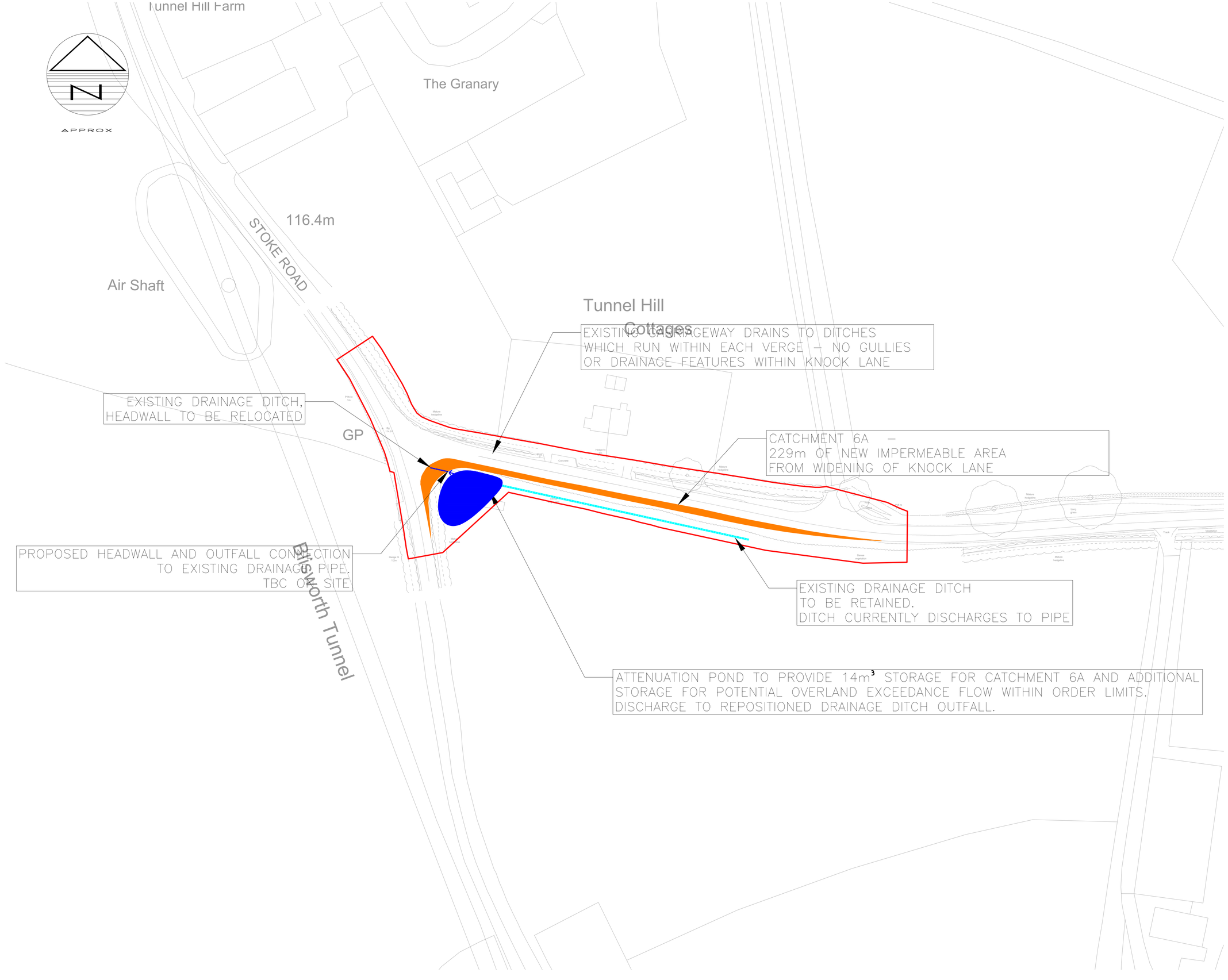
DRAINAGE STRATEGY - JUNCTION 15A (SITE 5)

Drawn:	R. WARD	Reviewed:	C. DODD
BWB Ref:	NTH2315	Date:	05.01.18	Scale: A1:	1:1000

Drawing Status

FOR INFORMATION

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
NGW-BWB-EWE-XX-DR-PD-0005	**S2**	**P1**



Notes

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Legend

Rev	Date	Details of issue / revision	Drw	Rev
P1	Jan 18	Preliminary Issue	RW	CD

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Client
ROXHILL

Project Title
NORTHAMPTON GATEWAY ADDITIONAL JUNCTIONS

Drawing Title
DRAINAGE STRATEGY - STOKE ROAD/KNOCK LANE (SITE 6)

Drawn:	R. WARD		Reviewed:	C. DODD	
BWB Ref:	NTH2315	Date:	05.01.18	Scale: A1:	1:500

Drawing Status
FOR INFORMATION

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
NGW-BWB-EWE-XX-DR-PD-0006	S2	P1

APPROX

EXISTING DRAINAGE DITCH HEADWALL TO BE RETAINED – DISCHARGE TO NORTH

WIDENING OF EXISTING DRAINAGE DITCH TO PROVIDE 18m³ STORAGE FOR CATCHMENT 7A.
DISCHARGE TO EXISTING DITCH TO BE CONTROLLED VIA CHECK DAM OR WEIR CONSTRUCTION
IN ORDER REDUCE IMPACT ON EXISTING NETWORK. WIDTH AND DEPTH OF WIDENING TO BE CONFIRMED AT DETAILED DESIGN, FOLLOWING CLEARANCE AND FURTHER SURVEYING OF THE EXISTING DRAINAGE SYSTEM

EXISTING CARRIAGEWAY DRAINED VIA GULLIES – DISCHARGE TO DRAINAGE DITCHES.

ALL EXISTING GULLY POSITIONS TO BE ADJUSTED IN ALIGNMENT WITH CARRIAGEWAY WIDENING. EXISTING CONNECTIONS AND OUTFALLS TO DRAINAGE DITCH TO BE RETAINED

EXISTING DRAINAGE DITCH TO BE RETAINED

CATCHMENT 7A – 303m² OF NEW IMPERMEABLE AREA

ASSUMED ROUTE OF EXISTING DRAINAGE DITCH OR PIPE TO BE RETAINED. UNABLE TO BE SURVEYED DUE TO DENSE VEGETATION – CONDITION TBC ON SITE

NET INCREASE IN IMPERMEABLE AREA = 426M²

ALL EXISTING GULLY POSITIONS TO BE ADJUSTED IN ALIGNMENT WITH CARRIAGEWAY WIDENING. EXISTING CONNECTIONS AND OUTFALLS TO DRAINAGE DITCH TO BE RETAINED

ASSUMED ROUTE OF EXISTING PIPED SECTION OF DRAINAGE DITCH – TO BE RETAINED

WIDENING OF EXISTING DRAINAGE DITCH TO PROVIDE 6m³ STORAGE FOR CATCHMENT 7B. DISCHARGE TO EXISTING DITCH OUTFALL TO BE CONTROLLED VIA CHECK DAM CONSTRUCTION – DETAILS TO BE SPECIFIED AT DESIGN. EXTENT OF WIDENING WORKS TO BE CONFIRMED AT DETAILED DESIGN, FOLLOWING CLEARANCE AND FURTHER SURVEYING OF THE EXISTING DRAINAGE SYSTEM

CATCHMENT 7B – 123m² OF NEW IMPERMEABLE AREA

ALL EXISTING GULLY POSITIONS TO BE ADJUSTED IN ALIGNMENT WITH CARRIAGEWAY WIDENING. EXISTING CONNECTIONS AND OUTFALLS TO DRAINAGE DITCH TO BE RETAINED

EXISTING DRAINAGE DITCH TO BE RETAINED

ASSUMED ROUTE OF EXISTING DRAINAGE DITCH – TBC ON SITE. UNABLE TO BE SURVEYED DUE TO DENSE VEGETATION

ASSUMED ROUTE OF EXISTING PIPED SECTION OF DRAINAGE DITCH – TO BE RETAINED

Def

Track

A 508

Notes

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3. All dimensions in millimetres unless noted otherwise. All levels in metres unless noted otherwise.
4. Any discrepancies noted on site are to be reported to the engineer immediately.

Legend

- NEW IMPERMEABLE AREA
- EXTENT OF WORKS TO EXISTING DRAINAGE DITCH
- PROPOSED SURFACE WATER STORAGE FEATURE
- PROPOSED DRAINAGE DITCH
- EXISTING DRAINAGE DTICH
- ASSUMED ROUTE OF EXISTING DRAINAGE DTICH OR PIPE (TBC ON SITE)

Rev	Date	Details of issue / revision	Drw	Rev
P1	an 18	Preliminary Issue	RW	CD

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Client

ROXHILL

Pro ect Title

NORTHAMPTON GATEWAY ADDITIONAL JUNCTIONS

Drawing Title

DRAINAGE STRATEGY - PURY ROAD (SITE 7)

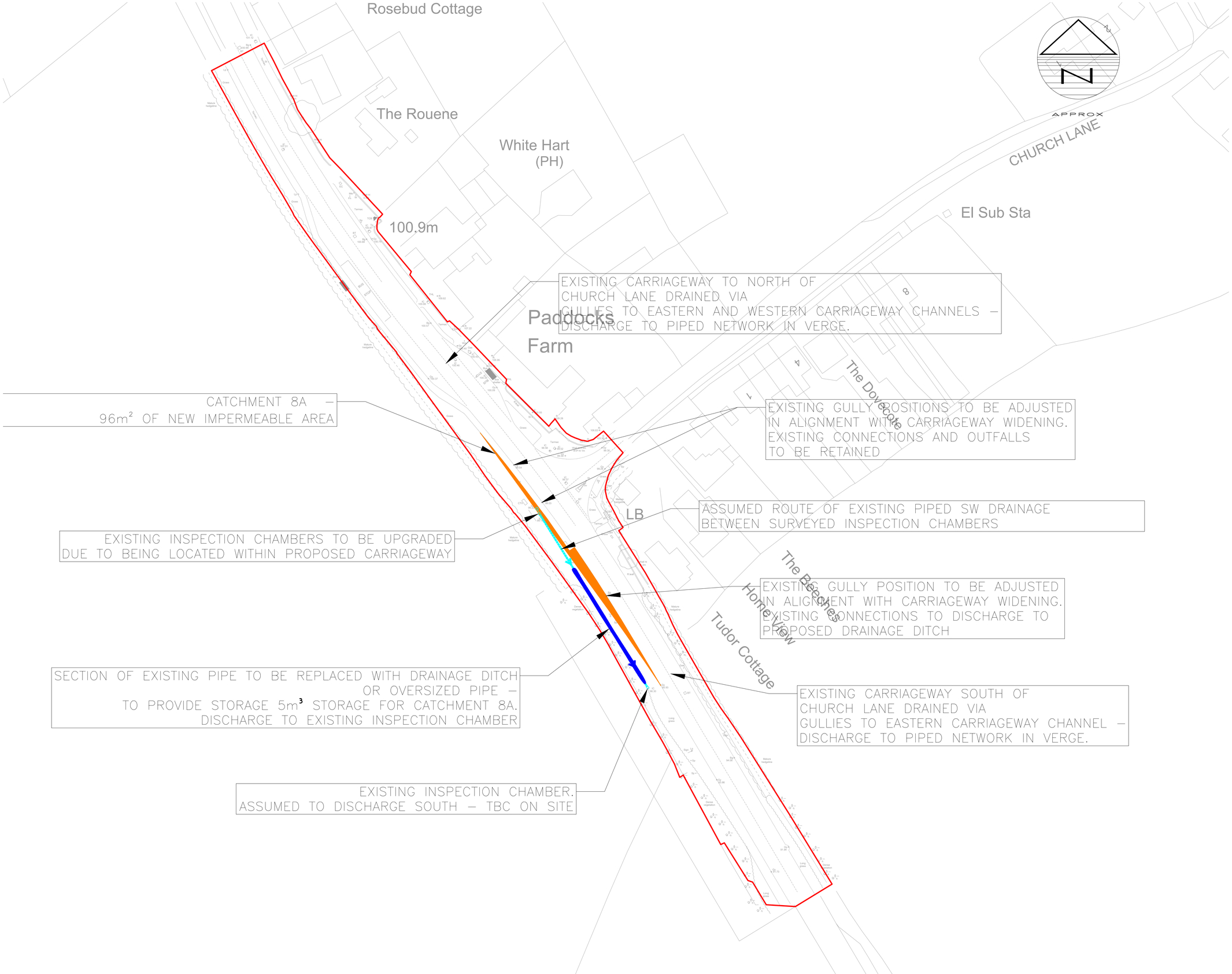
Drawn:	R. WARD		Reviewed:	C. DODD	
BWB Ref:	NTH2315	Date:	05.01.18	Scale: A1:	1:500

Drawing Status

FOR INFORMATION

Pro ect - Originator - Zone - Level - Type - Role - Number	Status	Rev
NGW-BWB-EWE-XX-DR-PD-0007	**S2**	**P1**

Y:\NTH\NTH2315\M1 15 SRF\1.02. Pro ect Delivery\01. WIP Drawings\Water\NGW-BWB-HDG-XX-DR-PD-0010 Additional unctions Drainage Strategy.dwg



Notes

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Legend

Rev	Date	Details of issue / revision	Drw	Rev
P1	an 18	Preliminary Issue	RW	CD

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Client

ROXHILL

Pro ect Title

NORTHAMPTON GATEWAY ADDITIONAL JUNCTIONS

Drawing Title

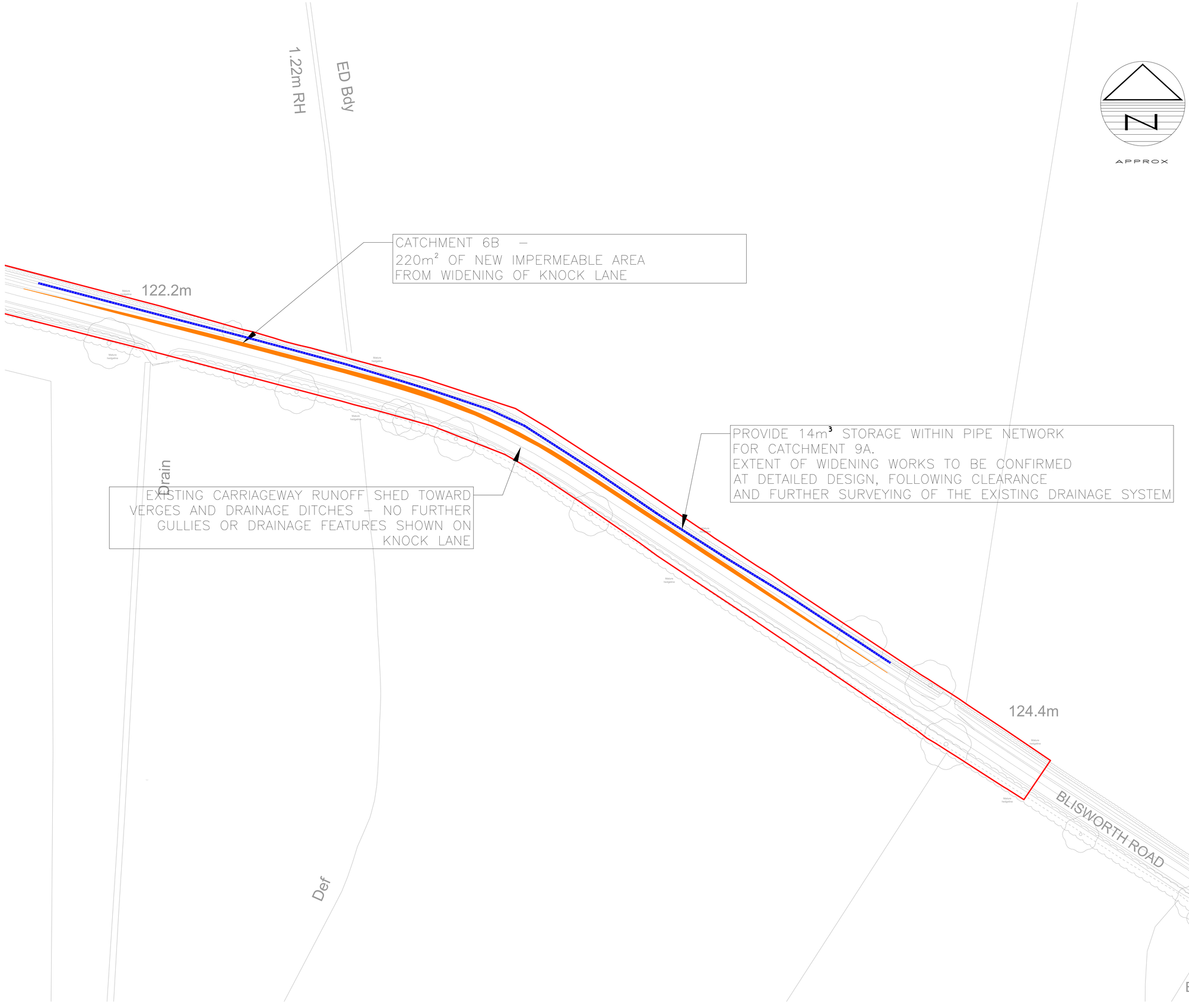
DRAINAGE STRATEGY - A508 GRAFTON REGIS (SITE 8)

Drawn:	R. WARD		Reviewed:	C. DODD	
BWB Ref:	NTH2315	Date:	05.01.18	Scale: A1:	1:500

Drawing Status

FOR INFORMATION

Pro ect - Originator - Zone - Level - Type - Role - Number	Status	Rev
NGW-BWB-EWE-XX-DR-PD-0008	**S2**	**P1**



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Legend

Rev	Date	Details of issue / revision	Drw	Rev
P1	an 18	Preliminary Issue	RW	CD

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Client
ROXHILL

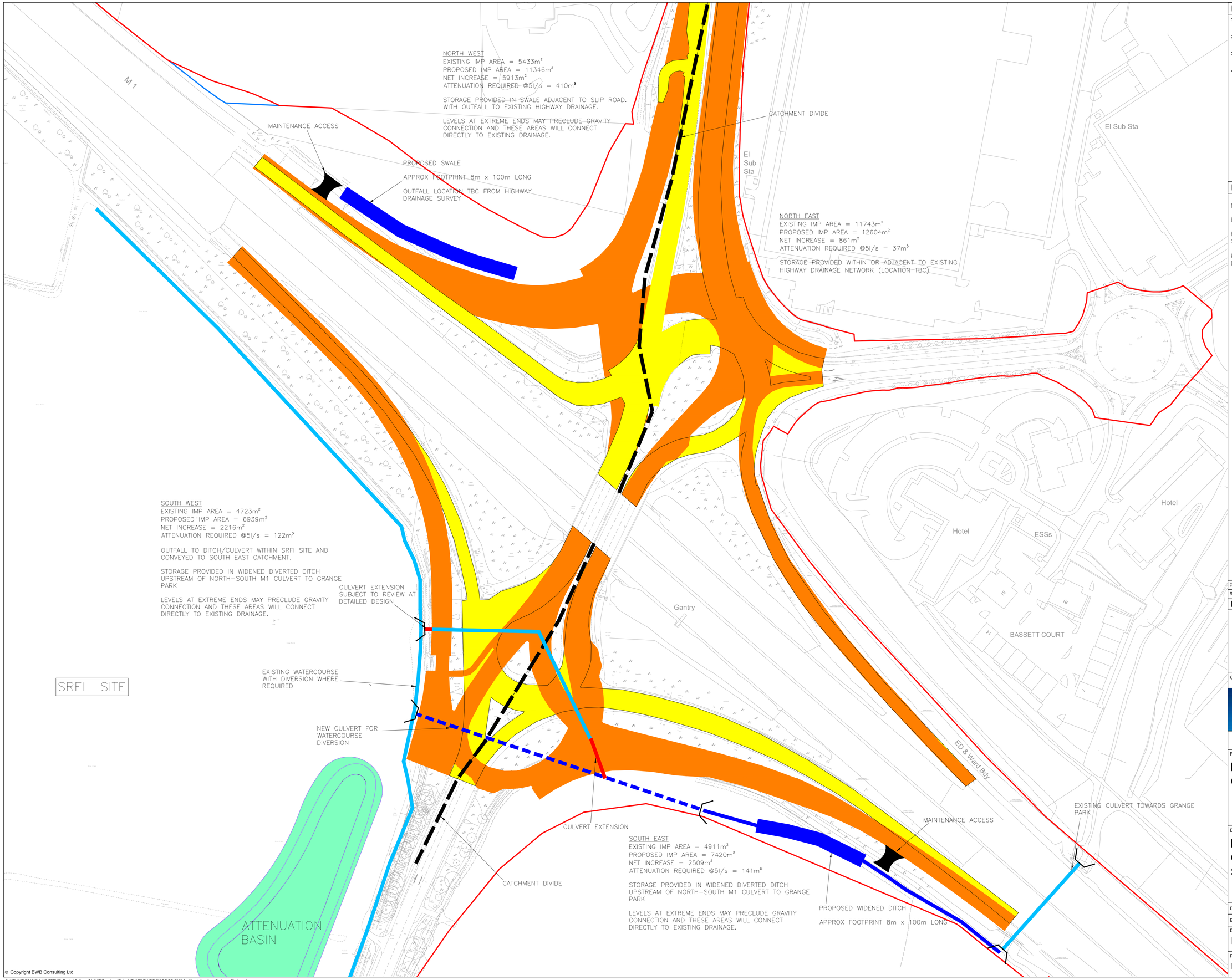
Project Title
NORTHAMPTON GATEWAY ADDITIONAL JUNCTIONS

Drawing Title
DRAINAGE STRATEGY - KNOCK LANE (SITE 9)

Drawn:	R. WARD	Reviewed:	C. DODD
BWB Ref:	NTH2315	Date:	05.01.18
Scale: A1:	1:500		

Drawing Status
FOR INFORMATION

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
NGW-BWB-EWE-XX-DR-PD-0009	**S2**	**P1**



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Legend

- NEW IMPERMEABLE AREA
- EXISTING IMPERMEABLE AREA
- PROPOSED SURFACE WATER STORAGE FEATURE
- PROPOSED/REALIGNED DRAINAGE DITCH

Rev	Date	Details of issue / revision	Drw	Rev
P1	01.03.18	Preliminary Issue	CMD	SRH

Issues & Revisions

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Client: ROXHILL

Project Title
NORTHAMPTON GATEWAY SRFI

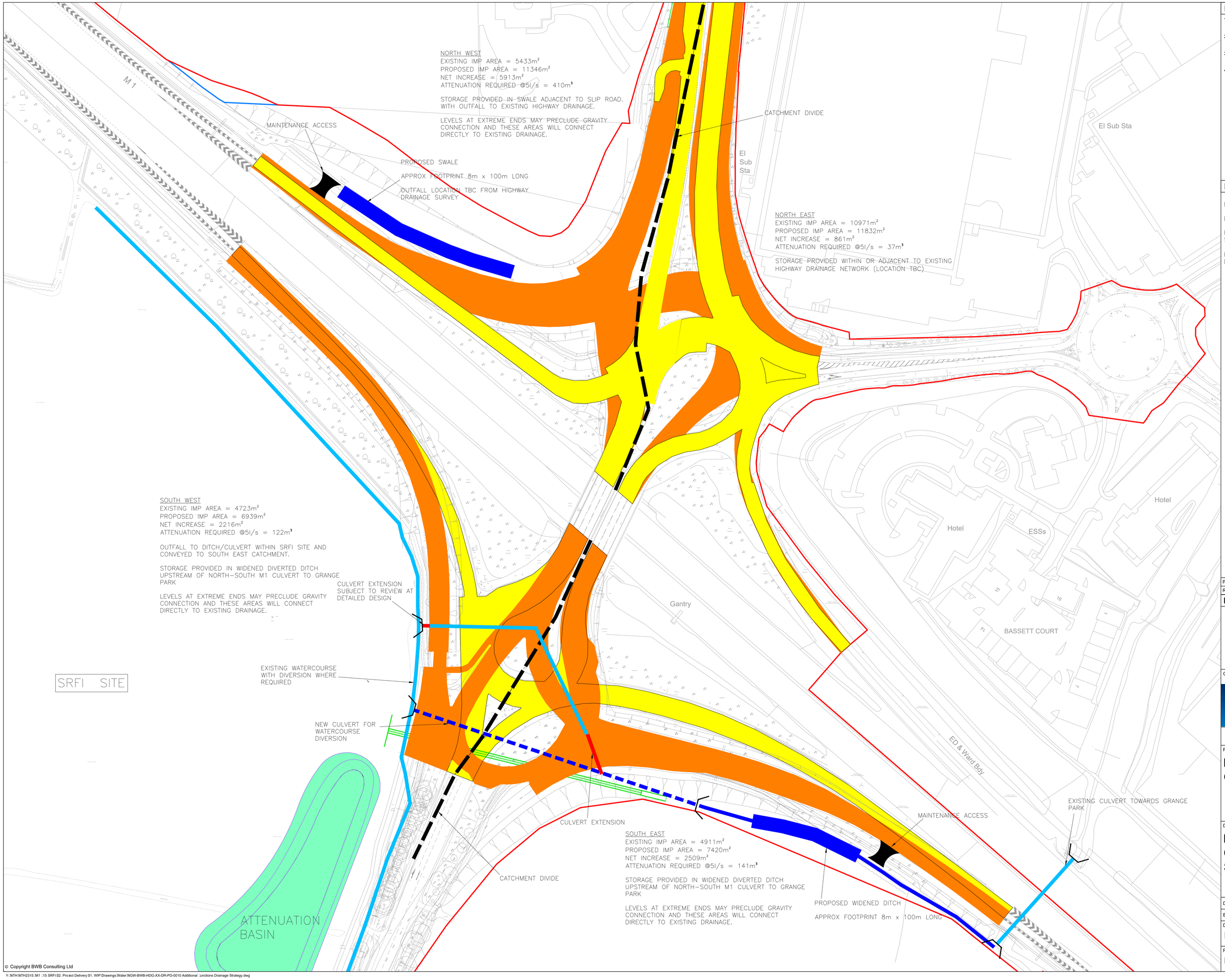
Drawing Title
M1 J15 OUTLINE DRAINAGE STRATEGY

Drawn:	C. DODD	Reviewed:	S. HILDITCH
BWB Ref:	NTH2315	Date:	01.03.18
Scale: A1:	1:500		

Drawing Status: **FOR INFORMATION**

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
NGW-BWB-EWE-XX-DR-PD-0010	S2	P1

Y:\NTH\NTH2315\M1 J15 SRFI\02. Project Delivery\01. WIP Drawings\Water\NGW-BWB-HDG-XX-DR-PD-0010 Additional Junctions Drainage Strategy.dwg



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Legend

- NEW IMPERMEABLE AREA
- EXISTING IMPERMEABLE AREA
- PROPOSED SURFACE WATER STORAGE FEATURE
- PROPOSED/REALIGNED DRAINAGE DITCH

Rev	Date	Details of issue / revision	Drw	Rev
P1	01.03.18	Preliminary Issue	CMD	SRH

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Client

ROXHILL

Project Title

NORTHAMPTON GATEWAY SRFI

Drawing Title

M1 J15 OUTLINE DRAINAGE STRATEGY

Drawn:	C. DODD	Reviewed:	S. HILDITCH
BWB Ref:	NTH2315	Date: 01.03.18	Scale☐ A1: 1:500

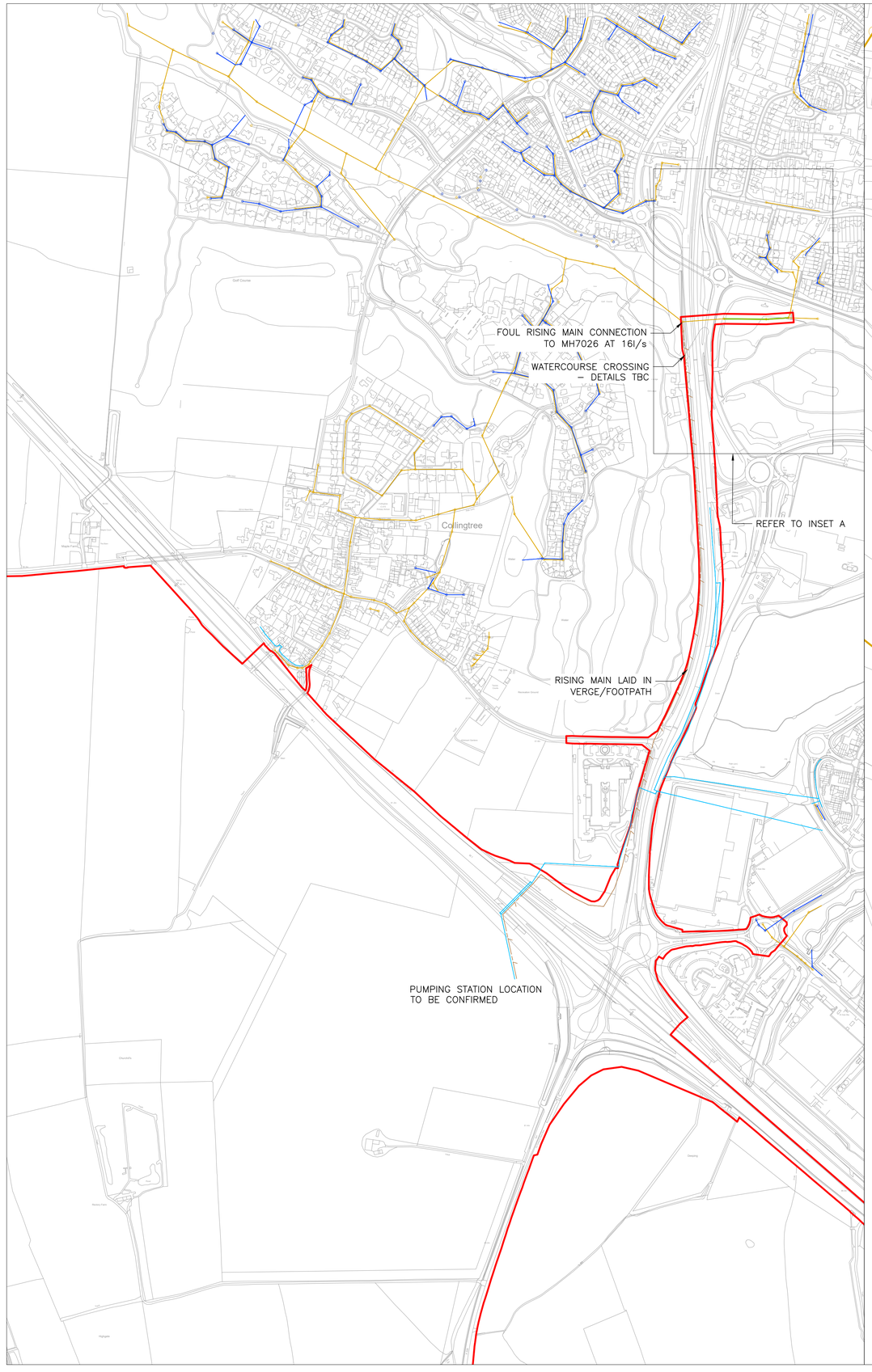
Drawing Status

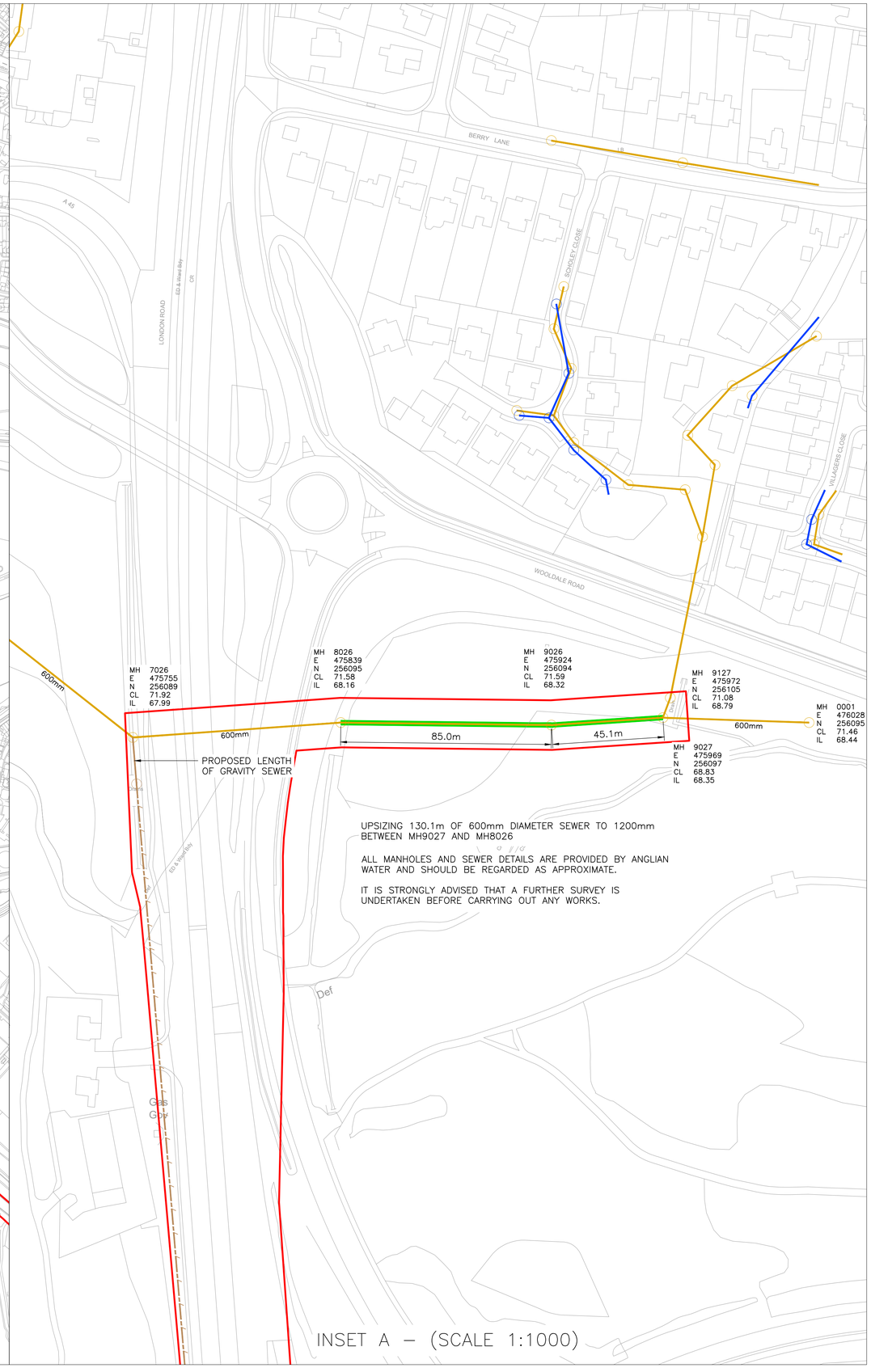
FOR INFORMATION

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
NGW-BWB-EWE-XX-DR-PD-0010	S2	P1

APPENDIX 11

Main Site Foul Water Strategy





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5. Sewer update works based on recommendations from Anglian Water 'Addendum to pre-planning report dated 4 th October 2016' Report date 9/03/17.

Key

- Proposed Foul Rising Main
- Proposed Foul Gravity Sewer
- Existing Foul Sewer
- Proposed Sewer Upsizing
- Existing Water Main
- Existing Surface Water Sewer
- Existing Foul Manhole
- Existing Surface Water Manhole
- Order Limits

Rev	Date	Details of issue / revision	Drw	Rev
P1	17.07.17	Preliminary Issue	SV	CD

Issues & Revisions

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Client

ROXHILL

Project Title

NORTHAMPTON GATEWAY RAIL FREIGHT INTERCHANGE

Drawing Title

FOUL RISING MAIN ROUTE AND SEWER UPSIZING

Drawn:	S. Vlatov	Reviewed:	C. Dodd	
BWB Ref:	NTH 2315	Date:	17.07.17	Scale: A1: 1:5000

Drawing Status

PRELIMINARY

Project - Originator - Zone - Level - Type - Role - Number	Status	Rev
NGW-BWB-GEN-XX-SK-C-SK13	S2	P1

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