# The Sizewell C Project

## 9.99 Comments on Earlier Deadlines and Subsequent Written Submissions to CAH1 and ISH8-ISH10 - Appendices Part 1 of 2

Revision: 1.0

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Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

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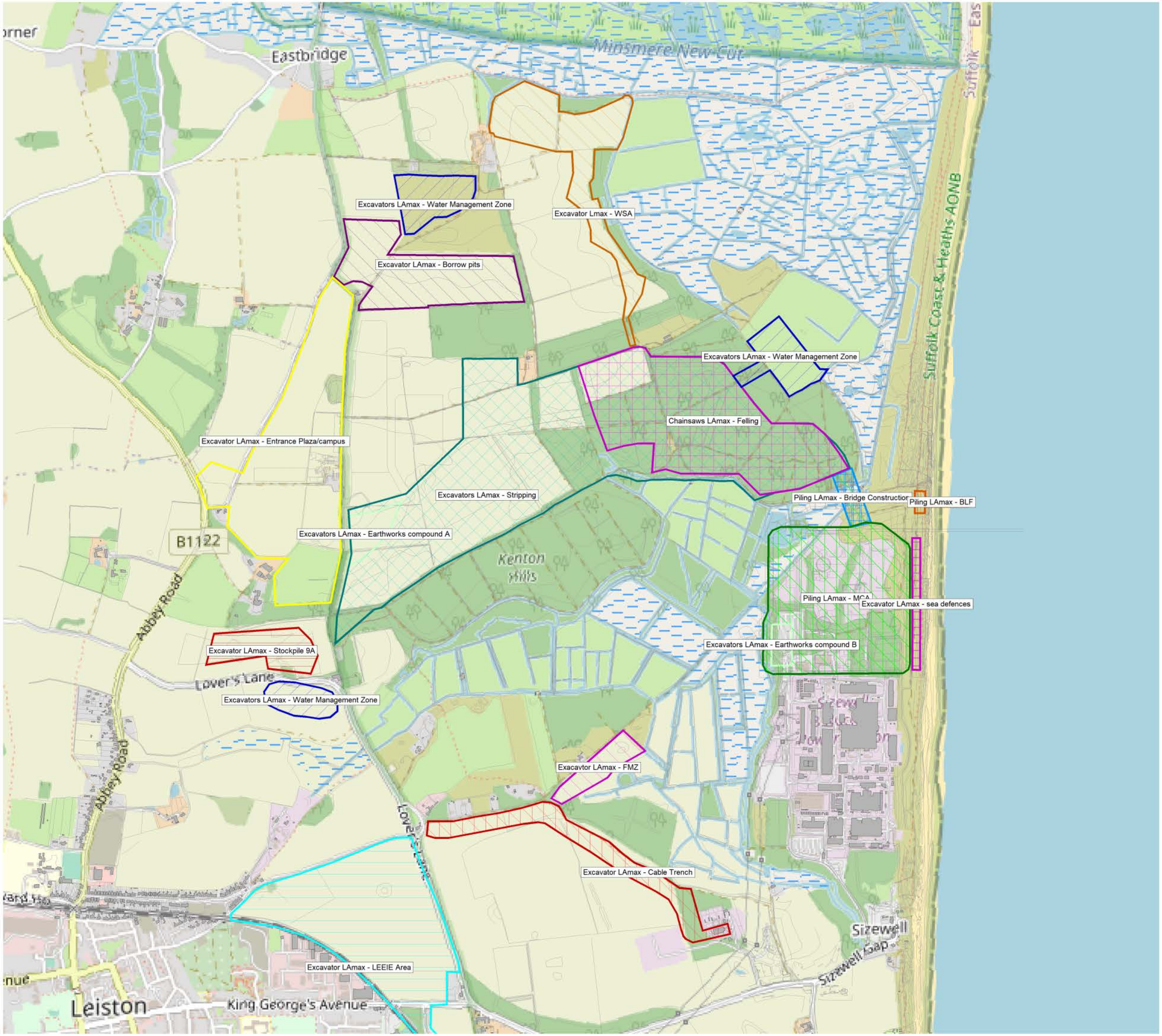
# APPENDICES

## Part 1 of 2



## Part 2 of 2

# APPENDIX A: BATS – EXPLANATION OF NOISE MODELLING




# Sizewell Construction Noise Phase 1 Lmax sources (22KHz)

## Activity Areas

- Excavators stripping LEEIE
- Chainsaws - Tree Felling
- Piling MCA
- Excavators WSA
- Excavators WMZ's
- Excavators Cable Trench
- Excavators Plaza/Campus
- Excavators Borrow PIts
- Piling BLF
- Excavators Sea Defences
- Excavators Stockpiling area
- Excavators Compounds
- Excavators Stripping TCA
- Excavators FMZ
- Bridge Piling SSSI Crossing

## Notes:

Excavator noise levels at 22KHz from individual Lmax events of around 60dB at 10m from source

Piling activity noise levels at 22KHz of around 60 to 85dB at 10m from the source location depending upon method.

Tree felling noise level from chainsaw activity at 22KHz of 25dB at 10m from source

All modelled as an array of point sources covering area where activity may occur

Plant cannot be located at all locations at the same time

Scale 1:20000

0 100 200 400 600 800 1000

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# Sizewell Construction Noise
# Phase 2
# Lmax sources (22KHz)

**Activity Areas**

- Excavators Stockpile area
- Piling MCA
- Excavators Cable Trench
- Excavators Plaza/Campus
- Excavators Borrow PIts
- Excavators Stockpiling area
- Excavators Stripping TCA
- ADT Haul Road & Loco Lmax
- Container 'bumping' Railhead

Notes:

Excavator noise levels at 22KHz from individual Lmax events of around 60dB at 10m from source

Container 'bumping' during railhead operation Lmax noise levels at 22KHz of around 50dB at 10m from the source

ADT movements along Haul Road Lmax noise levels at 22KHz of around 50dB at 10m from source

Locomotive movements under full power Lmax noise levels at 22KHz of around 75 at 10m from source.

Piling activity Noise levels at 22KHz of around 60 to 85dB at 10m from the source location depending upon method

All modelled as an array of point sources covering area where activity may occur with exception of ADT's on Haul Road and Locomotive modelled as moving point sources along defined route

Plant cannot be located in all locations at the same time

Scale 1:20000

0 100 200 400 600 800 1000

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# Sizewell Construction Noise
Phase 3
Lmax sources (22KHz)

Activity Areas

- Excavators Stockpile area
- Excavators MCA
- Tractor/Bowser Borrow PIt
- Excavators Stockpiling area
- ADT Haul Road & Loco Lmax
- Contractor Compound Lmax
- Container 'bumping' Railhead

Notes:

Excavator noise levels at 22KHz from individual Lmax events of around 60dB at 10m from the source

Container 'bumping' during railhead operation Lmax noise levels at 22KHz of around 50dB at 10m from the source

ADT movements along Haul Road Lmax noise levels at 22KHz of around 50dB at 10m from source

Locomotive movements under full power Lmax noise levels at 22KHz of around 75 at 10m from source.

Contractor Compounds Lmax noise events at 22KHz of around 50dB at 10m from individual sources

All modelled as an array of point sources covering area where activity may occur with exception of ADT's on Haul Road and Locomotive modelled as moving point sources along defined route

Plant cannot be located at all locations at the same time

Scale 1:20000

0 100 200 400 600 800 1000

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# APPENDIX B: FIGURE OF PROPOSED ADDITIONAL HABITAT IMPROVEMENT AND CREATION FOR BATS




KEY

- MAIN DEVELOPMENT SITE BOUNDARY
- DEMARCATION LINE
- NEW PLANTING AND RIDE CREATION

NOT PROTECTIVELY MARKED



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DOCUMENT:
PROPOSED ADDITIONAL HABITAT IMPROVEMENT AND CREATION FOR BATS

DRAWING TITLE:
PROPOSED ADDITIONAL HABITAT IMPROVEMENT AND CREATION FOR BATS

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# APPENDIX C: MAIN DEVELOPMENT SITE WATER MANAGEMENT ZONE SUMMARY

# CONTENTS



# TABLES

## FIGURES



## ANNEXES

# 1 INTRODUCTION

1.1.1 This document has been prepared to provide further background to the surface water management proposals for Sizewell C (SZC) nuclear power station basic design. The surface water proposals prioritise Sustainable Drainage Systems (SuDS) which are incorporated across the site in the forms of swales, infiltration trenches, permeable pavements and infiltration basins. These have been provisioned for early in the project. This document provides an overview about the Main Development Site water management zone (WMZ) infiltration basins, identifying design parameters and providing assurance that there is adequate storage on site for various storm events throughout the power station construction duration. Infiltration basins are proposed across the site in the Temporary Construction Area (TCA), Ancillary Construction Area (ACA), and the Green Rail route. The ACA is also known as the Land East of Eastlands Industrial Estate (LEEIE). In this document this will be referred to as the ACA.

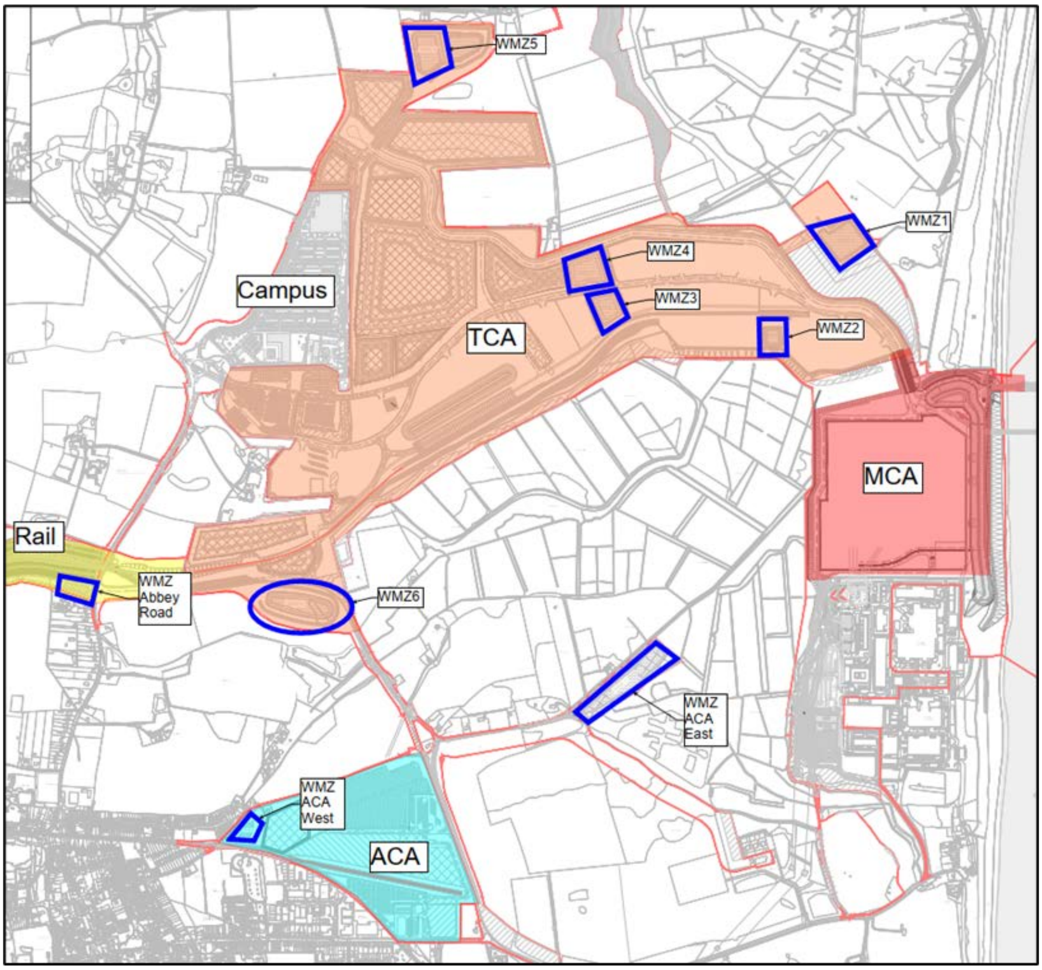
1.1.2 This note provides details of the WMZ infiltration basins for the established site. Temporary surface water control measures such as temporary sediment ponds will be required in areas prior to some of the WMZ infiltration basins are installed. The locations of the temporary surface water controls measures are to comply with the Code of Construction Practice (CoCP) and will be detailed alongside the construction sequencing with the Contractor.

1.1.3 The information presented in this report is in accordance with the overarching drainage principles that are documented in the Drainage Strategy [REP7-017] and subsequent revised Drainage Strategy submitted at Deadline 8.

## 1.2 Background

1.2.1 The extent of the SZC Main Development Site (MDS) is set by the red line boundary shown in the Construction Site Plot Plan (CSPP). This incorporates the ACA, TCA, Main Construction Area (MCA), and Railway to the west. These areas are approximately outlined in Figure 1-1. Surface water drainage infrastructure will be required for all areas within the red line boundary and to ensure no surface water, other than at controlled greenfield runoff rates, will runoff the site up to a 1:100 year storm including climate change.

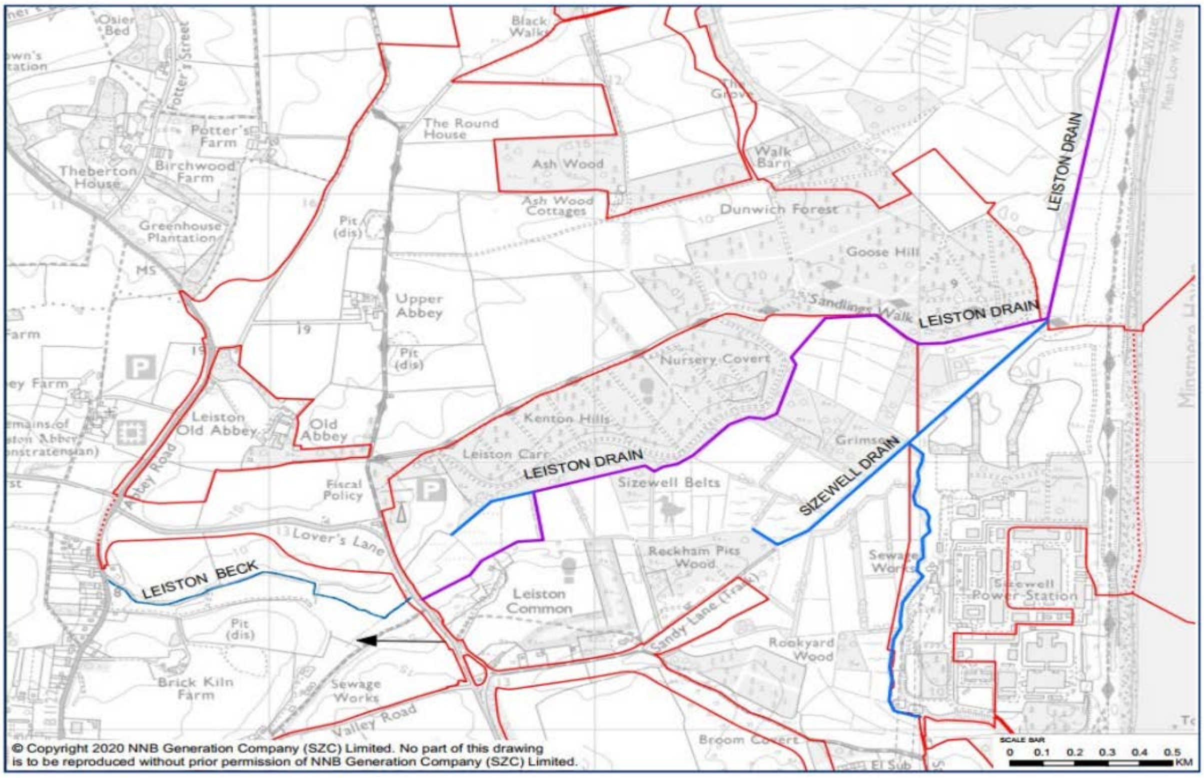
**Figure 1-1 - Site plot plan with construction areas**




## 1.2.2 Existing Site

1.2.3 The existing site is largely grassland across the TCA and the ACA. The MCA is also grassland with some ancillary Sizewell B buildings. The land to the south of the TCA is a Site of Special Scientific Interest (SSSI), which contains multiple watercourses, including two formal watercourses: the Leiston Drain and the Sizewell Drain. Surface water on the existing site currently infiltrates to ground and/or enters local watercourses which include the Leiston and Sizewell Drains and other minor tributaries – see Figure 1-2.

## Figure 1-2 - Existing Surface Water Drains




1.2.4 **Main Development Site Water Management Zones**

1.2.5 The surface water drainage design is required to capture all surface water runoff from within the red line boundary, as defined in the Drainage Strategy [REP7-017] and subsequent revised Drainage Strategy submitted at Deadline 8. To ensure that the construction site mimics the existing site surface water management, the runoff will be discharged through infiltration to ground where possible with some outfalls to existing watercourses or to the sea where necessary.

1.2.6 To manage the runoff across the MDS, catchments were identified across the TCA, ACA, MCA and Railway area. The following catchments were defined in the Outline Drainage Strategy:

- TCA – Catchments 1 to 6,
- ACA – Catchment ACA,
- MCA – Catchments 7 to 9,
- Railway

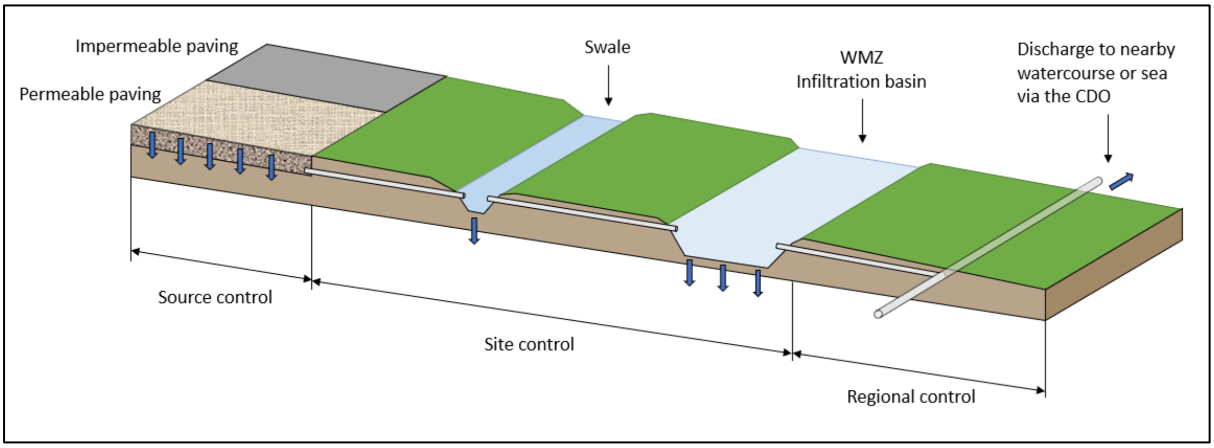
1.2.7 The surface water runoff within each catchment is proposed to infiltrate either directly through a permeable surface, or via a Sustainable Drainage System (SuDS) which will include:

- Swales;
- Infiltrations trenches; and,
- Infiltration basins (Water Management Zones).

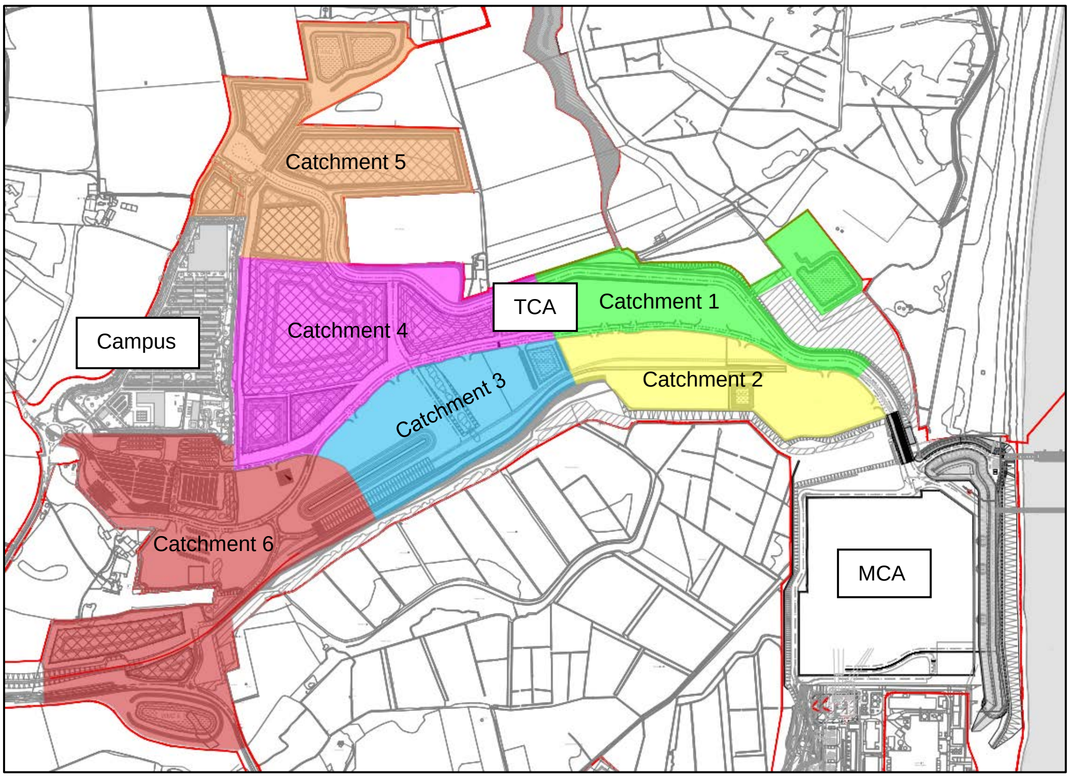
1.2.8 Where suitable, the surfaces of the catchments are proposed to be permeable, so surface water will infiltrate to ground in the first instance. Any runoff that does not infiltrate directly will be captured through swales that border each catchment. The swales provide local source control to ensure the management of water returning to the ground to mimic the existing condition. The swales contain an infiltration trench beneath them which will encourage further infiltration, as well as provide additional storage. Any water that does not infiltrate through the infiltration trench into the surrounding ground will be captured by a perforated pipe within the trench, which will convey the flow to a Water Management Zone (WMZ) infiltration basin. This concept is shown in Figure 1-3 below. More frequent storm events will not need to overflow into the WMZ infiltration basins and surface water will be primarily discharged through infiltration at source. In less frequent storm events, the WMZ infiltration basins will be used to attenuate and infiltrate surface water and as such have been sized so they have capacity for a 1:100-year storm event including climate change.

1.2.9 Infiltration basins in catchments 1, 2, 3, and 6 have an outlet to nearby watercourses, restricted to greenfield runoff rates, and to be agreed with external stakeholders Suffolk County Council (SCC), Environment Agency (EA) and/or Internal Drainage Board (IDB) where applicable. As an additional backup measure, the WMZ infiltration basins for catchments 1-4 have an allowance for an overflow into a conventional drainage system (spine network) discharging to the combined drainage outfall (CDO) which discharges to the sea. Hydraulic modelling shows this network is not required; this spine network has only been included at this stage as a precaution.

### Figure 1-3 - Surface water runoff capture and discharge process




### Figure 1-4 - TCA Enabling Works surface water drainage catchments




## 1.3 Scope

1.3.1 This document provides a summary of infiltration basins that are required to manage surface water runoff during the enabling works, in line with the Enabling Works surface water drainage strategy. The document presents the hydraulic assessment of the WMZs across the TCA, ACA and Railway area. Supporting Source Control Calculations are provided in Annex D.

1.3.2 This document does not address the design of other minor SuDS features such as swales, infiltration trenches, and permeable paving. These features will be further detailed in future proposals, in conjunction with Contractor involvement.

# 2 DESIGN REQUIREMENTS

2.1.1 In accordance with the Drainage Strategy [REP7-017] and subsequent revised Drainage Strategy submitted at Deadline 8, all infiltration basins within the MDS are designed to cater for a 100-year flood event plus a 20% allowance for climate change. This section summarises the design parameters used in the hydraulic assessment to determine the size of the WMZ infiltration basins. The volume assessment was conducted using MicroDrainage Source Control using the parameters and assumptions in the following sections. By sizing the infiltration basins using Source Control and not considering additional storage in the upstream network, the storage volumes calculated are conservative and will be able to be reduced in the next design phase.

## 2.2 General Parameters

2.2.1 The parameters in Table 2-1 were used to determine approximate storage volumes required for critical storm events for 100-year return period for a storm duration of up to 24 hours, including a 20% allowance for climate change in accordance with the Drainage Strategy [REP7-017] and subsequent revised Drainage Strategy submitted at Deadline 8.

**Table 2-1 - Input parameters for MicroDrainage Source Control storage volumes**

| | Parameter | Notes |
|---|---|---|
| **Rainfall-Runoff method** | Flood Studies Report (FSR), Flood Estimation Handbook (FEH) 1999 and 2013 | Sensitivity check using FEH 1999 and 2013 |
| **Return Period (years)** | 100 | As per DCO Outline Drainage Strategy [1] |
| **Storm duration (minutes)** | 15 – 1440 | As per DCO Outline Drainage Strategy [1] |
| **Climate Change (%)** | 20 | As per DCO Outline Drainage Strategy [1] and EA guidance [2] |
| **Volumetric Runoff Coefficient** | Varies per catchment | Wallingford Procedure Vol 1 Equation 7.3 |
| **Freeboard (mm)** | 300 | CIRIA C753 – The SuDS Manual |
| **Factor of Safety** | 1.5 | [3] |

[1] Environmental Statement – 6.3 Volume 2 Main Development Site, Chapter 2 Description of the Permanent Development, Appendix 2A Outline Drainage Strategy (EN010012-001802-SZC_Bk6_ES_V2_Ch2_Appx2A)

[2] Environment Agency – Flood risk assessment: climate change allowances - Table 2: peak rainfall intensity allowance in small catchments (less than 5 $km^2$) or urban drainage catchments (based on a 1961 to 1990 baseline)

[3] Table 25.2 in the CIRIA SuDS manual provides guidance on which Factor of Safety (FoS) to use given a range of areas and consequences of failure. Given this area is a temporary construction site for 10 years with infiltration basins designed for a 1:100 year return period, assuming only infiltration through the sides of the basin, and the selected infiltration rates are the worst case rates from a series of GI campaigns, it is proposed to use a FoS of 1.5 as opposed to 5 or 10. Use of a FoS of 5 or 10 would require even greater oversized infiltration basins which is not deemed necessary, especially where the basins have an overflow to the spine network.

2.2.2 All three rainfall-runoff methods were used to undertake sensitivity checks on the design volumes. It was noted that the FEH 2013 rainfall-runoff method generally provided more conservative values for greater return periods in comparison to FEH 1999 and FSR.

2.2.3 As the Sizewell development site is extensive, two FEH data sets were necessary to undertake the hydraulic modelling and are shown in Table 2-2 below. The rainfall data set used in the ACA drainage modelling was 'GB 647050, 262950', whereas all other areas used data set 'GB 647450, 264900'.

**Table 2-2 - FEH 1999 rainfall parameters**

| FEH Site | C (1km) | D1 (1km) | D2 (1km) | D3 (1km) | E (1km) | F (1km) |
|---|---|---|---|---|---|---|
| GB 647050 262950 | -0.019 | 0.298 | 0.279 | 0.207 | 0.309 | 2.506 |
| GB 647450 264900 | -0.02 | 0.299 | 0.272 | 0.215 | 0.311 | 2.506 |

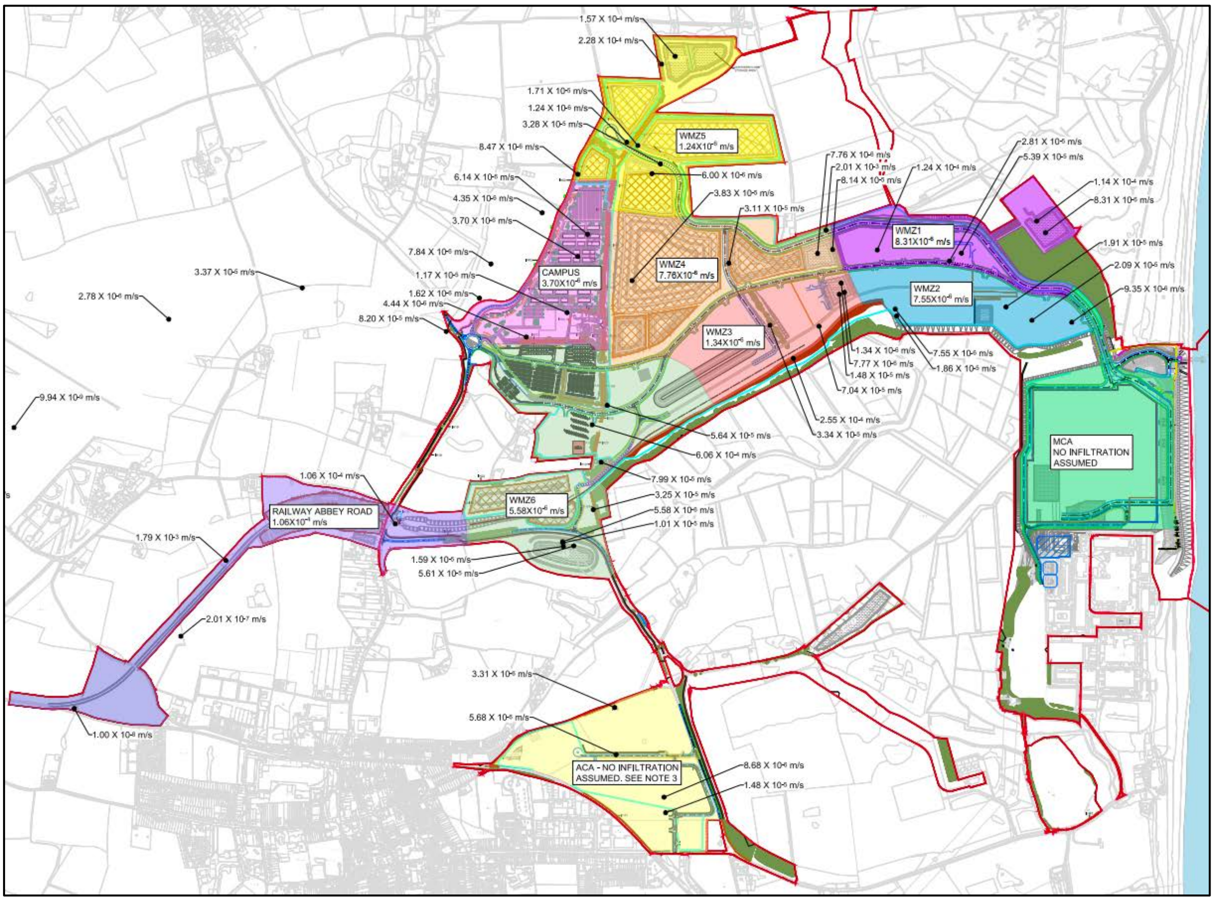
2.2.4 Using FSR, Sizewell, Suffolk was used as the location with M5-60 and 'r' ratio of 18.2 mm and 0.4 taken respectively. Storage estimates using all rainfall-runoff methods are included in this document.

2.2.5 Attenuation structures are modelled in Source Control to have side slopes of 1:3. The infiltration rate has been applied to the side walls of the attenuation structure only. No infiltration is applied to the base of the structure to account for any loss of efficiency over the design life.

## 2.3 Infiltration rates

2.3.1 Several ground investigation (GI) campaigns have been undertaken across the site to determine the infiltration potential across various catchment areas. The figure below summarises the range of infiltration rates recorded in four separate campaigns in 2014, 2015, 2017 and 2020. The lowest (worst-case) rate for each catchment has been used at this design stage for surface water calculations, specifically to calculate the storage volume required in infiltration basins. Further GI campaigns are planned, and results will be included during the next design stage. The geology across the site is largely sandy which provides confidence that the infiltration rates used in the surface water design are conservative.

### Figure 2-1 - Infiltration rates (refer to drawing SZC-EW0320-ATK-XX-000-XXXXXX-DRW-CCD-000001 in Annex A)




2.3.2 In order to calculate the contributing areas to each of the water management zones, they have been assessed based on their land use with their appropriate percentage impermeable (PIMP) value for each area type:

- Roofed buildings: 100%
- Asphalt roads/pavements: 90%
- Gravel areas: 50%
- Road verges: 50%
- Stockpile area: 30%
- Grassed areas: 30%

2.3.3 Using the above PIMP values and known areas within each catchment, a source control model has been run to provide assurance that the design storage is able to be catered for within the WMZ infiltration basins.

## 2.4 Water Quality

2.4.1 The purpose of this document is to provide clarity around sizing of WMZ infiltration basins, however quality of surface water runoff from the site is also important and therefore is summarised in this section. Surface water discharges to, in order of preference, the ground, nearby watercourses, or the sea.

2.4.2 Discharges to nearby watercourses and the sea will be controlled through permit applications and ongoing monitoring to ensure the quality of the water meets the Environment Agency's (EA) criteria prior to discharge.

2.4.3 There are possible contaminants that need to be considered in surface water treatment design across the site. These are divided into:

- Sediment runoff
- Chemical spills, including concrete batching plant, waste consolidation centre and fuel farm.

2.4.4 Treatment of sediment runoff will be managed through the implementation of SuDS features on site, including:

- Swales
- Infiltration trenches
- Hay bales (around stockpiles)
- Silt fences (where suitable)
- WMZ infiltration basins

2.4.5 The positioning and location of these features will be further defined in the following design phases and will follow overarching principles in the CIRIA SuDS Manual (C753) as well as the Drainage Strategy [REP7-017] and subsequent revised Drainage Strategy submitted at Deadline 8.

2.4.6 Treatment of chemical spills will be required at source, by specific treatment systems. For example, around the fuel storage area the pavement will be impermeable to prevent fuel seeping into the groundwater. Any potential oil spills will be captured and treated via an oil interceptor sized and designed suitably for the potentially contaminated spill volumes.

2.4.7 The assessment of water quality risk management for each WMZ will be provided through the simple index approach as outlined in Section 26.7.1 of the CIRIA SuDS Manual (C753). This method will ultimately determine what SuDS measures are required to treat different types of developments across the MDS. The steps are set out as:

**Step 1** – Allocate suitable pollution hazard indices for the proposed land use
**Step 2** – Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index
**Step 3** – Where the discharge is to protected surface waters or groundwater, consider the need for a more precautionary approach

2.4.8 Proposed SuDS features within each catchment will be used to determine a total pollution mitigation index (Table 26.3 CIRIA SuDS Manual). Where additional SuDS features are not considered appropriate at this design stage, proprietary, non-SuDS treatment may be proposed. This assessment will be carried out for each WMZ in the next design phase.

## 2.5 Discharge Rates

2.5.1 Proposed discharge rates from infiltration basins to nearby watercourses have been defined following the Environment Agency guidance (Report SC030219 – Rainfall runoff management for developments). A $Q_{bar}$ (peak rate of flow from a catchment for the mean annual flood - return period of approximately 1:2.3 years) greenfield runoff rate has been calculated for each catchment using UK SuDS guidance. In some cases (the ACA), this is the proposed restricting flow rate. Across the TCA however, it is noted that $Q_{bar}$ is extremely small, and therefore the Environment Agency guidance is followed, whereby if $Q_{bar}$ is less than 1 l/s/ha, the latter can be proposed as a limiting discharge rate. Where an outfall is proposed from an infiltration basin to nearby watercourses in the TCA and rail catchments, this is the proposed approach.

2.5.2 It is important that the SSSI is neither overwhelmed with additional surface water runoff, nor starved of surface water during the construction and operation of SZC. Maintaining the status quo of how the existing site drains is required to ensure the SSSI retains its current ecological and hydrological features. This has been reinforced by conversations with the EA and other stakeholders and is represented in both the groundwater/surface water modelling and flood risk modelling.

# 3 WATER MANAGEMENT ZONES

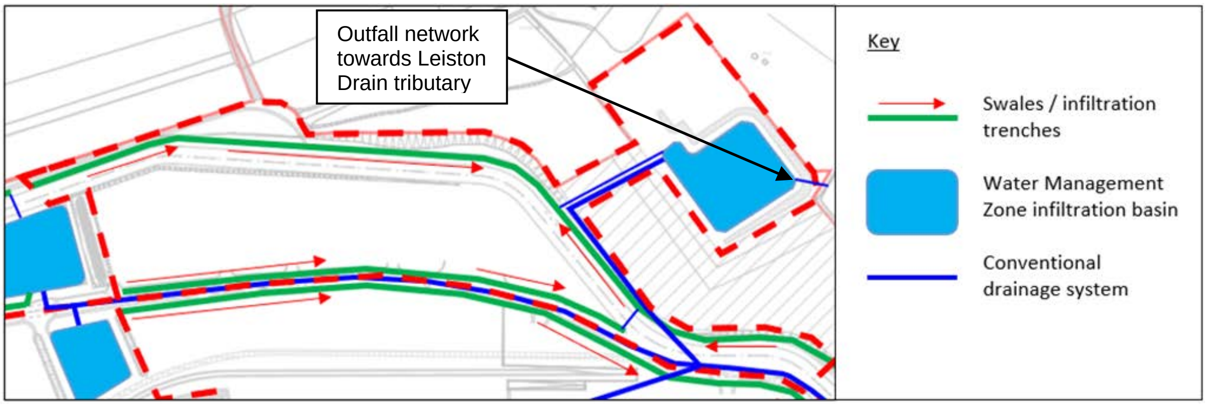
3.1.1 Generally, the surfaces of the catchments are largely permeable, so surface water will infiltrate to ground in the first instance. Any runoff that does not infiltrate directly or captured through swales with infiltration trenches will be captured by a perforated pipe within the trench, that will convey the flow to a Water Management Zone (WMZ) infiltration basin. The WMZs are designed for 100-year return period rainfall events including climate change. In extreme rainfall events the WMZs for catchments 1-4 will overflow into a conventional drainage system (spine network) discharging to the CDO which outflows to the sea.

## 3.2 Catchment 1

3.2.1 Catchment 1 is located in the north eastern area of proposed TCA. This catchment houses plant and workshops such as joinery/metal workshops, a formwork factory and slurry treatment plants. It also houses the fire and rescue centre, Emergency response facility and fuel farm. The catchment encompasses sections of the site access road to the south, haul roads to north and east, and one of the Contractor's working compounds. Catchment 1 has a total area of 19.4 ha and will drain via combined swale and infiltration trenches with perforated pipes. Two main runs are proposed, north and south of the catchment, both running from the west to WMZ1 which is proposed in the east. An outfall from WMZ1 is proposed to discharge surface water to the Leiston Drain tributary east of WMZ1, at 19.4 l/s (equivalent to 1 l/s/ha). An overflow connection is also proposed from WMZ1 to the Construction Drainage Outfall (CDO).

3.2.2 Due to the nature of the use for this catchment and the risk of potential contamination, most of this area will require control and treatment of surface water runoff prior to discharge. For example, the fuel farm will be concreted, and other areas in the Contractor's compound will be hard standing if there is potential for chemical spills. A 90% PIMP factor is assumed for this catchment. The area of hardstanding may decrease in the future, however for this stage of design, a more conservative value is considered more suitable to space proof the infiltration basin.

**Figure 3-1 - Catchment 1 proposed drainage**




### 3.2.3 **WMZ1**

3.2.4 Alongside the general parameters stated in Section 2.2, the parameters in Table 3-1 were used to determine a conservative estimate for the required storage volume for WMZ1. The volume allocated for WMZ1 in the Civil 3D model exceeds this.

3.2.5 WMZ1 is proposed at a low point east of the TCA where the ground levels range between 2 and 3 mAOD. The groundwater contours from Winter 2018 included in the Environmental Statement showed the groundwater level is approximately 0.9 mAOD at the location of WMZ1 (see Annex B). Given the proximity to the groundwater table, infiltration from the basin is not considered feasible and the basin is assumed to be lined.

3.2.6 A more detailed figure showing the proposed arrangement of the WMZ1 basin is provided in Annex C.

**Table 3-1 - Water Management Zone 1 - Infiltration Basin Summary**

| **Design Input** | | **Comment** |
|---|---|---|
| Total catchment area | 19.430 ha | |
| Percentage of runoff | 90% | To be revised as design progresses |
| Volumetric runoff coefficient (Cv) | 0.684, 0.746 | Summer, winter respectively |
| Infiltration rate | 0 m/s | |
| Overflow allowance to nearby watercourse | 19.43 l/s | Assumed at 1 l/s/ha [1] |
| Overflow to spine network | Yes | Allowance for 200 l/s, not included in model |
| Sediment forebay | Included | To be detailed in next design phase |
| Access ramp | Included | To be detailed in next design phase |
| Groundwater level | 0.900 mAOD | Based on Environment Statement groundwater contours (Annex B) |
| **MicroDrainage Source Control Summary** | | |
| FSR | 10770.1 $m^3$ | 1:100 year return period, 1440 winter storm |
| FEH 1999 | 13946.6 $m^3$ | 1:100 year return period, 1440 winter storm |
| FEH 2013 | **14690.4 $m^3$** | 1:100 year return period, 1440 winter storm |
| **Civil 3D Model Summary** | | |
| Invert level of basin | 1.200 mAOD | |
| Bottom of basin area | 10579.2 $m^2$ | |

| | | |
|---|---|---|
| Top of basin area (excluding freeboard) | 12618.8 m$^2$ | |
| Freeboard allowance | 300mm | |
| Side slopes | 1:3 | |
| Total volume provided | **17328 m$^3$** | (excluding 300mm freeboard) |

[1] Based on Environment Agency guidance - Rainfall runoff management for developments ref. SC030219. Limiting discharge rates for sites should be set to Qbar or 1 l/s/ha, whichever is greater.

## 3.3 Catchment 2

3.3.1 Catchment 2 is south of catchment 1 and encompasses sections of the site access and haul roads at the point they converge and then cross the SSSI. It will contain Contractor compounds, including concrete batching plant, the railhead, a waste consolidation area, and several laydown areas. The catchment has a total area of approximately 17.4 ha. The majority of this area will be hardstanding and therefore a 90% PIMP factor has been assumed. The area of hardstanding may decrease in the future, however for this stage of design, a more conservative value is considered more suitable to space proof the infiltration basin.

3.3.2 The drainage in this catchment includes road edge swales to the south of the main access road collecting road runoff and runoff from the compound area north of the railhead. A separate network made up of filter drains is proposed at the compound perimeter to cater for the runoff immediately south of the railhead. The network discharges into WMZ2 to the south. An outfall from WMZ2 is proposed to discharge surface water to the Leiston Drain south of WMZ2, at 17.4 l/s (equivalent to 1 l/s/ha). An overflow connection is also proposed from WMZ2 to the Construction Drainage Outfall (CDO) via a spine network as a precaution.

**Figure 3-2 - Catchment 2 proposed drainage**


3.3.3 **WMZ2**

3.3.4 The parameters in Table 3-2 were used to determine a conservative estimate of the attenuation volume required to serve TCA Catchment 2.

**Table 3-2 - Water Management Zone 2 - Infiltration Basin Summary**

| **Design Input** | | **Comment** |
|---|---|---|
| Total catchment area | 17.370 ha | |
| Percentage of runoff | 90% | To be revised as design progresses |
| Volumetric runoff coefficient (Cv) | 0.684, 0.746 | Summer, winter respectively |
| Infiltration rate | 7.55E-06 m/s | |
| Overflow allowance to nearby watercourse | 17.37 l/s | Assumed at 1 l/s/ha [1] |
| Overflow to spine network | Yes | Allowance for 200 l/s, not included in model |
| Sediment forebay | Included | To be detailed in next design phase |
| Access ramp | Included | To be detailed in next design phase |
| Groundwater level | 0.800 mAOD | Based on Environment Statement groundwater contours (Annex B) |
| **MicroDrainage Source Control Summary** | | |
| FSR | 9211.2 $m^3$ | 1:100 year return period, 1440 winter storm |
| FEH 1999 | 12005.4 $m^3$ | 1:100 year return period, 1440 winter storm |
| FEH 2013 | **12663.5 $m^3$** | 1:100 year return period, 1440 winter storm |
| **Civil 3D Model Summary** | | |
| Invert level of basin | 3.200 mAOD | |
| Bottom of basin area | 3290.1 $m^2$ | |
| Top of basin area (excluding freeboard) | 6274.5 $m^2$ | |
| Freeboard allowance | 300mm | |
| Side slopes | 1:3 | |
| Total volume provided | **17694.5 $m^3$** | (excluding 300mm freeboard) |

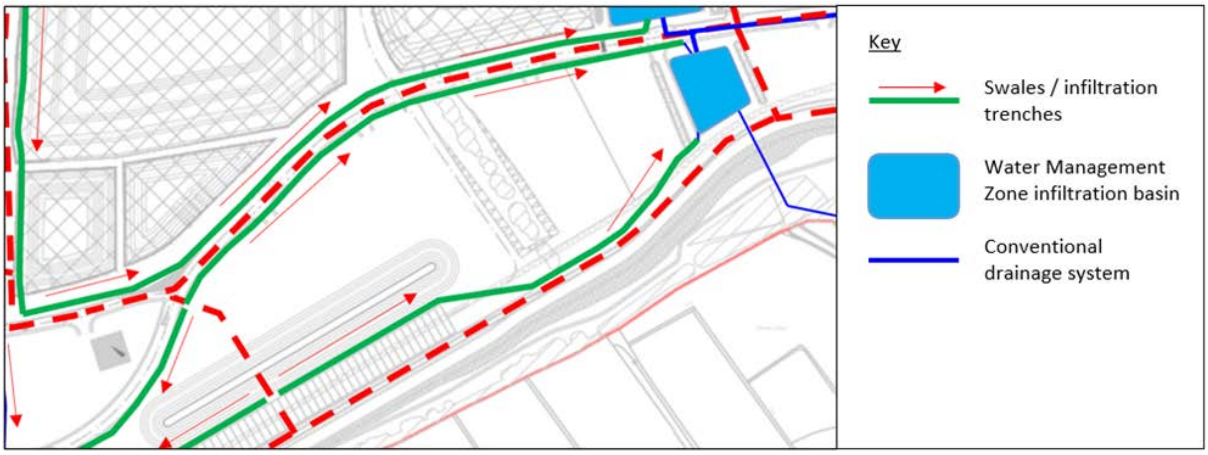
[1] Based on Environment Agency guidance - Rainfall runoff management for developments ref. SC030219. Limiting discharge rates for sites should be set to Qbar or 1 l/s/ha, whichever is greater.

## 3.4 Catchment 3

3.4.1 Catchment 3 is to the west of catchment 2 and is enclosed by roads on three sides and the rail to the south. It encompasses part of the combined site access road, a section of the railway and two Contractor's compounds. The catchment has a total area of approximately 21.0 ha. A 90% percentage of impermeable area has been allowed for in these areas conservatively, should the use of the Contractor compounds require hardstanding surfaces. This will likely be reduced in the future. A 50% PIMP has been applied to the railway sections.

3.4.2 The runoff is divided to drain into the road drainage swales proposed along the roads forming the perimeter drainage. A separate network has been designed to cater for the runoff from the unloading area platform and railway drainage. The perimeter drainage discharges to WMZ3 to the east of the catchment. An outfall from WMZ2 is proposed to discharge surface water to the Leiston Drain south of WMZ3, at 21.0 l/s (equivalent to 1 l/s/ha). An overflow connection is also proposed from WMZ3 to the Construction Drainage Outfall (CDO) via a spine network.

**Figure 3-3 - Catchment 3 proposed drainage**




3.4.3 **WMZ3**

3.4.4 Table 3-3 summarises the parameters used to determine a conservative estimate of the attenuation volume required and the volume space-proofed for WMZ3.

3.4.5 A more detailed figure showing the proposed arrangement of the WMZ3 basin is provided in Annex C.

**Table 3-3 - Water Management Zone 3 - Infiltration Basin Summary**

| **Design Input** | | **Comment** |
|---|---|---|
| Total catchment area | 20.960 ha | |
| Percentage of runoff | 90% | |
| Volumetric runoff coefficient (Cv) | 0.684, 0.746 | Summer, winter respectively |
| Infiltration rate | 1.34E-06 m/s | |
| Overflow allowance to nearby watercourse | 20.96 l/s | Assumed at 1 l/s/ha [1] |
| Overflow to spine network | Yes | Allowance for 200 l/s, not included in model |
| Sediment forebay | Included | To be detailed in next design phase |
| Access ramp | Included | To be detailed in next design phase |
| Groundwater level | 1.200 mAOD | Based on Environment Statement groundwater contours (Annex B) |
| **MicroDrainage Source Control Summary** | | |
| FSR | 11458.8 $m^3$ | 1:100 year return period, 1440 winter storm |
| FEH 1999 | 14887.7 $m^3$ | 1:100 year return period, 1440 winter storm |
| FEH 2013 | **15685.8 $m^3$** | 1:100 year return period, 1440 winter storm |
| **Civil 3D Model Summary** | | |
| Invert level of basin | 5.000 mAOD | |
| Bottom of basin area | 3346.8 $m^2$ | |
| Top of basin area (excluding freeboard) | 7162.9 $m^2$ | |
| Freeboard allowance | 300mm | |
| Side slopes | 1:3 | |
| Total volume provided | **17341.0 $m^3$** | (excluding 300mm freeboard) |

[1] Based on Environment Agency guidance - Rainfall runoff management for developments ref. SC030219. Limiting discharge rates for sites should be set to Qbar or 1 l/s/ha, whichever is greater.

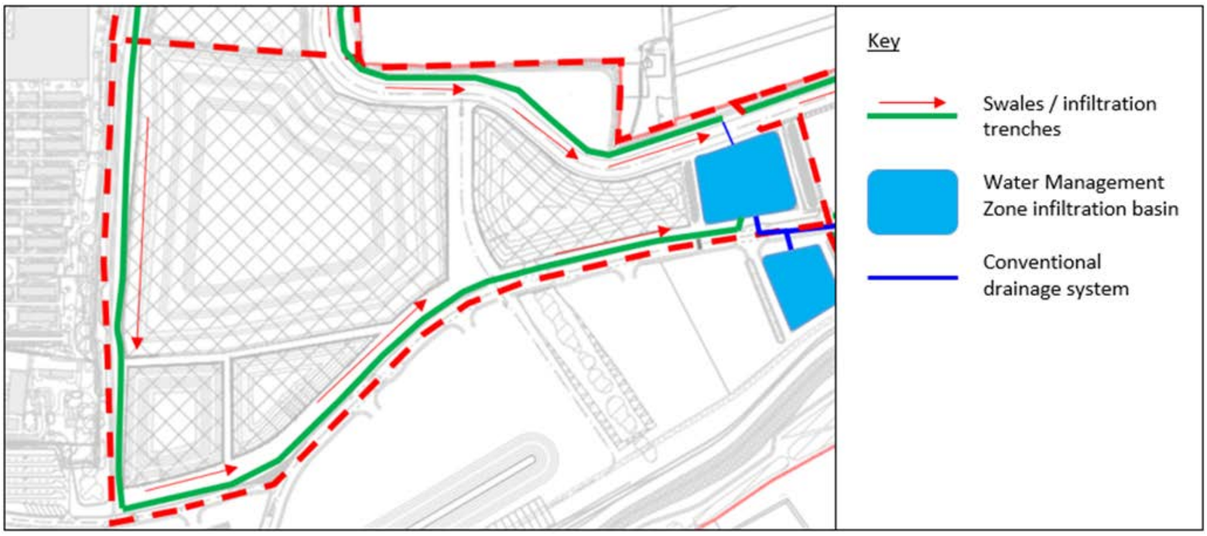
## 3.5 Catchment 4

3.5.1 Catchment 4 is to the west of catchment 1. It encompasses part of the access and haul road but is predominantly material storage and stockpile area. The catchment has a total area of approximately 33.3 ha. This results in a conservative percentage of impermeable area (PIMP) for the catchment to be 50%. As stockpiles are assigned a 30% PIMP, this figure may be reduced in the future, but for this design phase is considered conservative.

3.5.2 Perimeter road swales have been proposed along the roads to drain the runoff from the catchment. Two such networks, one from the north and the other from the south, discharge to WMZ4 located to the east of the catchment. An overflow connection is also proposed from WMZ4 to the Construction Drainage Outfall (CDO) via a spine network as a precaution.

3.5.3 A more detailed figure showing the proposed arrangement of the WMZ4 basin is provided in Annex C.

**Figure 3-4 - Catchment 4 proposed drainage**




3.5.4 **WMZ4**

3.5.5 Table 3-4 summarises the parameters used to determine a conservative estimate of the attenuation volume required and the volume space-proofed for WMZ4.

**Table 3-4 - Water Management Zone 4 - Infiltration Basin Summary**

| Design Input | | Comment |
|---|---|---|
| Total catchment area | 33.320 ha | |
| Percentage of runoff | 50% | |
| Volumetric runoff coefficient (Cv) | 0.568, 0.680 | Summer, winter respectively |
| Infiltration rate | 7.76E-06 m/s | |

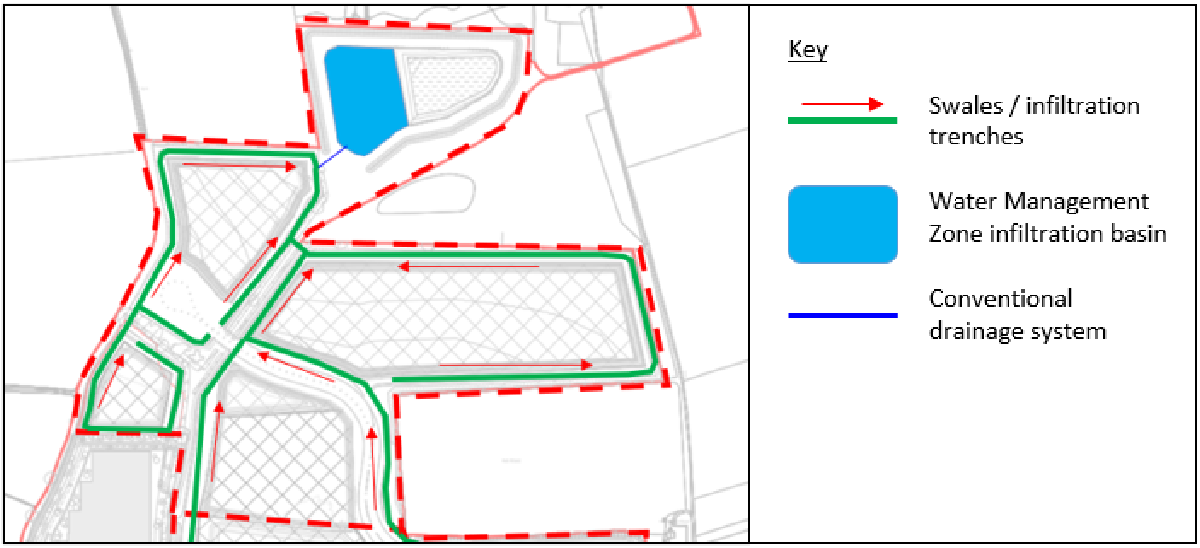
| | | |
|---|---|---|
| Overflow allowance to nearby watercourse | No | |
| Overflow to spine network | Yes | Allowance for 200 l/s, not included in model |
| Sediment forebay | Included | To be detailed in next design phase |
| Access ramp | Included | To be detailed in next design phase |
| Groundwater level | 1.200 mAOD | Based on Environment Statement groundwater contours (Annex B) |
| **MicroDrainage Source Control Summary** | | |
| FSR | 10080.8 $m^3$ | 1:100 year return period, 1440 winter storm |
| FEH 1999 | 12795.4 $m^3$ | 1:100 year return period, 1440 winter storm |
| FEH 2013 | **13422.3 $m^3$** | 1:100 year return period, 1440 winter storm |
| **Civil 3D Model Summary** | | |
| Invert level of basin | 5.200 mAOD | |
| Bottom of basin area | 4916.6 $m^2$ | |
| Top of basin area (excluding freeboard) | 9759.7 $m^2$ | |
| Freeboard allowance | 300mm | |
| Side slopes | 1:3 | |
| Total volume provided | **25688.8 $m^3$** | (excluding 300mm freeboard) |

## 3.6 Catchment 5

3.6.1 Catchment 5 is to be north of catchment 4. It encompasses part of the haul road and is predominantly made up of proposed borrow pits and stockpile areas. The catchment has a total area of approximately 31.2 ha. A 50% PIMP factor has been applied to this area. As with catchment 4, this may be reduced in the future.

3.6.2 Two drainage networks along the site boundary have been designed as perimeter swales/infiltration trenches with perforated pipes, as well as a network surrounding the storage area. These networks discharge to WMZ5 located to the north of the catchment. No outfalls are proposed from WMZ5 at this stage.

### Figure 3-5 - Catchment 5 proposed drainage




3.6.3 **WMZ5**

3.6.4 Table 3-5 summarises the parameters used to determine a conservative estimate of the attenuation volume required and the volume space-proofed for WMZ5.

### Table 3-5 - Water Management Zone 5 - Infiltration Basin Summary

| **Design Input** | | **Comment** |
|---|---|---|
| Total catchment area | 31.195 ha | |
| Percentage of runoff | 50% | |
| Volumetric runoff coefficient (Cv) | 0.568, 0.680 | Summer, winter respectively |
| Infiltration rate | 1.24E-06 m/s | |
| Overflow allowance to nearby watercourse | No | |
| Overflow to spine network | No | |
| Sediment forebay | Included | To be detailed in next design phase |
| Access ramp | Included | To be detailed in next design phase |
| Groundwater level | 1.400 mAOD | Based on Environment Statement groundwater contours (Annex B) |
| **MicroDrainage Source Control Summary** | | |
| FSR | 9715.2 $m^3$ | 1:100 year return period, 1440 winter storm |
| FEH 1999 | 12296.3 $m^3$ | 1:100 year return period, 1440 winter storm |

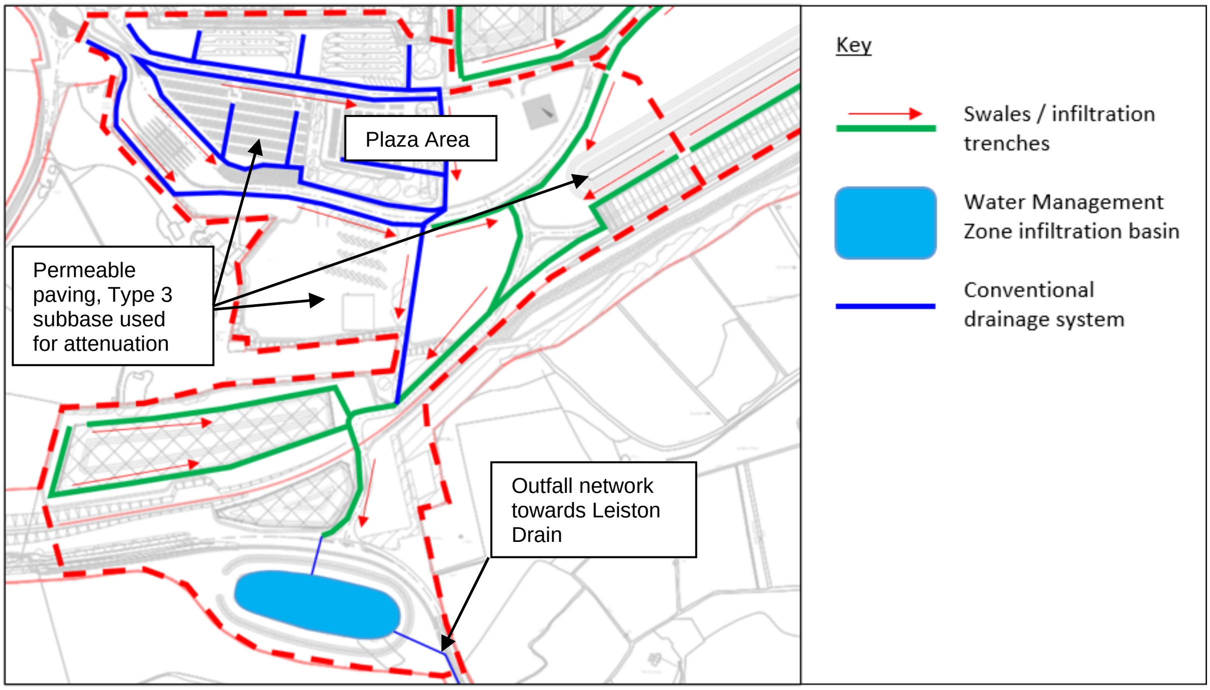
| | | |
|---|---|---|
| FEH 2013 | 12891.1 $m^3$ | 1:100 year return period, 1440 winter storm |
| **Civil 3D Model Summary** | | |
| Invert level of basin | 6.000 mAOD | |
| Bottom of basin area | 7658.1 $m^2$ | |
| Top of basin area (excluding freeboard) | 9615.7 $m^2$ | |
| Freeboard allowance | 300mm | |
| Side slopes | 1:3 | |
| Total volume provided | **17223.8 $m^3$** | (excluding 300mm freeboard) |

## 3.7 Catchment 6 & Plaza

3.7.1 Catchment 6 is located to the south-west of catchment 3 and encompasses site access roads, part of the railway, numerous site facilities, including rail and freight security buildings, vehicle inspection cabins, and the main TCA site offices. Catchment 6 also encompasses a sewage treatment plant, potable water storage facility and the Plaza area. The catchment has a total area of approximately 47.8 ha. A 58% PIMP has been applied to this catchment to account for stockpiles, soft landscaping and where TruckPave is proposed as hardstanding.

3.7.2 The rail drainage consists of filter drains adjacent to the track, cut off drains at the top of the cutting, and toe ditches at the bottom of the embankment. The Plaza drainage consists of filter drains along the road verges. Perimeter swales are proposed around the storage areas and adjacent to the access roads. All drainage networks discharge to WMZ6 located to the south of the catchment. An overflow is proposed to discharge runoff to the Leiston Drain near Lover's Lane.

### Figure 3-6 - Catchment 6 proposed drainage




3.7.3 **WMZ6**

3.7.4 Table 3-6 summarises the parameters used to determine a conservative estimate of the attenuation volume required and the volume space-proofed for WMZ6.

### Table 3-6 - Water Management Zone 6 - Infiltration Basin Summary

| Design Input | | Comment |
|---|---|---|
| Total catchment area | 47.770 ha | |
| Percentage of runoff | 58% | |
| Volumetric runoff coefficient (Cv) | 0.604, 0.701 | Summer, winter respectively |
| Infiltration rate | 5.58E-06 m/s | |
| Overflow allowance to nearby watercourse | 47.77 l/s | Assumed at 1 l/s/ha [1] |
| Overflow to spine network | No | |
| Sediment forebay | Included | To be detailed in next design phase |
| Access ramp | Included | To be detailed in next design phase |
| Groundwater level | 2.100 mAOD | Based on Environment Statement groundwater contours (Annex B) |

| **MicroDrainage Source Control Summary** | | |
|---|---|---|
| FSR | 14418.3 $m^3$ | 1:100 year return period, 1440 winter storm |
| FEH 1999 | 19117.2 $m^3$ | 1:100 year return period, 1440 winter storm |
| FEH 2013 | **20216.7 $m^3$** | 1:100 year return period, 1440 winter storm |
| **Civil 3D Model Summary** | | |
| Invert level of basin | 8.000 mAOD | |
| Bottom of basin area | 7165.8 $m^2$ | |
| Top of basin area (excluding freeboard) | 11287.5 $m^2$ | |
| Freeboard allowance | 300mm | |
| Side slopes | 1:3 | |
| Total volume provided | **19376.0 $m^3$** | (excluding 300mm freeboard) |

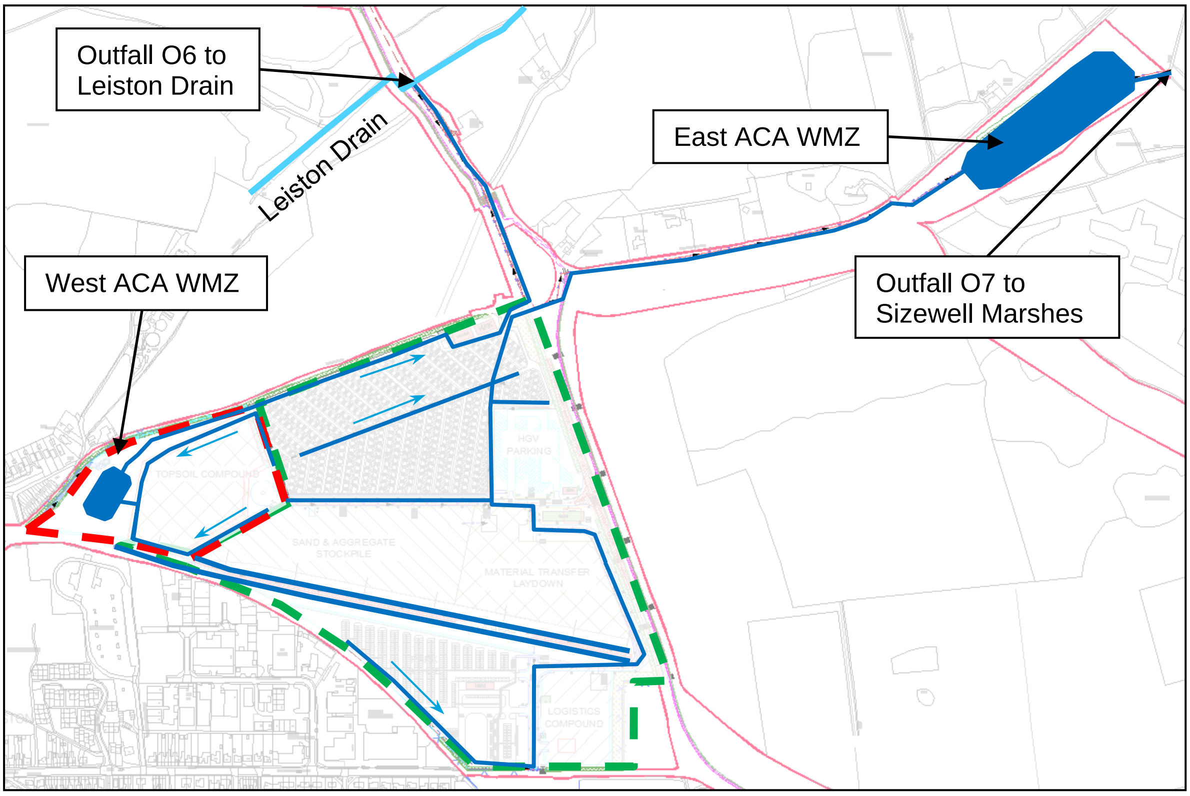
[1] Based on Environment Agency guidance - Rainfall runoff management for developments ref. SC030219. Limiting discharge rates for sites should be set to Qbar or 1 l/s/ha, whichever is greater.

## 3.8 Ancillary Construction Area (ACA)

3.8.1 The ACA is isolated from the TCA and MCA, and therefore has an independent surface water drainage network to that serving the main construction site. The ACA has an area of approximately 29.7 ha and encompasses caravan pitches, HGV parking, topsoil compound, sand and aggregate stockpile, material transfer laydown, park and ride and logistics compound. No infiltration is assumed within the ACA as per the DCO Outline Drainage Strategy, and runoff will be collected by a variety of features including swales, permeable paving with filter drains and conventional drainage elements.

3.8.2 Two water management zone attenuation features are proposed to store runoff prior to discharge. Runoff from the topsoil compound area and the area west of this compound (dashed red line in Figure 3-7) will be captured in swales and attenuated in the West ACA WMZ, before discharging to the Leiston Drain near Lover's Lane. Surface water runoff from all other areas (dashed green line in Figure 3-7) within the ACA will be conveyed to the East ACA WMZ, before discharging to the Sizewell Marshes. The outflows will be limited to greenfield runoff rates ($Q_{bar}$).

### Figure 3-7 - ACA proposed drainage




3.8.3 **East ACA WMZ**

3.8.4 The drainage strategy within the ACA has been modified since Basic Design following agreement with the Environment Agency and Suffolk County Council to allow more runoff to be attenuated in the East WMZ and discharge to the Sizewell Marshes. Therefore, the area currently designated for the East WMZ in the construction site plot plan is being increased to meet the required volume calculated in Table 3-7.

3.8.5 The required attenuation volume for the East ACA WMZ is conservatively estimated as 21700 $m^3$. Further work will be undertaken during Detailed Design to determine the actual volume required, allowing for storage in the pipe network and infiltration within the WMZ.

### Table 3-7 - ACA East - Infiltration Basin Summary

| Design Input | | Comment |
|---|---|---|
| Total catchment area | 25.222 ha | |
| Percentage of runoff | 100% | |
| Volumetric runoff coefficient (Cv) | 0.761, 0.817 | Summer, winter respectively |
| Infiltration rate | 0 m/s | |

| | | |
|---|---|---|
| Overflow allowance to nearby watercourse | 59.87 l/s | $Q_{bar}$ |
| Overflow to spine network | No | |
| Sediment forebay | Included | To be detailed in next design phase |
| Access ramp | Included | To be detailed in next design phase |
| Groundwater level | 1.000 mAOD | Based on Environment Statement groundwater contours (Annex B) |
| **MicroDrainage Source Control Summary** | | |
| FSR | 15381.1 $m^3$ | 1:100 year return period, 1440 winter storm |
| FEH 1999 | 20579.7 $m^3$ | 1:100 year return period, 1440 winter storm |
| FEH 2013 | **21641.3 $m^3$** | 1:100 year return period, 1440 winter storm |
| **Civil 3D Model Summary** | | |
| Invert level of basin | 2.450 mAOD | |
| Freeboard allowance | 300mm | |
| Side slopes | 1:3 | |
| Total volume provided | **22000 $m^3$** | (excluding 300mm freeboard) |

### 3.8.6 West ACA WMZ

3.8.7 As stated above, the ACA drainage strategy is under development and the required attenuation volume for the West ACA WMZ is conservatively estimated as 3850 $m^3$. The current CSPP and Civil3D model includes a significantly smaller volume based on the previous ACA drainage strategy. Further modelling will be undertaken during Detailed Design to verify the size of the attenuation basin, including allowance for storage in the pipe network. Following this, the CSPP and Civil3D model will be updated accordingly.

**Table 3-8 - ACA West - Infiltration Basin Summary**

| Design Input | | Comment |
|---|---|---|
| Total catchment area | 4.438 ha | |
| Percentage of runoff | 100% | |
| Volumetric runoff coefficient (Cv) | 0.761, 0.817 | Summer, winter respectively |
| Infiltration rate | 0 m/s | |

| | | |
|---|---|---|
| Overflow allowance to nearby watercourse | 10.53 l/s | $Q_{bar}$ |
| Overflow to spine network | Yes | Allowance for 200 l/s, not included in model |
| Sediment forebay | Included | To be detailed in next design phase |
| Access ramp | Included | To be detailed in next design phase |
| Groundwater level | 2.100 mAOD | Based on Environment Statement groundwater contours (Annex B) |
| **MicroDrainage Source Control Summary** | | |
| FSR | 2698.8 $m^3$ | 1:100 year return period, 1440 winter storm |
| FEH 1999 | 3623.2 $m^3$ | 1:100 year return period, 1440 winter storm |
| FEH 2013 | **3812.3 $m^3$** | 1:100 year return period, 1440 winter storm |
| **Civil 3D Model Summary** | | |
| Invert level of basin | 2.500 mAOD | |
| Freeboard allowance | 300mm | |
| Side slopes | 1:3 | |
| Total volume provided | **4000 $m^3$** | Still to be modelled, but this area has been space-proofed for this size basin |

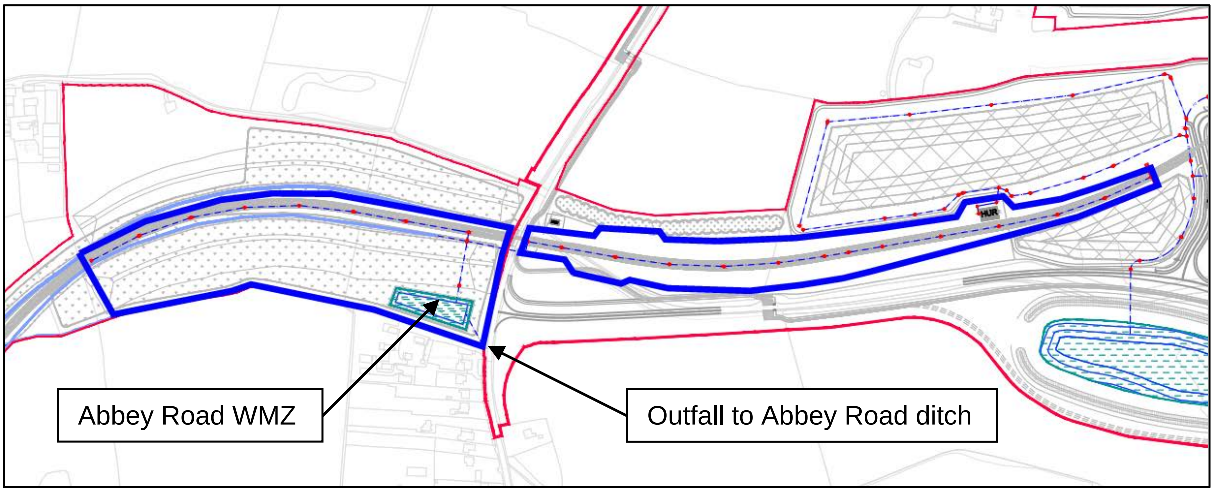
## 3.9 West Railway Catchment 3 - Abbey Road

3.9.1 The West Railway Catchment 3 is one of five catchments serving the proposed Green Rail Route, which is located with the Main Development Site. The railway drainage largely relies on infiltration trenches and swales to drain the proposed track in addition to allowing continuity of existing ditches and watercourses.

3.9.2 West Railways Catchment 3 is approximately 6.5 ha and is in cutting with a level crossing at Abbey Road. Cut-off ditches are proposed on both the side of the rail cutting in order to capture the runoff from the landscape bund. A filter drain is proposed at the downside of the embankment to drain the railway runoff. A WMZ basin coupled with hydro-brake is proposed to limit the discharge as required. Runoff that does not infiltrate at source will convey to a WMZ infiltration basin and overflow to the Abbey Road ditch.

3.9.3 Figure 3-8 shows the currently proposed Abbey Road WMZ basin location. This location may be updated in the future to account for emerging flood modelling information and existing known flooding issues in the vicinity of the current proposed WMZ basin.

**Figure 3-8 - West Railway Catchment 3 – Abbey Road WMZ**




### 3.9.4 Abbey Road WMZ

3.9.5 Table 3-9 summarises the parameters used to determine a conservative estimate of the attenuation volume required and the volume space-proofed for the Abbey Road WMZ.

**Table 3-9 - Abbey Road WMZ - Infiltration Basin Summary**

| **Design Input** | | **Comment** |
|---|---|---|
| Total catchment area | 6.478 ha | |
| Percentage of runoff | 50% | |
| Volumetric runoff coefficient (Cv) | 0.568, 0.680 | Summer, winter respectively |
| Infiltration rate | 1.06E-04 m/s | |
| Overflow allowance to nearby watercourse | 6.50 l/s | Assumed at 1 l/s/ha [1] |
| Overflow to spine network | No | |
| Sediment forebay | Included | To be detailed in next design phase |
| Access ramp | Included | To be detailed in next design phase |
| Groundwater level | 3.000 mAOD | Based on Environment Statement groundwater contours (Annex B) |
| **MicroDrainage Source Control Summary** | | |
| FSR | 1048.1 $m^3$ | 1:100 year return period, 240 winter storm |

| | | |
|---|---|---|
| FEH 1999 | **1413.5 m³** | 1:100 year return period, 240 winter storm |
| FEH 2013 | 1338.8 m³ | 1:100 year return period, 600 winter storm |
| **Civil 3D Model Summary** | | |
| Invert level of basin | 6.742 mAOD | |
| Bottom of basin area | 1268.6 m² | |
| Top of basin area (excluding freeboard) | 1964.5 m² | |
| Freeboard allowance | 300mm | |
| Side slopes | 1:3 | |
| Total volume provided | **1872.0 m³** | (excluding 300mm freeboard) |

[1] Based on Environment Agency guidance - Rainfall runoff management for developments ref. SC030219. Limiting discharge rates for sites should be set to Qbar or 1 l/s/ha, whichever is greater.

# 4 SUMMARY

4.1.1 This technical note summarises the required storage volumes for each WMZ attenuation basin across the SZC enabling works site. The volumes calculated are conservative and based on several assumptions. Further hydraulic modelling will be undertaken during Detailed Design which will decrease the required storage volumes. Table 4-1 provides a summary of the worst-case hydraulic model required storage volumes against the volumes currently provided for on the CSPP.

**Table 4-1 - Water Management Zone - Infiltration Basin Summary**

| Design Input | Design Volume ($m^3$) (worst case) | CAD Modelled Volume ($m^3$) | Comment |
|---|---|---|---|
| WMZ1 | 14690.4 | 17328 | Sufficient volume provided |
| WMZ2 | 12663.5 | 17694.5 | Sufficient volume provided |
| WMZ3 | 15685.8 | 17341 | Sufficient volume provided |
| WMZ4 | 13422.3 | 25688.8 | Sufficient volume provided |
| WMZ5 | 12891.1 | 17223.8 | Sufficient volume provided |
| WMZ6 | 20216.7 | 19376 | Sufficient volume provided [3] |
| WMZ – ACA west | 3812.3 | 4000 | [1],[2] Sufficient volume provided |

| | | | |
|---|---|---|---|
| WMZ – ACA east | 21641.3 | 22000 | [1],[2] Sufficient volume provided |
| WMZ – Abbey Road | 1413.5 | 1872 | Sufficient volume provided |

[1] Construction site plot plan is being updated to include additional volume as necessary to account for updated discharge strategy at the ACA in accordance with recent discussions with the EA and SCC.

[2] All WMZ infiltration basins have been sized based on source control models which do not consider additional storage volume in the network. Sizing the basins in this way allows space allocation on the plot plan, so that basin volumes and footprints can likely be downsized in the next design phase.

[3] Additional storage is provided in the Type 3 subbase of the permeable paving within the carpark of the plaza to provide the required design volume.

# REFERENCES

1. Environment Agency – Climate change allowances, Table 2. Flood risk assessments: climate change allowances - GOV.UK (www.gov.uk)

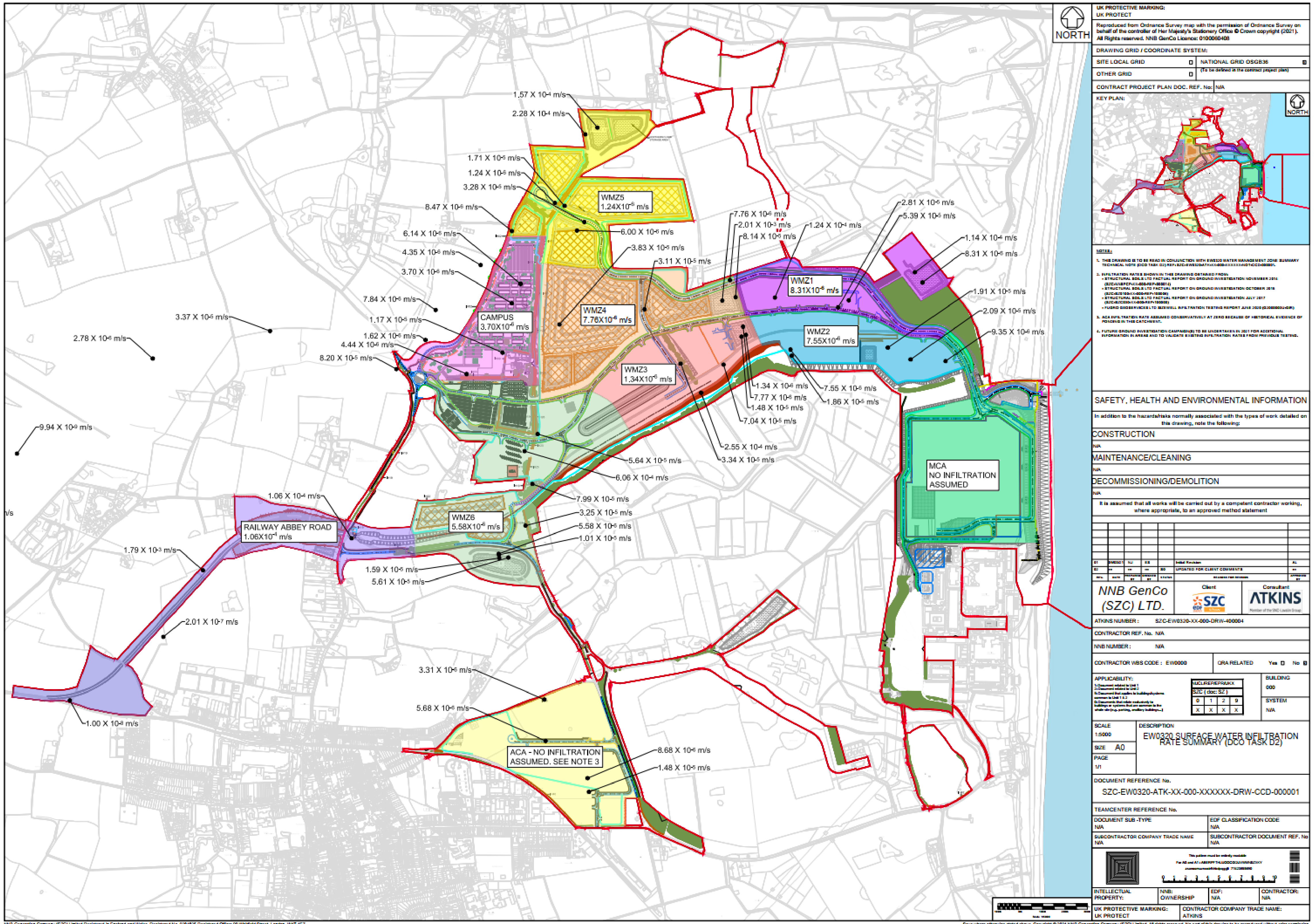
2. CIRIA - The SuDS Manual 2015. CIRIA C753

3. Fugro - Sizewell C Infiltration Testing Report on Ground Investigation without Geotechnical Evaluation. G200003U_GIR Rev 02

4. Environment Agency - Rainfall Runoff Management for Development. SC030219

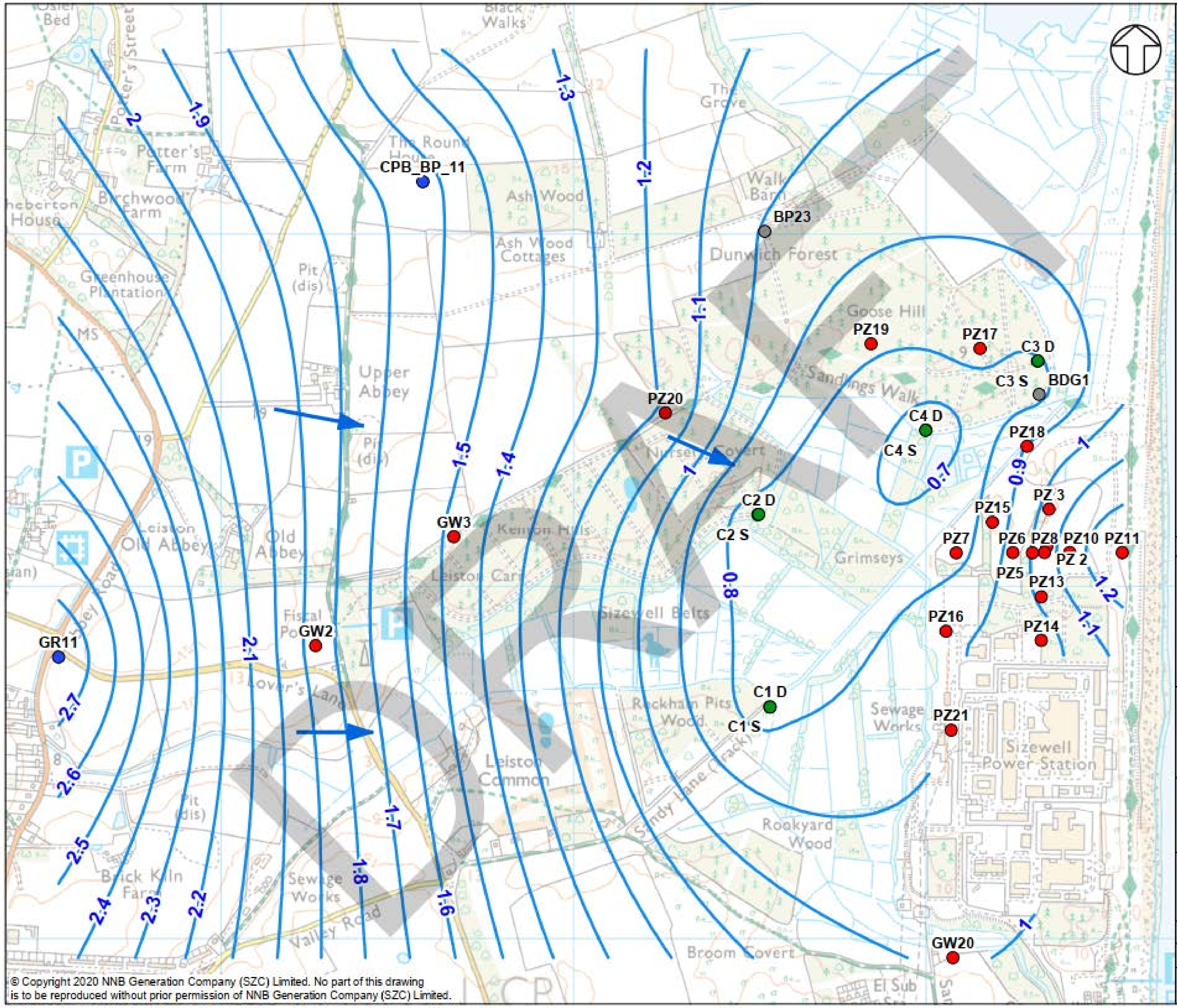
# ANNEX A

## Infiltration Tests Summary Drawing


NORTH
WMZ5
1.24X10-6 m/s
WMZ1
8.31X10-6 m/s
WMZ2
7.55X10-6 m/s
WMZ3
1.34X10-6 m/s
WMZ4
7.76X10-6 m/s
CAMPUS
3.70X10-6 m/s
WMZ6
5.58X10-6 m/s
RAILWAY ABBEY ROAD
1.06X10-4 m/s
MCA
NO INFILTRATION ASSUMED
ACA - NO INFILTRATION ASSUMED. SEE NOTE 3
1.57 X 10-4 m/s
2.28 X 10-4 m/s
1.71 X 10-5 m/s
1.24 X 10-8 m/s
3.28 X 10-5 m/s
8.47 X 10-6 m/s
6.14 X 10-6 m/s
4.35 X 10-6 m/s
3.70 X 10-6 m/s
7.84 X 10-6 m/s
1.17 X 10-6 m/s
1.62 X 10-5 m/s
4.44 X 10-6 m/s
8.20 X 10-5 m/s
3.37 X 10-6 m/s
2.78 X 10-6 m/s
9.94 X 10-9 m/s
6.00 X 10-6 m/s
3.83 X 10-6 m/s
3.11 X 10-5 m/s
7.76 X 10-6 m/s
2.01 X 10-5 m/s
8.14 X 10-6 m/s
1.24 X 10-4 m/s
2.81 X 10-5 m/s
5.39 X 10-5 m/s
1.14 X 10-4 m/s
8.31 X 10-6 m/s
1.91 X 10-6 m/s
2.09 X 10-6 m/s
9.35 X 10-6 m/s
1.34 X 10-6 m/s
7.77 X 10-6 m/s
1.48 X 10-5 m/s
7.04 X 10-5 m/s
7.55 X 10-6 m/s
1.86 X 10-5 m/s
2.55 X 10-4 m/s
3.34 X 10-5 m/s
5.64 X 10-5 m/s
6.06 X 10-4 m/s
1.06 X 10-4 m/s
7.99 X 10-5 m/s
3.25 X 10-5 m/s
5.58 X 10-6 m/s
1.01 X 10-5 m/s
1.79 X 10-3 m/s
1.59 X 10-5 m/s
5.61 X 10-5 m/s
2.01 X 10-7 m/s
1.00 X 10-8 m/s
3.31 X 10-6 m/s
5.68 X 10-5 m/s
8.68 X 10-6 m/s
1.48 X 10-5 m/s
UK PROTECTIVE MARKING:
UK PROTECT
DRAWING GRID / COORDINATE SYSTEM:
SITE LOCAL GRID
NATIONAL GRID OSGB36
OTHER GRID
CONTRACT PROJECT PLAN DOC. REF. No: N/A
KEY PLAN:
NOTES:
SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION
CONSTRUCTION
MAINTENANCE/CLEANING
DECOMMISSIONING/DEMOLITION
NNB GenCo (SZC) LTD.
ATKINS
ATKINS NUMBER: SZC-EW0320-XX-000-DRW-400004
CONTRACTOR REF. No. N/A
NNB NUMBER: N/A
CONTRACTOR WBS CODE: EW0000
QRA RELATED
APPLICABILITY:
BUILDING
000
SYSTEM
N/A
SCALE
1:5000
SIZE A0
PAGE
1/1
DESCRIPTION
EW0320 SURFACE WATER INFILTRATION RATE SUMMARY (DCO TASK D2)
DOCUMENT REFERENCE No.
SZC-EW0320-ATK-XX-000-XXXXXX-DRW-CCD-000001
TEAMCENTER REFERENCE No.
DOCUMENT SUB-TYPE
N/A
EDF CLASSIFICATION CODE
N/A
SUBCONTRACTOR COMPANY TRADE NAME
N/A
SUBCONTRACTOR DOCUMENT REF. No
N/A
INTELLECTUAL PROPERTY:
NNB: OWNERSHIP
EDF: N/A
CONTRACTOR: N/A
UK PROTECTIVE MARKING:
UK PROTECT
CONTRACTOR COMPANY TRADE NAME:
ATKINS

# ANNEX B

## Infiltration Tests Summary Drawing




NOTES

PEAT CONTOURS ARE CONSTRAINED TO THE EXTENT OF THE PEAT DEPOSITS

KEY

- 2010 BOREHOLES
- 2013 BOREHOLES
- 2014 BOREHOLES
- 2015 BOREHOLES
- GROUNDWATER CRAG CONTOURS (MAOD) - WINTER 2018
- GROUNDWATER FLOW DIRECTION

NOT PROTECTIVELY MARKED



Project Title:
SIZEWELL C PROJECT
ENVIRONMENTAL STATEMENT
VOLUME 2
CHAPTER 19B1
GROUNDWATER AND SURFACE WATER APPENDIX B1

DRAWING TITLE:
GROUNDWATER CONTOURS IN CRAG AQUIFER DURING WINTER 2018

DRAWING NO: FIGURE 19B 1.16

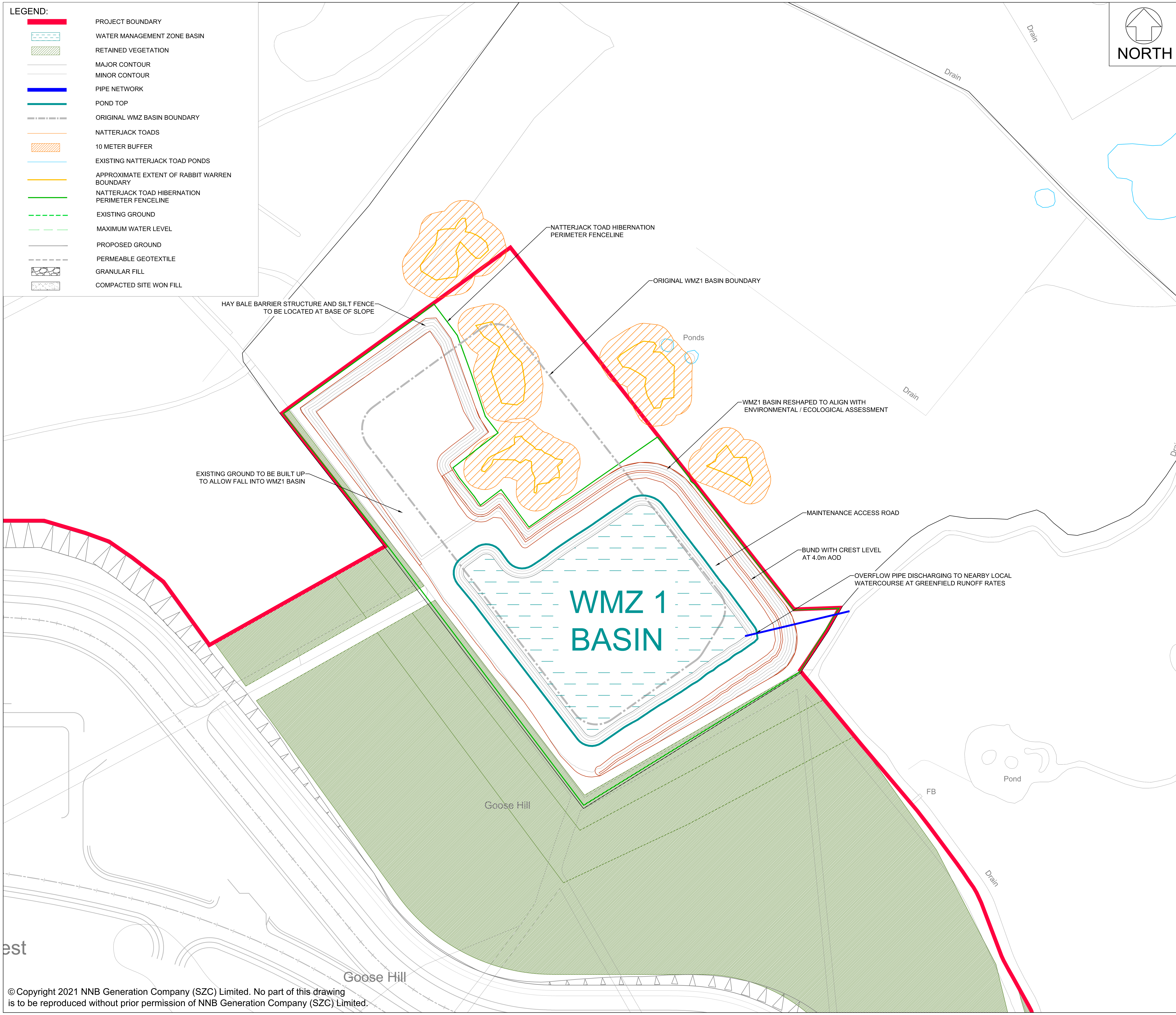
| DATE: | DRAWN: | SCALE: |
|---|---|---|
| JAN 2020 | S.R.H | 1:10,103 @A3 |

SCALE BAR: 0 0.1 0.2 0.3 0.4 0.5 KM

# ANNEX C

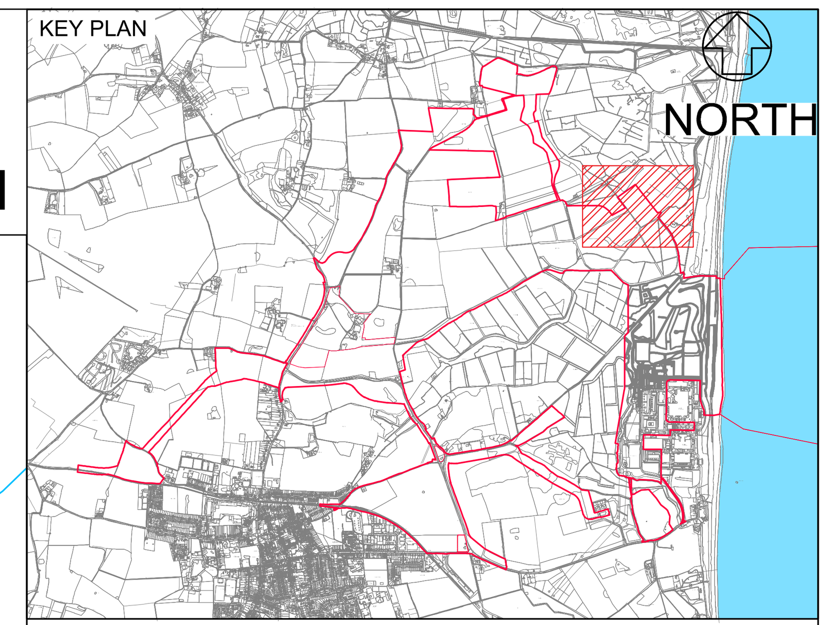
## Figure 1 – Water Management Zone 1 Basin

## Figure 2 – Water Management Zones 3 and 4 Basins






KEY PLAN




NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.

REFERENCES:

1. SZC_MDS_RABBIT WARREN INFO

| REVISION | DATE | DRAWN | CHECKED | REASONS FOR REVISION / COMMENTS | APPROVED |
|---|---|---|---|---|---|
| 01 | JULY 2021 | SN | RV | DCO SUBMISSION | SZC Co |

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COPYRIGHT:



PROJECT:
SIZEWELL C

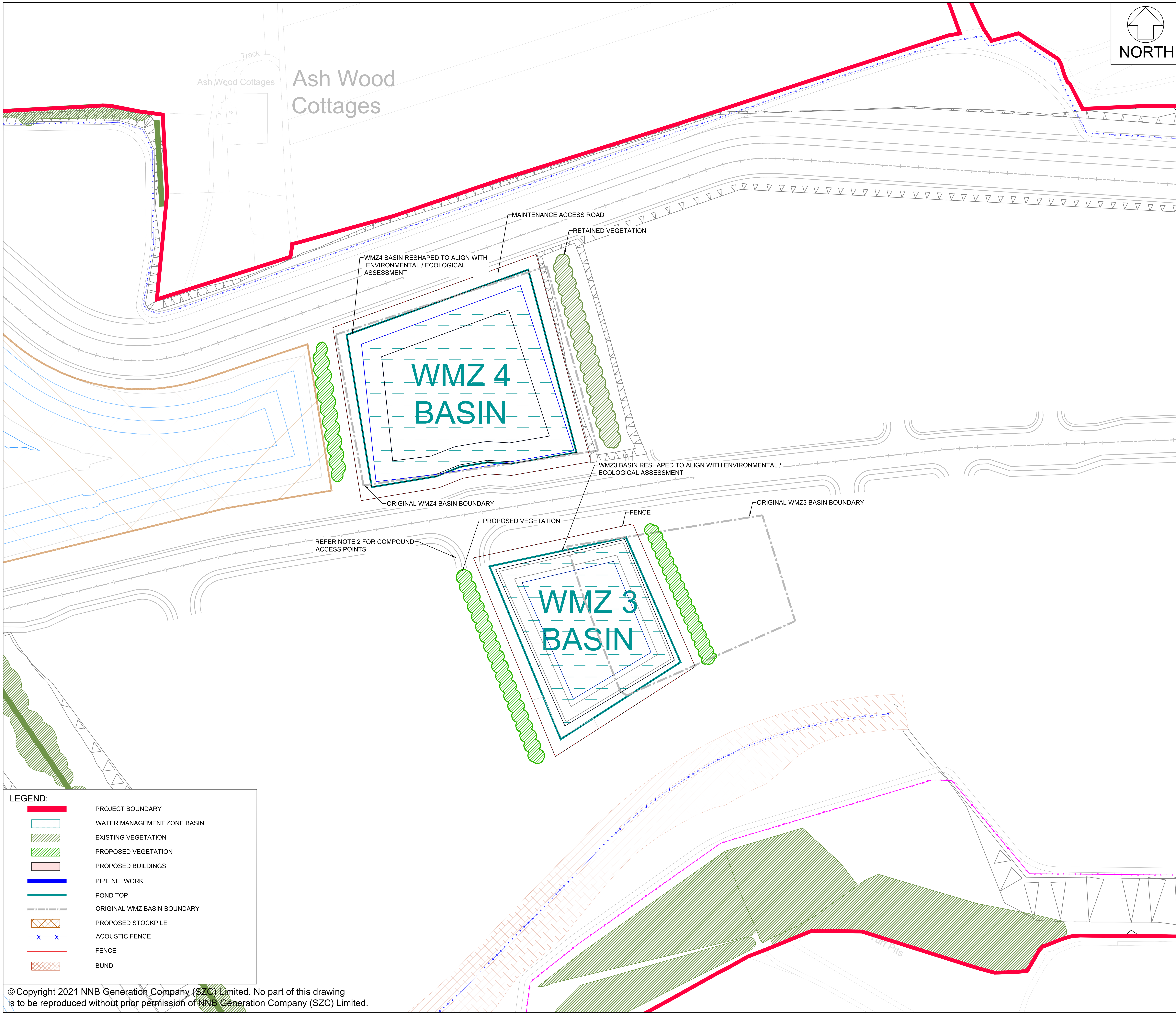
DOCUMENT:
MAIN DEVELOPMENT SITE
WATER MANAGEMENT ZONE SUMMARY
ANNEX C
DEADLINE 5 SUBMISSION JULY 2021

DRAWING TITLE:
WATER MANAGEMENT ZONE 1
DESIGN UPDATE - PLAN

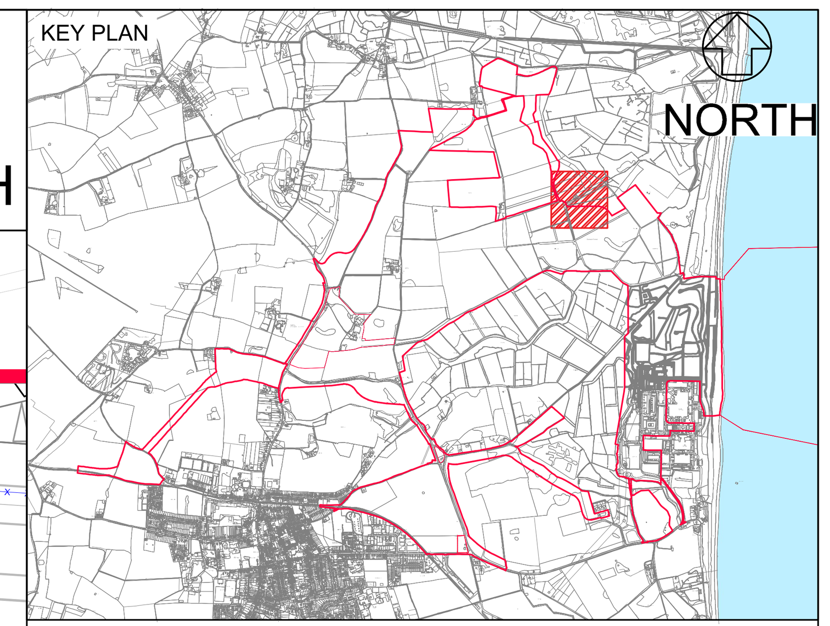
| FIGURE NO: | REVISION: |
|---|---|
| FIGURE 1 | 01 |

| DATE: | DRAWN: | SCALE: |
|---|---|---|
| JULY 2021 | SN | 1:1000 |

SCALE BAR:
10m 0m 10m 20m 30m 40m 50m 60m 70m
Scale 1:1000






NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.
2. COMPOUND ACCESS POINTS TO BE UPDATED IN THE NEXT DESIGN PHASE.

| REVISION | DATE | DRAWN | CHECKED | REASONS FOR REVISION / COMMENTS | APPROVED |
|---|---|---|---|---|---|
| 01 | JULY 2021 | SN | RV | DCO SUBMISSION | SZC Co |

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PROJECT:
SIZEWELL C

DOCUMENT:
MAIN DEVELOPMENT SITE
WATER MANAGEMENT ZONE SUMMARY
ANNEX C
DEADLINE 5 SUBMISSION JULY 2021

DRAWING TITLE:
WATER MANAGEMENT ZONE 3 &4
DESIGN UPDATE PLAN LAYOUT

| FIGURE NO: | REVISION: |
|---|---|
| FIGURE 2 | 01 |

| DATE: | DRAWN: | SCALE: |
|---|---|---|
| JULY 2021 | SN | 1:1000 |

SCALE BAR:
10m 0m 10m 20m 30m 40m 50m 60m 70m
Scale 1:1000

# ANNEX D

## Source Control Calculations

# Addendum to EW0320 Water Management Zone Summary (DCO Task D2)

This addendum has been prepared to support the EW0320 Water Management Zone Summary (DCO Task D2) (ref. SZC-EW0320-ATK-XX-000-XXXXXX-NOT-CCD-000001) technical note. This document contains calculation reports from Innovyze Source Control which support the initial sizing of the water management zone basins that are outlined in the above technical note.

# 1. Source Control Calculation Pack

Within each section, calculation reports for each rainfall-runoff method (Flood Studies Report (FSR), Flood Estimation Handbook (FEH) 1999 and FEH 2013) used in the assessment are presented.

## 1.1. Source Control Summary

## 1.2. WMZ1 Basin

## 1.3. WMZ2 Basin

## 1.4. WMZ3 Basin

## 1.5. WMZ4 Basin

Note. Source control results were presented for WMZ4 basin discharging via infiltration up to the 24 hour storm. These results show the half drain time exceeds 7 days; however sufficient land/volume has been allocated within the TCA to manage the critical storm volume.

Results are appended and show the critical storage volumes within greenfield runoff limited outflow to 1 l/s/ha in addition to the very low infiltration figures that were applied as a Worst Case Scenario.

## 1.6. WMZ5 Basin

Note. Source control results were presented for WMZ5 basin discharging via infiltration up to the 24 hour storm. These results show the half drain time exceeds 7 days; however sufficient land/volume has been allocated within the TCA to manage the critical storm volume.

Results are appended and show the critical storage volumes with greenfield runoff limited outflow to 1 l/s/ha in addition to the very low infiltration figures that were applied as a Worst Case Scenario.

## 1.7. WMZ6 Basin

## 1.8. ACA East Basin

## 1.9. ACA West Basin

## 1.10. Abbey Road Basin

## 1.1. Source Control Summary

**Table 1. Source Control Volume Summary - maximum storm duration 24 hours**

| WMZ | Catchment Area (ha) | PIMP (%) | Impermeable Area (ha) | Infiltration rate (m/hr) | Outflow (l/s) | Max Volume (15-1440 min) ($m^3$) | | | Storm Event | | | Allocated Storage Volume in the MDS ($m^3$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FSR | FEH 1999 | FEH 2013 | FSR | FEH 1999 | FEH 2013 | |
| WMZ1 | 19.43 | 90% | 17.49 | 0 | 19.43 | 10770.1 | 13946.6 | 14690.4 | 1440 min Winter | 1440 min Winter | 1440 min Winter | 17328.0 |
| WMZ2 | 17.37 | 90% | 15.63 | 0.0272 | 17.37 | 9211.2 | 12005.4 | 12663.5 | 1440 min Winter | 1440 min Winter | 1440 min Winter | 17694.5 |
| WMZ3 | 20.96 | 90% | 18.86 | 0.00482 | 20.96 | 11458.8 | 14887.7 | 15685.8 | 1440 min Winter | 1440 min Winter | 1440 min Winter | 17341.0 |
| WMZ4 | 33.32 | 50% | 16.66 | 0.0279 | 0 | 10080.8 | 12795.4 | 13422.3 | 1440 min Winter | 1440 min Winter | 1440 min Winter | 25688.8 |
| WMZ5 | 31.20 | 50% | 15.60 | 0.0045 | 0 | 9715.2 | 12296.3 | 12891.1 | 1440 min Winter | 1440 min Winter | 1440 min Winter | 17273.8 |
| WMZ6 | 47.77 | 58% | 27.71 | 0.0201 | 47.77 | 14418.3 | 19117.2 | 20216.7 | 1440 min Winter | 1440 min Winter | 1440 min Winter | 22376.0 |
| ACA East | 25.22 | 100% | 25.22 | 0 | 59.87 | 15381.1 | 20579.7 | 21641.3 | 1440 min Winter | 1440 min Winter | 1440 min Winter | 23221.0 |
| ACA West | 4.44 | 100% | 4.44 | 0 | 10.53 | 2698.8 | 3623.2 | 3812.3 | 1440 min Winter | 1440 min Winter | 1440 min Winter | 4000.0 |
| Abbey Road | 6.48 | 50% | 3.24 | 0.3816 | 6.5 | 1048.1 | 1413.5 | 1338.8 | 240 min Winter | 240 min Winter | 600 min Winter | 1872.0 |

**Table 2. Source Control Volume Summary - where critical storm exceeds 24 hours**

| WMZ | Catchment Area (ha) | PIMP (%) | Impermeable Area (ha) | Infiltration rate (m/hr) | Outflow (l/s) | Max Critical Volume ($m^3$) | | | Critical Event (100 RP) | | | Allocated Storage Volume in the MDS ($m^3$) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | FSR | FEH 1999 | FEH 2013 | FSR | FEH 1999 | FEH 2013 | |
| WMZ1 | 19.43 | 90% | 17.49 | 0 | 19.43 | 11231 | 14660.9 | 15067.6 | 2880 min Winter | 2880 min Winter | 2160 min Winter | 17328.0 |
| WMZ2 | 17.37 | 90% | 15.63 | 0.0272 | 17.37 | 9327.8 | 12221.1 | 12771.8 | 2160 min Winter | 2160 min Winter | 2160 min Winter | 17694.5 |
| WMZ3 | 20.96 | 90% | 18.86 | 0.00482 | 20.96 | 11814.5 | 15513.7 | 16016.4 | 2880 min Winter | 2880 min Winter | 2160 min Winter | 17341.0 |
| WMZ4 | 33.32 | 50% | 16.66 | 0.0279 | 33.32 | 7969.3 | 10647.2 | 11263.3 | 960 min Winter | 1440 min Winter | 1440 min Winter | 25688.8 |
| WMZ5 | 31.20 | 50% | 15.60 | 0.0045 | 31.95 | 7641.5 | 10213.3 | 10803.2 | 1440 min Winter | 1440 min Winter | 1440 min Winter | 17273.8 |

Notes:

1. On WMZs 1, 2, and 3 it is recognised that under a 100 year (+CC) storm condition the very low Worst Case Scenario (WCS) infiltration rates will exceed the 24 hour half drain down time in some circumstances. Should an exceptional storm event follow even these extreme conditions the basin will drain via an emergency overflow to the spine sewer for discharge via the Combined Drainage Outfall (CDO).
2. On WMZs 4 and 5 an additional outflow limited to greenfield runoff rate of 1 l/s/ha has been applied. Should subsequent infiltration rates indicate improved rates maximum discharge to the ground will be applied.

**Table 3. Volumetric Runoff Coefficient, Cv**

| | Coordinates | PIMP | SOIL | SAAR | UCWI (winter) | PR (winter) | Cv (winter) | UCWI (summer) | PR (summer) | Cv (summer) |
|---|---|---|---|---|---|---|---|---|---|---|
| WMZ1 | 52.22713° N, 1.61861° E | 90.00 | 0.15 | 578 | 122 | 67.176 | 0.746 | 50 | 61.56 | 0.684 |
| WMZ2 | 52.22369° N, 1.61326° E | 90.00 | 0.15 | 580 | 122 | 67.176 | 0.746 | 50 | 61.56 | 0.684 |
| WMZ3 | 52.22347° N, 1.59687° E | 90.00 | 0.15 | 581 | 122 | 67.176 | 0.746 | 50 | 61.56 | 0.684 |
| WMZ4 | 52.22643° N, 1.59734° E | 50.00 | 0.15 | 581 | 122 | 34.016 | 0.680 | 50 | 28.4 | 0.568 |
| WMZ5 | 52.23152° N, 1.59641° E | 50.00 | 0.15 | 581 | 122 | 34.016 | 0.680 | 50 | 28.4 | 0.568 |
| WMZ6 | 52.22067° N, 1.59064° E | 58.00 | 0.15 | 581 | 122 | 40.648 | 0.701 | 50 | 35.032 | 0.604 |
| ACA | 52.20902° N, 1.59176° E | 100.00 | 0.4 | 581 | 122 | 81.716 | 0.817 | 50 | 76.1 | 0.761 |
| Abbey Road | 52.21862° N, 1.57514° E | 50.00 | 0.15 | 582 | 122 | 34.016 | 0.680 | 50 | 28.4 | 0.568 |
| | | | *Ref 1* | *Ref 1* | *Ref 2* | *Eq 7.3 Ref 3* | *Eq 7.21 Ref 3* | *Ref 2* | *Eq 7.3 Ref 3* | *Eq 7.21 Ref 3* |

Ref 1 - UK SuDS Greenfield Estimation Tool (http://www.uksuds.com/drainage-calculation-tools/greenfield-runoff-rate-estimation)

Ref 2 - Figure 6.2 of Urban Drainage 3rd Edition David Butler and John W. Davies (overleaf)

Ref 3 - Design and Analysis of Urban Storm Drainage - The Wallingford Procedure, Volume 1, September 1981

Ref 2 - Figure 6.2 of Urban Drainage 3rd Edition David Butler and John W. Davies (below)

*UCWI*

The urban catchment wetness index *(UCWI)* represents the degree of wetness of the catchment at the start of a storm event. As *UCWI* increases, so does the *PR* value reflecting the increased runoff expected from a wetter catchment. It can be estimated for design purposes from its relationship with the standard average annual rainfall *(SAAR)* given in Fig. 6.2. A map of average annual rainfall is given in the *Wallingford Procedure*.

When simulating historical events:

$$UCWI = 125 + 8API5 - SMD \qquad (6.6)$$

*API5* 5-day antecedent precipitation index
*SMD* soil moisture deficit.

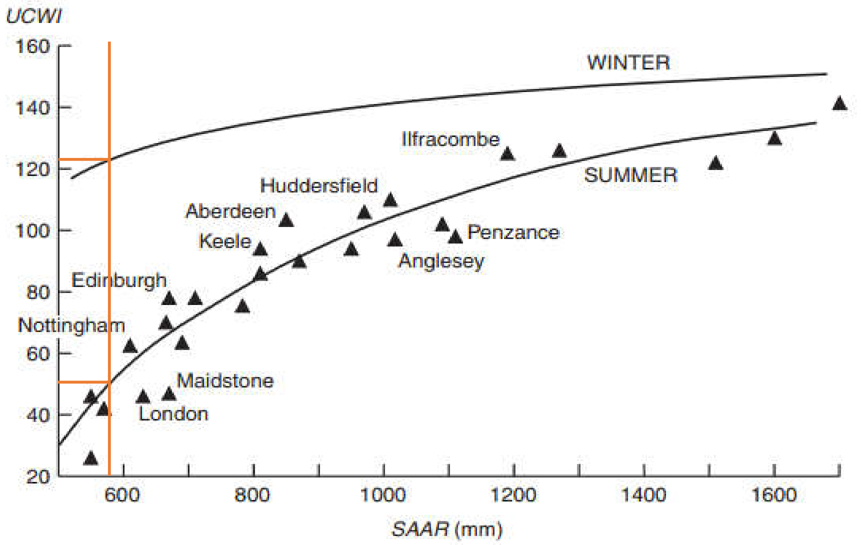


*Fig. 6.2* Relationship between *UCWI* and *SAAR* (based on Packman [1986] with permission of the Chartered Institution of Water and Environmental Management, London)

Ref 3 - Equation 7.3 and 7.21 reproduced from Design and Analysis of Urban Storm Drainage - The Wallingford Procedure, Volume 1, September 1981

The Cv Calculator can be used to calculate a more accurate value of Cv via equation 7.3

PR = 0.829 * PIMP + 25 * SOIL + 0.078 * UCWI - 20.7

and equation 7.21

Cv = PR / PIMP

of Reference 1.

***UCWI***
The UCWI (Urban Catchment Wetness Index) represents the degree of wetness of a catchment at the start of a storm event.

***Soil***
Soil index of the catchment from FSR figure I.4.18 or Wallingford Procedure Volume 3. Soil classes 1 to 5 have Soil Index values of 0.15, 0.3, 0.4, 0.45 and 0.5 respectively.

***PIMP (% Impervious)***
The Area specified for each pipe in the system is total contributing area with runoff only attributable to the impervious percentage. An individual PIMP may be specified for each pipe, those pipes whose PIMP is left empty will default to the Global value.

## 1.2. WMZ1 Basin

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 13:47<br>File WMZ1 FSR.SRCX | Designed by KPL<br>Checked by DH | Micro Drainage |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time : 4959 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 1.596 | 0.396 | 0.0 | 19.3 | 19.3 | 3174.4 | O K |
| 30 min Summer | 1.716 | 0.516 | 0.0 | 19.3 | 19.3 | 4169.3 | O K |
| 60 min Summer | 1.841 | 0.641 | 0.0 | 19.3 | 19.3 | 5217.8 | O K |
| 120 min Summer | 1.969 | 0.769 | 0.0 | 19.3 | 19.3 | 6306.9 | O K |
| 180 min Summer | 2.044 | 0.844 | 0.0 | 19.3 | 19.3 | 6950.0 | O K |
| 240 min Summer | 2.096 | 0.896 | 0.0 | 19.3 | 19.3 | 7399.3 | O K |
| 360 min Summer | 2.164 | 0.964 | 0.0 | 19.3 | 19.3 | 7996.6 | O K |
| 480 min Summer | 2.211 | 1.011 | 0.0 | 19.3 | 19.3 | 8410.6 | O K |
| 600 min Summer | 2.247 | 1.047 | 0.0 | 19.3 | 19.3 | 8732.3 | O K |
| 720 min Summer | 2.276 | 1.076 | 0.0 | 19.3 | 19.3 | 8986.0 | O K |
| 960 min Summer | 2.318 | 1.118 | 0.0 | 19.3 | 19.3 | 9361.2 | O K |
| 1440 min Summer | 2.368 | 1.168 | 0.0 | 19.3 | 19.3 | 9805.4 | O K |
| 2160 min Summer | 2.399 | 1.199 | 0.0 | 19.3 | 19.3 | 10088.1 | O K |
| 2880 min Summer | 2.405 | 1.205 | 0.0 | 19.3 | 19.3 | 10139.5 | O K |
| 4320 min Summer | 2.381 | 1.181 | 0.0 | 19.3 | 19.3 | 9923.6 | O K |
| 5760 min Summer | 2.350 | 1.150 | 0.0 | 19.3 | 19.3 | 9643.9 | O K |
| 15 min Winter | 1.631 | 0.431 | 0.0 | 19.3 | 19.3 | 3463.3 | O K |
| 30 min Winter | 1.762 | 0.562 | 0.0 | 19.3 | 19.3 | 4549.5 | O K |
| 60 min Winter | 1.897 | 0.697 | 0.0 | 19.3 | 19.3 | 5694.1 | O K |
| 120 min Winter | 2.036 | 0.836 | 0.0 | 19.3 | 19.3 | 6887.1 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 106.778 | 0.0 | 1619.1 | 27 |
| 30 min Summer | 70.214 | 0.0 | 1644.9 | 42 |
| 60 min Summer | 44.063 | 0.0 | 3268.3 | 72 |
| 120 min Summer | 26.779 | 0.0 | 3196.6 | 132 |
| 180 min Summer | 19.773 | 0.0 | 3099.9 | 192 |
| 240 min Summer | 15.863 | 0.0 | 3000.6 | 250 |
| 360 min Summer | 11.539 | 0.0 | 2879.3 | 370 |
| 480 min Summer | 9.189 | 0.0 | 2812.9 | 490 |
| 600 min Summer | 7.705 | 0.0 | 2775.4 | 610 |
| 720 min Summer | 6.669 | 0.0 | 2757.6 | 730 |
| 960 min Summer | 5.306 | 0.0 | 2759.1 | 968 |
| 1440 min Summer | 3.839 | 0.0 | 2739.7 | 1446 |
| 2160 min Summer | 2.773 | 0.0 | 5577.3 | 2164 |
| 2880 min Summer | 2.199 | 0.0 | 5481.1 | 2884 |
| 4320 min Summer | 1.584 | 0.0 | 5270.7 | 4028 |
| 5760 min Summer | 1.254 | 0.0 | 11106.2 | 4720 |
| 15 min Winter | 106.778 | 0.0 | 1637.2 | 27 |
| 30 min Winter | 70.214 | 0.0 | 1641.8 | 41 |
| 60 min Winter | 44.063 | 0.0 | 3260.0 | 70 |
| 120 min Winter | 26.779 | 0.0 | 3134.0 | 130 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:47<br>File WMZ1 FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 180 min Winter | 2.118 | 0.918 | 0.0 | 19.3 | 19.3 | 7593.1 | O K |
| 240 min Winter | 2.174 | 0.974 | 0.0 | 19.3 | 19.3 | 8084.0 | O K |
| 360 min Winter | 2.248 | 1.048 | 0.0 | 19.3 | 19.3 | 8738.6 | O K |
| 480 min Winter | 2.300 | 1.100 | 0.0 | 19.3 | 19.3 | 9195.0 | O K |
| 600 min Winter | 2.340 | 1.140 | 0.0 | 19.3 | 19.3 | 9551.8 | O K |
| 720 min Winter | 2.371 | 1.171 | 0.0 | 19.3 | 19.3 | 9834.8 | O K |
| 960 min Winter | 2.418 | 1.218 | 0.0 | 19.3 | 19.3 | 10257.2 | O K |
| 1440 min Winter | 2.475 | 1.275 | 0.0 | 19.3 | 19.3 | 10770.1 | O K |
| 2160 min Winter | 2.514 | 1.314 | 0.0 | 19.5 | 19.5 | 11124.8 | Flood Risk |
| 2880 min Winter | 2.525 | 1.325 | 0.0 | 19.6 | 19.6 | 11231.0 | Flood Risk |
| 4320 min Winter | 2.510 | 1.310 | 0.0 | 19.5 | 19.5 | 11088.2 | Flood Risk |
| 5760 min Winter | 2.470 | 1.270 | 0.0 | 19.3 | 19.3 | 10726.2 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 180 min Winter | 19.773 | 0.0 | 2995.2 | 188 |
| 240 min Winter | 15.863 | 0.0 | 2915.4 | 248 |
| 360 min Winter | 11.539 | 0.0 | 2843.8 | 366 |
| 480 min Winter | 9.189 | 0.0 | 2825.8 | 484 |
| 600 min Winter | 7.705 | 0.0 | 2839.8 | 602 |
| 720 min Winter | 6.669 | 0.0 | 2861.7 | 720 |
| 960 min Winter | 5.306 | 0.0 | 2880.1 | 954 |
| 1440 min Winter | 3.839 | 0.0 | 2857.9 | 1422 |
| 2160 min Winter | 2.773 | 0.0 | 5766.1 | 2120 |
| 2880 min Winter | 2.199 | 0.0 | 5731.0 | 2800 |
| 4320 min Winter | 1.584 | 0.0 | 5512.2 | 4112 |
| 5760 min Winter | 1.254 | 0.0 | 11308.0 | 5304 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:47<br>File WMZ1 FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.684 |
| Region | England and Wales | Cv (Winter) | 0.746 |
| M5-60 (mm) | 18.200 | Shortest Storm (mins) | 15 |
| Ratio R | 0.400 | Longest Storm (mins) | 5760 |
| Summer Storms | Yes | Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 17.487

| Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 5.829 | 4 | 8 | 5.829 | 8 | 12 | 5.829 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:47<br>File WMZ1 FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 2.800

## Infiltration Basin Structure

Invert Level (m) 1.200 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 7833.3 | 1.300 | 9104.7 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0192-1940-1300-1940 |
| Design Head (m) | 1.300 |
| Design Flow (l/s) | 19.4 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 192 |
| Invert Level (m) | 1.200 |
| Minimum Outlet Pipe Diameter (mm) | 225 |
| Suggested Manhole Diameter (mm) | 1500 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 1.300 | 19.4 |
| Flush-Flo™ | 0.399 | 19.3 |
| Kick-Flo® | 0.875 | 16.1 |
| Mean Flow over Head Range | - | 16.6 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.100 | 6.7 | 1.200 | 18.7 | 3.000 | 28.9 | 7.000 | 43.5 |
| 0.200 | 17.7 | 1.400 | 20.1 | 3.500 | 31.1 | 7.500 | 45.0 |
| 0.300 | 19.0 | 1.600 | 21.4 | 4.000 | 33.2 | 8.000 | 46.4 |
| 0.400 | 19.3 | 1.800 | 22.6 | 4.500 | 35.1 | 8.500 | 47.8 |
| 0.500 | 19.2 | 2.000 | 23.8 | 5.000 | 37.0 | 9.000 | 49.1 |
| 0.600 | 18.8 | 2.200 | 24.9 | 5.500 | 38.7 | 9.500 | 50.4 |
| 0.800 | 17.4 | 2.400 | 26.0 | 6.000 | 40.4 | | |
| 1.000 | 17.1 | 2.600 | 27.0 | 6.500 | 42.0 | | |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:51<br>File WMZ1 FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time : 6416 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 1.732 | 0.532 | 0.0 | 19.3 | 19.3 | 5500.9 | O K |
| 30 min Summer | 1.810 | 0.610 | 0.0 | 19.3 | 19.3 | 6341.8 | O K |
| 60 min Summer | 1.900 | 0.700 | 0.0 | 19.3 | 19.3 | 7302.4 | O K |
| 120 min Summer | 2.000 | 0.800 | 0.0 | 19.3 | 19.3 | 8391.2 | O K |
| 180 min Summer | 2.063 | 0.863 | 0.0 | 19.3 | 19.3 | 9089.0 | O K |
| 240 min Summer | 2.111 | 0.911 | 0.0 | 19.3 | 19.3 | 9610.1 | O K |
| 360 min Summer | 2.179 | 0.979 | 0.0 | 19.3 | 19.3 | 10373.0 | O K |
| 480 min Summer | 2.229 | 1.029 | 0.0 | 19.3 | 19.3 | 10927.9 | O K |
| 600 min Summer | 2.268 | 1.068 | 0.0 | 19.3 | 19.3 | 11361.1 | O K |
| 720 min Summer | 2.299 | 1.099 | 0.0 | 19.3 | 19.3 | 11713.5 | O K |
| 960 min Summer | 2.339 | 1.139 | 0.0 | 19.3 | 19.3 | 12159.6 | O K |
| 1440 min Summer | 2.388 | 1.188 | 0.0 | 19.3 | 19.3 | 12718.8 | O K |
| 2160 min Summer | 2.424 | 1.224 | 0.0 | 19.3 | 19.3 | 13133.4 | O K |
| 2880 min Summer | 2.438 | 1.238 | 0.0 | 19.3 | 19.3 | 13288.6 | O K |
| 4320 min Summer | 2.401 | 1.201 | 0.0 | 19.3 | 19.3 | 12864.6 | O K |
| 15 min Winter | 1.779 | 0.579 | 0.0 | 19.3 | 19.3 | 6001.0 | O K |
| 30 min Winter | 1.864 | 0.664 | 0.0 | 19.3 | 19.3 | 6918.8 | O K |
| 60 min Winter | 1.961 | 0.761 | 0.0 | 19.3 | 19.3 | 7967.9 | O K |
| 120 min Winter | 2.070 | 0.870 | 0.0 | 19.3 | 19.3 | 9160.7 | O K |
| 180 min Winter | 2.139 | 0.939 | 0.0 | 19.3 | 19.3 | 9924.8 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 184.621 | 0.0 | 1650.9 | 27 |
| 30 min Summer | 106.552 | 0.0 | 1628.5 | 42 |
| 60 min Summer | 61.496 | 0.0 | 3247.2 | 72 |
| 120 min Summer | 35.492 | 0.0 | 3144.7 | 132 |
| 180 min Summer | 25.733 | 0.0 | 3036.1 | 192 |
| 240 min Summer | 20.484 | 0.0 | 2934.0 | 252 |
| 360 min Summer | 14.851 | 0.0 | 2822.6 | 370 |
| 480 min Summer | 11.822 | 0.0 | 2779.7 | 490 |
| 600 min Summer | 9.905 | 0.0 | 2777.2 | 610 |
| 720 min Summer | 8.571 | 0.0 | 2795.2 | 730 |
| 960 min Summer | 6.770 | 0.0 | 2802.4 | 968 |
| 1440 min Summer | 4.855 | 0.0 | 2768.4 | 1448 |
| 2160 min Summer | 3.482 | 0.0 | 5635.6 | 2164 |
| 2880 min Summer | 2.750 | 0.0 | 5585.2 | 2884 |
| 4320 min Summer | 1.927 | 0.0 | 5294.9 | 4320 |
| 15 min Winter | 184.621 | 0.0 | 1642.9 | 27 |
| 30 min Winter | 106.552 | 0.0 | 1613.5 | 42 |
| 60 min Winter | 61.496 | 0.0 | 3205.7 | 72 |
| 120 min Winter | 35.492 | 0.0 | 3048.5 | 130 |
| 180 min Winter | 25.733 | 0.0 | 2919.7 | 190 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 13:51<br>File WMZ1 FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 240 min Winter | 2.190 | 0.990 | 0.0 | 19.3 | 19.3 | 10494.5 | O K |
| 360 min Winter | 2.265 | 1.065 | 0.0 | 19.3 | 19.3 | 11330.0 | O K |
| 480 min Winter | 2.319 | 1.119 | 0.0 | 19.3 | 19.3 | 11940.2 | O K |
| 600 min Winter | 2.362 | 1.162 | 0.0 | 19.3 | 19.3 | 12418.5 | O K |
| 720 min Winter | 2.396 | 1.196 | 0.0 | 19.3 | 19.3 | 12809.0 | O K |
| 960 min Winter | 2.440 | 1.240 | 0.0 | 19.3 | 19.3 | 13308.9 | O K |
| 1440 min Winter | 2.495 | 1.295 | 0.0 | 19.3 | 19.3 | 13946.6 | O K |
| 2160 min Winter | 2.539 | 1.339 | 0.0 | 19.7 | 19.7 | 14444.2 | Flood Risk |
| 2880 min Winter | 2.558 | 1.358 | 0.0 | 19.8 | 19.8 | 14660.9 | Flood Risk |
| 4320 min Winter | 2.526 | 1.326 | 0.0 | 19.6 | 19.6 | 14295.1 | Flood Risk |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 240 min Winter | 20.484 | 0.0 | 2856.0 | 248 |
| 360 min Winter | 14.851 | 0.0 | 2825.8 | 366 |
| 480 min Winter | 11.822 | 0.0 | 2862.9 | 484 |
| 600 min Winter | 9.905 | 0.0 | 2896.0 | 602 |
| 720 min Winter | 8.571 | 0.0 | 2916.7 | 722 |
| 960 min Winter | 6.770 | 0.0 | 2923.3 | 956 |
| 1440 min Winter | 4.855 | 0.0 | 2886.0 | 1428 |
| 2160 min Winter | 3.482 | 0.0 | 5887.7 | 2124 |
| 2880 min Winter | 2.750 | 0.0 | 5831.3 | 2824 |
| 4320 min Winter | 1.927 | 0.0 | 5529.5 | 4156 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:51<br>File WMZ1 FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| Return Period (years) | 100 |
| FEH Rainfall Version | 1999 |
| Site Location | GB 647450 264900 TM 47450 64900 |
| C (1km) | -0.020 |
| D1 (1km) | 0.299 |
| D2 (1km) | 0.272 |
| D3 (1km) | 0.215 |
| E (1km) | 0.311 |
| F (1km) | 2.506 |
| Summer Storms | Yes |
| Winter Storms | Yes |
| Cv (Summer) | 0.684 |
| Cv (Winter) | 0.746 |
| Shortest Storm (mins) | 15 |
| Longest Storm (mins) | 4320 |
| Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 17.487

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 5.829 | 4 | 8 | 5.829 | 8 | 12 | 5.829 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:51<br>File WMZ1 FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 2.800

## Infiltration Basin Structure

Invert Level (m) 1.200 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 10059.4 | 1.300 | 11493.8 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0192-1940-1300-1940 |
| Design Head (m) | 1.300 |
| Design Flow (l/s) | 19.4 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 192 |
| Invert Level (m) | 1.200 |
| Minimum Outlet Pipe Diameter (mm) | 225 |
| Suggested Manhole Diameter (mm) | 1500 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 1.300 | 19.4 |
| Flush-Flo™ | 0.399 | 19.3 |
| Kick-Flo® | 0.875 | 16.1 |
| Mean Flow over Head Range | - | 16.6 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.100 | 6.7 | 1.200 | 18.7 | 3.000 | 28.9 | 7.000 | 43.5 |
| 0.200 | 17.7 | 1.400 | 20.1 | 3.500 | 31.1 | 7.500 | 45.0 |
| 0.300 | 19.0 | 1.600 | 21.4 | 4.000 | 33.2 | 8.000 | 46.4 |
| 0.400 | 19.3 | 1.800 | 22.6 | 4.500 | 35.1 | 8.500 | 47.8 |
| 0.500 | 19.2 | 2.000 | 23.8 | 5.000 | 37.0 | 9.000 | 49.1 |
| 0.600 | 18.8 | 2.200 | 24.9 | 5.500 | 38.7 | 9.500 | 50.4 |
| 0.800 | 17.4 | 2.400 | 26.0 | 6.000 | 40.4 | | |
| 1.000 | 17.1 | 2.600 | 27.0 | 6.500 | 42.0 | | |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 13:52<br>File WMZ1 FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time : 6649 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 1.472 | 0.272 | 0.0 | 18.8 | 18.8 | 2976.6 | O K |
| 30 min Summer | 1.568 | 0.368 | 0.0 | 19.3 | 19.3 | 4051.5 | O K |
| 60 min Summer | 1.670 | 0.470 | 0.0 | 19.3 | 19.3 | 5197.5 | O K |
| 120 min Summer | 1.794 | 0.594 | 0.0 | 19.3 | 19.3 | 6619.8 | O K |
| 180 min Summer | 1.882 | 0.682 | 0.0 | 19.3 | 19.3 | 7627.4 | O K |
| 240 min Summer | 1.951 | 0.751 | 0.0 | 19.3 | 19.3 | 8432.6 | O K |
| 360 min Summer | 2.059 | 0.859 | 0.0 | 19.3 | 19.3 | 9696.9 | O K |
| 480 min Summer | 2.139 | 0.939 | 0.0 | 19.3 | 19.3 | 10641.3 | O K |
| 600 min Summer | 2.199 | 0.999 | 0.0 | 19.3 | 19.3 | 11348.7 | O K |
| 720 min Summer | 2.244 | 1.044 | 0.0 | 19.3 | 19.3 | 11894.5 | O K |
| 960 min Summer | 2.307 | 1.107 | 0.0 | 19.3 | 19.3 | 12645.0 | O K |
| 1440 min Summer | 2.369 | 1.169 | 0.0 | 19.3 | 19.3 | 13402.6 | O K |
| 2160 min Summer | 2.394 | 1.194 | 0.0 | 19.3 | 19.3 | 13709.3 | O K |
| 2880 min Summer | 2.388 | 1.188 | 0.0 | 19.3 | 19.3 | 13626.8 | O K |
| 15 min Winter | 1.496 | 0.296 | 0.0 | 19.0 | 19.0 | 3247.2 | O K |
| 30 min Winter | 1.601 | 0.401 | 0.0 | 19.3 | 19.3 | 4420.7 | O K |
| 60 min Winter | 1.711 | 0.511 | 0.0 | 19.3 | 19.3 | 5671.6 | O K |
| 120 min Winter | 1.847 | 0.647 | 0.0 | 19.3 | 19.3 | 7226.6 | O K |
| 180 min Winter | 1.942 | 0.742 | 0.0 | 19.3 | 19.3 | 8329.4 | O K |
| 240 min Winter | 2.018 | 0.818 | 0.0 | 19.3 | 19.3 | 9212.3 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 100.080 | 0.0 | 1428.4 | 27 |
| 30 min Summer | 68.208 | 0.0 | 1617.4 | 42 |
| 60 min Summer | 43.872 | 0.0 | 3231.5 | 72 |
| 120 min Summer | 28.074 | 0.0 | 3258.2 | 132 |
| 180 min Summer | 21.656 | 0.0 | 3204.3 | 192 |
| 240 min Summer | 18.024 | 0.0 | 3137.2 | 250 |
| 360 min Summer | 13.906 | 0.0 | 2969.4 | 370 |
| 480 min Summer | 11.513 | 0.0 | 2806.0 | 490 |
| 600 min Summer | 9.884 | 0.0 | 2740.5 | 610 |
| 720 min Summer | 8.689 | 0.0 | 2735.6 | 730 |
| 960 min Summer | 7.018 | 0.0 | 2769.0 | 970 |
| 1440 min Summer | 5.090 | 0.0 | 2749.4 | 1448 |
| 2160 min Summer | 3.610 | 0.0 | 5583.2 | 2168 |
| 2880 min Summer | 2.801 | 0.0 | 5482.9 | 2884 |
| 15 min Winter | 100.080 | 0.0 | 1514.7 | 27 |
| 30 min Winter | 68.208 | 0.0 | 1633.5 | 41 |
| 60 min Winter | 43.872 | 0.0 | 3270.5 | 70 |
| 120 min Winter | 28.074 | 0.0 | 3246.4 | 130 |
| 180 min Winter | 21.656 | 0.0 | 3170.3 | 188 |
| 240 min Winter | 18.024 | 0.0 | 3076.1 | 248 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:52<br>File WMZ1 FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 360 min Winter | 2.136 | 0.936 | 0.0 | 19.3 | 19.3 | 10599.5 | O K |
| 480 min Winter | 2.222 | 1.022 | 0.0 | 19.3 | 19.3 | 11628.9 | O K |
| 600 min Winter | 2.287 | 1.087 | 0.0 | 19.3 | 19.3 | 12404.0 | O K |
| 720 min Winter | 2.336 | 1.136 | 0.0 | 19.3 | 19.3 | 13004.8 | O K |
| 960 min Winter | 2.405 | 1.205 | 0.0 | 19.3 | 19.3 | 13836.5 | O K |
| 1440 min Winter | 2.475 | 1.275 | 0.0 | 19.3 | 19.3 | 14690.4 | O K |
| 2160 min Winter | 2.506 | 1.306 | 0.0 | 19.4 | 19.4 | 15067.6 | Flood Risk |
| 2880 min Winter | 2.502 | 1.302 | 0.0 | 19.4 | 19.4 | 15020.6 | Flood Risk |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 360 min Winter | 13.906 | 0.0 | 2854.1 | 366 |
| 480 min Winter | 11.513 | 0.0 | 2779.7 | 484 |
| 600 min Winter | 9.884 | 0.0 | 2812.3 | 602 |
| 720 min Winter | 8.689 | 0.0 | 2853.1 | 722 |
| 960 min Winter | 7.019 | 0.0 | 2889.3 | 958 |
| 1440 min Winter | 5.090 | 0.0 | 2867.0 | 1428 |
| 2160 min Winter | 3.610 | 0.0 | 5833.7 | 2124 |
| 2880 min Winter | 2.801 | 0.0 | 5728.3 | 2824 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:52<br>File WMZ1 FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| Return Period (years) | 100 |
| FEH Rainfall Version | 2013 |
| Site Location | GB 647450 264900 TM 47450 64900 |
| Data Type | Catchment |
| Summer Storms | Yes |
| Winter Storms | Yes |
| Cv (Summer) | 0.684 |
| Cv (Winter) | 0.746 |
| Shortest Storm (mins) | 15 |
| Longest Storm (mins) | 2880 |
| Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 17.487

| Time (mins) From: | To: | Area (ha) | Time (mins) From: | To: | Area (ha) | Time (mins) From: | To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 5.829 | 4 | 8 | 5.829 | 8 | 12 | 5.829 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:52<br>File WMZ1 FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 2.800

## Infiltration Basin Structure

Invert Level (m) 1.200 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 10803.7 | 1.300 | 12288.4 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0192-1940-1300-1940 |
| Design Head (m) | 1.300 |
| Design Flow (l/s) | 19.4 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 192 |
| Invert Level (m) | 1.200 |
| Minimum Outlet Pipe Diameter (mm) | 225 |
| Suggested Manhole Diameter (mm) | 1500 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 1.300 | 19.4 |
| Flush-Flo™ | 0.399 | 19.3 |
| Kick-Flo® | 0.875 | 16.1 |
| Mean Flow over Head Range | - | 16.6 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.100 | 6.7 | 1.200 | 18.7 | 3.000 | 28.9 | 7.000 | 43.5 |
| 0.200 | 17.7 | 1.400 | 20.1 | 3.500 | 31.1 | 7.500 | 45.0 |
| 0.300 | 19.0 | 1.600 | 21.4 | 4.000 | 33.2 | 8.000 | 46.4 |
| 0.400 | 19.3 | 1.800 | 22.6 | 4.500 | 35.1 | 8.500 | 47.8 |
| 0.500 | 19.2 | 2.000 | 23.8 | 5.000 | 37.0 | 9.000 | 49.1 |
| 0.600 | 18.8 | 2.200 | 24.9 | 5.500 | 38.7 | 9.500 | 50.4 |
| 0.800 | 17.4 | 2.400 | 26.0 | 6.000 | 40.4 | | |
| 1.000 | 17.1 | 2.600 | 27.0 | 6.500 | 42.0 | | |

## 1.3. WMZ2 Basin

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:53<br>File WMZ2 FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time : 3485 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 3.872 | 0.672 | 2.5 | 17.4 | 19.8 | 2834.0 | O K |
| 30 min Summer | 4.068 | 0.868 | 3.2 | 17.4 | 20.1 | 3720.9 | O K |
| 60 min Summer | 4.267 | 1.067 | 4.0 | 17.4 | 20.1 | 4652.0 | O K |
| 120 min Summer | 4.467 | 1.267 | 4.8 | 17.4 | 20.1 | 5614.4 | O K |
| 180 min Summer | 4.581 | 1.381 | 5.2 | 17.4 | 20.1 | 6174.4 | O K |
| 240 min Summer | 4.658 | 1.458 | 5.5 | 17.4 | 20.5 | 6557.5 | O K |
| 360 min Summer | 4.756 | 1.556 | 5.9 | 17.4 | 21.3 | 7054.7 | O K |
| 480 min Summer | 4.821 | 1.621 | 6.2 | 17.4 | 21.9 | 7388.5 | O K |
| 600 min Summer | 4.870 | 1.670 | 6.4 | 17.4 | 22.3 | 7640.2 | O K |
| 720 min Summer | 4.906 | 1.706 | 6.5 | 17.4 | 22.6 | 7831.0 | O K |
| 960 min Summer | 4.957 | 1.757 | 6.7 | 17.4 | 23.1 | 8094.2 | O K |
| 1440 min Summer | 5.005 | 1.805 | 6.9 | 17.4 | 23.5 | 8349.3 | O K |
| 2160 min Summer | 5.014 | 1.814 | 7.0 | 17.4 | 23.6 | 8397.9 | O K |
| 2880 min Summer | 4.990 | 1.790 | 6.9 | 17.4 | 23.4 | 8269.5 | O K |
| 15 min Winter | 3.929 | 0.729 | 2.7 | 17.4 | 19.9 | 3092.2 | O K |
| 30 min Winter | 4.141 | 0.941 | 3.5 | 17.4 | 20.1 | 4060.7 | O K |
| 60 min Winter | 4.357 | 1.157 | 4.3 | 17.4 | 20.1 | 5078.6 | O K |
| 120 min Winter | 4.573 | 1.373 | 5.2 | 17.4 | 20.1 | 6132.1 | O K |
| 180 min Winter | 4.695 | 1.495 | 5.7 | 17.4 | 20.8 | 6745.4 | O K |
| 240 min Winter | 4.778 | 1.578 | 6.0 | 17.4 | 21.5 | 7166.5 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 106.778 | 0.0 | 1619.9 | 27 |
| 30 min Summer | 70.214 | 0.0 | 1690.2 | 42 |
| 60 min Summer | 44.063 | 0.0 | 3350.8 | 72 |
| 120 min Summer | 26.779 | 0.0 | 3355.5 | 132 |
| 180 min Summer | 19.773 | 0.0 | 3329.2 | 190 |
| 240 min Summer | 15.863 | 0.0 | 3319.5 | 250 |
| 360 min Summer | 11.539 | 0.0 | 3316.5 | 370 |
| 480 min Summer | 9.189 | 0.0 | 3322.5 | 488 |
| 600 min Summer | 7.705 | 0.0 | 3335.2 | 608 |
| 720 min Summer | 6.669 | 0.0 | 3352.2 | 728 |
| 960 min Summer | 5.306 | 0.0 | 3389.0 | 966 |
| 1440 min Summer | 3.839 | 0.0 | 3384.4 | 1444 |
| 2160 min Summer | 2.773 | 0.0 | 6693.1 | 2160 |
| 2880 min Summer | 2.199 | 0.0 | 6569.3 | 2680 |
| 15 min Winter | 106.778 | 0.0 | 1649.8 | 27 |
| 30 min Winter | 70.214 | 0.0 | 1704.2 | 41 |
| 60 min Winter | 44.063 | 0.0 | 3380.9 | 70 |
| 120 min Winter | 26.779 | 0.0 | 3347.6 | 130 |
| 180 min Winter | 19.773 | 0.0 | 3344.6 | 188 |
| 240 min Winter | 15.863 | 0.0 | 3355.7 | 246 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 13:53<br>File WMZ2 FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 360 min Winter | 4.884 | 1.684 | 6.4 | 17.4 | 22.5 | 7716.8 | O K |
| 480 min Winter | 4.956 | 1.756 | 6.7 | 17.4 | 23.1 | 8089.4 | O K |
| 600 min Winter | 5.009 | 1.809 | 6.9 | 17.4 | 23.5 | 8372.4 | O K |
| 720 min Winter | 5.050 | 1.850 | 7.1 | 17.4 | 23.9 | 8589.3 | O K |
| 960 min Winter | 5.107 | 1.907 | 7.3 | 17.4 | 24.3 | 8894.5 | O K |
| 1440 min Winter | 5.166 | 1.966 | 7.6 | 17.4 | 24.8 | 9211.2 | O K |
| 2160 min Winter | 5.187 | 1.987 | 7.7 | 17.4 | 25.0 | 9327.8 | O K |
| 2880 min Winter | 5.171 | 1.971 | 7.6 | 17.4 | 24.9 | 9241.6 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 360 min Winter | 11.539 | 0.0 | 3389.7 | 364 |
| 480 min Winter | 9.189 | 0.0 | 3432.8 | 482 |
| 600 min Winter | 7.705 | 0.0 | 3484.0 | 600 |
| 720 min Winter | 6.669 | 0.0 | 3524.9 | 716 |
| 960 min Winter | 5.306 | 0.0 | 3566.7 | 950 |
| 1440 min Winter | 3.839 | 0.0 | 3554.0 | 1412 |
| 2160 min Winter | 2.773 | 0.0 | 6941.7 | 2084 |
| 2880 min Winter | 2.199 | 0.0 | 6880.8 | 2740 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:53<br>File WMZ2 FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.684 |
| Region | England and Wales | Cv (Winter) | 0.746 |
| M5-60 (mm) | 18.200 | Shortest Storm (mins) | 15 |
| Ratio R | 0.400 | Longest Storm (mins) | 2880 |
| Summer Storms | Yes | Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 15.633

| Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 5.211 | 4 | 8 | 5.211 | 8 | 12 | 5.211 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:53<br>File WMZ2 FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 5.500

## Infiltration Basin Structure

Invert Level (m) 3.200 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.02720

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 3989.0 | 2.000 | 5445.5 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0172-1740-2000-1740 |
| Design Head (m) | 2.000 |
| Design Flow (l/s) | 17.4 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 172 |
| Invert Level (m) | 3.200 |
| Minimum Outlet Pipe Diameter (mm) | 225 |
| Suggested Manhole Diameter (mm) | 1800 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 2.000 | 17.4 |
| Flush-Flo™ | 0.588 | 17.4 |
| Kick-Flo® | 1.231 | 13.8 |
| Mean Flow over Head Range | - | 15.2 |

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 | 6.1 | 1.200 | 14.3 | 3.000 | 21.1 | 7.000 | 31.7 |
| 0.200 | 14.5 | 1.400 | 14.7 | 3.500 | 22.7 | 7.500 | 32.8 |
| 0.300 | 16.1 | 1.600 | 15.6 | 4.000 | 24.2 | 8.000 | 33.8 |
| 0.400 | 16.9 | 1.800 | 16.5 | 4.500 | 25.6 | 8.500 | 34.8 |
| 0.500 | 17.3 | 2.000 | 17.4 | 5.000 | 26.9 | 9.000 | 35.8 |
| 0.600 | 17.4 | 2.200 | 18.2 | 5.500 | 28.2 | 9.500 | 36.7 |
| 0.800 | 17.1 | 2.400 | 19.0 | 6.000 | 29.4 | | |
| 1.000 | 16.3 | 2.600 | 19.7 | 6.500 | 30.6 | | |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:54<br>File WMZ2 FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time : 4385 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Σ Max Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 4.079 | 0.879 | 3.7 | 17.4 | 20.5 | 4913.3 | O K |
| 30 min Summer | 4.204 | 1.004 | 4.3 | 17.4 | 20.6 | 5662.2 | O K |
| 60 min Summer | 4.344 | 1.144 | 4.9 | 17.4 | 20.6 | 6514.5 | O K |
| 120 min Summer | 4.498 | 1.298 | 5.6 | 17.4 | 20.6 | 7474.7 | O K |
| 180 min Summer | 4.594 | 1.394 | 6.0 | 17.4 | 20.6 | 8081.3 | O K |
| 240 min Summer | 4.664 | 1.464 | 6.3 | 17.4 | 21.3 | 8528.0 | O K |
| 360 min Summer | 4.763 | 1.563 | 6.8 | 17.4 | 22.2 | 9170.9 | O K |
| 480 min Summer | 4.833 | 1.633 | 7.1 | 17.4 | 22.9 | 9627.4 | O K |
| 600 min Summer | 4.886 | 1.686 | 7.3 | 17.4 | 23.3 | 9974.8 | O K |
| 720 min Summer | 4.927 | 1.727 | 7.5 | 17.4 | 23.7 | 10249.9 | O K |
| 960 min Summer | 4.975 | 1.775 | 7.7 | 17.4 | 24.2 | 10570.0 | O K |
| 1440 min Summer | 5.026 | 1.826 | 8.0 | 17.4 | 24.6 | 10912.7 | O K |
| 2160 min Summer | 5.047 | 1.847 | 8.1 | 17.4 | 24.8 | 11053.7 | O K |
| 2880 min Summer | 5.035 | 1.835 | 8.0 | 17.4 | 24.7 | 10973.1 | O K |
| 15 min Winter | 4.154 | 0.954 | 4.0 | 17.4 | 20.6 | 5360.2 | O K |
| 30 min Winter | 4.289 | 1.089 | 4.6 | 17.4 | 20.6 | 6177.9 | O K |
| 60 min Winter | 4.440 | 1.240 | 5.3 | 17.4 | 20.6 | 7110.1 | O K |
| 120 min Winter | 4.607 | 1.407 | 6.0 | 17.4 | 20.8 | 8160.4 | O K |
| 180 min Winter | 4.710 | 1.510 | 6.5 | 17.4 | 21.7 | 8825.2 | O K |
| 240 min Winter | 4.786 | 1.586 | 6.9 | 17.4 | 22.4 | 9315.5 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 184.621 | 0.0 | 1740.9 | 27 |
| 30 min Summer | 106.552 | 0.0 | 1752.9 | 42 |
| 60 min Summer | 61.496 | 0.0 | 3483.9 | 72 |
| 120 min Summer | 35.492 | 0.0 | 3436.1 | 132 |
| 180 min Summer | 25.733 | 0.0 | 3412.3 | 190 |
| 240 min Summer | 20.484 | 0.0 | 3407.6 | 250 |
| 360 min Summer | 14.851 | 0.0 | 3424.0 | 370 |
| 480 min Summer | 11.822 | 0.0 | 3459.2 | 490 |
| 600 min Summer | 9.905 | 0.0 | 3505.8 | 610 |
| 720 min Summer | 8.571 | 0.0 | 3547.0 | 728 |
| 960 min Summer | 6.770 | 0.0 | 3573.6 | 968 |
| 1440 min Summer | 4.855 | 0.0 | 3543.5 | 1446 |
| 2160 min Summer | 3.482 | 0.0 | 6996.2 | 2164 |
| 2880 min Summer | 2.750 | 0.0 | 6929.7 | 2880 |
| 15 min Winter | 184.621 | 0.0 | 1754.1 | 27 |
| 30 min Winter | 106.552 | 0.0 | 1753.8 | 41 |
| 60 min Winter | 61.496 | 0.0 | 3470.3 | 72 |
| 120 min Winter | 35.492 | 0.0 | 3432.8 | 130 |
| 180 min Winter | 25.733 | 0.0 | 3441.8 | 188 |
| 240 min Winter | 20.484 | 0.0 | 3468.2 | 248 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 13:54<br>File WMZ2 FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 360 min Winter | 4.893 | 1.693 | 7.4 | 17.4 | 23.4 | 10024.3 | O K |
| 480 min Winter | 4.969 | 1.769 | 7.7 | 17.4 | 24.1 | 10530.8 | O K |
| 600 min Winter | 5.027 | 1.827 | 8.0 | 17.4 | 24.6 | 10918.6 | O K |
| 720 min Winter | 5.073 | 1.873 | 8.2 | 17.4 | 25.0 | 11227.2 | O K |
| 960 min Winter | 5.127 | 1.927 | 8.4 | 17.4 | 25.5 | 11594.2 | O K |
| 1440 min Winter | 5.187 | 1.987 | 8.7 | 17.4 | 26.0 | 12005.4 | O K |
| 2160 min Winter | 5.218 | 2.018 | 8.8 | 17.5 | 26.3 | 12221.1 | Flood Risk |
| 2880 min Winter | 5.215 | 2.015 | 8.8 | 17.4 | 26.2 | 12200.7 | Flood Risk |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 360 min Winter | 14.851 | 0.0 | 3547.1 | 366 |
| 480 min Winter | 11.822 | 0.0 | 3635.5 | 482 |
| 600 min Winter | 9.905 | 0.0 | 3697.6 | 600 |
| 720 min Winter | 8.571 | 0.0 | 3739.2 | 718 |
| 960 min Winter | 6.770 | 0.0 | 3763.5 | 952 |
| 1440 min Winter | 4.855 | 0.0 | 3723.8 | 1418 |
| 2160 min Winter | 3.482 | 0.0 | 7356.8 | 2104 |
| 2880 min Winter | 2.750 | 0.0 | 7311.0 | 2772 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:54<br>File WMZ2 FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| Return Period (years) | 100 |
| FEH Rainfall Version | 1999 |
| Site Location | GB 647450 264900 TM 47450 64900 |
| C (1km) | -0.020 |
| D1 (1km) | 0.299 |
| D2 (1km) | 0.272 |
| D3 (1km) | 0.215 |
| E (1km) | 0.311 |
| F (1km) | 2.506 |
| Summer Storms | Yes |
| Winter Storms | Yes |
| Cv (Summer) | 0.684 |
| Cv (Winter) | 0.746 |
| Shortest Storm (mins) | 15 |
| Longest Storm (mins) | 2880 |
| Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 15.633

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 5.211 | 4 | 8 | 5.211 | 8 | 12 | 5.211 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 13:54<br>File WMZ2 FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 5.500

## Infiltration Basin Structure

Invert Level (m) 3.200 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.02720

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 5240.9 | 2.000 | 6893.8 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0172-1740-2000-1740 |
| Design Head (m) | 2.000 |
| Design Flow (l/s) | 17.4 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 172 |
| Invert Level (m) | 3.200 |
| Minimum Outlet Pipe Diameter (mm) | 225 |
| Suggested Manhole Diameter (mm) | 1800 |

| **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|
| Design Point (Calculated) | 2.000 | 17.4 |
| Flush-Flo™ | 0.588 | 17.4 |
| Kick-Flo® | 1.231 | 13.8 |
| Mean Flow over Head Range | - | 15.2 |

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 | 6.1 | 1.200 | 14.3 | 3.000 | 21.1 | 7.000 | 31.7 |
| 0.200 | 14.5 | 1.400 | 14.7 | 3.500 | 22.7 | 7.500 | 32.8 |
| 0.300 | 16.1 | 1.600 | 15.6 | 4.000 | 24.2 | 8.000 | 33.8 |
| 0.400 | 16.9 | 1.800 | 16.5 | 4.500 | 25.6 | 8.500 | 34.8 |
| 0.500 | 17.3 | 2.000 | 17.4 | 5.000 | 26.9 | 9.000 | 35.8 |
| 0.600 | 17.4 | 2.200 | 18.2 | 5.500 | 28.2 | 9.500 | 36.7 |
| 0.800 | 17.1 | 2.400 | 19.0 | 6.000 | 29.4 | | |
| 1.000 | 16.3 | 2.600 | 19.7 | 6.500 | 30.6 | | |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:54<br>File WMZ2 FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time : 4569 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 3.655 | 0.455 | 2.0 | 17.2 | 19.2 | 2657.0 | O K |
| 30 min Summer | 3.812 | 0.612 | 2.7 | 17.4 | 20.0 | 3615.8 | O K |
| 60 min Summer | 3.975 | 0.775 | 3.4 | 17.4 | 20.5 | 4634.4 | O K |
| 120 min Summer | 4.173 | 0.973 | 4.3 | 17.4 | 20.7 | 5892.0 | O K |
| 180 min Summer | 4.308 | 1.108 | 4.9 | 17.4 | 20.7 | 6779.2 | O K |
| 240 min Summer | 4.415 | 1.215 | 5.4 | 17.4 | 20.7 | 7486.2 | O K |
| 360 min Summer | 4.578 | 1.378 | 6.1 | 17.4 | 20.7 | 8582.4 | O K |
| 480 min Summer | 4.694 | 1.494 | 6.7 | 17.4 | 21.8 | 9381.0 | O K |
| 600 min Summer | 4.779 | 1.579 | 7.1 | 17.4 | 22.6 | 9969.9 | O K |
| 720 min Summer | 4.842 | 1.642 | 7.4 | 17.4 | 23.2 | 10415.7 | O K |
| 960 min Summer | 4.925 | 1.725 | 7.8 | 17.4 | 24.0 | 11003.5 | O K |
| 1440 min Summer | 4.997 | 1.797 | 8.1 | 17.4 | 24.6 | 11518.1 | O K |
| 2160 min Summer | 5.003 | 1.803 | 8.1 | 17.4 | 24.7 | 11563.5 | O K |
| 2880 min Summer | 4.964 | 1.764 | 8.0 | 17.4 | 24.3 | 11279.4 | O K |
| 15 min Winter | 3.695 | 0.495 | 2.1 | 17.3 | 19.4 | 2898.9 | O K |
| 30 min Winter | 3.865 | 0.665 | 2.9 | 17.4 | 20.2 | 3945.8 | O K |
| 60 min Winter | 4.042 | 0.842 | 3.7 | 17.4 | 20.6 | 5058.2 | O K |
| 120 min Winter | 4.256 | 1.056 | 4.7 | 17.4 | 20.7 | 6435.1 | O K |
| 180 min Winter | 4.404 | 1.204 | 5.3 | 17.4 | 20.7 | 7408.8 | O K |
| 240 min Winter | 4.519 | 1.319 | 5.9 | 17.4 | 20.7 | 8183.7 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 100.080 | 0.0 | 1511.2 | 27 |
| 30 min Summer | 68.208 | 0.0 | 1643.9 | 42 |
| 60 min Summer | 43.872 | 0.0 | 3284.0 | 72 |
| 120 min Summer | 28.074 | 0.0 | 3443.7 | 132 |
| 180 min Summer | 21.656 | 0.0 | 3473.6 | 190 |
| 240 min Summer | 18.024 | 0.0 | 3447.7 | 250 |
| 360 min Summer | 13.906 | 0.0 | 3380.4 | 370 |
| 480 min Summer | 11.513 | 0.0 | 3382.8 | 490 |
| 600 min Summer | 9.884 | 0.0 | 3421.3 | 610 |
| 720 min Summer | 8.689 | 0.0 | 3479.3 | 728 |
| 960 min Summer | 7.018 | 0.0 | 3554.1 | 968 |
| 1440 min Summer | 5.090 | 0.0 | 3547.6 | 1446 |
| 2160 min Summer | 3.610 | 0.0 | 6992.0 | 2164 |
| 2880 min Summer | 2.801 | 0.0 | 6842.5 | 2880 |
| 15 min Winter | 100.080 | 0.0 | 1555.0 | 27 |
| 30 min Winter | 68.208 | 0.0 | 1674.2 | 41 |
| 60 min Winter | 43.872 | 0.0 | 3360.7 | 70 |
| 120 min Winter | 28.074 | 0.0 | 3480.6 | 130 |
| 180 min Winter | 21.656 | 0.0 | 3471.4 | 188 |
| 240 min Winter | 18.024 | 0.0 | 3421.6 | 248 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:54<br>File WMZ2 FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 360 min Winter | 4.694 | 1.494 | 6.7 | 17.4 | 21.8 | 9381.4 | O K |
| 480 min Winter | 4.820 | 1.620 | 7.3 | 17.4 | 23.0 | 10259.8 | O K |
| 600 min Winter | 4.912 | 1.712 | 7.7 | 17.4 | 23.9 | 10910.8 | O K |
| 720 min Winter | 4.981 | 1.781 | 8.0 | 17.4 | 24.5 | 11405.7 | O K |
| 960 min Winter | 5.073 | 1.873 | 8.5 | 17.4 | 25.3 | 12064.8 | O K |
| 1440 min Winter | 5.155 | 1.955 | 8.9 | 17.4 | 26.1 | 12663.5 | O K |
| 2160 min Winter | 5.169 | 1.969 | 8.9 | 17.4 | 26.2 | 12771.8 | O K |
| 2880 min Winter | 5.136 | 1.936 | 8.8 | 17.4 | 25.9 | 12524.2 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 360 min Winter | 13.906 | 0.0 | 3416.6 | 366 |
| 480 min Winter | 11.513 | 0.0 | 3488.9 | 482 |
| 600 min Winter | 9.884 | 0.0 | 3593.3 | 600 |
| 720 min Winter | 8.689 | 0.0 | 3669.4 | 718 |
| 960 min Winter | 7.019 | 0.0 | 3744.5 | 952 |
| 1440 min Winter | 5.090 | 0.0 | 3729.7 | 1418 |
| 2160 min Winter | 3.610 | 0.0 | 7352.5 | 2104 |
| 2880 min Winter | 2.801 | 0.0 | 7221.8 | 2772 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 13:54<br>File WMZ2 FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| Return Period (years) | 100 |
| FEH Rainfall Version | 2013 |
| Site Location | GB 647450 264900 TM 47450 64900 |
| Data Type | Catchment |
| Summer Storms | Yes |
| Winter Storms | Yes |
| Cv (Summer) | 0.684 |
| Cv (Winter) | 0.746 |
| Shortest Storm (mins) | 15 |
| Longest Storm (mins) | 2880 |
| Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 15.633

| Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 5.211 | 4 | 8 | 5.211 | 8 | 12 | 5.211 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:54<br>File WMZ2 FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 5.500

## Infiltration Basin Structure

Invert Level (m) 3.200 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.02720

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 5660.6 | 2.000 | 7374.0 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0172-1740-2000-1740 |
| Design Head (m) | 2.000 |
| Design Flow (l/s) | 17.4 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 172 |
| Invert Level (m) | 3.200 |
| Minimum Outlet Pipe Diameter (mm) | 225 |
| Suggested Manhole Diameter (mm) | 1800 |

| **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|
| Design Point (Calculated) | 2.000 | 17.4 |
| Flush-Flo™ | 0.588 | 17.4 |
| Kick-Flo® | 1.231 | 13.8 |
| Mean Flow over Head Range | - | 15.2 |

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 | 6.1 | 1.200 | 14.3 | 3.000 | 21.1 | 7.000 | 31.7 |
| 0.200 | 14.5 | 1.400 | 14.7 | 3.500 | 22.7 | 7.500 | 32.8 |
| 0.300 | 16.1 | 1.600 | 15.6 | 4.000 | 24.2 | 8.000 | 33.8 |
| 0.400 | 16.9 | 1.800 | 16.5 | 4.500 | 25.6 | 8.500 | 34.8 |
| 0.500 | 17.3 | 2.000 | 17.4 | 5.000 | 26.9 | 9.000 | 35.8 |
| 0.600 | 17.4 | 2.200 | 18.2 | 5.500 | 28.2 | 9.500 | 36.7 |
| 0.800 | 17.1 | 2.400 | 19.0 | 6.000 | 29.4 | | |
| 1.000 | 16.3 | 2.600 | 19.7 | 6.500 | 30.6 | | |

## 1.4. WMZ3 Basin

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:55<br>File WMZ3 FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time : 4651 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 5.656 | 0.656 | 0.5 | 21.0 | 21.4 | 3418.2 | O K |
| 30 min Summer | 5.849 | 0.849 | 0.6 | 21.0 | 21.4 | 4490.9 | O K |
| 60 min Summer | 6.048 | 1.048 | 0.8 | 21.0 | 21.4 | 5620.0 | O K |
| 120 min Summer | 6.248 | 1.248 | 0.9 | 21.0 | 21.4 | 6792.7 | O K |
| 180 min Summer | 6.363 | 1.363 | 1.0 | 21.0 | 21.4 | 7481.3 | O K |
| 240 min Summer | 6.441 | 1.441 | 1.1 | 21.0 | 21.4 | 7956.7 | O K |
| 360 min Summer | 6.543 | 1.543 | 1.2 | 21.0 | 21.4 | 8583.5 | O K |
| 480 min Summer | 6.612 | 1.612 | 1.2 | 21.0 | 21.4 | 9014.0 | O K |
| 600 min Summer | 6.665 | 1.665 | 1.2 | 21.0 | 21.4 | 9346.0 | O K |
| 720 min Summer | 6.707 | 1.707 | 1.3 | 21.0 | 21.4 | 9604.9 | O K |
| 960 min Summer | 6.766 | 1.766 | 1.3 | 21.0 | 21.4 | 9980.4 | O K |
| 1440 min Summer | 6.832 | 1.832 | 1.4 | 21.0 | 21.5 | 10403.7 | O K |
| 2160 min Summer | 6.867 | 1.867 | 1.4 | 21.0 | 21.7 | 10629.6 | O K |
| 2880 min Summer | 6.864 | 1.864 | 1.4 | 21.0 | 21.7 | 10612.0 | O K |
| 4320 min Summer | 6.813 | 1.813 | 1.4 | 21.0 | 21.4 | 10282.4 | O K |
| 15 min Winter | 5.713 | 0.713 | 0.5 | 21.0 | 21.4 | 3730.0 | O K |
| 30 min Winter | 5.922 | 0.922 | 0.7 | 21.0 | 21.4 | 4901.4 | O K |
| 60 min Winter | 6.136 | 1.136 | 0.8 | 21.0 | 21.4 | 6135.4 | O K |
| 120 min Winter | 6.352 | 1.352 | 1.0 | 21.0 | 21.4 | 7419.0 | O K |
| 180 min Winter | 6.476 | 1.476 | 1.1 | 21.0 | 21.4 | 8172.2 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 106.778 | 0.0 | 1804.0 | 31 |
| 30 min Summer | 70.214 | 0.0 | 1820.7 | 46 |
| 60 min Summer | 44.063 | 0.0 | 3605.9 | 76 |
| 120 min Summer | 26.779 | 0.0 | 3438.8 | 136 |
| 180 min Summer | 19.773 | 0.0 | 3297.1 | 194 |
| 240 min Summer | 15.863 | 0.0 | 3224.9 | 254 |
| 360 min Summer | 11.539 | 0.0 | 3166.9 | 374 |
| 480 min Summer | 9.189 | 0.0 | 3162.7 | 492 |
| 600 min Summer | 7.705 | 0.0 | 3190.0 | 612 |
| 720 min Summer | 6.669 | 0.0 | 3221.6 | 732 |
| 960 min Summer | 5.306 | 0.0 | 3255.3 | 970 |
| 1440 min Summer | 3.839 | 0.0 | 3253.5 | 1448 |
| 2160 min Summer | 2.773 | 0.0 | 6466.4 | 2164 |
| 2880 min Summer | 2.199 | 0.0 | 6445.9 | 2884 |
| 4320 min Summer | 1.584 | 0.0 | 6244.2 | 3848 |
| 15 min Winter | 106.778 | 0.0 | 1820.1 | 31 |
| 30 min Winter | 70.214 | 0.0 | 1812.8 | 45 |
| 60 min Winter | 44.063 | 0.0 | 3569.5 | 74 |
| 120 min Winter | 26.779 | 0.0 | 3328.9 | 134 |
| 180 min Winter | 19.773 | 0.0 | 3229.6 | 192 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 13:55<br>File WMZ3 FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 240 min Winter | 6.561 | 1.561 | 1.2 | 21.0 | 21.4 | 8694.0 | O K |
| 360 min Winter | 6.672 | 1.672 | 1.3 | 21.0 | 21.4 | 9386.2 | O K |
| 480 min Winter | 6.748 | 1.748 | 1.3 | 21.0 | 21.4 | 9864.9 | O K |
| 600 min Winter | 6.806 | 1.806 | 1.4 | 21.0 | 21.4 | 10236.3 | O K |
| 720 min Winter | 6.851 | 1.851 | 1.4 | 21.0 | 21.6 | 10528.2 | O K |
| 960 min Winter | 6.917 | 1.917 | 1.4 | 21.0 | 22.0 | 10957.2 | O K |
| 1440 min Winter | 6.994 | 1.994 | 1.5 | 21.0 | 22.5 | 11458.8 | O K |
| 2160 min Winter | 7.041 | 2.041 | 1.5 | 21.2 | 22.7 | 11768.0 | Flood Risk |
| 2880 min Winter | 7.048 | 2.048 | 1.5 | 21.2 | 22.8 | 11814.5 | Flood Risk |
| 4320 min Winter | 7.007 | 2.007 | 1.5 | 21.0 | 22.5 | 11542.7 | Flood Risk |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 240 min Winter | 15.863 | 0.0 | 3197.7 | 250 |
| 360 min Winter | 11.539 | 0.0 | 3218.3 | 368 |
| 480 min Winter | 9.189 | 0.0 | 3281.5 | 486 |
| 600 min Winter | 7.705 | 0.0 | 3328.3 | 604 |
| 720 min Winter | 6.669 | 0.0 | 3359.2 | 720 |
| 960 min Winter | 5.306 | 0.0 | 3390.1 | 956 |
| 1440 min Winter | 3.839 | 0.0 | 3380.0 | 1422 |
| 2160 min Winter | 2.773 | 0.0 | 6742.7 | 2112 |
| 2880 min Winter | 2.199 | 0.0 | 6723.3 | 2796 |
| 4320 min Winter | 1.584 | 0.0 | 6501.4 | 4076 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 13:55<br>File WMZ3 FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.684 |
| Region | England and Wales | Cv (Winter) | 0.746 |
| M5-60 (mm) | 18.200 | Shortest Storm (mins) | 15 |
| Ratio R | 0.400 | Longest Storm (mins) | 4320 |
| Summer Storms | Yes | Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 18.864

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 4.716 | 4 | 8 | 4.716 | 8 | 12 | 4.716 | 12 | 16 | 4.716 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 13:55<br>File WMZ3 FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 7.300

## Infiltration Basin Structure

Invert Level (m) 5.000 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00482

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 4961.7 | 2.000 | 6573.0 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0188-2100-2000-2100 |
| Design Head (m) | 2.000 |
| Design Flow (l/s) | 21.0 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 188 |
| Invert Level (m) | 5.000 |
| Minimum Outlet Pipe Diameter (mm) | 225 |
| Suggested Manhole Diameter (mm) | 1800 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 2.000 | 21.0 |
| Flush-Flo™ | 0.585 | 21.0 |
| Kick-Flo® | 1.239 | 16.7 |
| Mean Flow over Head Range | - | 18.3 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.100 | 6.6 | 1.200 | 17.4 | 3.000 | 25.5 | 7.000 | 38.3 |
| 0.200 | 17.2 | 1.400 | 17.7 | 3.500 | 27.4 | 7.500 | 39.6 |
| 0.300 | 19.5 | 1.600 | 18.9 | 4.000 | 29.3 | 8.000 | 40.9 |
| 0.400 | 20.4 | 1.800 | 20.0 | 4.500 | 31.0 | 8.500 | 42.1 |
| 0.500 | 20.9 | 2.000 | 21.0 | 5.000 | 32.6 | 9.000 | 43.3 |
| 0.600 | 21.0 | 2.200 | 22.0 | 5.500 | 34.1 | 9.500 | 44.4 |
| 0.800 | 20.6 | 2.400 | 22.9 | 6.000 | 35.6 | | |
| 1.000 | 19.7 | 2.600 | 23.8 | 6.500 | 37.0 | | |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:56<br>File WMZ3 FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time : 6047 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 5.850 | 0.850 | 0.7 | 21.0 | 21.5 | 5928.0 | O K |
| 30 min Summer | 5.973 | 0.973 | 0.8 | 21.0 | 21.5 | 6834.7 | O K |
| 60 min Summer | 6.110 | 1.110 | 0.9 | 21.0 | 21.5 | 7869.2 | O K |
| 120 min Summer | 6.263 | 1.263 | 1.1 | 21.0 | 21.5 | 9040.9 | O K |
| 180 min Summer | 6.359 | 1.359 | 1.2 | 21.0 | 21.5 | 9787.4 | O K |
| 240 min Summer | 6.430 | 1.430 | 1.2 | 21.0 | 21.5 | 10341.3 | O K |
| 360 min Summer | 6.531 | 1.531 | 1.3 | 21.0 | 21.5 | 11148.1 | O K |
| 480 min Summer | 6.604 | 1.604 | 1.4 | 21.0 | 21.5 | 11731.3 | O K |
| 600 min Summer | 6.660 | 1.660 | 1.4 | 21.0 | 21.5 | 12183.6 | O K |
| 720 min Summer | 6.705 | 1.705 | 1.5 | 21.0 | 21.5 | 12549.3 | O K |
| 960 min Summer | 6.760 | 1.760 | 1.5 | 21.0 | 21.5 | 13002.5 | O K |
| 1440 min Summer | 6.827 | 1.827 | 1.6 | 21.0 | 21.7 | 13550.4 | O K |
| 2160 min Summer | 6.871 | 1.871 | 1.6 | 21.0 | 22.0 | 13918.8 | O K |
| 2880 min Summer | 6.882 | 1.882 | 1.6 | 21.0 | 22.0 | 14010.8 | O K |
| 4320 min Summer | 6.811 | 1.811 | 1.6 | 21.0 | 21.6 | 13420.4 | O K |
| 15 min Winter | 5.923 | 0.923 | 0.8 | 21.0 | 21.5 | 6467.6 | O K |
| 30 min Winter | 6.056 | 1.056 | 0.9 | 21.0 | 21.5 | 7457.5 | O K |
| 60 min Winter | 6.204 | 1.204 | 1.0 | 20.9 | 21.5 | 8588.4 | O K |
| 120 min Winter | 6.370 | 1.370 | 1.2 | 21.0 | 21.5 | 9870.3 | O K |
| 180 min Winter | 6.473 | 1.473 | 1.3 | 21.0 | 21.5 | 10687.4 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 184.621 | 0.0 | 1833.4 | 31 |
| 30 min Summer | 106.552 | 0.0 | 1803.5 | 46 |
| 60 min Summer | 61.496 | 0.0 | 3578.8 | 76 |
| 120 min Summer | 35.492 | 0.0 | 3381.4 | 136 |
| 180 min Summer | 25.733 | 0.0 | 3251.1 | 194 |
| 240 min Summer | 20.484 | 0.0 | 3188.0 | 254 |
| 360 min Summer | 14.851 | 0.0 | 3161.4 | 374 |
| 480 min Summer | 11.822 | 0.0 | 3205.0 | 494 |
| 600 min Summer | 9.905 | 0.0 | 3250.0 | 614 |
| 720 min Summer | 8.571 | 0.0 | 3280.7 | 732 |
| 960 min Summer | 6.770 | 0.0 | 3301.3 | 972 |
| 1440 min Summer | 4.855 | 0.0 | 3282.8 | 1450 |
| 2160 min Summer | 3.482 | 0.0 | 6605.7 | 2168 |
| 2880 min Summer | 2.750 | 0.0 | 6575.0 | 2884 |
| 4320 min Summer | 1.927 | 0.0 | 6280.2 | 4320 |
| 15 min Winter | 184.621 | 0.0 | 1822.3 | 31 |
| 30 min Winter | 106.552 | 0.0 | 1776.0 | 45 |
| 60 min Winter | 61.496 | 0.0 | 3488.0 | 76 |
| 120 min Winter | 35.492 | 0.0 | 3263.6 | 134 |
| 180 min Winter | 25.733 | 0.0 | 3194.2 | 192 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:56<br>File WMZ3 FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 240 min Winter | 6.550 | 1.550 | 1.3 | 21.0 | 21.5 | 11294.6 | O K |
| 360 min Winter | 6.660 | 1.660 | 1.4 | 21.0 | 21.5 | 12182.4 | O K |
| 480 min Winter | 6.739 | 1.739 | 1.5 | 21.0 | 21.5 | 12827.3 | O K |
| 600 min Winter | 6.800 | 1.800 | 1.5 | 21.0 | 21.5 | 13330.2 | O K |
| 720 min Winter | 6.849 | 1.849 | 1.6 | 21.0 | 21.8 | 13738.2 | O K |
| 960 min Winter | 6.911 | 1.911 | 1.7 | 21.0 | 22.2 | 14251.2 | O K |
| 1440 min Winter | 6.987 | 1.987 | 1.7 | 21.0 | 22.6 | 14887.7 | O K |
| 2160 min Winter | 7.042 | 2.042 | 1.7 | 21.2 | 22.9 | 15350.1 | Flood Risk |
| 2880 min Winter | 7.061 | 2.061 | 1.7 | 21.3 | 23.0 | 15513.7 | Flood Risk |
| 4320 min Winter | 7.000 | 2.000 | 1.7 | 21.0 | 22.7 | 14995.0 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 240 min Winter | 20.484 | 0.0 | 3193.1 | 252 |
| 360 min Winter | 14.851 | 0.0 | 3277.5 | 370 |
| 480 min Winter | 11.822 | 0.0 | 3345.3 | 486 |
| 600 min Winter | 9.905 | 0.0 | 3390.3 | 604 |
| 720 min Winter | 8.571 | 0.0 | 3420.4 | 722 |
| 960 min Winter | 6.770 | 0.0 | 3437.9 | 958 |
| 1440 min Winter | 4.855 | 0.0 | 3410.7 | 1428 |
| 2160 min Winter | 3.482 | 0.0 | 6893.2 | 2124 |
| 2880 min Winter | 2.750 | 0.0 | 6849.3 | 2808 |
| 4320 min Winter | 1.927 | 0.0 | 6530.7 | 4152 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 13:56<br>File WMZ3 FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| Return Period (years) | 100 |
| FEH Rainfall Version | 1999 |
| Site Location | GB 647450 264900 TM 47450 64900 |
| C (1km) | -0.020 |
| D1 (1km) | 0.299 |
| D2 (1km) | 0.272 |
| D3 (1km) | 0.215 |
| E (1km) | 0.311 |
| F (1km) | 2.506 |
| Summer Storms | Yes |
| Winter Storms | Yes |
| Cv (Summer) | 0.684 |
| Cv (Winter) | 0.746 |
| Shortest Storm (mins) | 15 |
| Longest Storm (mins) | 4320 |
| Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 18.864

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 4.716 | 4 | 8 | 4.716 | 8 | 12 | 4.716 | 12 | 16 | 4.716 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:56<br>File WMZ3 FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 7.300

## Infiltration Basin Structure

| | | | |
|---|---|---|---|
| Invert Level (m) | 5.000 | Safety Factor | 1.5 |
| Infiltration Coefficient Base (m/hr) | 0.00000 | Porosity | 1.00 |
| Infiltration Coefficient Side (m/hr) | 0.00482 | | |

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 6597.1 | 2.000 | 8437.8 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0188-2100-2000-2100 |
| Design Head (m) | 2.000 |
| Design Flow (l/s) | 21.0 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 188 |
| Invert Level (m) | 5.000 |
| Minimum Outlet Pipe Diameter (mm) | 225 |
| Suggested Manhole Diameter (mm) | 1800 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 2.000 | 21.0 |
| Flush-Flo™ | 0.585 | 21.0 |
| Kick-Flo® | 1.239 | 16.7 |
| Mean Flow over Head Range | - | 18.3 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.100 | 6.6 | 1.200 | 17.4 | 3.000 | 25.5 | 7.000 | 38.3 |
| 0.200 | 17.2 | 1.400 | 17.7 | 3.500 | 27.4 | 7.500 | 39.6 |
| 0.300 | 19.5 | 1.600 | 18.9 | 4.000 | 29.3 | 8.000 | 40.9 |
| 0.400 | 20.4 | 1.800 | 20.0 | 4.500 | 31.0 | 8.500 | 42.1 |
| 0.500 | 20.9 | 2.000 | 21.0 | 5.000 | 32.6 | 9.000 | 43.3 |
| 0.600 | 21.0 | 2.200 | 22.0 | 5.500 | 34.1 | 9.500 | 44.4 |
| 0.800 | 20.6 | 2.400 | 22.9 | 6.000 | 35.6 | | |
| 1.000 | 19.7 | 2.600 | 23.8 | 6.500 | 37.0 | | |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:56<br>File WMZ3 FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time : 6238 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 5.441 | 0.441 | 0.4 | 20.7 | 21.0 | 3204.9 | O K |
| 30 min Summer | 5.595 | 0.595 | 0.5 | 21.0 | 21.5 | 4363.7 | O K |
| 60 min Summer | 5.755 | 0.755 | 0.7 | 21.0 | 21.5 | 5597.6 | O K |
| 120 min Summer | 5.950 | 0.950 | 0.8 | 21.0 | 21.5 | 7126.2 | O K |
| 180 min Summer | 6.085 | 1.085 | 0.9 | 21.0 | 21.5 | 8208.7 | O K |
| 240 min Summer | 6.192 | 1.192 | 1.0 | 21.0 | 21.5 | 9074.5 | O K |
| 360 min Summer | 6.356 | 1.356 | 1.2 | 21.0 | 21.5 | 10429.0 | O K |
| 480 min Summer | 6.475 | 1.475 | 1.3 | 21.0 | 21.5 | 11426.5 | O K |
| 600 min Summer | 6.563 | 1.563 | 1.4 | 21.0 | 21.5 | 12171.6 | O K |
| 720 min Summer | 6.630 | 1.630 | 1.4 | 21.0 | 21.5 | 12744.5 | O K |
| 960 min Summer | 6.720 | 1.720 | 1.5 | 21.0 | 21.5 | 13524.2 | O K |
| 1440 min Summer | 6.807 | 1.807 | 1.6 | 21.0 | 21.6 | 14283.8 | O K |
| 2160 min Summer | 6.835 | 1.835 | 1.6 | 21.0 | 21.8 | 14533.7 | O K |
| 2880 min Summer | 6.817 | 1.817 | 1.6 | 21.0 | 21.7 | 14368.3 | O K |
| 15 min Winter | 5.480 | 0.480 | 0.4 | 20.8 | 21.2 | 3496.8 | O K |
| 30 min Winter | 5.647 | 0.647 | 0.6 | 21.0 | 21.5 | 4762.3 | O K |
| 60 min Winter | 5.821 | 0.821 | 0.7 | 21.0 | 21.5 | 6109.7 | O K |
| 120 min Winter | 6.032 | 1.032 | 0.9 | 21.0 | 21.5 | 7782.2 | O K |
| 180 min Winter | 6.179 | 1.179 | 1.0 | 21.0 | 21.5 | 8969.4 | O K |
| 240 min Winter | 6.295 | 1.295 | 1.1 | 21.0 | 21.5 | 9919.6 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 100.080 | 0.0 | 1703.4 | 31 |
| 30 min Summer | 68.208 | 0.0 | 1804.2 | 46 |
| 60 min Summer | 43.872 | 0.0 | 3606.2 | 76 |
| 120 min Summer | 28.074 | 0.0 | 3625.5 | 134 |
| 180 min Summer | 21.656 | 0.0 | 3548.5 | 194 |
| 240 min Summer | 18.024 | 0.0 | 3430.4 | 254 |
| 360 min Summer | 13.906 | 0.0 | 3185.5 | 374 |
| 480 min Summer | 11.513 | 0.0 | 3120.2 | 494 |
| 600 min Summer | 9.884 | 0.0 | 3163.7 | 614 |
| 720 min Summer | 8.689 | 0.0 | 3218.5 | 732 |
| 960 min Summer | 7.018 | 0.0 | 3274.2 | 972 |
| 1440 min Summer | 5.090 | 0.0 | 3273.4 | 1450 |
| 2160 min Summer | 3.610 | 0.0 | 6571.2 | 2168 |
| 2880 min Summer | 2.801 | 0.0 | 6480.6 | 2884 |
| 15 min Winter | 100.080 | 0.0 | 1741.5 | 31 |
| 30 min Winter | 68.208 | 0.0 | 1820.2 | 45 |
| 60 min Winter | 43.872 | 0.0 | 3640.6 | 74 |
| 120 min Winter | 28.074 | 0.0 | 3601.6 | 134 |
| 180 min Winter | 21.656 | 0.0 | 3469.5 | 192 |
| 240 min Winter | 18.024 | 0.0 | 3290.1 | 252 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 13:56<br>File WMZ3 FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 360 min Winter | 6.472 | 1.472 | 1.3 | 21.0 | 21.5 | 11398.1 | O K |
| 480 min Winter | 6.600 | 1.600 | 1.4 | 21.0 | 21.5 | 12492.9 | O K |
| 600 min Winter | 6.696 | 1.696 | 1.5 | 21.0 | 21.5 | 13314.6 | O K |
| 720 min Winter | 6.769 | 1.769 | 1.6 | 21.0 | 21.5 | 13948.8 | O K |
| 960 min Winter | 6.868 | 1.868 | 1.7 | 21.0 | 22.0 | 14818.2 | O K |
| 1440 min Winter | 6.965 | 1.965 | 1.8 | 21.0 | 22.6 | 15685.8 | O K |
| 2160 min Winter | 7.002 | 2.002 | 1.8 | 21.0 | 22.8 | 16016.4 | Flood Risk |
| 2880 min Winter | 6.989 | 1.989 | 1.8 | 21.0 | 22.7 | 15894.0 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 360 min Winter | 13.906 | 0.0 | 3148.7 | 370 |
| 480 min Winter | 11.513 | 0.0 | 3218.6 | 486 |
| 600 min Winter | 9.884 | 0.0 | 3301.8 | 604 |
| 720 min Winter | 8.689 | 0.0 | 3356.8 | 722 |
| 960 min Winter | 7.019 | 0.0 | 3410.7 | 958 |
| 1440 min Winter | 5.090 | 0.0 | 3401.7 | 1428 |
| 2160 min Winter | 3.610 | 0.0 | 6858.1 | 2128 |
| 2880 min Winter | 2.801 | 0.0 | 6755.0 | 2812 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 13:56<br>File WMZ3 FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| Return Period (years) | 100 |
| FEH Rainfall Version | 2013 |
| Site Location | GB 647450 264900 TM 47450 64900 |
| Data Type | Catchment |
| Summer Storms | Yes |
| Winter Storms | Yes |
| Cv (Summer) | 0.684 |
| Cv (Winter) | 0.746 |
| Shortest Storm (mins) | 15 |
| Longest Storm (mins) | 2880 |
| Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 18.864

| Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 4.716 | 4 | 8 | 4.716 | 8 | 12 | 4.716 | 12 | 16 | 4.716 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:56<br>File WMZ3 FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 7.300

## Infiltration Basin Structure

Invert Level (m) 5.000 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00482

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 7066.7 | 2.000 | 8967.8 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0188-2100-2000-2100 |
| Design Head (m) | 2.000 |
| Design Flow (l/s) | 21.0 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 188 |
| Invert Level (m) | 5.000 |
| Minimum Outlet Pipe Diameter (mm) | 225 |
| Suggested Manhole Diameter (mm) | 1800 |

| **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|
| Design Point (Calculated) | 2.000 | 21.0 |
| Flush-Flo™ | 0.585 | 21.0 |
| Kick-Flo® | 1.239 | 16.7 |
| Mean Flow over Head Range | - | 18.3 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|
| 0.100 | 6.6 | 1.200 | 17.4 | 3.000 | 25.5 | 7.000 | 38.3 |
| 0.200 | 17.2 | 1.400 | 17.7 | 3.500 | 27.4 | 7.500 | 39.6 |
| 0.300 | 19.5 | 1.600 | 18.9 | 4.000 | 29.3 | 8.000 | 40.9 |
| 0.400 | 20.4 | 1.800 | 20.0 | 4.500 | 31.0 | 8.500 | 42.1 |
| 0.500 | 20.9 | 2.000 | 21.0 | 5.000 | 32.6 | 9.000 | 43.3 |
| 0.600 | 21.0 | 2.200 | 22.0 | 5.500 | 34.1 | 9.500 | 44.4 |
| 0.800 | 20.6 | 2.400 | 22.9 | 6.000 | 35.6 | | |
| 1.000 | 19.7 | 2.600 | 23.8 | 6.500 | 37.0 | | |

## 1.5. WMZ4 Basin

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:57<br>File WMZ4 FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time exceeds 7 days.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Summer | 5.738 | 0.538 | 2.1 | 2524.3 | O K |
| 30 min Summer | 5.898 | 0.698 | 2.8 | 3318.6 | O K |
| 60 min Summer | 6.065 | 0.865 | 3.5 | 4162.1 | O K |
| 120 min Summer | 6.236 | 1.036 | 4.2 | 5051.4 | O K |
| 180 min Summer | 6.337 | 1.137 | 4.6 | 5586.5 | O K |
| 240 min Summer | 6.407 | 1.207 | 4.9 | 5966.7 | O K |
| 360 min Summer | 6.504 | 1.304 | 5.3 | 6491.1 | O K |
| 480 min Summer | 6.573 | 1.373 | 5.6 | 6872.4 | O K |
| 600 min Summer | 6.629 | 1.429 | 5.9 | 7181.5 | O K |
| 720 min Summer | 6.674 | 1.474 | 6.1 | 7437.2 | O K |
| 960 min Summer | 6.747 | 1.547 | 6.4 | 7843.8 | O K |
| 1440 min Summer | 6.846 | 1.646 | 6.8 | 8413.9 | O K |
| 2160 min Summer | 6.941 | 1.741 | 7.2 | 8959.1 | O K |
| 2880 min Summer | 7.001 | 1.801 | 7.5 | 9311.9 | O K |
| 4320 min Summer | 7.070 | 1.870 | 7.8 | 9721.8 | O K |
| 5760 min Summer | 7.103 | 1.903 | 8.0 | 9916.2 | O K |
| 7200 min Summer | 7.115 | 1.915 | 8.0 | 9989.8 | O K |
| 8640 min Summer | 7.116 | 1.916 | 8.0 | 9990.1 | O K |
| 10080 min Summer | 7.114 | 1.914 | 8.0 | 9979.0 | O K |
| 15 min Winter | 5.839 | 0.639 | 2.5 | 3022.1 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Time-Peak (mins) |
|---|---|---|---|
| 15 min Summer | 106.778 | 0.0 | 27 |
| 30 min Summer | 70.214 | 0.0 | 42 |
| 60 min Summer | 44.063 | 0.0 | 72 |
| 120 min Summer | 26.779 | 0.0 | 132 |
| 180 min Summer | 19.773 | 0.0 | 192 |
| 240 min Summer | 15.863 | 0.0 | 252 |
| 360 min Summer | 11.539 | 0.0 | 372 |
| 480 min Summer | 9.189 | 0.0 | 492 |
| 600 min Summer | 7.705 | 0.0 | 610 |
| 720 min Summer | 6.669 | 0.0 | 730 |
| 960 min Summer | 5.306 | 0.0 | 970 |
| 1440 min Summer | 3.839 | 0.0 | 1450 |
| 2160 min Summer | 2.773 | 0.0 | 2168 |
| 2880 min Summer | 2.199 | 0.0 | 2888 |
| 4320 min Summer | 1.584 | 0.0 | 4324 |
| 5760 min Summer | 1.254 | 0.0 | 5760 |
| 7200 min Summer | 1.046 | 0.0 | 7200 |
| 8640 min Summer | 0.901 | 0.0 | 8384 |
| 10080 min Summer | 0.794 | 0.0 | 8776 |
| 15 min Winter | 106.778 | 0.0 | 27 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:57<br>File WMZ4 FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 30 min Winter | 6.028 | 0.828 | 3.3 | 3973.0 | O K |
| 60 min Winter | 6.223 | 1.023 | 4.1 | 4982.9 | O K |
| 120 min Winter | 6.422 | 1.222 | 5.0 | 6047.6 | O K |
| 180 min Winter | 6.540 | 1.340 | 5.5 | 6688.6 | O K |
| 240 min Winter | 6.622 | 1.422 | 5.8 | 7144.1 | O K |
| 360 min Winter | 6.734 | 1.534 | 6.3 | 7772.5 | O K |
| 480 min Winter | 6.814 | 1.614 | 6.7 | 8229.6 | O K |
| 600 min Winter | 6.879 | 1.679 | 7.0 | 8600.2 | O K |
| 720 min Winter | 6.932 | 1.732 | 7.2 | 8907.0 | O K |
| 960 min Winter | 7.015 | 1.815 | 7.6 | 9395.1 | O K |
| 1440 min Winter | 7.131 | 1.931 | 8.1 | 10080.8 | O K |
| 2160 min Winter | 7.240 | 2.040 | 8.4 | 10740.4 | Flood Risk |
| 2880 min Winter | 7.312 | 2.112 | 8.5 | 11175.5 | Flood Risk |
| 4320 min Winter | 7.400 | 2.200 | 8.7 | 11706.4 | Flood Risk |
| 5760 min Winter | 7.447 | 2.247 | 8.7 | 11988.5 | Flood Risk |
| 7200 min Winter | 7.471 | 2.271 | 8.8 | 12130.9 | Flood Risk |
| 8640 min Winter | 7.480 | 2.280 | 8.8 | 12185.0 | Flood Risk |
| 10080 min Winter | 7.479 | 2.279 | 8.8 | 12178.8 | Flood Risk |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Time-Peak (mins) |
|---|---|---|---|
| 30 min Winter | 70.214 | 0.0 | 42 |
| 60 min Winter | 44.063 | 0.0 | 72 |
| 120 min Winter | 26.779 | 0.0 | 132 |
| 180 min Winter | 19.773 | 0.0 | 190 |
| 240 min Winter | 15.863 | 0.0 | 250 |
| 360 min Winter | 11.539 | 0.0 | 368 |
| 480 min Winter | 9.189 | 0.0 | 486 |
| 600 min Winter | 7.705 | 0.0 | 604 |
| 720 min Winter | 6.669 | 0.0 | 724 |
| 960 min Winter | 5.306 | 0.0 | 960 |
| 1440 min Winter | 3.839 | 0.0 | 1434 |
| 2160 min Winter | 2.773 | 0.0 | 2144 |
| 2880 min Winter | 2.199 | 0.0 | 2852 |
| 4320 min Winter | 1.584 | 0.0 | 4240 |
| 5760 min Winter | 1.254 | 0.0 | 5600 |
| 7200 min Winter | 1.046 | 0.0 | 6984 |
| 8640 min Winter | 0.901 | 0.0 | 8296 |
| 10080 min Winter | 0.794 | 0.0 | 9576 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:57<br>File WMZ4 FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.568 |
| Region | England and Wales | Cv (Winter) | 0.680 |
| M5-60 (mm) | 18.200 | Shortest Storm (mins) | 15 |
| Ratio R | 0.400 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 16.660

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 5.553 | 4 | 8 | 5.553 | 8 | 12 | 5.553 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 13:57<br>File WMZ4 FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 7.500

## Infiltration Basin Structure

Invert Level (m) 5.200 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.02790

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 4497.6 | 2.000 | 6037.1 |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:57<br>File WMZ4 FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time exceeds 7 days.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Summer | 5.933 | 0.733 | 3.3 | 4364.9 | O K |
| 30 min Summer | 6.039 | 0.839 | 3.8 | 5036.7 | O K |
| 60 min Summer | 6.160 | 0.960 | 4.3 | 5809.9 | O K |
| 120 min Summer | 6.296 | 1.096 | 5.0 | 6697.3 | O K |
| 180 min Summer | 6.383 | 1.183 | 5.4 | 7273.9 | O K |
| 240 min Summer | 6.449 | 1.249 | 5.7 | 7710.0 | O K |
| 360 min Summer | 6.545 | 1.345 | 6.1 | 8362.8 | O K |
| 480 min Summer | 6.617 | 1.417 | 6.5 | 8852.6 | O K |
| 600 min Summer | 6.675 | 1.475 | 6.8 | 9246.6 | O K |
| 720 min Summer | 6.722 | 1.522 | 7.0 | 9577.2 | O K |
| 960 min Summer | 6.788 | 1.588 | 7.3 | 10033.5 | O K |
| 1440 min Summer | 6.880 | 1.680 | 7.8 | 10680.9 | O K |
| 2160 min Summer | 6.968 | 1.768 | 8.2 | 11311.7 | O K |
| 2880 min Summer | 7.026 | 1.826 | 8.5 | 11729.3 | O K |
| 4320 min Summer | 7.057 | 1.857 | 8.6 | 11952.5 | O K |
| 5760 min Summer | 7.065 | 1.865 | 8.7 | 12006.3 | O K |
| 7200 min Summer | 7.059 | 1.859 | 8.6 | 11967.5 | O K |
| 15 min Winter | 6.069 | 0.869 | 3.9 | 5225.6 | O K |
| 30 min Winter | 6.194 | 0.994 | 4.5 | 6029.9 | O K |
| 60 min Winter | 6.335 | 1.135 | 5.1 | 6955.5 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Time-Peak (mins) |
|---|---|---|---|
| 15 min Summer | 184.621 | 0.0 | 27 |
| 30 min Summer | 106.552 | 0.0 | 42 |
| 60 min Summer | 61.496 | 0.0 | 72 |
| 120 min Summer | 35.492 | 0.0 | 132 |
| 180 min Summer | 25.733 | 0.0 | 192 |
| 240 min Summer | 20.484 | 0.0 | 252 |
| 360 min Summer | 14.851 | 0.0 | 372 |
| 480 min Summer | 11.822 | 0.0 | 492 |
| 600 min Summer | 9.905 | 0.0 | 612 |
| 720 min Summer | 8.571 | 0.0 | 730 |
| 960 min Summer | 6.770 | 0.0 | 970 |
| 1440 min Summer | 4.855 | 0.0 | 1450 |
| 2160 min Summer | 3.482 | 0.0 | 2168 |
| 2880 min Summer | 2.750 | 0.0 | 2888 |
| 4320 min Summer | 1.927 | 0.0 | 4324 |
| 5760 min Summer | 1.497 | 0.0 | 5760 |
| 7200 min Summer | 1.231 | 0.0 | 7200 |
| 15 min Winter | 184.621 | 0.0 | 27 |
| 30 min Winter | 106.552 | 0.0 | 42 |
| 60 min Winter | 61.496 | 0.0 | 72 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 13:57<br>File WMZ4 FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 120 min Winter | 6.494 | 1.294 | 5.9 | 8018.0 | O K |
| 180 min Winter | 6.596 | 1.396 | 6.4 | 8708.9 | O K |
| 240 min Winter | 6.672 | 1.472 | 6.7 | 9231.2 | O K |
| 360 min Winter | 6.785 | 1.585 | 7.3 | 10013.4 | O K |
| 480 min Winter | 6.868 | 1.668 | 7.7 | 10600.3 | O K |
| 600 min Winter | 6.935 | 1.735 | 8.0 | 11072.9 | O K |
| 720 min Winter | 6.990 | 1.790 | 8.3 | 11469.3 | O K |
| 960 min Winter | 7.066 | 1.866 | 8.7 | 12016.9 | O K |
| 1440 min Winter | 7.173 | 1.973 | 9.2 | 12795.4 | O K |
| 2160 min Winter | 7.276 | 2.076 | 9.5 | 13559.6 | Flood Risk |
| 2880 min Winter | 7.346 | 2.146 | 9.6 | 14075.2 | Flood Risk |
| 4320 min Winter | 7.387 | 2.187 | 9.6 | 14376.8 | Flood Risk |
| 5760 min Winter | 7.401 | 2.201 | 9.6 | 14479.6 | Flood Risk |
| 7200 min Winter | 7.400 | 2.200 | 9.6 | 14475.0 | Flood Risk |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Time-Peak (mins) |
|---|---|---|---|
| 120 min Winter | 35.492 | 0.0 | 132 |
| 180 min Winter | 25.733 | 0.0 | 190 |
| 240 min Winter | 20.484 | 0.0 | 250 |
| 360 min Winter | 14.851 | 0.0 | 368 |
| 480 min Winter | 11.822 | 0.0 | 486 |
| 600 min Winter | 9.905 | 0.0 | 606 |
| 720 min Winter | 8.571 | 0.0 | 724 |
| 960 min Winter | 6.770 | 0.0 | 962 |
| 1440 min Winter | 4.855 | 0.0 | 1434 |
| 2160 min Winter | 3.482 | 0.0 | 2144 |
| 2880 min Winter | 2.750 | 0.0 | 2852 |
| 4320 min Winter | 1.927 | 0.0 | 4240 |
| 5760 min Winter | 1.497 | 0.0 | 5640 |
| 7200 min Winter | 1.231 | 0.0 | 6992 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 13:57<br>File WMZ4 FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| Return Period (years) | 100 |
| FEH Rainfall Version | 1999 |
| Site Location | GB 647450 264900 TM 47450 64900 |
| C (1km) | -0.020 |
| D1 (1km) | 0.299 |
| D2 (1km) | 0.272 |
| D3 (1km) | 0.215 |
| E (1km) | 0.311 |
| F (1km) | 2.506 |
| Summer Storms | Yes |
| Winter Storms | Yes |
| Cv (Summer) | 0.568 |
| Cv (Winter) | 0.680 |
| Shortest Storm (mins) | 15 |
| Longest Storm (mins) | 7200 |
| Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 16.660

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 5.553 | 4 | 8 | 5.553 | 8 | 12 | 5.553 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 13:57<br>File WMZ4 FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 7.500

## Infiltration Basin Structure

Invert Level (m) 5.200 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.02790

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 5660.6 | 2.000 | 7374.0 |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:58<br>File WMZ4 FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time exceeds 7 days.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Summer | 5.591 | 0.391 | 1.8 | 2366.2 | O K |
| 30 min Summer | 5.728 | 0.528 | 2.4 | 3224.2 | O K |
| 60 min Summer | 5.872 | 0.672 | 3.1 | 4144.9 | O K |
| 120 min Summer | 6.048 | 0.848 | 3.9 | 5297.7 | O K |
| 180 min Summer | 6.172 | 0.972 | 4.5 | 6121.9 | O K |
| 240 min Summer | 6.270 | 1.070 | 4.9 | 6784.7 | O K |
| 360 min Summer | 6.422 | 1.222 | 5.7 | 7831.5 | O K |
| 480 min Summer | 6.536 | 1.336 | 6.2 | 8622.4 | O K |
| 600 min Summer | 6.621 | 1.421 | 6.6 | 9229.9 | O K |
| 720 min Summer | 6.689 | 1.489 | 7.0 | 9711.4 | O K |
| 960 min Summer | 6.785 | 1.585 | 7.4 | 10405.7 | O K |
| 1440 min Summer | 6.894 | 1.694 | 8.0 | 11204.4 | O K |
| 2160 min Summer | 6.967 | 1.767 | 8.3 | 11739.6 | O K |
| 2880 min Summer | 6.996 | 1.796 | 8.5 | 11957.5 | O K |
| 4320 min Summer | 7.002 | 1.802 | 8.5 | 12004.8 | O K |
| 5760 min Summer | 6.990 | 1.790 | 8.5 | 11914.0 | O K |
| 15 min Winter | 5.665 | 0.465 | 2.1 | 2832.8 | O K |
| 30 min Winter | 5.827 | 0.627 | 2.8 | 3860.0 | O K |
| 60 min Winter | 5.997 | 0.797 | 3.6 | 4962.3 | O K |
| 120 min Winter | 6.205 | 1.005 | 4.6 | 6342.4 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Time-Peak (mins) |
|---|---|---|---|
| 15 min Summer | 100.080 | 0.0 | 27 |
| 30 min Summer | 68.208 | 0.0 | 42 |
| 60 min Summer | 43.872 | 0.0 | 72 |
| 120 min Summer | 28.074 | 0.0 | 132 |
| 180 min Summer | 21.656 | 0.0 | 192 |
| 240 min Summer | 18.024 | 0.0 | 252 |
| 360 min Summer | 13.906 | 0.0 | 372 |
| 480 min Summer | 11.513 | 0.0 | 492 |
| 600 min Summer | 9.884 | 0.0 | 612 |
| 720 min Summer | 8.689 | 0.0 | 730 |
| 960 min Summer | 7.018 | 0.0 | 970 |
| 1440 min Summer | 5.090 | 0.0 | 1450 |
| 2160 min Summer | 3.610 | 0.0 | 2168 |
| 2880 min Summer | 2.801 | 0.0 | 2888 |
| 4320 min Summer | 1.933 | 0.0 | 4324 |
| 5760 min Summer | 1.483 | 0.0 | 5760 |
| 15 min Winter | 100.080 | 0.0 | 27 |
| 30 min Winter | 68.208 | 0.0 | 42 |
| 60 min Winter | 43.872 | 0.0 | 72 |
| 120 min Winter | 28.074 | 0.0 | 132 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:58<br>File WMZ4 FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 180 min Winter | 6.350 | 1.150 | 5.3 | 7329.5 | O K |
| 240 min Winter | 6.464 | 1.264 | 5.9 | 8123.3 | O K |
| 360 min Winter | 6.642 | 1.442 | 6.7 | 9377.1 | O K |
| 480 min Winter | 6.774 | 1.574 | 7.4 | 10324.6 | O K |
| 600 min Winter | 6.874 | 1.674 | 7.9 | 11052.7 | O K |
| 720 min Winter | 6.952 | 1.752 | 8.3 | 11629.9 | O K |
| 960 min Winter | 7.063 | 1.863 | 8.8 | 12462.5 | O K |
| 1440 min Winter | 7.190 | 1.990 | 9.5 | 13422.3 | O K |
| 2160 min Winter | 7.275 | 2.075 | 9.6 | 14071.9 | Flood Risk |
| 2880 min Winter | 7.311 | 2.111 | 9.7 | 14344.0 | Flood Risk |
| 4320 min Winter | 7.321 | 2.121 | 9.7 | 14424.9 | Flood Risk |
| 5760 min Winter | 7.310 | 2.110 | 9.7 | 14341.0 | Flood Risk |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Time-Peak (mins) |
|---|---|---|---|
| 180 min Winter | 21.656 | 0.0 | 190 |
| 240 min Winter | 18.024 | 0.0 | 250 |
| 360 min Winter | 13.906 | 0.0 | 368 |
| 480 min Winter | 11.513 | 0.0 | 486 |
| 600 min Winter | 9.884 | 0.0 | 606 |
| 720 min Winter | 8.689 | 0.0 | 724 |
| 960 min Winter | 7.019 | 0.0 | 962 |
| 1440 min Winter | 5.090 | 0.0 | 1434 |
| 2160 min Winter | 3.610 | 0.0 | 2144 |
| 2880 min Winter | 2.801 | 0.0 | 2852 |
| 4320 min Winter | 1.932 | 0.0 | 4240 |
| 5760 min Winter | 1.483 | 0.0 | 5608 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 13:58<br>File WMZ4 FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| Return Period (years) | 100 |
| FEH Rainfall Version | 2013 |
| Site Location | GB 647450 264900 TM 47450 64900 |
| Data Type | Catchment |
| Summer Storms | Yes |
| Winter Storms | Yes |
| Cv (Summer) | 0.568 |
| Cv (Winter) | 0.680 |
| Shortest Storm (mins) | 15 |
| Longest Storm (mins) | 5760 |
| Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 16.660

| Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 5.553 | 4 | 8 | 5.553 | 8 | 12 | 5.553 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 13:58<br>File WMZ4 FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 7.500

## Infiltration Basin Structure

Invert Level (m) 5.200 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.02790

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 5894.2 | 2.000 | 7640.3 |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 16/08/2021 16:29<br>File WMZ4 FSR (with outflow)... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2020.1.3 | |

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

Half Drain Time : 1807 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 5.820 | 0.620 | 2.3 | 33.3 | 35.6 | 2490.4 | O K |
| 30 min Summer | 6.000 | 0.800 | 3.0 | 33.3 | 35.8 | 3265.4 | O K |
| 60 min Summer | 6.182 | 0.982 | 3.7 | 33.3 | 35.8 | 4067.6 | O K |
| 120 min Summer | 6.359 | 1.159 | 4.4 | 33.3 | 35.8 | 4874.9 | O K |
| 180 min Summer | 6.457 | 1.257 | 4.7 | 33.3 | 35.8 | 5329.1 | O K |
| 240 min Summer | 6.521 | 1.321 | 5.0 | 33.3 | 35.8 | 5629.2 | O K |
| 360 min Summer | 6.596 | 1.396 | 5.3 | 33.3 | 35.8 | 5987.8 | O K |
| 480 min Summer | 6.640 | 1.440 | 5.5 | 33.3 | 35.8 | 6199.4 | O K |
| 600 min Summer | 6.669 | 1.469 | 5.6 | 33.3 | 35.8 | 6337.6 | O K |
| 720 min Summer | 6.686 | 1.486 | 5.7 | 33.3 | 35.8 | 6422.4 | O K |
| 960 min Summer | 6.700 | 1.500 | 5.7 | 33.3 | 35.8 | 6489.8 | O K |
| 1440 min Summer | 6.682 | 1.482 | 5.6 | 33.3 | 35.8 | 6402.9 | O K |
| 15 min Winter | 5.936 | 0.736 | 2.7 | 33.3 | 35.8 | 2987.1 | O K |
| 30 min Winter | 6.149 | 0.949 | 3.5 | 33.3 | 35.8 | 3918.9 | O K |
| 60 min Winter | 6.362 | 1.162 | 4.4 | 33.3 | 35.8 | 4888.2 | O K |
| 120 min Winter | 6.572 | 1.372 | 5.2 | 33.3 | 35.8 | 5873.4 | O K |
| 180 min Winter | 6.688 | 1.488 | 5.7 | 33.3 | 35.8 | 6428.3 | O K |
| 240 min Winter | 6.763 | 1.563 | 6.0 | 33.3 | 35.8 | 6795.5 | O K |
| 360 min Winter | 6.854 | 1.654 | 6.3 | 33.3 | 36.7 | 7245.3 | O K |
| 480 min Winter | 6.909 | 1.709 | 6.6 | 33.3 | 37.4 | 7521.9 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 106.778 | 0.0 | 2186.0 | 27 |
| 30 min Summer | 70.214 | 0.0 | 2749.6 | 41 |
| 60 min Summer | 44.063 | 0.0 | 3981.5 | 70 |
| 120 min Summer | 26.779 | 0.0 | 4796.5 | 130 |
| 180 min Summer | 19.773 | 0.0 | 5242.0 | 190 |
| 240 min Summer | 15.863 | 0.0 | 5505.3 | 250 |
| 360 min Summer | 11.539 | 0.0 | 5708.8 | 368 |
| 480 min Summer | 9.189 | 0.0 | 5702.9 | 486 |
| 600 min Summer | 7.705 | 0.0 | 5663.5 | 606 |
| 720 min Summer | 6.669 | 0.0 | 5612.7 | 724 |
| 960 min Summer | 5.306 | 0.0 | 5498.4 | 962 |
| 1440 min Summer | 3.839 | 0.0 | 5251.3 | 1378 |
| 15 min Winter | 106.778 | 0.0 | 2566.0 | 26 |
| 30 min Winter | 70.214 | 0.0 | 2977.8 | 41 |
| 60 min Winter | 44.063 | 0.0 | 4733.7 | 70 |
| 120 min Winter | 26.779 | 0.0 | 5565.6 | 128 |
| 180 min Winter | 19.773 | 0.0 | 5819.8 | 186 |
| 240 min Winter | 15.863 | 0.0 | 5848.0 | 246 |
| 360 min Winter | 11.539 | 0.0 | 5837.6 | 362 |
| 480 min Winter | 9.189 | 0.0 | 5809.3 | 478 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 16/08/2021 16:29<br>File WMZ4 FSR (with outflow)... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2020.1.3 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 600 min Winter | 6.947 | 1.747 | 6.7 | 33.3 | 37.9 | 7711.6 | O K |
| 720 min Winter | 6.972 | 1.772 | 6.8 | 33.3 | 38.2 | 7837.9 | O K |
| 960 min Winter | 6.998 | 1.798 | 6.9 | 33.3 | 38.6 | 7969.3 | O K |
| 1440 min Winter | 6.997 | 1.797 | 6.9 | 33.3 | 38.6 | 7966.3 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 600 min Winter | 7.705 | 0.0 | 5777.7 | 594 |
| 720 min Winter | 6.669 | 0.0 | 5744.1 | 710 |
| 960 min Winter | 5.306 | 0.0 | 5672.2 | 938 |
| 1440 min Winter | 3.839 | 0.0 | 5522.3 | 1384 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 16/08/2021 16:29<br>File WMZ4 FSR (with outflow)... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2020.1.3 | |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.568 |
| Region | England and Wales | Cv (Winter) | 0.680 |
| M5-60 (mm) | 18.200 | Shortest Storm (mins) | 15 |
| Ratio R | 0.400 | Longest Storm (mins) | 1440 |
| Summer Storms | Yes | Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 16.660

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 5.553 | 4 | 8 | 5.553 | 8 | 12 | 5.553 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 16/08/2021 16:29<br>File WMZ4 FSR (with outflow)... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2020.1.3 | |

## Model Details

Storage is Online Cover Level (m) 7.500

## Infiltration Basin Structure

Invert Level (m) 5.200 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.02790

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 3811.8 | 2.000 | 5238.1 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0234-3330-2000-3330 |
| Design Head (m) | 2.000 |
| Design Flow (l/s) | 33.3 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 234 |
| Invert Level (m) | 5.200 |
| Minimum Outlet Pipe Diameter (mm) | 300 |
| Suggested Manhole Diameter (mm) | 1800 |

| **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|
| Design Point (Calculated) | 2.000 | 33.3 |
| Flush-Flo™ | 0.591 | 33.3 |
| Kick-Flo® | 1.281 | 26.9 |
| Mean Flow over Head Range | - | 28.9 |

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 | 7.7 | 1.200 | 28.9 | 3.000 | 40.5 | 7.000 | 61.0 |
| 0.200 | 23.5 | 1.400 | 28.1 | 3.500 | 43.6 | 7.500 | 63.0 |
| 0.300 | 30.9 | 1.600 | 29.9 | 4.000 | 46.5 | 8.000 | 65.0 |
| 0.400 | 32.4 | 1.800 | 31.7 | 4.500 | 49.2 | 8.500 | 67.0 |
| 0.500 | 33.1 | 2.000 | 33.3 | 5.000 | 51.8 | 9.000 | 68.9 |
| 0.600 | 33.3 | 2.200 | 34.9 | 5.500 | 54.2 | 9.500 | 70.7 |
| 0.800 | 32.8 | 2.400 | 36.3 | 6.000 | 56.6 | | |
| 1.000 | 31.6 | 2.600 | 37.8 | 6.500 | 58.8 | | |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 16/08/2021 16:32<br>File WMZ4 FEH (with outflow)... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2020.1.3 | |

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

Half Drain Time : 2334 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 6.020 | 0.820 | 3.5 | 33.3 | 36.2 | 4329.4 | O K |
| 30 min Summer | 6.136 | 0.936 | 4.0 | 33.3 | 36.2 | 4982.0 | O K |
| 60 min Summer | 6.264 | 1.064 | 4.5 | 33.3 | 36.2 | 5714.6 | O K |
| 120 min Summer | 6.401 | 1.201 | 5.1 | 33.3 | 36.2 | 6520.9 | O K |
| 180 min Summer | 6.485 | 1.285 | 5.5 | 33.3 | 36.2 | 7017.9 | O K |
| 240 min Summer | 6.544 | 1.344 | 5.8 | 33.3 | 36.2 | 7373.0 | O K |
| 360 min Summer | 6.624 | 1.424 | 6.1 | 33.3 | 36.2 | 7858.0 | O K |
| 480 min Summer | 6.676 | 1.476 | 6.4 | 33.3 | 36.2 | 8176.1 | O K |
| 600 min Summer | 6.712 | 1.512 | 6.5 | 33.3 | 36.2 | 8396.6 | O K |
| 720 min Summer | 6.738 | 1.538 | 6.6 | 33.3 | 36.2 | 8553.1 | O K |
| 960 min Summer | 6.756 | 1.556 | 6.7 | 33.3 | 36.2 | 8665.5 | O K |
| 1440 min Summer | 6.751 | 1.551 | 6.7 | 33.3 | 36.2 | 8638.1 | O K |
| 2160 min Summer | 6.705 | 1.505 | 6.5 | 33.3 | 36.2 | 8354.8 | O K |
| 15 min Winter | 6.172 | 0.972 | 4.1 | 33.3 | 36.2 | 5189.3 | O K |
| 30 min Winter | 6.308 | 1.108 | 4.7 | 33.3 | 36.2 | 5975.2 | O K |
| 60 min Winter | 6.459 | 1.259 | 5.4 | 33.3 | 36.2 | 6861.4 | O K |
| 120 min Winter | 6.622 | 1.422 | 6.1 | 33.3 | 36.2 | 7842.4 | O K |
| 180 min Winter | 6.720 | 1.520 | 6.6 | 33.3 | 36.2 | 8447.1 | O K |
| 240 min Winter | 6.791 | 1.591 | 6.9 | 33.3 | 36.7 | 8881.2 | O K |
| 360 min Winter | 6.887 | 1.687 | 7.3 | 33.3 | 38.0 | 9483.2 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 184.621 | 0.0 | 3000.9 | 27 |
| 30 min Summer | 106.552 | 0.0 | 3054.4 | 42 |
| 60 min Summer | 61.496 | 0.0 | 5303.1 | 72 |
| 120 min Summer | 35.492 | 0.0 | 5841.3 | 130 |
| 180 min Summer | 25.733 | 0.0 | 5938.3 | 190 |
| 240 min Summer | 20.484 | 0.0 | 5920.3 | 250 |
| 360 min Summer | 14.851 | 0.0 | 5859.0 | 368 |
| 480 min Summer | 11.822 | 0.0 | 5796.3 | 488 |
| 600 min Summer | 9.905 | 0.0 | 5737.3 | 606 |
| 720 min Summer | 8.571 | 0.0 | 5681.1 | 726 |
| 960 min Summer | 6.770 | 0.0 | 5566.9 | 964 |
| 1440 min Summer | 4.855 | 0.0 | 5338.9 | 1442 |
| 2160 min Summer | 3.482 | 0.0 | 10945.2 | 1880 |
| 15 min Winter | 184.621 | 0.0 | 3075.8 | 27 |
| 30 min Winter | 106.552 | 0.0 | 3077.0 | 41 |
| 60 min Winter | 61.496 | 0.0 | 5943.4 | 70 |
| 120 min Winter | 35.492 | 0.0 | 5984.4 | 128 |
| 180 min Winter | 25.733 | 0.0 | 5963.7 | 188 |
| 240 min Winter | 20.484 | 0.0 | 5945.7 | 246 |
| 360 min Winter | 14.851 | 0.0 | 5921.2 | 362 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 16/08/2021 16:32<br>File WMZ4 FEH (with outflow)... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2020.1.3 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 480 min Winter | 6.950 | 1.750 | 7.6 | 33.3 | 38.9 | 9887.9 | O K |
| 600 min Winter | 6.996 | 1.796 | 7.8 | 33.3 | 39.4 | 10176.8 | O K |
| 720 min Winter | 7.029 | 1.829 | 8.0 | 33.3 | 39.9 | 10389.3 | O K |
| 960 min Winter | 7.058 | 1.858 | 8.1 | 33.3 | 40.3 | 10575.0 | O K |
| 1440 min Winter | 7.069 | 1.869 | 8.2 | 33.3 | 40.4 | 10647.2 | O K |
| 2160 min Winter | 7.032 | 1.832 | 8.0 | 33.3 | 39.9 | 10409.3 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 480 min Winter | 11.822 | 0.0 | 5904.0 | 480 |
| 600 min Winter | 9.905 | 0.0 | 5889.7 | 596 |
| 720 min Winter | 8.571 | 0.0 | 5877.6 | 714 |
| 960 min Winter | 6.770 | 0.0 | 5842.1 | 944 |
| 1440 min Winter | 4.855 | 0.0 | 5780.6 | 1398 |
| 2160 min Winter | 3.482 | 0.0 | 11610.6 | 2044 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 16/08/2021 16:32<br>File WMZ4 FEH (with outflow)... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2020.1.3 | |

## Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| Return Period (years) | 100 |
| FEH Rainfall Version | 1999 |
| Site Location | GB 647450 264900 TM 47450 64900 |
| C (1km) | -0.020 |
| D1 (1km) | 0.299 |
| D2 (1km) | 0.272 |
| D3 (1km) | 0.215 |
| E (1km) | 0.311 |
| F (1km) | 2.506 |
| Summer Storms | Yes |
| Winter Storms | Yes |
| Cv (Summer) | 0.568 |
| Cv (Winter) | 0.680 |
| Shortest Storm (mins) | 15 |
| Longest Storm (mins) | 2160 |
| Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 16.660

| Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 5.553 | 4 | 8 | 5.553 | 8 | 12 | 5.553 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 16/08/2021 16:32<br>File WMZ4 FEH (with outflow)... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2020.1.3 | |

## Model Details

Storage is Online Cover Level (m) 7.500

## Infiltration Basin Structure

Invert Level (m) 5.200 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.02790

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 4964.2 | 2.000 | 6575.8 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0234-3330-2000-3330 |
| Design Head (m) | 2.000 |
| Design Flow (l/s) | 33.3 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 234 |
| Invert Level (m) | 5.200 |
| Minimum Outlet Pipe Diameter (mm) | 300 |
| Suggested Manhole Diameter (mm) | 1800 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 2.000 | 33.3 |
| Flush-Flo™ | 0.591 | 33.3 |
| Kick-Flo® | 1.281 | 26.9 |
| Mean Flow over Head Range | - | 28.9 |

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 | 7.7 | 1.200 | 28.9 | 3.000 | 40.5 | 7.000 | 61.0 |
| 0.200 | 23.5 | 1.400 | 28.1 | 3.500 | 43.6 | 7.500 | 63.0 |
| 0.300 | 30.9 | 1.600 | 29.9 | 4.000 | 46.5 | 8.000 | 65.0 |
| 0.400 | 32.4 | 1.800 | 31.7 | 4.500 | 49.2 | 8.500 | 67.0 |
| 0.500 | 33.1 | 2.000 | 33.3 | 5.000 | 51.8 | 9.000 | 68.9 |
| 0.600 | 33.3 | 2.200 | 34.9 | 5.500 | 54.2 | 9.500 | 70.7 |
| 0.800 | 32.8 | 2.400 | 36.3 | 6.000 | 56.6 | | |
| 1.000 | 31.6 | 2.600 | 37.8 | 6.500 | 58.8 | | |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 16/08/2021 16:34<br>File WMZ4 FEH13 (with outflo... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2020.1.3 | |

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

Half Drain Time : 2457 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 5.636 | 0.436 | 1.8 | 32.8 | 34.6 | 2335.8 | O K |
| 30 min Summer | 5.786 | 0.586 | 2.5 | 33.3 | 35.8 | 3174.2 | O K |
| 60 min Summer | 5.940 | 0.740 | 3.2 | 33.3 | 36.2 | 4054.6 | O K |
| 120 min Summer | 6.123 | 0.923 | 4.0 | 33.3 | 36.2 | 5125.3 | O K |
| 180 min Summer | 6.247 | 1.047 | 4.5 | 33.3 | 36.2 | 5864.8 | O K |
| 240 min Summer | 6.342 | 1.142 | 5.0 | 33.3 | 36.2 | 6443.7 | O K |
| 360 min Summer | 6.486 | 1.286 | 5.6 | 33.3 | 36.2 | 7330.9 | O K |
| 480 min Summer | 6.586 | 1.386 | 6.1 | 33.3 | 36.2 | 7957.8 | O K |
| 600 min Summer | 6.655 | 1.455 | 6.4 | 33.3 | 36.2 | 8391.5 | O K |
| 720 min Summer | 6.702 | 1.502 | 6.6 | 33.3 | 36.2 | 8696.7 | O K |
| 960 min Summer | 6.755 | 1.555 | 6.9 | 33.3 | 36.4 | 9038.5 | O K |
| 1440 min Summer | 6.773 | 1.573 | 6.9 | 33.3 | 36.6 | 9151.6 | O K |
| 2160 min Summer | 6.713 | 1.513 | 6.7 | 33.3 | 36.2 | 8762.1 | O K |
| 15 min Winter | 5.719 | 0.519 | 2.2 | 33.2 | 35.4 | 2800.7 | O K |
| 30 min Winter | 5.897 | 0.697 | 3.0 | 33.3 | 36.1 | 3808.4 | O K |
| 60 min Winter | 6.080 | 0.880 | 3.8 | 33.3 | 36.2 | 4869.7 | O K |
| 120 min Winter | 6.297 | 1.097 | 4.8 | 33.3 | 36.2 | 6166.8 | O K |
| 180 min Winter | 6.444 | 1.244 | 5.4 | 33.3 | 36.2 | 7072.6 | O K |
| 240 min Winter | 6.559 | 1.359 | 6.0 | 33.3 | 36.2 | 7786.8 | O K |
| 360 min Winter | 6.728 | 1.528 | 6.7 | 33.3 | 36.2 | 8864.4 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 100.080 | 0.0 | 1905.0 | 27 |
| 30 min Summer | 68.208 | 0.0 | 2533.5 | 41 |
| 60 min Summer | 43.872 | 0.0 | 3849.1 | 70 |
| 120 min Summer | 28.074 | 0.0 | 4866.1 | 130 |
| 180 min Summer | 21.656 | 0.0 | 5491.1 | 190 |
| 240 min Summer | 18.024 | 0.0 | 5831.1 | 250 |
| 360 min Summer | 13.906 | 0.0 | 5893.1 | 368 |
| 480 min Summer | 11.513 | 0.0 | 5808.8 | 488 |
| 600 min Summer | 9.884 | 0.0 | 5739.0 | 606 |
| 720 min Summer | 8.689 | 0.0 | 5680.7 | 726 |
| 960 min Summer | 7.018 | 0.0 | 5576.5 | 964 |
| 1440 min Summer | 5.090 | 0.0 | 5369.0 | 1442 |
| 2160 min Summer | 3.610 | 0.0 | 11076.1 | 1924 |
| 15 min Winter | 100.080 | 0.0 | 2267.5 | 26 |
| 30 min Winter | 68.208 | 0.0 | 2859.1 | 41 |
| 60 min Winter | 43.872 | 0.0 | 4581.4 | 70 |
| 120 min Winter | 28.074 | 0.0 | 5641.5 | 128 |
| 180 min Winter | 21.656 | 0.0 | 5966.8 | 188 |
| 240 min Winter | 18.024 | 0.0 | 5946.6 | 246 |
| 360 min Winter | 13.906 | 0.0 | 5884.4 | 362 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 16/08/2021 16:34<br>File WMZ4 FEH13 (with outflo... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2020.1.3 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 480 min Winter | 6.846 | 1.646 | 7.3 | 33.3 | 37.6 | 9627.9 | O K |
| 600 min Winter | 6.929 | 1.729 | 7.7 | 33.3 | 38.7 | 10169.5 | O K |
| 720 min Winter | 6.988 | 1.788 | 8.0 | 33.3 | 39.5 | 10559.5 | O K |
| 960 min Winter | 7.057 | 1.857 | 8.3 | 33.3 | 40.4 | 11021.1 | O K |
| 1440 min Winter | 7.093 | 1.893 | 8.5 | 33.3 | 40.9 | 11263.3 | O K |
| 2160 min Winter | 7.041 | 1.841 | 8.2 | 33.3 | 40.2 | 10913.7 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 480 min Winter | 11.513 | 0.0 | 5859.2 | 480 |
| 600 min Winter | 9.884 | 0.0 | 5853.3 | 596 |
| 720 min Winter | 8.689 | 0.0 | 5855.9 | 714 |
| 960 min Winter | 7.019 | 0.0 | 5868.2 | 944 |
| 1440 min Winter | 5.090 | 0.0 | 5851.7 | 1400 |
| 2160 min Winter | 3.610 | 0.0 | 11659.6 | 2056 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 16/08/2021 16:34<br>File WMZ4 FEH13 (with outflo... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2020.1.3 | |

## Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| Return Period (years) | 100 |
| FEH Rainfall Version | 2013 |
| Site Location | GB 647450 264900 TM 47450 64900 |
| Data Type | Catchment |
| Summer Storms | Yes |
| Winter Storms | Yes |
| Cv (Summer) | 0.568 |
| Cv (Winter) | 0.680 |
| Shortest Storm (mins) | 15 |
| Longest Storm (mins) | 2160 |
| Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 16.660

| Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 5.553 | 4 | 8 | 5.553 | 8 | 12 | 5.553 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 16/08/2021 16:34<br>File WMZ4 FEH13 (with outflo... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2020.1.3 | |

## Model Details

Storage is Online Cover Level (m) 7.500

## Infiltration Basin Structure

Invert Level (m) 5.200 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.02790

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 5192.0 | 2.000 | 6837.7 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0234-3330-2000-3330 |
| Design Head (m) | 2.000 |
| Design Flow (l/s) | 33.3 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 234 |
| Invert Level (m) | 5.200 |
| Minimum Outlet Pipe Diameter (mm) | 300 |
| Suggested Manhole Diameter (mm) | 1800 |

| **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|
| Design Point (Calculated) | 2.000 | 33.3 |
| Flush-Flo™ | 0.591 | 33.3 |
| Kick-Flo® | 1.281 | 26.9 |
| Mean Flow over Head Range | - | 28.9 |

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 | 7.7 | 1.200 | 28.9 | 3.000 | 40.5 | 7.000 | 61.0 |
| 0.200 | 23.5 | 1.400 | 28.1 | 3.500 | 43.6 | 7.500 | 63.0 |
| 0.300 | 30.9 | 1.600 | 29.9 | 4.000 | 46.5 | 8.000 | 65.0 |
| 0.400 | 32.4 | 1.800 | 31.7 | 4.500 | 49.2 | 8.500 | 67.0 |
| 0.500 | 33.1 | 2.000 | 33.3 | 5.000 | 51.8 | 9.000 | 68.9 |
| 0.600 | 33.3 | 2.200 | 34.9 | 5.500 | 54.2 | 9.500 | 70.7 |
| 0.800 | 32.8 | 2.400 | 36.3 | 6.000 | 56.6 | | |
| 1.000 | 31.6 | 2.600 | 37.8 | 6.500 | 58.8 | | |

## 1.6. WMZ5 Basin

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 13:59<br>File WMZ5 FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time exceeds 7 days.

Outflow is too low. Design is unsatisfactory.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Summer | 6.531 | 0.531 | 0.3 | 2364.8 | O K |
| 30 min Summer | 6.690 | 0.690 | 0.4 | 3109.8 | O K |
| 60 min Summer | 6.854 | 0.854 | 0.5 | 3902.7 | O K |
| 120 min Summer | 7.024 | 1.024 | 0.7 | 4742.5 | O K |
| 180 min Summer | 7.125 | 1.125 | 0.7 | 5251.3 | O K |
| 240 min Summer | 7.196 | 1.196 | 0.8 | 5615.7 | O K |
| 360 min Summer | 7.294 | 1.294 | 0.8 | 6124.4 | O K |
| 480 min Summer | 7.366 | 1.366 | 0.9 | 6500.1 | O K |
| 600 min Summer | 7.424 | 1.424 | 0.9 | 6809.1 | O K |
| 720 min Summer | 7.473 | 1.473 | 1.0 | 7068.7 | O K |
| 960 min Summer | 7.552 | 1.552 | 1.0 | 7491.6 | O K |
| 1440 min Summer | 7.666 | 1.666 | 1.1 | 8114.5 | O K |
| 2160 min Summer | 7.783 | 1.783 | 1.2 | 8766.5 | O K |
| 2880 min Summer | 7.868 | 1.868 | 1.2 | 9243.9 | O K |
| 4320 min Summer | 7.989 | 1.989 | 1.3 | 9931.3 | O K |
| 5760 min Summer | 8.074 | 2.074 | 1.3 | 10423.2 | Flood Risk |
| 7200 min Summer | 8.140 | 2.140 | 1.4 | 10804.1 | Flood Risk |
| 8640 min Summer | 8.193 | 2.193 | 1.4 | 11112.0 | Flood Risk |
| 10080 min Summer | 8.238 | 2.238 | 1.4 | 11368.0 | Flood Risk |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Time-Peak (mins) |
|---|---|---|---|
| 15 min Summer | 106.778 | 0.0 | 27 |
| 30 min Summer | 70.214 | 0.0 | 42 |
| 60 min Summer | 44.063 | 0.0 | 72 |
| 120 min Summer | 26.779 | 0.0 | 132 |
| 180 min Summer | 19.773 | 0.0 | 192 |
| 240 min Summer | 15.863 | 0.0 | 252 |
| 360 min Summer | 11.539 | 0.0 | 372 |
| 480 min Summer | 9.189 | 0.0 | 492 |
| 600 min Summer | 7.705 | 0.0 | 612 |
| 720 min Summer | 6.669 | 0.0 | 732 |
| 960 min Summer | 5.306 | 0.0 | 972 |
| 1440 min Summer | 3.839 | 0.0 | 1452 |
| 2160 min Summer | 2.773 | 0.0 | 2172 |
| 2880 min Summer | 2.199 | 0.0 | 2892 |
| 4320 min Summer | 1.584 | 0.0 | 4332 |
| 5760 min Summer | 1.254 | 0.0 | 5776 |
| 7200 min Summer | 1.046 | 0.0 | 7216 |
| 8640 min Summer | 0.901 | 0.0 | 8648 |
| 10080 min Summer | 0.794 | 0.0 | 10088 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 13:59<br>File WMZ5 FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Winter | 6.631 | 0.631 | 0.4 | 2831.1 | O K |
| 30 min Winter | 6.817 | 0.817 | 0.5 | 3723.0 | O K |
| 60 min Winter | 7.010 | 1.010 | 0.6 | 4672.3 | O K |
| 120 min Winter | 7.208 | 1.208 | 0.8 | 5677.7 | O K |
| 180 min Winter | 7.325 | 1.325 | 0.9 | 6286.9 | O K |
| 240 min Winter | 7.408 | 1.408 | 0.9 | 6723.1 | O K |
| 360 min Winter | 7.522 | 1.522 | 1.0 | 7332.1 | O K |
| 480 min Winter | 7.605 | 1.605 | 1.0 | 7781.9 | O K |
| 600 min Winter | 7.673 | 1.673 | 1.1 | 8151.9 | O K |
| 720 min Winter | 7.729 | 1.729 | 1.1 | 8462.8 | O K |
| 960 min Winter | 7.820 | 1.820 | 1.2 | 8969.2 | O K |
| 1440 min Winter | 7.951 | 1.951 | 1.3 | 9715.2 | O K |
| 2160 min Winter | 8.087 | 2.087 | 1.3 | 10496.6 | Flood Risk |
| 2880 min Winter | 8.186 | 2.186 | 1.4 | 11070.5 | Flood Risk |
| 4320 min Winter | 8.330 | 2.330 | 1.4 | 11900.6 | FLOOD |
| 5760 min Winter | 8.434 | 2.434 | 1.4 | 12499.6 | FLOOD |
| 7200 min Winter | 8.515 | 2.515 | 1.4 | 12966.2 | FLOOD |
| 8640 min Winter | 8.580 | 2.580 | 1.4 | 13345.8 | FLOOD |
| 10080 min Winter | 8.636 | 2.636 | 1.4 | 13663.6 | FLOOD |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Time-Peak (mins) |
|---|---|---|---|
| 15 min Winter | 106.778 | 0.0 | 27 |
| 30 min Winter | 70.214 | 0.0 | 42 |
| 60 min Winter | 44.063 | 0.0 | 72 |
| 120 min Winter | 26.779 | 0.0 | 132 |
| 180 min Winter | 19.773 | 0.0 | 192 |
| 240 min Winter | 15.863 | 0.0 | 252 |
| 360 min Winter | 11.539 | 0.0 | 370 |
| 480 min Winter | 9.189 | 0.0 | 490 |
| 600 min Winter | 7.705 | 0.0 | 610 |
| 720 min Winter | 6.669 | 0.0 | 730 |
| 960 min Winter | 5.306 | 0.0 | 970 |
| 1440 min Winter | 3.839 | 0.0 | 1448 |
| 2160 min Winter | 2.773 | 0.0 | 2168 |
| 2880 min Winter | 2.199 | 0.0 | 2884 |
| 4320 min Winter | 1.584 | 172.8 | 4320 |
| 5760 min Winter | 1.254 | 771.8 | 5720 |
| 7200 min Winter | 1.046 | 1238.5 | 7144 |
| 8640 min Winter | 0.901 | 1618.0 | 8568 |
| 10080 min Winter | 0.794 | 1935.8 | 9992 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 13:59<br>File WMZ5 FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.568 |
| Region | England and Wales | Cv (Winter) | 0.680 |
| M5-60 (mm) | 18.200 | Shortest Storm (mins) | 15 |
| Ratio R | 0.400 | Longest Storm (mins) | 10080 |
| Summer Storms | Yes | Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 15.598

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 5.199 | 4 | 8 | 5.199 | 8 | 12 | 5.199 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 13:59<br>File WMZ5 FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 8.300

## Infiltration Basin Structure

Invert Level (m) 6.000 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00450

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 4266.3 | 2.000 | 5768.6 |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:00<br>File WMZ5 FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time exceeds 7 days.

Outflow is too low. Design is unsatisfactory.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Summer | 6.688 | 0.688 | 0.5 | 4088.8 | O K |
| 30 min Summer | 6.789 | 0.789 | 0.6 | 4719.4 | O K |
| 60 min Summer | 6.903 | 0.903 | 0.7 | 5446.9 | O K |
| 120 min Summer | 7.033 | 1.033 | 0.8 | 6285.9 | O K |
| 180 min Summer | 7.117 | 1.117 | 0.8 | 6834.8 | O K |
| 240 min Summer | 7.180 | 1.180 | 0.9 | 7252.6 | O K |
| 360 min Summer | 7.275 | 1.275 | 0.9 | 7884.2 | O K |
| 480 min Summer | 7.346 | 1.346 | 1.0 | 8364.4 | O K |
| 600 min Summer | 7.403 | 1.403 | 1.0 | 8756.0 | O K |
| 720 min Summer | 7.452 | 1.452 | 1.1 | 9088.9 | O K |
| 960 min Summer | 7.520 | 1.520 | 1.1 | 9563.8 | O K |
| 1440 min Summer | 7.621 | 1.621 | 1.2 | 10270.5 | O K |
| 2160 min Summer | 7.727 | 1.727 | 1.3 | 11020.1 | O K |
| 2880 min Summer | 7.805 | 1.805 | 1.3 | 11576.5 | O K |
| 4320 min Summer | 7.878 | 1.878 | 1.4 | 12107.1 | O K |
| 5760 min Summer | 7.930 | 1.930 | 1.4 | 12479.8 | O K |
| 7200 min Summer | 7.968 | 1.968 | 1.5 | 12762.6 | O K |
| 8640 min Summer | 7.999 | 1.999 | 1.5 | 12986.7 | O K |
| 10080 min Summer | 8.023 | 2.023 | 1.5 | 13169.4 | Flood Risk |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Time-Peak (mins) |
|---|---|---|---|
| 15 min Summer | 184.621 | 0.0 | 27 |
| 30 min Summer | 106.552 | 0.0 | 42 |
| 60 min Summer | 61.496 | 0.0 | 72 |
| 120 min Summer | 35.492 | 0.0 | 132 |
| 180 min Summer | 25.733 | 0.0 | 192 |
| 240 min Summer | 20.484 | 0.0 | 252 |
| 360 min Summer | 14.851 | 0.0 | 372 |
| 480 min Summer | 11.822 | 0.0 | 492 |
| 600 min Summer | 9.905 | 0.0 | 612 |
| 720 min Summer | 8.571 | 0.0 | 732 |
| 960 min Summer | 6.770 | 0.0 | 972 |
| 1440 min Summer | 4.855 | 0.0 | 1452 |
| 2160 min Summer | 3.482 | 0.0 | 2172 |
| 2880 min Summer | 2.750 | 0.0 | 2892 |
| 4320 min Summer | 1.927 | 0.0 | 4332 |
| 5760 min Summer | 1.497 | 0.0 | 5776 |
| 7200 min Summer | 1.231 | 0.0 | 7216 |
| 8640 min Summer | 1.049 | 0.0 | 8648 |
| 10080 min Summer | 0.917 | 0.0 | 10088 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 14:00<br>File WMZ5 FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Winter | 6.817 | 0.817 | 0.6 | 4895.0 | O K |
| 30 min Winter | 6.935 | 0.935 | 0.7 | 5649.9 | O K |
| 60 min Winter | 7.069 | 1.069 | 0.8 | 6520.9 | O K |
| 120 min Winter | 7.221 | 1.221 | 0.9 | 7525.4 | O K |
| 180 min Winter | 7.319 | 1.319 | 1.0 | 8182.5 | O K |
| 240 min Winter | 7.392 | 1.392 | 1.0 | 8682.7 | O K |
| 360 min Winter | 7.502 | 1.502 | 1.1 | 9438.9 | O K |
| 480 min Winter | 7.585 | 1.585 | 1.2 | 10013.8 | O K |
| 600 min Winter | 7.652 | 1.652 | 1.2 | 10482.8 | O K |
| 720 min Winter | 7.708 | 1.708 | 1.3 | 10881.4 | O K |
| 960 min Winter | 7.787 | 1.787 | 1.3 | 11450.0 | O K |
| 1440 min Winter | 7.904 | 1.904 | 1.4 | 12296.3 | O K |
| 2160 min Winter | 8.027 | 2.027 | 1.5 | 13194.2 | Flood Risk |
| 2880 min Winter | 8.117 | 2.117 | 1.5 | 13861.8 | Flood Risk |
| 4320 min Winter | 8.204 | 2.204 | 1.6 | 14501.1 | Flood Risk |
| 5760 min Winter | 8.265 | 2.265 | 1.6 | 14953.5 | Flood Risk |
| 7200 min Winter | 8.312 | 2.312 | 1.6 | 15299.7 | FLOOD |
| 8640 min Winter | 8.350 | 2.350 | 1.6 | 15576.6 | FLOOD |
| 10080 min Winter | 8.381 | 2.381 | 1.6 | 15804.4 | FLOOD |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Time-Peak (mins) |
|---|---|---|---|
| 15 min Winter | 184.621 | 0.0 | 27 |
| 30 min Winter | 106.552 | 0.0 | 42 |
| 60 min Winter | 61.496 | 0.0 | 72 |
| 120 min Winter | 35.492 | 0.0 | 132 |
| 180 min Winter | 25.733 | 0.0 | 192 |
| 240 min Winter | 20.484 | 0.0 | 252 |
| 360 min Winter | 14.851 | 0.0 | 372 |
| 480 min Winter | 11.822 | 0.0 | 490 |
| 600 min Winter | 9.905 | 0.0 | 610 |
| 720 min Winter | 8.571 | 0.0 | 730 |
| 960 min Winter | 6.770 | 0.0 | 970 |
| 1440 min Winter | 4.855 | 0.0 | 1448 |
| 2160 min Winter | 3.482 | 0.0 | 2168 |
| 2880 min Winter | 2.750 | 0.0 | 2884 |
| 4320 min Winter | 1.927 | 0.0 | 4320 |
| 5760 min Winter | 1.497 | 0.0 | 5720 |
| 7200 min Winter | 1.231 | 90.6 | 7144 |
| 8640 min Winter | 1.049 | 367.5 | 8568 |
| 10080 min Winter | 0.917 | 595.4 | 9992 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:00<br>File WMZ5 FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| Return Period (years) | 100 |
| FEH Rainfall Version | 1999 |
| Site Location | GB 647450 264900 TM 47450 64900 |
| C (1km) | -0.020 |
| D1 (1km) | 0.299 |
| D2 (1km) | 0.272 |
| D3 (1km) | 0.215 |
| E (1km) | 0.311 |
| F (1km) | 2.506 |
| Summer Storms | Yes |
| Winter Storms | Yes |
| Cv (Summer) | 0.568 |
| Cv (Winter) | 0.680 |
| Shortest Storm (mins) | 15 |
| Longest Storm (mins) | 10080 |
| Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 15.598

| Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 5.199 | 4 | 8 | 5.199 | 8 | 12 | 5.199 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 14:00<br>File WMZ5 FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

Model Details

Storage is Online Cover Level (m) 8.300

Infiltration Basin Structure

Invert Level (m) 6.000 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00450

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 5660.6 | 2.000 | 7374.0 |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:00<br>File WMZ5 FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time exceeds 7 days.

Critical storm may not be identified, please run longer storm durations.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 15 min Summer | 6.381 | 0.381 | 0.3 | 2216.5 | O K |
| 30 min Summer | 6.515 | 0.515 | 0.4 | 3021.0 | O K |
| 60 min Summer | 6.656 | 0.656 | 0.5 | 3885.9 | O K |
| 120 min Summer | 6.829 | 0.829 | 0.6 | 4972.1 | O K |
| 180 min Summer | 6.951 | 0.951 | 0.7 | 5751.9 | O K |
| 240 min Summer | 7.048 | 1.048 | 0.8 | 6381.6 | O K |
| 360 min Summer | 7.200 | 1.200 | 0.9 | 7382.3 | O K |
| 480 min Summer | 7.313 | 1.313 | 1.0 | 8145.4 | O K |
| 600 min Summer | 7.400 | 1.400 | 1.0 | 8738.1 | O K |
| 720 min Summer | 7.470 | 1.470 | 1.1 | 9213.7 | O K |
| 960 min Summer | 7.571 | 1.571 | 1.2 | 9914.7 | O K |
| 1440 min Summer | 7.692 | 1.692 | 1.3 | 10767.3 | O K |
| 2160 min Summer | 7.784 | 1.784 | 1.3 | 11426.9 | O K |
| 2880 min Summer | 7.834 | 1.834 | 1.4 | 11788.4 | O K |
| 4320 min Summer | 7.883 | 1.883 | 1.4 | 12140.4 | O K |
| 5760 min Summer | 7.913 | 1.913 | 1.4 | 12358.1 | O K |
| 15 min Winter | 6.454 | 0.454 | 0.3 | 2653.5 | O K |
| 30 min Winter | 6.612 | 0.612 | 0.4 | 3616.7 | O K |
| 60 min Winter | 6.778 | 0.778 | 0.6 | 4652.1 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Time-Peak (mins) |
|---|---|---|---|
| 15 min Summer | 100.080 | 0.0 | 27 |
| 30 min Summer | 68.208 | 0.0 | 42 |
| 60 min Summer | 43.872 | 0.0 | 72 |
| 120 min Summer | 28.074 | 0.0 | 132 |
| 180 min Summer | 21.656 | 0.0 | 192 |
| 240 min Summer | 18.024 | 0.0 | 252 |
| 360 min Summer | 13.906 | 0.0 | 372 |
| 480 min Summer | 11.513 | 0.0 | 492 |
| 600 min Summer | 9.884 | 0.0 | 612 |
| 720 min Summer | 8.689 | 0.0 | 732 |
| 960 min Summer | 7.018 | 0.0 | 972 |
| 1440 min Summer | 5.090 | 0.0 | 1452 |
| 2160 min Summer | 3.610 | 0.0 | 2172 |
| 2880 min Summer | 2.801 | 0.0 | 2892 |
| 4320 min Summer | 1.933 | 0.0 | 4332 |
| 5760 min Summer | 1.483 | 0.0 | 5776 |
| 15 min Winter | 100.080 | 0.0 | 27 |
| 30 min Winter | 68.208 | 0.0 | 42 |
| 60 min Winter | 43.872 | 0.0 | 72 |

| | | |
|---|---|---|
| Atkins (Epsom) | | Page 2 |
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 14:00<br>File WMZ5 FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|
| 120 min Winter | 6.982 | 0.982 | 0.7 | 5952.6 | O K |
| 180 min Winter | 7.125 | 1.125 | 0.8 | 6886.1 | O K |
| 240 min Winter | 7.238 | 1.238 | 0.9 | 7640.0 | O K |
| 360 min Winter | 7.415 | 1.415 | 1.0 | 8838.0 | O K |
| 480 min Winter | 7.547 | 1.547 | 1.1 | 9751.6 | O K |
| 600 min Winter | 7.649 | 1.649 | 1.2 | 10461.3 | O K |
| 720 min Winter | 7.729 | 1.729 | 1.3 | 11030.7 | O K |
| 960 min Winter | 7.846 | 1.846 | 1.4 | 11870.0 | O K |
| 1440 min Winter | 7.986 | 1.986 | 1.5 | 12891.1 | O K |
| 2160 min Winter | 8.093 | 2.093 | 1.5 | 13681.7 | Flood Risk |
| 2880 min Winter | 8.152 | 2.152 | 1.5 | 14116.2 | Flood Risk |
| 4320 min Winter | 8.209 | 2.209 | 1.6 | 14541.2 | Flood Risk |
| 5760 min Winter | 8.245 | 2.245 | 1.6 | 14806.8 | Flood Risk |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Time-Peak (mins) |
|---|---|---|---|
| 120 min Winter | 28.074 | 0.0 | 132 |
| 180 min Winter | 21.656 | 0.0 | 192 |
| 240 min Winter | 18.024 | 0.0 | 252 |
| 360 min Winter | 13.906 | 0.0 | 372 |
| 480 min Winter | 11.513 | 0.0 | 490 |
| 600 min Winter | 9.884 | 0.0 | 610 |
| 720 min Winter | 8.689 | 0.0 | 730 |
| 960 min Winter | 7.019 | 0.0 | 970 |
| 1440 min Winter | 5.090 | 0.0 | 1448 |
| 2160 min Winter | 3.610 | 0.0 | 2168 |
| 2880 min Winter | 2.801 | 0.0 | 2884 |
| 4320 min Winter | 1.932 | 0.0 | 4324 |
| 5760 min Winter | 1.483 | 0.0 | 5720 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 14:00<br>File WMZ5 FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| Return Period (years) | 100 |
| FEH Rainfall Version | 2013 |
| Site Location | GB 647450 264900 TM 47450 64900 |
| Data Type | Catchment |
| Summer Storms | Yes |
| Winter Storms | Yes |
| Cv (Summer) | 0.568 |
| Cv (Winter) | 0.680 |
| Shortest Storm (mins) | 15 |
| Longest Storm (mins) | 5760 |
| Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 15.598

| Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 5.199 | 4 | 8 | 5.199 | 8 | 12 | 5.199 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 14:00<br>File WMZ5 FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 8.300

## Infiltration Basin Structure

Invert Level (m) 6.000 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00450

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 5660.6 | 2.000 | 7374.0 |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 16/08/2021 16:19<br>File WMZ5 FSR (with outflow)... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time : 2085 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 6.656 | 0.656 | 0.4 | 31.1 | 31.4 | 2332.7 | O K |
| 30 min Summer | 6.846 | 0.846 | 0.5 | 31.1 | 31.4 | 3059.6 | O K |
| 60 min Summer | 7.037 | 1.037 | 0.6 | 31.1 | 31.4 | 3813.7 | O K |
| 120 min Summer | 7.224 | 1.224 | 0.7 | 31.1 | 31.4 | 4578.1 | O K |
| 180 min Summer | 7.328 | 1.328 | 0.8 | 31.1 | 31.4 | 5012.1 | O K |
| 240 min Summer | 7.396 | 1.396 | 0.8 | 31.1 | 31.4 | 5297.7 | O K |
| 360 min Summer | 7.476 | 1.476 | 0.9 | 31.1 | 31.4 | 5644.1 | O K |
| 480 min Summer | 7.525 | 1.525 | 0.9 | 31.1 | 31.4 | 5854.5 | O K |
| 600 min Summer | 7.558 | 1.558 | 0.9 | 31.1 | 31.4 | 5996.9 | O K |
| 720 min Summer | 7.579 | 1.579 | 0.9 | 31.1 | 31.4 | 6089.5 | O K |
| 960 min Summer | 7.599 | 1.599 | 0.9 | 31.1 | 31.4 | 6178.9 | O K |
| 1440 min Summer | 7.591 | 1.591 | 0.9 | 31.1 | 31.4 | 6144.2 | O K |
| 2160 min Summer | 7.541 | 1.541 | 0.9 | 31.1 | 31.4 | 5922.4 | O K |
| 15 min Winter | 6.779 | 0.779 | 0.4 | 31.1 | 31.4 | 2798.0 | O K |
| 30 min Winter | 7.002 | 1.002 | 0.6 | 31.1 | 31.4 | 3672.2 | O K |
| 60 min Winter | 7.226 | 1.226 | 0.7 | 31.1 | 31.4 | 4584.2 | O K |
| 120 min Winter | 7.446 | 1.446 | 0.8 | 31.1 | 31.4 | 5512.6 | O K |
| 180 min Winter | 7.567 | 1.567 | 0.9 | 31.1 | 31.4 | 6038.8 | O K |
| 240 min Winter | 7.647 | 1.647 | 1.0 | 31.1 | 31.4 | 6390.3 | O K |
| 360 min Winter | 7.745 | 1.745 | 1.0 | 31.1 | 31.4 | 6827.1 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 106.778 | 0.0 | 2059.0 | 27 |
| 30 min Summer | 70.214 | 0.0 | 2536.6 | 41 |
| 60 min Summer | 44.063 | 0.0 | 3732.1 | 70 |
| 120 min Summer | 26.779 | 0.0 | 4469.3 | 130 |
| 180 min Summer | 19.773 | 0.0 | 4819.0 | 190 |
| 240 min Summer | 15.863 | 0.0 | 4946.8 | 250 |
| 360 min Summer | 11.539 | 0.0 | 4911.3 | 368 |
| 480 min Summer | 9.189 | 0.0 | 4841.7 | 488 |
| 600 min Summer | 7.705 | 0.0 | 4773.6 | 606 |
| 720 min Summer | 6.669 | 0.0 | 4710.9 | 726 |
| 960 min Summer | 5.306 | 0.0 | 4598.0 | 964 |
| 1440 min Summer | 3.839 | 0.0 | 4400.6 | 1440 |
| 2160 min Summer | 2.773 | 0.0 | 8586.4 | 1820 |
| 15 min Winter | 106.778 | 0.0 | 2395.2 | 27 |
| 30 min Winter | 70.214 | 0.0 | 2640.6 | 41 |
| 60 min Winter | 44.063 | 0.0 | 4414.8 | 70 |
| 120 min Winter | 26.779 | 0.0 | 4991.5 | 128 |
| 180 min Winter | 19.773 | 0.0 | 4975.6 | 188 |
| 240 min Winter | 15.863 | 0.0 | 4930.9 | 246 |
| 360 min Winter | 11.539 | 0.0 | 4862.1 | 362 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 16/08/2021 16:19<br>File WMZ5 FSR (with outflow)... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 480 min Winter | 7.805 | 1.805 | 1.1 | 31.1 | 31.4 | 7102.4 | O K |
| 600 min Winter | 7.848 | 1.848 | 1.1 | 31.1 | 31.4 | 7296.6 | O K |
| 720 min Winter | 7.877 | 1.877 | 1.1 | 31.1 | 31.4 | 7431.2 | O K |
| 960 min Winter | 7.911 | 1.911 | 1.1 | 31.1 | 31.6 | 7586.3 | O K |
| 1440 min Winter | 7.923 | 1.923 | 1.1 | 31.1 | 31.7 | 7641.5 | O K |
| 2160 min Winter | 7.878 | 1.878 | 1.1 | 31.1 | 31.4 | 7434.0 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 480 min Winter | 9.189 | 0.0 | 4814.2 | 480 |
| 600 min Winter | 7.705 | 0.0 | 4778.4 | 596 |
| 720 min Winter | 6.669 | 0.0 | 4750.4 | 712 |
| 960 min Winter | 5.306 | 0.0 | 4712.1 | 942 |
| 1440 min Winter | 3.839 | 0.0 | 4683.3 | 1392 |
| 2160 min Winter | 2.773 | 0.0 | 9595.7 | 2036 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 16/08/2021 16:19<br>File WMZ5 FSR (with outflow)... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.568 |
| Region | England and Wales | Cv (Winter) | 0.680 |
| M5-60 (mm) | 18.200 | Shortest Storm (mins) | 15 |
| Ratio R | 0.400 | Longest Storm (mins) | 2160 |
| Summer Storms | Yes | Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 15.598

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 5.199 | 4 | 8 | 5.199 | 8 | 12 | 5.199 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 16/08/2021 16:19<br>File WMZ5 FSR (with outflow)... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 8.300

## Infiltration Basin Structure

Invert Level (m) 6.000 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00450

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 3348.0 | 2.000 | 4691.8 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0227-3120-2000-3120 |
| Design Head (m) | 2.000 |
| Design Flow (l/s) | 31.2 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 227 |
| Invert Level (m) | 6.000 |
| Minimum Outlet Pipe Diameter (mm) | 300 |
| Suggested Manhole Diameter (mm) | 1800 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 2.000 | 31.1 |
| Flush-Flo™ | 0.591 | 31.1 |
| Kick-Flo® | 1.272 | 25.1 |
| Mean Flow over Head Range | - | 27.0 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.100 | 7.6 | 1.200 | 26.8 | 3.000 | 37.8 | 7.000 | 57.0 |
| 0.200 | 22.6 | 1.400 | 26.3 | 3.500 | 40.8 | 7.500 | 58.9 |
| 0.300 | 28.8 | 1.600 | 28.0 | 4.000 | 43.5 | 8.000 | 60.8 |
| 0.400 | 30.3 | 1.800 | 29.6 | 4.500 | 46.0 | 8.500 | 62.6 |
| 0.500 | 30.9 | 2.000 | 31.1 | 5.000 | 48.4 | 9.000 | 64.4 |
| 0.600 | 31.1 | 2.200 | 32.6 | 5.500 | 50.7 | 9.500 | 66.1 |
| 0.800 | 30.6 | 2.400 | 34.0 | 6.000 | 52.9 | | |
| 1.000 | 29.4 | 2.600 | 35.3 | 6.500 | 55.0 | | |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 16/08/2021 16:21<br>File WMZ5 FEH (with outflow)... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time : 2769 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 6.844 | 0.844 | 0.5 | 31.1 | 31.4 | 4055.5 | O K |
| 30 min Summer | 6.962 | 0.962 | 0.6 | 31.1 | 31.4 | 4668.2 | O K |
| 60 min Summer | 7.093 | 1.093 | 0.7 | 31.1 | 31.4 | 5357.9 | O K |
| 120 min Summer | 7.235 | 1.235 | 0.8 | 31.1 | 31.4 | 6121.4 | O K |
| 180 min Summer | 7.322 | 1.322 | 0.9 | 31.1 | 31.4 | 6595.7 | O K |
| 240 min Summer | 7.384 | 1.384 | 0.9 | 31.1 | 31.4 | 6935.7 | O K |
| 360 min Summer | 7.468 | 1.468 | 1.0 | 31.1 | 31.4 | 7405.9 | O K |
| 480 min Summer | 7.524 | 1.524 | 1.0 | 31.1 | 31.4 | 7721.2 | O K |
| 600 min Summer | 7.564 | 1.564 | 1.0 | 31.1 | 31.4 | 7945.8 | O K |
| 720 min Summer | 7.593 | 1.593 | 1.1 | 31.1 | 31.4 | 8110.4 | O K |
| 960 min Summer | 7.617 | 1.617 | 1.1 | 31.1 | 31.4 | 8251.4 | O K |
| 1440 min Summer | 7.625 | 1.625 | 1.1 | 31.1 | 31.4 | 8294.7 | O K |
| 2160 min Summer | 7.587 | 1.587 | 1.1 | 31.1 | 31.4 | 8077.3 | O K |
| 15 min Winter | 6.999 | 0.999 | 0.7 | 31.1 | 31.4 | 4861.1 | O K |
| 30 min Winter | 7.138 | 1.138 | 0.7 | 31.1 | 31.4 | 5598.9 | O K |
| 60 min Winter | 7.293 | 1.293 | 0.9 | 31.1 | 31.4 | 6433.3 | O K |
| 120 min Winter | 7.460 | 1.460 | 1.0 | 31.1 | 31.4 | 7359.6 | O K |
| 180 min Winter | 7.562 | 1.562 | 1.0 | 31.1 | 31.4 | 7935.0 | O K |
| 240 min Winter | 7.635 | 1.635 | 1.1 | 31.1 | 31.4 | 8351.1 | O K |
| 360 min Winter | 7.736 | 1.736 | 1.2 | 31.1 | 31.4 | 8935.5 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 184.621 | 0.0 | 2662.1 | 27 |
| 30 min Summer | 106.552 | 0.0 | 2663.6 | 42 |
| 60 min Summer | 61.496 | 0.0 | 4887.3 | 72 |
| 120 min Summer | 35.492 | 0.0 | 5144.8 | 130 |
| 180 min Summer | 25.733 | 0.0 | 5064.5 | 190 |
| 240 min Summer | 20.484 | 0.0 | 4982.0 | 250 |
| 360 min Summer | 14.851 | 0.0 | 4854.4 | 370 |
| 480 min Summer | 11.822 | 0.0 | 4762.3 | 488 |
| 600 min Summer | 9.905 | 0.0 | 4690.7 | 608 |
| 720 min Summer | 8.571 | 0.0 | 4631.9 | 726 |
| 960 min Summer | 6.770 | 0.0 | 4536.1 | 966 |
| 1440 min Summer | 4.855 | 0.0 | 4392.4 | 1442 |
| 2160 min Summer | 3.482 | 0.0 | 9360.0 | 2100 |
| 15 min Winter | 184.621 | 0.0 | 2669.1 | 27 |
| 30 min Winter | 106.552 | 0.0 | 2611.2 | 41 |
| 60 min Winter | 61.496 | 0.0 | 5144.4 | 70 |
| 120 min Winter | 35.492 | 0.0 | 4993.9 | 130 |
| 180 min Winter | 25.733 | 0.0 | 4902.1 | 188 |
| 240 min Winter | 20.484 | 0.0 | 4845.9 | 246 |
| 360 min Winter | 14.851 | 0.0 | 4785.5 | 364 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 16/08/2021 16:21<br>File WMZ5 FEH (with outflow)... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 480 min Winter | 7.804 | 1.804 | 1.2 | 31.1 | 31.4 | 9335.6 | O K |
| 600 min Winter | 7.854 | 1.854 | 1.2 | 31.1 | 31.4 | 9628.3 | O K |
| 720 min Winter | 7.891 | 1.891 | 1.3 | 31.1 | 31.6 | 9849.2 | O K |
| 960 min Winter | 7.927 | 1.927 | 1.3 | 31.1 | 31.9 | 10065.4 | O K |
| 1440 min Winter | 7.952 | 1.952 | 1.3 | 31.1 | 32.1 | 10213.3 | O K |
| 2160 min Winter | 7.932 | 1.932 | 1.3 | 31.1 | 31.9 | 10093.6 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 480 min Winter | 11.822 | 0.0 | 4761.2 | 482 |
| 600 min Winter | 9.905 | 0.0 | 4759.2 | 598 |
| 720 min Winter | 8.571 | 0.0 | 4774.4 | 716 |
| 960 min Winter | 6.770 | 0.0 | 4802.5 | 948 |
| 1440 min Winter | 4.855 | 0.0 | 4775.0 | 1406 |
| 2160 min Winter | 3.482 | 0.0 | 9558.2 | 2076 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 16/08/2021 16:21<br>File WMZ5 FEH (with outflow)... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| Return Period (years) | 100 |
| FEH Rainfall Version | 1999 |
| Site Location | GB 647450 264900 TM 47450 64900 |
| C (1km) | -0.020 |
| D1 (1km) | 0.299 |
| D2 (1km) | 0.272 |
| D3 (1km) | 0.215 |
| E (1km) | 0.311 |
| F (1km) | 2.506 |
| Summer Storms | Yes |
| Winter Storms | Yes |
| Cv (Summer) | 0.568 |
| Cv (Winter) | 0.680 |
| Shortest Storm (mins) | 15 |
| Longest Storm (mins) | 2160 |
| Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 15.598

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 5.199 | 4 | 8 | 5.199 | 8 | 12 | 5.199 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 16/08/2021 16:21<br>File WMZ5 FEH (with outflow)... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 8.300

## Infiltration Basin Structure

Invert Level (m) 6.000 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00450

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 4500.0 | 2.000 | 6039.9 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0227-3120-2000-3120 |
| Design Head (m) | 2.000 |
| Design Flow (l/s) | 31.2 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 227 |
| Invert Level (m) | 6.000 |
| Minimum Outlet Pipe Diameter (mm) | 300 |
| Suggested Manhole Diameter (mm) | 1800 |

| **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|
| Design Point (Calculated) | 2.000 | 31.1 |
| Flush-Flo™ | 0.591 | 31.1 |
| Kick-Flo® | 1.272 | 25.1 |
| Mean Flow over Head Range | - | 27.0 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|
| 0.100 | 7.6 | 1.200 | 26.8 | 3.000 | 37.8 | 7.000 | 57.0 |
| 0.200 | 22.6 | 1.400 | 26.3 | 3.500 | 40.8 | 7.500 | 58.9 |
| 0.300 | 28.8 | 1.600 | 28.0 | 4.000 | 43.5 | 8.000 | 60.8 |
| 0.400 | 30.3 | 1.800 | 29.6 | 4.500 | 46.0 | 8.500 | 62.6 |
| 0.500 | 30.9 | 2.000 | 31.1 | 5.000 | 48.4 | 9.000 | 64.4 |
| 0.600 | 31.1 | 2.200 | 32.6 | 5.500 | 50.7 | 9.500 | 66.1 |
| 0.800 | 30.6 | 2.400 | 34.0 | 6.000 | 52.9 | | |
| 1.000 | 29.4 | 2.600 | 35.3 | 6.500 | 55.0 | | |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 16/08/2021 16:23<br>File WMZ5 FEH13 (with outflo... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time : 2908 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 6.447 | 0.447 | 0.3 | 30.6 | 30.9 | 2187.7 | O K |
| 30 min Summer | 6.600 | 0.600 | 0.4 | 31.1 | 31.4 | 2973.9 | O K |
| 60 min Summer | 6.758 | 0.758 | 0.5 | 31.1 | 31.5 | 3800.8 | O K |
| 120 min Summer | 6.946 | 0.946 | 0.6 | 31.1 | 31.5 | 4809.9 | O K |
| 180 min Summer | 7.073 | 1.073 | 0.7 | 31.1 | 31.5 | 5510.7 | O K |
| 240 min Summer | 7.172 | 1.172 | 0.8 | 31.1 | 31.5 | 6062.5 | O K |
| 360 min Summer | 7.322 | 1.322 | 0.9 | 31.1 | 31.5 | 6914.1 | O K |
| 480 min Summer | 7.426 | 1.426 | 1.0 | 31.1 | 31.5 | 7516.8 | O K |
| 600 min Summer | 7.498 | 1.498 | 1.0 | 31.1 | 31.5 | 7941.6 | O K |
| 720 min Summer | 7.550 | 1.550 | 1.1 | 31.1 | 31.5 | 8246.6 | O K |
| 960 min Summer | 7.610 | 1.610 | 1.1 | 31.1 | 31.5 | 8606.4 | O K |
| 1440 min Summer | 7.640 | 1.640 | 1.1 | 31.1 | 31.5 | 8787.0 | O K |
| 2160 min Summer | 7.590 | 1.590 | 1.1 | 31.1 | 31.5 | 8483.9 | O K |
| 15 min Winter | 6.532 | 0.532 | 0.3 | 31.0 | 31.3 | 2623.2 | O K |
| 30 min Winter | 6.714 | 0.714 | 0.5 | 31.1 | 31.5 | 3568.2 | O K |
| 60 min Winter | 6.901 | 0.901 | 0.6 | 31.1 | 31.5 | 4565.0 | O K |
| 120 min Winter | 7.123 | 1.123 | 0.8 | 31.1 | 31.5 | 5787.6 | O K |
| 180 min Winter | 7.275 | 1.275 | 0.9 | 31.1 | 31.5 | 6647.0 | O K |
| 240 min Winter | 7.392 | 1.392 | 0.9 | 31.1 | 31.5 | 7323.5 | O K |
| 360 min Winter | 7.568 | 1.568 | 1.1 | 31.1 | 31.5 | 8352.5 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 100.080 | 0.0 | 1788.7 | 27 |
| 30 min Summer | 68.208 | 0.0 | 2349.5 | 41 |
| 60 min Summer | 43.872 | 0.0 | 3600.0 | 70 |
| 120 min Summer | 28.074 | 0.0 | 4520.2 | 130 |
| 180 min Summer | 21.656 | 0.0 | 5011.6 | 190 |
| 240 min Summer | 18.024 | 0.0 | 5128.0 | 250 |
| 360 min Summer | 13.906 | 0.0 | 4962.8 | 370 |
| 480 min Summer | 11.513 | 0.0 | 4803.0 | 488 |
| 600 min Summer | 9.884 | 0.0 | 4698.1 | 608 |
| 720 min Summer | 8.689 | 0.0 | 4624.6 | 726 |
| 960 min Summer | 7.018 | 0.0 | 4526.2 | 966 |
| 1440 min Summer | 5.090 | 0.0 | 4408.5 | 1444 |
| 2160 min Summer | 3.610 | 0.0 | 9350.4 | 2144 |
| 15 min Winter | 100.080 | 0.0 | 2118.4 | 26 |
| 30 min Winter | 68.208 | 0.0 | 2590.7 | 41 |
| 60 min Winter | 43.872 | 0.0 | 4269.0 | 70 |
| 120 min Winter | 28.074 | 0.0 | 5108.0 | 128 |
| 180 min Winter | 21.656 | 0.0 | 5110.0 | 188 |
| 240 min Winter | 18.024 | 0.0 | 4969.3 | 246 |
| 360 min Winter | 13.906 | 0.0 | 4795.7 | 364 |

| | | |
|---|---|---|
| Atkins (Epsom) | | Page 2 |
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 16/08/2021 16:23<br>File WMZ5 FEH13 (with outflo... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 480 min Winter | 7.691 | 1.691 | 1.2 | 31.1 | 31.5 | 9090.0 | O K |
| 600 min Winter | 7.778 | 1.778 | 1.2 | 31.1 | 31.5 | 9620.9 | O K |
| 720 min Winter | 7.841 | 1.841 | 1.3 | 31.1 | 31.5 | 10010.1 | O K |
| 960 min Winter | 7.918 | 1.918 | 1.3 | 31.1 | 31.8 | 10489.3 | O K |
| 1440 min Winter | 7.968 | 1.968 | 1.4 | 31.1 | 32.3 | 10803.2 | O K |
| 2160 min Winter | 7.933 | 1.933 | 1.3 | 31.1 | 32.0 | 10582.2 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 480 min Winter | 11.513 | 0.0 | 4724.8 | 482 |
| 600 min Winter | 9.884 | 0.0 | 4710.8 | 598 |
| 720 min Winter | 8.689 | 0.0 | 4732.6 | 716 |
| 960 min Winter | 7.019 | 0.0 | 4806.6 | 948 |
| 1440 min Winter | 5.090 | 0.0 | 4803.2 | 1408 |
| 2160 min Winter | 3.610 | 0.0 | 9542.8 | 2080 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 16/08/2021 16:23<br>File WMZ5 FEH13 (with outflo... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| Return Period (years) | 100 |
| FEH Rainfall Version | 2013 |
| Site Location | GB 647450 264900 TM 47450 64900 |
| Data Type | Catchment |
| Summer Storms | Yes |
| Winter Storms | Yes |
| Cv (Summer) | 0.568 |
| Cv (Winter) | 0.680 |
| Shortest Storm (mins) | 15 |
| Longest Storm (mins) | 2160 |
| Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 15.598

| Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 5.199 | 4 | 8 | 5.199 | 8 | 12 | 5.199 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 16/08/2021 16:23<br>File WMZ5 FEH13 (with outflo... | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 8.300

## Infiltration Basin Structure

Invert Level (m) 6.000 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00450

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 4731.7 | 2.000 | 6307.8 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0227-3120-2000-3120 |
| Design Head (m) | 2.000 |
| Design Flow (l/s) | 31.2 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 227 |
| Invert Level (m) | 6.000 |
| Minimum Outlet Pipe Diameter (mm) | 300 |
| Suggested Manhole Diameter (mm) | 1800 |

| **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|
| Design Point (Calculated) | 2.000 | 31.1 |
| Flush-Flo™ | 0.591 | 31.1 |
| Kick-Flo® | 1.272 | 25.1 |
| Mean Flow over Head Range | - | 27.0 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|
| 0.100 | 7.6 | 1.200 | 26.8 | 3.000 | 37.8 | 7.000 | 57.0 |
| 0.200 | 22.6 | 1.400 | 26.3 | 3.500 | 40.8 | 7.500 | 58.9 |
| 0.300 | 28.8 | 1.600 | 28.0 | 4.000 | 43.5 | 8.000 | 60.8 |
| 0.400 | 30.3 | 1.800 | 29.6 | 4.500 | 46.0 | 8.500 | 62.6 |
| 0.500 | 30.9 | 2.000 | 31.1 | 5.000 | 48.4 | 9.000 | 64.4 |
| 0.600 | 31.1 | 2.200 | 32.6 | 5.500 | 50.7 | 9.500 | 66.1 |
| 0.800 | 30.6 | 2.400 | 34.0 | 6.000 | 52.9 | | |
| 1.000 | 29.4 | 2.600 | 35.3 | 6.500 | 55.0 | | |

## 1.7. WMZ6 Basin

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:04<br>File WMZ6 FSR (New).SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time : 2328 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 8.663 | 0.663 | 2.3 | 47.7 | 49.9 | 4409.3 | O K |
| 30 min Summer | 8.860 | 0.860 | 2.9 | 47.7 | 50.0 | 5788.3 | O K |
| 60 min Summer | 9.059 | 1.059 | 3.6 | 47.7 | 50.0 | 7226.1 | O K |
| 120 min Summer | 9.258 | 1.258 | 4.4 | 47.7 | 50.0 | 8692.8 | O K |
| 180 min Summer | 9.370 | 1.370 | 4.8 | 47.7 | 50.0 | 9534.5 | O K |
| 240 min Summer | 9.444 | 1.444 | 5.0 | 47.7 | 50.0 | 10096.8 | O K |
| 360 min Summer | 9.535 | 1.535 | 5.4 | 47.7 | 50.0 | 10797.2 | O K |
| 480 min Summer | 9.592 | 1.592 | 5.6 | 47.7 | 50.0 | 11239.7 | O K |
| 600 min Summer | 9.632 | 1.632 | 5.7 | 47.7 | 50.0 | 11552.6 | O K |
| 720 min Summer | 9.660 | 1.660 | 5.8 | 47.7 | 50.0 | 11770.7 | O K |
| 960 min Summer | 9.692 | 1.692 | 5.9 | 47.7 | 50.0 | 12022.9 | O K |
| 1440 min Summer | 9.703 | 1.703 | 6.0 | 47.7 | 50.2 | 12112.7 | O K |
| 2160 min Summer | 9.666 | 1.666 | 5.9 | 47.7 | 50.0 | 11823.9 | O K |
| 15 min Winter | 8.766 | 0.766 | 2.6 | 47.7 | 50.0 | 5125.1 | O K |
| 30 min Winter | 8.991 | 0.991 | 3.4 | 47.7 | 50.0 | 6730.3 | O K |
| 60 min Winter | 9.220 | 1.220 | 4.2 | 47.7 | 50.0 | 8409.3 | O K |
| 120 min Winter | 9.448 | 1.448 | 5.1 | 47.7 | 50.0 | 10130.1 | O K |
| 180 min Winter | 9.576 | 1.576 | 5.5 | 47.7 | 50.0 | 11114.2 | O K |
| 240 min Winter | 9.660 | 1.660 | 5.8 | 47.7 | 50.0 | 11777.3 | O K |
| 360 min Winter | 9.767 | 1.767 | 6.2 | 47.7 | 51.3 | 12616.2 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 106.778 | 0.0 | 3545.5 | 31 |
| 30 min Summer | 70.214 | 0.0 | 4156.4 | 45 |
| 60 min Summer | 44.063 | 0.0 | 6771.6 | 74 |
| 120 min Summer | 26.779 | 0.0 | 7899.7 | 134 |
| 180 min Summer | 19.773 | 0.0 | 8153.0 | 194 |
| 240 min Summer | 15.863 | 0.0 | 8110.9 | 252 |
| 360 min Summer | 11.539 | 0.0 | 8001.4 | 372 |
| 480 min Summer | 9.189 | 0.0 | 7902.4 | 490 |
| 600 min Summer | 7.705 | 0.0 | 7814.9 | 610 |
| 720 min Summer | 6.669 | 0.0 | 7735.1 | 728 |
| 960 min Summer | 5.306 | 0.0 | 7587.3 | 966 |
| 1440 min Summer | 3.839 | 0.0 | 7317.4 | 1442 |
| 2160 min Summer | 2.773 | 0.0 | 15216.9 | 1888 |
| 15 min Winter | 106.778 | 0.0 | 3952.5 | 30 |
| 30 min Winter | 70.214 | 0.0 | 4232.2 | 45 |
| 60 min Winter | 44.063 | 0.0 | 7675.5 | 74 |
| 120 min Winter | 26.779 | 0.0 | 8200.5 | 132 |
| 180 min Winter | 19.773 | 0.0 | 8146.5 | 190 |
| 240 min Winter | 15.863 | 0.0 | 8099.8 | 248 |
| 360 min Winter | 11.539 | 0.0 | 8038.8 | 366 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:04<br>File WMZ6 FSR (New).SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 480 min Winter | 9.835 | 1.835 | 6.5 | 47.7 | 52.3 | 13158.6 | O K |
| 600 min Winter | 9.883 | 1.883 | 6.7 | 47.7 | 53.1 | 13551.3 | O K |
| 720 min Winter | 9.918 | 1.918 | 6.8 | 47.7 | 53.6 | 13834.0 | O K |
| 960 min Winter | 9.962 | 1.962 | 7.0 | 47.7 | 54.3 | 14187.7 | O K |
| 1440 min Winter | 9.990 | 1.990 | 7.1 | 47.7 | 54.7 | 14418.3 | O K |
| 2160 min Winter | 9.965 | 1.965 | 7.0 | 47.7 | 54.4 | 14208.1 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 480 min Winter | 9.189 | 0.0 | 7998.1 | 482 |
| 600 min Winter | 7.705 | 0.0 | 7967.6 | 598 |
| 720 min Winter | 6.669 | 0.0 | 7942.8 | 714 |
| 960 min Winter | 5.306 | 0.0 | 7909.5 | 946 |
| 1440 min Winter | 3.839 | 0.0 | 7865.4 | 1398 |
| 2160 min Winter | 2.773 | 0.0 | 15864.7 | 2048 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 14:04<br>File WMZ6 FSR (New).SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.604 |
| Region | England and Wales | Cv (Winter) | 0.701 |
| M5-60 (mm) | 18.200 | Shortest Storm (mins) | 15 |
| Ratio R | 0.400 | Longest Storm (mins) | 2160 |
| Summer Storms | Yes | Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 27.707

| Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 6.927 | 4 | 8 | 6.927 | 8 | 12 | 6.927 | 12 | 16 | 6.927 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:04<br>File WMZ6 FSR (New).SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 10.300

## Infiltration Basin Structure

Invert Level (m) 8.000 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.02010

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 6362.6 | 2.000 | 8172.2 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0276-4780-2000-4780 |
| Design Head (m) | 2.000 |
| Design Flow (l/s) | 47.8 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 276 |
| Invert Level (m) | 8.000 |
| Minimum Outlet Pipe Diameter (mm) | 300 |
| Suggested Manhole Diameter (mm) | 2100 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 2.000 | 47.8 |
| Flush-Flo™ | 0.608 | 47.7 |
| Kick-Flo® | 1.324 | 39.2 |
| Mean Flow over Head Range | - | 41.2 |

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 | 8.7 | 1.200 | 42.9 | 3.000 | 58.1 | 7.000 | 87.7 |
| 0.200 | 28.4 | 1.400 | 40.3 | 3.500 | 62.6 | 7.500 | 90.7 |
| 0.300 | 44.0 | 1.600 | 42.9 | 4.000 | 66.8 | 8.000 | 93.6 |
| 0.400 | 46.3 | 1.800 | 45.4 | 4.500 | 70.7 | 8.500 | 96.4 |
| 0.500 | 47.4 | 2.000 | 47.8 | 5.000 | 74.5 | 9.000 | 99.1 |
| 0.600 | 47.7 | 2.200 | 50.0 | 5.500 | 78.0 | 9.500 | 101.8 |
| 0.800 | 47.2 | 2.400 | 52.2 | 6.000 | 81.4 | | |
| 1.000 | 45.8 | 2.600 | 54.2 | 6.500 | 84.6 | | |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 14:04<br>File WMZ6 FEH (New).SRCX | Designed by KPL<br>Checked by DH | Micro Drainage |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time : 3042 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 8.851 | 0.851 | 3.4 | 47.7 | 50.3 | 7662.4 | O K |
| 30 min Summer | 8.974 | 0.974 | 3.9 | 47.7 | 50.3 | 8825.6 | O K |
| 60 min Summer | 9.110 | 1.110 | 4.4 | 47.7 | 50.3 | 10140.7 | O K |
| 120 min Summer | 9.260 | 1.260 | 5.0 | 47.7 | 50.3 | 11605.8 | O K |
| 180 min Summer | 9.352 | 1.352 | 5.4 | 47.7 | 50.3 | 12523.0 | O K |
| 240 min Summer | 9.419 | 1.419 | 5.7 | 47.7 | 50.3 | 13187.4 | O K |
| 360 min Summer | 9.512 | 1.512 | 6.1 | 47.7 | 50.3 | 14120.7 | O K |
| 480 min Summer | 9.574 | 1.574 | 6.4 | 47.7 | 50.3 | 14760.0 | O K |
| 600 min Summer | 9.620 | 1.620 | 6.6 | 47.7 | 50.3 | 15227.5 | O K |
| 720 min Summer | 9.655 | 1.655 | 6.7 | 47.7 | 50.3 | 15581.1 | O K |
| 960 min Summer | 9.689 | 1.689 | 6.8 | 47.7 | 50.9 | 15930.4 | O K |
| 1440 min Summer | 9.712 | 1.712 | 6.9 | 47.7 | 51.3 | 16169.2 | O K |
| 2160 min Summer | 9.692 | 1.692 | 6.9 | 47.7 | 51.0 | 15966.3 | O K |
| 15 min Winter | 8.982 | 0.982 | 3.9 | 47.7 | 50.3 | 8901.2 | O K |
| 30 min Winter | 9.122 | 1.122 | 4.5 | 47.7 | 50.3 | 10256.8 | O K |
| 60 min Winter | 9.279 | 1.279 | 5.1 | 47.7 | 50.3 | 11793.2 | O K |
| 120 min Winter | 9.451 | 1.451 | 5.8 | 47.7 | 50.3 | 13510.5 | O K |
| 180 min Winter | 9.557 | 1.557 | 6.3 | 47.7 | 50.3 | 14583.2 | O K |
| 240 min Winter | 9.634 | 1.634 | 6.6 | 47.7 | 50.3 | 15364.5 | O K |
| 360 min Winter | 9.741 | 1.741 | 7.1 | 47.7 | 51.8 | 16472.3 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 184.621 | 0.0 | 4273.0 | 31 |
| 30 min Summer | 106.552 | 0.0 | 4287.6 | 46 |
| 60 min Summer | 61.496 | 0.0 | 8327.6 | 76 |
| 120 min Summer | 35.492 | 0.0 | 8417.2 | 134 |
| 180 min Summer | 25.733 | 0.0 | 8294.5 | 194 |
| 240 min Summer | 20.484 | 0.0 | 8181.2 | 254 |
| 360 min Summer | 14.851 | 0.0 | 8023.2 | 372 |
| 480 min Summer | 11.822 | 0.0 | 7913.6 | 492 |
| 600 min Summer | 9.905 | 0.0 | 7828.2 | 610 |
| 720 min Summer | 8.571 | 0.0 | 7757.0 | 730 |
| 960 min Summer | 6.770 | 0.0 | 7628.6 | 968 |
| 1440 min Summer | 4.855 | 0.0 | 7430.8 | 1444 |
| 2160 min Summer | 3.482 | 0.0 | 15489.7 | 2160 |
| 15 min Winter | 184.621 | 0.0 | 4305.9 | 31 |
| 30 min Winter | 106.552 | 0.0 | 4272.6 | 45 |
| 60 min Winter | 61.496 | 0.0 | 8460.9 | 74 |
| 120 min Winter | 35.492 | 0.0 | 8271.0 | 132 |
| 180 min Winter | 25.733 | 0.0 | 8170.0 | 192 |
| 240 min Winter | 20.484 | 0.0 | 8115.4 | 250 |
| 360 min Winter | 14.851 | 0.0 | 8065.6 | 366 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 14:04<br>File WMZ6 FEH (New).SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 480 min Winter | 9.815 | 1.815 | 7.4 | 47.7 | 53.0 | 17242.0 | O K |
| 600 min Winter | 9.869 | 1.869 | 7.6 | 47.7 | 53.9 | 17813.4 | O K |
| 720 min Winter | 9.911 | 1.911 | 7.8 | 47.7 | 54.6 | 18253.3 | O K |
| 960 min Winter | 9.955 | 1.955 | 8.0 | 47.7 | 55.2 | 18717.7 | O K |
| 1440 min Winter | 9.992 | 1.992 | 8.1 | 47.7 | 55.8 | 19117.2 | O K |
| 2160 min Winter | 9.988 | 1.988 | 8.1 | 47.7 | 55.8 | 19074.6 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 480 min Winter | 11.822 | 0.0 | 8054.3 | 484 |
| 600 min Winter | 9.905 | 0.0 | 8066.7 | 600 |
| 720 min Winter | 8.571 | 0.0 | 8098.3 | 718 |
| 960 min Winter | 6.770 | 0.0 | 8139.3 | 952 |
| 1440 min Winter | 4.855 | 0.0 | 8062.8 | 1410 |
| 2160 min Winter | 3.482 | 0.0 | 16049.8 | 2080 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 14:04<br>File WMZ6 FEH (New).SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| Return Period (years) | 100 |
| FEH Rainfall Version | 1999 |
| Site Location | GB 647450 264900 TM 47450 64900 |
| C (1km) | -0.020 |
| D1 (1km) | 0.299 |
| D2 (1km) | 0.272 |
| D3 (1km) | 0.215 |
| E (1km) | 0.311 |
| F (1km) | 2.506 |
| Summer Storms | Yes |
| Winter Storms | Yes |
| Cv (Summer) | 0.604 |
| Cv (Winter) | 0.701 |
| Shortest Storm (mins) | 15 |
| Longest Storm (mins) | 2160 |
| Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 27.707

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 6.927 | 4 | 8 | 6.927 | 8 | 12 | 6.927 | 12 | 16 | 6.927 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 14:04<br>File WMZ6 FEH (New).SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 10.300

## Infiltration Basin Structure

Invert Level (m) 8.000 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.02010

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 8576.1 | 2.000 | 10658.9 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0276-4780-2000-4780 |
| Design Head (m) | 2.000 |
| Design Flow (l/s) | 47.8 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 276 |
| Invert Level (m) | 8.000 |
| Minimum Outlet Pipe Diameter (mm) | 300 |
| Suggested Manhole Diameter (mm) | 2100 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 2.000 | 47.8 |
| Flush-Flo™ | 0.608 | 47.7 |
| Kick-Flo® | 1.324 | 39.2 |
| Mean Flow over Head Range | - | 41.2 |

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 | 8.7 | 1.200 | 42.9 | 3.000 | 58.1 | 7.000 | 87.7 |
| 0.200 | 28.4 | 1.400 | 40.3 | 3.500 | 62.6 | 7.500 | 90.7 |
| 0.300 | 44.0 | 1.600 | 42.9 | 4.000 | 66.8 | 8.000 | 93.6 |
| 0.400 | 46.3 | 1.800 | 45.4 | 4.500 | 70.7 | 8.500 | 96.4 |
| 0.500 | 47.4 | 2.000 | 47.8 | 5.000 | 74.5 | 9.000 | 99.1 |
| 0.600 | 47.7 | 2.200 | 50.0 | 5.500 | 78.0 | 9.500 | 101.8 |
| 0.800 | 47.2 | 2.400 | 52.2 | 6.000 | 81.4 | | |
| 1.000 | 45.8 | 2.600 | 54.2 | 6.500 | 84.6 | | |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 14:05<br>File WMZ6 FEH13 (New).SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time : 3194 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 8.439 | 0.439 | 1.8 | 46.9 | 48.7 | 4136.9 | O K |
| 30 min Summer | 8.593 | 0.593 | 2.4 | 47.7 | 50.1 | 5627.0 | O K |
| 60 min Summer | 8.752 | 0.752 | 3.1 | 47.7 | 50.5 | 7202.0 | O K |
| 120 min Summer | 8.943 | 0.943 | 3.9 | 47.7 | 50.5 | 9133.4 | O K |
| 180 min Summer | 9.075 | 1.075 | 4.4 | 47.7 | 50.5 | 10480.9 | O K |
| 240 min Summer | 9.177 | 1.177 | 4.9 | 47.7 | 50.5 | 11544.1 | O K |
| 360 min Summer | 9.334 | 1.334 | 5.5 | 47.7 | 50.5 | 13190.7 | O K |
| 480 min Summer | 9.445 | 1.445 | 6.0 | 47.7 | 50.4 | 14377.3 | O K |
| 600 min Summer | 9.524 | 1.524 | 6.4 | 47.7 | 50.5 | 15226.0 | O K |
| 720 min Summer | 9.581 | 1.581 | 6.6 | 47.7 | 50.4 | 15847.6 | O K |
| 960 min Summer | 9.652 | 1.652 | 6.9 | 47.7 | 50.5 | 16614.0 | O K |
| 1440 min Summer | 9.698 | 1.698 | 7.1 | 47.7 | 51.3 | 17120.0 | O K |
| 2160 min Summer | 9.666 | 1.666 | 7.0 | 47.7 | 50.7 | 16771.8 | O K |
| 15 min Winter | 8.508 | 0.508 | 2.1 | 47.5 | 49.5 | 4806.7 | O K |
| 30 min Winter | 8.685 | 0.685 | 2.8 | 47.7 | 50.4 | 6541.0 | O K |
| 60 min Winter | 8.869 | 0.869 | 3.6 | 47.7 | 50.5 | 8377.3 | O K |
| 120 min Winter | 9.090 | 1.090 | 4.5 | 47.7 | 50.5 | 10635.1 | O K |
| 180 min Winter | 9.242 | 1.242 | 5.1 | 47.7 | 50.5 | 12220.5 | O K |
| 240 min Winter | 9.361 | 1.361 | 5.7 | 47.7 | 50.5 | 13480.6 | O K |
| 360 min Winter | 9.541 | 1.541 | 6.4 | 47.7 | 50.5 | 15408.3 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 100.080 | 0.0 | 2984.2 | 31 |
| 30 min Summer | 68.208 | 0.0 | 3862.7 | 45 |
| 60 min Summer | 43.872 | 0.0 | 6400.6 | 74 |
| 120 min Summer | 28.074 | 0.0 | 7842.0 | 134 |
| 180 min Summer | 21.656 | 0.0 | 8341.3 | 194 |
| 240 min Summer | 18.024 | 0.0 | 8366.6 | 254 |
| 360 min Summer | 13.906 | 0.0 | 8167.2 | 372 |
| 480 min Summer | 11.513 | 0.0 | 7952.8 | 492 |
| 600 min Summer | 9.884 | 0.0 | 7821.5 | 610 |
| 720 min Summer | 8.689 | 0.0 | 7731.5 | 730 |
| 960 min Summer | 7.018 | 0.0 | 7606.8 | 968 |
| 1440 min Summer | 5.090 | 0.0 | 7436.1 | 1446 |
| 2160 min Summer | 3.610 | 0.0 | 15467.2 | 2160 |
| 15 min Winter | 100.080 | 0.0 | 3428.0 | 30 |
| 30 min Winter | 68.208 | 0.0 | 4136.7 | 45 |
| 60 min Winter | 43.872 | 0.0 | 7305.4 | 74 |
| 120 min Winter | 28.074 | 0.0 | 8397.6 | 132 |
| 180 min Winter | 21.656 | 0.0 | 8414.1 | 190 |
| 240 min Winter | 18.024 | 0.0 | 8253.7 | 250 |
| 360 min Winter | 13.906 | 0.0 | 8031.5 | 366 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 14:05<br>File WMZ6 FEH13 (New).SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 480 min Winter | 9.669 | 1.669 | 7.0 | 47.7 | 50.8 | 16798.4 | O K |
| 600 min Winter | 9.760 | 1.760 | 7.4 | 47.7 | 52.3 | 17808.0 | O K |
| 720 min Winter | 9.828 | 1.828 | 7.7 | 47.7 | 53.4 | 18557.6 | O K |
| 960 min Winter | 9.912 | 1.912 | 8.1 | 47.7 | 54.8 | 19506.8 | O K |
| 1440 min Winter | 9.975 | 1.975 | 8.3 | 47.7 | 55.8 | 20216.7 | O K |
| 2160 min Winter | 9.956 | 1.956 | 8.2 | 47.7 | 55.5 | 19998.5 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 480 min Winter | 11.513 | 0.0 | 7956.0 | 484 |
| 600 min Winter | 9.884 | 0.0 | 7950.6 | 602 |
| 720 min Winter | 8.689 | 0.0 | 7986.3 | 718 |
| 960 min Winter | 7.019 | 0.0 | 8099.6 | 952 |
| 1440 min Winter | 5.090 | 0.0 | 8070.3 | 1412 |
| 2160 min Winter | 3.610 | 0.0 | 16016.9 | 2084 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 14:05<br>File WMZ6 FEH13 (New).SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| Return Period (years) | 100 |
| FEH Rainfall Version | 2013 |
| Site Location | GB 647450 264900 TM 47450 64900 |
| Data Type | Catchment |
| Summer Storms | Yes |
| Winter Storms | Yes |
| Cv (Summer) | 0.604 |
| Cv (Winter) | 0.701 |
| Shortest Storm (mins) | 15 |
| Longest Storm (mins) | 2160 |
| Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 27.707

| Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 6.927 | 4 | 8 | 6.927 | 8 | 12 | 6.927 | 12 | 16 | 6.927 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:05<br>File WMZ6 FEH13 (New).SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 10.300

## Infiltration Basin Structure

Invert Level (m) 8.000 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.02010

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 9191.1 | 2.000 | 11343.3 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0276-4780-2000-4780 |
| Design Head (m) | 2.000 |
| Design Flow (l/s) | 47.8 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 276 |
| Invert Level (m) | 8.000 |
| Minimum Outlet Pipe Diameter (mm) | 300 |
| Suggested Manhole Diameter (mm) | 2100 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 2.000 | 47.8 |
| Flush-Flo™ | 0.608 | 47.7 |
| Kick-Flo® | 1.324 | 39.2 |
| Mean Flow over Head Range | - | 41.2 |

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 | 8.7 | 1.200 | 42.9 | 3.000 | 58.1 | 7.000 | 87.7 |
| 0.200 | 28.4 | 1.400 | 40.3 | 3.500 | 62.6 | 7.500 | 90.7 |
| 0.300 | 44.0 | 1.600 | 42.9 | 4.000 | 66.8 | 8.000 | 93.6 |
| 0.400 | 46.3 | 1.800 | 45.4 | 4.500 | 70.7 | 8.500 | 96.4 |
| 0.500 | 47.4 | 2.000 | 47.8 | 5.000 | 74.5 | 9.000 | 99.1 |
| 0.600 | 47.7 | 2.200 | 50.0 | 5.500 | 78.0 | 9.500 | 101.8 |
| 0.800 | 47.2 | 2.400 | 52.2 | 6.000 | 81.4 | | |
| 1.000 | 45.8 | 2.600 | 54.2 | 6.500 | 84.6 | | |

## 1.8. ACA East Basin

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 14:07<br>File ACA East FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time : 2163 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 2.897 | 0.447 | 0.0 | 59.6 | 59.6 | 5062.9 | O K |
| 30 min Summer | 3.032 | 0.582 | 0.0 | 59.8 | 59.8 | 6643.3 | O K |
| 60 min Summer | 3.172 | 0.722 | 0.0 | 59.8 | 59.8 | 8295.2 | O K |
| 120 min Summer | 3.313 | 0.863 | 0.0 | 59.8 | 59.8 | 9984.4 | O K |
| 180 min Summer | 3.393 | 0.943 | 0.0 | 59.8 | 59.8 | 10955.4 | O K |
| 240 min Summer | 3.447 | 0.997 | 0.0 | 59.8 | 59.8 | 11615.3 | O K |
| 360 min Summer | 3.516 | 1.066 | 0.0 | 59.8 | 59.8 | 12451.2 | O K |
| 480 min Summer | 3.559 | 1.109 | 0.0 | 59.8 | 59.8 | 12988.0 | O K |
| 600 min Summer | 3.590 | 1.140 | 0.0 | 59.8 | 59.8 | 13374.0 | O K |
| 720 min Summer | 3.613 | 1.163 | 0.0 | 59.8 | 59.8 | 13649.9 | O K |
| 960 min Summer | 3.640 | 1.190 | 0.0 | 59.8 | 59.8 | 13987.5 | O K |
| 1440 min Summer | 3.655 | 1.205 | 0.0 | 59.8 | 59.8 | 14176.4 | O K |
| 2160 min Summer | 3.636 | 1.186 | 0.0 | 59.8 | 59.8 | 13938.4 | O K |
| 15 min Winter | 2.929 | 0.479 | 0.0 | 59.8 | 59.8 | 5439.0 | O K |
| 30 min Winter | 3.074 | 0.624 | 0.0 | 59.8 | 59.8 | 7138.5 | O K |
| 60 min Winter | 3.224 | 0.774 | 0.0 | 59.8 | 59.8 | 8916.7 | O K |
| 120 min Winter | 3.375 | 0.925 | 0.0 | 59.8 | 59.8 | 10737.9 | O K |
| 180 min Winter | 3.462 | 1.012 | 0.0 | 59.8 | 59.8 | 11791.1 | O K |
| 240 min Winter | 3.520 | 1.070 | 0.0 | 59.8 | 59.8 | 12502.8 | O K |
| 360 min Winter | 3.593 | 1.143 | 0.0 | 59.8 | 59.8 | 13404.0 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 106.778 | 0.0 | 3585.7 | 31 |
| 30 min Summer | 70.214 | 0.0 | 4573.6 | 45 |
| 60 min Summer | 44.063 | 0.0 | 7304.8 | 74 |
| 120 min Summer | 26.779 | 0.0 | 8678.1 | 134 |
| 180 min Summer | 19.773 | 0.0 | 9296.3 | 194 |
| 240 min Summer | 15.863 | 0.0 | 9531.9 | 252 |
| 360 min Summer | 11.539 | 0.0 | 9448.0 | 372 |
| 480 min Summer | 9.189 | 0.0 | 9261.2 | 490 |
| 600 min Summer | 7.705 | 0.0 | 9091.0 | 610 |
| 720 min Summer | 6.669 | 0.0 | 8937.0 | 728 |
| 960 min Summer | 5.306 | 0.0 | 8662.9 | 966 |
| 1440 min Summer | 3.839 | 0.0 | 8190.5 | 1442 |
| 2160 min Summer | 2.773 | 0.0 | 17077.5 | 1896 |
| 15 min Winter | 106.778 | 0.0 | 3848.9 | 30 |
| 30 min Winter | 70.214 | 0.0 | 4790.6 | 45 |
| 60 min Winter | 44.063 | 0.0 | 7810.0 | 74 |
| 120 min Winter | 26.779 | 0.0 | 9150.1 | 132 |
| 180 min Winter | 19.773 | 0.0 | 9591.2 | 190 |
| 240 min Winter | 15.863 | 0.0 | 9603.7 | 248 |
| 360 min Winter | 11.539 | 0.0 | 9409.6 | 366 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 14:07<br>File ACA East FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 480 min Winter | 3.640 | 1.190 | 0.0 | 59.8 | 59.8 | 13988.9 | O K |
| 600 min Winter | 3.674 | 1.224 | 0.0 | 59.8 | 59.8 | 14414.4 | O K |
| 720 min Winter | 3.699 | 1.249 | 0.0 | 59.8 | 59.8 | 14722.4 | O K |
| 960 min Winter | 3.730 | 1.280 | 0.0 | 59.8 | 59.8 | 15112.4 | O K |
| 1440 min Winter | 3.751 | 1.301 | 0.0 | 59.8 | 59.8 | 15381.1 | O K |
| 2160 min Winter | 3.735 | 1.285 | 0.0 | 59.8 | 59.8 | 15181.5 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 480 min Winter | 9.189 | 0.0 | 9244.1 | 482 |
| 600 min Winter | 7.705 | 0.0 | 9102.4 | 598 |
| 720 min Winter | 6.669 | 0.0 | 8978.4 | 714 |
| 960 min Winter | 5.306 | 0.0 | 8762.0 | 946 |
| 1440 min Winter | 3.839 | 0.0 | 8403.3 | 1398 |
| 2160 min Winter | 2.773 | 0.0 | 17771.6 | 2044 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 14:07<br>File ACA East FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.761 |
| Region | England and Wales | Cv (Winter) | 0.817 |
| M5-60 (mm) | 18.200 | Shortest Storm (mins) | 15 |
| Ratio R | 0.400 | Longest Storm (mins) | 2160 |
| Summer Storms | Yes | Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 25.222

| Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 6.306 | 4 | 8 | 6.306 | 8 | 12 | 6.306 | 12 | 16 | 6.306 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:07<br>File ACA East FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 4.100

## Infiltration Basin Structure

Invert Level (m) 2.450 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 11077.9 | 1.350 | 12640.5 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0314-5990-1350-5990 |
| Design Head (m) | 1.350 |
| Design Flow (l/s) | 59.9 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 314 |
| Invert Level (m) | 2.450 |
| Minimum Outlet Pipe Diameter (mm) | 375 |
| Suggested Manhole Diameter (mm) | 2100 |

| **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|
| Design Point (Calculated) | 1.350 | 59.9 |
| Flush-Flo™ | 0.505 | 59.8 |
| Kick-Flo® | 0.997 | 51.8 |
| Mean Flow over Head Range | - | 49.6 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|
| 0.100 | 9.4 | 1.200 | 56.6 | 3.000 | 88.2 | 7.000 | 133.3 |
| 0.200 | 32.2 | 1.400 | 61.0 | 3.500 | 95.0 | 7.500 | 137.9 |
| 0.300 | 55.9 | 1.600 | 65.0 | 4.000 | 101.4 | 8.000 | 142.3 |
| 0.400 | 59.2 | 1.800 | 68.8 | 4.500 | 107.4 | 8.500 | 146.6 |
| 0.500 | 59.8 | 2.000 | 72.4 | 5.000 | 113.1 | 9.000 | 150.7 |
| 0.600 | 59.5 | 2.200 | 75.9 | 5.500 | 118.5 | 9.500 | 154.8 |
| 0.800 | 57.4 | 2.400 | 79.1 | 6.000 | 123.6 | | |
| 1.000 | 51.9 | 2.600 | 82.3 | 6.500 | 128.5 | | |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:09<br>File ACA East FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time : 2909 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 3.026 | 0.576 | 0.0 | 59.8 | 59.8 | 8667.7 | O K |
| 30 min Summer | 3.113 | 0.663 | 0.0 | 59.8 | 59.8 | 10008.1 | O K |
| 60 min Summer | 3.210 | 0.760 | 0.0 | 59.8 | 59.8 | 11531.0 | O K |
| 120 min Summer | 3.319 | 0.869 | 0.0 | 59.8 | 59.8 | 13237.1 | O K |
| 180 min Summer | 3.387 | 0.937 | 0.0 | 59.8 | 59.8 | 14309.6 | O K |
| 240 min Summer | 3.436 | 0.986 | 0.0 | 59.8 | 59.8 | 15096.8 | O K |
| 360 min Summer | 3.506 | 1.056 | 0.0 | 59.8 | 59.8 | 16221.2 | O K |
| 480 min Summer | 3.555 | 1.105 | 0.0 | 59.8 | 59.8 | 17002.9 | O K |
| 600 min Summer | 3.591 | 1.141 | 0.0 | 59.8 | 59.8 | 17583.3 | O K |
| 720 min Summer | 3.618 | 1.168 | 0.0 | 59.8 | 59.8 | 18030.4 | O K |
| 960 min Summer | 3.650 | 1.200 | 0.0 | 59.8 | 59.8 | 18552.0 | O K |
| 1440 min Summer | 3.680 | 1.230 | 0.0 | 59.8 | 59.8 | 19029.1 | O K |
| 2160 min Summer | 3.680 | 1.230 | 0.0 | 59.8 | 59.8 | 19037.8 | O K |
| 2880 min Summer | 3.661 | 1.211 | 0.0 | 59.8 | 59.8 | 18722.8 | O K |
| 15 min Winter | 3.068 | 0.618 | 0.0 | 59.8 | 59.8 | 9309.1 | O K |
| 30 min Winter | 3.161 | 0.711 | 0.0 | 59.8 | 59.8 | 10752.1 | O K |
| 60 min Winter | 3.265 | 0.815 | 0.0 | 59.8 | 59.8 | 12390.9 | O K |
| 120 min Winter | 3.382 | 0.932 | 0.0 | 59.8 | 59.8 | 14229.8 | O K |
| 180 min Winter | 3.454 | 1.004 | 0.0 | 59.8 | 59.8 | 15391.0 | O K |
| 240 min Winter | 3.507 | 1.057 | 0.0 | 59.8 | 59.8 | 16241.4 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 182.019 | 0.0 | 4959.7 | 31 |
| 30 min Summer | 105.313 | 0.0 | 5069.5 | 45 |
| 60 min Summer | 60.933 | 0.0 | 9138.7 | 76 |
| 120 min Summer | 35.255 | 0.0 | 9836.5 | 134 |
| 180 min Summer | 25.598 | 0.0 | 9830.5 | 194 |
| 240 min Summer | 20.398 | 0.0 | 9675.1 | 254 |
| 360 min Summer | 14.811 | 0.0 | 9364.1 | 372 |
| 480 min Summer | 11.802 | 0.0 | 9134.0 | 492 |
| 600 min Summer | 9.896 | 0.0 | 8953.0 | 610 |
| 720 min Summer | 8.569 | 0.0 | 8802.7 | 730 |
| 960 min Summer | 6.791 | 0.0 | 8553.6 | 968 |
| 1440 min Summer | 4.893 | 0.0 | 8165.6 | 1446 |
| 2160 min Summer | 3.526 | 0.0 | 17520.2 | 2160 |
| 2880 min Summer | 2.794 | 0.0 | 16753.3 | 2520 |
| 15 min Winter | 182.019 | 0.0 | 5063.3 | 31 |
| 30 min Winter | 105.313 | 0.0 | 5073.3 | 45 |
| 60 min Winter | 60.933 | 0.0 | 9571.5 | 74 |
| 120 min Winter | 35.255 | 0.0 | 9916.0 | 132 |
| 180 min Winter | 25.598 | 0.0 | 9723.8 | 192 |
| 240 min Winter | 20.398 | 0.0 | 9537.6 | 250 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:09<br>File ACA East FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 360 min Winter | 3.583 | 1.133 | 0.0 | 59.8 | 59.8 | 17451.7 | O K |
| 480 min Winter | 3.635 | 1.185 | 0.0 | 59.8 | 59.8 | 18298.0 | O K |
| 600 min Winter | 3.674 | 1.224 | 0.0 | 59.8 | 59.8 | 18931.0 | O K |
| 720 min Winter | 3.704 | 1.254 | 0.0 | 59.8 | 59.8 | 19422.3 | O K |
| 960 min Winter | 3.740 | 1.290 | 0.0 | 59.8 | 59.8 | 20007.5 | O K |
| 1440 min Winter | 3.775 | 1.325 | 0.0 | 59.8 | 59.8 | 20579.7 | O K |
| 2160 min Winter | 3.782 | 1.332 | 0.0 | 59.8 | 59.8 | 20698.9 | O K |
| 2880 min Winter | 3.763 | 1.313 | 0.0 | 59.8 | 59.8 | 20396.1 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 360 min Winter | 14.811 | 0.0 | 9278.5 | 366 |
| 480 min Winter | 11.802 | 0.0 | 9103.1 | 484 |
| 600 min Winter | 9.896 | 0.0 | 8972.1 | 600 |
| 720 min Winter | 8.569 | 0.0 | 8868.5 | 718 |
| 960 min Winter | 6.791 | 0.0 | 8703.1 | 952 |
| 1440 min Winter | 4.893 | 0.0 | 8487.1 | 1412 |
| 2160 min Winter | 3.526 | 0.0 | 17754.1 | 2084 |
| 2880 min Winter | 2.794 | 0.0 | 17086.1 | 2720 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 14:09<br>File ACA East FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| Return Period (years) | 100 |
| FEH Rainfall Version | 1999 |
| Site Location | GB 647050 262950 TM 47050 62950 |
| C (1km) | -0.019 |
| D1 (1km) | 0.298 |
| D2 (1km) | 0.279 |
| D3 (1km) | 0.207 |
| E (1km) | 0.309 |
| F (1km) | 2.506 |
| Summer Storms | Yes |
| Winter Storms | Yes |
| Cv (Summer) | 0.761 |
| Cv (Winter) | 0.817 |
| Shortest Storm (mins) | 15 |
| Longest Storm (mins) | 2880 |
| Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 25.222

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 6.306 | 4 | 8 | 6.306 | 8 | 12 | 6.306 | 12 | 16 | 6.306 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 14:09<br>File ACA East FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 4.100

## Infiltration Basin Structure

Invert Level (m) 2.450 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 14667.6 | 1.350 | 16457.9 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0314-5990-1350-5990 |
| Design Head (m) | 1.350 |
| Design Flow (l/s) | 59.9 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 314 |
| Invert Level (m) | 2.450 |
| Minimum Outlet Pipe Diameter (mm) | 375 |
| Suggested Manhole Diameter (mm) | 2100 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 1.350 | 59.9 |
| Flush-Flo™ | 0.505 | 59.8 |
| Kick-Flo® | 0.997 | 51.8 |
| Mean Flow over Head Range | - | 49.6 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.100 | 9.4 | 1.200 | 56.6 | 3.000 | 88.2 | 7.000 | 133.3 |
| 0.200 | 32.2 | 1.400 | 61.0 | 3.500 | 95.0 | 7.500 | 137.9 |
| 0.300 | 55.9 | 1.600 | 65.0 | 4.000 | 101.4 | 8.000 | 142.3 |
| 0.400 | 59.2 | 1.800 | 68.8 | 4.500 | 107.4 | 8.500 | 146.6 |
| 0.500 | 59.8 | 2.000 | 72.4 | 5.000 | 113.1 | 9.000 | 150.7 |
| 0.600 | 59.5 | 2.200 | 75.9 | 5.500 | 118.5 | 9.500 | 154.8 |
| 0.800 | 57.4 | 2.400 | 79.1 | 6.000 | 123.6 | | |
| 1.000 | 51.9 | 2.600 | 82.3 | 6.500 | 128.5 | | |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 11:52<br>File ACA East FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2020.1.3 | |

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

Half Drain Time : 3054 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 2.775 | 0.325 | 0.0 | 57.8 | 57.8 | 5076.6 | O K |
| 30 min Summer | 2.884 | 0.434 | 0.0 | 59.6 | 59.6 | 6804.7 | O K |
| 60 min Summer | 2.996 | 0.546 | 0.0 | 59.8 | 59.8 | 8596.5 | O K |
| 120 min Summer | 3.132 | 0.682 | 0.0 | 59.8 | 59.8 | 10801.6 | O K |
| 180 min Summer | 3.225 | 0.775 | 0.0 | 59.8 | 59.8 | 12332.3 | O K |
| 240 min Summer | 3.298 | 0.848 | 0.0 | 59.8 | 59.8 | 13532.1 | O K |
| 360 min Summer | 3.410 | 0.960 | 0.0 | 59.8 | 59.8 | 15385.5 | O K |
| 480 min Summer | 3.491 | 1.041 | 0.0 | 59.8 | 59.8 | 16749.2 | O K |
| 600 min Summer | 3.550 | 1.100 | 0.0 | 59.8 | 59.8 | 17736.6 | O K |
| 720 min Summer | 3.593 | 1.143 | 0.0 | 59.8 | 59.8 | 18462.8 | O K |
| 960 min Summer | 3.646 | 1.196 | 0.0 | 59.8 | 59.8 | 19366.3 | O K |
| 1440 min Summer | 3.685 | 1.235 | 0.0 | 59.8 | 59.8 | 20019.4 | O K |
| 2160 min Summer | 3.667 | 1.217 | 0.0 | 59.8 | 59.8 | 19718.9 | O K |
| 15 min Winter | 2.799 | 0.349 | 0.0 | 58.4 | 58.4 | 5452.1 | O K |
| 30 min Winter | 2.916 | 0.466 | 0.0 | 59.7 | 59.7 | 7310.6 | O K |
| 60 min Winter | 3.036 | 0.586 | 0.0 | 59.8 | 59.8 | 9239.2 | O K |
| 120 min Winter | 3.182 | 0.732 | 0.0 | 59.8 | 59.8 | 11613.0 | O K |
| 180 min Winter | 3.282 | 0.832 | 0.0 | 59.8 | 59.8 | 13264.0 | O K |
| 240 min Winter | 3.360 | 0.910 | 0.0 | 59.8 | 59.8 | 14561.2 | O K |
| 360 min Winter | 3.481 | 1.031 | 0.0 | 59.8 | 59.8 | 16571.1 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 106.848 | 0.0 | 2999.0 | 31 |
| 30 min Summer | 71.808 | 0.0 | 4116.7 | 45 |
| 60 min Summer | 45.588 | 0.0 | 6973.5 | 74 |
| 120 min Summer | 28.884 | 0.0 | 8648.2 | 134 |
| 180 min Summer | 22.152 | 0.0 | 9495.2 | 194 |
| 240 min Summer | 18.357 | 0.0 | 9785.9 | 254 |
| 360 min Summer | 14.084 | 0.0 | 9562.1 | 372 |
| 480 min Summer | 11.627 | 0.0 | 9213.6 | 492 |
| 600 min Summer | 9.966 | 0.0 | 8965.6 | 610 |
| 720 min Summer | 8.750 | 0.0 | 8788.1 | 730 |
| 960 min Summer | 7.054 | 0.0 | 8534.5 | 968 |
| 1440 min Summer | 5.109 | 0.0 | 8173.4 | 1446 |
| 2160 min Summer | 3.619 | 0.0 | 17461.7 | 2160 |
| 15 min Winter | 106.848 | 0.0 | 3261.9 | 30 |
| 30 min Winter | 71.808 | 0.0 | 4381.1 | 45 |
| 60 min Winter | 45.588 | 0.0 | 7477.0 | 74 |
| 120 min Winter | 28.884 | 0.0 | 9134.0 | 132 |
| 180 min Winter | 22.152 | 0.0 | 9793.6 | 190 |
| 240 min Winter | 18.357 | 0.0 | 9801.7 | 250 |
| 360 min Winter | 14.084 | 0.0 | 9421.2 | 366 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 11:52<br>File ACA East FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2020.1.3 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 480 min Winter | 3.567 | 1.117 | 0.0 | 59.8 | 59.8 | 18031.6 | O K |
| 600 min Winter | 3.630 | 1.180 | 0.0 | 59.8 | 59.8 | 19095.7 | O K |
| 720 min Winter | 3.677 | 1.227 | 0.0 | 59.8 | 59.8 | 19884.9 | O K |
| 960 min Winter | 3.735 | 1.285 | 0.0 | 59.8 | 59.8 | 20880.7 | O K |
| 1440 min Winter | 3.779 | 1.329 | 0.0 | 59.8 | 59.8 | 21641.3 | O K |
| 2160 min Winter | 3.766 | 1.316 | 0.0 | 59.8 | 59.8 | 21420.7 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 480 min Winter | 11.627 | 0.0 | 9128.9 | 484 |
| 600 min Winter | 9.966 | 0.0 | 8952.0 | 602 |
| 720 min Winter | 8.750 | 0.0 | 8835.9 | 718 |
| 960 min Winter | 7.054 | 0.0 | 8690.4 | 952 |
| 1440 min Winter | 5.108 | 0.0 | 8510.6 | 1412 |
| 2160 min Winter | 3.619 | 0.0 | 17688.3 | 2084 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 11:52<br>File ACA East FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2020.1.3 | |

## Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| Return Period (years) | 100 |
| FEH Rainfall Version | 2013 |
| Site Location | GB 647050 262950 TM 47050 62950 |
| Data Type | Catchment |
| Summer Storms | Yes |
| Winter Storms | Yes |
| Cv (Summer) | 0.761 |
| Cv (Winter) | 0.817 |
| Shortest Storm (mins) | 15 |
| Longest Storm (mins) | 2160 |
| Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 25.222

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 6.306 | 4 | 8 | 6.306 | 8 | 12 | 6.306 | 12 | 16 | 6.306 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 11:52<br>File ACA East FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2020.1.3 | |

## Model Details

Storage is Online Cover Level (m) 4.100

## Infiltration Basin Structure

Invert Level (m) 2.450 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 15387.2 | 1.350 | 17219.6 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0314-5990-1350-5990 |
| Design Head (m) | 1.350 |
| Design Flow (l/s) | 59.9 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 314 |
| Invert Level (m) | 2.450 |
| Minimum Outlet Pipe Diameter (mm) | 375 |
| Suggested Manhole Diameter (mm) | 2100 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 1.350 | 59.9 |
| Flush-Flo™ | 0.505 | 59.8 |
| Kick-Flo® | 0.997 | 51.8 |
| Mean Flow over Head Range | - | 49.6 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.100 | 9.4 | 1.200 | 56.6 | 3.000 | 88.2 | 7.000 | 133.3 |
| 0.200 | 32.2 | 1.400 | 61.0 | 3.500 | 95.0 | 7.500 | 137.9 |
| 0.300 | 55.9 | 1.600 | 65.0 | 4.000 | 101.4 | 8.000 | 142.3 |
| 0.400 | 59.2 | 1.800 | 68.8 | 4.500 | 107.4 | 8.500 | 146.6 |
| 0.500 | 59.8 | 2.000 | 72.4 | 5.000 | 113.1 | 9.000 | 150.7 |
| 0.600 | 59.5 | 2.200 | 75.9 | 5.500 | 118.5 | 9.500 | 154.8 |
| 0.800 | 57.4 | 2.400 | 79.1 | 6.000 | 123.6 | | |
| 1.000 | 51.9 | 2.600 | 82.3 | 6.500 | 128.5 | | |

## 1.10. ACA West Basin

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:10<br>File ACA West FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time : 2145 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 3.130 | 0.630 | 0.0 | 10.5 | 10.5 | 892.4 | O K |
| 30 min Summer | 3.306 | 0.806 | 0.0 | 10.5 | 10.5 | 1170.9 | O K |
| 60 min Summer | 3.482 | 0.982 | 0.0 | 10.5 | 10.5 | 1462.3 | O K |
| 120 min Summer | 3.653 | 1.153 | 0.0 | 10.5 | 10.5 | 1759.4 | O K |
| 180 min Summer | 3.748 | 1.248 | 0.0 | 10.5 | 10.5 | 1930.2 | O K |
| 240 min Summer | 3.811 | 1.311 | 0.0 | 10.5 | 10.5 | 2044.5 | O K |
| 360 min Summer | 3.888 | 1.388 | 0.0 | 10.5 | 10.5 | 2188.3 | O K |
| 480 min Summer | 3.937 | 1.437 | 0.0 | 10.5 | 10.5 | 2281.5 | O K |
| 600 min Summer | 3.972 | 1.472 | 0.0 | 10.5 | 10.5 | 2348.0 | O K |
| 720 min Summer | 3.997 | 1.497 | 0.0 | 10.5 | 10.5 | 2395.7 | O K |
| 960 min Summer | 4.026 | 1.526 | 0.0 | 10.5 | 10.5 | 2452.1 | O K |
| 1440 min Summer | 4.039 | 1.539 | 0.0 | 10.5 | 10.5 | 2476.3 | O K |
| 2160 min Summer | 4.010 | 1.510 | 0.0 | 10.5 | 10.5 | 2421.3 | O K |
| 15 min Winter | 3.172 | 0.672 | 0.0 | 10.5 | 10.5 | 958.7 | O K |
| 30 min Winter | 3.359 | 0.859 | 0.0 | 10.5 | 10.5 | 1257.8 | O K |
| 60 min Winter | 3.545 | 1.045 | 0.0 | 10.5 | 10.5 | 1571.2 | O K |
| 120 min Winter | 3.727 | 1.227 | 0.0 | 10.5 | 10.5 | 1890.9 | O K |
| 180 min Winter | 3.827 | 1.327 | 0.0 | 10.5 | 10.5 | 2073.9 | O K |
| 240 min Winter | 3.894 | 1.394 | 0.0 | 10.5 | 10.5 | 2199.1 | O K |
| 360 min Winter | 3.976 | 1.476 | 0.0 | 10.5 | 10.5 | 2355.7 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 106.778 | 0.0 | 496.3 | 27 |
| 30 min Summer | 70.214 | 0.0 | 780.4 | 41 |
| 60 min Summer | 44.063 | 0.0 | 1082.9 | 72 |
| 120 min Summer | 26.779 | 0.0 | 1403.5 | 130 |
| 180 min Summer | 19.773 | 0.0 | 1598.1 | 190 |
| 240 min Summer | 15.863 | 0.0 | 1737.8 | 250 |
| 360 min Summer | 11.539 | 0.0 | 1736.2 | 368 |
| 480 min Summer | 9.189 | 0.0 | 1712.2 | 488 |
| 600 min Summer | 7.705 | 0.0 | 1689.4 | 606 |
| 720 min Summer | 6.669 | 0.0 | 1666.7 | 726 |
| 960 min Summer | 5.306 | 0.0 | 1623.7 | 964 |
| 1440 min Summer | 3.839 | 0.0 | 1541.6 | 1442 |
| 2160 min Summer | 2.773 | 0.0 | 2966.3 | 1844 |
| 15 min Winter | 106.778 | 0.0 | 562.6 | 27 |
| 30 min Winter | 70.214 | 0.0 | 867.8 | 41 |
| 60 min Winter | 44.063 | 0.0 | 1192.5 | 70 |
| 120 min Winter | 26.779 | 0.0 | 1536.9 | 128 |
| 180 min Winter | 19.773 | 0.0 | 1745.7 | 186 |
| 240 min Winter | 15.863 | 0.0 | 1765.2 | 246 |
| 360 min Winter | 11.539 | 0.0 | 1743.8 | 362 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:10<br>File ACA West FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 480 min Winter | 4.030 | 1.530 | 0.0 | 10.5 | 10.5 | 2458.8 | O K |
| 600 min Winter | 4.068 | 1.568 | 0.0 | 10.5 | 10.5 | 2532.9 | O K |
| 720 min Winter | 4.095 | 1.595 | 0.0 | 10.5 | 10.5 | 2586.8 | O K |
| 960 min Winter | 4.129 | 1.629 | 0.0 | 10.5 | 10.5 | 2654.9 | O K |
| 1440 min Winter | 4.151 | 1.651 | 0.0 | 10.5 | 10.5 | 2698.8 | O K |
| 2160 min Winter | 4.127 | 1.627 | 0.0 | 10.5 | 10.5 | 2650.5 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 480 min Winter | 9.189 | 0.0 | 1721.3 | 480 |
| 600 min Winter | 7.705 | 0.0 | 1700.8 | 596 |
| 720 min Winter | 6.669 | 0.0 | 1680.3 | 712 |
| 960 min Winter | 5.306 | 0.0 | 1640.2 | 942 |
| 1440 min Winter | 3.839 | 0.0 | 1563.4 | 1396 |
| 2160 min Winter | 2.773 | 0.0 | 3214.6 | 2036 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:10<br>File ACA West FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.761 |
| Region | England and Wales | Cv (Winter) | 0.817 |
| M5-60 (mm) | 18.200 | Shortest Storm (mins) | 15 |
| Ratio R | 0.400 | Longest Storm (mins) | 2160 |
| Summer Storms | Yes | Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 4.438

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 1.479 | 4 | 8 | 1.479 | 8 | 12 | 1.479 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:10<br>File ACA West FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 4.500

## Infiltration Basin Structure

Invert Level (m) 2.500 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 1292.8 | 1.700 | 2024.6 |

## Pump Outflow Control

Invert Level (m) 2.800

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| 0.001 | 10.5300 | 1.000 | 10.5300 | 1.700 | 10.5300 |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 14:11<br>File ACA West FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time : 2886 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 3.271 | 0.771 | 0.0 | 10.5 | 10.5 | 1527.0 | O K |
| 30 min Summer | 3.378 | 0.878 | 0.0 | 10.5 | 10.5 | 1762.9 | O K |
| 60 min Summer | 3.496 | 0.996 | 0.0 | 10.5 | 10.5 | 2032.0 | O K |
| 120 min Summer | 3.624 | 1.124 | 0.0 | 10.5 | 10.5 | 2331.6 | O K |
| 180 min Summer | 3.702 | 1.202 | 0.0 | 10.5 | 10.5 | 2520.2 | O K |
| 240 min Summer | 3.759 | 1.259 | 0.0 | 10.5 | 10.5 | 2658.3 | O K |
| 360 min Summer | 3.837 | 1.337 | 0.0 | 10.5 | 10.5 | 2853.9 | O K |
| 480 min Summer | 3.892 | 1.392 | 0.0 | 10.5 | 10.5 | 2990.8 | O K |
| 600 min Summer | 3.932 | 1.432 | 0.0 | 10.5 | 10.5 | 3092.6 | O K |
| 720 min Summer | 3.962 | 1.462 | 0.0 | 10.5 | 10.5 | 3170.8 | O K |
| 960 min Summer | 3.998 | 1.498 | 0.0 | 10.5 | 10.5 | 3262.6 | O K |
| 1440 min Summer | 4.029 | 1.529 | 0.0 | 10.5 | 10.5 | 3343.7 | O K |
| 2160 min Summer | 4.025 | 1.525 | 0.0 | 10.5 | 10.5 | 3333.8 | O K |
| 2880 min Summer | 4.000 | 1.500 | 0.0 | 10.5 | 10.5 | 3269.7 | O K |
| 15 min Winter | 3.323 | 0.823 | 0.0 | 10.5 | 10.5 | 1640.1 | O K |
| 30 min Winter | 3.436 | 0.936 | 0.0 | 10.5 | 10.5 | 1894.0 | O K |
| 60 min Winter | 3.561 | 1.061 | 0.0 | 10.5 | 10.5 | 2182.6 | O K |
| 120 min Winter | 3.696 | 1.196 | 0.0 | 10.5 | 10.5 | 2505.2 | O K |
| 180 min Winter | 3.779 | 1.279 | 0.0 | 10.5 | 10.5 | 2708.6 | O K |
| 240 min Winter | 3.839 | 1.339 | 0.0 | 10.5 | 10.5 | 2857.8 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 182.019 | 0.0 | 902.8 | 27 |
| 30 min Summer | 105.313 | 0.0 | 899.1 | 42 |
| 60 min Summer | 60.933 | 0.0 | 1500.8 | 72 |
| 120 min Summer | 35.255 | 0.0 | 1786.7 | 130 |
| 180 min Summer | 25.598 | 0.0 | 1772.8 | 190 |
| 240 min Summer | 20.398 | 0.0 | 1758.9 | 250 |
| 360 min Summer | 14.811 | 0.0 | 1733.3 | 370 |
| 480 min Summer | 11.802 | 0.0 | 1708.4 | 488 |
| 600 min Summer | 9.896 | 0.0 | 1684.4 | 608 |
| 720 min Summer | 8.569 | 0.0 | 1661.3 | 728 |
| 960 min Summer | 6.791 | 0.0 | 1615.2 | 966 |
| 1440 min Summer | 4.893 | 0.0 | 1528.0 | 1444 |
| 2160 min Summer | 3.526 | 0.0 | 3224.7 | 2160 |
| 2880 min Summer | 2.794 | 0.0 | 3106.6 | 2456 |
| 15 min Winter | 182.019 | 0.0 | 902.8 | 27 |
| 30 min Winter | 105.313 | 0.0 | 899.1 | 41 |
| 60 min Winter | 60.933 | 0.0 | 1652.2 | 70 |
| 120 min Winter | 35.255 | 0.0 | 1789.3 | 128 |
| 180 min Winter | 25.598 | 0.0 | 1776.6 | 188 |
| 240 min Winter | 20.398 | 0.0 | 1764.0 | 246 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:11<br>File ACA West FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 360 min Winter | 3.923 | 1.423 | 0.0 | 10.5 | 10.5 | 3069.5 | O K |
| 480 min Winter | 3.981 | 1.481 | 0.0 | 10.5 | 10.5 | 3218.7 | O K |
| 600 min Winter | 4.023 | 1.523 | 0.0 | 10.5 | 10.5 | 3330.2 | O K |
| 720 min Winter | 4.057 | 1.557 | 0.0 | 10.5 | 10.5 | 3417.4 | O K |
| 960 min Winter | 4.096 | 1.596 | 0.0 | 10.5 | 10.5 | 3521.5 | O K |
| 1440 min Winter | 4.134 | 1.634 | 0.0 | 10.5 | 10.5 | 3623.2 | O K |
| 2160 min Winter | 4.141 | 1.641 | 0.0 | 10.5 | 10.5 | 3641.3 | O K |
| 2880 min Winter | 4.117 | 1.617 | 0.0 | 10.5 | 10.5 | 3577.5 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 360 min Winter | 14.811 | 0.0 | 1741.2 | 364 |
| 480 min Winter | 11.802 | 0.0 | 1718.5 | 482 |
| 600 min Winter | 9.896 | 0.0 | 1697.0 | 598 |
| 720 min Winter | 8.569 | 0.0 | 1675.5 | 716 |
| 960 min Winter | 6.791 | 0.0 | 1633.5 | 948 |
| 1440 min Winter | 4.893 | 0.0 | 1553.0 | 1408 |
| 2160 min Winter | 3.526 | 0.0 | 3257.6 | 2080 |
| 2880 min Winter | 2.794 | 0.0 | 3147.0 | 2716 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:11<br>File ACA West FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| Return Period (years) | 100 |
| FEH Rainfall Version | 1999 |
| Site Location | GB 647050 262950 TM 47050 62950 |
| C (1km) | -0.019 |
| D1 (1km) | 0.298 |
| D2 (1km) | 0.279 |
| D3 (1km) | 0.207 |
| E (1km) | 0.309 |
| F (1km) | 2.506 |
| Summer Storms | Yes |
| Winter Storms | Yes |
| Cv (Summer) | 0.761 |
| Cv (Winter) | 0.817 |
| Shortest Storm (mins) | 15 |
| Longest Storm (mins) | 2880 |
| Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 4.438

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 1.479 | 4 | 8 | 1.479 | 8 | 12 | 1.479 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:11<br>File ACA West FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 4.500

## Infiltration Basin Structure

Invert Level (m) 2.500 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 1781.9 | 1.700 | 2723.8 |

## Pump Outflow Control

Invert Level (m) 2.800

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|
| 0.001 | 10.5300 | 1.000 | 10.5300 | 1.700 | 10.5300 |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 11:50<br>File ACA West FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2020.1.3 | |

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

Half Drain Time : 3019 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 2.947 | 0.447 | 0.0 | 10.5 | 10.5 | 894.9 | O K |
| 30 min Summer | 3.088 | 0.588 | 0.0 | 10.5 | 10.5 | 1199.1 | O K |
| 60 min Summer | 3.230 | 0.730 | 0.0 | 10.5 | 10.5 | 1515.0 | O K |
| 120 min Summer | 3.397 | 0.897 | 0.0 | 10.5 | 10.5 | 1904.0 | O K |
| 180 min Summer | 3.510 | 1.010 | 0.0 | 10.5 | 10.5 | 2174.9 | O K |
| 240 min Summer | 3.596 | 1.096 | 0.0 | 10.5 | 10.5 | 2386.5 | O K |
| 360 min Summer | 3.724 | 1.224 | 0.0 | 10.5 | 10.5 | 2710.4 | O K |
| 480 min Summer | 3.816 | 1.316 | 0.0 | 10.5 | 10.5 | 2947.2 | O K |
| 600 min Summer | 3.881 | 1.381 | 0.0 | 10.5 | 10.5 | 3119.8 | O K |
| 720 min Summer | 3.929 | 1.429 | 0.0 | 10.5 | 10.5 | 3247.6 | O K |
| 960 min Summer | 3.988 | 1.488 | 0.0 | 10.5 | 10.5 | 3406.4 | O K |
| 1440 min Summer | 4.030 | 1.530 | 0.0 | 10.5 | 10.5 | 3520.1 | O K |
| 2160 min Summer | 4.006 | 1.506 | 0.0 | 10.5 | 10.5 | 3454.8 | O K |
| 15 min Winter | 2.978 | 0.478 | 0.0 | 10.5 | 10.5 | 960.6 | O K |
| 30 min Winter | 3.129 | 0.629 | 0.0 | 10.5 | 10.5 | 1288.6 | O K |
| 60 min Winter | 3.279 | 0.779 | 0.0 | 10.5 | 10.5 | 1628.9 | O K |
| 120 min Winter | 3.457 | 0.957 | 0.0 | 10.5 | 10.5 | 2047.2 | O K |
| 180 min Winter | 3.576 | 1.076 | 0.0 | 10.5 | 10.5 | 2337.6 | O K |
| 240 min Winter | 3.667 | 1.167 | 0.0 | 10.5 | 10.5 | 2565.7 | O K |
| 360 min Winter | 3.804 | 1.304 | 0.0 | 10.5 | 10.5 | 2915.3 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 106.848 | 0.0 | 313.5 | 27 |
| 30 min Summer | 71.808 | 0.0 | 624.1 | 41 |
| 60 min Summer | 45.588 | 0.0 | 951.2 | 72 |
| 120 min Summer | 28.884 | 0.0 | 1362.5 | 130 |
| 180 min Summer | 22.152 | 0.0 | 1655.9 | 190 |
| 240 min Summer | 18.357 | 0.0 | 1755.1 | 250 |
| 360 min Summer | 14.084 | 0.0 | 1729.6 | 370 |
| 480 min Summer | 11.627 | 0.0 | 1704.6 | 488 |
| 600 min Summer | 9.966 | 0.0 | 1680.9 | 608 |
| 720 min Summer | 8.750 | 0.0 | 1657.8 | 728 |
| 960 min Summer | 7.054 | 0.0 | 1613.6 | 966 |
| 1440 min Summer | 5.109 | 0.0 | 1526.1 | 1444 |
| 2160 min Summer | 3.619 | 0.0 | 3217.1 | 2160 |
| 15 min Winter | 106.848 | 0.0 | 380.0 | 27 |
| 30 min Winter | 71.808 | 0.0 | 713.3 | 41 |
| 60 min Winter | 45.588 | 0.0 | 1064.6 | 70 |
| 120 min Winter | 28.884 | 0.0 | 1506.2 | 128 |
| 180 min Winter | 22.152 | 0.0 | 1772.8 | 188 |
| 240 min Winter | 18.357 | 0.0 | 1760.2 | 246 |
| 360 min Winter | 14.084 | 0.0 | 1737.4 | 364 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 11:50<br>File ACA West FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2020.1.3 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 480 min Winter | 3.900 | 1.400 | 0.0 | 10.5 | 10.5 | 3170.8 | O K |
| 600 min Winter | 3.970 | 1.470 | 0.0 | 10.5 | 10.5 | 3358.2 | O K |
| 720 min Winter | 4.022 | 1.522 | 0.0 | 10.5 | 10.5 | 3498.5 | O K |
| 960 min Winter | 4.086 | 1.586 | 0.0 | 10.5 | 10.5 | 3676.0 | O K |
| 1440 min Winter | 4.135 | 1.635 | 0.0 | 10.5 | 10.5 | 3812.3 | O K |
| 2160 min Winter | 4.119 | 1.619 | 0.0 | 10.5 | 10.5 | 3768.1 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 480 min Winter | 11.627 | 0.0 | 1715.7 | 480 |
| 600 min Winter | 9.966 | 0.0 | 1694.5 | 598 |
| 720 min Winter | 8.750 | 0.0 | 1673.0 | 716 |
| 960 min Winter | 7.054 | 0.0 | 1631.6 | 950 |
| 1440 min Winter | 5.108 | 0.0 | 1550.8 | 1412 |
| 2160 min Winter | 3.619 | 0.0 | 3251.9 | 2080 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 11:50<br>File ACA West FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2020.1.3 | |

## Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| Return Period (years) | 100 |
| FEH Rainfall Version | 2013 |
| Site Location | GB 647050 262950 TM 47050 62950 |
| Data Type | Catchment |
| Summer Storms | Yes |
| Winter Storms | Yes |
| Cv (Summer) | 0.761 |
| Cv (Winter) | 0.817 |
| Shortest Storm (mins) | 15 |
| Longest Storm (mins) | 2160 |
| Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 4.438

| Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) | Time From: | (mins) To: | Area (ha) |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 1.479 | 4 | 8 | 1.479 | 8 | 12 | 1.479 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 11:50<br>File ACA West FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2020.1.3 | |

## Model Details

Storage is Online Cover Level (m) 4.500

## Infiltration Basin Structure

Invert Level (m) 2.500 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.00000

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 1884.7 | 1.700 | 2850.5 |

## Pump Outflow Control

Invert Level (m) 2.800

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|
| 0.001 | 10.5300 | 1.000 | 10.5300 | 1.700 | 10.5300 |

## 1.12. Abbey Road Basin

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:06<br>File Abbey Road FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time : 270 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 7.825 | 1.083 | 17.8 | 5.7 | 22.7 | 470.6 | O K |
| 30 min Summer | 8.058 | 1.316 | 22.3 | 5.7 | 27.6 | 608.1 | O K |
| 60 min Summer | 8.255 | 1.513 | 26.3 | 5.7 | 32.0 | 735.2 | O K |
| 120 min Summer | 8.392 | 1.650 | 29.1 | 5.9 | 35.1 | 830.3 | O K |
| 180 min Summer | 8.427 | 1.685 | 29.9 | 6.0 | 35.9 | 855.4 | O K |
| 240 min Summer | 8.436 | 1.694 | 30.1 | 6.0 | 36.1 | 862.0 | O K |
| 360 min Summer | 8.430 | 1.688 | 29.9 | 6.0 | 35.9 | 857.3 | O K |
| 480 min Summer | 8.411 | 1.669 | 29.5 | 6.0 | 35.5 | 843.7 | O K |
| 600 min Summer | 8.386 | 1.644 | 29.0 | 5.9 | 34.9 | 826.4 | O K |
| 720 min Summer | 8.359 | 1.617 | 28.4 | 5.9 | 34.3 | 806.8 | O K |
| 960 min Summer | 8.299 | 1.557 | 27.2 | 5.8 | 33.0 | 765.5 | O K |
| 1440 min Summer | 8.182 | 1.440 | 24.8 | 5.7 | 30.4 | 687.2 | O K |
| 15 min Winter | 7.987 | 1.245 | 20.9 | 5.7 | 26.1 | 564.9 | O K |
| 30 min Winter | 8.248 | 1.506 | 26.1 | 5.7 | 31.8 | 731.1 | O K |
| 60 min Winter | 8.470 | 1.728 | 30.8 | 6.1 | 36.9 | 886.6 | O K |
| 120 min Winter | 8.629 | 1.887 | 34.3 | 6.3 | 40.6 | 1007.5 | O K |
| 180 min Winter | 8.676 | 1.934 | 35.3 | 6.4 | 41.7 | 1044.4 | O K |
| 240 min Winter | 8.681 | 1.939 | 35.4 | 6.4 | 41.8 | 1048.1 | O K |
| 360 min Winter | 8.668 | 1.926 | 35.1 | 6.4 | 41.5 | 1038.2 | O K |
| 480 min Winter | 8.639 | 1.897 | 34.5 | 6.3 | 40.8 | 1014.8 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 106.778 | 0.0 | 490.4 | 26 |
| 30 min Summer | 70.214 | 0.0 | 644.9 | 39 |
| 60 min Summer | 44.063 | 0.0 | 810.7 | 68 |
| 120 min Summer | 26.779 | 0.0 | 985.3 | 122 |
| 180 min Summer | 19.773 | 0.0 | 1091.3 | 174 |
| 240 min Summer | 15.863 | 0.0 | 1167.3 | 200 |
| 360 min Summer | 11.539 | 0.0 | 1273.6 | 264 |
| 480 min Summer | 9.189 | 0.0 | 1352.4 | 332 |
| 600 min Summer | 7.705 | 0.0 | 1417.4 | 402 |
| 720 min Summer | 6.669 | 0.0 | 1472.1 | 470 |
| 960 min Summer | 5.306 | 0.0 | 1561.7 | 606 |
| 1440 min Summer | 3.839 | 0.0 | 1694.6 | 874 |
| 15 min Winter | 106.778 | 0.0 | 587.1 | 25 |
| 30 min Winter | 70.214 | 0.0 | 772.0 | 39 |
| 60 min Winter | 44.063 | 0.0 | 970.5 | 66 |
| 120 min Winter | 26.779 | 0.0 | 1179.6 | 122 |
| 180 min Winter | 19.773 | 0.0 | 1306.5 | 176 |
| 240 min Winter | 15.863 | 0.0 | 1397.5 | 224 |
| 360 min Winter | 11.539 | 0.0 | 1524.8 | 280 |
| 480 min Winter | 9.189 | 0.0 | 1619.1 | 356 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 14:06<br>File Abbey Road FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 600 min Winter | 8.602 | 1.860 | 33.7 | 6.3 | 39.9 | 986.1 | O K |
| 720 min Winter | 8.561 | 1.819 | 32.8 | 6.2 | 39.0 | 954.5 | O K |
| 960 min Winter | 8.475 | 1.733 | 30.9 | 6.1 | 37.0 | 890.1 | O K |
| 1440 min Winter | 8.310 | 1.568 | 27.4 | 5.8 | 33.2 | 773.1 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 600 min Winter | 7.705 | 0.0 | 1696.9 | 432 |
| 720 min Winter | 6.669 | 0.0 | 1762.4 | 506 |
| 960 min Winter | 5.306 | 0.0 | 1869.6 | 652 |
| 1440 min Winter | 3.839 | 0.0 | 2028.7 | 930 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:06<br>File Abbey Road FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | | | |
|---|---|---|---|
| Rainfall Model | FSR | Winter Storms | Yes |
| Return Period (years) | 100 | Cv (Summer) | 0.568 |
| Region | England and Wales | Cv (Winter) | 0.680 |
| M5-60 (mm) | 18.200 | Shortest Storm (mins) | 15 |
| Ratio R | 0.400 | Longest Storm (mins) | 1440 |
| Summer Storms | Yes | Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 3.239

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 1.080 | 4 | 8 | 1.080 | 8 | 12 | 1.080 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:06<br>File Abbey Road FSR.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 9.042

## Infiltration Basin Structure

Invert Level (m) 6.742 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.38160

| Depth (m) | Area (m²) | Depth (m) | Area (m²) |
|---|---|---|---|
| 0.000 | 320.5 | 2.000 | 814.4 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0105-6500-2000-6500 |
| Design Head (m) | 2.000 |
| Design Flow (l/s) | 6.5 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 105 |
| Invert Level (m) | 6.742 |
| Minimum Outlet Pipe Diameter (mm) | 150 |
| Suggested Manhole Diameter (mm) | 1200 |

| Control Points | Head (m) | Flow (l/s) |
|---|---|---|
| Design Point (Calculated) | 2.000 | 6.5 |
| Flush-Flo™ | 0.459 | 5.7 |
| Kick-Flo® | 0.937 | 4.6 |
| Mean Flow over Head Range | - | 5.3 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) | Depth (m) | Flow (l/s) |
|---|---|---|---|---|---|---|---|
| 0.100 | 3.5 | 1.200 | 5.1 | 3.000 | 7.9 | 7.000 | 11.7 |
| 0.200 | 5.1 | 1.400 | 5.5 | 3.500 | 8.4 | 7.500 | 12.1 |
| 0.300 | 5.5 | 1.600 | 5.8 | 4.000 | 9.0 | 8.000 | 12.5 |
| 0.400 | 5.7 | 1.800 | 6.2 | 4.500 | 9.5 | 8.500 | 12.9 |
| 0.500 | 5.7 | 2.000 | 6.5 | 5.000 | 10.0 | 9.000 | 13.2 |
| 0.600 | 5.6 | 2.200 | 6.8 | 5.500 | 10.5 | 9.500 | 13.6 |
| 0.800 | 5.3 | 2.400 | 7.1 | 6.000 | 10.9 | | |
| 1.000 | 4.7 | 2.600 | 7.3 | 6.500 | 11.3 | | |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:06<br>File Abbey Road FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time : 332 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 8.021 | 1.279 | 25.6 | 5.7 | 30.9 | 822.1 | O K |
| 30 min Summer | 8.154 | 1.412 | 28.7 | 5.7 | 34.2 | 934.1 | O K |
| 60 min Summer | 8.279 | 1.537 | 31.6 | 5.7 | 37.3 | 1044.4 | O K |
| 120 min Summer | 8.375 | 1.633 | 33.9 | 5.9 | 39.8 | 1132.3 | O K |
| 180 min Summer | 8.402 | 1.660 | 34.6 | 6.0 | 40.5 | 1157.5 | O K |
| 240 min Summer | 8.404 | 1.662 | 34.6 | 6.0 | 40.6 | 1159.8 | O K |
| 360 min Summer | 8.401 | 1.659 | 34.5 | 5.9 | 40.5 | 1156.6 | O K |
| 480 min Summer | 8.390 | 1.648 | 34.3 | 5.9 | 40.2 | 1146.0 | O K |
| 600 min Summer | 8.372 | 1.630 | 33.8 | 5.9 | 39.7 | 1129.9 | O K |
| 720 min Summer | 8.352 | 1.610 | 33.3 | 5.9 | 39.2 | 1110.4 | O K |
| 960 min Summer | 8.295 | 1.553 | 32.0 | 5.8 | 37.7 | 1058.3 | O K |
| 1440 min Summer | 8.183 | 1.441 | 29.3 | 5.7 | 34.9 | 959.2 | O K |
| 15 min Winter | 8.214 | 1.472 | 30.1 | 5.7 | 35.7 | 985.8 | O K |
| 30 min Winter | 8.363 | 1.621 | 33.6 | 5.9 | 39.5 | 1121.5 | O K |
| 60 min Winter | 8.505 | 1.763 | 37.1 | 6.1 | 43.2 | 1256.8 | O K |
| 120 min Winter | 8.619 | 1.877 | 39.9 | 6.3 | 46.2 | 1369.9 | O K |
| 180 min Winter | 8.656 | 1.914 | 40.9 | 6.4 | 47.2 | 1407.6 | O K |
| 240 min Winter | 8.662 | 1.920 | 41.0 | 6.4 | 47.4 | 1413.5 | O K |
| 360 min Winter | 8.649 | 1.907 | 40.7 | 6.3 | 47.1 | 1400.6 | O K |
| 480 min Winter | 8.631 | 1.889 | 40.2 | 6.3 | 46.6 | 1381.6 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 184.621 | 0.0 | 845.3 | 26 |
| 30 min Summer | 106.552 | 0.0 | 975.5 | 40 |
| 60 min Summer | 61.496 | 0.0 | 1131.2 | 68 |
| 120 min Summer | 35.492 | 0.0 | 1305.7 | 124 |
| 180 min Summer | 25.733 | 0.0 | 1420.0 | 180 |
| 240 min Summer | 20.484 | 0.0 | 1507.1 | 214 |
| 360 min Summer | 14.851 | 0.0 | 1639.0 | 276 |
| 480 min Summer | 11.822 | 0.0 | 1739.5 | 342 |
| 600 min Summer | 9.905 | 0.0 | 1821.7 | 410 |
| 720 min Summer | 8.571 | 0.0 | 1891.6 | 478 |
| 960 min Summer | 6.770 | 0.0 | 1991.9 | 616 |
| 1440 min Summer | 4.855 | 0.0 | 2141.8 | 886 |
| 15 min Winter | 184.621 | 0.0 | 1011.8 | 26 |
| 30 min Winter | 106.552 | 0.0 | 1167.4 | 39 |
| 60 min Winter | 61.496 | 0.0 | 1354.2 | 66 |
| 120 min Winter | 35.492 | 0.0 | 1563.2 | 122 |
| 180 min Winter | 25.733 | 0.0 | 1700.0 | 178 |
| 240 min Winter | 20.484 | 0.0 | 1804.3 | 230 |
| 360 min Winter | 14.851 | 0.0 | 1962.2 | 288 |
| 480 min Winter | 11.822 | 0.0 | 2082.5 | 364 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
| Date 11/08/2021 14:06<br>File Abbey Road FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 600 min Winter | 8.603 | 1.861 | 39.5 | 6.3 | 45.8 | 1353.5 | O K |
| 720 min Winter | 8.570 | 1.828 | 38.7 | 6.2 | 44.9 | 1320.9 | O K |
| 960 min Winter | 8.488 | 1.746 | 36.7 | 6.1 | 42.8 | 1240.2 | O K |
| 1440 min Winter | 8.332 | 1.590 | 32.9 | 5.8 | 38.7 | 1092.3 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 600 min Winter | 9.905 | 0.0 | 2180.8 | 440 |
| 720 min Winter | 8.571 | 0.0 | 2264.6 | 516 |
| 960 min Winter | 6.770 | 0.0 | 2384.6 | 664 |
| 1440 min Winter | 4.855 | 0.0 | 2563.9 | 946 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:06<br>File Abbey Road FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| Return Period (years) | 100 |
| FEH Rainfall Version | 1999 |
| Site Location | GB 647450 264900 TM 47450 64900 |
| C (1km) | -0.020 |
| D1 (1km) | 0.299 |
| D2 (1km) | 0.272 |
| D3 (1km) | 0.215 |
| E (1km) | 0.311 |
| F (1km) | 2.506 |
| Summer Storms | Yes |
| Winter Storms | Yes |
| Cv (Summer) | 0.568 |
| Cv (Winter) | 0.680 |
| Shortest Storm (mins) | 15 |
| Longest Storm (mins) | 1440 |
| Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 3.239

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 1.080 | 4 | 8 | 1.080 | 8 | 12 | 1.080 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:06<br>File Abbey Road FEH.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 9.042

## Infiltration Basin Structure

Invert Level (m) 6.742 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.38160

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 478.3 | 2.000 | 1056.6 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0105-6500-2000-6500 |
| Design Head (m) | 2.000 |
| Design Flow (l/s) | 6.5 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 105 |
| Invert Level (m) | 6.742 |
| Minimum Outlet Pipe Diameter (mm) | 150 |
| Suggested Manhole Diameter (mm) | 1200 |

| **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|
| Design Point (Calculated) | 2.000 | 6.5 |
| Flush-Flo™ | 0.459 | 5.7 |
| Kick-Flo® | 0.937 | 4.6 |
| Mean Flow over Head Range | - | 5.3 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|
| 0.100 | 3.5 | 1.200 | 5.1 | 3.000 | 7.9 | 7.000 | 11.7 |
| 0.200 | 5.1 | 1.400 | 5.5 | 3.500 | 8.4 | 7.500 | 12.1 |
| 0.300 | 5.5 | 1.600 | 5.8 | 4.000 | 9.0 | 8.000 | 12.5 |
| 0.400 | 5.7 | 1.800 | 6.2 | 4.500 | 9.5 | 8.500 | 12.9 |
| 0.500 | 5.7 | 2.000 | 6.5 | 5.000 | 10.0 | 9.000 | 13.2 |
| 0.600 | 5.6 | 2.200 | 6.8 | 5.500 | 10.5 | 9.500 | 13.6 |
| 0.800 | 5.3 | 2.400 | 7.1 | 6.000 | 10.9 | | |
| 1.000 | 4.7 | 2.600 | 7.3 | 6.500 | 11.3 | | |

| Atkins (Epsom) | | Page 1 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:07<br>File Abbey Road FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

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

Half Drain Time : 305 minutes.

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 15 min Summer | 7.566 | 0.824 | 15.1 | 5.7 | 20.3 | 442.0 | O K |
| 30 min Summer | 7.792 | 1.050 | 19.7 | 5.7 | 24.5 | 593.6 | O K |
| 60 min Summer | 7.990 | 1.248 | 24.0 | 5.7 | 29.2 | 738.3 | O K |
| 120 min Summer | 8.176 | 1.434 | 28.1 | 5.7 | 33.7 | 884.9 | O K |
| 180 min Summer | 8.267 | 1.525 | 30.2 | 5.7 | 35.9 | 960.6 | O K |
| 240 min Summer | 8.322 | 1.580 | 31.5 | 5.8 | 37.3 | 1007.5 | O K |
| 360 min Summer | 8.395 | 1.653 | 33.2 | 5.9 | 39.1 | 1071.5 | O K |
| 480 min Summer | 8.434 | 1.692 | 34.1 | 6.0 | 40.1 | 1105.8 | O K |
| 600 min Summer | 8.448 | 1.706 | 34.4 | 6.0 | 40.4 | 1118.3 | O K |
| 720 min Summer | 8.447 | 1.705 | 34.4 | 6.0 | 40.4 | 1117.2 | O K |
| 960 min Summer | 8.416 | 1.674 | 33.7 | 6.0 | 39.6 | 1090.1 | O K |
| 1440 min Summer | 8.312 | 1.570 | 31.2 | 5.8 | 37.0 | 999.2 | O K |
| 15 min Winter | 7.701 | 0.959 | 17.8 | 5.7 | 22.4 | 530.8 | O K |
| 30 min Winter | 7.957 | 1.215 | 23.3 | 5.7 | 28.4 | 713.4 | O K |
| 60 min Winter | 8.181 | 1.439 | 28.2 | 5.7 | 33.8 | 889.3 | O K |
| 120 min Winter | 8.396 | 1.654 | 33.2 | 5.9 | 39.1 | 1071.7 | O K |
| 180 min Winter | 8.504 | 1.762 | 35.8 | 6.1 | 41.9 | 1169.6 | O K |
| 240 min Winter | 8.566 | 1.824 | 37.3 | 6.2 | 43.5 | 1227.2 | O K |
| 360 min Winter | 8.640 | 1.898 | 39.1 | 6.3 | 45.4 | 1297.7 | O K |
| 480 min Winter | 8.677 | 1.935 | 40.0 | 6.4 | 46.4 | 1332.6 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 15 min Summer | 100.080 | 0.0 | 458.7 | 26 |
| 30 min Summer | 68.208 | 0.0 | 625.2 | 40 |
| 60 min Summer | 43.872 | 0.0 | 807.0 | 68 |
| 120 min Summer | 28.074 | 0.0 | 1032.8 | 124 |
| 180 min Summer | 21.656 | 0.0 | 1195.1 | 180 |
| 240 min Summer | 18.024 | 0.0 | 1326.2 | 210 |
| 360 min Summer | 13.906 | 0.0 | 1534.8 | 272 |
| 480 min Summer | 11.513 | 0.0 | 1694.1 | 340 |
| 600 min Summer | 9.884 | 0.0 | 1818.1 | 408 |
| 720 min Summer | 8.689 | 0.0 | 1917.8 | 478 |
| 960 min Summer | 7.018 | 0.0 | 2065.2 | 616 |
| 1440 min Summer | 5.090 | 0.0 | 2245.8 | 886 |
| 15 min Winter | 100.080 | 0.0 | 549.2 | 26 |
| 30 min Winter | 68.208 | 0.0 | 748.4 | 39 |
| 60 min Winter | 43.872 | 0.0 | 966.2 | 66 |
| 120 min Winter | 28.074 | 0.0 | 1236.5 | 122 |
| 180 min Winter | 21.656 | 0.0 | 1430.7 | 178 |
| 240 min Winter | 18.024 | 0.0 | 1587.7 | 230 |
| 360 min Winter | 13.906 | 0.0 | 1837.4 | 286 |
| 480 min Winter | 11.513 | 0.0 | 2028.1 | 362 |

| Atkins (Epsom) | | Page 2 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
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Summary of Results for 100 year Return Period (+20%)

| Storm Event | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max Σ Outflow (l/s) | Max Volume (m³) | Status |
|---|---|---|---|---|---|---|---|
| 600 min Winter | 8.683 | 1.941 | 40.1 | 6.4 | 46.5 | 1338.8 | O K |
| 720 min Winter | 8.672 | 1.930 | 39.8 | 6.4 | 46.2 | 1327.8 | O K |
| 960 min Winter | 8.618 | 1.876 | 38.5 | 6.3 | 44.8 | 1276.2 | O K |
| 1440 min Winter | 8.468 | 1.726 | 34.9 | 6.1 | 41.0 | 1136.2 | O K |

| Storm Event | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|---|---|---|---|---|
| 600 min Winter | 9.884 | 0.0 | 2176.6 | 440 |
| 720 min Winter | 8.689 | 0.0 | 2295.9 | 514 |
| 960 min Winter | 7.019 | 0.0 | 2472.4 | 662 |
| 1440 min Winter | 5.090 | 0.0 | 2688.5 | 946 |

| Atkins (Epsom) | | Page 3 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | |
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| Innovyze | Source Control 2019.1 | |

## Rainfall Details

| | |
|---|---|
| Rainfall Model | FEH |
| Return Period (years) | 100 |
| FEH Rainfall Version | 2013 |
| Site Location | GB 647450 264900 TM 47450 64900 |
| Data Type | Catchment |
| Summer Storms | Yes |
| Winter Storms | Yes |
| Cv (Summer) | 0.568 |
| Cv (Winter) | 0.680 |
| Shortest Storm (mins) | 15 |
| Longest Storm (mins) | 1440 |
| Climate Change % | +20 |

## Time Area Diagram

Total Area (ha) 3.239

| **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** | **Time From:** | **(mins) To:** | **Area (ha)** |
|---|---|---|---|---|---|---|---|---|
| 0 | 4 | 1.080 | 4 | 8 | 1.080 | 8 | 12 | 1.080 |

| Atkins (Epsom) | | Page 4 |
|---|---|---|
| Woodcoste Grove<br>Ashley Road, Epsom<br>Surrey, KT18 5BW | | Micro Drainage |
| Date 11/08/2021 14:07<br>File Abbey Road FEH13.SRCX | Designed by KPL<br>Checked by DH | |
| Innovyze | Source Control 2019.1 | |

## Model Details

Storage is Online Cover Level (m) 9.042

## Infiltration Basin Structure

Invert Level (m) 6.742 Safety Factor 1.5
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
Infiltration Coefficient Side (m/hr) 0.38160

| **Depth (m)** | **Area (m²)** | **Depth (m)** | **Area (m²)** |
|---|---|---|---|
| 0.000 | 438.3 | 2.000 | 996.6 |

## Hydro-Brake® Optimum Outflow Control

| | |
|---|---|
| Unit Reference | MD-SHE-0105-6500-2000-6500 |
| Design Head (m) | 2.000 |
| Design Flow (l/s) | 6.5 |
| Flush-Flo™ | Calculated |
| Objective | Minimise upstream storage |
| Application | Surface |
| Sump Available | Yes |
| Diameter (mm) | 105 |
| Invert Level (m) | 6.742 |
| Minimum Outlet Pipe Diameter (mm) | 150 |
| Suggested Manhole Diameter (mm) | 1200 |

| **Control Points** | **Head (m)** | **Flow (l/s)** |
|---|---|---|
| Design Point (Calculated) | 2.000 | 6.5 |
| Flush-Flo™ | 0.459 | 5.7 |
| Kick-Flo® | 0.937 | 4.6 |
| Mean Flow over Head Range | - | 5.3 |

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

| **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** | **Depth (m)** | **Flow (l/s)** |
|---|---|---|---|---|---|---|---|
| 0.100 | 3.5 | 1.200 | 5.1 | 3.000 | 7.9 | 7.000 | 11.7 |
| 0.200 | 5.1 | 1.400 | 5.5 | 3.500 | 8.4 | 7.500 | 12.1 |
| 0.300 | 5.5 | 1.600 | 5.8 | 4.000 | 9.0 | 8.000 | 12.5 |
| 0.400 | 5.7 | 1.800 | 6.2 | 4.500 | 9.5 | 8.500 | 12.9 |
| 0.500 | 5.7 | 2.000 | 6.5 | 5.000 | 10.0 | 9.000 | 13.2 |
| 0.600 | 5.6 | 2.200 | 6.8 | 5.500 | 10.5 | 9.500 | 13.6 |
| 0.800 | 5.3 | 2.400 | 7.1 | 6.000 | 10.9 | | |
| 1.000 | 4.7 | 2.600 | 7.3 | 6.500 | 11.3 | | |

# APPENDIX D: EMBEDDED FLOOD RISK MITIGATION MEASURES

## CONTENTS



## TABLES



## PLATES

# EXECUTIVE SUMMARY

NNB Generation Company (SZC) Limited (SZC Co.) submitted an application for a Development Consent Order (DCO) for the Sizewell C Project (the Project) to the Planning Inspectorate under the Planning Act 2008 in May 2020 (the Application). The Application was accepted for examination in June 2020.

As part of the flood risk assessment process, the Application includes the **Main Development Site Flood Risk Assessment** (Doc Ref. 5.2) [APP-093] and the subsequent **Main Development Site Flood Risk Assessment (MDS FRA) Addendum** (Doc Ref. 5.2(A)Ad) [AS-157], considering all sources of flood risk.

The assessment of the change in flood risk from all sources of flooding showed a clear but limited impact on flood risk as a result of the Project. As such it was acknowledged that there was a requirement, in line with the policies set out in the Overarching National Policy Statement (NPS) for Energy (EN-1) (Ref. 1) and National Policy Statement for Nuclear Power (EN-6) (Ref. 2), to minimise flood risk impact and to set out measures to mitigate the risk of flooding that may result from the development.

This report sets out the iterative approach used in the identification, review, adoption and optimisation of appropriate mitigation measures which have been embedded within the design of the Project.

It demonstrates the approach taken to the identification and development of an appropriate flood mitigation area as well as the development and optimisation of the SSSI crossing design.

SZC Co. undertook a thorough review of potential locations for the provision of a flood mitigation area, based on their proximity to the main development site and hydraulic connectivity to both the watercourse and existing floodplain. This review identified nine potential locations. Each of these locations was evaluated based on a number of factors including existing topography, environmental sensitivities such as protected areas / habitats and the presence of overground or buried services / utilities.

Of the nine potential locations, six were found to be unsuitable on the basis of either environmental sensitivities / designations or constructability constraints. Additionally, one location was discounted as it is already required as a mitigation measure for the works to be carried out as part of the Sizewell B relocated facilities. However, two locations were considered appropriate for both the provision of flood storage, as well as permanent wetland habitat.

The assessment identified that by combining the two areas together this would provide the greatest benefits in terms of storage area and connectivity to the floodplain. Therefore, these two areas were taken forward as a single mitigation area, as the only viable locations for providing flood storage.

Further to the above, SZC Co. also carried out a process of reviewing and optimising the design of the SSSI crossing. This included assessing the use of flood relief culverts within the embankments compared with the provision of a single span bridge option, adoption of the single span bridge option and refinement of the span width and bridge opening / soffit levels.

SZC Co. has concluded that the current design iteration of the SSSI crossing, submitted for approval at Deadline 8, has sought to minimise the impact of the Project on flood risk and that the design has been optimised hydraulically such that no further significant hydraulic efficiency gains can be achieved through further iteration of the design.

The two mitigation measures identified above have subsequently been embedded into the design of the Project.

SZC Co. believes that all potential mitigation options have been adequately considered as part of the assessment.

Taking into account the limited changes in flood depth and extent as a result of the Project, SZC Co. has concluded that through the process of iterative design the mitigation measures described in this report and embedded into the Project design provide appropriate flood risk mitigation to an acceptable level to satisfy the national policy requirements set out in EN-1 paragraph 5.7.17 and EN-6 paragraph 3.6.16 and limit the off-site impacts of the Project such that no further measures are required.

# 1 INTRODUCTION

1.1.1 NNB Generation Company (SZC) Limited (SZC Co.) submitted an application for a Development Consent Order (DCO) for the Sizewell C Project (the Project) to the Planning Inspectorate under the Planning Act 2008 in May 2020 (the Application). The Application was accepted for examination in June 2020.

1.1.2 As outlined in the **Main Development Site Flood Risk Assessment (MDS)** (Doc Ref. 5.2) [APP-093], the Project requires the construction of a site platform in an area of flood risk. The construction of the main platform and the SSSI crossing involves raising the ground levels within areas at potential risk of fluvial and coastal (inundation and tidal breach) flooding that will result in a slight reduction in the currently available flood storage.

1.1.3 The assessment of the change in flood risk from all sources of flooding presented in the Application (**MDS FRA** (Doc Ref. 5.2) [APP-093] and the subsequent **Main Development Site Flood Risk Assessment (MDS FRA) Addendum** (Doc Ref. 5.2(A)Ad) [AS-157]) showed a clear but limited impact on flood risk as a result of the Project, although the extent to which the change will be as a result of the restriction posed by the crossing (embankment with a culvert) or loss of a portion of the floodplain (main platform area) had not been determined.

1.1.4 The MDS FRA and its addendum also indicated where there would be a potential flood risk impact to off-site receptors, for example, residential and non-residential properties, areas of land in the ownership of local stakeholders and sensitive, designated ecological habitats.

1.1.5 A thorough review of flood risk impacts within the context of the design of the Project has been undertaken and demonstrated within this report.

1.1.6 The purpose of this report is to show that the Project has met the requirements of the Overarching National Policy Statement (NPS) for Energy (EN-1) (Ref. 1) and National Policy Statement for Nuclear Power (EN-6) (Ref. 2) in demonstrating that the Application is supported by an appropriate FRA, which has considered flood risk both to and from the Project.

1.1.7 It demonstrates that the Project is in accordance with EN-1 paragraph 5.7.17 and NPS EN-6 paragraph 3.6.16, such that where there is an increase in flood risk which cannot be avoided or wholly mitigated, the increase in present and future flood risk can be mitigated to an acceptable level.

1.1.8 The mitigation measures identified during the development of the Project, and set out in this report, comprise improvements to the design and provision of flood storage. These are embedded into the Project, such that whilst the increase in offsite flood risk cannot be avoided or wholly mitigated, it demonstrates that it can be mitigated to an acceptable level.

# 2 LEGISLATION AND POLICY

2.1.1 This section briefly summarises the national policy relevant to the flood risk mitigation measures for the Project. The following two policies are considered to be of greatest relevance:

- Overarching National Policy Statement (NPS) for Energy EN-1 (Ref. 1); and
- National Policy Statement for Nuclear Power (EN-6) (Ref. 2).

## 2.2 Overarching National Policy Statement (NPS) for Energy (EN-1)

2.2.1 NPS EN-1 (Ref. 1) was published in July 2011. It contains a section within the Part 5 Generic Impacts on flood risk (Part 5.7) which is based on definitions of flood zones and other flood risk information as presented in Planning Policy Statement 25 for Development and Flood Risk, which was relevant at the time.

2.2.2 NPS EN-1 Part 5.7 sets out the minimum requirements for a Flood Risk Assessment, guidance on the application of the Sequential Test and Exception Test and mitigation measures applicable to a site including Sustainable Drainage Systems.

2.2.3 NPS EN-1 Part 5.7 provides guidance in relation to the siting of a development and impact on flood risk, noting in paragraph 5.7.17 that:

> *"Exceptionally, where an increase in flood risk elsewhere cannot be avoided or wholly mitigated, the IPC may grant consent if it is satisfied that the increase in present and future flood risk can be mitigated to an acceptable level and taking account of the benefits of, including the need for, nationally significant energy infrastructure as set out in Part 3 above…"*

2.2.4 The nature of the existing flood risk at the Sizewell C site is variable and as such, whilst part of the Project is located in Flood Zones 1 and 2, some parts are also located in Flood Zone 3. With this in mind, the assessment of the Project took account of the guidance provided in NPS EN-1 paragraph 5.7.24 as follows:

> *"Essential energy infrastructure which has to be located in flood risk areas should be designed to remain operational when floods occur. In addition, any energy projects proposed in Flood Zone 3b the Functional Floodplain (where water has to flow or be stored in times of flood)… should only be permitted if the development will not result in a net loss of floodplain storage, and will not impede water flows."*

2.2.5 It is within the context of paragraphs 5.7.17 and 5.7.24 that the findings of the **MDS FRA** (Doc Ref. 5.2) [APP-093] and the subsequent **MDS FRA Addendum** (Doc Ref. 5.2(A)Ad) [AS-157] have been reviewed.

2.2.6 With specific regard to paragraph 5.7.17, i.e. minimising the flood risk impact as a result of the Project, a thorough approach to the review of appropriate mitigation measures was undertaken. The mitigation measures have been subsequently embedded within the design of the Project, as set out in this report.

## 2.3 National Policy Statement for Nuclear Power (NPS EN-6)

2.3.1 Further to the policy related to flood risk set out in NPS EN-1, there is also reference to flood risk within NPS EN-6 Part 3 Impacts and general siting considerations, Section 3.6 Nuclear Impact: flood risk (Ref. 2).

2.3.2 NPS EN-6 paragraph 3.4.1 notes that:

> *"In certain cases, the text in this Part amends the application of policy in EN-1 for this NPS, for example see Section 3.6 (flood risk)."*

2.3.3 The policy set out within Section 3.6 notes at paragraph 3.6.1 that:

> *"Generic flood risk impacts of new energy NSIPs are covered in Section 5.7 of EN-1. In addition, policy specific to new nuclear power stations is set out below. It should be noted that the policy set out in Section 5.7 of EN-1 is relevant to applications for new nuclear power stations with the exception of the application of the Sequential Test and Exception Test."*

2.3.4 NPS EN-6 provides clarification on the likely need for nuclear power stations to be located adjacent to coastal or estuarine sites and confirms that the Sequential Test has been carried out by the Government as a separate assessment. It notes that a sequential approach to locating development within a site is still required and that some elements of the Exception Test remain valid.

2.3.5 In accordance with elements of the Exception Test, NPS EN-6 paragraphs 3.6.15 and 3.6.16 are of specific note as follows:

> *"Based on the advice of the relevant Nuclear Regulators, the IPC should be satisfied that the applicant is able to demonstrate suitable flood risk mitigation measures. These mitigation measures should take account of the potential effects of the credible maximum scenario in the most recent marine and coastal flood projections. Applicants should demonstrate that future adaptation/flood mitigation would be achievable at the site, after any power station is built, to allow for any future credible predictions that might arise during the life of the station and the interim spent fuel stores.*
>
> *Applicants should set out measures to mitigate the risk of flooding on or from individual sites that may result from the development, including any associated infrastructure such as possible marine landing jetties/docks. For further information on mitigation measures see Section 5.7 of EN-1."*

2.3.6 Therefore, it is within the policy context of NPS EN-6 paragraph 3.6.16, alongside NPS EN-1 paragraph 5.7.17, that a review of appropriate mitigation measures was undertaken. The mitigation measures have been subsequently embedded within the design of the Project, as set out in this report.

# 3 APPLICATION DESIGN

3.1.1 The Application does not apply for the SSSI Crossing in detail and a parameters based approach was proposed in May 2020, which inlcuded:

- A zone was defined within which the SSSI Crossing must be built (**Parameter Zone 1E. Main Development Site Operational Parameter Plans**) [APP-018].
- Minimum and maximum heights for the finished ground level of the SSSI Crossing were specified (7.3m AOD to 10.5m AOD) (Table 2.3 of **ES Volume 2, Chapter 2, Description of Permanent Development**) [APP-180];

- A description of the SSSI Crossing during the construction stage (Paragraphs 3.4.35 – 3.4.38 of **ES Volume 2 Main Development Site, Chapter 3, Description of Construction**) [APP-185].
- An indicative visualisation of the SSSI Crossing (Figure 2.11 of ES Volume 2, Chapter 2 Figures) [APP-183].
- An indicative cross-section of the SSSI Crossing, showing an 8m wide and 3.5m tall culvert above ditch level (Figure 2.11 of ES Volume 2, Chapter 2 Figures) [APP-186]. The carriageway is shown at 7.3m AOD.

3.1.2 These matters were presented in section 8.3b of the **MDS FRA** (Doc Ref. 5.2) [APP-093] (epage 152).

3.1.3 In **section 11** of the **MDS FRA** (Doc Ref. 5.2) [APP-093] (epage 179) it was reported that the Project would result in a change in the maximum flood levels of up to 0.02m for the fluvial flood events. For the coastal inundation and tidal breach events the reported maximum increase in flood levels was up to 0.07m for some properties and the majority of the catchment area, and up to 0.3m for a limited area near the main development platform and the SSSI crossing (near Tank Traps).

3.1.4 In its Relevant Representation on the Application, [RR-0373] (epage 3), the Environment Agency provided comment on its concerns relating to the increased flood risk, stating:

> *"[…] The current Flood Risk Assessment (FRA) identifies increased flooding to properties without identifying appropriate mitigation […] In terms of the objectives of an FRA, this is an unacceptable conclusion. "*

3.1.5 Further to the above Relevant Representation, the Environment Agency also provided comment in its Written Representation at Deadline 2 (dated 2nd June 2021) [REP2-135] (epage 6), on its concerns relating to increased flood risk and mitigation measures, stating:

> *"In the design tidal 0.5% (1 in 200) annual probability flood event in 2090, the development would result in one residential and two commercial properties experiencing an increase in flood depth of 0.02m, although they are already at risk of flooding to approximately 0.5m in this event. The very small increase in flood depths and no change in flood hazard or numbers of properties flooded could potentially be considered insignificant and not requiring any further mitigation, beyond the enlarged*

*SSSI crossing and flood storage area now proposed. National Policy Statement for Energy (EN-1) Paragraph 5.7.17 allows an increase in flood risk elsewhere if it cannot be avoided or wholly mitigated, and if it can be mitigated to an acceptable level.*

*The modelling shows that there is an increase to third party land at tank traps by up to 0.24m depth in the design tidal 0.5% (1 in 200) annual probability flood event in 2090. The affected area appears to be approximately 130,000m². The land is already at risk of flooding by over a metre in this flood event. NNBGenCo (SzC) Ltd intends to mitigate this increased flood risk by securing landowner consent. This has presently not been achieved."*

3.1.6 Following the Application submission, SZC Co. continued to develop the detail of its proposals for the implementation of the Project and undertook further environmental assessment work in response to the continued engagement with stakeholders aimed at addressing their comments and concerns.

# 4 DESIGN CHANGES

## 4.1 Introduction

4.1.1 The SSSI crossing provides an essential pedestrian and vehicular connection across the Sizewell Marshes SSSI, linking the main platform with the temporary construction area and the new permanent access road.

4.1.2 It was assumed for the purposes of assessment that the design of the SSSI crossing within the Application submitted in May 2020 comprised an 8m wide portal culvert with soffit level at 3.5m AOD, as presented in section 8.3b of the **MDS FRA** (Doc Ref. 5.2) [APP-093] (epage 152).

4.1.3 It was assessed within the hydraulic modelling and indicatively designed to provide sufficient capacity to convey extreme fluvial flows, however the embankments occupied a significant portion of the existing floodplain.

4.1.4 This was perceived by stakeholders as posing not only an increased flood risk but concerns were expressed that there were also likely to be impacts on ecology, on the basis that the culvert and embankment option could limit the upstream and downstream migration of numerous species (principally polarotactic invertebrates).

4.1.5 In its Relevant Representation [RR-0373] (epage 11) the Environment Agency stated:

> *"The choice of a culvert is contrary to Environment Agency expectations that watercourses should be crossed by means other than culverts wherever a practical and viable alternative may exist, due to the flood risk implications that culverts present and the overwhelming evidence that they cause harm to the delicate balance of ecosystems that reside within, and along, the watercourse into which the culvert may be placed."*

4.1.6 Additionally, as discussed in paragraphs 3.1.4 and 3.1.5 of **section 3**, the Environment Agency raised comments with regard to the increase in flood risk to off-site receptors as a result of the Project and that there was insufficient evidence of appropriate mitigation.

## 4.2 Summary of Design Changes

4.2.1 The preceding **section 3** provided a brief summary of the design proposed in the Application and the impacts on flood risk as a result of the Project.

4.2.2 Following feedback from stakeholders and to further develop the design proposals, SZC Co. assessed a number of potential mitigation measures to reduce the flood risk and environmental impacts posed by the SSSI crossing as well as offset flood risk impacts of the platform. An interim internal option for the crossing design incorporating flood relief culverts was considered, and is further discussed in **section 4.3**.

4.2.3 The interim option was then superseded by Change 5 (relocation of the water resource storage area and provision of a flood mitigation area) and Change 6 (revision of the SSSI crossing design).

4.2.4 The changes are described in **Chapter 2** of **Volume 1** of the **ES Addendum** Doc. Ref. 6.14(Ad)) [AS-181] (epage 59), submitted to the Planning Inspectorate in January 2021 and accepted for examination in April 2021.

4.2.5 In line with NPS EN-1 paragraph 5.7.17 and NPS EN-6 paragraph 3.6.16, these changes formed the embedded mitigation measures to reduce the flood risk impacts to off-site receptors, as a result of the Project, and are discussed in **section 4.4** and **section 4.4**, respectively.

4.2.6 These mitigation measures were referred to by the Environment Agency in its Written Representation at Deadline 2 (dated 2$^{nd}$ June 2021) [REP2-135] (epage 6).

4.2.7 The following sections present details of the staged approach adopted in identifying potential mitigation options. By adopting an iterative approach to optimising the design of the embedded mitigation measures this has ensured the development of the most suitable mitigation measures to satisfy the requirements of the policies in NPS EN-1 and NPS EN-6.

## 4.3 Flood Relief Culverts (Interim Crossing Design)

4.3.1 To reduce the potential constriction at the SSSI crossing and therefore reduce the flood risk impacts identified in paragraph 3.1.3 in **section 3**, an iterative approach to the mitigation was explored in the form of testing a series of flood relief culverts through the embankment.

4.3.2 Within the assessment the number and the size of the flood relief culverts was considered to optimise the provision of the largest plausible box culvert, compared with the delivery and constructability constraints. This resulted in the identification of a 5.4m wide and 3m high culvert (measured from top of bank) as the optimal size.

4.3.3 During the assessment the culverts were placed within the floodplain with the invert level set at the corresponding ground levels. They were then assessed in pairs, with at least one flood relief culvert on each side of the main SSSI crossing culvert.

4.3.4 To determine the potential reduction in flood risk impacts associated with incorporating additional flood relief culverts into the design, a series of hydraulic modelling exercises were carried out for the fluvial, coastal and tidal breach flood risk assessment.

### a) Fluvial flood risk

4.3.5 The fluvial model was run for the 1 in 100-year return period event with 35% climate change allowance. Initially two flood relief culverts were considered but it was found they would have minimal effect in further reducing flood risk and therefore four culverts were also tested (two on each side of the main SSSI crossing culvert). These were represented in the 1D model domain following the same model schematisation as that adopted for the main SSSI crossing culvert.

4.3.6 The results of the modelling showed that there is no discernible reduction in flood risk impacts from the addition of either two or four flood relief culverts in mitigating the change to the fluvial flood risk as a result of the Project. It was concluded that this is due to the fact that the size of the proposed main SSSI crossing culvert itself would be sufficient to convey the flows resulting from high fluvial flow events with allowance for climate change (i.e. the peak water levels do not reach the soffit and the culvert is not surcharged).

4.3.7 In addition, the flooding mechanism is impacted by the Minsmere Sluice structure, which controls the discharge from the Leiston Drain and as a result acts like an attenuation basin. This leads to water levels reaching equilibrium on both sides of the SSSI crossing despite some constriction on the floodplain by the SSSI crossing embankments.

4.3.8 The overall conclusion of this assessment was that the provision of flood relief culverts would not mitigate the slight increase (mostly 0.01m with a localised increase of up to 0.02m) in fluvial flood risk as a result of the Project. It was concluded, therefore that the loss of floodplain within the main platform area is the driving factor for any potential fluvial impact on flood risk.

4.3.9 This was confirmed by additional sensitivity testing, where a scenario with the main platform in place but without the SSSI crossing was simulated in the fluvial hydraulic model. The results showed that the relative impact on the change in flood risk was similar (0.01m change in flood levels) to that reported with both the main platform and SSSI crossing in place.

4.3.10 Therefore, it was concluded that the flood relief culverts would not provide an appropriate mitigation for the fluvial flood risk impacts and on the basis of fluvial flood risk they should not be progressed further within the design of the embedded mitigation measures for the Project. They were not submitted into the application accordingly.

### b) Coastal inundation and tidal breach

4.3.11 A further assessment of the requirement for flood relief culverts in the context of the coastal inundation and tidal breach models was carried out for the 1 in 1,000-year return period event at 2030 epoch. This scenario was chosen as it was identified in the Application as having the greatest impact on overall change in flood levels.

4.3.12 As there is a greater flood risk associated with coastal inundation and tidal breach, the relative reduction in flood risk impacts of sets of two, four and six flood relief culverts were assessed for this event. However, it was found that the relative change in flood levels between the scenario with four and six flood relief culverts was insignificant, i.e. change in peak flood levels between the two scenarios was less than 0.01m. On this basis, it was concluded that there was no additional reduction in flood risk impacts from incorporating six or more culverts in reducing the relative change in flood risk to properties, land and environmentally sensitive areas. Therefore, it was decided to carry out further testing with four flood relief culverts for the 1 in 1,000-year return period event at the 2030 and 2090 epochs.

4.3.13 Overall, the results of this testing showed that the flood relief culverts help to reduce the change in flood levels between the 'With Scheme' and 'Baseline' scenarios. However, the additional culverts have the most impact (and provide the most reduction in flood risk impacts) in the scenarios with overall lower flood levels, i.e. during the earlier epochs. In the coastal inundation model, the flood relief culverts reduced the impact on peak flood level from 0.1m to 0.06m in the Minsmere South area, whereas in the tidal breach scenario the flood relief culverts reduced the impact from 0.31m to 0.22m in a localised area near the Tank Traps.

4.3.14 Overall, the flood relief culverts would mitigate some of the localised impacts of the Project on coastal and tidal breach flood risk to the off-site receptors, however the change would not be eliminated, and the further reduction in flood risk impacts would be relatively small compared with the overall impact on the Project, in terms of environmental, engineering and cost implications.

4.3.15 In conclusion, the provision of the additional flood relief culverts would have limited contribution in mitigating the flood risk impacts of the Project and would have the same adverse impacts on flood risk and wider environmental receptors as the design presented in the Application. On this basis it was concluded that flood relief culverts would not be progressed further within the design of the embedded mitigation measures for the Project. Therefore, other mitigation measures were considered, as discussed below.

## 4.4 Flood Mitigation Area (Change 5)

### a) Introduction

4.4.1 Paragraph 4.2.3 in **section 4.1** summarised the embedded mitigation measures for the Project, i.e. design of the proposed SSSI crossing and provision of a flood mitigation area for flood storage to further reduce the potential impact of the Project on flood risk.

4.4.2 As part of Change 5 (flood mitigation area) it was identified that the area proposed for a temporary non-potable water storage area was no longer required.

4.4.3 A discussion on the iterative approach adopted in the selection of suitable sites for the flood mitigation area is presented in the following **section 4.4b)** whilst **section 5** presents the flood risk impacts with the combined embedded mitigation measures submitted as part of the January 2021 submission.

### b) Site selection

4.4.4 A staged approach to the selection of potential flood storage / mitigation sites was undertaken. The initial sites selected for further consideration were sought based on the following characteristics:

- A location along the same watercourse as that of the lost floodplain, to prioritise the provision of flood storage within the same catchment;
- A location adjacent to the existing floodplain, so that water can readily access the storage site in the event of flooding; and
- A location within or adjacent to the main development site to provide mitigation as close to the area of floodplain loss as possible.

4.4.5 A review of each of the potential sites was undertaken to identify sensitive sites to be rejected, taking into account the following:

- Existing topography, favouring low-level areas to manage construction in a sustainable manner (i.e. less ground excavation required and less disruption to surrounding habitats);
- Environmental sensitivities such as protected areas and habitats; and
- Overground and buried utilities / services.

4.4.6 The above criteria were applied in the assessment of the potential sites and used to derive a shortlist of the most suitable flood storage mitigation sites to be taken forward within the assessment.

4.4.7 The site selection process aimed to find an area that would maximise the provision of flood storage area as close as possible to the area of floodplain loss (i.e. as close to the main platform and SSSI crossing as possible).

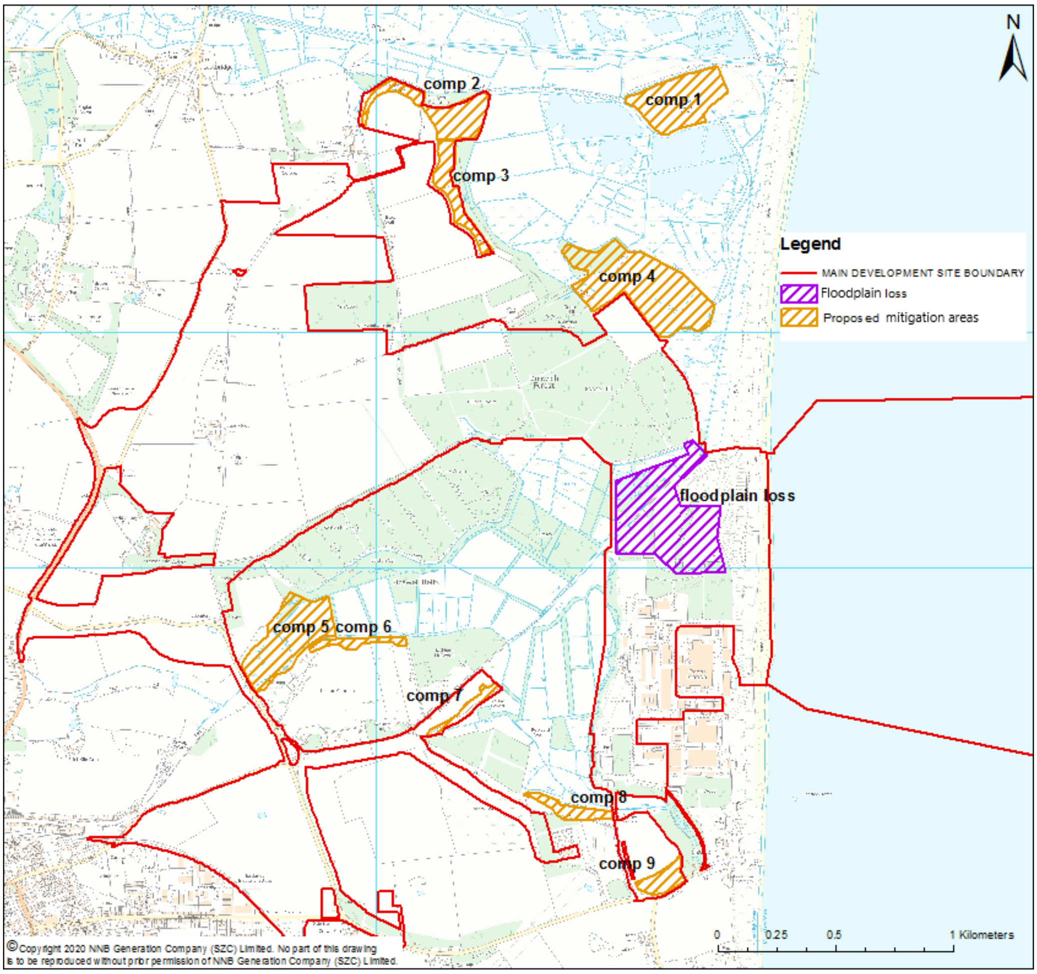
4.4.8 The area required was determined based on the flood extent of the 1 in 100-year event with 35% climate change allowance that is located within the development footprint.

#### i. Initial identification of potential locations

4.4.9 As the first step, initial potential flood storage areas were sought within the vicinity of the proposed main development platform; however, none were available immediately adjacent to the site. The search for viable locations was then extended into the wider catchment along the affected watercourse but further away from the main development platform.

4.4.10 The search considered available arable and pastureland both downstream and upstream of the proposed main development site, focusing on areas that were connected to the existing floodplain providing the potential to fill and drain freely subject to altering the existing ground levels. The nine potential areas initially identified for consideration are shown in **Plate 4.1**.

**Plate 4.1: Initial identification of the potential flood storage mitigation areas for the main development site (as at 2020)**

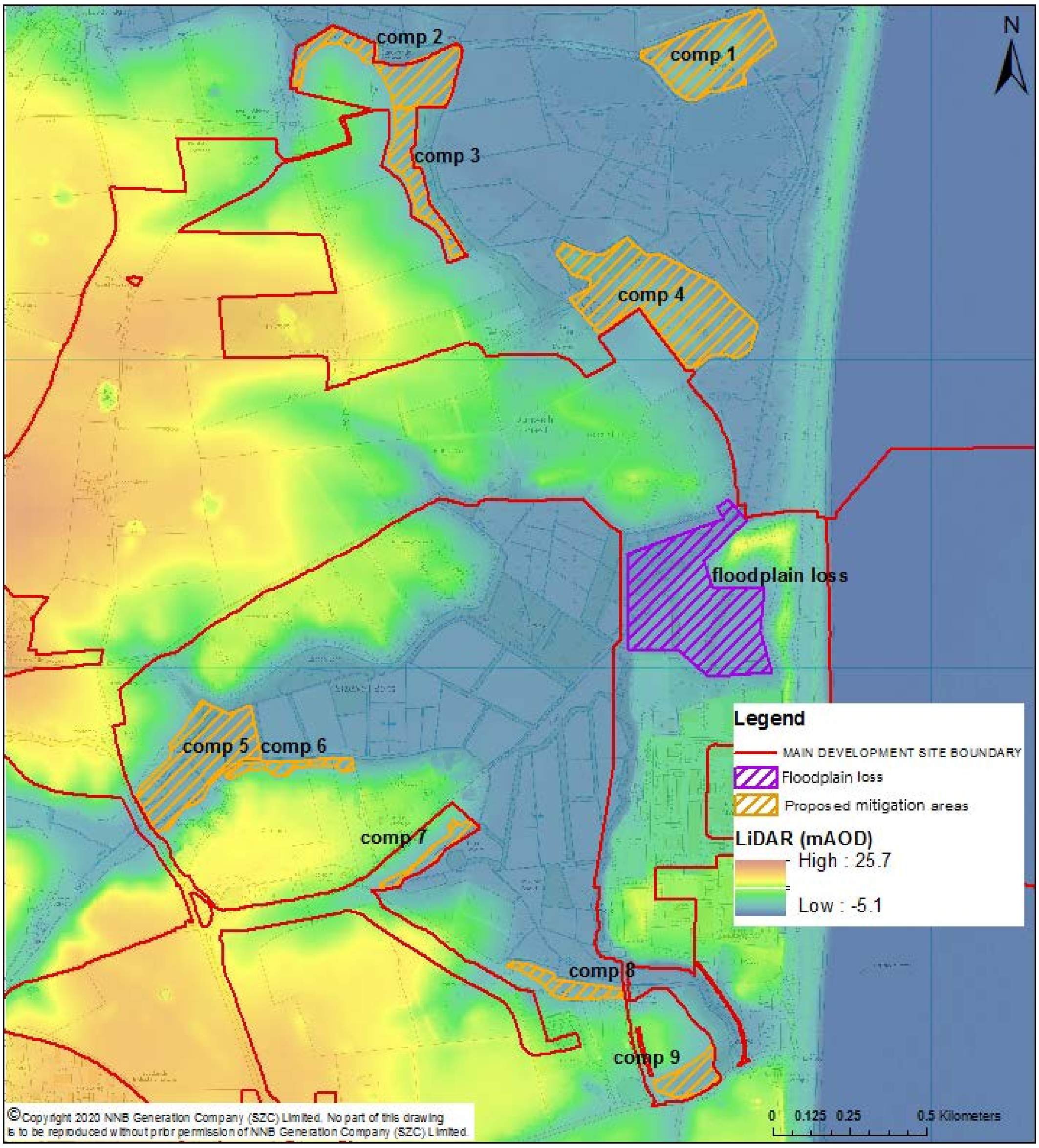



4.4.11 The nine potential locations were considered for their appropriateness based on topography and environmental constraints.

4.4.12 The assessment of the geometry aimed to evaluate the amount of earth movement likely to be required as well as the available access to the working area to undertake the construction of the flood storage mitigation. There was a focus on ground level elevations between 1mAOD and

3mAOD (**Plate 4.2**). This approach was adopted to minimise the overburden requiring removal which could cause disruption to the surrounding areas.

**Plate 4.2: Initial identification of the nine potential flood storage mitigation areas with topography range from 1mAOD to 3mAOD (as at 2020)**




4.4.13 The potential mitigation sites were then evaluated based on their suitability considering the storage area they would provide and any environmental constraints and constructability issues. The list of the initial sites and justification for their selection or exclusion is provided in **Table 4.1**.

**Table 4.1: Review of potential flood storage mitigation areas**

| Flood Mitigation Area | Initial Area ($m^2$) | Environmental Constraints | Constructability Issues | Selection Status |
|---|---|---|---|---|
| 1 | 69,983 | Located in the Minsmere to Walberswick SSSI. | Isolated location would make it difficult to access. | Exclude |
| 2 | 47,971 | Not located in a designated site. Contains some woodland areas important for bat foraging. | - | Retain |
| 3 | 68,941 | Not located in a designated site. Contains some woodland areas important for bat foraging. | - | Retain |
| 4 | 135,948 | Approximately half of the site is located in the Minsmere to Walberswick SSSI and also in SAC, SPA and Ramsar. | - | Exclude |
| 5 | 79,838 | Located in Sizewell Marshes SSSI. | - | Exclude |
| 6 | 11,554 | Located in Leiston Common County Wildlife Site. | The existing elevation would require significant changes in ground levels. | Exclude |
| 7 | 16,533 | Not located in a designated site. Located in a planned mitigation area for alternative bat roosts. | The area is relatively narrow with steeply rising ground levels and therefore would require significant changes in ground levels. | Exclude |
| 8 | 15,692 | Located in Sizewell Marshes SSSI. | - | Exclude |
| 9 | 16,640 | Not located in a designated site. There is a known overlap with the landscaping area which is required as a separate mitigation measure for the Sizewell B Relocated Facilities. | Located within Pillbox Field where there are existing piped services. | Exclude |

4.4.14 As shown in **Table 4.1**, the majority of the potential sites identified in the initial section have either environmental or constructability constraints or both. Additionally, areas 6 - 9 would provide very limited mitigation due their relatively small size. Furthermore, area 9 has been discounted as it is required as a mitigation measure for the works to be carried out as part of the Sizewell B relocated facilities. Based on the evaluation it was found that the most suitable and only viable areas for flood storage are mitigation area 2 and / or mitigation area 3.

#### ii. Shortlisted locations

4.4.15 Further investigation of the two most viable flood storage mitigation areas (highlighted in **Table 4.1**) was undertaken. Both sites had some environmental constraints which required further consideration.

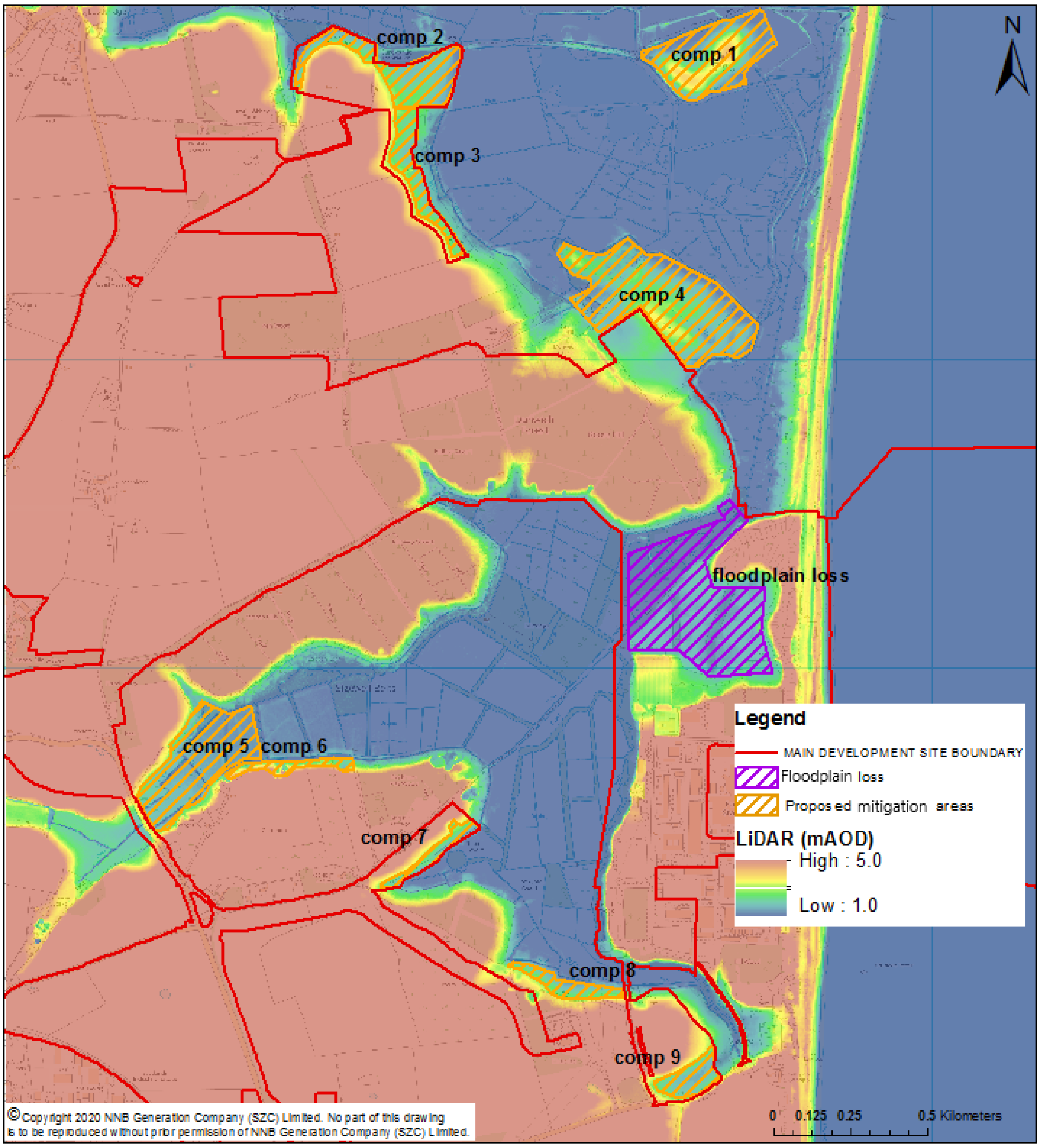
4.4.16 Both mitigation areas 2 and 3 contain woodland areas which are important for bat foraging. Currently, the woodland areas provide a number of existing bat roosts and support approximately half of the bat boxes already erected as alternative roost sites in accordance with the Project bat mitigation strategy for roost loss. In addition, the woodland area is likely to be an important bat commuting route north/south during the construction phase of the main development site. These aspects are discussed further in the **Terrestrial Ecology Monitoring and Mitigation Plan** Revision 3.0 (Doc. Ref. 9.4(B)).

4.4.17 The assessment of the storage areas available in these locations indicated that by combining areas 2 and 3 this would provide the greatest benefits in terms of storage area and connectivity to the floodplain. Therefore, these two areas were taken forward as a single mitigation area.

4.4.18 The further potential to extend the mitigation area to the west of the existing woodland has been considered. This would avoid disturbing the woodland although it would involve working adjacent to the woodland.

4.4.19 To assess the potential expansion of the area, the topography range upper limit was extended from 3mAOD to 5mAOD. This resulted in a relatively narrow band of additional land (**Plate 4.3**) as the ground levels rise steeply and therefore provide very limited opportunity for additional area as well as requiring significant excavation works. Furthermore, the steepening of the side slopes was considered to be inconsistent with the natural landscape form. Consequently, the additional extent was not progressed as part of the design.

**Plate 4.3: Initial identification of the nine potential flood storage mitigation areas with topography range from 1mAOD to 5mAOD (as at 2020)**

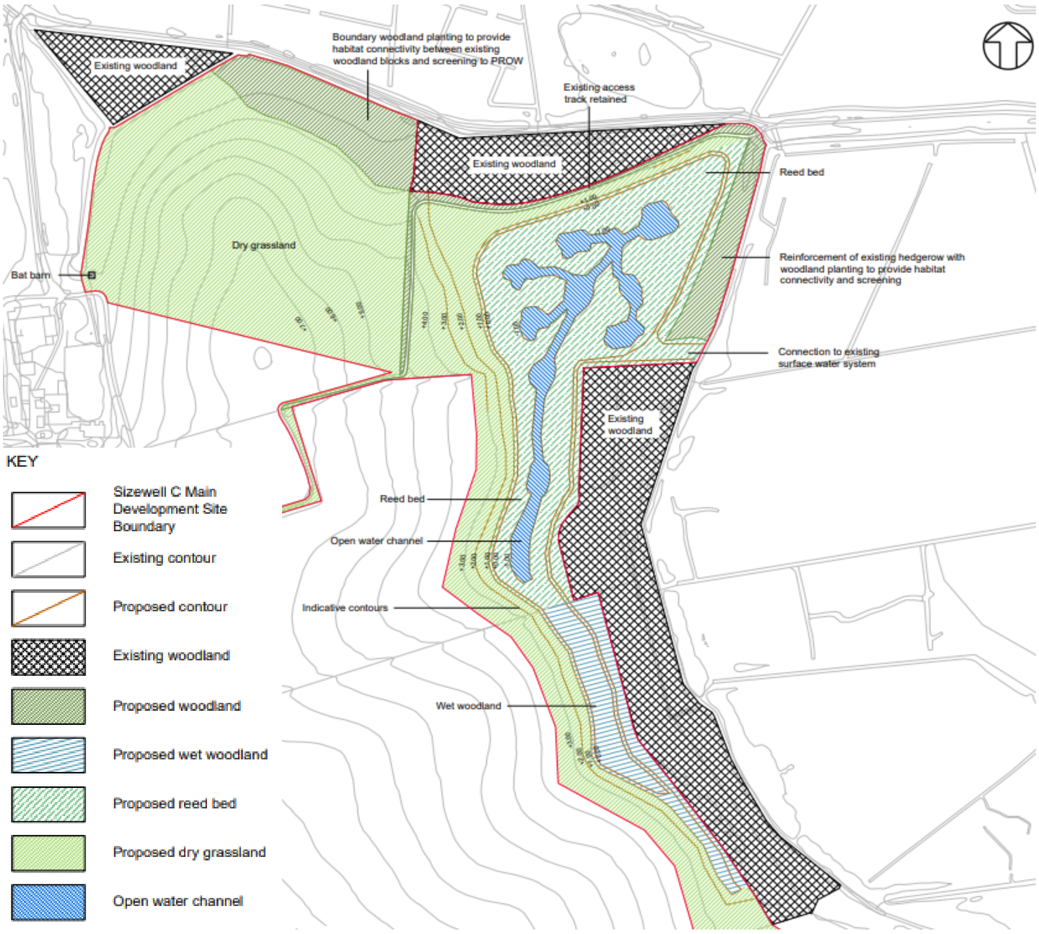



4.4.20 The opportunity to provide not only a flood storage mitigation area but also a 'wet woodland' habitat was considered within the identified areas. The combined areas 2 and 3 were found to be suitable for the provision of permanent wetland habitat. The wetland habitats would be open water channels and wet reedbeds to provide high quality foraging habitats for marsh harriers.

4.4.21 In the Application as submitted in May 2020, the combined areas 2 and 3 were allocated as a water storage resource area, for the storage of potable water during the construction phase. However, changes to the design for the January 2021 submission meant that the water resource storage area was relocated outside of the floodplain, thereby opening up this area to other potential uses. On this basis the combined areas 2 and 3 were reviewed for their suitability as flood and habitat mitigation area instead.

4.4.22 Furthermore, the combined flood mitigation area would be linked to the proposed permanent wetland habitat corridor immediately to the south to create a single integrated wetland feature, as illustrated in **Plate 4.4**.

**Plate 4.4: Proposed habitat and flood mitigation area (extract from Figure 2.2.14 of Chapter 2 of Volume 2 of the ES Addendum (Doc Ref. 6.14) [AS-190])**




4.4.23 Following the site selection assessment, it was concluded that, despite some constraints, the combined mitigation areas 2 and 3 remained the most suitable locations to provide flood storage. Limited flood storage benefit of the other potential areas would not justify the environmental constraints and constructability issues. As such, it was concluded that the combined mitigation areas 2 and 3 are the best option for flood storage. These were therefore proposed as one mitigation area embedded into the design submitted (Change 5) in January 2021, as discussed further in **section 5**.

## 4.5 Single span bridge (Change 6)

4.5.1 Following on from the interim crossing design option discussed in **section 4.3**, to address the concerns raised by the Environment Agency on the Application (summarised in **section 4.1**) and to provide appropriate mitigation, SZC Co. proposed changing the indicative design of the SSSI crossing structure as explained in the January 2021 submission (**Chapter 2** of **Volume 1** of the **ES Addendum** Doc. Ref. 6.14(Ad)) [AS-181] (epage 61).

4.5.2 SZC Co. has adopted an iterative approach, whereby the revised indicative design for the SSSI crossing has been refined such that it comprises an approximately 30m wide single span bridge with separate embankments at either end of the SSSI crossing. By adopting this approach, it was concluded that the Project will provide additional flood relief and ecological connectivity, with less SSSI land-take (a reduction of approximately 450m$^2$), compared with the design presented in the May 2020 Application.

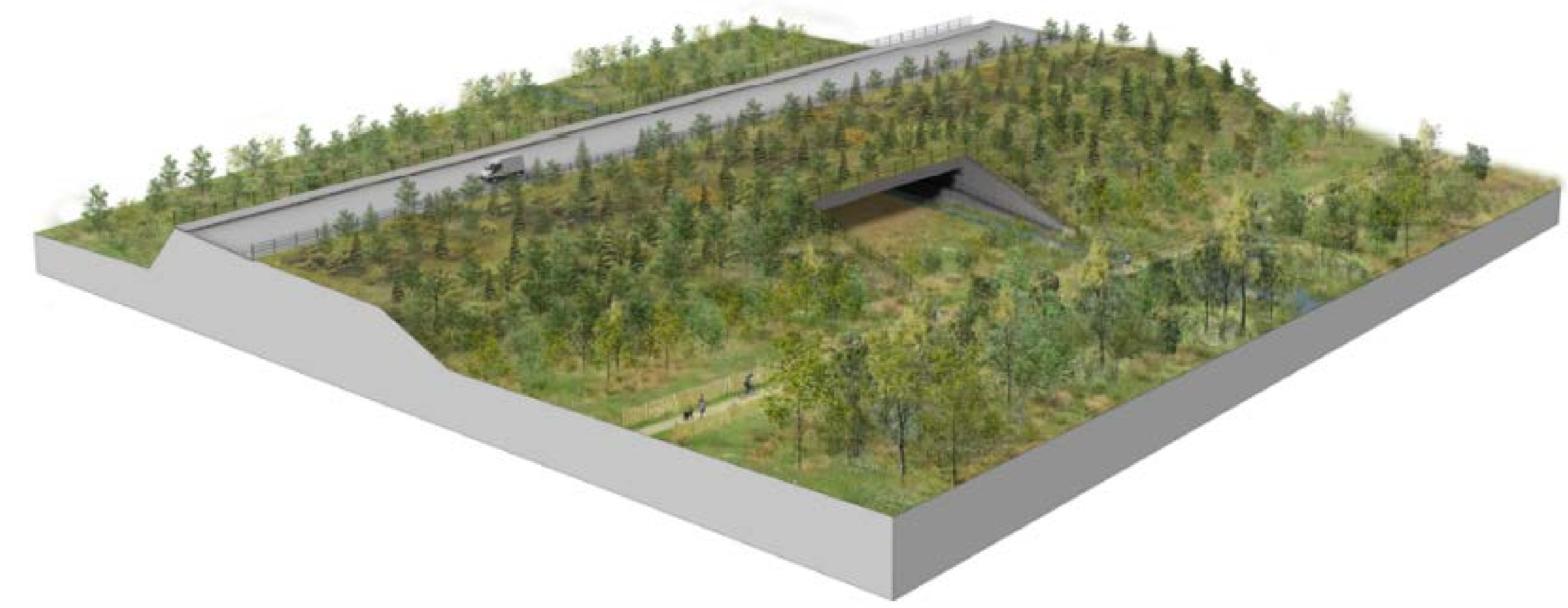
4.5.3 Sheet pile barriers would be installed to separate the existing ground around the Leiston Drain channel and floodplain from the crossing embankments, giving an approximately 24m wide aperture which would contain the channel and floodplain. A ledge would also be installed to enable passage by otters, and artificial bat roosts would be included either within or on the bridge abutments. A visualisation showing the SSSI crossing is shown in **Plate 4.5**.

4.5.4 Together with the flood mitigation area (discussed in the following **section 4.4**), the revised crossing design forms part of the embedded mitigation measures introduced by SZC Co. to reduce the impacts on flood risk posed by the Project. On this basis it was assessed within the hydraulic modelling studies to determine the reduced on-site and off-site impacts that the design would have on the fluvial, coastal inundation and tidal breach flood risk.

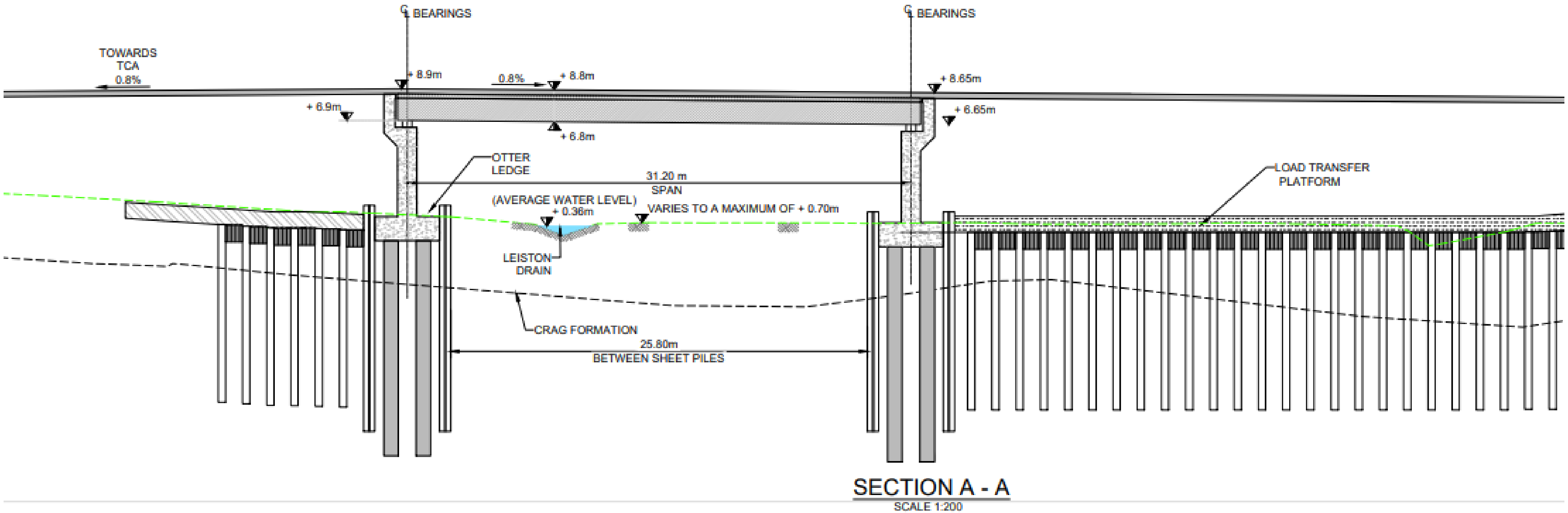
4.5.5 Details of the assessment including this embedded mitigation measure were presented in the **MDS FRA Addendum** (Doc. Ref. 5.2(A)Ad) [AS-157] and relevant **Appendix C** (Doc. Ref. 5.2(A)Ad) [AS-161] (epage 26) for the fluvial modelling and **Appendix D** (Doc. Ref. 5.2(A)Ad) [AS-164] (epage 20) for the coastal inundation and tidal breach modelling. **Section 5** presents summary of the flood risk impacts with the combined embedded mitigation measures submitted as part of the January 2021 submission.

4.5.6 The revised indicative SSSI crossing design and updated assumptions for the purpose of assessment was submitted by SZC Co. to the Planning Inspectorate in January 2021 and accepted for examination in April 2021.

**Plate 4.5: Visualisation of the accepted SSSI crossing design (Change 6) (extract from Figure 2.2.16 of Chapter 2 of Volume 2 of the ES Addendum (Doc Ref. 6.14) [AS-190] (epage 22))**



## Plate 4.6: Optimised SSSI crossing design (extract from drawing no. SZC-SZ0100-XX-000-DRW-100205 submitted For Approval at Deadline 8)



a) Further optimisation of the SSSI crossing design

4.5.7 Following submission of the **MDS FRA Addendum** (Doc. Ref. 5.2(A)Ad) [AS-157], subsequent works have been carried out to further optimise the design of the single span bridge option (Doc. Ref. 2.5(E)) and to address concerns raised by the Environment Agency and other stakeholders, specifically with regard to the headroom between the level of the otter ledge and the soffit of the bridge.

4.5.8 Additional constraints were placed on the SSSI Crossing at Deadline 5 by amending Requirement 12C (Schedule 2, draft Development Consent Order [REP5-028]. This is illustrated at **Plate 4.6** and served to reduce the flexibility previously identified and sought to address stakeholder concerns.:

- Increasing the minimum crest height of the bridge within its original parameter from 7.3mAOD to 8.6mAOD.
- Reducing the vertical depth of the bridge span, which combined with the above allowed the bridge clearance over the Leiston Drain to be no lower than 6.8mAOD.

4.5.9 Considering the proposed constraints identified above , it is concluded that the optimised SSSI crossing design would not result in an increased risk of flooding to that presented in the **MDS FRA Addendum** (Doc. Ref. 5.2(A)Ad) [AS-157].

4.5.10 This was confirmed by sensitivity testing which was carried out within the hydraulic model for the tidal breach flood risk for the 1 in 200-year and 1 in 1,000-year events at 2090 epoch. Furthermore, this sensitivity test confirmed that the increased width and soffit level of the crossing opening would marginally reduce the impact on flood risk (i.e. up to 0.01m reduction in the impact on flood levels) when compared to that presented in the **MDS FRA Addendum** (Doc. Ref. 5.2(A)Ad) [AS-157]. As such, SZC Co. concludes that this further iteration to the design seeks to further minimise the impact of the Project on flood risk and as a result there is no requirement for additional hydraulic modelling or an update to the assessment of flood risk. Furthermore, the marginal reduction of flood risk provided by the revised design clearly indicates that the design has been optimised hydraulically and that no further significant hydraulic efficiency gains can be achieved through further iteration of the design.

4.5.11 A review of the potential impact that the single span SSSI crossing would have on flood risk to its users is provided in **Appendix J Future Adaptation of the SSSI Crossing in the DCO Submission** of the **SZC Co. Comments on Submissions from Earlier Deadlines (Deadlines 2 – 4)** [REP5-120]. It concludes that, with the revised level, safe access and egress via the

SSSI crossing to Sizewell C will be maintained up to the 1 in 1,000-year event until the end of the decommissioning phase of the Project.

4.5.12 Therefore, the conclusions presented in the **MDS FRA Addendum** (Doc. Ref. 5.2(A)Ad) [AS-157] remain valid for the Project.

# 5 EMBEDDED MITIGATION MEASURES

5.1.1 As discussed in **section 2**, NPS EN-1 and NPS EN-6 require flood risk mitigation to be considered in the proposed development for a nuclear site. Additional work undertaken following submission of the Application identified the two mitigation measures discussed in **section 4.4** and **section 4.5** (i.e. the flood mitigation area and the SSSI crossing deign). These have been assessed and embedded into the design of the Project to provide appropriate mitigation measures in order to reduce flood risk impacts and satisfy the national policy requirements.

5.1.2 The proposed changes were submitted to the Planning Inspectorate in January 2021 and subsequently accepted for examination in April 2021.

5.1.3 The flood mitigation area and the SSSI crossing design are illustrated in **Figure 2.2.14** and **Figure 2.2.16** of **Chapter 2** of **Volume 2** of the **ES Addendum** (Doc Ref. 6.14) [AS-190] (epage 20 and 22), respectively and further described in **Chapter 2** of **Volume 1** of the **ES Addendum** (Doc. Ref. 6.14(Ad)) [AS-181] (epage 59).

5.1.4 The combined embedded mitigation formed part of the updated hydraulic modelling undertaken to inform the **MDS FRA Addendum** (Doc Ref. 5.2Ad) [AS-157] and discussed in **Appendix C** (Doc Ref. 5.2Ad) [AS-161] (epage 26) and **Appendix D** (Doc. Ref. 5.2(A)Ad) [AS-164] (epage 20) of the **MDS FRA Addendum**.

5.1.5 Similar to the conclusions drawn in the Application, the results of the hydraulic modelling, incorporating the updated design of the SSSI crossing and the addition of the flood mitigation area, show that the Project will not have a significant impact on flood risk to off-site receptors. Furthermore, the results show there are no additional properties flooded as a result of the Project.

5.1.6 Considering the fluvial flood risk, the maximum increase in flood levels as a result of the Project is up to 0.01m across the catchment area. There are a limited number of residential and non-residential properties at fluvial flood risk (total of 16). Of these properties 6 are affected by a maximum increase in flood depth of 0.01m as a result of the Project (the remaining 10 properties have no change in flood depth). This is considered in the context of the existing baseline flood depth of between 0.14m and 0.59m, as presented in **Table 5.4** of **Appendix C** of the **MDS FRA Addendum** [AS-161] (epage 75). There is no change in flood velocity or hazard rating when comparing the 'With Scheme' (including the embedded mitigation measures) scenario with the 'Baseline' scenario.

5.1.7 For the coastal inundation and tidal breach scenarios, the modelling results show there is a very localised area of increased flood depth, up to 0.3m in the 2090 epoch, around the Tank Traps. However, there are no property receptors, and this land is within the British Energy Generation Limited & EDF Energy Nuclear Generation Limited ownership. Furthermore, the baseline flood depth at this area is greater than 1.5m for the 200-year event at 2090 epoch and the difference diminishes relatively close to that location. The results show that for the majority of the wider Minsmere area (including areas of land in the ownership of local stakeholders) the increase is limited to an increased depth of up to 0.06m.

5.1.8 Engagement has been had with all landowners impacted by the flood risk in proximity to the MDS. Terms have been agreed for the freehold acquisition of a large portion of the land impacted by this increased flood risk. Engagement is ongoing in relation to land where terms for acquisition have not been agreed.

5.1.9 There are a limited number of properties affected, up to 17 residential and 16 non-residential properties with a maximum relative increase in flood depth of 0.06m, in the 2090 epoch (comprising a total of 34 properties with an average baseline flood depth of between 0.5m and 1m). There is no significant change in flood velocity and no change in flood hazard rating when comparing the 'With Scheme' (including the embedded mitigation measures) scenario with the 'Baseline' scenario. There is no change in practical risk from flooding.

5.1.10 Within the North and South Minsmere Levels (land in the ownership of the Royal Society for the Protection of Birds (RSPB)), there is a maximum change in flood depth up to 0.3m, limited to a small area in close proximity to the Tank Traps, whereas across the remainder of the RSPB owned area, the increase is less than 0.06m in the 2090 epoch.

5.1.11 As a result of the mitigation measures embedded within the design of the Project, the impact on flood risk to off-site receptors described in the **MDS FRA Addendum** (Doc Ref. 5.2Ad) [AS-157] has reduced when comparing the results to those presented in the Application. Thereby demonstrating their overall contribution to the Project in addressing flood risk impact.

# 6 CONCLUSIONS

6.1.1 The national policy set out in NPS EN-1 and NPS EN-6, relevant to flood risk, states that where possible a development should be located in areas at low flood risk, and where development is necessary in areas of higher risk, the development should be made safe for its lifetime without increasing flood risk elsewhere.

6.1.2 It also states that the proposed development should consider appropriate measures to mitigate flood risk that may arise from the development.

6.1.3 This was raised in the Relevant Representation from the Environment Agency [RR-0373] (epage 3) as discussed in paragraph 3.1.5 in **section 3**, where it identified the need for mitigation measures to be included in the Application. To address these concerns, following submission of the Application, SZC Co. undertook additional work to identify appropriate mitigation measures not only to reduce flood risk impacts as a result of the Project but to also find potential solutions to reduce environmental impacts and provide other benefits.

6.1.4 SZC Co. has undertaken a thorough review to consider the options available for providing flood risk mitigation as part of the Project. The review identified those opportunities which provide the optimum mitigation in terms of flood risk. These opportunities were thoroughly tested in terms of their hydraulic efficiency and subsequently embedded within the design of the Project.

6.1.5 Two key opportunities were identified to provide mitigation, i.e. through the revised design of the SSSI crossing to reduce the constriction and the provision of a flood mitigation area to provide flood storage within the catchment during extreme events.

6.1.6 A series of scenarios were considered within the modelling to determine the optimal solution for the SSSI crossing. As a result of this assessment, it was found that flood relief culverts through the SSSI crossing embankment would not provide further benefit in reducing flood risk and would still occupy a significant portion of the floodplain and the SSSI marshes. Therefore, the design was amended from the use of culverts with embankment to the provision of a single span bridge option. The revised SSSI crossing design was submitted by SZC Co. to the Planning Inspectorate in January 2021 and accepted for examination in April 2021.

6.1.7 The option for the design of the SSSI crossing has been further optimised by increasing the soffit level. This change would not increase the potential impact of the SSSI crossing on flood risk but would provide marginal benefit in reducing the impact. At Deadline 8, SZC Co. is submitted updated plans for the SSSI Crossing. These are limited to the removal of a temporary drainage pipe during the construction stage and a change in the status of the drawings from "Not for Approval" to "For Approval". The detailed design of the SSSI Crossing will still be subject to a further approval process pursuant to **Requirement 12C** of the draft **Development Consent Order**.

6.1.8 In addition an assessment was undertaken to identify potential areas for flood storage and subsequently to determine which of these would comprise the optimal location for the provision of flood mitigation.

6.1.9 As outlined in **section 4.4**, nine potential locations for the provision of a flood mitigation area were identified. These were selected on the basis of their proximity to the same watercourse as that of the lost floodplain, adjacent to the existing watercourse so water can readily access the location and proximity to the main development site to ensure mitigation would be as close to the area of loss as possible.

6.1.10 Each of the nine potential locations were evaluated based on a number of factors including existing topography, environmental sensitivities such as protected areas / habitats and the presence of overground or buried services / utilities.

6.1.11 Of the nine potential locations, six were found to be unsuitable on the basis of either environmental sensitivities (i.e. environmental designations) or constructability constraints. Further to this, one location was discounted as it is already required as a mitigation measure for the works to be carried out as part of the Sizewell B relocated facilities.

6.1.12 On this basis, only two viable areas were identified as being appropriate for both the provision of flood storage as well as permanent wetland habitat, that would compensate for the loss of wet woodland from the Sizewell Marshes SSSI. The assessment of the storage areas available in these locations indicated that by combining the two areas together this would provide the greatest benefits in terms of storage area and connectivity to the floodplain. Therefore, these two areas were taken forward as a single mitigation area.

6.1.13 Through the completion of a thorough review of potential locations in proximity to the area of lost floodplain, the proposed flood mitigation area is the most appropriate in terms of addressing flood risk, whilst taking into account other factors such as environmental constraints, topography and constructability, and that none of the discounted locations, or other locations within proximity to the site, would meet these requirements.

6.1.14 The two mitigation measures identified above were subsequently embedded into the design of the Project and submitted to the Planning Inspectorate in January 2021 as changes to the Project. These changes were accepted for examination in April 2021. Furthermore, these embedded mitigation measures have been recognised by the Environment Agency in its Written Representation at Deadline 2 [REP2-135] (epage 6).

6.1.15 Analysis of the results from the coastal inundation and tidal breach hydraulic modelling was undertaken to determine the potential impacts on flood risk for the areas within the ownership of key landowners in the vicinity of the Project. The greatest change in flood depth is limited to the area in the vicinity of the Tank Traps i.e. up to 0.3m (where the baseline flood depth at this area is greater than 1.5m for the 200-year event at 2090 epoch); however, in the wider area the increase in flood depth is up to 0.06m. On this basis, the impact on flood risk to landowners in the wider area would not be significant.

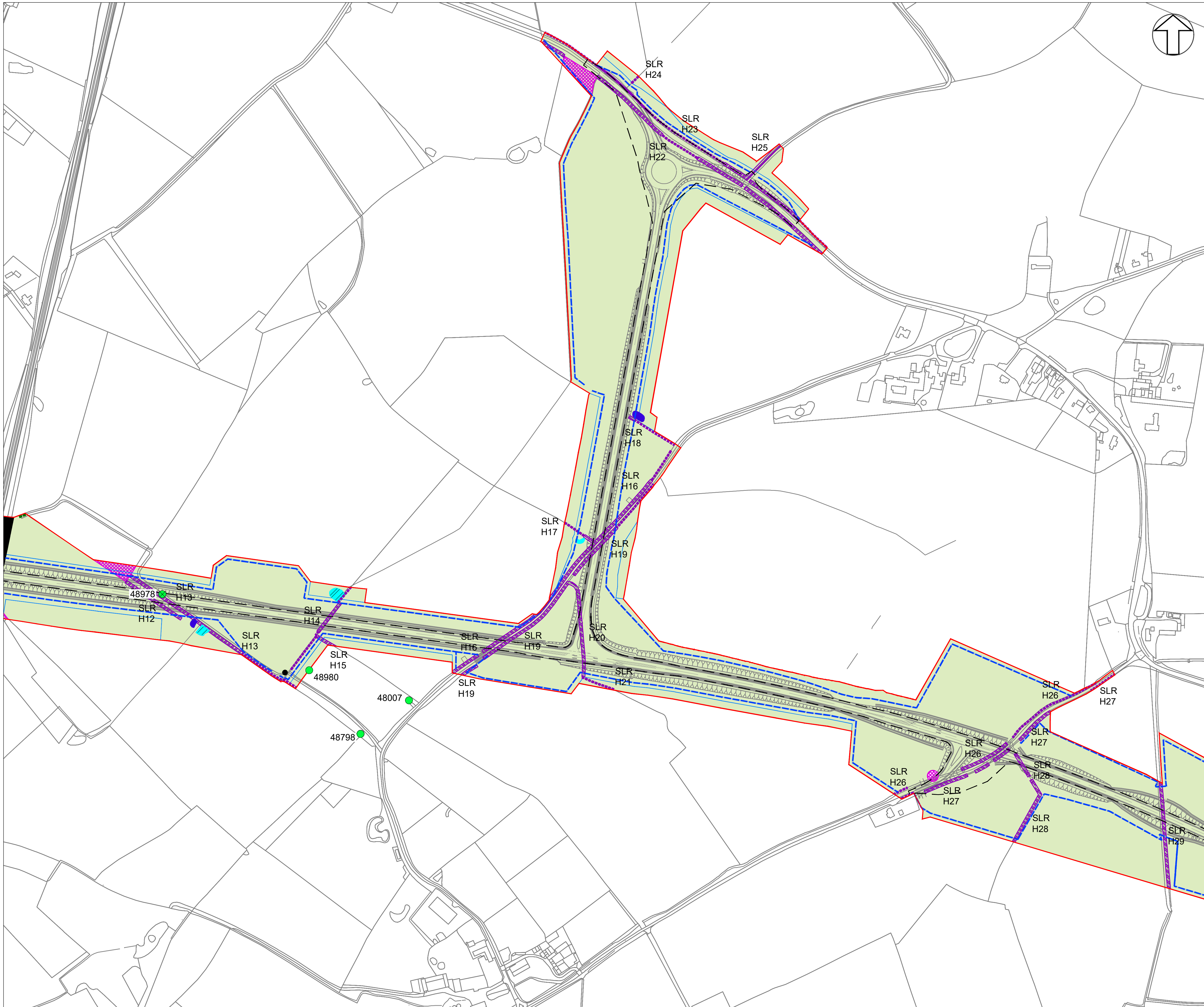
6.1.16 SZC Co. believes that all potential mitigation options have been adequately considered as part of the assessment.

6.1.17 Taking into account the limited changes in flood depth and extent as a result of the Project, SZC Co. has concluded that through the process of iterative design the embedded mitigation measures set out within this report provide appropriate flood risk mitigation to an acceptable level to satisfy the national policy requirements set out in NPS EN-1 paragraph 5.7.17 and NPS EN-6 paragraph 3.6.16 and to limit the impacts of the Project such that no further measures are required.

# REFERENCES


1. Department of Energy and Climate Change. Overarching National Policy Statement for Energy (EN-1). London: The Stationery Office, July 2011
2. Department of Energy and Climate Change. National Policy Statement for Nuclear Power Generation (EN-6). London: The Stationery Office, July 2011

# APPENDIX E: SLR VETERAN TREES FIGURE






## NOTES:

1. FOR DETAILS OF PERMANENT AND TEMPORARY POSSESSION WITHIN ORDER LIMITS REFER TO LAND PLANS.
2. THE LOCATIONS OF FEATURES SHOWN ARE INDICATIVE ONLY. EXACT LOCATIONS TO BE CONFIRMED ON SITE.
3. ADDITIONAL FEATURES MAY BE PRESENT ON SITE THAT HAVE NOT BEEN IDENTIFIED.
4. THIS DRAWING IS BASED ON AERIAL PHOTOGRAPHS AND SITE VISITS.
5. FOR HEDGEROW REFERENCES (H01-H63) PLEASE REFER TO SCHEDULE 21 OF DRAFT DCO (DOC REF 3.1 (D))
6. WITHIN THE AREA SHOWN AS 'GENERAL SITE CLEARANCE' NOT EVERYTHING WOULD BE CLEARED. SITE CLEARANCE WOULD BE THE MINIMUM REQUIRED TO UNDERTAKE THE WORKS. GENERAL SITE CLEARANCE CONSISTS OF REMOVAL OF OVERGROWN VEGETATION IN VERGES, AND TOPSOIL REMOVAL AND DISPOSAL.

## KEY:

SIZEWELL LINK ROAD DEVELOPMENT SITE BOUNDARY
PERMANENT BOUNDARY
EXTENT OF WORK No. 12B
HIGHWAY BOUNDARY FENCE
RETAINED HEDGEROW
RETAINED IMPORTANT HEDGEROW (HEDGEROW REGULATIONS 1997)
RETAINED AND ENHANCED TREES AND SHRUBS
RETAINED AND ENHANCED POND
AREA OF GENERAL SITE CLEARANCE FOR CONSTRUCTION WORKS WITHIN THE SITE
VEGETATION TO BE REMOVED
IMPORTANT HEDGEROW (HEDGEROW REGULATIONS 1997) TO BE REMOVED
POND TO BE REMOVED

WOODLAND TRUST ANCIENT TREE INVENTORY

TO BE RETAINED — TO BE REMOVED — VETERAN TREE

48007 - ASH - VETERAN TREE
48798 - OAK - VETERAN TREE
48978 - OAK - VETERAN TREE TO BE REMOVED
48980 - OAK - VETERAN TREE

NB TREE POSITIONS HAVE BEEN AMENDED FROM THE GRID REFERENCES PROVIDED ON THE ANCIENT TREE INVENTORY TO ENSURE THEY RELATE TO ACTUAL TREE LOCATIONS ON THE GROUND

NOT PROTECTIVELY MARKED



SizewellC
Doing the power of good for Britain

DOCUMENT:
ADDITIONAL WRITTEN SUBMISSIONS ARISING FROM ISH10 - LOCATION OF VETERAN TREES WITHIN THE SIZEWELL LINK ROAD SITE

DRAWING TITLE:
SIZEWELL LINK ROAD
SITE CLEARANCE PLAN
SHEET 2 OF 4
ANCIENT AND VETERAN TREES ADDED

DRAWING NO:
FIGURE 1.1

| DATE: | DRAWN: | SCALE: | REVISION: |
|---|---|---|---|
| SEPT 2021 | J.B. | 1:5000 @ A3 | |

SCALE BAR:
50m 0 50 100 150m

# APPENDIX F: BAILEY BRIDGE NOTE

# 1. SSSI Crossing – Modular Bridge

## Need case

Achieving a crossing between the TCA and the MCA is on the critical path of the project, meaning that any delay to establishing this causes delay to the wider project. This is because it provides a form of direct access between the TCA and MCA that allows construction activity to increase in line with the programme demands and reduces the reliance on the SZB access road for material import to the MCA.

A modular bridge will be used to establish this crossing as quickly as possible, since it can be constructed faster than an intermediate/temporary crossing arrangement of the SSSI Crossing. Furthermore, the modular bridge allows simultaneous construction of the SSSI Crossing adjacent to it, so does not delay its construction.

As stated previously, the modular bridge will allow construction activity across the site to ramp up, which includes the preparatory earthworks, as the modular bridge can accommodate reduced-size earthworks vehicles. However, since it is the primary access between the TCA and MCA at this time, its use for earthworks activities may be superseded by other construction activities. Similarly, its limited capacity means that it is not viable for the more substantive construction works required by the project, which means that establishing the permanent SSSI Crossing becomes the key SSSI Crossing construction milestone once the modular bridge has been installed.

## Details

The modular bridge will be a pre-fabricated bridge of 50m length and 20m total width, and is proposed to be installed entirely within the permanent landtake area of the SSSI Crossing where the eastern slope of the crossing would ultimately be constructed. This allows the main site access road and temporary haul road to be constructed adjacent to the modular bridge, with a stepped embankment used to account for the difference in elevation between the modular bridge access road (at +3.5mAOD) and the main site access road / haul road (at +8.8mAOD). Then, when the construction of the temporary and permanent bridges are complete, the modular bridge can be removed and the permanent eastern embankment slope constructed on the eastern side of the SSSI Crossing.

The modular bridge will be constructed within the same sheet piled perimeter used for the permanent SSSI Crossing. In addition, ground improvement of rigid inclusions is required for the modular bridge to be constructed, sheet piling around the perimeter of the SSSI Crossing needs to be installed (within which the modular bridge is located. In addition, ground improvement of CMCs is required for the abutments of the modular bridge, and its access track. The abutments of the modular bridge are concrete, and are designed to provide a road level of +3.5mAOD over the modular bridge. The arrangement of the modular bridge is shown in Figure 1-1 and Figure 1-2.

The modular bridge will provide a crossing after 18 weeks of construction, and remains for a period of 22 weeks until it is removed to allow the completion of the eastern embankment slope of the SSSI Crossing.

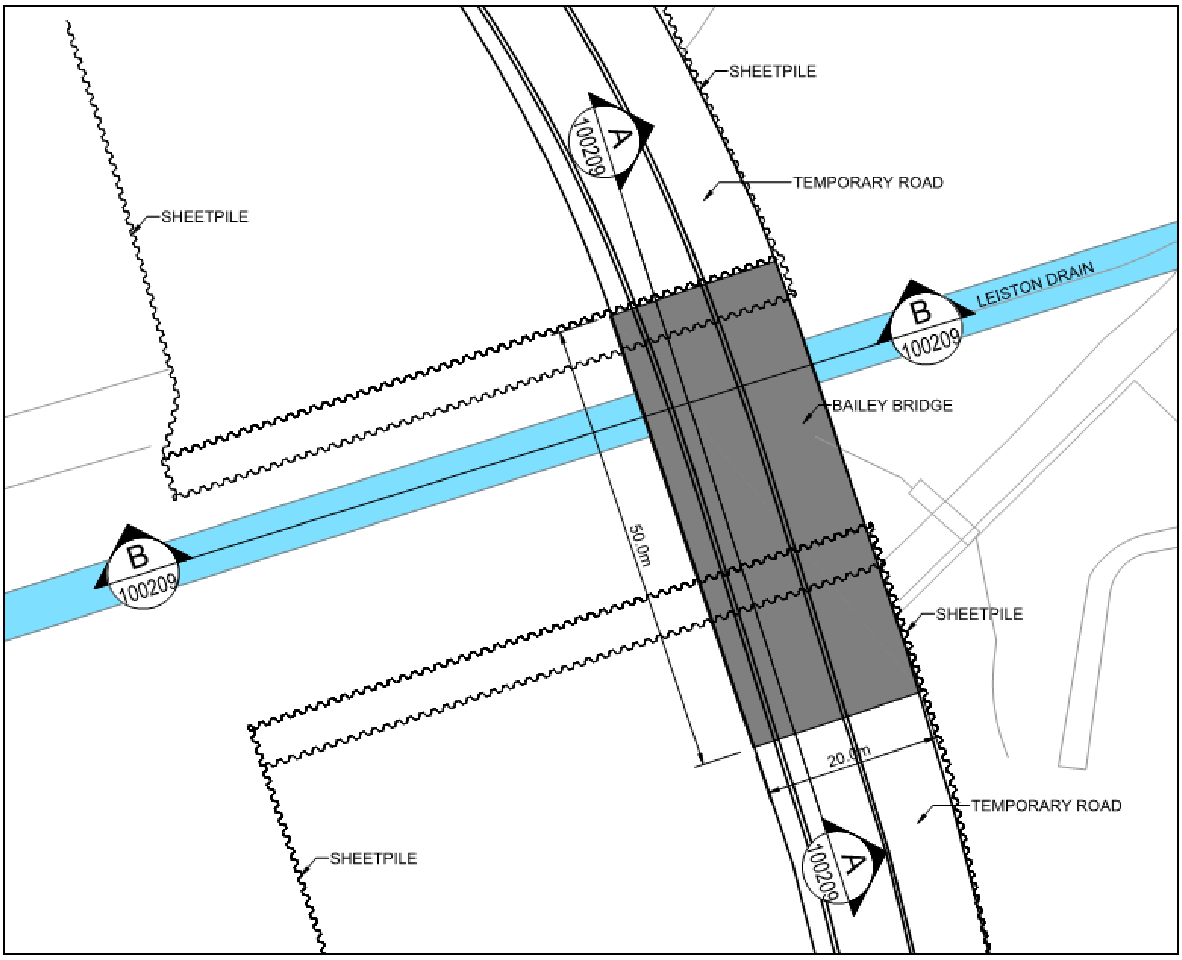



Figure 1-1 - Modular bridge (plan view)

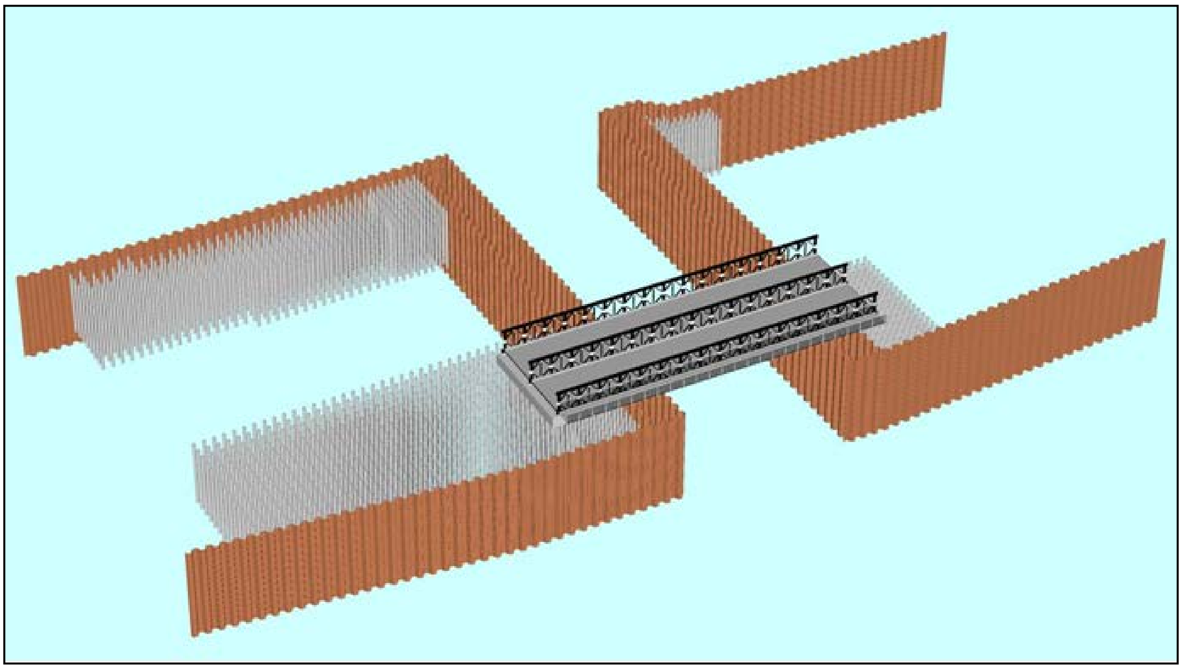


Figure 1-2 - Model view of modular bridge, sheet piling, and CMCs

# Environmental considerations

## Light

The northern and southern SSSI Crossing construction areas would be illuminated to ensure a safe working area during dark hours of work (see Figure 1-3 for construction areas). However, these dark hours would be limited and seasonally dependent, such as the hours of the working day that are outside the daylight hours during winter.

The modular bridge itself would not be illuminated and so there would be no lighting within the dark corridor defined for bats within Section 1.3 of the Lighting Management Plan.

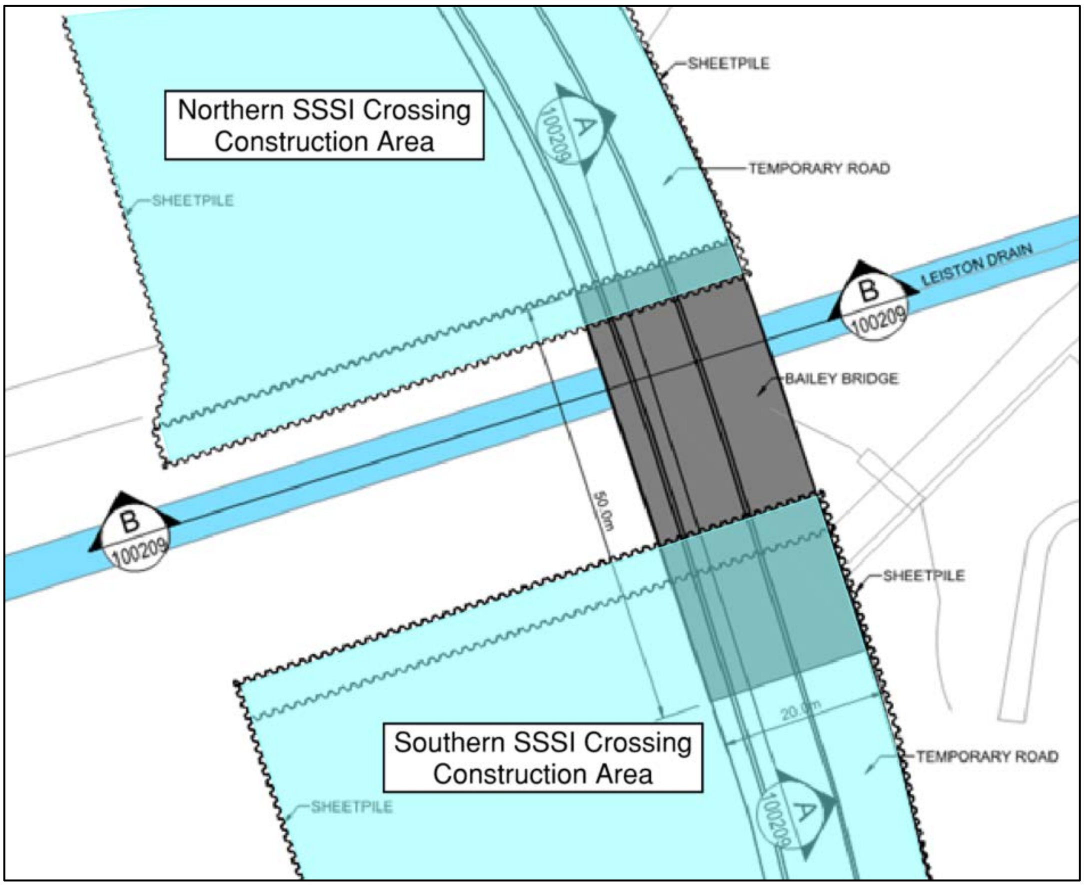



**Figure 1-3 - SSSI Crossing construction areas**

## Noise

The vehicles using the modular bridge would mostly be a smaller size (compared to the vehicles using the final configuration of the SSSI Crossing), due to the limited capacity of the modular bridge. For example, the earthworks vehicles that would use the modular bridge are approximately half the gross weight of the earthworks vehicles that use the final construction phase crossing.

The modular bridge will also incorporate acoustic reduction measures in the road surface and structure, which will provide a reduction in road noise.

## Conclusion

The conclusions of the Environmental Statement (and subsequent addenda) are unaltered by the additional details provided above in relation to the modular bridge. The bridge will be unlit and road noise mitigated through surfacing. The short duration of use will ensure that no substantive barrier effect will arise.

# APPENDIX G: APPRAISAL OF SUSTAINABILITY ROUTE MAP

| Paragraph and Comment | Response |
|---|---|
| Appraisal of Sustainability: Site Report for Sizewell | |
| *4.9 There is a high concentration of designated sites and a wide range of biodiversity interest surrounding the nominated site, including nationally important SSSIs and European designated sites. Further information on the European designated sites and their current condition is given in the separate HRA Report for Sizewell.* | These sites are covered as necessary in the **ES** and the **Shadow HRA Report**.<br><br>Designated Sites that fall within the Study areas of the main development site and Associated Development sites were identified in response to **Bio.1.0** [REP2-109], this includes a description of the features. Individual links for the sites and the mapping are provided below:<br><br>Main development site, described in **Table 1** on e-page 13 [REP2-109], depicted on **Figure 7.1** on e-page 149 [REP2-109]. **Table 1.6** of **Volume 2**, **Chapter 7**, **Appendix 14A2** on e-page 40 [APP-227] provides a screening exercise and identifies the SPAs, SACs and Ramsar sites taken forward for further assessment within the ES where they are considered in relation to the following aspects, where no significant effects are identified:<br><br>• Habitats loss; and<br>• Ornithology.<br><br>Northern park and ride, described in **Table 3** on e-page 36 [REP2-109], depicted on **Figure 7.2** on e-page 153 [REP2-109]. **Table 1.16** on e-page 62 of **Volume 3**, **Chapter 7**, **Appendix 7A** [APP-364] identifies that no direct land take of these sites will occur, and |

| Paragraph and Comment | Response |
|---|---|
| | no obvious impact pathways have been identified and therefore effects are not considered further in the ES.<br><br>Southern park and ride, described in **Table 5** on e-page 40 [REP2-109], depicted on **Figure 7.3** on e-page 154 [REP2-109]. **Table 1.11** on e-page 52 of **Volume 4**, **Chapter 7**, **Appendix 7A** [APP-395] identifies that no direct land take of these sites will occur, and no obvious impact pathways have been identified and therefore effects are not considered further in the ES.<br><br>Two village bypass, described in **Table 6** on e-page 42 [REP2-109], depicted on **Figure 7.4** on e-page 155 [REP2-109]. **Table 1.14** on e-page 67 of **Volume 5**, **Chapter 7**, **Appendix 7A** [APP-426] provides a screening exercise of these and identifies that Alde-Ore Estuary SPA, SAC and Ramsar site is taken forward for further assessment within the ES. The effects are described as The effects are described negligible adverse (not significant) within **Volume 5**, **Chapter 7** of the **ES** [APP-425].<br><br>Sizewell link road, described in **Table 8** on e-page 51 [REP2-109], depicted on **Figure 7.5** on e-page 156 [REP2-109]. in **Table 1.12** on e-page 66 of **Volume 6**, **Chapter 7**, **Appendix 7A** [APP-462] identifies that no direct land take of these sites will occur, and no obvious impact pathways have been identified and therefore effects are not considered further in the ES.<br><br>Yoxford, described in **Table 10** on e-page 61 [REP2-109], depicted on **Figure 7.6** on e-page 157 [REP2-109]. **Table 1.7** on e-page 44 of **Volume 7**, **Chapter 7**, **Appendix 7A** |

| Paragraph and Comment | Response |
|---|---|
| | [APP-495] identifies that the Minsmere to Walberswick Heaths and Marshes SPA, SAC, Ramsar Site, and SSSI is scoped in for further assessment within the ES. The effects are described negligible adverse (not significant) within **Volume 7**, **Chapter 7** of the **ES** [APP-494].<br><br>Freight management facility, described in **Table 12** on e-page 66 [REP2-109], depicted on **Figure 7.7** on e-page 158 [REP2-109]. **Table 1.7** on e-page 41 of **Volume 8**, **Chapter 7**, **Appendix 7A** [APP-524] identifies that no direct land take of these sites will occur, and no obvious impact pathways have been identified and therefore effects are not considered further in the ES.<br><br>Rail, described in **Table 14** on e-page 73 [REP2-109], depicted on **Figure 7.8** on e-page 159 [REP2-109]. **Table 1.16** on e-page 78 of **Volume 9**, **Chapter 7**, **Appendix 7A** [APP-556] identifies that no direct land take of these sites will occur, and no obvious impact pathways have been identified and therefore effects are not considered further in the ES.<br><br>The **Shadow Habitats Regulation Assessment (sHRA) Report** [APP-145] and its subsequent addenda considered impacts of the Sizewell C Project on a number of European sites. Section 4 [APP-145] provides a summary of the scoping of European sites. It summarises that a total 30 European sites were included in the likely significant effects screening assessment as detailed in Table 4.4 [APP-145] and a description of each of the sites and its qualifying features provided in Table 4.5 [APP-145]. |

| Paragraph and Comment | Response |
|---|---|
| | The screening exercise described in **Section 5** [APP-145] concluded that likely significant effects could not be excluded for at least one screening category for 29 of the scoped in European sites (and certain relevant qualifying features). The exception was the Staverton Park and the Thicks, Wantisden SAC, for which likely significant effects could be excluded for all screening categories and qualifying features.<br><br>**Section 7** of the **SHRA report** [APP-145] provides an assessment of effects on Coastal, Freshwater and Terrestrial Habitats in relation to the following sites:<br><br>• Alde, Ore and Butley Estuaries SAC and Alde-Ore Estuaries Ramsar site [APP-145]<br>• Benacre to Easton Bavents Lagoons SAC [APP-145]<br>• Dew's Ponds SAC [APP-145]<br>• Minsmere to Walberswick Heaths and Marshes SAC [APP-145]<br>• Minsmere-Walberswick Ramsar site [APP-145]; and<br>• Orfordness to Shingle Street SAC [APP-145]. |

| Paragraph and Comment | Response |
|---|---|
| | The **Shadow HRA** concludes that adverse effects on site integrity can be excluded for the European sites screened into the assessment (with respect to the non-bird qualifying interest features), both alone and in-combination with other plans and projects.<br><br>**Section 8** of the **SHRA Report** [APP-145] provides an assessment of effects on birds in relation to the following sites:<br><br>• Alde-Ore Estuary SPA [APP-145];<br>• Alde-Ore Estuary Ramsar site [APP-145];<br>• Benacre to Easton Bavents SPA [APP-145];<br>• Deben Estuary SPA [APP-145];<br>• Deben Estuary Ramsar site [APP-145];<br>• Minsmere–Walberswick SPA [APP-145];<br>• Minsmere-Walberswick Ramsar site [APP-145];<br>• Outer Thames Estuary SPA [APP-145];<br>• Sandlings SPA [APP-145]; |

| Paragraph and Comment | Response |
|---|---|
| | • Stour and Orwell Estuaries SPA [APP-145]; and<br>• Stour and Orwell Estuaries Ramsar site [APP-145].<br><br>For all SPA and Ramsar qualifying features, with the exception of breeding marsh harrier at the Minsmere-Walberswick SPA and Ramsar site, it is concluded that construction, operation and decommissioning activities would not have an adverse effect on the integrity of the European sites, either alone or in-combination with other plans and projects.<br><br>For the breeding marsh harrier qualifying interest feature of Minsmere Walberswick SPA and Ramsar site, it is concluded that, with the adoption of the proposed mitigation measures (including those embedded into the design), an adverse effect on the integrity of these European sites cannot be excluded due to noise and visual disturbance during construction phase. Habitat improvement measures are proposed to compensate for the predicted effect on the marsh harrier population.<br><br>**Section 9** of the **SHRA Report** [APP-145] provides an assessment of effects on marine mammals in relation to the following sites:<br><br>• Humber Estuary SAC [APP-145];<br>• Southern North Sea SAC [APP-145]; and |

| Paragraph and Comment | Response |
|---|---|
| | • The Wash and North Norfolk Coast SAC [APP-145].<br><br>The assessment of the Humber Estuary SAC (for grey seals), the Southern North Sea SAC (for harbour porpoise) and The Wash and North Norfolk Coast SAC (for harbour seals) (based on the proportion of the management unit population potentially affected) concludes that there would be no adverse effect on the integrity of the above SACs. The in-combination assessment also concluded that there would be no adverse effect on integrity when the Sizewell C Project is assessed in-combination with other plans and projects<br><br>**Section 10** of the **SHRA** [APP-145] provides an assessment of effects on migratory fish in relation to the following sites:<br><br>Humber Estuary SAC [APP-145]; and<br><br>Mainland European SAC [APP-145].<br><br>For all European sites with migratory fish as qualifying interest features (river lamprey, sea lamprey and twaite shad), it is concluded that construction, operation and decommissioning activities of the Sizewell C Project would not have an adverse effect on the integrity of these European sites.<br><br>The **sHRA Report First Addendum** [AS-173] concluded the following: |

| Paragraph and Comment | Response |
|---|---|
| | The proposed changes do not alter the findings of the Shadow HRA Report for these European sites. Therefore, it is concluded that there would not be an adverse effect on the integrity of these European sites.<br><br>The proposed changes and additional information do not change the conclusion of no adverse effect on integrity European sites screened into the assessment with migratory fish qualifying interest features<br><br>Additional European sites were scoped in following the Environment Agency's Relevant Representation. The proposed changes and additional information do not change the conclusion of no adverse effect on integrity European sites screened into the assessment (including the additional sites) with migratory fish qualifying interest features<br><br>The **sHRA Report Second Addendum** concludes that there would be no changes to the conclusions of the **sHRA Report** [APP-145].<br><br>The **sHRA Report Third Addendum** [REP7-279] concluded that all potential effects are within the worst-case previously assessed and would not result in changes to the existing in-combination assessments. |
| *4.10 Sizewell lies to the south of the Minsmere to Walberswick Heaths and Marshes SAC, which is also recognised as a SPA for birds and a Ramsar wetland site. The Minsmere to Walberswick* | The Minsmere European sites are covered in detail in the **Volume 2**, **Chapter 14** of the **ES** at **Section 14.7** to **14.12** (as relevant) [AS-033] and extensively in the **Shadow HRA Report** as relevant (see response to paragraph 4.9). This includes: |

| Paragraph and Comment | Response |
| --- | --- |
| *European designated areas are protected for their coastal and estuarine habitats and important breeding and wintering bird populations.* | Impacts on marsh harriers and the compensatory habitat approach<br><br>**Volume 2**, **Chapter 14** of the **ES** [AS-033] outlines an assessment of effects on the breeding and wintering bird assemblage associated with the Minsmere European Sites from construction disturbance and disturbance from recreational pressure are considered minor adverse (not significant).<br><br>The **sHRA Report** [APP-145] concludes that based on the assessment presented above, it is concluded that the construction, operation and decommissioning activities of Sizewell C would not adversely affect the integrity of the Minsmere to Walberswick Heaths and Marshes SAC in view of its conservation objective<br><br>The **sHRA Report** [APP-145] also concludes that it is not possible to discount the possibility of an adverse effect on the marsh harrier population occurring as a consequence of noise and visual disturbance from construction and decommissioning activities. With the exception of this effect, no other adverse effects on marsh harrier, or any other species are predicted. It is concluded, therefore, that an adverse effect on the integrity of the Minsmere-Walberswick SPA cannot be excluded due to noise and visual disturbance from construction and decommissioning activities.<br><br>A MMP for recreational displacement at the Minsmere sites [REP5-105] which provides details of monitoring and mitigation with respect to recreational disturbance will be implemented at four European sites to ensure that adverse effect on the integrity (AEoI) of the sites does not arise as a consequence of this effect pathway. The mitigation and |

| Paragraph and Comment | Response |
|---|---|
| | monitoring requirements specified in the Plan are secured via the draft Deed of Obligation (Doc Ref. 3.11(I)) (see paragraph 6 of Schedule 11 (Natural Environment)).<br><br>Additional information in relation to compensatory habitats for marsh harrier has been submitted at:<br><br>• **Note on Marsh Harrier Habitat** [AS-408];<br>• Deadline 2: **The on-site Marsh Harrier Compensatory Habitat Strategy** (Doc Ref. 9.16(A))<br>• Deadline 3: **The Westleton Marsh Harrier Compensatory Habitat Strategy** (Doc Ref. 9.35(A))<br>• Deadline 5: **Abbey Farm Compensation Site** [REP5-120]; and<br>• Deadline 5: **The Minsmere-Walberswick SPA and Ramsar Site Marsh Harrier Population** [REP5-120]. |
| *4.11 Other European protected areas within close proximity which could be potentially impacted upon from the development of the nominated site include the Sandlings SPA and Alde-Ore Estuaries SAC, SPA and Ramsar wetland sites.* | The other European sites are covered in detail in the **Shadow HRA Report** [APP-145] as relevant. For example the SHRA considers in detail consideration of the Sandlings SPA and Alde-Ore Estuaries SAC, SPA and Ramsar wetland sites. The Outer Thames Estuary SPA. Further detail is provided in response to Paragraph 4.9 in relation to the scoping and screening of European sites. |

| Paragraph and Comment | Response |
|---|---|
| *The Outer Thames Estuary SPA borders the site as part of an offshore habitat area that extends at least 20km north and south of the nominated site.* | There is a MMP for recreational displacement [REP5-105] at the northern part of the Sandlings SPA an MMP for recreational displacement that covers Alde-Ore Estuaries SPA and Ramsar and the southern part of the Sandlings SPA [REP5-122]. These plans provides details of monitoring and mitigation with respect to recreational disturbance will be implemented at these European sites to ensure that adverse effect on the integrity (AEoI) of the sites does not arise as a consequence of this effect pathway. The mitigation and monitoring requirements specified in the Plans are secured via the draft Deed of Obligation (Doc Ref. 8.17(G)) (see paragraph 6 of Schedule 11 (Natural Environment)). These plans set out requirements for monitoring.<br><br>There is an Outline Vessel Management Plan (Doc Ref. 9.65(B)) to mitigate for the possible impact on red-throated divers in the Outer Thames Estuary SPA. |
| <u>*4.12*</u> *Sizewell Marshes SSSI is an area of grazing marsh (including Sizewell Belts nature reserve) with important assemblages of invertebrates and breeding and winter bird populations, situated adjacent to and within the nominated site boundary. There are three other SSSIs that could be affected by the nominated site; Leiston-Aldeburgh SSSI, which supports important breeding bird populations; Minsmere-Walberswick* | Sizewell Marshes SSSI is assessed in detail in the **Volume 2**, **Chapter 14** of the **ES** [AS-033]. The Aldhurst farm proposals, the Fen Meadow Plan [REP6-026] and the Wet Woodland Strategy [REP1-020] all respond directly to landtake impacts from the SSSI. A summary of the assessment of effects on invertebrates, breeding and wintering birds populations is presented below:<br><br><u>Invertebrates – Section 14.8 [AS-033], Assessment compartments 1, 2, 3, 6/6a, 7, 8, 9, 10, 11 and 12</u> |

| Paragraph and Comment | Response |
|---|---|
| *Heaths and Marshes SSSI; and the Alde-Ore Estuary SSSI.* | • **Table 14.15** [e-page 109] provides a screening assessment and details those compartments taken forward for further assessment. It concludes that compartments 6/6a, 9, and 10 can be scoped out of further assessment.<br><br>• **Table 14.16** [e-page 131] summarises the residual effects during construction and states that the habitat loss would be moderate adverse (significant) for the wet woodland assemblage, and minor adverse (not significant) on all other assemblages.<br><br>• **Table 14.17** [e-page 133] summarised the residual effects during construction and identified that there are not envisaged to be any impacts (adverse or beneficial) during operation.<br><br>Wintering and Breeding birds – Section 14.12 [AS-033]<br><br>• **Table 14.24** [e-page 167] discusses the potential ornithological effects associated with the main development site.<br><br>• **Table 14.25** [e-page 172] identifies that disturbance impacts from increased recreational pressure were scoped out for the bird assemblage of the Sizewell Marshes SSSI. |

| Paragraph and Comment | Response |
| --- | --- |
| | • **Table 14.32** [e-page 219] summarises the effects on the bird assemblage associated with the Sizewell Mashes SSSI during construction:<br>• Effects from habitat loss would be minor adverse (not significant); and<br>• Disturbance effects would be minor adverse (not significant).<br>**Table 14.33** [e-page 225] summarises the effects on the bird assemblage associated with the Sizewell Mashes SSSI during operation:<br>Disturbance effects would be minor adverse (not significant).<br>An overview of the assessment in relation to the three other SSSIs identified in paragraph 4.12 is summarised below.<br><br>Leiston-Aldeburgh SSSI<br>There would be no direct land take from this site. **Volume 2**, **Appendix 14A7** of the **ES** [APP-237] identified that this sites supports the following species:<br>- Bittern;<br>- Gadwall; |

| Paragraph and Comment | Response |
|---|---|
| | - White-fronted Geese;<br>- Marsh Harrier; and<br>- Nightjar.<br><br>Whilst not assessed individually, **Section 14.12** of **Volume 2**, **Chapter 14** of the **ES** [AS-033] presents an assessment of the effects on the IEFs above as collective population across all designated sites within the ZoI. These disturbance effects are predicted to be minor adverse (not significant). **Section 2.9** of **Volume 1**, **Chapter 2** of the **First ES Addendum** [AS-181] provides an updated assessment to consider the accepted changes and confirms there would be no change to the original assessment,<br><br>Due to the distance between the main development site and this site (0.7km) there would be no direct or indirect impacts on invertebrate species.<br><br>Minsmere-Walberswick Heaths and Marshes SSSI<br><br>This site is considered within **Volume 2**, **Chapter 14** of the **ES** [AS-033] as its own IEF. Effects on the breeding and wintering bird assemblage associated with this site from |

| Paragraph and Comment | Response |
| --- | --- |
| | construction disturbance and disturbance from recreational pressure are considered minor adverse (not significant) .<br><br>**Volume 2**, **Appendix 14A4** of the **ES** [APP-231] identifies that assessment compartment 6 lie within Minsmere Walberswick Heaths and Marshes SSSI. **Volume 2**, **Chapter 14** of the **ES** [AS-033] identifies that this compartment was scoped out of the detailed assessment on the following basis: "*There would be no direct habitat loss. Part of Minsmere European site/SSSI, and also supports an invertebrate assemblage of national importance. Whilst potential impact pathways exist, such as recreation pressure and hydrological effects, however the effects would be mitigated through primary and tertiary mitigation measures outlined in Section 14.12 of this chapter. The invertebrate assemblage present within this compartment would not be directly affected by the proposed development*."<br><br>Alde-Ore Estuary SSSI<br><br>This site is considered within **Volume 2**, **Chapter 14** of the **ES** [AS-033] as its own IEF. Effects on the breeding and wintering bird assemblage associated with this site from construction disturbance and disturbance from recreational pressure are considered minor adverse (not significant). |

| Paragraph and Comment | Response |
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| | Due to the distance between the main development site and this site (5km) there would be no direct or indirect impacts on invertebrate species. |
| *<u>4.13</u> The above designated sites include RSPB reserves adjacent to the nominated site (Minsmere) and within 1.5km to the north (North Warren).* | The RSPB Minsmere reserve site is considered in the **Volume 2**, **Chapter 14** of the **ES** [AS-033] and sHRA through its designation in large part as a SSSI and under both SPA and SAC designations. Please see the response provided for Paragraph 4.10.<br><br>North Warren is included in the assessment presented within the **ES** [AS-033] by way of its inclusion as part of the 'Leiston - Aldeburgh' SSSI considered as part of the SSSIs underpinning the Sandlings SPA. North Warren is identified by the RSPB to contain grazing marshes, reedbeds, heathland and woodland. The RSPB notes that thousands of ducks, swans and geese use the marshes in winter, while spring brings breeding bitterns, marsh harriers, woodlarks and nightingales. They also note that there are many species of butterflies and dragonflies that are known to be within the site. Effects on these are described within **Volume 2**, **Chapter 14** of the **ES** [AS-033].<br><br>There would be no direct impacts on the habitats present within the site, however, minor adverse effects as predicted from disturbance effects on habitats from displacement of recreational users;<br><br>Impacts on breeding wintering bird assemblage from disturbance effects (light noise and visual) during construction would be minor adverse (not significant). |

| Paragraph and Comment | Response |
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| | Impacts on breeding wintering bird assemblage from disturbance due to increased recreational pressure during construction would be minor adverse (not significant); and<br><br>Impacts on breeding  wintering bird assemblage during operation would be minor positive (not significant).<br><br>There would be no impact on the invertebrate assemblage. |
| *4.14 There are four National Nature Reserves (NNRs) within 20km of the nominated site. These are Orfordness-Havergate; Suffolk Coast; Westleton Heath and Benacre.* | SZC Co has considered the four National Nature Reserves (NNR) and can confirm:<br><br>• Orfodness Havergate National Nature Reserve (NNR) is located 7.7km from the main development site at is closest point.<br><br>• Suffolk Coast NNR is located 4.47km from the main development site at is closest point.<br><br>• Westleton Heath is located 3.04km from the main development site at is closest point.<br><br>• Benacre NNR is located 3.49km from the main development site at is closest point.<br><br>These NNRs are not covered in any volumes of the ES as they were considered too remote to be likely to experience an impact pathway to the proposals. |

| Paragraph and Comment | Response |
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| *4.15 At the local level, a number of protected and priority habitats and species are associated with the area and are likely to be on or within close proximity of the nominated site.* | A summary of the mitigation measures relevant to the protected and priority habitats and species is being prepared and submitted at deadline 7 in response to **Bio.2.11** to account for additional mitigation presented within the recent updates to the **TEMMP** and draft licence submissions to Natural England (as detailed within **Section 2.9** of the **Fourth ES Addendum** [REP7-030]). SZC Co would like to clarify that **Appendix 7B**, prepared in response to **Bio.1.5** to **1.7** [REP2-109] did consider these.<br><br>A detailed baseline of the sites, including details of local records is included within the supporting appendices to the **ES**. This has been used to identify relevant IEFs for each of the sites. The **ES** provides details of protected or priority habitats within the assessment, including a detailed baseline and clarifies whether they are scoped in, or out, of the detailed assessment. Further information for the main development site and the associated development sites is presented in the locations detailed below:<br><br>Main development site, described in **Volume 2**, **Chapter 14 Appendices 14A3** to **Appendix 14A9** of the **ES** [APP-228 to APP-249]. The following species groups were scoped in for further assessment:<br>• Plants and habitats;<br>• Invertebrates; |

| Paragraph and Comment | Response |
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| | • Fish;<br>• Amphibians;<br>• Reptiles;<br>• Ornithology;<br>• Bats, and<br>• Terrestrial Mammals.<br>Northern park and ride, described in **Table 1.16** on e-page 62 of **Volume 3**, **Chapter 7**, **Appendix 7A** [APP-364]. The following species were scoped in for further assessment:<br>• Great crested newt; and<br>• Bat assemblage.<br>Southern park and ride, described in **Table 1.11** on e-page 52 of **Volume 4**, **Chapter 7**, **Appendix 7A** [APP-395]. The following species were scoped in for further assessment:<br>Bat assemblage |

| Paragraph and Comment | Response |
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| | Two village bypass, described in **Table 1.14** on e-page 67 of **Volume 5**, **Chapter 7**, **Appendix 7A** [APP-426]. The following habitats and species were scoped in for further assessment:<br>• Hedgerows;<br>• Lowland mixed deciduous woodland;<br>• Rivers;<br>• Floodplain grassland;<br>• Invertebrate assemblage;<br>• Breeding bird assemblage;<br>• Bat assemblage;;<br>• Water vole and<br>• Otter. |

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| | Sizewell link road, described in **Table 1.12** on e-page 66 of **Volume 6**, **Chapter 7**, **Appendix 7A** [APP-462]. The following habitats and species were scoped in for further assessment:<br>• Lowland mixed deciduous woodland;<br>• Ponds;<br>• Hedgerows;<br>• Great crested newt;<br>• Breeding bird assemblage; and<br>• Bat assemblage.<br>Yoxford, described in **Table 1.7** on e-page 44 of **Volume 7**, **Chapter 7**, **Appendix 7A** [APP-495]. The following habitats were scoped in for further assessment:<br>• River habitat.<br>Freight management facility, described in **Table 1.7** on e-page 41 of **Volume 8**, **Chapter 7**, **Appendix 7A** [APP-524]. The following species were scoped in for further assessment: |

| Paragraph and Comment | Response |
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| | • Bat assembla.ge<br><br>Rail, described in **Table 1.16** on e-page 78 of **Volume 9**, **Chapter 7**, **Appendix 7A** [APP-556]. The following species were scoped in for further assessment:<br><br>• Great crested newt; and<br><br>• Bat assemblage.<br><br>The assessments are presented in the following locations:<br><br>• **Environmental Statement** [AS-033, APP-363, APP-394, APP-425, APP-461, APP-494, APP-523, APP-555 and APP-578]<br><br>• **First Environmental Statement Addendum [**AS-180 to AS-189]<br><br>• **Second Environmental Statement Addendum** [REP5-063 to REP5-069]<br><br>• **Fourth Environmental Statement Addendum** [REP7-030]<br><br>With the exception of Invertebrate compartments 1,2 and 4, Deptford Pink, Suffolk Shingle and Sizewell Levels and Associated Areas CWS and Southern Minsmere Levels CWS at the main development site during construction, adverse effects on all of these habitats and species are considered to not significant. |

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| *5.9 Throughout the construction, operation and decommissioning phases of a nuclear power station, the potential exists for the accidental release of pollutants into the environment, which could have significant impacts on biodiversity. However, the risks of accidental releases would be minimised by the existing risk assessment and regulatory processes that are referred to in the sections on Air Quality and Water Resources. Construction activities, such as earthworks, new buildings and infrastructure could lead to direct habitat loss, increased noise disturbance and impacts on air and water quality, which,in turn, could affect sensitive ecosystems. During operation, the cooling and discharge of heated water and routine discharge of radioactive material could affect aquatic habitats and species if not managed appropriately* | These effects identified in paragraph 5.9 are fully assessed in the **ES**.<br>Effects from heated water I are considered in **Volume 2**, **Chapter 22** of the **ES** [AS-035]. Further information on effects from heated water is provided in response to Paragraph 5.14. The assessment of effects associated with discharges of radioactive material are considered in **Volume 2**, **Chapter 25** of the **ES**, where it is concluded that there are no significant effects identified from the routine radiological discharges of the Sizewell C development [APP-340].<br>Accidental releases as described are covered in the Major Accidents and Disasters assessment presented in **Volume 2**, **Chapter 24** of the **ES** [APP-344] Risk ID C17, C18,O14 and O17. The residual risks are considered tolerable if as low as reasonably practicable (not significant).<br>Habitat loss is fully covered in the terrestrial ecology chapters of the ES and subsequent ES addenda, for the relevant sites, as are any increases in noise disturbance and the impacts on air and water quality. The findings of the assessments as described in response to Paragraph 5.8 also apply here. |
| *5.10 There is the potential that activities may lead to detrimental effects on, and displacement of, important bird populations associated with the Minsmere-Walberswick SPA and Ramsar sites* | A summary of the effects on important bird populations associated with the Sizewell Marshes SSSI, and the location of the assessment within the **Volume 2**, **Chapter 14** of |

| Paragraph and Comment | Response |
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| *and Sizewell Marshes SSSI. This may include visual and noise disturbance from general construction and operation site activities, plus potential impacts from construction traffic and site lighting.* | the **ES** [AS-033] and **Section 2.9** of **Volume 1**, **Chapter 2** of the **First ES Addendum** [AS-181], is described above in response to Paragraph 4.12.<br><br>A summary of the effects on important bird populations associated with the Minsmere-Walberswick SPA and Ramsar sites, and the location of the assessment within the **sHRA Report** [APP-145], is described above in response to Paragraph 4.10. |
| 5.11. *The site boundary indicates a land-take from Sizewell Marshes SSSI. Construction and the presence of development are likely to lead to direct loss and fragmentation of priority terrestrial and coastal habitats (including habitats within Minsmere-Walberswick Heaths and Marshes SAC; and Sizewell Marshes SSSI; and Outer Thames SPA) and wildlife corridors for protected species. This may include direct loss of grazing marsh and coastal habitats, through the construction of a new access road and a potential marine landing station. Indirect impacts may also occur at four National Nature Reserves (NNRs) in the region. Within 20km of the site* | The landtake of habitats on the sites mentioned are fully addressed in **Table 14.12** (habitats) [AS-033], **Table 14.16** (invertebrates) [AS-033] and **Table 14.32** (ornithology) [AS-033] of **Volume 2**, **Chapter 14** of the **ES** and within **Section 2.9** of **Volume 1**, **Chapter 2** of the **First ES Addendum** [AS-181]. **Sections 7.7** [APP-145] and **8.8** [APP-145] (Minsmere-Walberswick Heaths and Marshes SAC) and **Section 8.10** [APP-145] (Outer Thames Estuary SPA) the **sHRA Report**.<br><br>**Volume 2**, **Chapter 14** of the **ES** [AS-033] concludes that effects from direct land take (during construction) on habitats would be minor adverse (not significant), effects on the invertebrate compartment (wet woodland) would be moderate adverse (significant) and there would be no significant adverse effects on the bird assemblage. **Volume 1**, **Chapter 2** of the **First ES Addendum** presents an updated assessment of effects associated with the clear span SSSI crossing using the revised land take calculation (**Table 2.36** [AS-181] and concludes the land take effects would remain minor adverse (not significant). |

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| | The sHRA concludes the following:<br><br>In relation to habitats of the Minsmere-Walberswick Heaths and Marshes SAC it is concluded that the construction, operation and decommissioning activities of Sizewell C would not adversely affect the integrity of the Minsmere to Walberswick Heaths and Marshes SAC in view of its conservation objectives<br><br>In relation to the bird assemblage of the Minsmere-Walberswick Heaths and Marshes SAC it is concluded that it is not possible to discount the possibility of an adverse effect on the marsh harrier population occurring as a consequence of noise and visual disturbance from construction and decommissioning activities. With the exception of this effect, no other adverse effects on marsh harrier, or any other species are predicted. It is concluded, therefore, that an adverse effect on the integrity of the Minsmere-Walberswick SPA cannot be excluded due to noise and visual disturbance from construction and decommissioning activities<br><br>In relation to the bird assemblage of the Outer Thames Estuary SPA the Sizewell C development would not result in adverse effects on the integrity of the Outer Thames Estuary SPA. Specifically, with reference to the conservation objectives for the SPA, it is predicted that the Sizewell C development would not:<br><br>• affect the extent and distribution of the habitats of the qualifying features; |

| Paragraph and Comment | Response |
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| | • adversely affect the structure and function of the habitats of the qualifying features;<br>• adversely affect the supporting processes on which the habitats of the qualifying features rely;<br>• adversely affect the populations of each of the qualifying features; and<br>• adversely affect the distribution of the qualifying features within the site.<br><br>As identified in response to Paragraph 4.14, there would be no direct landtake from the four identified NNRs would and they are located beyond the likely zones of influence of any indirect effects as they considered too remote to be likely to be subject to experience an impact pathways to the proposals. |
| *5.12 Biodiversity would also be affected at a more local level if important habitats/species (for example, UK Biodiversity Action Plan habitats/species or legally protected species) are present within, or in close proximity to, the site.* | UK Biodiversity Action Plan habitats/species or legally protected species County Wildlife Sites have been considered in the **ES**. Please see the response provided at Paragraph 4.15 above which also applies in response to paragraph 5.12. |
| *5.13: There will be a need for the developer to avoid or minimise such losses and disturbance to protected species through careful site layout, design, routing, location of the development,* | These points are covered fully in response to Paragraph 4.15 above however details of primary mitigation measures to avoid or minimise such losses and disturbance to protected species are included within the following locations: |

| Paragraph and Comment | Response |
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| *associated infrastructure, and construction management and timings. There is potential for habitat creation within the wider area in order to replace lost 'wet meadows' habitats of the Sizewell Marshes SSSI, but it may not be possible to fully compensate for losses of this habitat.. The developer will therefore need to develop an ecological mitigation and management plan to minimise the impacts.* | Main Development Site<br>• **Section 14.4** of **Volume 2**, **Chapter 14** of the **ES** [AS-033];<br>• **Sections 2.9d) ii) b)** [AS-181], **d) iii) b)** [AS-181], **e) ii)** [AS-181], **f) ii)** [AS-181], **g) ii)** [AS-181], **h) ii)** [AS-181], **i) ii)** [AS-181] **and j) ii)** [AS-181] of **Volume 1**, **Chapter 2** of the **First ES Addendum**;<br>• **Section 2.4** of **Volume 1**, **Chapter 2** of the **Second ES Addendum** [REP5-064];<br>• **Section 2.9 ii)** of **Volume 1, Chapter 2** of the **Fourth ES Addendum** [REP7-030];<br>• **Outline Landscape and Ecology Management Plan** (Doc Ref 8.2); and<br>• **The on-site Marsh Harrier Compensatory Habitat Strategy** (Doc Ref. 9.16 (A)).<br>Northern Park and Ride<br>• **Section 7.5** of **Volume 3**, **Chapter 7** of the **ES** [APP-363]; and<br>• **Associated Development Design Principles** (Doc Ref. 8.3).<br>Southern Park and Ride |

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| | • **Section 7.5** of **Volume 4**, **Chapter 7** of the **ES** [APP-394]; and<br>• **Associated Development Design Principles** (Doc Ref. 8.3).<br>Two Village Bypass<br>• **Section 7.5** of **Volume 5**, **Chapter 7** of the **ES** [APP-425];<br>• **Section 5.6** of **Volume 1**, **Chapter 5** of the **Second ES Addendum** [AS-184];<br>• **Associated Development Design Principles** (Doc Ref. 8.3); and<br>• **Two Village Bypass Landscape and Ecology Management Plan** (Doc Ref. 8.3 A).<br>Sizewell Link Road<br>• **Section 7.5** of **Volume 6, Chapter 7** of the **ES** [APP-461];<br>• **Section 6.6** of **Volume 1**, **Chapter 6** of the **First ES Addendum** [AS-185];<br>• **Associated Development Design Principles** (Doc Ref. 8.3); and |

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| | • **Sizewell Link Road Landscape and Ecology Management Plan** (Doc Ref. 8.3 B).<br><br>Yoxford Roundabout<br><br>• **Section 7.4b)** of **Volume 7**, **Chapter 7** of the **ES** [APP-494]; and<br><br>• **Associated Development Design Principles** (Doc Ref. 8.3).<br><br>Freight Management Facility<br><br>• **Section 7.5** of **Volume 8**, **Chapter 7** of the **ES** [APP-523]; and<br><br>• **Associated Development Design Principles** (Doc Ref. 8.3).<br><br>Rail<br><br>• **Section 7.5** of **Volume 9**, **Chapter 7** of the **ES** [APP-555];<br><br>• **Section 9.5** of **Volume 1**, **Chapter 9** of the **First ES Addendum** [AS-188]; and<br><br>• **Associated Development Design Principles** (Doc Ref. 8.3).<br><br>Details of construction management measure are provided in the following locations: |

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| | Main Development Site<br><br>• **Part B** of the **CoCP** (Doc Ref. 8.11)<br><br>• **Sizewell C Project Draft Bat Method Statement** [REP7-080 to REP7-085] and **main development site Bat Mitigation Strategy** [APP-252];<br><br>• **Main development site Badger Draft Licence Method Statement** [REP5-049] and **main Development Site Badger mitigation strategy** [APP-225];<br><br>• **Main development site Water Vole Draft Licence** [REP5-050] and **main development site Water Vole Mitigation Strategy** [APP-252];<br><br>• **Main development site Draft Natterjack Toad Licence** [REP5-053] and **main development site Natterjack Toad Mitigation Strategy** [APP-252];<br><br>• **Main development site Deptford Pink Draft Licence** [REP5-052];<br><br>• **Main development site Otter Draft Method Statement** [REP5-051];<br><br>• **Main development site Bat Non-licensable Method Statement** (Doc Ref. 6.3 14C1B(A)) |

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| | • **Main development site Reptile Non-licensable Method Statement** (Doc Ref. 14C2B(A)) ;<br><br>• **Main development site Great Crested Newt Method Statement** (Doc Ref. 6.14 2.9C(A)); and<br><br>• **Freshwater Fish and Aquatic Invertebrates Mitigation Strategy** (Doc Ref. 8.11 A(E)).<br><br>Northern Park and Ride<br><br>• **Part C** of the **CoCP** (Doc Ref. 8.11)<br><br>• **Sizewell C Project  Bat Method Statement** [REP7-080 to REP7-085];<br><br>• **Northern Park and Ride Great Crested Newt Licence** [REP7-025];<br><br>• **Northern Park and Ride Bat Non-licensable Method Statement** (Doc Ref. 6.4 7A6A; and<br><br>• **Northern Park and Ride Reptile Non-licensable Method Statement** (Doc Ref. 6.47A6B).<br><br>Southern Park and Ride |

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| | • **Part C** of the **CoCP** (Doc Ref. 8.11)<br>• **Sizewell C Project Bat Method Statement** [REP7-080 to REP7-085];<br>• **Southern Park and Ride Bat Non-licensable Method Statement** (Doc Ref. 6.5 7A5A); and<br>• **Southern Park and Ride Reptile Non-licensable Method Statement** (Doc Ref. 6.5 7A5B).<br><br>Two Village Bypass<br>• **Part C** of the **CoCP** (Doc Ref. 8.11)<br>• **Sizewell C Project Bat Method Statement** [REP7-080 to REP7-085];<br>• **Two Village Bypass Badger Method Statement** [REP5-054];<br>• **Two Village Bypass Water vole Method Statement** [REP5-055];<br>• **Two Village Bypass Bat Non-licensable Method Statement** (Doc Ref. 6.6 7A6A); |

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| | • **Two Village Bypass Great Crested Newt Non-licensable Method Statement** (Doc Ref. 6.6 7A6B);<br>• **Two Village Bypass Otter Non-licensable Method Statement** (Doc Ref. 6.6 7A6C); and<br>• **Two Village Bypass Reptiles Non-licensable Method Statement** (Doc Ref. 6.6 7A6D).<br><u>Sizewell Link Road</u><br>• **Part C of** the **CoCP** (Doc Ref. 8.11)<br>• **Sizewell C Project  Bat Method Statement** [REP7-080 to REP7-085];<br>• **Sizewell Link Road Great Crested Newt Licence** [REP7-026 and REP7-026a];<br>• **Sizewell Link Road Bat Non-licensable Method Statement** (Doc Ref. 6.7 7A6A); and<br>• **Sizewell Link Road Reptile Non-licensable Method Statement** (Doc Ref. 6.7 7A6B).<br><u>Yoxford Roundabout</u> |

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| | • **Part C** of the **CoCP** (Doc Ref. 8.11).<br><br>Freight Management Facility<br><br>• **Part C** of the **CoCP** (Doc Ref. 8.11);<br><br>• **Sizewell C Project  Bat Method Statement** [REP7-080 to REP7-085];<br><br>• **Freight Management Facility Bat Non-licensable Method Statement** (Doc Ref. 6.9 7A4A); and<br><br>• **Freight Management Facility Reptile Non-licensable Method Statement** (Doc Ref. 6.9 7A4B).<br><br>Rail<br><br>• **Part C** of the **CoCP** (Doc Ref. 8.11);<br><br>• **Sizewell C Project  Bat Method Statement** [REP7-080 to REP7-085];<br><br>• **Rail Great Crested Newt Licence** [REP7-086];<br><br>• **Rail Great Crested New Non-licensable Method Statement** (Doc Ref. 6.10 7A6A); and |

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| | • **Rail Reptile Non-licensable Method Statement** (Doc Ref. 6.10 7A6B). |
| *5.14 Cooling water abstraction may impact on fish species as the coastal waters adjacent to the site are important and prosperous fisheries for a range of commercial species. The incorporation of fish protection measures within cooling water intake/system design will therefore need to be secured to safeguard the marine environment. Discharge of heated waters into the North Sea may affect aquatic ecology but further studies by the developer are necessary to determine impact. Increased boat activity in the Outer Thames Estuary SPA related to a marine landing station may also impact aquatic ecology but again further studies by the developer would be required to determine the impact* | These points are fully addressed in the marine ecology chapter of the **ES** and the **sHRA** as relevant, the locations of these are summarised below:<br><br>Fisheries baseline is described **Volume 2**, **Chapter 22** of the **ES** in **Sections 22.4 c.e** [AS-035] and **22.8** [AS-035] and in **Appendix 22D** [APP-321].<br><br>Fish protection measures can be found in **Section 2.5 D** of **Volume 2**, **Chapter 22** of the **ES** [AS-035] and **Section 3.9 c) ii.** of **Volume 1**, **Chapter 3** of the **Fourth ES Addendum** [REP7-030].<br><br>An assessment of discharges of heated waters is provided in **Section 22.8 D.c.f** of **Volume 2**, **Chapter 22** of the **ES** [AS-035] and summarised in **Table 22.162** [AS-035] where effects are described as negligible (not significant).<br><br>Consideration of the potential impacts of increased vessel activity is given in **Volume 2**, **Chapter 22** of the **ES** [AS-035]. The only effects considered within the detailed are those on marine mammals (see **Sections 22. 9 C.b.b** [AS-035] and **22.9 C.b.d** [AS-035] and **Table 22.158** [AS-035]. Effects on all other aquatic ecological receptors are scoped out on the basis they would not be significant. |

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| 5.15. *Hydrologically the site is continuous with the Sizewell Marshes SSSI, a sensitive grazing marsh area. There is risk of pollution into watercourses from a range of sources during all phases of the power station life cycle. Risks would be minimised and impacts avoided through safe operation and monitoring procedures. Also, it is unclear what effect a development would have on the water table.* | Natural England (Doc Ref. 9.10.7(A)) and the Environment Agency [REP7-090] agree, via SOCGs, that the CoCP (Doc Ref. 8.11) will ensure that there are no substantive risks from water pollution.<br><br>The impact on the water table is fully assessed in the Groundwater chapter for the MDS in the **ES** (see **Section 18.6** of **Volume 2**, **Chapter 19** [APP-280]). The modelling has been agreed with then EA. All parties, including SWT, agree that SZC will be able to maintain water levels within the Sizewell Marshes SSSI. |
| 5.16. *Further studies carried out by the developer through the EIA process will be required in order to fully understand the potential effects on designated sites and on biodiversity in the area as a whole.*<br><br>*Design and mitigation measures should in the first instance seek to avoid and minimise loss of habitat and avoid disturbance of legally protected species. Once defined, mitigation measures could be implemented through an ecological mitigation and management plan or similar document.* | The EIA undertaken fully addressed the potential effects on designated sites and on biodiversity in the area as a whole, the locations of these assessments are provided in response to Paragraph 4.9.<br><br>The response to Paragraph 5.13 demonstrate the design and mitigation measures in place.<br><br>SZC Co. has undertaken a Biodiversity Net Gain Assessment using Metric 2.0 (see [REP1-004] [REP5-090] [REP5-091] and [REP5-092]. The findings of the assessment are that for the Sizewell C Project as a whole, including four elements, i.e. the main development site and three associated development sites, is similar to that presented in the previously submitted reports, with an overall 19% increase in biodiversity units predicted for the development proposals as a whole. |

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| *Opportunities for biodiversity enhancement may be possible* | |
| 5.17 *A HRA report for Sizewell[32] has been undertaken. This report should be referred to for further information relating to the effects of a new nuclear power station at Sizewell on European-designated habitat sites*<br><br>*32. Habitat Regulations Assessment Pilot Sizewell: HRA Screening and Appropriate Assessment Report.* | SZC Co confirms that the HRA report was consulted in developing the **sHRA** for the SZC proposals, most notably at the scoping stage. For example see Section 4.1 and 4.2 of the **sHRA** (scoping of European sites) [APP-147] which clarifies how the report was considered. Please see response to Paragraph 4.9 for further details. |
| 5.18 Potential Effects on Biodiversity and Ecosystems: The potential for adverse effects on sites and species considered to be of UK-wide and European nature conservation importance (the Minsmere to Walberswick Heaths and Marshes SAC/SPA/Ramsar/SSSI site, Outer Thames Estuary SPA, Sizewell Marshes SSSI sites, Leiston-Aldeburgh SSSI and the Alde-Ore Estuary SSSI) means that significant strategic effects on the biodiversity cannot be ruled out at this stage of the appraisal. There is, however, | Please see response to Paragraph 4.9 for details of the **sHRA**.<br><br>Detailed baseline surveys have been undertaken and reported within the **ES**, **sHRA Report** and subsequently submitted to examination. A full list of surveys undertaken as part of the Sizewell C Project is not provided herein, however the following links provide details of relevant survey information in relation to ornithology for the main development site:<br><br>• **Volume 2**, **Chapter 14**, **Appendix 14A7** of the **ES** [APP-237 and APP-238]; |

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| potential for the mitigation or compensation of biodiversity effects in some cases, including the creation of compensatory habitat for UK designated sites. Detailed baseline studies will form part of the project level EIA. The HRA for Sizewell should be referred to for further details and advice on internationally designated sites. | • **Breeding Bird & Waterfowl Survey Report 2020** [AS-021];<br>• **Tern Survey Report 2020** [AS-022];<br>• **Marsh Harrier Survey Report 2020** [AS-036];<br>• **Barn Owl and Nightjar Survey Report 2020** [AS-035];<br>• **Wintering Bird Survey Report 2019 to 2020** [AS-208];<br>• **Additional Incidental Bird Sightings Report July to September 2020** [AS-208];<br>• **White-fronted Goose Report** [REP5-125]; and<br>• **Bittern Survey Report** [REP7-027].<br>Further information on primary mitigation measures is provided in response to Paragraph 5.13.<br>The Sizewell C Project has identified the potential for creation of compensatory habitat, which are to be secured by requirement, as defined within the following documents:<br>• **Fen Meadow Strategy** (Doc Ref. 6.14 2.9D) and **Fen Meadow Plan Draft** (Doc Ref. 9.34) |

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| | • **Wet Woodland Strategy** (Doc Ref. 9.8) and **Wet Woodland Plan Draft** (Doc Ref. 9.108)<br>• **Outline Landscape and Ecology Management Plan** (Doc Ref 8.2);<br>• **The on-site Marsh Harrier Compensatory Habitat Strategy** (Doc Ref. 9.16 (A)); and<br>• **The Westleton Marsh Harrier Compensatory Habitat Strategy** (Doc Ref. 9.35(A)).<br><br>It should also be noted that EDF Energy has created compensatory habitat at Aldhurst Farm ahead of the DCO submission. |
| National Policy Statement for Nuclear Power Generation (EN-6) Volume II of II - Annexes | |
| C.8.52 A number of responses expressed concern over the impacts that a new nuclear power station may have on European protected sites which are situated near the site. These concerns include impacts on protected bird populations (including nightjar, woodlark and little tern), water quality, fish and shellfish populations and the effects of cooling water abstraction and | **Volume 2**, **Chapter 14** of the **ES** [AS-033] considers nightjar, woodlark and little tern<br><br>Nightjar<br><br>Consideration of displacement effects from habitat loss and fragmentation as well as potential disturbance effects from noise, lighting and visual influences and recreational pressure<br><br>Woodlark |

| Paragraph and Comment | Response |
|---|---|
| discharge. There was a particular concern that the recently designated Outer Thames Estuary Special Protection Area (SPA) should be considered as part of the assessment. | Consideration of displacement effects from habitat loss and fragmentation as well as potential disturbance effects from noise, lighting and visual influences and recreational pressure<br><br><u>Little tern</u><br><br>Consideration of potential disturbance effects from noise, lighting and visual influences and recreational pressure. These are considered as part of the qualifying features of the Outer Thames Estuary SPA.<br><br>None of the effects described above are considered significant.<br><br>sHRA also considers nightjar, woodlark and little te rn in relation to the Outer Thames Estuary SPA and confirms in Paragraph 8.10.66 and 67 (e page 567 [APP-145] that "*It is concluded that, with the adoption of the proposed mitigation measures (including those embedded into the design), the Sizewell C development would not result in adverse effects on the integrity of the Outer Thames Estuary SPA. 8.10.67. Specifically, with reference to the conservation objectives for the SPA, it is predicted that the Sizewell C development would not:*<br><br>• *affect the extent and distribution of the habitats of the qualifying features;*<br><br>• *adversely affect the structure and function of the habitats of the qualifying features;* |

| Paragraph and Comment | Response |
| --- | --- |
| | • *adversely affect the supporting processes on which the habitats of the qualifying features rely;*<br>• *adversely affect the populations of each of the qualifying features; and*<br>• *adversely affect the distribution of the qualifying features within the site."* |
| C.8.53 The Appraisal of Sustainability has identified the potential for adverse effects on sites and species considered to be of European nature conservation importance. This means that significant strategic effects on the biodiversity cannot be ruled out at this stage of the appraisal. The findings of the Appraisal of Sustainability on European Sites are drawn from the Habitats Regulations Assessment for Sizewell. The Habitats Regulations Assessment notes that its key findings are limited by the strategic nature of the assessment process and the information available, which does not generally allow for a definitive prediction of effects on the European | Sandlings SPA<br><br>Woodlark and nightjar in Sandlings SPA are considers in respect of the following effect pathways (starting e-page 577 [APP-145]):<br>• Changes in air quality during construction, operation and decommissioning.<br>• Direct habitat loss and fragmentation during construction, operation and decommissioning.<br>• Disturbance effects on species populations during construction, operation and decommissioning.<br>• Disturbance due to increase in recreational pressure during construction, operation and decommissioning |

| Paragraph and Comment | Response |
|---|---|
| Sites considered. A precautionary approach suggests that the assessment at this strategic level cannot rule out the potential for adverse effects on the integrity of nine European Sites (Alde-Ore and Butley Estuaries Special Area of Conservation (SAC), Alde-Ore Estuary SPA / Ramsar, Minsmere to Walberswick Heaths and Marshes SAC, Minsmere to Walberswick SPA/ Ramsar, Orfordness-Shingle Street SAC, Sandlings SPA, Outer Thames Estuary SPA) through potential impacts on water resources and quality, habitat and species loss and fragmentation, and disturbance (noise, light and visual). For example, the assessment has identified that development could result in habitat loss which could affect breeding populations of woodlark and nightjar in Sandlings SPA or cause disturbance to little terns in the Minsmere to Walberswicke SPA and Ramsar. | • No potential effects were screened in for Appropriate Assessment in relation to associated development sites.<br><br>It is concluded that, with the adoption of the proposed mitigation measures (including those embedded into the design), the Sizewell C development would not result in adverse effects on the integrity of the Sandlings SPA (Paragraph 8.11.77, e-page 591) [APP-145].<br><br>Minsmere to Walberswick SPA and Ramsar<br><br>It is concluded that, with the adoption of the proposed mitigation measures (including those embedded into the design), the Sizewell C development would not result in adverse effects on the integrity of the Minsmere to Walberswick SPA and Ramsar (Paragraph 8.8.557, e-page 536) [APP-145]. |

| Paragraph and Comment | Response |
|---|---|
| C.8.54 The Habitats Regulations Assessment on sites of international importance has proposed a suite of avoidance and mitigation measures to be considered as part of the project level Habitats Regulations Assessment. At this stage, it is assessed that the effective implementation of the proposed suite of avoidance and mitigation measures may help to address adverse effects on European Site integrity, but that more detailed project level Habitats Regulations Assessment is required to reach conclusions that are in accordance with the requirements of the Habitats Directive. | Avoidance and mitigation measures relevant to the **sHRA** are detailed through the sHRA and subsequent addenda.<br><br>**Section 11.6** and **Table 11.1** provide a schedule of mitigation measures, timing and securing permissions relevant to the HRA [APP-145].<br>Additional avoidance and mitigation measure are also set out in the following addenda as relevant:<br>• **sHRA Volume 4 - Compensatory Measures** [APP-152]<br>• The **sHRA Report First Addendum** [AS-173]<br>• The **sHRA Report Second Addendum**<br>• The **sHRA Report Third Addendum** [REP7-279] |
| C.8.55 The Outer Thames Estuary SPA is considered in the Habitats Regulations Assessment. The assessment concludes that adverse effects on water resource and quality, habitat loss and fragmentation, and disturbance (noise, light and visual) cannot be ruled out until further site specific detail including on technology | The **sHRA** provides an assessment of adverse effects on water resource and quality, habitat loss and fragmentation, and disturbance (noise, light and visual) on the Outer Thames Estuary SPA on little tern, common tern and red-throated diver at the following locations: |

| Paragraph and Comment | Response |
|---|---|
| and mitigation measures, and processes such as the extent and location of coastal defences, dredging, or marine offloading facilities) are known. Air Quality impacts on the Outer Thames Estuary SPA were screened into the appropriate assessment due to the close proximity of the SPA to Sizewell. However, after further consideration, adverse effects on site integrity have been ruled out. It is considered unlikely that any localised changes to air quality will reach a level that results in impacts on the integrity of the SPA. | Water resource and quality: Considered in relation to little tern (e-page 550), common tern (e-page 551) and red-throated diver (e-page 561). No adverse effects on the populations of the Outer Thames Estuary SPA are predicted.<br><br>Habitat loss and fragmentation: Considered in relation to little tern, common tern and red-throated diver (e-page 566). No adverse effects on the populations of the Outer Thames Estuary SPA are predicted.<br><br>Disturbance: Considered in relation to little tern (e-page 550), common tern (e-page 558) and red-throated diver (e-page 564). No adverse effects on the populations of the Outer Thames Estuary SPA are predicted. This is because noise and visual disturbance in the marine environment as a result of construction activities would represent small changes relative to the existing situation (in terms of vessel traffic) or would produce effects which extend over relatively small parts of the foraging ranges only and which are largely of temporary nature and produced by activities which would be of relatively short duration. During operation noise and visual disturbance during operation of the Sizewell C Project are unlikely to differ substantially from the existing situation, except in relation to artificial lighting. |
| C.8.56 The Government notes the scope for avoidance and mitigation identified in the Habitats Regulations Assessment, and the need for more detailed studies should an application for development consent come forward. Given that | Further assessment has been undertaken and is presented within the following documents:<br><br>• **Shadow HRA** [APP-145 to APP-152]; |

| Paragraph and Comment | Response |
|---|---|
| the Habitats Regulations Assessment has not been able to rule out adverse impacts on sites of European nature conservation importance, the Government has carefully considered whether it is appropriate to include this site in the NPS. | • **Shadow HRA first addendum** [AS-173 to AS-178] to consider Proposed Changes 1 to 15 as appropriate to the shadow HRA;<br>• **Shadow HRA second addendum** [REP2-032], submitted to report an update to the calculations of potential change in recreational use of European sites by displaced visitors and construction workers; and<br>• **Shadow HRA third addendum** [REP7-279], submitted to consider Proposed Change 19 (Desalination Plant). |
| C.8.57 Annex A of this NPS sets out that the Government has concluded that there is an Imperative Reason of Overriding Public Interest that favours the inclusion of this site in the Nuclear NPS despite the inability to rule out adverse effects on European Sites at this stage. This takes into account the need for sites to be available for potential deployment by the end of 2025, the lack of alternatives, and the consideration given to compensatory measures. | No response required . |

| Paragraph and Comment | Response |
|---|---|
| C.8.58 See the relevant guidance in EN-1, including that on the Environmental Statement, Habitats Regulations Assessment and biodiversity and geological conservation. See the relevant guidance in Part 3 of this NPS, including that on biodiversity and geological conservation. | No response required. |
| C.8.59 The IPC should also refer to the Appraisal of Sustainability and Habitats Regulations Assessment for Sizewell and consider whether the applicant's proposals have sufficiently taken into account the issues identified, where they are still relevant. | This AoS Route Map has been prepared to assist the ExA's consideration of this point. |
| C.8.60 Some responses focused on designated sites including Sizewell Marshes Site of Special Scientific Interest (SSSI) and Leiston-Aldeburgh SSSI, and potential effects on Minsmere-Walberswick Heaths and Marshes SSSI, from which the site boundary includes some land-take. | The location of these figures can be seen on Figure 7.1 on e-page 149 of [REP2-109] and Figure 7.9 on e-page 160 [REP2-109].<br><br>Direct land take form these designated sites is summarised in below: |

| Paragraph and Comment | Response |
| --- | --- |
| Some responses questioned how direct land take could be mitigated. Responses were particularly concerned that an access road which is reflected in the site boundary could result in the loss of woodland and heathland habitat at Kenton Hills, Goose Hills and Sizewell Belts. Some responses noted that planning permission had been refused in this area in the past. | • Sizewell Marshes SSSI: There would be temporary and permanent land take grom the Sizewell Marshes SSSI and this has been assessed within the **ES** (and subsequent **ES Addenda**.<br>• Leiston-Aldeburgh SSSI. The main development site boundary has been updated following the publication of the AoS and there is no longer any proposed land take from the Leiston-Aldeburgh SSSI.<br>• Minsmere-Walberswick Heaths and Marshes SSSI: The main development site boundary has been updated following the publication of the AoS and there is no longer any proposed land take from the Minsmere-Walberswick Heaths and Marshes SSSI.<br><br>Whilst it should be noted that compensatory open water and reedbed habitats have been established at Aldhurst Farm. this landtake is proposed to be further mitigated by the following requirements, as set out in the Draft DCO:<br>• Requirement 4: Terrestrial Ecology Monitoring and Mitigation Plan (TEMMP) – provides details of monitoring of habitat creation sites as well as monitoring for retained areas of the Sizewell Marshes SSSI; |

| Paragraph and Comment | Response |
|---|---|
| | • Requirement 14: Main development site: Landscape works – OLEMP [REP2-010] provides details of habitat creation at Aldhurst Farm and within the EDF Energy Estate and how these will areas will be monitored;<br><br>• Requirement 14A: Main development site: Fen meadow - The Sizewell C proposals would lead to the permanent loss of approximately 0.46ha of 'fen meadow' habitat. Natural England advised that "*that the extent of compensatory habitat required is 9x that which would be destroyed by the development*". SZC Co. is therefore proposing to deliver 4.14ha of compensatory fen meadow habitat at three sites, Benhall, Halesworth and Pakenham; and<br><br>• Requirement 14B: Main development site: Wet woodland - The Sizewell C proposals would lead to the permanent loss of approximately 3.06ha of 'wet woodland' habitat from the Sizewell Marshes SSSI. 3.06 ha of 'wet woodland' habitat will be provided.<br><br>Volume 2, Chapter 14 of the ES [AS-033] and the updated bat impact assessment [AS-208] (starting e-page 174) provides a description of the key impacts associated with Kenton Hills, Goose Hills and Sizewell Belts. Whilst these assessment [AS-033] consider the woodland and heathland habitat within the main development site as a whole and when considering the proposed reprovision as stated in the oLEMP [REP2-110] the effects would be at minor adverse (not significant). Effects on bat species through habitat loss (roost resource, foraging and fragmentation) of these area, combined with other |

| Paragraph and Comment | Response |
|---|---|
| | areas of woodland within the main development site are considered minor adverse (not significant) for all species [4th ES Addendum and AS-208]. |
| C.8.61 The Appraisal of Sustainability identified the potential for adverse effects on sites and species considered to be of national nature conservation importance means that significant strategic effects on biodiversity cannot be ruled out at this stage of the appraisal. The Appraisal of Sustainability identifies that there could be potential significant effects at the following SSSIs which are within 5km of the site: Sizewell Marshes SSSI; MinsmereWalberswick Heaths and Marshes SSSI; Leiston-Aldeburgh SSSI; AldeOre Estuary SSSI. The Appraisal of Sustainability also notes that the above designated sites include RSPB reserves adjacent to the site (Minsmere) and within 1.5km to the north (North Warren). | The response provided at Para 4.12 and 4.13 of the Appraisal of Sustainability: Site Report for Sizewell is also relevant here. No further response is provided. |

| Paragraph and Comment | Response |
|---|---|
| C.8.62 As the site boundary also indicates land-take from Sizewell Marshes SSSI, the Appraisal of Sustainability finds that construction and the presence of development are likely to lead to direct loss and fragmentation of habitats within the Sizewell Marshes SSSI. Sizewell Marshes SSSI is an area of grazing marsh with important assemblages of invertebrates and breeding and winter bird populations. | The response provided at Para 4.12 of the Appraisal of Sustainability: Site Report for Sizewell is also relevant here. No further response is provided. |
| C8.63 The Appraisal of Sustainability identified the potential for the mitigation of biodiversity effects on sites of UK wide conservation importance (Sizewell Marshes SSSI), including the creation of replacement habitat. The Appraisal of Sustainability notes that developers could avoid or minimise losses and disturbance to protected species through careful site layout, design, routing, location of the development, associated infrastructure, and construction management and timings. The Appraisal of Sustainability finds that | The key points in this paragraph are the AoS finds ‘that there is the potential for habitat creation within the wider area in order to replace lost ‘wet meadows’ habitats of the Sizewell Marshes SSSI, whilst noting ‘that it may not be possible to fully compensate for losses of this habitat.’<br><br>SZC Co. believes that it has demonstrated the first part of this statement and disagree with the second.<br><br>SZC Co. has demonstrated the first part of the statement through the **Fen Meadow Strategy** (Doc Ref. 6.14 2.9D) and the **Fen Meadow Plan** (Doc Ref. 9.34), in which we |

| Paragraph and Comment | Response |
|---|---|
| there is potential for habitat creation within the wider area in order to replace lost 'wet meadows' habitats of the Sizewell Marshes SSSI, but also finds that it may not be possible to fully compensate for losses of this habitat. The applicant will need to develop an ecological mitigation and management plan to minimise the impacts. | identify the three sites at Benhall, Halesworth and Pakenham to deliver the compensatory habitats.<br><br>Having reviewed the baseline data for these three sites, Natural England (see Section 2 of [REP6-042]) conclude that fen meadow creation at these three sites is 'feasible'.<br><br>The loss of fen meadow habitat from the SSSI will be 0.46ha. Given the 9X multiplier set by Natural England which results in a delivery target of 4.14ha, and which embeds risks associated with habitat quality, SZC Co. conclude, on the evidence presented in the Fen Meadow Plan and on the evidence shared with the examination to date on fen meadow delivery, that creating the replacement habitat is achievable and that this will fully compensate for the loss of 0.46ha from the SSSI.<br><br>SZC Co. therefore does not agree that 'it may not be possible to fully compensate for losses of this habitat.'<br><br>The '*ecological mitigation and management plan to minimise the impacts'* referred to in the paragraph is represented by the **Fen Meadow Plan** (Doc Ref. 9.34), in relation to the compensatory habitats and by the **TEMMP** (Doc Ref. 9.4), which defines the approach to monitoring the retained areas of fen meadow on the SSSI.<br><br>The response to Paragraph c.8.60 also applies here . |
| C.8.64 The Government notes that the Appraisal of Sustainability has identified potential impacts | |

| Paragraph and Comment | Response |
|---|---|
| on nationally designated sites of ecological importance which it considers of strategic significance. Given the scope for mitigation of biodiversity effects identified in the Appraisal of Sustainability for sites of national importance it is reasonable to conclude that it may be possible to avoid or mitigate impacts to an extent. However, the Appraisal of Sustainability has highlighted that the site includes land take from Sizewell Marshes SSSI that could lead to direct impacts. | The responses provided for Paragraphs 4.12, 5.11, 5.13, 5.18 and C.8.60 are applicable to this paragraph. |
| C.8.65 The Government has carefully considered whether this site meets this criterion given the direct impact on Sizewell Marshes SSSI. However, given the need to ensure sufficient sites are available for development to meet the Government's energy policy objectives (as described in Part 2 of this NPS), the Government believes that it does. In view of the need for sites and the limited number of potentially suitable sites, the Government does not think the issues in | |

| Paragraph and Comment | Response |
|---|---|
| relation to this criterion are sufficient to justify not including the site in this NPS. The Government has also noted that there will be further assessment of any proposal for the site at project level and that EN-1 sets out detailed consideration that must be given to issues related to nationally designated sites, should an application for development consent come forward. | |
| C8.66 See the relevant guidance in EN-1, including that on the Environmental Statement and biodiversity and geological conservation. See the relevant guidance in Part 3 of this NPS, including that on biodiversity and geological conservation. | No response required. |
| C.8.67 The IPC should also refer to the Appraisal of Sustainability for Sizewell and consider whether the applicant's proposals have sufficiently taken into account the issues identified, where they are still relevant. | This **AoS Route Map** has been prepared to assist the ExA's consideration of this point. |

| Paragraph and Comment | Response |
| --- | --- |
| | |

# APPENDIX H: HABITAT REGULATION ASSESSMENT REPORT FOR SIZEWELL ROUTE MAP

# 1 HABITATS REGULATIONS ASSESSMENT: SITE REPORT FOR SIZEWELL (2010) ROUTE MAP

## 1.1 Introduction

1.1.1 The Habitats Regulations Assessment: Site Report For Sizewell (2010) presents a strategic level Habitats Regulations Assessment (HRA) Screening and Appropriate Assessment (AA) components of the HRA of the proposals for Sizewell C. The Report, in Table 2, details thirteen European Sites Scoped into the HRA Screening Assessment

1.1.2 The **Shadow Habitats Regulation Assessment (sHRA) Report** [APP-145] and its subsequent addenda considered impacts of the Sizewell C Project on a number of European sites. Section 4 [APP-145] provides a summary of the scoping of European sites, which details consideration of the Habitats Regulations Assessment: Site Report For Sizewell (2010). It summarises that a total 30 European sites were included in the likely significant effects screening assessment as detailed in Table 4.4 [APP-145] and a description of each of the sites and its qualifying features provided in Table 4.5 [APP-145].

1.1.3 The screening exercise described in **Section 5** [APP-145] concluded that likely significant effects could not be excluded for at least one screening category for 29 of the scoped in European sites (and certain relevant qualifying features). The exception was the Staverton Park and the Thicks, Wantisden SAC, for which likely significant effects could be excluded for all screening categories and qualifying features.

1.1.4 **Section 7** of the **SHRA report** [APP-145] provides an assessment of effects on Coastal, Freshwater and Terrestrial Habitats in relation to the following sites:

- Alde, Ore and Butley Estuaries SAC and Alde-Ore Estuaries Ramsar site [APP-145]
- Benacre to Easton Bavents Lagoons SAC [APP-145]
- Dew's Ponds SAC [APP-145]
- Minsmere to Walberswick Heaths and Marshes SAC [APP-145]
- Minsmere-Walberswick Ramsar site [APP-145]; and
- Orfordness to Shingle Street SAC [APP-145].

1.1.5 The **Shadow HRA** concludes that adverse effects on site integrity can be excluded for the European sites screened into the assessment (with respect to the non-bird qualifying interest features), both alone and in-combination with other plans and projects.

1.1.6 **Section 8** of the **SHRA Report** [APP-145] provides an assessment of effects on birds in relation to the following sites:

- Alde-Ore Estuary SPA [APP-145];
- Alde-Ore Estuary Ramsar site [APP-145];
- Benacre to Easton Bavents SPA [APP-145];
- Deben Estuary SPA [APP-145];
- Deben Estuary Ramsar site [APP-145];
- Minsmere–Walberswick SPA [APP-145];
- Minsmere-Walberswick Ramsar site [APP-145];
- Outer Thames Estuary SPA [APP-145];
- Sandlings SPA [APP-145];
- Stour and Orwell Estuaries SPA [APP-145]; and
- Stour and Orwell Estuaries Ramsar site [APP-145].

1.1.7 For all SPA and Ramsar qualifying features, with the exception of breeding marsh harrier at the Minsmere-Walberswick SPA and Ramsar site, it is concluded that construction, operation and decommissioning activities would not have an adverse effect on the integrity of the European sites, either alone or in-combination with other plans and projects.

1.1.8 For the breeding marsh harrier qualifying interest feature of Minsmere Walberswick SPA and Ramsar site, it is concluded that, with the adoption of the proposed mitigation measures (including those embedded into the design), an adverse effect on the integrity of these European sites cannot be excluded due to noise and visual disturbance during construction phase. Habitat improvement measures are proposed to compensate for the predicted effect on the marsh harrier population.

1.1.9 **Section 9** of the **SHRA Report** [APP-145] provides an assessment of effects on marine mammals in relation to the following sites:

- Humber Estuary SAC [APP-145];
- Southern North Sea SAC [APP-145]; and
- The Wash and North Norfolk Coast SAC [APP-145].

1.1.10 The assessment of the Humber Estuary SAC (for grey seals), the Southern North Sea SAC (for harbour porpoise) and The Wash and North Norfolk Coast SAC (for harbour seals) (based on the proportion of the management unit population potentially affected) concludes that there would be no adverse effect on the integrity of the above SACs. The in-combination assessment also concluded that there would be no adverse effect on integrity when the Sizewell C Project is assessed in-combination with other plans and projects

1.1.11 **Section 10** of the **SHRA** [APP-145] provides an assessment of effects on migratory fish in relation to the following sites:

- Humber Estuary SAC [APP-145]; and
- Mainland European SAC [APP-145].

1.1.12 For all European sites with migratory fish as qualifying interest features (river lamprey, sea lamprey and twaite shad), it is concluded that construction, operation and decommissioning activities of the Sizewell C Project would not have an adverse effect on the integrity of these European sites.

1.1.13 The **sHRA Report First Addendum** [AS-173] concluded the following:

- The proposed changes do not alter the findings of the Shadow HRA Report for these European sites. Therefore, it is concluded that there would not be an adverse effect on the integrity of these European sites.
- The proposed changes and additional information do not change the conclusion of no adverse effect on integrity European sites screened into the assessment with migratory fish qualifying interest features.
- Additional European sites were scoped in following the Environment Agency's Relevant Representation. The proposed changes and additional information do not change the conclusion of no adverse effect on integrity European sites screened into the assessment (including the additional sites) with migratory fish qualifying interest features.

1.1.14 The **sHRA Report Second Addendum** [REP2-032] concludes that there would be no changes to the conclusions of the **sHRA Report** [APP-145].

1.1.15 The **sHRA Report Third Addendum** [REP7-279] concluded that all potential effects are within the worst-case previously assessed and would not result in changes to the existing in-combination assessments.

## 1.2 Comparison of Screening Assessments

1.2.1 **Table 2** has been prepared to act as a comparison between the Summary of Likely Significant Effect Screening presented in Table 3 of the Habitats Regulations Assessment: Site Report For Sizewell (2010).

1.2.2 The following key (**Table 1**) should be used for interpretation.

**Table 1: Key for Table 2**

| Key | |
|---|---|
| (green) | Where the scope of the **sHRA** is consistent, or goes beyond, the scope identified in the Habitats Regulations Assessment: Site Report For Sizewell (2010). |
| (orange) | Where the Scope of the **sHRA** is not consistent with the scope identified in the Habitats Regulations Assessment: Site Report For Sizewell (2010).Where this is the case, justification is provided in **Table 3.** |

## Table 2: Comparison of Likely Significant Effects

| European Site | Water Resources and Quality | Habitat Loss and Fragmentation | Disturbance (Noise, Light, Visual) | Air Quality |
|---|---|---|---|---|
| | | | | |
| Alde-Ore and Butley Estuaries SAC | | | | |
| Alde-Ore Estuary SPA | | | | |
| Alde-Ore Estuary Ramsar | | | | |
| Benacre to Easton Bavents Lagoons SAC | | | | |
| Benacre to Easton Bavents Lagoons SPA | | | | |
| Dew’s Ponds SAC | | | | |
| Minsmere to Walberswick Heaths and Marshes SAC | | | | |
| Minsmere to Walberswick SPA | | | | |
| Minsmere to Walberswick Ramsar | | | | |
| Orfordness-Shingle Street SAC | | | | |
| Staverton Park and The Thicks, Wantisden SAC | | | | |
| Sandlings SPA | | | | |
| Outer Thames Estuary SPA | | | | |

## 1.3 Route Map

### a) Alone Effects

1.3.2 **Table 3** has been prepared to act as a route map to detail where within the **sHRA** [APP-145] and subsequent Addenda, the effects discussed within the Habitats Regulations Assessment: Site Report For Sizewell (2010) are located.

1.3.3 The table has been structured to follow Section 3 of the Habitats Regulations Assessment: Site Report For Sizewell (2010) rather than that of [APP-145] and is presented in four themes as detailed below:

- Water resources and quality;
- Habitat (and species) loss and fragmentation;
- Disturbance (noise, light, visual); and
- Air quality.

1.3.4 Whilst the sHRA [APP-145] is structured based on qualifying features, as described in the introduction above, it considers these four themes throughout. Please note it does not consider those sites screened in for effects on migratory fish.

### a) In-Combination Effects

1.3.5 **Appendix C** of the **sHRA** [APP-148] provides details of the Screening of Projects and Scoping of Plans for Likely Significant In-Combination Effect Assessment. Table C.1 (Appendix C) provides details of each of the plans and projects that it was considered could act in-combination with the predicted effects of the Sizewell C Project and justifies whether the plan/project was screened in (and will be considered in the Appropriate Assessment in-combination assessment) or out (and will not be considered). The European sites for which a potential in-combination effect could occur are also listed in Table C.1.

1.3.6 **Table 4** presents a summary of the locations of In-combination effects assessments with the **sHRA** [APP-145] and subsequent addenda. Please note it does not consider those sites screened in for effects on migratory fish.

1.3.7 Note, where N/A has been assigned in the NPS HRA column of **Table 3**, it was not included in Table 5, or deemed that further appropriate assessment was required, in the Habitats Regulations Assessment: Site Report For Sizewell (2010). In addition, where a column has been greyed out in the subsequent addenda columns, an updated assessment was not presented within the addendum.

## Table 3: NPS HRA Report Route Map

| European Site | Receptor Category | Qualifying Feature | NPS HRA Paragraphs | sHRA Location [APP-145] | sHRA First Addendum Location [AS-173] | sHRA Second Addendum Location [REP2-032] | sHRA Third Addendum Location [REP7-279] |
|---|---|---|---|---|---|---|---|
| **Water Resources and Quality** | | | | | | | |
| Alde-Ore and Butley Estuaries SAC | Coastal, Freshwater and Terrestrial Habitats | 'Estuaries', 'mudflats and sandflats not covered by seawater at low tide' and 'Atlantic salt meadows' (Glauco-Puccinellietalia) | 3.22 to 3.27 | 7.4 b) i e-page 262<br>7.4 b) ii) e-page 262<br>7.4 b) iii e-page 269<br>7.4 b) iv e-page 270 | 7.4, e-page 70 | | |
| Alde-Ore Estuary SPA | Birds | Sandwich tern | 3.22 to 3.27 | 8.3 b) i e-page 341<br>8.3 b) ii e-page 343<br>8.3 b) iii e-page 355<br>8.3 b) iv e-page 355 | 8.2 a) e-page 74<br>8.6 e-page 89 | | 8.1 a) i and ii e-page 34 |
| | | Breeding little tern | | 8.3 c) I e-page 369<br>8.3 c) ii e-page 369<br>8.3 c) iii e-page 371<br>8.3 c) iv e-page 372 | 8.2 b), e-page 74<br>8.6 e-page 89 | | 8.1 a) i and ii e-page 34 |

| European Site | Receptor Category | Qualifying Feature | NPS HRA Paragraphs | sHRA Location [APP-145] | sHRA First Addendum Location [AS-173] | sHRA Second Addendum Location [REP2-032] | sHRA Third Addendum Location [REP7-279] |
|---|---|---|---|---|---|---|---|
| | | Breeding lesser black-backed gull | | 8.3 d) I e-page 374<br>8.3 d) ii e-page 374<br>8.3 d) iii e-page 377<br>8.3 d) iv e-page 378 | 8.6 e-page 89 | | 8.1 a) i and ii e-page 34 |
| | | Non-breeding avocet | | 8.3 g) i e-page 383<br>8.3 g) ii e-page 383<br>8.3 g) iii e-page 383 | 8.6 e-page 89 | | |
| | | Non-breeding redshank | | 8.3 h) i e-page 385<br>8.3 h) ii e-page 385<br>8.3 h) iii e-page 385 | 8.6 e-page 89 | | |
| | | Non-breeding ruff | | 8.3 i) i e-page 387<br>8.3 i) ii e-page 387<br>8.3 i) iii e-page 387 | 8.6 e-page 89 | | |

| European Site | Receptor Category | Qualifying Feature | NPS HRA Paragraphs | sHRA Location [APP-145] | sHRA First Addendum Location [AS-173] | sHRA Second Addendum Location [REP2-032] | sHRA Third Addendum Location [REP7-279] |
|---|---|---|---|---|---|---|---|
| Alde-Ore Estuary Ramsar | Coastal, Freshwater and Terrestrial Habitats | 'Estuaries', 'mudflats and sandflats not covered by seawater at low tide' and 'Atlantic salt meadows' (Glauco-Puccinellietalia) | 3.22 to 3.27 | 7.4 b) i e-page 262<br>7.4 b) ii) e-page 262<br>7.4 b) iii e-page 269<br>7.4 b) iv e-page 270 | 7.4 e-page 70 | | |
| | | Ramsar Criterion 2 | | 7.4 c) i e-page 274 | 7.4 e-page 70 | | |
| | Birds | *As per Alde-Ore Estuary SPA* | | *As per Alde-Ore Estuary SPA* | 8.6 e-page 89 | | |
| Benacre to Easton Bavents Lagoons SAC | Coastal, Freshwater and Terrestrial Habitats | Coastal Lagoons | N/A | 7.5 b) i e-page 279<br>7.5 b) ii e-page 279 | 7.4 e-page 70 | | |
| | Birds | Breeding Little tern | | 8.5 c) i e-page 397<br>8.5 c) ii e-page 397 | | | |
| Dew's Pond SAC | Coastal, Freshwater and Terrestrial Habitats | Great Crested Newt | N/A | 7.6 b) e-page 283 | | | |
| Humber Estuary SAC | Marine Mammals | | N/A | 9.4 a) e-page 639 | | | 9.1 a) i e-page 49 |

| European Site | Receptor Category | Qualifying Feature | NPS HRA Paragraphs | sHRA Location [APP-145] | sHRA First Addendum Location [AS-173] | sHRA Second Addendum Location [REP2-032] | sHRA Third Addendum Location [REP7-279] |
|---|---|---|---|---|---|---|---|
| Minsmere to Walberswick Heaths and Marshes SAC | Coastal, Freshwater and Terrestrial Habitats | Annual vegetation of drift lines and perennial vegetation of stony banks | 3.6 to 3.10 | 7.7 c) i e-page 291<br><br>7.7 c) ii e-page 291 | 7.3 e-page 70 | | 7.2 e-page 32 |
| Minsmere to Walberswick SPA | Birds | Breeding avocet | 3.6 to 3.10 | 8.8 b) I e-page 408<br><br>8.8 b) ii e-page 409 | | | |
| | | Breeding bittern | | 8.8 c) I e-page 439<br><br>8.8 c) ii e-page 439 | | | |
| | | Breeding marsh harrier | | 8.8 d) i e-page 443<br><br>8.8 d) ii e-page 443 | | | |
| | | Breeding little tern | | 8.8 e) I e-page 479<br><br>8.8 e) ii e-page 481<br><br>8.8 e) iii e-page 486<br><br>8.8 e) iv e-page 486 | 8.3 e) i e-page 80<br><br>8.7 c) i e-page 91<br><br>8.7 c) ii e-page 92 | | 8.2 b) I and ii e-page 38 |
| | | Breeding gadwall | | 8.8 f) i e-page 497<br><br>8.8 f) ii e-page 498 | | | |

| European Site | Receptor Category | Qualifying Feature | NPS HRA Paragraphs | sHRA Location [APP-145] | sHRA First Addendum Location [AS-173] | sHRA Second Addendum Location [REP2-032] | sHRA Third Addendum Location [REP7-279] |
|---|---|---|---|---|---|---|---|
| | | Breeding shoveler | | 8.8 g) i e-page 502<br><br>8.8 g) ii e-page 502 | | | |
| | | Breeding teal | | 8.8 h) i e-page 506<br><br>8.8 h) ii e-page 507 | | | |
| | | Non-breeding hen harrier | | 8.8 j) i e-page 513 | | | |
| | | Non-breeding gadwall | | 8.8 k) i e-page 517 | | | |
| | | Non-breeding shoveler | | 8.8 l) i e-page 526 | | | |
| | | Non-breeding white-fronted goose | | 8.8 m) i e-page 533 | | | |
| Minsmere to Walberswick Ramsar | Coastal, Freshwater and Terrestrial Habitats | Ramsar criterion 1 and 2 | 3.6 to 3.10 | 7.8 b) I e page 308<br><br>7.8 b) ii e-page 309<br><br>7.8 b) iii e-page 310<br><br>7.8 b) iv e-page 312 | 7.4 e-page 70 | | 7.3 e-page 33 |
| | Birds | *As per Minsmere to Walberswick SPA* | | *As per Minsmere to Walberswick SPA* | | | |
| Orfordness-Shingle Street SAC | Coastal, Freshwater | Coastal lagoons | 3.22 to 3.27 | 7.9 b) i e-page 324<br><br>7.9 b) ii e-page 324 | 7.4 e-page 70 | | |

| European Site | Receptor Category | Qualifying Feature | NPS HRA Paragraphs | sHRA Location [APP-145] | sHRA First Addendum Location [AS-173] | sHRA Second Addendum Location [REP2-032] | sHRA Third Addendum Location [REP7-279] |
|---|---|---|---|---|---|---|---|
| | and Terrestrial Habitats | Annual vegetation of drift lines and perennial vegetation of stony banks | | 7.9 c) i e-page 327<br><br>7.9 c) ii e-page 327 | | | |
| Outer Thames Estuary SPA | Birds | Breeding little tern | 3.28 and 3.29 | 8.10 b) i e-page 549 | 8.4 a) e-page 87<br><br>8.8 a) i e-page 94 | | 8.3 a) i e-page 41 |
| | | Breeding common tern | | 8.10 c) i e-page 551 | 8.4 b) e-page 88<br><br>8.8 b) i e-page 94 | | 8.3 b) i e-page 42 |
| | | Non-breeding red-throated diver | | 8.10 d) i e-page 561 | 8.8 c) i e-page 96 | | 8.3 c) i e-page 45 |
| Sandlings SPA | Birds | | 3.15 to 3.17 | No effect pathways related to water quality or resources were screened in for further assessment. **Appendix B**, HRA Screening Matrix B2.6: Sandlings SPA [APP-148] (e-page 108) and the supporting evidence provided provide justification for this:<br><br>**Alteration of coastal processes/sediment transport:** The qualifying feature is not dependent on the potentially affected habitats; no discernible impact pathway is apparent. | | | |

| European Site | Receptor Category | Qualifying Feature | NPS HRA Paragraphs | sHRA Location [APP-145] | sHRA First Addendum Location [AS-173] | sHRA Second Addendum Location [REP2-032] | sHRA Third Addendum Location [REP7-279] |
|---|---|---|---|---|---|---|---|
| | | | | **Water quality effects – marine environment:** The qualifying feature is not dependent on estuarine or marine habitats; no discernible impact pathway is apparent.<br><br>**Water quality effects – terrestrial environment:** The qualifying feature is not dependent upon wetland habitats; no discernible impact pathway is apparent.<br><br>**Alteration of local hydrology and hydrogeology:** The qualifying feature is not dependent upon wetland habitats, so no discernible impact pathway is apparent | | | |
| Southern North Sea SAC | Marine Mammals | | N/A | 9.5 a) e-page 677 | | | 9.2 a) i e-page 60 |
| The Wash and North Norfolk Coast SAC | Marine Mammals | | N/A | 9.6 a) e-page 720 | | | 9.3 a) i e-page 71 |
| **Habitat (and species) Loss and Fragmentation** | | | | | | | |
| Alde-Ore and Butley Estuaries SAC | Coastal, Freshwater and Terrestrial Habitats | 'Estuaries', 'mudflats and sandflats not covered by seawater at low tide' and 'Atlantic salt meadows' (Glauco-Puccinellietalia) | 3.47 to 3.49 | 7.4 c) ii e-page 274<br><br>7.4 b) iv e-page 270 | | | |

| European Site | Receptor Category | Qualifying Feature | NPS HRA Paragraphs | sHRA Location [APP-145] | sHRA First Addendum Location [AS-173] | sHRA Second Addendum Location [REP2-032] | sHRA Third Addendum Location [REP7-279] |
|---|---|---|---|---|---|---|---|
| Alde-Ore Estuary SPA | Birds | Sandwich tern | 3.47 to 3.49 | 8.3 b) vii e-page 362 | | | 8.1 a) iii e-page 36 |
| | | Breeding little tern | | 8.3 c) vii e-page 373 | | | 8.1 a) iii e-page 36 |
| | | Breeding lesser black-backed gull | | 8.3 d) vii e-page 379 | | | 8.1 a) iii e-page 36 |
| Alde-Ore Estuary Ramsar | Coastal, Freshwater and Terrestrial Habitats | 'Estuaries', 'mudflats and sandflats not covered by seawater at low tide' and 'Atlantic salt meadows' (Glauco-Puccinellietalia) | 3.47 to 3.49 | 7.4 b) i e-page 262<br>7.4 c) ii e-page 274 | 7.4 e-page 70 | | |
| | | Ramsar criterion 2 | | 7.4 c) ii e-page 274 | | | |
| Benacre to Easton Bavents Lagoons SAC | Birds | Breeding Little tern | N/A | 8.5 c) iv e-page 398 | | | |
| Humber Estuary SAC | Marine Mammals | | N/A | 9.4 c) e-page 655 | | | 9.1 a) iii and iv e-page 57 |
| | | European dry heaths | | 7.7 b) ii e-page 288 | | 2.3 e-page 7 | |

| European Site | Receptor Category | Qualifying Feature | NPS HRA Paragraphs | sHRA Location [APP-145] | sHRA First Addendum Location [AS-173] | sHRA Second Addendum Location [REP2-032] | sHRA Third Addendum Location [REP7-279] |
|---|---|---|---|---|---|---|---|
| Minsmere to Walberswick Heaths and Marshes SAC | Coastal, Freshwater and Terrestrial Habitats | Annual vegetation of drift lines and perennial vegetation of stony banks | 3.33 to 3.35[1] | 7.7 c) i e-page 291<br><br>7.7 c) ii e-page 291<br><br>7.7 c) iv e-page 299 | 7.3 e-page 70 | | 7.2 e-page 32 |
| Minsmere to Walberswick SPA | Birds | Breeding marsh harrier | 3.33 to 3.35 | 8.8 d) iv e-page 444 | | | |
| | | Breeding little tern | | 8.8 e) viii e-page 497 | | | 8.2 b) iv e-page 40 |
| | | Breeding nightjar | | 8.8 i) ii e-page 510 | | | |
| | | Non-breeding hen harrier | | 8.8 j) iii e-page 513 | | | |
| | | Non-breeding gadwall | | 8.8 k) iii e-page 517 | | | |
| | | Non-breeding shoveler | | 8.8 l) iii e-page 526 | | | |
| Minsmere to Walberswick Ramsar | Coastal, Freshwater and Terrestrial Habitats | Ramsar criterion 1 and 2 | 3.33 to 3.35[2] | *As per Minsmere to Walberswick* Heaths and Marshes *SAC* | 7.3 e-page 70 | 2.3 e-page 7 | 7.2 e-page 32 |
| | Birds | *As per Minsmere to Walberswick SPA* | | *As per Minsmere to Walberswick SPA* | | | |
| | | Coastal Lagoons | | 7.9 b) i e-page 324 | 7.4 e-page 70 | | |

[1] Note HRA Screening Matrix B1.5: Minsmere to Walberswick Heaths and Marshes SAC in **Appendix B** of the **sHRA** [APP-148] (e-page 27) identifies that for 'Direct habitat loss and fragmentation: No discernible impact pathway is evident'

[2] HRA Screening Matrix B3.3: Minsmere-Walberswick Ramsar site in **Appendix B** of the **sHRA** [APP-148] (e-page 127) identifies that there is no direct habitat loss of the Ramsar site during construction and no direct habitat loss of terrestrial habitats. No Likely Significant Effect is predicted (Table 5.2, item 7b) [APP-145] (e-page 99)

| European Site | Receptor Category | Qualifying Feature | NPS HRA Paragraphs | sHRA Location [APP-145] | sHRA First Addendum Location [AS-173] | sHRA Second Addendum Location [REP2-032] | sHRA Third Addendum Location [REP7-279] |
|---|---|---|---|---|---|---|---|
| Orfordness-Shingle Street SAC | Coastal, Freshwater and Terrestrial Habitats | Annual vegetation of drift lines and perennial vegetation of stony banks | 3.47 to 3.49[3] | 7.9 c) i e-page 327<br>7.9 c) iv e-page 329 | | | |
| Outer Thames Estuary SPA | Birds | Breeding little tern | 3.54 to 3.57 | 8.10 b) iii e-page 550 | | | 8.3 a) iii e-page 42 |
| | | Breeding common tern | | 8.10 c) iii e-page 560 | | | 8.3 b) iii e-page 44 |
| | | Non-breeding red-throated diver | | 8.10 d) iii e-page 565 | | | 8.3 c) iii e-page 46 |
| Sandlings SPA | Birds | Breeding nightjar | 3.41 and 3.42 | 8.11 b) ii e-page 579 | | | |
| | | Breeding woodlark | | 8.11 c) ii e-page 586 | | | |
| Southern North Sea SAC | Marine Mammals | | N/A | 9.5 c) e-page 689<br>9.5 d) e-page 690 | | | 9.2 a) iii and iv e-page 67 |
| The Wash and North Norfolk Coast SAC | Marine Mammals | | N/A | 9.6 c) e-page 730 | | | 9.3 a) iii e-page 78 |
| Disturbance (Noise, Light, Visual) | | | | | | | |
| | Birds | Sandwich tern | N/A | 8.3 b) vi e-page 358 | | 2.2 e-page 5 | |

[3] HRA Screening Matrix B1.6: Orfordness to Shingle Street SAC in **Appendix B** of the **sHRA** [APP-148] (e-page 30) identifies that for direct habitat loss and fragmentation there is no discernible impact pathway is evident.

| European Site | Receptor Category | Qualifying Feature | NPS HRA Paragraphs | sHRA Location [APP-145] | sHRA First Addendum Location [AS-173] | sHRA Second Addendum Location [REP2-032] | sHRA Third Addendum Location [REP7-279] |
|---|---|---|---|---|---|---|---|
| Alde-Ore Estuary SPA and Ramsar | | Breeding little tern | | 8.3 c) vi e-page 372 | | | |
| | | Breeding lesser black-backed gull | | 8.3 d) vi e-page 378 | | | |
| | | Breeding avocet | | 8.3 e) ii e-page 380 | | | |
| | | Breeding marsh harrier | | 8.3 f) ii e-page 382 | | | |
| | | Non-breeding avocet | | 8.3 g) v e-page 384 | | | |
| | | Non-breeding redshank | | 8.3 h) v e-page 386 | | | |
| | | Non-breeding ruff | | 8.3 i) v e-page 387 | | | |
| Benacre to Easton Bavents Lagoons SAC | Birds | Breeding Bittern | N/A | 8.5 b) i e-page 396 | | | |
| | | Breeding Little tern | | 8.5 c) iii e-page 398 | | | |
| | | Breeding marsh harrier | | 8.5 d) i e-page 399 | | | |
| Deben Estuary SPA | Birds | SPA qualifying features | N/A | 8.6 b) i e-page 403 | | | |
| Deben Estuary Ramsar | Birds | Ramsar qualifying features | | 8.7 b) e-page 405 | | | |
| Humber Estuary SAC | Marine Mammals | | N/A | 9.4 b) e-page 647 | 9.3 a) e-page 117 | | 9.1 a) ii e-page 52 |
| Minsmere to Walberswick Heaths and Marshes SAC | Coastal, Freshwater and Terrestrial Habitats | European dry heaths | N/A | 7.7 b) ii e-page 288 | | 2.3 e-page 7 | |
| | | Annual vegetation of drift lines and perennial vegetation of stony banks | N/A | 7.7 c) iv e-page 299 | | | |
| Minsmere to Walberswick SPA | Birds | Breeding avocet | 3.62 and 3.63 | 8.8 b) iv e-page 411 | 8.3 b) i e-page 77 | | 8.2 a) i e-page 37 |

| European Site | Receptor Category | Qualifying Feature | NPS HRA Paragraphs | sHRA Location [APP-145] | sHRA First Addendum Location [AS-173] | sHRA Second Addendum Location [REP2-032] | sHRA Third Addendum Location [REP7-279] |
|---|---|---|---|---|---|---|---|
| | | | | 8.8 b) v e-page 435 | 8.5 e-page 88<br><br>8.7 b) i e-page 90<br><br>8.9 e-page 100 | | |
| | | Breeding bittern | | 8.8 c) iv e-page 440<br><br>8.8 c) v e-page 442 | 8.3 c) i e-page 78<br><br>8.5 e-page 88<br><br>8.7 b) i e-page 90<br><br>8.9 e-page 100 | | 8.2 a) i e-page 37 |
| | | Breeding marsh harrier | | 8.8 d) v e-page 445<br><br>8.8 d) vi e-page 478 | 8.3 d) i e-page 79<br><br>8.5 e-page 88<br><br>8.7 b) i e-page 90 | | 8.2 a) i e-page 37 |

| European Site | Receptor Category | Qualifying Feature | NPS HRA Paragraphs | sHRA Location [APP-145] | sHRA First Addendum Location [AS-173] | sHRA Second Addendum Location [REP2-032] | sHRA Third Addendum Location [REP7-279] |
|---|---|---|---|---|---|---|---|
| | | | | | 8.9 e-page 100 | | |
| | | Breeding little tern | | 8.8 e) vi e-page 487<br><br>8.8 e) vii e-page 494 | 8.3 e) ii e-page 80<br><br>8.5 e-page 88<br><br>8.7 c) iii e-page 92<br><br>8.9 e-page 100 | | 8.2 b) iii e-page 39 |
| | | Breeding gadwall | | 8.8 f) iv e-page 498<br><br>8.8 f) v e-page 501 | 8.3 f) i e-page 81<br><br>8.7 b) i e-page 90<br><br>8.9 e-page 100 | | 8.2 a) i e-page 37 |
| | | Breeding shoveler | | 8.8 g) iv e-page 503<br><br>8.8 g) v e-page 505 | 8.3 g) i e-page 82<br><br>8.5 e-page 88<br><br>8.7 b) i e-page 90 | | 8.2 a) i e-page 37 |

| European Site | Receptor Category | Qualifying Feature | NPS HRA Paragraphs | sHRA Location [APP-145] | sHRA First Addendum Location [AS-173] | sHRA Second Addendum Location [REP2-032] | sHRA Third Addendum Location [REP7-279] |
|---|---|---|---|---|---|---|---|
| | | | | | 8.9 e-page 100 | | |
| | | Breeding teal | | 8.8 h) iv e-page 507<br>8.8 h) v e-page 508 | 8.3 h) i e-page 83<br>8.5 e-page 88<br>8.7 b) i e-page 90<br>8.9 e-page 100 | | 8.2 a) i e-page 37 |
| | | Breeding nightjar | | 8.8 i) iii e-page 510<br>8.8 i) iv e-page 511 | 8.3 i) i e-page 83<br>8.5 e-page 88<br>8.7 b) i e-page 90<br>8.9 e-page 100 | | 8.2 a) i e-page 37 |
| | | Non-breeding hen harrier | | 8.8 j) iv e-page 514<br>8.8 j) v e-page 515 | 8.3 j) i e-page 84<br>8.5 e-page 88 | | 8.2 a) i e-page 37 |

| European Site | Receptor Category | Qualifying Feature | NPS HRA Paragraphs | sHRA Location [APP-145] | sHRA First Addendum Location [AS-173] | sHRA Second Addendum Location [REP2-032] | sHRA Third Addendum Location [REP7-279] |
|---|---|---|---|---|---|---|---|
| | | | | | 8.7 b) i e-page 90<br><br>8.9 e-page 100 | | |
| | | Non-breeding gadwall | | 8.8 k) iv e-page 518<br><br>8.8 k) v e-page 524 | 8.3 k) i e-page 84<br><br>8.5 e-page 88<br><br>8.7 b) i e-page 90<br><br>8.9 e-page 100 | | 8.2 a) i e-page 37 |
| | | Non-breeding shoveler | | 8.8 l) iv e-page 526<br><br>8.8 l) v e-page 526 | 8.3 l) i e-page 86<br><br>8.5 e-page 88<br><br>8.7 b) i e-page 90<br><br>8.9 e-page 100 | | 8.2 a) i e-page 37 |

| European Site | Receptor Category | Qualifying Feature | NPS HRA Paragraphs | sHRA Location [APP-145] | sHRA First Addendum Location [AS-173] | sHRA Second Addendum Location [REP2-032] | sHRA Third Addendum Location [REP7-279] |
|---|---|---|---|---|---|---|---|
| | | Non-breeding white-fronted goose | | 8.8 m) iii e-page 533<br><br>8.8 m) iv e-page 535 | 8.3 m) i e-page 87<br><br>8.5 e-page 88<br><br>8.7 b) i e-page 90<br><br>8.9 e-page 100 | | 8.2 a) i e-page 37 |
| Minsmere to Walberswick Ramsar | Coastal, Freshwater and Terrestrial Habitats | Ramsar criterion 1 and 2 | N/A | 7.8 b) vi e-page 315 | | 2.3 e-page 7 | 7.3 e-page 33 |
| | Birds | *As per Minsmere to Walberswick SPA* | 3.62 and 3.63 | *As per Minsmere to Walberswick SPA* | 8.5 e-page 88<br><br>8.9 e-page 100 | | |
| Orfordness-Shingle Street SAC | Coastal, Freshwater and Terrestrial Habitats | Annual vegetation of drift lines and perennial vegetation of stony banks | N/A | 7.9 c) iv e-page 329 | | | |
| Outer Thames Estuary SPA | Birds | Breeding little tern | 3.73 to 3.76 | 8.10 b) ii e-page 550 | 8.4 a) e-page 87 | | 8.3 a) ii e-page 42 |

| European Site | Receptor Category | Qualifying Feature | NPS HRA Paragraphs | sHRA Location [APP-145] | sHRA First Addendum Location [AS-173] | sHRA Second Addendum Location [REP2-032] | sHRA Third Addendum Location [REP7-279] |
|---|---|---|---|---|---|---|---|
| | | | | | 8.8 a) ii e-page 94 | | |
| | | Breeding common tern | | 8.10 c) ii e-page 559 | 8.4 b) e-page 88<br><br>8.8 b) ii 8.e-page 95 | | 8.3 b) ii e-page 43 |
| | | Non-breeding red-throated diver | | 8.10 d) ii e-page 564 | 8.8 c) i e-page 96 | | 8.3 c) ii e-page 46 |
| Sandlings SPA | Birds | Breeding nightjar | 3.67 and 3.68 | 8.11 b) iii e-page 579<br><br>8.11 b) iv e-page 580 | | 2.4 e-page 8 | |
| | | Breeding woodlark | | 8.11 c) iii e-page 586<br><br>8.11 c) iv e-page 587 | | | |
| Southern North Sea SAC | Marine Mammals | | N/A | 9.5 b) e-page 681 | 9.4 a) e-page 118 | | 9.2 a) ii e-page 63 |
| Stour and Orwell Estuaries SPA | Birds | SPA qualifying features | N/A | 8.12 b) i e-page 598 | | | |
| Stour and Orwell Estuaries Ramsar | Birds | Ramsar qualifying features | N/A | 8.13 b) e-page 600 | | | |
| The Wash and North Norfolk Coast SAC | Marine Mammals | | N/A | 9.6 b) e-page 723 | 9.5 a) e-page 119 | | 9.3 a) ii e-page 74 |

| European Site | Receptor Category | Qualifying Feature | NPS HRA Paragraphs | sHRA Location [APP-145] | sHRA First Addendum Location [AS-173] | sHRA Second Addendum Location [REP2-032] | sHRA Third Addendum Location [REP7-279] |
|---|---|---|---|---|---|---|---|
| **Air Quality** | | | | | | | |
| Alde-Ore and Butley Estuaries SAC | Coastal, Freshwater and Terrestrial Habitats | 'Estuaries', 'mudflats and sandflats not covered by seawater at low tide' and 'Atlantic salt meadows' (Glauco-Puccinellietalia) | N/A | 7.4 b) v e-page 271 | | | |
| Alde-Ore Estuary SPA | Birds | Sandwich tern | N/A | 8.3 b) v e-page 356 | | | |
| | | Breeding little tern | | 8.3 c) v e-page 372 | | | |
| | | Breeding lesser black-backed gull | | 8.3 d) v e-page 378 | | | |
| | | Breeding avocet | | 8.3 e) i e-page 380 | | | |
| | | Breeding marsh harrier | | 8.3 f) i e-page 381 | | | |
| | | Non-breeding avocet | | 8.3 g) iv e-page 383 | | | |
| | | Non-breeding redshank | | 8.3 h) iv e-page 385 | | | |
| | | Non-breeding ruff | | 8.3 i) iv e-page 387 | | | |
| Alde-Ore Estuaries Ramsar | Coastal, Freshwater and Terrestrial Habitats | 'Estuaries', 'mudflats and sandflats not covered by seawater at low tide' and 'Atlantic salt meadows' (Glauco-Puccinellietalia) | N/A | 7.4 b) iii e-page 270 | | | |
| | Birds | *As per Alde-Ore Estuary SPA* | | *As per Alde-Ore Estuary SPA* | | | |

| European Site | Receptor Category | Qualifying Feature | NPS HRA Paragraphs | sHRA Location [APP-145] | sHRA First Addendum Location [AS-173] | sHRA Second Addendum Location [REP2-032] | sHRA Third Addendum Location [REP7-279] |
|---|---|---|---|---|---|---|---|
| Minsmere to Walberswick Heaths and Marshes SAC | Coastal, Freshwater and Terrestrial Habitats | European dry heaths | 3.83 | 7.7 b) i e -page 284 | | | |
| | | Annual vegetation of drift lines and perennial vegetation of stony banks | | 7.7 c) iii e-page 296 | | | |
| Minsmere to Walberswick SPA | Birds | Breeding avocet | 3.83 | 8.8 b) iii e-page 410 | | | |
| | | Breeding bittern | | 8.8 c) iii e-page 440 | | | |
| | | Breeding marsh harrier | | 8.8 d) iii e-page 443 | | | |
| | | Breeding little tern | | 8.8 e) v e-page 486 | | | |
| | | Breeding gadwall | | 8.8 f) iii e-page 498 | | | |
| | | Breeding shoveler | | 8.8 g) iii e-page 503 | | | |
| | | Breeding teal | | 8.8 h) iii e-page 507 | | | |
| | | Breeding nightjar | | 8.8 i) i e-page 509 | | | |
| | | Non-breeding hen harrier | | 8.8 j) ii e-page 513 | | | |
| | | Non-breeding gadwall | | 8.8 k) ii e-page 517 | | | |
| | | Non-breeding shoveler | | 8.8 l) ii e-page 526 | | | |
| | | Non-breeding white-fronted goose | | 8.8 m) ii e-page 533 | | | |
| Minsmere to Walberswick Ramsar | Coastal, Freshwater and Terrestrial Habitats | Ramsar criterion 1 and 2 | 3.83 | 7.8 b) v e-page 313 | | | 7.3 e-page 33 |
| | Birds | *As per Minsmere to Walberswick SPA* | | *As per Minsmere to Walberswick SPA* | | | |

| European Site | Receptor Category | Qualifying Feature | NPS HRA Paragraphs | sHRA Location [APP-145] | sHRA First Addendum Location [AS-173] | sHRA Second Addendum Location [REP2-032] | sHRA Third Addendum Location [REP7-279] |
|---|---|---|---|---|---|---|---|
| Orfordness-Shingle Street SAC | Coastal, Freshwater and Terrestrial Habitats | Coastal lagoons | N/A | 7.9 b) iii e-page 326 | | | |
| | | Annual vegetation of drift lines and perennial vegetation of stony banks | | 7.9 c) iii e-page 328 | | | |
| Outer Thames Estuary SPA | Birds | | 3.92 to 3.94 | The Habitats Regulations Assessment: Site Report For Sizewell (2010), at paragraph 3.94, states "*after further rconsideration, adverse effects on site integrity have been ruled out as a result of either the proposals alone, or in-combination with other plans or projects*."<br><br>The **sHRA** identified that no effect pathways related to water quality or resources were screened in for further assessment. **Appendix B**, HRA Screening Matrix B2.5: Outer Thames Estuary SPA [APP-148] (e-page 105) and the supporting evidence provided provide justification for this:<br><br>Changes in air quality would not have a direct effect upon SPA qualifying features and would not affect the marine habitats upon which these qualifying features depend. Therefore, no discernible impact pathway is apparent. | | | |
| Sandlings SPA | Birds | Breeding nightjar | 3.87 | 8.11 b) i e-page 577 | | | |
| | | Breeding woodlark | | 8.11 c) i e-page 585 | | | |

## Table 4: Summary of Locations of In-combination Effects Assessments

| European Site | Qualifying Feature | NPS HRA Para | sHRA Location [APP-145] | sHRA First Addendum Location [AS-173] | sHRA Second Addendum Location [REP2-032] | sHRA Third Addendum Location [REP7-279] |
|---|---|---|---|---|---|---|
| Alde-Ore and Butley Estuaries SAC | Coastal, Freshwater and Terrestrial Habitats | 3.24 to 3.27<br><br>3.50 to 3.53 | 7.4 e) e-page 276 | | | |
| Alde-Ore Estuary SPA | Birds | 3.24 to 3.27<br><br>3.50 to 3.53 | 8.3 k) e-page 389 | | | 8.5 e-page 48 |
| Alde-Ore Estuary Ramsar | Birds | 3.24 to 3.27<br><br>3.50 to 3.53 | 8.4 d) e-page 395 | | | |
| Benacre to Easton Bavents Lagoons SAC | Coastal, Freshwater and Terrestrial Habitats | N/A | 7.5 d) e-page 280 | | | |
| | Birds | N/A | 8.5 f) e-page 400 | | | |
| Deben Estuary SPA | Birds | N/A | 8.6 d) e-page 404 | | | |
| Deben Estuary Ramsar | Ramsar qualifying features | N/A | 8.6 c) e-page 407 | | | |
| Dew's Pond SAC | Coastal, Freshwater and Terrestrial Habitats | N/A | 7.6 d) e-page 283 | | | |

| European Site | Qualifying Feature | NPS HRA Para | sHRA Location [APP-145] | sHRA First Addendum Location [AS-173] | sHRA Second Addendum Location [REP2-032] | sHRA Third Addendum Location [REP7-279] |
|---|---|---|---|---|---|---|
| Humber Estuary SAC | Marine Mammals | N/A | 9.4 d) e-page 657 | 9.6 e-page 120 | | 9.5 e-page 83 |
| Minsmere to Walberswick Heaths and Marshes SAC | Coastal, Freshwater and Terrestrial Habitats | 3.11 to 3.14<br><br>3.36 to 3.40<br><br>3.64 to 3.66<br><br>3.84 to 3.86 | 7.7 e) e-page 299 | | | 7.5 e-page 34 |
| Minsmere to Walberswick SPA | Birds | 3.11 to 3.14<br><br>3.36 to 3.40 | 8.8 o) e-page 536 | | | 8.5 e-page 48 |
| Minsmere to Walberswick Ramsar | Coastal, Freshwater and Terrestrial Habitats | 3.11 to 3.14<br><br>3.36 to 3.40 | 7.8 d) e-page 315 | | | 7.5 e-page 34 |
| Orfordness-Shingle Street SAC | Coastal, Freshwater and Terrestrial Habitats | 3.24 to 3.27<br><br>3.50 to 3.53 | 7.9 e) e-page 330 | | | |
| Outer Thames Estuary SPA | Birds | 3.30 to 3.32<br><br>3.58 to 3.61 | 8.10 e) e-page 567 | | | 8.5 e-page 48 |

| European Site | Qualifying Feature | NPS HRA Para | sHRA Location [APP-145] | sHRA First Addendum Location [AS-173] | sHRA Second Addendum Location [REP2-032] | sHRA Third Addendum Location [REP7-279] |
|---|---|---|---|---|---|---|
| | | 3.77 to 3.80 | | | | |
| Sandlings SPA | Birds | 3.18 to 3.21<br><br>3.43 to 3.46<br><br>3.69 to 3.72<br><br>3.88 to 3.91 | 8.11 e) e-page 591 | | | |
| Stour and Orwell Estuaries SPA | Birds | N/A | 8.12 d) e-page 600 | | | |
| Stour and Orwell Estuaries Ramsar | Birds | N/A | 8.13 c) e-page 600 | | | |
| Southern North Sea SAC | Marine Mammals | N/A | 9.5 e) e-page 692 | 9.4 a) e-page 118 | | 9.5 e-page 83 |
| The Wash and North Norfolk Coast SAC | Marine Mammals | N/A | 9.6 d) e-page 732 | 9.6 e-page 120 | | 9.5 e-page 83 |

# APPENDIX I: RESPONSE TO NATURAL ENGLAND AND ENVIRONMENT AGENCY COMMENTS ON SZC TECHNICAL NOTE ON EAV AND STOCK SIZE

## CONTENTS

# RESPONSE TO COMMENTS ON TECHNICAL NOTE ON EAV AND STOCK SIZE

## 1.1 Introduction

1.1.25 At Deadline 6 a Technical Note was submitted setting out the SZC Co. position on Equivalent Adult Values (EAV) and stock sizes used in the assessment of effects of entrapment on the sustainability of fish populations (Deadline 6 Submission - 9.63 Comments on Earlier Deadlines and Subsequent Written Submissions to ISH1-ISH6 (Appendix F); [REP6-024]).

1.1.26 At Deadline 7, Natural England (Deadline 7 Submission - Comments on submissions from earlier deadlines and subsequent written submissions to ISH1 to ISH6 and appendices [REP7-143]) and the Environment Agency (Deadline 7 Submission Comments on reports contained within Comments on Earlier Submissions and Subsequent Written Submissions to ISH1-ISH6 [REP7-128]) provided comments on the Technical Note (Appendix F of [REP6-024]). A summary of the key messages in response to the comments is provided below together with more specific responses.

## 1.2 Summary of key messages for the application of EAVs

1.2.27 This section summarises the key points in relation to EAVs. It aims to address the fundamental basis of the approach and the differences between the Cefas (Centre of Environment Fisheries and Aquaculture Science) and Environment Agency approaches.

**What does the Cefas EAV method seek to achieve?**

- The size of an adult fish population changes from year to year because spawners are being added as they mature and because spawners are dying due to fishing, predation, disease or senescence. The rate at which fish join the population is expressed as an annual rate, as are the rate of deaths. So, annual rates provide appropriate comparators for the losses due to entrapment (impingement + entrainment).
- The Cefas EAV calculation involves forward projection of the annual numbers of entrapment losses, accounting for natural mortality, to give the rate of equivalent numbers of adult fish that are predicted to be lost from the spawning population each year.
- The Cefas EAV method thus converts an annual rate of entrapment to an annual rate of loss of adult fish.

- Estimates of annual adult loss as calculated using the Cefas EAV method are expressed as a percentage of spawning population size e.g., spawning stock biomass (SSB) or other relevant comparator such as annual fisheries landings.

- The advantage of using annual rates is the existence of comparators that are also annual rates (i.e. there is an equivalent baseline with which to compare the impact). One such comparator is the annual rates of fishing mortality. Decades of work on exploited fish populations have shown that fish populations can sustain fishing mortality of 10 to 20% or more per year in addition to natural mortality.

**What is the basis of the threshold?**

- The EAV approach was conceived as a simple method of risk assessment.

- Annual rates of entrapment mortality of around one percent and lower, as calculated with the Cefas EAV method, pose very low risks to the population because they are so low in relation to sustainable rates (10 – 20%, see above) of fishing mortality[1].

- Therefore, when the Cefas EAV method estimates an annual rate of around one percent or lower, the rates and timing of increases and decreases in spawning population size will be almost indistinguishable with or without the operation of the station.

- As annual rates rise above one percent or so, then risks of detectable effects on population dynamics begin to increase. For annual rates much exceeding one percent then more detailed analysis and consideration of risks may be required.

**What does the Environment Agency SPF extension seek to achieve?**

- The spawning production foregone (SPF) extension, as proposed by the Environment Agency, seeks to account for the potential of some species to spawn multiple times. In so doing, the Environment Agency argue that they provide a more realistic reflection of the long-term impacts of the station.

- What the SPF extension calculates is the potential life-time loss of the fish, accounting for that fish surviving from year to year and spawning in each year (repeat spawning), that are estimated to have been present had they not been entrapped at Sizewell.

[1] A detailed description of the threshold for effects for difference fish species is provided in BEEMS Technical Report TR406.v7 in Section 5 '*Assessing the significance of impingement effects'* (report pg. 55 pg. [AS-238]).

- Because the SPF method aggregates losses over many years it estimates entrapment losses that are multi-annual rates and not annual rates (because they attribute several future years of spawning to entrapped fish).

- Provided the complexities of fishing mortality over multiple years can be factored into the calculations, the outputs are valid reflections of life-time losses from a given starting year. However, the Environment Agency treats the EAV-SPF estimates as annual rates and link them to thresholds for annual rates. This is incorrect.

- The key issue is how do you treat the EAV-SPF multi-annual rates?

- While the technical basis of the SPF extension may be sound for estimating how year on year entrapment mortality propagates through to average reductions in the numbers of adult fish in successive years, the application of the method, is not compatible with the EAV risk assessment approach or thresholds used in the assessment.

- The SPF extension necessarily generates a higher predicted rate than the Cefas EAV method because the "annual" SPF impact is a summation of impacts over more than one year i.e., repeat spawning.

- Since SPF does not generate an estimate of an annual rate it is misleading and inappropriate to compare results to thresholds that are defined based on an annual rate of loss.

- It is noteworthy that annual fishing mortality of commercially fished species is effectively expressed as a proportion of SSB. It is inconsistent to suggest the impacts of Sizewell C should be treated as multi-annual rates because this would not provide a fair comparison with the annual rates of fishing mortality (which may be orders of magnitude greater than annual rates of entrapment mortality).

**Is the Cefas EAV suitable precautionary?**

- A concern raised by Natural England and the Environment Agency is that by only accounting for first-time spawners, the Cefas EAV approach does not include the fact that older fish tend to be larger and more fecund (produce more offspring). However, this is already accounted for in the Cefas EAV method. The Cefas EAV approach calculates the number of first-time spawners (EAV number) from the predominantly juvenile fish impinged at Sizewell. The Cefas EAV biomass is then calculated by multiplying the EAV number (of first-time spawners) by the mean individual adult weight in the spawning population (all spawners).

- This is conservative as there would be more first-time spawners in any given cohort than there would in subsequent year classes. As the weight and fecundity of first-time spawners would be less than older fish in the spawning population, apparent losses are upweighted. As stated in BEEMS Scientific Position Paper SPP116 [REP6-028], for repeat spawning species, this correctly results in a precautionary higher rate of annual EAV biomass loss that is compared against the spawning population biomass.

- It is important to note that for the Annex II species impinged at Sizewell, a highly precautionary EAV of 1 has been applied i.e., it assumes that every fish impinged is equivalent to a spawning adult (see Table 3 in BEEMS Scientific Position Paper SPP116 [REP6-028]). These species include:
  - twaite shad,
  - allis shad,
  - river lamprey, and
  - sea lamprey.
- An EAV of 1 has also been applied to European eel.
- In the case of semelparous species (those that spawn once then die), such as European eel and lamprey, an EAV of 1 is the theoretical maximum, as confirmed by the Environment Agency (Deadline 7 Submission - Post Hearing submissions including written submissions of oral case [REP7-131]).
- For most of the key species assessed at Sizewell, EAV annual rates of entrapment are predicted to be less than 0.1% of the relevant population comparator (see Table 7 of BEEMS Scientific Position Paper SPP116 [REP6-028]), and such rates imply a very low risk of detectable impacts on population dynamics
- Sea bass and sand gobies are the only species where the predicted entrapment effect approaches or exceeds 1% based on the detailed uncertainty analysis (see Table 7 of BEEMS Scientific Position Paper SPP116 [REP6-028]). It is noteworthy that the MMO in their Written Representations at Deadline 2 (para 3.2.7 of Marine Management Organisation (MMO) Deadline 2 Submission - Written Representation [REP2-140]) note that:

> *"Notwithstanding these uncertainties, the entrapment estimates indicate that even in the absence of LVSE and FRR mitigation measures, only 4 species exceed the 1% threshold: bass, for which density adjustment substantially reduces assessment of impact; sand goby, for which mortality rate >1% Spawning Stock Biomass (SSB) is not a concern at population level; thin-lipped mullet, for which value is an artefact of the low level of landings and absence of SSB; and eel, for which the applied Equivalent Adult Value (EAV) of 1 is unrealistically high, and is a species most likely to benefit from the FRR. On this basis, the MMO consider there is a good level of confidence that actual impacts to all fish species*

*will not be significant. Therefore, the MMO support the conclusions of the ES."*

- In the case that the Cefas EAV risk assessment exceeds given thresholds, additional assessments may be required. To provide the greatest degree of confidence for the ExA, SZC Co. has submitted a full ICES stock assessment for sea bass at Deadline 8 to provide the most robust evidence available for the effects of the station of the population sustainability (Doc. Ref. 9.110). Natural England have welcomed the commitment to provide this stock assessment and agreed with the selection of sea bass as a model species (see Section 1.3.31b).
- Stock assessments account for the effects of the survival of spawners from one year to the next by treating all spawners in any given year of assessment as contributors to the spawning stock. Thus, the spawning stock in any given year may be comprised of fish that are spawning for the first, second, third or $n^{th}$ time, depending on their longevity. But, in any one year of assessment, each fish contributes to the spawning stock biomass in that year.
- The SPF extension is not an annual risk assessment and is not a stock assessment.

## 1.3 Natural England Comments

1.3.25 SZC Co. responses to Natural England comments at Deadline 7 [REP7-143] on the Technical Note (Appendix F of [REP6-024]) are provided in this section in relation to:

- EAV/SPF – comparing to an annual SSB.
- EAV – stock size (sea bass).
- Stock size.

### a) EAV/SPF – comparing to an annual SSB

1.3.26 Natural England support the extended EAV-SPF approach suggested by the Environment Agency on the basis that:

*"…it reflects the losses from all year classes in a given year, not just the first-time spawners". This is apt for an annual impact estimate attempting to contextualise impacts for such a long-lived project. It gives a more realistic picture of, and estimated value to, the lost adult spawning potential from a given year during the operation for Sizewell C. The extension method remains an annual estimate, and so can be compared against an annually estimated baseline population such as SSB."*

1.3.27 The SPF extension is an attempt to determine the longer-term effects of entrapment of Sizewell C, whereas the Cefas EAV method is a within year risk assessment. However, the key issue is that SZC Co. strongly disagrees that the SPF extension provides estimates of annual rates and that those estimates can be compared with thresholds for annual rates. By summing the potential spawning opportunities foregone, the extension method aggregates impacts over multiple years. In essence, the SPF method attributes greater value to fish lost due to entrapment than fish remaining in the population, which would also have the opportunity to spawn again.

1.3.28 In BEEMS Scientific Position Paper SPP102 (pdf page 347 of [AS-238]) the applicability of the SPF extension is considered in further detail. The report includes an example whereby the SPF method is applied to fisheries landings of sea bass.

1.3.29 The Cefas EAV assessment applies thresholds that have been identified from rates of fishing mortality, that are also expressed as annual rates, and are set well below values that would cause population level effects. In the case that the EAV risk assessment suggests that entrapment poses a risk, then the most appropriate method for determining long-term impacts is stock assessment.

1.3.30 Stock assessment is a method for assessing the effects of additional mortality on spawning population size and trends in population sizeThe results from a stock assessment can be used to check conclusions drawn from the risk-based Cefas EAV assessment, as well as allowing us to infer the effects on other species.

1.3.31 An example of such a stock assessment for sea bass has been provided at Deadline 8 [Doc. Ref. 9.100] and is summarised Section 1.3.34(b), below.

1.3.32 Natural England suggest that the Cefas EAV method, by only accounting for first-time spawners, does not include the fact that older fish tend to be larger and more fecund. However, this is accounted for in the Cefas EAV method. The approach calculates the number of first-time spawners (EAV number) from the predominantly juvenile fish impinged at Sizewell. The EAV biomass multiplies the EAV number (of first-time spawners) by the mean adult weight of the spawning population. As the weight and fecundity of first-time spawners would be less than older fish in the spawning population apparent losses are upweighted.

1.3.33 SZC Co. considers that the Cefas EAV method is an effective method for determining the impacts of the proposed development and is suitably precautionary.

### b) EAV – stock size (sea bass)

1.3.1 Natural England welcomed the commitment to include an assessment of the long-term effects of the station on sea bass by applying a full ICES stock assessment. Natural England confirmed that they agree with the selection of sea bass as a model species for this exercise.

1.3.2 The sea bass stock assessment has been delivered at Deadline 8 as [Doc. Ref. 9.100]. Annual impingement predictions were added as an extra source of mortality within the existing ICES sea bass stock assessment. The stock assessment is computed for a period of 35 years from 1985 to 2020. Mean and upper 95% confidence interval impingement predictions for SZC were incorporated into historic estimates of sea bass mortality to simulate a scenario with SZC operating for 35 years. The estimated sizes of the spawning populations of sea bass, with and without the simulated SZC impingement mortality, were then compared. Impingement predictions included an extreme worst-case scenario of unmitigated upper 95% confidence interval impingement rates in every year for the 35-year assessment period. Assessments also considered the effects of fish recovery and return (FRR) system mitigation by assuming mean and upper 95% confidence interval impingement predictions. In summary, the sea bass stock assessment shows that:

- In all scenarios tested, including the extreme worst-case scenario, SZC impingement had no discernible effects on the population trends and only very minor effects on absolute SSB. That is, the size of the spawning population would still increase and decrease at the same times and at an almost identical rate whether or not impingement was occurring.
- Commercial and recreational fisheries mortality dominates the mortality of sea bass and the addition of SZC impingement making negligible differences. This is to be expected because the vast majority of sea bass impinged at Sizewell are 0-3-year-old fish and below the minimum conservation reference size (MCRS), currently set at 42cm. In contrast, fisheries mortality is more intensive and targeted at 4–15-year-old fish.
- The application of the ICES stock assessments incorporating precautionary SZC impingement estimates for a duration of 35 years provides powerful evidence that there would be no significant impact on the spawning population size of sea bass.

### c) Stock Size

1.3.3 SZC Co. thanks Natural England for their comments on the stock size explanation in the Technical Note [REP6-024] and await any further comments on BEEMS Scientific Position Paper SPP103 (Appendix F of [REP6-016]).

## 1.4 Environment Agency Comments

1.4.25 SZC Co. responses to the Environment Agency Deadline 7 [REP7-128] and comments on the Technical Note (Appendix F of [REP6-024]) are provided in the following section.

| EA Reference | EA Issue | EA Impact | EA Solution | SZC Co. Response |
|---|---|---|---|---|
| **Appendix F: Technical Note on EAV and stock size [REP6-024]** | | | | |
| 1.1.2 | [quote from REP6-024] 'detailed evidence provided in support of the Hinkley Point C WDA Appeal Inquiry, including the main Proof of Evidence of Dr Jennings of Cefas (Centre for Environment Fisheries and Aquaculture Science) and the Rebuttal Proof of Evidence of Dr Simon Jennings on EAVs and the underlying principles of defining stock areas is analogous in the two developments.' | For completeness, the proof of evidence and rebuttal proof of Dr Jerome Masters of the Environment Agency should also be referred to.<br><br>CD 6.7 Proof of Evidence of Jerome Masters (EAVs) DEFRA file sharing service (sharefile.com)[2]<br>CD 6.16 Rebuttal Proof of Evidence of Jerome Masters DEFRA file sharing service (sharefile.com)[1] | The Environment Agency has provided a document to the Sizewell hearings which summarises the differences of opinion between the parties with regard to EAV, as expressed in the Hinkley documentation, and provides examples to aid understanding.<br>If further detail is required then the Examining Authority may find it helpful to consult the proofs of evidence presented to the Hinkley inquiry by the Environment Agency as well as those presented by Cefas. | No comment required. |
| 1.2.31 | [quote from REP6-024]:<br>One precautionary assumption is that the EAV assumes no fisheries mortality of the juvenile stages. By assuming no fishing mortality before first | Fishing mortality is of less concern for species which are not targeted commercially, including twaite shad and smelt. | | The assumption of limited fishing mortality is indeed correct (rather than precautionary) for species which are not subject to targeted commercial fishing.<br>In the case of smelt, the Environment Agency licence a small-scale restricted fishery in the Anglian region with average annual landings in the period 2009-2017 of |

[2] https://ea.sharefile.com/share/view/sfb86ac1978a14420862086325f233f9f/fo0eb3c3-a748-4816-be7c-c98a687d4955

| EA Reference | EA Issue | EA Impact | EA Solution | SZC Co. Response |
|---|---|---|---|---|
| | maturity, the EAV assessment overestimates the chance of survival to maturity, particularly for species such as cod, whiting and sea bass. | | | 8.63t (for years with landings data). The predicted impact from the station is less than 0.3t per annum (EAV weight) with no mitigation. |
| 1.2.32 | [quote from REP6-024]:<br>Furthermore, the EAV biomass is calculated by multiplying the EAV number by the mean adult fish weight from the spawning population. The individual weight at the age at first maturity will be lower than the individual weight of older and more fecund fish in the spawning population. Therefore, the EAV biomass upweights apparent losses of spawner biomass due to entrapment and their potential contribution to | The use of the mean adult fish weight will 'upweight' to some degree (which may vary from year to year as the mean adult fish weight also changes). However, the upweighting is not going to be equivalent to calculating the number of repeat spawners, as is would be done through the SPF extension. | | The Environment Agency accept that the Cefas EAV method 'upweights' first-time spawners to account for the mean weight of the adult spawning population.<br><br>The comparison between the upweighted first time spawners and the SPF extension is not valid as the Cefas EAV method calculates an annual rate which can directly be compared with the SSB whilst the SPF method generates a multi-annual rate which cannot be compared with the SSB (see response to 1.2.35 below). |

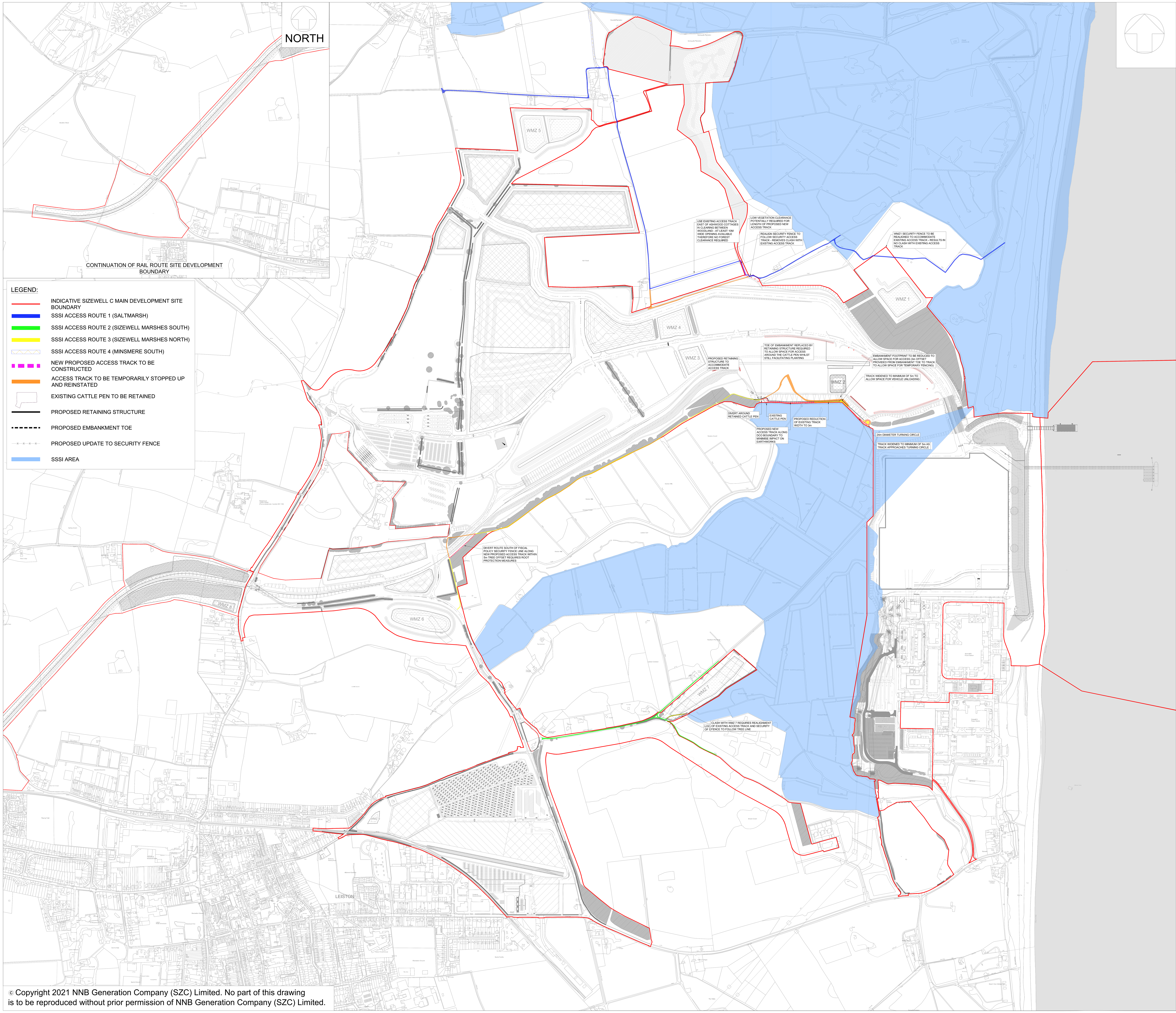
| EA Reference | EA Issue | EA Impact | EA Solution | SZC Co. Response |
|---|---|---|---|---|
| | the spawning population biomass. | | | |
| 1.2.35 | [quote from REP6-024]<br>In accounting for repeat spawning, the assessment necessarily estimates a multiannual rate of losses and not an annual one. | The Cefas method and the SPF extension both return annual rates.<br>The 'annual rate' of the Cefas method is the number of first time spawners that would otherwise enter the population each year, had they not previously been impinged.<br>The 'annual rate' of the SPF extension is the number of first time and repeat spawners that would have otherwise been present in the population in any given year, had they not previously been impinged. | Please refer to Example 2 of our explanatory note [REP5-150, pg 29] | The Cefas method forward projects the predominantly juvenile fish impinged at Sizewell to estimate the number of first-time spawners that would be lost within a given year. As such, it is an annual rate of loss. This annual rate of loss from the population can be compared against the spawning stock biomass (SSB) and other annual rates of loss such as fisheries landings.<br><br>The SPF does not calculate an annual rate. By accounting for repeat spawning over multiple years it creates a summed impact on first time and repeat spawners and not annual rates. It cannot, therefore, be compared with the SSB.<br><br>The challenge is how to apply the SPF losses:<br><br>SPF losses cannot be compared with annual fishing mortality rates. In effect, the EA method provides a half-way house between the Cefas EAV risk assessment and a full (ICES) stock assessment. But the |

| EA Reference | EA Issue | EA Impact | EA Solution | SZC Co. Response |
|---|---|---|---|---|
| | | | | thresholds for population stability applied in the annual Cefas EAV risk assessment method are based on comparisons to sustainable annual fisheries landings. These annual thresholds are not relevant for the SPF method.<br><br>The most appropriate method is to apply the Cefas EAV approach to assess risks. If precautionary thresholds for annual projected rates of entrapment mortality are exceeded, more data-demanding sophisticated methods, such as stock assessment, may be applied to more accurately assess risks and the scale of impacts at a population level. As an example of this SZC Co. has provided a stock assessment for sea bass (Doc. Ref. 9.100, see also Section 1.3.31b). |
| 1.2.36 | [quote from REP6-024]<br>A second important issue with the application of the SPF extension is the need to deal with fishing mortality | Fishing mortality can be included into the SPF extension, just as it can into the Cefas method. However, there are considerable difficulties associated with selecting a value of fishing mortality that will be appropriate for the sixty year plus operational lifetime of SZC. Even if fishing | | Notwithstanding the challenges of determining the appropriate rate of fishing mortality, age specific fishing mortality could indeed be factored into both the Cefas EAV and the Environment Agency SPF method.<br>In most cases fishing mortality increases with age whilst natural mortality decreases. By not incorporating fishing mortality for |

| EA Reference | EA Issue | EA Impact | EA Solution | SZC Co. Response |
|---|---|---|---|---|
| | | mortality were included, the SPF extension would still return a higher EAV value than the Cefas method. | | juvenile stages into the calculations the Cefas EAV is already precautionary.<br>The effect of including fisheries mortality into the SPF method was considered in BEEMS Scientific Position Paper SPP102 (pdf page 347 of [AS-238]).<br><br>As stated by the Environment Agency, the inclusion of fishing mortality into the SPF method would still result in higher EAVs than the Cefas EAV method. However, as described in response to 1.2.35, the SPF approach has limited applicability in that the losses cannot meaningfully be compared to thresholds for annual rates of mortality in relation to SSB. |
| 1.2.39 | [quote from REP6-024]<br>However, to provide the highest level of confidence available in the assessment of no significant effects SZC Co. has committed to completing a full ICES stock assessment for sea bass based on precautionary assumptions which will | Stock assessment for seabass will be based upon the ICES stock area, which extends from the North Sea, through the English Channel, Western Approaches and Celtic Sea, to the Irish Sea. However, many seabass off Sizewell will not migrate to spawning grounds to the western extremity of this range (e.g. Trevose Head off the North Coast of Devon), and relatively few | | ICES stock advice is used to inform both EU and UK fisheries policy and the setting of Total Allowable Catches from fish stocks.<br>ICES stock assessments provide internationally generated and approved estimates of stock sizes. Sizewell C would impact the same population as the fishery so it is appropriate to adopt the ICES stock definition. It is noted that Natural England welcomed the commitment to provide a full stock assessment and agreed with the |

| EA Reference | EA Issue | EA Impact | EA Solution | SZC Co. Response |
|---|---|---|---|---|
| | be provided at Deadline 8. | larvae produced in these western spawning grounds will settle in the North Sea. Consequently, while stock assessment will provide an estimate of impact on the fishery stock, it (alone) cannot answer questions about localised depletion around Sizewell. The Applicant may address localised depletion using different analytical approaches. | | selection of sea bass as a model species (Section 1.3.31b).<br>The population level effects assessment is independent but complementary to the local depletion assessments that have been provided in parallel in BEEMS Scientific Position Paper SPP103 Rev 5 [REP6-016]. SZC Co. acknowledges the comments from the Environment Agency on the local depletion assessment [REP7-133]. Responses to these comments will be provided at Deadline 10, following anticipated MMO and NE comments on the same report. |

# APPENDIX J: ACCESS ROUTES TO MINSMERE AND SIZEWELL MARSHES SSSI






KEY:

NORTH

NOTES:

1. DRAWING BASED ON EW0000 ENGINEERING DCO BACKGROUND (SZC-EW0000-ATK-XX-000-XXXXXX-DRW-CIV-000044).
2. ALL LAYOUT DETAILS INDICATED ARE SUBJECT TO VERIFICATION AND CONSIDERATION OF ENVIRONMENTAL AND ENGINEERING CONDITIONS.

NOT PROTECTIVELY MARKED



DOCUMENT:
COMMENTS AT DEADLINE 8 ON EARLIER DEADLINES AND CAH1 & ISH8-ISH10.

DRAWING TITLE:
ACCESS ROUTES TO MINSMERE AND SIZEWELL MARSHES SSSI

DRAWING NO:
FIGURE 1

| DATE: | DRAWN: | SCALE: | REV: |
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# APPENDIX K: SIZEWELL C CONSTRUCTION PHASE VISUALISATIONS - REPORT

# CONTENTS



## TABLES



## FIGURES

## APPENDICES

# 1 SIZEWELL C CONSTRUCTION PHASE VISUALISATIONS

## 1.1 Introduction

1.1.1 The purpose of this report is to provide illustrative visualisations from several publicly accessible locations within the Suffolk Coast and Heaths AONB to assist Interested Parties in visualising the construction working heights applied for and assessed in the DCO and the visual character of the Sizewell C construction site during the day and at night.

1.1.2 The report includes details regarding the selection of representative viewpoints and the methodology used for the production of the visualisations provided in **Appendix B**. It also highlights the limitations of the visualisations and assumptions made in their production.

## 1.2 Background and context for the production of visualisations

1.2.1 The adequacy of visual material provided in support of the Main Development Site Landscape and Visual Impact Assessment (**ES Volume 2 Chapter 13** [APP-216]), and submitted subsequently as part of the ES Addendum in January 2021 (**ES Addendum Volume 1 Chapter 2** [AS-181]) and in response to the Examining Authorities request for further information [AS-050] was discussed under Agenda Item 3 of Issue Specific Hearing 5 (ISH5), held on 13 July 2021.

1.2.2 In Section 1.5 (Additional Construction Period Visualisations) of SZC Co.'s written submission responding to actions arising from ISH5 [REP5-117], SZC Co. notes that Suffolk County Council (SCC) and East Suffolk Council (ESC) agree with SZC Co. that the parameters-based construction phase photowire visualisations presented in the LVIA are appropriate to inform the assessment of effects. It also records that that the report (Appendix 18E 'Hinkley Point C Construction Phase Visual Analysis' [REP2-111]) that was submitted by SZC Co. in support of its response to ExQ1 LI.1.22 [REP2-100] is regarded as helpful in understanding the nature of construction phase activity, structures, vehicles and other characteristic features that can reasonably be anticipated to be present at or near peak construction activity at Sizewell C.

1.2.3 However, SZC Co. also notes that Interested Parties, notably the Suffolk Coast and Heaths AONB Partnership, the National Trust, TASC and Stop Sizewell C have requested additional visualisations of construction phase activity at Sizewell C (both during the day and at night) in order to inform a better appreciation of the visual appearance of the construction phase at the Sizewell C main development site amongst non-technical audiences.

1.2.4 SZC Co. has given careful consideration to this request and in accordance with the commitment reported in its response following ISH5 [REP5-117] it has prepared illustrative construction phase day and night-time visualisations (the visualisations) from four selected representative viewpoint locations.

## 1.3 Selection of viewpoints

1.3.1 In its written submission responding to actions arising from ISH5 [REP5-117], SZC Co. proposed to prepare construction phase visualisations from the following representative viewpoints.

- Representative Viewpoint 9: Sizewell Gap south of Greater Gabbard sub-station
- Representative Viewpoint 10: Suffolk Coast Path and Sandlings Walk east of Hill Wood
- Representative Viewpoint 14: Suffolk Coast Path at Minsmere Sluice
- Representative Viewpoint 17: National Trust Dunwich Coastguard Cottages

1.3.2 These viewpoint locations were selected to provide an indication of how construction of Sizewell C may appear from the most visited publicly accessible locations from where the visual impacts of the construction phase would be experienced, including from representative viewpoint 17 which is located at the National Trust Dunwich Coastguard Cottages.

1.3.3 In its second round of questions (ExQ2 LI.2.1 [PD-035]), the Examining Authority sought comments from SCC, ESC, Natural England, Suffolk Coast and Heaths AONB Partnership, National Trust, Stop Sizewell C and TASC on the suitability of the four viewpoints proposed by SZC Co. for the production of the visualisations.

1.3.4 In their respective responses to question ExQ2 LI.2.1 SCC [REP7-163], ESC [REP7-119] and the National Trust [REP7-138] confirmed that the proposed viewpoints are suitable for the purpose of giving an understanding of construction activity from a range of viewpoints with important public access. In their respective responses, the Suffolk Coast and Heaths AONB Partnership [REP7-230], TASC [REP7-253] and Stop Sizewell C [REP7-228] requested additional construction phase visualisations to those proposed and agreed as suitable by ESC, SCC and the National Trust.

1.3.5 In its response provided at Deadline 8 to the comments from Interested Parties that responded to ExQ2 LI.2.1, SZC Co. records that it welcomes agreement by ESC, SCC and the National Trust to the representative viewpoints selected to be used in the production of illustrative day and night-time construction visualisations, and notes that The Suffolk Coast and Heaths AONB Partnership and TASC record that visualisations from these locations would be useful. It also records that SZC Co. considers that the visualisations for the viewpoints selected and supported by ESC, SCC and National Trust taken together provide an appropriate and proportionate response to the request for additional visualisations and as such does not consider that preparation of additional construction phase visualisations requested by the Suffolk Coast and Heaths AONB Partnership, TASC and Stop Sizewell C is necessary to support the understanding of the impacts of the construction phase of the Sizewell C project.

## 1.4 Method for production of visualisations

1.4.1 Details of the methodology used in the production of visualisations is presented in Annex 6I.2 of Appendix 6I Landscape and Visual Legislation and Methodology (**ES Volume 1, Chapter 6** [APP-171]). As recorded, the approach draws on the Landscape Institute Technical Guidance Note 06/19 'Visual Representation of Development' published in September 2019 (Ref 1).

1.4.2 The visualisations have been prepared using the best available information at the time of their preparation. In producing the visualisations reference has been made to the following sources of information:

- Navisworks Model[1].
- Main Development Site Chapter 3 Description of Construction Appendix 3D of the Environmental Statement: Construction Method Statement (Revision 4.0) [REP7-281].
- Main Development Site Chapter 3 Description of Construction Figures (latest version of each figure is listed in Construction Method Statement [REP7-281]).
- Main Development Site Construction Parameter Plans - Plans For Approval (Revision 6.0) [REP7-269].

[1] Navisworks Model - SZC-EW0000-ATK-XX-000-XXXXXX-MDL-CIV-000003 (July 2021). The Navisworks model is a technical working Federated model to aid design coordination, space proofing and clash detection. It visualises the designs from multiple native file types to allow holistic design decisions to be made).

- Code of Construction Practice (Revision 5.0) [REP7-038]

1.4.3 The precise details of temporary structures, activity, vehicles and plant to be used during the construction of Sizewell C is not confirmed in all cases. Furthermore, the positions of plant, cranes, temporary buildings and structures will vary throughout the different phases of construction.

1.4.4 As such certain assumptions are made regarding the locations of mobile and temporary structures and plant within the various construction zones in the visualisations. Furthermore, the visualisations are based on the various phases of construction activity (as described in the Construction Method Statement and provided within the Navisworks model) happening concurrently. This is to illustrate the 'worst-case scenario'. In reality, construction activities would be phased, and the actual visual impact at any point in time in the construction programme is likely to be less than that illustrated in the visualisations.

1.4.5 The colour and materials for temporary structures and certain types of plant, including cranes, is not confirmed. However, to provide as accurate and realistic representation of construction as is possible, modelled elements are rendered as follows:

- With the exception of the mobile and crawler cranes (yellow), 'Big Carl' -Sarens SGC-250 crane (yellow) and the Sarens CC8800-1 crane (yellow), all cranes have been illustrated in white (RAL 9016), replicating the situation at Hinkley Point C.
- The temporary accommodation campus is illustrated with example materials.
- Temporary buildings and structures, including the concrete batching plant are illustrated in mid grey (RAL 7016)
- Where possible roads have been illustrated with an asphalt finish.

1.4.6 The visualisations also include plant such as excavators, bulldozers and dumper trucks. These are illustrated with a make and model of vehicle similar to that expected to be utilised and are colour rendered accordingly (typically yellow which is characteristic of much construction plant).

1.4.7 The coastal defence feature is included in the visualisations and construction plant is illustrated along the coastal frontage of the Main Development Site in order to represent the worst-case scenario in views along the coastline.

1.4.8 The night-time visualisations have been rendered using a specialist rendering application that allows the use of photometric lighting (a file that can be applied to the light in the 3d model that accurately replicates the characteristics of a physical light). SZC Co.'s lighting engineers have provided technical details (make, model, location and photometric files) and the lighting model was built to the same specifications. Exposure settings for the visualisations use the photography of the construction phase at Hinkley Point C as a reference point for brightness, colour and sky glow treatment. Offshore navigation lighting and aviation lighting is illustrated where information is available (for example aviation lighting on cranes at above 45m AoD and navigation lighting attached to the beach landing facilities). SZC Co. will undertake the necessary engagement, for example with the Civil Aviation Authority, at the appropriate time to agree the specific requirements for offshore navigation and aviation lighting.

1.4.9 With reference to the above, tables presented in **Appendix A** of this report provide details of tall structures, plant and other vehicles included in the visualisations in each of the construction zones. The tables draw on information within the Navisworks model supplemented with additional information provided by SZC Co.'s engineering and delivery team concerning elements that would also potentially be present in each construction zone not included in the Navisworks model.

## 1.5 Assumptions

1.5.1 As noted previously, the visualisations have been prepared using the best available information at the time of production. Whilst some specifics regarding the types of plant, equipment and colour finishes may vary, these would in all cases sit within the normal and exceptional parameters as described in the DCO and illustrated on the Main Development Site Construction Parameter Plans Revision 6.0 [REP7-269] and on construction phase parameters based photowire visualisations presented in Figures 13.10.1-13.10.107 (**ES Volume 2, Chapter 13** [APP-222] and [APP-223]); updated construction phase parameters based photowire visualisations submitted as part of the ES Addendum [AS-193]; and construction phase visualisations for the accommodation campus and land east of Eastlands Industrial Estate, provided by SZC Co. [AS-050] in its response the ExA's request for further information -Rule 17 [PD-009].

1.5.2 As previously noted, the positions of plant, cranes, temporary buildings, vehicles and structures will vary throughout the period of construction. Therefore, the visualisations are based upon construction occurring within all parts of the site happening concurrently. This is to illustrate the 'worst-case scenario'. In reality, construction activities would be phased, and the actual visual impact at any point in time in the construction programme is likely to be less than that illustrated in the visualisations.

1.5.3 For each of the visualisations, winter views are illustrated. This is to illustrate the worst-case scenario, as during winter, deciduous trees and shrubs are out of leaf and their visual screening is reduced compared to periods when they are in full leaf. Furthermore, whilst the visualisations take account of vegetation to be removed, they do not include any proposed planting in order to represent the worst-case scenario.

## 1.6 Limitations

1.6.1 Reference should be made to general limitations set out in the LVIA (**ES Volume 2 Chapter 13** [APP-216]).

1.6.2 For the reasons set out above, the illustrative construction visualisations are indicative and intended to illustrate examples of typical cranes, plant, temporary structures and vehicles likely to be present during the construction of Sizewell C.

1.6.3 The illustrative construction visualisations are provided for information only.

## 1.7 The visualisations

1.7.1 The visualisations are appended to this report in **Appendix B**:

1.7.2 The illustrative construction phase visualisations should be viewed alongside information, figures and visualisations presented in the LVIA (**ES Volume 2 Chapter 13** [APP-216] and submitted during the examination as follows:

- Representative Viewpoint locations illustrated on Figure 13.6A and Figure 13.6B in ES Volume 2 Chapter 13 [APP-220]
- Baseline views from Representative Viewpoint locations presented in ES Volume 2, Chapter 13 [APP-221];
- Construction phase parameters based photowire visualisations presented in ES Volume 2, Chapter 13 [APP-222 and APP 223];
- Updated baseline views from Representative Viewpoint locations presented in the ES Addendum [AS-192];
- Updated construction phase parameters based photowire visualisations submitted as part of the ES Addendum [AS-193];

- Construction phase visualisations for the accommodation campus and land east of Eastlands Industrial Estate, provided by SZC Co. [AS-050] in its response the ExA's request for further information -Rule 17 [PD-009]; and

- Hinkley Point C Construction Phase Visual Analysis report and photographs contained in this report [REP2-111].

# REFERENCES

1. Landscape Institute (2019) Technical Guidance Note 06/19 – Visual Representation of Development Proposals

# APPENDIX A: ELEMENTS AND PLANT INCLUDED IN THE VISUALISATIONS

**Table 2.1: Main platform**

| Construction Zone | Construction Zone Parameter (Max. Height m above ordnance datum (AoD) | Elements and plant included in visualisations |
|---|---|---|
| Zone C1: Construction of the main platform. | 160m AoD | 51no. Tower cranes, a mix of flat top and luffing jib cranes and 'Big Carl' (Sarens SGC-250) (provided in Navisworks file). |
| Zone C1: Construction of the main Platform – exceptional circumstances. | 250m AoD. | |
| Zone C16: Construction of the permanent beach landing facility | 25m AoD. | Piling equipment (suggested type Casagrande CFA26; modelled with LB28-320 at 25m tall).<br>1no. Crawler crane on a barge (suggested model LR1110; modelled with LR1160). |
| Zone C16: Construction of the permanent beach landing facility – exceptional circumstances | 60m AoD. | |
| Zone C20: Construction of the temporary beach landing facility | 25m AoD. | Piling equipment (suggested type Casagrande CFA26; modelled with LB28-320 at 25m tall).<br>1no. Crawler crane on a barge (suggested model LR1110; modelled with LR1160). |
| Zone C20: Construction of | 60m AoD. | |

| Construction Zone | Construction Zone Parameter (Max. Height m above ordnance datum (AoD) | Elements and plant included in visualisations |
|---|---|---|
| the temporary beach landing facility | | 1no. Mobile crane with Cantitravel system (suggested model LTM1300; model used HS890). |
| Zone C21: Marine tunnelling and shafts | 40m AoD. | 1no. Gantry Crawler crane (suggested type LR1300; modelled with LR1160).<br>1no. Mobile crane (suggested model LTM1500; modelled with LTM1450). |
| Zone C21: Marine tunnelling and shafts–<br>exceptional circumstances | 70m AoD. | |
| Hard coastal defence feature | 15m AOD | Large Excavators.<br>Piling equipment (suggested type Casagrande CFA26; modelled with LB28-320 at 25m tall).<br>2no. Crawler cranes (suggested model LR1110; modelled with LR1160). |
| Hard coastal defence feature – exceptional circumstances | 35m AOD | |

### Table 2.2: Sizewell B relocated facilities and National Grid land

| Construction Zone | Construction Zone Parameter (Max. Height) | Tall elements included in visualisations |
|---|---|---|
| Zone C17 Construction activities on Sizewell B relocated facilities | 50m AoD. | 2no. Mobile cranes (modelled with LTM1200). |
| Zone C19 Working envelope for National Grid | 120m AoD. | 1no. Mobile crane modelled with LTM1450 & fly jib |

### Table 2.3: Temporary construction area

<table>
<tr><th>Construction Zone</th><th>Construction Zone Parameter (Max. Height)</th><th>Tall elements included in visualisations</th></tr>
<tr><td>Zones C2a and C2b: Construction of common user facilities.</td><td>Zone C2a: 70m AoD Zone C2b: 70m AoD.</td><td rowspan="2">3no. Mobile cranes (modelled with LTM1450).<br>3no. Flat top tower cranes in C2a (model provided in Navisworks file).<br>IT/Comms mast 43.5m tall.<br>1no. Terex CC8800 with boom booster.</td></tr>
<tr><td>Zones C2a and C2b: Construction of common user facilities – exceptional circumstances.</td><td>Zone C2a: 160m AoD. Zone C2b: 140m AoD.</td></tr>
<tr><td>Zone C3: Construction of contractor compounds and other yards.</td><td>35m AoD.</td><td>2no Tower cranes (provided in Navisworks model).<br>1no. Mobile crane (modelled with LTM1200).</td></tr>
</table>

| Construction Zone | Construction Zone Parameter (Max. Height) | Tall elements included in visualisations |
|---|---|---|
| Zone C3: Construction of contractor compounds and other yards– exceptional circumstances. | 120m AoD. | 1no. Crawler crane (sugsted type LR1300; modeled with LR1160).<br>1no. Mobile crane with fly jib (suggested type LTM1500; modelled with LTM1450).<br>Vertical PT grouting trials (modelled at 70m). |
| Zone C4: Construction of southern earth bund. | 18m AoD. | Excavators. |
| Zone C5: Construction of main stockpile. | 50m AoD. | 1no. Bulldozer.<br>1no. Excavator.<br>4no. Dumper trucks (suggested type A60; modelled with HM300). |
| Zone C5a: Construction of stockpile, contractor compounds and other yards. | 35m AoD. | 1no. Excavator.<br>1no. Dumper truck (suggested type A60; modelled with HM300).<br>Rapidmix plant with 400CW silos (modelled at 12.8m).<br>1no. Mobile crane (suggested type LTM 1050; modelled with LTC1050). |
| Zone C6: Construction of eastern borrow pit and stockpile. | 20m AoD. | 1no. Bulldozer.<br>1no. Excavator.<br>4no. Dumper trucks (suggested type A60; modelled with HM300). |
| Zone C7: Construction of western borrow pit and stockpile. | 20m AoD. | 1no. Bulldozer.<br>1no. Excavator.<br>4no. Dumper trucks (suggested type A60; modelled with HM300) |

| Construction Zone | Construction Zone Parameter (Max. Height) | Tall elements included in visualisations |
|---|---|---|
| Zone C8: Construction of northern stockpile area. | 20m AoD. | 1no. Bulldozer.<br>1no. Excavator.<br>4no. Dumper trucks (suggested type A60; modelled with HM300). |
| Zone C9: Construction of site entrance hub. | 35m AoD. | 1no. Crawler crane (suggested type LR1110; modelled with LR1160).<br>2no. Mobile cranes (suggested type LTM1120; modelled with LTM1200). |
| Zone C9: Construction of site Entrance hub exceptional circumstance. | 65m AoD. | |
| Zone C10: Construction of rail extension route stockpile area. | 30m AoD. | 1no. Mobile crane (suggested type LTM 1050; modelled with LTC1050). |
| Zone C11: Construction of Lover's Lane stockpile area. | 30m AoD. | |
| Zone CA1: Construction of accommodation campus residential buildings. | 36m AoD. | 1no. Excavator.<br>1no. Mobile crane (suggested type LTM 1050; modelled with LTC1050).<br>2no. Mobile cranes (suggested type LTM1100; modelled with LTM1450). |
| Zone CA1: Construction of accommodation campus | 70m AoD. | |

| Construction Zone | Construction Zone Parameter (Max. Height) | Tall elements included in visualisations |
|---|---|---|
| residential buildings– exceptional circumstances. | | |
| Zone CA2: Construction of accommodation campus multi-storey car park. | 25m AoD. | 2no. Mobile cranes (suggested type LTM1100; modelled with LTM1450). |
| Zone CA2: Construction of accommodation campus multi-storey car park – exceptional circumstances. | 70m AoD. | |
| Zone CA3: Construction of accommodation campus non-residential buildings. | 35m AoD. | 2no. Mobile cranes (suggested type LTM1100; modelled with LTM1450). |
| Zone CA3: Construction of accommodation campus non-residential buildings - exceptional circumstances. | 65m AoD. | |

### Table 2.4: Land east of Eastlands Industrial Estate

| Construction Zone | Construction Zone Parameter (Max. Height) | Tall elements included in visualisations |
|---|---|---|
| Zone C12: Construction of LEEIE stockpile area. | 21m AoD. | 1no. Bulldozer.<br>1no. Excavator.<br>4no. Dumper trucks (suggested type A60; modelled with HM300). |
| Zone C13: Construction of caravan site. | 35m AoD. | 1no. Mobile crane (suggested type LTM1050; modelled with LTC1050). |
| Zone C14: Contractor areas to the north of railhead. | 35m AoD. | 1no. Excavator.<br>1no. Mobile crane (suggested type LTM1050; modelled with LTC1050).<br>ACA Telcoms Mast shown at 30m tall.<br>1no. Mobile crane (suggested type LTM1050; modelled with LTM1450). |
| Zone C14: Contractor areas to the north of railhead– exceptional circumstances. | 75m AoD. | |
| Zone C15: Construction related areas and rail infrastructure. | 30m AoD. | 1no. Mobile crane (suggested type LTM1050; modelled with LTC1050). |