HyNet North West Hydrogen Pipeline

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Appendix 7F: Annex 7F6

Outline Drainage Strategy

October 2024

Revision 1
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Glossary

Term	Description
AEP	Annual Exceedance Probability
AOD	Above Ordnance Datum
BGS	British Geological Survey
BVIs	Block Valve Installations
CBSCB	Cheshire Brine Subsidence Compensation Board
CEMP	Construction Environmental Management Plan
CIRIA	Construction industry research and information association
CW&C	Cheshire West & Chester
DCO	Development Consent Order.
DCO	Development Consent Order
DEFRA	Department for Environment, Food and Rural Affairs
DoT	Department of Transport
EA	Environment Agency
EET	Essar Energy Transition Hydrogen
ES	Environmental Statement
FEH	Flood Estimation Handbook
FRA	Flood Risk Assessment
HAGI	Hydrogen Above Ground Installation
HDD	Horizontal Directional Drilling
HPP	Hydrogen Production Plant
LLFA	Lead Local Flood Authority
LoD	Limits of Deviation
LPA	Local Planning Authority
NPPF	National Planning Policy Framework

Term	Description
SuDS	Sustainable Urban Drainage System
TSS	Total Suspended Solids
UU	United Utilities

Contents

1 Introduction 8
1.2 Design Principles and Criteria 10

2 Proposed Drainage Strategy - General Principles 16
2.1 Permanent Above Ground Infrastructure 16
2.2 SuDS Based Surface Water Quality Control Measures 19
2.3 Drainage of Temporary Construction Compounds and Pipe Laydown Areas 23
2.4 Foul Drainage 25
Operational Sites 25
Temporary Construction Sites 25
2.5 Existing Utilities 25

3 Stanlow Hydrogen Production Plant (HPP) HAGI Site 26
3.2 Existing Site 26
3.3 Proposed Permanent Development 27
3.4 Allowable Site Discharge 28
3.5 Provision of Attenuation Storage 28
3.6 Temporary Construction Compound Drainage 29
Allowable Site Discharge 29
Attenuation Provision 29
3.7 Existing Utilities in the Area 29

4 Rocksavage HAGI Site 30
4.2 Existing Site 30
4.3 Proposed Permanent Development 31
4.4 Attenuation Provision 32
4.5 Temporary Construction Compound Drainage 32
Allowable site discharge 33
Attenuation Provision 33
4.6 Existing Utilities in the Area 33

5 Runcorn HAGI Site 35
5.2 Existing Site 35
5.3 Proposed Permanent Development 35
5.4 Allowable Site Discharge 36
5.5 Attenuation Provision 37

5.6 Temporary Construction Compound Drainage 37
Allowable Site Discharge 37
Attenuation Provision 38
5.7 Existing Utilities in the Area 38

6 Central Hub HAGI Site 39
6.2 Existing Site 39
6.3 Proposed Permanent Development 39
6.4 Allowable Site Discharge 40
6.5 Attenuation Provision 41
6.6 Temporary Construction Compound Drainage 41
Allowable Site Discharge 42
Attenuation Provision 42
6.7 Existing Utilities in the Area 43

7 Higher Walton HAGI Sites 44
7.2 Site 1 (HWH2) 44
7.3 Proposed Permanent Development 44
7.4 Allowable Site Discharge 45
7.5 Attenuation Provision 46
7.6 Temporary Construction Compound Drainage 46
Allowable Site Discharge 47
Attenuation Provision 47
7.7 Existing Utilities in the Area 47
7.8 Site 2 (HWH8) 48
7.9 Proposed Permanent Development 48
7.10 Allowable Site Discharge 49
7.11 Attenuation Provision 49
7.12 Temporary Construction Compound Drainage 49
Allowable Site Discharge 50
Attenuation Provision 50
7.13 Existing Utilities in the Area 50

8 Clock Face HAGI Site 51
8.2 Existing Site 51
8.3 Proposed Permanent Development 51
8.4 Allowable Site Discharge 52
8.5 Attenuation Provision 53
8.6 Temporary Construction Compound Drainage 53
Allowable Site Discharge 53
Attenuation Provision 54
8.7 Existing Utilities in the Area 54

9 Warburton HAGI Site 55

9.2 Existing Site 55
9.3 Proposed Permanent Development 55
9.4 Allowable Site Discharge 56
9.5 Attenuation Provision 57
9.6 Temporary Construction Compound Drainage 57
Allowable Site Discharge 57
Attenuation Provision 58
9.7 Existing Utilities in the Area 58

10 Partington HAGI Site 59

10.2 Site 1 59
10.3 Proposed Permanent Development 60
10.4 Allowable Site Discharge 60
10.5 Attenuation Provision 61
10.6 Temporary Construction Compound Drainage 62
Allowable Site Discharge 62
Attenuation Provision 62
10.7 Existing Utilities in the Area 62
10.8 Site 2 62
10.9 Proposed Permanent Development 63
10.10 Allowable Site Discharge 63
10.11 Attenuation Provision 64
10.12 Temporary Construction Compound Drainage 64
Allowable Site Discharge 64
Attenuation Provision 64
10.13 Existing Utilities in the Area 65

11 Hydrogen Storage Facility HAGI Site 66

11.2 Existing Site 66
11.3 Proposed Permanent Development 66
11.4 Allowable Site Discharge 67
11.5 Attenuation Provision 68
11.6 Temporary Construction Compound Drainage 68
Allowable Site Discharge 69
Attenuation Provision 69
11.7 Existing Utilities in the Area 69

12 Sworton Block Valve Installation Site 70

12.2 Existing Site 70
12.3 Proposed Permanent Development 70
12.4 Allowable Site Discharge 71

12.5 Attenuation Provision 72
12.6 Temporary Construction Compound Drainage 72
Allowable Site Discharge 72
Attenuation Provision 73
12.7 Existing Utilities in the Area 73

13 Hartford Block Valve Installation Site 74
13.2 Existing Site 74
13.3 Proposed Permanent Development 74
13.4 Allowable Site Discharge 75
13.5 Attenuation Provision 76
13.6 Temporary Construction Compound Drainage 76
Allowable Site Discharge 76
Attenuation Provision 77
13.7 Existing Utilities in the Area 77

14 Greenfield Pipe Laydown Areas Along the Pipeline Route 78

15 Other Drainage Strategy Principles for Temporary Construction Areas 80
15.2 Temporary Areas Subject to Soil Stripping and Excavation for Pipeline Construction 80
15.3 Crossing Field Drainage Ditches or Small Watercourses Using Dry Open Cut Method 81
15.4 Treatment of Agricultural Field Drains 82

Table 7F6 1.1 SuDS Guidance for Local Councils 12
Table 7F6 2.1 Environment Agency peak rainfall intensity allowances (% increase relative to 1981 to 2000 baseline) 18
Table 7F6 2.2 – Pollution Hazard Indices for Different Land Use Classifications.(Source: The SuDS Manual, CIRIA C753) 20
Table 7F6 2.3 – Indicative SuDS Mitigation Indices for Discharges to Groundwater. (Source: The SuDS Manual, CIRIA C753) 21
Table 7F6 2.4 – Indicative SuDS Mitigation Indices for Discharges to Surface Water (Source: The SuDS Manual, CIRIA C753) 21
Table 7F6 2.5 – Summary of Proposed Hazard and Mitigation Indices for Discharges to Surface Water. 22
Table 7F6 2.6 – Summary of Proposed Hazard and Mitigation Indices for Discharges to Groundwater 22
Table 7F6 14.1 Summary of Greenfield Pipe Laydown Areas 78

Figure 7F6 1.1 Total Extents of the Hynet North West Hydrogen Pipeline Project, including HAGI and BV site locations 9
Figure 7F6 2.1 Section Through Temporary Construction Area 24
Figure 7F6 3.1 Stanlow HPP HAGI Site Layout Plan 27
Figure 7F6 4.1 Rocksavage HAGI Site Plan 31
Figure 7F6 5.1 Runcorn HAGI Site Layout Plan 36
Figure 7F6 6.1 Central Hub HAGI Site Layout Plan 40
Figure 7F6 7.1 Higher Walton HAGI Sites (HWH2 and HWH8) Layout Plan 45
Figure 7F6 8.1 Clock Face HAGI Site Layout Plan 52
Figure 7F6 9.1 Warburton HAGI Site Layout Plan 56
Figure 7F6 10.1 Partington HAGI Sites Plan 60
Figure 7F6 11.1 Hydrogen Storage Facility HAGI Site Layout Plan 67

Figure 7F6 12.1 Sworton Block Valve Installation Site Layout Plan 71
Figure 7F6 13.1 Hartford Block Valve Site Plan 75

Appendix A Indicative Drainage Layout Plans
Appendix B Greenfield Runoff Calculations
Appendix C Attenuation Storage Calculations
Appendix D Temporary Construction Area Details
Appendix E Indicative Pipe Laydown Site Plans
Appendix F Pipe Laydown Areas - Attenuation Storage Calculations

1 Introduction

1.1.1 This Outline Drainage Strategy forms **Appendix F** of the Flood Risk Assessment (FRA) which is **Appendix 7F** of **Chapter 7: Water Environment**, of the Environmental Statement (ES) for the HyNet North West Hydrogen Pipeline Project ('the Project').

1.1.2 This document should also be read in conjunction with the full description of the Project provided in **Chapter 2: The Project** and **Chapter 12: Ground Conditions** in relation to expect ground conditions with respect to infiltration prospects.

1.1.3 The HyNet North West Hydrogen Pipeline project includes the construction and operation of approximately 100km of new pipeline to distribute hydrogen to industry in the North West of England. A number of Hydrogen Above Ground Installations (HAGIs), including Block Valve Installations (BVIs) are required to control the flow and pressure of hydrogen at key points along the proposed pipeline. **Figure 7F6 1.1** illustrates the extent of the Project.

1.1.4 The Project connects the Hydrogen Production Plant at the Essar Stanlow site south of Liverpool, as the source of hydrogen, for onward distribution to the Network. The pipeline transports hydrogen to the Central Hub at the centre of the Network, which then serves as the connection and onward distribution point to the North, East and South corridors, which would extend to St. Helens, Partington and Northwich respectively. Branching off from each main corridor would be pipeline spurs connecting hydrogen customers to the main pipeline. Infrastructure has also been included which supports the potential blending of hydrogen with methane in the existing gas network, should government support this activity.

1.1.5 The presently anticipated maximum extent of land in which the Project may take place, which is assessed in the Draft ES, is defined by the 'Draft Order Limits', land within which is hereafter referred to as 'land within the Draft Order Limits'.

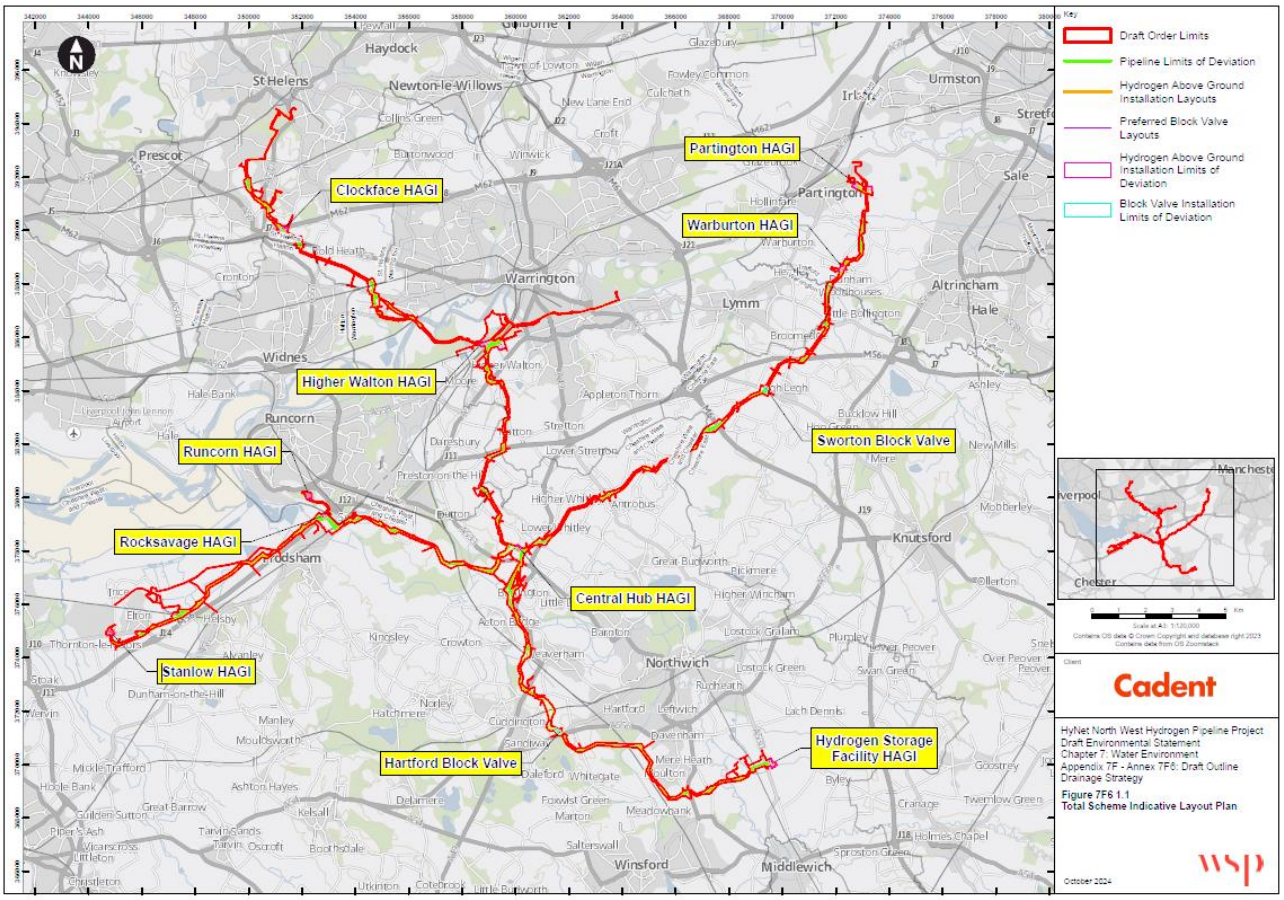
1.1.6 A proportionate degree of flexibility has been incorporated into the project design so that unforeseen issues that may be encountered following consent can be dealt with. For example, previously unidentified poor ground conditions may require a pipeline section to be re-routed slightly for geotechnical reasons. Therefore, to allow for this, new infrastructure would be constructed within specified Limits of Deviation (LoD) which identify a maximum distance or measurement of variation within which the works must be constructed.

1.1.7 The site-specific drainage designs presented in this document are preliminary at this stage based on the information presently available. We therefore expect changes to be applied throughout the developing design process before final approved construction design documentation would be available.

1.1.8 These designs therefore demonstrate the feasibility of the drainage systems presented but do not account for all the detail required for final approval and construction, as such a conservative approach has been adopted and detailed design by an elected skilled contractor will seek to refine the design within the parameters set.

1.1.9 Refinement and approval of final designs will occur post DCO consent and included in the DCO requirements will be the approval of the relevant final plans by the relevant planning authorities including the EA and LLFAs.

Figure 7F6 1.1 Total Extents of the Hynet North West Hydrogen Pipeline Project, including HAGI and BV site locations



1.1.10 The purpose of this document is to set out the Outline Drainage Strategy to be applied to all components of the Project which includes the permanent above ground installations including all Hydrogen Above Ground Installations (HAGI) and Block Valve Installation (BVI) sites. These sites are considered by way of site specific preliminary quantitative drainage designs.

1.1.11 In addition, the report also considers the drainage strategies to be applied to the temporary construction areas including:

- Temporary areas used as construction compounds for the HAGIs and BVIs.
- Temporary areas used for the storage of equipment (e.g. material storage areas).
- Temporary areas subject to soil stripping and excavation for pipeline construction, including:
  - open cut crossings of minor watercourses;
  - trenchless crossings for major watercourses; and

- linear infrastructure, potentially requiring dewatering.

1.1.12 These areas are the subject of clear drainage principles as described further in Section 15, which will be taken forward at detailed design.

1.2 Design Principles and Criteria

1.2.1 Generally, the following design criteria will apply to all permanent and temporary sites.

- The drainage design will be carried out with reference to the National Planning Policy Framework (NPPF)[1], Building Regulations Part H[2], CIRIA C753 SuDS Manual[3], DEFRA/Environment Agency guidance and the relevant LLFA's where appropriate.
- The drainage systems will be designed for 1% Annual Exceedance Probability (AEP) event with a climate change allowance that satisfies all the various LLFAs requirements. Further clarification of the climate change upliftment to be used is given in section 2.1.14
- The drainage designs will show that runoff from the site during the 1% AEP event will not increase flood risk to the surrounding environment (discharge to natural water course) as required by the NPPF. Furthermore, exceedance flows over and above this event (eg 0.5% AEP) will not increase flood risk to the site infrastructure by ensuring exceedance flow routes channel the runoff away from the infrastructure.

1.2.2 The topography of the sites has been approximated from available Lidar Contour data from DEFRA data service platform while the physical topoFigureal surveys of the sites are being undertaken. The outline drainage strategies are therefore based on this data.

1.2.3 At this stage the exact configuration of land drainage in the adjacent agricultural fields is not known, however reinstatement of these will be included in construction of the pipeline and components whether permanent or temporary. Refer to Section 15 for further detail of how these will be treated.

1.2.4 In the hydrological calculations for estimating attenuation volumes (in the MicroDrainage software) the synthetic rainfall storms were generated using FEH 2013 data in line with current best practice as FEH contains a more recent and more extensive dataset.

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[1] Ministry of Housing, Communities and Local Government. National Planning Policy Framework. 2023. (Online) Available from: https://www.gov.uk/guidance/national-planning-policy-framework (Accessed 02/08/2024)

[2] HM Government. The Building Regulations 2010. Drainage and Waste Disposal. 2015. (Online) Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/442889/BR_PDF_AD_H_2015.pdf (Accessed 02/08/2024)

[3] Woods Ballard, B.; Wilson, S.; Udale-Clarke, H.; Illman, S.; Scott, T.; Ashley, R.; Kellagher, R. The SuDS Manual (C753F), CIRIA.

1.2.5 In the calculations a conservative volumetric runoff coefficient (Cv) value has been used in accordance with industry best practice as it is assumed all rainfall will be deposited on the site directly.

1.2.6 In the current revision of the project all HAGI and BVI sites are greenfield sites except for Stanlow which is to be constructed on the existing Stanlow Refinery site in Ince and Partington HAGI Option 1 which is proposed to be constructed adjacent to the existing Cadent Gas Above Ground Installation site in Partington. Both sites are brownfield sites.

1.2.7 Greenfield runoff rates were calculated using the Wallingford website using FEH 2013 rainfall data and Qbar was chosen as the representative design runoff rate to be used. It is assumed for the greenfield sites that the surface water runoff is restricted to these calculated greenfield runoff rates.

1.2.8 In the absence of site specific infiltration testing results, a conservative assumption has been made that no infiltration is possible. This will be revisited during detailed design post-grant of the DCO. If site testing can demonstrate viable infiltration potential the relevant drainage strategies will require amending accordingly.

1.2.9 Information obtained to inform the Strategy includes the Halite Risk Assessment (2024). This provides information relating to possible subsidence due to historical brine related activities such as rock salt mining and brine pumping where the route of the proposed hydrogen distribution pipeline passes through the Cheshire Brine Subsidence Compensation District. This district affects approximately 45km of the pipeline route from Partington in the northeast through to the Hydrogen Storage Facility on the end of the southern leg.

1.2.10 The LLFA's from the six Local Planning Authorities (LPA's) covering the extent of the Project will be statutory consultees in the DCO process and therefore their requirements regarding the drainage designs and implementation of SuDS will need to be satisfied.

1.2.11 A summary of SuDS guidance from each LLFA is summarised in **Table 7F6 1.1** below.

Table 7F6 1.1 SuDS Guidance for Local Councils

Local Council	SuDS Guidance
Cheshire East Council	All developments in Cheshire East are required to implement SuDS in accordance with the SuDS's supplementary planning document for Cheshire East[4]. Development proposals must include a site- specific drainage strategy in line with SuDS guidelines[5]. It should be ensured that there is no increase in runoff rates for greenfield sites. For previously developed sites, the Non-Statutory Technical Standards for Sustainable Drainage Systems (2015)[6] must be followed to demonstrate a reduction in run-off rates.
Cheshire West and Chester Council	The possible runoff destinations in order of preference: • To ground; • To surface water body; • To surface water sewer; • To combined sewer. *"In line with policy ENV 1 of the Local Plan (Part One), residential development of* *10 dwellings or more and non-residential development of over 1,000 square* *metres of floorspace or with a site area over 1 hectare, will be required to incorporate SuDS scoping and design* *SuDS must be included within the early stages of the site design to incorporate appropriate SuDS within the development and will be required to satisfy technical standards and design requirements in accordance with the D5 SuDS Design Handbook.* *For brownfield sites, where current infrastructure may be in staying in place, then runoff should attempt to mimic that of greenfield rates with betterment of at least 30% as a minimum, unless it can be demonstrated that this is unachievable or hydraulically impractical to do so."*

[4] Sustainable (Urban) Drainage Guide Supplementary Planning Document (2024) Cheshire East Council https://moderngov.cheshireeast.gov.uk/ecminutes/documents/s114559/Sustainable%20Urban%20Drainage%20Supplementary%20Planning%20Document.pdf (Accessed 23/07/2024)

[5] Sustainable Urban Drainage Systems (2024) Cheshire East Council https://www.cheshireeast.gov.uk/planning/flooding/floods-and-flood-risk/surface-water-management.aspx (Accessed 23/07/2024)

[6] Non-Statutory Technical Standards for Sustainable Drainage Systems (2015) DEFRA https://assets.publishing.service.gov.uk/media/5a815646ed915d74e6231b43/sustainable-drainage-technical-standards.pdf (Accessed 23/07/2024)

Local Council	SuDS Guidance
Halton Council	Halton Borough Council initial assessments of the soil type and geology indicates that there is a low suitability for infiltration-type SuDS. Attenuation techniques which reduce runoff volumes and allow for water reuse may be more applicable[7].
St Helens Council	There is a comprehensive SuDS Design and Technical Guide (>100 pages), plus a SuDS assessment checklist available. Individual SuDS, within public and/ or private areas, need to follow the Management Train that reinforces the natural pattern of drainage. There is a hierarchy of techniques: • *"Prevention- use of good site design/housekeeping measures on individual sites to prevent runoff/pollution;* • *Source control – control of runoff at, or very near, its source;* • *Site control – management of water from several sub-catchments;* • *Regional control – management of runoff from several sites."*[8] For small developments, prevention and source controls must be considered. Site or regional controls e.g. detention ponds may not be feasible. The reduction of runoff and the treatment of runoff at source should follow the guidance document.
Trafford Council	Much of the Trafford Borough area is within a nationally recognised Critical Drainage Area[9]. Any new drainage systems for surface water management on development sites must be designed to 'greenfield' standards. This also applies if the land has been previously developed. *"For greenfield development, the runoff volume from the development to any sewer* *or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the greenfield runoff volume for the same event."* "*For developments which have been previously developed, the runoff volume from the development to any sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same*

[7] Local Flood Risk Management Strategy (2015) Halton Borough Council https://moderngov.halton.gov.uk/documents/s36570/Halton%20Draft%20LSD%20v13.pdf (Accessed 24/07/2024)

[8] Sustainable Urban Drainage Systems (2020) St Helens Council https://www.sthelens.gov.uk/media/5280/SuDS-Guidance-Document/pdf/sth_suds_2020_adoption_version_1.pdf?m=1672324166017 (Accessed 23/07/2024)

[9] Drainage and SuDS, Trafford Council https://trafforddesigncode.uk/landscape-and-nature/drainage-and-suds/ (Accessed 24/07/2024)

Local Council	SuDS Guidance
	event, but should never exceed the runoff volume from the development site prior to redevelopment for that event. *Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with the above, the runoff volume must be discharged at a rate that does not adversely affect flood risk (usually Qbar).”* The drainage hierarchy should be followed as reasonably practicable. In order of priority: 1. into the ground (infiltration); 2. to a surface waterbody; 3. to a surface water sewer; 4. to a combined sewer. Evidence and justification must be submitted to demonstrate the appropriate level of drainage has been taken. Further information is included in the SuDS Pro-forma.[10]
Warrington Council	In the event of low rainfall, the first 5mm of rainfall should not be discharged to a sewer or surface water body. Where this is not achievable (for low permeability soils), the developer must demonstrate that the SuDS Management Train has been adhered to and infiltration has been encouraged. For high rainfall events, there are two approaches which must be used to manage the surface runoff discharge unless the volume and peak flow rate do not apply. Approach 1: Peak flow and volume runoff restriction. *“The peak flow rates for the:* *A. 1 in 1 year rainfall event, and;* *B. 1 in 100 year + Climate Change rainfall event.* *Must not be greater than the equivalent greenfield runoff rates for these events. The critical duration rainfall event must be used to calculate the required storage volume for the 1 in 100 year + Climate Change rainfall event. The volume of runoff must not be greater than the greenfield runoff volume from the site for the 1 in 100 year + climate change, 6 hour rainfall event.”* Approach 2: Peak flow rate Restriction “*The critical duration rainfall event must be used to calculate the required storage volume for the 1 in 100 year + Climate Change rainfall event. The flow rate discharged:* *For the 1 in 1 year event, must not be greater than either* • *The greenfield runoff rate from the site for the 1 in 1 year event, or;* • *2 litres per second per hectare (l/s/ha);*

[10] North West SuDS Pro-Forma (2020) North West Regional Flood & Coast Committee https://www.trafford.gov.uk/planning/planning-for-householders/docs/Validation-Checklist-NW-SuDS-Pro-forma-Guidance.pdf (Accessed 24/07/2024)

Local Council	SuDS Guidance
	And for the 1 in 100 year + Climate Change event must not be greater than either: • *The greenfield mean annual flood for the site, or;* • *2 litres per second per hectare (l/s/ha).* *Further detail is included in the SuDS guidance document*."[11]

1.2.12 The preliminary designs used in the following sections for the preliminary drainage systems for the HAGIs and BVIs comply with the LLFA requirements shown above.

[11] Sustainable Urban Drainage Systems (SuDS) Design and Technical Guidance (2017) Warrington Borough Council https://www.warrington.gov.uk/sites/default/files/2019-10/suds_guidance_approved_document_0.pdf (Accessed 24/07/2024)

2 Proposed Drainage Strategy - General Principles

2.1 Permanent Above Ground Infrastructure

2.1.1 The following specifications generally apply to all the permanent above ground components (HAGIs and BVIs). Any site-specific variations are considered in the following site-specific sections. Best practise guidelines and standards are drawn from a variety of sectors and areas within the industry. These will be specifically referenced where appropriate.

2.1.2 Detailed construction specifications for construction methods and materials to be used will be included on the construction drawings which will be produced during the detailed design stage of the project. These will be produced post DCO consent.

2.1.3 The typical general layout for all HAGIs and BVIs includes an impermeable access road around the perimeter of the works with a layer consisting of imported DoT Type 3 stone (as specified by Ministry of Transport, Specification for Highway Works, clause 805[12]) covering the site within the bounds of the access road.

2.1.4 The nature of the proposed site works for the HAGIs and BVIs provides an opportunity to utilise the natural voids in the Type 3 porous material as in-situ attenuation storage. The site layout plans for each permanent site included in Appendix A clearly illustrates this general arrangement.

2.1.5 At each site the depth of Type 3 stone will be specified to ensure sufficient storage is provided in each case.

2.1.6 Apart from the above ground pipework of varying sizes, the site development comprises pressure reducing units, metering and pigging facilities, instrumentation and control kiosks, electrical equipment and access roads. This will generally be a typical arrangement across all the HAGI sites.

2.1.7 Each of the HAGI or BVI sites are all substantially located in Flood Zone 1 areas and consequently none of the permanent sites require extra flood mitigation measures for flood risk associated with local watercourses. For more detail of the flood risk of each HAGI or BVI site see section 6.3 of the **FRA (Appendix 7F of Chapter 7: Water Environment**).

[12] Ministry for Transport (2021) Manual Of Contract Documents For Highway Works Volume 1 Specification For Highway Works (online) https://www.standardsforhighways.co.uk/tses/attachments/c7f58300-b868-43ae-819a-7b600e764000?inline=true (Accessed 16th September 2024)

2.1.8 Across each site the stone layer will be set slightly lower than the adjacent access roads and equipment foundation plinths and a filter drain system will collect runoff water from the porous stone layer in these areas. The flow will be discharged into the nearby watercourse via a flow control valve at a greenfield rate in accordance with national[13] and local policies. The only brownfield sites in the project are Stanlow HPP and Partington 1 sites. Details of the proposed drainage from these sites are considered in sections 3 and 10 of the report respectively.

2.1.9 To mobilise this storage, in areas with high groundwater levels (not viable to use infiltration) it will be necessary to wrap the entire type 3 stone layer in an impermeable membrane. This will prevent ingress of groundwater into the stone layer and preserve this storage volume for storage of surface water running off from the site during the storm event. The attenuated water within the stone layer will drain via a filter drain installed beneath the stone layer and connected to the outfall.

2.1.10 If infiltration proves a viable method of surface water disposal then the membrane around the stone layer attenuating the surface water runoff will be a permeable type, to allow infiltration to occur directly from the stone layer into the subsurface material.

2.1.11 For the purposes of this exercise the greenfield runoff rates have been calculated at each HAGI and BVI site using the HR Wallingford Greenfield Runoff Rate Estimation tool on their website. The rainfall model used in each case was the FEH 2013 data set.

2.1.12 Most of the sites are relatively small in area and therefore generate small greenfield runoff flows. When considering the practicality of the operation of a flow control valve to restrict the flow to these very low flows, in terms of the blockage potential caused by a small orifice size, we have assumed a minimum orifice diameter of 75mm. This equates to an approximate flow of 3 l/s flowing through the control valve at an assumed design head of 1m. Therefore, the practical minimum greenfield flowrate of 3 l/s has been used in the hydraulic calculations.

2.1.13 **Section 7.16** of the Draft ES **Chapter 7: Water Environment** details the future baseline for the Project. In terms of climate change the recommendation for peak rainfall intensity allowances is shown in Table 7.13 and is consistent with Environment Agency guidelines. This table is reproduced in **Table 7F6 2.1** below:

[13] Department for Environment, Food & Rural Affairs (2015) Sustainable drainage systems: non-statutory technical standards (online) Available at: https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards (accessed 17th September 2024)

Table 7F6 2.1 Environment Agency peak rainfall intensity allowances (% increase relative to 1981 to 2000 baseline)

Allowance category	Total potential change anticipated for the '2050s' (to 2060)	Total potential change anticipated for the '2070s' (2061 to 2125)
Peak rainfall – Lower Mersey Management Catchment – 3.33% AEP*		
Upper	35%	40%
Central	20%	30%
Peak rainfall – Lower Mersey Management Catchment – 1% AEP		
Upper	40%	45%
Central	25%	30%
Peak rainfall – Upper Mersey Management Catchment – 3.33% AEP		
Upper	35%	40%
Central	20%	30%
Peak rainfall – Upper Mersey Management Catchment – 1% AEP		
Upper	40%	45%
Central	25%	30%
Peak rainfall – Weaver Gowy Management Catchment – 3.3% AEP		
Upper	35%	40%
Central	20%	25%
Peak rainfall – Weaver Gowy Management Catchment – 1% AEP		
Upper	40%	45%
Central	25%	30%

*AEP – Annual Exceedance Probability

2.1.14 EA guidelines also state that a development with a lifetime of between the years 2061 and 2100 (such as this Project) should use the central allowance for the 2070s epoch. However, some LLFA's require a climate change uplift higher than that reflected in the EA guidelines therefore to consider a single criterion across all LLFA's, and in view of the significant nature of this project, it is proposed that the higher upper end allowances are used when considering the effects of climate change on the peak rainfall intensities.

2.1.15 It can be seen from **Table 7F6 2.1** above that the recommended rainfall intensity climate change allowances for the 1% AEP (1:100 yr) storm event is thus 45% for all three management catchments. This is therefore the climate change upliftment which has been used in sizing the attenuation storages across all the HAGI's and BVI's.

2.1.16 It is noted that drainage from any area that may contain contamination by oils or similar will need to pass through an oil/water interceptor before discharge to the environment. At the time of writing this report we are not aware of any specific components planned for the sites that may discharge this effluent type.

2.1.17 Any components that may require separate bunding to isolate high pollution risk areas will be assessed during detailed design stage.

2.2 SuDS Based Surface Water Quality Control Measures

2.2.1 SuDS provide natural variability in their ability to remove contamination from surface water runoff which drains across a development site, therefore the management of water quality is founded on a risk-based approach. The SuDS Manual CIRIA C753 (Ref. 3) suggests a risk-based approach based on land use type and specific contaminants.

2.2.2 The SuDS Manual CIRIA C753, Table 26.1 suggests a Simple Index Approach (SIA) for low-risk developments, which follows a three-step process, namely:

- Allocate suitable pollution hazard indices for the proposed land use;
- Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index; and
- Where the discharge is protected surface waters or groundwater, consider the need for a more precautionary approach.

2.2.3 To successfully deliver adequate treatment, the proposed SuDS components should have a total pollution mitigation index that equals or exceeds the pollution hazard index.

- **Total SuDS mitigation index ≥ Pollution hazard index:**
  - Where the mitigation index of an individual component is insufficient, two components (or more) in series will be required, where:
- **Total SuDS mitigation index = mitigation index1 + 0.5 (mitigation index2):**
  - Where - mitigation Indexn = mitigation index for component n

2.2.4 A factor of 0.50 is used to account for the reduced performance of secondary or tertiary components associated with already reduced inflow concentration.

2.2.5 **Table 7F6 2.2** below shows the pollution hazard indices for different land use classifications. The land use category in row 3 with Total suspended solids (TSS) (0.5), Metals (0.4) and Hydrocarbons (0.4) have been used to represent usage of the access roads in the HAGIs.

Table 7F6 2.2 – Pollution Hazard Indices for Different Land Use Classifications.(Source: The SuDS Manual, CIRIA C753)

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (eg hospitals, retail), all roads except low traffic roads and trunk roads/motorways[1]	Medium	0.7	0.6	0.7
Sites with heavy pollution (eg haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways[1]	High	0.8[2]	0.8[2]	0.9[2]

2.2.6 In England and Wales, where the principal destination of the runoff is to surface water, but small amounts of infiltration may occur from unlined components, then the groundwater indices (**Table 7F6 2.3** below) should be used for the discharge to groundwater, and the surface water indices (**Table 7F6 2.4** below) should be used for the main surface water discharge.

Table 7F6 2.3 – Indicative SuDS Mitigation Indices for Discharges to Groundwater. (Source: The SuDS Manual, CIRIA C753)

Characteristics of the material overlying the proposed infiltration surface, through which the runoff percolates[1]	TSS	Metals	Hydrocarbons
A layer of dense vegetation underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.6[4]	0.5	0.6
A soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.4[4]	0.3	0.3
Infiltration trench (where a suitable depth of filtration material is included that provides treatment, ie graded gravel with sufficient smaller particles but not single size coarse aggregate such as 20 mm gravel) underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.4[4]	0.4	0.4
Constructed permeable pavement (where a suitable filtration layer is included that provides treatment, and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.7	0.6	0.7
Bioretention underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.8[4]	0.8	0.8
Proprietary treatment systems[5, 6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for inflow concentrations relevant to the contributing drainage area.		

Table 7F6 2.4 – Indicative SuDS Mitigation Indices for Discharges to Surface Water (Source: The SuDS Manual, CIRIA C753)

	Mitigation indices[1]		
Type of SuDS component	TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4[2]	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond[4]	0.7[3]	0.7	0.5
Wetland	0.8[3]	0.8	0.8
Proprietary treatment systems[5,6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

2.2.7 The tables below show summaries of the proposed mitigation indices against the pollution hazard indices to be applied for a typical HAGI or BVI site draining to surface water **Table 7F6 2.5**) and to groundwater (**Table 7F6 2.6**) as follows:

Table 7F6 2.5 – Summary of Proposed Hazard and Mitigation Indices for Discharges to Surface Water.

Type of SuDS Component	TSS	Metals	Hydrocarbons
Proposed Pollution Hazard Indices			
Low Traffic general access roads	0.5	0.4	0.4
Proposed SuDS Mitigation Indices			
Porous Stone Blanket Layer (This component has been assumed to be equivalent to Permeable Paving)	0.7	0.6	0.7
Filter Drain	0.4	0.4	0.4
Total Mitigation Indices	1.1	1.0	1.1

Table 7F6 2.6 – Summary of Proposed Hazard and Mitigation Indices for Discharges to Groundwater

Type of SuDS Component	TSS	Metals	Hydrocarbons
Proposed Pollution Hazard Indices			
Low Traffic general access roads	0.5	0.4	0.4
Proposed SuDS Mitigation Indices			
Porous Stone Blanket Layer (This component has been assumed to be equivalent to Permeable Paving)	0.7	0.6	0.7

2.2.8 As can be seen from the above, the total SuDS mitigation indices for the typical site draining to surface water or groundwater is greater than the pollution hazard index, therefore meeting the requirements of the SIA as specified in SuDS CIRIA C753 (Ref. 3).

2.2.9 This method of surface water management allows for the water to be treated as close to the source as possible prior to being conveyed elsewhere and is in line with SuDS management good practice.

2.2.10 The proposed SuDS components to be incorporated in the project will be incorporated in the drainage designs which will require final approval by the LLFAs by way of fulfilment of requirements of the DCO to be discharged post consent.

2.3 Drainage of Temporary Construction Compounds and Pipe Laydown Areas

2.3.1 All the temporary construction areas and pipe laydown areas will require temporary drainage and associated attenuation for the duration of construction.

2.3.2 Within the construction compound areas there will be a variety of uses such as cabins, vehicle parking and storage. It should be noted that areas with particular pollution risks such as chemical and fuel storage areas will need to be separately bunded, drained and discharged via a closed system.

2.3.3 The allowable discharge rate from these areas will also be based on the calculated Qbar Greenfield runoff rate. This applies to all greenfield sites which includes all sites except Stanlow and Partington site 1 which are brownfield sites. See the site specific sections for specific runoff calculations for these brownfield temporary construction sites.

2.3.4 It is proposed these temporary construction areas will be surfaced with Type 1 MOT granular material. A 50% runoff coefficient for surface water runoff from these areas will be applied in the hydraulic drainage calculations.

2.3.5 The expected construction period for the entire project is approximately 2 years and therefore it has been agreed that no climate change uplift for these temporary areas will be applied. See para 2.6.3 of the FRA report.

2.3.6 It is proposed that the climate change uplift of those compounds that may be constructed later, up to 2031, will be reassessed during detailed design stage (closer to start of construction) to ensure the upliftment is aligned with the current recommendations at that time. However, if the construction period is over a short period (2 years) no upliftment will apply during the construction period.

2.3.7 The principle of the drainage for these areas will be to grade the surfaces towards strategically positioned filter drain trenches, which will collect the surface water and discharge to a watercourse via suitable attenuation storage and a flow control device.

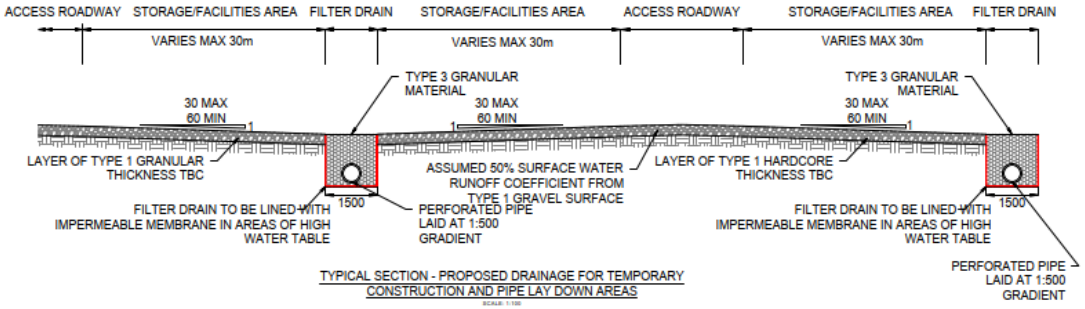
2.3.8 During the detailed design stage (post DCO), detailed design information will be produced for the drainage of these temporary areas including specification of methods and materials to be used to deliver the drainage for these areas. These will comprise “design packs” to be approved by the statutory authorities before construction of these areas begins.

2.3.9 Where possible the temporary drainage will discharge via the same outfall identified for the permanent drainage of the HAGI. This will economise on the number of outlets required across the Project. Instances where this is possible will be highlighted on a case by case basis in the following site specific sections.

2.3.10 Appendix D includes a typical detail drawing which shows a typical section through the proposed drainage as described above. The filter drains are shown positioned in the valleys of the Site and access roadways should generally be located on the crown of the graded area with storage and facilities zone between these.

2.3.11 An excerpt from the drawing showing the typical section through temporary area is shown in **Figure 7F6 2.1** below:

Figure 7F6 2.1 Section Through Temporary Construction Area



2.3.12 This arrangement should help minimise ponding of surface water on the temporary platform areas which will facilitate better, more durable accessways and storage areas.

2.3.13 Attenuation storage will be provided by temporary basins or swales positioned immediately adjacent to the temporary area.

2.3.14 Using filter trenches to collect the surface water from the gravel hardstanding area affords a degree of improvement to the water quality of the runoff and will also remove any silt from the outflowing surface water from the area.

2.3.15 Any additional dewatering that may be required during construction will need the appropriate pollution control measures to remove silt prior to discharging to the environment.

2.3.16 Spatial planning of the components occupying the construction compound area such as the cabins etc should be located away from the main overland flow routes, which should discharge unobstructed towards the filter drains.

2.3.17 The use of a swale around the boundary of the areas will provide significant in system water quality benefits in accordance with best SuDS practice, as well as providing additional attenuation storage.

2.4 Foul Drainage

Operational Sites

2.4.1 Most of the sites are remote from adopted drainage assets and so the foul drainage system will need to be designed and provided as appropriate to the individual site specific constraints.

2.4.2 It is assumed that the occupancy of these sites will be intermittent and hold a peak of five personnel at any one time.

2.4.3 The likely variation in flow is problematic, and while a package treatment option would provide the highest level of treatment, the flow regime may not be suitable for these systems.

2.4.4 At this stage it is assumed that a sealed cesspit solution may be utilised. To be compliant with Building Regulations Part H (H2 - 1.61) the minimum volume would be 38.4m^3. However, an alternative solution may be to supply temporary welfare facilities just for the duration of any work operations to be carried out on site.

2.4.5 With the progression of the more detailed design stages, more detailed information on the expected usage of sanitation facilities will become available, enabling identification and design of the appropriate solutions to accommodate the expected foul flow regime.

Temporary Construction Sites

2.4.6 Welfare facilities will be provided at the main construction compounds along the route where construction staff spend extended periods through the day.

2.4.7 The type of ablution facilities will most probably consist of sealed chemical based units, probably serviced by an external contractor.

2.4.8 These will require ongoing monitoring and servicing throughout the construction contract period.

2.4.9 A complete delivery, operation and maintenance plan for these facilities will be compiled and proposed by the construction contractor post DCO, as part of the detailed construction plans for delivery of the asset.

2.5 Existing Utilities

2.5.1 In each of the following site specific sections mention of existing utilities in the area of each site is made. This information has been drawn from statutory utilities search results which have been supplied by the utility providers and captured in the project GIS database.

2.5.2 No further on site investigations have been done to ascertain utility service layouts therefore the positions of these utilities as shown on the drawings are approximate at this stage and will require confirmation and more detailed location information in conjunction with the utility supplier companies during the detailed design stages of each site. This will be secured as part of the DCO requirements.

3 Stanlow Hydrogen Production Plant (HPP) HAGI Site

3.1.1 This section of the report sets out the outline drainage strategy for the proposed Stanlow HPP HAGI site, which is located at the western end of the western corridor of the hydrogen distribution network. This location can be seen in **Figure 7F6 1.1**

3.2 Existing Site

3.2.1 The proposed HAGI site is situated on the southern extremity of the existing Stanlow Refinery in Ellesmere Port industrial area. The proposed hydrogen production plant (which does not form part of this project) will be constructed in this industrial area adjacent to the proposed HAGI. The surrounding area to the north of the site is therefore all brownfield industrial area with the A5117 (NCR 5) main road bordering the southern boundary of the site. The area to the south of the A5117 is agricultural land.

3.2.2 In discussions with the existing site operators (EET) it was confirmed that there is an extensive drainage system in operation on this existing brownfield site.

3.2.3 The approximate site grid reference is 344752E 374967N.

3.2.4 The existing topography of the site has been approximated from Lidar Contour data and this shows that the southwestern corner is at approximately 8mAOD elevation sloping to approximately 12mAOD in the northeastern corner. This is a fall of approximately 4m in 345m which equates to an average slope of approximately 1:86 across the site.

3.2.5 Ground investigations are in progress however the British Geological Survey website indicates that the site is underlain by the Chester Formation, which consists of sandstone, pebbles and gravel. Sedimentary bedrock formed during the Triassic period. Superficial deposits of Diamicton glacial till exist across the HAGI site. The dominant soils in the area are described as slowly permeable, seasonally waterlogged reddish fine loamy and clayey soils.

3.2.6 This site is presently an industrial site and therefore confirmation of any contamination as a result of these activities will need to be determined with future onsite intrusive testing. Draft ES **Chapter 12: Ground Conditions** details the ground condition investigations that have been undertaken to date.

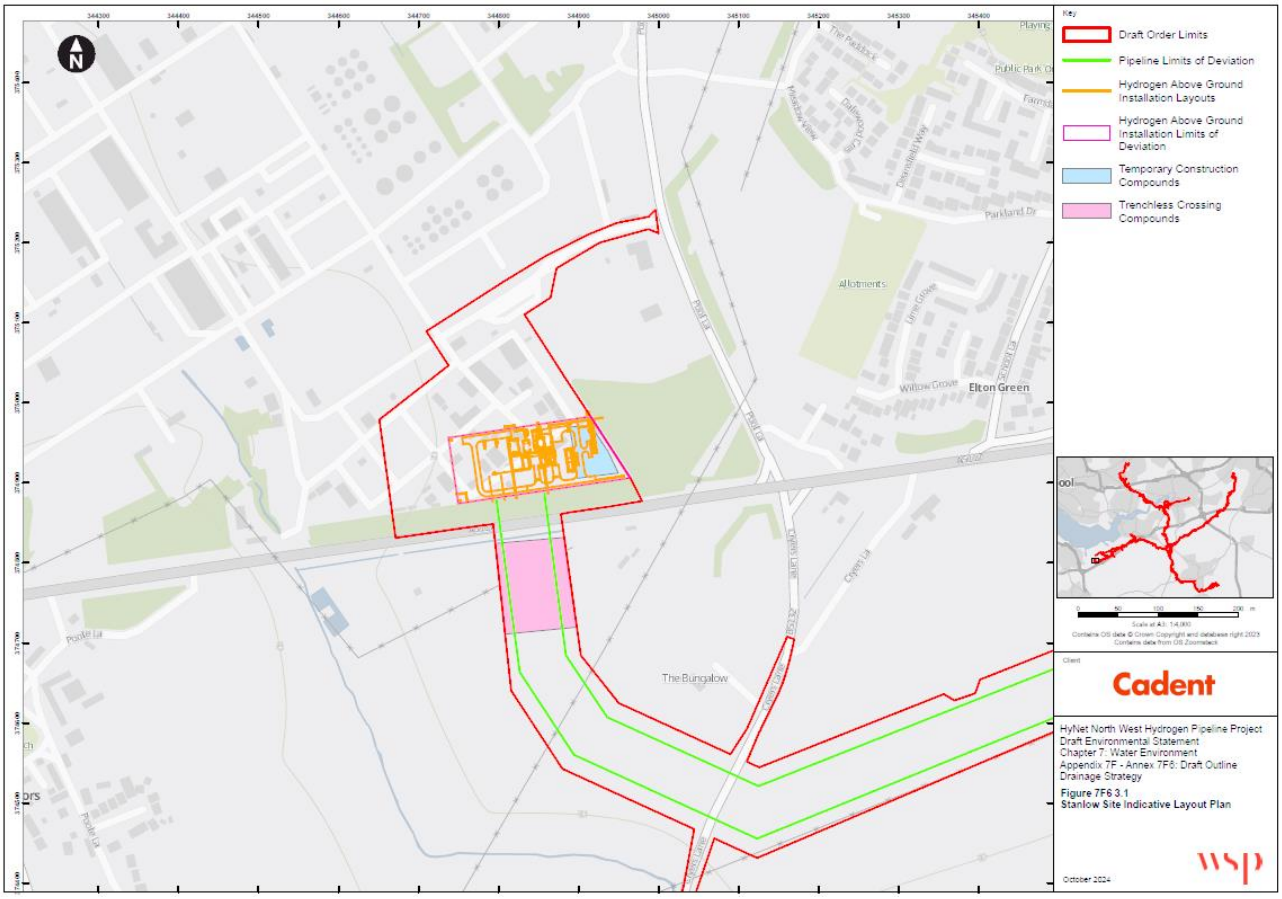
3.2.7 Information from the BGS website borehole logs within proximity to the site indicate that groundwater may be in the order of 2m below ground level. This indicates that the poor permeability of the soils and probability of high-water table would probably mean that infiltration, as a surface water disposal method would not be viable.

3.3 Proposed Permanent Development

3.3.1 The proposed site is shown in **Figure 7F6 3.1** below. The Limit of Deviation (LoD) for the actual hydrogen pipeline is represented by the green lines and the red line represents the Draft Order Limits. The light blue area indicated is the proposed temporary construction compound area.

3.3.2 The proposed HAGI covers a total area of approximately 16,900m^2 (1.69 hectares).

Figure 7F6 3.1 Stanlow HPP HAGI Site Layout Plan



3.3.3 The Stanlow HPP HAGI Indicative Drainage Layout Plan is included in Appendix A1. As the site is brownfield and has access to an existing drainage network it is assumed that the proposed HAGI drainage will discharge to the existing network.

3.3.4 In discussion with the existing site operator, it was confirmed that the proposed drainage will connect into the existing network and an approximate position was proposed along the northern access road. The exact location of the connection point is to be determined prior to detailed design.

3.4 Allowable Site Discharge

3.4.1 The existing 'brownfield' runoff rate has been estimated using the BS EN 752 calculation method with an assumed rainfall intensity of 50mm/hr.

3.4.2 The impermeable area of the original site was measured at approximately 1.69 ha. The runoff from this area would therefore be approximately 2.781 x 1.69 ha x 50mm/h = 235l/s**.**

3.4.3 The Cheshire West and Chester (CW&C) LLFA require that new development on a brownfield site should discharge surface water runoff at a rate which is at least 30% less than the current brownfield runoff rate.

3.4.4 In accordance with this requirement the discharge rate of surface water from the new proposed site would therefore need to be less than 235l/s x 70% = 164.5 l/s.

3.4.5 It is proposed that a gravity discharge from the site will be restricted to a maximum of 164.5l/s and connected into the existing drainage network at a point to be determined in the northern access road adjacent to the site boundary as agreed with the current site operator (EET Hydrogen).

3.4.6 An unrestricted flow through a 225mm diameter pipe from the HAGI site northwestern corner to the connection point into the existing drainage network would yield a flow rate of approximately 58 l/s. This is in accordance with the above flow restriction requirement and therefore shows that a flow control valve is not required to restrict this flow. The normal flow through a 225mm diameter pipe will be less than the maximum allowed.

3.5 Provision of Attenuation Storage

3.5.1 It is proposed that the site platform will have an approximate surface level of 10.82mAOD and will contain a granular type 3 stone blanket layer across the site. The stone blanket is approximately 7645m^2 in area and will have a minimum depth of approximately 300mm which will yield a total potential available attenuation storage volume of approximately 690m^3 assuming a void ratio of 30% in the granular material.

3.5.2 The preliminary hydraulic model calculations (using MicroDrainage Source Control module) show that for the 1:100 year plus climate change rainfall event and restricting the discharge from the site to the agreed restricted flowrate of 58l/s, to prevent any flooding from the site, the volume of attenuation storage required is 630m^3. These calculations are included in Appendix C1.

3.5.3 In order to mobilise this storage, it will be necessary to place an impermeable membrane at the base of the granular material. This will prevent any groundwater ingress into the granular layer. The attenuated water will be collected via a filter drain positioned along the edge of the stone blanket as shown in the indicative Drainage Layout drawing in Appendix A1.

3.6 Temporary Construction Compound Drainage

3.6.1 The site layout plan identifies a 0.26ha temporary construction compound demarcated on the east of the HAGI site. This area is however included in the total measured area of the HAGI, which will also require temporary drainage during construction. Therefore, the total catchment area of the construction compound and HAGI site during construction will also be 1.69ha.

3.6.2 The present surfacing of this area is hardstanding. This should be suitable to support the temporary construction compound activities to be carried out on the area. Phasing of demolition of the hardstanding will be dictated by the detailed construction programme once finalised.

Allowable Site Discharge

3.6.3 As referred to above, the allowable discharge from the total site (permanent HAGI and temporary construction camp) is estimated at 164.5 l/s (30% betterment on the present brownfield runoff rate).

3.6.4 Based on the preliminary hydraulic calculations for the temporary drainage a full-bore flow through a 225mm diameter pipe would discharge at a rate of 99.5 l/s. This is acceptable as it is less than the allowable 164.5 l/s and represents a 58% reduction from the present brownfield runoff rate.

3.6.5 It is proposed that the outfall from this temporary system will be to the same proposed drainage outlet for the permanent drainage as shown in the indicative drainage layout in Appendix A1.

Attenuation Provision

3.6.6 Based on the discharge flowrate noted above and the catchment area of the HAGI plus temporary compound, the volume of attenuation required to prevent flooding during the 1 in 100-year (1%AEP) event is estimated to be 185m^3.

3.6.7 It is proposed that this storage volume is provided in a temporary open basin created after demolition of the hardstanding covering the area of the permanent HAGI. The basin should be lined with an impermeable membrane to prevent ingress of groundwater into the subsurface layers and possible transportation of any potential pollution hazard in the existing site. The approximate dimensions of the pond are shown on the indicative drainage layout in Appendix A1.

3.7 Existing Utilities in the Area

3.7.1 Due to the Stanlow site being located on an existing industrial zone there will be extensive existing utilities on the site, which will need to be made safe and removed from the proposed HAGI site by a separate demolition contractor. No hazards from potential utilities are assumed on the HAGI site at this time.

3.7.2 There are a multitude of utilities running in the A5117 highway corridor which all cross the hydrogen pipeline LoD which will need to be documented and avoided by the trenchless crossing operation in this area.

3.7.3 The utilities zone in the A5117 corridor is shown on the layout plan in Appendix A1.

4 Rocksavage HAGI Site

4.1.1 This section of the report sets out the outline drainage strategy for the proposed Rocksavage HAGI site, which is located midway along the western corridor between the Central Hub HAGI and Stanlow HPP HAGI. This location can be seen in **Figure 7F6 1.1**

4.2 Existing Site

4.2.1 The existing site is a greenfield site situated in existing wooded land adjacent to the M56 between the River Weaver to the southwest and the Weaver Navigation canal to the northeast. The Frodsham Electrical Substation is located due west of the site on the opposite side of the M56 motorway and the old East Clifton Marsh historical industrial landfill site is located approximately 150m to the southeast of the site.

4.2.2 The approximate site grid reference is 352827E 379240N.

4.2.3 The topography of the site has been approximated from Lidar Contour data. This shows an elevated area of approximately 17.5m AOD on the northern edge of the permanent HAGI site sloping down to a level of approximately 13.5mAOD in the southern corner and 15.5m AOD in the western corner. It is proposed that the final level of the HAGI may be approximately 14.5mAOD, however this will be finalised during the detailed design stage.

4.2.4 There are two existing outfalls shown on the GIS discharging from this area westwards into the River Weaver.

4.2.5 There is also the Halton Borough Council lagoon shown approximately 100m to the southwest of the site.

4.2.6 In view of the above historical industrial nature of the site it is proposed that a detailed contamination investigation is undertaken at detailed design stage to ascertain the full impact of contamination levels in the area.

4.2.7 Based on information from Draft ES **Chapter 12: Ground Conditions** superficial alluvium deposits of clay, silt and sand (Tidal Flat Deposits) exist in the HAGI area. These deposits are expected to consist of weathered marl comprising firm red brown gravelly clay to a depth of c. 3.0m bgl and firm to soft sandy silty clay, silty gravelly sand and loose sandy gravel with bands of peaty clay to a depth of 17.1m bgl.

4.2.8 The bedrock underlying the area consists of mudstone (Bollin Mudstone) comprising of fractured sandstones, mudstones and siltstones with occasional calcite and possible nodules to a proven depth of at least 29m bgl.

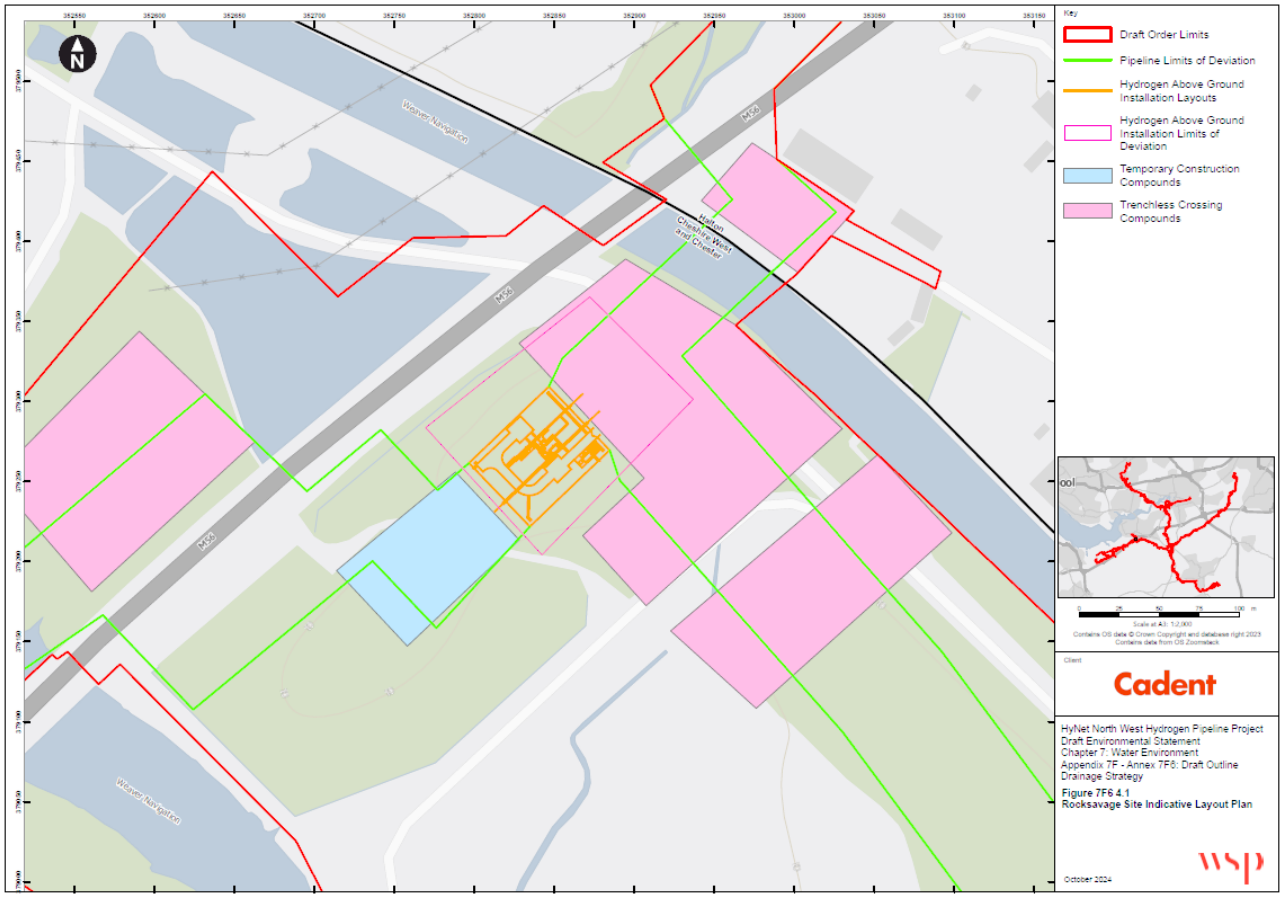
4.2.9 Groundwater levels were recorded at 5.4m bgl at the HAGI site.

4.3 Proposed Permanent Development

4.3.1 The proposed site layout is shown in **Figure 7F6 4.1** below. The limit of deviation (LoD) is shown in green and indicates the location of the pipeline route. The pink areas shown are construction compound sites for the trenchless crossing operations under the adjacent canal and river.

4.3.2 The proposed HAGI site covers a total area of approximately 3,950m^2 (0.4 hectares).

Figure 7F6 4.1 Rocksavage HAGI Site Plan



4.3.3 The Rocksavage HAGI Indicative Drainage Layout Plan is included in Appendix A2.

4.3.4 In the absence of confirmed infiltration test results for the site the initial proposal is to discharge surface water to the River Weaver approximately 260m southwest of the site.

4.3.5 This section of the River Weaver is an Open Inland River. Consent for discharge into the River will be required from the LLFA.

4.4 Attenuation Provision

4.4.1 The overall area of the development site is 4,000m^2. However, some of this area will be occupied by impermeable areas such as access roads and foundation plinths. The approximate impermeable area on the site is 2,330m^2. An estimated 1,670m^2 will be available as in-situ attenuation storage on the site.

4.4.2 It is proposed that the site platform will have an approximate surface level of 14.5mAOD and will contain a granular blanket across the site. The granular blanket will have a minimum depth of approximately 500mm that will yield a total potential available attenuation storage volume of approximately 250m^3 assuming a void ratio of 30% in the granular material.

4.4.3 A gravity outfall will discharge via a new headwall to the brook which is located approximately 130m to the southeast of the site. The brook is known as Flood Brook and discharges southwards into the River Weaver. This will require the consent of the Lead Local Flood Authority and will be subject to an ordinary watercourse discharge consent.

4.4.4 As the flow through the granular sub-base will receive a high level of percolation, it is proposed that flow rates from the site are controlled via a flow control valve in a chamber upstream of the connection to the offsite outfall pipe.

4.4.5 The preliminary hydraulic model calculations (using MicroDrainage Source Control module) show that for the 1:100 year plus climate change rainfall event and restricting the discharge from the site to the agreed greenfield runoff rate, and in order to prevent any flooding from the site, the volume of attenuation storage required is 240m^3. These calculations are included in Appendix C2.

4.4.6 To mobilise this storage, it will be necessary to place an impermeable membrane at the base of the granular material. This will prevent water percolating vertically through to the underlying soil and horizontally through the embankments. The membrane will also prevent any high-level ground water seeping into the granular layer. The attenuated water will be collected via a perforated collection pipe measuring a minimum of 10m in length and 150mm in diameter on the southern side of the platform.

4.4.7 An Indicative Drainage Layout plan is included in Appendix A2.

4.5 Temporary Construction Compound Drainage

4.5.1 The site layout plan identifies a 0.5ha temporary construction compound to the south of the HAGI site.

4.5.2 In addition, there are three proposed trenchless crossing construction compound areas lying to the east and west of the site. These are 1.20ha, 2.00ha and 1.20ha in size respectively.

4.5.3 The western trenchless crossing site will drain west into the River Weaver via one outfall with the HAGI and temporary HAGI construction site compound drainage draining southward to Flood Brook. The eastern sites will all drain eastwards into the Weaver Navigation Canal.

4.5.4 All the above temporary areas (including the HAGI site itself) will require temporary drainage and associated attenuation for the duration of construction.

Allowable site discharge

4.5.5 The total site area of the HAGI plus HAGI construction compound is 0.9ha which yields an equivalent greenfield runoff rate (Qbar) of 1.71/s (based on a unit greenfield runoff rate of 1.9l/s/ha). This flowrate is less than the minimum 3 l/s, therefore a restricted discharge rate of 3 l/s will be used for sizing the required attenuation storage volume.

4.5.6 The total site area of the western trenchless construction compound is 1.2ha which yields an equivalent greenfield runoff rate (Qbar) of 2.28l/s (based on a unit greenfield runoff rate of 1.9l/s/ha). This flowrate is less than the minimum 3 l/s, therefore a restricted discharge rate of 3 l/s will be used for sizing the required attenuation storage volume.

4.5.7 Appendix B shows the unit Greenfield Runoff Rate calculation sheet.

4.5.8 For the above two sites it is proposed that a gravity discharge from the sites will be restricted via a flow control valve to be equal to the greenfield runoff rate Qbar or a minimum of 3 l/s.

4.5.9 Similarly, the greenfield runoff rate for the easterly draining areas is estimated at 6.1l/s.

4.5.10 The indicative temporary drainage layout plan is included in Appendix A2.

Attenuation Provision

4.5.11 For the 1 in 100-year (1%AEP) rainfall event assuming the discharge rates as above the attenuation storage volume required for the HAGI and temporary HAGI construction compound is 220m^3 and that of the western trenchless construction compound is 320m^3.

4.5.12 The attenuation storage volume for the two easterly draining trenchless construction compounds which will discharge at a single point into the Weaver Navigation Canal is estimated at 900m^3.

4.5.13 These storage volumes will be provided by detention basins as shown on the indicative layout plan in Appendix A2.

4.6 Existing Utilities in the Area

4.6.1 There is an ESSAR fuel pipeline traversing under the eastern section of the HAGI site as shown on the indicative drainage layout in Appendix A2. On the same alignment as this pipe there appear to be a number of abandoned pipelines.

4.6.2 To the southeast of the site is a number of United Utilities 2 No. 72 inch and 2No. 60-inch diameter approx. 60m from the HAGI site and below the proposed trenchless crossing compound.

4.6.3 There are a number of utility services shown within the road boundary to the east of the site including underground Openreach telecommunication cables and high voltage power cables.

4.6.4 To the north west of the site on the other side of the M56 motorway there are two 11kV overhead power lines. These are however not within the construction area of the HAGI site.

4.6.5 The above utilities are shown on the layout plan in Appendix A2.

5 Runcorn HAGI Site

5.1.1 This section of the report sets out the outline drainage strategy for the proposed Runcorn HAGI site, which is located on a northern spur, midway along the western leg of the network. This location can be seen in **Figure 7F6 1.1**.

5.2 Existing Site

5.2.1 The existing site is greenfield and is located immediately adjacent to the east end of the Integen Rocksavage power station. An existing above ground gas pipe installation is immediately south of the proposed HAGI site. Open agricultural land extends to the north of the site.

5.2.2 The approximate site grid reference is 352248E 380070N.

5.2.3 The topography of the site has been approximated from Lidar Contour data and this shows that the site has a steep gradient sloping from the northern boundary at a level of approximately 45 mAOD down to the southern boundary at a level of approximately 30 mAOD.

5.2.4 The HAGI site level of approximately 32 mAOD is proposed, this will result in substantial earthworks in order to form the HAGI platform. An appreciable cut embankment will be created around the northern half of the site with a surface water cut-off berm positioned along the top of the embankment to divert overland runoff flow around the HAGI site.

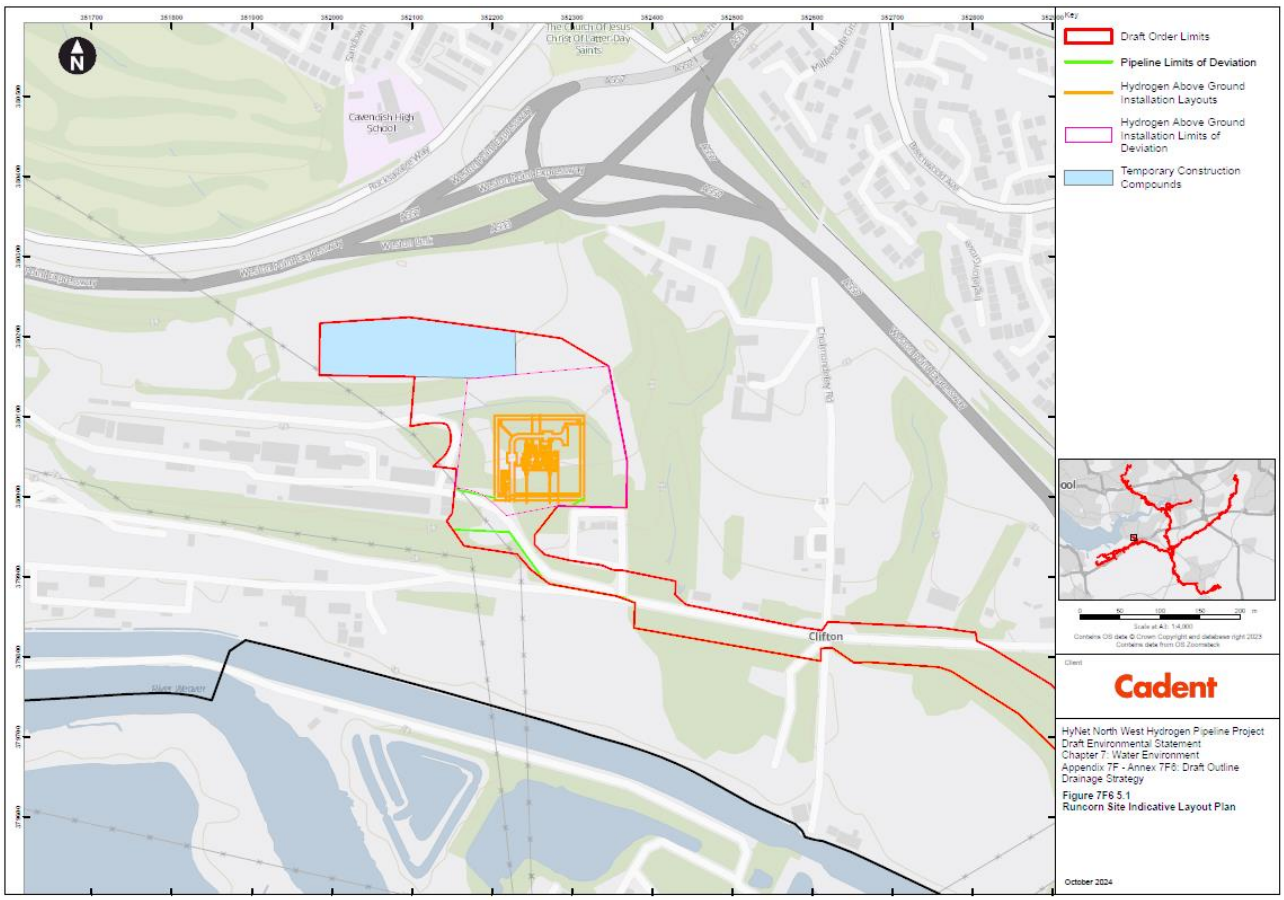
5.2.5 According to the British Geological Survey website data the site is underlain by the Bollin Mudstone Member - Mudstone with superficial deposits of Tidal Flat Deposits - clay, silt and sand. These superficial deposits may have relatively good permeability.

5.2.6 Information from the BGS website borehole logs within proximity to the site indicate that groundwater may be in the order of 1.2m to 5m below ground level.

5.3 Proposed Permanent Development

5.3.1 The proposed site is shown in **Figure 7F6 5.1** below. The proposed HAGI site covers a total area of approximately 12,000m^2 (1.20 hectares).

Figure 7F6 5.1 Runcorn HAGI Site Layout Plan



5.4 Allowable Site Discharge

5.4.1 The total site area of 1.20ha yields an equivalent greenfield runoff rate (Qbar) of 4.36 l/s using the FEH method (3.80 l/s/ha). Appendix B3 shows the Greenfield Runoff Rate calculation sheet.

5.4.2 The Runcorn HAGI Indicative Drainage Layout Plan is included in Appendix A3. Should infiltration not be viable on this site, it is proposed that the drainage discharge is connected into the existing above ground gas pipe installation drainage system. Further investigation will be required to determine the viability of connecting into this drainage system. It is being considered whether this will be included in the DCO requirements.

5.4.3 It is proposed that gravity discharge from the site will be restricted via a flow control valve to be equal to the greenfield runoff rate Qbar. If discharge under gravity is not possible then a pumped solution pumping at the agreed restricted rate will be required.

5.5 Attenuation Provision

5.5.1 The overall area of the development site is 12,000m^2 however, some of this area will be occupied by impermeable area such as access roads and foundation plinths. The approximate impermeable area on the site is 5,940m^2, therefore an estimated 6,060m2 will be available as in-situ attenuation storage on the site.

5.5.2 It is proposed that the site platform will have an approximate surface level of 32.0mAOD and will contain a granular blanket across the site. The granular blanket will have a minimum depth of approximately 500mm that will yield a total potential available attenuation storage volume of around 900m^3 assuming a void ratio of 30% in the granular material.

5.5.3 The preliminary hydraulic model calculations (using MicroDrainage Source Control module) shows that for the 1:100 year plus climate change rainfall event and restricting the discharge from the site to the agreed greenfield runoff rate, in order to prevent any flooding from the site, the volume of attenuation storage required is 870m^3. These calculations are included in Appendix C3.

5.5.4 The preliminary design indicates that with the available area of stone blanket on this site, in order to provide this volume of storage, approximately 500mm depth of type 3 stone will be required.

5.5.5 In order to mobilise this storage, it will be necessary to place an impermeable membrane at the base of the granular material. This will prevent water percolating vertically through to the underlying soil and horizontally through the embankments. The membrane will also prevent any high-level ground water seeping into the granular layer. The attenuated water will drain from the stone blanket area via a filter drain installed along the eastern side of the platform and connected to the outfall.

5.5.6 The preliminary hydraulic calculations for the attenuation storage volume sizing is included in Appendix C3 and an Indicative Drainage Layout is included in Appendix A3.

5.6 Temporary Construction Compound Drainage

5.6.1 The site layout plan in **Figure 7F6 5.1** shows the HAGI temporary construction compound to the north of the HAGI site approximately 1.6ha in area. This compound will require temporary drainage and associated attenuation for the duration of construction.

5.6.2 The total areas requiring drainage include the temporary construction compound and the permanent HAGI site while it is under construction. This area in total is approximately 1.60 + 1.20 = 2.80ha.

Allowable Site Discharge

5.6.3 Based on the calculated Qbar rate of 3.14 l/s/ha noted in Section 5.4, the allowed discharge rates from the temporary construction site will be 5 l/s from the northern site and 3.8 l/s from the HAGI site itself.

5.6.4 It is therefore proposed that the discharge rates for the temporary construction compound will be 5l/s from the northern construction compound area and 3.8l/s from the HAGI site during construction.

5.6.5 The temporary construction compound will discharge restricted flows into the proposed attenuation for the HAGI. The combined flows will then be discharged at a combined rate of 8.8l/s.

5.6.6 Appendix A3 shows an indicative drainage layout plan for these temporary works.

Attenuation Provision

5.6.7 Based on the allowable discharges noted above and the total areas of the compounds, the volume of attenuation storage required for the northern temporary compound is estimated to be 400m^3 for the 1 in 100-year (1%AEP) event, and the volume of attenuation storage required for the HAGI compound is estimated to be 300m^3. These details will be finalised in the next more detailed stage of design. It is being considered whether this will form a DCO requirement.

5.6.8 The approximate area of attenuation storage ponds, based on a depth of 1.7m is shown on the indicative temporary drainage layout in Appendix A3.

5.7 Existing Utilities in the Area

5.7.1 There is a United Utilities 225mm diameter foul water sewer encroaching across the proposed HAGI site. This existing sewer will require diversion/relocating in consultation with United Utilities. The recorded present alignment of this sewer is shown on the Drainage Layout Plan in Appendix A3.

5.7.2 An 11kV overhead powerline also spans east-west across the northern half of the site. A 132kV overhead electrical line runs immediately past the southwest corner of the site in a northwest-southeast direction.

5.7.3 There is a Sabic UK Petrochemicals Northwest pipeline running past the northern boundary of the site.

5.7.4 There is also a National Grid Gas Transmission high pressure main to the south of the proposed HAGI site which connects into the existing above ground installation immediately south of the site.

5.7.5 These utilities are shown on the layout plan in Appendix A3.

6 Central Hub HAGI Site

6.1.1 This section of the report sets out the Outline Drainage Strategy for the proposed Central Hub HAGI site, which is located in the centre of the distribution network as shown in **Figure 7F6 6.1**.

6.2 Existing Site

6.2.1 The existing site is greenfield surrounded by existing agricultural land. There is a small hardstanding immediately adjacent to the western corner of the HAGI site.

6.2.2 The approximate site grid reference is 360106E 378096N.

6.2.3 The topography of the site has been approximated from Lidar Contour data and this shows that the northern corner is at approximately 49mAOD falling to approximately 45mAOD in the lower southern corner. This is a fall of approximately 4m in 167m which equates to an average slope of approximately 1:42 across the site.

6.2.4 Based on the information from the British Geological Survey website, superficial deposits of Diamicton Glacial Till exist across the Central Hub area. Sand and gravel (Glaciofluvial sheet deposits) are located predominantly in the southwest of the HAGI area. However superficial deposits were absent at the Central HAGI site. The bedrock underlying the area consists of mudstone (Bollin Mudstone Member) across the entire area.

6.2.5 Records from the National Soil Map shows the dominant soils profile in this area is slowly permeable seasonally waterlogged reddish fine loamy over clayey soils. These soils are considered to have poor permeability with respect to infiltration.

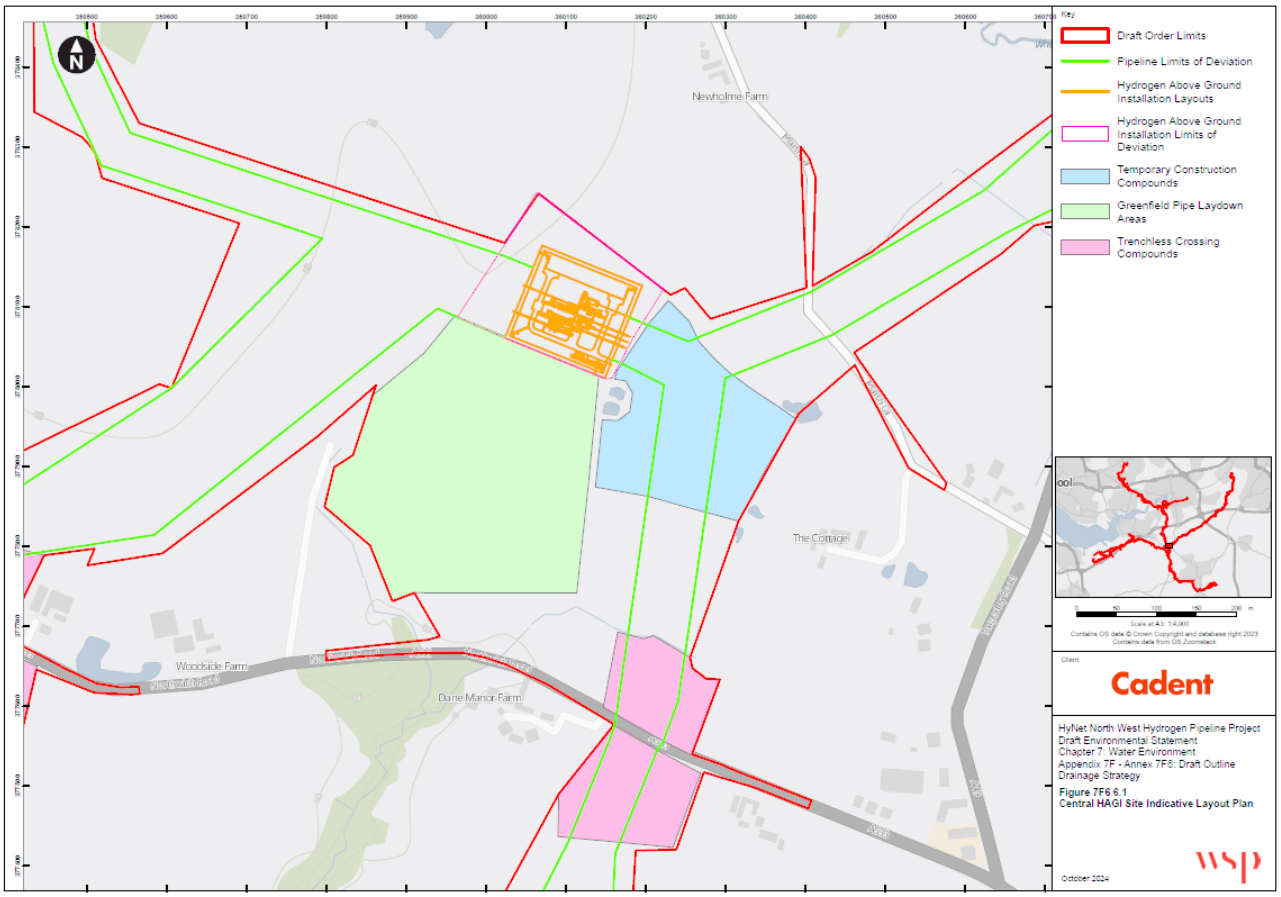
6.2.6 Based on interpretation of exploratory hole data from historical ground investigations in the surrounding areas it is anticipated that groundwater levels may be encountered between 5 and 8m bgl.

6.3 Proposed Permanent Development

6.3.1 The proposed site development is shown in **Figure 7F6 6.1** below. The blue area indicates the proposed temporary construction compound area for the HAGI and the green area indicates a proposed pipe laydown area.

6.3.2 The proposed Hydrogen Above Ground Installation (HAGI) site covers a total area of approximately 16,000m^2 (1.60Ha).

Figure 7F6 6.1 Central Hub HAGI Site Layout Plan



6.3.3 The Central Hub HAGI Indicative Drainage Layout Plan for the permanent drainage of the site is included in Appendix A4. This also shows the location of a land drainage ditch approximately 300m to the east of the site. If infiltration is proven not to be viable on this site, drainage will probably be discharged to this watercourse.

6.3.4 An ordinary watercourse consent will need to be agreed with the LLFA for this outfall discharge connection.

6.4 Allowable Site Discharge

6.4.1 The total site area of 1.6ha yields an equivalent greenfield runoff rate (Qbar) of 7.80l/s. The unit greenfield runoff rate for this area is calculated at 4.85l/s/ha.

6.4.2 The Greenfield Runoff Rate as calculated using the HR Wallingford greenfield runoff tool is shown in Appendix B4.

6.4.3 Surface water runoff from the proposed development will be restricted to this equivalent greenfield runoff rate.

6.4.4 It is proposed that a gravity discharge from the site will be restricted via a flow control valve to be equal to the greenfield runoff rate Qbar. If discharge under gravity is not possible then a pumped solution pumping at the agreed restricted rate will be required. This will be finalised at the next, more detailed stage of

design. It is being considered whether this will be included in the DCO requirements.

6.5 Attenuation Provision

6.5.1 The overall area of the development site is 16,000m^2 however, some of this area will be occupied by impermeable area such as access roads and foundation plinths. The approximate impermeable area on the site is 7,075m^2. An estimated 8,925m^2 will be available as in-situ attenuation storage on the site.

6.5.2 It is proposed that the site platform will have an approximate surface level of 47.36mAOD. The Type 3 stone blanket will have a minimum depth of around 450mm that will yield a total potential available attenuation storage volume of approximately 1200m3 assuming a void ratio of 30% in the granular material.

6.5.3 A positive outfall will discharge via a new headwall to the unnamed drainage ditch to the east of the site. This will require an ordinary watercourse discharge consent from the Lead Local Flood Authority (LLFA).

6.5.4 The preliminary hydraulic model calculations (using MicroDrainage Source Control module) show that for the 1:100 year plus climate change rainfall event and restricting the discharge from the site to the agreed greenfield runoff rate, to prevent any flooding from the site, the volume of attenuation storage required is 1,124m^3. These calculations are included in Appendix C4.

6.5.5 To mobilise this storage, it will be necessary to place an impermeable membrane at the base of the granular material. This will prevent water percolating vertically through to the underlying soil and horizontally through the embankments. The membrane will also prevent any high-level ground water seeping into the granular layer. The attenuated water will drain from the stone blanket area via a filter drain installed along the northern side of the platform and connected to the outfall.

6.5.6 The preliminary Indicative Drainage Layout is included in Appendix A4.

6.6 Temporary Construction Compound Drainage

6.6.1 The site layout plan shows a 3.9ha temporary construction compound to the east of the HAGI site and a proposed pipe laydown area immediately south of the site. The area of this laydown area is proposed as 9.07ha.

6.6.2 All the above temporary areas will require temporary drainage and associated attenuation for the duration of construction.

6.6.3 For the purposes of this exercise, it was assumed that:

- The HAGI site plus the northern half of the HAGI construction compound site drained eastwards to the drainage ditch to the east of the site (total area of 3.45ha).
- The southern half of the HAGI construction compound drained southwards and discharged to an ordinary watercourse to the south (area of 1.78ha).
- The temporary pipe laydown area drained southwards to the ordinary watercourse in this area (area of 9.07ha).

Allowable Site Discharge

6.6.4 Based on the calculated Qbar rate noted in the previous section, the allowable discharge rates for all the above areas will be as follows:

- 16.1l/s to be discharged from the combined HAGI permanent and half of the construction site to be discharged to the drainage ditch to the east of the sites.
- 8.3l/s to be discharged from the southern half of the HAGI construction compound to be drained to the watercourse in the south.
- 42.4/s to be discharged from the temporary pipe laydown area to be drained to the watercourse in the south.

6.6.5 The above proposed outfalls are shown in Appendix A4. These outlets will all be new discharge headwalls to the ordinary watercourses installed in accordance with the LLFA consent requirements.

Attenuation Provision

6.6.6 Based on the allowable discharge rates noted above and the corresponding areas of the compounds draining to the three separate basins, the individual attenuation volumes required for the temporary compounds are estimated as follows:

- 820m^3 storage for the combined HAGI permanent and half the construction site.
- 425m^3 storage for half the HAGI construction compound draining southwards.
- 2,150m^3 storage for the pipe laydown area draining southwards.

6.6.7 It is noted that as these compounds are temporary, they will be removed after construction. It is being considered whether the rehabilitation of the site after removal will be the subject of a DCO requirement.

6.6.8 The approximate locations and sizes of detention basins are based on a 1.7m deep basin as shown on the indicative drainage layout in Appendix A4.

6.7 Existing Utilities in the Area

6.7.1 There is a SABIC UK Petrochemicals underground pipeline running across the northern corner of the proposed HAGI site from west to east approximately 10m from the actual HAGI structure.

6.7.2 There are several high voltage 11kV overhead electrical lines traversing the agricultural field to the south, crossing over the proposed temporary construction compound and pipe laydown area.

6.7.3 These existing utilities are shown on the layout plan in Appendix A4.

7 Higher Walton HAGI Sites

7.1.1 This section of the report sets out the Outline Drainage Strategy for two alternative proposed sites for the Higher Walton HAGI site which is located approximately mid-way along the northern corridor of the distribution network. This is approximately 3 km south west of Warrington. **Figure 7F6 1.1** shows the full extents of the Hynet North West Hydrogen Pipeline Project with Higher Walton HAGI site labelled.

7.1.2 The two sites to be considered in this section are Site 1 – HWH2 and Site 2 – HWH8 as shown on **Figure 7F6 7.1** below.

7.1.3 The final decision on which site will eventually be developed is still to be made hence assessment of both sites will be included in this study.

7.2 Site 1 (HWH2)

7.2.1 This site is situated immediately adjacent to the Manchester Ship Canal opposite the Acton Grange railway viaduct. Port Warrington is immediately west of the HAGI site with a local wildlife site and agricultural land to the north.

7.2.2 It appears this site has previously had some ground works performed on it however historically there is no record of previous building development. For the purpose of this study, it is anticipated that the LLFA will treat this site as a greenfield site as there is no evidence of previous drainage systems on the site.

7.2.3 The approximate site grid reference is 358861E 385746N.

7.2.4 The topography of the site has been approximated from Lidar Contour data and this shows that the levels across the site range from approximately 12mAOD in the northwest corner down to approximately 10.75mAOD in the northeast corner. This equates to an average slope of approximately 1:92 across the site west to east.

7.2.5 The British Geological Survey website indicates that the site is underlain by the Helsby Sandstone Formation - Sandstone, pebbly (gravelly), with superficial deposits of Alluvium - Clay, silt and sand. These deposits are considered to have relatively good permeability.

7.2.6 Information from the BGS website borehole logs within proximity to the site indicate that groundwater may be in the order of 4m below ground level. The adjacent canal water level is at a level of approximately 4.5mAOD according to the Lidar topoFigureal information.

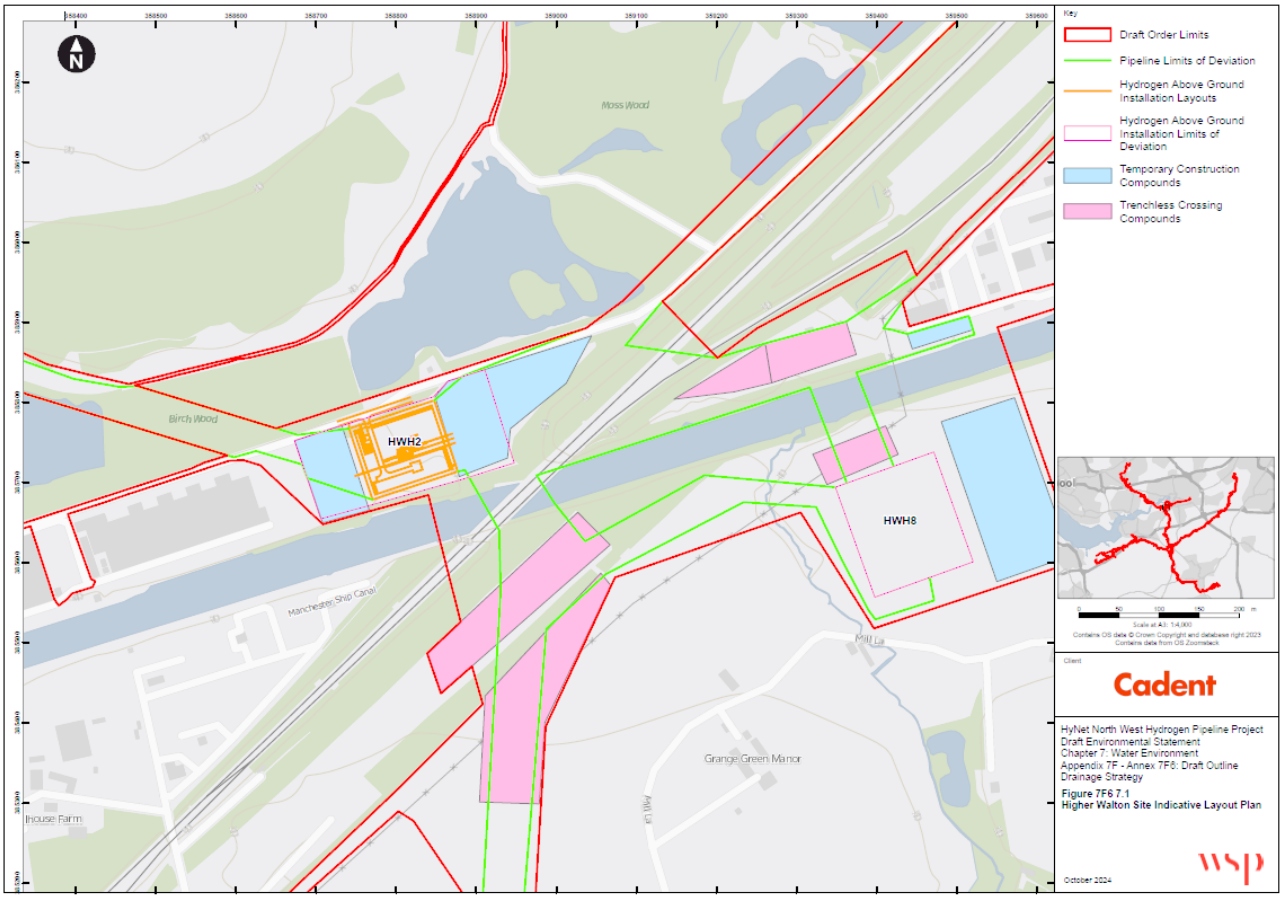
7.3 Proposed Permanent Development

7.3.1 The proposed site development plans for both sites are shown in **Figure 7F6 7.1** below. The pink areas show the proposed trenchless crossings construction compounds for the pipeline crossing the canal.

7.3.2 The alternative site location HWH8 will be assessed in the next section of this report. Until a decision has been made on which site will eventually be developed both are assessed.

7.3.3 The proposed HAGI site 1 (HWH2 outlined in orange) covers a total area of approximately 11,000m2 (1.10 hectares).

Figure 7F6 7.1 Higher Walton HAGI Sites (HWH2 and HWH8) Layout Plan



7.3.4 The Higher Walton HAGI Indicative Drainage Layout Plan for the permanent site drainage of HWH2 is included in Appendix A5. If infiltration proves not to be viable, the surface water drainage can potentially be discharged to the adjacent Manchester Ship Canal.

7.3.5 Consent for this discharge will be required from the owners of the Canal (Peel Holdings).

7.4 Allowable Site Discharge

7.4.1 The total site area of 1.1ha yields an equivalent greenfield runoff rate (Qbar) of 2.62l/s using the unit greenfield runoff rate of 2.38l/s/ha as calculated using the HR Wallingford tool using the FEH 2013 data set. The result of this calculation is shown in Appendix B5. This greenfield runoff rate has been uplifted to the practical minimum flow of 3 l/s. The layout of site 2 (HWH8) is assumed to be identical to site 1 (HWH2) and the unit greenfield runoff rates are assumed not to vary

between the two sites therefore the calculation shown in Appendix B5 will also apply to site 2(HWH8).

7.4.2 Surface water runoff from the proposed development will be restricted to this equivalent greenfield runoff rate.

7.4.3 It is proposed that a gravity discharge from the site will be restricted via a flow control valve to be equal to the greenfield runoff rate Qbar.

7.5 Attenuation Provision

7.5.1 The approximate overall area of the development site is a maximum of 11,000m^2 however, some of this area will be occupied by impermeable area such as access roads and foundation plinths. The approximate impermeable area on the site is 3,550m^2. An estimated 7,450m^2 will be available as in-situ attenuation storage on the site.

7.5.2 It is proposed that the HAGI site platform will have an approximate surface level of 11.75mAOD. The type 3 stone blanket will have a minimum depth of approximately 400mm that will yield a total potential available attenuation storage volume of around 900m^3 assuming a void ratio of 30% in the granular material.

7.5.3 A positive outfall will discharge via a new headwall to the Manchester Shipping Canal immediately south of the site. This will require the consent of the Canal owners who are Peel Holdings to be pursued post DCO consent.

7.5.4 The preliminary hydraulic model calculations (using MicroDrainage Source Control module) show that for the 1:100 year plus climate change rainfall event and restricting the discharge from the site to the agreed greenfield runoff rate, to prevent any flooding from the site, the total minimum volume of attenuation storage required is 835m^3. These calculations are included in Appendix C5. As the layouts of both sites are assumed to be identical and the greenfield runoff rate is the same these calculations showing the attenuation storage will apply to both sites.

7.5.5 To mobilise this storage, it will be recommended to place an impermeable membrane at the base of the granular material. This will prevent water percolating vertically through to the underlying soil and horizontally through the embankments. The membrane will also prevent any possible high-level ground water seeping into the granular layer. The attenuated water will drain from the stone blanket area via a filter drain installed through the stone blanket and connected to the outfall.

7.5.6 The preliminary Indicative Drainage Layout is included in Appendix A5.

7.6 Temporary Construction Compound Drainage

7.6.1 As can be seen on the site layout plan, two areas for the HAGI construction site compounds have been proposed, a 0.60ha compound immediately west of the site and a 1.5ha site immediately east of the HAGI site. It is proposed that the eastern site will also accommodate the trenchless crossing construction compound for the canal crossing just south of this area.

7.6.2 Both of the above temporary areas and including the HAGI site itself will require temporary drainage and associated attenuation for the duration of construction of the HAGI and canal crossing.

Allowable Site Discharge

7.6.3 Based on the same unit greenfield flowrate (2.38l/s/ha Qbar) mentioned in the previous section, the allowable discharge rates from the temporary construction areas will be as follows:

- Western construction compound plus the HAGI site itself is a total area of 1.7ha which translates to an equivalent allowable discharge rate of 4.0l/s.
- Eastern construction compound at 1.5ha would translate to an allowable greenfield runoff rate of 3.6l/s. Due to the position and elevation of this proposed detention pond it is likely that this discharge will require a pumped solution to discharge at the required outfall position into the canal.

7.6.4 As shown in the preliminary drainage layout plan in Appendix A5, it is proposed that the discharges from all the temporary areas combine to discharge at the proposed permanent outfall position. The total discharge flowrate will be 7.6/s.

Attenuation Provision

7.6.5 Based on the allowable discharge rates noted above and the total areas of the temporary construction compounds, the volumes of attenuation storage required for each compound is estimated as follows:

- For the eastern compound and detention basin (known as Pond A on the drawing in Appendix A5) the required storage is estimated at 410m^3.
- For the combined western compound and HAGI construction site attenuation will be stored in detention Pond B and will need to provide 470m^3.

7.6.6 The approximate locations and sizes of detention basins based on a 1.7m water depth basin are shown on the indicative drainage layout in Appendix A5.

7.7 Existing Utilities in the Area

7.7.1 There's is a BT overhead telecommunications line along the northern boundary of the HAGI site and through the centre of the eastern temporary site. Another underground BT cable runs across along the southern boundary of the HAGI and the eastern temporary site.

7.7.2 A 2inch diameter United Utilities underground distribution water main lies along the southern boundary of the sites between the site and the Manchester shipping canal. An unknown utility also encroaches slightly onto the south side footprint of the eastern temporary compound.

7.7.3 An underground petrochemical SABIC pipeline also runs along the southern boundary of the HAGI and east compound sites. In addition, another SABIC pipeline crosses the canal running parallel to the railway line. Along this same

alignment is also a Shell NOP pipeline. These do not encroach onto the HAGI or temporary compound sites.

7.7.4 This is shown on the layout plan in Appendix A5.

7.8 Site 2 (HWH8)

7.8.1 This site is situated immediately adjacent to the south bank of the Manchester Ship Canal opposite the Perstorp/Solvay Industrial site just east of Acton Grange railway viaduct. Agricultural land extends to the south of the site.

7.8.2 This is presently a greenfield site.

7.8.3 The approximate site grid reference is 359400E 385645N.

7.8.4 The topography of the site has been approximated from Lidar Contour data and this shows that the levels across the site range from approximately 10.7mAOD in the northwest corner up to approximately 13.3mAOD in the southeast corner. This equates to an average slope of approximately 1:58 across the site southeast to northwest.

7.8.5 The British Geological Survey website indicates that the site is underlain by the Helsby Sandstone Formation - Sandstone, pebbly (gravelly), with superficial deposits of Alluvium - Clay, silt and sand and some Glaciofluvial sheet deposits. These deposits are considered to have relatively good permeability.

7.8.6 Information from the BGS website borehole logs within proximity to the site indicate that groundwater may be in the order of 4m below ground level. The adjacent canal water level is at a level of approximately 4.5mAOD according to the Lidar topoFigureal information.

7.9 Proposed Permanent Development

7.9.1 The proposed site development plans for both sites are shown in **Figure 7F6 7.1** above. The pink areas show the proposed trenchless crossings construction compounds for the pipeline crossing the Canal.

7.9.2 The proposed HAGI site 1 (HWH8, eastern site) covers a total area of approximately 11,000m2 (1.10 hectares).

7.9.3 The Higher Walton HAGI Indicative Drainage Layout Plan for the permanent site drainage of HWH8 is included in Appendix A5. If infiltration proves not to be viable, the surface water drainage can be potentially discharged to the adjacent unknown water course to the west which drains into the Canal. An ordinary watercourse consent will most likely be required from the LLFA for this discharge.

7.9.4 Consent for this discharge may also be required from the owners of the Canal (Peel Holdings). It is proposed that these consenting issues are finalised post DCO consent.

7.10 Allowable Site Discharge

7.10.1 The total site area of 1.1ha yields an equivalent greenfield runoff rate (Qbar) of 2.62l/s using the unit greenfield runoff rate of 2.38l/s/ha as calculated using the HR Wallingford tool using the FEH 2013 data set. The result of this calculation is shown in Appendix B5. This greenfield runoff rate has been uplifted to the practical minimum flow of 3 l/s. (Same calculation as for site 1(HWH2)).

7.10.2 Surface water runoff from the proposed development will be restricted to this equivalent greenfield runoff rate.

7.10.3 It is proposed that a gravity discharge from the site will be restricted via a flow control valve to be equal to the greenfield runoff rate Qbar.

7.11 Attenuation Provision

7.11.1 The approximate overall area of the development site is a maximum of 11,000m^2 however, some of this area will be occupied by impermeable area such as access roads and foundation plinths. The approximate impermeable area on the site is 3,550m^2. An estimated 7,450m^2 will be available as in-situ attenuation storage on the site.

7.11.2 It is proposed that the HAGI site platform will have an approximate surface level of 12.5mAOD. The type 3 stone blanket will have a minimum depth of approximately 400mm that will yield a total potential available attenuation storage volume of approximately 900m^3 assuming a void ratio of 30% in the granular material.

7.11.3 A positive outfall will discharge via a new headwall to the watercourse to the west of the site. This will require the consent from the LLFA to be pursued post DCO consent.

7.11.4 The preliminary hydraulic model calculations (using MicroDrainage Source Control module) show that for the 1:100 year plus climate change rainfall event and restricting the discharge from the site to the agreed greenfield runoff rate, to prevent any flooding from the site, the total minimum volume of attenuation storage required is 900m^3. These calculations are included in Appendix C5. (Same calculation as for site 1 (HWH2)).

7.11.5 The preliminary Indicative Drainage Layout for this site 2 (HWH8) is included in Appendix A5.

7.12 Temporary Construction Compound Drainage

7.12.1 As can be seen on the site layout plan for the temporary construction compound in Appendix A5, a 2.0ha area for the HAGI construction site compound has been proposed east of the HAGI site. It is proposed that drainage from the adjacent trenchless crossing construction compound for the canal crossing will also be accommodated. The approximate area of this compound is 0.4ha.

7.12.2 Both of the above temporary areas and including the HAGI site itself will require temporary drainage and associated attenuation for the duration of construction of the HAGI and canal crossing, total area of 3.5ha.

Allowable Site Discharge

7.12.3 Based on the same unit greenfield flowrate (2.38l/s/ha Qbar) mentioned in the previous section, the allowable discharge rate from the temporary construction areas is estimated at 8.3l/s.

7.12.4 As shown in the preliminary drainage layout plan in Appendix A5, it is proposed that the discharges from all the temporary areas combine to discharge at the proposed permanent outfall position. The total discharge flowrate will be 7.6/s.

Attenuation Provision

7.12.5 Based on the allowable discharge rates noted above and the total areas of the temporary construction compounds, the volume of attenuation storage required for all the compounds is estimated at 960m^3.

7.12.6 The approximate location and size of the detention basin based on a 1.7m water depth basin is shown on the indicative drainage layout in Appendix A5.

7.13 Existing Utilities in the Area

7.13.1 According to the GIS there were no existing utilities recorded in the immediate area of the site.

8 Clock Face HAGI Site

8.1.1 This section of the report sets out the Outline Drainage Strategy for the proposed Clock Face HAGI which is located on the northern corridor of the distribution network. This can be seen on **Figure 7F6 1.1** which shows the extents of the complete Hynet North West Hydrogen Pipeline Project.

8.2 Existing Site

8.2.1 The existing site is situated on existing agricultural land between the M62 motorway and B5419. The site is approximately 5km due south of St Helens. The surrounding area is extensive agricultural land.

8.2.2 The approximate site grid reference is 351331E 390013N.

8.2.3 The topography of the site has been approximated from Lidar Contour data and this shows that the land slopes gently from the highest point on the southern corner at an elevation approximately 57.5mAOD down to the lowest point midway along the northern boundary at an approximate elevation of 56mAOD. This equates to an average slope of approximately 1:103 across the site, sloping from south to north.

8.2.4 The British Geological Survey website indicates that the site is underlain by the Kinnerton Sandstone Formation in the southeast and mudstone, sandstone and conglomerate (Etruria Formation) in the northwest. Superficial deposits consist of Till, Devensian - Diamicton. These deposits are considered to be soils of relatively poor permeability.

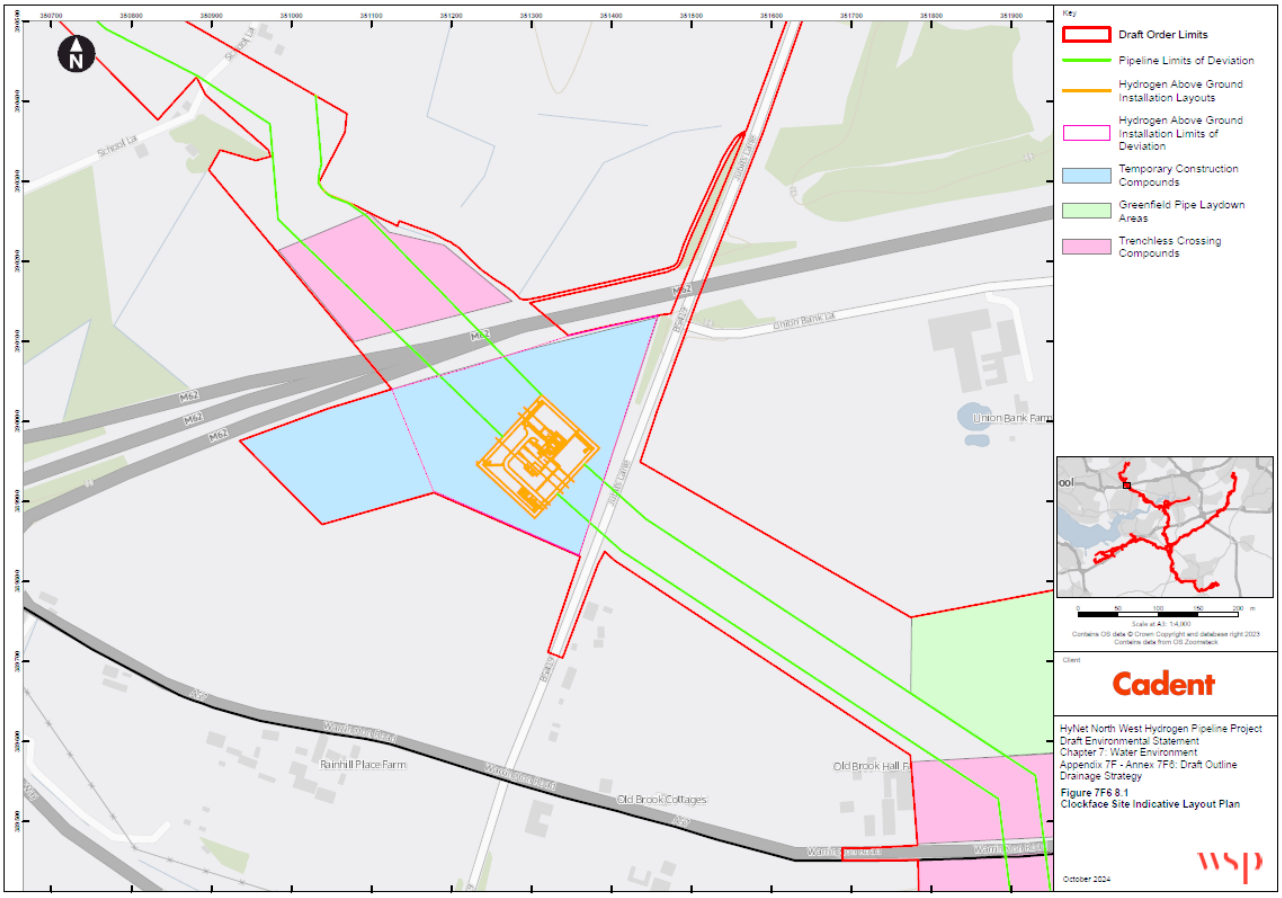
8.2.5 Information from the BGS website borehole logs within proximity to the site indicate that groundwater may be in the order of 3.6m to 7m below ground level.

8.3 Proposed Permanent Development

8.3.1 The proposed site is shown in **Figure 7F6 8.1** below. The blue area represents the proposed temporary construction compound area for the HAGI.

8.3.2 The proposed HAGI covers a total area of approximately 12,000m^2 (1.20 hectares).

Figure 7F6 8.1 Clock Face HAGI Site Layout Plan



8.3.3 The Clock Face HAGI Indicative Drainage Layout Plan for the drainage of the permanent site is included in Appendix A6. The soils in this area are anticipated to have relatively poor permeability, therefore if infiltration is not a viable method of surface water disposal on this site, the surface water will require draining either to a water course or sewer.

8.3.4 Information for the site shows that there are no water courses that are accessible from the site, however there is an agricultural drainage ditch draining from the north side of the M62 motorway. There is also evidence of a culvert headwall or similar on the southern side of the M62, opposite the drainage ditch on the north side. Therefore, the proposal is to discharge to the drainage ditch via the existing culvert headwall on the south side of the motorway. More investigation and details are required to finalise this discharge position in the next detailed design stage. It is being considered whether this will be included in a DCO requirement.

8.4 Allowable Site Discharge

8.4.1 The total site area of 1.20ha yields an equivalent greenfield runoff rate (Qbar) of 9.14l/s. The unit greenfield runoff rate for this area is calculated at 7.62l/s/ha

8.4.2 Appendix B6 shows the Greenfield Runoff Rate calculation sheet.

8.4.3 Surface water runoff from the proposed development will be restricted to this equivalent greenfield runoff rate.

8.4.4 It is proposed that gravity discharge from the site will be restricted via a flow control valve to be equal to the greenfield runoff rate Qbar. If discharge under gravity is not possible then a pumped solution, pumping at the agreed restricted rate will be required. This will be finalised at the next, more detailed stage of design. It is being considered whether this will be included in the DCO requirements.

8.5 Attenuation Provision

8.5.1 The overall area of the development site is 12,000m^2 however, some of this area will be occupied by impermeable area such as access roads and foundation plinths. The approximate impermeable area on the site is 6,780m^2. An estimated 5,220m^2 will be available as in-situ attenuation storage on the site.

8.5.2 It is proposed that the site platform will have an approximate surface level of approximately 56.5mAOD. The type 3 stone blanket will have a minimum depth of approximately 450mm that will yield a total potential available attenuation storage volume of approximately 700m^3 assuming a void ratio of 30% in the stone material.

8.5.3 A positive outfall will discharge at the restricted greenfield runoff rate via a new headwall to the highways drainage running along the southern edge of the M62 motorway. This discharge connection will require the agreement of Highways England and the Lead Local Flood Authority.

8.5.4 The preliminary hydraulic model calculations (using MicroDrainage Source Control module) show that for the 1:100 year plus climate change rainfall event and restricting the discharge from the site to the agreed greenfield runoff rate, to prevent any flooding from the site, the volume of attenuation storage required is 700m^3. These calculations are included in Appendix C6.

8.5.5 The preliminary Indicative Drainage Layout is included in Appendix A6.

8.6 Temporary Construction Compound Drainage

8.6.1 In addition to the HAGI site itself, which will require temporary drainage during construction, there is a 7.8ha temporary construction compound surrounding the HAGI site.

8.6.2 All the above areas will require temporary drainage and associated attenuation for the duration of construction. The total area of both sites then will be approximately 9.0ha.

Allowable Site Discharge

8.6.3 Based on the calculated Qbar unit greenfield runoff rate noted in the previous section, the allowable discharge rate for all of the above areas will be 68.6/s.

8.6.4 There is a high risk that the capacity of the existing culvert under the M62 may not be sufficient to accommodate this proposed discharge rate. More temporary attenuation storage may need to be provided to reduce the discharge rate and

balance it with the culvert capacity. More investigation into the culvert capacity will be required in detailed design stage. It is being considered whether this will be secured within a DCO requirement.

8.6.5 It is proposed that the outfall from this system will be to the same discharge point to be used for the permanent scheme and is shown in Appendix A6.

Attenuation Provision

8.6.6 Based on the allowable discharge noted above and the total area of the temporary construction compounds, the volume of attenuation required for the temporary construction compound and HAGI site during construction is estimated to be 1,600m^3 to retain the 1 in 100-year (1%AEP) event without flooding occurring from the site.

8.6.7 It is noted that as the compound is a temporary feature that will be removed after construction.

8.6.8 The approximate size of basin is based on a 1.7m deep pond/swale and is shown on the indicative drainage layout in Appendix A6.

8.7 Existing Utilities in the Area

8.7.1 There are 4 No. United Utilities underground main water pipelines crossing the western section of the site from the south to the northwest of the HAGI. The pipe sizes range from 1000mm diameter, 42 inches and 72 inches.

8.7.2 There is a possible surface water culvert draining under the M62 motorway – size and capacity unknown.

8.7.3 These utilities are shown on the layout plan in Appendix A6.

9 Warburton HAGI Site

9.1.1 This section of the report sets out the outline drainage strategy for the proposed Warburton HAGI site which is located approximately 2.5km south east of Warburton village, on the eastern corridor of the distribution network as shown in **Figure 7F6 1.1**.

9.2 Existing Site

9.2.1 The existing site is situated on existing agricultural land immediately adjacent to an existing gas above ground installation on the west side of the HAGI with some residential buildings immediately east. The remainder of the surrounding area is agricultural lands.

9.2.2 The approximate site grid reference is 372238E 388586N.

9.2.3 The topography of the site has been approximated from Lidar Contour data and this shows that the southwestern corner is at approximately 25mAOD elevation falling to approximately 23.5mAOD in the eastern corner. This is a fall of approximately 1.5m in 120m which equates to an average slope of approximately 1:80 across the site.

9.2.4 Ground investigations are in progress however the British Geological Survey website indicates that the site is underlain Wilmslow Sandstone Formation - Sandstone. Superficial deposits of Shirdley Hill Sand Formation formed from windblown sand. These deposits are associated with deep well drained sandy soils with anticipated good permeability.

9.2.5 Information from the BGS website borehole logs within proximity to the site indicate that groundwater may be in the order of 2.4m below ground level.

9.2.6 According to the Halite Risk Assessment 2024 (Wardell Armstrong) this HAGI site falls within the Cheshire Brine Compensation District. Although this HAGI site is within the compensation district, it is not in a “wet rockhead” area where the possibility of natural subsidence at the surface is greatest, through dissolution of the subterranean salt rock.

9.2.7 The Cheshire Brine Subsidence Compensation Board (CBSCB) will need to be consulted with regard to the surface water drainage proposals for the HAGI due to the sensitive nature associated with infiltration in this area. The CBSCB will be a statutory consultee in the DCO process.

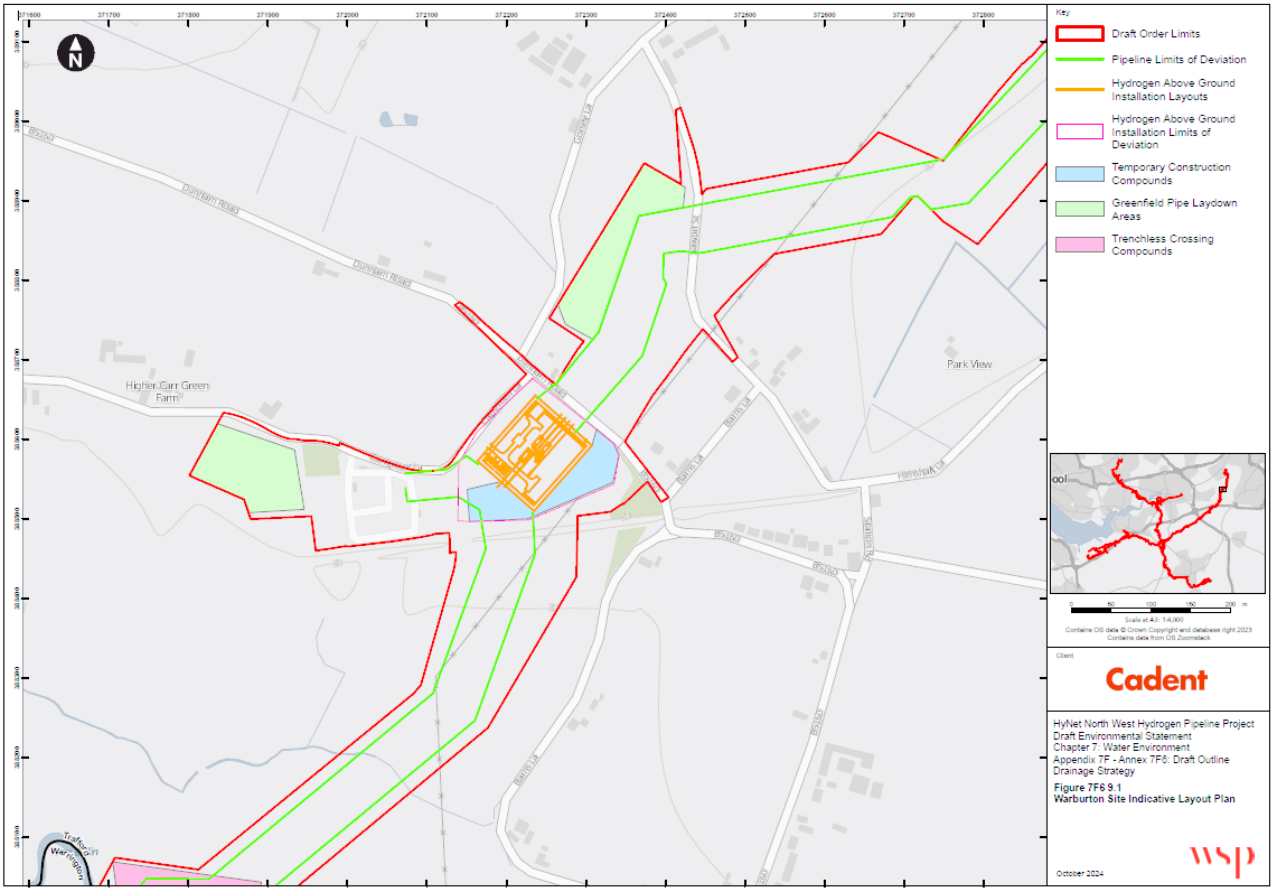
9.2.8 Should infiltration be shown to be a viable method of surface water disposal it will need to be considered in close consultation with the CBSCB.

9.3 Proposed Permanent Development

9.3.1 The proposed site development is shown in **Figure 7F6 9.1** below. The green areas indicate proposed greenfield pipe laydown areas to be used in the construction process. The blue area is the temporary construction compound area.

9.3.2 The proposed permanent HAGI site covers a total area of approximately 10,000m^2 (1.00Ha).

Figure 7F6 9.1 Warburton HAGI Site Layout Plan



9.3.3 The Warburton HAGI Indicative Drainage Layout Plan for the permanent drainage is shown in Appendix A7. This also shows the location of a watercourse approximately 450m to the south of the site. Preliminary indications are that infiltration may be a viable method of surface water disposal in this area, however, if infiltration is not viable, drainage will probably be discharged to this watercourse.

9.3.4 An ordinary watercourse consent will need to be agreed with the LLFA should this outfall discharge connection be required.

9.4 Allowable Site Discharge

9.4.1 The total site area of 1.00ha yields an equivalent greenfield runoff rate (Qbar) of 2.38l/s. This low total flow rate has been uplifted to the minimum practical flowrate of 3l/s to be used for the attenuation storage calculations for this HAGI.

9.4.2 Appendix B7 shows the Greenfield Runoff Rate calculation sheet using the HR Wallingford greenfield runoff tool with FEH 2013 rainfall data.

9.4.3 Surface water runoff from the proposed development will be restricted to the equivalent greenfield runoff rate.

9.4.4 It is proposed that a gravity discharge from the site will be restricted via a flow control valve to be equal to the greenfield runoff rate Qbar. If discharge under gravity is not possible then a pumped solution pumping at the agreed restricted rate will be required. It is being considered whether this will be secured as a DCO requirement.

9.5 Attenuation Provision

9.5.1 The total area of the development site is 10,000m^2 however, some of this area will be occupied by impermeable area such as access roads and foundation plinths. The approximate impermeable area on the site is 4,420m^2. An estimated 5,580m^2 will therefore be available as in-situ attenuation storage on the site.

9.5.2 It is proposed that the site platform will have an approximate surface level of 24.5mAOD.

9.5.3 A positive outfall will discharge via a new headwall to the River Bollin approximately 800m to the south of the site. This will probably require a FRAP from the EA as this is classified as a main river.

9.5.4 The preliminary hydraulic calculations indicate that using a vortex flow control valve to restrict the discharge to the required greenfield flow (3l/s) will require an attenuation storage volume of approximately 755m^3 , which translates to an equivalent 450mm depth of type 3 stone blanket to avoid flooding occurring during the critical 1 in 100-year + climate change event. These calculations are included in Appendix C7.

9.5.5 The preliminary Indicative Drainage Layout for the permanent drainage is included in Appendix A7.

9.6 Temporary Construction Compound Drainage

9.6.1 The site layout plan identifies a 0.72ha temporary construction compound adjacent to the south of the HAGI site. The total area then to be drained during the construction stage will be 1.72ha.

9.6.2 All the above temporary areas will require temporary drainage and associated attenuation for the duration of construction.

9.6.3 It is proposed that all the areas will drain to a temporary attenuation basin along the southern boundary of the construction sites, which will drain at an agreed restricted flow to the River Bollin as above.

Allowable Site Discharge

9.6.4 Based on the calculated Qbar unit rate of 2.38l/s/ha noted in the previous section, the allowable discharge rate for all of the above areas will be 4.1l/s. It is proposed that the outfall from this system will also be to the proposed outlet for the permanent drainage to the watercourse south of the site as shown in Appendix A7.

Attenuation Provision

9.6.5 Based on the allowable discharge noted above and the total area of the compounds, the volume of attenuation required for the compound is estimated to be 470m^3 for the 1 in 100-year (1%AEP) event. It is noted that as the compound is a temporary feature that will be removed after construction of the HAGI and it has been agreed in principal that these will be assessed using present day flood risk estimates only and therefore no allowance for climate change has been considered.

9.6.6 The approximate area based on a 1.7m deep pond/swale is shown on the indicative drainage layout in Appendix A7.

9.7 Existing Utilities in the Area

9.7.1 There is an overhead national grid electric power line running parallel with the southeast boundary of the HAGI. The overhead line is approximately 30m from the HAGI boundary but crosses the temporary construction compound area. There is also an SP Energy Networks underground low voltage cable in Dunham Road, which is approximately 20m north of the northeastern HAGI boundary.

9.7.2 There is a BT underground cable which runs into the eastern and southern area of the HAGI site. This branches off from a number of other BT cables in Dunham Road as well as in Carrgreen Lane running parallel to the northwestern HAGI boundary approximately 20m to the west.

9.7.3 There is also a National Grid high pressure gas transmission line connected to the above ground installation to the west of the site. This gas line runs in a north/south direction approximately 65m west of the western corner of the HAGI site.

9.7.4 There is a 400mm diameter United Utilities watermain running east/west in the Trans Pennine Trail route approximately 25m south of the southern corner of the site. There is also a 110mm diameter UU distribution watermain in Carrgreen Lane and Dunham Road.

9.7.5 All the above utilities are shown on the layout plan in Appendix A7.

10 Partington HAGI Site

10.1.1 This section of the report sets out the Outline Drainage Strategy for the proposed Partington HAGI sites, which is located at the northern end of the eastern corridor of the distribution network as shown in **Figure 7F6 1.1**. At Stage three statutory consultation, two alternative site locations are proposed, (see **Figure 7F6 10.1** below). This Outline Drainage Strategy will consider both alternatives, site 1 on the existing derelict Cadent Gas Installation brownfield site and site 2 approximately 550m due east of alternative site 1.

10.1.2 The alternate sites will be considered in the following two separate sections.

10.2 Site 1

10.2.1 The site is situated on the eastern portion of the existing Cadent Gas Installation site with derelict industrial land surrounding the new proposed site on all sides except the southern boundary which is adjacent to the previous railway link which is now abandoned and has naturally revegetated with thick growth forming a green corridor along this boundary.

10.2.2 For the purposes of this study the site is treated as a brownfield (predeveloped) site.

10.2.3 The approximate grid reference of Site 1 is 372737E 391668N.

10.2.4 The topography of the site has been approximated from Lidar Contour data and this shows that the site is very flat at an approximate elevation of 20.0mAOD. The location of the HAGI is positioned over the previously demolished gas holder which was on this site.

10.2.5 The British Geological Survey website indicates that the site is underlain by gravelly sandstone (Wilmslow Sandstone Formation). Superficial deposits in the area of the HAGI site are River Terrace deposits, sand and gravel. The area has also contained a layer of made ground from the previous development/s. These deposits are considered to have low permeability; therefore, infiltration would probably not be viable.

10.2.6 According to the Halite Risk Assessment this HAGI site falls within the Cheshire Brine Compensation District. Although this HAGI site is within the compensation district, it is not in a “wet rockhead” area where the possibility of natural subsidence at the surface, through dissolution of the subterranean salt rock, is greatest.

10.2.7 The Cheshire Brine Subsidence Compensation Board (CBSCB) will need to be consulted with regard to the drainage proposals for the HAGI. The CBSCB will be a statutory consultee in the DCO process.

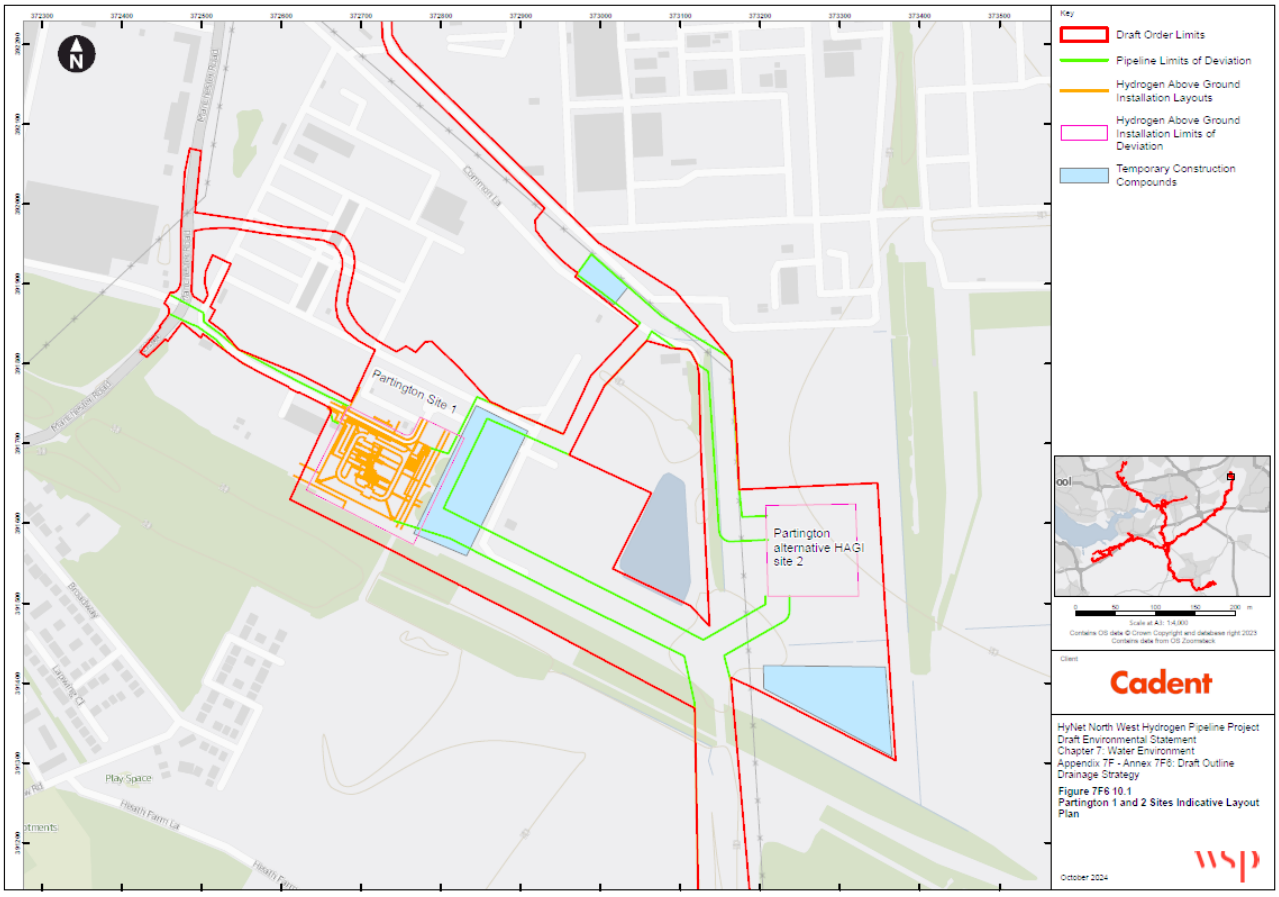
10.2.8 Should infiltration be shown to be a viable method of surface water disposal it will need to be considered in close consultation with the CBSCB.

10.3 Proposed Permanent Development

10.3.1 The proposed Sites (1 and 2) are shown in **Figure 7F6 10.1** below**.** The blue areas adjacent to the sites are to accommodate the temporary construction compounds for each site.

10.3.2 The proposed HAGI site covers a total area of approximately 11,000m^2 (1.1 hectares).

Figure 7F6 10.1 Partington HAGI Sites Plan



10.3.3 The Partington HAGI Indicative Drainage Layout Plan for the permanent drainage for site 1 is included in Appendix A8. As shown on this plan it is proposed to drain the new proposed site into the existing drainage infrastructure on the brownfield site.

10.3.4 It is proposed at this stage that the details of the exact connection point to the existing infrastructure will be finalised during the next stage of detailed design to be done post DCO consent.

10.4 Allowable Site Discharge

10.4.1 As this site is a brownfield site, normally the LLFA would allow a restricted flow from the site equal to the previous brownfield runoff less an agreed percentage betterment (usually ranging from 30% to 50%).

10.4.2 The Trafford LLFA requirement for discharge from a brownfield site is stated as; "*Previously Developed Site: For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.*" [10]

10.4.3 Using the above criteria, the unit greenfield runoff rate for the 1% AEP event for this area is calculated at 9.4l/s/ha. The total HAGI site area of 1.1ha yields an equivalent greenfield runoff rate of 10.4l/s. This will be used as the brownfield runoff rate according to Trafford LLFA requirements. This calculation is shown in Appendix B8.

10.4.4 Surface water runoff from the Project will be restricted to this equivalent "brownfield" runoff rate.

10.4.5 It is proposed that gravity discharge from the site will be restricted via a flow control valve to this flow rate. If discharge under gravity is not possible then a pumped solution, pumping at the agreed restricted rate will be required. This will be finalised at the next, more detailed stage of design. It is being considered whether this will be included as a DCO requirement.

10.5 Attenuation Provision

10.5.1 The overall area of the development site is 11,000m^2 however, some of this area will be occupied by impermeable area such as access roads and foundation plinths. The approximate impermeable area on the site is 7,845m^2, therefore an estimated 3,155m^2 will be available as in-situ attenuation storage on the site.

10.5.2 It is proposed that the site platform will have an approximate surface level of 19.7mAOD. The type 3 stone blanket will have a minimum thickness of approximately 700mm that will yield a total potential available attenuation storage volume of approximately 660m^3 assuming a void ratio of 30% in the granular material.

10.5.3 It is proposed that a positive outfall will discharge via a new connection pipe to the existing site drainage to the north. This will probably require an internal approval from Cadent.

10.5.4 The preliminary hydraulic model calculations show that restricting the discharge rate from the site to the agreed greenfield runoff rate, an attenuation storage volume of approximately 660m^3 will be required to prevent flooding occurring during the 1 in 100-year + climate change event. These calculations are contained in Appendix C8.

10.5.5 The Indicative Drainage Layout for the permanent installation is shown in Appendix A8.

10.6 Temporary Construction Compound Drainage

10.6.1 As can be seen on the site layout plan, in addition to the HAGI site there is a 1.1ha temporary construction compound to the east of the permanent HAGI site.

10.6.2 Therefore, a total temporary area of 2.2ha will require temporary drainage and associated attenuation for the duration of construction.

Allowable Site Discharge

10.6.3 Based on the unit greenfield 1% AEP runoff rate of 9.4l/s/ha noted in the above section, the total allowable discharge rate for all of the above areas will be 22.6l/s. It is proposed that the outfall from this system will be to the newly installed drainage connection for the permanent drainage as shown in Appendix A8.

Attenuation Provision

10.6.4 Based on the allowable discharge noted above and the total area of the construction compound and HAGI site, the total volume of attenuation storage required to prevent flooding during the critical 1 in 100-year (1%AEP) event is estimated to be 470m^3.

10.6.5 It is noted that as the compound is a temporary feature it will be removed after construction.

10.6.6 The approximate location and size of the detention basin based on a 1.7m deep basin is shown on the indicative drainage layout in Appendix A8.

10.7 Existing Utilities in the Area

10.7.1 There is a National Grid high pressure underground gas line which runs between the permanent HAGI site and the temporary construction compound.

10.7.2 There is a Zayo Group underground telecom cable encroaching across the northern and eastern sections of the HAGI site, and an overhead BT telecom line encroaching across the western side of the site.

10.7.3 There is an abandoned underground high voltage Electricity North West cable skirting the northern side of the site and encroaching across the eastern half of the site.

10.7.4 These existing utilities are shown on the layout plan in Appendix A8.

10.8 Site 2

10.8.1 The Site is situated in an agricultural field approximately 550m due east of site 1 as shown in **Figure 7F6 10.1**. To the north lies the Partington industrial area with agricultural land stretching to the east and south of the site.

10.8.2 The approximate grid reference of Site 2 is 373264E 391568N.

10.8.3 The topography of the Site has been approximated from Lidar Contour data and this shows that the site is very flat at an approximate elevation of 20.0mAOD.

10.8.4 The British Geological Survey website indicates that the site is underlain by gravelly sandstone (Wilmslow Sandstone Formation). Superficial deposits in the area of the HAGI site are Peat. These deposits are considered to have very low permeability; therefore, infiltration would probably not be viable.

10.8.5 Information from the BGS website borehole logs within proximity to the site indicate that groundwater may be in the order of 2m below ground level.

10.8.6 According to the Halite Risk Assessment this HAGI site falls within the Cheshire Brine Compensation District. Although this HAGI site is within the compensation district, it is not in a “wet rockhead” area where the possibility of natural subsidence at the surface, through dissolution of the subterranean salt rock, is greatest.

10.8.7 The Cheshire Brine Subsidence Compensation Board (CBSCB) will need to be consulted with regard to the drainage proposals for the HAGI. The CBSCB will be a statutory consultee in the DCO process.

10.8.8 Should infiltration be shown to be a viable method of surface water disposal it will need to be considered in close consultation with the CBSCB.

10.9 Proposed Permanent Development

10.9.1 The proposed Site 2 is shown in **Figure 7F6 10.1** above**.** The blue area to the south of the site is to accommodate the temporary construction compound.

10.9.2 The proposed HAGI site covers a total area of approximately 11,000m^2 (1.1 hectares).

10.9.3 The Partington HAGI Site 2 Indicative Drainage Layout Plan for the permanent drainage proposed for this site is included in Appendix A8. The Main Rivers Map shows a drainage ditch on the western boundary of the field in which the HAGI is positioned, therefore if infiltration is not viable on this site drainage will be discharged to this drain.

10.10 Allowable Site Discharge

10.10.1 The total HAGI site area of 1.1ha yields an equivalent greenfield runoff rate (Qbar) of 4.2l/s. The unit greenfield runoff rate for this area is calculated at 3.80l/s/ha. This calculation is shown in Appendix B8.

10.10.2 Surface water runoff from the Project will be restricted to this equivalent greenfield runoff rate.

10.10.3 It is proposed that gravity discharge from the site will be restricted via a flow control valve to this flow rate. If discharge under gravity is not possible then a pumped solution pumping at the agreed restricted rate will be required. This will be finalised at the next, more detailed stage of design. It is being considered whether this will be included as a DCO requirement.

10.11 Attenuation Provision

10.11.1 The overall area of the development site is 11,000m^2 however, some of this area will be occupied by impermeable area such as access roads and foundation plinths. The approximate impermeable area on the site is 7,840m^2, therefore an estimated 3,160m^2 will be available as in-situ attenuation storage on the site.

10.11.2 It is proposed that the site platform will have an approximate surface level of 20.5mAOD. The type 3 stone blanket will have a minimum thickness of approximately 850mm that will yield a total potential available attenuation storage volume of approximately 810m^3 assuming a void ratio of 30% in the granular material.

10.11.3 A positive outfall will discharge via a new headwall to the drainage ditch to the west of the site. This will require the approval of the LLFA and will be subject to an ordinary watercourse discharge consent.

10.11.4 The preliminary hydraulic model calculations show that restricting the discharge rate from the site to the agreed greenfield runoff rate, an attenuation storage volume of approximately 810m^3 will be required to prevent flooding occurring during the 1 in 100-year + climate change event. These calculations are contained in Appendix C8.

10.11.5 The Indicative Drainage Layout for the permanent installation is shown in Appendix A8.

10.12 Temporary Construction Compound Drainage

10.12.1 As can be seen on the site layout plan in addition to the HAGI site there is a 1.1ha temporary construction compound to the south of the HAGI site.

10.12.2 Therefore, a total temporary area of 2.2ha will require temporary drainage and associated attenuation for the duration of construction.

Allowable Site Discharge

10.12.3 Based on the calculated Qbar rate of 3.8l/s/ha noted in the above section, the total allowable discharge rate for all of the above areas will be 8.4l/s. It is proposed that the outfall from this system will be to the newly installed drainage outlet for the permanent drainage as shown in Appendix A8.

Attenuation Provision

10.12.4 Based on the allowable discharge noted above and the total area of the construction compound and HAGI site, the total volume of attenuation storage required to prevent flooding during the critical 1 in 100-year (1% AEP) event is estimated to be 550m^3.

10.12.5 It is noted that as the compound is a temporary feature it will be removed after construction.

10.12.6 The approximate location and size of the detention basin based on a 1.7m deep basin is shown on the indicative drainage layout in Appendix A8.

10.13 Existing Utilities in the Area

10.13.1 There is an ESSAR petro-chemical pipeline running along the western boundary of the agricultural field approximately 50m from the west side of the HAGI site.

10.13.2 Also running along the western boundary of the field is an extra high voltage 132kV overhead electric power line. Providers are SP Energy Networks and Electricity North West.

10.13.3 These existing utilities are shown on the layout plan in Appendix A8.

11 Hydrogen Storage Facility HAGI Site

11.1.1 This section of the report sets out the outline drainage strategy for the proposed Hydrogen Storage Facility (HSF) HAGI site, which is located at the end of the South Corridor as shown in **Figure 7F6 1.1.**

11.2 Existing Site

11.2.1 The existing site is situated on a greenfield site which is surrounded by existing agricultural land. The site is located on the northern bank of the adjacent Puddinglake Brook, which is classified as an EA main river.

11.2.2 The approximate site grid reference is 369714E 370014N.

11.2.3 A topography survey has not been undertaken; however Lidar data of the site shows the lower south side of the site at an elevation of 31.5mAOD rising to the northern side at an approximate elevation of 32.5mAOD. This results in an average slope across the site of approximately 1:108 from north to south.

11.2.4 The British Geological Survey website indicates that the site is underlain by Sidmouth Mudstone Formation - Mudstone. Halite is also present in the mudstones. The superficial geology consists of deposits of Diamicton Glacial Till - Clay, silt and sand (Tidal Flat Deposits). These soils are seasonally wet deep red clay – considered to have relatively low permeability.

11.2.5 Information from the BGS website borehole logs within proximity to the site indicate that groundwater may be in the order of 2m to 2.9m below ground level.

11.2.6 According to the Halite Risk Assessment this HAGI site falls within the Cheshire Brine Compensation District. In addition, this site falls just east of the “wet rockhead” area where the possibility of natural subsidence at the surface is greatest, through dissolution of the subterranean salt rock.

11.2.7 For this reason, we recommend that infiltration as a surface water disposal method should be avoided at this site and that discharge to the nearby Puddinglake Brook is preferred.

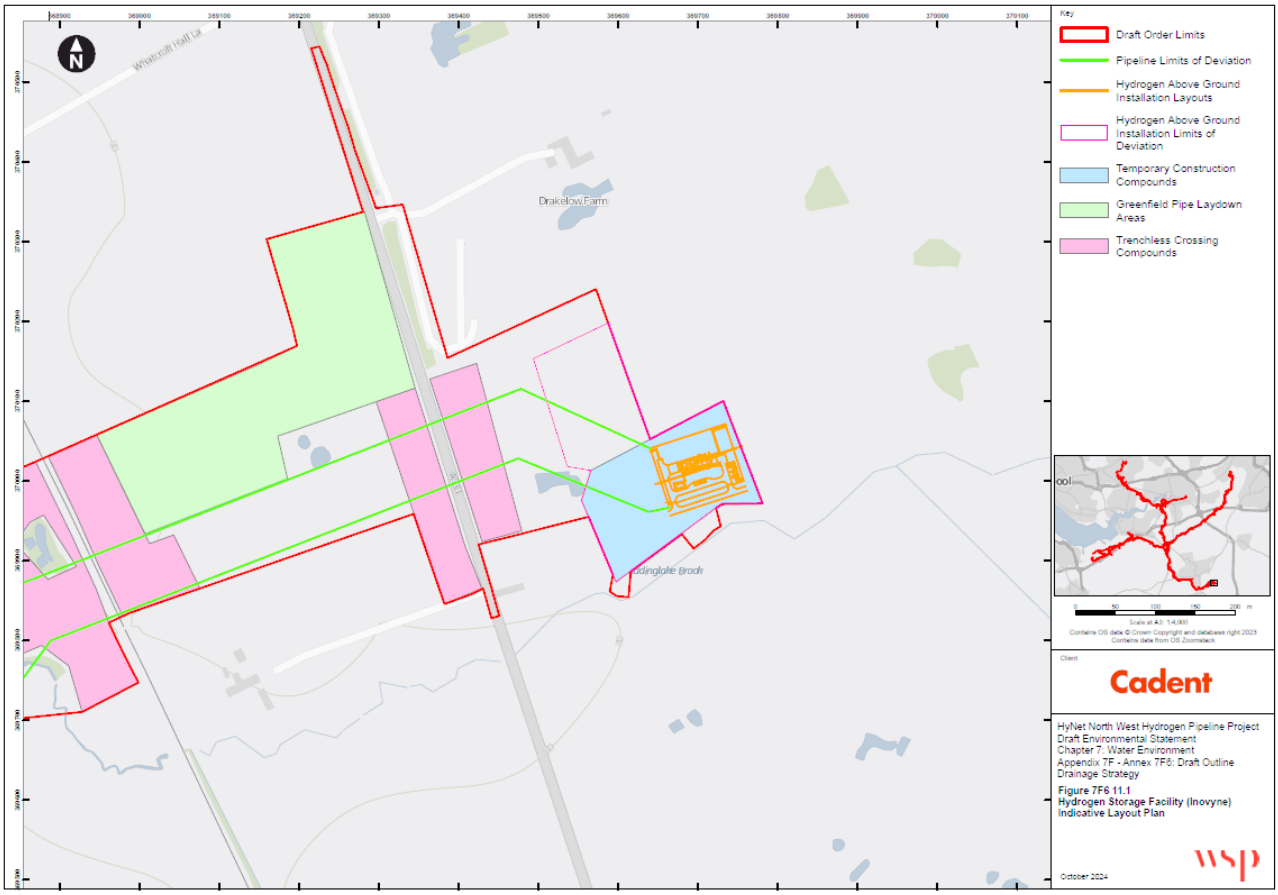
11.2.8 The Cheshire Brine Subsidence Compensation Board (CBSCB) will need to be consulted with regard to the drainage proposals for the HAGI. The CBSCB will be a statutory consultee in the DCO process.

11.3 Proposed Permanent Development

11.3.1 The proposed site is shown in **Figure 7F6 11.1** below. Two nearby trenchless crossing construction compounds and a greenfield pipe laydown area are also proposed. Only the drainage of the permanent HAGI site is considered here.

11.3.2 The proposed HAGI covers a total area of approximately 8,800m^2 (0.88 hectares).

Figure 7F6 11.1 Hydrogen Storage Facility HAGI Site Layout Plan



11.3.3 The Hydrogen Storage HAGI Indicative Drainage Layout Plan is included in Appendix A9. This also shows the location of the Puddinglake Brook approximately 25m to the south of the site. Due to the halite classification of this site, infiltration is to be avoided and therefore drainage will be discharged to this watercourse.

11.3.4 The Puddinglake Brook is an EA main river and therefore a Flood Risk Activity Permit (FRAP) may be required for this discharge outfall.

11.4 Allowable Site Discharge

11.4.1 The total site area of 0.88ha yields an equivalent greenfield runoff rate (Qbar) of 5.6l/s using the HR Wallingford Greenfield Runoff Tool with FEH (2013) rainfall data. The unit greenfield runoff rate is calculated at 6.35l/s/ha.

11.4.2 Appendix B9 shows the Greenfield Runoff Rate calculation sheet.

11.4.3 Surface water runoff from the proposed development will be restricted to the equivalent greenfield runoff rate.

11.4.4 It is proposed that a gravity discharge from the site will be restricted via a flow control valve to be equal to the greenfield runoff rate Qbar. The riverbank is shown at a level of approximately 30mAOB in this area therefore a gravity connection should be feasible.

11.5 Attenuation Provision

11.5.1 The overall area of the development site is 8,800m^2 however, some of this area will be occupied by impermeable area such as access roads and foundation plinths. The approximate impermeable area on the site is 4,660m^2. An estimated 4,140m^2 will be available as in-situ attenuation storage on the site.

11.5.2 It is proposed that the site platform will have an approximate surface level of 32.18mAOD. The type 3 stone blanket will have a minimum depth of approximately 550mm that will yield a total potential available attenuation storage volume of approximately 690m^3 assuming a void ratio of 30% in the granular material.

11.5.3 A positive gravity outfall will discharge via a new headwall to the Puddinglake Brook immediately south of the site. This outfall will require a FRAP from the EA.

11.5.4 The preliminary hydraulic calculations indicate that for the 1 in 100-year + 45% climate change event and restricting the discharge to greenfield runoff rate, to prevent flooding during this event, an attenuation storage volume of 620m^3 will be required.

11.5.5 The preliminary hydraulic calculations for the attenuation volume sizing as summarised above is included in Appendix C9 and an Indicative Drainage Layout Plan is included in Appendix A9.

11.6 Temporary Construction Compound Drainage

11.6.1 A 2.6ha temporary construction compound is to enable the construction of the HAGI.

11.6.2 There is also a proposed pipe laydown area of approximately 6.86ha and two trenchless crossing compounds totalling 8.07ha within the vicinity of this HAGI site.

11.6.3 The above temporary areas will require temporary drainage and associated attenuation for the duration of construction.

11.6.4 For the purposes of this exercise the following was assumed:

- The HAGI site plus construction compound will drain to pond A. Total catchment area of 2.6ha.
- The eastern crossing compounds plus the eastern portion of the pipe laydown compound totalling an area of 7.1ha will drain to pond B.
- The western portion of the pipe laydown area plus the eastern section of the western crossing compound totalling an area of 1.8ha will drain to pond C.
- Western section of the western crossing compound totalling 4.0ha will drain to pond D.

Allowable Site Discharge

11.6.5 Based on the calculated Qbar rate of 6.35l/s/ha noted in the above section, the allowable discharge rates for the above areas will be as follows:

- Areas draining to basin A, 16.5l/s plus flow received from pond B = 61.4l/s discharging to the Brook at the permanent drainage outlet location.
- Areas draining to basin B, 45.1l/s discharging to pond A.
- Areas draining to basin C, 11.8l/s discharging to pond D.
- Areas draining to basin D, 25.4l/s plus 11.8l/s from basin C = 37.2l/s discharging to the Brook at a temporary location.

Attenuation Provision

11.6.6 Based on the allowable discharge rates noted above and the total areas of the compound areas, the attenuation volumes of the individual basins are estimated as follows:

- Attenuation volume of basin A is 600 m^3.
- Attenuation volume of basin B is 1620 m^3.
- Attenuation volume of basin C is 410 m^3.
- Attenuation volume of basin D is 920 m^3.

11.6.7 It is noted that as the compounds are temporary, they will be removed after construction.

11.6.8 The approximate locations and sizes of detention basins as shown in Appendix A9 are based on a 1.7m basin.

11.7 Existing Utilities in the Area

11.7.1 There is an existing National Grid high pressure gas pipeline approximately 180m to the west of the HAGI site. This pipeline runs to the existing gas above ground installation in this area.

11.7.2 There is also an 11kV overhead high voltage SP Energy Networks electrical power line running north/south approximately 140m to the west of the site.

11.7.3 There are BT telecom cables and a 6 inch diameter UU watermain running in King Street (A530) road reserve approximately 250m west of the site.

11.7.4 All the above utilities are shown on the layout plan in Appendix A9.

12 Sworton Block Valve Installation Site

12.1.1 This section of the report sets out the outline drainage strategy for the proposed Sworton BVI site which is located approximately halfway along the eastern corridor of the pipeline distribution network as shown in **Figure 7F6 1.1.**

12.2 Existing Site

12.2.1 The site is situated on existing agricultural land adjacent to the north side of the A50. The surrounding area is agricultural with the village of High Legh approximately 600m to the east of the site.

12.2.2 The approximate site grid reference is 369382E 384055N.

12.2.3 The topography of the site has been approximated from Lidar Contour data and this shows that the BVI site is situated on the highest ground in the field at an approximate elevation of 73mAOD. The site slopes away very gradually downhill towards the north, south and west from the site.

12.2.4 Ground investigations are in progress however the British Geological Survey website indicates that the site is underlain by the Bollin Mudstone Member - Mudstone. There is an absence of superficial deposits around this block valve site area. The soils in this area are seasonally wet deep red loam to clay and are considered to have relatively low permeability.

12.2.5 Information from the BGS website shows no available borehole logs in the area with information for the area ground water levels.

12.2.6 According to the Halite Risk Assessment this BVI site falls within the Cheshire Brine Compensation District. Although this site is within the compensation district, it is not in a “wet rockhead” area where the possibility of natural subsidence at the surface is greatest, through dissolution of the subterranean salt rock.

12.2.7 The Cheshire Brine Subsidence Compensation Board (CBSCB) will need to be consulted with regard to the drainage proposals for the BV. The CBSCB will be statutory consultees in the DCO process.

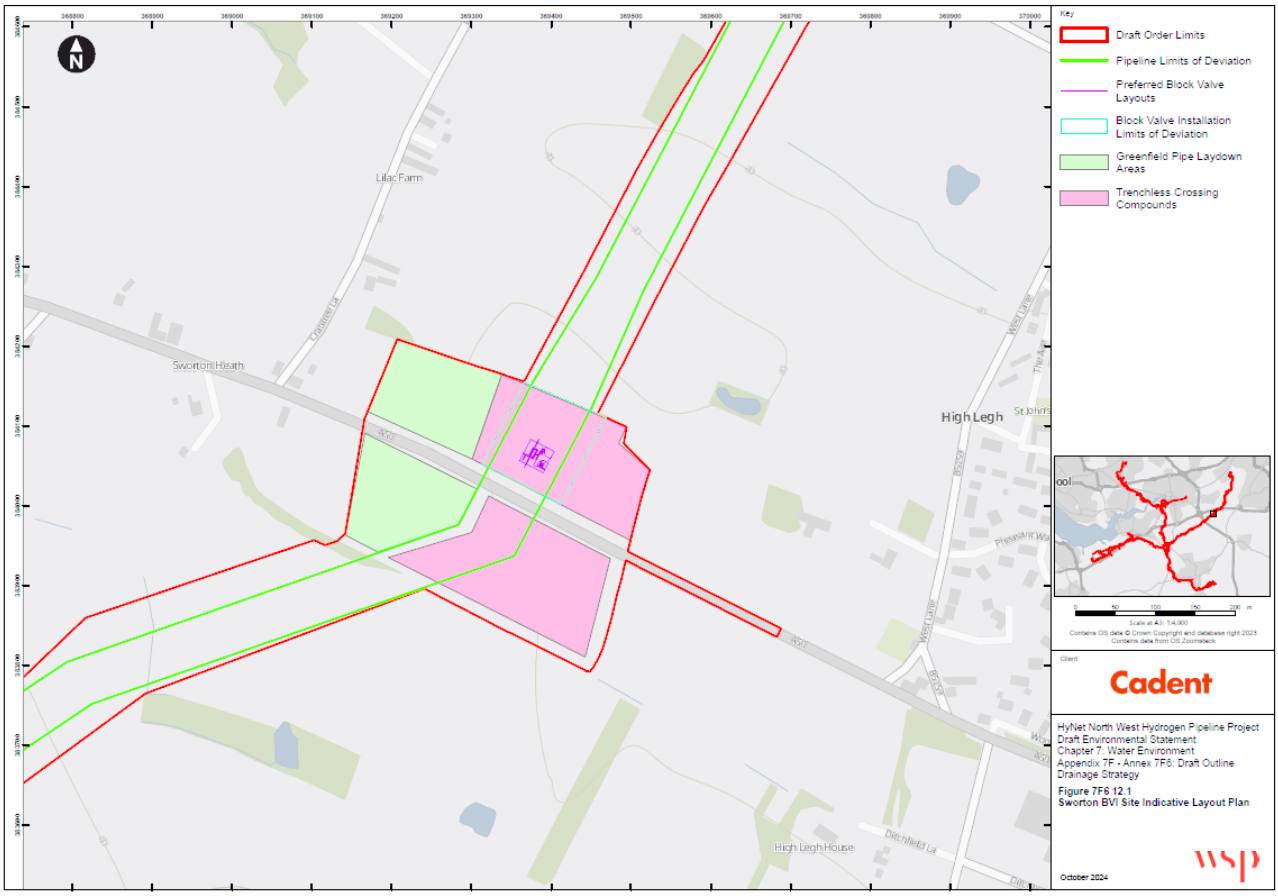
12.2.8 Should infiltration be shown to be a viable method of surface water disposal it will need to be considered in close consultation with the CBSCB.

12.3 Proposed Permanent Development

12.3.1 The proposed site is shown in **Figure 7F6 12.1** below. Note that the proposed construction compound area for the BVI site is the same area as the site itself, however the site is located within a trenchless crossing construction site (pink area) for the road crossing immediately south of the site.

12.3.2 The proposed BVI site covers a total area of approximately 1,000m^2 (0.1Ha).

Figure 7F6 12.1 Sworton Block Valve Installation Site Layout Plan



12.3.3 The Sworton BVI Indicative Drainage Layout Plan is included in Appendix A10. If infiltration is not viable and there are no accessible water courses to discharge to in the area, then there is a 750mm diameter United Utilities surface water sewer approximately 660m north of the site. Drainage from this site will probably need to be discharged to this sewer.

12.4 Allowable Site Discharge

12.4.1 The total site area of 0.10ha yields an equivalent greenfield runoff rate (Qbar) of 0.64l/s (using the calculated unit greenfield runoff rate of 6.43l/s/ha). As explained in section 2, this very low runoff rate will be uplifted to the minimum practical rate of 3l/s for the attenuation storage calculations for this BV.

12.4.2 Appendix B10 shows the Greenfield Runoff Rate calculation sheet using the HR Wallingford greenfield runoff tool with FEH 2013 rainfall data.

12.4.3 Surface water runoff from the proposed development will be restricted to this equivalent greenfield runoff rate.

12.4.4 It is proposed that the restricted discharge from the BV site is gravitated to connect into the 700mm diameter UU surface water sewer approximately 660m north of the site where the UU sewer crosses the Hydrogen pipeline route. The ground level at the proposed point of connection, according to Lidar data, is approximately 68mAOD.

12.4.5 An S106 connection will need to be agreed with UU during finalisation of the detailed drainage design.

12.4.6 If discharge under gravity is not possible then a pumped solution pumping at the agreed restricted rate will be required. It is proposed that this will be finalised during detailed design stage to be done post DCO consent.

12.5 Attenuation Provision

12.5.1 The overall area of the development site is 1,000m^2 however, some of this area will be occupied by impermeable area such as access roads and foundation plinths. The approximate impermeable area on the site is 200m^2. An estimated 800m2 will therefore be available as in-situ attenuation storage on the site.

12.5.2 It is proposed that the site platform will have an approximate surface level of 72.85mAOD.

12.5.3 The preliminary hydraulic calculations indicate that using a vortex flow control valve to restrict the discharge to the required greenfield flow (3l/s) will require an attenuation storage volume of approximately 50m^3, which translates to an equivalent 200mm depth of type 3 stone blanket to avoid flooding occurring during the critical 1 in 100-year + 45% climate change event. These hydraulic calculations are shown in Appendix C10.

12.5.4 The Indicative Drainage Layout for the permanent drainage from this BV is shown in Appendix A10.

12.6 Temporary Construction Compound Drainage

12.6.1 In addition to the BVI site itself, there is a proposed 2.5ha trenchless crossing and also a 1.4ha proposed pipe storage area lying to the west of the site. These are all shown to drain into attenuation basin A.

12.6.2 Across the main road the site the layout plan shows a 1.8ha proposed pipe storage area and a 2.25ha trenchless crossing compound draining to proposed attenuation basin B.

12.6.3 All the above temporary areas will require temporary drainage and associated attenuation storage for the duration of construction.

Allowable Site Discharge

12.6.4 Based on the calculated Qbar rate of 6.43l/s/ha noted in the previous section, the allowable discharge rates for all of the above areas will be:

- 25.1l/s from basin A, and
- 26.0l/s from basin B.

12.6.5 The combined discharge rate therefore during the construction stage will be approximately 51.1l/s discharging to the UU surface water sewer.

12.6.6 It is proposed that the outfall from these basins will discharge to the same UU surface water sewer described for the permanent scheme. This temporary discharge outlet will also need agreement with UU to utilise their existing sewer.

12.6.7 Should a gravity outfall not be feasible then a pumped solution for this outfall will be required. It is being considered whether this will be secured as a DCO requirement.

Attenuation Provision

12.6.8 Based on the allowable discharge rates noted above and the total areas of the compounds, preliminary hydraulic calculations show that the volume of attenuation storage required for these areas, to prevent flooding during 1 in 100-year (1%AEP) event, are as follows:

- 820m^3 for those areas draining into Basin A, and
- 850m^3 for those areas draining to basin B.

12.6.9 It is noted that these compounds and basins are temporary and will therefore be removed after construction.

12.6.10 The approximate locations and basin sizes, based on a 1.7m deep basin are shown on the indicative drainage layout in Appendix A10.

12.7 Existing Utilities in the Area

12.7.1 There is an overhead 11kV electric power line approximately 60m to the north of the BV site, travelling across the site and along the northern boundary of the temporary and trenchless crossing compounds.

12.7.2 Within the A50 reserve there are telecommunication overhead lines belonging to BT and underground cables belonging to Virgin media and Vodafone.

12.7.3 A 6 inch United Utilities water main also runs in the A50 main road reserve.

12.7.4 All the above utilities are shown on the layout plan in Appendix A10.

13 Hartford Block Valve Installation Site

13.1.1 This section of the report sets out the outline drainage strategy for the proposed Hartford Block Valve Installation, which is located approximately halfway along the southern corridor of the pipeline distribution network as shown in **Figure 7F6 1.1.**

13.2 Existing Site

13.2.1 The existing site is situated on existing agricultural land adjacent to the A556. The surrounding area is agricultural with the Sandiway golf course on the opposite side of the A556. There are scattered residential sites to the east of the site. Cemex Forrest Hill Quarry is situated approximately 600m west of the BVI site.

13.2.2 The approximate site grid reference is 361662E 371181N.

13.2.3 The topography of the site has been approximated from Lidar Contour data and this shows that the western corner is at approximately 39mAOD elevation rising to approximately 45m in the east corner. This is a fall of approximately 6m in 43m which equates to an average slope of approximately 1:7 across the site.

13.2.4 To create a level platform for the BVI, substantial earthworks will be required. See comment on this in the next section.

13.2.5 The British Geological Survey website indicates that the site is underlain by the Bollin Mudstone Member - Mudstone. Superficial deposits of Glaciofluvial Deposits, Devensian - Sand and gravel. The soils in this area are deep sandy well drained, and coarse loamy soils and are anticipated to have a relatively good permeability.

13.2.6 According to the Halite Risk Assessment this BVI site falls within the Cheshire Brine Compensation District. Although this HAGI site is within the compensation district, it is not in a “wet rockhead” area where the possibility of natural subsidence at the surface is greatest, through dissolution of the subterranean salt rock.

13.2.7 The Cheshire Brine Subsidence Compensation Board (CBSCB) will need to be consulted with regard to the proposals for the BV. The CBSCB will be statutory consultees in the DCO process.

13.2.8 Should infiltration be shown to be a viable method of surface water disposal it will need to be considered in close consultation with the CBSCB.

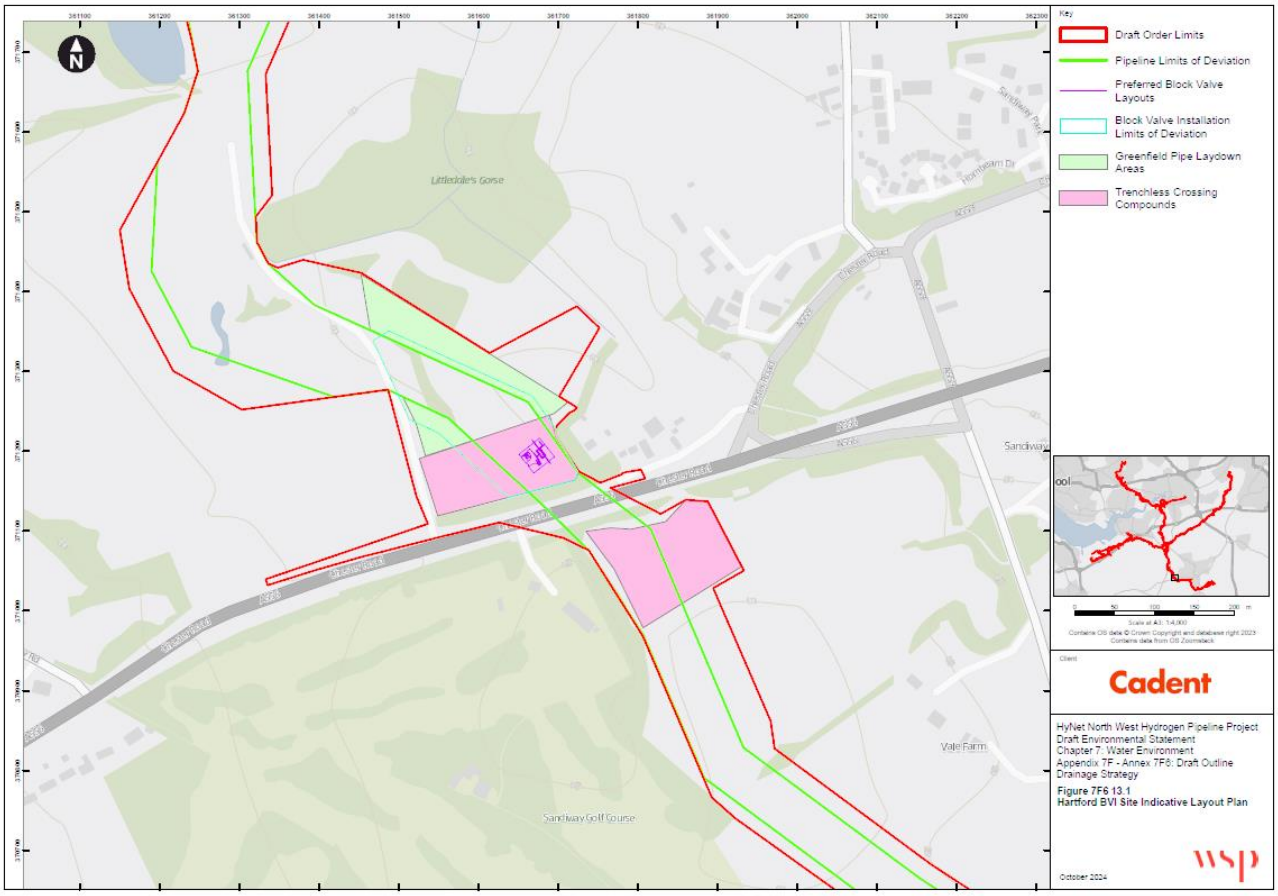
13.2.9 Information from the BGS website borehole logs within proximity to the site indicate that groundwater may be in the order of 17.4m to 22m below ground level.

13.3 Proposed Permanent Development

13.3.1 The proposed site is shown in **Figure 7F6 13.1** below. As can be seen the BVI site is located within a proposed trenchless crossing temporary construction compound (shown in pink) with two pipe laydown areas proposed to the north of the site.

13.3.2 The proposed Block Valve Installation (BVI) covers a total area of approximately 1,000m^2 (0.10Ha).

Figure 7F6 13.1 Hartford Block Valve Site Plan



13.3.3 The Hartford Option A Block Valve HAGI Indicative Drainage Layout Plan is included in Appendix A11. This also shows the location of an agricultural drainage ditch approximately 190m to the north of the site. If infiltration is not viable on this site, drainage will probably be discharged to this watercourse.

13.3.4 It is proposed that the BV site will have a platform level of approximately 41.38 mAOD. This will result in a cut embankment around the eastern corner of the site of an approximate height of 6m (nb. the DCO will allow for the micrositing of the HAGI which could allow significant earthworks to be avoided). A surface water cutoff berm will be required along the top edge of the embankment to divert surface water runoff around the site.

13.3.5 Discharge connection to the drainage ditch will need to be consented by the LLFA.

13.4 Allowable Site Discharge

13.4.1 The total site area of 0.10ha yields an equivalent greenfield runoff rate (Qbar) of 0.14l/s using the HR Wallingford Greenfield Runoff Tool with FEH 2013 rainfall data (unit greenfield runoff rate of 1.44l/s/ha). Due to the very low discharge

flowrate calculated, the flowrate will be uplifted to the practical minimum value of 3l/s for the attenuation storage calculations for this BV.

13.4.2 Appendix B11 shows the Greenfield Runoff Rate calculation sheet.

13.4.3 Surface water runoff from the proposed development will be restricted to this equivalent greenfield runoff rate.

13.4.4 It is proposed that the restricted discharge from the site is gravitated to the drainage ditch north of the site. If discharge under gravity is not possible then a pumped solution at the agreed restricted rate will be required. This will be finalised post DCO.

13.5 Attenuation Provision

13.5.1 The overall area of the development site is 1,000m2 however, some of this area will be occupied by impermeable area such as access roads and foundation plinths this area is estimated at 300m^2. Therefore, an estimated 700m^2 will be available as in-situ attenuation storage on the site.

13.5.2 The preliminary hydraulic calculations indicate that using a vortex flow control valve to restrict the discharge to the required greenfield flow (3l/s) will require an attenuation storage volume of approximately 45m^3 which translates to an equivalent 200mm depth of type 3 stone blanket to avoid flooding occurring during the critical 1 in 100-year + 45% climate change event. These hydraulic calculations are shown in Appendix C11.

13.5.3 The proposed Indicative Drainage Layout for the permanent drainage from this BV is included in Appendix A11.

13.6 Temporary Construction Compound Drainage

13.6.1 In addition to the BVI site, there is a 1.4ha trenchless crossing compound proposed together with two pipe laydown areas lying to the north of the site also totalling 1.4ha in area. These are all shown to drain into the attenuation basin along the northern boundary of the temporary construction site.

13.6.2 All the above temporary areas will require temporary drainage and associated attenuation for the duration of construction.

Allowable Site Discharge

13.6.3 Based on the calculated Qbar unit runoff rate of 1.44l/s/ha (uplifted to the practical minimum of 2l/s/ha as recommended in the HR Wallingford tool). The proposed greenfield runoff rate from the total area of 2.8ha will therefore be 5.6 l/s.

13.6.4 It is proposed that the outfall from this system will be to the same outfall as for the permanent drainage to the drainage ditch in the north. From preliminary observations it appears unlikely that this outfall will gravitate it will therefore require a pumped solution for the duration of the construction period. However, this will be finalised post DCO.

Attenuation Provision

13.6.5 Based on the allowable discharge flowrate noted above and the total area of the compounds and storage areas, the volume of attenuation required for the compound is estimated to be 810m^3 to prevent surface water flooding during the 1 in 100-year (1%AEP) event.

13.6.6 It is noted that as these compounds and attenuation basin are temporary, they will be removed after construction.

13.6.7 The approximate location and size of basin based on a 1.7m water depth is shown on the indicative drainage layout in Appendix A11.

13.7 Existing Utilities in the Area

13.7.1 There are no utilities shown below the footprint of the proposed BV site.

13.7.2 To the south of the site, within the road reserve of the A556 (Chester Road), there are overhead BT telecommunications lines and underground BT cables as well as several abandoned high and low voltage electrical power cables and high/ low voltage power lines.

13.7.3 There are live 11kV electrical underground cables in the middle and southern road reserves of the motorway, these are however well away from the BV site and should not impact on the construction work for the BV.

13.7.4 These utilities are shown on the layout plan in Appendix A11.

14 Greenfield Pipe Laydown Areas Along the Pipeline Route

14.1.1 In addition to the above HAGI and BVI sites there are 11 temporary greenfield pipe laydown sites identified along the pipeline route that are not associated with the individual HAGI or BVI sites and are of substantial footprint that will require a degree of temporary drainage infrastructure to control the surface water runoff from these areas.

14.1.2 The runoff from these areas have been assessed assuming the following overarching principles:

- The areas are assumed to be surfaced with an MOT type 1 gravel material and as previously assumed a 50% surface water runoff coefficient will apply.
- The runoff from these areas will be restricted to the greenfield runoff rates using similar unit rates to those calculated for the closest HAGI site.
- Attenuation volumes have been calculated in a similar manner to those of other temporary areas assuming no flooding occurs during the 1 in 100-year (1%AEP) event with no upliftment for climate change applied.
- Attenuation will generally be provided by means of an earth basin located on the site.
- In the absence of confirmed infiltration test results, it has initially been assumed that infiltration will not apply.

14.1.3 **Table 7F6 14.1** below shows a list of these sites with pertinent information for each.

Table 7F6 14.1 Summary of Greenfield Pipe Laydown Areas

Site Number	Eastings	Northings	Catchment Area (ha)	Unit Discharge rate (l/s/ha)	Discharge Rate (l/s)	Attenuation Volume (m^3)
1	354056	379264	2.7	1.9	5.1	810
2	366454	368805	1.9	1.9	3.6	600
3	345900	374926	2.4	4.4	10.6	555
4A	358773	380312	3.9	4.9	19.1	910
4B	358554	380234	3.6	4.9	17.6	840
5A	359510	386771	1.3	2.4	3.1	355

Site Number	Eastings	Northings	Catchment Area (ha)	Unit Discharge rate (l/s/ha)	Discharge Rate (l/s)	Attenuation Volume (m^3)
5B	359538	386543	1.2	2.4	Uplifted to 3	325
6	371495	386437	2.9	2.4	7.0	785
7	350806	390770	2.7	7.6	20.5	480
8	351881	389708	3.7	7.6	28.1	655
9A	354559	387821	2.8	2.4	6.7	765
9B	354789	387597	1.4	2.4	3.4	380
9C	354829	387530	2.6	2.4	6.2	710
9D	354768	387299	6.6	2.4	15.8	1800
10	360088	375590	2.3	4.9	11.3	540
11	360647	372806	2.5	4.9	11.5	595

14.1.4 Appendices E and F include illustrative drainage layout plans and hydraulic calculations respectively for all the above pipe laydown sites.

14.1.5 Outfall locations will be finalised post DCO.

15 Other Drainage Strategy Principles for Temporary Construction Areas

15.1.1 In addition to the temporary construction areas related to HAGIs, BVIs and greenfield pipe laydown areas as covered in the previous sections there are other temporary areas which will require a strategy to guide the construction activities.

15.1.2 Presently there is a single brownfield pipe laydown area proposed on the existing hardstanding yard of Gibbs Surfacing, off Burtonhead Road in St Helens. It is proposed that the drainage of this area will utilise the existing drainage system and continue to operate as existing during the construction period while pipes are stored on this site.

15.1.3 The following principles apply in general to construction along the length of the pipeline route.

15.2 Temporary Areas Subject to Soil Stripping and Excavation for Pipeline Construction

15.2.1 In addition to management of surface runoff from the pipeline construction swathe, there will also be areas where dewatering will be required from excavations for pipeline construction, HDD/micro tunnelling launch and reception pits for the crossing of major watercourses and linear infrastructure such as roads and railways.

15.2.2 Discharge from dewatering operations could include attenuation and infiltration into neighbouring ground, piping to a ditch or watercourse and/or tankering away and disposal at a remote site.

15.2.3 If dewatering entails pumping to a nearby watercourse, then the rate of discharge will be determined by the estimated volume of water to be dewatered, the available pumping equipment and the construction operations in the area of dewatering.

15.2.4 Discharge to the watercourse will occur via an appropriate sediment trap to ensure no silt is transported downstream into the watercourse. Application of embedded mitigation measure C8 (detailed in table 7.16 of Draft ES **Chapter 7: Water Environment**) will ensure the reduction of silt being transported to the existing water courses.

15.2.5 At this stage there is insufficient information available to accurately predict the amount of dewatering required at each relevant area of excavation or crossing and therefore a quantitative assessment of this is not possible and it will be provided post consent and prior to construction. It is being considered whether this will be secured via a DCO requirement.

15.2.6 Areas of effective infiltration along the pipeline route will be used as infiltration basins available as discharge points for the dewatering operations.

15.2.7 Areas of shallow groundwater along the pipeline route where groundwater flow has the potential to interact with the Hynet pipeline subsurface infrastructure have been identified in the baseline conditions within Draft ES **Chapter 7: Water Environment**. Works within the Draft Order Limits, such as pipeline installation have the potential to create barriers to groundwater flow or act as areas for preferential pathways. These areas are listed and screened in Table 7B.8 of Appendix 7B of the Draft ES **Chapter 7: Water Environment**.

15.2.8 Embedded environmental mitigation measures C5 and D5 (detailed in table 7.16 of Draft ES **Chapter 7: Water Environment** will apply in these instances.

15.2.9 Full details of these arrangements will set out in the Outline CEMP pre-submission and finalised post DCO consent.

15.3 Crossing Field Drainage Ditches or Small Watercourses Using Dry Open Cut Method

15.3.1 Most minor watercourse/ditch crossings may be carried out using a dry open cut trench methodology. In dry open cut methods water flow is maintained by damming and over pumping or using temporary “flume” pipes installed in the bed of the watercourse. Details of these methods are outlined below.

15.3.2 The site is first prepared by stripping the topsoil from the banks and areas adjacent to the river at the crossing point and storing it separately within the working area, taking care to exercise appropriate erosion prevention measures to avoid silt wash into the watercourse. If practicable the bed material and a selection of vegetation is stored, for replacement after the pipeline has been laid.

15.3.3 For dry open cut watercourses / ditch crossings a suitably sized flume pipe will be installed over the point of the proposed crossing ensuring that it extends on each side of the main pipeline trench line crossing point for a suitable distance. The flume pipe will then be bedded and packed or surrounded with soil filled sandbags to create a seal or dam across the watercourse, so that the flow is diverted through the flume pipes.

15.3.4 Excavation of the pipeline trench then proceeds beneath the flume pipe. The excavated material will be stored within the working width separately from the bank material.

15.3.5 If damming and over pumping method is adopted then soil filled sandbags can be used to create a seal or dam across the watercourse. However, a pump will be set up to take the flow from upstream to downstream of the crossing point. The discharge hose will be directed through a filtering medium to limit silt carry over or bed disturbance before the pumped water is returned to the watercourse.

15.3.6 After installation and backfilling of the hydrogen pipeline, the banks of the watercourse/drainage ditch will be reformed to their original profile in accordance with the EA / LLFA and the landowners’ requirements.

15.3.7 The flume pipe and packing or bags are removed once the bed materials and bank profile is reinstated.

15.3.8 The only exception to this might be locations where the water environment is particularly sensitive or of high value and where more detailed, site specific consideration may be required. These sites are identified in **Appendix 7B: Detailed Water Environment Baseline Information** to Draft ES **Chapter 7: Water Environment**. Additional site specific mitigation measures may be identified for these locations as appropriate for inclusion within the Outline CEMP.

15.3.9 In addition to the scrutiny afforded via the DCO application process, all watercourse crossings would be subject to the appropriate permit (either a Flood Risk Activities Permit from the Environment Agency for Main Rivers, or a Land Drainage Consent from the LLFA for Ordinary Watercourses). These permit applications would contain site specific detail for each crossing and would normally be applied for by the contractor post DCO consent.

15.4 Treatment of Agricultural Field Drains

15.4.1 To minimise impacts on surrounding agricultural land particular care will be taken to ensure that the existing land drainage regime is not compromised as a result of construction. Existing land drainage systems will be maintained and diverted as necessary during construction and reinstated on completion.

15.4.2 Field drains are often unrecorded but are an asset of high importance to landowners. It is therefore important to make every effort to, in consultation with landowners, confirm locations of field drainage systems, mark the existing positions of these for reinstatement after installation of the pipeline has been completed in the particular area.

15.4.3 It is the preference that the land drains are discontinued during pipeline installation to be reinstated on completion.

15.4.4 Unidentified field drains broken during the trenching operation will be physically marked for reconnection and reinstatement after completion of the pipeline laying operation in that area.

15.4.5 Reinstatement of the agricultural land drainage systems will be a requirement of the DCO.

15.4.6 The Outline CEMP for construction should therefore establish the overall approach to the diversion and reinstatement of agricultural land drainage.

HyNet North West Hydrogen Pipeline

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Appendix A
Indicative Drainage Layout Plans

PROPOSED HAGI COMPOUND ESTIMATED APPROXIMATE LEVEL = 10.820 mAoD

7645m² OF POROUS STONE BLANKET TO PROVIDE 690m³ OF ATTENUATION AT 300mm DEPTH

DISCHARGE TO AGREED CONNECTION POINT ON EXISTING SITE DRAINAGE SYSTEM

FULL BORE FLOW THROUGH 0.225M PIPE TO DISCHARGE AT 58l/s

PROPOSED FILTER TRENCH WITHIN STONED AREA

A5117 HIGHWAY

11.00
10.50
10.00
9.50
9.00
8.50
8.00

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.
2. 5M OUTSIDE OF SECURITY FENCE SHOULD BE CLEARED AND MAINTAINED FREE OF ALL UNNECESSARY VEGETATION.
3. MINIMUM PIPELINE COVER = 1200MM.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — Scale 1:500 @ A1 — 30 m

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HyNet North West Hydrogen Pipeline Project
HyNet Drainage Strategy Report

Appendix A1
Indicative Permanent HAGI Drainage Layout - Stanlow HPP

wsp

August 2024

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\807733-WSP-XX-XX-DR-D-000X-S0_P02.1 - Stanlow-Appendix - A7-Indicative - Permanent_HAGI_Drainage.dwg - Originator: UKJRN776

FULL BORE THROUGH
0.225m PIPE TO DISCHARGE
AT 99.5l/s

TEMPORARY
DISCHARGE FROM
HAGI SITE DURING
CONSTRUCTION

CATCHMENT AREA = 1.69 Ha
PROPOSED TEMPORARY
ATTENUATION BASIN TO
STORE 185m³

DISCHARGE TO AGREED
CONNECTION POINT ON
EXISTING SITE DRAINAGE
SYSTEM

CONNECTION TO
PROPOSED
PERMANENT
DRAINAGE

A5117 HIGHWAY

10.50
10.00
9.50
9.00
8.50
8.00

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Temporary Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- Proposed Permanent Surface Water Drain
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — Scale 1:500 @ A1 — 30 m

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HyNet Drainage Strategy Report

Appendix XX
Indicative Temporary HAGI Drainage
Layout - Stanlow HPP

wsp

August 2024

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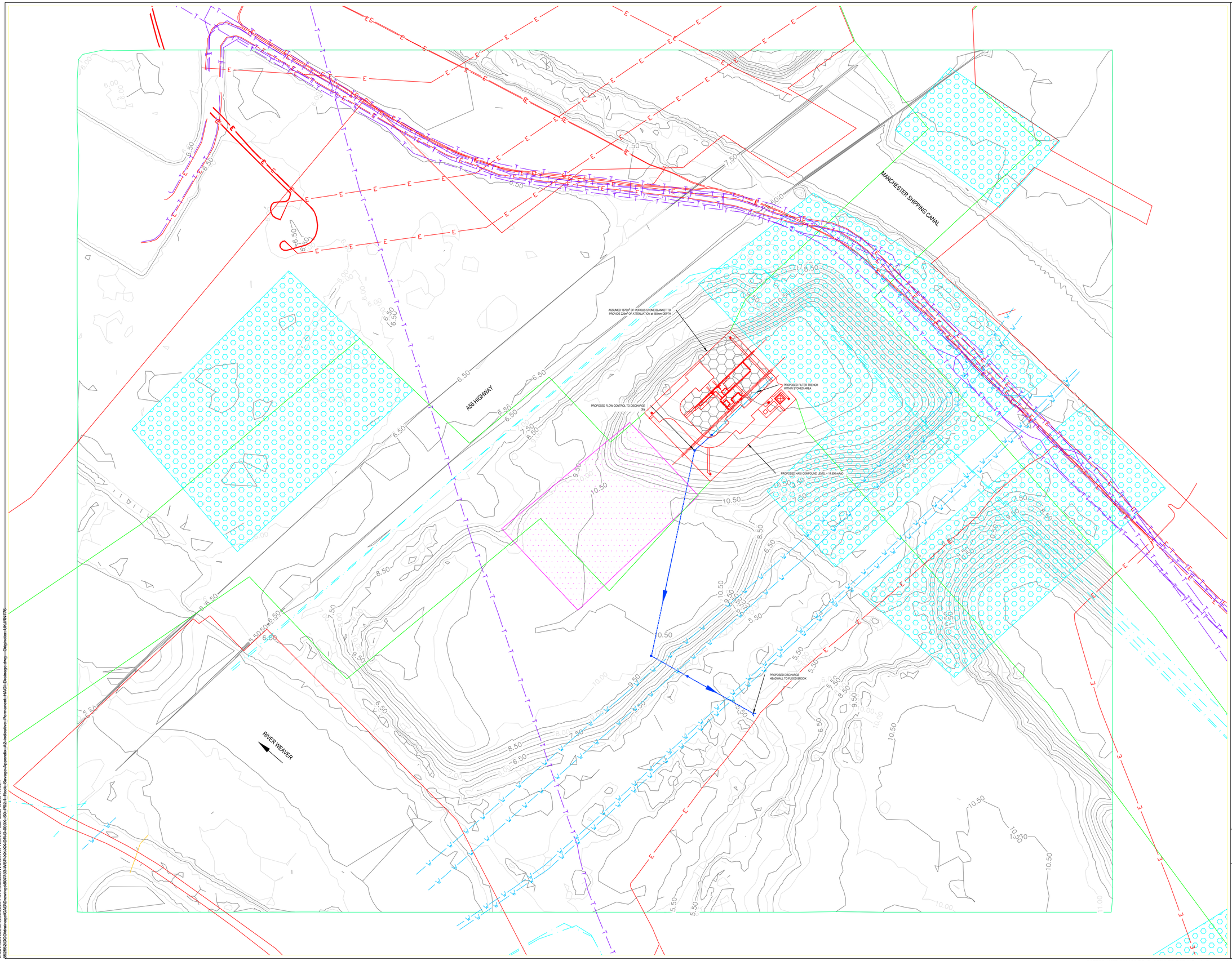
807624-GOS\Drawings\CAD\Drawings\807733-WSP-XX-XX-DR-D-000X_S0_P02.1_Stanlow-Appendix_A7-Indicative_Temporary_HAGI_Drainage.dwg - Originator: UK\RN776



NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.
2. 5M OUTSIDE OF SECURITY FENCE SHOULD BE CLEARED AND MAINTAINED FREE OF ALL UNNECESSARY VEGETATION.
3. MINIMUM PIPELINE COVER = 1200MM.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 50 m
Scale 1:1000 @ A1

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HyNet Drainage Strategy Report

Appendix A2
Indicative Permanent HAGI Drainage Layout - Rock Savage

September 2024

wsp

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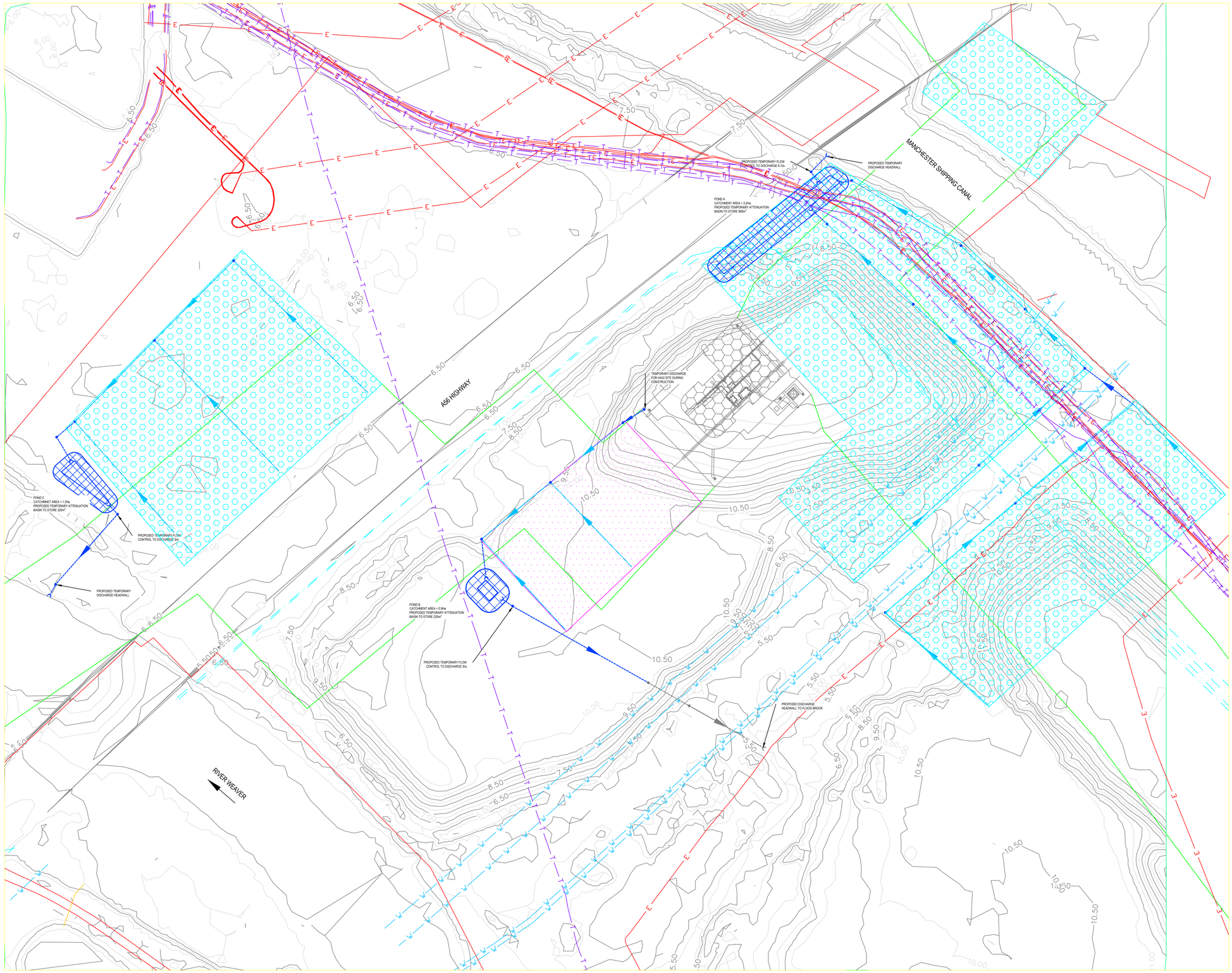
\\5566ADC\Drawings\CAD\Drawings\807733-WSP-XX-XX-DR-D-000X_S0_P02.1_Rock_Savage-Appendix_A2-Indicative_Permanent_HAGI_Drainage.dwg – Originator: UK/RN776



NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Temporary Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- Proposed Permanent Surface Water Drain
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 50 m

Scale 1:1000 @ A1

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Appendix XX
IndicativeTemporary HAGI Drainage Layout - Rock Savage

wsp

September 2024

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SABIC UK
PETROCHEMICALS
NORTHWEST PIPELINE

INDICATIVE POSITION OF
SURFACE WATER CUT OFF
BERM TO DIVERT OVERLAND
FLOW AROUND THE HAGI SITE

6060m² OF POROUS STONE
BLANKET TO PROVIDE 420m³ OF
ATTENUATION AT 300mm DEPTH

PROPOSED HAGI
COMPOUND ESTIMATED
APPROXIMATE
LEVEL =32.000 mAoD

PROPOSED FILTER TRENCH
WITHIN STONED AREA

EXISTING FOUL
SEWER TO BE
RELOCATED

CATCHPIT

PROPOSED FLOW
CONTROL TO
DISCHARGE 3.8l/s

PROPOSED DISCHARGE TO CONNECT
INTO EXISTING CADENT AGI SYSTEM.
LOCATION TO BE DETERMINED.

45.00
40.00
35.00
30.00

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.
2. 5M OUTSIDE OF SECURITY FENCE SHOULD BE CLEARED AND MAINTAINED FREE OF ALL UNNECESSARY VEGETATION.
3. MINIMUM PIPELINE COVER = 1200MM.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 25 m
Scale 1:500 @ A1

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HyNet North West Hydrogen Pipeline Project
HyNet Drainage Strategy Report

Appendix A3
Indicative Permanent HAGI Drainage
Layout - Runcorn

August 2024

wsp

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807733-WSP-XX-XX-DR-D-000X_S0_P02.1_Runcorn-Appendix_A3_Indicative_Permanent_HAGI_Drainage

POND A
CATCHMENT AREA = 1.6 Ha
PROPOSED TEMPORARY ATTENUATION BASIN TO STORE 400m³

PROPOSED FLOW CONTROL TO DISCHARGE 5l/s

SABIC UK PETROCHEMICALS NORTHWEST PIPELINE

EXISTING FOUL SEWER TO BE RELOCATED

PROPOSED TEMPORARY DISCHARGE FROM HAGI SITE DURING CONSTRUCTION

POND B
CATCHMENT AREA = 1.2 Ha
PROPOSED TEMPORARY STORAGE SWALE TO COLLECT RUNOFF FROM HAGI CONSTRUCTION SITE AND TO STORE 300m³

CONNECTION TO PROPOSED PERMANENT DRAINAGE

PROPOSED FLOW CONTROL TO DISCHARGE 8.8l/s

PROPOSED DISCHARGE TO CONNECT INTO EXISTING CADENT AGI SYSTEM. LOCATION TO BE DETERMINED.

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Temporary Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- Proposed Permanent Surface Water Drain
- E Electric Lines
- W Water Lines
- T Telecom Lines
- SS Sewer Lines
- Pipelines
- GAS Gas Lines

0 m — 40 m
Scale 1:750 @ A3

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Appendix AX
Indicative Temporary HAGI Drainage Layout - Runcorn

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wsp

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SABIC UK PETROCHEMICALS
NORTH WEST PIPELINE

ASSUMED 8925m² OF POROUS STONE
BLANKET TO PROVIDE 1200m³ OF
ATTENUATION AT 450mm DEPTH

PROPOSED FLOW
CONTROL TO
DISCHARGE 7.8l/s

PROPOSED HAGI
COMPOUND ESTIMATED
APPROXIMATE LEVEL =
47.360 mAoD

PROPOSED FILTER
TRENCH WITHIN
STONED AREA

PROPOSED HEADWALL
TO DRAINAGE DITCH

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.
2. 5M OUTSIDE OF SECURITY FENCE SHOULD BE CLEARED AND MAINTAINED FREE OF ALL UNNECESSARY VEGETATION.
3. MINIMUM PIPELINE COVER = 1200MM.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m 50 m
Scale 1:1,250 @ A1

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HyNet Drainage Strategy Report

Appendix A4
Indicative Permanent HAGI Drainage Layout - Central Hub

August 2024

wsp

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SABIC UK PETROCHEMICALS
NORTH WEST PIPELINE

TEMPORARY DISCHARGE FOR
HAGI SITE DURING
CONSTRUCTION

LINK TO PROPOSED PERMANENT
DISCHARGE PIPE

PROPOSED TEMPORARY FLOW
CONTROL TO DISCHARGE 16.1l/s

PROPOSED HEADWALL
TO DRAINAGE DITCH

POND A
CATCHMENT AREA = 3.45 Ha
PROPOSED TEMPORARY ATTENUATION
BASIN TO STORE 820m^3

POND B
CATCHMENT AREA = 1.78 Ha
PROPOSED TEMPORARY ATTENUATION
BASIN TO STORE 425m^3

PROPOSED TEMPORARY FLOW
CONTROL TO DISCHARGE 8.3l/s

DISCHARGE TO ASSUMED WATERCOURSE

POND C
CATCHMENT AREA = 9.07 Ha
PROPOSED TEMPORARY
ATTENUATION BASIN TO STORE
2150m^3

DISCHARGE TO ASSUMED WATERCOURSE

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Temporary Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- Proposed Permenant Surface Water Drain
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 50 m
Scale 1:1000 @ A1

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HyNet North West Hydrogen Pipeline Project
HyNet Drainage Strategy Report

Appendix A4
Indicative Temporary HAGI Drainage
Layout - Central Hub

August 2024

wsp

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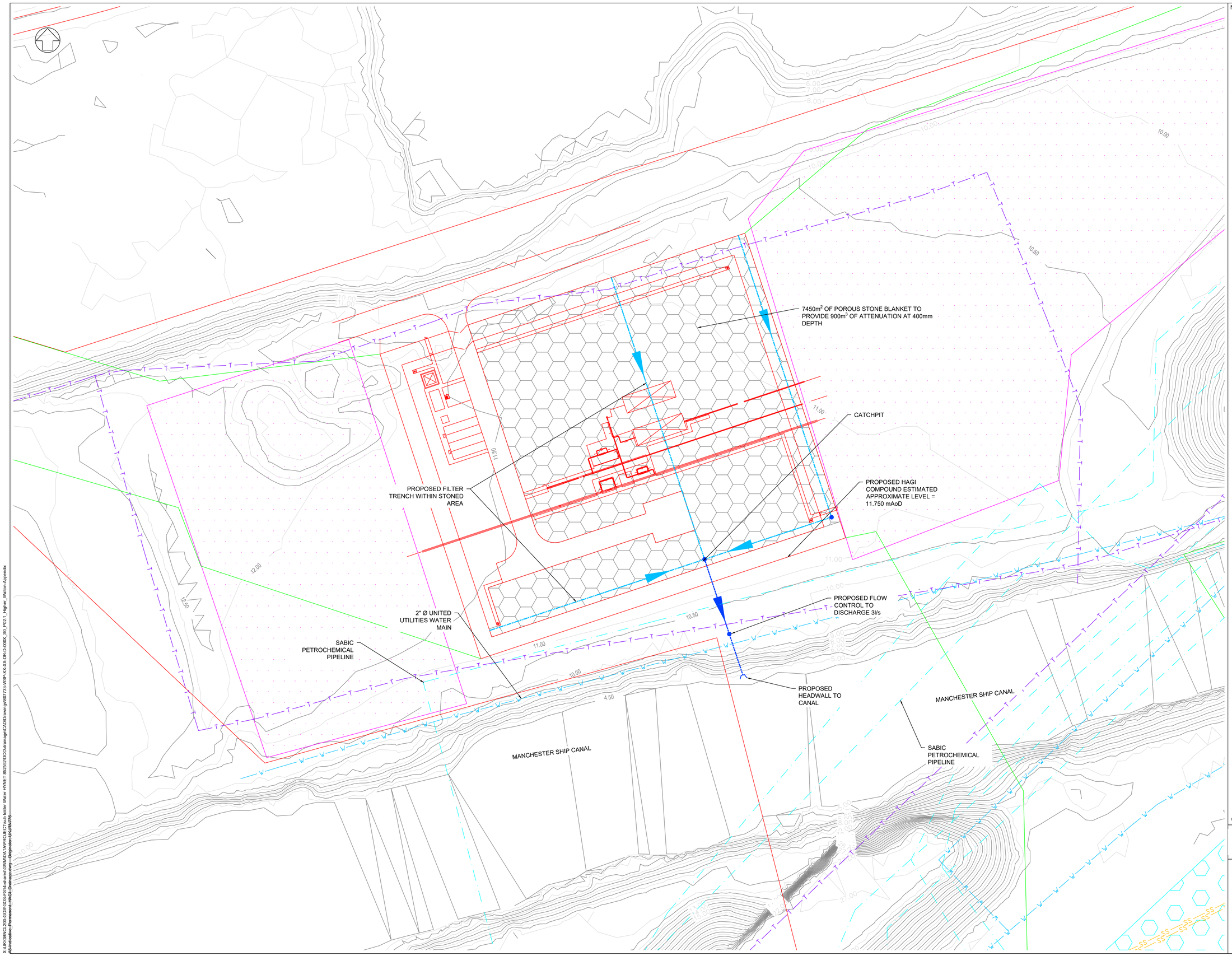

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.
2. 5M OUTSIDE OF SECURITY FENCE SHOULD BE CLEARED AND MAINTAINED FREE OF ALL UNNECESSARY VEGETATION.
3. MINIMUM PIPELINE COVER = 1200MM.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 30 m

Scale 1:500 @ A1

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HyNet Drainage Strategy Report

Appendix A5
Indicative Permanent HAGI Drainage Layout - Higher Walton 2

August 2024

wsp

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POND A
CATCHMENT AREA = 1.5Ha
PROPOSED TEMPORARY
ATTENUATION BASIN TO STORE 410m^3

PROPOSED
TEMPORARY
PACKAGE PUMP TO
DISCHARGE AT 3.6l/s

SABIC
PETROCHEMICAL
PIPELINE

TEMPORARY
DISCHARGE FOR
HAGI SITE DURING
CONSTRUCTION

LINK TO PROPOSED
PERMANENT DISCHARGE

PROPOSED HEADWALL TO
CANAL TO BE THE
PERMANENT DISCHARGE
POSITION FOR THE
OPERATIONAL SCHEME.
TO TEMPORARILY
DISCHARGE AT 7.6l/s

2" Ø UNITED
UTILITIES WATER
MAIN

PROPOSED FLOW CONTROL
TO DISCHARGE 4/s

MANCHESTER SHIP CANAL

POND B
CATCHMENT AREA = 1.7Ha
PROPOSED TEMPORARY
ATTENUATION BASIN TO STORE
470m^3

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Temporary Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- Proposed Permenant Surface Water Drain
- Proposed Temporary Surface Water Rising Main
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 30 m
Scale 1:500 @ A1

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HyNet Drainage Strategy Report

Appendix A5
Indicative Temporary HAGI Drainage Layout - Higher Walton 2

August 2024

wsp

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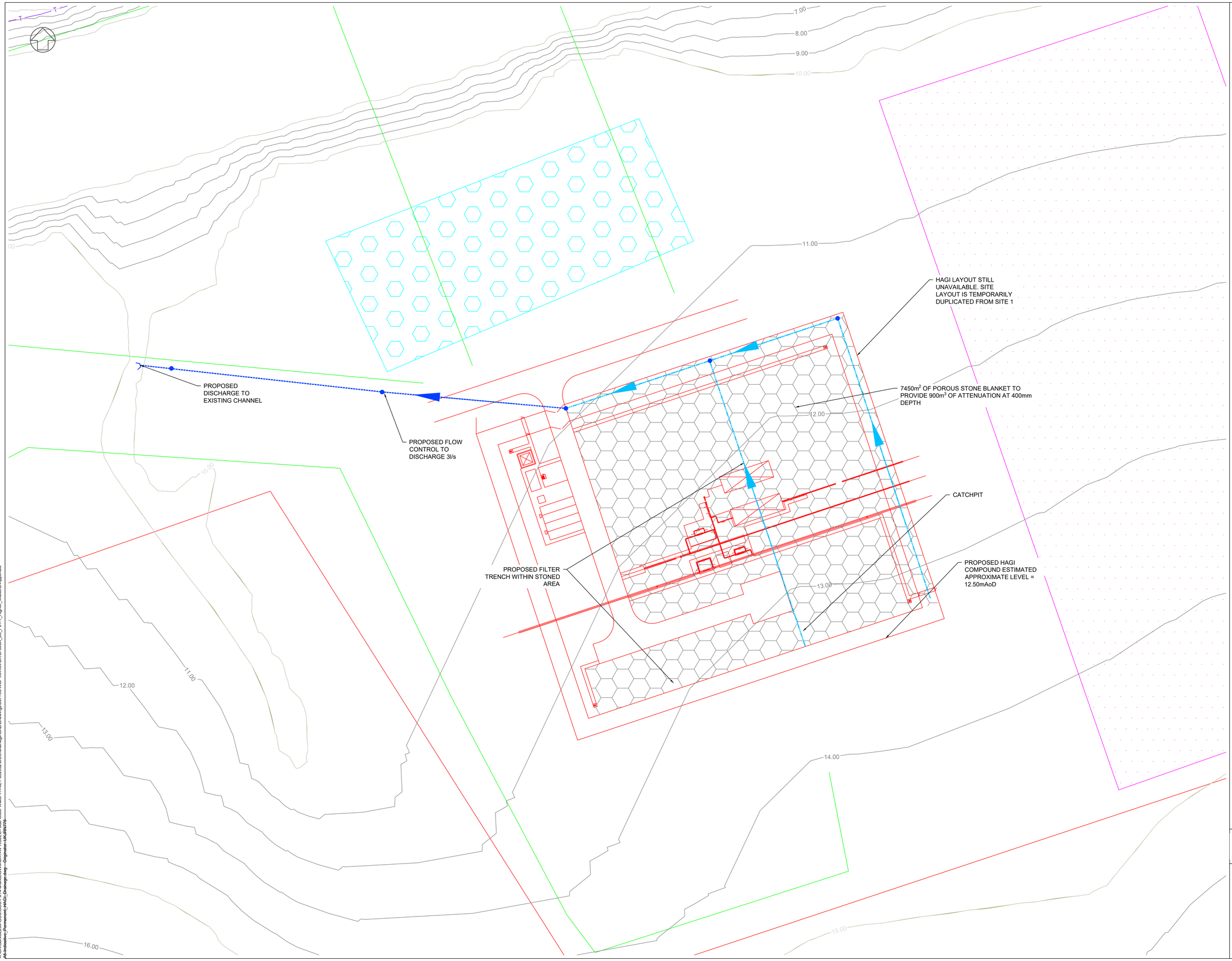

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.
2. 5M OUTSIDE OF SECURITY FENCE SHOULD BE CLEARED AND MAINTAINED FREE OF ALL UNNECESSARY VEGETATION.
3. MINIMUM PIPELINE COVER = 1200MM.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 30 m

Scale 1:500 @ A1

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Appendix A5
Indicative Permanent HAGI Drainage Layout - Higher Walton 8

wsp

September 2024

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PROPOSED FLOW CONTROL TO DISCHARGE 8.3l/s

LINK TO PROPOSED PERMANENT DISCHARGE PIPE

CATCHMENT AREA = 3.5 Ha
PROPOSED TEMPORARY ATTENUATION BASIN TO STORE 960m^3

PROPOSED DISCHARGE TO EXISTING CHANNEL

TEMPORARY DISCHARGE FROM HAGI SITE DURING CONSTRUCTION

HAGI LAYOUT STILL UNAVAILABLE. SITE LAYOUT IS TEMPORARILY DUPLICATED FROM SITE 1

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Temporary Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- Proposed Permenant Surface Water Drain
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m 50 m

Scale 1:500 @ A1

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Appendix A5
Indicative Temporary HAGI Drainage Layout - Higher Walton 8

September 2024

wsp

807733-WSP-XX-XX-DR-D-000X_S0_P01.1_Higher_Walton8-Appendix A5-Indicative_Temporary_HAGI_Drainage

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M62 HIGHWAY

DISCHARGE TO EXISTING CULVERT HEADWALL TO DRAIN UNDER MOTORWAY TO LAND DRAIN ON NORTHERN SIDE OF MOTORWAY

PROPOSED FLOW CONTROL TO DISCHARGE 9.1l/s

CATCHPIT

PROPOSED HAGI COMPOUND ESTIMATED APPROXIMATE LEVEL = 56.50 mAoD

5220m^2 OF POROUS STONE BLANKET TO PROVIDE 700m^3 OF ATTENUATION AT 450mm DEPTH

PROPOSED FILTER TRENCH WITHIN STONED AREA

B5419 HIGHWAY

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.
2. 5M OUTSIDE OF SECURITY FENCE SHOULD BE CLEARED AND MAINTAINED FREE OF ALL UNNECESSARY VEGETATION.
3. MINIMUM PIPELINE COVER = 1200MM.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 30 m

Scale 1:500 @ A1

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Appendix A6
Indicative Permanent HAGI Drainage - Clockface

August 2024

wsp

807733-WSP-XX-XX-DR-D-000X_S0_P02.1_Clockface-Appendix A6-Indicative_Permanent_HAGI_Drainage

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DISCHARGE TO EXISTING CULVERT HEADWALL TO DRAIN UNDER MOTORWAY TO LAND DRAIN ON NORTHERN SIDE OF MOTORWAY

M62 HIGHWAY

PROPOSED TEMPORARY FLOW CONTROL TO DISCHARGE 68.6l/s

CATCHMENT AREA = 9 Ha. PROPOSED TEMPORARY ATTENUATION BASIN TO STORE 1600m³

TEMPORARY DISCHARGE FOR HAGI SITE DURING CONSTRUCTION

B5419 HIGHWAY

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Temporary Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- Proposed Permanent Surface Water Drain
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 50 m

Scale 1:1000 @ A1

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HyNet Drainage Strategy Report

Appendix XX
Indicative Temporary HAGI Drainage - Clockface

August 2024

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CARRGREEN LANE

PROPOSED HAGI COMPOUND ESTIMATED APPROXIMATE LEVEL = 24.500 mAoD

DUNHAM ROAD

5580m² OF POROUS STONE BLANKET TO PROVIDE 755m³ OF ATTENUATION AT 450mm DEPTH

PROPOSED FILTER TRENCH WITHIN STONED AREA

CATCHPIT

PROPOSED FLOW CONTROL TO DISCHARGE 3l/s

TRANS PENNINE TRAIL

TRANS PENNINE TRAIL

REFER TO PLAN

PROPOSED OUTFALL HEADWALL DISCHARGE TO RIVER BOLLIN

REFER TO INSET

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.
2. 5M OUTSIDE OF SECURITY FENCE SHOULD BE CLEARED AND MAINTAINED FREE OF ALL UNNECESSARY VEGETATION.
3. MINIMUM PIPELINE COVER = 1200MM.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m 50 m

Scale 1:1000 @ A1

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HyNet Drainage Strategy Report

Appendix A7
Indicative Permanent HAGI Drainage Layout - Warburton

August 2024

wsp

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CARRGREEN LANE

PROPOSED HAGI COMPOUND ESTIMATED APPROXIMATE LEVEL = 24.500 mAoD

PROPOSED FILTER TRENCH WITHIN STONED AREA

DUNHAM ROAD

TEMPORARY DISCHARGE FOR HAGI SITE DURING CONSTRUCTION

CATCHMENT AREA = 1.72Ha
PROPOSED TEMPORARY ATTENUATION BASIN TO STORE 470m³

PROPOSED TEMPORARY FLOW CONTROL TO DISCHARGE AT 4.1l/s

TEMPORARY NETWORK TO TIE INTO PROPOSED PERMANENT DRAINAGE

TRANS PENNINE TRAIL

TRANS PENNINE TRAIL

REFER TO PLAN

REFER TO INSET

PROPOSED OUTFALL HEADWALL DISCHARGE TO RIVER BOLLIN

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.
2. 5M OUTSIDE OF SECURITY FENCE SHOULD BE CLEARED AND MAINTAINED FREE OF ALL UNNECESSARY VEGETATION.
3. MINIMUM PIPELINE COVER = 1200MM.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Temporary Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Permanent Surface Water Drain
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m 50 m
Scale 1:1000 @ A1

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Appendix A7
Indicative Temporary HAGI Drainage Layout - Warburton

August 2024

wsp

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PROPOSED DISCHARGE TO EXISTING SITE

PROPOSED FLOW CONTROL TO DISCHARGE 10.4l/s

3155 m² OF POROUS STONE BLANKET TO PROVIDE 660m³ OF ATTENUATION at 700mm DEPTH

PROPOSED HAGI COMPOUND LEVEL = 19.700 mAoD

CATCHPIT

PROPOSED FILTER TRENCH WITHIN STONED AREA

20.00

25.00

20.00

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.
2. 5M OUTSIDE OF SECURITY FENCE SHOULD BE CLEARED AND MAINTAINED FREE OF ALL UNNECESSARY VEGETATION.
3. MINIMUM PIPELINE COVER = 1200MM.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 30 m

Scale 1:500 @ A1

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HyNet Drainage Strategy Report

Appendix A8
Indicative Permanent HAGI Drainage Layout - Partington 1

September 2024

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Originator: LK-LRN776

PROPOSED DISCHARGE TO EXISTING SITE

PROPOSED FLOW CONTROL TO DISCHARGE 22.6l/s

CATCHMENT AREA = 2.2Ha. PROPOSED TEMPORARY ATTENUATION BASIN TO STORE 470m³

TEMPORARY DISCHARGE FROM HAGI SITE DURING CONSTRUCTION

20.00

20.00

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m 30 m

Scale 1:500 @ A1

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Appendix XX
Indicative Temporary HAGI Drainage Layout - Partington 1

wsp

September 2024

807733-WSP-XX-XX-DR-D-000X_S0_P01.1_Partington1-Appendix_XX-Indicative_Temporary_HAGI_Drainage

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Plotted on: 04/09/2024 09:47:16

PROPOSED HAGI COMPOUND ESTIMATED APPROXIMATE LEVEL = 20.50mAoD

HAGI LAYOUT STILL UNAVAILABLE. SITE LAYOUT IS TEMPORARILY DUPLICATED FROM SITE 1

3160m^2 OF POROUS STONE BLANKET TO PROVIDE 810m^3 OF ATTENUATION at 850mm DEPTH

PROPOSED FILTER TRENCH WITHIN STONED AREA

PROPOSED DISCHARGE TO DRAINAGE DITCH

CATCHPIT

PROPOSED FLOW CONTROL TO DISCHARGE 4.2l/s

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.
2. 5M OUTSIDE OF SECURITY FENCE SHOULD BE CLEARED AND MAINTAINED FREE OF ALL UNNECESSARY VEGETATION.
3. MINIMUM PIPELINE COVER = 1200MM.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 30 m

Scale 1:500 @ A1

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Appendix A8
Indicative Permanent HAGI Drainage Layout - Partington 2

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September 2024

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Engineer: UK-IRN776

HAGI LAYOUT STILL UNAVAILABLE. SITE LAYOUT IS TEMPORARILY DUPLICATED FROM SITE 1

TEMPORARY DISCHARGE FROM HAGI SITE DURING CONSTRUCTION

CATCHPIT

PROPOSED TEMPORARY ATTENUATION BASIN TO STORE 550m³

PROPOSED FLOW CONTROL TO DISCHARGE 8.4l/s

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Temporary Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 45 m

Scale 1:750 @ A1

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Appendix XX
Indicative Temporary HAGI Drainage Layout - Partington 2

August 2024

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Partington, UK, RN176

4140m² OF POROUS STONE BLANKET TO PROVIDE 690m³ OF ATTENUATION AT 550mm DEPTH

PROPOSED HAGI COMPOUND ESTIMATED APPROXIMATE LEVEL = 32.180 mAoD

CATCHPIT

PROPOSED FILTER TRENCH WITHIN STONED AREA

PROPOSED FLOW CONTROL TO DISCHARGE 5.6l/s

PUDDINGLAKE BROOK

PROPOSED HEADWALL TO DITCH

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.
2. 5M OUTSIDE OF SECURITY FENCE SHOULD BE CLEARED AND MAINTAINED FREE OF ALL UNNECESSARY VEGETATION.
3. MINIMUM PIPELINE COVER = 1200MM.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m 30 m

Scale 1:500 @ A1

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HyNet North West Hydrogen Pipeline Project
HyNet Drainage Strategy Report

Appendix A9
Indicative Permanent HAGI Drainage - Hydrogen Storage

August 2024

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POND C
CATCHMENT AREA = 1.8 Ha
PROPOSED TEMPORARY
ATTENUATION BASIN TO
STORE 410m³

PROPOSED TEMPORARY PACKAGE PUMP
TO DISCHARGE 11.8l/s

POND D
CATCHMENT AREA = 4Ha
PROPOSED TEMPORARY
ATTENUATION BASIN TO
STORE 920m³

PROPOSED FLOW CONTROL
TO DISCHARGE 37.2l/s

PROPOSED TEMPORARY
DISCHARGE POINT

POND B
CATCHMENT AREA = 7.1Ha
PROPOSED TEMPORARY
ATTENUATION BASIN TO
STORE 1620m³

PROPOSED FLOW
CONTROL TO
DISCHARGE 45.1l/s

POND A
CATCHMENT AREA = 2.6Ha
PROPOSED TEMPORARY
ATTENUATION BASIN TO
STORE 600m³

PROPOSED FLOW CONTROL
TO DISCHARGE 61.4l/s

CONNECTION TO PROPOSED
PERMANENT DRAINAGE OUTFALL

PUDDINGLAKE BROOK

A530

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

Key

- DCO Boundary
- Temporary Construction Compounds
- **Pipe Dump locations**
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Temporary Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- Proposed Permenant Surface Water Drain
- Proposed Temporary Surface Water Rising Main
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 100 m
Scale 1:2,000 @ A1

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HyNet North West Hydrogen Pipeline Project
HyNet Drainage Strategy Report

Appendix AX
Indicative Temporary HAGI Drainage - Hydrogen Storage

August 2024

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REFER TO INSET

DRAINAGE TO CONNECT TO EXISTING SEWER SHOULD INFILTRATION PROVE NON-VIABLE. TO BE OVERSIZED TO ACCOMODATE TEMPORARY DISCHARGE RATE.

PROPOSED FLOW CONTROL TO DISCHARGE 3.0l/s

PROPOSED FILTER TRENCH WITHIN STONED AREA

800m² OF POROUS STONE BLANKET TO PROVIDE 50m³ OF ATTENUATION AT 200mm DEPTH

PROPOSED HAGI COMPOUND ESTIMATED APPROXIMATE LEVEL = 72.85 mAoD

A50 HIGHWAY

69.00

70.00

71.00

72.00

REFER TO PLAN

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.
2. 5M OUTSIDE OF SECURITY FENCE SHOULD BE CLEARED AND MAINTAINED FREE OF ALL UNNECESSARY VEGETATION.
3. MINIMUM PIPELINE COVER = 1200MM.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m 30 m

Scale 1:500 @ A1

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HyNet Drainage Strategy Report

Appendix A10
Indicative Permanent Drainage Layout - Swarton Block Valve

August 2024

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POND A
CATCHMENT AREA = 3.9Ha
PROPOSED TEMPORARY
STORAGE BASIN TO STORE
820m^3

PROPOSED TEMPORARY PACKAGE PUMP
MAY BE REQUIRED SHOULD INFILTRATION
BE PROVEN NON-VIABLE TO DISCHARGE
25.1l/s

PROPOSED CONNECTION
TO PERMANENT
DRAINAGE

DRAINAGE TO CONNECT
TO EXISTING SEWER
SHOULD INFILTRATION
PROVE NON-VIABLE

PROPOSED TEMPORARY PACKAGE PUMP
MAY BE REQUIRED SHOULD INFILTRATION
BE PROVEN NON-VIABLE TO DISCHARGE
26l/s

POND B
CATCHMENT AREA = 4.05Ha
PROPOSED TEMPORARY
STORAGE BASIN TO STORE
850m^3

A50 HIGHWAY

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Temporary Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- Proposed Permanant Surface Water Drain
- Proposed Temporary Surface Water Rising Main
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 40 m
Scale 1:750 @ A3

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Appendix AX
Indicative Temporary Drainage Layout - Swarton Block Valve

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PROPOSED HEADWALL TO WATERCOURSE

PROPOSED HAGI COMPOUND ESTIMATED APPROXIMATE LEVEL = 41.380 mAoD

PROPOSED FILTER TRENCH WITHIN STONED AREA

PROPOSED FLOW CONTROL TO DISCHARGE 3.0l/s

700m² OF POROUS STONE BLANKET TO PROVIDE 45m³ OF ATTENUATION AT 200mm DEPTH

A556 HIGHWAY

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.
2. 5M OUTSIDE OF SECURITY FENCE SHOULD BE CLEARED AND MAINTAINED FREE OF ALL UNNECESSARY VEGETATION.
3. MINIMUM PIPELINE COVER = 1200MM.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 45 m

Scale 1:750 @ A1

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Appendix A11
Indicative Permanent HAGI Drainage Layout - Hartford Block Valve

August 2024

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2024\05\06\Drawings\807733-WSP-XX-XX-DR-D-0000X_S0_P02.1_SBV-Appendix_A11_Indicative_Permanent_HAGI_Drainage.dwg Originator: UKJRN776

PROPOSED TEMPORARY PACKAGE PUMP
MAY BE REQUIRED SHOULD INFILTRATION BE
PROVEN NON-VIABLE TO DISCHARGE 5.6l/s

CATCHMENT AREA - 2.8Ha.
PROPOSED TEMPORARY TEMPORARY
ATTENUATION BASIN TO STORE 810m^3

PROPOSED HEADWALL TO WATERCOURSE

CONNECTION TO PROPOSED
PERMANENT DRAINAGE

A556 HIGHWAY

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Temporary Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- Proposed Porous Blanket (TYPE - 3 Granular Material)
- Proposed Permanent Surface Water Drain
- Proposed Temporary Surface Water Rising Main
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 30 m
Scale 1:500 @ A1

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HyNet Drainage Strategy Report

Appendix A11
Indicative Temporary HAGI Drainage
Layout - Hartford Block Valve

August 2024

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HyNet North West Hydrogen Pipeline

Delivering clean growth

Appendix B
Greenfield Runoff Calculations

Brownfield Runoff Rate

The existing ‘brownfield’ runoff rate has been estimated using the BS EN 752 calculation method and assuming a rainfall intensity of 50mm/hr.

The impermeable area of the original site was measured at a total area of 1.9 ha. The runoff from this area would be approximately 2.781 x 1.9 ha x 50mm/h = 264l/s - this would approximate the brown field runoff rate from the existing site.

Proposed discharge rate

To offer a 30% degree of betterment on the existing situation, a surface water discharge rate of 70% of the brownfield rate i.e., 264 x 0.7 = 185 l/s, is proposed as the restricted flow from the site to the public system.

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Arun Millar
Site name:	Rocksavage
Site location:	

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	
Longitude:	
Reference:	3499645947
Date:	Aug 01 2024 14:56

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha): 1

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	0.704
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.11

Hydrological characteristics

	Default	Edited
SAAR (mm):	0	0762
Hydrological region:	1	1
Growth curve factor 1 year:	-	0.85
Growth curve factor 30 years:	-	1.95
Growth curve factor 100 years:	-	2.48
Growth curve factor 200 years:	-	2.84

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):		1.9
1 in 1 year (l/s):		1.62
1 in 30 years (l/s):		3.71
1 in 100 year (l/s):		4.72
1 in 200 years (l/s):		5.41

This report was produced using the greenfield runoff tool developed by HR Wallingford and available at www.uksuds.com. The use of this tool is subject to the UK SuDS terms and conditions and licence agreement , which can both be found at www.uksuds.com/terms-and-conditions.htm. The outputs from this tool are estimates of greenfield runoff rates. The use of these results is the responsibility of the users of this tool. No liability will be accepted by HR Wallingford, the Environment Agency, CEH, Hydrosolutions or any other organisation for the use of this data in the design or operational characteristics of any drainage scheme.

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Arun Millar
Site name:	Runcorn
Site location:	

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	
Longitude:	
Reference:	3412945253
Date:	Aug 01 2024 14:32

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha): 1

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	0.589
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.11

Hydrological characteristics

	Default	Edited
SAAR (mm):	0	776
Hydrological region:	1	1
Growth curve factor 1 year:	-	0.85
Growth curve factor 30 years:	-	1.95
Growth curve factor 100 years:	-	2.48
Growth curve factor 200 years:	-	2.84

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):		3.14
1 in 1 year (l/s):		2.67
1 in 30 years (l/s):		6.13
1 in 100 year (l/s):		7.8
1 in 200 years (l/s):		8.93

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Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Arun Millar
Site name:	Central Hub
Site location:	

Site Details

Latitude:	
Longitude:	
Reference:	2146381471
Date:	Aug 01 2024 14:12

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha): 1

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	0.469
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.11

Hydrological characteristics

	Default	Edited
SAAR (mm):	0	0790
Hydrological region:	1	1
Growth curve factor 1 year:	-	0.85
Growth curve factor 30 years:	-	1.95
Growth curve factor 100 years:	-	2.48
Growth curve factor 200 years:	-	2.84

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):		4.85
1 in 1 year (l/s):		4.12
1 in 30 years (l/s):		9.46
1 in 100 year (l/s):		12.03
1 in 200 years (l/s):		13.78

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Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Arun Millar
Site name:	Higher Walton
Site location:	

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	
Longitude:	
Reference:	911793276
Date:	Aug 01 2024 14:21

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha): 1

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	0.69
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.11

Hydrological characteristics

	Default	Edited
SAAR (mm):	0	816
Hydrological region:	1	1
Growth curve factor 1 year:	-	0.85
Growth curve factor 30 years:	-	1.95
Growth curve factor 100 years:	-	2.48
Growth curve factor 200 years:	-	2.84

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):		2.38
1 in 1 year (l/s):		2.02
1 in 30 years (l/s):		4.64
1 in 100 year (l/s):		5.9
1 in 200 years (l/s):		6.75

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Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Arun Millar
Site name:	Clock Face
Site location:	

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	
Longitude:	
Reference:	3736553680
Date:	Aug 01 2024 14:17

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha): 1

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	0.371
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.11

Hydrological characteristics

	Default	Edited
SAAR (mm):	0	862
Hydrological region:	1	1
Growth curve factor 1 year:	-	0.85
Growth curve factor 30 years:	-	1.95
Growth curve factor 100 years:	-	2.48
Growth curve factor 200 years:	-	2.84

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):		7.62
1 in 1 year (l/s):		6.48
1 in 30 years (l/s):		14.86
1 in 100 year (l/s):		18.9
1 in 200 years (l/s):		21.65

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Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Arun Millar
Site name:	Warburton
Site location:	

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	
Longitude:	
Reference:	1227958261
Date:	Aug 01 2024 14:34

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha): 1

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	0.69
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.11

Hydrological characteristics

	Default	Edited
SAAR (mm):	0	816
Hydrological region:	1	1
Growth curve factor 1 year:	-	0.85
Growth curve factor 30 years:	-	1.95
Growth curve factor 100 years:	-	2.48
Growth curve factor 200 years:	-	2.84

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):		2.38
1 in 1 year (l/s):		2.02
1 in 30 years (l/s):		4.64
1 in 100 year (l/s):		5.9
1 in 200 years (l/s):		6.75

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Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Arun Millar
Site name:	Partington
Site location:	

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	
Longitude:	
Reference:	1841025085
Date:	Aug 01 2024 14:27

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha): 1

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	0.578
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.11

Hydrological characteristics

	Default	Edited
SAAR (mm):	0	827
Hydrological region:	1	1
Growth curve factor 1 year:	-	0.85
Growth curve factor 30 years:	-	1.95
Growth curve factor 100 years:	-	2.48
Growth curve factor 200 years:	-	2.84

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):		3.8
1 in 1 year (l/s):		3.23
1 in 30 years (l/s):		7.4
1 in 100 year (l/s):		9.42
1 in 200 years (l/s):		10.78

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Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Arun Millar
Site name:	Innovyn HAGI
Site location:	

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	
Longitude:	
Reference:	1590392877
Date:	Aug 01 2024 14:24

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha): 1

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	0.328
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.11

Hydrological characteristics

	Default	Edited
SAAR (mm):	0	765
Hydrological region:	1	1
Growth curve factor 1 year:	-	0.85
Growth curve factor 30 years:	-	1.95
Growth curve factor 100 years:	-	2.48
Growth curve factor 200 years:	-	2.84

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):		6.35
1 in 1 year (l/s):		5.39
1 in 30 years (l/s):		12.38
1 in 100 year (l/s):		15.74
1 in 200 years (l/s):		18.03

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Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Arun Millar
Site name:	EBV
Site location:	

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	
Longitude:	
Reference:	4246534825
Date:	Aug 01 2024 14:19

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha): 1

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	0.409
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.11

Hydrological characteristics

	Default	Edited
SAAR (mm):	0	832
Hydrological region:	1	1
Growth curve factor 1 year:	-	0.85
Growth curve factor 30 years:	-	1.95
Growth curve factor 100 years:	-	2.48
Growth curve factor 200 years:	-	2.84

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

Default Edited

Q_{BAR} (l/s):		6.43
1 in 1 year (l/s):		5.47
1 in 30 years (l/s):		12.54
1 in 100 year (l/s):		15.95
1 in 200 years (l/s):		18.27

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Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Arun Millar
Site name:	SBV
Site location:	

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	
Longitude:	
Reference:	2863272125
Date:	Aug 01 2024 14:33

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha): 1

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	0.793
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.11

Hydrological characteristics

	Default	Edited
SAAR (mm):	0	804
Hydrological region:	1	1
Growth curve factor 1 year:	-	0.85
Growth curve factor 30 years:	-	1.95
Growth curve factor 100 years:	-	2.48
Growth curve factor 200 years:	-	2.84

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):		1.44
1 in 1 year (l/s):		1.22
1 in 30 years (l/s):		2.8
1 in 100 year (l/s):		3.56
1 in 200 years (l/s):		4.08

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HyNet North West Hydrogen Pipeline

Delivering clean growth

Appendix C
Attenuation Storage Calculations

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 91 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	99.862	0.162	0.0	58.4	58.4	370.9	Flood Risk
30 min Summer	99.907	0.207	0.0	58.4	58.4	471.9	Flood Risk
60 min Summer	99.934	0.234	0.0	58.4	58.4	533.7	Flood Risk
120 min Summer	99.926	0.226	0.0	58.4	58.4	517.2	Flood Risk
180 min Summer	99.915	0.215	0.0	58.4	58.4	490.7	Flood Risk
240 min Summer	99.902	0.202	0.0	58.4	58.4	461.9	Flood Risk
360 min Summer	99.875	0.175	0.0	58.4	58.4	399.4	Flood Risk
480 min Summer	99.847	0.147	0.0	58.4	58.4	335.8	Flood Risk
600 min Summer	99.821	0.121	0.0	58.4	58.4	275.9	Flood Risk
720 min Summer	99.796	0.096	0.0	58.4	58.4	220.4	Flood Risk
960 min Summer	99.756	0.056	0.0	58.4	58.4	129.0	Flood Risk
1440 min Summer	99.710	0.010	0.0	58.4	58.4	21.8	Flood Risk
2160 min Summer	99.700	0.000	0.0	48.0	48.0	0.0	O K
2880 min Summer	99.700	0.000	0.0	37.7	37.7	0.0	O K
4320 min Summer	99.700	0.000	0.0	27.0	27.0	0.0	O K
5760 min Summer	99.700	0.000	0.0	21.5	21.5	0.0	O K
15 min Winter	99.887	0.187	0.0	58.4	58.4	427.5	Flood Risk
30 min Winter	99.939	0.239	0.0	58.4	58.4	545.1	Flood Risk
60 min Winter	99.974	0.274	0.0	58.4	58.4	625.9	Flood Risk
120 min Winter	99.970	0.270	0.0	58.4	58.4	616.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	144.884	0.0	419.4	18
30 min Summer	95.120	0.0	562.0	32
60 min Summer	59.740	0.0	713.8	60
120 min Summer	35.786	0.0	868.8	98
180 min Summer	26.380	0.0	963.1	130
240 min Summer	21.170	0.0	1031.9	164
360 min Summer	15.418	0.0	1129.4	232
480 min Summer	12.251	0.0	1194.2	298
600 min Summer	10.223	0.0	1248.2	362
720 min Summer	8.803	0.0	1288.2	422
960 min Summer	6.934	0.0	1353.1	540
1440 min Summer	4.929	0.0	1436.6	752
2160 min Summer	3.501	0.0	1525.0	0
2880 min Summer	2.753	0.0	1591.5	0
4320 min Summer	1.978	0.0	1698.4	0
5760 min Summer	1.578	0.0	1790.5	0
15 min Winter	144.884	0.0	476.2	18
30 min Winter	95.120	0.0	634.0	32
60 min Winter	59.740	0.0	806.9	60
120 min Winter	35.786	0.0	978.8	112

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Summary of Results for 100 year Return Period (+45%)

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	99.953	0.253	0.0	58.4	58.4	578.1	Flood Risk
240 min Winter	99.934	0.234	0.0	58.4	58.4	535.5	Flood Risk
360 min Winter	99.892	0.192	0.0	58.4	58.4	438.7	Flood Risk
480 min Winter	99.849	0.149	0.0	58.4	58.4	341.1	Flood Risk
600 min Winter	99.810	0.110	0.0	58.4	58.4	250.8	Flood Risk
720 min Winter	99.775	0.075	0.0	58.4	58.4	170.5	Flood Risk
960 min Winter	99.721	0.021	0.0	58.4	58.4	48.9	Flood Risk
1440 min Winter	99.700	0.000	0.0	48.9	48.9	0.0	O K
2160 min Winter	99.700	0.000	0.0	34.6	34.6	0.0	O K
2880 min Winter	99.700	0.000	0.0	27.2	27.2	0.0	O K
4320 min Winter	99.700	0.000	0.0	19.5	19.5	0.0	O K
5760 min Winter	99.700	0.000	0.0	15.5	15.5	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
180 min Winter	26.380	0.0	1078.6	140
240 min Winter	21.170	0.0	1158.5	178
360 min Winter	15.418	0.0	1266.3	252
480 min Winter	12.251	0.0	1342.7	322
600 min Winter	10.223	0.0	1400.9	386
720 min Winter	8.803	0.0	1448.1	444
960 min Winter	6.934	0.0	1520.7	548
1440 min Winter	4.929	0.0	1618.3	0
2160 min Winter	3.501	0.0	1716.7	0
2880 min Winter	2.753	0.0	1792.5	0
4320 min Winter	1.978	0.0	1915.1	0
5760 min Winter	1.578	0.0	2021.3	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 344827 374941 SJ 44827 74941
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+45

Time Area Diagram

Total Area (ha) 1.690

Time (mins) From:	To:	Area (ha)
0	4	1.690

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	68.0
Membrane Percolation (mm/hr)	1000	Length (m)	112.0
Max Percolation (l/s)	2115.6	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	99.700	Cap Volume Depth (m)	0.300

Pipe Outflow Control

Diameter (m)	0.225	Entry Loss Coefficient	0.500
Slope (1:X)	200.0	Coefficient of Contraction	0.600
Length (m)	100.000	Upstream Invert Level (m)	98.850
Roughness k (mm)	0.600		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.689	0.689	99.5	183.4	O K
30 min Summer	99.617	0.617	99.5	160.6	O K
60 min Summer	99.508	0.508	99.5	128.0	O K
120 min Summer	99.326	0.326	99.5	76.7	O K
180 min Summer	99.170	0.170	99.5	38.0	O K
240 min Summer	99.065	0.065	99.5	13.8	O K
360 min Summer	99.000	0.000	91.3	0.0	O K
480 min Summer	99.000	0.000	72.3	0.0	O K
600 min Summer	99.000	0.000	60.4	0.0	O K
720 min Summer	99.000	0.000	52.1	0.0	O K
960 min Summer	99.000	0.000	41.8	0.0	O K
1440 min Summer	99.000	0.000	30.7	0.0	O K
2160 min Summer	99.000	0.000	22.5	0.0	O K
2880 min Summer	99.000	0.000	18.1	0.0	O K
4320 min Summer	99.000	0.000	13.2	0.0	O K
5760 min Summer	99.000	0.000	10.5	0.0	O K
7200 min Summer	99.000	0.000	8.8	0.0	O K
8640 min Summer	99.000	0.000	7.6	0.0	O K
10080 min Summer	99.000	0.000	6.8	0.0	O K
15 min Winter	99.692	0.692	99.5	184.7	O K
30 min Winter	99.611	0.611	99.5	158.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	130.184	0.0	274.5	16
30 min Summer	74.254	0.0	313.1	25
60 min Summer	42.353	0.0	356.8	42
120 min Summer	24.157	0.0	408.1	74
180 min Summer	17.395	0.0	440.6	104
240 min Summer	13.779	0.0	465.6	168
360 min Summer	9.922	0.0	503.0	0
480 min Summer	7.859	0.0	531.3	0
600 min Summer	6.560	0.0	554.3	0
720 min Summer	5.659	0.0	573.8	0
960 min Summer	4.544	0.0	614.3	0
1440 min Summer	3.335	0.0	676.3	0
2160 min Summer	2.447	0.0	744.5	0
2880 min Summer	1.965	0.0	797.0	0
4320 min Summer	1.429	0.0	869.6	0
5760 min Summer	1.140	0.0	925.1	0
7200 min Summer	0.957	0.0	970.6	0
8640 min Summer	0.830	0.0	1009.4	0
10080 min Summer	0.735	0.0	1043.4	0
15 min Winter	130.184	0.0	274.5	16
30 min Winter	74.254	0.0	313.1	26

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.462	0.462	99.5	113.7	O K
120 min Winter	99.178	0.178	99.5	40.0	O K
180 min Winter	99.006	0.006	99.5	1.2	O K
240 min Winter	99.000	0.000	81.8	0.0	O K
360 min Winter	99.000	0.000	58.9	0.0	O K
480 min Winter	99.000	0.000	46.7	0.0	O K
600 min Winter	99.000	0.000	38.9	0.0	O K
720 min Winter	99.000	0.000	33.6	0.0	O K
960 min Winter	99.000	0.000	27.0	0.0	O K
1440 min Winter	99.000	0.000	19.8	0.0	O K
2160 min Winter	99.000	0.000	14.5	0.0	O K
2880 min Winter	99.000	0.000	11.7	0.0	O K
4320 min Winter	99.000	0.000	8.5	0.0	O K
5760 min Winter	99.000	0.000	6.8	0.0	O K
7200 min Winter	99.000	0.000	5.7	0.0	O K
8640 min Winter	99.000	0.000	4.9	0.0	O K
10080 min Winter	99.000	0.000	4.4	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	42.353	0.0	357.7	44
120 min Winter	24.157	0.0	407.8	76
180 min Winter	17.395	0.0	440.8	170
240 min Winter	13.779	0.0	465.7	0
360 min Winter	9.922	0.0	503.0	0
480 min Winter	7.859	0.0	531.3	0
600 min Winter	6.560	0.0	554.3	0
720 min Winter	5.659	0.0	573.8	0
960 min Winter	4.544	0.0	614.3	0
1440 min Winter	3.335	0.0	676.3	0
2160 min Winter	2.447	0.0	744.5	0
2880 min Winter	1.965	0.0	797.0	0
4320 min Winter	1.429	0.0	869.6	0
5760 min Winter	1.140	0.0	925.1	0
7200 min Winter	0.957	0.0	970.6	0
8640 min Winter	0.830	0.0	1009.4	0
10080 min Winter	0.735	0.0	1043.4	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 345850 373850 SJ 45850 73850
C (1km)	-0.025
D1 (1km)	0.305
D2 (1km)	0.352
D3 (1km)	0.330
E (1km)	0.290
F (1km)	2.412
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.690

Time (mins) From:	To:	Area (ha)
0	4	1.690

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 99.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	209.0	1.000	391.0

Pipe Outflow Control

Diameter (m)	0.225	Entry Loss Coefficient	0.500
Slope (1:X)	10.0	Coefficient of Contraction	0.600
Length (m)	10.000	Upstream Invert Level (m)	99.000
Roughness k (mm)	0.600		

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Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 672 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	99.696	0.196	0.0	3.0	3.0	97.3	O K
30 min Summer	99.758	0.258	0.0	3.0	3.0	128.5	Flood Risk
60 min Summer	99.817	0.317	0.0	3.0	3.0	157.8	Flood Risk
120 min Summer	99.867	0.367	0.0	3.0	3.0	182.5	Flood Risk
180 min Summer	99.892	0.392	0.0	3.0	3.0	194.9	Flood Risk
240 min Summer	99.905	0.405	0.0	3.0	3.0	201.3	Flood Risk
360 min Summer	99.912	0.412	0.0	3.0	3.0	204.9	Flood Risk
480 min Summer	99.905	0.405	0.0	3.0	3.0	201.7	Flood Risk
600 min Summer	99.892	0.392	0.0	3.0	3.0	195.2	Flood Risk
720 min Summer	99.880	0.380	0.0	3.0	3.0	189.0	Flood Risk
960 min Summer	99.858	0.358	0.0	3.0	3.0	178.3	Flood Risk
1440 min Summer	99.824	0.324	0.0	3.0	3.0	161.1	Flood Risk
2160 min Summer	99.777	0.277	0.0	3.0	3.0	138.0	Flood Risk
2880 min Summer	99.736	0.236	0.0	3.0	3.0	117.2	Flood Risk
4320 min Summer	99.664	0.164	0.0	3.0	3.0	81.7	O K
5760 min Summer	99.608	0.108	0.0	3.0	3.0	53.5	O K
15 min Winter	99.722	0.222	0.0	3.0	3.0	110.3	Flood Risk
30 min Winter	99.793	0.293	0.0	3.0	3.0	145.6	Flood Risk
60 min Winter	99.860	0.360	0.0	3.0	3.0	179.1	Flood Risk
120 min Winter	99.918	0.418	0.0	3.0	3.0	208.0	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	144.362	0.0	99.7	19
30 min Summer	94.598	0.0	133.2	34
60 min Summer	58.740	0.0	167.4	64
120 min Summer	35.126	0.0	201.7	122
180 min Summer	25.907	0.0	223.8	182
240 min Summer	20.815	0.0	240.3	242
360 min Summer	15.198	0.0	263.7	362
480 min Summer	12.115	0.0	280.6	480
600 min Summer	10.140	0.0	293.5	550
720 min Summer	8.757	0.0	304.1	606
960 min Summer	6.933	0.0	320.8	724
1440 min Summer	4.986	0.0	345.5	984
2160 min Summer	3.584	0.0	371.0	1388
2880 min Summer	2.840	0.0	390.7	1788
4320 min Summer	2.056	0.0	420.8	2552
5760 min Summer	1.642	0.0	444.2	3288
15 min Winter	144.362	0.0	112.6	19
30 min Winter	94.598	0.0	150.3	33
60 min Winter	58.740	0.0	188.6	62
120 min Winter	35.126	0.0	227.0	120

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Summary of Results for 100 year Return Period (+45%)

	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	99.949	0.449	0.0	3.0	3.0	223.3	Flood Risk
240	min Winter	99.966	0.466	0.0	3.0	3.0	231.9	Flood Risk
360	min Winter	99.980	0.480	0.0	3.0	3.0	238.8	Flood Risk
480	min Winter	99.979	0.479	0.0	3.0	3.0	238.4	Flood Risk
600	min Winter	99.970	0.470	0.0	3.0	3.0	234.0	Flood Risk
720	min Winter	99.956	0.456	0.0	3.0	3.0	227.1	Flood Risk
960	min Winter	99.924	0.424	0.0	3.0	3.0	211.1	Flood Risk
1440	min Winter	99.878	0.378	0.0	3.0	3.0	188.0	Flood Risk
2160	min Winter	99.809	0.309	0.0	3.0	3.0	153.6	Flood Risk
2880	min Winter	99.745	0.245	0.0	3.0	3.0	121.7	Flood Risk
4320	min Winter	99.637	0.137	0.0	3.0	3.0	68.0	O K
5760	min Winter	99.557	0.057	0.0	3.0	3.0	28.5	O K

	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
180	min Winter	25.907	0.0	251.8	180
240	min Winter	20.815	0.0	270.3	238
360	min Winter	15.198	0.0	296.4	352
480	min Winter	12.115	0.0	315.5	466
600	min Winter	10.140	0.0	330.0	574
720	min Winter	8.757	0.0	342.0	680
960	min Winter	6.933	0.0	361.0	772
1440	min Winter	4.986	0.0	388.7	1070
2160	min Winter	3.584	0.0	417.6	1516
2880	min Winter	2.840	0.0	439.3	1932
4320	min Winter	2.056	0.0	473.7	2728
5760	min Winter	1.642	0.0	501.1	3352

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 352854 379250 SJ 52854 79250
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.400

Time (mins) From:	To:	Area (ha)
0	4	0.400

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	31.0
Membrane Percolation (mm/hr)	1000	Length (m)	53.5
Max Percolation (l/s)	460.7	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	99.500	Cap Volume Depth (m)	0.500

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0082-3000-1000-3000
Design Head (m)	1.000
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	82
Invert Level (m)	99.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.0	Kick-Flo®	0.623	2.4
Flush-Flo™	0.297	3.0	Mean Flow over Head Range	-	2.6

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	2.4	1.200	3.3	3.000	5.0	7.000	7.4
0.200	2.9	1.400	3.5	3.500	5.4	7.500	7.7
0.300	3.0	1.600	3.7	4.000	5.7	8.000	7.9
0.400	2.9	1.800	3.9	4.500	6.0	8.500	8.2
0.500	2.8	2.000	4.1	5.000	6.3	9.000	8.4
0.600	2.5	2.200	4.3	5.500	6.6	9.500	8.6
0.800	2.7	2.400	4.5	6.000	6.9		
1.000	3.0	2.600	4.7	6.500	7.2		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	98.899	0.899	6.1	391.5	O K
30 min Summer	99.108	1.108	6.1	509.7	O K
60 min Summer	99.295	1.295	6.1	625.1	O K
120 min Summer	99.454	1.454	6.1	730.3	O K
180 min Summer	99.541	1.541	6.1	790.7	O K
240 min Summer	99.595	1.595	6.1	829.8	O K
360 min Summer	99.655	1.655	6.1	873.8	O K
480 min Summer	99.681	1.681	6.1	893.3	O K
600 min Summer	99.689	1.689	6.1	899.1	O K
720 min Summer	99.685	1.685	6.1	896.0	O K
960 min Summer	99.654	1.654	6.1	873.0	O K
1440 min Summer	99.568	1.568	6.1	810.2	O K
2160 min Summer	99.475	1.475	6.1	745.1	O K
2880 min Summer	99.402	1.402	6.1	695.4	O K
4320 min Summer	99.271	1.271	6.1	609.6	O K
5760 min Summer	99.148	1.148	6.1	533.7	O K
15 min Winter	98.899	0.899	6.1	391.5	O K
30 min Winter	99.108	1.108	6.1	509.6	O K
60 min Winter	99.295	1.295	6.1	625.1	O K
120 min Winter	99.455	1.455	6.1	731.0	O K
180 min Winter	99.542	1.542	6.1	792.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	99.560	0.0	385.6	19
30 min Summer	65.240	0.0	421.0	34
60 min Summer	40.510	0.0	643.9	64
120 min Summer	24.225	0.0	766.8	124
180 min Summer	17.867	0.0	838.7	184
240 min Summer	14.355	0.0	868.6	242
360 min Summer	10.482	0.0	882.3	362
480 min Summer	8.355	0.0	889.1	482
600 min Summer	6.993	0.0	895.2	602
720 min Summer	6.039	0.0	901.3	722
960 min Summer	4.781	0.0	913.6	960
1440 min Summer	3.438	0.0	930.4	1240
2160 min Summer	2.471	0.0	1420.9	1600
2880 min Summer	1.959	0.0	1500.2	1992
4320 min Summer	1.418	0.0	1599.7	2812
5760 min Summer	1.133	0.0	1739.0	3632
15 min Winter	99.560	0.0	385.6	19
30 min Winter	65.240	0.0	420.9	33
60 min Winter	40.510	0.0	643.9	64
120 min Winter	24.225	0.0	766.8	122
180 min Winter	17.867	0.0	838.5	180

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	99.598	1.598	6.1	831.8	O K
360 min Winter	99.659	1.659	6.1	876.6	O K
480 min Winter	99.687	1.687	6.1	897.4	O K
600 min Winter	99.696	1.696	6.1	904.7	O K
720 min Winter	99.695	1.695	6.1	903.6	O K
960 min Winter	99.671	1.671	6.1	885.5	O K
1440 min Winter	99.585	1.585	6.1	822.4	O K
2160 min Winter	99.468	1.468	6.1	740.1	O K
2880 min Winter	99.368	1.368	6.1	672.5	O K
4320 min Winter	99.167	1.167	6.1	544.9	O K
5760 min Winter	98.968	0.968	6.1	429.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	14.355	0.0	868.0	240
360 min Winter	10.482	0.0	880.8	356
480 min Winter	8.355	0.0	887.0	472
600 min Winter	6.993	0.0	892.3	588
720 min Winter	6.039	0.0	897.3	702
960 min Winter	4.781	0.0	907.2	926
1440 min Winter	3.438	0.0	928.0	1344
2160 min Winter	2.471	0.0	1420.9	1668
2880 min Winter	1.959	0.0	1500.5	2108
4320 min Winter	1.418	0.0	1616.9	2988
5760 min Winter	1.133	0.0	1739.1	3856

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 352854 379250 SJ 52854 79250
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 3.200

Time (mins) From:	To:	Area (ha)
0	4	3.200

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	339.9	2.000	845.1

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0101-6100-2000-6100
Design Head (m)	2.000
Design Flow (l/s)	6.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	101
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	6.1	Kick-Flo®	0.908	4.2
Flush-Flo™	0.444	5.3	Mean Flow over Head Range	-	4.9

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	3.4	1.200	4.8	3.000	7.4	7.000	11.0
0.200	4.8	1.400	5.2	3.500	7.9	7.500	11.4
0.300	5.2	1.600	5.5	4.000	8.4	8.000	11.7
0.400	5.3	1.800	5.8	4.500	8.9	8.500	12.1
0.500	5.3	2.000	6.1	5.000	9.4	9.000	12.4
0.600	5.2	2.200	6.4	5.500	9.8	9.500	12.7
0.800	4.8	2.400	6.6	6.000	10.2		
1.000	4.4	2.600	6.9	6.500	10.6		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.138	1.138	3.0	108.7	O K
30 min Summer	99.324	1.324	3.0	140.8	O K
60 min Summer	99.478	1.478	3.0	171.0	O K
120 min Summer	99.592	1.592	3.0	195.9	O K
180 min Summer	99.646	1.646	3.0	208.4	O K
240 min Summer	99.674	1.674	3.0	214.9	O K
360 min Summer	99.687	1.687	3.0	218.1	O K
480 min Summer	99.672	1.672	3.0	214.4	O K
600 min Summer	99.641	1.641	3.0	207.2	O K
720 min Summer	99.612	1.612	3.0	200.5	O K
960 min Summer	99.563	1.563	3.0	189.4	O K
1440 min Summer	99.483	1.483	3.0	172.0	O K
2160 min Summer	99.368	1.368	3.0	149.0	O K
2880 min Summer	99.255	1.255	3.0	128.3	O K
4320 min Summer	99.032	1.032	3.0	92.4	O K
5760 min Summer	98.813	0.813	3.0	63.4	O K
15 min Winter	99.138	1.138	3.0	108.7	O K
30 min Winter	99.325	1.325	3.0	140.9	O K
60 min Winter	99.478	1.478	3.0	171.1	O K
120 min Winter	99.594	1.594	3.0	196.4	O K
180 min Winter	99.650	1.650	3.0	209.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	99.560	0.0	111.9	19
30 min Summer	65.240	0.0	146.6	34
60 min Summer	40.510	0.0	182.3	64
120 min Summer	24.225	0.0	217.9	122
180 min Summer	17.867	0.0	241.1	182
240 min Summer	14.355	0.0	258.3	242
360 min Summer	10.482	0.0	282.9	362
480 min Summer	8.355	0.0	300.7	480
600 min Summer	6.993	0.0	314.6	574
720 min Summer	6.039	0.0	326.0	622
960 min Summer	4.781	0.0	344.1	742
1440 min Summer	3.438	0.0	371.1	996
2160 min Summer	2.471	0.0	400.4	1408
2880 min Summer	1.959	0.0	423.0	1816
4320 min Summer	1.418	0.0	459.3	2596
5760 min Summer	1.133	0.0	489.3	3456
15 min Winter	99.560	0.0	111.9	19
30 min Winter	65.240	0.0	146.6	33
60 min Winter	40.510	0.0	182.2	62
120 min Winter	24.225	0.0	217.9	120
180 min Winter	17.867	0.0	241.2	180

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	99.678	1.678	3.0	216.0	O K
360 min Winter	99.695	1.695	3.0	220.0	O K
480 min Winter	99.685	1.685	3.0	217.5	O K
600 min Winter	99.660	1.660	3.0	211.5	O K
720 min Winter	99.626	1.626	3.0	203.6	O K
960 min Winter	99.562	1.562	3.0	189.2	O K
1440 min Winter	99.456	1.456	3.0	166.5	O K
2160 min Winter	99.282	1.282	3.0	133.1	O K
2880 min Winter	99.099	1.099	3.0	102.5	O K
4320 min Winter	98.714	0.714	3.0	52.2	O K
5760 min Winter	98.312	0.312	3.0	17.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	14.355	0.0	258.3	238
360 min Winter	10.482	0.0	282.9	352
480 min Winter	8.355	0.0	300.7	464
600 min Winter	6.993	0.0	314.6	572
720 min Winter	6.039	0.0	326.0	674
960 min Winter	4.781	0.0	344.1	760
1440 min Winter	3.438	0.0	371.1	1066
2160 min Winter	2.471	0.0	400.4	1496
2880 min Winter	1.959	0.0	423.0	1904
4320 min Winter	1.418	0.0	459.3	2640
5760 min Winter	1.133	0.0	489.3	3288

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 352854 379250 SJ 52854 79250
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.900

Time (mins) From:	To:	Area (ha)
0	4	0.900

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	43.4	2.000	296.6

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0070-3000-2000-3000
Design Head (m)	2.000
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	70
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	3.0	Kick-Flo®	0.630	1.8
Flush-Flo™	0.310	2.2	Mean Flow over Head Range	-	2.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.8	1.200	2.4	3.000	3.6	7.000	5.4
0.200	2.1	1.400	2.5	3.500	3.9	7.500	5.6
0.300	2.2	1.600	2.7	4.000	4.1	8.000	5.7
0.400	2.2	1.800	2.9	4.500	4.4	8.500	5.9
0.500	2.1	2.000	3.0	5.000	4.6	9.000	6.1
0.600	1.9	2.200	3.1	5.500	4.8	9.500	6.2
0.800	2.0	2.400	3.3	6.000	5.0		
1.000	2.2	2.600	3.4	6.500	5.2		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.051	1.051	3.0	146.0	O K
30 min Summer	99.245	1.245	3.0	189.7	O K
60 min Summer	99.410	1.410	3.0	231.7	O K
120 min Summer	99.542	1.542	3.0	268.6	O K
180 min Summer	99.609	1.609	3.0	288.7	O K
240 min Summer	99.649	1.649	3.0	300.9	O K
360 min Summer	99.685	1.685	3.0	312.3	O K
480 min Summer	99.692	1.692	3.0	314.5	O K
600 min Summer	99.683	1.683	3.0	311.5	O K
720 min Summer	99.663	1.663	3.0	305.3	O K
960 min Summer	99.611	1.611	3.0	289.3	O K
1440 min Summer	99.536	1.536	3.0	266.9	O K
2160 min Summer	99.445	1.445	3.0	241.2	O K
2880 min Summer	99.361	1.361	3.0	218.8	O K
4320 min Summer	99.200	1.200	3.0	179.1	O K
5760 min Summer	99.044	1.044	3.0	144.7	O K
15 min Winter	99.051	1.051	3.0	146.0	O K
30 min Winter	99.245	1.245	3.0	189.7	O K
60 min Winter	99.410	1.410	3.0	231.7	O K
120 min Winter	99.543	1.543	3.0	269.0	O K
180 min Winter	99.612	1.612	3.0	289.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	99.560	0.0	148.5	19
30 min Summer	65.240	0.0	183.6	34
60 min Summer	40.510	0.0	242.9	64
120 min Summer	24.225	0.0	290.4	124
180 min Summer	17.867	0.0	321.1	182
240 min Summer	14.355	0.0	344.0	242
360 min Summer	10.482	0.0	376.5	362
480 min Summer	8.355	0.0	399.5	482
600 min Summer	6.993	0.0	415.7	600
720 min Summer	6.039	0.0	423.6	720
960 min Summer	4.781	0.0	429.9	858
1440 min Summer	3.438	0.0	429.8	1084
2160 min Summer	2.471	0.0	533.7	1476
2880 min Summer	1.959	0.0	563.9	1876
4320 min Summer	1.418	0.0	612.2	2684
5760 min Summer	1.133	0.0	652.4	3464
15 min Winter	99.560	0.0	148.5	19
30 min Winter	65.240	0.0	183.5	33
60 min Winter	40.510	0.0	242.8	62
120 min Winter	24.225	0.0	290.4	122
180 min Winter	17.867	0.0	321.2	180

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	99.652	1.652	3.0	301.9	O K
360 min Winter	99.690	1.690	3.0	313.9	O K
480 min Winter	99.700	1.700	3.0	317.0	O K
600 min Winter	99.694	1.694	3.0	315.1	O K
720 min Winter	99.678	1.678	3.0	310.1	O K
960 min Winter	99.630	1.630	3.0	295.0	O K
1440 min Winter	99.533	1.533	3.0	266.0	O K
2160 min Winter	99.411	1.411	3.0	231.9	O K
2880 min Winter	99.283	1.283	3.0	199.0	O K
4320 min Winter	99.020	1.020	3.0	139.8	O K
5760 min Winter	98.753	0.753	3.0	90.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	14.355	0.0	344.0	238
360 min Winter	10.482	0.0	376.5	354
480 min Winter	8.355	0.0	399.4	470
600 min Winter	6.993	0.0	415.1	584
720 min Winter	6.039	0.0	421.6	694
960 min Winter	4.781	0.0	427.9	906
1440 min Winter	3.438	0.0	430.5	1126
2160 min Winter	2.471	0.0	533.7	1580
2880 min Winter	1.959	0.0	563.9	2020
4320 min Winter	1.418	0.0	612.3	2856
5760 min Winter	1.133	0.0	652.3	3584

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 352854 379250 SJ 52854 79250
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.200

Time (mins) From:	To:	Area (ha)
0	4	1.200

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	79.0	2.000	381.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0070-3000-2000-3000
Design Head (m)	2.000
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	70
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	3.0	Kick-Flo®	0.630	1.8
Flush-Flo™	0.310	2.2	Mean Flow over Head Range	-	2.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.8	1.200	2.4	3.000	3.6	7.000	5.4
0.200	2.1	1.400	2.5	3.500	3.9	7.500	5.6
0.300	2.2	1.600	2.7	4.000	4.1	8.000	5.7
0.400	2.2	1.800	2.9	4.500	4.4	8.500	5.9
0.500	2.1	2.000	3.0	5.000	4.6	9.000	6.1
0.600	1.9	2.200	3.1	5.500	4.8	9.500	6.2
0.800	2.0	2.400	3.3	6.000	5.0		
1.000	2.2	2.600	3.4	6.500	5.2		

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Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 1913 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	99.658	0.158	0.0	3.8	3.8	287.3	O K
30 min Summer	99.712	0.212	0.0	3.8	3.8	384.2	Flood Risk
60 min Summer	99.764	0.264	0.0	3.8	3.8	479.7	Flood Risk
120 min Summer	99.813	0.313	0.0	3.8	3.8	568.0	Flood Risk
180 min Summer	99.842	0.342	0.0	3.8	3.8	621.0	Flood Risk
240 min Summer	99.862	0.362	0.0	3.8	3.8	656.9	Flood Risk
360 min Summer	99.887	0.387	0.0	3.8	3.8	701.7	Flood Risk
480 min Summer	99.900	0.400	0.0	3.8	3.8	726.4	Flood Risk
600 min Summer	99.908	0.408	0.0	3.8	3.8	740.5	Flood Risk
720 min Summer	99.912	0.412	0.0	3.8	3.8	747.7	Flood Risk
960 min Summer	99.912	0.412	0.0	3.8	3.8	748.0	Flood Risk
1440 min Summer	99.898	0.398	0.0	3.8	3.8	722.0	Flood Risk
2160 min Summer	99.869	0.369	0.0	3.8	3.8	670.2	Flood Risk
2880 min Summer	99.849	0.349	0.0	3.8	3.8	632.8	Flood Risk
4320 min Summer	99.817	0.317	0.0	3.8	3.8	574.3	Flood Risk
5760 min Summer	99.789	0.289	0.0	3.8	3.8	523.6	Flood Risk
15 min Winter	99.680	0.180	0.0	3.8	3.8	325.8	O K
30 min Winter	99.739	0.239	0.0	3.8	3.8	434.5	Flood Risk
60 min Winter	99.799	0.299	0.0	3.8	3.8	542.2	Flood Risk
120 min Winter	99.854	0.354	0.0	3.8	3.8	643.2	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	142.680	0.0	287.7	19
30 min Summer	93.525	0.0	277.2	34
60 min Summer	58.087	0.0	491.0	64
120 min Summer	34.677	0.0	571.4	124
180 min Summer	25.564	0.0	570.2	184
240 min Summer	20.536	0.0	571.2	244
360 min Summer	15.000	0.0	575.3	362
480 min Summer	11.964	0.0	581.0	482
600 min Summer	10.022	0.0	585.7	602
720 min Summer	8.664	0.0	589.1	722
960 min Summer	6.870	0.0	593.5	962
1440 min Summer	4.954	0.0	598.1	1430
2160 min Summer	3.567	0.0	1097.8	1752
2880 min Summer	2.830	0.0	1134.3	2108
4320 min Summer	2.050	0.0	1056.9	2900
5760 min Summer	1.639	0.0	1312.6	3752
15 min Winter	142.680	0.0	282.6	19
30 min Winter	93.525	0.0	276.0	34
60 min Winter	58.087	0.0	553.6	64
120 min Winter	34.677	0.0	570.7	122

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Summary of Results for 100 year Return Period (+45%)

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	99.888	0.388	0.0	3.8	3.8	704.2	Flood Risk
240 min Winter	99.911	0.411	0.0	3.8	3.8	746.3	Flood Risk
360 min Winter	99.941	0.441	0.0	3.8	3.8	799.7	Flood Risk
480 min Winter	99.958	0.458	0.0	3.8	3.8	830.9	Flood Risk
600 min Winter	99.969	0.469	0.0	3.8	3.8	850.7	Flood Risk
720 min Winter	99.975	0.475	0.0	3.8	3.8	862.4	Flood Risk
960 min Winter	99.980	0.480	0.0	3.8	3.8	870.6	Flood Risk
1440 min Winter	99.973	0.473	0.0	3.8	3.8	858.2	Flood Risk
2160 min Winter	99.942	0.442	0.0	3.8	3.8	802.6	Flood Risk
2880 min Winter	99.913	0.413	0.0	3.8	3.8	748.5	Flood Risk
4320 min Winter	99.867	0.367	0.0	3.8	3.8	666.2	Flood Risk
5760 min Winter	99.824	0.324	0.0	3.8	3.8	588.1	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
180 min Winter	25.564	0.0	573.8	182
240 min Winter	20.536	0.0	578.9	240
360 min Winter	15.000	0.0	589.1	358
480 min Winter	11.964	0.0	596.0	476
600 min Winter	10.022	0.0	600.2	592
720 min Winter	8.664	0.0	603.3	708
960 min Winter	6.870	0.0	606.5	936
1440 min Winter	4.954	0.0	607.5	1386
2160 min Winter	3.567	0.0	1175.4	2012
2880 min Winter	2.830	0.0	1159.2	2276
4320 min Winter	2.050	0.0	1112.8	3160
5760 min Winter	1.639	0.0	1482.7	4096

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 352287 380052 SJ 52287 80052
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+45

Time Area Diagram

Total Area (ha) 1.200

Time (mins) From:	To:	Area (ha)
0	4	1.200

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	72.0
Membrane Percolation (mm/hr)	1000	Length (m)	84.0
Max Percolation (l/s)	1680.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	99.500	Cap Volume Depth (m)	0.500

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0092-3800-1000-3800
Design Head (m)	1.000
Design Flow (l/s)	3.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	92
Invert Level (m)	99.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.8	Kick-Flo®	0.632	3.1
Flush-Flo™	0.298	3.8	Mean Flow over Head Range	-	3.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.9	1.200	4.1	3.000	6.3	7.000	9.5
0.200	3.7	1.400	4.4	3.500	6.8	7.500	9.8
0.300	3.8	1.600	4.7	4.000	7.3	8.000	10.1
0.400	3.7	1.800	5.0	4.500	7.7	8.500	10.4
0.500	3.6	2.000	5.2	5.000	8.1	9.000	10.7
0.600	3.3	2.200	5.5	5.500	8.4	9.500	10.9
0.800	3.4	2.400	5.7	6.000	8.8		
1.000	3.8	2.600	5.9	6.500	9.1		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.065	1.065	5.0	191.3	O K
30 min Summer	99.269	1.269	5.0	248.0	O K
60 min Summer	99.441	1.441	5.0	301.6	O K
120 min Summer	99.570	1.570	5.0	345.7	O K
180 min Summer	99.633	1.633	5.0	368.4	O K
240 min Summer	99.666	1.666	5.0	380.7	O K
360 min Summer	99.686	1.686	5.0	388.3	O K
480 min Summer	99.675	1.675	5.0	384.1	O K
600 min Summer	99.646	1.646	5.0	373.2	O K
720 min Summer	99.614	1.614	5.0	361.5	O K
960 min Summer	99.562	1.562	5.0	342.9	O K
1440 min Summer	99.478	1.478	5.0	314.0	O K
2160 min Summer	99.360	1.360	5.0	275.8	O K
2880 min Summer	99.246	1.246	5.0	241.3	O K
4320 min Summer	99.022	1.022	5.0	180.3	O K
5760 min Summer	98.808	0.808	5.0	129.8	O K
15 min Winter	99.065	1.065	5.0	191.3	O K
30 min Winter	99.269	1.269	5.0	248.1	O K
60 min Winter	99.441	1.441	5.0	301.8	O K
120 min Winter	99.572	1.572	5.0	346.6	O K
180 min Winter	99.637	1.637	5.0	369.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	98.400	0.0	196.2	19
30 min Summer	64.500	0.0	257.0	34
60 min Summer	40.060	0.0	320.3	64
120 min Summer	23.915	0.0	382.2	122
180 min Summer	17.630	0.0	422.7	182
240 min Summer	14.163	0.0	452.9	242
360 min Summer	10.345	0.0	496.2	362
480 min Summer	8.251	0.0	527.6	480
600 min Summer	6.912	0.0	552.5	596
720 min Summer	5.975	0.0	573.1	644
960 min Summer	4.738	0.0	605.8	760
1440 min Summer	3.417	0.0	654.4	1038
2160 min Summer	2.460	0.0	708.5	1408
2880 min Summer	1.951	0.0	749.2	1820
4320 min Summer	1.414	0.0	814.2	2596
5760 min Summer	1.131	0.0	868.2	3352
15 min Winter	98.400	0.0	196.2	19
30 min Winter	64.500	0.0	257.0	33
60 min Winter	40.060	0.0	320.2	62
120 min Winter	23.915	0.0	382.2	120
180 min Winter	17.630	0.0	422.8	180

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Summary of Results for 100 year Return Period

	Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240	min Winter	99.671	1.671	5.0	382.5	O K
360	min Winter	99.695	1.695	5.0	391.4	O K
480	min Winter	99.688	1.688	5.0	389.0	O K
600	min Winter	99.666	1.666	5.0	380.5	O K
720	min Winter	99.633	1.633	5.0	368.5	O K
960	min Winter	99.562	1.562	5.0	342.9	O K
1440	min Winter	99.456	1.456	5.0	306.5	O K
2160	min Winter	99.280	1.280	5.0	251.3	O K
2880	min Winter	99.097	1.097	5.0	199.7	O K
4320	min Winter	98.725	0.725	5.0	112.2	O K
5760	min Winter	98.364	0.364	5.0	47.7	O K

	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240	min Winter	14.163	0.0	452.9	238
360	min Winter	10.345	0.0	496.2	352
480	min Winter	8.251	0.0	527.6	466
600	min Winter	6.912	0.0	552.5	574
720	min Winter	5.975	0.0	573.0	680
960	min Winter	4.738	0.0	605.8	772
1440	min Winter	3.417	0.0	654.6	1070
2160	min Winter	2.460	0.0	708.5	1516
2880	min Winter	1.951	0.0	749.2	1932
4320	min Winter	1.414	0.0	814.3	2748
5760	min Winter	1.131	0.0	868.2	3352

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 352287 380052 SJ 52287 80052
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.600

Time (mins) From:	To:	Area (ha)
0	4	1.600

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	109.6	2.000	445.4

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0092-5000-2000-5000
Design Head (m)	2.000
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	92
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	5.0	Kick-Flo®	0.816	3.3
Flush-Flo™	0.398	4.1	Mean Flow over Head Range	-	3.9

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	2.9	1.200	3.9	3.000	6.0	7.000	9.0
0.200	3.8	1.400	4.2	3.500	6.5	7.500	9.3
0.300	4.1	1.600	4.5	4.000	6.9	8.000	9.6
0.400	4.1	1.800	4.8	4.500	7.3	8.500	9.9
0.500	4.1	2.000	5.0	5.000	7.7	9.000	10.2
0.600	4.0	2.200	5.2	5.500	8.0	9.500	10.4
0.800	3.4	2.400	5.4	6.000	8.4		
1.000	3.6	2.600	5.6	6.500	8.7		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.093	1.093	8.8	141.4	O K
30 min Summer	99.290	1.290	8.8	184.0	O K
60 min Summer	99.454	1.454	8.8	224.2	O K
120 min Summer	99.578	1.578	8.8	257.6	O K
180 min Summer	99.638	1.638	8.8	274.5	O K
240 min Summer	99.669	1.669	8.8	283.7	O K
360 min Summer	99.688	1.688	8.8	289.3	O K
480 min Summer	99.667	1.667	8.8	283.1	O K
600 min Summer	99.630	1.630	8.8	272.4	O K
720 min Summer	99.594	1.594	8.8	262.0	O K
960 min Summer	99.527	1.527	8.8	243.3	O K
1440 min Summer	99.400	1.400	8.8	210.4	O K
2160 min Summer	99.196	1.196	8.8	163.0	O K
2880 min Summer	99.018	1.018	8.8	126.9	O K
4320 min Summer	98.090	0.090	8.8	6.7	O K
5760 min Summer	98.000	0.000	7.4	0.0	O K
15 min Winter	99.093	1.093	8.8	141.5	O K
30 min Winter	99.292	1.292	8.8	184.3	O K
60 min Winter	99.457	1.457	8.8	225.0	O K
120 min Winter	99.583	1.583	8.8	258.8	O K
180 min Winter	99.644	1.644	8.8	276.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	98.400	0.0	507.7	19
30 min Summer	64.500	0.0	553.7	34
60 min Summer	40.060	0.0	736.1	64
120 min Summer	23.915	0.0	782.8	122
180 min Summer	17.630	0.0	813.1	182
240 min Summer	14.163	0.0	835.7	242
360 min Summer	10.345	0.0	868.3	362
480 min Summer	8.251	0.0	891.9	480
600 min Summer	6.912	0.0	910.6	536
720 min Summer	5.975	0.0	926.0	588
960 min Summer	4.738	0.0	950.7	704
1440 min Summer	3.417	0.0	987.8	956
2160 min Summer	2.460	0.0	1027.6	1344
2880 min Summer	1.951	0.0	1058.2	1760
4320 min Summer	1.414	0.0	1107.0	2396
5760 min Summer	1.131	0.0	1147.4	0
15 min Winter	98.400	0.0	507.8	19
30 min Winter	64.500	0.0	553.6	33
60 min Winter	40.060	0.0	736.2	62
120 min Winter	23.915	0.0	782.8	122
180 min Winter	17.630	0.0	813.2	180

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Summary of Results for 100 year Return Period

	Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240	min Winter	99.677	1.677	8.8	286.0	O K
360	min Winter	99.699	1.699	8.8	292.6	O K
480	min Winter	99.682	1.682	8.8	287.7	O K
600	min Winter	99.649	1.649	8.8	277.7	O K
720	min Winter	99.604	1.604	8.8	264.9	O K
960	min Winter	99.522	1.522	8.8	242.2	O K
1440	min Winter	99.352	1.352	8.8	198.6	O K
2160	min Winter	99.041	1.041	8.8	131.2	O K
2880	min Winter	98.762	0.762	8.8	83.0	O K
4320	min Winter	98.014	0.014	8.8	1.0	O K
5760	min Winter	98.000	0.000	6.1	0.0	O K

	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240	min Winter	14.163	0.0	835.7	238
360	min Winter	10.345	0.0	868.3	352
480	min Winter	8.251	0.0	891.9	462
600	min Winter	6.912	0.0	910.6	566
720	min Winter	5.975	0.0	926.0	638
960	min Winter	4.738	0.0	950.7	734
1440	min Winter	3.417	0.0	987.8	1024
2160	min Winter	2.460	0.0	1027.6	1408
2880	min Winter	1.951	0.0	1058.2	1848
4320	min Winter	1.414	0.0	1107.0	2476
5760	min Winter	1.131	0.0	1147.4	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 352287 380052 SJ 52287 80052
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.200

Time (mins) From:	To:	Area (ha)
0	4	1.200

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	69.7	2.000	360.3

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0123-8800-2000-8800
Design Head (m)	2.000
Design Flow (l/s)	8.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	123
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	8.8	Kick-Flo®	1.092	6.6
Flush-Flo™	0.536	8.3	Mean Flow over Head Range	-	7.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.4	1.200	6.9	3.000	10.6	7.000	15.9
0.200	7.1	1.400	7.4	3.500	11.4	7.500	16.5
0.300	7.9	1.600	7.9	4.000	12.2	8.000	17.0
0.400	8.2	1.800	8.4	4.500	12.9	8.500	17.5
0.500	8.3	2.000	8.8	5.000	13.6	9.000	18.0
0.600	8.3	2.200	9.2	5.500	14.2	9.500	18.4
0.800	8.0	2.400	9.6	6.000	14.8		
1.000	7.3	2.600	9.9	6.500	15.4		

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Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 1223 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	99.693	0.143	0.0	7.8	7.8	400.7	O K
30 min Summer	99.740	0.190	0.0	7.8	7.8	531.5	Flood Risk
60 min Summer	99.786	0.236	0.0	7.8	7.8	659.3	Flood Risk
120 min Summer	99.831	0.281	0.0	7.8	7.8	785.7	Flood Risk
180 min Summer	99.856	0.306	0.0	7.8	7.8	855.6	Flood Risk
240 min Summer	99.872	0.322	0.0	7.8	7.8	900.6	Flood Risk
360 min Summer	99.889	0.339	0.0	7.8	7.8	948.6	Flood Risk
480 min Summer	99.896	0.346	0.0	7.8	7.8	966.0	Flood Risk
600 min Summer	99.896	0.346	0.0	7.8	7.8	967.1	Flood Risk
720 min Summer	99.893	0.343	0.0	7.8	7.8	958.3	Flood Risk
960 min Summer	99.880	0.330	0.0	7.8	7.8	922.1	Flood Risk
1440 min Summer	99.853	0.303	0.0	7.8	7.8	847.1	Flood Risk
2160 min Summer	99.824	0.274	0.0	7.8	7.8	764.9	Flood Risk
2880 min Summer	99.800	0.250	0.0	7.8	7.8	697.2	Flood Risk
4320 min Summer	99.758	0.208	0.0	7.8	7.8	582.0	Flood Risk
5760 min Summer	99.723	0.173	0.0	7.8	7.8	482.9	Flood Risk
15 min Winter	99.713	0.163	0.0	7.8	7.8	454.8	Flood Risk
30 min Winter	99.766	0.216	0.0	7.8	7.8	602.5	Flood Risk
60 min Winter	99.817	0.267	0.0	7.8	7.8	747.2	Flood Risk
120 min Winter	99.869	0.319	0.0	7.8	7.8	891.4	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	151.322	0.0	405.7	19
30 min Summer	98.513	0.0	542.3	34
60 min Summer	60.987	0.0	682.8	64
120 min Summer	36.823	0.0	833.3	124
180 min Summer	27.226	0.0	928.6	182
240 min Summer	21.895	0.0	998.1	242
360 min Summer	15.996	0.0	1096.4	362
480 min Summer	12.731	0.0	1164.8	482
600 min Summer	10.637	0.0	1198.0	602
720 min Summer	9.172	0.0	1196.8	720
960 min Summer	7.244	0.0	1194.5	934
1440 min Summer	5.181	0.0	1176.3	1140
2160 min Summer	3.701	0.0	1509.3	1516
2880 min Summer	2.920	0.0	1578.9	1932
4320 min Summer	2.104	0.0	1686.0	2724
5760 min Summer	1.677	0.0	1773.4	3520
15 min Winter	151.322	0.0	460.1	19
30 min Winter	98.513	0.0	585.6	33
60 min Winter	60.987	0.0	770.5	64
120 min Winter	36.823	0.0	939.2	122

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Summary of Results for 100 year Return Period (+45%)

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	99.899	0.349	0.0	7.8	7.8	974.4	Flood Risk
240 min Winter	99.918	0.368	0.0	7.8	7.8	1027.6	Flood Risk
360 min Winter	99.939	0.389	0.0	7.8	7.8	1088.5	Flood Risk
480 min Winter	99.949	0.399	0.0	7.8	7.8	1115.5	Flood Risk
600 min Winter	99.952	0.402	0.0	7.8	7.8	1124.3	Flood Risk
720 min Winter	99.952	0.402	0.0	7.8	7.8	1122.1	Flood Risk
960 min Winter	99.943	0.393	0.0	7.8	7.8	1097.7	Flood Risk
1440 min Winter	99.911	0.361	0.0	7.8	7.8	1010.1	Flood Risk
2160 min Winter	99.872	0.322	0.0	7.8	7.8	899.4	Flood Risk
2880 min Winter	99.837	0.287	0.0	7.8	7.8	803.1	Flood Risk
4320 min Winter	99.774	0.224	0.0	7.8	7.8	627.0	Flood Risk
5760 min Winter	99.720	0.170	0.0	7.8	7.8	473.9	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
180 min Winter	27.226	0.0	1046.5	180
240 min Winter	21.895	0.0	1124.5	240
360 min Winter	15.996	0.0	1204.9	356
480 min Winter	12.731	0.0	1204.8	472
600 min Winter	10.637	0.0	1205.5	588
720 min Winter	9.172	0.0	1206.3	700
960 min Winter	7.244	0.0	1207.5	924
1440 min Winter	5.181	0.0	1209.3	1328
2160 min Winter	3.701	0.0	1701.6	1644
2880 min Winter	2.920	0.0	1779.5	2104
4320 min Winter	2.104	0.0	1904.9	2944
5760 min Winter	1.677	0.0	2005.8	3752

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 360158 378110 SJ 60158 78110
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+45

Time Area Diagram

Total Area (ha) 1.600

Time (mins) From:	To:	Area (ha)
0	4	1.600

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	90.0
Membrane Percolation (mm/hr)	1000	Length (m)	103.5
Max Percolation (l/s)	2587.5	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	99.550	Cap Volume Depth (m)	0.450

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0130-7800-1000-7800
Design Head (m)	1.000
Design Flow (l/s)	7.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	130
Invert Level (m)	99.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	7.8	Kick-Flo®	0.664	6.4
Flush-Flo™	0.302	7.8	Mean Flow over Head Range	-	6.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.7	1.200	8.5	3.000	13.1	7.000	19.6
0.200	7.6	1.400	9.1	3.500	14.1	7.500	20.3
0.300	7.8	1.600	9.7	4.000	15.0	8.000	20.9
0.400	7.7	1.800	10.3	4.500	15.9	8.500	21.6
0.500	7.5	2.000	10.8	5.000	16.7	9.000	22.2
0.600	7.1	2.200	11.3	5.500	17.5	9.500	22.7
0.800	7.0	2.400	11.8	6.000	18.2		
1.000	7.8	2.600	12.2	6.500	18.9		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.081	1.081	16.1	432.2	O K
30 min Summer	99.295	1.295	16.1	553.5	O K
60 min Summer	99.473	1.473	16.1	664.8	O K
120 min Summer	99.612	1.612	16.1	758.0	O K
180 min Summer	99.666	1.666	16.1	796.4	O K
240 min Summer	99.684	1.684	16.1	809.3	O K
360 min Summer	99.663	1.663	16.1	794.3	O K
480 min Summer	99.612	1.612	16.1	758.0	O K
600 min Summer	99.568	1.568	16.1	727.9	O K
720 min Summer	99.528	1.528	16.1	700.8	O K
960 min Summer	99.454	1.454	16.1	652.3	O K
1440 min Summer	99.313	1.313	16.1	564.3	O K
2160 min Summer	99.106	1.106	16.1	445.7	O K
2880 min Summer	98.907	0.907	16.1	343.4	O K
4320 min Summer	98.551	0.551	16.1	185.3	O K
5760 min Summer	98.272	0.272	16.1	83.1	O K
15 min Winter	99.080	1.080	16.1	431.9	O K
30 min Winter	99.297	1.297	16.1	554.6	O K
60 min Winter	99.475	1.475	16.1	666.1	O K
120 min Winter	99.616	1.616	16.1	761.2	O K
180 min Winter	99.673	1.673	16.1	801.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	104.360	0.0	448.3	19
30 min Summer	67.940	0.0	583.6	33
60 min Summer	42.060	0.0	724.7	64
120 min Summer	25.395	0.0	875.0	122
180 min Summer	18.777	0.0	970.8	182
240 min Summer	15.100	0.0	1040.9	242
360 min Summer	11.032	0.0	1140.7	360
480 min Summer	8.780	0.0	1210.6	422
600 min Summer	7.336	0.0	1264.3	482
720 min Summer	6.326	0.0	1308.3	542
960 min Summer	4.996	0.0	1377.5	674
1440 min Summer	3.573	0.0	1477.7	940
2160 min Summer	2.552	0.0	1584.5	1344
2880 min Summer	2.014	0.0	1667.0	1728
4320 min Summer	1.451	0.0	1800.8	2424
5760 min Summer	1.157	0.0	1915.0	3120
15 min Winter	104.360	0.0	447.9	18
30 min Winter	67.940	0.0	583.9	33
60 min Winter	42.060	0.0	724.7	62
120 min Winter	25.395	0.0	875.2	120
180 min Winter	18.777	0.0	970.7	178

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	99.694	1.694	16.1	816.3	O K
360 min Winter	99.682	1.682	16.1	807.5	O K
480 min Winter	99.632	1.632	16.1	772.0	O K
600 min Winter	99.569	1.569	16.1	728.8	O K
720 min Winter	99.523	1.523	16.1	697.9	O K
960 min Winter	99.427	1.427	16.1	634.9	O K
1440 min Winter	99.220	1.220	16.1	509.4	O K
2160 min Winter	98.898	0.898	16.1	338.8	O K
2880 min Winter	98.584	0.584	16.1	198.8	O K
4320 min Winter	98.078	0.078	16.1	22.1	O K
5760 min Winter	98.000	0.000	14.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	15.100	0.0	1040.9	236
360 min Winter	11.032	0.0	1140.7	348
480 min Winter	8.780	0.0	1210.5	454
600 min Winter	7.336	0.0	1264.3	494
720 min Winter	6.326	0.0	1308.3	564
960 min Winter	4.996	0.0	1377.5	714
1440 min Winter	3.573	0.0	1477.8	1010
2160 min Winter	2.552	0.0	1584.5	1408
2880 min Winter	2.014	0.0	1667.0	1784
4320 min Winter	1.451	0.0	1800.9	2380
5760 min Winter	1.157	0.0	1915.3	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 360158 378110 SJ 60158 78110
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 3.450

Time (mins) From:	To:	Area (ha)
0	4	3.450

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	277.9	2.000	822.1

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0166-1610-2000-1610
Design Head (m)	2.000
Design Flow (l/s)	16.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	166
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	16.1	Kick-Flo®	1.226	12.8
Flush-Flo™	0.585	16.1	Mean Flow over Head Range	-	14.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.9	1.200	13.1	3.000	19.5	7.000	29.3
0.200	13.4	1.400	13.6	3.500	21.0	7.500	30.3
0.300	14.9	1.600	14.5	4.000	22.4	8.000	31.2
0.400	15.7	1.800	15.3	4.500	23.7	8.500	32.2
0.500	16.0	2.000	16.1	5.000	24.9	9.000	33.1
0.600	16.1	2.200	16.8	5.500	26.1	9.500	33.9
0.800	15.8	2.400	17.5	6.000	27.2		
1.000	15.0	2.600	18.2	6.500	28.3		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.143	1.143	8.3	223.0	O K
30 min Summer	99.339	1.339	8.3	285.6	O K
60 min Summer	99.500	1.500	8.3	343.0	O K
120 min Summer	99.623	1.623	8.3	391.1	O K
180 min Summer	99.671	1.671	8.3	410.9	O K
240 min Summer	99.687	1.687	8.3	417.6	O K
360 min Summer	99.668	1.668	8.3	409.9	O K
480 min Summer	99.623	1.623	8.3	391.1	O K
600 min Summer	99.584	1.584	8.3	375.6	O K
720 min Summer	99.548	1.548	8.3	361.6	O K
960 min Summer	99.483	1.483	8.3	336.6	O K
1440 min Summer	99.356	1.356	8.3	291.2	O K
2160 min Summer	99.166	1.166	8.3	230.0	O K
2880 min Summer	98.980	0.980	8.3	177.3	O K
4320 min Summer	98.629	0.629	8.3	95.7	O K
5760 min Summer	98.330	0.330	8.3	43.0	O K
15 min Winter	99.142	1.142	8.3	222.8	O K
30 min Winter	99.341	1.341	8.3	286.1	O K
60 min Winter	99.502	1.502	8.3	343.7	O K
120 min Winter	99.627	1.627	8.3	392.7	O K
180 min Winter	99.677	1.677	8.3	413.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	104.360	0.0	231.9	19
30 min Summer	67.940	0.0	301.8	33
60 min Summer	42.060	0.0	374.2	64
120 min Summer	25.395	0.0	451.8	122
180 min Summer	18.777	0.0	501.2	182
240 min Summer	15.100	0.0	537.4	242
360 min Summer	11.032	0.0	588.9	360
480 min Summer	8.780	0.0	624.9	422
600 min Summer	7.336	0.0	652.7	482
720 min Summer	6.326	0.0	675.4	542
960 min Summer	4.996	0.0	711.1	674
1440 min Summer	3.573	0.0	762.9	940
2160 min Summer	2.552	0.0	817.7	1344
2880 min Summer	2.014	0.0	860.3	1732
4320 min Summer	1.451	0.0	929.5	2424
5760 min Summer	1.157	0.0	988.1	3120
15 min Winter	104.360	0.0	231.7	19
30 min Winter	67.940	0.0	301.9	33
60 min Winter	42.060	0.0	374.2	62
120 min Winter	25.395	0.0	451.9	120
180 min Winter	18.777	0.0	501.2	178

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Summary of Results for 100 year Return Period

	Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240	min Winter	99.695	1.695	8.3	421.2	O K
360	min Winter	99.685	1.685	8.3	416.7	O K
480	min Winter	99.641	1.641	8.3	398.4	O K
600	min Winter	99.585	1.585	8.3	376.1	O K
720	min Winter	99.545	1.545	8.3	360.2	O K
960	min Winter	99.458	1.458	8.3	327.7	O K
1440	min Winter	99.271	1.271	8.3	262.9	O K
2160	min Winter	98.971	0.971	8.3	174.9	O K
2880	min Winter	98.664	0.664	8.3	102.8	O K
4320	min Winter	98.100	0.100	8.3	11.5	O K
5760	min Winter	98.000	0.000	7.2	0.0	O K

	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240	min Winter	15.100	0.0	537.4	236
360	min Winter	11.032	0.0	588.9	348
480	min Winter	8.780	0.0	624.9	454
600	min Winter	7.336	0.0	652.7	494
720	min Winter	6.326	0.0	675.4	564
960	min Winter	4.996	0.0	711.1	714
1440	min Winter	3.573	0.0	763.0	1010
2160	min Winter	2.552	0.0	817.7	1408
2880	min Winter	2.014	0.0	860.3	1788
4320	min Winter	1.451	0.0	929.5	2380
5760	min Winter	1.157	0.0	988.2	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 360158 378110 SJ 60158 78110
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.780

Time (mins) From:	To:	Area (ha)
0	4	1.780

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	108.1	2.000	501.8

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0119-8300-2000-8300
Design Head (m)	2.000
Design Flow (l/s)	8.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	119
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	8.3	Kick-Flo®	1.065	6.2
Flush-Flo™	0.520	7.8	Mean Flow over Head Range	-	7.0

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	4.2	1.200	6.5	3.000	10.0	7.000	15.0
0.200	6.7	1.400	7.0	3.500	10.8	7.500	15.5
0.300	7.4	1.600	7.5	4.000	11.5	8.000	16.0
0.400	7.7	1.800	7.9	4.500	12.2	8.500	16.5
0.500	7.8	2.000	8.3	5.000	12.8	9.000	16.9
0.600	7.8	2.200	8.7	5.500	13.4	9.500	17.4
0.800	7.5	2.400	9.0	6.000	14.0		
1.000	6.7	2.600	9.4	6.500	14.5		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.018	1.018	42.4	1136.1	O K
30 min Summer	99.249	1.249	42.4	1454.9	O K
60 min Summer	99.447	1.447	42.4	1747.1	O K
120 min Summer	99.604	1.604	42.4	1991.8	O K
180 min Summer	99.666	1.666	42.4	2092.4	O K
240 min Summer	99.687	1.687	42.4	2125.6	O K
360 min Summer	99.662	1.662	42.4	2085.4	O K
480 min Summer	99.603	1.603	42.4	1989.9	O K
600 min Summer	99.553	1.553	42.4	1910.7	O K
720 min Summer	99.507	1.507	42.4	1839.5	O K
960 min Summer	99.424	1.424	42.4	1711.9	O K
1440 min Summer	99.266	1.266	42.4	1480.1	O K
2160 min Summer	99.041	1.041	42.4	1167.5	O K
2880 min Summer	98.833	0.833	42.4	898.3	O K
4320 min Summer	98.479	0.479	42.4	483.1	O K
5760 min Summer	98.224	0.224	42.4	214.8	O K
15 min Winter	99.017	1.017	42.4	1135.2	O K
30 min Winter	99.251	1.251	42.4	1457.8	O K
60 min Winter	99.450	1.450	42.4	1751.1	O K
120 min Winter	99.609	1.609	42.4	2000.2	O K
180 min Winter	99.674	1.674	42.4	2105.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	104.360	0.0	1169.1	19
30 min Summer	67.940	0.0	1523.2	33
60 min Summer	42.060	0.0	1900.6	64
120 min Summer	25.395	0.0	2295.4	122
180 min Summer	18.777	0.0	2546.8	182
240 min Summer	15.100	0.0	2731.0	242
360 min Summer	11.032	0.0	2993.0	360
480 min Summer	8.780	0.0	3176.4	422
600 min Summer	7.336	0.0	3317.4	482
720 min Summer	6.326	0.0	3432.6	542
960 min Summer	4.996	0.0	3613.9	674
1440 min Summer	3.573	0.0	3876.1	940
2160 min Summer	2.552	0.0	4162.7	1340
2880 min Summer	2.014	0.0	4379.0	1728
4320 min Summer	1.451	0.0	4728.0	2424
5760 min Summer	1.157	0.0	5032.7	3120
15 min Winter	104.360	0.0	1168.0	18
30 min Winter	67.940	0.0	1524.0	33
60 min Winter	42.060	0.0	1900.6	62
120 min Winter	25.395	0.0	2295.8	120
180 min Winter	18.777	0.0	2546.7	178

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	99.698	1.698	42.4	2144.2	O K
360 min Winter	99.684	1.684	42.4	2120.3	O K
480 min Winter	99.625	1.625	42.4	2026.2	O K
600 min Winter	99.554	1.554	42.4	1912.9	O K
720 min Winter	99.502	1.502	42.4	1831.7	O K
960 min Winter	99.393	1.393	42.4	1665.5	O K
1440 min Winter	99.164	1.164	42.4	1334.8	O K
2160 min Winter	98.822	0.822	42.4	885.5	O K
2880 min Winter	98.510	0.510	42.4	517.6	O K
4320 min Winter	98.059	0.059	42.4	54.8	O K
5760 min Winter	98.000	0.000	36.8	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	15.100	0.0	2731.0	236
360 min Winter	11.032	0.0	2993.0	348
480 min Winter	8.780	0.0	3176.3	454
600 min Winter	7.336	0.0	3317.4	494
720 min Winter	6.326	0.0	3432.6	564
960 min Winter	4.996	0.0	3614.0	714
1440 min Winter	3.573	0.0	3876.7	1010
2160 min Winter	2.552	0.0	4162.8	1408
2880 min Winter	2.014	0.0	4379.1	1784
4320 min Winter	1.451	0.0	4728.7	2340
5760 min Winter	1.157	0.0	5035.2	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 360158 378110 SJ 60158 78110
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 9.070

Time (mins) From:	To:	Area (ha)
0	4	9.070

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	919.0	2.000	1790.8

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0261-4240-2000-4240
Design Head (m)	2.000
Design Flow (l/s)	42.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	261
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	42.4	Kick-Flo®	1.309	34.6
Flush-Flo™	0.602	42.4	Mean Flow over Head Range	-	36.6

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	8.4	1.200	37.7	3.000	51.6	7.000	77.7
0.200	26.9	1.400	35.7	3.500	55.5	7.500	80.4
0.300	39.2	1.600	38.1	4.000	59.2	8.000	83.0
0.400	41.2	1.800	40.3	4.500	62.7	8.500	85.4
0.500	42.2	2.000	42.4	5.000	66.0	9.000	87.9
0.600	42.4	2.200	44.4	5.500	69.1	9.500	90.2
0.800	41.8	2.400	46.3	6.000	72.1		
1.000	40.5	2.600	48.1	6.500	75.0		

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Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 2340 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	99.716	0.116	0.0	3.0	3.0	261.2	Flood Risk
30 min Summer	99.757	0.157	0.0	3.0	3.0	351.9	Flood Risk
60 min Summer	99.798	0.198	0.0	3.0	3.0	443.4	Flood Risk
120 min Summer	99.837	0.237	0.0	3.0	3.0	532.1	Flood Risk
180 min Summer	99.861	0.261	0.0	3.0	3.0	585.1	Flood Risk
240 min Summer	99.877	0.277	0.0	3.0	3.0	621.3	Flood Risk
360 min Summer	99.897	0.297	0.0	3.0	3.0	667.2	Flood Risk
480 min Summer	99.909	0.309	0.0	3.0	3.0	692.8	Flood Risk
600 min Summer	99.915	0.315	0.0	3.0	3.0	707.9	Flood Risk
720 min Summer	99.919	0.319	0.0	3.0	3.0	716.1	Flood Risk
960 min Summer	99.921	0.321	0.0	3.0	3.0	720.7	Flood Risk
1440 min Summer	99.913	0.313	0.0	3.0	3.0	702.6	Flood Risk
2160 min Summer	99.891	0.291	0.0	3.0	3.0	653.6	Flood Risk
2880 min Summer	99.874	0.274	0.0	3.0	3.0	615.3	Flood Risk
4320 min Summer	99.850	0.250	0.0	3.0	3.0	561.0	Flood Risk
5760 min Summer	99.831	0.231	0.0	3.0	3.0	517.3	Flood Risk
15 min Winter	99.733	0.133	0.0	3.0	3.0	297.4	Flood Risk
30 min Winter	99.778	0.178	0.0	3.0	3.0	399.2	Flood Risk
60 min Winter	99.824	0.224	0.0	3.0	3.0	502.3	Flood Risk
120 min Winter	99.869	0.269	0.0	3.0	3.0	602.8	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	146.102	0.0	215.3	19
30 min Summer	95.613	0.0	220.8	34
60 min Summer	59.508	0.0	440.7	64
120 min Summer	35.735	0.0	450.2	124
180 min Summer	26.385	0.0	456.6	184
240 min Summer	21.203	0.0	460.9	244
360 min Summer	15.486	0.0	466.2	362
480 min Summer	12.320	0.0	469.1	482
600 min Summer	10.291	0.0	470.7	602
720 min Summer	8.872	0.0	471.7	722
960 min Summer	7.009	0.0	472.4	962
1440 min Summer	5.009	0.0	470.8	1440
2160 min Summer	3.581	0.0	913.2	1860
2880 min Summer	2.828	0.0	901.6	2220
4320 min Summer	2.039	0.0	853.4	2984
5760 min Summer	1.627	0.0	1160.2	3808
15 min Winter	146.102	0.0	217.5	19
30 min Winter	95.613	0.0	223.7	34
60 min Winter	59.508	0.0	446.5	64
120 min Winter	35.735	0.0	458.2	122

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Summary of Results for 100 year Return Period (+45%)

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	99.896	0.296	0.0	3.0	3.0	663.2	Flood Risk
240 min Winter	99.914	0.314	0.0	3.0	3.0	705.3	Flood Risk
360 min Winter	99.938	0.338	0.0	3.0	3.0	759.5	Flood Risk
480 min Winter	99.952	0.352	0.0	3.0	3.0	790.9	Flood Risk
600 min Winter	99.961	0.361	0.0	3.0	3.0	810.0	Flood Risk
720 min Winter	99.966	0.366	0.0	3.0	3.0	822.3	Flood Risk
960 min Winter	99.971	0.371	0.0	3.0	3.0	833.4	Flood Risk
1440 min Winter	99.968	0.368	0.0	3.0	3.0	825.4	Flood Risk
2160 min Winter	99.949	0.349	0.0	3.0	3.0	783.7	Flood Risk
2880 min Winter	99.925	0.325	0.0	3.0	3.0	729.2	Flood Risk
4320 min Winter	99.893	0.293	0.0	3.0	3.0	657.3	Flood Risk
5760 min Winter	99.864	0.264	0.0	3.0	3.0	592.1	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
180 min Winter	26.385	0.0	465.4	182
240 min Winter	21.203	0.0	469.8	240
360 min Winter	15.486	0.0	475.5	358
480 min Winter	12.320	0.0	478.4	476
600 min Winter	10.291	0.0	480.2	594
720 min Winter	8.872	0.0	480.8	710
960 min Winter	7.009	0.0	480.9	942
1440 min Winter	5.009	0.0	477.7	1398
2160 min Winter	3.581	0.0	933.7	2052
2880 min Winter	2.828	0.0	930.4	2396
4320 min Winter	2.039	0.0	892.7	3244
5760 min Winter	1.627	0.0	1315.5	4152

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 358800 385744 SJ 58800 85744
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+45

Time Area Diagram

Total Area (ha) 1.100

Time (mins) From:	To:	Area (ha)
0	4	1.100

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	88.0
Membrane Percolation (mm/hr)	1000	Length (m)	85.0
Max Percolation (l/s)	2077.8	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	99.600	Cap Volume Depth (m)	0.400

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0082-3000-1000-3000
Design Head (m)	1.000
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	82
Invert Level (m)	99.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.0	Kick-Flo®	0.623	2.4
Flush-Flo™	0.297	3.0	Mean Flow over Head Range	-	2.6

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	2.4	1.200	3.3	3.000	5.0	7.000	7.4
0.200	2.9	1.400	3.5	3.500	5.4	7.500	7.7
0.300	3.0	1.600	3.7	4.000	5.7	8.000	7.9
0.400	2.9	1.800	3.9	4.500	6.0	8.500	8.2
0.500	2.8	2.000	4.1	5.000	6.3	9.000	8.4
0.600	2.5	2.200	4.3	5.500	6.6	9.500	8.6
0.800	2.7	2.400	4.5	6.000	6.9		
1.000	3.0	2.600	4.7	6.500	7.2		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.007	1.007	3.6	184.9	O K
30 min Summer	99.206	1.206	3.6	240.0	O K
60 min Summer	99.379	1.379	3.6	294.2	O K
120 min Summer	99.522	1.522	3.6	343.1	O K
180 min Summer	99.596	1.596	3.6	369.8	O K
240 min Summer	99.640	1.640	3.6	386.3	O K
360 min Summer	99.682	1.682	3.6	402.5	O K
480 min Summer	99.690	1.690	3.6	405.9	O K
600 min Summer	99.682	1.682	3.6	402.5	O K
720 min Summer	99.663	1.663	3.6	395.1	O K
960 min Summer	99.608	1.608	3.6	374.5	O K
1440 min Summer	99.521	1.521	3.6	342.7	O K
2160 min Summer	99.422	1.422	3.6	308.3	O K
2880 min Summer	99.334	1.334	3.6	279.5	O K
4320 min Summer	99.169	1.169	3.6	229.4	O K
5760 min Summer	99.015	1.015	3.6	186.8	O K
15 min Winter	99.007	1.007	3.6	184.9	O K
30 min Winter	99.206	1.206	3.6	240.1	O K
60 min Winter	99.379	1.379	3.6	294.1	O K
120 min Winter	99.524	1.524	3.6	343.7	O K
180 min Winter	99.598	1.598	3.6	370.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	100.760	0.0	187.2	19
30 min Summer	65.940	0.0	224.4	34
60 min Summer	41.040	0.0	307.4	64
120 min Summer	24.645	0.0	369.0	124
180 min Summer	18.197	0.0	408.4	182
240 min Summer	14.623	0.0	437.3	242
360 min Summer	10.680	0.0	477.7	362
480 min Summer	8.496	0.0	500.6	482
600 min Summer	7.097	0.0	508.9	602
720 min Summer	6.118	0.0	514.1	720
960 min Summer	4.834	0.0	521.4	894
1440 min Summer	3.455	0.0	520.6	1112
2160 min Summer	2.469	0.0	666.5	1496
2880 min Summer	1.950	0.0	701.9	1904
4320 min Summer	1.406	0.0	758.7	2724
5760 min Summer	1.122	0.0	807.6	3464
15 min Winter	100.760	0.0	187.2	19
30 min Winter	65.940	0.0	224.3	33
60 min Winter	41.040	0.0	307.2	62
120 min Winter	24.645	0.0	369.0	122
180 min Winter	18.197	0.0	408.5	180

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	99.643	1.643	3.6	387.4	O K
360 min Winter	99.686	1.686	3.6	404.3	O K
480 min Winter	99.697	1.697	3.6	408.6	O K
600 min Winter	99.692	1.692	3.6	406.6	O K
720 min Winter	99.677	1.677	3.6	400.6	O K
960 min Winter	99.629	1.629	3.6	382.4	O K
1440 min Winter	99.520	1.520	3.6	342.2	O K
2160 min Winter	99.392	1.392	3.6	298.2	O K
2880 min Winter	99.262	1.262	3.6	256.9	O K
4320 min Winter	99.000	1.000	3.6	183.0	O K
5760 min Winter	98.741	0.741	3.6	121.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	14.623	0.0	437.3	238
360 min Winter	10.680	0.0	477.6	356
480 min Winter	8.496	0.0	499.8	470
600 min Winter	7.097	0.0	507.2	584
720 min Winter	6.118	0.0	511.5	696
960 min Winter	4.834	0.0	518.0	914
1440 min Winter	3.455	0.0	521.5	1140
2160 min Winter	2.469	0.0	666.5	1584
2880 min Winter	1.950	0.0	701.9	2020
4320 min Winter	1.406	0.0	758.9	2856
5760 min Winter	1.122	0.0	807.6	3640

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 358800 385744 SJ 58800 85744
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.500

Time (mins) From:	To:	Area (ha)
0	4	1.500

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	116.3	2.000	458.7

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0077-3600-2000-3600
Design Head (m)	2.000
Design Flow (l/s)	3.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	77
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	3.6	Kick-Flo®	0.691	2.2
Flush-Flo™	0.339	2.7	Mean Flow over Head Range	-	2.8

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.2	1.200	2.8	3.000	4.3	7.000	6.5
0.200	2.6	1.400	3.1	3.500	4.7	7.500	6.7
0.300	2.7	1.600	3.2	4.000	5.0	8.000	6.9
0.400	2.7	1.800	3.4	4.500	5.3	8.500	7.1
0.500	2.7	2.000	3.6	5.000	5.5	9.000	7.3
0.600	2.5	2.200	3.8	5.500	5.8	9.500	7.5
0.800	2.4	2.400	3.9	6.000	6.0		
1.000	2.6	2.600	4.1	6.500	6.2		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	98.991	0.991	4.0	209.7	O K
30 min Summer	99.192	1.192	4.0	272.2	O K
60 min Summer	99.369	1.369	4.0	333.7	O K
120 min Summer	99.515	1.515	4.0	389.5	O K
180 min Summer	99.591	1.591	4.0	420.1	O K
240 min Summer	99.636	1.636	4.0	439.0	O K
360 min Summer	99.681	1.681	4.0	457.9	O K
480 min Summer	99.691	1.691	4.0	462.4	O K
600 min Summer	99.684	1.684	4.0	459.2	O K
720 min Summer	99.665	1.665	4.0	451.4	O K
960 min Summer	99.611	1.611	4.0	428.5	O K
1440 min Summer	99.522	1.522	4.0	392.3	O K
2160 min Summer	99.422	1.422	4.0	353.6	O K
2880 min Summer	99.334	1.334	4.0	321.4	O K
4320 min Summer	99.172	1.172	4.0	265.6	O K
5760 min Summer	99.018	1.018	4.0	217.7	O K
15 min Winter	98.991	0.991	4.0	209.7	O K
30 min Winter	99.192	1.192	4.0	272.3	O K
60 min Winter	99.368	1.368	4.0	333.7	O K
120 min Winter	99.517	1.517	4.0	390.1	O K
180 min Winter	99.593	1.593	4.0	421.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	100.760	0.0	211.8	19
30 min Summer	65.940	0.0	252.9	34
60 min Summer	41.040	0.0	348.2	64
120 min Summer	24.645	0.0	418.0	124
180 min Summer	18.197	0.0	462.5	182
240 min Summer	14.623	0.0	495.1	242
360 min Summer	10.680	0.0	539.9	362
480 min Summer	8.496	0.0	561.6	482
600 min Summer	7.097	0.0	569.3	602
720 min Summer	6.118	0.0	574.5	720
960 min Summer	4.834	0.0	582.5	914
1440 min Summer	3.455	0.0	581.1	1124
2160 min Summer	2.469	0.0	755.3	1496
2880 min Summer	1.950	0.0	795.3	1904
4320 min Summer	1.406	0.0	859.7	2724
5760 min Summer	1.122	0.0	915.3	3520
15 min Winter	100.760	0.0	211.8	19
30 min Winter	65.940	0.0	252.9	33
60 min Winter	41.040	0.0	348.0	62
120 min Winter	24.645	0.0	418.0	122
180 min Winter	18.197	0.0	462.6	180

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Summary of Results for 100 year Return Period

	Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240	min Winter	99.639	1.639	4.0	440.3	O K
360	min Winter	99.685	1.685	4.0	460.0	O K
480	min Winter	99.698	1.698	4.0	465.4	O K
600	min Winter	99.694	1.694	4.0	463.6	O K
720	min Winter	99.679	1.679	4.0	457.3	O K
960	min Winter	99.633	1.633	4.0	437.7	O K
1440	min Winter	99.522	1.522	4.0	392.0	O K
2160	min Winter	99.394	1.394	4.0	343.2	O K
2880	min Winter	99.265	1.265	4.0	297.1	O K
4320	min Winter	99.007	1.007	4.0	214.4	O K
5760	min Winter	98.754	0.754	4.0	145.3	O K

	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240	min Winter	14.623	0.0	495.1	238
360	min Winter	10.680	0.0	539.8	356
480	min Winter	8.496	0.0	560.4	470
600	min Winter	7.097	0.0	567.3	584
720	min Winter	6.118	0.0	571.6	696
960	min Winter	4.834	0.0	578.2	914
1440	min Winter	3.455	0.0	582.4	1142
2160	min Winter	2.469	0.0	755.3	1600
2880	min Winter	1.950	0.0	795.4	2048
4320	min Winter	1.406	0.0	859.9	2856
5760	min Winter	1.122	0.0	915.3	3640

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 358800 385744 SJ 58800 85744
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.700

Time (mins) From:	To:	Area (ha)
0	4	1.700

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	140.1	2.000	504.9

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0082-4000-2000-4000
Design Head (m)	2.000
Design Flow (l/s)	4.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	82
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	4.0	Kick-Flo®	0.729	2.5
Flush-Flo™	0.356	3.1	Mean Flow over Head Range	-	3.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.4	1.200	3.2	3.000	4.8	7.000	7.2
0.200	3.0	1.400	3.4	3.500	5.2	7.500	7.4
0.300	3.1	1.600	3.6	4.000	5.5	8.000	7.7
0.400	3.1	1.800	3.8	4.500	5.8	8.500	7.9
0.500	3.1	2.000	4.0	5.000	6.1	9.000	8.1
0.600	2.9	2.200	4.2	5.500	6.4	9.500	8.3
0.800	2.6	2.400	4.3	6.000	6.7		
1.000	2.9	2.600	4.5	6.500	6.9		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	98.924	0.924	8.3	431.6	O K
30 min Summer	99.137	1.137	8.3	560.3	O K
60 min Summer	99.329	1.329	8.3	686.9	O K
120 min Summer	99.491	1.491	8.3	801.4	O K
180 min Summer	99.575	1.575	8.3	864.1	O K
240 min Summer	99.626	1.626	8.3	902.8	O K
360 min Summer	99.675	1.675	8.3	941.3	O K
480 min Summer	99.686	1.686	8.3	950.0	O K
600 min Summer	99.677	1.677	8.3	942.8	O K
720 min Summer	99.656	1.656	8.3	926.3	O K
960 min Summer	99.594	1.594	8.3	878.8	O K
1440 min Summer	99.495	1.495	8.3	804.3	O K
2160 min Summer	99.383	1.383	8.3	724.5	O K
2880 min Summer	99.286	1.286	8.3	657.8	O K
4320 min Summer	99.108	1.108	8.3	542.2	O K
5760 min Summer	98.944	0.944	8.3	443.0	O K
15 min Winter	98.924	0.924	8.3	431.6	O K
30 min Winter	99.137	1.137	8.3	560.4	O K
60 min Winter	99.329	1.329	8.3	686.7	O K
120 min Winter	99.492	1.492	8.3	802.6	O K
180 min Winter	99.578	1.578	8.3	866.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	100.760	0.0	434.5	19
30 min Summer	65.940	0.0	562.0	34
60 min Summer	41.040	0.0	715.5	64
120 min Summer	24.645	0.0	858.9	124
180 min Summer	18.197	0.0	950.4	182
240 min Summer	14.623	0.0	1017.7	242
360 min Summer	10.680	0.0	1113.1	362
480 min Summer	8.496	0.0	1177.6	482
600 min Summer	7.097	0.0	1224.5	602
720 min Summer	6.118	0.0	1258.8	720
960 min Summer	4.834	0.0	1291.4	896
1440 min Summer	3.455	0.0	1269.3	1114
2160 min Summer	2.469	0.0	1554.1	1496
2880 min Summer	1.950	0.0	1636.4	1904
4320 min Summer	1.406	0.0	1768.5	2724
5760 min Summer	1.122	0.0	1884.0	3464
15 min Winter	100.760	0.0	434.5	19
30 min Winter	65.940	0.0	561.9	33
60 min Winter	41.040	0.0	715.2	62
120 min Winter	24.645	0.0	858.9	122
180 min Winter	18.197	0.0	950.7	180

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Summary of Results for 100 year Return Period

	Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240	min Winter	99.629	1.629	8.3	905.4	O K
360	min Winter	99.681	1.681	8.3	945.6	O K
480	min Winter	99.694	1.694	8.3	956.3	O K
600	min Winter	99.689	1.689	8.3	952.1	O K
720	min Winter	99.672	1.672	8.3	938.8	O K
960	min Winter	99.619	1.619	8.3	897.5	O K
1440	min Winter	99.494	1.494	8.3	803.6	O K
2160	min Winter	99.351	1.351	8.3	702.2	O K
2880	min Winter	99.209	1.209	8.3	606.7	O K
4320	min Winter	98.931	0.931	8.3	435.6	O K
5760	min Winter	98.669	0.669	8.3	292.8	O K

	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240	min Winter	14.623	0.0	1017.8	238
360	min Winter	10.680	0.0	1113.0	356
480	min Winter	8.496	0.0	1177.3	470
600	min Winter	7.097	0.0	1223.8	584
720	min Winter	6.118	0.0	1256.4	696
960	min Winter	4.834	0.0	1282.7	914
1440	min Winter	3.455	0.0	1273.2	1142
2160	min Winter	2.469	0.0	1554.1	1600
2880	min Winter	1.950	0.0	1636.4	2048
4320	min Winter	1.406	0.0	1769.2	2856
5760	min Winter	1.122	0.0	1884.0	3640

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 358800 385744 SJ 58800 85744
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 3.500

Time (mins) From:	To:	Area (ha)
0	4	3.500

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	365.2	2.000	884.7

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0119-8300-2000-8300
Design Head (m)	2.000
Design Flow (l/s)	8.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	119
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	8.3
Flush-Flo™	0.520	7.8
Kick-Flo®	1.065	6.2
Mean Flow over Head Range	-	7.0

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	4.2	1.200	6.5	3.000	10.0	7.000	15.0
0.200	6.7	1.400	7.0	3.500	10.8	7.500	15.5
0.300	7.4	1.600	7.5	4.000	11.5	8.000	16.0
0.400	7.7	1.800	7.9	4.500	12.2	8.500	16.5
0.500	7.8	2.000	8.3	5.000	12.8	9.000	16.9
0.600	7.8	2.200	8.7	5.500	13.4	9.500	17.4
0.800	7.5	2.400	9.0	6.000	14.0		
1.000	6.7	2.600	9.4	6.500	14.5		

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Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 610 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	99.725	0.175	0.0	9.1	9.1	274.8	Flood Risk
30 min Summer	99.784	0.234	0.0	9.1	9.1	366.1	Flood Risk
60 min Summer	99.839	0.289	0.0	9.1	9.1	452.5	Flood Risk
120 min Summer	99.879	0.329	0.0	9.1	9.1	514.7	Flood Risk
180 min Summer	99.897	0.347	0.0	9.1	9.1	544.2	Flood Risk
240 min Summer	99.907	0.357	0.0	9.1	9.1	558.3	Flood Risk
360 min Summer	99.909	0.359	0.0	9.1	9.1	561.5	Flood Risk
480 min Summer	99.899	0.349	0.0	9.1	9.1	546.8	Flood Risk
600 min Summer	99.887	0.337	0.0	9.1	9.1	527.2	Flood Risk
720 min Summer	99.876	0.326	0.0	9.1	9.1	510.3	Flood Risk
960 min Summer	99.858	0.308	0.0	9.1	9.1	481.7	Flood Risk
1440 min Summer	99.828	0.278	0.0	9.1	9.1	435.4	Flood Risk
2160 min Summer	99.788	0.238	0.0	9.1	9.1	372.6	Flood Risk
2880 min Summer	99.752	0.202	0.0	9.1	9.1	315.9	Flood Risk
4320 min Summer	99.691	0.141	0.0	9.1	9.1	220.4	O K
5760 min Summer	99.643	0.093	0.0	9.1	9.1	145.9	O K
15 min Winter	99.749	0.199	0.0	9.1	9.1	311.9	Flood Risk
30 min Winter	99.815	0.265	0.0	9.1	9.1	415.3	Flood Risk
60 min Winter	99.878	0.328	0.0	9.1	9.1	514.1	Flood Risk
120 min Winter	99.924	0.374	0.0	9.1	9.1	586.3	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	137.344	0.0	282.1	19
30 min Summer	90.567	0.0	380.6	34
60 min Summer	56.594	0.0	481.4	64
120 min Summer	33.350	0.0	571.9	122
180 min Summer	24.452	0.0	631.8	182
240 min Summer	19.582	0.0	675.3	242
360 min Summer	14.239	0.0	738.2	360
480 min Summer	11.326	0.0	783.7	478
600 min Summer	9.473	0.0	819.6	520
720 min Summer	8.183	0.0	848.9	580
960 min Summer	6.491	0.0	897.7	704
1440 min Summer	4.695	0.0	972.1	970
2160 min Summer	3.403	0.0	1052.9	1384
2880 min Summer	2.718	0.0	1116.0	1764
4320 min Summer	1.996	0.0	1220.3	2552
5760 min Summer	1.615	0.0	1306.2	3240
15 min Winter	137.344	0.0	319.0	19
30 min Winter	90.567	0.0	429.1	33
60 min Winter	56.594	0.0	543.4	62
120 min Winter	33.350	0.0	643.6	120

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Summary of Results for 100 year Return Period (+45%)

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	99.948	0.398	0.0	9.1	9.1	623.9	Flood Risk
240 min Winter	99.961	0.411	0.0	9.1	9.1	644.4	Flood Risk
360 min Winter	99.970	0.420	0.0	9.1	9.1	657.2	Flood Risk
480 min Winter	99.965	0.415	0.0	9.1	9.1	650.1	Flood Risk
600 min Winter	99.954	0.404	0.0	9.1	9.1	633.2	Flood Risk
720 min Winter	99.940	0.390	0.0	9.1	9.1	610.4	Flood Risk
960 min Winter	99.914	0.364	0.0	9.1	9.1	569.6	Flood Risk
1440 min Winter	99.872	0.322	0.0	9.1	9.1	504.5	Flood Risk
2160 min Winter	99.811	0.261	0.0	9.1	9.1	408.5	Flood Risk
2880 min Winter	99.755	0.205	0.0	9.1	9.1	320.4	Flood Risk
4320 min Winter	99.662	0.112	0.0	9.1	9.1	174.7	O K
5760 min Winter	99.594	0.044	0.0	9.1	9.1	69.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
180 min Winter	24.452	0.0	710.1	180
240 min Winter	19.582	0.0	759.9	238
360 min Winter	14.239	0.0	829.9	352
480 min Winter	11.326	0.0	880.9	464
600 min Winter	9.473	0.0	921.5	572
720 min Winter	8.183	0.0	955.6	672
960 min Winter	6.491	0.0	1010.1	754
1440 min Winter	4.695	0.0	1093.7	1056
2160 min Winter	3.403	0.0	1184.6	1496
2880 min Winter	2.718	0.0	1257.4	1904
4320 min Winter	1.996	0.0	1375.1	2680
5760 min Winter	1.615	0.0	1473.3	3344

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 351306 389946 SJ 51306 89946
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+45

Time Area Diagram

Total Area (ha) 1.200

Time (mins) From:	To:	Area (ha)
0	4	1.200

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	58.0
Membrane Percolation (mm/hr)	1000	Length (m)	90.0
Max Percolation (l/s)	1450.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	99.550	Cap Volume Depth (m)	0.450

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0140-9100-1000-9100
Design Head (m)	1.000
Design Flow (l/s)	9.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	140
Invert Level (m)	99.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	9.1	Kick-Flo®	0.671	7.6
Flush-Flo™	0.304	9.1	Mean Flow over Head Range	-	7.8

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.0	1.200	9.9	3.000	15.3	7.000	23.0
0.200	8.8	1.400	10.7	3.500	16.5	7.500	23.7
0.300	9.1	1.600	11.4	4.000	17.6	8.000	24.5
0.400	9.0	1.800	12.0	4.500	18.6	8.500	25.2
0.500	8.8	2.000	12.6	5.000	19.5	9.000	25.9
0.600	8.3	2.200	13.2	5.500	20.4	9.500	26.6
0.800	8.2	2.400	13.8	6.000	21.3		
1.000	9.1	2.600	14.3	6.500	22.2		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.179	1.179	68.6	989.7	O K
30 min Summer	99.433	1.433	68.6	1270.2	O K
60 min Summer	99.625	1.625	68.6	1500.0	O K
120 min Summer	99.683	1.683	68.6	1572.1	O K
180 min Summer	99.655	1.655	68.6	1536.3	O K
240 min Summer	99.608	1.608	68.6	1478.7	O K
360 min Summer	99.529	1.529	68.6	1382.7	O K
480 min Summer	99.456	1.456	68.6	1297.2	O K
600 min Summer	99.383	1.383	68.6	1213.5	O K
720 min Summer	99.311	1.311	68.6	1132.4	O K
960 min Summer	99.166	1.166	68.6	976.3	O K
1440 min Summer	98.889	0.889	68.6	700.9	O K
2160 min Summer	98.522	0.522	68.6	379.5	O K
2880 min Summer	98.246	0.246	68.6	167.5	O K
4320 min Summer	98.000	0.000	67.4	0.0	O K
5760 min Summer	98.000	0.000	54.6	0.0	O K
15 min Winter	99.180	1.180	68.6	991.4	O K
30 min Winter	99.435	1.435	68.6	1273.2	O K
60 min Winter	99.632	1.632	68.6	1507.6	O K
120 min Winter	99.697	1.697	68.6	1588.6	O K
180 min Winter	99.678	1.678	68.6	1565.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	94.720	0.0	1059.3	18
30 min Summer	62.460	0.0	1399.6	33
60 min Summer	39.030	0.0	1753.1	62
120 min Summer	23.000	0.0	2067.3	122
180 min Summer	16.863	0.0	2273.8	180
240 min Summer	13.505	0.0	2428.1	206
360 min Summer	9.820	0.0	2648.5	268
480 min Summer	7.811	0.0	2809.0	334
600 min Summer	6.533	0.0	2936.7	404
720 min Summer	5.643	0.0	3044.1	470
960 min Summer	4.477	0.0	3220.0	606
1440 min Summer	3.238	0.0	3492.6	864
2160 min Summer	2.347	0.0	3800.2	1212
2880 min Summer	1.874	0.0	4046.0	1560
4320 min Summer	1.377	0.0	4460.0	0
5760 min Summer	1.114	0.0	4811.9	0
15 min Winter	94.720	0.0	1060.2	18
30 min Winter	62.460	0.0	1398.8	32
60 min Winter	39.030	0.0	1753.7	62
120 min Winter	23.000	0.0	2067.0	118
180 min Winter	16.863	0.0	2273.8	174

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	99.624	1.624	68.6	1498.1	O K
360 min Winter	99.520	1.520	68.6	1372.6	O K
480 min Winter	99.419	1.419	68.6	1254.1	O K
600 min Winter	99.310	1.310	68.6	1131.7	O K
720 min Winter	99.198	1.198	68.6	1010.3	O K
960 min Winter	98.971	0.971	68.6	779.8	O K
1440 min Winter	98.541	0.541	68.6	394.9	O K
2160 min Winter	98.059	0.059	68.6	38.8	O K
2880 min Winter	98.000	0.000	59.3	0.0	O K
4320 min Winter	98.000	0.000	43.5	0.0	O K
5760 min Winter	98.000	0.000	35.2	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	13.505	0.0	2428.0	226
360 min Winter	9.820	0.0	2648.5	280
480 min Winter	7.811	0.0	2809.0	356
600 min Winter	6.533	0.0	2936.7	430
720 min Winter	5.643	0.0	3044.3	500
960 min Winter	4.477	0.0	3220.0	638
1440 min Winter	3.238	0.0	3492.7	882
2160 min Winter	2.347	0.0	3800.4	1172
2880 min Winter	1.874	0.0	4048.2	0
4320 min Winter	1.377	0.0	4460.0	0
5760 min Winter	1.114	0.0	4811.8	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 351306 389946 SJ 51306 89946
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 9.000

Time (mins) From:	To:	Area (ha)
0	4	9.000

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	643.9	2.000	1396.1

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0324-6860-2000-6860
Design Head (m)	2.000
Design Flow (l/s)	68.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	324
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	68.6	Kick-Flo®	1.368	57.1
Flush-Flo™	0.627	68.6	Mean Flow over Head Range	-	58.6

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	9.7	1.200	63.1	3.000	83.4	7.000	126.0
0.200	33.1	1.400	57.7	3.500	89.9	7.500	130.4
0.300	58.6	1.600	61.5	4.000	95.9	8.000	134.5
0.400	66.3	1.800	65.1	4.500	101.6	8.500	138.6
0.500	68.0	2.000	68.6	5.000	107.0	9.000	142.5
0.600	68.5	2.200	71.8	5.500	112.0	9.500	146.3
0.800	67.9	2.400	74.9	6.000	116.9		
1.000	66.3	2.600	77.8	6.500	121.6		

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Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 2078 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	99.704	0.154	0.0	3.0	3.0	255.2	Flood Risk
30 min Summer	99.756	0.206	0.0	3.0	3.0	342.0	Flood Risk
60 min Summer	99.809	0.259	0.0	3.0	3.0	430.2	Flood Risk
120 min Summer	99.854	0.304	0.0	3.0	3.0	504.5	Flood Risk
180 min Summer	99.879	0.329	0.0	3.0	3.0	545.5	Flood Risk
240 min Summer	99.895	0.345	0.0	3.0	3.0	572.4	Flood Risk
360 min Summer	99.915	0.365	0.0	3.0	3.0	605.0	Flood Risk
480 min Summer	99.926	0.376	0.0	3.0	3.0	623.1	Flood Risk
600 min Summer	99.932	0.382	0.0	3.0	3.0	633.4	Flood Risk
720 min Summer	99.935	0.385	0.0	3.0	3.0	639.3	Flood Risk
960 min Summer	99.937	0.387	0.0	3.0	3.0	641.7	Flood Risk
1440 min Summer	99.928	0.378	0.0	3.0	3.0	626.5	Flood Risk
2160 min Summer	99.904	0.354	0.0	3.0	3.0	587.5	Flood Risk
2880 min Summer	99.887	0.337	0.0	3.0	3.0	558.8	Flood Risk
4320 min Summer	99.861	0.311	0.0	3.0	3.0	515.2	Flood Risk
5760 min Summer	99.837	0.287	0.0	3.0	3.0	476.6	Flood Risk
15 min Winter	99.724	0.174	0.0	3.0	3.0	289.3	Flood Risk
30 min Winter	99.783	0.233	0.0	3.0	3.0	386.8	Flood Risk
60 min Winter	99.843	0.293	0.0	3.0	3.0	486.3	Flood Risk
120 min Winter	99.894	0.344	0.0	3.0	3.0	570.7	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	152.250	0.0	216.0	19
30 min Summer	99.934	0.0	218.5	34
60 min Summer	62.408	0.0	439.0	64
120 min Summer	36.830	0.0	447.8	124
180 min Summer	26.840	0.0	453.1	184
240 min Summer	21.373	0.0	457.9	244
360 min Summer	15.433	0.0	464.0	362
480 min Summer	12.224	0.0	467.6	482
600 min Summer	10.198	0.0	470.3	602
720 min Summer	8.794	0.0	471.9	722
960 min Summer	6.969	0.0	474.3	962
1440 min Summer	5.031	0.0	475.8	1440
2160 min Summer	3.638	0.0	915.9	1800
2880 min Summer	2.896	0.0	900.0	2164
4320 min Summer	2.109	0.0	855.7	2944
5760 min Summer	1.691	0.0	1122.4	3808
15 min Winter	152.250	0.0	215.9	19
30 min Winter	99.934	0.0	222.3	34
60 min Winter	62.408	0.0	446.4	64
120 min Winter	36.830	0.0	456.1	122

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Summary of Results for 100 year Return Period (+45%)

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	99.922	0.372	0.0	3.0	3.0	617.9	Flood Risk
240 min Winter	99.942	0.392	0.0	3.0	3.0	649.6	Flood Risk
360 min Winter	99.965	0.415	0.0	3.0	3.0	688.9	Flood Risk
480 min Winter	99.979	0.429	0.0	3.0	3.0	711.8	Flood Risk
600 min Winter	99.988	0.438	0.0	3.0	3.0	726.3	Flood Risk
720 min Winter	99.993	0.443	0.0	3.0	3.0	735.7	Flood Risk
960 min Winter	99.999	0.449	0.0	3.0	3.0	744.6	Flood Risk
1440 min Winter	99.996	0.446	0.0	3.0	3.0	740.6	Flood Risk
2160 min Winter	99.975	0.425	0.0	3.0	3.0	705.5	Flood Risk
2880 min Winter	99.949	0.399	0.0	3.0	3.0	661.7	Flood Risk
4320 min Winter	99.913	0.363	0.0	3.0	3.0	601.6	Flood Risk
5760 min Winter	99.877	0.327	0.0	3.0	3.0	542.7	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
180 min Winter	26.840	0.0	463.8	182
240 min Winter	21.373	0.0	468.7	240
360 min Winter	15.433	0.0	474.8	358
480 min Winter	12.224	0.0	478.6	476
600 min Winter	10.198	0.0	481.0	592
720 min Winter	8.794	0.0	482.4	708
960 min Winter	6.969	0.0	483.7	940
1440 min Winter	5.032	0.0	482.9	1388
2160 min Winter	3.638	0.0	932.3	2032
2880 min Winter	2.896	0.0	931.1	2308
4320 min Winter	2.109	0.0	898.0	3204
5760 min Winter	1.691	0.0	1269.4	4152

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 372232 388607 SJ 72232 88607
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+45

Time Area Diagram

Total Area (ha) 1.000

Time (mins) From:	To:	Area (ha)
0	4	1.000

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000
Membrane Percolation (mm/hr)	1000
Max Percolation (l/s)	1536.1
Safety Factor	2.0
Porosity	0.30
Invert Level (m)	99.550
Width (m)	70.0
Length (m)	79.0
Slope (1:X)	0.0
Depression Storage (mm)	5
Evaporation (mm/day)	3
Cap Volume Depth (m)	0.450

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0082-3000-1000-3000
Design Head (m)	1.000
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	82
Invert Level (m)	99.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.0
Flush-Flo™	0.297	3.0
Kick-Flo®	0.623	2.4
Mean Flow over Head Range	-	2.6

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	2.4	0.800	2.7	2.000	4.1	4.000	5.7
0.200	2.9	1.000	3.0	2.200	4.3	4.500	6.0
0.300	3.0	1.200	3.3	2.400	4.5	5.000	6.3
0.400	2.9	1.400	3.5	2.600	4.7	5.500	6.6
0.500	2.8	1.600	3.7	3.000	5.0	6.000	6.9
0.600	2.5	1.800	3.9	3.500	5.4	6.500	7.2

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Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
7.000	7.4	8.000	7.9	9.000	8.4		
7.500	7.7	8.500	8.2	9.500	8.6		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.030	1.030	4.1	221.2	O K
30 min Summer	99.239	1.239	4.1	288.1	O K
60 min Summer	99.425	1.425	4.1	354.7	O K
120 min Summer	99.558	1.558	4.1	406.6	O K
180 min Summer	99.621	1.621	4.1	432.4	O K
240 min Summer	99.656	1.656	4.1	447.4	O K
360 min Summer	99.686	1.686	4.1	460.2	O K
480 min Summer	99.689	1.689	4.1	461.6	O K
600 min Summer	99.679	1.679	4.1	457.0	O K
720 min Summer	99.659	1.659	4.1	448.7	O K
960 min Summer	99.608	1.608	4.1	427.1	O K
1440 min Summer	99.534	1.534	4.1	396.8	O K
2160 min Summer	99.449	1.449	4.1	363.9	O K
2880 min Summer	99.373	1.373	4.1	335.2	O K
4320 min Summer	99.225	1.225	4.1	283.5	O K
5760 min Summer	99.081	1.081	4.1	236.7	O K
15 min Winter	99.030	1.030	4.1	221.2	O K
30 min Winter	99.239	1.239	4.1	288.1	O K
60 min Winter	99.425	1.425	4.1	354.5	O K
120 min Winter	99.560	1.560	4.1	407.2	O K
180 min Winter	99.624	1.624	4.1	433.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	105.000	0.0	223.2	19
30 min Summer	68.920	0.0	261.4	34
60 min Summer	43.040	0.0	369.5	64
120 min Summer	25.400	0.0	435.9	124
180 min Summer	18.510	0.0	476.0	182
240 min Summer	14.740	0.0	505.2	242
360 min Summer	10.643	0.0	545.7	362
480 min Summer	8.430	0.0	571.8	482
600 min Summer	7.033	0.0	583.6	602
720 min Summer	6.065	0.0	589.8	720
960 min Summer	4.806	0.0	597.8	896
1440 min Summer	3.470	0.0	596.3	1112
2160 min Summer	2.509	0.0	776.5	1496
2880 min Summer	1.997	0.0	824.1	1904
4320 min Summer	1.455	0.0	899.6	2724
5760 min Summer	1.166	0.0	962.7	3520
15 min Winter	105.000	0.0	223.2	19
30 min Winter	68.920	0.0	261.4	33
60 min Winter	43.040	0.0	369.3	62
120 min Winter	25.400	0.0	435.9	122
180 min Winter	18.510	0.0	476.2	180

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	99.659	1.659	4.1	448.7	O K
360 min Winter	99.691	1.691	4.1	462.3	O K
480 min Winter	99.697	1.697	4.1	464.8	O K
600 min Winter	99.689	1.689	4.1	461.6	O K
720 min Winter	99.674	1.674	4.1	455.0	O K
960 min Winter	99.630	1.630	4.1	436.1	O K
1440 min Winter	99.533	1.533	4.1	396.4	O K
2160 min Winter	99.421	1.421	4.1	353.2	O K
2880 min Winter	99.305	1.305	4.1	310.8	O K
4320 min Winter	99.064	1.064	4.1	231.5	O K
5760 min Winter	98.820	0.820	4.1	162.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	14.740	0.0	505.2	238
360 min Winter	10.643	0.0	545.7	356
480 min Winter	8.430	0.0	571.2	470
600 min Winter	7.033	0.0	581.7	584
720 min Winter	6.065	0.0	586.8	696
960 min Winter	4.806	0.0	593.8	914
1440 min Winter	3.470	0.0	597.4	1142
2160 min Winter	2.509	0.0	776.5	1600
2880 min Winter	1.998	0.0	824.2	2048
4320 min Winter	1.455	0.0	899.9	2896
5760 min Winter	1.166	0.0	962.7	3688

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 372232 388607 SJ 72232 88607
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.720

Time (mins) From:	To:	Area (ha)
0	4	1.720

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	140.0	2.000	504.8

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0083-4100-2000-4100
Design Head (m)	2.000
Design Flow (l/s)	4.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	83
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	4.1	Kick-Flo®	0.738	2.6
Flush-Flo™	0.362	3.2	Mean Flow over Head Range	-	3.2

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.4	1.200	3.2	3.000	5.0	7.000	7.4
0.200	3.0	1.400	3.5	3.500	5.3	7.500	7.6
0.300	3.2	1.600	3.7	4.000	5.7	8.000	7.9
0.400	3.2	1.800	3.9	4.500	6.0	8.500	8.1
0.500	3.2	2.000	4.1	5.000	6.3	9.000	8.3
0.600	3.0	2.200	4.3	5.500	6.6	9.500	8.5
0.800	2.7	2.400	4.5	6.000	6.9		
1.000	3.0	2.600	4.6	6.500	7.1		

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Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 1615 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	99.467	0.317	0.0	4.2	4.2	300.8	O K
30 min Summer	99.571	0.421	0.0	4.2	4.2	399.2	O K
60 min Summer	99.675	0.525	0.0	4.2	4.2	497.6	O K
120 min Summer	99.759	0.609	0.0	4.2	4.2	577.6	Flood Risk
180 min Summer	99.803	0.653	0.0	4.2	4.2	619.7	Flood Risk
240 min Summer	99.832	0.682	0.0	4.2	4.2	646.7	Flood Risk
360 min Summer	99.862	0.712	0.0	4.2	4.2	675.8	Flood Risk
480 min Summer	99.877	0.727	0.0	4.2	4.2	689.6	Flood Risk
600 min Summer	99.883	0.733	0.0	4.2	4.2	695.0	Flood Risk
720 min Summer	99.883	0.733	0.0	4.2	4.2	695.0	Flood Risk
960 min Summer	99.873	0.723	0.0	4.2	4.2	686.0	Flood Risk
1440 min Summer	99.830	0.680	0.0	4.2	4.2	645.2	Flood Risk
2160 min Summer	99.781	0.631	0.0	4.2	4.2	598.2	Flood Risk
2880 min Summer	99.745	0.595	0.0	4.2	4.2	564.2	Flood Risk
4320 min Summer	99.685	0.535	0.0	4.2	4.2	507.4	O K
5760 min Summer	99.632	0.482	0.0	4.2	4.2	457.0	O K
15 min Winter	99.508	0.358	0.0	4.2	4.2	339.2	O K
30 min Winter	99.624	0.474	0.0	4.2	4.2	449.9	O K
60 min Winter	99.741	0.591	0.0	4.2	4.2	561.0	Flood Risk
120 min Winter	99.838	0.688	0.0	4.2	4.2	652.7	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	155.440	0.0	304.2	19
30 min Summer	102.457	0.0	351.6	34
60 min Summer	64.018	0.0	511.6	64
120 min Summer	37.736	0.0	605.4	124
180 min Summer	27.468	0.0	662.2	184
240 min Summer	21.852	0.0	671.0	242
360 min Summer	15.752	0.0	668.3	362
480 min Summer	12.466	0.0	666.0	482
600 min Summer	10.395	0.0	664.3	602
720 min Summer	8.961	0.0	662.9	722
960 min Summer	7.100	0.0	661.5	960
1440 min Summer	5.112	0.0	659.5	1312
2160 min Summer	3.687	0.0	1064.7	1664
2880 min Summer	2.932	0.0	1125.6	2048
4320 min Summer	2.135	0.0	1191.2	2856
5760 min Summer	1.713	0.0	1303.7	3688
15 min Winter	155.440	0.0	342.6	19
30 min Winter	102.457	0.0	344.5	34
60 min Winter	64.018	0.0	575.1	64
120 min Winter	37.736	0.0	670.8	122

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Summary of Results for 100 year Return Period (+45%)

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	99.890	0.740	0.0	4.2	4.2	702.4	Flood Risk
240 min Winter	99.924	0.774	0.0	4.2	4.2	734.3	Flood Risk
360 min Winter	99.963	0.813	0.0	4.2	4.2	771.2	Flood Risk
480 min Winter	99.984	0.834	0.0	4.2	4.2	790.9	Flood Risk
600 min Winter	99.995	0.845	0.0	4.2	4.2	801.7	Flood Risk
720 min Winter	100.000	0.850	0.0	4.2	4.2	806.2	Flood Risk
960 min Winter	99.999	0.849	0.0	4.2	4.2	805.4	Flood Risk
1440 min Winter	99.969	0.819	0.0	4.2	4.2	776.8	Flood Risk
2160 min Winter	99.897	0.747	0.0	4.2	4.2	708.8	Flood Risk
2880 min Winter	99.850	0.700	0.0	4.2	4.2	664.4	Flood Risk
4320 min Winter	99.762	0.612	0.0	4.2	4.2	580.3	Flood Risk
5760 min Winter	99.678	0.528	0.0	4.2	4.2	500.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
180 min Winter	27.468	0.0	668.5	180
240 min Winter	21.852	0.0	666.3	240
360 min Winter	15.752	0.0	663.4	358
480 min Winter	12.466	0.0	661.7	474
600 min Winter	10.395	0.0	660.5	590
720 min Winter	8.961	0.0	659.8	706
960 min Winter	7.100	0.0	659.3	934
1440 min Winter	5.112	0.0	662.3	1372
2160 min Winter	3.687	0.0	1195.9	1776
2880 min Winter	2.932	0.0	1265.8	2196
4320 min Winter	2.135	0.0	1230.2	3116
5760 min Winter	1.713	0.0	1465.1	3984

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 372706 391679 SJ 72706 91679
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+45

Time Area Diagram

Total Area (ha) 1.100

Time (mins) From:	To:	Area (ha)
0	4	1.100

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	51.0
Membrane Percolation (mm/hr)	1000	Length (m)	62.0
Max Percolation (l/s)	878.3	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	99.150	Cap Volume Depth (m)	0.850

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0097-4200-1000-4200
Design Head (m)	1.000
Design Flow (l/s)	4.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	97
Invert Level (m)	99.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	4.2	Kick-Flo®	0.635	3.4
Flush-Flo™	0.299	4.2	Mean Flow over Head Range	-	3.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.2	1.200	4.6	3.000	7.0	7.000	10.4
0.200	4.1	1.400	4.9	3.500	7.5	7.500	10.8
0.300	4.2	1.600	5.2	4.000	8.0	8.000	11.1
0.400	4.1	1.800	5.5	4.500	8.5	8.500	11.5
0.500	4.0	2.000	5.8	5.000	8.9	9.000	11.8
0.600	3.6	2.200	6.0	5.500	9.3	9.500	12.1
0.800	3.8	2.400	6.3	6.000	9.7		
1.000	4.2	2.600	6.5	6.500	10.1		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.256	1.256	22.6	296.8	O K
30 min Summer	99.481	1.481	22.6	379.5	O K
60 min Summer	99.643	1.643	22.6	445.6	O K
120 min Summer	99.678	1.678	22.6	460.6	O K
180 min Summer	99.630	1.630	22.6	440.0	O K
240 min Summer	99.580	1.580	22.6	419.4	O K
360 min Summer	99.496	1.496	22.6	385.3	O K
480 min Summer	99.418	1.418	22.6	355.1	O K
600 min Summer	99.340	1.340	22.6	326.5	O K
720 min Summer	99.264	1.264	22.6	299.4	O K
960 min Summer	99.113	1.113	22.6	249.3	O K
1440 min Summer	98.814	0.814	22.6	162.5	O K
2160 min Summer	98.413	0.413	22.6	70.1	O K
2880 min Summer	98.123	0.123	22.6	18.4	O K
4320 min Summer	98.000	0.000	19.2	0.0	O K
5760 min Summer	98.000	0.000	15.4	0.0	O K
15 min Winter	99.258	1.258	22.6	297.4	O K
30 min Winter	99.484	1.484	22.6	380.7	O K
60 min Winter	99.648	1.648	22.6	448.0	O K
120 min Winter	99.692	1.692	22.6	466.7	O K
180 min Winter	99.651	1.651	22.6	449.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	107.200	0.0	321.0	18
30 min Summer	70.660	0.0	423.6	33
60 min Summer	44.150	0.0	529.6	62
120 min Summer	26.025	0.0	624.1	120
180 min Summer	18.943	0.0	681.8	170
240 min Summer	15.070	0.0	723.2	196
360 min Summer	10.863	0.0	782.0	258
480 min Summer	8.598	0.0	825.2	326
600 min Summer	7.169	0.0	860.1	394
720 min Summer	6.180	0.0	889.8	462
960 min Summer	4.897	0.0	940.0	590
1440 min Summer	3.526	0.0	1015.2	840
2160 min Summer	2.543	0.0	1098.5	1188
2880 min Summer	2.022	0.0	1164.7	1504
4320 min Summer	1.472	0.0	1272.1	0
5760 min Summer	1.182	0.0	1361.3	0
15 min Winter	107.200	0.0	321.3	18
30 min Winter	70.660	0.0	423.4	32
60 min Winter	44.150	0.0	529.7	62
120 min Winter	26.025	0.0	624.5	118
180 min Winter	18.943	0.0	681.8	172

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	99.582	1.582	22.6	420.2	O K
360 min Winter	99.478	1.478	22.6	378.5	O K
480 min Winter	99.366	1.366	22.6	336.0	O K
600 min Winter	99.249	1.249	22.6	294.1	O K
720 min Winter	99.128	1.128	22.6	254.1	O K
960 min Winter	98.885	0.885	22.6	181.5	O K
1440 min Winter	98.400	0.400	22.6	67.5	O K
2160 min Winter	98.000	0.000	21.4	0.0	O K
2880 min Winter	98.000	0.000	17.0	0.0	O K
4320 min Winter	98.000	0.000	12.4	0.0	O K
5760 min Winter	98.000	0.000	10.0	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	15.070	0.0	723.2	202
360 min Winter	10.863	0.0	782.0	274
480 min Winter	8.598	0.0	825.2	348
600 min Winter	7.169	0.0	860.1	422
720 min Winter	6.180	0.0	889.8	500
960 min Winter	4.897	0.0	940.0	626
1440 min Winter	3.526	0.0	1015.2	852
2160 min Winter	2.543	0.0	1098.6	0
2880 min Winter	2.022	0.0	1164.8	0
4320 min Winter	1.472	0.0	1272.1	0
5760 min Winter	1.182	0.0	1361.3	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 372706 391679 SJ 72706 91679
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 2.400

Time (mins) From:	To:	Area (ha)
0	4	2.400

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	141.8	2.000	508.2

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0195-2260-2000-2260
Design Head (m)	2.000
Design Flow (l/s)	22.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	195
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	22.6
Flush-Flo™	0.579	22.6
Kick-Flo®	1.240	18.0
Mean Flow over Head Range	-	19.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.8	1.200	18.8	3.000	27.4	7.000	41.2
0.200	18.2	1.400	19.1	3.500	29.5	7.500	42.6
0.300	21.0	1.600	20.3	4.000	31.5	8.000	44.0
0.400	22.0	1.800	21.5	4.500	33.3	8.500	45.3
0.500	22.5	2.000	22.6	5.000	35.1	9.000	46.6
0.600	22.6	2.200	23.6	5.500	36.7	9.500	47.8
0.800	22.2	2.400	24.6	6.000	38.3		
1.000	21.2	2.600	25.6	6.500	39.8		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.086	1.086	8.4	285.5	O K
30 min Summer	99.311	1.311	8.4	371.8	O K
60 min Summer	99.502	1.502	8.4	453.9	O K
120 min Summer	99.624	1.624	8.4	510.6	O K
180 min Summer	99.671	1.671	8.4	533.4	O K
240 min Summer	99.688	1.688	8.4	541.5	O K
360 min Summer	99.675	1.675	8.4	535.3	O K
480 min Summer	99.634	1.634	8.4	515.0	O K
600 min Summer	99.587	1.587	8.4	492.9	O K
720 min Summer	99.550	1.550	8.4	475.8	O K
960 min Summer	99.490	1.490	8.4	448.6	O K
1440 min Summer	99.387	1.387	8.4	403.5	O K
2160 min Summer	99.240	1.240	8.4	343.5	O K
2880 min Summer	99.097	1.097	8.4	289.4	O K
4320 min Summer	98.825	0.825	8.4	197.8	O K
5760 min Summer	98.579	0.579	8.4	126.7	O K
15 min Winter	99.086	1.086	8.4	285.5	O K
30 min Winter	99.312	1.312	8.4	372.1	O K
60 min Winter	99.503	1.503	8.4	454.3	O K
120 min Winter	99.628	1.628	8.4	512.2	O K
180 min Winter	99.676	1.676	8.4	535.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	107.200	0.0	293.8	19
30 min Summer	70.660	0.0	387.2	34
60 min Summer	44.150	0.0	485.2	64
120 min Summer	26.025	0.0	571.8	122
180 min Summer	18.943	0.0	624.6	182
240 min Summer	15.070	0.0	662.5	242
360 min Summer	10.863	0.0	716.2	360
480 min Summer	8.598	0.0	755.9	480
600 min Summer	7.169	0.0	787.9	526
720 min Summer	6.180	0.0	815.0	586
960 min Summer	4.897	0.0	861.0	706
1440 min Summer	3.526	0.0	929.6	980
2160 min Summer	2.543	0.0	1006.8	1384
2880 min Summer	2.022	0.0	1067.5	1788
4320 min Summer	1.472	0.0	1165.6	2552
5760 min Summer	1.182	0.0	1247.8	3240
15 min Winter	107.200	0.0	293.8	19
30 min Winter	70.660	0.0	387.2	33
60 min Winter	44.150	0.0	485.2	62
120 min Winter	26.025	0.0	571.9	120
180 min Winter	18.943	0.0	624.5	180

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	99.694	1.694	8.4	544.7	O K
360 min Winter	99.687	1.687	8.4	541.3	O K
480 min Winter	99.653	1.653	8.4	524.6	O K
600 min Winter	99.606	1.606	8.4	502.0	O K
720 min Winter	99.553	1.553	8.4	477.0	O K
960 min Winter	99.483	1.483	8.4	445.3	O K
1440 min Winter	99.338	1.338	8.4	382.9	O K
2160 min Winter	99.109	1.109	8.4	293.8	O K
2880 min Winter	98.878	0.878	8.4	214.6	O K
4320 min Winter	98.434	0.434	8.4	90.0	O K
5760 min Winter	98.078	0.078	8.4	14.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	15.070	0.0	662.5	236
360 min Winter	10.863	0.0	716.4	350
480 min Winter	8.598	0.0	755.9	462
600 min Winter	7.169	0.0	787.9	566
720 min Winter	6.180	0.0	815.0	644
960 min Winter	4.897	0.0	861.0	742
1440 min Winter	3.526	0.0	929.7	1040
2160 min Winter	2.543	0.0	1006.8	1472
2880 min Winter	2.022	0.0	1067.5	1876
4320 min Winter	1.472	0.0	1165.6	2596
5760 min Winter	1.182	0.0	1247.8	3120

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 372706 391679 SJ 72706 91679
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 2.200

Time (mins) From:	To:	Area (ha)
0	4	2.200

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	175.2	2.000	569.8

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0120-8400-2000-8400
Design Head (m)	2.000
Design Flow (l/s)	8.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	120
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	8.4	Kick-Flo®	1.066	6.2
Flush-Flo™	0.523	7.9	Mean Flow over Head Range	-	7.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.2	1.200	6.6	3.000	10.2	7.000	15.2
0.200	6.8	1.400	7.1	3.500	10.9	7.500	15.7
0.300	7.5	1.600	7.6	4.000	11.6	8.000	16.2
0.400	7.8	1.800	8.0	4.500	12.3	8.500	16.7
0.500	7.9	2.000	8.4	5.000	12.9	9.000	17.1
0.600	7.8	2.200	8.8	5.500	13.5	9.500	17.6
0.800	7.6	2.400	9.1	6.000	14.1		
1.000	6.7	2.600	9.5	6.500	14.7		

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Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 928 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	99.637	0.187	0.0	5.6	5.6	229.2	O K
30 min Summer	99.698	0.248	0.0	5.6	5.6	303.9	O K
60 min Summer	99.759	0.309	0.0	5.6	5.6	378.4	Flood Risk
120 min Summer	99.816	0.366	0.0	5.6	5.6	448.6	Flood Risk
180 min Summer	99.847	0.397	0.0	5.6	5.6	485.6	Flood Risk
240 min Summer	99.864	0.414	0.0	5.6	5.6	506.5	Flood Risk
360 min Summer	99.880	0.430	0.0	5.6	5.6	526.2	Flood Risk
480 min Summer	99.881	0.431	0.0	5.6	5.6	528.2	Flood Risk
600 min Summer	99.876	0.426	0.0	5.6	5.6	521.1	Flood Risk
720 min Summer	99.865	0.415	0.0	5.6	5.6	508.0	Flood Risk
960 min Summer	99.841	0.391	0.0	5.6	5.6	478.9	Flood Risk
1440 min Summer	99.804	0.354	0.0	5.6	5.6	433.4	Flood Risk
2160 min Summer	99.759	0.309	0.0	5.6	5.6	378.4	Flood Risk
2880 min Summer	99.720	0.270	0.0	5.6	5.6	331.0	Flood Risk
4320 min Summer	99.654	0.204	0.0	5.6	5.6	250.2	O K
5760 min Summer	99.601	0.151	0.0	5.6	5.6	184.3	O K
7200 min Summer	99.559	0.109	0.0	5.6	5.6	133.2	O K
8640 min Summer	99.526	0.076	0.0	5.6	5.6	92.5	O K
10080 min Summer	99.500	0.050	0.0	5.6	5.6	61.5	O K
15 min Winter	99.662	0.212	0.0	5.6	5.6	259.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	154.292	0.0	233.3	19
30 min Summer	101.171	0.0	312.4	34
60 min Summer	63.304	0.0	396.1	64
120 min Summer	38.385	0.0	484.6	124
180 min Summer	28.390	0.0	539.7	182
240 min Summer	22.822	0.0	579.1	242
360 min Summer	16.665	0.0	635.7	362
480 min Summer	13.266	0.0	675.2	482
600 min Summer	11.085	0.0	705.5	600
720 min Summer	9.555	0.0	729.7	714
960 min Summer	7.536	0.0	766.7	810
1440 min Summer	5.365	0.0	816.4	1042
2160 min Summer	3.806	0.0	864.4	1452
2880 min Summer	2.987	0.0	901.1	1848
4320 min Summer	2.134	0.0	955.9	2640
5760 min Summer	1.692	0.0	1001.0	3400
7200 min Summer	1.424	0.0	1045.3	4112
8640 min Summer	1.243	0.0	1087.1	4760
10080 min Summer	1.111	0.0	1124.7	5536
15 min Winter	154.292	0.0	263.9	19

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Summary of Results for 100 year Return Period (+45%)

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
30 min Winter	99.731	0.281	0.0	5.6	5.6	344.1	Flood Risk
60 min Winter	99.800	0.350	0.0	5.6	5.6	428.7	Flood Risk
120 min Winter	99.867	0.417	0.0	5.6	5.6	509.9	Flood Risk
180 min Winter	99.902	0.452	0.0	5.6	5.6	553.8	Flood Risk
240 min Winter	99.924	0.474	0.0	5.6	5.6	579.8	Flood Risk
360 min Winter	99.946	0.496	0.0	5.6	5.6	607.1	Flood Risk
480 min Winter	99.953	0.503	0.0	5.6	5.6	615.3	Flood Risk
600 min Winter	99.951	0.501	0.0	5.6	5.6	613.2	Flood Risk
720 min Winter	99.944	0.494	0.0	5.6	5.6	604.7	Flood Risk
960 min Winter	99.920	0.470	0.0	5.6	5.6	575.7	Flood Risk
1440 min Winter	99.868	0.418	0.0	5.6	5.6	512.3	Flood Risk
2160 min Winter	99.807	0.357	0.0	5.6	5.6	436.5	Flood Risk
2880 min Winter	99.749	0.299	0.0	5.6	5.6	366.2	Flood Risk
4320 min Winter	99.650	0.200	0.0	5.6	5.6	244.3	O K
5760 min Winter	99.570	0.120	0.0	5.6	5.6	147.0	O K
7200 min Winter	99.511	0.061	0.0	5.6	5.6	74.5	O K
8640 min Winter	99.470	0.020	0.0	5.6	5.6	24.5	O K
10080 min Winter	99.450	0.000	0.0	5.6	5.6	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	101.171	0.0	352.6	33
60 min Winter	63.304	0.0	446.3	62
120 min Winter	38.385	0.0	545.3	122
180 min Winter	28.390	0.0	607.2	180
240 min Winter	22.822	0.0	651.8	238
360 min Winter	16.665	0.0	715.3	354
480 min Winter	13.266	0.0	759.5	470
600 min Winter	11.085	0.0	793.2	584
720 min Winter	9.555	0.0	820.2	694
960 min Winter	7.536	0.0	862.3	906
1440 min Winter	5.365	0.0	853.9	1126
2160 min Winter	3.806	0.0	973.9	1580
2880 min Winter	2.987	0.0	1013.9	2020
4320 min Winter	2.134	0.0	1077.6	2812
5760 min Winter	1.692	0.0	1130.3	3576
7200 min Winter	1.424	0.0	1180.9	4256
8640 min Winter	1.243	0.0	1228.6	4760
10080 min Winter	1.111	0.0	1274.0	5144

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 369669 370032 SJ 69669 70032
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.880

Time (mins) From:	To:	Area (ha)
0	4	0.880

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	53.0
Membrane Percolation (mm/hr)	1000	Length (m)	77.0
Max Percolation (l/s)	1133.6	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	99.450	Cap Volume Depth (m)	0.550

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0111-5600-1000-5600
Design Head (m)	1.000
Design Flow (l/s)	5.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	111
Invert Level (m)	99.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	5.6	Kick-Flo®	0.641	4.6
Flush-Flo™	0.294	5.6	Mean Flow over Head Range	-	4.9

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	3.9	1.200	6.1	3.000	9.4	7.000	14.0
0.200	5.4	1.400	6.6	3.500	10.1	7.500	14.5
0.300	5.6	1.600	7.0	4.000	10.7	8.000	15.0
0.400	5.5	1.800	7.4	4.500	11.4	8.500	15.4
0.500	5.3	2.000	7.7	5.000	11.9	9.000	15.8
0.600	4.9	2.200	8.1	5.500	12.5	9.500	16.2
0.800	5.0	2.400	8.4	6.000	13.0		
1.000	5.6	2.600	8.8	6.500	13.5		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.101	1.101	61.4	319.7	O K
30 min Summer	99.328	1.328	61.4	415.1	O K
60 min Summer	99.515	1.515	61.4	501.9	O K
120 min Summer	99.645	1.645	61.4	567.4	O K
180 min Summer	99.679	1.679	61.4	585.4	O K
240 min Summer	99.649	1.649	61.4	569.6	O K
360 min Summer	99.554	1.554	61.4	521.1	O K
480 min Summer	99.447	1.447	61.4	469.3	O K
600 min Summer	99.334	1.334	61.4	417.5	O K
720 min Summer	99.281	1.281	61.4	394.4	O K
960 min Summer	99.262	1.262	61.4	385.9	O K
1440 min Summer	98.860	0.860	61.4	230.2	O K
2160 min Summer	98.000	0.000	51.3	0.0	O K
2880 min Summer	98.000	0.000	48.6	0.0	O K
4320 min Summer	98.000	0.000	47.2	0.0	O K
5760 min Summer	98.000	0.000	46.6	0.0	O K
7200 min Summer	98.000	0.000	46.3	0.0	O K
8640 min Summer	98.000	0.000	46.2	0.0	O K
10080 min Summer	98.000	0.000	46.0	0.0	O K
15 min Winter	99.103	1.103	61.4	320.6	O K
30 min Winter	99.332	1.332	61.4	416.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	106.800	0.0	2418.2	19
30 min Summer	70.000	0.0	2526.4	33
60 min Summer	43.800	0.0	2653.2	64
120 min Summer	26.550	0.0	2774.3	122
180 min Summer	19.633	0.0	2850.1	180
240 min Summer	15.775	0.0	2904.5	230
360 min Summer	11.500	0.0	2981.4	272
480 min Summer	9.145	0.0	3035.5	332
600 min Summer	7.634	0.0	3076.8	410
720 min Summer	6.575	0.0	3110.1	492
960 min Summer	5.176	0.0	3161.1	636
1440 min Summer	3.675	0.0	3231.0	780
2160 min Summer	2.599	0.0	3302.4	0
2880 min Summer	2.035	0.0	3356.1	0
4320 min Summer	1.450	0.0	3443.2	0
5760 min Summer	1.148	0.0	3520.1	0
7200 min Summer	0.966	0.0	3594.2	0
8640 min Summer	0.844	0.0	3666.7	0
10080 min Summer	0.756	0.0	3738.8	0
15 min Winter	106.800	0.0	2418.3	18
30 min Winter	70.000	0.0	2526.2	33

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.523	1.523	61.4	506.2	O K
120 min Winter	99.656	1.656	61.4	573.4	O K
180 min Winter	99.694	1.694	61.4	593.4	O K
240 min Winter	99.669	1.669	61.4	579.8	O K
360 min Winter	99.560	1.560	61.4	524.4	O K
480 min Winter	99.428	1.428	61.4	460.5	O K
600 min Winter	99.302	1.302	61.4	403.5	O K
720 min Winter	99.218	1.218	61.4	367.3	O K
960 min Winter	99.134	1.134	61.4	332.8	O K
1440 min Winter	98.610	0.610	61.4	149.8	O K
2160 min Winter	98.000	0.000	54.3	0.0	O K
2880 min Winter	98.000	0.000	49.0	0.0	O K
4320 min Winter	98.000	0.000	47.4	0.0	O K
5760 min Winter	98.000	0.000	46.9	0.0	O K
7200 min Winter	98.000	0.000	46.6	0.0	O K
8640 min Winter	98.000	0.000	46.3	0.0	O K
10080 min Winter	98.000	0.000	46.1	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	43.800	0.0	2653.8	62
120 min Winter	26.550	0.0	2774.7	120
180 min Winter	19.633	0.0	2849.9	178
240 min Winter	15.775	0.0	2904.6	230
360 min Winter	11.500	0.0	2981.4	282
480 min Winter	9.145	0.0	3035.5	352
600 min Winter	7.634	0.0	3076.8	442
720 min Winter	6.575	0.0	3110.1	528
960 min Winter	5.176	0.0	3161.0	690
1440 min Winter	3.675	0.0	3231.0	764
2160 min Winter	2.599	0.0	3302.4	0
2880 min Winter	2.035	0.0	3356.1	0
4320 min Winter	1.450	0.0	3443.2	0
5760 min Winter	1.148	0.0	3520.1	0
7200 min Winter	0.966	0.0	3594.2	0
8640 min Winter	0.844	0.0	3666.7	0
10080 min Winter	0.756	0.0	3738.8	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 369500 369800 SJ 69500 69800
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 2.600

Time (mins) From:	To:	Area (ha)
0	4	2.600

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	196.8	2.000	608.2

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0309-6160-2000-6160
Design Head (m)	2.000
Design Flow (l/s)	61.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	309
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	61.4	Kick-Flo®	1.360	51.0
Flush-Flo™	0.625	61.4	Mean Flow over Head Range	-	52.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.4	1.200	56.4	3.000	74.8	7.000	112.9
0.200	31.7	1.400	51.7	3.500	80.6	7.500	116.8
0.300	54.6	1.600	55.2	4.000	86.0	8.000	120.5
0.400	59.4	1.800	58.4	4.500	91.0	8.500	124.1
0.500	60.9	2.000	61.4	5.000	95.8	9.000	127.6
0.600	61.4	2.200	64.3	5.500	100.4	9.500	131.0
0.800	60.8	2.400	67.1	6.000	104.7		
1.000	59.3	2.600	69.8	6.500	108.9		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.020	1.020	45.1	896.6	O K
30 min Summer	99.273	1.273	45.1	1152.6	O K
60 min Summer	99.491	1.491	45.1	1384.2	O K
120 min Summer	99.646	1.646	45.1	1555.8	O K
180 min Summer	99.686	1.686	45.1	1601.3	O K
240 min Summer	99.676	1.676	45.1	1589.9	O K
360 min Summer	99.600	1.600	45.1	1505.1	O K
480 min Summer	99.534	1.534	45.1	1431.3	O K
600 min Summer	99.472	1.472	45.1	1364.1	O K
720 min Summer	99.412	1.412	45.1	1299.7	O K
960 min Summer	99.292	1.292	45.1	1172.5	O K
1440 min Summer	99.058	1.058	45.1	933.9	O K
2160 min Summer	98.737	0.737	45.1	626.2	O K
2880 min Summer	98.470	0.470	45.1	386.9	O K
4320 min Summer	98.124	0.124	45.1	97.8	O K
5760 min Summer	98.000	0.000	44.4	0.0	O K
7200 min Summer	98.000	0.000	37.3	0.0	O K
8640 min Summer	98.000	0.000	32.6	0.0	O K
10080 min Summer	98.000	0.000	29.2	0.0	O K
15 min Winter	99.022	1.022	45.1	898.1	O K
30 min Winter	99.276	1.276	45.1	1155.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	106.800	0.0	937.5	19
30 min Summer	70.000	0.0	1232.1	33
60 min Summer	43.800	0.0	1548.9	62
120 min Summer	26.550	0.0	1880.4	122
180 min Summer	19.633	0.0	2086.1	182
240 min Summer	15.775	0.0	2234.7	240
360 min Summer	11.500	0.0	2444.3	312
480 min Summer	9.145	0.0	2591.8	372
600 min Summer	7.634	0.0	2704.5	446
720 min Summer	6.575	0.0	2795.1	500
960 min Summer	5.176	0.0	2933.9	636
1440 min Summer	3.675	0.0	3123.9	898
2160 min Summer	2.599	0.0	3318.8	1280
2880 min Summer	2.035	0.0	3464.8	1640
4320 min Summer	1.450	0.0	3699.6	2292
5760 min Summer	1.148	0.0	3912.1	0
7200 min Summer	0.966	0.0	4114.4	0
8640 min Summer	0.844	0.0	4312.4	0
10080 min Summer	0.756	0.0	4509.3	0
15 min Winter	106.800	0.0	938.3	18
30 min Winter	70.000	0.0	1232.4	33

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.496	1.496	45.1	1390.0	O K
120 min Winter	99.654	1.654	45.1	1565.4	O K
180 min Winter	99.699	1.699	45.1	1616.7	O K
240 min Winter	99.697	1.697	45.1	1613.7	O K
360 min Winter	99.621	1.621	45.1	1528.0	O K
480 min Winter	99.532	1.532	45.1	1429.3	O K
600 min Winter	99.455	1.455	45.1	1346.0	O K
720 min Winter	99.374	1.374	45.1	1258.4	O K
960 min Winter	99.201	1.201	45.1	1078.5	O K
1440 min Winter	98.857	0.857	45.1	738.8	O K
2160 min Winter	98.402	0.402	45.1	327.8	O K
2880 min Winter	98.084	0.084	45.1	66.0	O K
4320 min Winter	98.000	0.000	36.2	0.0	O K
5760 min Winter	98.000	0.000	28.6	0.0	O K
7200 min Winter	98.000	0.000	24.1	0.0	O K
8640 min Winter	98.000	0.000	21.0	0.0	O K
10080 min Winter	98.000	0.000	18.9	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	43.800	0.0	1550.5	62
120 min Winter	26.550	0.0	1880.4	120
180 min Winter	19.633	0.0	2085.7	176
240 min Winter	15.775	0.0	2234.9	234
360 min Winter	11.500	0.0	2444.3	338
480 min Winter	9.145	0.0	2591.8	382
600 min Winter	7.634	0.0	2704.5	458
720 min Winter	6.575	0.0	2795.1	534
960 min Winter	5.176	0.0	2934.1	676
1440 min Winter	3.675	0.0	3124.1	954
2160 min Winter	2.599	0.0	3318.9	1320
2880 min Winter	2.035	0.0	3465.0	1588
4320 min Winter	1.450	0.0	3706.1	0
5760 min Winter	1.148	0.0	3912.1	0
7200 min Winter	0.966	0.0	4114.4	0
8640 min Winter	0.844	0.0	4312.4	0
10080 min Winter	0.756	0.0	4509.3	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 369500 369800 SJ 69500 69800
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 7.100

Time (mins) From:	To:	Area (ha)
0	4	7.100

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	776.8	2.000	1208.1

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0269-4510-2000-4510
Design Head (m)	2.000
Design Flow (l/s)	45.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	269
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	45.1	Kick-Flo®	1.312	36.8
Flush-Flo™	0.599	45.1	Mean Flow over Head Range	-	38.8

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.5	1.200	40.1	3.000	54.8	7.000	82.7
0.200	27.6	1.400	38.0	3.500	59.0	7.500	85.5
0.300	41.7	1.600	40.5	4.000	63.0	8.000	88.2
0.400	43.8	1.800	42.8	4.500	66.7	8.500	90.9
0.500	44.8	2.000	45.1	5.000	70.2	9.000	93.4
0.600	45.1	2.200	47.2	5.500	73.5	9.500	95.9
0.800	44.5	2.400	49.2	6.000	76.7		
1.000	43.1	2.600	51.1	6.500	79.7		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.095	1.095	11.8	226.9	O K
30 min Summer	99.328	1.328	11.8	291.5	O K
60 min Summer	99.521	1.521	11.8	349.6	O K
120 min Summer	99.652	1.652	11.8	391.7	O K
180 min Summer	99.683	1.683	11.8	402.0	O K
240 min Summer	99.670	1.670	11.8	397.8	O K
360 min Summer	99.604	1.604	11.8	375.9	O K
480 min Summer	99.545	1.545	11.8	357.2	O K
600 min Summer	99.490	1.490	11.8	340.1	O K
720 min Summer	99.436	1.436	11.8	323.4	O K
960 min Summer	99.325	1.325	11.8	290.5	O K
1440 min Summer	99.103	1.103	11.8	229.0	O K
2160 min Summer	98.784	0.784	11.8	150.1	O K
2880 min Summer	98.504	0.504	11.8	89.8	O K
4320 min Summer	98.119	0.119	11.8	19.1	O K
5760 min Summer	98.000	0.000	11.2	0.0	O K
7200 min Summer	98.000	0.000	9.5	0.0	O K
8640 min Summer	98.000	0.000	8.3	0.0	O K
10080 min Summer	98.000	0.000	7.4	0.0	O K
15 min Winter	99.097	1.097	11.8	227.3	O K
30 min Winter	99.331	1.331	11.8	292.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	106.800	0.0	239.5	19
30 min Summer	70.000	0.0	314.3	33
60 min Summer	43.800	0.0	393.6	62
120 min Summer	26.550	0.0	477.7	122
180 min Summer	19.633	0.0	529.8	182
240 min Summer	15.775	0.0	567.6	240
360 min Summer	11.500	0.0	620.7	308
480 min Summer	9.145	0.0	658.2	368
600 min Summer	7.634	0.0	686.8	430
720 min Summer	6.575	0.0	709.8	498
960 min Summer	5.176	0.0	745.1	628
1440 min Summer	3.675	0.0	793.4	896
2160 min Summer	2.599	0.0	842.0	1276
2880 min Summer	2.035	0.0	879.1	1616
4320 min Summer	1.450	0.0	939.2	2292
5760 min Summer	1.148	0.0	991.8	0
7200 min Summer	0.966	0.0	1043.1	0
8640 min Summer	0.844	0.0	1093.3	0
10080 min Summer	0.756	0.0	1143.2	0
15 min Winter	106.800	0.0	239.7	18
30 min Winter	70.000	0.0	314.4	33

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.526	1.526	11.8	351.1	O K
120 min Winter	99.660	1.660	11.8	394.3	O K
180 min Winter	99.695	1.695	11.8	406.1	O K
240 min Winter	99.690	1.690	11.8	404.2	O K
360 min Winter	99.618	1.618	11.8	380.5	O K
480 min Winter	99.542	1.542	11.8	356.2	O K
600 min Winter	99.472	1.472	11.8	334.4	O K
720 min Winter	99.397	1.397	11.8	311.5	O K
960 min Winter	99.235	1.235	11.8	264.8	O K
1440 min Winter	98.898	0.898	11.8	177.1	O K
2160 min Winter	98.420	0.420	11.8	73.2	O K
2880 min Winter	98.065	0.065	11.8	10.3	O K
4320 min Winter	98.000	0.000	9.2	0.0	O K
5760 min Winter	98.000	0.000	7.3	0.0	O K
7200 min Winter	98.000	0.000	6.1	0.0	O K
8640 min Winter	98.000	0.000	5.3	0.0	O K
10080 min Winter	98.000	0.000	4.8	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	43.800	0.0	394.0	62
120 min Winter	26.550	0.0	477.7	120
180 min Winter	19.633	0.0	529.8	176
240 min Winter	15.775	0.0	567.6	232
360 min Winter	11.500	0.0	620.7	336
480 min Winter	9.145	0.0	658.2	378
600 min Winter	7.634	0.0	686.8	454
720 min Winter	6.575	0.0	709.8	530
960 min Winter	5.176	0.0	745.1	676
1440 min Winter	3.675	0.0	793.4	952
2160 min Winter	2.599	0.0	842.0	1300
2880 min Winter	2.035	0.0	879.2	1588
4320 min Winter	1.450	0.0	939.6	0
5760 min Winter	1.148	0.0	991.8	0
7200 min Winter	0.966	0.0	1043.1	0
8640 min Winter	0.844	0.0	1093.3	0
10080 min Winter	0.756	0.0	1143.2	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 369500 369800 SJ 69500 69800
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.800

Time (mins) From:	To:	Area (ha)
0	4	1.800

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	155.4	2.000	374.5

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0142-1180-2000-1180
Design Head (m)	2.000
Design Flow (l/s)	11.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	142
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	11.8	Kick-Flo®	1.213	9.3
Flush-Flo™	0.589	11.8	Mean Flow over Head Range	-	10.3

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	5.1	1.200	9.5	3.000	14.3	7.000	21.4
0.200	9.8	1.400	10.0	3.500	15.4	7.500	22.2
0.300	10.9	1.600	10.6	4.000	16.4	8.000	22.9
0.400	11.5	1.800	11.2	4.500	17.3	8.500	23.5
0.500	11.7	2.000	11.8	5.000	18.2	9.000	24.2
0.600	11.8	2.200	12.3	5.500	19.1	9.500	24.8
0.800	11.6	2.400	12.9	6.000	19.9		
1.000	10.9	2.600	13.4	6.500	20.7		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.092	1.092	37.2	502.7	O K
30 min Summer	99.324	1.324	37.2	647.0	O K
60 min Summer	99.517	1.517	37.2	778.0	O K
120 min Summer	99.652	1.652	37.2	875.4	O K
180 min Summer	99.686	1.686	37.2	900.7	O K
240 min Summer	99.673	1.673	37.2	891.4	O K
360 min Summer	99.602	1.602	37.2	838.4	O K
480 min Summer	99.535	1.535	37.2	790.2	O K
600 min Summer	99.468	1.468	37.2	743.8	O K
720 min Summer	99.410	1.410	37.2	703.6	O K
960 min Summer	99.311	1.311	37.2	638.3	O K
1440 min Summer	99.034	1.034	37.2	468.8	O K
2160 min Summer	98.365	0.365	37.2	138.1	O K
2880 min Summer	98.103	0.103	37.2	36.3	O K
4320 min Summer	98.000	0.000	31.6	0.0	O K
5760 min Summer	98.000	0.000	25.0	0.0	O K
7200 min Summer	98.000	0.000	21.0	0.0	O K
8640 min Summer	98.000	0.000	18.4	0.0	O K
10080 min Summer	98.000	0.000	16.5	0.0	O K
15 min Winter	99.093	1.093	37.2	503.5	O K
30 min Winter	99.326	1.326	37.2	648.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	106.800	0.0	1058.8	19
30 min Summer	70.000	0.0	1225.2	33
60 min Summer	43.800	0.0	1404.3	62
120 min Summer	26.550	0.0	1590.6	122
180 min Summer	19.633	0.0	1706.4	182
240 min Summer	15.775	0.0	1790.5	240
360 min Summer	11.500	0.0	1908.5	302
480 min Summer	9.145	0.0	1991.8	362
600 min Summer	7.634	0.0	2055.3	424
720 min Summer	6.575	0.0	2106.5	494
960 min Summer	5.176	0.0	2184.9	636
1440 min Summer	3.675	0.0	2292.3	854
2160 min Summer	2.599	0.0	2400.7	1192
2880 min Summer	2.035	0.0	2483.2	1504
4320 min Summer	1.450	0.0	2617.8	0
5760 min Summer	1.148	0.0	2734.3	0
7200 min Summer	0.966	0.0	2848.3	0
8640 min Summer	0.844	0.0	2959.8	0
10080 min Summer	0.756	0.0	3070.7	0
15 min Winter	106.800	0.0	1059.2	18
30 min Winter	70.000	0.0	1224.9	33

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.523	1.523	37.2	782.0	O K
120 min Winter	99.660	1.660	37.2	881.1	O K
180 min Winter	99.699	1.699	37.2	911.0	O K
240 min Winter	99.693	1.693	37.2	905.9	O K
360 min Winter	99.615	1.615	37.2	848.3	O K
480 min Winter	99.531	1.531	37.2	787.6	O K
600 min Winter	99.449	1.449	37.2	730.5	O K
720 min Winter	99.369	1.369	37.2	676.7	O K
960 min Winter	99.220	1.220	37.2	580.7	O K
1440 min Winter	98.781	0.781	37.2	331.7	O K
2160 min Winter	98.000	0.000	36.6	0.0	O K
2880 min Winter	98.000	0.000	28.6	0.0	O K
4320 min Winter	98.000	0.000	20.4	0.0	O K
5760 min Winter	98.000	0.000	16.1	0.0	O K
7200 min Winter	98.000	0.000	14.1	0.0	O K
8640 min Winter	98.000	0.000	13.7	0.0	O K
10080 min Winter	98.000	0.000	13.4	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	43.800	0.0	1404.6	62
120 min Winter	26.550	0.0	1590.0	120
180 min Winter	19.633	0.0	1706.4	176
240 min Winter	15.775	0.0	1790.5	232
360 min Winter	11.500	0.0	1908.5	334
480 min Winter	9.145	0.0	1991.8	392
600 min Winter	7.634	0.0	2055.3	452
720 min Winter	6.575	0.0	2106.5	530
960 min Winter	5.176	0.0	2184.9	676
1440 min Winter	3.675	0.0	2292.3	878
2160 min Winter	2.599	0.0	2401.2	0
2880 min Winter	2.035	0.0	2483.9	0
4320 min Winter	1.450	0.0	2617.8	0
5760 min Winter	1.148	0.0	2734.3	0
7200 min Winter	0.966	0.0	2848.3	0
8640 min Winter	0.844	0.0	2959.8	0
10080 min Winter	0.756	0.0	3070.7	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 369500 369800 SJ 69500 69800
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 4.000

Time (mins) From:	To:	Area (ha)
0	4	4.000

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	341.8	2.000	848.2

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0246-3720-2000-3720
Design Head (m)	2.000
Design Flow (l/s)	37.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	246
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	37.2	Kick-Flo®	1.290	30.1
Flush-Flo™	0.596	37.0	Mean Flow over Head Range	-	32.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.0	1.200	32.5	3.000	45.2	7.000	68.1
0.200	25.1	1.400	31.3	3.500	48.7	7.500	70.4
0.300	34.3	1.600	33.4	4.000	51.9	8.000	72.7
0.400	36.0	1.800	35.3	4.500	55.0	8.500	74.8
0.500	36.8	2.000	37.2	5.000	57.8	9.000	77.0
0.600	37.0	2.200	38.9	5.500	60.6	9.500	79.0
0.800	36.5	2.400	40.6	6.000	63.2		
1.000	35.3	2.600	42.2	6.500	65.7		

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Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 112 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	99.892	0.092	0.0	3.0	3.0	21.9	Flood Risk
30 min Summer	99.920	0.120	0.0	3.0	3.0	28.5	Flood Risk
60 min Summer	99.939	0.139	0.0	3.0	3.0	33.0	Flood Risk
120 min Summer	99.940	0.140	0.0	3.0	3.0	33.4	Flood Risk
180 min Summer	99.934	0.134	0.0	3.0	3.0	31.8	Flood Risk
240 min Summer	99.927	0.127	0.0	3.0	3.0	30.2	Flood Risk
360 min Summer	99.913	0.113	0.0	3.0	3.0	26.8	Flood Risk
480 min Summer	99.898	0.098	0.0	3.0	3.0	23.4	Flood Risk
600 min Summer	99.884	0.084	0.0	3.0	3.0	20.1	Flood Risk
720 min Summer	99.871	0.071	0.0	3.0	3.0	17.0	Flood Risk
960 min Summer	99.849	0.049	0.0	3.0	3.0	11.5	Flood Risk
1440 min Summer	99.817	0.017	0.0	3.0	3.0	4.1	Flood Risk
2160 min Summer	99.800	0.000	0.0	2.9	2.9	0.0	Flood Risk
2880 min Summer	99.800	0.000	0.0	2.3	2.3	0.0	Flood Risk
4320 min Summer	99.800	0.000	0.0	1.7	1.7	0.0	Flood Risk
5760 min Summer	99.800	0.000	0.0	1.3	1.3	0.0	Flood Risk
15 min Winter	99.906	0.106	0.0	3.0	3.0	25.1	Flood Risk
30 min Winter	99.937	0.137	0.0	3.0	3.0	32.7	Flood Risk
60 min Winter	99.962	0.162	0.0	3.0	3.0	38.5	Flood Risk
120 min Winter	99.967	0.167	0.0	3.0	3.0	39.7	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	149.756	0.0	24.0	18
30 min Summer	97.904	0.0	32.5	32
60 min Summer	61.002	0.0	41.4	62
120 min Summer	36.417	0.0	50.2	106
180 min Summer	26.743	0.0	55.8	136
240 min Summer	21.409	0.0	59.9	170
360 min Summer	15.561	0.0	65.4	238
480 min Summer	12.356	0.0	69.3	304
600 min Summer	10.314	0.0	72.3	370
720 min Summer	8.891	0.0	74.9	434
960 min Summer	7.028	0.0	78.7	558
1440 min Summer	5.045	0.0	84.3	792
2160 min Summer	3.630	0.0	90.5	0
2880 min Summer	2.882	0.0	95.0	0
4320 min Summer	2.094	0.0	102.0	0
5760 min Summer	1.678	0.0	107.4	0
15 min Winter	149.756	0.0	27.3	18
30 min Winter	97.904	0.0	36.9	32
60 min Winter	61.002	0.0	46.9	60
120 min Winter	36.417	0.0	57.0	116

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Summary of Results for 100 year Return Period (+45%)

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	99.959	0.159	0.0	3.0	3.0	37.7	Flood Risk
240 min Winter	99.949	0.149	0.0	3.0	3.0	35.5	Flood Risk
360 min Winter	99.928	0.128	0.0	3.0	3.0	30.4	Flood Risk
480 min Winter	99.906	0.106	0.0	3.0	3.0	25.1	Flood Risk
600 min Winter	99.884	0.084	0.0	3.0	3.0	20.0	Flood Risk
720 min Winter	99.865	0.065	0.0	3.0	3.0	15.4	Flood Risk
960 min Winter	99.832	0.032	0.0	3.0	3.0	7.6	Flood Risk
1440 min Winter	99.800	0.000	0.0	2.9	2.9	0.0	Flood Risk
2160 min Winter	99.800	0.000	0.0	2.1	2.1	0.0	Flood Risk
2880 min Winter	99.800	0.000	0.0	1.7	1.7	0.0	Flood Risk
4320 min Winter	99.800	0.000	0.0	1.2	1.2	0.0	Flood Risk
5760 min Winter	99.800	0.000	0.0	1.0	1.0	0.0	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
180 min Winter	26.743	0.0	62.9	146
240 min Winter	21.409	0.0	67.6	184
360 min Winter	15.561	0.0	73.6	260
480 min Winter	12.356	0.0	78.0	330
600 min Winter	10.314	0.0	81.4	398
720 min Winter	8.891	0.0	84.3	462
960 min Winter	7.028	0.0	88.9	578
1440 min Winter	5.045	0.0	95.4	0
2160 min Winter	3.630	0.0	102.2	0
2880 min Winter	2.882	0.0	107.5	0
4320 min Winter	2.094	0.0	115.6	0
5760 min Winter	1.678	0.0	122.0	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 369383 384061 SJ 69383 84061
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.100

Time (mins) From:	To:	Area (ha)
0	4	0.100

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	24.0
Membrane Percolation (mm/hr)	1000	Length (m)	33.0
Max Percolation (l/s)	220.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	99.800	Cap Volume Depth (m)	0.200

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0082-3000-1000-3000
Design Head (m)	1.000
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	82
Invert Level (m)	99.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.0	Kick-Flo®	0.623	2.4
Flush-Flo™	0.297	3.0	Mean Flow over Head Range	-	2.6

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	2.4	1.200	3.3	3.000	5.0	7.000	7.4
0.200	2.9	1.400	3.5	3.500	5.4	7.500	7.7
0.300	3.0	1.600	3.7	4.000	5.7	8.000	7.9
0.400	2.9	1.800	3.9	4.500	6.0	8.500	8.2
0.500	2.8	2.000	4.1	5.000	6.3	9.000	8.4
0.600	2.5	2.200	4.3	5.500	6.6	9.500	8.6
0.800	2.7	2.400	4.5	6.000	6.9		
1.000	3.0	2.600	4.7	6.500	7.2		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.145	1.145	25.0	475.2	O K
30 min Summer	99.378	1.378	25.0	608.5	O K
60 min Summer	99.564	1.564	25.0	725.9	O K
120 min Summer	99.671	1.671	25.0	797.0	O K
180 min Summer	99.686	1.686	25.0	807.1	O K
240 min Summer	99.663	1.663	25.0	791.4	O K
360 min Summer	99.591	1.591	25.0	743.4	O K
480 min Summer	99.530	1.530	25.0	703.9	O K
600 min Summer	99.475	1.475	25.0	668.8	O K
720 min Summer	99.421	1.421	25.0	635.1	O K
960 min Summer	99.314	1.314	25.0	570.7	O K
1440 min Summer	99.105	1.105	25.0	453.2	O K
2160 min Summer	98.806	0.806	25.0	304.3	O K
2880 min Summer	98.540	0.540	25.0	188.9	O K
4320 min Summer	98.154	0.154	25.0	48.0	O K
5760 min Summer	98.000	0.000	24.6	0.0	O K
15 min Winter	99.147	1.147	25.0	476.0	O K
30 min Winter	99.380	1.380	25.0	609.9	O K
60 min Winter	99.569	1.569	25.0	729.0	O K
120 min Winter	99.679	1.679	25.0	802.4	O K
180 min Winter	99.699	1.699	25.0	816.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	103.280	0.0	501.3	19
30 min Summer	67.520	0.0	656.4	33
60 min Summer	42.070	0.0	818.9	62
120 min Summer	25.115	0.0	978.7	122
180 min Summer	18.443	0.0	1077.7	182
240 min Summer	14.765	0.0	1150.8	240
360 min Summer	10.732	0.0	1254.7	300
480 min Summer	8.521	0.0	1328.4	360
600 min Summer	7.113	0.0	1386.1	424
720 min Summer	6.132	0.0	1433.9	492
960 min Summer	4.847	0.0	1511.2	626
1440 min Summer	3.480	0.0	1627.3	894
2160 min Summer	2.503	0.0	1756.9	1276
2880 min Summer	1.987	0.0	1859.5	1616
4320 min Summer	1.444	0.0	2026.0	2292
5760 min Summer	1.157	0.0	2166.5	0
15 min Winter	103.280	0.0	501.7	18
30 min Winter	67.520	0.0	656.6	33
60 min Winter	42.070	0.0	819.6	62
120 min Winter	25.115	0.0	978.7	120
180 min Winter	18.443	0.0	1078.1	176

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Summary of Results for 100 year Return Period

	Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240	min Winter	99.683	1.683	25.0	805.5	O K
360	min Winter	99.598	1.598	25.0	748.3	O K
480	min Winter	99.525	1.525	25.0	700.2	O K
600	min Winter	99.451	1.451	25.0	653.8	O K
720	min Winter	99.374	1.374	25.0	606.4	O K
960	min Winter	99.213	1.213	25.0	512.6	O K
1440	min Winter	98.886	0.886	25.0	342.1	O K
2160	min Winter	98.422	0.422	25.0	142.5	O K
2880	min Winter	98.069	0.069	25.0	21.1	O K
4320	min Winter	98.000	0.000	19.8	0.0	O K
5760	min Winter	98.000	0.000	15.9	0.0	O K

	Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240	min Winter	14.765	0.0	1150.9	232
360	min Winter	10.732	0.0	1254.7	332
480	min Winter	8.521	0.0	1328.4	374
600	min Winter	7.113	0.0	1386.1	448
720	min Winter	6.132	0.0	1433.9	526
960	min Winter	4.847	0.0	1511.2	674
1440	min Winter	3.480	0.0	1627.3	940
2160	min Winter	2.503	0.0	1756.9	1300
2880	min Winter	1.987	0.0	1859.5	1560
4320	min Winter	1.444	0.0	2027.2	0
5760	min Winter	1.157	0.0	2166.5	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 369383 384061 SJ 69383 84061
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 3.900

Time (mins) From:	To:	Area (ha)
0	4	3.900

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	297.5	2.000	777.4

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0205-2510-2000-2510
Design Head (m)	2.000
Design Flow (l/s)	25.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	205
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	25.0	Kick-Flo®	1.249	20.0
Flush-Flo™	0.583	24.9	Mean Flow over Head Range	-	21.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.0	1.200	21.0	3.000	30.4	7.000	45.7
0.200	19.5	1.400	21.1	3.500	32.7	7.500	47.2
0.300	23.2	1.600	22.5	4.000	34.9	8.000	48.7
0.400	24.3	1.800	23.8	4.500	36.9	8.500	50.2
0.500	24.8	2.000	25.0	5.000	38.8	9.000	51.6
0.600	24.9	2.200	26.2	5.500	40.7	9.500	53.0
0.800	24.5	2.400	27.3	6.000	42.4		
1.000	23.5	2.600	28.4	6.500	44.1		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.141	1.141	26.0	493.4	O K
30 min Summer	99.374	1.374	26.0	631.9	O K
60 min Summer	99.561	1.561	26.0	753.7	O K
120 min Summer	99.668	1.668	26.0	827.5	O K
180 min Summer	99.683	1.683	26.0	838.0	O K
240 min Summer	99.660	1.660	26.0	821.5	O K
360 min Summer	99.588	1.588	26.0	771.7	O K
480 min Summer	99.527	1.527	26.0	730.7	O K
600 min Summer	99.472	1.472	26.0	694.2	O K
720 min Summer	99.417	1.417	26.0	659.2	O K
960 min Summer	99.310	1.310	26.0	592.2	O K
1440 min Summer	99.099	1.099	26.0	470.2	O K
2160 min Summer	98.800	0.800	26.0	315.4	O K
2880 min Summer	98.535	0.535	26.0	195.7	O K
4320 min Summer	98.151	0.151	26.0	49.5	O K
5760 min Summer	98.000	0.000	25.5	0.0	O K
15 min Winter	99.143	1.143	26.0	494.3	O K
30 min Winter	99.376	1.376	26.0	633.3	O K
60 min Winter	99.566	1.566	26.0	757.0	O K
120 min Winter	99.676	1.676	26.0	833.1	O K
180 min Winter	99.697	1.697	26.0	847.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	103.280	0.0	520.5	19
30 min Summer	67.520	0.0	681.6	33
60 min Summer	42.070	0.0	850.4	62
120 min Summer	25.115	0.0	1016.3	122
180 min Summer	18.443	0.0	1119.1	182
240 min Summer	14.765	0.0	1195.0	240
360 min Summer	10.732	0.0	1303.0	300
480 min Summer	8.521	0.0	1379.5	360
600 min Summer	7.113	0.0	1439.4	440
720 min Summer	6.132	0.0	1488.9	492
960 min Summer	4.847	0.0	1569.3	626
1440 min Summer	3.480	0.0	1689.8	894
2160 min Summer	2.503	0.0	1824.4	1276
2880 min Summer	1.987	0.0	1931.0	1616
4320 min Summer	1.444	0.0	2103.9	2300
5760 min Summer	1.157	0.0	2249.8	0
15 min Winter	103.280	0.0	520.9	18
30 min Winter	67.520	0.0	681.7	33
60 min Winter	42.070	0.0	851.1	62
120 min Winter	25.115	0.0	1016.3	120
180 min Winter	18.443	0.0	1119.5	176

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	99.681	1.681	26.0	836.2	O K
360 min Winter	99.595	1.595	26.0	776.7	O K
480 min Winter	99.521	1.521	26.0	726.8	O K
600 min Winter	99.448	1.448	26.0	678.6	O K
720 min Winter	99.370	1.370	26.0	629.3	O K
960 min Winter	99.208	1.208	26.0	531.9	O K
1440 min Winter	98.880	0.880	26.0	354.7	O K
2160 min Winter	98.417	0.417	26.0	147.4	O K
2880 min Winter	98.068	0.068	26.0	21.6	O K
4320 min Winter	98.000	0.000	20.5	0.0	O K
5760 min Winter	98.000	0.000	16.5	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	14.765	0.0	1195.1	232
360 min Winter	10.732	0.0	1303.0	332
480 min Winter	8.521	0.0	1379.5	374
600 min Winter	7.113	0.0	1439.4	448
720 min Winter	6.132	0.0	1489.0	524
960 min Winter	4.847	0.0	1569.3	674
1440 min Winter	3.480	0.0	1689.8	940
2160 min Winter	2.503	0.0	1824.4	1300
2880 min Winter	1.987	0.0	1931.0	1560
4320 min Winter	1.444	0.0	2105.2	0
5760 min Winter	1.157	0.0	2249.8	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 369383 384061 SJ 69383 84061
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 4.050

Time (mins) From:	To:	Area (ha)
0	4	4.050

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	312.8	2.000	802.1

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0208-2600-2000-2600
Design Head (m)	2.000
Design Flow (l/s)	26.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	208
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	26.0	Kick-Flo®	1.247	20.7
Flush-Flo™	0.577	25.9	Mean Flow over Head Range	-	22.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.1	1.200	21.8	3.000	31.6	7.000	47.5
0.200	20.0	1.400	21.9	3.500	34.0	7.500	49.1
0.300	24.1	1.600	23.4	4.000	36.3	8.000	50.7
0.400	25.3	1.800	24.7	4.500	38.4	8.500	52.2
0.500	25.9	2.000	26.0	5.000	40.4	9.000	53.7
0.600	25.9	2.200	27.2	5.500	42.3	9.500	55.1
0.800	25.5	2.400	28.4	6.000	44.1		
1.000	24.4	2.600	29.5	6.500	45.8		

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Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 112 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	99.908	0.108	0.0	3.0	3.0	22.3	Flood Risk
30 min Summer	99.939	0.139	0.0	3.0	3.0	28.8	Flood Risk
60 min Summer	99.961	0.161	0.0	3.0	3.0	33.3	Flood Risk
120 min Summer	99.962	0.162	0.0	3.0	3.0	33.5	Flood Risk
180 min Summer	99.954	0.154	0.0	3.0	3.0	31.8	Flood Risk
240 min Summer	99.946	0.146	0.0	3.0	3.0	30.2	Flood Risk
360 min Summer	99.930	0.130	0.0	3.0	3.0	26.8	Flood Risk
480 min Summer	99.913	0.113	0.0	3.0	3.0	23.4	Flood Risk
600 min Summer	99.897	0.097	0.0	3.0	3.0	20.1	Flood Risk
720 min Summer	99.882	0.082	0.0	3.0	3.0	17.0	Flood Risk
960 min Summer	99.856	0.056	0.0	3.0	3.0	11.6	Flood Risk
1440 min Summer	99.820	0.020	0.0	3.0	3.0	4.1	Flood Risk
2160 min Summer	99.800	0.000	0.0	2.9	2.9	0.0	Flood Risk
2880 min Summer	99.800	0.000	0.0	2.3	2.3	0.0	Flood Risk
4320 min Summer	99.800	0.000	0.0	1.7	1.7	0.0	Flood Risk
5760 min Summer	99.800	0.000	0.0	1.3	1.3	0.0	Flood Risk
15 min Winter	99.924	0.124	0.0	3.0	3.0	25.7	Flood Risk
30 min Winter	99.961	0.161	0.0	3.0	3.0	33.2	Flood Risk
60 min Winter	99.988	0.188	0.0	3.0	3.0	38.9	Flood Risk
120 min Winter	99.992	0.192	0.0	3.0	3.0	39.8	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	149.756	0.0	24.4	18
30 min Summer	97.904	0.0	33.0	32
60 min Summer	61.002	0.0	42.2	62
120 min Summer	36.417	0.0	50.9	106
180 min Summer	26.743	0.0	56.5	136
240 min Summer	21.409	0.0	60.3	170
360 min Summer	15.561	0.0	66.1	238
480 min Summer	12.356	0.0	70.0	304
600 min Summer	10.314	0.0	73.0	370
720 min Summer	8.891	0.0	75.3	434
960 min Summer	7.028	0.0	79.4	558
1440 min Summer	5.045	0.0	85.3	780
2160 min Summer	3.630	0.0	91.5	0
2880 min Summer	2.882	0.0	96.2	0
4320 min Summer	2.094	0.0	103.4	0
5760 min Summer	1.678	0.0	109.1	0
15 min Winter	149.756	0.0	27.9	18
30 min Winter	97.904	0.0	37.4	32
60 min Winter	61.002	0.0	47.6	60
120 min Winter	36.417	0.0	57.3	116

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Summary of Results for 100 year Return Period (+45%)

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	99.982	0.182	0.0	3.0	3.0	37.7	Flood Risk
240 min Winter	99.971	0.171	0.0	3.0	3.0	35.5	Flood Risk
360 min Winter	99.947	0.147	0.0	3.0	3.0	30.4	Flood Risk
480 min Winter	99.921	0.121	0.0	3.0	3.0	25.1	Flood Risk
600 min Winter	99.897	0.097	0.0	3.0	3.0	20.1	Flood Risk
720 min Winter	99.875	0.075	0.0	3.0	3.0	15.4	Flood Risk
960 min Winter	99.837	0.037	0.0	3.0	3.0	7.7	Flood Risk
1440 min Winter	99.800	0.000	0.0	3.0	3.0	0.0	Flood Risk
2160 min Winter	99.800	0.000	0.0	2.1	2.1	0.0	Flood Risk
2880 min Winter	99.800	0.000	0.0	1.7	1.7	0.0	Flood Risk
4320 min Winter	99.800	0.000	0.0	1.2	1.2	0.0	Flood Risk
5760 min Winter	99.800	0.000	0.0	1.0	1.0	0.0	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
180 min Winter	26.743	0.0	63.7	146
240 min Winter	21.409	0.0	68.1	184
360 min Winter	15.561	0.0	74.4	258
480 min Winter	12.356	0.0	78.7	330
600 min Winter	10.314	0.0	82.1	398
720 min Winter	8.891	0.0	85.0	462
960 min Winter	7.028	0.0	89.5	578
1440 min Winter	5.045	0.0	96.2	0
2160 min Winter	3.630	0.0	103.2	0
2880 min Winter	2.882	0.0	108.6	0
4320 min Winter	2.094	0.0	117.0	0
5760 min Winter	1.678	0.0	123.7	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 369383 384061 SJ 69383 84061
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+45

Time Area Diagram

Total Area (ha) 0.100

Time (mins) From:	To:	Area (ha)
0	4	0.100

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	23.0
Membrane Percolation (mm/hr)	1000	Length (m)	30.0
Max Percolation (l/s)	191.7	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	99.800	Cap Volume Depth (m)	0.200

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0082-3000-1000-3000
Design Head (m)	1.000
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	82
Invert Level (m)	99.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	3.0	Kick-Flo®	0.623	2.4
Flush-Flo™	0.297	3.0	Mean Flow over Head Range	-	2.6

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	2.4	1.200	3.3	3.000	5.0	7.000	7.4
0.200	2.9	1.400	3.5	3.500	5.4	7.500	7.7
0.300	3.0	1.600	3.7	4.000	5.7	8.000	7.9
0.400	2.9	1.800	3.9	4.500	6.0	8.500	8.2
0.500	2.8	2.000	4.1	5.000	6.3	9.000	8.4
0.600	2.5	2.200	4.3	5.500	6.6	9.500	8.6
0.800	2.7	2.400	4.5	6.000	6.9		
1.000	3.0	2.600	4.7	6.500	7.2		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	98.930	0.930	5.6	355.3	O K
30 min Summer	99.139	1.139	5.6	461.4	O K
60 min Summer	99.330	1.330	5.6	567.9	O K
120 min Summer	99.487	1.487	5.6	662.0	O K
180 min Summer	99.568	1.568	5.6	713.2	O K
240 min Summer	99.617	1.617	5.6	745.2	O K
360 min Summer	99.669	1.669	5.6	779.9	O K
480 min Summer	99.688	1.688	5.6	792.8	O K
600 min Summer	99.690	1.690	5.6	794.1	O K
720 min Summer	99.682	1.682	5.6	788.3	O K
960 min Summer	99.645	1.645	5.6	763.6	O K
1440 min Summer	99.556	1.556	5.6	705.6	O K
2160 min Summer	99.466	1.466	5.6	648.8	O K
2880 min Summer	99.394	1.394	5.6	605.5	O K
4320 min Summer	99.265	1.265	5.6	530.7	O K
5760 min Summer	99.145	1.145	5.6	464.6	O K
15 min Winter	98.930	0.930	5.6	355.3	O K
30 min Winter	99.139	1.139	5.6	461.4	O K
60 min Winter	99.330	1.330	5.6	567.9	O K
120 min Winter	99.488	1.488	5.6	662.7	O K
180 min Winter	99.570	1.570	5.6	714.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	103.280	0.0	350.1	19
30 min Summer	67.520	0.0	376.3	34
60 min Summer	42.070	0.0	585.7	64
120 min Summer	25.115	0.0	696.7	124
180 min Summer	18.443	0.0	760.1	184
240 min Summer	14.765	0.0	788.5	242
360 min Summer	10.732	0.0	802.4	362
480 min Summer	8.521	0.0	809.6	482
600 min Summer	7.113	0.0	815.7	602
720 min Summer	6.132	0.0	821.7	722
960 min Summer	4.847	0.0	833.5	960
1440 min Summer	3.480	0.0	846.8	1214
2160 min Summer	2.503	0.0	1259.8	1580
2880 min Summer	1.987	0.0	1332.8	1964
4320 min Summer	1.444	0.0	1438.3	2772
5760 min Summer	1.157	0.0	1555.0	3584
15 min Winter	103.280	0.0	350.1	19
30 min Winter	67.520	0.0	376.2	33
60 min Winter	42.070	0.0	585.7	64
120 min Winter	25.115	0.0	696.7	122
180 min Winter	18.443	0.0	760.0	180

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	99.620	1.620	5.6	747.1	O K
360 min Winter	99.673	1.673	5.6	782.5	O K
480 min Winter	99.694	1.694	5.6	796.6	O K
600 min Winter	99.698	1.698	5.6	799.4	O K
720 min Winter	99.692	1.692	5.6	795.4	O K
960 min Winter	99.663	1.663	5.6	775.5	O K
1440 min Winter	99.568	1.568	5.6	713.6	O K
2160 min Winter	99.456	1.456	5.6	642.7	O K
2880 min Winter	99.355	1.355	5.6	582.6	O K
4320 min Winter	99.154	1.154	5.6	469.6	O K
5760 min Winter	98.956	0.956	5.6	367.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	14.765	0.0	787.9	240
360 min Winter	10.732	0.0	801.1	356
480 min Winter	8.521	0.0	807.6	472
600 min Winter	7.113	0.0	813.0	588
720 min Winter	6.132	0.0	818.0	702
960 min Winter	4.847	0.0	827.5	924
1440 min Winter	3.480	0.0	846.6	1340
2160 min Winter	2.503	0.0	1259.9	1648
2880 min Winter	1.987	0.0	1332.9	2108
4320 min Winter	1.444	0.0	1446.1	2984
5760 min Winter	1.157	0.0	1555.0	3808

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 369383 384061 SJ 69383 84061
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 2.800

Time (mins) From:	To:	Area (ha)
0	4	2.800

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	289.8	2.000	765.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0097-5600-2000-5600
Design Head (m)	2.000
Design Flow (l/s)	5.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	97
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	5.6	Kick-Flo®	0.868	3.8
Flush-Flo™	0.425	4.8	Mean Flow over Head Range	-	4.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.2	1.200	4.4	3.000	6.8	7.000	10.1
0.200	4.3	1.400	4.7	3.500	7.3	7.500	10.4
0.300	4.7	1.600	5.0	4.000	7.7	8.000	10.8
0.400	4.8	1.800	5.3	4.500	8.2	8.500	11.1
0.500	4.7	2.000	5.6	5.000	8.6	9.000	11.4
0.600	4.6	2.200	5.8	5.500	9.0	9.500	11.7
0.800	4.2	2.400	6.1	6.000	9.4		
1.000	4.1	2.600	6.3	6.500	9.7		

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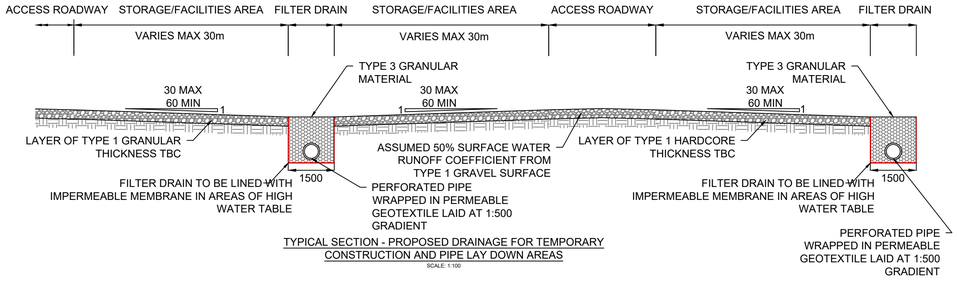
HyNet North West Hydrogen Pipeline

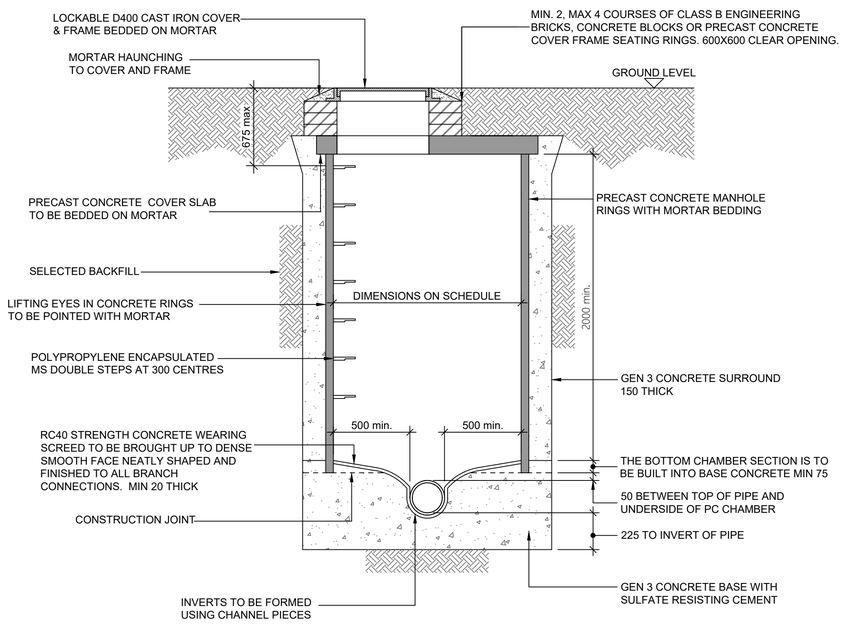
Delivering clean growth

Appendix D
Temporary Construction Area Details



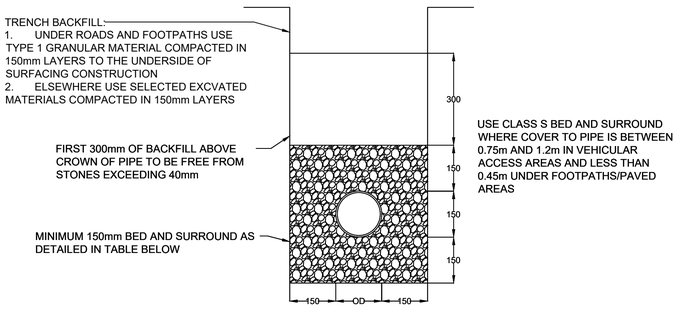
TYPICAL SECTION - PROPOSED DRAINAGE FOR TEMPORARY CONSTRUCTION AND PIPE LAY DOWN AREAS

SCALE: 1:100



CONCRETE MANHOLE - SECTION

SCALE: 1:20

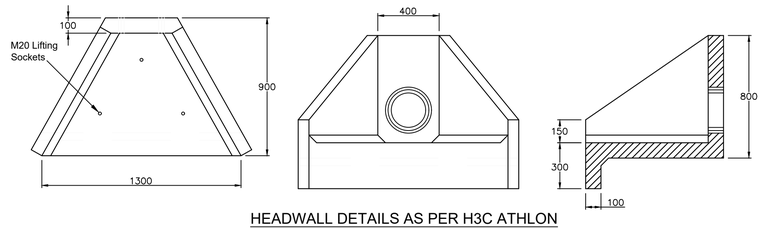


PIPE DIAMETER:	BEDDING MATERIAL:
100 DIA	10mm SINGLE SIZE AGGREGATE
101 - 150 DIA	10mm OR 14mm SINGLE SIZE AGGREGATE
151 - 500 DIA	10mm, 14mm OR 20mm SINGLE SIZE AGGREGATE

NOTE:
THE ABOVE MATERIALS ARE FOR GUIDANCE OTHER BEDDING MATERIALS CAN BE USED IN ACCORDANCE WITH THE PIPE MANUFACTURERS RECOMMENDATIONS

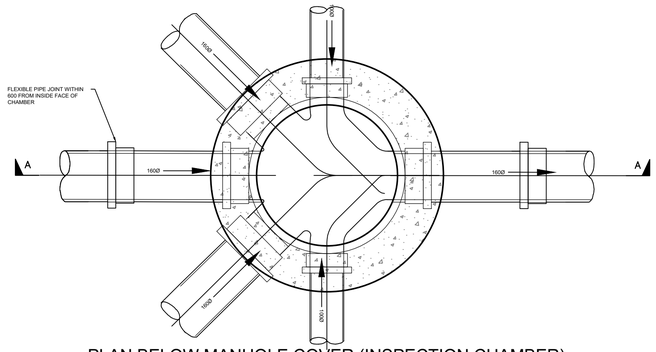
CLASS S GRANULAR BEDDING AND SURROUND FOR FLEXIBLE PIPES

SCALE 1:10



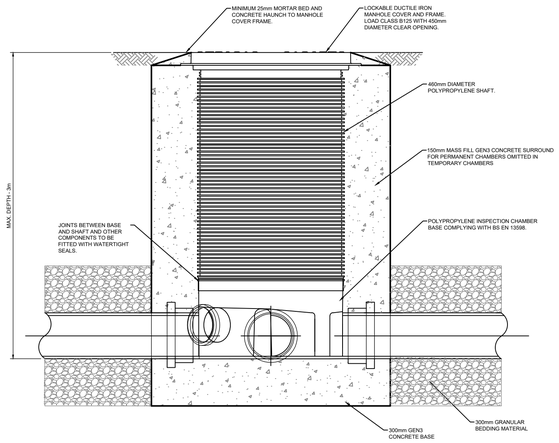
HEADWALL DETAILS AS PER H3C ATHLON

SCALE: 1:20



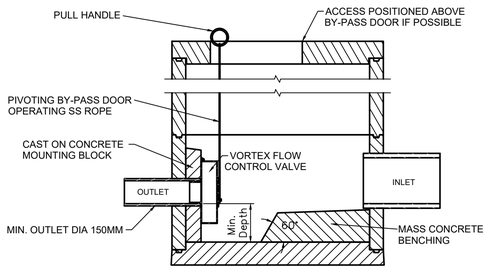
PLAN BELOW MANHOLE COVER (INSPECTION CHAMBER)

SCALE: 1:10



POLYPROPYLENE INSPECTION CHAMBER DETAIL

SCALE: 1:10



FLOW CONTROL MANHOLE (HYDROBRAKE)

SCALE: 1:20

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.
2. GROUND CONDITIONS ARE CURRENTLY UNKNOWN. GEOTECHNICAL STUDIES REQUIRED TO DETERMINE RECEIVING WATERCOURSE BANK STABILITY AND CONFIRM APPROPRIATE HEADWALL SELECTION AND PLACEMENT.
3. EXISTING GROUND LEVEL SURVEY DATA IS BASED ON LIDAR DATA. DETAILED TOPOGRAPHIC SURVEYS ARE REQUIRED TO ACCURATELY DETERMINE EXISTING GROUND LEVELS.
4. BASIN DETAILS INCLUDING OUTLET FROM BASIN AND FLOW CONTROL DEVICE TO BE CONFIRMED FOLLOWING DETAILED DESIGN.
5. EROSION PROTECTION WILL BE SPECIFIED FOLLOWING TOPOGRAPHIC SURVEY.
6. DRAIN FLOW DIRECTIONS ASSUMED BASED ON LIDAR AND OS MAP DATA.THIS WILL BE CONFIRMED DURING DETAILED DESIGN STAGE.
7. THE WATERCOURSE BANK WILL NEED TO BE REPROFILED TO SUIT THE HEADWALL PLACEMENT.

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Appendix X.X
TYPICAL DRAINAGE DETAILS FOR TEMPORARY CONSTRUCTION AND PIPE LAY DOWN AREAS

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Appendix E
Indicative Pipe Laydown Site Plans

PROPOSED TEMPORARY ATTENUATION BASIN TO STORE 810m³

SHOULD INFILTRATION BE PROVEN NON-VIABLE, SITE TO DISCHARGE AT 5.1l/s. DISCHARGE POINT TO BE CONFIRMED

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Temporary Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 50 m

Scale 1:1000 @ A1

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Appendix XX
Indicative Temporary Pipe Laydown Area Drainage Layout - Additional Area 1

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PROPOSED TEMPORARY ATTENUATION BASIN TO STORE 600m^3

SHOULD INFILTRATION BE PROVEN NON-VIABLE, SITE TO DISCHARGE AT 3.6l/s. DISCHARGE POINT TO BE CONFIRMED

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Temporary Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 30 m

Scale 1:500 @ A1

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Appendix XX
Indicative Temporary Pipe Laydown Area Drainage Layout - Additional Area 2

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PROPOSED TEMPORARY ATTENUATION BASIN TO STORE 555m^3

SHOULD INFILTRATION BE PROVEN NON-VIABLE, SITE TO DISCHARGE AT 10.6l/s. DISCHARGE POINT TO BE CONFIRMED

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Temporary Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 30 m

Scale 1:500 @ A1

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Appendix XX
Indicative Temporary Pipe Laydown Area Drainage Layout - Additional Area 3

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POND B
CATCHMENT AREA = 3.6Ha.
PROPOSED TEMPORARY ATTENUATION BASIN TO STORE 840m³

SHOULD INFILTRATION BE PROVEN NON-VIABLE, SITE TO DISCHARGE AT 17.6l/s. DISCHARGE POINT TO BE CONFIRMED

POND A
CATCHMENT AREA = 3.9Ha.
PROPOSED TEMPORARY ATTENUATION BASIN TO STORE 910m³

SHOULD INFILTRATION BE PROVEN NON-VIABLE, SITE TO DISCHARGE AT 19.1l/s. DISCHARGE POINT TO BE CONFIRMED

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Temporary Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 50 m
Scale 1:1000 @ A1

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Appendix XX
Indicative Temporary Pipe Laydown Area Drainage Layout - Additional Area 4

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SHOULD INFILTRATION BE PROVEN NON-VIABLE, SITE TO DISCHARGE AT 3.1l/s. DISCHARGE POINT TO BE CONFIRMED

POND A
CATCHMENT AREA = 1.3Ha
PROPOSED TEMPORARY ATTENUATION BASIN TO STORE 355m³

SHOULD INFILTRATION BE PROVEN NON-VIABLE, SITE TO DISCHARGE AT 3l/s. DISCHARGE POINT TO BE CONFIRMED

POND B
CATCHMENT AREA = 1.2Ha
PROPOSED TEMPORARY ATTENUATION BASIN TO STORE 325m³

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Temporary Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 50 m
Scale 1:1000 @ A1

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Appendix XX
Indicative Temporary Pipe Laydown Area Drainage Layout - Additional Area 5

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NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Temporary Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 50 m

Scale 1:1000 @ A1

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Appendix XX
Indicative Temporary Pipe Laydown Area Drainage Layout - Additional Area 6

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PROPOSED TEMPORARY ATTENUATION BASIN TO STORE 480m³

SHOULD INFILTRATION BE PROVEN NON-VIABLE, SITE TO DISCHARGE AT 20.5l/s. DISCHARGE POINT TO BE CONFIRMED

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Temporary Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 30 m

Scale 1:500 @ A1

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Appendix XX
Indicative Temporary Pipe Laydown Area Drainage Layout - Additional Area 7

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PROPOSED TEMPORARY ATTENUATION BASIN TO STORE 655m^3

SHOULD INFILTRATION BE PROVEN NON-VIABLE, SITE TO DISCHARGE AT 28.1l/s. DISCHARGE POINT TO BE CONFIRMED

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Temporary Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 30 m

Scale 1:500 @ A1

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Appendix XX
Indicative Temporary Pipe Laydown Area Drainage Layout - Additional Area 8

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EXISTING DITCH

PROPOSED TEMPORARY FLOW CONTROL TO DISCHARGE AT 3.4l/s

PROPOSED TEMPORARY FLOW CONTROL TO DISCHARGE AT 6.1l/s

POND C
CATCHMENT AREA = 2.6Ha.
PROPOSED TEMPORARY ATTENUATION BASIN TO STORE 710m³

POND B
CATCHMENT AREA = 1.4Ha.
PROPOSED TEMPORARY ATTENUATION BASIN TO STORE 380m³

POND D
CATCHMENT AREA = 6.6Ha
PROPOSED TEMPORARY ATTENUATION BASIN TO STORE 1800m³

SHOULD INFILTRATION BE PROVEN NON-VIABLE, SITE TO DISCHARGE AT 19.8l/s. DISCHARGE POINT TO BE CONFIRMED

SHOULD INFILTRATION BE PROVEN NON-VIABLE, SITE TO DISCHARGE AT 6.7l/s. DISCHARGE POINT TO BE CONFIRMED

POND A
CATCHMENT AREA = 2.80Ha.
PROPOSED TEMPORARY ATTENUATION BASIN TO STORE 765m³

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Temporary Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 50 m

Scale 1:1250 @ A1

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Appendix XX
Indicative Temporary Pipe Laydown Area Drainage Layout - Additional Area 9

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NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Temporary Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
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- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 50 m

Scale 1:1000 @ A1

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Appendix XX
Indicative Temporary Pipe Laydown Area Drainage Layout - Additional Area 10

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PROPOSED TEMPORARY ATTENUATION BASIN TO STORE 595m³

SHOULD INFILTRATION BE PROVEN NON-VIABLE, SITE TO DISCHARGE AT 11.5l/s. DISCHARGE POINT TO BE CONFIRMED

NOTES:

1. ALL DIMENSIONS IN MILLIMETRES UNLESS STATED OTHERWISE.

Key

- DCO Boundary
- Temporary Construction Compounds
- Pipe Dump locations
- Trenchless Crossing Compounds
- Limits of Deviation - Pipelines
- Proposed Temporary Surface Water Drain
- Proposed Headwall Discharge Point
- Proposed Filter Trench
- E — Electric Lines
- W — Water Lines
- T — Telecom Lines
- SS — Sewer Lines
- Pipelines
- GAS — Gas Lines

0 m — 50 m

Scale 1:1000 @ A1

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Appendix XX
Indicative Temporary Pipe Laydown Area Drainage Layout - Additional Area 11

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Appendix F
Pipe Laydown Areas - Attenuation Storage Calculations

Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	98.899	0.899	5.1	346.5	O K
30 min Summer	99.100	1.100	5.1	448.4	O K
60 min Summer	99.281	1.281	5.1	548.5	O K
120 min Summer	99.448	1.448	5.1	648.0	O K
180 min Summer	99.537	1.537	5.1	704.5	O K
240 min Summer	99.593	1.593	5.1	740.9	O K
360 min Summer	99.656	1.656	5.1	782.7	O K
480 min Summer	99.682	1.682	5.1	800.7	O K
600 min Summer	99.690	1.690	5.1	806.3	O K
720 min Summer	99.687	1.687	5.1	804.1	O K
960 min Summer	99.659	1.659	5.1	785.1	O K
1440 min Summer	99.570	1.570	5.1	725.7	O K
2160 min Summer	99.471	1.471	5.1	662.4	O K
2880 min Summer	99.395	1.395	5.1	615.6	O K
4320 min Summer	99.264	1.264	5.1	538.8	O K
5760 min Summer	99.146	1.146	5.1	473.1	O K
7200 min Summer	99.037	1.037	5.1	415.5	O K
8640 min Summer	98.936	0.936	5.1	364.3	O K
10080 min Summer	98.839	0.839	5.1	317.9	O K
15 min Winter	98.899	0.899	5.1	346.5	O K
30 min Winter	99.100	1.100	5.1	448.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	104.350	0.0	331.5	19
30 min Summer	67.948	0.0	332.9	34
60 min Summer	42.061	0.0	563.4	64
120 min Summer	25.395	0.0	671.1	124
180 min Summer	18.778	0.0	702.2	184
240 min Summer	15.101	0.0	709.8	242
360 min Summer	11.032	0.0	719.9	362
480 min Summer	8.780	0.0	728.9	482
600 min Summer	7.336	0.0	737.6	602
720 min Summer	6.326	0.0	746.2	722
960 min Summer	4.996	0.0	763.7	960
1440 min Summer	3.573	0.0	787.1	1258
2160 min Summer	2.552	0.0	1237.8	1624
2880 min Summer	2.014	0.0	1300.6	2020
4320 min Summer	1.451	0.0	1333.5	2812
5760 min Summer	1.157	0.0	1498.3	3640
7200 min Summer	0.975	0.0	1579.6	4400
8640 min Summer	0.852	0.0	1655.3	5192
10080 min Summer	0.762	0.0	1726.6	5952
15 min Winter	104.350	0.0	331.5	19
30 min Winter	67.948	0.0	332.8	33

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.281	1.281	5.1	548.5	O K
120 min Winter	99.449	1.449	5.1	648.6	O K
180 min Winter	99.539	1.539	5.1	705.5	O K
240 min Winter	99.596	1.596	5.1	742.6	O K
360 min Winter	99.659	1.659	5.1	784.9	O K
480 min Winter	99.687	1.687	5.1	804.0	O K
600 min Winter	99.697	1.697	5.1	810.8	O K
720 min Winter	99.696	1.696	5.1	810.1	O K
960 min Winter	99.674	1.674	5.1	795.0	O K
1440 min Winter	99.591	1.591	5.1	739.3	O K
2160 min Winter	99.466	1.466	5.1	659.5	O K
2880 min Winter	99.367	1.367	5.1	598.8	O K
4320 min Winter	99.171	1.171	5.1	486.7	O K
5760 min Winter	98.981	0.981	5.1	387.0	O K
7200 min Winter	98.801	0.801	5.1	300.5	O K
8640 min Winter	98.631	0.631	5.1	225.4	O K
10080 min Winter	98.472	0.472	5.1	160.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	42.061	0.0	563.4	64
120 min Winter	25.395	0.0	671.1	122
180 min Winter	18.778	0.0	701.7	180
240 min Winter	15.101	0.0	709.2	240
360 min Winter	11.032	0.0	718.8	356
480 min Winter	8.780	0.0	727.3	474
600 min Winter	7.336	0.0	735.5	590
720 min Winter	6.326	0.0	743.5	702
960 min Winter	4.996	0.0	759.6	926
1440 min Winter	3.573	0.0	782.7	1356
2160 min Winter	2.552	0.0	1237.8	1688
2880 min Winter	2.014	0.0	1301.0	2136
4320 min Winter	1.451	0.0	1366.0	3028
5760 min Winter	1.157	0.0	1498.3	3864
7200 min Winter	0.975	0.0	1579.7	4616
8640 min Winter	0.852	0.0	1655.4	5368
10080 min Winter	0.762	0.0	1726.8	6056

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 360158 378110 SJ 60158 78110
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 2.700

Time (mins) From:	To:	Area (ha)
0	4	2.700

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	295.6	2.000	774.3

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0093-5100-2000-5100
Design Head (m)	2.000
Design Flow (l/s)	5.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	93
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	5.1	Kick-Flo®	0.825	3.4
Flush-Flo™	0.405	4.2	Mean Flow over Head Range	-	4.0

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	2.9	1.200	4.0	3.000	6.2	7.000	9.2
0.200	3.9	1.400	4.3	3.500	6.6	7.500	9.5
0.300	4.2	1.600	4.6	4.000	7.1	8.000	9.8
0.400	4.2	1.800	4.9	4.500	7.5	8.500	10.1
0.500	4.2	2.000	5.1	5.000	7.8	9.000	10.4
0.600	4.1	2.200	5.3	5.500	8.2	9.500	10.6
0.800	3.5	2.400	5.6	6.000	8.6		
1.000	3.7	2.600	5.8	6.500	8.9		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	98.885	0.885	3.6	248.7	O K
30 min Summer	99.087	1.087	3.6	324.2	O K
60 min Summer	99.274	1.274	3.6	401.1	O K
120 min Summer	99.443	1.443	3.6	476.4	O K
180 min Summer	99.532	1.532	3.6	518.5	O K
240 min Summer	99.587	1.587	3.6	545.5	O K
360 min Summer	99.649	1.649	3.6	576.8	O K
480 min Summer	99.677	1.677	3.6	591.3	O K
600 min Summer	99.687	1.687	3.6	596.4	O K
720 min Summer	99.686	1.686	3.6	595.6	O K
960 min Summer	99.661	1.661	3.6	582.6	O K
1440 min Summer	99.569	1.569	3.6	536.8	O K
2160 min Summer	99.462	1.462	3.6	485.4	O K
2880 min Summer	99.381	1.381	3.6	448.1	O K
4320 min Summer	99.243	1.243	3.6	387.9	O K
5760 min Summer	99.122	1.122	3.6	337.9	O K
7200 min Summer	99.014	1.014	3.6	295.9	O K
8640 min Summer	98.914	0.914	3.6	259.1	O K
10080 min Summer	98.820	0.820	3.6	225.9	O K
15 min Winter	98.885	0.885	3.6	248.7	O K
30 min Winter	99.087	1.087	3.6	324.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	106.408	0.0	219.0	19
30 min Summer	69.773	0.0	217.0	34
60 min Summer	43.658	0.0	410.6	64
120 min Summer	26.472	0.0	466.2	124
180 min Summer	19.579	0.0	475.6	184
240 min Summer	15.739	0.0	482.7	242
360 min Summer	11.493	0.0	496.2	362
480 min Summer	9.149	0.0	509.5	482
600 min Summer	7.645	0.0	520.6	602
720 min Summer	6.590	0.0	529.3	722
960 min Summer	5.197	0.0	542.7	960
1440 min Summer	3.700	0.0	559.2	1312
2160 min Summer	2.625	0.0	895.6	1644
2880 min Summer	2.060	0.0	935.1	2020
4320 min Summer	1.472	0.0	922.0	2812
5760 min Summer	1.167	0.0	1063.8	3640
7200 min Summer	0.982	0.0	1119.3	4400
8640 min Summer	0.857	0.0	1171.8	5192
10080 min Summer	0.766	0.0	1221.5	5952
15 min Winter	106.408	0.0	219.0	19
30 min Winter	69.773	0.0	217.0	34

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.274	1.274	3.6	401.1	O K
120 min Winter	99.444	1.444	3.6	476.8	O K
180 min Winter	99.533	1.533	3.6	519.2	O K
240 min Winter	99.589	1.589	3.6	546.7	O K
360 min Winter	99.652	1.652	3.6	578.4	O K
480 min Winter	99.682	1.682	3.6	593.5	O K
600 min Winter	99.693	1.693	3.6	599.5	O K
720 min Winter	99.694	1.694	3.6	599.6	O K
960 min Winter	99.674	1.674	3.6	589.4	O K
1440 min Winter	99.591	1.591	3.6	547.7	O K
2160 min Winter	99.459	1.459	3.6	484.0	O K
2880 min Winter	99.356	1.356	3.6	437.0	O K
4320 min Winter	99.156	1.156	3.6	351.8	O K
5760 min Winter	98.964	0.964	3.6	277.4	O K
7200 min Winter	98.787	0.787	3.6	214.8	O K
8640 min Winter	98.621	0.621	3.6	161.0	O K
10080 min Winter	98.466	0.466	3.6	115.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	43.658	0.0	410.6	64
120 min Winter	26.472	0.0	466.1	122
180 min Winter	19.579	0.0	475.2	180
240 min Winter	15.739	0.0	482.4	240
360 min Winter	11.493	0.0	495.5	358
480 min Winter	9.149	0.0	508.6	474
600 min Winter	7.645	0.0	519.4	590
720 min Winter	6.590	0.0	527.7	706
960 min Winter	5.197	0.0	539.8	932
1440 min Winter	3.700	0.0	555.0	1358
2160 min Winter	2.625	0.0	895.7	1688
2880 min Winter	2.060	0.0	935.6	2136
4320 min Winter	1.472	0.0	945.3	3028
5760 min Winter	1.167	0.0	1063.8	3864
7200 min Winter	0.982	0.0	1119.3	4616
8640 min Winter	0.857	0.0	1171.8	5368
10080 min Winter	0.766	0.0	1221.6	6056

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 369669 370032 SJ 69669 70032
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.900

Time (mins) From:	To:	Area (ha)
0	4	1.900

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	212.5	2.000	587.5

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0077-3600-2000-3600
Design Head (m)	2.000
Design Flow (l/s)	3.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	77
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	3.6	Kick-Flo®	0.691	2.2
Flush-Flo™	0.339	2.7	Mean Flow over Head Range	-	2.8

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.2	1.200	2.8	3.000	4.3	7.000	6.5
0.200	2.6	1.400	3.1	3.500	4.7	7.500	6.7
0.300	2.7	1.600	3.2	4.000	5.0	8.000	6.9
0.400	2.7	1.800	3.4	4.500	5.3	8.500	7.1
0.500	2.7	2.000	3.6	5.000	5.5	9.000	7.3
0.600	2.5	2.200	3.8	5.500	5.8	9.500	7.5
0.800	2.4	2.400	3.9	6.000	6.0		
1.000	2.6	2.600	4.1	6.500	6.2		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.081	1.081	10.6	288.0	O K
30 min Summer	99.297	1.297	10.6	372.1	O K
60 min Summer	99.488	1.488	10.6	454.3	O K
120 min Summer	99.616	1.616	10.6	514.4	O K
180 min Summer	99.667	1.667	10.6	539.4	O K
240 min Summer	99.684	1.684	10.6	547.5	O K
360 min Summer	99.662	1.662	10.6	536.5	O K
480 min Summer	99.609	1.609	10.6	511.1	O K
600 min Summer	99.565	1.565	10.6	489.9	O K
720 min Summer	99.524	1.524	10.6	470.8	O K
960 min Summer	99.449	1.449	10.6	436.9	O K
1440 min Summer	99.303	1.303	10.6	374.5	O K
2160 min Summer	99.093	1.093	10.6	292.7	O K
2880 min Summer	98.894	0.894	10.6	223.5	O K
4320 min Summer	98.540	0.540	10.6	118.7	O K
5760 min Summer	98.264	0.264	10.6	52.4	O K
7200 min Summer	98.087	0.087	10.6	16.0	O K
8640 min Summer	98.000	0.000	10.6	0.0	O K
10080 min Summer	98.000	0.000	9.6	0.0	O K
15 min Winter	99.080	1.080	10.6	287.8	O K
30 min Winter	99.299	1.299	10.6	372.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	99.936	0.0	299.0	19
30 min Summer	65.592	0.0	392.4	33
60 min Summer	41.196	0.0	494.0	64
120 min Summer	24.678	0.0	591.7	122
180 min Summer	18.192	0.0	654.5	182
240 min Summer	14.600	0.0	700.4	242
360 min Summer	10.633	0.0	765.1	360
480 min Summer	8.449	0.0	810.6	464
600 min Summer	7.050	0.0	845.5	484
720 min Summer	6.071	0.0	873.7	544
960 min Summer	4.782	0.0	917.5	674
1440 min Summer	3.399	0.0	978.2	940
2160 min Summer	2.414	0.0	1042.7	1344
2880 min Summer	1.899	0.0	1093.5	1728
4320 min Summer	1.364	0.0	1178.0	2424
5760 min Summer	1.088	0.0	1253.5	3120
7200 min Summer	0.922	0.0	1328.1	3752
8640 min Summer	0.811	0.0	1401.8	7608
10080 min Summer	0.732	0.0	1475.0	0
15 min Winter	99.936	0.0	298.7	18
30 min Winter	65.592	0.0	392.6	33

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.490	1.490	10.6	455.2	O K
120 min Winter	99.621	1.621	10.6	516.5	O K
180 min Winter	99.674	1.674	10.6	542.5	O K
240 min Winter	99.693	1.693	10.6	552.0	O K
360 min Winter	99.679	1.679	10.6	545.1	O K
480 min Winter	99.630	1.630	10.6	521.0	O K
600 min Winter	99.567	1.567	10.6	490.7	O K
720 min Winter	99.521	1.521	10.6	469.3	O K
960 min Winter	99.424	1.424	10.6	425.8	O K
1440 min Winter	99.214	1.214	10.6	338.6	O K
2160 min Winter	98.891	0.891	10.6	222.2	O K
2880 min Winter	98.576	0.576	10.6	128.4	O K
4320 min Winter	98.069	0.069	10.6	12.6	O K
5760 min Winter	98.000	0.000	9.2	0.0	O K
7200 min Winter	98.000	0.000	7.8	0.0	O K
8640 min Winter	98.000	0.000	6.8	0.0	O K
10080 min Winter	98.000	0.000	6.2	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	41.196	0.0	494.0	62
120 min Winter	24.678	0.0	591.8	120
180 min Winter	18.192	0.0	654.4	178
240 min Winter	14.600	0.0	700.4	236
360 min Winter	10.633	0.0	765.1	348
480 min Winter	8.449	0.0	810.6	454
600 min Winter	7.050	0.0	845.5	500
720 min Winter	6.071	0.0	873.7	564
960 min Winter	4.782	0.0	917.5	714
1440 min Winter	3.399	0.0	978.2	1010
2160 min Winter	2.414	0.0	1042.7	1408
2880 min Winter	1.899	0.0	1093.5	1784
4320 min Winter	1.364	0.0	1178.0	2340
5760 min Winter	1.088	0.0	1253.6	0
7200 min Winter	0.922	0.0	1328.3	0
8640 min Winter	0.811	0.0	1401.8	0
10080 min Winter	0.732	0.0	1475.0	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 344827 374941 SJ 44827 74941
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 2.400

Time (mins) From:	To:	Area (ha)
0	4	2.400

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	178.7	2.000	576.2

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0135-1060-2000-1060
Design Head (m)	2.000
Design Flow (l/s)	10.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	135
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	10.6
Flush-Flo™	0.593	10.5
Kick-Flo®	1.206	8.4
Mean Flow over Head Range	-	9.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.9	1.200	8.4	3.000	12.8	7.000	19.2
0.200	8.8	1.400	9.0	3.500	13.8	7.500	19.9
0.300	9.8	1.600	9.5	4.000	14.7	8.000	20.5
0.400	10.3	1.800	10.1	4.500	15.6	8.500	21.1
0.500	10.5	2.000	10.6	5.000	16.4	9.000	21.7
0.600	10.5	2.200	11.1	5.500	17.1	9.500	22.3
0.800	10.3	2.400	11.6	6.000	17.9		
1.000	9.8	2.600	12.0	6.500	18.6		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.083	1.083	19.1	487.5	O K
30 min Summer	99.300	1.300	19.1	624.0	O K
60 min Summer	99.479	1.479	19.1	747.1	O K
120 min Summer	99.618	1.618	19.1	850.2	O K
180 min Summer	99.670	1.670	19.1	890.5	O K
240 min Summer	99.685	1.685	19.1	901.7	O K
360 min Summer	99.655	1.655	19.1	878.3	O K
480 min Summer	99.602	1.602	19.1	837.6	O K
600 min Summer	99.556	1.556	19.1	803.5	O K
720 min Summer	99.514	1.514	19.1	772.8	O K
960 min Summer	99.436	1.436	19.1	717.0	O K
1440 min Summer	99.285	1.285	19.1	614.1	O K
2160 min Summer	99.063	1.063	19.1	476.0	O K
2880 min Summer	98.853	0.853	19.1	358.3	O K
4320 min Summer	98.483	0.483	19.1	180.8	O K
5760 min Summer	98.207	0.207	19.1	70.7	O K
7200 min Summer	98.043	0.043	19.1	14.0	O K
8640 min Summer	98.000	0.000	18.1	0.0	O K
10080 min Summer	98.000	0.000	16.2	0.0	O K
15 min Winter	99.082	1.082	19.1	487.2	O K
30 min Winter	99.302	1.302	19.1	625.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	104.350	0.0	506.6	19
30 min Summer	67.948	0.0	659.6	33
60 min Summer	42.061	0.0	818.1	64
120 min Summer	25.395	0.0	989.1	122
180 min Summer	18.778	0.0	1097.4	182
240 min Summer	15.101	0.0	1176.7	242
360 min Summer	11.032	0.0	1289.5	360
480 min Summer	8.780	0.0	1368.3	412
600 min Summer	7.336	0.0	1429.1	472
720 min Summer	6.326	0.0	1478.7	534
960 min Summer	4.996	0.0	1557.0	664
1440 min Summer	3.573	0.0	1670.4	938
2160 min Summer	2.552	0.0	1791.1	1324
2880 min Summer	2.014	0.0	1884.3	1704
4320 min Summer	1.451	0.0	2035.6	2420
5760 min Summer	1.157	0.0	2164.8	3064
7200 min Summer	0.975	0.0	2282.2	4696
8640 min Summer	0.852	0.0	2392.3	0
10080 min Summer	0.762	0.0	2496.4	0
15 min Winter	104.350	0.0	506.1	18
30 min Winter	67.948	0.0	660.0	33

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.483	1.483	19.1	749.8	O K
120 min Winter	99.623	1.623	19.1	854.1	O K
180 min Winter	99.678	1.678	19.1	896.4	O K
240 min Winter	99.695	1.695	19.1	910.2	O K
360 min Winter	99.676	1.676	19.1	894.7	O K
480 min Winter	99.617	1.617	19.1	849.6	O K
600 min Winter	99.556	1.556	19.1	803.5	O K
720 min Winter	99.507	1.507	19.1	767.3	O K
960 min Winter	99.401	1.401	19.1	692.5	O K
1440 min Winter	99.177	1.177	19.1	545.1	O K
2160 min Winter	98.832	0.832	19.1	347.2	O K
2880 min Winter	98.503	0.503	19.1	189.3	O K
4320 min Winter	98.023	0.023	19.1	7.4	O K
5760 min Winter	98.000	0.000	15.8	0.0	O K
7200 min Winter	98.000	0.000	13.4	0.0	O K
8640 min Winter	98.000	0.000	11.7	0.0	O K
10080 min Winter	98.000	0.000	10.4	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	42.061	0.0	819.2	62
120 min Winter	25.395	0.0	989.3	120
180 min Winter	18.778	0.0	1097.4	178
240 min Winter	15.101	0.0	1176.6	236
360 min Winter	11.032	0.0	1289.5	346
480 min Winter	8.780	0.0	1368.3	450
600 min Winter	7.336	0.0	1429.1	482
720 min Winter	6.326	0.0	1478.7	556
960 min Winter	4.996	0.0	1557.0	706
1440 min Winter	3.573	0.0	1670.5	996
2160 min Winter	2.552	0.0	1791.1	1404
2880 min Winter	2.014	0.0	1884.3	1756
4320 min Winter	1.451	0.0	2035.8	2356
5760 min Winter	1.157	0.0	2165.0	0
7200 min Winter	0.975	0.0	2282.6	0
8640 min Winter	0.852	0.0	2392.3	0
10080 min Winter	0.762	0.0	2496.4	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 360158 378110 SJ 60158 78110
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 3.900

Time (mins) From:	To:	Area (ha)
0	4	3.900

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	319.5	2.000	895.4

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0180-1910-2000-1910
Design Head (m)	2.000
Design Flow (l/s)	19.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	180
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	19.1
Flush-Flo™	0.584	19.1
Kick-Flo®	1.231	15.2
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	6.3	1.200	15.7	3.000	23.2	7.000	34.8
0.200	15.9	1.400	16.1	3.500	24.9	7.500	36.0
0.300	17.7	1.600	17.2	4.000	26.6	8.000	37.1
0.400	18.6	1.800	18.2	4.500	28.1	8.500	38.3
0.500	19.0	2.000	19.1	5.000	29.6	9.000	39.3
0.600	19.1	2.200	20.0	5.500	31.0	9.500	40.4
0.800	18.7	2.400	20.8	6.000	32.3		
1.000	17.8	2.600	21.6	6.500	33.6		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.088	1.088	17.6	450.0	O K
30 min Summer	99.304	1.304	17.6	576.1	O K
60 min Summer	99.480	1.480	17.6	689.7	O K
120 min Summer	99.618	1.618	17.6	785.0	O K
180 min Summer	99.670	1.670	17.6	822.3	O K
240 min Summer	99.684	1.684	17.6	832.7	O K
360 min Summer	99.655	1.655	17.6	811.3	O K
480 min Summer	99.602	1.602	17.6	773.7	O K
600 min Summer	99.558	1.558	17.6	742.2	O K
720 min Summer	99.516	1.516	17.6	713.9	O K
960 min Summer	99.439	1.439	17.6	662.4	O K
1440 min Summer	99.290	1.290	17.6	567.6	O K
2160 min Summer	99.070	1.070	17.6	440.2	O K
2880 min Summer	98.861	0.861	17.6	331.6	O K
4320 min Summer	98.492	0.492	17.6	167.7	O K
5760 min Summer	98.212	0.212	17.6	65.8	O K
7200 min Summer	98.045	0.045	17.6	13.1	O K
8640 min Summer	98.000	0.000	16.7	0.0	O K
10080 min Summer	98.000	0.000	14.9	0.0	O K
15 min Winter	99.088	1.088	17.6	449.8	O K
30 min Winter	99.306	1.306	17.6	577.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	104.350	0.0	467.8	19
30 min Summer	67.948	0.0	609.1	33
60 min Summer	42.061	0.0	755.3	64
120 min Summer	25.395	0.0	913.1	122
180 min Summer	18.778	0.0	1013.1	182
240 min Summer	15.101	0.0	1086.3	242
360 min Summer	11.032	0.0	1190.4	360
480 min Summer	8.780	0.0	1263.2	412
600 min Summer	7.336	0.0	1319.3	476
720 min Summer	6.326	0.0	1365.1	534
960 min Summer	4.996	0.0	1437.4	664
1440 min Summer	3.573	0.0	1542.0	938
2160 min Summer	2.552	0.0	1653.4	1324
2880 min Summer	2.014	0.0	1739.4	1704
4320 min Summer	1.451	0.0	1879.2	2420
5760 min Summer	1.157	0.0	1998.3	3096
7200 min Summer	0.975	0.0	2106.7	4480
8640 min Summer	0.852	0.0	2208.2	0
10080 min Summer	0.762	0.0	2304.4	0
15 min Winter	104.350	0.0	467.4	18
30 min Winter	67.948	0.0	609.4	33

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.484	1.484	17.6	692.2	O K
120 min Winter	99.623	1.623	17.6	788.5	O K
180 min Winter	99.677	1.677	17.6	827.7	O K
240 min Winter	99.695	1.695	17.6	840.6	O K
360 min Winter	99.676	1.676	17.6	826.4	O K
480 min Winter	99.618	1.618	17.6	784.9	O K
600 min Winter	99.558	1.558	17.6	742.2	O K
720 min Winter	99.509	1.509	17.6	708.9	O K
960 min Winter	99.405	1.405	17.6	640.0	O K
1440 min Winter	99.184	1.184	17.6	504.1	O K
2160 min Winter	98.841	0.841	17.6	321.5	O K
2880 min Winter	98.512	0.512	17.6	175.8	O K
4320 min Winter	98.025	0.025	17.6	7.2	O K
5760 min Winter	98.000	0.000	14.6	0.0	O K
7200 min Winter	98.000	0.000	12.3	0.0	O K
8640 min Winter	98.000	0.000	10.8	0.0	O K
10080 min Winter	98.000	0.000	9.6	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	42.061	0.0	756.3	62
120 min Winter	25.395	0.0	913.3	120
180 min Winter	18.778	0.0	1013.1	178
240 min Winter	15.101	0.0	1086.2	236
360 min Winter	11.032	0.0	1190.4	346
480 min Winter	8.780	0.0	1263.2	450
600 min Winter	7.336	0.0	1319.3	484
720 min Winter	6.326	0.0	1365.1	556
960 min Winter	4.996	0.0	1437.4	706
1440 min Winter	3.573	0.0	1542.1	996
2160 min Winter	2.552	0.0	1653.4	1404
2880 min Winter	2.014	0.0	1739.4	1756
4320 min Winter	1.451	0.0	1879.3	3008
5760 min Winter	1.157	0.0	1998.5	0
7200 min Winter	0.975	0.0	2107.0	0
8640 min Winter	0.852	0.0	2208.2	0
10080 min Winter	0.762	0.0	2304.4	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 360158 378110 SJ 60158 78110
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 3.600

Time (mins) From:	To:	Area (ha)
0	4	3.600

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	288.0	2.000	842.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0173-1760-2000-1760
Design Head (m)	2.000
Design Flow (l/s)	17.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	173
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	17.6
Flush-Flo™	0.578	17.6
Kick-Flo®	1.223	13.9
Mean Flow over Head Range	-	15.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.1	1.200	14.3	3.000	21.4	7.000	32.1
0.200	14.7	1.400	14.9	3.500	23.0	7.500	33.2
0.300	16.4	1.600	15.8	4.000	24.5	8.000	34.2
0.400	17.2	1.800	16.7	4.500	25.9	8.500	35.2
0.500	17.5	2.000	17.6	5.000	27.3	9.000	36.2
0.600	17.6	2.200	18.4	5.500	28.6	9.500	37.2
0.800	17.3	2.400	19.2	6.000	29.8		
1.000	16.4	2.600	19.9	6.500	31.0		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.052	1.052	3.1	160.3	O K
30 min Summer	99.240	1.240	3.1	208.1	O K
60 min Summer	99.403	1.403	3.1	255.0	O K
120 min Summer	99.536	1.536	3.1	297.6	O K
180 min Summer	99.604	1.604	3.1	320.8	O K
240 min Summer	99.645	1.645	3.1	335.1	O K
360 min Summer	99.684	1.684	3.1	349.3	O K
480 min Summer	99.692	1.692	3.1	352.4	O K
600 min Summer	99.685	1.685	3.1	349.6	O K
720 min Summer	99.668	1.668	3.1	343.4	O K
960 min Summer	99.618	1.618	3.1	325.6	O K
1440 min Summer	99.538	1.538	3.1	298.1	O K
2160 min Summer	99.446	1.446	3.1	268.3	O K
2880 min Summer	99.364	1.364	3.1	243.5	O K
4320 min Summer	99.211	1.211	3.1	200.4	O K
5760 min Summer	99.065	1.065	3.1	163.5	O K
7200 min Summer	98.928	0.928	3.1	132.5	O K
8640 min Summer	98.795	0.795	3.1	105.6	O K
10080 min Summer	98.671	0.671	3.1	83.2	O K
15 min Winter	99.052	1.052	3.1	160.3	O K
30 min Winter	99.240	1.240	3.1	208.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	100.750	0.0	162.6	19
30 min Summer	65.938	0.0	190.5	34
60 min Summer	41.037	0.0	266.5	64
120 min Summer	24.646	0.0	320.0	124
180 min Summer	18.196	0.0	354.1	182
240 min Summer	14.623	0.0	379.3	242
360 min Summer	10.680	0.0	414.3	362
480 min Summer	8.496	0.0	430.5	482
600 min Summer	7.097	0.0	436.3	602
720 min Summer	6.119	0.0	440.9	720
960 min Summer	4.834	0.0	448.2	896
1440 min Summer	3.455	0.0	451.8	1112
2160 min Summer	2.469	0.0	577.7	1496
2880 min Summer	1.950	0.0	608.4	1904
4320 min Summer	1.406	0.0	657.8	2724
5760 min Summer	1.122	0.0	700.0	3464
7200 min Summer	0.947	0.0	738.6	4256
8640 min Summer	0.828	0.0	774.8	5016
10080 min Summer	0.741	0.0	809.1	5656
15 min Winter	100.750	0.0	162.6	19
30 min Winter	65.938	0.0	190.4	33

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.403	1.403	3.1	255.0	O K
120 min Winter	99.537	1.537	3.1	298.0	O K
180 min Winter	99.606	1.606	3.1	321.6	O K
240 min Winter	99.647	1.647	3.1	336.1	O K
360 min Winter	99.688	1.688	3.1	350.9	O K
480 min Winter	99.699	1.699	3.1	354.7	O K
600 min Winter	99.694	1.694	3.1	353.1	O K
720 min Winter	99.681	1.681	3.1	348.1	O K
960 min Winter	99.637	1.637	3.1	332.5	O K
1440 min Winter	99.537	1.537	3.1	297.7	O K
2160 min Winter	99.419	1.419	3.1	259.8	O K
2880 min Winter	99.298	1.298	3.1	224.2	O K
4320 min Winter	99.053	1.053	3.1	160.5	O K
5760 min Winter	98.804	0.804	3.1	107.4	O K
7200 min Winter	98.559	0.559	3.1	65.0	O K
8640 min Winter	98.320	0.320	3.1	32.3	O K
10080 min Winter	98.112	0.112	3.1	9.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	41.037	0.0	266.4	62
120 min Winter	24.646	0.0	320.0	122
180 min Winter	18.196	0.0	354.3	180
240 min Winter	14.623	0.0	379.4	238
360 min Winter	10.680	0.0	414.2	356
480 min Winter	8.496	0.0	429.5	470
600 min Winter	7.097	0.0	434.8	584
720 min Winter	6.119	0.0	438.8	696
960 min Winter	4.834	0.0	445.4	914
1440 min Winter	3.455	0.0	452.5	1142
2160 min Winter	2.469	0.0	577.7	1600
2880 min Winter	1.950	0.0	608.4	2048
4320 min Winter	1.406	0.0	657.9	2856
5760 min Winter	1.122	0.0	700.0	3640
7200 min Winter	0.947	0.0	738.7	4328
8640 min Winter	0.828	0.0	774.8	4936
10080 min Winter	0.741	0.0	809.1	5552

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 358800 385744 SJ 58800 85744
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.300

Time (mins) From:	To:	Area (ha)
0	4	1.300

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	82.1	2.000	442.9

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0071-3100-2000-3100
Design Head (m)	2.000
Design Flow (l/s)	3.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	71
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	3.1
Flush-Flo™	0.313	2.3
Kick-Flo®	0.640	1.8
Mean Flow over Head Range	-	2.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.9	1.200	2.4	3.000	3.7	7.000	5.6
0.200	2.2	1.400	2.6	3.500	4.0	7.500	5.7
0.300	2.3	1.600	2.8	4.000	4.3	8.000	5.9
0.400	2.3	1.800	2.9	4.500	4.5	8.500	6.1
0.500	2.2	2.000	3.1	5.000	4.7	9.000	6.3
0.600	2.0	2.200	3.2	5.500	5.0	9.500	6.4
0.800	2.0	2.400	3.4	6.000	5.2		
1.000	2.3	2.600	3.5	6.500	5.4		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.063	1.063	3.0	147.8	O K
30 min Summer	99.248	1.248	3.0	191.8	O K
60 min Summer	99.408	1.408	3.0	234.9	O K
120 min Summer	99.538	1.538	3.0	273.6	O K
180 min Summer	99.603	1.603	3.0	294.6	O K
240 min Summer	99.642	1.642	3.0	307.3	O K
360 min Summer	99.677	1.677	3.0	319.4	O K
480 min Summer	99.683	1.683	3.0	321.3	O K
600 min Summer	99.672	1.672	3.0	317.8	O K
720 min Summer	99.653	1.653	3.0	311.0	O K
960 min Summer	99.601	1.601	3.0	294.0	O K
1440 min Summer	99.522	1.522	3.0	268.8	O K
2160 min Summer	99.429	1.429	3.0	240.9	O K
2880 min Summer	99.345	1.345	3.0	217.2	O K
4320 min Summer	99.185	1.185	3.0	176.2	O K
5760 min Summer	99.033	1.033	3.0	141.3	O K
7200 min Summer	98.887	0.887	3.0	111.8	O K
8640 min Summer	98.749	0.749	3.0	87.2	O K
10080 min Summer	98.619	0.619	3.0	66.7	O K
15 min Winter	99.063	1.063	3.0	147.8	O K
30 min Winter	99.248	1.248	3.0	191.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	100.750	0.0	150.4	19
30 min Summer	65.938	0.0	184.0	34
60 min Summer	41.037	0.0	246.1	64
120 min Summer	24.646	0.0	295.5	124
180 min Summer	18.196	0.0	327.1	182
240 min Summer	14.623	0.0	350.5	242
360 min Summer	10.680	0.0	383.6	362
480 min Summer	8.496	0.0	405.9	482
600 min Summer	7.097	0.0	419.1	600
720 min Summer	6.119	0.0	424.6	720
960 min Summer	4.834	0.0	430.6	858
1440 min Summer	3.455	0.0	430.7	1084
2160 min Summer	2.469	0.0	533.3	1476
2880 min Summer	1.950	0.0	561.6	1876
4320 min Summer	1.406	0.0	607.3	2684
5760 min Summer	1.122	0.0	646.2	3464
7200 min Summer	0.947	0.0	681.8	4184
8640 min Summer	0.828	0.0	715.2	4936
10080 min Summer	0.741	0.0	746.9	5648
15 min Winter	100.750	0.0	150.4	19
30 min Winter	65.938	0.0	183.9	33

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.408	1.408	3.0	234.9	O K
120 min Winter	99.539	1.539	3.0	274.1	O K
180 min Winter	99.606	1.606	3.0	295.4	O K
240 min Winter	99.645	1.645	3.0	308.3	O K
360 min Winter	99.682	1.682	3.0	321.0	O K
480 min Winter	99.690	1.690	3.0	323.7	O K
600 min Winter	99.683	1.683	3.0	321.3	O K
720 min Winter	99.667	1.667	3.0	315.8	O K
960 min Winter	99.619	1.619	3.0	299.9	O K
1440 min Winter	99.519	1.519	3.0	268.0	O K
2160 min Winter	99.396	1.396	3.0	231.5	O K
2880 min Winter	99.270	1.270	3.0	197.3	O K
4320 min Winter	99.011	1.011	3.0	136.7	O K
5760 min Winter	98.748	0.748	3.0	86.9	O K
7200 min Winter	98.486	0.486	3.0	48.3	O K
8640 min Winter	98.236	0.236	3.0	19.9	O K
10080 min Winter	98.039	0.039	3.0	2.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	41.037	0.0	246.0	62
120 min Winter	24.646	0.0	295.5	122
180 min Winter	18.196	0.0	327.2	180
240 min Winter	14.623	0.0	350.5	238
360 min Winter	10.680	0.0	383.6	356
480 min Winter	8.496	0.0	405.8	470
600 min Winter	7.097	0.0	417.9	584
720 min Winter	6.119	0.0	422.5	694
960 min Winter	4.834	0.0	428.5	906
1440 min Winter	3.455	0.0	431.4	1126
2160 min Winter	2.469	0.0	533.3	1580
2880 min Winter	1.950	0.0	561.6	2020
4320 min Winter	1.406	0.0	607.3	2852
5760 min Winter	1.122	0.0	646.1	3648
7200 min Winter	0.947	0.0	681.9	4256
8640 min Winter	0.828	0.0	715.2	4848
10080 min Winter	0.741	0.0	746.9	5352

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 358800 385744 SJ 58800 85744
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.200

Time (mins) From:	To:	Area (ha)
0	4	1.200

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	71.7	2.000	418.3

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0070-3000-2000-3000
Design Head (m)	2.000
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	70
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	3.0	Kick-Flo®	0.630	1.8
Flush-Flo™	0.310	2.2	Mean Flow over Head Range	-	2.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.8	1.200	2.4	3.000	3.6	7.000	5.4
0.200	2.1	1.400	2.5	3.500	3.9	7.500	5.6
0.300	2.2	1.600	2.7	4.000	4.1	8.000	5.7
0.400	2.2	1.800	2.9	4.500	4.4	8.500	5.9
0.500	2.1	2.000	3.0	5.000	4.6	9.000	6.1
0.600	1.9	2.200	3.1	5.500	4.8	9.500	6.2
0.800	2.0	2.400	3.3	6.000	5.0		
1.000	2.2	2.600	3.4	6.500	5.2		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	98.983	0.983	7.0	372.9	O K
30 min Summer	99.204	1.204	7.0	485.6	O K
60 min Summer	99.403	1.403	7.0	597.6	O K
120 min Summer	99.547	1.547	7.0	685.0	O K
180 min Summer	99.615	1.615	7.0	728.3	O K
240 min Summer	99.653	1.653	7.0	753.1	O K
360 min Summer	99.685	1.685	7.0	774.2	O K
480 min Summer	99.688	1.688	7.0	775.9	O K
600 min Summer	99.675	1.675	7.0	767.5	O K
720 min Summer	99.653	1.653	7.0	753.0	O K
960 min Summer	99.596	1.596	7.0	716.1	O K
1440 min Summer	99.515	1.515	7.0	665.1	O K
2160 min Summer	99.423	1.423	7.0	609.4	O K
2880 min Summer	99.339	1.339	7.0	560.6	O K
4320 min Summer	99.179	1.179	7.0	472.2	O K
5760 min Summer	99.024	1.024	7.0	392.8	O K
7200 min Summer	98.877	0.877	7.0	322.7	O K
8640 min Summer	98.738	0.738	7.0	260.8	O K
10080 min Summer	98.608	0.608	7.0	206.8	O K
15 min Winter	98.983	0.983	7.0	372.9	O K
30 min Winter	99.204	1.204	7.0	485.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	105.017	0.0	375.8	19
30 min Summer	68.922	0.0	481.4	34
60 min Summer	43.037	0.0	622.1	64
120 min Summer	25.400	0.0	734.0	124
180 min Summer	18.512	0.0	801.7	182
240 min Summer	14.741	0.0	850.9	242
360 min Summer	10.644	0.0	920.5	362
480 min Summer	8.430	0.0	970.1	482
600 min Summer	7.033	0.0	1008.2	602
720 min Summer	6.065	0.0	1037.6	720
960 min Summer	4.806	0.0	1065.9	878
1440 min Summer	3.470	0.0	1049.2	1112
2160 min Summer	2.509	0.0	1308.8	1496
2880 min Summer	1.998	0.0	1389.0	1904
4320 min Summer	1.455	0.0	1516.0	2724
5760 min Summer	1.166	0.0	1622.9	3680
7200 min Summer	0.986	0.0	1714.8	4256
8640 min Summer	0.861	0.0	1797.7	5016
10080 min Summer	0.770	0.0	1874.0	5752
15 min Winter	105.017	0.0	375.8	19
30 min Winter	68.922	0.0	481.4	33

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.402	1.402	7.0	597.4	O K
120 min Winter	99.548	1.548	7.0	686.0	O K
180 min Winter	99.618	1.618	7.0	730.2	O K
240 min Winter	99.656	1.656	7.0	755.4	O K
360 min Winter	99.690	1.690	7.0	777.8	O K
480 min Winter	99.696	1.696	7.0	781.4	O K
600 min Winter	99.687	1.687	7.0	775.5	O K
720 min Winter	99.669	1.669	7.0	763.7	O K
960 min Winter	99.619	1.619	7.0	731.0	O K
1440 min Winter	99.513	1.513	7.0	664.1	O K
2160 min Winter	99.390	1.390	7.0	590.4	O K
2880 min Winter	99.263	1.263	7.0	518.0	O K
4320 min Winter	99.004	1.004	7.0	382.9	O K
5760 min Winter	98.750	0.750	7.0	265.7	O K
7200 min Winter	98.510	0.510	7.0	168.2	O K
8640 min Winter	98.293	0.293	7.0	90.6	O K
10080 min Winter	98.116	0.116	7.0	33.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	43.037	0.0	621.8	62
120 min Winter	25.400	0.0	734.0	122
180 min Winter	18.512	0.0	802.0	180
240 min Winter	14.741	0.0	851.0	238
360 min Winter	10.644	0.0	920.4	356
480 min Winter	8.430	0.0	969.8	470
600 min Winter	7.033	0.0	1007.7	584
720 min Winter	6.065	0.0	1035.8	696
960 min Winter	4.806	0.0	1059.4	914
1440 min Winter	3.470	0.0	1051.7	1140
2160 min Winter	2.509	0.0	1308.8	1600
2880 min Winter	1.998	0.0	1389.1	2048
4320 min Winter	1.455	0.0	1516.5	2896
5760 min Winter	1.166	0.0	1622.9	3640
7200 min Winter	0.986	0.0	1714.8	4400
8640 min Winter	0.861	0.0	1797.8	5016
10080 min Winter	0.770	0.0	1874.2	5552

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 372232 388607 SJ 72232 88607
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 2.900

Time (mins) From:	To:	Area (ha)
0	4	2.900

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	282.2	2.000	752.6

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0109-7000-2000-7000
Design Head (m)	2.000
Design Flow (l/s)	7.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	109
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	7.0
Flush-Flo™	0.475	6.3
Kick-Flo®	0.973	5.0
Mean Flow over Head Range	-	5.8

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.7	1.200	5.5	3.000	8.5	7.000	12.7
0.200	5.6	1.400	5.9	3.500	9.1	7.500	13.1
0.300	6.1	1.600	6.3	4.000	9.7	8.000	13.5
0.400	6.3	1.800	6.7	4.500	10.3	8.500	13.9
0.500	6.3	2.000	7.0	5.000	10.8	9.000	14.3
0.600	6.2	2.200	7.3	5.500	11.3	9.500	14.6
0.800	5.9	2.400	7.6	6.000	11.8		
1.000	5.1	2.600	7.9	6.500	12.2		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.241	1.241	20.5	297.1	O K
30 min Summer	99.468	1.468	20.5	381.3	O K
60 min Summer	99.636	1.636	20.5	450.4	O K
120 min Summer	99.686	1.686	20.5	472.4	O K
180 min Summer	99.663	1.663	20.5	462.1	O K
240 min Summer	99.623	1.623	20.5	444.7	O K
360 min Summer	99.554	1.554	20.5	416.0	O K
480 min Summer	99.491	1.491	20.5	390.3	O K
600 min Summer	99.428	1.428	20.5	365.4	O K
720 min Summer	99.364	1.364	20.5	341.2	O K
960 min Summer	99.234	1.234	20.5	294.5	O K
1440 min Summer	98.978	0.978	20.5	212.2	O K
2160 min Summer	98.614	0.614	20.5	115.6	O K
2880 min Summer	98.312	0.312	20.5	51.8	O K
4320 min Summer	98.000	0.000	20.2	0.0	O K
5760 min Summer	98.000	0.000	16.4	0.0	O K
7200 min Summer	98.000	0.000	14.0	0.0	O K
8640 min Summer	98.000	0.000	12.3	0.0	O K
10080 min Summer	98.000	0.000	11.1	0.0	O K
15 min Winter	99.243	1.243	20.5	297.6	O K
30 min Winter	99.471	1.471	20.5	382.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	94.738	0.0	319.1	18
30 min Summer	62.468	0.0	421.3	33
60 min Summer	39.034	0.0	526.6	62
120 min Summer	22.999	0.0	620.8	122
180 min Summer	16.864	0.0	682.9	180
240 min Summer	13.505	0.0	729.1	208
360 min Summer	9.820	0.0	795.3	274
480 min Summer	7.811	0.0	843.4	334
600 min Summer	6.533	0.0	881.8	404
720 min Summer	5.643	0.0	914.0	470
960 min Summer	4.477	0.0	966.8	606
1440 min Summer	3.238	0.0	1048.7	866
2160 min Summer	2.347	0.0	1140.4	1216
2880 min Summer	1.874	0.0	1214.3	1560
4320 min Summer	1.376	0.0	1337.9	0
5760 min Summer	1.114	0.0	1443.6	0
7200 min Summer	0.951	0.0	1540.3	0
8640 min Summer	0.839	0.0	1630.8	0
10080 min Summer	0.757	0.0	1717.0	0
15 min Winter	94.738	0.0	319.4	18
30 min Winter	62.468	0.0	421.0	32

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	99.641	1.641	20.5	452.7	O K
120 min Winter	99.697	1.697	20.5	477.3	O K
180 min Winter	99.683	1.683	20.5	470.9	O K
240 min Winter	99.637	1.637	20.5	450.8	O K
360 min Winter	99.547	1.547	20.5	413.1	O K
480 min Winter	99.459	1.459	20.5	377.7	O K
600 min Winter	99.364	1.364	20.5	341.2	O K
720 min Winter	99.264	1.264	20.5	304.9	O K
960 min Winter	99.056	1.056	20.5	236.0	O K
1440 min Winter	98.635	0.635	20.5	120.6	O K
2160 min Winter	98.085	0.085	20.5	12.8	O K
2880 min Winter	98.000	0.000	17.8	0.0	O K
4320 min Winter	98.000	0.000	13.1	0.0	O K
5760 min Winter	98.000	0.000	10.6	0.0	O K
7200 min Winter	98.000	0.000	9.0	0.0	O K
8640 min Winter	98.000	0.000	8.0	0.0	O K
10080 min Winter	98.000	0.000	7.2	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	39.034	0.0	526.8	62
120 min Winter	22.999	0.0	620.7	118
180 min Winter	16.864	0.0	682.9	174
240 min Winter	13.505	0.0	729.1	226
360 min Winter	9.820	0.0	795.2	280
480 min Winter	7.811	0.0	843.4	356
600 min Winter	6.533	0.0	881.8	440
720 min Winter	5.643	0.0	914.0	502
960 min Winter	4.477	0.0	966.8	638
1440 min Winter	3.238	0.0	1048.8	884
2160 min Winter	2.347	0.0	1140.5	1284
2880 min Winter	1.874	0.0	1214.4	0
4320 min Winter	1.376	0.0	1337.9	0
5760 min Winter	1.114	0.0	1443.6	0
7200 min Winter	0.951	0.0	1540.3	0
8640 min Winter	0.839	0.0	1630.8	0
10080 min Winter	0.757	0.0	1717.0	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 351306 389946 SJ 51306 89946
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 2.700

Time (mins) From:	To:	Area (ha)
0	4	2.700

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	145.3	2.000	514.7

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0186-2050-2000-2050
Design Head (m)	2.000
Design Flow (l/s)	20.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	186
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	20.5
Flush-Flo™	0.582	20.4
Kick-Flo®	1.230	16.2
Mean Flow over Head Range	-	17.8

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.5	1.200	16.8	3.000	24.8	7.000	37.3
0.200	16.9	1.400	17.3	3.500	26.7	7.500	38.6
0.300	18.9	1.600	18.4	4.000	28.5	8.000	39.8
0.400	19.9	1.800	19.5	4.500	30.2	8.500	41.0
0.500	20.3	2.000	20.5	5.000	31.7	9.000	42.1
0.600	20.3	2.200	21.4	5.500	33.2	9.500	43.3
0.800	20.0	2.400	22.3	6.000	34.6		
1.000	19.0	2.600	23.2	6.500	36.0		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.220	1.220	28.1	407.0	O K
30 min Summer	99.457	1.457	28.1	522.4	O K
60 min Summer	99.634	1.634	28.1	617.1	O K
120 min Summer	99.687	1.687	28.1	647.1	O K
180 min Summer	99.662	1.662	28.1	632.8	O K
240 min Summer	99.620	1.620	28.1	609.0	O K
360 min Summer	99.547	1.547	28.1	569.6	O K
480 min Summer	99.481	1.481	28.1	534.5	O K
600 min Summer	99.414	1.414	28.1	500.2	O K
720 min Summer	99.347	1.347	28.1	467.0	O K
960 min Summer	99.211	1.211	28.1	403.0	O K
1440 min Summer	98.947	0.947	28.1	290.1	O K
2160 min Summer	98.580	0.580	28.1	157.7	O K
2880 min Summer	98.286	0.286	28.1	70.4	O K
4320 min Summer	98.000	0.000	27.7	0.0	O K
5760 min Summer	98.000	0.000	22.4	0.0	O K
15 min Winter	99.222	1.222	28.1	407.7	O K
30 min Winter	99.460	1.460	28.1	523.6	O K
60 min Winter	99.640	1.640	28.1	620.2	O K
120 min Winter	99.699	1.699	28.1	653.9	O K
180 min Winter	99.683	1.683	28.1	644.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	94.720	0.0	436.9	18
30 min Summer	62.460	0.0	576.9	33
60 min Summer	39.030	0.0	721.4	62
120 min Summer	23.000	0.0	850.6	122
180 min Summer	16.863	0.0	935.5	180
240 min Summer	13.505	0.0	999.0	208
360 min Summer	9.820	0.0	1089.6	268
480 min Summer	7.811	0.0	1155.6	334
600 min Summer	6.533	0.0	1208.2	404
720 min Summer	5.643	0.0	1252.4	470
960 min Summer	4.477	0.0	1324.6	606
1440 min Summer	3.238	0.0	1437.0	866
2160 min Summer	2.347	0.0	1562.8	1216
2880 min Summer	1.874	0.0	1663.9	1584
4320 min Summer	1.377	0.0	1833.5	0
5760 min Summer	1.114	0.0	1978.2	0
15 min Winter	94.720	0.0	437.3	18
30 min Winter	62.460	0.0	576.6	32
60 min Winter	39.030	0.0	721.7	62
120 min Winter	23.000	0.0	850.5	118
180 min Winter	16.863	0.0	935.5	174

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	99.635	1.635	28.1	617.3	O K
360 min Winter	99.540	1.540	28.1	565.6	O K
480 min Winter	99.447	1.447	28.1	517.1	O K
600 min Winter	99.347	1.347	28.1	466.9	O K
720 min Winter	99.242	1.242	28.1	417.2	O K
960 min Winter	99.027	1.027	28.1	322.6	O K
1440 min Winter	98.601	0.601	28.1	164.5	O K
2160 min Winter	98.075	0.075	28.1	17.1	O K
2880 min Winter	98.000	0.000	24.4	0.0	O K
4320 min Winter	98.000	0.000	17.9	0.0	O K
5760 min Winter	98.000	0.000	14.5	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	13.505	0.0	999.0	226
360 min Winter	9.820	0.0	1089.6	280
480 min Winter	7.811	0.0	1155.6	356
600 min Winter	6.533	0.0	1208.1	430
720 min Winter	5.643	0.0	1252.4	502
960 min Winter	4.477	0.0	1324.7	638
1440 min Winter	3.238	0.0	1437.0	884
2160 min Winter	2.347	0.0	1562.9	1176
2880 min Winter	1.874	0.0	1664.3	0
4320 min Winter	1.377	0.0	1833.5	0
5760 min Winter	1.114	0.0	1978.2	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 351306 389946 SJ 51306 89946
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 3.700

Time (mins) From:	To:	Area (ha)
0	4	3.700

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	222.7	2.000	653.3

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0216-2810-2000-2810
Design Head (m)	2.000
Design Flow (l/s)	28.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	216
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	28.1
Flush-Flo™	0.586	27.9
Kick-Flo®	1.256	22.5
Mean Flow over Head Range	-	24.3

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	7.3	1.200	23.8	3.000	34.1	7.000	51.3
0.200	21.1	1.400	23.7	3.500	36.7	7.500	53.1
0.300	25.9	1.600	25.2	4.000	39.2	8.000	54.8
0.400	27.2	1.800	26.7	4.500	41.5	8.500	56.4
0.500	27.8	2.000	28.1	5.000	43.6	9.000	58.0
0.600	27.9	2.200	29.4	5.500	45.7	9.500	59.5
0.800	27.5	2.400	30.6	6.000	47.6		
1.000	26.4	2.600	31.8	6.500	49.5		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	98.947	0.947	6.7	345.2	O K
30 min Summer	99.158	1.158	6.7	448.1	O K
60 min Summer	99.346	1.346	6.7	549.2	O K
120 min Summer	99.503	1.503	6.7	640.6	O K
180 min Summer	99.585	1.585	6.7	690.6	O K
240 min Summer	99.634	1.634	6.7	721.3	O K
360 min Summer	99.681	1.681	6.7	751.7	O K
480 min Summer	99.691	1.691	6.7	758.1	O K
600 min Summer	99.682	1.682	6.7	752.0	O K
720 min Summer	99.661	1.661	6.7	738.3	O K
960 min Summer	99.600	1.600	6.7	699.9	O K
1440 min Summer	99.503	1.503	6.7	640.5	O K
2160 min Summer	99.394	1.394	6.7	576.4	O K
2880 min Summer	99.298	1.298	6.7	522.7	O K
4320 min Summer	99.121	1.121	6.7	429.4	O K
5760 min Summer	98.958	0.958	6.7	350.0	O K
15 min Winter	98.947	0.947	6.7	345.2	O K
30 min Winter	99.158	1.158	6.7	448.2	O K
60 min Winter	99.346	1.346	6.7	549.1	O K
120 min Winter	99.505	1.505	6.7	641.6	O K
180 min Winter	99.588	1.588	6.7	692.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	100.760	0.0	348.3	19
30 min Summer	65.940	0.0	447.9	34
60 min Summer	41.040	0.0	572.8	64
120 min Summer	24.645	0.0	687.7	124
180 min Summer	18.197	0.0	761.0	182
240 min Summer	14.623	0.0	814.9	242
360 min Summer	10.680	0.0	891.2	362
480 min Summer	8.496	0.0	942.4	482
600 min Summer	7.097	0.0	978.5	602
720 min Summer	6.118	0.0	1001.6	720
960 min Summer	4.834	0.0	1018.3	896
1440 min Summer	3.455	0.0	1000.5	1112
2160 min Summer	2.469	0.0	1243.6	1496
2880 min Summer	1.950	0.0	1309.4	1904
4320 min Summer	1.406	0.0	1415.3	2724
5760 min Summer	1.122	0.0	1507.4	3464
15 min Winter	100.760	0.0	348.3	19
30 min Winter	65.940	0.0	447.8	33
60 min Winter	41.040	0.0	572.6	62
120 min Winter	24.645	0.0	687.7	122
180 min Winter	18.197	0.0	761.2	180

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	99.637	1.637	6.7	723.5	O K
360 min Winter	99.687	1.687	6.7	755.1	O K
480 min Winter	99.699	1.699	6.7	763.3	O K
600 min Winter	99.693	1.693	6.7	759.5	O K
720 min Winter	99.676	1.676	6.7	748.5	O K
960 min Winter	99.624	1.624	6.7	714.7	O K
1440 min Winter	99.502	1.502	6.7	639.6	O K
2160 min Winter	99.361	1.361	6.7	557.8	O K
2880 min Winter	99.220	1.220	6.7	480.7	O K
4320 min Winter	98.943	0.943	6.7	343.1	O K
5760 min Winter	98.679	0.679	6.7	228.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	14.623	0.0	814.9	238
360 min Winter	10.680	0.0	891.2	356
480 min Winter	8.496	0.0	942.1	470
600 min Winter	7.097	0.0	977.6	584
720 min Winter	6.118	0.0	998.2	696
960 min Winter	4.834	0.0	1011.3	914
1440 min Winter	3.455	0.0	1003.1	1140
2160 min Winter	2.469	0.0	1243.6	1600
2880 min Winter	1.950	0.0	1309.5	2020
4320 min Winter	1.406	0.0	1415.7	2856
5760 min Winter	1.122	0.0	1507.4	3640

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 358800 385744 SJ 58800 85744
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 2.800

Time (mins) From:	To:	Area (ha)
0	4	2.800

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	272.8	2.000	737.1

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0107-6700-2000-6700
Design Head (m)	2.000
Design Flow (l/s)	6.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	106
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	6.7
Flush-Flo™	0.466	6.0
Kick-Flo®	0.953	4.7
Mean Flow over Head Range	-	5.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.6	1.200	5.3	3.000	8.1	7.000	12.1
0.200	5.3	1.400	5.7	3.500	8.7	7.500	12.5
0.300	5.8	1.600	6.0	4.000	9.3	8.000	12.9
0.400	5.9	1.800	6.4	4.500	9.8	8.500	13.3
0.500	6.0	2.000	6.7	5.000	10.3	9.000	13.7
0.600	5.9	2.200	7.0	5.500	10.8	9.500	14.0
0.800	5.5	2.400	7.3	6.000	11.3		
1.000	4.9	2.600	7.6	6.500	11.7		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.017	1.017	3.4	172.6	O K
30 min Summer	99.214	1.214	3.4	224.0	O K
60 min Summer	99.386	1.386	3.4	274.5	O K
120 min Summer	99.527	1.527	3.4	320.0	O K
180 min Summer	99.599	1.599	3.4	344.8	O K
240 min Summer	99.642	1.642	3.4	360.0	O K
360 min Summer	99.682	1.682	3.4	374.9	O K
480 min Summer	99.690	1.690	3.4	377.8	O K
600 min Summer	99.681	1.681	3.4	374.4	O K
720 min Summer	99.662	1.662	3.4	367.2	O K
960 min Summer	99.607	1.607	3.4	347.7	O K
1440 min Summer	99.521	1.521	3.4	318.1	O K
2160 min Summer	99.422	1.422	3.4	286.0	O K
2880 min Summer	99.334	1.334	3.4	258.9	O K
4320 min Summer	99.170	1.170	3.4	211.8	O K
5760 min Summer	99.014	1.014	3.4	171.9	O K
15 min Winter	99.017	1.017	3.4	172.6	O K
30 min Winter	99.214	1.214	3.4	224.0	O K
60 min Winter	99.385	1.385	3.4	274.4	O K
120 min Winter	99.528	1.528	3.4	320.5	O K
180 min Winter	99.601	1.601	3.4	345.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	100.760	0.0	174.9	19
30 min Summer	65.940	0.0	210.3	34
60 min Summer	41.040	0.0	286.9	64
120 min Summer	24.645	0.0	344.5	124
180 min Summer	18.197	0.0	381.3	182
240 min Summer	14.623	0.0	408.3	242
360 min Summer	10.680	0.0	446.4	362
480 min Summer	8.496	0.0	469.4	482
600 min Summer	7.097	0.0	478.3	602
720 min Summer	6.118	0.0	483.5	720
960 min Summer	4.834	0.0	490.4	878
1440 min Summer	3.455	0.0	489.9	1110
2160 min Summer	2.469	0.0	622.1	1492
2880 min Summer	1.950	0.0	655.1	1904
4320 min Summer	1.406	0.0	708.2	2684
5760 min Summer	1.122	0.0	753.8	3464
15 min Winter	100.760	0.0	174.9	19
30 min Winter	65.940	0.0	210.2	33
60 min Winter	41.040	0.0	286.8	62
120 min Winter	24.645	0.0	344.5	122
180 min Winter	18.197	0.0	381.4	180

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	99.645	1.645	3.4	361.1	O K
360 min Winter	99.687	1.687	3.4	376.6	O K
480 min Winter	99.697	1.697	3.4	380.4	O K
600 min Winter	99.692	1.692	3.4	378.2	O K
720 min Winter	99.676	1.676	3.4	372.4	O K
960 min Winter	99.628	1.628	3.4	355.0	O K
1440 min Winter	99.519	1.519	3.4	317.6	O K
2160 min Winter	99.391	1.391	3.4	276.2	O K
2880 min Winter	99.261	1.261	3.4	237.3	O K
4320 min Winter	98.997	0.997	3.4	167.8	O K
5760 min Winter	98.736	0.736	3.4	110.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	14.623	0.0	408.3	238
360 min Winter	10.680	0.0	446.3	356
480 min Winter	8.496	0.0	468.8	470
600 min Winter	7.097	0.0	476.7	584
720 min Winter	6.118	0.0	481.1	696
960 min Winter	4.834	0.0	487.4	914
1440 min Winter	3.455	0.0	490.6	1140
2160 min Winter	2.469	0.0	622.1	1584
2880 min Winter	1.950	0.0	655.1	2020
4320 min Winter	1.406	0.0	708.3	2856
5760 min Winter	1.122	0.0	753.8	3632

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 358800 385744 SJ 58800 85744
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.400

Time (mins) From:	To:	Area (ha)
0	4	1.400

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	104.6	2.000	435.3

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0075-3400-2000-3400
Design Head (m)	2.000
Design Flow (l/s)	3.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	75
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	3.4
Flush-Flo™	0.330	2.6
Kick-Flo®	0.671	2.1
Mean Flow over Head Range	-	2.6

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	2.1	1.200	2.7	3.000	4.1	7.000	6.1
0.200	2.4	1.400	2.9	3.500	4.4	7.500	6.3
0.300	2.6	1.600	3.1	4.000	4.7	8.000	6.5
0.400	2.5	1.800	3.2	4.500	5.0	8.500	6.7
0.500	2.5	2.000	3.4	5.000	5.2	9.000	6.9
0.600	2.3	2.200	3.5	5.500	5.4	9.500	7.0
0.800	2.2	2.400	3.7	6.000	5.7		
1.000	2.5	2.600	3.8	6.500	5.9		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	98.952	0.952	6.2	320.6	O K
30 min Summer	99.161	1.161	6.2	416.2	O K
60 min Summer	99.348	1.348	6.2	510.1	O K
120 min Summer	99.504	1.504	6.2	595.0	O K
180 min Summer	99.585	1.585	6.2	641.5	O K
240 min Summer	99.633	1.633	6.2	670.1	O K
360 min Summer	99.680	1.680	6.2	698.5	O K
480 min Summer	99.690	1.690	6.2	704.7	O K
600 min Summer	99.681	1.681	6.2	699.1	O K
720 min Summer	99.661	1.661	6.2	686.6	O K
960 min Summer	99.601	1.601	6.2	651.0	O K
1440 min Summer	99.505	1.505	6.2	595.8	O K
2160 min Summer	99.397	1.397	6.2	536.4	O K
2880 min Summer	99.303	1.303	6.2	486.7	O K
4320 min Summer	99.128	1.128	6.2	400.4	O K
5760 min Summer	98.966	0.966	6.2	326.6	O K
15 min Winter	98.952	0.952	6.2	320.6	O K
30 min Winter	99.161	1.161	6.2	416.2	O K
60 min Winter	99.348	1.348	6.2	510.0	O K
120 min Winter	99.505	1.505	6.2	596.0	O K
180 min Winter	99.588	1.588	6.2	643.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	100.760	0.0	323.5	19
30 min Summer	65.940	0.0	413.6	34
60 min Summer	41.040	0.0	532.0	64
120 min Summer	24.645	0.0	638.7	124
180 min Summer	18.197	0.0	706.7	182
240 min Summer	14.623	0.0	756.7	242
360 min Summer	10.680	0.0	827.4	362
480 min Summer	8.496	0.0	874.1	482
600 min Summer	7.097	0.0	905.1	602
720 min Summer	6.118	0.0	921.3	720
960 min Summer	4.834	0.0	933.8	896
1440 min Summer	3.455	0.0	918.5	1112
2160 min Summer	2.469	0.0	1154.8	1496
2880 min Summer	1.950	0.0	1216.0	1904
4320 min Summer	1.406	0.0	1314.2	2724
5760 min Summer	1.122	0.0	1399.7	3464
15 min Winter	100.760	0.0	323.5	19
30 min Winter	65.940	0.0	413.6	33
60 min Winter	41.040	0.0	531.8	62
120 min Winter	24.645	0.0	638.7	122
180 min Winter	18.197	0.0	706.9	180

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	99.636	1.636	6.2	672.1	O K
360 min Winter	99.685	1.685	6.2	701.7	O K
480 min Winter	99.698	1.698	6.2	709.4	O K
600 min Winter	99.692	1.692	6.2	706.1	O K
720 min Winter	99.676	1.676	6.2	695.9	O K
960 min Winter	99.624	1.624	6.2	664.8	O K
1440 min Winter	99.504	1.504	6.2	595.1	O K
2160 min Winter	99.366	1.366	6.2	519.4	O K
2880 min Winter	99.227	1.227	6.2	448.1	O K
4320 min Winter	98.952	0.952	6.2	320.6	O K
5760 min Winter	98.690	0.690	6.2	214.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	14.623	0.0	756.8	238
360 min Winter	10.680	0.0	827.3	356
480 min Winter	8.496	0.0	873.7	470
600 min Winter	7.097	0.0	903.8	584
720 min Winter	6.118	0.0	917.3	696
960 min Winter	4.834	0.0	927.0	914
1440 min Winter	3.455	0.0	920.9	1140
2160 min Winter	2.469	0.0	1154.9	1600
2880 min Winter	1.950	0.0	1216.0	2048
4320 min Winter	1.406	0.0	1314.6	2856
5760 min Winter	1.122	0.0	1399.7	3640

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 358800 385744 SJ 58800 85744
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 2.600

Time (mins) From:	To:	Area (ha)
0	4	2.600

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	248.3	2.000	696.6

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0102-6200-2000-6200
Design Head (m)	2.000
Design Flow (l/s)	6.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	102
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	6.2
Flush-Flo™	0.448	5.4
Kick-Flo®	0.912	4.3
Mean Flow over Head Range	-	5.0

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.4	1.200	4.9	3.000	7.5	7.000	11.2
0.200	4.9	1.400	5.2	3.500	8.1	7.500	11.6
0.300	5.2	1.600	5.6	4.000	8.6	8.000	11.9
0.400	5.4	1.800	5.9	4.500	9.1	8.500	12.3
0.500	5.4	2.000	6.2	5.000	9.5	9.000	12.6
0.600	5.3	2.200	6.5	5.500	10.0	9.500	13.0
0.800	4.9	2.400	6.7	6.000	10.4		
1.000	4.5	2.600	7.0	6.500	10.8		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	98.886	0.886	15.8	813.7	O K
30 min Summer	99.106	1.106	15.8	1056.3	O K
60 min Summer	99.309	1.309	15.8	1294.6	O K
120 min Summer	99.481	1.481	15.8	1510.0	O K
180 min Summer	99.572	1.572	15.8	1627.6	O K
240 min Summer	99.626	1.626	15.8	1700.1	O K
360 min Summer	99.679	1.679	15.8	1771.5	O K
480 min Summer	99.691	1.691	15.8	1786.7	O K
600 min Summer	99.680	1.680	15.8	1772.1	O K
720 min Summer	99.656	1.656	15.8	1739.8	O K
960 min Summer	99.588	1.588	15.8	1649.1	O K
1440 min Summer	99.480	1.480	15.8	1509.1	O K
2160 min Summer	99.360	1.360	15.8	1358.1	O K
2880 min Summer	99.256	1.256	15.8	1231.4	O K
4320 min Summer	99.067	1.067	15.8	1011.5	O K
5760 min Summer	98.896	0.896	15.8	824.1	O K
15 min Winter	98.886	0.886	15.8	813.7	O K
30 min Winter	99.106	1.106	15.8	1056.4	O K
60 min Winter	99.308	1.308	15.8	1294.3	O K
120 min Winter	99.483	1.483	15.8	1512.3	O K
180 min Winter	99.575	1.575	15.8	1631.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	100.760	0.0	811.5	19
30 min Summer	65.940	0.0	1055.1	34
60 min Summer	41.040	0.0	1345.2	64
120 min Summer	24.645	0.0	1614.9	124
180 min Summer	18.197	0.0	1786.7	182
240 min Summer	14.623	0.0	1913.3	242
360 min Summer	10.680	0.0	2093.0	362
480 min Summer	8.496	0.0	2215.7	482
600 min Summer	7.097	0.0	2308.0	602
720 min Summer	6.118	0.0	2381.3	720
960 min Summer	4.834	0.0	2488.4	896
1440 min Summer	3.455	0.0	2508.5	1112
2160 min Summer	2.469	0.0	2927.9	1496
2880 min Summer	1.950	0.0	3082.6	1904
4320 min Summer	1.406	0.0	3331.3	2724
5760 min Summer	1.122	0.0	3551.6	3464
15 min Winter	100.760	0.0	811.5	19
30 min Winter	65.940	0.0	1054.9	33
60 min Winter	41.040	0.0	1344.6	62
120 min Winter	24.645	0.0	1614.9	122
180 min Winter	18.197	0.0	1787.3	180

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	99.630	1.630	15.8	1705.1	O K
360 min Winter	99.685	1.685	15.8	1779.6	O K
480 min Winter	99.699	1.699	15.8	1798.8	O K
600 min Winter	99.693	1.693	15.8	1789.9	O K
720 min Winter	99.674	1.674	15.8	1763.8	O K
960 min Winter	99.614	1.614	15.8	1684.0	O K
1440 min Winter	99.479	1.479	15.8	1507.1	O K
2160 min Winter	99.324	1.324	15.8	1314.0	O K
2880 min Winter	99.172	1.172	15.8	1132.3	O K
4320 min Winter	98.881	0.881	15.8	807.8	O K
5760 min Winter	98.615	0.615	15.8	537.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	14.623	0.0	1913.4	238
360 min Winter	10.680	0.0	2092.8	356
480 min Winter	8.496	0.0	2215.3	470
600 min Winter	7.097	0.0	2307.4	584
720 min Winter	6.118	0.0	2379.6	696
960 min Winter	4.834	0.0	2482.8	914
1440 min Winter	3.455	0.0	2516.0	1140
2160 min Winter	2.469	0.0	2928.0	1584
2880 min Winter	1.950	0.0	3083.0	2020
4320 min Winter	1.406	0.0	3332.2	2856
5760 min Winter	1.122	0.0	3551.6	3632

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 358800 385744 SJ 58800 85744
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 6.600

Time (mins) From:	To:	Area (ha)
0	4	6.600

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	779.0	2.000	1485.8

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0164-1580-2000-1580
Design Head (m)	2.000
Design Flow (l/s)	15.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	164
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	15.8
Flush-Flo™	0.590	15.8
Kick-Flo®	1.228	12.5
Mean Flow over Head Range	-	13.8

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.9	1.200	13.0	3.000	19.2	7.000	28.8
0.200	13.2	1.400	13.3	3.500	20.6	7.500	29.7
0.300	14.6	1.600	14.2	4.000	22.0	8.000	30.7
0.400	15.4	1.800	15.0	4.500	23.3	8.500	31.6
0.500	15.7	2.000	15.8	5.000	24.5	9.000	32.5
0.600	15.8	2.200	16.5	5.500	25.6	9.500	33.3
0.800	15.5	2.400	17.2	6.000	26.7		
1.000	14.8	2.600	17.9	6.500	27.8		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.105	1.105	11.3	287.5	O K
30 min Summer	99.316	1.316	11.3	367.9	O K
60 min Summer	99.487	1.487	11.3	440.4	O K
120 min Summer	99.621	1.621	11.3	501.2	O K
180 min Summer	99.670	1.670	11.3	524.8	O K
240 min Summer	99.683	1.683	11.3	531.3	O K
360 min Summer	99.654	1.654	11.3	517.3	O K
480 min Summer	99.604	1.604	11.3	493.3	O K
600 min Summer	99.560	1.560	11.3	473.2	O K
720 min Summer	99.521	1.521	11.3	455.1	O K
960 min Summer	99.446	1.446	11.3	422.2	O K
1440 min Summer	99.300	1.300	11.3	361.4	O K
2160 min Summer	99.084	1.084	11.3	279.8	O K
2880 min Summer	98.877	0.877	11.3	210.4	O K
4320 min Summer	98.505	0.505	11.3	105.6	O K
5760 min Summer	98.219	0.219	11.3	41.0	O K
15 min Winter	99.105	1.105	11.3	287.3	O K
30 min Winter	99.318	1.318	11.3	368.6	O K
60 min Winter	99.491	1.491	11.3	442.0	O K
120 min Winter	99.625	1.625	11.3	503.5	O K
180 min Winter	99.677	1.677	11.3	528.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	104.360	0.0	299.3	19
30 min Summer	67.940	0.0	389.6	33
60 min Summer	42.060	0.0	482.7	64
120 min Summer	25.395	0.0	583.6	122
180 min Summer	18.777	0.0	647.4	182
240 min Summer	15.100	0.0	694.2	242
360 min Summer	11.032	0.0	760.8	360
480 min Summer	8.780	0.0	807.3	412
600 min Summer	7.336	0.0	843.2	472
720 min Summer	6.326	0.0	872.5	534
960 min Summer	4.996	0.0	918.7	664
1440 min Summer	3.573	0.0	985.6	938
2160 min Summer	2.552	0.0	1056.5	1324
2880 min Summer	2.014	0.0	1111.5	1704
4320 min Summer	1.451	0.0	1200.8	2420
5760 min Summer	1.157	0.0	1276.8	3064
15 min Winter	104.360	0.0	299.1	18
30 min Winter	67.940	0.0	389.8	33
60 min Winter	42.060	0.0	483.4	62
120 min Winter	25.395	0.0	583.7	120
180 min Winter	18.777	0.0	647.4	178

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	99.694	1.694	11.3	536.3	O K
360 min Winter	99.675	1.675	11.3	527.0	O K
480 min Winter	99.619	1.619	11.3	500.3	O K
600 min Winter	99.560	1.560	11.3	473.2	O K
720 min Winter	99.513	1.513	11.3	451.8	O K
960 min Winter	99.412	1.412	11.3	407.6	O K
1440 min Winter	99.195	1.195	11.3	320.5	O K
2160 min Winter	98.855	0.855	11.3	203.5	O K
2880 min Winter	98.524	0.524	11.3	110.5	O K
4320 min Winter	98.022	0.022	11.3	3.8	O K
5760 min Winter	98.000	0.000	9.3	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	15.100	0.0	694.1	236
360 min Winter	11.032	0.0	760.8	346
480 min Winter	8.780	0.0	807.3	450
600 min Winter	7.336	0.0	843.2	482
720 min Winter	6.326	0.0	872.5	556
960 min Winter	4.996	0.0	918.7	706
1440 min Winter	3.573	0.0	985.6	996
2160 min Winter	2.552	0.0	1056.5	1404
2880 min Winter	2.014	0.0	1111.5	1756
4320 min Winter	1.451	0.0	1200.9	2728
5760 min Winter	1.157	0.0	1276.8	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 360158 378110 SJ 60158 78110
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 2.300

Time (mins) From:	To:	Area (ha)
0	4	2.300

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	171.6	2.000	563.3

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0139-1130-2000-1130
Design Head (m)	2.000
Design Flow (l/s)	11.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	139
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	11.3
Flush-Flo™	0.593	11.3
Kick-Flo®	1.214	8.9
Mean Flow over Head Range	-	9.9

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.0	1.200	9.1	3.000	13.7	7.000	20.5
0.200	9.4	1.400	9.5	3.500	14.7	7.500	21.2
0.300	10.4	1.600	10.2	4.000	15.7	8.000	21.9
0.400	11.0	1.800	10.7	4.500	16.6	8.500	22.5
0.500	11.2	2.000	11.3	5.000	17.5	9.000	23.1
0.600	11.3	2.200	11.8	5.500	18.3	9.500	23.8
0.800	11.1	2.400	12.3	6.000	19.1		
1.000	10.5	2.600	12.8	6.500	19.8		

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.085	1.085	11.5	313.4	O K
30 min Summer	99.297	1.297	11.5	401.4	O K
60 min Summer	99.474	1.474	11.5	482.3	O K
120 min Summer	99.612	1.612	11.5	550.5	O K
180 min Summer	99.667	1.667	11.5	578.9	O K
240 min Summer	99.686	1.686	11.5	588.8	O K
360 min Summer	99.667	1.667	11.5	579.1	O K
480 min Summer	99.617	1.617	11.5	552.9	O K
600 min Summer	99.573	1.573	11.5	531.0	O K
720 min Summer	99.534	1.534	11.5	511.4	O K
960 min Summer	99.462	1.462	11.5	476.5	O K
1440 min Summer	99.324	1.324	11.5	413.2	O K
2160 min Summer	99.122	1.122	11.5	328.0	O K
2880 min Summer	98.928	0.928	11.5	254.5	O K
4320 min Summer	98.574	0.574	11.5	139.4	O K
5760 min Summer	98.295	0.295	11.5	64.7	O K
15 min Winter	99.084	1.084	11.5	313.1	O K
30 min Winter	99.299	1.299	11.5	402.2	O K
60 min Winter	99.476	1.476	11.5	483.4	O K
120 min Winter	99.616	1.616	11.5	552.7	O K
180 min Winter	99.673	1.673	11.5	582.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	104.360	0.0	325.2	19
30 min Summer	67.940	0.0	423.2	33
60 min Summer	42.060	0.0	525.3	64
120 min Summer	25.395	0.0	634.2	122
180 min Summer	18.777	0.0	703.6	182
240 min Summer	15.100	0.0	754.5	242
360 min Summer	11.032	0.0	826.8	360
480 min Summer	8.780	0.0	877.4	430
600 min Summer	7.336	0.0	916.4	484
720 min Summer	6.326	0.0	948.2	560
960 min Summer	4.996	0.0	998.4	674
1440 min Summer	3.573	0.0	1071.1	940
2160 min Summer	2.552	0.0	1148.3	1364
2880 min Summer	2.014	0.0	1208.0	1732
4320 min Summer	1.451	0.0	1305.1	2424
5760 min Summer	1.157	0.0	1387.7	3120
15 min Winter	104.360	0.0	324.9	18
30 min Winter	67.940	0.0	423.5	33
60 min Winter	42.060	0.0	525.3	62
120 min Winter	25.395	0.0	634.4	120
180 min Winter	18.777	0.0	703.6	178

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Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
240 min Winter	99.695	1.695	11.5	593.8	O K
360 min Winter	99.685	1.685	11.5	588.4	O K
480 min Winter	99.637	1.637	11.5	563.6	O K
600 min Winter	99.575	1.575	11.5	531.9	O K
720 min Winter	99.531	1.531	11.5	509.7	O K
960 min Winter	99.437	1.437	11.5	464.6	O K
1440 min Winter	99.236	1.236	11.5	374.8	O K
2160 min Winter	98.921	0.921	11.5	251.9	O K
2880 min Winter	98.613	0.613	11.5	150.9	O K
4320 min Winter	98.099	0.099	11.5	20.3	O K
5760 min Winter	98.000	0.000	10.2	0.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	15.100	0.0	754.5	236
360 min Winter	11.032	0.0	826.8	348
480 min Winter	8.780	0.0	877.4	454
600 min Winter	7.336	0.0	916.4	500
720 min Winter	6.326	0.0	948.2	564
960 min Winter	4.996	0.0	998.4	714
1440 min Winter	3.573	0.0	1071.1	1010
2160 min Winter	2.552	0.0	1148.3	1408
2880 min Winter	2.014	0.0	1208.1	1788
4320 min Winter	1.451	0.0	1305.2	2380
5760 min Winter	1.157	0.0	1387.9	0

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Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 360158 378110 SJ 60158 78110
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.500
Cv (Winter)	0.500
Shortest Storm (mins)	15
Longest Storm (mins)	5760
Climate Change %	+0

Time Area Diagram

Total Area (ha) 2.500

Time (mins) From:	To:	Area (ha)
0	4	2.500

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Model Details

Storage is Offline Dividing Weir Level (m) 100.000
Cover Level (m) 100.000

Tank or Pond Structure

Invert Level (m) 98.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	196.8	2.000	608.2

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0140-1150-2000-1150
Design Head (m)	2.000
Design Flow (l/s)	11.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	140
Invert Level (m)	98.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.000	11.5
Flush-Flo™	0.581	11.5
Kick-Flo®	1.202	9.0
Mean Flow over Head Range	-	10.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.1	1.200	9.1	3.000	13.9	7.000	20.9
0.200	9.6	1.400	9.7	3.500	15.0	7.500	21.6
0.300	10.7	1.600	10.3	4.000	16.0	8.000	22.3
0.400	11.2	1.800	10.9	4.500	16.9	8.500	22.9
0.500	11.4	2.000	11.5	5.000	17.8	9.000	23.5
0.600	11.5	2.200	12.0	5.500	18.6	9.500	24.2
0.800	11.2	2.400	12.5	6.000	19.4		
1.000	10.6	2.600	13.0	6.500	20.1		

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