Lawnswood Road, Ridgehill

FLOOD RISK ASSESSMENT

FRA001
DECEMBER 2019

PUBLIC

Lawnswood Road, Ridgehill

FLOOD RISK ASSESSMENT

REPORT (RV0) PUBLIC

PROJECT NO. 70066405

OUR REF. NO. FRA001

DATE: DECEMBER 2019

WSP

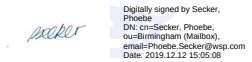
The Mailbox
Level 2
100 Wharfside Street
Birmingham
B1 1RT

Phone: +44 1213 524 700

Fax: +44 121 352 4701

WSP.com

QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3
Remarks	Draft for Comment	Issue		
Date	December 2019	December 2019		
Prepared by	Phoebe Secker	Phoebe Secker		
Signature		 Digitally signed by Secker, Phoebe DN: cn=Secker, Phoebe, ou=Birmingham (Mailbox), email=Phoebe.Secker@wsp.com Date: 2019.12.12 15:05:08		
Checked by	Alison Caldwell	Alison Caldwell		
Signature		 Digitally signed by Caldwell, Alison DN: cn=Caldwell, Alison, ou=Birmingham (Mailbox), email=Alison.Caldwell@wsp.com Reason: I have checked this document Date: 2019.12.12 15:03:22		
Authorised by	Dave Woolley	Dave Woolley		
Signature	 Digitally signed by Woolley, Dave DN: cn=Woolley, Dave, ou=Birmingham (Mailbox), email=Dave.Woolley@wsp.com Reason: I am approving this document Date: 2019.12.12 15:01:37			
Project number	70066405	70066405		
Report number	FRA001	FRA001		
File reference	70066405 FRA001 Rv0	70066405 FRA001 Rv1		

CONTENTS

TABLES

FIGURES

APPENDICES

EXECUTIVE SUMMARY

This Flood Risk Assessment has been undertaken to support the proposed local plan allocation for residential development at 'Land at Lawnswood Road, Wordsley' in accordance with the guidelines set out in the National Planning Policy Framework (NPPF) and other relevant local and national guidance.

Item	Overview
Site Location	The site is located to the north and south of Lawnswood Road in two parcels and is bound to the west by the A449 and to the east by an existing residential development. NGR: 387236, 287142
Development Proposals	The development proposals comprise residential uses.
Environment Agency Flood Zone(s)	Flood Zone 1.
Vulnerability Classification(s)	More Vulnerable.
Fluvial Flood Risk	Low Risk
Tidal Flood Risk	Very Low Risk.
Surface Water Flood Risk	Low Risk
Groundwater Flood Risk	Low Risk
Sewer Flood Risk	Low Risk
Artificial Flood Risk	Low Risk
Storm Drainage	The proposed drainage strategy aims to mimic the behaviour of the site pre-development (greenfield), through the utilisation of conveyance swales, attenuation basin, and flow control devices (e.g. hydrobrake). The maximum peak rate of discharge from the site will be 33.3l/s and the total storage volume required is 10,500m³ for the critical 1 in 100 year event plus climate change.
Foul Drainage	The proposed foul flows will discharge into the Severn Trent Water network surrounding the site.

1. INTRODUCTION

1.1. BACKGROUND

1.1.1. WSP has been appointed by Clowes Developments to prepare a high level Flood Risk Assessment (FRA) and Drainage Strategy to support the proposed local plan allocation for residential development at 'Land at Lawnswood Road, Wordsley' (approximate Post Code: DY7 5AW).

1.1.2. The objective of the study is to demonstrate that the site may be developed safely, without exposing the development to an unacceptable degree of flood risk or increasing the flood risk to third parties. The objectives are to:

- Confirm the sources of flooding which may affect the site;
- Provide a drainage strategy for the proposed development
- Provide an appraisal of the availability and adequacy of existing information; and
- Undertake an appraisal of the flood risk posed to the site and potential impact of the development on flood risk elsewhere.

1.2. LIMITATIONS

1.2.1. WSP has prepared this report in accordance with the instructions of their client, Clowes Developments, for their sole and specific use. Any person who uses any information contained herein do so at their own risk.

1.2.2. The conclusions and recommendations contained herein are limited by the availability of background information and the planned use for the site.

1.2.3. Third party information has been used in the preparation of this report, which WSP UK Ltd, by necessity assumes is correct at the time of writing. Whilst all reasonable checks have been made on data sources and the accuracy of the data, WSP UK Ltd accepts no liability for same.

1.3. CONSTRUCTION (DESIGN AND MANAGEMENT) REGULATIONS 2015

1.3.1. The revised Construction (Design and Management) Regulations 2015 (CDM Regulations) came into force on April 2015 to update certain duties on all parties involved in a construction project, including those promoting the development. One of the designer's responsibilities under clause 9 (1) is to ensure that the client organisation, in this instance Clowes Developments, is made aware of their duties under the CDM Regulations.

1.4. SCOPE OF ASSESSMENT

1.4.1. This assessment has been undertaken in accordance with the overarching national requirements for Flood Risk Assessments for proposed developments which may include, but are not limited to, the following:

- National Planning Policy Framework (NPPF)
- Development and Flood Risk (C624)
- The SuDS Manual (CIRIA C753)
- Flood Risk Assessments: Climate Change Allowances 2017
- DEFRA R&D Technical Report W5-074/A/TR/1 Revision D

- Rainfall Runoff Management for Developments Report – SC030219

1.4.2. This flood risk assessment is solely to be used support the proposed local plan allocation for residential development at 'Land at Lawnswood Road, Wordsley.'

1.5. CONSULTATION

1.5.1. Ahead of production of this report, initial pre-application consultation requests were issued to the relevant stakeholders with the following responses received.

Table 1 - Stakeholder Consultation Summary

Stakeholder	Date Received	Comments
Staffordshire Lead Local Flood Authority (LLFA)	25.11.2019	At the time of writing, a historic flood enquiry had been made to Staffordshire County Council LLFA however, no response had been received.
Environment Agency (EA)	28.11.2019	A Product 4 Request was received from the Environment Agency which confirmed that the site is wholly within Flood Zone 1.
Severn Trent Water	10.12.2019	Severn Trent Water confirmed there have been incidents of sewer flooding within the area, however given the sensitive nature of the information no further information was available.
Severn Trent Water	03.12.2019	A pre-development enquiry was issued to Severn Trent Water on the 3rd December however, at the time of writing no response has been received.

1.5.2. The full consultation responses are contained in Appendix C and have been thereafter used, where relevant within the report.

2. SITE SETTING

2.1. LOCATION

2.1.1. ‘Land at Lawnswood Road, Wordsley,’ hereafter referred to as the ‘site,’ is located to the north and south of Lawnswood Road. The site comprises two parcels, bound to the west by the A449 and to the east by an existing residential development, hereafter referred to as the northern and southern parcels respectively.

2.1.2. A site location plan is shown in Figure 1 and is also included in Appendix A.

Figure 1 – Site Location

2.2. DEVELOPMENT PROPOSALS

2.2.1. It is proposed to promote the site for allocation within the Local Plan for residential uses.

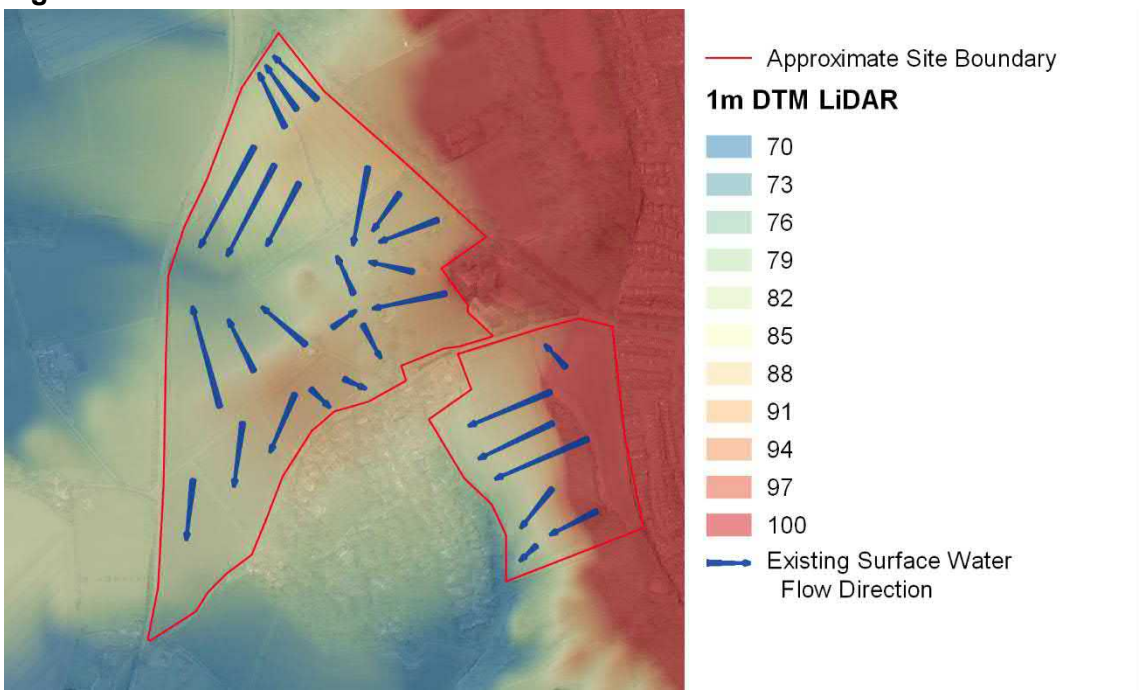
2.3. TOPOGRAPHY

2.3.1. From a review of the existing publicly available Environment Agency 1m DTM LiDAR (downloaded November 2019), the southern parcel generally falls from east to west from a level of approximately 124mAOD in the south-eastern corner of the site to 73mAOD.

2.3.2. The northern parcel generally falls from east to west from a high point of 99mAOD along the south-eastern boundary, where the existing woodland is located, to a low point along the centre of the western boundary 73mAOD where an existing culvert is located.

2.3.3. An extract of the available Environment Agency 1m DTM LiDAR is available in Figure 2.

Figure 2 – 1m DTM LiDAR Extract



2.4. EXISTING DRAINAGE NETWORK

2.4.1. The River Stour lies approximately 750m west and 450m south of the site.

2.4.2. The Severn Trent Water asset maps identify a number of existing sewers within the vicinity of the site, including a 450mm diameter combined rising main which crosses the far west of the northern parcel of the site and a 160mm and 80mm foul sewer which crosses the south of the southern parcel of the site.

2.4.3. The Severn Trent Water sewer asset maps are contained within Appendix C and an extract is available within Figure 4.

Figure 3 – Severn Trent Water Sewer Map Extract

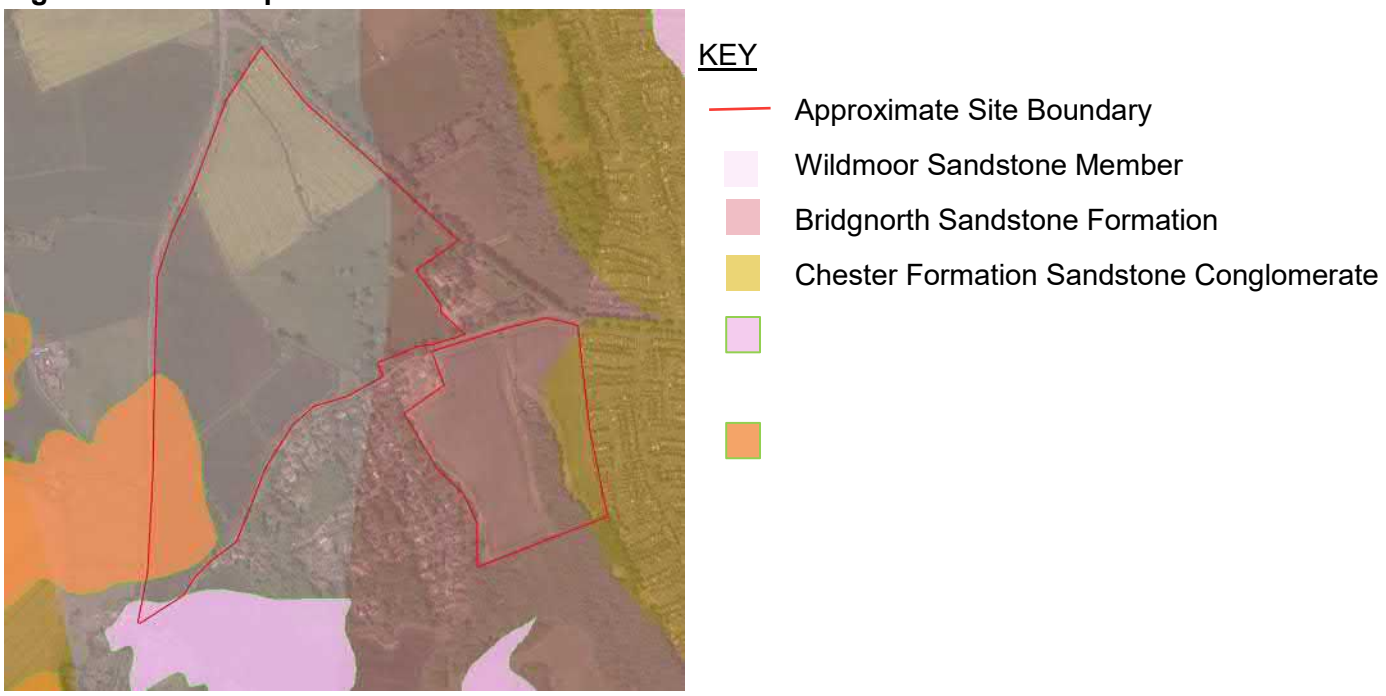
2.5. GEOLOGICAL AND HYDROGEOLOGICAL CONTEXT

Geology

2.5.1. Reference to the British Geological Survey (BGS) published mapping identifies the west of the site to be underlain by a bedrock of Wildmoor Sandstone Member, including the majority of the northern parcel whilst the east of the site, including all of the southern parcel, is underlain of a bedrock of Bridgnorth Sandstone Formation. Whilst the majority of the site is not identified to have overlying superficial deposits, the far east of the northern parcel of the site has overlying superficial deposits of Chester Formation Sandstone Conglomerate whilst the far west has Glaciofluvial Terrace Deposits Devensian – Sand & Gravel.

2.5.2. An extract of the publically available BGS mapping is available within Figure 3.

Figure 4 – BGS Map Extract



2.5.3. There are several publicly available borehole logs registered within the site boundary. The deepest of which is located within the northern parcel, in the south west corner, and has a depth of approximately 5.0m. Its profile is available in Table 2.

Table 2 - BGS Borehole Summary

Description	Approximate Depth [mBGL]
Top Soil	0 – 0.3
Loose reddish-brown silty sand with occasional sandstone and gravel	0.3 – 1.5
Very dense silty sand slightly cemented and thinly laminated with occasional sandstone	1.5 - 2.5
Reddish brown grained sandstone very weak (Wildmoor Sandstone)	2.5 – 5.0

Hydrogeology

2.5.4. According to the Source Protection Zone map provided by the Environment Agency, the site lies within Source Protection Zone III. That is defined as *"the area around a source within which all groundwater recharge is presumed to be discharged at the source. In confined aquifers, the source catchment may be displaced some distance from the source. For heavily exploited aquifers, the final Source Catchment Protection Zone can be defined as the whole aquifer recharge area where the ratio of groundwater abstraction to aquifer recharge (average recharge multiplied by outcrop area) is >0.75. There is still the need to define individual source protection areas to assist operators in catchment management";*

2.5.5. The online BGS Aquifer Map (Superficial Deposits Designation) indicates that a small area of the northern parcel of the site is underlined by a 'Secondary A' aquifer. That is: "*permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers;"*

2.5.6. The online BGS Aquifer Map (Bedrock Designation) indicates that the site comprises stratum that is considered a 'Principal' aquifer. That is *"These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer".*

2.5.7. As such, whilst underlying geology suggests the ground conditions may be suitable for an infiltration led surface water drainage strategy, underlying aquifers and source protection zone may mean that it is unsuitable.

3. POLICY CONTEXT

3.1. NATIONAL PLANNING POLICY FRAMEWORK 2019

3.1.1. The Updated National Planning Policy Framework (NPPF), most recently published in February 2019, sets out the Government's national policies for flood risk management in a land use planning context within England.

3.1.2. Paragraph 155 of the NPPF states "*Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere."*

3.1.3. The guidance further states that local planning authorities should "*ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment."*

3.1.4. Allocation and planning of development should therefore be considered against a risk-based search sequence as provided by the guidance.

3.2. LOCAL PLANNING POLICY

South Staffordshire Core Strategy (December 2012)

3.2.1. Core Policy 2: Protecting and Enhancing the Natural and Historic Environment identifies that development proposals should have regard to and support the actions and objectives of the Severn and Humber River Basin Management Plans (RBMPs) and also have regard to the River Severn and River Trent Catchment Flood Management Plans (CFMPs).

3.2.2. In addition, point J, K and L of Core Policy 3 (Sustainable Development and Climate Change) identify the following;

"j) guiding development away from known areas of flood risk as identified in the Strategic Flood Risk Assessment, Surface Water Management Plan and consistent with NPPF;

k) ensuring the use of sustainable drainage (Sustainable Drainage Systems) in all new development and promoting the retrofitting of SUDs where possible;

l) ensuring that all development includes pollution prevention measures where appropriate to prevent risk of pollution to controlled waters"

3.2.3. Given this, the surface water drainage strategy proposed for this site demonstrates the use SuDS features and provides treatment for surface water runoff.

South Staffordshire Sustainable Development SPD (2018)

3.2.4. The 2018 Sustainable Development SPD published by South Staffordshire Council has a chapter on Water Conservation and Quality which advocate the following:

- Greywater Recycling,
- Rainwater Harvesting,
- Permeable Surfaces, and
- Sustainable Drainage Systems.

3.2.5. As previously noted, the surface water drainage strategy proposed for this site demonstrates the use SuDS features.

Staffordshire SuDS Handbook (February 2017)

3.2.6. A SuDS Handbook has been produced by Staffordshire Lead Local Flood Authority (LLFA) which includes SuDS design guidance which identifies information relating to different types of SuDS which could be used on development site depending on different site constraints (e.g. topography or underlying geology).

3.2.7. The document also identifies that Climate Change should be considered through the development as well as Urban Creep to account for an increase in impermeable area across the lifetime of a development.

3.2.8. The SuDS Handbook will be taken into consideration within the surface water drainage strategy design for this site.

South Staffordshire Strategic Flood Risk Assessment (SFRA) (October 2019)

3.2.9. The South Staffordshire SFRA provides flood risk mapping for the district. The site is included on Map G2 of Appendix A. This identifies that the proposed development site is an area of less than 25% susceptible from groundwater flooding.

3.2.10. It also confirms that the site is wholly within Flood Zone 1 and confirms that there are some identified areas of surface water ponding within the site. There are no flood warning areas or flood alert areas identified within the site.

3.2.11. Severn Trent Water properties at risk register was reviewed as part of the SFRA and did not identify the site location as an area at risk from sewer flooding.

3.2.12. Further assessment of flood risk to the site has been undertaken and is summarised within this report.

4. ASSESSMENT OF FLOOD RISK

4.1. OVERVIEW

4.1.1. Having completed a desk-based assessment, the possible flooding mechanisms at the site are summarised in Table 3.

Table 3 - Flood Risk Overview

Mechanism	Risk	Comment
Fluvial	Low	The site is located wholly within Flood Zone 1, outside the maximum extent of flooding from nearby Main Rivers in the 1 in 100 year & 1 in 1,000 year event.
Tidal	Low	The site is located in land.
Surface Water	Low	Some surface water flow paths and surface water ponding is identified within the site boundary however, the surface water mapping may not represent culverts and other existing drainage features on site.
Ground Water	Low	The SFRA mapping does not identify the site is at risk from groundwater flooding and the borehole records on site did record water in their length.
Sewers	Low	Whilst there are Severn Trent Water sewers crossing the site boudanry, no records identifying the site to be at risk have been provided.
Artificial Sources	Low	The site is located outside the maximum extent of flooding in the reservoir flood risk map and

4.2. HISTORIC FLOODING

4.2.1. The Environment Agency were consulted through writing this report and did not identify any historic reports of flooding.

4.3. FLUVIAL FLOOD RISK

4.3.1. Reference to the publicly available Flood Map for Planning identifies the site to currently lie wholly within Flood Zone 1, outside of both the 1 in 100 and 1 in 1,000 year flood events of the River Stour, which runs approximately 750m west of the site and 450m south of the site.

4.3.2. The current Flood Map for Planning is reprinted as Figure 5.

Figure 5 – Environment Agency Flood Map for Planning

Vulnerability Classification

4.3.3. The development is classified as '*More Vulnerable'* under the NPPF which is defined as follows:

"**More Vulnerable**

- Hospitals
- Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.
- **Buildings used for dwelling houses**, student halls of residence, drinking establishments, nightclubs and hotels.
- Non–residential uses for health services, nurseries and educational establishments.
- Landfill* and sites used for waste management facilities for hazardous waste.
- Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan."

4.3.4. Given the sites location within Flood Zone 1, in accordance with current national guidance, the site is not required to undertake the Sequential and Exception Tests and is considered to be in an appropriate location for development.

Identified Fluvial Flood Risk: Low

4.4. TIDAL FLOOD RISK

4.4.1. Due to its inland location, tidal flooding is not considered a risk to this site.

Identified Tidal Flood Risk: Very Low

4.5. SURFACE WATER FLOOD RISK

4.5.1. The 'Long Term Flood Risk Information,' in particular relating to the 'Flood Risk from Surface Water' has been reviewed and identifies the site to be at predominantly very low risk of surface water flooding, with localised areas of surface water ponding identified within the northern parcel; at the northern site boundary and at the centre of both the eastern boundary and southern boundary of the site as identified in Figure 6. The entirety of the southern parcel is identified to be at very low risk of surface water flooding.

4.5.2. Where the surface water ponding is identified along the western boundary of the northern parcel, an existing culvert, passing under the A449, has been identified which will allow surface water to flow west, away from the site.

4.5.3. The Flood Risk from Surface Water map is reprinted as Figure 6.

Figure 6 – Surface Water Flood Risk Map

4.5.4. The production of this mapping has been undertaken at a national scale to provide the first publicly available generation of surface water flood risk mapping. The two previous generations were primarily developed for regulator use as the approach and risk was refined. For example, the first did not include any allowance for sewers, whilst the second incorporated a national loss coefficient.

4.5.5. Although this generation incorporates local estimates of the sewer infiltration loss, generally at a LLFA level along with various other refinements in runoff estimation, it does not allow for local improvements to the underlying Digital Terrain Model (DTM). This means that local features such as the adjoining highways are represented as determined from the LiDAR without any consideration to drainage

features such as culverts or small watercourses which typically provide the associated surface water drainage.

4.5.6. As part of the final site design, to ensure that there is no increase to the flood risk to the development or third-party land, appropriate measures will be implemented in accordance with best practice guidance to ensure any surface water is directed away from the existing and proposed properties.

Identified Surface Water Flood Risk: Low

4.6. GROUND WATER FLOOD RISK

4.6.1. Correspondence from the Environment Agency did not identify that the site was at risk from ground water flooding. In addition, the South Staffordshire SFRA provides flood risk mapping for the district, the site is included on Map G2 of Appendix A of the SFRA. This identifies that the site is located in an area of less than 25% susceptibility to groundwater.

4.6.2. There are several publicly available borehole logs registered within the site boundary. The deepest of which is located south-west of the northern parcel with a depth of approximately 5.0m, which did not hit water in its length.

4.6.3. Given this, groundwater flood risk to the site may be considered to be low.

Identified Groundwater Flood Risk: Low

4.7. SEWER FLOOD RISK

4.7.1. Sewer flooding occurs as a result of a number of influencing factors. It is most likely to occur during storms, when large volumes of rainwater enter the sewers. However, it can also occur when pipes become blocked or damaged.

4.7.2. Existing sewerage systems are present on land surrounding the site, by way of existing highway and adopted public sewers serving built development.

4.7.1. The Severn Trent Water asset maps also identify a number of existing sewers present serving the existing development site including a 450mm diameter combined rising main which crosses the far west of the northern parcel of the site and a 160mm and 80mm foul sewer which crosses the south of the southern parcel of the site.

4.7.2. Severn Trent Water were contacted with regards to historic sewer flood records and confirmed that there have been incidents of sewer flooding within the area, however given the sensitive nature of the development they could not disclose any further information. Given this, it is Severn Trent Waters duty to ensure that there is adequate capacity within their network to receive flows from new developments and provide upgrades through the AMP cycle.

4.7.3. Severn Trent Water properties at risk register was reviewed as part of the South Staffordshire SFRA and did not identify the site location as an area at risk from sewer flooding.

4.7.4. Given this, the site may be considered to be at low risk from sewer flooding.

Identified Sewer Flood Risk: Low

4.8. ARTIFICIAL SOURCE FLOOD RISK

Reservoirs

4.8.1. The Long Term Flood Risk Information, Flood Risk from Reservoirs map identifies the site to lie outside of the zone of influence for the nearby reservoirs.

4.8.2. An extract of the Environment Agency Mapping is shown in Figure 7.

Figure 7 – Environment Agency Reservoir Flood Map

4.8.3. Given the nature of these features, flooding from this source is rare and indeed it has been confirmed by the Environment Agency that:

"Reservoir flooding is extremely unlikely to happen. There has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers. As the enforcement authority for the Reservoirs Act 1975 in England, we ensure that reservoirs are inspected regularly and essential safety work is carried out"

4.8.4. Given the site is identified to be outside the maximum extent of reservoir flooding from nearby reservoirs, flood risk from this source is considered low.

Identified Flood Risk from Reservoirs: Low

Canals

4.8.5. Canal flooding is generally rare and the canal network is designed in such a way so as to direct all additional water beyond the navigation capacity to impounding areas or surrounding watercourses to be conveyed downstream. The risk from canal flooding becomes more of a concern where the structure is elevated on an earth embankment and if there is a rare instance of a catastrophic breach, leading to a sudden drain-down of the pound and resultant overland flow flood risk to development immediately downstream.

4.8.6. The Staffordshire and Worcestershire Canal lies approximately 1.2km south of the site, canal flooding is generally rare, and the canal network is designed in such a way so as to direct all additional water

beyond the navigation capacity to impounding areas or surrounding watercourses to be conveyed downstream.

4.8.7. Given that the existing topography of the land surrounding the site slopes towards to the canal, and that canal flooding is considered rare, the flood risk from this source may be considered to be low.

Identified Flood Risk from Canals: Low

4.9. DEVELOPMENT EXCEEDANCE FLOWS

4.9.1. Careful regard has to be made in respect of potential exceedance flows, being events that are more extreme than current design criteria. Various national guidance has been published on the matter of exceedance flows and measures that should be incorporated into a development to ensure the safety of occupiers and those using the infrastructure.

4.9.2. Published guidance in the form of Sewers for Adoption 7th Edition and the Environment Agency document “Improving the Flood Performance of New Buildings: Flood Resilient Construction" advocate the design of developments that implement infrastructure routes that will safely convey flood waters resulting from sewer flooding or overland flows away from buildings and along defined corridors.

4.9.3. The principal aim is to direct exceedance flows away from properties and along defined corridors. At a local level, this may mean water being conveyed along a length of highway, as long as the predicted flow depths and velocities are acceptable. More strategically, the implementation of conveyance corridors are important in avoiding deep and high velocity flows that present a high risk.

4.9.4. Whilst many of the measures for dealing with exceedance flows must be dealt with at detailed design stage, the strategic layout for the site provides a framework that can effectively deal with any future exceedance flows.

4.9.5. Given the baseline site characteristics and further measures to be implemented within the proposed development, the risk of flooding from exceedance flows may be considered to be low.

Identified Flood Risk from Exceedance Flows: Low

5. SURFACE WATER DRAINAGE

5.1. EXISTING SURFACE WATER DRAINAGE REGIME

5.1.1. The River Stour lies approximately 750m west and 450m south of the site.

5.1.2. The Severn Trent Water asset maps also identify a number of existing sewers present serving the existing development site including a 450mm diameter combined rising main which crosses the far west of the northern parcel of the site and a 160mm and 80mm foul sewer which crosses the south of the southern parcel of the site.

5.1.3. An existing drainage features plan is available within Appendix A, an extract of which is contained in Figure 8.

Figure 8 – Baseline Drainage Features

5.2. DRAINAGE STRATEGY

Discharge Location

5.2.1. In order to determine the most appropriate receptor for storm water discharges from the proposed development, the Planning Practice Guidance (PPG) provides the following order of priority, supported by the Environment Agency and Lead Local Flood Authority:

Table 4 - SuDS Drainage Hierarchy

		Discharge Location	Availability	Comments
Search Sequence	↓	Re-Use	-	Space for further re-use will be considered at a later design stage.
		Infiltration	-	Infiltration testing may be undertaken to determine the infiltration potential of the site prior to a later design stage.
		Watercourse	✓	An existing watercourse has been identified at the west of the southern parcel, with an existing culvert identified at the centre of the western site boundary of the southern parcel. In addition, there is are existing highway drains present surrounding the site where connections could be made.
		Surface Water Sewer	-	While considered unlikely, should the need for a positive connection be required existing public surface water sewers have been identified serving the existing development south and east of the site.
		Combined Sewer	-	While considered unlikely, should the need for a positive connection be required a combined rising main is identified on the Severn Trent Water asset maps crossing the western boundary of the site.
		Foul Sewer	×	Whilst foul sewers are identified south and east of the site serving the existing development, a connection is not proposed into these.

5.2.2. In accordance with the above search sequence, it is proposed to discharge surface water flows to the existing naturalised watercourse adjacent to the southern parcel and the existing culvert adjacent to the northern parcel.

5.2.3. Existing public sewers are present serving the existing development surrounding the site which could be utilised should the need arise.

SuDS Proposals

5.2.4. Current guidance requires that all new developments implement Sustainable Drainage Systems (SuDS) as the primary means of controlling surface water run-off in order to maintain flow rates and volumes discharged to the identified receptor post development.

5.2.5. In addition to the water control benefits, The SuDS Manual (CIRIA C753) states that *"SuDS can treat and clean surface water runoff from urban areas so that the receiving environment is protected, while at the same time conveying, storing and infiltrating surface water to protect flood risk, river morphology and water resources, and delivering amenity and biodiversity value for the development."*

5.2.6. At the proposed site, a surface water drainage strategy has been prepared in conjunction with the masterplan development ensuring space for multi-functional SuDS within the site boundary. Table 5 below provides a summary of the SuDS selection process and identifies potential features that are proposed as part of the surface water drainage strategy.

Table 5 - Summary of SuDS Selection

Feature	Description	Selection
Green Roofs	Green roofs are systems which cover a building's roof with vegetation. They are laid over a drainage layer, with other layers providing protection, waterproofing and insulation.	✓ / × Green roofs could be further considered at a later design stage
Filter Strips	These are wide, gently sloping areas of grass or other dense vegetation that treat runoff from adjacent impermeable areas.	✓ / × The use of filter strips could be further considered at a later design stage.
Pervious Surfaces	Pervious surfaces allow rainwater to infiltrate through the surface into an underlying storage layer, where water is stored before infiltration to the ground, reuse, or release to surface water.	✓ / × Pervious surface could be considered to help manage pollution from trafficked areas at a later design stage
Swales	Swales are broad, shallow channels covered by grass or other suitable vegetation. They are designed to convey and/or store runoff, and can infiltrate the water into the ground (if ground conditions allow).	✓ Swales have been proposed to provide water quality benefits to the proposed development as well as provide some attenuation capacity.
Infiltration Basins	Infiltration basins are depressions in the surface that are designed to store runoff and infiltrate the water to the ground. They may also be landscaped to provide aesthetic and amenity value.	✓ / × Infiltration testing could be undertaken at a later design stage where an infiltration led drainage strategy would be explored for the site.
Wet Ponds	Wet ponds are basins that have a permanent pool of water for water quality treatment. They provide temporary storage for additional storm runoff above the permanent water level. Wet ponds may provide amenity and wildlife benefits.	✓ / × Attenuation basins have been proposed on site however, the exact wet-dry nature will be determined at the detailed design stage.
Attenuation Basins	Attenuation basins are normally dry, though they may have small permanent pools at the inlet and outlet. They are designed to detain a certain volume of runoff as well as providing water quality treatment.	✓ / × Attenuation basins have been proposed on site however, the exact wet-dry nature will be determined at the detailed design stage.

Greenfield Run-Off

5.2.7. Current best practice guidance identifies that FEH rainfall data largely supersede the previously used FSR Rainfall data. Therefore, the catchment descriptors for the proposed development site have been purchased from the FEH web service and the QMED discharge rate from the site will be calculated, as identified in Table 6 and contained within Appendix B.

Table 6 - Greenfield Run-Off Rates

Event	50ha (l/s)	1ha (l/s)
QMED	79.00	1.58

Development Run-Off & Attenuation

5.2.8. As the site is currently undeveloped, the proposals will result in an increase in impermeable area, which will increase the overall rate of water discharging from the site if left un-attenuated.

5.2.9. The surface water drainage strategy drawing 6405-D-002 in Appendix A indicates the site catchments based on the site topography as calculated in Table 7.

Table 7 - Site Run-Off Assessment

Catchment	Area Identified for Proposed Residential Development Area (ha)	Proposed Impermeable Area (ha)	QMED (l/s)
A	3.10	2.02	4.90
B	0.80	0.52	1.26
C	2.80	1.82	4.42
D	4.70	3.06	7.43
E	1.90	1.24	3.00
F	0.50	0.33	0.79
G	6.10	3.97	9.64
Total	**19.90**	**12.94**	**31.44**

5.2.10. Where long term storage is not proposed, in order to mitigate for the increased volume of run-off associated with built development, peak flows in the 1 in 100 year event must be attenuated to the QMED discharge rates for each catchment.

5.2.11. Where the development run-off from each catchment falls below 2l/s value, a maximum proposed peak discharge rate of 2l/s has been utilised to help reduce the risk of blockage of a flow control within the drainage network.

5.2.12. Assessments have thereafter been completed to determine the characteristics of the SuDS features required. The Micro Drainage Source Control module has been utilised to provide routing calculations

for the 1 in 100 year flood event to identify the size and nature of storage required, ensuring the peak outflows are in line with those identified in Table 7.

5.2.13. A summary of the nature of SuDS proposed is contained in Table 8, whilst the drainage strategy is shown on D-002 in Appendix A and Micro Drainage summary calculations are contained in Appendix B.

Table 8 - Site Attenuation Requirements

Catchment	Proposed Discharge Rate (l/s)	Approximate Storage Volume Required (m^3)	Potential SuDS
A	4.9	1,640	Attenuation Basin & Conveyance Swales
B	2.0	390	Attenuation Basin
C	4.4	1,480	Attenuation Basin & Conveyance Swales
D	7.4	2,500	Attenuation Basin & Swales
E	3.0	1,000	Attenuation Basin & Conveyance Swales
F	2.0	240	Attenuation Basin & Conveyance Swales
G	9.6	3,250	Attenuation Basin
Total	**33.3**	**10,250**	

5.2.14. In accordance with legislative requirements, the detention proposals have also been assessed for the potential effects of climate change. The 1 in 100 year (1% AEP) return events have been modelled for 40% climate change (including peak rainfall intensity). Calculations for the climate change scenarios are also contained in the Appendix B.

5.2.15. Climate change assessments show each attenuation feature to perform adequately by retaining the additional flows within the system without overflow or unacceptable consequences.

5.2.16. The surface water drainage strategy will be designed in accordance with Sewers for Adoption (7th Edition) such that the proposed network will not surcharge during the critical 1 in 2 year event and will not flood during the 1 in 30 year event. For the 1 in 100 year return period, the sewer network will be designed so that surface flooding will be contained and conveyed within the highway boundary and directed to the attenuation basin.

5.2.17. The 1 in 30 year criterion meets the requirements of BS EN 752 and is also in accordance with Sewers for Adoption 7th Edition. However, the design of the system exceeds the requirements of these documents by accommodating the volumes and flow rates generated by the 1 in 100 year event.

5.2.18. The surface water drainage strategy is based upon the site masterplanning details at the time of production. Changes to the site development profile, impermeable areas across the site or other such aspects of the scheme will result in the need to revise the calculations.

Development Creep

5.2.19. Over the lifetime of a development, it is possible that the overall impermeable area within the site could increase by as much as 10% through the house buyers undertaking activities such as property extensions and introducing paved gardens.

5.2.20. Table 9 shows how this increase in impermeable area relates to the primary catchments within the site.

Table 9 - Development Creep Assessment

Catchment	Impermeable Area (ha)	10% Creep (ha)	Total Impermeable Area (ha)
A	2.02	0.20	2.22
B	0.52	0.05	0.57
C	1.82	0.18	2.00
D	3.06	0.31	3.36
E	1.24	0.12	1.36
F	0.33	0.03	0.36
G	3.97	0.40	4.36
Total	**12.94**	**1.29**	**9.87**

5.2.21. Micro Drainage calculations contained in Appendix B confirm that the proposed SuDS system has sufficient capacity to accommodate a 10% increase in impermeable area during the 1 in 100 year + 40% event without overflow.

5.2.22. In addition to this, during the detailed design phase, the positive impacts of the potential source control measures (permeable paving et al.,) should be further considered.

5.2.23. Without the benefit of a detailed plot level masterplan, it is not possible to appraise the function of the individual source control systems down to plot level. Source control measures should be further considered during detailed design and implemented as far as reasonably practicable.

5.2.24. As such, the impacts of development creep on the proposed SuDS system are not considered to pose a significant risk to the site.

Climate Change

5.2.25. The purpose of the proposed drainage strategy is to ensure that the proposed scheme does not exacerbate any existing flood risks upstream or downstream of the site, in accordance with the principles set out within the NPPF.

5.2.26. SuDS will be implemented throughout this development scheme. The conceptual SuDS strategy for the proposed development has been devised using the principles outlined within the current published guidance in the form of the NPPF, PPG and CIRIA amongst others.

5.2.27. The impact of climate change is a key factor when determining a drainage strategy. The NPPF and PPG guidance advocate a “development lifespan” approach for dealing with climate change allowances.

5.2.28. In light of this and in accordance with local requirements, an increase of 40% in peak rainfall intensity has been used as the allowance for climate change within the proposed drainage design to determine the performance of the drainage system.

5.2.29. Climate change assessments show each attenuation feature to perform adequately by retaining the additional flows within the system without overflow or unacceptable consequences. Calculations for the climate change scenarios are also contained in the Appendix B.

SuDS Management Train

5.2.30. The SuDS Manual (CIRIA C753) states the SuDS Management Train is a central design concept for SuDS. SuDS should not be thought of as an individual component, but as an interconnected system designed to manage, treat and make best use of surface water, from where it falls as rain to the point at which it is discharged into the receiving environment beyond the boundaries of the site.

5.2.31. There are six specific functions provided by SuDS components (rainwater harvesting, pervious surface systems, infiltration systems, conveyance systems, storage systems and treatment systems), which are not independent with one component being able to provide two or more functions.

5.2.32. There are many types of SuDS components which means that SuDS can be delivered anywhere, tailored to individual local contexts. Wherever possible, runoff should be managed at source with residual flows then conveyed downstream to further storage or treatment components.

5.2.33. Treatment design should implement SuDS components that use a range of treatment processes to reduce contaminant level in runoff to acceptable levels. This can be facilitated by the SuDS management train of a number of components in series that provide a range of treatment processes, delivering gradual improvement in water quality and providing an environmental buffer for accidental spills or unexpected high pollutant loadings from the site

5.2.34. The above has been considered in applying SuDS into the proposed development to help provide; prevention in terms of pollution, source control and site controls.

5.2.35. The proposed development will utilise attenuation basins and swales to provide attenuation storage on site. Flows will be limited, via a flow control device (e.g. hydrobrake) to ensure that maximum peak discharge rates do not exceed 38.4l/s for any event up to and including the 1 in 100 year plus climate change event.

Health and Safety

5.2.36. The proposed layout of the SuDS features will be designed in accordance with the best practice SuDS guidance documents and national standards, supplemented, where appropriate, with Leicestershire County Council guidance and the requirements of the water company and maintenance company to ensure the features are effective not only in terms of their hydraulic design but also from a safety perspective during construction, operation and maintenance.

5.2.37. Detailed health and safety risk assessments should be completed for the individual drainage features proposed as part of the final site design, setting out the risks and incorporating proposals for how these are to be managed.

6. FOUL DRAINAGE

6.1. EXISTING FOUL WATER DRAINAGE REGIME

6.1.1. Network Asset Plans obtained from Severn Trent Water identify a number of existing sewers present serving the existing development site including a 450mm diameter combined rising main which crosses the far west of the northern parcel of the site and a 160mm and 80mm foul sewer which crosses the south of the southern parcel of the site.

6.2. PROPOSED FOUL FLOWS

6.2.1. Peak design discharges have been calculated based on a maximum number of 900 dwellings, it has been estimated that a maximum of 550 dwellings will be proposed in the northern parcel and a maximum of 350 dwellings will be proposed in the southern parcel.

- Residential = 4,000 litres / dwelling / day (peak)

6.2.2. Assessed in accordance with Sewers for Adoption requirements, it is anticipated that the planned development will produce a peak flow discharge of approximately 25l/s from the northern parcel and 16l/s from the southern parcel. Therefore, a maximum peak discharge from the site is proposed of 41l/s.

6.3. NETWORK CAPACITY AVAILABILITY

6.3.1. A pre-development enquiry has been sent to Severn Trent Water to confirm the available capacity within their network however, at the time of writing no response has been received.

6.4. IMPLEMENTATION PROPOSALS

6.4.1. A Severn Trent Water developer enquiry has been sought to identify proposed points of connection with available capacity for the proposed site. At the time of writing, no response has been received.

7. OPERATION AND MAINTENANCE

7.1. SURFACE WATER FEATURES

7.1.1. The proposed on-site surface water and foul drainage sewerage networks will be designed to the current version of Sewers for Adoption and will be offered for adoption by Severn Trent Water.

7.1.2. With regards to SuDS, in view of the recent central government decision not to create SAB's, some uncertainty remains regarding by whom and how these features will be adopted and maintained. With the above in mind, it is likely that, should the SuDS be offered to the council for adoption and maintenance, commuted sums will be required for all adoptable SuDS processes.

7.1.3. As an alternative, it is becoming increasingly common for SuDS features to be operated and maintained by a third-party private maintenance company. Should this be necessary, a third-party management company would be established to maintain the features in perpetuity. An adoption agreement between the final site developer and Maintenance Company would be based upon the CIRIA ICoP MA2 SuDS Maintenance Framework Agreement.

7.1.4. A typical maintenance schedule of the attenuation and flow control devices proposed on site are shown in tables below.

Table 10 - Swale Indicative Maintenance Schedule

FREQUENCY	ACTION
Monthly	▪ Litter and debris removal. ▪ Mow grasses (where required to promote lateral runoff inflow) and remove resultant clippings (during growing season only). ▪ Remove nuisance and invasive vegetation (for 12 months following installation). ▪ Inspect/check all inlets, outlets, surface and overflows (where required) to ensure that they are in good condition, free from blockages and operating as designed. Take action where required.
Six Monthly	▪ Remove nuisance and invasive vegetation.
Annually	▪ Check for poor vegetation growth due to lack of sunlight or dropping of leaf litter, and cut back adjacent vegetation where required. ▪ Re-seed areas of poor vegetation growth. Alter plant types to better suit conditions, where required. ▪ Inspect and document the presence of wildlife.
As-Required	▪ Repair erosion or other damage by re-turfing, reseeding or replacing filter material. ▪ Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface where required. ▪ (typically every 60 month period). ▪ Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip, where required. ▪ Remove and dispose of oils or petrol residues using safe standard practices.
Following all significant storm events	▪ Inspect and carry out essential recovery works to return the feature to full working order.

Table 11 - Flow Control (e.g Hydrobrake) Indicative Maintenance Schedule

FREQUENCY	ACTION
Monthly	▪ Inspect and identify any areas that are not operating correctly. If required, take remedial action (for three months following installation)
Six Monthly	▪ Inspect and identify any areas that are not operating correctly. If required, take remedial action. ▪ Remove sediment from pre-treatment structures
Annually	▪ N/A
Following all significant storm events	▪ Inspect and carry out essential recovery works to return the feature to full working order.

Table 12 - Attenuation Basin Indicative Maintenance Schedule

Monthly	▪ Litter and debris removal. ▪ Mow grasses (where required to promote lateral runoff inflow) and remove resultant clippings (during growing season only). ▪ Remove nuisance and invasive vegetation (for 12 months following installation). ▪ Inspect/check all inlets, outlets, surface and overflows (where required) to ensure that they are in good condition, free from blockages and operating as designed. Take action where required.
Six Monthly	▪ Remove nuisance and invasive vegetation.
Annually	▪ Remove all dead growth prior to the start of growing season. ▪ Re-seed areas of poor vegetation growth. Alter plant types to better suit conditions, where required. ▪ Inspect and document the presence of wildlife. ▪ Remove sediment from inlets, outlet and forebay ▪ Manage wetland plants, where required
As-Required	▪ Prune and trim trees and remove cuttings. ▪ Remove sediment from forebay, when 50% full and from micropools if volume reduced by more than 25% ▪ Repair erosion or other damage by re-turfing or reseeding ▪ Re-level uneven surfaces and reinstate design levels (typically once every 60 month period) ▪ Remove and dispose of oils or petrol residues using safe standard practices
Following all significant storm events	▪ Inspect and carry out essential recovery works to return the feature to full working order.

7.1.5. The proposed maintenance regimes for the devices should be in accordance with The SuDS Manual (CIRIA C753) and other best practice guidelines and in accordance with manufacturer's recommendations. This will ensure the design performance, structural integrity and where applicable-appearance of each feature is maintained throughout its lifetime.

7.1.6. The details of the party responsible for maintenance of each feature will be confirmed prior to occupation of the proposed development. Until such times as this may be determined.

7.2. FOUL DRAINAGE NETWORK

7.2.1. The foul drainage system will be offered for the adoption of Severn Trent Water under S104 of the Water Industry Act 1991.

8. CONCLUSIONS

8.1.1. The risk of flooding to and from the proposed development has been assessed largely in accordance with the NPPF February 2019.

8.1.2. This assessment demonstrates that the site lies within an appropriate location for the proposed land uses in accordance with the vulnerability classifications of the NPPF and supported by the Planning Authority and the Environment Agency.

8.1.3. Management of extreme event flood risk may be achieved through ensuring the finished floor levels of the proposed building are set at a minimum of 150mm above adjacent roads and open space levels in areas where designated overland flood routes are identified.

8.1.4. The proposed surface water drainage strategy aims to mimic the behaviour of the site pre-development (greenfield), through the utilisation of conveyance swales, attenuation basins, and flow control devices. The maximum peak rate of discharge from the site is proposed to be 33.3l/s and the total approximate storage volume required is 10,500m³ for the critical 1 in 100 year event plus climate change.

8.1.5. In addition to the NPPF, the proposed surface water drainage strategy complies with local policy and site-specific requirements.

8.1.6. The responsibility for the operation and maintenance of each SuDS feature will be confirmed prior to construction. The SuDS used on site will be maintained in accordance with manufacturer's recommendations and current best practice and guidelines to ensure routine operation.

8.1.7. Safe access and egress will be available to and from the site for events up to and including the 1 in 100 year plus climate change (40%) rainfall events.

8.1.8. This report demonstrates that the proposed development can be undertaken in a sustainable manner without increasing the flood risk either at the site or to any third-party land in line with NPPF requirements.

Appendix A

INFILTRATION TESTING

LEGEND

Site boundary
(55.89ha)

0 100
metres

Revisions	A: Final for submission
Site:	**Lawnswood Road, Wordsley**
Client:	Clowes Developments
Title:	**Site boundary**
Scale:	1:2000 @ A1
Drawing No.	001
Revision:	A
Date of Issue:	11.12.2019
Drawn by:	AJF
Node Ref:	CLO0548

Node
Imperial & Whitehall
23 Colmore Row
Birmingham
B3 2BS

thisisnode.com | 0121 667 9259

LEGEND

Site boundary
(55.89ha)

Land use

Residential development
(20.05ha)

Public Open Space

Children's play area

Access & movement

Existing footway

Strategic pedestrian/ cycle link

Existing public footpath

Redirected public footpath

Primary avenue

Circulation road

Residential street

Informal street

Proposed all-mode access

Landscape features

Contour levels

Existing tree canopy

Existing hedgerow

Proposed tree/ vegetation

Existing waterbody

Existing watercourse

Proposed attenuation basin

Proposed swale

Historic setting

Grade II listed building

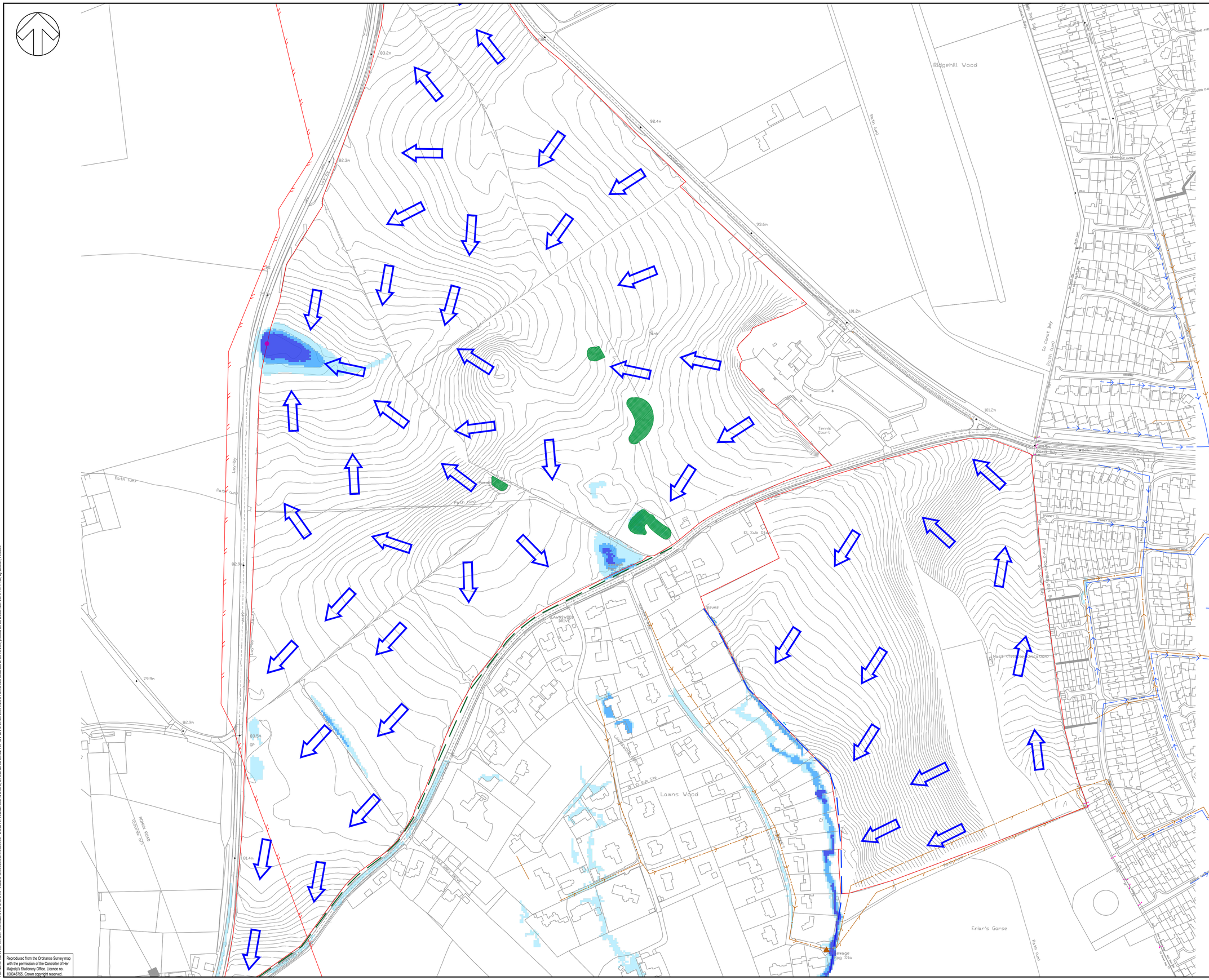
Local historic environment record

0 100
metres

Revisions	A: Final for submission
Site:	**Lawnswood Road, Wordsley**
Client:	Clowes Developments
Title:	**Design framework**
Scale:	1:2000 @ A1
Drawing No.	004
Revision:	A
Date of Issue:	11.12.2019
Drawn by:	AJF
Node Ref:	CLO0548

Node
Imperial & Whitehall
23 Colmore Row
Birmingham
B3 2BS

thisisnode.com | 0121 667 9259



DO NOT SCALE

NOTES

1. DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.

2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT SCHEME DRAWINGS.

3. THIS DRAWING IS NOT TO BE REPRODUCED IN ANY PART OR FORM WITHOUT CONSENT OF WSP DEVELOPMENT LIMITED. ALL COPYRIGHT RESERVED.

4. DO NOT SCALE. IF IN DOUBT CONTACT WSP DEVELOPMENT LIMITED.

5. EXISTING ROAD LEVELS AND DRAINAGE INVERT LEVELS SHALL BE CHECKED PRIOR TO CONSTRUCTION COMMENCEMENT. ANY DISCREPANCY SHALL BE REFERRED TO THE ENGINEER.

6. THE LOCATION AND DEPTHS OF ALL EXISTING SERVICE APPARATUS SHOULD BE CONFIRMED WITH THE SERVICE AUTHORITIES PRIOR TO ANY EXCAVATION WORKS TAKING PLACE.

7. ILLUSTRATIVE PLAN BASED ON:
   - 7.1. SEVERN TRENT WATER ASSET MAPS (DATA UPDATED 31/07/2019).
   - 7.2. ENVIRONMENT AGENCY SURFACE WATER FLOOD MAPPING (EXTENTS DOWNLOADED NOVEMBER 2019).
   - 7.3. SITE TOPOGRAPHIC SURVEY, BWB (3RD DECEMBER 2019).

KEY

- SITE BOUNDARY
- EXISTING WATERCOURSE
- EXISTING HIGHWAY DRAIN
- EXISTING SURFACE WATER SEWER
- EXISTING FOUL WATER SEWER
- EXISTING COMBINED RISING MAIN
- EXISTING FOUL WATER RISING MAIN
- EXISTING CULVERT
- 1 IN 30 YEAR SURFACE WATER FLOOD EXTENT
- 1 IN 100 YEAR SURFACE WATER FLOOD EXTENT
- 1 IN 1,000 YEAR SURFACE WATER FLOOD EXTENT
- EXISTING POND
- EXISTING SURFACE WATER FLOW ROUTE

UNTIL TECHNICAL APPROVAL HAS BEEN OBTAINED FROM THE RELEVANT LOCAL AUTHORITIES OR STATUTORY BODIES, IT SHOULD BE UNDERSTOOD THAT ALL DRAWINGS ARE ISSUED AS PRELIMINARY AND NOT FOR CONSTRUCTION. SHOULD THE CONTRACTOR AND / OR EMPLOYER COMMENCE WORK PRIOR TO APPROVAL BEING GIVEN, IT IS ENTIRELY AT THEIR OWN RISK.

REV	DATE	BY	DESCRIPTION	CHK	APP
P01	04/12/2019	PS	FIRST ISSUE	AC	DW

DRAWING STATUS: S2 - FOR INFORMATION

wsp

The Mailbox, Level 2, 100 Wharfside Street, Birmingham, B1 1RT, UK
T+ 44 (0) 121 352 4700, F+ 44 (0) 121 352 4701
wsp.com

CLIENT: CLOWES DEVELOPMENTS

ARCHITECT:

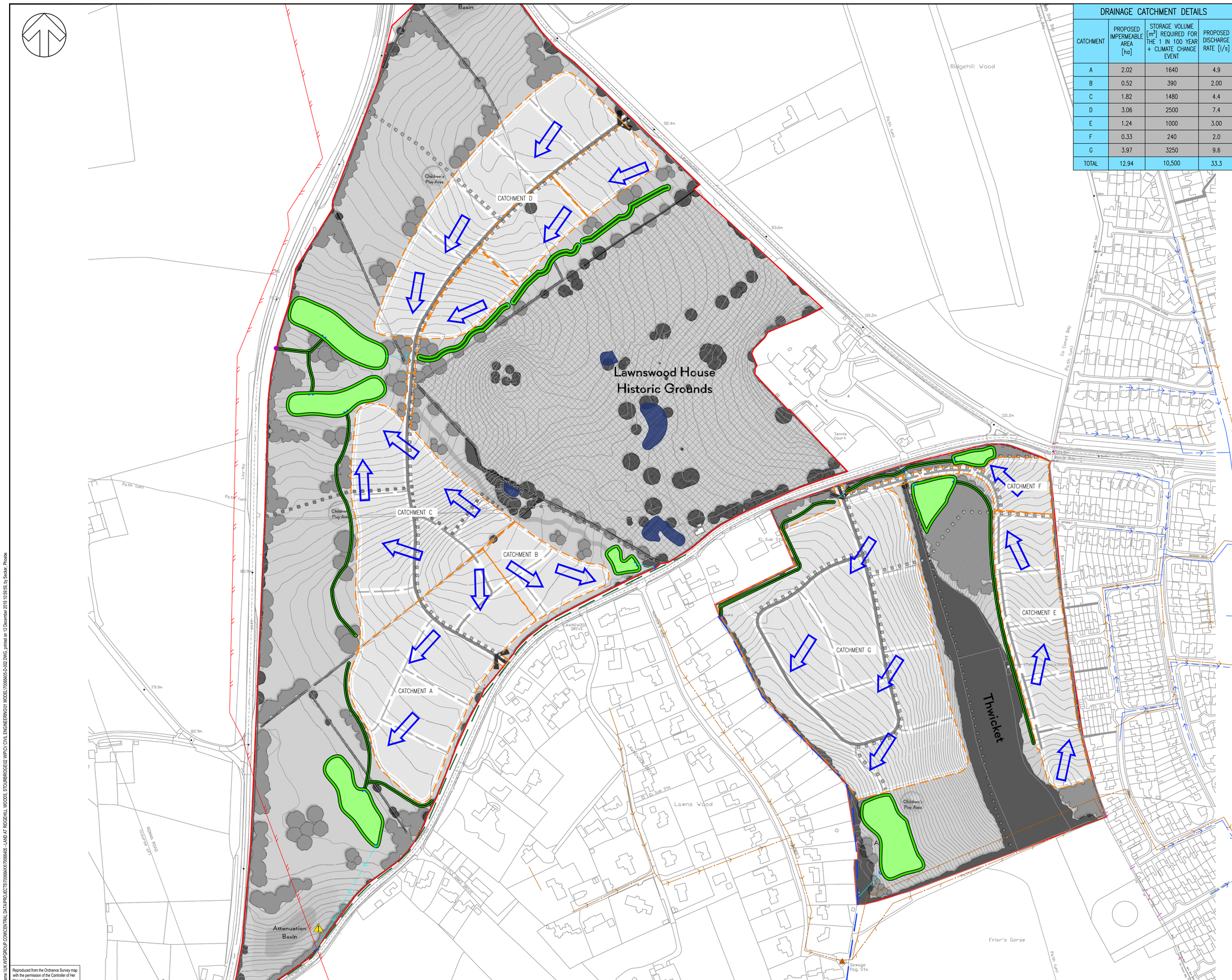
SITE/PROJECT: LAWNSWOOD ROAD

TITLE: EXISTING DRAINAGE FEATURES

SCALE @ A1:	CHECKED:		APPROVED:
1:2000	AC		DW
PROJECT NO:	DESIGNED:	DRAWN:	DATE:
70066405	PS	PS	December 19

DRAWING No: 70066405-D-001 REV: P01

File name: \\UK.WSPGROUP.COM\CENTRAL DATA\PROJECTS\70066405\70066405 - LAND AT RIDGEHILL WOODS, STOURBRIDGE\01 WIP\CIV ENGINEERING\01 MODEL\70066405-D-001.DWG, printed on 05 December, 2019 14:11:48, by Becker, Phoebe



DRAINAGE CATCHMENT DETAILS			
CATCHMENT	PROPOSED IMPERMEABLE AREA [ha]	STORAGE VOLUME [m^3] REQUIRED FOR THE 1 IN 100 YEAR + CLIMATE CHANGE EVENT	PROPOSED DISCHARGE RATE [l/s]
A	2.02	1640	4.9
B	0.52	390	2.00
C	1.82	1480	4.4
D	3.06	2500	7.4
E	1.24	1000	3.00
F	0.33	240	2.0
G	3.97	3250	9.6
TOTAL	12.94	10,500	33.3

DO NOT SCALE

NOTES
1. DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT SCHEME DRAWINGS.
3. THIS DRAWING IS NOT TO BE REPRODUCED IN ANY PART OR FORM WITHOUT CONSENT OF WSP DEVELOPMENT LIMITED. ALL COPYRIGHT RESERVED.
4. DO NOT SCALE. IF IN DOUBT CONTACT WSP DEVELOPMENT LIMITED.
5. EXISTING ROAD LEVELS AND DRAINAGE INVERT LEVELS SHALL BE CHECKED PRIOR TO CONSTRUCTION COMMENCEMENT. ANY DISCREPANCY SHALL BE REFERRED TO THE ENGINEER.
6. THE LOCATION AND DEPTHS OF ALL EXISTING SERVICE APPARATUS SHOULD BE CONFIRMED WITH THE SERVICE AUTHORITIES PRIOR TO ANY EXCAVATION WORKS TAKING PLACE.
7. ILLUSTRATIVE PLAN BASED ON:
   - 7.1. SEVERN TRENT WATER ASSET MAPS (DATA UPDATED 31/07/2019).
   - 7.2. ENVIRONMENT AGENCY SURFACE WATER FLOOD MAPPING (EXTENTS DOWNLOADED NOVEMBER 2019).
   - 7.3. SITE TOPOGRAPHIC SURVEY, BWB (3RD DECEMBER 2019).
   - 7.4. DESIGN FRAMEWORK REVB, NODE (11TH DECEMBER 2019)
8. ILLUSTRATIVE DRAINAGE STRATEGY BASED ON:
   - 8.1. CALCULATIONS UNDERTAKEN IN MICRODRAINAGE SOURCE CONTROL MODULE.
   - 8.2. PROPOSED QMED DISCHARGE RATE.
   - 8.3. PONDS ASSUMED 1m DEEP, 1:3 SIDE SLOPES, 300mm FREEBOARD UP TO THE 1 IN 100 YEAR + 40% CLIMATE CHANGE EVENT.
   - 8.4. SWALES FOR CONVEYANCE ONLY.
   - 8.5. RESIDENTIAL AREAS ASSUMED 65% IMPERMEABLE.
   - 8.6. SUBJECT TO AGREEMENT FROM SEVERN TRENT WATER / LEAD LOCAL FLOOD AUTHORITY.
9. NO EARTHWORKS EXERCISE HAS BEEN UNDERTAKEN FOR THE PROPOSED. ALL ATTENUATION SUBJECT TO DETAILED EARTHWORKS DESIGN.

KEY

- SITE BOUNDARY
- EXISTING WATERCOURSE
- EXISTING HIGHWAY DRAIN
- EXISTING SURFACE WATER SEWER
- EXISTING FOUL WATER SEWER
- EXISTING COMBINED RISING MAIN
- EXISTING FOUL WATER RISING MAIN
- EXISTING CULVERT
- EXISTING POND
- PROPOSED SURFACE WATER FLOW ROUTE
- PROPOSED ATTENUATION POND
- PROPOSED SURFACE WATER SEWER
- PROPOSED SWALE
- PROPOSED SURFACE WATER DRAINAGE CATCHMENT
- PROPOSED SURFACE WATER HEADWALL

UNTIL TECHNICAL APPROVAL HAS BEEN OBTAINED FROM THE RELEVANT LOCAL AUTHORITIES OR STATUTORY BODIES, IT SHOULD BE UNDERSTOOD THAT ALL DRAWINGS ARE ISSUED AS PRELIMINARY AND NOT FOR CONSTRUCTION. SHOULD THE CONTRACTOR AND / OR EMPLOYER COMMENCE WORK PRIOR TO APPROVAL BEING GIVEN, IT IS ENTIRELY AT THEIR OWN RISK.

⚠ POTENTIAL CONNECTION TO COMBINED RISING MAIN OR HIGHWAY DITCH, SUBJECT TO CONFIRMATION FROM RELATIVE PARTIES.

REV	DATE	BY	DESCRIPTION	CHK	APP
P02	12/12/2019	PS	UPDATED MASTERPLAN	AC	DW
P01	05/12/2019	PS	DRAFT FOR COMMENT	AC	DW

DRAWING STATUS: S2 - FOR INFORMATION

wsp
The Mailbox, Level 2, 100 Wharfside Street, Birmingham, B1 1RT, UK
T+ 44 (0) 121 352 4700, F+ 44 (0) 121 352 4701
wsp.com

CLIENT: CLOWES DEVELOPMENTS

ARCHITECT: NODE

SITE/PROJECT: LAWNSWOOD ROAD

TITLE: PROPOSED SURFACE WATER DRAINAGE STRATEGY

SCALE @ A1:	CHECKED:		APPROVED:
1:2000	AC		DW
PROJECT NO: 70066405	DESIGNED: PS	DRAWN: PS	DATE: December 19

DRAWING No: 70066405-D-002 REV: P02

DO NOT SCALE

NOTES

1. DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE STATED.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT SCHEME DRAWINGS.
3. THIS DRAWING IS NOT TO BE REPRODUCED IN ANY PART OR FORM WITHOUT CONSENT OF WSP DEVELOPMENT LIMITED. ALL COPYRIGHT RESERVED.
4. DO NOT SCALE. IF IN DOUBT CONTACT WSP DEVELOPMENT LIMITED.
5. EXISTING ROAD LEVELS AND DRAINAGE INVERT LEVELS SHALL BE CHECKED PRIOR TO CONSTRUCTION COMMENCEMENT. ANY DISCREPANCY SHALL BE REFERRED TO THE ENGINEER.
6. THE LOCATION AND DEPTHS OF ALL EXISTING SERVICE APPARATUS SHOULD BE CONFIRMED WITH THE SERVICE AUTHORITIES PRIOR TO ANY EXCAVATION WORKS TAKING PLACE.
7. ILLUSTRATIVE PLAN BASED ON:
   - 7.1. SEVERN TRENT WATER ASSET MAPS (DATA UPDATED 31/07/2019).
   - 7.2. ENVIRONMENT AGENCY SURFACE WATER FLOOD MAPPING (EXTENTS DOWNLOADED NOVEMBER 2019).
   - 7.3. SITE TOPOGRAPHIC SURVEY, BWB (3RD DECEMBER 2019).
   - 7.4. DESIGN FRAMEWORK REVB, NODE (11TH DECEMBER 2019)
8. TO BE READ IN CONJUNCTION WITH PROPOSED SURFACE WATER DRAINAGE STRATEGY DRAWING 70066405-D-002, WSP.

KEY

- SITE BOUNDARY
- EXISTING WATERCOURSE
- EXISTING HIGHWAY DRAIN
- EXISTING SURFACE WATER SEWER
- EXISTING FOUL WATER SEWER
- EXISTING COMBINED RISING MAIN
- EXISTING FOUL WATER RISING MAIN
- EXISTING CULVERT
- EXISTING POND
- PROPOSED SURFACE WATER EXCEEDANCE ROUTE
- PROPOSED ATTENUATION POND
- PROPOSED SURFACE WATER SEWER
- PROPOSED SWALE
- PROPOSED SURFACE WATER HEADWALL

UNTIL TECHNICAL APPROVAL HAS BEEN OBTAINED FROM THE RELEVANT LOCAL AUTHORITIES OR STATUTORY BODIES, IT SHOULD BE UNDERSTOOD THAT ALL DRAWINGS ARE ISSUED AS PRELIMINARY AND NOT FOR CONSTRUCTION. SHOULD THE CONTRACTOR AND / OR EMPLOYER COMMENCE WORK PRIOR TO APPROVAL BEING GIVEN, IT IS ENTIRELY AT THEIR OWN RISK.

⚠ POTENTIAL CONNECTION TO COMBINED RISING MAIN OR HIGHWAY DITCH. SUBJECT TO CONFIRMATION FROM RELATIVE PARTIES.

REV	DATE	BY	DESCRIPTION	CHK	APP
P01	12/12/2019	PS	DRAFT FOR COMMENT	AC	DW

DRAWING STATUS: S2 - FOR INFORMATION

wsp
The Mailbox, Level 2, 100 Wharfside Street, Birmingham, B1 1RT, UK
T+ 44 (0) 121 352 4700, F+ 44 (0) 121 352 4701
wsp.com

CLIENT: CLOWES DEVELOPMENTS

ARCHITECT: NODE

SITE/PROJECT: LAWNSWOOD ROAD

TITLE: INDICATIVE SURFACE WATER EXCEEDANCE STRATEGY

SCALE @ A1:	CHECKED:		APPROVED:
1:2000	AC		DW
PROJECT NO: 70066405	DESIGNED: PS	DRAWN: PS	DATE: December 19

DRAWING No: 70066405-D-003 REV: P01

File name:\\UK.WSPGROUP.COM\CENTRAL DATA\PROJECTS\70066XXX\70066405 - LAND AT RIDGEHILL WOODS, STOURBRIDGE\02 WIP\CV CIVIL ENGINEERING\SH MODEL\70066405-D-003.DWG, printed on 12 December 2019 11:26:30, by Secker, Phoebe

Appendix B

CALCULATIONS

Appendix B.1

GREENFIELD RUN-OFF

FEH Mean Annual Flood

Input

Site Location	GB 386300 285500 SO 86300 85500
Area (ha)	50.000
SAAR (mm)	698
URBEXT (2000)	0.2963
SPRHOST	31.010
BFIHOST	0.576
FARL	0.979

Results

QMED Rural (l/s) 79.0 QMED Urban (l/s) 120.4

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.150
Area (ha)	50.000	Urban	0.000
SAAR (mm)	700	Region Number	Region 4

Results l/s

QBAR Rural	20.2
QBAR Urban	20.2
Q100 years	52.0
Q1 year	16.8
Q2 years	18.1
Q5 years	24.9
Q10 years	30.2
Q20 years	36.0
Q25 years	38.0
Q30 years	39.7
Q50 years	44.6
Q100 years	52.0
Q200 years	61.2
Q250 years	64.2
Q1000 years	84.2

Appendix B.2

1 IN 100 YEAR

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	83.171	0.171	4.9	437.3	O K
30 min Summer	83.222	0.222	4.9	572.3	O K
60 min Summer	83.275	0.275	4.9	713.7	O K
120 min Summer	83.318	0.318	4.9	831.1	O K
180 min Summer	83.340	0.340	4.9	892.1	O K
240 min Summer	83.354	0.354	4.9	929.4	O K
360 min Summer	83.368	0.368	4.9	969.8	O K
480 min Summer	83.374	0.374	4.9	986.8	O K
600 min Summer	83.377	0.377	4.9	993.4	O K
720 min Summer	83.377	0.377	4.9	993.8	O K
960 min Summer	83.374	0.374	4.9	984.4	O K
1440 min Summer	83.360	0.360	4.9	947.1	O K
2160 min Summer	83.343	0.343	4.9	899.0	O K
2880 min Summer	83.330	0.330	4.9	865.1	O K
4320 min Summer	83.313	0.313	4.9	817.7	O K
5760 min Summer	83.300	0.300	4.9	782.4	O K
7200 min Summer	83.290	0.290	4.9	756.0	O K
8640 min Summer	83.283	0.283	4.9	736.0	O K
10080 min Summer	83.278	0.278	4.9	721.8	O K
15 min Winter	83.191	0.191	4.9	490.0	O K
30 min Winter	83.248	0.248	4.9	641.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	116.400	0.0	300.1	23
30 min Summer	76.400	0.0	378.0	38
60 min Summer	47.900	0.0	618.3	68
120 min Summer	28.200	0.0	712.4	128
180 min Summer	20.392	0.0	754.1	186
240 min Summer	16.100	0.0	774.7	246
360 min Summer	11.433	0.0	787.2	366
480 min Summer	8.908	0.0	783.8	484
600 min Summer	7.323	0.0	774.3	604
720 min Summer	6.233	0.0	763.6	724
960 min Summer	4.829	0.0	741.5	962
1440 min Summer	3.375	0.0	696.6	1404
2160 min Summer	2.375	0.0	1199.9	1708
2880 min Summer	1.865	0.0	1235.5	2072
4320 min Summer	1.353	0.0	1248.4	2860
5760 min Summer	1.097	0.0	1562.0	3688
7200 min Summer	0.945	0.0	1677.1	4536
8640 min Summer	0.844	0.0	1790.4	5280
10080 min Summer	0.774	0.0	1895.8	6144
15 min Winter	116.400	0.0	334.2	23
30 min Winter	76.400	0.0	402.3	37

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	83.307	0.307	4.9	800.4	O K
120 min Winter	83.355	0.355	4.9	933.0	O K
180 min Winter	83.380	0.380	4.9	1002.4	O K
240 min Winter	83.395	0.395	4.9	1045.2	O K
360 min Winter	83.412	0.412	4.9	1092.8	O K
480 min Winter	83.420	0.420	4.9	1114.2	O K
600 min Winter	83.424	0.424	4.9	1123.9	O K
720 min Winter	83.425	0.425	4.9	1126.8	O K
960 min Winter	83.423	0.423	4.9	1121.3	O K
1440 min Winter	83.412	0.412	4.9	1090.5	O K
2160 min Winter	83.389	0.389	4.9	1028.5	O K
2880 min Winter	83.372	0.372	4.9	979.7	O K
4320 min Winter	83.346	0.346	4.9	907.6	O K
5760 min Winter	83.324	0.324	4.9	846.6	O K
7200 min Winter	83.305	0.305	4.9	796.3	O K
8640 min Winter	83.290	0.290	4.9	754.0	O K
10080 min Winter	83.277	0.277	4.9	719.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	47.900	0.0	685.2	66
120 min Winter	28.200	0.0	772.8	126
180 min Winter	20.392	0.0	800.2	184
240 min Winter	16.100	0.0	805.5	242
360 min Winter	11.433	0.0	796.2	360
480 min Winter	8.908	0.0	784.6	478
600 min Winter	7.323	0.0	773.1	594
720 min Winter	6.233	0.0	762.0	712
960 min Winter	4.829	0.0	740.7	942
1440 min Winter	3.375	0.0	700.5	1388
2160 min Winter	2.375	0.0	1326.3	1996
2880 min Winter	1.865	0.0	1352.5	2244
4320 min Winter	1.353	0.0	1308.6	3156
5760 min Winter	1.097	0.0	1750.4	4032
7200 min Winter	0.945	0.0	1878.9	4896
8640 min Winter	0.844	0.0	2005.6	5712
10080 min Winter	0.774	0.0	2124.8	6560

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 386300 285500 SO 86300 85500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 2.020

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	1.010	4	8	1.010

Model Details

Storage is Online Cover Level (m) 84.000

Tank or Pond Structure

Invert Level (m) 83.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2500.0	1.000	3260.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0109-4900-0700-4900
Design Head (m)	0.700
Design Flow (l/s)	4.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	109
Invert Level (m)	83.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	4.9
Flush-Flo™	0.214	4.9
Kick-Flo®	0.482	4.1
Mean Flow over Head Range	-	4.2

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.7	1.200	6.3	3.000	9.7	7.000	14.5
0.200	4.9	1.400	6.8	3.500	10.4	7.500	15.0
0.300	4.8	1.600	7.2	4.000	11.1	8.000	15.5
0.400	4.6	1.800	7.6	4.500	11.7	8.500	15.9
0.500	4.2	2.000	8.0	5.000	12.4	9.000	16.4
0.600	4.6	2.200	8.4	5.500	12.9	9.500	16.9
0.800	5.2	2.400	8.7	6.000	13.5		
1.000	5.8	2.600	9.1	6.500	14.0		

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	88.220	0.220	2.0	111.8	O K
30 min Summer	88.282	0.282	2.0	146.1	O K
60 min Summer	88.343	0.343	2.0	181.4	O K
120 min Summer	88.391	0.391	2.0	209.5	O K
180 min Summer	88.413	0.413	2.0	223.1	O K
240 min Summer	88.425	0.425	2.0	230.6	O K
360 min Summer	88.436	0.436	2.0	237.0	O K
480 min Summer	88.436	0.436	2.0	237.3	O K
600 min Summer	88.432	0.432	2.0	234.8	O K
720 min Summer	88.426	0.426	2.0	230.7	O K
960 min Summer	88.408	0.408	2.0	219.9	O K
1440 min Summer	88.378	0.378	2.0	201.7	O K
2160 min Summer	88.344	0.344	2.0	181.6	O K
2880 min Summer	88.316	0.316	2.0	165.4	O K
4320 min Summer	88.273	0.273	2.0	141.4	O K
5760 min Summer	88.242	0.242	2.0	123.8	O K
7200 min Summer	88.218	0.218	2.0	110.6	O K
8640 min Summer	88.199	0.199	2.0	100.5	O K
10080 min Summer	88.184	0.184	2.0	92.7	O K
15 min Winter	88.245	0.245	2.0	125.4	O K
30 min Winter	88.313	0.313	2.0	163.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	116.400	0.0	104.0	23
30 min Summer	76.400	0.0	134.8	37
60 min Summer	47.900	0.0	181.9	68
120 min Summer	28.200	0.0	213.9	126
180 min Summer	20.392	0.0	231.6	186
240 min Summer	16.100	0.0	243.3	246
360 min Summer	11.433	0.0	258.1	364
480 min Summer	8.908	0.0	267.0	484
600 min Summer	7.323	0.0	273.1	602
720 min Summer	6.233	0.0	277.7	722
960 min Summer	4.829	0.0	283.7	918
1440 min Summer	3.375	0.0	286.5	1104
2160 min Summer	2.375	0.0	330.4	1472
2880 min Summer	1.865	0.0	345.6	1876
4320 min Summer	1.353	0.0	375.0	2680
5760 min Summer	1.097	0.0	409.4	3456
7200 min Summer	0.945	0.0	440.4	4184
8640 min Summer	0.844	0.0	471.7	4928
10080 min Summer	0.774	0.0	503.0	5648
15 min Winter	116.400	0.0	116.3	23
30 min Winter	76.400	0.0	148.5	37

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	88.381	0.381	2.0	203.7	O K
120 min Winter	88.434	0.434	2.0	235.9	O K
180 min Winter	88.460	0.460	2.0	251.9	O K
240 min Winter	88.474	0.474	2.0	261.0	O K
360 min Winter	88.487	0.487	2.0	269.2	O K
480 min Winter	88.490	0.490	2.0	270.7	O K
600 min Winter	88.487	0.487	2.0	269.3	O K
720 min Winter	88.483	0.483	2.0	266.3	O K
960 min Winter	88.469	0.469	2.0	257.5	O K
1440 min Winter	88.431	0.431	2.0	234.2	O K
2160 min Winter	88.385	0.385	2.0	206.1	O K
2880 min Winter	88.345	0.345	2.0	182.7	O K
4320 min Winter	88.281	0.281	2.0	145.6	O K
5760 min Winter	88.230	0.230	2.0	117.6	O K
7200 min Winter	88.192	0.192	2.0	96.9	O K
8640 min Winter	88.163	0.163	2.0	81.6	O K
10080 min Winter	88.142	0.142	1.9	70.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	47.900	0.0	203.6	66
120 min Winter	28.200	0.0	239.0	124
180 min Winter	20.392	0.0	258.1	184
240 min Winter	16.100	0.0	270.4	242
360 min Winter	11.433	0.0	285.2	358
480 min Winter	8.908	0.0	293.0	474
600 min Winter	7.323	0.0	297.4	590
720 min Winter	6.233	0.0	299.3	704
960 min Winter	4.829	0.0	298.5	928
1440 min Winter	3.375	0.0	290.6	1330
2160 min Winter	2.375	0.0	370.1	1620
2880 min Winter	1.865	0.0	387.1	2048
4320 min Winter	1.353	0.0	419.8	2892
5760 min Winter	1.097	0.0	458.7	3640
7200 min Winter	0.945	0.0	493.5	4392
8640 min Winter	0.844	0.0	528.7	5104
10080 min Winter	0.774	0.0	564.0	5760

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 386300 285500 SO 86300 85500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.520

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.260	4	8	0.260

Model Details

Storage is Online Cover Level (m) 89.000

Tank or Pond Structure

Invert Level (m) 88.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	474.0	1.000	830.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0071-2000-0700-2000
Design Head (m)	0.700
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	71
Invert Level (m)	88.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	2.0
Flush-Flo™	0.207	2.0
Kick-Flo®	0.450	1.6
Mean Flow over Head Range	-	1.7

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	1.8	1.200	2.6	3.000	3.9	7.000	5.8
0.200	2.0	1.400	2.7	3.500	4.2	7.500	6.0
0.300	2.0	1.600	2.9	4.000	4.5	8.000	6.2
0.400	1.8	1.800	3.1	4.500	4.7	8.500	6.4
0.500	1.7	2.000	3.2	5.000	5.0	9.000	6.6
0.600	1.9	2.200	3.4	5.500	5.2	9.500	6.8
0.800	2.1	2.400	3.5	6.000	5.4		
1.000	2.4	2.600	3.7	6.500	5.6		

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	75.174	0.174	4.4	393.9	O K
30 min Summer	75.226	0.226	4.4	515.6	O K
60 min Summer	75.279	0.279	4.4	642.9	O K
120 min Summer	75.322	0.322	4.4	748.6	O K
180 min Summer	75.344	0.344	4.4	803.5	O K
240 min Summer	75.358	0.358	4.4	837.0	O K
360 min Summer	75.373	0.373	4.4	873.3	O K
480 min Summer	75.379	0.379	4.4	888.4	O K
600 min Summer	75.381	0.381	4.4	894.1	O K
720 min Summer	75.381	0.381	4.4	894.3	O K
960 min Summer	75.378	0.378	4.4	885.6	O K
1440 min Summer	75.364	0.364	4.4	851.4	O K
2160 min Summer	75.346	0.346	4.4	806.7	O K
2880 min Summer	75.333	0.333	4.4	775.1	O K
4320 min Summer	75.315	0.315	4.4	731.1	O K
5760 min Summer	75.302	0.302	4.4	698.3	O K
7200 min Summer	75.292	0.292	4.4	674.0	O K
8640 min Summer	75.284	0.284	4.4	655.7	O K
10080 min Summer	75.279	0.279	4.4	642.7	O K
15 min Winter	75.194	0.194	4.4	441.5	O K
30 min Winter	75.252	0.252	4.4	578.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	116.400	0.0	276.7	23
30 min Summer	76.400	0.0	344.7	38
60 min Summer	47.900	0.0	563.3	68
120 min Summer	28.200	0.0	647.6	128
180 min Summer	20.392	0.0	684.2	186
240 min Summer	16.100	0.0	701.2	246
360 min Summer	11.433	0.0	709.9	366
480 min Summer	8.908	0.0	704.8	484
600 min Summer	7.323	0.0	695.8	604
720 min Summer	6.233	0.0	686.4	724
960 min Summer	4.829	0.0	667.0	962
1440 min Summer	3.375	0.0	627.7	1406
2160 min Summer	2.375	0.0	1087.4	1708
2880 min Summer	1.865	0.0	1120.0	2076
4320 min Summer	1.353	0.0	1130.2	2892
5760 min Summer	1.097	0.0	1410.5	3688
7200 min Summer	0.945	0.0	1514.8	4536
8640 min Summer	0.844	0.0	1617.8	5352
10080 min Summer	0.774	0.0	1714.2	6152
15 min Winter	116.400	0.0	306.9	23
30 min Winter	76.400	0.0	364.3	37

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	75.311	0.311	4.4	721.0	O K
120 min Winter	75.359	0.359	4.4	840.5	O K
180 min Winter	75.384	0.384	4.4	902.9	O K
240 min Winter	75.400	0.400	4.4	941.4	O K
360 min Winter	75.417	0.417	4.4	984.2	O K
480 min Winter	75.424	0.424	4.4	1003.4	O K
600 min Winter	75.428	0.428	4.4	1012.0	O K
720 min Winter	75.429	0.429	4.4	1014.5	O K
960 min Winter	75.427	0.427	4.4	1009.4	O K
1440 min Winter	75.416	0.416	4.4	981.1	O K
2160 min Winter	75.393	0.393	4.4	924.4	O K
2880 min Winter	75.375	0.375	4.4	879.1	O K
4320 min Winter	75.348	0.348	4.4	812.8	O K
5760 min Winter	75.326	0.326	4.4	756.9	O K
7200 min Winter	75.307	0.307	4.4	710.9	O K
8640 min Winter	75.291	0.291	4.4	672.4	O K
10080 min Winter	75.278	0.278	4.4	640.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	47.900	0.0	623.4	66
120 min Winter	28.200	0.0	700.3	126
180 min Winter	20.392	0.0	721.9	184
240 min Winter	16.100	0.0	724.0	242
360 min Winter	11.433	0.0	714.4	360
480 min Winter	8.908	0.0	703.9	478
600 min Winter	7.323	0.0	693.7	594
720 min Winter	6.233	0.0	683.9	712
960 min Winter	4.829	0.0	665.3	942
1440 min Winter	3.375	0.0	630.3	1388
2160 min Winter	2.375	0.0	1201.3	2008
2880 min Winter	1.865	0.0	1224.6	2248
4320 min Winter	1.353	0.0	1181.0	3156
5760 min Winter	1.097	0.0	1580.4	4032
7200 min Winter	0.945	0.0	1696.9	4896
8640 min Winter	0.844	0.0	1811.9	5712
10080 min Winter	0.774	0.0	1920.8	6560

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 386300 285500 SO 86300 85500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.820

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.910	4	8	0.910

Model Details

Storage is Online Cover Level (m) 76.000

Tank or Pond Structure

Invert Level (m) 75.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2200.0	1.000	3020.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0104-4400-0700-4400
Design Head (m)	0.700
Design Flow (l/s)	4.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	104
Invert Level (m)	75.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	4.4
Flush-Flo™	0.214	4.4
Kick-Flo®	0.480	3.7
Mean Flow over Head Range	-	3.8

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	3.5	1.200	5.6	3.000	8.7	7.000	13.0
0.200	4.4	1.400	6.1	3.500	9.3	7.500	13.4
0.300	4.3	1.600	6.5	4.000	9.9	8.000	13.8
0.400	4.1	1.800	6.8	4.500	10.5	8.500	14.3
0.500	3.8	2.000	7.2	5.000	11.1	9.000	14.7
0.600	4.1	2.200	7.5	5.500	11.6	9.500	15.1
0.800	4.7	2.400	7.8	6.000	12.1		
1.000	5.2	2.600	8.1	6.500	12.5		

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	74.673	0.173	7.3	662.7	O K
30 min Summer	74.725	0.225	7.4	867.3	O K
60 min Summer	74.779	0.279	7.4	1081.7	O K
120 min Summer	74.824	0.324	7.4	1260.1	O K
180 min Summer	74.847	0.347	7.4	1353.0	O K
240 min Summer	74.861	0.361	7.4	1410.1	O K
360 min Summer	74.876	0.376	7.4	1472.3	O K
480 min Summer	74.882	0.382	7.4	1499.2	O K
600 min Summer	74.885	0.385	7.4	1510.1	O K
720 min Summer	74.886	0.386	7.4	1511.7	O K
960 min Summer	74.883	0.383	7.4	1499.5	O K
1440 min Summer	74.870	0.370	7.4	1447.0	O K
2160 min Summer	74.853	0.353	7.4	1379.7	O K
2880 min Summer	74.842	0.342	7.4	1332.9	O K
4320 min Summer	74.826	0.326	7.4	1268.8	O K
5760 min Summer	74.814	0.314	7.4	1220.6	O K
7200 min Summer	74.805	0.305	7.4	1184.7	O K
8640 min Summer	74.798	0.298	7.4	1157.2	O K
10080 min Summer	74.793	0.293	7.4	1137.8	O K
15 min Winter	74.693	0.193	7.4	742.6	O K
30 min Winter	74.752	0.252	7.4	972.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	116.400	0.0	424.6	23
30 min Summer	76.400	0.0	548.2	38
60 min Summer	47.900	0.0	906.6	68
120 min Summer	28.200	0.0	1048.7	128
180 min Summer	20.392	0.0	1114.0	186
240 min Summer	16.100	0.0	1148.4	246
360 min Summer	11.433	0.0	1174.8	366
480 min Summer	8.908	0.0	1175.4	484
600 min Summer	7.323	0.0	1165.2	604
720 min Summer	6.233	0.0	1149.2	724
960 min Summer	4.829	0.0	1114.4	962
1440 min Summer	3.375	0.0	1043.1	1402
2160 min Summer	2.375	0.0	1785.5	1708
2880 min Summer	1.865	0.0	1835.4	2072
4320 min Summer	1.353	0.0	1852.0	2860
5760 min Summer	1.097	0.0	2350.1	3688
7200 min Summer	0.945	0.0	2521.5	4536
8640 min Summer	0.844	0.0	2688.7	5280
10080 min Summer	0.774	0.0	2841.1	6152
15 min Winter	116.400	0.0	477.3	23
30 min Winter	76.400	0.0	592.2	37

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	74.812	0.312	7.4	1213.0	O K
120 min Winter	74.862	0.362	7.4	1414.4	O K
180 min Winter	74.888	0.388	7.4	1520.0	O K
240 min Winter	74.904	0.404	7.4	1585.3	O K
360 min Winter	74.921	0.421	7.4	1658.3	O K
480 min Winter	74.929	0.429	7.4	1691.7	O K
600 min Winter	74.933	0.433	7.4	1707.2	O K
720 min Winter	74.934	0.434	7.4	1712.5	O K
960 min Winter	74.933	0.433	7.4	1706.0	O K
1440 min Winter	74.922	0.422	7.4	1662.8	O K
2160 min Winter	74.901	0.401	7.4	1574.2	O K
2880 min Winter	74.884	0.384	7.4	1505.5	O K
4320 min Winter	74.859	0.359	7.4	1404.4	O K
5760 min Winter	74.838	0.338	7.4	1318.2	O K
7200 min Winter	74.820	0.320	7.4	1246.8	O K
8640 min Winter	74.805	0.305	7.4	1186.4	O K
10080 min Winter	74.793	0.293	7.4	1136.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	47.900	0.0	1007.3	66
120 min Winter	28.200	0.0	1143.9	126
180 min Winter	20.392	0.0	1193.4	184
240 min Winter	16.100	0.0	1209.2	242
360 min Winter	11.433	0.0	1203.0	360
480 min Winter	8.908	0.0	1185.5	478
600 min Winter	7.323	0.0	1167.9	594
720 min Winter	6.233	0.0	1150.5	710
960 min Winter	4.829	0.0	1116.7	942
1440 min Winter	3.375	0.0	1051.9	1388
2160 min Winter	2.375	0.0	1974.6	1996
2880 min Winter	1.865	0.0	2011.8	2244
4320 min Winter	1.353	0.0	1951.1	3156
5760 min Winter	1.097	0.0	2634.1	4032
7200 min Winter	0.945	0.0	2825.3	4896
8640 min Winter	0.844	0.0	3012.4	5712
10080 min Winter	0.774	0.0	3185.0	6560

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 386300 285500 SO 86300 85500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 3.060

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	1.530	4	8	1.530

Model Details

Storage is Online Cover Level (m) 75.500

Tank or Pond Structure

Invert Level (m) 74.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	3760.0	1.000	4630.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0131-7400-0700-7400
Design Head (m)	0.700
Design Flow (l/s)	7.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	131
Invert Level (m)	74.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	7.4
Flush-Flo™	0.230	7.4
Kick-Flo®	0.501	6.3
Mean Flow over Head Range	-	6.2

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	4.7	1.200	9.5	3.000	14.7	7.000	22.1
0.200	7.4	1.400	10.2	3.500	15.8	7.500	22.8
0.300	7.3	1.600	10.9	4.000	16.9	8.000	23.5
0.400	7.1	1.800	11.5	4.500	17.9	8.500	24.2
0.500	6.4	2.000	12.1	5.000	18.8	9.000	24.9
0.600	6.9	2.200	12.7	5.500	19.7	9.500	25.6
0.800	7.9	2.400	13.2	6.000	20.5		
1.000	8.7	2.600	13.7	6.500	21.3		

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	103.180	0.180	3.0	268.3	O K
30 min Summer	103.234	0.234	3.0	351.1	O K
60 min Summer	103.289	0.289	3.0	437.8	O K
120 min Summer	103.333	0.333	3.0	509.5	O K
180 min Summer	103.356	0.356	3.0	546.7	O K
240 min Summer	103.370	0.370	3.0	569.3	O K
360 min Summer	103.385	0.385	3.0	593.5	O K
480 min Summer	103.391	0.391	3.0	603.4	O K
600 min Summer	103.393	0.393	3.0	606.9	O K
720 min Summer	103.393	0.393	3.0	606.7	O K
960 min Summer	103.389	0.389	3.0	599.9	O K
1440 min Summer	103.373	0.373	3.0	574.9	O K
2160 min Summer	103.353	0.353	3.0	541.6	O K
2880 min Summer	103.338	0.338	3.0	517.9	O K
4320 min Summer	103.318	0.318	3.0	484.7	O K
5760 min Summer	103.303	0.303	3.0	460.5	O K
7200 min Summer	103.292	0.292	3.0	442.6	O K
8640 min Summer	103.283	0.283	3.0	429.3	O K
10080 min Summer	103.277	0.277	3.0	419.8	O K
15 min Winter	103.201	0.201	3.0	300.7	O K
30 min Winter	103.261	0.261	3.0	393.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	116.400	0.0	200.3	23
30 min Summer	76.400	0.0	242.6	38
60 min Summer	47.900	0.0	395.6	68
120 min Summer	28.200	0.0	453.0	128
180 min Summer	20.392	0.0	476.2	186
240 min Summer	16.100	0.0	485.4	246
360 min Summer	11.433	0.0	486.9	366
480 min Summer	8.908	0.0	481.5	484
600 min Summer	7.323	0.0	475.5	604
720 min Summer	6.233	0.0	469.3	724
960 min Summer	4.829	0.0	456.8	962
1440 min Summer	3.375	0.0	432.0	1428
2160 min Summer	2.375	0.0	753.1	1712
2880 min Summer	1.865	0.0	777.3	2076
4320 min Summer	1.353	0.0	785.6	2892
5760 min Summer	1.097	0.0	966.4	3688
7200 min Summer	0.945	0.0	1038.5	4536
8640 min Summer	0.844	0.0	1110.3	5352
10080 min Summer	0.774	0.0	1178.8	6152
15 min Winter	116.400	0.0	220.1	23
30 min Winter	76.400	0.0	252.0	37

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	103.322	0.322	3.0	491.0	O K
120 min Winter	103.372	0.372	3.0	572.2	O K
180 min Winter	103.397	0.397	3.0	614.5	O K
240 min Winter	103.413	0.413	3.0	640.6	O K
360 min Winter	103.430	0.430	3.0	669.6	O K
480 min Winter	103.438	0.438	3.0	682.4	O K
600 min Winter	103.442	0.442	3.0	688.1	O K
720 min Winter	103.442	0.442	3.0	689.6	O K
960 min Winter	103.440	0.440	3.0	685.6	O K
1440 min Winter	103.428	0.428	3.0	665.0	O K
2160 min Winter	103.403	0.403	3.0	623.9	O K
2880 min Winter	103.383	0.383	3.0	590.0	O K
4320 min Winter	103.353	0.353	3.0	541.2	O K
5760 min Winter	103.328	0.328	3.0	500.6	O K
7200 min Winter	103.307	0.307	3.0	467.6	O K
8640 min Winter	103.290	0.290	3.0	440.2	O K
10080 min Winter	103.276	0.276	3.0	417.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	47.900	0.0	436.7	66
120 min Winter	28.200	0.0	485.9	126
180 min Winter	20.392	0.0	495.1	184
240 min Winter	16.100	0.0	492.8	242
360 min Winter	11.433	0.0	484.8	360
480 min Winter	8.908	0.0	477.0	478
600 min Winter	7.323	0.0	469.9	596
720 min Winter	6.233	0.0	463.2	712
960 min Winter	4.829	0.0	451.2	942
1440 min Winter	3.375	0.0	429.7	1390
2160 min Winter	2.375	0.0	831.5	2012
2880 min Winter	1.865	0.0	848.2	2248
4320 min Winter	1.353	0.0	816.7	3156
5760 min Winter	1.097	0.0	1082.6	4032
7200 min Winter	0.945	0.0	1163.2	4896
8640 min Winter	0.844	0.0	1243.3	5712
10080 min Winter	0.774	0.0	1320.7	6560

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 386300 285500 SO 86300 85500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 1.240

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.620	4	8	0.620

Model Details

Storage is Online Cover Level (m) 104.000

Tank or Pond Structure

Invert Level (m) 103.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1440.0	1.000	2010.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0087-3000-0700-3000
Design Head (m)	0.700
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	87
Invert Level (m)	103.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	3.0
Flush-Flo™	0.210	3.0
Kick-Flo®	0.465	2.5
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	2.6	1.200	3.8	3.000	5.9	7.000	8.8
0.200	3.0	1.400	4.1	3.500	6.3	7.500	9.1
0.300	2.9	1.600	4.4	4.000	6.7	8.000	9.4
0.400	2.8	1.800	4.6	4.500	7.1	8.500	9.7
0.500	2.6	2.000	4.9	5.000	7.5	9.000	9.9
0.600	2.8	2.200	5.1	5.500	7.8	9.500	10.2
0.800	3.2	2.400	5.3	6.000	8.2		
1.000	3.5	2.600	5.5	6.500	8.5		

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	97.143	0.143	2.0	70.5	O K
30 min Summer	97.184	0.184	2.0	91.9	O K
60 min Summer	97.225	0.225	2.0	113.6	O K
120 min Summer	97.255	0.255	2.0	129.9	O K
180 min Summer	97.268	0.268	2.0	136.9	O K
240 min Summer	97.273	0.273	2.0	140.0	O K
360 min Summer	97.274	0.274	2.0	140.7	O K
480 min Summer	97.269	0.269	2.0	137.5	O K
600 min Summer	97.262	0.262	2.0	133.6	O K
720 min Summer	97.255	0.255	2.0	130.0	O K
960 min Summer	97.243	0.243	2.0	123.4	O K
1440 min Summer	97.222	0.222	2.0	111.8	O K
2160 min Summer	97.194	0.194	2.0	97.2	O K
2880 min Summer	97.172	0.172	2.0	85.4	O K
4320 min Summer	97.140	0.140	1.9	68.8	O K
5760 min Summer	97.119	0.119	1.9	58.0	O K
7200 min Summer	97.105	0.105	1.9	50.9	O K
8640 min Summer	97.095	0.095	1.8	46.2	O K
10080 min Summer	97.089	0.089	1.7	43.3	O K
15 min Winter	97.160	0.160	2.0	79.1	O K
30 min Winter	97.206	0.206	2.0	103.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	116.400	0.0	65.3	22
30 min Summer	76.400	0.0	86.6	37
60 min Summer	47.900	0.0	115.0	66
120 min Summer	28.200	0.0	135.7	126
180 min Summer	20.392	0.0	147.2	184
240 min Summer	16.100	0.0	155.0	244
360 min Summer	11.433	0.0	165.1	362
480 min Summer	8.908	0.0	171.4	480
600 min Summer	7.323	0.0	176.0	522
720 min Summer	6.233	0.0	179.7	576
960 min Summer	4.829	0.0	185.2	694
1440 min Summer	3.375	0.0	193.1	956
2160 min Summer	2.375	0.0	209.4	1360
2880 min Summer	1.865	0.0	219.0	1736
4320 min Summer	1.353	0.0	237.2	2472
5760 min Summer	1.097	0.0	259.4	3176
7200 min Summer	0.945	0.0	279.0	3896
8640 min Summer	0.844	0.0	298.7	4584
10080 min Summer	0.774	0.0	318.1	5336
15 min Winter	116.400	0.0	73.5	22
30 min Winter	76.400	0.0	97.1	37

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	97.251	0.251	2.0	127.7	O K
120 min Winter	97.285	0.285	2.0	146.4	O K
180 min Winter	97.299	0.299	2.0	154.7	O K
240 min Winter	97.307	0.307	2.0	158.7	O K
360 min Winter	97.310	0.310	2.0	160.4	O K
480 min Winter	97.305	0.305	2.0	158.0	O K
600 min Winter	97.298	0.298	2.0	153.9	O K
720 min Winter	97.289	0.289	2.0	148.9	O K
960 min Winter	97.273	0.273	2.0	139.9	O K
1440 min Winter	97.244	0.244	2.0	123.9	O K
2160 min Winter	97.205	0.205	2.0	102.7	O K
2880 min Winter	97.172	0.172	2.0	85.5	O K
4320 min Winter	97.126	0.126	1.9	61.8	O K
5760 min Winter	97.099	0.099	1.8	47.9	O K
7200 min Winter	97.086	0.086	1.7	41.5	O K
8640 min Winter	97.078	0.078	1.5	37.6	O K
10080 min Winter	97.073	0.073	1.4	34.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	47.900	0.0	129.0	66
120 min Winter	28.200	0.0	152.1	124
180 min Winter	20.392	0.0	165.1	182
240 min Winter	16.100	0.0	173.7	240
360 min Winter	11.433	0.0	185.0	354
480 min Winter	8.908	0.0	192.0	466
600 min Winter	7.323	0.0	197.1	574
720 min Winter	6.233	0.0	201.2	672
960 min Winter	4.829	0.0	207.3	750
1440 min Winter	3.375	0.0	216.0	1044
2160 min Winter	2.375	0.0	234.7	1472
2880 min Winter	1.865	0.0	245.5	1872
4320 min Winter	1.353	0.0	266.1	2596
5760 min Winter	1.097	0.0	290.7	3240
7200 min Winter	0.945	0.0	312.7	3960
8640 min Winter	0.844	0.0	334.8	4664
10080 min Winter	0.774	0.0	356.9	5344

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 386300 285500 SO 86300 85500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.330

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.165	4	8	0.165

Model Details

Storage is Online Cover Level (m) 98.000

Tank or Pond Structure

Invert Level (m) 97.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	470.0	1.000	820.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0071-2000-0700-2000
Design Head (m)	0.700
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	71
Invert Level (m)	97.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	2.0
Flush-Flo™	0.207	2.0
Kick-Flo®	0.450	1.6
Mean Flow over Head Range	-	1.7

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	1.8	1.200	2.6	3.000	3.9	7.000	5.8
0.200	2.0	1.400	2.7	3.500	4.2	7.500	6.0
0.300	2.0	1.600	2.9	4.000	4.5	8.000	6.2
0.400	1.8	1.800	3.1	4.500	4.7	8.500	6.4
0.500	1.7	2.000	3.2	5.000	5.0	9.000	6.6
0.600	1.9	2.200	3.4	5.500	5.2	9.500	6.8
0.800	2.1	2.400	3.5	6.000	5.4		
1.000	2.4	2.600	3.7	6.500	5.6		

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	74.181	0.181	9.5	866.4	O K
30 min Summer	74.236	0.236	9.7	1133.9	O K
60 min Summer	74.293	0.293	9.7	1414.2	O K
120 min Summer	74.340	0.340	9.7	1647.6	O K
180 min Summer	74.364	0.364	9.7	1769.3	O K
240 min Summer	74.379	0.379	9.7	1844.2	O K
360 min Summer	74.396	0.396	9.7	1926.1	O K
480 min Summer	74.403	0.403	9.7	1961.7	O K
600 min Summer	74.406	0.406	9.7	1976.5	O K
720 min Summer	74.406	0.406	9.7	1979.2	O K
960 min Summer	74.403	0.403	9.7	1964.1	O K
1440 min Summer	74.390	0.390	9.7	1897.2	O K
2160 min Summer	74.373	0.373	9.7	1811.8	O K
2880 min Summer	74.361	0.361	9.7	1752.9	O K
4320 min Summer	74.345	0.345	9.7	1672.6	O K
5760 min Summer	74.333	0.333	9.7	1612.4	O K
7200 min Summer	74.324	0.324	9.7	1567.3	O K
8640 min Summer	74.317	0.317	9.7	1532.9	O K
10080 min Summer	74.312	0.312	9.7	1508.7	O K
15 min Winter	74.203	0.203	9.6	970.8	O K
30 min Winter	74.264	0.264	9.7	1271.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	116.400	0.0	539.3	23
30 min Summer	76.400	0.0	703.7	38
60 min Summer	47.900	0.0	1169.1	68
120 min Summer	28.200	0.0	1355.1	128
180 min Summer	20.392	0.0	1441.8	186
240 min Summer	16.100	0.0	1488.3	246
360 min Summer	11.433	0.0	1526.4	366
480 min Summer	8.908	0.0	1530.2	484
600 min Summer	7.323	0.0	1519.1	604
720 min Summer	6.233	0.0	1499.6	724
960 min Summer	4.829	0.0	1453.3	962
1440 min Summer	3.375	0.0	1358.5	1402
2160 min Summer	2.375	0.0	2317.0	1708
2880 min Summer	1.865	0.0	2380.6	2072
4320 min Summer	1.353	0.0	2402.8	2860
5760 min Summer	1.097	0.0	3062.7	3688
7200 min Summer	0.945	0.0	3285.1	4536
8640 min Summer	0.844	0.0	3501.2	5280
10080 min Summer	0.774	0.0	3696.8	6152
15 min Winter	116.400	0.0	608.7	23
30 min Winter	76.400	0.0	764.6	37

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	74.328	0.328	9.7	1585.9	O K
120 min Winter	74.380	0.380	9.7	1849.4	O K
180 min Winter	74.408	0.408	9.7	1987.6	O K
240 min Winter	74.425	0.425	9.7	2073.3	O K
360 min Winter	74.444	0.444	9.7	2169.3	O K
480 min Winter	74.452	0.452	9.7	2213.5	O K
600 min Winter	74.456	0.456	9.7	2234.4	O K
720 min Winter	74.458	0.458	9.7	2241.8	O K
960 min Winter	74.456	0.456	9.7	2234.3	O K
1440 min Winter	74.446	0.446	9.7	2179.7	O K
2160 min Winter	74.423	0.423	9.7	2066.2	O K
2880 min Winter	74.406	0.406	9.7	1978.2	O K
4320 min Winter	74.380	0.380	9.7	1849.8	O K
5760 min Winter	74.359	0.359	9.7	1739.9	O K
7200 min Winter	74.340	0.340	9.7	1648.7	O K
8640 min Winter	74.325	0.325	9.7	1571.5	O K
10080 min Winter	74.312	0.312	9.7	1507.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	47.900	0.0	1300.8	66
120 min Winter	28.200	0.0	1481.6	126
180 min Winter	20.392	0.0	1550.0	184
240 min Winter	16.100	0.0	1574.4	242
360 min Winter	11.433	0.0	1571.1	360
480 min Winter	8.908	0.0	1547.8	478
600 min Winter	7.323	0.0	1524.1	594
720 min Winter	6.233	0.0	1500.8	710
960 min Winter	4.829	0.0	1455.5	942
1440 min Winter	3.375	0.0	1368.9	1388
2160 min Winter	2.375	0.0	2563.0	1996
2880 min Winter	1.865	0.0	2611.3	2244
4320 min Winter	1.353	0.0	2537.0	3156
5760 min Winter	1.097	0.0	3433.2	4032
7200 min Winter	0.945	0.0	3681.4	4896
8640 min Winter	0.844	0.0	3923.4	5712
10080 min Winter	0.774	0.0	4145.1	6560

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 386300 285500 SO 86300 85500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
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)	Time (mins) From:	To:	Area (ha)
0	4	2.000	4	8	2.000

Model Details

Storage is Online Cover Level (m) 75.000

Tank or Pond Structure

Invert Level (m) 74.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	4700.0	1.000	5580.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0148-9700-0700-9700
Design Head (m)	0.700
Design Flow (l/s)	9.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	148
Invert Level (m)	74.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	9.7
Flush-Flo™	0.245	9.7
Kick-Flo®	0.513	8.4
Mean Flow over Head Range	-	8.1

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	5.3	1.200	12.5	3.000	19.3	7.000	29.1
0.200	9.6	1.400	13.4	3.500	20.8	7.500	29.9
0.300	9.6	1.600	14.3	4.000	22.2	8.000	30.9
0.400	9.3	1.800	15.2	4.500	23.5	8.500	31.9
0.500	8.6	2.000	15.9	5.000	24.7	9.000	32.8
0.600	9.0	2.200	16.7	5.500	25.9	9.500	33.7
0.800	10.3	2.400	17.4	6.000	27.0		
1.000	11.5	2.600	18.1	6.500	28.0		

Appendix B.3

1 IN 100 YEAR + CLIMATE CHANGE

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	83.237	0.237	4.9	613.2	O K
30 min Summer	83.308	0.308	4.9	803.4	O K
60 min Summer	83.380	0.380	4.9	1003.3	O K
120 min Summer	83.441	0.441	4.9	1171.9	O K
180 min Summer	83.472	0.472	4.9	1261.6	O K
240 min Summer	83.492	0.492	4.9	1318.5	O K
360 min Summer	83.515	0.515	4.9	1384.2	O K
480 min Summer	83.526	0.526	4.9	1416.9	O K
600 min Summer	83.533	0.533	4.9	1434.8	O K
720 min Summer	83.536	0.536	4.9	1444.1	O K
960 min Summer	83.537	0.537	4.9	1448.7	O K
1440 min Summer	83.532	0.532	4.9	1432.7	O K
2160 min Summer	83.516	0.516	4.9	1386.6	O K
2880 min Summer	83.500	0.500	4.9	1339.5	O K
4320 min Summer	83.480	0.480	4.9	1284.8	O K
5760 min Summer	83.469	0.469	4.9	1252.4	O K
7200 min Summer	83.463	0.463	4.9	1236.2	O K
8640 min Summer	83.461	0.461	4.9	1230.0	O K
10080 min Summer	83.462	0.462	4.9	1232.4	O K
15 min Winter	83.265	0.265	4.9	687.2	O K
30 min Winter	83.343	0.343	4.9	900.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	162.960	0.0	394.2	23
30 min Summer	106.960	0.0	416.3	38
60 min Summer	67.060	0.0	800.5	68
120 min Summer	39.480	0.0	812.1	128
180 min Summer	28.549	0.0	795.6	188
240 min Summer	22.540	0.0	779.5	246
360 min Summer	16.007	0.0	757.4	366
480 min Summer	12.471	0.0	742.0	486
600 min Summer	10.252	0.0	729.3	606
720 min Summer	8.727	0.0	717.9	726
960 min Summer	6.761	0.0	697.0	964
1440 min Summer	4.725	0.0	659.1	1442
2160 min Summer	3.324	0.0	1429.9	2160
2880 min Summer	2.610	0.0	1367.6	2512
4320 min Summer	1.895	0.0	1248.8	3248
5760 min Summer	1.536	0.0	2177.9	4040
7200 min Summer	1.322	0.0	2325.3	4896
8640 min Summer	1.182	0.0	2445.4	5712
10080 min Summer	1.083	0.0	2451.7	6560
15 min Winter	162.960	0.0	412.7	23
30 min Winter	106.960	0.0	414.9	37

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	83.424	0.424	4.9	1124.8	O K
120 min Winter	83.491	0.491	4.9	1315.3	O K
180 min Winter	83.526	0.526	4.9	1416.9	O K
240 min Winter	83.549	0.549	4.9	1481.2	O K
360 min Winter	83.574	0.574	4.9	1556.1	O K
480 min Winter	83.587	0.587	4.9	1594.3	O K
600 min Winter	83.595	0.595	4.9	1616.0	O K
720 min Winter	83.599	0.599	4.9	1628.3	O K
960 min Winter	83.602	0.602	4.9	1637.0	O K
1440 min Winter	83.598	0.598	4.9	1626.8	O K
2160 min Winter	83.585	0.585	4.9	1587.8	O K
2880 min Winter	83.569	0.569	4.9	1541.4	O K
4320 min Winter	83.544	0.544	4.9	1468.6	O K
5760 min Winter	83.530	0.530	4.9	1426.5	O K
7200 min Winter	83.519	0.519	4.9	1396.5	O K
8640 min Winter	83.512	0.512	4.9	1374.8	O K
10080 min Winter	83.507	0.507	4.9	1361.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	67.060	0.0	820.5	68
120 min Winter	39.480	0.0	792.6	126
180 min Winter	28.549	0.0	771.3	184
240 min Winter	22.540	0.0	758.8	244
360 min Winter	16.007	0.0	743.4	362
480 min Winter	12.471	0.0	732.8	480
600 min Winter	10.252	0.0	723.8	596
720 min Winter	8.727	0.0	715.6	714
960 min Winter	6.761	0.0	700.7	948
1440 min Winter	4.725	0.0	675.1	1410
2160 min Winter	3.324	0.0	1435.0	2080
2880 min Winter	2.610	0.0	1379.1	2736
4320 min Winter	1.895	0.0	1273.7	3424
5760 min Winter	1.536	0.0	2426.2	4376
7200 min Winter	1.322	0.0	2566.0	5328
8640 min Winter	1.182	0.0	2601.7	6232
10080 min Winter	1.083	0.0	2496.7	7168

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 386300 285500 SO 86300 85500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 2.020

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	1.010	4	8	1.010

Model Details

Storage is Online Cover Level (m) 84.000

Tank or Pond Structure

Invert Level (m) 83.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2500.0	1.000	3260.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0109-4900-0700-4900
Design Head (m)	0.700
Design Flow (l/s)	4.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	109
Invert Level (m)	83.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	4.9
Flush-Flo™	0.214	4.9
Kick-Flo®	0.482	4.1
Mean Flow over Head Range	-	4.2

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.7	1.200	6.3	3.000	9.7	7.000	14.5
0.200	4.9	1.400	6.8	3.500	10.4	7.500	15.0
0.300	4.8	1.600	7.2	4.000	11.1	8.000	15.5
0.400	4.6	1.800	7.6	4.500	11.7	8.500	15.9
0.500	4.2	2.000	8.0	5.000	12.4	9.000	16.4
0.600	4.6	2.200	8.4	5.500	12.9	9.500	16.9
0.800	5.2	2.400	8.7	6.000	13.5		
1.000	5.8	2.600	9.1	6.500	14.0		

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	88.301	0.301	2.0	157.1	O K
30 min Summer	88.384	0.384	2.0	205.5	O K
60 min Summer	88.466	0.466	2.0	256.1	O K
120 min Summer	88.531	0.531	2.0	297.2	O K
180 min Summer	88.562	0.562	2.0	317.9	O K
240 min Summer	88.580	0.580	2.0	330.0	O K
360 min Summer	88.598	0.598	2.0	341.8	O K
480 min Summer	88.603	0.603	2.0	345.3	O K
600 min Summer	88.603	0.603	2.0	345.2	O K
720 min Summer	88.600	0.600	2.0	342.9	O K
960 min Summer	88.588	0.588	2.0	335.1	O K
1440 min Summer	88.557	0.557	2.0	314.7	O K
2160 min Summer	88.521	0.521	2.0	290.6	O K
2880 min Summer	88.492	0.492	2.0	272.5	O K
4320 min Summer	88.450	0.450	2.0	245.8	O K
5760 min Summer	88.415	0.415	2.0	224.5	O K
7200 min Summer	88.390	0.390	2.0	209.3	O K
8640 min Summer	88.371	0.371	2.0	197.7	O K
10080 min Summer	88.356	0.356	2.0	188.9	O K
15 min Winter	88.334	0.334	2.0	176.1	O K
30 min Winter	88.425	0.425	2.0	230.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	162.960	0.0	142.8	23
30 min Summer	106.960	0.0	166.3	38
60 min Summer	67.060	0.0	253.1	68
120 min Summer	39.480	0.0	292.6	126
180 min Summer	28.549	0.0	308.9	186
240 min Summer	22.540	0.0	313.7	246
360 min Summer	16.007	0.0	312.1	366
480 min Summer	12.471	0.0	309.0	484
600 min Summer	10.252	0.0	305.7	604
720 min Summer	8.727	0.0	302.3	724
960 min Summer	6.761	0.0	295.6	962
1440 min Summer	4.725	0.0	281.8	1346
2160 min Summer	3.324	0.0	461.3	1688
2880 min Summer	2.610	0.0	481.3	2076
4320 min Summer	1.895	0.0	512.0	2900
5760 min Summer	1.536	0.0	573.5	3688
7200 min Summer	1.322	0.0	617.1	4472
8640 min Summer	1.182	0.0	661.2	5272
10080 min Summer	1.083	0.0	705.4	6048
15 min Winter	162.960	0.0	155.9	23
30 min Winter	106.960	0.0	165.5	37

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	88.516	0.516	2.0	287.4	O K
120 min Winter	88.586	0.586	2.0	333.9	O K
180 min Winter	88.621	0.621	2.0	357.5	O K
240 min Winter	88.642	0.642	2.0	371.6	O K
360 min Winter	88.662	0.662	2.0	386.0	O K
480 min Winter	88.669	0.669	2.0	390.9	O K
600 min Winter	88.671	0.671	2.0	391.8	O K
720 min Winter	88.669	0.669	2.0	390.3	O K
960 min Winter	88.659	0.659	2.0	383.6	O K
1440 min Winter	88.631	0.631	2.0	364.4	O K
2160 min Winter	88.587	0.587	2.0	334.2	O K
2880 min Winter	88.553	0.553	2.0	311.9	O K
4320 min Winter	88.498	0.498	2.0	276.0	O K
5760 min Winter	88.447	0.447	2.0	244.1	O K
7200 min Winter	88.399	0.399	2.0	214.8	O K
8640 min Winter	88.362	0.362	2.0	192.2	O K
10080 min Winter	88.331	0.331	2.0	174.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	67.060	0.0	280.8	66
120 min Winter	39.480	0.0	314.1	126
180 min Winter	28.549	0.0	316.5	184
240 min Winter	22.540	0.0	315.0	242
360 min Winter	16.007	0.0	311.9	360
480 min Winter	12.471	0.0	308.9	476
600 min Winter	10.252	0.0	306.1	594
720 min Winter	8.727	0.0	303.3	708
960 min Winter	6.761	0.0	297.8	936
1440 min Winter	4.725	0.0	286.8	1374
2160 min Winter	3.324	0.0	515.2	1772
2880 min Winter	2.610	0.0	535.7	2200
4320 min Winter	1.895	0.0	536.1	3152
5760 min Winter	1.536	0.0	642.3	4040
7200 min Winter	1.322	0.0	691.2	4832
8640 min Winter	1.182	0.0	740.8	5624
10080 min Winter	1.083	0.0	790.8	6448

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 386300 285500 SO 86300 85500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.520

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.260	4	8	0.260

Model Details

Storage is Online Cover Level (m) 89.000

Tank or Pond Structure

Invert Level (m) 88.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	474.0	1.000	830.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0071-2000-0700-2000
Design Head (m)	0.700
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	71
Invert Level (m)	88.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	2.0
Flush-Flo™	0.207	2.0
Kick-Flo®	0.450	1.6
Mean Flow over Head Range	-	1.7

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	1.8	1.200	2.6	3.000	3.9	7.000	5.8
0.200	2.0	1.400	2.7	3.500	4.2	7.500	6.0
0.300	2.0	1.600	2.9	4.000	4.5	8.000	6.2
0.400	1.8	1.800	3.1	4.500	4.7	8.500	6.4
0.500	1.7	2.000	3.2	5.000	5.0	9.000	6.6
0.600	1.9	2.200	3.4	5.500	5.2	9.500	6.8
0.800	2.1	2.400	3.5	6.000	5.4		
1.000	2.4	2.600	3.7	6.500	5.6		

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	75.241	0.241	4.4	552.5	O K
30 min Summer	75.312	0.312	4.4	723.8	O K
60 min Summer	75.385	0.385	4.4	903.9	O K
120 min Summer	75.445	0.445	4.4	1055.7	O K
180 min Summer	75.477	0.477	4.4	1136.5	O K
240 min Summer	75.496	0.496	4.4	1187.7	O K
360 min Summer	75.519	0.519	4.4	1246.6	O K
480 min Summer	75.530	0.530	4.4	1275.9	O K
600 min Summer	75.536	0.536	4.4	1291.7	O K
720 min Summer	75.539	0.539	4.4	1300.0	O K
960 min Summer	75.541	0.541	4.4	1303.7	O K
1440 min Summer	75.535	0.535	4.4	1288.6	O K
2160 min Summer	75.519	0.519	4.4	1246.2	O K
2880 min Summer	75.502	0.502	4.4	1203.0	O K
4320 min Summer	75.483	0.483	4.4	1153.5	O K
5760 min Summer	75.471	0.471	4.4	1123.2	O K
7200 min Summer	75.465	0.465	4.4	1108.0	O K
8640 min Summer	75.463	0.463	4.4	1102.0	O K
10080 min Summer	75.464	0.464	4.4	1104.2	O K
15 min Winter	75.269	0.269	4.4	619.1	O K
30 min Winter	75.348	0.348	4.4	811.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	162.960	0.0	358.1	23
30 min Summer	106.960	0.0	373.5	38
60 min Summer	67.060	0.0	723.2	68
120 min Summer	39.480	0.0	727.7	128
180 min Summer	28.549	0.0	711.6	188
240 min Summer	22.540	0.0	697.1	246
360 min Summer	16.007	0.0	678.0	366
480 min Summer	12.471	0.0	664.8	486
600 min Summer	10.252	0.0	653.8	606
720 min Summer	8.727	0.0	644.0	726
960 min Summer	6.761	0.0	626.0	964
1440 min Summer	4.725	0.0	593.4	1442
2160 min Summer	3.324	0.0	1285.8	2160
2880 min Summer	2.610	0.0	1230.8	2512
4320 min Summer	1.895	0.0	1122.7	3288
5760 min Summer	1.536	0.0	1966.7	4040
7200 min Summer	1.322	0.0	2100.5	4896
8640 min Summer	1.182	0.0	2209.2	5712
10080 min Summer	1.083	0.0	2206.9	6560
15 min Winter	162.960	0.0	371.9	23
30 min Winter	106.960	0.0	372.0	37

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	75.428	0.428	4.4	1013.4	O K
120 min Winter	75.495	0.495	4.4	1185.0	O K
180 min Winter	75.530	0.530	4.4	1276.4	O K
240 min Winter	75.552	0.552	4.4	1334.2	O K
360 min Winter	75.578	0.578	4.4	1401.5	O K
480 min Winter	75.591	0.591	4.4	1435.8	O K
600 min Winter	75.598	0.598	4.4	1455.2	O K
720 min Winter	75.602	0.602	4.4	1466.1	O K
960 min Winter	75.605	0.605	4.4	1473.6	O K
1440 min Winter	75.601	0.601	4.4	1463.8	O K
2160 min Winter	75.588	0.588	4.4	1428.0	O K
2880 min Winter	75.572	0.572	4.4	1385.5	O K
4320 min Winter	75.547	0.547	4.4	1318.7	O K
5760 min Winter	75.532	0.532	4.4	1280.1	O K
7200 min Winter	75.521	0.521	4.4	1252.7	O K
8640 min Winter	75.514	0.514	4.4	1233.1	O K
10080 min Winter	75.509	0.509	4.4	1220.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	67.060	0.0	735.6	68
120 min Winter	39.480	0.0	708.6	126
180 min Winter	28.549	0.0	690.2	184
240 min Winter	22.540	0.0	679.5	244
360 min Winter	16.007	0.0	666.3	362
480 min Winter	12.471	0.0	657.2	480
600 min Winter	10.252	0.0	649.6	596
720 min Winter	8.727	0.0	642.7	714
960 min Winter	6.761	0.0	630.3	948
1440 min Winter	4.725	0.0	609.2	1410
2160 min Winter	3.324	0.0	1290.2	2080
2880 min Winter	2.610	0.0	1241.2	2736
4320 min Winter	1.895	0.0	1149.0	3456
5760 min Winter	1.536	0.0	2191.5	4376
7200 min Winter	1.322	0.0	2318.2	5328
8640 min Winter	1.182	0.0	2342.9	6232
10080 min Winter	1.083	0.0	2247.4	7168

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 386300 285500 SO 86300 85500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.820

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.910	4	8	0.910

Model Details

Storage is Online Cover Level (m) 76.000

Tank or Pond Structure

Invert Level (m) 75.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2200.0	1.000	3020.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0104-4400-0700-4400
Design Head (m)	0.700
Design Flow (l/s)	4.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	104
Invert Level (m)	75.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	4.4
Flush-Flo™	0.214	4.4
Kick-Flo®	0.480	3.7
Mean Flow over Head Range	-	3.8

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	3.5	1.200	5.6	3.000	8.7	7.000	13.0
0.200	4.4	1.400	6.1	3.500	9.3	7.500	13.4
0.300	4.3	1.600	6.5	4.000	9.9	8.000	13.8
0.400	4.1	1.800	6.8	4.500	10.5	8.500	14.3
0.500	3.8	2.000	7.2	5.000	11.1	9.000	14.7
0.600	4.1	2.200	7.5	5.500	11.6	9.500	15.1
0.800	4.7	2.400	7.8	6.000	12.1		
1.000	5.2	2.600	8.1	6.500	12.5		

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	74.741	0.241	7.4	929.2	O K
30 min Summer	74.813	0.313	7.4	1217.3	O K
60 min Summer	74.888	0.388	7.4	1520.4	O K
120 min Summer	74.950	0.450	7.4	1776.2	O K
180 min Summer	74.983	0.483	7.4	1912.4	O K
240 min Summer	75.003	0.503	7.4	1999.0	O K
360 min Summer	75.027	0.527	7.4	2099.6	O K
480 min Summer	75.039	0.539	7.4	2150.1	O K
600 min Summer	75.046	0.546	7.4	2178.2	O K
720 min Summer	75.050	0.550	7.4	2193.3	O K
960 min Summer	75.052	0.552	7.4	2202.0	O K
1440 min Summer	75.047	0.547	7.4	2181.0	O K
2160 min Summer	75.031	0.531	7.4	2115.5	O K
2880 min Summer	75.015	0.515	7.4	2049.0	O K
4320 min Summer	74.997	0.497	7.4	1974.1	O K
5760 min Summer	74.987	0.487	7.4	1931.9	O K
7200 min Summer	74.982	0.482	7.4	1911.8	O K
8640 min Summer	74.981	0.481	7.4	1905.4	O K
10080 min Summer	74.982	0.482	7.4	1911.0	O K
15 min Winter	74.769	0.269	7.4	1041.2	O K
30 min Winter	74.849	0.349	7.4	1364.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	162.960	0.0	576.2	23
30 min Summer	106.960	0.0	628.8	38
60 min Summer	67.060	0.0	1190.8	68
120 min Summer	39.480	0.0	1230.8	128
180 min Summer	28.549	0.0	1209.8	188
240 min Summer	22.540	0.0	1187.5	246
360 min Summer	16.007	0.0	1153.7	366
480 min Summer	12.471	0.0	1129.5	486
600 min Summer	10.252	0.0	1109.2	606
720 min Summer	8.727	0.0	1090.8	726
960 min Summer	6.761	0.0	1057.0	964
1440 min Summer	4.725	0.0	995.0	1442
2160 min Summer	3.324	0.0	2156.9	2160
2880 min Summer	2.610	0.0	2058.9	2508
4320 min Summer	1.895	0.0	1873.5	3244
5760 min Summer	1.536	0.0	3275.1	4032
7200 min Summer	1.322	0.0	3491.0	4896
8640 min Summer	1.182	0.0	3662.3	5704
10080 min Summer	1.083	0.0	3670.3	6552
15 min Winter	162.960	0.0	613.1	23
30 min Winter	106.960	0.0	628.1	37

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	74.932	0.432	7.4	1704.4	O K
120 min Winter	75.002	0.502	7.4	1993.3	O K
180 min Winter	75.039	0.539	7.4	2147.6	O K
240 min Winter	75.062	0.562	7.4	2245.5	O K
360 min Winter	75.089	0.589	7.4	2359.8	O K
480 min Winter	75.103	0.603	7.4	2418.5	O K
600 min Winter	75.110	0.610	7.4	2452.2	O K
720 min Winter	75.115	0.615	7.4	2471.5	O K
960 min Winter	75.118	0.618	7.4	2486.2	O K
1440 min Winter	75.115	0.615	7.4	2473.5	O K
2160 min Winter	75.103	0.603	7.4	2418.4	O K
2880 min Winter	75.087	0.587	7.4	2351.6	O K
4320 min Winter	75.063	0.563	7.4	2249.6	O K
5760 min Winter	75.049	0.549	7.4	2191.4	O K
7200 min Winter	75.039	0.539	7.4	2150.1	O K
8640 min Winter	75.032	0.532	7.4	2120.7	O K
10080 min Winter	75.028	0.528	7.4	2102.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	67.060	0.0	1238.8	68
120 min Winter	39.480	0.0	1208.3	126
180 min Winter	28.549	0.0	1176.9	184
240 min Winter	22.540	0.0	1158.0	244
360 min Winter	16.007	0.0	1134.3	362
480 min Winter	12.471	0.0	1117.3	480
600 min Winter	10.252	0.0	1102.7	596
720 min Winter	8.727	0.0	1089.2	714
960 min Winter	6.761	0.0	1064.2	948
1440 min Winter	4.725	0.0	1019.5	1410
2160 min Winter	3.324	0.0	2171.7	2080
2880 min Winter	2.610	0.0	2082.7	2716
4320 min Winter	1.895	0.0	1915.0	3420
5760 min Winter	1.536	0.0	3646.8	4376
7200 min Winter	1.322	0.0	3850.3	5328
8640 min Winter	1.182	0.0	3909.5	6224
10080 min Winter	1.083	0.0	3752.8	7160

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 386300 285500 SO 86300 85500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 3.060

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	1.530	4	8	1.530

Model Details

Storage is Online Cover Level (m) 75.500

Tank or Pond Structure

Invert Level (m) 74.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	3760.0	1.000	4630.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0131-7400-0700-7400
Design Head (m)	0.700
Design Flow (l/s)	7.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	131
Invert Level (m)	74.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	7.4
Flush-Flo™	0.230	7.4
Kick-Flo®	0.501	6.3
Mean Flow over Head Range	-	6.2

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	4.7	1.200	9.5	3.000	14.7	7.000	22.1
0.200	7.4	1.400	10.2	3.500	15.8	7.500	22.8
0.300	7.3	1.600	10.9	4.000	16.9	8.000	23.5
0.400	7.1	1.800	11.5	4.500	17.9	8.500	24.2
0.500	6.4	2.000	12.1	5.000	18.8	9.000	24.9
0.600	6.9	2.200	12.7	5.500	19.7	9.500	25.6
0.800	7.9	2.400	13.2	6.000	20.5		
1.000	8.7	2.600	13.7	6.500	21.3		

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	103.250	0.250	3.0	376.3	O K
30 min Summer	103.323	0.323	3.0	493.0	O K
60 min Summer	103.398	0.398	3.0	615.6	O K
120 min Summer	103.460	0.460	3.0	719.0	O K
180 min Summer	103.492	0.492	3.0	773.9	O K
240 min Summer	103.512	0.512	3.0	808.4	O K
360 min Summer	103.535	0.535	3.0	847.8	O K
480 min Summer	103.546	0.546	3.0	867.1	O K
600 min Summer	103.552	0.552	3.0	877.3	O K
720 min Summer	103.555	0.555	3.0	882.3	O K
960 min Summer	103.556	0.556	3.0	883.7	O K
1440 min Summer	103.549	0.549	3.0	871.4	O K
2160 min Summer	103.531	0.531	3.0	840.0	O K
2880 min Summer	103.513	0.513	3.0	809.2	O K
4320 min Summer	103.492	0.492	3.0	774.0	O K
5760 min Summer	103.480	0.480	3.0	753.8	O K
7200 min Summer	103.474	0.474	3.0	743.3	O K
8640 min Summer	103.472	0.472	3.0	739.2	O K
10080 min Summer	103.473	0.473	3.0	740.4	O K
15 min Winter	103.279	0.279	3.0	421.7	O K
30 min Winter	103.360	0.360	3.0	552.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	162.960	0.0	249.7	23
30 min Summer	106.960	0.0	254.7	38
60 min Summer	67.060	0.0	497.8	68
120 min Summer	39.480	0.0	490.2	128
180 min Summer	28.549	0.0	476.5	188
240 min Summer	22.540	0.0	467.7	246
360 min Summer	16.007	0.0	456.5	366
480 min Summer	12.471	0.0	448.8	486
600 min Summer	10.252	0.0	442.3	606
720 min Summer	8.727	0.0	436.6	726
960 min Summer	6.761	0.0	426.1	964
1440 min Summer	4.725	0.0	407.2	1442
2160 min Summer	3.324	0.0	879.3	2160
2880 min Summer	2.610	0.0	843.4	2508
4320 min Summer	1.895	0.0	769.6	3248
5760 min Summer	1.536	0.0	1347.8	4088
7200 min Summer	1.322	0.0	1440.8	4904
8640 min Summer	1.182	0.0	1515.5	5792
10080 min Summer	1.083	0.0	1499.4	6648
15 min Winter	162.960	0.0	254.8	23
30 min Winter	106.960	0.0	252.9	37

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	103.443	0.443	3.0	690.3	O K
120 min Winter	103.511	0.511	3.0	807.0	O K
180 min Winter	103.547	0.547	3.0	868.9	O K
240 min Winter	103.570	0.570	3.0	908.0	O K
360 min Winter	103.595	0.595	3.0	953.3	O K
480 min Winter	103.608	0.608	3.0	976.1	O K
600 min Winter	103.615	0.615	3.0	988.8	O K
720 min Winter	103.619	0.619	3.0	995.7	O K
960 min Winter	103.622	0.622	3.0	999.9	O K
1440 min Winter	103.617	0.617	3.0	991.4	O K
2160 min Winter	103.602	0.602	3.0	964.5	O K
2880 min Winter	103.584	0.584	3.0	933.5	O K
4320 min Winter	103.557	0.557	3.0	885.9	O K
5760 min Winter	103.541	0.541	3.0	857.9	O K
7200 min Winter	103.530	0.530	3.0	838.2	O K
8640 min Winter	103.522	0.522	3.0	824.4	O K
10080 min Winter	103.517	0.517	3.0	815.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	67.060	0.0	497.7	68
120 min Winter	39.480	0.0	475.0	126
180 min Winter	28.549	0.0	464.2	184
240 min Winter	22.540	0.0	458.2	244
360 min Winter	16.007	0.0	451.1	362
480 min Winter	12.471	0.0	446.5	480
600 min Winter	10.252	0.0	442.7	596
720 min Winter	8.727	0.0	439.3	714
960 min Winter	6.761	0.0	433.6	948
1440 min Winter	4.725	0.0	424.0	1410
2160 min Winter	3.324	0.0	883.0	2080
2880 min Winter	2.610	0.0	851.7	2716
4320 min Winter	1.895	0.0	793.1	3420
5760 min Winter	1.536	0.0	1503.9	4376
7200 min Winter	1.322	0.0	1594.4	5328
8640 min Winter	1.182	0.0	1605.9	6232
10080 min Winter	1.083	0.0	1538.2	7168

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 386300 285500 SO 86300 85500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.240

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.620	4	8	0.620

Model Details

Storage is Online Cover Level (m) 104.000

Tank or Pond Structure

Invert Level (m) 103.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1440.0	1.000	2010.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0087-3000-0700-3000
Design Head (m)	0.700
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	87
Invert Level (m)	103.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	3.0
Flush-Flo™	0.210	3.0
Kick-Flo®	0.465	2.5
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	2.6	1.200	3.8	3.000	5.9	7.000	8.8
0.200	3.0	1.400	4.1	3.500	6.3	7.500	9.1
0.300	2.9	1.600	4.4	4.000	6.7	8.000	9.4
0.400	2.8	1.800	4.6	4.500	7.1	8.500	9.7
0.500	2.6	2.000	4.9	5.000	7.5	9.000	9.9
0.600	2.8	2.200	5.1	5.500	7.8	9.500	10.2
0.800	3.2	2.400	5.3	6.000	8.2		
1.000	3.5	2.600	5.5	6.500	8.5		

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	97.198	0.198	2.0	99.2	O K
30 min Summer	97.254	0.254	2.0	129.5	O K
60 min Summer	97.310	0.310	2.0	160.6	O K
120 min Summer	97.352	0.352	2.0	185.1	O K
180 min Summer	97.372	0.372	2.0	196.6	O K
240 min Summer	97.382	0.382	2.0	202.6	O K
360 min Summer	97.390	0.390	2.0	207.1	O K
480 min Summer	97.388	0.388	2.0	206.1	O K
600 min Summer	97.383	0.383	2.0	202.8	O K
720 min Summer	97.375	0.375	2.0	198.0	O K
960 min Summer	97.358	0.358	2.0	188.1	O K
1440 min Summer	97.331	0.331	2.0	172.5	O K
2160 min Summer	97.298	0.298	2.0	154.0	O K
2880 min Summer	97.271	0.271	2.0	139.0	O K
4320 min Summer	97.231	0.231	2.0	116.6	O K
5760 min Summer	97.200	0.200	2.0	100.3	O K
7200 min Summer	97.178	0.178	2.0	88.6	O K
8640 min Summer	97.161	0.161	2.0	79.8	O K
10080 min Summer	97.148	0.148	2.0	73.1	O K
15 min Winter	97.221	0.221	2.0	111.2	O K
30 min Winter	97.283	0.283	2.0	145.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	162.960	0.0	92.5	23
30 min Summer	106.960	0.0	120.9	37
60 min Summer	67.060	0.0	161.6	66
120 min Summer	39.480	0.0	190.3	126
180 min Summer	28.549	0.0	206.3	186
240 min Summer	22.540	0.0	216.9	246
360 min Summer	16.007	0.0	230.6	364
480 min Summer	12.471	0.0	239.1	482
600 min Summer	10.252	0.0	245.2	602
720 min Summer	8.727	0.0	249.8	720
960 min Summer	6.761	0.0	256.8	818
1440 min Summer	4.725	0.0	265.0	1042
2160 min Summer	3.324	0.0	293.6	1432
2880 min Summer	2.610	0.0	307.1	1824
4320 min Summer	1.895	0.0	333.2	2600
5760 min Summer	1.536	0.0	363.6	3352
7200 min Summer	1.322	0.0	391.1	4104
8640 min Summer	1.182	0.0	418.9	4840
10080 min Summer	1.083	0.0	446.6	5544
15 min Winter	162.960	0.0	103.6	22
30 min Winter	106.960	0.0	134.4	37

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	97.345	0.345	2.0	180.5	O K
120 min Winter	97.392	0.392	2.0	208.4	O K
180 min Winter	97.415	0.415	2.0	221.9	O K
240 min Winter	97.427	0.427	2.0	229.4	O K
360 min Winter	97.437	0.437	2.0	235.7	O K
480 min Winter	97.438	0.438	2.0	236.0	O K
600 min Winter	97.434	0.434	2.0	233.6	O K
720 min Winter	97.427	0.427	2.0	229.5	O K
960 min Winter	97.410	0.410	2.0	219.0	O K
1440 min Winter	97.373	0.373	2.0	197.4	O K
2160 min Winter	97.330	0.330	2.0	172.1	O K
2880 min Winter	97.291	0.291	2.0	150.0	O K
4320 min Winter	97.229	0.229	2.0	115.6	O K
5760 min Winter	97.183	0.183	2.0	90.9	O K
7200 min Winter	97.150	0.150	2.0	73.7	O K
8640 min Winter	97.126	0.126	1.9	61.7	O K
10080 min Winter	97.110	0.110	1.9	53.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	67.060	0.0	181.1	66
120 min Winter	39.480	0.0	213.0	124
180 min Winter	28.549	0.0	230.6	182
240 min Winter	22.540	0.0	242.2	242
360 min Winter	16.007	0.0	257.0	358
480 min Winter	12.471	0.0	265.9	474
600 min Winter	10.252	0.0	272.2	588
720 min Winter	8.727	0.0	276.8	700
960 min Winter	6.761	0.0	283.2	916
1440 min Winter	4.725	0.0	287.6	1130
2160 min Winter	3.324	0.0	328.9	1564
2880 min Winter	2.610	0.0	344.1	1992
4320 min Winter	1.895	0.0	373.5	2808
5760 min Winter	1.536	0.0	407.4	3528
7200 min Winter	1.322	0.0	438.3	4256
8640 min Winter	1.182	0.0	469.5	4928
10080 min Winter	1.083	0.0	500.8	5640

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 386300 285500 SO 86300 85500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.330

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.165	4	8	0.165

Model Details

Storage is Online Cover Level (m) 98.000

Tank or Pond Structure

Invert Level (m) 97.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	470.0	1.000	820.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0071-2000-0700-2000
Design Head (m)	0.700
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	71
Invert Level (m)	97.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	2.0
Flush-Flo™	0.207	2.0
Kick-Flo®	0.450	1.6
Mean Flow over Head Range	-	1.7

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	1.8	1.200	2.6	3.000	3.9	7.000	5.8
0.200	2.0	1.400	2.7	3.500	4.2	7.500	6.0
0.300	2.0	1.600	2.9	4.000	4.5	8.000	6.2
0.400	1.8	1.800	3.1	4.500	4.7	8.500	6.4
0.500	1.7	2.000	3.2	5.000	5.0	9.000	6.6
0.600	1.9	2.200	3.4	5.500	5.2	9.500	6.8
0.800	2.1	2.400	3.5	6.000	5.4		
1.000	2.4	2.600	3.7	6.500	5.6		

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	74.253	0.253	9.7	1214.7	O K
30 min Summer	74.329	0.329	9.7	1591.4	O K
60 min Summer	74.408	0.408	9.7	1987.7	O K
120 min Summer	74.474	0.474	9.7	2322.4	O K
180 min Summer	74.509	0.509	9.7	2501.0	O K
240 min Summer	74.531	0.531	9.7	2614.4	O K
360 min Summer	74.556	0.556	9.7	2745.7	O K
480 min Summer	74.569	0.569	9.7	2811.6	O K
600 min Summer	74.576	0.576	9.7	2848.2	O K
720 min Summer	74.580	0.580	9.7	2867.8	O K
960 min Summer	74.582	0.582	9.7	2879.2	O K
1440 min Summer	74.576	0.576	9.7	2851.6	O K
2160 min Summer	74.560	0.560	9.7	2765.7	O K
2880 min Summer	74.544	0.544	9.7	2683.9	O K
4320 min Summer	74.527	0.527	9.7	2597.1	O K
5760 min Summer	74.518	0.518	9.7	2549.6	O K
7200 min Summer	74.514	0.514	9.7	2526.8	O K
8640 min Summer	74.512	0.512	9.7	2520.3	O K
10080 min Summer	74.514	0.514	9.7	2529.4	O K
15 min Winter	74.282	0.282	9.7	1361.1	O K
30 min Winter	74.367	0.367	9.7	1783.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	162.960	0.0	741.9	23
30 min Summer	106.960	0.0	822.0	38
60 min Summer	67.060	0.0	1545.1	68
120 min Summer	39.480	0.0	1607.7	128
180 min Summer	28.549	0.0	1578.0	188
240 min Summer	22.540	0.0	1549.1	246
360 min Summer	16.007	0.0	1508.8	366
480 min Summer	12.471	0.0	1479.1	486
600 min Summer	10.252	0.0	1453.5	606
720 min Summer	8.727	0.0	1430.0	724
960 min Summer	6.761	0.0	1386.0	964
1440 min Summer	4.725	0.0	1304.4	1442
2160 min Summer	3.324	0.0	2821.4	2160
2880 min Summer	2.610	0.0	2690.9	2480
4320 min Summer	1.895	0.0	2426.2	3240
5760 min Summer	1.536	0.0	4265.6	4040
7200 min Summer	1.322	0.0	4542.2	4896
8640 min Summer	1.182	0.0	4756.1	5712
10080 min Summer	1.083	0.0	4749.1	6560
15 min Winter	162.960	0.0	794.7	23
30 min Winter	106.960	0.0	821.7	37

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	74.455	0.455	9.7	2228.3	O K
120 min Winter	74.529	0.529	9.7	2606.2	O K
180 min Winter	74.568	0.568	9.7	2807.7	O K
240 min Winter	74.593	0.593	9.7	2935.5	O K
360 min Winter	74.621	0.621	9.7	3084.7	O K
480 min Winter	74.636	0.636	9.7	3161.2	O K
600 min Winter	74.644	0.644	9.7	3205.1	O K
720 min Winter	74.649	0.649	9.7	3230.2	O K
960 min Winter	74.652	0.652	9.7	3249.1	O K
1440 min Winter	74.649	0.649	9.7	3231.8	O K
2160 min Winter	74.635	0.635	9.7	3159.1	O K
2880 min Winter	74.619	0.619	9.7	3071.4	O K
4320 min Winter	74.594	0.594	9.7	2945.3	O K
5760 min Winter	74.581	0.581	9.7	2872.8	O K
7200 min Winter	74.571	0.571	9.7	2821.6	O K
8640 min Winter	74.564	0.564	9.7	2785.1	O K
10080 min Winter	74.559	0.559	9.7	2762.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	67.060	0.0	1615.3	68
120 min Winter	39.480	0.0	1576.9	126
180 min Winter	28.549	0.0	1541.9	184
240 min Winter	22.540	0.0	1520.9	244
360 min Winter	16.007	0.0	1493.8	362
480 min Winter	12.471	0.0	1473.7	480
600 min Winter	10.252	0.0	1455.9	596
720 min Winter	8.727	0.0	1439.1	714
960 min Winter	6.761	0.0	1407.4	946
1440 min Winter	4.725	0.0	1350.3	1404
2160 min Winter	3.324	0.0	2856.1	2076
2880 min Winter	2.610	0.0	2737.9	2712
4320 min Winter	1.895	0.0	2515.2	3412
5760 min Winter	1.536	0.0	4753.9	4328
7200 min Winter	1.322	0.0	5019.3	5264
8640 min Winter	1.182	0.0	5104.9	6224
10080 min Winter	1.083	0.0	4900.8	7160

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 386300 285500 SO 86300 85500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 4.000

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	2.000	4	8	2.000

Model Details

Storage is Online Cover Level (m) 75.000

Tank or Pond Structure

Invert Level (m) 74.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	4700.0	1.000	5580.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0148-9700-0700-9700
Design Head (m)	0.700
Design Flow (l/s)	9.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	148
Invert Level (m)	74.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	9.7
Flush-Flo™	0.245	9.7
Kick-Flo®	0.513	8.4
Mean Flow over Head Range	-	8.1

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	5.3	1.200	12.5	3.000	19.3	7.000	29.1
0.200	9.6	1.400	13.4	3.500	20.8	7.500	29.9
0.300	9.6	1.600	14.3	4.000	22.2	8.000	30.9
0.400	9.3	1.800	15.2	4.500	23.5	8.500	31.9
0.500	8.6	2.000	15.9	5.000	24.7	9.000	32.8
0.600	9.0	2.200	16.7	5.500	25.9	9.500	33.7
0.800	10.3	2.400	17.4	6.000	27.0		
1.000	11.5	2.600	18.1	6.500	28.0		

Appendix B.4

1 IN 100 YEAR + CLIMATE CHANGE & CREEP

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	83.260	0.260	4.9	674.2	O K
30 min Summer	83.337	0.337	4.9	883.5	O K
60 min Summer	83.416	0.416	4.9	1103.8	O K
120 min Summer	83.482	0.482	4.9	1290.4	O K
180 min Summer	83.517	0.517	4.9	1390.0	O K
240 min Summer	83.539	0.539	4.9	1453.1	O K
360 min Summer	83.564	0.564	4.9	1526.4	O K
480 min Summer	83.577	0.577	4.9	1563.6	O K
600 min Summer	83.584	0.584	4.9	1584.6	O K
720 min Summer	83.588	0.588	4.9	1596.3	O K
960 min Summer	83.591	0.591	4.9	1604.1	O K
1440 min Summer	83.587	0.587	4.9	1592.1	O K
2160 min Summer	83.572	0.572	4.9	1549.6	O K
2880 min Summer	83.556	0.556	4.9	1502.4	O K
4320 min Summer	83.539	0.539	4.9	1452.1	O K
5760 min Summer	83.530	0.530	4.9	1427.2	O K
7200 min Summer	83.527	0.527	4.9	1418.7	O K
8640 min Summer	83.528	0.528	4.9	1420.1	O K
10080 min Summer	83.531	0.531	4.9	1429.9	O K
15 min Winter	83.290	0.290	4.9	755.5	O K
30 min Winter	83.376	0.376	4.9	990.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	162.960	0.0	410.4	23
30 min Summer	106.960	0.0	415.3	38
60 min Summer	67.060	0.0	820.1	68
120 min Summer	39.480	0.0	796.6	128
180 min Summer	28.549	0.0	774.1	188
240 min Summer	22.540	0.0	760.6	246
360 min Summer	16.007	0.0	743.7	366
480 min Summer	12.471	0.0	731.9	486
600 min Summer	10.252	0.0	722.0	606
720 min Summer	8.727	0.0	713.0	726
960 min Summer	6.761	0.0	696.3	964
1440 min Summer	4.725	0.0	667.0	1442
2160 min Summer	3.324	0.0	1427.3	2160
2880 min Summer	2.610	0.0	1366.9	2624
4320 min Summer	1.895	0.0	1250.6	3332
5760 min Summer	1.536	0.0	2380.6	4144
7200 min Summer	1.322	0.0	2517.0	4968
8640 min Summer	1.182	0.0	2544.0	5800
10080 min Summer	1.083	0.0	2422.9	6656
15 min Winter	162.960	0.0	417.5	23
30 min Winter	106.960	0.0	411.6	38

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	83.464	0.464	4.9	1237.5	O K
120 min Winter	83.537	0.537	4.9	1447.7	O K
180 min Winter	83.576	0.576	4.9	1559.8	O K
240 min Winter	83.600	0.600	4.9	1631.3	O K
360 min Winter	83.628	0.628	4.9	1715.1	O K
480 min Winter	83.643	0.643	4.9	1758.6	O K
600 min Winter	83.652	0.652	4.9	1784.0	O K
720 min Winter	83.657	0.657	4.9	1799.0	O K
960 min Winter	83.661	0.661	4.9	1811.7	O K
1440 min Winter	83.659	0.659	4.9	1806.4	O K
2160 min Winter	83.647	0.647	4.9	1772.0	O K
2880 min Winter	83.633	0.633	4.9	1728.9	O K
4320 min Winter	83.609	0.609	4.9	1657.5	O K
5760 min Winter	83.597	0.597	4.9	1622.5	O K
7200 min Winter	83.590	0.590	4.9	1601.1	O K
8640 min Winter	83.586	0.586	4.9	1588.8	O K
10080 min Winter	83.584	0.584	4.9	1584.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	67.060	0.0	811.3	68
120 min Winter	39.480	0.0	773.1	126
180 min Winter	28.549	0.0	757.9	184
240 min Winter	22.540	0.0	750.0	244
360 min Winter	16.007	0.0	741.2	362
480 min Winter	12.471	0.0	735.5	480
600 min Winter	10.252	0.0	731.0	598
720 min Winter	8.727	0.0	727.0	714
960 min Winter	6.761	0.0	720.3	948
1440 min Winter	4.725	0.0	703.3	1412
2160 min Winter	3.324	0.0	1441.7	2084
2880 min Winter	2.610	0.0	1392.2	2740
4320 min Winter	1.895	0.0	1306.0	3500
5760 min Winter	1.536	0.0	2641.5	4384
7200 min Winter	1.322	0.0	2726.1	5336
8640 min Winter	1.182	0.0	2633.3	6304
10080 min Winter	1.083	0.0	2521.2	7256

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 386300 285500 SO 86300 85500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 2.220

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	1.110	4	8	1.110

Model Details

Storage is Online Cover Level (m) 84.000

Tank or Pond Structure

Invert Level (m) 83.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2500.0	1.000	3260.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0109-4900-0700-4900
Design Head (m)	0.700
Design Flow (l/s)	4.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	109
Invert Level (m)	83.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	4.9
Flush-Flo™	0.214	4.9
Kick-Flo®	0.482	4.1
Mean Flow over Head Range	-	4.2

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.7	1.200	6.3	3.000	9.7	7.000	14.5
0.200	4.9	1.400	6.8	3.500	10.4	7.500	15.0
0.300	4.8	1.600	7.2	4.000	11.1	8.000	15.5
0.400	4.6	1.800	7.6	4.500	11.7	8.500	15.9
0.500	4.2	2.000	8.0	5.000	12.4	9.000	16.4
0.600	4.6	2.200	8.4	5.500	12.9	9.500	16.9
0.800	5.2	2.400	8.7	6.000	13.5		
1.000	5.8	2.600	9.1	6.500	14.0		

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	88.328	0.328	2.0	172.3	O K
30 min Summer	88.417	0.417	2.0	225.6	O K
60 min Summer	88.506	0.506	2.0	281.2	O K
120 min Summer	88.575	0.575	2.0	326.5	O K
180 min Summer	88.609	0.609	2.0	349.5	O K
240 min Summer	88.629	0.629	2.0	363.0	O K
360 min Summer	88.649	0.649	2.0	376.7	O K
480 min Summer	88.655	0.655	2.0	381.2	O K
600 min Summer	88.656	0.656	2.0	381.7	O K
720 min Summer	88.653	0.653	2.0	379.8	O K
960 min Summer	88.643	0.643	2.0	372.4	O K
1440 min Summer	88.613	0.613	2.0	351.9	O K
2160 min Summer	88.575	0.575	2.0	326.4	O K
2880 min Summer	88.547	0.547	2.0	307.8	O K
4320 min Summer	88.509	0.509	2.0	282.8	O K
5760 min Summer	88.481	0.481	2.0	265.1	O K
7200 min Summer	88.460	0.460	2.0	251.9	O K
8640 min Summer	88.441	0.441	2.0	240.3	O K
10080 min Summer	88.427	0.427	2.0	231.5	O K
15 min Winter	88.363	0.363	2.0	193.2	O K
30 min Winter	88.462	0.462	2.0	253.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	162.960	0.0	153.6	23
30 min Summer	106.960	0.0	165.9	38
60 min Summer	67.060	0.0	275.5	68
120 min Summer	39.480	0.0	311.2	128
180 min Summer	28.549	0.0	316.3	186
240 min Summer	22.540	0.0	315.1	246
360 min Summer	16.007	0.0	312.0	366
480 min Summer	12.471	0.0	308.9	484
600 min Summer	10.252	0.0	306.0	604
720 min Summer	8.727	0.0	303.1	724
960 min Summer	6.761	0.0	297.2	962
1440 min Summer	4.725	0.0	285.3	1400
2160 min Summer	3.324	0.0	504.6	1712
2880 min Summer	2.610	0.0	524.9	2104
4320 min Summer	1.895	0.0	524.9	2940
5760 min Summer	1.536	0.0	628.6	3752
7200 min Summer	1.322	0.0	676.3	4608
8640 min Summer	1.182	0.0	724.9	5440
10080 min Summer	1.083	0.0	773.5	6248
15 min Winter	162.960	0.0	163.9	23
30 min Winter	106.960	0.0	161.5	37

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	88.558	0.558	2.0	315.4	O K
120 min Winter	88.635	0.635	2.0	366.7	O K
180 min Winter	88.672	0.672	2.0	393.0	O K
240 min Winter	88.695	0.695	2.0	408.8	O K
360 min Winter	88.718	0.718	2.0	425.2	Flood Risk
480 min Winter	88.726	0.726	2.0	431.4	Flood Risk
600 min Winter	88.729	0.729	2.0	433.1	Flood Risk
720 min Winter	88.727	0.727	2.0	432.1	Flood Risk
960 min Winter	88.719	0.719	2.0	426.0	Flood Risk
1440 min Winter	88.693	0.693	2.0	407.4	O K
2160 min Winter	88.649	0.649	2.0	376.4	O K
2880 min Winter	88.615	0.615	2.0	353.6	O K
4320 min Winter	88.564	0.564	2.0	318.9	O K
5760 min Winter	88.522	0.522	2.0	291.3	O K
7200 min Winter	88.486	0.486	2.0	268.4	O K
8640 min Winter	88.452	0.452	2.0	247.1	O K
10080 min Winter	88.418	0.418	2.0	226.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	67.060	0.0	302.4	66
120 min Winter	39.480	0.0	317.9	126
180 min Winter	28.549	0.0	316.5	184
240 min Winter	22.540	0.0	315.1	242
360 min Winter	16.007	0.0	312.9	360
480 min Winter	12.471	0.0	310.9	476
600 min Winter	10.252	0.0	309.0	594
720 min Winter	8.727	0.0	306.9	708
960 min Winter	6.761	0.0	302.9	936
1440 min Winter	4.725	0.0	295.7	1384
2160 min Winter	3.324	0.0	561.6	1968
2880 min Winter	2.610	0.0	577.1	2224
4320 min Winter	1.895	0.0	542.4	3160
5760 min Winter	1.536	0.0	704.0	4088
7200 min Winter	1.322	0.0	757.4	4976
8640 min Winter	1.182	0.0	811.7	5888
10080 min Winter	1.083	0.0	866.8	6664

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 386300 285500 SO 86300 85500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.570

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.285	4	8	0.285

Model Details

Storage is Online Cover Level (m) 89.000

Tank or Pond Structure

Invert Level (m) 88.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	474.0	1.000	830.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0071-2000-0700-2000
Design Head (m)	0.700
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	71
Invert Level (m)	88.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	2.0
Flush-Flo™	0.207	2.0
Kick-Flo®	0.450	1.6
Mean Flow over Head Range	-	1.7

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	1.8	1.200	2.6	3.000	3.9	7.000	5.8
0.200	2.0	1.400	2.7	3.500	4.2	7.500	6.0
0.300	2.0	1.600	2.9	4.000	4.5	8.000	6.2
0.400	1.8	1.800	3.1	4.500	4.7	8.500	6.4
0.500	1.7	2.000	3.2	5.000	5.0	9.000	6.6
0.600	1.9	2.200	3.4	5.500	5.2	9.500	6.8
0.800	2.1	2.400	3.5	6.000	5.4		
1.000	2.4	2.600	3.7	6.500	5.6		

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	75.264	0.264	4.4	607.4	O K
30 min Summer	75.341	0.341	4.4	795.9	O K
60 min Summer	75.421	0.421	4.4	994.3	O K
120 min Summer	75.487	0.487	4.4	1162.4	O K
180 min Summer	75.521	0.521	4.4	1252.0	O K
240 min Summer	75.543	0.543	4.4	1308.7	O K
360 min Summer	75.568	0.568	4.4	1374.5	O K
480 min Summer	75.580	0.580	4.4	1407.8	O K
600 min Summer	75.587	0.587	4.4	1426.5	O K
720 min Summer	75.591	0.591	4.4	1436.8	O K
960 min Summer	75.594	0.594	4.4	1443.5	O K
1440 min Summer	75.589	0.589	4.4	1431.9	O K
2160 min Summer	75.575	0.575	4.4	1392.7	O K
2880 min Summer	75.558	0.558	4.4	1349.3	O K
4320 min Summer	75.540	0.540	4.4	1302.6	O K
5760 min Summer	75.532	0.532	4.4	1279.3	O K
7200 min Summer	75.528	0.528	4.4	1271.1	O K
8640 min Summer	75.529	0.529	4.4	1272.2	O K
10080 min Summer	75.532	0.532	4.4	1281.0	O K
15 min Winter	75.294	0.294	4.4	680.6	O K
30 min Winter	75.380	0.380	4.4	892.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	162.960	0.0	370.4	23
30 min Summer	106.960	0.0	372.4	38
60 min Summer	67.060	0.0	736.0	68
120 min Summer	39.480	0.0	712.1	128
180 min Summer	28.549	0.0	692.6	188
240 min Summer	22.540	0.0	681.0	246
360 min Summer	16.007	0.0	666.6	366
480 min Summer	12.471	0.0	656.5	486
600 min Summer	10.252	0.0	648.1	606
720 min Summer	8.727	0.0	640.4	726
960 min Summer	6.761	0.0	626.5	964
1440 min Summer	4.725	0.0	602.1	1442
2160 min Summer	3.324	0.0	1283.9	2160
2880 min Summer	2.610	0.0	1231.1	2624
4320 min Summer	1.895	0.0	1129.2	3332
5760 min Summer	1.536	0.0	2150.3	4144
7200 min Summer	1.322	0.0	2274.1	4968
8640 min Summer	1.182	0.0	2292.2	5800
10080 min Summer	1.083	0.0	2182.8	6664
15 min Winter	162.960	0.0	374.7	23
30 min Winter	106.960	0.0	368.9	38

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	75.468	0.468	4.4	1114.8	O K
120 min Winter	75.541	0.541	4.4	1304.1	O K
180 min Winter	75.579	0.579	4.4	1405.0	O K
240 min Winter	75.603	0.603	4.4	1469.3	O K
360 min Winter	75.631	0.631	4.4	1544.6	O K
480 min Winter	75.646	0.646	4.4	1583.6	O K
600 min Winter	75.654	0.654	4.4	1606.4	O K
720 min Winter	75.659	0.659	4.4	1619.8	O K
960 min Winter	75.663	0.663	4.4	1630.9	O K
1440 min Winter	75.661	0.661	4.4	1625.5	O K
2160 min Winter	75.649	0.649	4.4	1593.8	O K
2880 min Winter	75.635	0.635	4.4	1554.4	O K
4320 min Winter	75.611	0.611	4.4	1488.8	O K
5760 min Winter	75.598	0.598	4.4	1456.4	O K
7200 min Winter	75.591	0.591	4.4	1436.6	O K
8640 min Winter	75.587	0.587	4.4	1425.3	O K
10080 min Winter	75.585	0.585	4.4	1421.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	67.060	0.0	725.9	68
120 min Winter	39.480	0.0	691.8	126
180 min Winter	28.549	0.0	678.8	184
240 min Winter	22.540	0.0	672.2	244
360 min Winter	16.007	0.0	665.1	362
480 min Winter	12.471	0.0	660.7	480
600 min Winter	10.252	0.0	657.3	598
720 min Winter	8.727	0.0	654.5	714
960 min Winter	6.761	0.0	649.6	948
1440 min Winter	4.725	0.0	634.9	1412
2160 min Winter	3.324	0.0	1296.6	2084
2880 min Winter	2.610	0.0	1253.5	2740
4320 min Winter	1.895	0.0	1179.4	3504
5760 min Winter	1.536	0.0	2385.9	4392
7200 min Winter	1.322	0.0	2458.4	5336
8640 min Winter	1.182	0.0	2372.2	6312
10080 min Winter	1.083	0.0	2272.7	7256

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 386300 285500 SO 86300 85500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 2.000

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	1.000	4	8	1.000

Model Details

Storage is Online Cover Level (m) 76.000

Tank or Pond Structure

Invert Level (m) 75.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2200.0	1.000	3020.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0104-4400-0700-4400
Design Head (m)	0.700
Design Flow (l/s)	4.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	104
Invert Level (m)	75.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	4.4
Flush-Flo™	0.214	4.4
Kick-Flo®	0.480	3.7
Mean Flow over Head Range	-	3.8

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	3.5	1.200	5.6	3.000	8.7	7.000	13.0
0.200	4.4	1.400	6.1	3.500	9.3	7.500	13.4
0.300	4.3	1.600	6.5	4.000	9.9	8.000	13.8
0.400	4.1	1.800	6.8	4.500	10.5	8.500	14.3
0.500	3.8	2.000	7.2	5.000	11.1	9.000	14.7
0.600	4.1	2.200	7.5	5.500	11.6	9.500	15.1
0.800	4.7	2.400	7.8	6.000	12.1		
1.000	5.2	2.600	8.1	6.500	12.5		

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	74.764	0.264	7.4	1020.7	O K
30 min Summer	74.843	0.343	7.4	1337.5	O K
60 min Summer	74.924	0.424	7.4	1671.1	O K
120 min Summer	74.993	0.493	7.4	1953.8	O K
180 min Summer	75.029	0.529	7.4	2105.2	O K
240 min Summer	75.051	0.551	7.4	2201.1	O K
360 min Summer	75.078	0.578	7.4	2313.1	O K
480 min Summer	75.091	0.591	7.4	2370.4	O K
600 min Summer	75.099	0.599	7.4	2403.1	O K
720 min Summer	75.103	0.603	7.4	2421.6	O K
960 min Summer	75.106	0.606	7.4	2435.2	O K
1440 min Summer	75.103	0.603	7.4	2420.1	O K
2160 min Summer	75.089	0.589	7.4	2360.0	O K
2880 min Summer	75.073	0.573	7.4	2293.0	O K
4320 min Summer	75.057	0.557	7.4	2224.9	O K
5760 min Summer	75.049	0.549	7.4	2192.8	O K
7200 min Summer	75.047	0.547	7.4	2183.4	O K
8640 min Summer	75.048	0.548	7.4	2187.9	O K
10080 min Summer	75.052	0.552	7.4	2204.0	O K
15 min Winter	74.795	0.295	7.4	1143.7	O K
30 min Winter	74.882	0.382	7.4	1498.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	162.960	0.0	607.8	23
30 min Summer	106.960	0.0	628.4	38
60 min Summer	67.060	0.0	1234.4	68
120 min Summer	39.480	0.0	1213.6	128
180 min Summer	28.549	0.0	1180.9	188
240 min Summer	22.540	0.0	1160.4	246
360 min Summer	16.007	0.0	1134.1	366
480 min Summer	12.471	0.0	1115.3	486
600 min Summer	10.252	0.0	1099.1	606
720 min Summer	8.727	0.0	1084.2	726
960 min Summer	6.761	0.0	1056.4	964
1440 min Summer	4.725	0.0	1006.0	1442
2160 min Summer	3.324	0.0	2157.0	2160
2880 min Summer	2.610	0.0	2061.1	2620
4320 min Summer	1.895	0.0	1877.2	3328
5760 min Summer	1.536	0.0	3574.8	4096
7200 min Summer	1.322	0.0	3773.5	4968
8640 min Summer	1.182	0.0	3822.5	5792
10080 min Summer	1.083	0.0	3644.0	6656
15 min Winter	162.960	0.0	629.2	23
30 min Winter	106.960	0.0	624.1	38

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	74.973	0.473	7.4	1873.4	O K
120 min Winter	75.049	0.549	7.4	2191.9	O K
180 min Winter	75.089	0.589	7.4	2362.1	O K
240 min Winter	75.115	0.615	7.4	2470.6	O K
360 min Winter	75.144	0.644	7.4	2598.2	O K
480 min Winter	75.160	0.660	7.4	2664.8	O K
600 min Winter	75.169	0.669	7.4	2704.1	O K
720 min Winter	75.174	0.674	7.4	2727.5	O K
960 min Winter	75.179	0.679	7.4	2748.0	O K
1440 min Winter	75.178	0.678	7.4	2742.5	O K
2160 min Winter	75.167	0.667	7.4	2694.1	O K
2880 min Winter	75.152	0.652	7.4	2632.1	O K
4320 min Winter	75.129	0.629	7.4	2531.7	O K
5760 min Winter	75.118	0.618	7.4	2484.0	O K
7200 min Winter	75.111	0.611	7.4	2455.3	O K
8640 min Winter	75.107	0.607	7.4	2439.0	O K
10080 min Winter	75.106	0.606	7.4	2434.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	67.060	0.0	1233.1	68
120 min Winter	39.480	0.0	1180.6	126
180 min Winter	28.549	0.0	1157.8	184
240 min Winter	22.540	0.0	1145.8	244
360 min Winter	16.007	0.0	1131.7	362
480 min Winter	12.471	0.0	1121.7	480
600 min Winter	10.252	0.0	1113.0	598
720 min Winter	8.727	0.0	1105.1	714
960 min Winter	6.761	0.0	1090.8	948
1440 min Winter	4.725	0.0	1061.4	1412
2160 min Winter	3.324	0.0	2185.2	2080
2880 min Winter	2.610	0.0	2105.6	2740
4320 min Winter	1.895	0.0	1964.8	3464
5760 min Winter	1.536	0.0	3965.6	4384
7200 min Winter	1.322	0.0	4098.2	5336
8640 min Winter	1.182	0.0	3969.7	6304
10080 min Winter	1.083	0.0	3799.5	7168

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 386300 285500 SO 86300 85500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 3.360

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	1.680	4	8	1.680

Model Details

Storage is Online Cover Level (m) 75.500

Tank or Pond Structure

Invert Level (m) 74.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	3760.0	1.000	4630.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0131-7400-0700-7400
Design Head (m)	0.700
Design Flow (l/s)	7.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	131
Invert Level (m)	74.500
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	7.4
Flush-Flo™	0.230	7.4
Kick-Flo®	0.501	6.3
Mean Flow over Head Range	-	6.2

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	4.7	1.200	9.5	3.000	14.7	7.000	22.1
0.200	7.4	1.400	10.2	3.500	15.8	7.500	22.8
0.300	7.3	1.600	10.9	4.000	16.9	8.000	23.5
0.400	7.1	1.800	11.5	4.500	17.9	8.500	24.2
0.500	6.4	2.000	12.1	5.000	18.8	9.000	24.9
0.600	6.9	2.200	12.7	5.500	19.7	9.500	25.6
0.800	7.9	2.400	13.2	6.000	20.5		
1.000	8.7	2.600	13.7	6.500	21.3		

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	103.273	0.273	3.0	413.0	O K
30 min Summer	103.353	0.353	3.0	541.1	O K
60 min Summer	103.434	0.434	3.0	676.0	O K
120 min Summer	103.502	0.502	3.0	790.1	O K
180 min Summer	103.537	0.537	3.0	850.6	O K
240 min Summer	103.559	0.559	3.0	888.7	O K
360 min Summer	103.584	0.584	3.0	932.8	O K
480 min Summer	103.596	0.596	3.0	954.8	O K
600 min Summer	103.603	0.603	3.0	966.9	O K
720 min Summer	103.607	0.607	3.0	973.2	O K
960 min Summer	103.609	0.609	3.0	976.6	O K
1440 min Summer	103.603	0.603	3.0	966.5	O K
2160 min Summer	103.586	0.586	3.0	937.0	O K
2880 min Summer	103.568	0.568	3.0	905.4	O K
4320 min Summer	103.549	0.549	3.0	871.1	O K
5760 min Summer	103.538	0.538	3.0	853.6	O K
7200 min Summer	103.535	0.535	3.0	846.9	O K
8640 min Summer	103.535	0.535	3.0	847.0	O K
10080 min Summer	103.538	0.538	3.0	852.5	O K
15 min Winter	103.304	0.304	3.0	462.8	O K
30 min Winter	103.393	0.393	3.0	606.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	162.960	0.0	254.3	23
30 min Summer	106.960	0.0	253.3	38
60 min Summer	67.060	0.0	499.0	68
120 min Summer	39.480	0.0	477.3	128
180 min Summer	28.549	0.0	465.7	188
240 min Summer	22.540	0.0	459.1	246
360 min Summer	16.007	0.0	451.2	366
480 min Summer	12.471	0.0	445.8	486
600 min Summer	10.252	0.0	441.3	606
720 min Summer	8.727	0.0	437.4	726
960 min Summer	6.761	0.0	430.3	964
1440 min Summer	4.725	0.0	418.9	1442
2160 min Summer	3.324	0.0	879.8	2160
2880 min Summer	2.610	0.0	846.0	2620
4320 min Summer	1.895	0.0	780.7	3332
5760 min Summer	1.536	0.0	1473.1	4104
7200 min Summer	1.322	0.0	1562.0	4968
8640 min Summer	1.182	0.0	1572.9	5800
10080 min Summer	1.083	0.0	1497.9	6656
15 min Winter	162.960	0.0	255.8	23
30 min Winter	106.960	0.0	249.9	38

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	103.483	0.483	3.0	758.0	O K
120 min Winter	103.557	0.557	3.0	886.3	O K
180 min Winter	103.596	0.596	3.0	954.6	O K
240 min Winter	103.621	0.621	3.0	998.0	O K
360 min Winter	103.649	0.649	3.0	1048.6	O K
480 min Winter	103.663	0.663	3.0	1074.6	O K
600 min Winter	103.671	0.671	3.0	1089.6	O K
720 min Winter	103.676	0.676	3.0	1098.1	O K
960 min Winter	103.680	0.680	3.0	1104.6	O K
1440 min Winter	103.677	0.677	3.0	1099.0	O K
2160 min Winter	103.663	0.663	3.0	1074.8	O K
2880 min Winter	103.647	0.647	3.0	1045.7	O K
4320 min Winter	103.621	0.621	3.0	998.4	O K
5760 min Winter	103.607	0.607	3.0	974.3	O K
7200 min Winter	103.599	0.599	3.0	959.4	O K
8640 min Winter	103.594	0.594	3.0	950.6	O K
10080 min Winter	103.592	0.592	3.0	947.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	67.060	0.0	486.4	68
120 min Winter	39.480	0.0	465.6	126
180 min Winter	28.549	0.0	458.7	184
240 min Winter	22.540	0.0	455.7	244
360 min Winter	16.007	0.0	453.6	362
480 min Winter	12.471	0.0	453.0	480
600 min Winter	10.252	0.0	453.0	598
720 min Winter	8.727	0.0	453.0	714
960 min Winter	6.761	0.0	450.9	948
1440 min Winter	4.725	0.0	441.6	1412
2160 min Winter	3.324	0.0	889.2	2080
2880 min Winter	2.610	0.0	862.2	2740
4320 min Winter	1.895	0.0	819.4	3464
5760 min Winter	1.536	0.0	1636.9	4384
7200 min Winter	1.322	0.0	1690.3	5336
8640 min Winter	1.182	0.0	1631.6	6304
10080 min Winter	1.083	0.0	1564.4	7256

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 386300 285500 SO 86300 85500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 1.360

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.680	4	8	0.680

Model Details

Storage is Online Cover Level (m) 104.000

Tank or Pond Structure

Invert Level (m) 103.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1440.0	1.000	2010.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0087-3000-0700-3000
Design Head (m)	0.700
Design Flow (l/s)	3.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	87
Invert Level (m)	103.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	3.0
Flush-Flo™	0.210	3.0
Kick-Flo®	0.465	2.5
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	2.6	1.200	3.8	3.000	5.9	7.000	8.8
0.200	3.0	1.400	4.1	3.500	6.3	7.500	9.1
0.300	2.9	1.600	4.4	4.000	6.7	8.000	9.4
0.400	2.8	1.800	4.6	4.500	7.1	8.500	9.7
0.500	2.6	2.000	4.9	5.000	7.5	9.000	9.9
0.600	2.8	2.200	5.1	5.500	7.8	9.500	10.2
0.800	3.2	2.400	5.3	6.000	8.2		
1.000	3.5	2.600	5.5	6.500	8.5		

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	97.238	0.238	2.0	120.5	O K
30 min Summer	97.304	0.304	2.0	157.5	O K
60 min Summer	97.371	0.371	2.0	195.7	O K
120 min Summer	97.422	0.422	2.0	226.4	O K
180 min Summer	97.447	0.447	2.0	241.5	O K
240 min Summer	97.461	0.461	2.0	250.1	O K
360 min Summer	97.473	0.473	2.0	257.8	O K
480 min Summer	97.475	0.475	2.0	258.9	O K
600 min Summer	97.472	0.472	2.0	257.2	O K
720 min Summer	97.467	0.467	2.0	253.9	O K
960 min Summer	97.451	0.451	2.0	244.3	O K
1440 min Summer	97.417	0.417	2.0	223.2	O K
2160 min Summer	97.380	0.380	2.0	201.2	O K
2880 min Summer	97.351	0.351	2.0	184.1	O K
4320 min Summer	97.307	0.307	2.0	159.2	O K
5760 min Summer	97.275	0.275	2.0	140.8	O K
7200 min Summer	97.250	0.250	2.0	126.9	O K
8640 min Summer	97.230	0.230	2.0	116.1	O K
10080 min Summer	97.214	0.214	2.0	107.6	O K
15 min Winter	97.264	0.264	2.0	135.1	O K
30 min Winter	97.338	0.338	2.0	176.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	162.960	0.0	112.0	23
30 min Summer	106.960	0.0	144.0	37
60 min Summer	67.060	0.0	195.9	68
120 min Summer	39.480	0.0	230.1	126
180 min Summer	28.549	0.0	248.8	186
240 min Summer	22.540	0.0	261.0	246
360 min Summer	16.007	0.0	275.9	364
480 min Summer	12.471	0.0	284.4	484
600 min Summer	10.252	0.0	289.7	604
720 min Summer	8.727	0.0	292.9	722
960 min Summer	6.761	0.0	295.0	960
1440 min Summer	4.725	0.0	289.3	1160
2160 min Summer	3.324	0.0	355.9	1512
2880 min Summer	2.610	0.0	372.2	1904
4320 min Summer	1.895	0.0	403.6	2688
5760 min Summer	1.536	0.0	441.0	3464
7200 min Summer	1.322	0.0	474.4	4248
8640 min Summer	1.182	0.0	508.2	5008
10080 min Summer	1.083	0.0	541.9	5744
15 min Winter	162.960	0.0	125.0	23
30 min Winter	106.960	0.0	156.8	37

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	97.411	0.411	2.0	219.8	O K
120 min Winter	97.468	0.468	2.0	254.9	O K
180 min Winter	97.496	0.496	2.0	272.3	O K
240 min Winter	97.512	0.512	2.0	282.3	O K
360 min Winter	97.527	0.527	2.0	291.7	O K
480 min Winter	97.530	0.530	2.0	293.9	O K
600 min Winter	97.529	0.529	2.0	292.9	O K
720 min Winter	97.524	0.524	2.0	290.1	O K
960 min Winter	97.511	0.511	2.0	281.9	O K
1440 min Winter	97.479	0.479	2.0	261.3	O K
2160 min Winter	97.430	0.430	2.0	231.2	O K
2880 min Winter	97.389	0.389	2.0	206.3	O K
4320 min Winter	97.322	0.322	2.0	167.5	O K
5760 min Winter	97.269	0.269	2.0	137.7	O K
7200 min Winter	97.228	0.228	2.0	115.0	O K
8640 min Winter	97.195	0.195	2.0	97.7	O K
10080 min Winter	97.170	0.170	2.0	84.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	67.060	0.0	219.2	66
120 min Winter	39.480	0.0	256.5	124
180 min Winter	28.549	0.0	276.2	184
240 min Winter	22.540	0.0	288.4	242
360 min Winter	16.007	0.0	301.2	358
480 min Winter	12.471	0.0	305.6	476
600 min Winter	10.252	0.0	305.8	590
720 min Winter	8.727	0.0	303.7	706
960 min Winter	6.761	0.0	297.9	930
1440 min Winter	4.725	0.0	284.7	1356
2160 min Winter	3.324	0.0	398.4	1664
2880 min Winter	2.610	0.0	416.7	2084
4320 min Winter	1.895	0.0	451.5	2940
5760 min Winter	1.536	0.0	494.1	3744
7200 min Winter	1.322	0.0	531.6	4472
8640 min Winter	1.182	0.0	569.5	5192
10080 min Winter	1.083	0.0	607.7	5944

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 386300 285500 SO 86300 85500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.400

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.200	4	8	0.200

Model Details

Storage is Online Cover Level (m) 98.000

Tank or Pond Structure

Invert Level (m) 97.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	470.0	1.000	820.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0071-2000-0700-2000
Design Head (m)	0.700
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	71
Invert Level (m)	97.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	2.0
Flush-Flo™	0.207	2.0
Kick-Flo®	0.450	1.6
Mean Flow over Head Range	-	1.7

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	1.8	1.200	2.6	3.000	3.9	7.000	5.8
0.200	2.0	1.400	2.7	3.500	4.2	7.500	6.0
0.300	2.0	1.600	2.9	4.000	4.5	8.000	6.2
0.400	1.8	1.800	3.1	4.500	4.7	8.500	6.4
0.500	1.7	2.000	3.2	5.000	5.0	9.000	6.6
0.600	1.9	2.200	3.4	5.500	5.2	9.500	6.8
0.800	2.1	2.400	3.5	6.000	5.4		
1.000	2.4	2.600	3.7	6.500	5.6		

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	74.275	0.275	9.7	1324.5	O K
30 min Summer	74.358	0.358	9.7	1735.6	O K
60 min Summer	74.444	0.444	9.7	2168.5	O K
120 min Summer	74.515	0.515	9.7	2535.7	O K
180 min Summer	74.553	0.553	9.7	2731.9	O K
240 min Summer	74.577	0.577	9.7	2856.1	O K
360 min Summer	74.605	0.605	9.7	3001.1	O K
480 min Summer	74.619	0.619	9.7	3075.0	O K
600 min Summer	74.627	0.627	9.7	3117.1	O K
720 min Summer	74.632	0.632	9.7	3140.8	O K
960 min Summer	74.635	0.635	9.7	3157.6	O K
1440 min Summer	74.631	0.631	9.7	3136.5	O K
2160 min Summer	74.616	0.616	9.7	3056.0	O K
2880 min Summer	74.599	0.599	9.7	2971.4	O K
4320 min Summer	74.583	0.583	9.7	2888.0	O K
5760 min Summer	74.576	0.576	9.7	2849.4	O K
7200 min Summer	74.574	0.574	9.7	2838.4	O K
8640 min Summer	74.575	0.575	9.7	2843.9	O K
10080 min Summer	74.579	0.579	9.7	2863.8	O K
15 min Winter	74.307	0.307	9.7	1484.1	O K
30 min Winter	74.399	0.399	9.7	1945.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	162.960	0.0	783.8	23
30 min Summer	106.960	0.0	822.2	38
60 min Summer	67.060	0.0	1605.0	68
120 min Summer	39.480	0.0	1585.6	128
180 min Summer	28.549	0.0	1547.6	188
240 min Summer	22.540	0.0	1523.7	246
360 min Summer	16.007	0.0	1492.5	366
480 min Summer	12.471	0.0	1469.3	486
600 min Summer	10.252	0.0	1448.9	606
720 min Summer	8.727	0.0	1429.7	726
960 min Summer	6.761	0.0	1393.5	964
1440 min Summer	4.725	0.0	1327.0	1442
2160 min Summer	3.324	0.0	2833.5	2160
2880 min Summer	2.610	0.0	2705.9	2516
4320 min Summer	1.895	0.0	2460.7	3284
5760 min Summer	1.536	0.0	4628.0	4088
7200 min Summer	1.322	0.0	4889.6	4904
8640 min Summer	1.182	0.0	4984.0	5792
10080 min Summer	1.083	0.0	4766.9	6648
15 min Winter	162.960	0.0	819.1	23
30 min Winter	106.960	0.0	817.2	38

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	74.495	0.495	9.7	2431.1	O K
120 min Winter	74.575	0.575	9.7	2844.2	O K
180 min Winter	74.617	0.617	9.7	3064.7	O K
240 min Winter	74.644	0.644	9.7	3205.3	O K
360 min Winter	74.675	0.675	9.7	3370.4	O K
480 min Winter	74.692	0.692	9.7	3456.3	O K
600 min Winter	74.701	0.701	9.7	3506.7	Flood Risk
720 min Winter	74.707	0.707	9.7	3536.6	Flood Risk
960 min Winter	74.712	0.712	9.8	3562.3	Flood Risk
1440 min Winter	74.710	0.710	9.8	3553.2	Flood Risk
2160 min Winter	74.698	0.698	9.7	3487.9	O K
2880 min Winter	74.682	0.682	9.7	3405.1	O K
4320 min Winter	74.658	0.658	9.7	3279.8	O K
5760 min Winter	74.647	0.647	9.7	3218.6	O K
7200 min Winter	74.639	0.639	9.7	3180.7	O K
8640 min Winter	74.635	0.635	9.7	3158.8	O K
10080 min Winter	74.634	0.634	9.7	3151.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	67.060	0.0	1611.9	68
120 min Winter	39.480	0.0	1550.3	126
180 min Winter	28.549	0.0	1525.7	184
240 min Winter	22.540	0.0	1512.8	244
360 min Winter	16.007	0.0	1497.7	362
480 min Winter	12.471	0.0	1486.3	480
600 min Winter	10.252	0.0	1475.9	596
720 min Winter	8.727	0.0	1466.1	714
960 min Winter	6.761	0.0	1447.9	948
1440 min Winter	4.725	0.0	1405.9	1412
2160 min Winter	3.324	0.0	2882.0	2080
2880 min Winter	2.610	0.0	2775.5	2736
4320 min Winter	1.895	0.0	2587.0	3424
5760 min Winter	1.536	0.0	5140.8	4376
7200 min Winter	1.322	0.0	5341.5	5328
8640 min Winter	1.182	0.0	5211.3	6232
10080 min Winter	1.083	0.0	4987.7	7160

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 386300 285500 SO 86300 85500
Data Type	Catchment
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 4.360

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	2.180	4	8	2.180

Model Details

Storage is Online Cover Level (m) 75.000

Tank or Pond Structure

Invert Level (m) 74.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	4700.0	1.000	5580.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0148-9700-0700-9700
Design Head (m)	0.700
Design Flow (l/s)	9.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	148
Invert Level (m)	74.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	9.7
Flush-Flo™	0.245	9.7
Kick-Flo®	0.513	8.4
Mean Flow over Head Range	-	8.1

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	5.3	1.200	12.5	3.000	19.3	7.000	29.1
0.200	9.6	1.400	13.4	3.500	20.8	7.500	29.9
0.300	9.6	1.600	14.3	4.000	22.2	8.000	30.9
0.400	9.3	1.800	15.2	4.500	23.5	8.500	31.9
0.500	8.6	2.000	15.9	5.000	24.7	9.000	32.8
0.600	9.0	2.200	16.7	5.500	25.9	9.500	33.7
0.800	10.3	2.400	17.4	6.000	27.0		
1.000	11.5	2.600	18.1	6.500	28.0		

Appendix C

CORRESPONDENCE

Secker, Phoebe

From: Enquiries_Westmids <Enquiries_Westmids@environment-agency.gov.uk>
Sent: 28 November 2019 09:03
To: Secker, Phoebe
Subject: Ref 152410 Product 4 Request - Lawnswood Road
Attachments: 152410 Map.pdf

Dear Phoebe

Enquiry regarding Flood Map for Planning (Rivers and Sea) Information for Lawnswood Road

Thank you for your enquiry which was received on 25 November.

We respond to requests under the Freedom of Information Act 2000 and Environmental Information Regulations 2004.

The information on Flood Zones in the area relating to this address is as follows:

The property is in an area located within Flood Zone 1 shown on our Flood Map for Planning (Rivers and Sea). Note - This information relates to the area that the above named property is in and is not specific to the property itself as it is influenced by factors such as the height of door steps, air bricks or the height of surrounding walls. We do not have access to this information and is not currently used in our flood modelling. Flood Zone definitions can be found at www.gov.uk/guidance/flood-risk-and-coastal-change#Table-1-Flood-Zones

Please find attached a copy of the Flood Map for Planning (Rivers and Sea) for the area relating to your address.

More information can be found on the website at: https://flood-map-for-planning.service.gov.uk/ You can draw your development extent and the service then provides details on what level of Flood Risk Assessment you would require and the reasons why.

Abstract

Name	Product 1
Description	Flood Map for Planning (Rivers and Sea) for planning SO8776986914
Licence	Open Government Licence
Information Warning - OS background mapping	The mapping of features provided as a background in this product is © Ordnance Survey. It is provided to give context to this product. The Open Government Licence does not apply to this background mapping. You are granted a non-exclusive, royalty free, revocable licence solely to view the Licensed Data for non-commercial purposes for the period during which the Environment Agency makes it available. You are not permitted to copy, sub-license, distribute, sell or otherwise make available the Licensed Data to third parties in any form. Third party rights to enforce the terms of this licence shall be reserved to OS.

Attribution	Contains Environment Agency information © Environment Agency and/or database rights. Contains Ordnance Survey data © Crown copyright 2017 Ordnance Survey 100024198.

Data Available Online
Many of our flood datasets are available online:

- Flood Map For Planning (Flood Zone 2, Flood Zone 3 ,Flood Storage Areas, Flood Defences, Areas Benefiting from Defences)
- Risk of Flooding from Rivers and Sea
- Historic Flood Map
- Current Flood Warnings

Further details about the Environment Agency information supplied can be found on the GOV.UK website:

https://www.gov.uk/browse/environment-countryside/flooding-extreme-weather

If you have requested this information to help inform a development proposal, then you should note the information on GOV.UK on the use of Environment Agency Information for Flood Risk Assessments.

https://www.gov.uk/planning-applications-assessing-flood-risk
https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion

Please get in touch if you have any further queries or contact us within two months if you'd like us to review the information we have sent.

Yours sincerely

Carolyn Fowler
Customers & Engagement Officer
West Midlands Area

For further information please contact the Customers & Engagement team on
Tel: 02084 747856
Direct e-mail:- enquiries_WestMids@environment-agency.gov.uk

From: Secker, Phoebe [mailto:Phoebe.Secker@wsp.com]
Sent: 25 November 2019 08:15
To: Enquiries, Unit <enquiries@environment-agency.gov.uk>
Subject: Product 4 Request - Lawnswood Road

Hello,

We would like the Product 4 information for a site at Lawnswood Road, an approximate postcode is DY7 5AW (site co-ordinates 387309, 287480).

Please find the following site location plan for reference.

Kind regards,
Phoebe
Phoebe Secker ***BSc (Hons) MCIWEM***
Assistant Engineer

T +44 (0) 121 352 4926
F +44 (0) 121 352 4701

WSP, The Mailbox
Level 2
100 Wharfside Street
Birmingham
B1 1RT

wsp.com

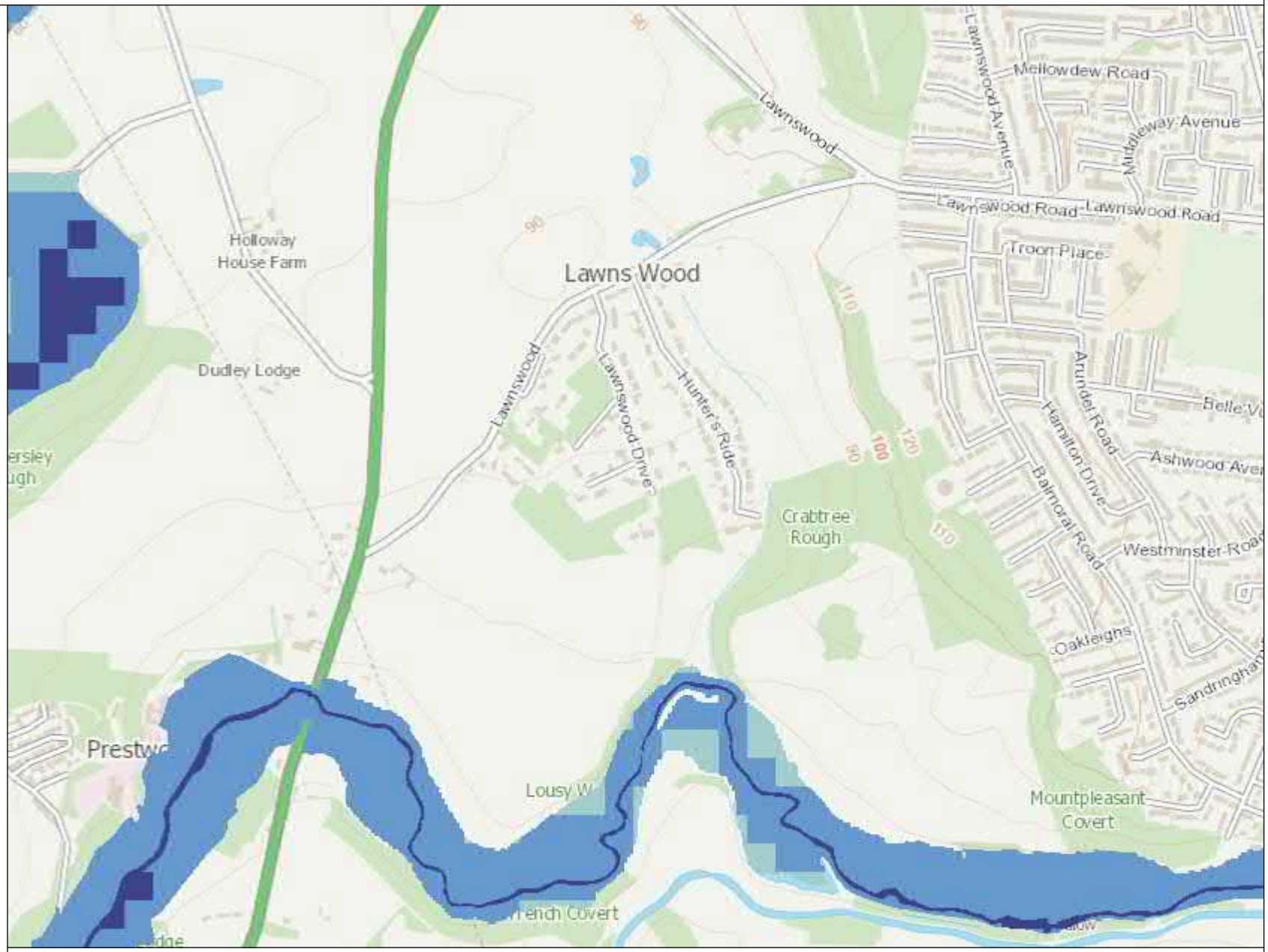
Flood Map for Planning(Rivers & Sea)centred on SO8776986914created-281119

Environment Agency

Legend

Risk of flooding from rivers and sea

- High (>=3.3%)
- Medium (3.3% - 1%)
- Low (1% - 0.1%)
- Very Low (<0.1%)



1: 10,000

0 250

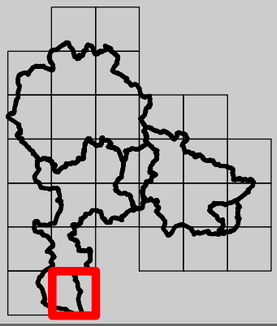
Metres

N W E S

SOUTHERN STAFFORDSHIRE COUNCILS LEVEL 1 STRATEGIC FLOOD RISK ASSESSMENT

APPENDIX A: GEO PDF FLOOD RISK MAPPING

INDEX GRID: G2



Note: All layers are turned off by default. Click the box next to the layer of interest to turn on.

Authority Information
- Council Boundary
- Detailed River Network
- Main Rivers

Flood Zones
- Flood Zone 3b
- Indicative Flood Zone 3b
- Flood Zone 3a
- Flood Zone 2

Surface Water
- RoFfSW 3.3% AEP
- RoFfSW 1% AEP
- RoFfSW 0.1% AEP

Historical Flooding
- Historic Flooding

Emergency Planning
- Flood Warning Areas
- Flood Alert Areas

Climate Change
- Climate Change Central
- Climate Change Higher Central
- Climate Change Upper End
- Indicative Climate Change

Areas Susceptible to Groundwater Flooding
- >= 75%
- >= 50% <75%
- >= 25% <50%
- < 25%

Culvert Blockage Results
- Culverts assessed
- 100 year event with 33% blockage
- 100 year event with 66% blockage

Defences
- Demountable Defence
- Embankment
- Flood Gate
- Wall

0 0.5 1 2 3 4 Km

(c) Crown copyright and database rights 2019 Ordnance Survey 100031673 | Date: 27/11/19 | Scale: 1:1250 | Map Centre: 387841,286978 | Data updated: 31/07/19 | Our Ref: 355791 - 2 | Wastewater Plan A0

piriyasha.jeyanayagam@wsp.com

Lawnswood Road East

SEVERN TRENT

SEVERN TRENT

GENERAL CONDITIONS AND PRECAUTIONS TO BE TAKEN WHEN CARRYING OUT WORK ADJACENT TO SEVERN TRENT WATER'S APPARATUS

Please ensure that a copy of these conditions is passed to your representative and/or your contractor on site. If any damage is caused to Severn Trent Water Limited (STW) apparatus (defined below), the person, contractor or subcontractor responsible must inform STW immediately on:
0800 783 4444 (24 hours)

a) These general conditions and precautions apply to the public sewerage, water distribution and cables in ducts including (but not limited to) sewers which are the subject of an Agreement under Section 104 of the Water Industry Act 1991(a legal agreement between a developer and STW, where a developer agrees to build sewers to an agreed standard, which STW will then adopt); mains installed in accordance with an agreement for the self-construction of water mains entered into with STW and the assets described at condition b) of these general conditions and precautions. Such apparatus is referred to as "STW Apparatus" in these general conditions and precautions.

b) Please be aware that due to The Private Sewers Transfer Regulations June 2011, the number of public sewers has increased, but many of these are not shown on the public sewer record. However, some idea of their positions may be obtained from the position of inspection covers and their existence must be anticipated.

c) On request, STW will issue a copy of the plan showing the approximate locations of STW Apparatus although in certain instances a charge will be made. The position of private drains, private sewers and water service pipes to properties are not normally shown but their presence must be anticipated. This plan and the information supplied with it is furnished as a general guide only and STW does not guarantee its accuracy.

d) STW does not update these plans on a regular basis. Therefore the position and depth of STW Apparatus may change and this plan is issued subject to any such change. Before any works are carried out, you should confirm whether any changes to the plan have been made since it was issued.

e) The plan must not be relied upon in the event of excavations or other works in the vicinity of STW Apparatus. It is your responsibility to ascertain the precise location of any STW Apparatus prior to undertaking any development or other works (including but not limited to excavations).

f) No person or company shall be relieved from liability for loss and/or damage caused to STW Apparatus by reason of the actual position and/or depths of STW Apparatus being different from those shown on the plan.

In order to achieve safe working conditions adjacent to any STW Apparatus the following should be observed:

1. All STW Apparatus should be located by hand digging prior to the use of mechanical excavators.

2. All information set out in any plans received from us, or given by our staff at the site of the works, about the position and depth of the mains, is approximate. Every possible precaution should be taken to avoid damage to STW Apparatus. You or your contractor must ensure the safety of STW Apparatus and will be responsible for the cost of repairing any loss and/or damage caused (including without limitation replacement parts).

3. Water mains are normally laid at a depth of 900mm. No records are kept of customer service pipes which are normally laid at a depth of 750mm; but some idea of their positions may be obtained from the position of stop tap covers and their existence must be anticipated.

4. During construction work, where heavy plant will cross the line of STW Apparatus, specific crossing points must be agreed with STW and suitably reinforced where required. These crossing points should be clearly marked and crossing of the line of STW Apparatus at other locations must be prevented.

5. Where it is proposed to carry out piling or boring within 20 metres of any STW Apparatus, STW should be consulted to enable any affected STW Apparatus to be surveyed prior to the works commencing.

6. Where excavation of trenches adjacent to any STW Apparatus affects its support, the STW Apparatus must be supported to the satisfaction of STW. Water mains and some sewers are pressurised and can fail if excavation removes support to thrust blocks to bends and other fittings.

7. Where a trench is excavated crossing or parallel to the line of any STW Apparatus, the backfill should be adequately compacted to prevent any settlement which could subsequently cause damage to the STW Apparatus. In special cases, it may be necessary to provide permanent support to STW Apparatus which has been exposed over a length of the excavation before backfilling and reinstatement is carried out. There should be no concrete backfill in contact with the STW Apparatus.

8. No other apparatus should be laid along the line of STW Apparatus irrespective of clearance. Above ground apparatus must not be located within a minimum of 3 metres either side of the centre line of STW Apparatus for smaller sized pipes and 6 metres either side for larger sized pipes without prior approval. No manhole or chamber shall be built over or around any STW Apparatus.

9. A minimum radial clearance of 300 millimetres should be allowed between any plant or equipment being installed and existing STW Apparatus. We reserve the right to increase this distance where strategic assets are affected.

10. Where any STW Apparatus coated with a special wrapping is damaged, even to a minor extent, STW must be notified and the trench left open until the damage has been inspected and the necessary repairs have been carried out. In the case of any material damage to any STW Apparatus causing leakage, weakening of the mechanical strength of the pipe or corrosion-protection damage, the necessary remedial work will be recharged to you.

11. It may be necessary to adjust the finished level of any surface boxes which may fall within your proposed construction. Please ensure that these are not damaged, buried or otherwise rendered inaccessible as a result of the works and that all stop taps, valves, hydrants, etc. remain accessible and operable. Minor reduction in existing levels may result in conflict with STW Apparatus such as valve spindles or tops of hydrants housed under the surface boxes. Checks should be made during site investigations to ascertain the level of such STW Apparatus in order to determine any necessary alterations in advance of the works.

12. With regard to any proposed resurfacing works, you are required to contact STW on the number given above to arrange a site inspection to establish the condition of any STW Apparatus in the nature of surface boxes or manhole covers and frames affected by the works. STW will then advise on any measures to be taken, in the event of this a proportionate charge will be made.

13. You are advised that STW will not agree to either the erection of posts, directly over or within 1.0 metre of valves and hydrants,

14. No explosives are to be used in the vicinity of any STW Apparatus without prior consultation with STW.

TREE PLANTING RESTRICTIONS

There are many problems with the location of trees adjacent to sewers, water mains and other STW Apparatus and these can lead to the loss of trees and hence amenity to the area which many people may have become used to. It is best if the problem is not created in the first place. Set out below are the recommendations for tree planting in close proximity to public sewers, water mains and other STW Apparatus.

15. Please ensure that, in relation to STW Apparatus, the mature root systems and canopies of any tree planted do not and will not encroach within the recommended distances specified in the notes below.

16. Both Poplar and Willow trees have extensive root systems and should not be planted within 12 metres of a sewer, water main or other STW Apparatus.

17. The following trees and those of similar size, be they deciduous or evergreen, should not be planted within 6 metres of a sewer, water main or other STW Apparatus. E.g. Ash, Beech, Birch, most Conifers, Elm, Horse Chestnut, Lime, Oak, Sycamore, Apple and Pear. Asset Protection Statements Updated May 2014

18. STW personnel require a clear path to conduct surveys etc. No shrubs or bushes should be planted within 2 metre of the centre line of a sewer, water main or other STW Apparatus.

19. In certain circumstances, both STW and landowners may wish to plant shrubs/bushes in close proximity to a sewer, water main of other STW Apparatus for screening purposes. The following are shallow rooting and are suitable for this purpose: Blackthorn, Broom, Cotoneaster, Elder, Hazel, Laurel, Privet, Quickthorn, Snowberry, and most ornamental flowering shrubs.

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
	C		0	0
	F		0	0
	F		0	0
	F		0	0
	F		0	0
	F		0	0
	F		0	0
	F		0	0
	F		0	0
	F		0	0
	F		0	0
	F		0	0
	F		0	0
	F		0	0
0002	F	112.5	110.15	2.3499999999 9999
0003	F	109.3199	106.73	2.5899
0004	F	104	102.85	1.1500000000 0001
0008	F	103.9	100.53	3.37
0102	F	102.9899	101.92	1.0699
0104	F	103.36	101.22	2.14
0400	F		0	0
0401	F		0	0
0701	F	117.4199	115.9	1.5198999999 9999
0702	F		0	0
0801	F	118.66	117.31	1.3499999999 9999
0802	F		0	0
0803	F	116.65	114.33	2.3200000000 0001
0804	F		0	0
0805	F		0	0
0901	F	113.4499	111.42	2.0299
0905	F	112.3099	108.95	3.3599
0907	F	110.41	106.75	3.66
0959	F	106.66	104.84	1.8199999999 9999
1001	F	101.4	98.82	2.5800000000 0001
1003	F	98.7799	97.01	1.7698999999 9999
1104	F	97.9	95.17	2.73
1106	F	101.9499	100.13	1.8199
1200	F		0	0
1202	F	105.8	104.38	1.42
1207	F	102.8499	100.48	2.3699
1208	F	104.7239	103.53	1.1939
1301	F	111.2399	108.78	2.4599
1303	F	110.8799	109.71	1.1699000000 0001
1304	F	108.6699	107.21	1.4599
1403	F	111.5199	110.46	1.0599000000 0001
1701	F	112.4899	110.26	2.2299
1703	F	107.48	106.17	1.31
1901	F	107.98	105.75	2.23
1902	F	106.25	104.23	2.02
1903	F	105.01	102.72	2.2900000000 0001
1904	F	100.5	97.29	3.2099999999 9999
1905	F	103.3499	100.38	2.9699000000 0001
1906	F	97.47	94.02	3.45
2001	F	94.7099	91.95	2.7599
2005	F	93.76	91.23	2.53
2006	F	91.3499	89.23	2.1199
2008	F	91.2799	88.32	2.9599
2101	F	96.0699	93.7	2.3699
2102	F	95.2799	92.66	2.6199
2103	F	99.47	97.44	2.03
2104	F	100.37	98.56	1.81
2105	F	99.4899	97.68	1.8099
2106	F	97.93	95.99	1.9400000000 0001
2107	F	97.94	95.89	2.05
2201	F	100.87	98.95	1.92
2204	F	99.41	97.78	1.63
2205	F	99.3899	97.43	1.9598999999 9999
2206	F	100.37	97.99	2.3800000000 0001
2208	F	103.68	102.19	1.4900000000 0001
2304	F	102.3799	101.62	0.7599000000 00002
2306	F	100.19	98.06	2.13
2308	F	99.44	97.74	1.7
2402	F	104.4199	102.35	2.0699
2403	F	101.36	98.83	2.53
2504	F	105.9499	104.31	1.6399
2602	F	106.9199	104.51	2.4098999999 9999
2605	F	105.3499	103.33	2.0199000000 0001
2702	F	108.7399	105.49	3.2499000000 0001
2802	F	97.55	95.25	2.3
2803	F	92.5599	88.66	3.8999
2901	F	94.23	91.35	2.8800000000 0001
2903	F	91.7799	90.11	1.6699
2904	F	91.43	89.84	1.59
2909	F	91.9599	89.57	2.3899000000 0001
2963	F	92.4	90.74	1.6600000000 0001
2964	F	92.0999	90.34	1.7599
2965	F	92.0999	90.505	1.5949000000 0001
3000	F		0	0
3001	F	94.05	90.83	3.22
3002	F		0	0
3003	F	89.9	87.44	2.4600000000 0001
3101	F	97.5899	95.78	1.8099
3104	F		0	0
3105	F		0	0
3108	F		0	0
3202	F	95.8499	93.55	2.2999000000 0001
3204	F	94.1999	91.47	2.7299
3206	F	93.19	90.43	2.7599999999 9999
3209	F	92.47	89.37	3.0999999999 9999
3302	F	95.5299	93.56	1.9699
3303	F	94.3899	91.58	2.8099
3403	F	99.7699	96.95	2.8199
3404	F	97.8099	95.19	2.6199
3501	F		0	0
3503	F	98.4599	95.96	2.4999000000 0001
3700	F		0	0
3701	F	95.0699	94.2	0.8699000000 00001
3704	F	97.15	93.76	3.39
3705	F	95.8199	93.21	2.6099000000 0001
3707	F	94.8199	92.64	2.1799
3801	F	90.41	86.5	3.91
3803	F	91.6299	89.25	2.3799000000 0001
3902	F	88.69	86.22	2.47
4101	F	88.8	87.39	1.41
4103	F	87.43	85.66	1.7700000000 0001
4202	F	89.9499	87.87	2.0799
4205	F	90.5999	87.62	2.9799
4206	F	88.5199	86.22	2.2999000000 0001
4301	F	94.18	91.78	2.4000000000 0001
4302	F	92.8799	90.54	2.3399
4304	F	93.18	90.89	2.2900000000 0001
4305	F	91.8099	89.57	2.2399000000 0001
4401	F	94.8799	92.76	2.1199

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
5201	F	89.8499	87.4	2.4499
5204	F	89.2799	86.05	3.2299
5302	F	91.0699	88.56	2.5099
5304	F	89.22	87.01	2.2099999999 9999
5306	F	88.3199	86.61	1.7099
5307	F		0	0
5501	F	93.12	86.38	0
5503	F		0	0
5506	F		0	0
5701	F		76.12	
5702	F		76.68	
5703	F		76.59	
5703	F		0	0
5802	F	83.65	81.73	1.92
5805	F	84.611	0	0
5808	F	83.6679	0	0
5811	F	83.3069	0	0
5814	F	83.234	0	0
5815	F	83.3369	82.837	0.4998999999 99997
5816	F	83.382	83.002	0.3800000000 0001
5901	F		83.27	
6601	F		71.59	
6602	F		68.96	
6701	F		75.17	
6800	F		0	0
6801	F		78.5	
6802	F		0	0
0051	S	110.55	109.69	0.8599999999 99999
0055	S	105.01	103.39	1.62
0056	S	109.33	107.29	2.0399999999 9999
0057	S	103.75	101.05	2.7
0151	S	104.8	102.71	2.09
0153	S	105.4199	104.19	1.2299
0155	S	103.2399	101.3	1.9399000000 0001
0251	S	114.5	113.35	1.1500000000 0001
0252	S	106.5699	104.94	1.6299000000 0001
0253	S	106.1399	104.29	1.8498999999 9999
0752	S	117.11	115.02	2.09
0852	S	116.62	114.87	1.75
0950	S	115.1399	112.94	2.1999
0952	S		0	0
0953	S	114.5199	112.92	1.5999000000 0001
0956	S	112.05	109.55	2.5
0958	S	110.16	107.33	2.83
1052	S	101.2799	99.28	1.9999
1054	S	98.7399	97.32	1.4199000000 0001
1055	S	99.47	97.24	2.23
1056	S	96.15	93.89	2.2600000000 0001
1151	S	103.08	101.8	1.28
1152	S	100.76	99.14	1.62
1153	S		0	0
1155	S	97.72	95.68	2.0399999999 9999
1251	S	107.5199	105.91	1.6099000000 0001
1253	S	104.8099	103.33	1.4799
1254	S	105.16	103.39	1.77
1255	S	104.55	103.02	1.53
1256	S	102.97	101.58	1.39
1352	S	110.8799	109.71	1.1699000000 0001
1454	S	112.5999	111.09	1.5099
1455	S	107.4	105.23	2.17
1456	S	107.29	106.14	1.1500000000 0001
1651	S		0	0
1752	S	112.83	111.14	1.69
1754	S	107.44	106.34	1.0999999999 9999
1755	S	108.54	105.93	2.61
1756	S	114.44	112.53	1.91
1800	S		0	0
1851	S	107.15	105.64	1.5100000000 0001
1951	S	107.0999	104.61	2.4899000000 0001
1952	S	108.01	105.72	2.2900000000 0001
1953	S	107.97	104.98	2.9899999999 9999
1954	S	97.7099	95.3	2.4099000000 0001
1955	S	101.5899	99.27	2.3199
2052	S	94.5199	92.42	2.0999000000 0001
2053	S	94.1299	92.09	2.0399
2054	S	93.79	90.89	2.9000000000 0001
2057	S	91.3399	89.32	2.0199000000 0001
2059	S		0	0
2151	S	95.3399	93.38	1.9599
2152	S	100.3799	96.63	3.7499000000 0001
2153	S	98.3099	96.32	1.9899000000 0001
2154	S	98.6399	96.62	2.0198999999 9999
2155	S	98.0999	96.32	1.7799000000 0001
2252	S	100.87	99.33	1.5400000000 0001
2253	S	99.5	97.45	2.05
2257	S	100.01	98.22	1.7900000000 0001
2351	S	101.1299	99.49	1.6399000000 0001
2352	S	99.91	98.46	1.45
2353	S	100.19	98.06	2.13
2355	S	102.7799	101.19	1.5899
2357	S		0	0
2451	S	105.0699	102.53	2.5399
2454	S	110.15	108.6	1.5500000000 0001
2454	S	100.5999	98.19	2.4099000000 0001
2551	S	110.9199	108.8	2.1199
2552	S	107.87	105.92	1.95
2553	S	106.5699	105.02	1.5499000000 0001
2555	S	105.55	104.08	1.47
2651	S	107.72	105.65	2.0699999999 9999
2653	S	105.37	103.79	1.58
2751	S	100.5	99.1	1.4000000000 0001
2851	S	101.04	98.85	2.1900000000 0001
2854	S	92.76	90.61	2.1500000000 0001
2855	S		0	0
2952	S	93.94	91.79	2.1499999999 9999
2957	S	96.3799	93.84	2.5399
2958	S	92.55	90.958	1.592
2959	S	91.9899	90.027	1.9629
2960	S	91.7799	89.42	2.3599
2961	S	92.25	90.949	1.301
2962	S	0	0	0
3052	S	93.9899	91.34	2.6499
3054	S	89.83	88.03	1.8
3152	S	97.7799	96.16	1.6199
3153	S		0	0
3156	S		0	0
3157	S		0	0
3159	S	92.9	90.69	2.2100000000 0001
3251	S	95.9499	94.01	1.9398999999 9999
3253	S	94.1999	92.11	2.0899
3255	S	93.3899	91.22	2.1699

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
4454	S	90.6399	89.19	1.4499
4454	S	94.3099	92.58	1.7299
4552	S	96.41	94.3	2.11
4553	S	95.54	93.79	1.75
4556	S	94.3099	92.5	1.8099
4652	S	97.6699	96.02	1.6499
4654	S	96.9899	95.51	1.4799
4656	S		0	0
4658	S	92.11	90.36	1.75
4753	S	89.44	87.9	1.5399999999 9999
4852	S	87.36	84.33	3.03
4853	S	86	84.16	1.84
4856	S	86.9899	85.67	1.3199
4952	S	87.33	85.92	1.41
5157	S	86.8	84.68	2.1199999999 9999
5252	S	89.5999	86.97	2.6299000000 0001
5253	S	89.12	85.2	3.92
5257	S	87.98	86.05	1.9300000000 0001
5258	S	88.1299	86.43	1.6999
5351	S	91.15	89.07	2.0800000000 0001
5353	S	89.19	87.41	1.78
5355	S	88.83	87.04	1.7899999999 9999
5358	S	89.0599	86.58	2.4799
5552	S		0	0
5554	S	94.08	92.5	1.58
5555	S	91.97	89.64	2.33
5751	S	86.4599	85.42	1.0399
5752	S	86.4	85.58	0.8200000000 00007
5851	S	84.1299	82.38	1.7499000000 0001
5853	S	83.0599	81.38	1.6799

4403	F	90.6399	89.4	1.239899999999999
4501	F	96.4029	93.913	2.489000000
4504	F	95.51	93.73	1.78
4505	F	94.3499	92.84	1.5099
4601	F	98.0699	96.22	1.849900000
4603	F	96.98	95.22	1.760000000
4605	F		0	0
4607	F	91.9499	90.63	1.3199
4701	F	93.23	91.67	1.56
4702	F		0	0
4704	F	89.5599	88.44	1.1199
4801	F		81.06	
4801	F	88.98	87.31	1.67
4802	F		82.69	
4805	F	87.22	84.6	2.62
4807	F	86.9599	84.95	2.0099
4813	F	83.5199	0	0
4816	F	83.1269	0	0
4901	F		83.02	
4901	F	87.3099	85.1	2.2099
5001	F		85.33	
5101	F	87.9199	85.46	2.4599
5105	F	87.4199	85.66	1.7599
5106	F		0	0

4452	S	94.3099	92.48	1.829899999999999
4456	S	90.0299	89.23	0.799899999999999
4352	S	92.91	91.32	1.59
4257	S	88.5999	86.79	1.8099
4254	S	90.2399	87.96	2.279000000
4253	S	89.8399	87.39	2.4499
4251	S	90.2699	88.09	2.1799
4152	S	87.8	85.86	1.94
4152	S	87.9499	86.18	1.769899999999999
4151	S	89	87.5	1.5
3955	S	88.1299	87.18	0.9499
3954	S	88.54	87.73	0.810000000
3953	S	89.0999	87.09	2.0099
3951	S	88.9	86.24	0.660000000
3852	S	90.2799	88.16	2.1199
3758	S		0	0
3756	S	95.33	93.29	2.029999999999999
3753	S		0	0
3752	S	95.0899	93.9	1.189899999999999
3651	S	100.5999	98.91	1.689900000
3554	S	98.4899	96.24	2.249900000
3552	S	100.7999	98.33	2.379900000
3455	S	97.75	95.61	2.14
3452	S	99.7699	97.27	2.499900000
3451	S	100.44	99.47	0.969999999999999
3354	S	94.4	92.3	2.100000000
3351	S	95.9199	94.29	1.629899999999999
3258	S	92.48	89.86	2.62
3257	S	93.18	90.83	2.350000000

(c) Crown copyright and database rights 2019 Ordnance Survey 100031673 | Date: 27/11/19 | Scale: 1:1250 | Map Centre: 387302,287307 | Data updated: 31/07/19 | Our Ref: 355791 - 1 | Wastewater Plan A0

piriyasha.jeyanayagam@wsp.com

Lawnswood Road West

SEVERN TRENT

SEVERN TRENT

GENERAL CONDITIONS AND PRECAUTIONS TO BE TAKEN WHEN CARRYING OUT WORK ADJACENT TO SEVERN TRENT WATER'S APPARATUS

Please ensure that a copy of these conditions is passed to your representative and/or your contractor on site. If any damage is caused to Severn Trent Water Limited (STW) apparatus (defined below), the person, contractor or subcontractor responsible must inform STW immediately on:
0800 783 4444 (24 hours)

a) These general conditions and precautions apply to the public sewerage, water distribution and cables in ducts including (but not limited to) sewers which are the subject of an Agreement under Section 104 of the Water Industry Act 1991(a legal agreement between a developer and STW, where a developer agrees to build sewers to an agreed standard, which STW will then adopt); mains installed in accordance with an agreement for the self-construction of water mains entered into with STW and the assets described at condition b) of these general conditions and precautions. Such apparatus is referred to as "STW Apparatus" in these general conditions and precautions.

b) Please be aware that due to The Private Sewers Transfer Regulations June 2011, the number of public sewers has increased, but many of these are not shown on the public sewer record. However, some idea of their positions may be obtained from the position of inspection covers and their existence must be anticipated.

c) On request, STW will issue a copy of the plan showing the approximate locations of STW Apparatus although in certain instances a charge will be made. The position of private drains, private sewers and water service pipes to properties are not normally shown but their presence must be anticipated. This plan and the information supplied with it is furnished as a general guide only and STW does not guarantee its accuracy.

d) STW does not update these plans on a regular basis. Therefore the position and depth of STW Apparatus may change and this plan is issued subject to any such change. Before any works are carried out, you should confirm whether any changes to the plan have been made since it was issued.

e) The plan must not be relied upon in the event of excavations or other works in the vicinity of STW Apparatus. It is your responsibility to ascertain the precise location of any STW Apparatus prior to undertaking any development or other works (including but not limited to excavations).

f) No person or company shall be relieved from liability for loss and/or damage caused to STW Apparatus by reason of the actual position and/or depths of STW Apparatus being different from those shown on the plan.

In order to achieve safe working conditions adjacent to any STW Apparatus the following should be observed:

1. All STW Apparatus should be located by hand digging prior to the use of mechanical excavators.

2. All information set out in any plans received from us, or given by our staff at the site of the works, about the position and depth of the mains, is approximate. Every possible precaution should be taken to avoid damage to STW Apparatus. You or your contractor must ensure the safety of STW Apparatus and will be responsible for the cost of repairing any loss and/or damage caused (including without limitation replacement parts).

3. Water mains are normally laid at a depth of 900mm. No records are kept of customer service pipes which are normally laid at a depth of 750mm; but some idea of their positions may be obtained from the position of stop tap covers and their existence must be anticipated.

4. During construction work, where heavy plant will cross the line of STW Apparatus, specific crossing points must be agreed with STW and suitably reinforced where required. These crossing points should be clearly marked and crossing of the line of STW Apparatus at other locations must be prevented.

5. Where it is proposed to carry out piling or boring within 20 metres of any STW Apparatus, STW should be consulted to enable any affected STW Apparatus to be surveyed prior to the works commencing.

6. Where excavation of trenches adjacent to any STW Apparatus affects its support, the STW Apparatus must be supported to the satisfaction of STW. Water mains and some sewers are pressurised and can fail if excavation removes support to thrust blocks to bends and other fittings.

7. Where a trench is excavated crossing or parallel to the line of any STW Apparatus, the backfill should be adequately compacted to prevent any settlement which could subsequently cause damage to the STW Apparatus. In special cases, it may be necessary to provide permanent support to STW Apparatus which has been exposed over a length of the excavation before backfilling and reinstatement is carried out. There should be no concrete backfill in contact with the STW Apparatus.

8. No other apparatus should be laid along the line of STW Apparatus irrespective of clearance. Above ground apparatus must not be located within a minimum of 3 metres either side of the centre line of STW Apparatus for smaller sized pipes and 6 metres either side for larger sized pipes without prior approval. No manhole or chamber shall be built over or around any STW Apparatus.

9. A minimum radial clearance of 300 millimetres should be allowed between any plant or equipment being installed and existing STW Apparatus. We reserve the right to increase this distance where strategic assets are affected.

10. Where any STW Apparatus coated with a special wrapping is damaged, even to a minor extent, STW must be notified and the trench left open until the damage has been inspected and the necessary repairs have been carried out. In the case of any material damage to any STW Apparatus causing leakage, weakening of the mechanical strength of the pipe or corrosion-protection damage, the necessary remedial work will be recharged to you.

11. It may be necessary to adjust the finished level of any surface boxes which may fall within your proposed construction. Please ensure that these are not damaged, buried or otherwise rendered inaccessible as a result of the works and that all stop taps, valves, hydrants, etc. remain accessible and operable. Minor reduction in existing levels may result in conflict with STW Apparatus such as valve spindles or tops of hydrants housed under the surface boxes. Checks should be made during site investigations to ascertain the level of such STW Apparatus in order to determine any necessary alterations in advance of the works.

12. With regard to any proposed resurfacing works, you are required to contact STW on the number given above to arrange a site inspection to establish the condition of any STW Apparatus in the nature of surface boxes or manhole covers and frames affected by the works. STW will then advise on any measures to be taken, in the event of this a proportionate charge will be made.

13. You are advised that STW will not agree to either the erection of posts, directly over or within 1.0 metre of valves and hydrants,

14. No explosives are to be used in the vicinity of any STW Apparatus without prior consultation with STW.

TREE PLANTING RESTRICTIONS

There are many problems with the location of trees adjacent to sewers, water mains and other STW Apparatus and these can lead to the loss of trees and hence amenity to the area which many people may have become used to. It is best if the problem is not created in the first place. Set out below are the recommendations for tree planting in close proximity to public sewers, water mains and other STW Apparatus.

15. Please ensure that, in relation to STW Apparatus, the mature root systems and canopies of any tree planted do not and will not encroach within the recommended distances specified in the notes below.

16. Both Poplar and Willow trees have extensive root systems and should not be planted within 12 metres of a sewer, water main or other STW Apparatus.

17. The following trees and those of similar size, be they deciduous or evergreen, should not be planted within 6 metres of a sewer, water main or other STW Apparatus. E.g. Ash, Beech, Birch, most Conifers, Elm, Horse Chestnut, Lime, Oak, Sycamore, Apple and Pear. Asset Protection Statements Updated May 2014

18. STW personnel require a clear path to conduct surveys etc. No shrubs or bushes should be planted within 2 metre of the centre line of a sewer, water main or other STW Apparatus.

19. In certain circumstances, both STW and landowners may wish to plant shrubs/bushes in close proximity to a sewer, water main of other STW Apparatus for screening purposes. The following are shallow rooting and are suitable for this purpose: Blackthorn, Broom, Cotoneaster, Elder, Hazel, Laurel, Privet, Quickthorn, Snowberry, and most ornamental flowering shrubs.

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert
0002	F	112.5	110.15	2.34999999999999
0003	F	109.3199	106.73	2.5899
0602	F	120.413	0	0
0701	F	117.65	115.39	2.26000000000001
0704	F		0	0
4802	F		82.69	
4901	F		83.02	
5001	F		85.33	
5901	F		83.27	
6800	F		0	0
6801	F		78.5	
6802	F		0	0
0056	S	109.33	107.29	2.03999999999999
0153	S	105.4199	104.19	1.2299
0252	S	106.5699	104.94	1.62990000000001
0554	S	122.76	121.61	1.15000000000001

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Manhole Reference	Liquid Type	Cover Level	Invert Level	Depth to Invert

Secker, Phoebe

From: Net Dev West <net.dev.west@severntrent.co.uk>
Sent: 10 December 2019 12:24
To: Secker, Phoebe
Cc: Jeyanayagam, Piriyasha
Subject: Lanswood Road DY7 5AW OUR REF: 2019112524098

Follow Up Flag: Follow up
Flag Status: Flagged

Hi Phoebe,

Thank you for your email dated 25th November, regarding the named site.
Having reviewed our records, I can confirm we have recorded flooding incidents within the area. However, due to the sensitivity of the data, we are not in a position to share specifics or location of the incidents.

Regards,
Matthew Evans

Asset Protection (wastewater)
Severn Trent Water Ltd

Tel: 0345 266 7930

From: Secker, Phoebe [mailto:Phoebe.Secker@wsp.com]
Sent: 25 November 2019 09:48
To: Net Dev West <net.dev.west@severntrent.co.uk>
Cc: Jeyanayagam, Piriyasha <piriyasha.jeyanayagam@wsp.com>
Subject: Lawnswood Road

Dear Sir/Madam,

WSP has been appointed to undertake a flood risk assessment (FRA) and drainage strategy for a site at Lawnswood Road, an approximate postcode is DY7 5AW (site co-ordinates 387309, 287480).

Please find the following site location plan for reference.

We would like to request any records of flooding for the site or local area that you hold.

Many thanks,
Phoebe

Phoebe Secker ***BSc (Hons) MCIWEM***
Assistant Engineer

T +44 (0) 121 352 4926
F +44 (0) 121 352 4701

WSP, The Mailbox
Level 2
100 Wharfside Street
Birmingham
B1 1RT

wsp.com

The Mailbox
Level 2
100 Wharfside Street
Birmingham
B1 1RT

wsp.com