Merton College

YARNTON, OXFORDSHIRE

Flood Risk Assessment and Drainage Strategy

MC-WSP-YARN-XXXX-RE-D-0502
OCTOBER 2021

CONFIDENTIAL

Merton College

YARNTON, OXFORDSHIRE

Flood Risk Assessment and Drainage Strategy

REPORT (RV5) CONFIDENTIAL

PROJECT NO. 70048642

OUR REF. NO. MC-WSP-YARN-XXXX-RE-D-0502

DATE: OCTOBER 2021

WSP

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

Phone: +44 121 352 4700

WSP.com

QUALITY CONTROL

Issue/revision	First issue	Revision 3	Revision 4	Revision 5
Remarks	Draft for Comment	Updated from Comments	Updated for July 2021 NPPF	PDF Split Into Two Parts
Date	September 2020	October 2020	September 2021	October 2021
Prepared by	Aimee Durkin	Phoebe Ryding	Aimee Durkin	Aimee Durkin
Signature				[redacted] Digitally signed by Durkin, Aimee (UKAMD008) DN: cn=Durkin, Aimee (UKAMD008), ou=Active, email=Aimee.Durkin@wsp.com Date: 2021.10.05 12:04:42 +01'00'
Checked by	Chris Brammeier & Phoebe Ryding	Chris Brammeier	Chris Brammeier	Chris Brammeier
Signature				[redacted] Brammeier, Chris (UKCSB002) 2021.10.05 12:12:05 +01'00'
Authorised by	Alison Caldwell	Alison Caldwell	Greg Dobbins	Jyoti Goyal
Signature				
Project number	70048642			
Report number	FRA005			
File reference	MC-WSP-YARN-XXXX-RE-D-0502			

CONTENTS

EXECUTIVE SUMMARY 1

1. INTRODUCTION 2

2. SITE SETTING 5

3. POLICY CONTEXT 11

4. ASSESSMENT OF FLOOD RISK 13

5. SURFACE WATER DRAINAGE 20

6. OPERATION AND MAINTENANCE 30

7. CONCLUSIONS AND RECOMMENDATIONS 34

TABLES

Table 1 - Stakeholder Consultation Summary 3

Table 2 –Meeting Advice and Response of FRA & Surface Water Drainage Strategy 4

Table 3 - BGS Borehole Summary 10

Table 4 - Flood Risk Overview 13

Table 5 - Flood Vulnerability and Flood Zone Compatibility (PPG Table 3) 15

Table 6 - SuDS Drainage Hierarchy 22

Table 7 - Summary of SuDS Selection 24

Table 8 – Green Field Run-Off Rates 25

Table 9 – Site Run-Off Assessment 26

Table 10 – Site Attenuation Requirements 27

Table 11 – Attenuation Basin Design Risk Consideration 29

Table 12 - Flow Control (e.g Hydrobrake) Indicative Maintenance Schedule 30

Table 13 - Attenuation Basin Indicative Maintenance Schedule 31

Table 14 - Swale Indicative Maintenance Schedule 32

Table 15 - Infiltration Blanket/ Trench Indicative Maintenance Schedule 33

FIGURES

Figure 1 - Site Location 5

Figure 2 - Baseline Drainage Features 7

Figure 3 - Outfall A (Northern Outfall) 8

Figure 4 - Outfall B (Central Outfall) 8

Figure 5 - Outfall C (Southern Outfall) 9

Figure 6 - BGS Bedrock and Superficial Deposits Map Extract 9

Figure 7 - Environment Agency Flood Map for Planning 14

Figure 8 - Surface Water Flood Risk Map 16

Figure 9 – 'Cut-off' ditch and Basin Performance 17

Figure 10 - Baseline Existing Surface Water Drainage Features 20

Figure 11 - Indicative drawing demonstrating identified outfalls, indicative existing sewers and surrounding watercourses. 21

Figure 12 - Extract from MC-WSP-YARN-XXXX-SK-D-0501 23

APPENDICES

APPENDIX A DRAWINGS

APPENDIX B CALCULATIONS

APPENDIX B.1 GREENFIELD RUN-OFF

APPENDIX B.2 1 IN 100 YEAR PLUS CLIMATE CHANGE

APPENDIC B.3 DEVELOPMENT CREEP

APPENDIX C CORRESPONDENCE

APPENDIX D HIGH LEVEL SURFACE WATER HYDRAULIC MODELLING

EXECUTIVE SUMMARY

This Flood Risk Assessment (FRA) has been undertaken to support the proposed outline planning application for site PR9.identified in Cherwell Local Plan 2011 – 2031 (Part1) Partial Review. This FRA has been produced in accordance with the guidelines set out in the National Planning Policy Framework (NPPF) published in July 2021 along with other relevant local and national guidance including CIRIA C624 Development and Flood Risk.

Item	Overview
Site Location	The proposed development site is located on an area of undeveloped, greenfield land alongside the A44/Woodstock Road, between Begbroke to the north and Yarnton to the south. The site is approximately 11 km north of the city of Oxford. It is identified as Site PR9 in the Cherwell Local Plan 2011 – 2031 (Part1) Partial Review – Oxford's Unmet Housing Need'
Development Proposals	The development proposals comprise up to 540 dwellings, elderly / extra care residential floorspace, a community home work hub, together with associated green infrastructure, meadowland and community woodland.
Environment Agency Flood Zone(s)	In accordance with the publicly available Flood Map for Planning, the proposed development site has been identified to lie wholly within Flood Zone 1.
Vulnerability Classification(s)	'More Vulnerable' – residential development.
Fluvial Flood Risk	Low risk of fluvial flooding.
Tidal Flood Risk	Very low risk of tidal flooding.
Surface Water Flood Risk	Low risk of surface water flooding.
Groundwater Flood Risk	Low risk of ground water flooding.
Sewer Flood Risk	Low risk of sewer flooding.
Artificial Flood Risk	Low risk of flooding from artificial sources.
Storm Drainage	Surface water within the site will be directed into a network of swales and attenuation basins, run-off rates are to be limited to the existing site-specific greenfield rate for all events up to and including the 100 year plus climate change event.

1. INTRODUCTION

1.1. BACKGROUND

1.1.1. WSP UK Ltd (WSP) has been appointed by Merton College, Oxford to prepare a Flood Risk Assessment (FRA) and a surface water drainage strategy to support the outline planning application for the proposed residential development site at Yarnton, Cherwell, Oxfordshire (Approximate nearest postcode: OX5 1FW) and will be defined as 'the Site' throughout the FRA.

1.1.2. The 'Proposed Development' comprise up to 540 dwellings, elderly / extra care residential floorspace, a community home work hub, together with associated green infrastructure, meadowland and community woodland.

1.1.3. The site is allocated as 'PR9 Land West of Yarnton' in Cherwell District Council's Local Plan 2011 – 2031 (Part1) Partial Review – 'Oxford's Unmet Housing Need'.

1.1.4. 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:

- Identify the likely potential sources of flooding which may affect the site;
- Undertake an appraisal of the flood risk posed to the site and potential impact of the development on flood risk elsewhere; and,
- Provide an indicative surface water drainage strategy to demonstrate that surface water from the proposed development may be sustainably managed.

1.2. LIMITATIONS

1.2.1. WSP has prepared this report in accordance with the instructions of their client, Merton College, 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, 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 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 in 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 Merton College, is made aware of their duties under the CDM Regulations.

1.4. SCOPE OF ASSESSMENT

1.4.1. The assessment has been undertaken in accordance with the overarching national requirements for Flood Risk Assessments for proposed developments including, but not limited to, the following:

- National Planning Policy Framework (NPPF) (July 2021)

- Development and Flood Risk (C624)
- The SuDS Manual (CIRIA C753)
- Flood Risk Assessments: Climate Change Allowances 2016
- 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 for the proposed outline planning application for the proposed residential development at Yarnton (allocation reference PR9).

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, summarised in Table 1, received.

Table 1 - Stakeholder Consultation Summary

Stakeholder	Date Received	Comments
Thames Water	09.10.2018	Clean water and waste water pipeline data within Asset Location Search Documentation.
Oxfordshire County Council	02.01.2019	Confirmation of ownership of the drainage ditch running alongside the A44/Woodstock Road.
Cherwell District Council	15.07.2020	A meeting was held with Tony Brummel, Flood Risk Officer, which is detailed below.

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

1.6. MEETING NOTES

A meeting was held with Tony Brummel (Cherwell District Council) on the 15th July 2020 which identified that the proposals were generally acceptable. The key points raised through this and how these have been incorporated into the proposals are summarised in Table 2 below.

Table 2 –Advice Identified in Meeting with Tony Brummel, CDC, 15/7/2020, and Response of FRA & Surface Water Drainage Strategy

Key Point	CDC Comment	Response
Thames Water Rising Mains	It is noted that Thames Water Foul Rising Mains cross the existing site.	These rising mains are to be diverted or a suitable easement will be provided from the rising mains.
Existing Drainage Infrastructure	Surface water flows through Rutten Lane, as any highway drainage will have little / no capacity and the sewers to serve the development east of the site will only have been designed to have capacity to serve the existing development.	Surface water discharges from the site are not proposed to discharge to the sewers in Rutten Lane.
Surface Water Attenuation Basins	The attenuation areas must be people friendly spaces and consider pedestrian and cycle crossings	The areas of surface water attenuation will incorporate walkways and crossings to be further considered at detailed design.
Surface Water Attenuation Basins	Pond side slopes should be no greater than 1:4.	Ponds have been designed with side slopes at 1:4.
Surface Water Drainage	Need to demonstrate the proposal does not concentrate flows on the south-western corner of the site which could potentially exacerbate flood risk.	Surface water hydraulic modelling has been undertaken which demonstrates that existing flood risk is not exacerbated, and the site is suitable for development.
Existing Overland Flow Routes	Need to demonstrate we protect the proposed development from flows entering the site from the north and west.	A series of cut-off ditches have been proposed which are demonstrated through hydraulic modelling to provide a level of protection to the proposed development site.
Existing Overland Flow Routes	In storm events, large flows are identified down Frogwelldown Lane, which then flow down Cassington Road and pool at the junction of Rutten Lane and Cassington Road.	Cherwell District Policy identifies that the land to the south & east of the site will remain as greenbelt and as such it is highly recommended that we avoid works in this location and levels seem unlikely to work to provide a solution within the development boundary.

2. SITE SETTING

2.1. LOCATION

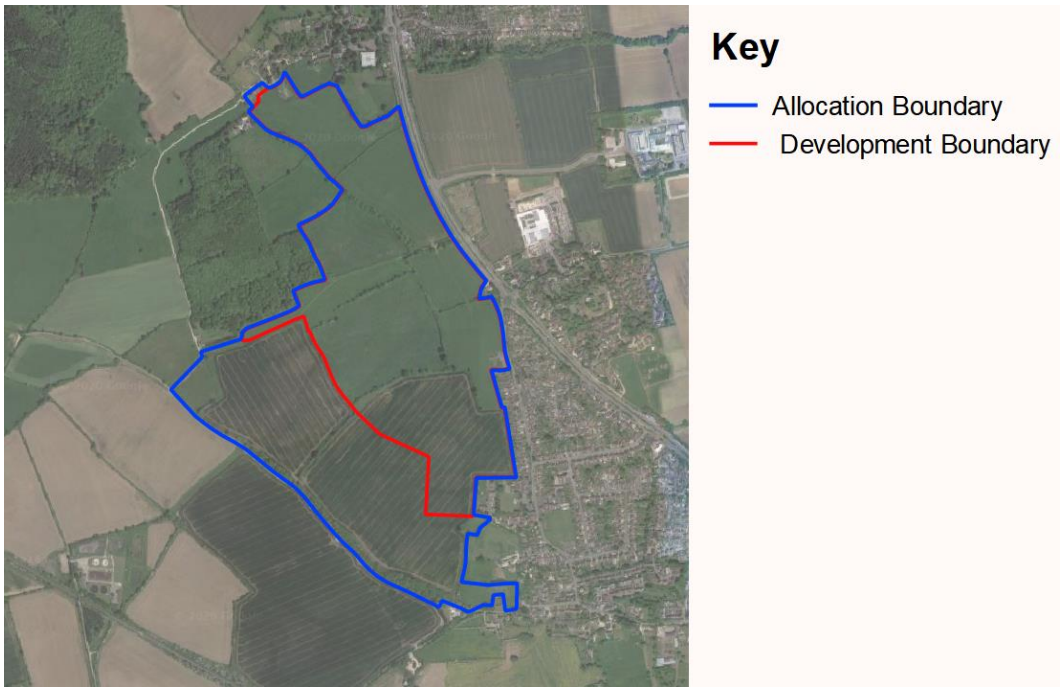
2.1.1. The development site is located in existing agricultural, undeveloped land located alongside the A44/Woodstock Road, between Begbroke to the north and Yarnton to the south. The site is approximately 11 km north of the city of Oxford. An approximate postcode for the site is OX5 1LT.

2.1.2. The site is bound:

- To the East by the A44 and existing residential development and associated Medical Centre and Primary School;
- To the south west by Frogwelldown lane;
- To the north west by existing fields.

2.1.3. The extent of the PR9 Local Plan allocation boundary is shown in Figure 1, alongside the proposed development boundary.

Figure 1 - Site Location



2.2. DEVELOPMENT PROPOSALS

2.2.1. Cherwell District Council's Local Plan Part One Partial Review (Adopted September 2020) identifies the site as PR9 'Land West of Yarnton'. It is described as follows:

2.2.2. *"A village extension to Yarnton will be developed within 99 hectares of land to the west of Yarnton… Development proposals will be permitted if they meet the following requirements:*

- *Construction of 540 dwellings (net) on approximately 25 hectares of land (the residential area as shown).*
- *The provision of 50% of the homes as affordable housing as defined by the National Planning Policy Framework.*

- *The provision of 1.8 hectares of land for use by the existing William Fletcher Primary School to enable potential school expansion within the existing school site and the replacement of playing pitches and amenity space.*
- *The provision of facilities for formal sports, play areas and allotments to adopted standards within the developable area (unless shared or part shared use with William Fletcher Primary School is agreed with the Education Authority).*
- *The provision of public open green space as informal parkland on 24.8 hectares of land to the west of the residential area and a new Local Nature Reserve accessible to William Fletcher Primary School.*
- *The creation of an area of a community woodland within 7.8 hectares of land to the north-west of the developable area and to the east of Dolton Lane.*
- *The retention of 39.2 hectares of land in agricultural use in the location shown.*

2.3. TOPOGRAPHY

2.3.1. A detailed topographic survey of the site was undertaken by MK Surveys in September 2018, and is provided in Appendix A.

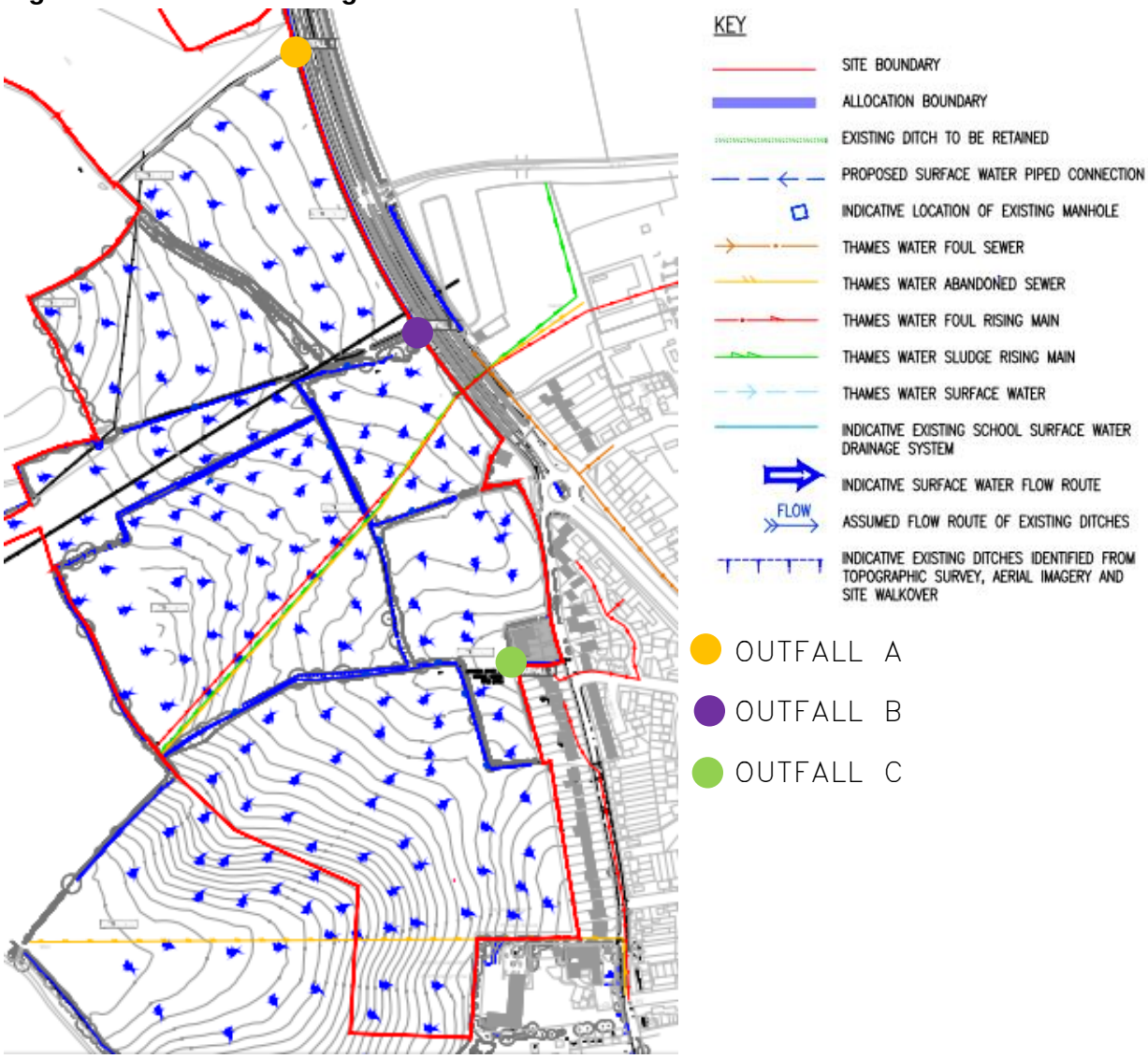
2.3.2. The survey identifies the site to have a maximum elevation of approximately 84mAOD to the south-western extent, and a minimum elevation of approximately 66mAOD in the south east. Generally, the site slopes from west to east, towards the A44.

2.1. EXISTING SURFACE WATER DRAINAGE NETWORK

2.1.1. The site is currently formed by existing agricultural land which has been assumed to drain through a series of ditches which convey surface water runoff throughout the site, the location and connection of these ditches were identified by the topographic survey alongside analysis of aerial images, the publicly available Flood Risk from Surface Water map and site visits.

2.1.2. During the site visit, three potential outfalls of the site were identified and labelled as Outfall 1, 2 and 3 on the baseline drainage features plan, contained within Appendix A, YARN-XXXX-SK-D-0504. An extract of this is provided in Figure 2.

Figure 2 - Baseline Drainage Features



2.1.3. Photographs taken on the site visit have been included as Figure 3, Figure 4 and Figure 5 that demonstrate the condition of the outfalls identified.

Figure 3 - Outfall A (Northern Outfall)

Figure 4 - Outfall B (Central Outfall)

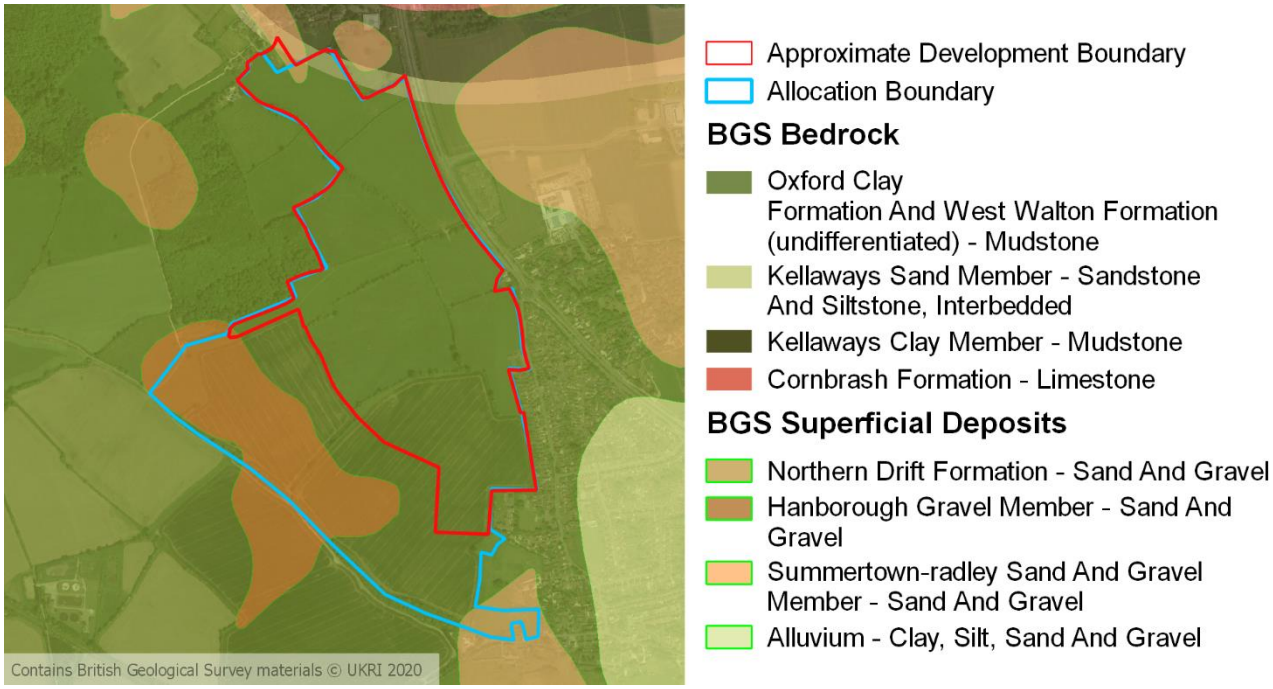
Figure 5 - Outfall C (Southern Outfall)

2.2. GEOLOGICAL AND HYDROGEOLOGICAL CONTEXT

Geology

2.2.1. Reference to the available BGS published mapping identifies the whole site to be underlain by bedrock of 'Oxford Clay Formation and West Walton Formation (undifferentiated) - Mudstone', with the northern most edges also underlain by Kellaways Sand Member – Sandstone and Siltstone, Interbedded, shown by Figure 6. The site has no identified superficial deposits.

Figure 6 - BGS Bedrock and Superficial Deposits Map Extract



2.2.2. There are no boreholes registered within the site boundary. However, Borehole SP41SE14 is located in the middle of the A44/Woodstock Road, adjacent to the site in the centre of the north Yarnton roundabout, and therefore may be considered to be representative of the underlying geology of the site. This has been summarised in Table 3.

Table 3 - BGS Borehole Summary

Description	Approximate Depth [mBGL]
Oxford Clay	0 – 6.9
Kellaways Sand	6.9 – 7.6 (End of borehole)

2.2.3. Groundwater was not identified or recorded in this borehole.

Hydrogeology

2.2.4. The online BGS Aquifer Map (Bedrock Designation) indicates that most of the site is underlined by an unproductive aquifer. This is assigned where there is 'geological strata with low permeability that have negligible significance for water supply or river base flow'.

2.2.5. According to the Source Protection Zone map provided by the Environment Agency, the site does not lie within any Source Protection Zone.

2.2.6. Given the underlying London Clay of the site geology, low infiltration rates are likely across the development site. Infiltration testing should be undertaken at the next stage to inform the detailed design of the proposed development site.

3. POLICY CONTEXT

3.1. NATIONAL PLANNING POLICY FRAMEWORK 2021

3.1.1. The Updated National Planning Policy Framework (NPPF), published in July 2021, sets out the Government's national policies for flood risk management in a land use planning context within England.

3.1.2. Paragraph 159 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 (Paragraph 167) 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 must therefore be considered against a risk-based search sequence as provided by the guidance.

3.2. LOCAL PLANNING POLICY

Cherwell Level 1 Strategic Flood Risk Assessment (SFRA) – May 2017

3.2.1. The SFRA Level 1 reveals that there have been small scale instances of flooding related to the River Cherwell Corridor in July 2007 (4 properties) and January 2008 (1 property).

3.2.2. This site nor any of the local watercourses are mentioned within this document.

Cherwell Level 2 Strategic Flood Risk Assessment (SFRA) – May 2017

3.2.3. The Level 2 SFRA references the PR9 allocation site, identified as SFRA Site 51 - Land to west of A44/Rutten Lane, north of Cassington Road.

3.2.4. Section 9 "Assessment of Strategic Sites in Yarnton" addresses the site and provides information on sources of flood risk and recommendations. In relation to the fluvial and sewer flood risk of the site the SFRA states that:

> *"there are no Main Rivers or Ordinary Watercourses flowing through the site or immediately adjacent to the site, but there are several land drains flowing through the site. Most of the drains are present on the north and north eastern side of the site. Additional land drains are also present on the west of the site. These drain into an Ordinary Watercourse before flowing into the River Thames … There are no recorded incidents of flooding on this site."*

> *"The Thames Water (TW) DG5 register identifies 20-25 recorded incidents of foul sewer flooding within the post code area covering the eastern half of the site between 2006 and 2016, and 0-5 recorded in the post code area covering the western half."*

3.2.5. The document provides guidance and recommendations on the approach of a surface water drainage system and FRA:

> *"As the area is primarily greenfield, any development within the area will increase surface water runoff (unless attenuated). A surface water management framework should be adopted as part of a masterplan to reduce surface water runoff to greenfield runoff rates and volumes*

from the developed site as required by the EA, and as such prevent any resultant increase in flood risk posed downstream."

3.2.6. The information provided in the SFRA has been incorporated throughout this report.

The Cherwell Local Plan 2011-2031 (Part 1) Partial Review – Adopted 7 September 2020

3.2.7. The site is described as a "*village extension to Yarnton will be developed within 99 hectares of land to the west of Yarnton.*"

3.2.8. Development proposals will be permitted so far as they meet the following requirements:

"*Key Delivery Requirements*

- *Construction of 540 dwellings (net) on approximately 25 hectares of land (the residential area as shown).*
- *The provision of 50% of the homes as affordable housing as defined by the National Planning Policy Framework.*
- *The provision of 1.8 hectares of land for use by the existing William Fletcher Primary School to enable potential school expansion within the existing school site and the replacement of playing pitches and amenity space.*
- *The provision of facilities for formal sports, play areas and allotments to adopted standards within the developable area (unless shared or part shared use with William Fletcher Primary School is agreed with the Education Authority).*
- *The provision of public open green space as informal parkland on 24.8 hectares of land to the west of the residential area and a new Local Nature Reserve accessible to William Fletcher Primary School.*
- *The creation of an area of a community woodland within 7.8 hectares of land to the north-west of the developable area and to the east of Dolton Lane.*
- *The retention of 39.2 hectares of land in agricultural use in the location shown."*

3.2.9. The policy additionally sates that "*The application shall be supported by a Flood Risk Assessment informed by a suitable ground investigation and having regard to guidance contained within the Council's Level 2 Strategic Flood Risk Assessment. A surface water management framework shall be prepared to maintain run off rates to greenfield run off rates and volumes, with use of Sustainable Drainage Systems in accordance with adopted Policy ESD7, taking into account recommendations contained in the Council's Level 1 and Level 2 SFRAs.*"

- Policy ESD7 states that SuDS are considered to be suitable for use in association with developments across the District. In considering SuDS solutions, the need to protect ground water quality must be taken into account, especially where infiltration techniques are proposed. Where possible, multiple benefits including for recreation and wildlife should be delivered. Proposals must include an agreement on the future management, maintenance and replacement of the drainage structures. The policy also states that non-highway SuDS draining two properties or more will be adopted by the Local Lead Flood Authority (LLFA) after Schedule 3 of the Flood and Water Management 2010 Act comes into force.

4. ASSESSMENT OF FLOOD RISK

4.1. OVERVIEW

4.1.1. Following completion of a desk-based assessment, the possible flooding mechanisms at the site are summarised in Table 4.

Table 4 - Flood Risk Overview

Mechanism	Risk	Comment
Fluvial	Low	The proposed built development is located wholly within Flood Zone 1.
Tidal	Very Low	The site is located inland.
Surface Water	Low	High level hydraulic modelling has been undertaken to enhance understanding of the baseline and proposed development conditions. Through the modelling undertaken to date, the risk of surface water flooding to future development may be considered to be low.
Groundwater	Low	Given the underlying site geology; location of the majority of the site within the <25% risk category for the Environment Agency's Areas Susceptible to Groundwater Flooding mapping; and that no groundwater was recorded in the nearest borehole, it may be assumed that groundwater poses a low risk of flooding to the site.
Sewers	Low	There are Thames Water Rising Mains identified that cross through the centre of the site. As part of future development it is suggested that these rising mains could be diverted or a suitable easement will be provided from the rising mains the development, therefore it may be reasonable to consider the site to be at low risk of sewer flooding.
Artificial Sources	Low	The site is not located within any area of influence of reservoir flooding so risk of flooding from artificial sources may be considered to be low.

4.2. HISTORIC FLOODING

4.2.1. The publicly available Historical Flood Map was inspected and showed that there were no events of flooding recorded within the site boundary. Additionally, reference to historical flooding incidents reported to Oxfordshire County Council (contained within the LLFA in Cherwell District Council's Level 2 SFRA) identify no incidents of historic flooding within the site.

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, indicating that the land is assessed as having a less than 1 in 1,000 annual probability of river flooding.

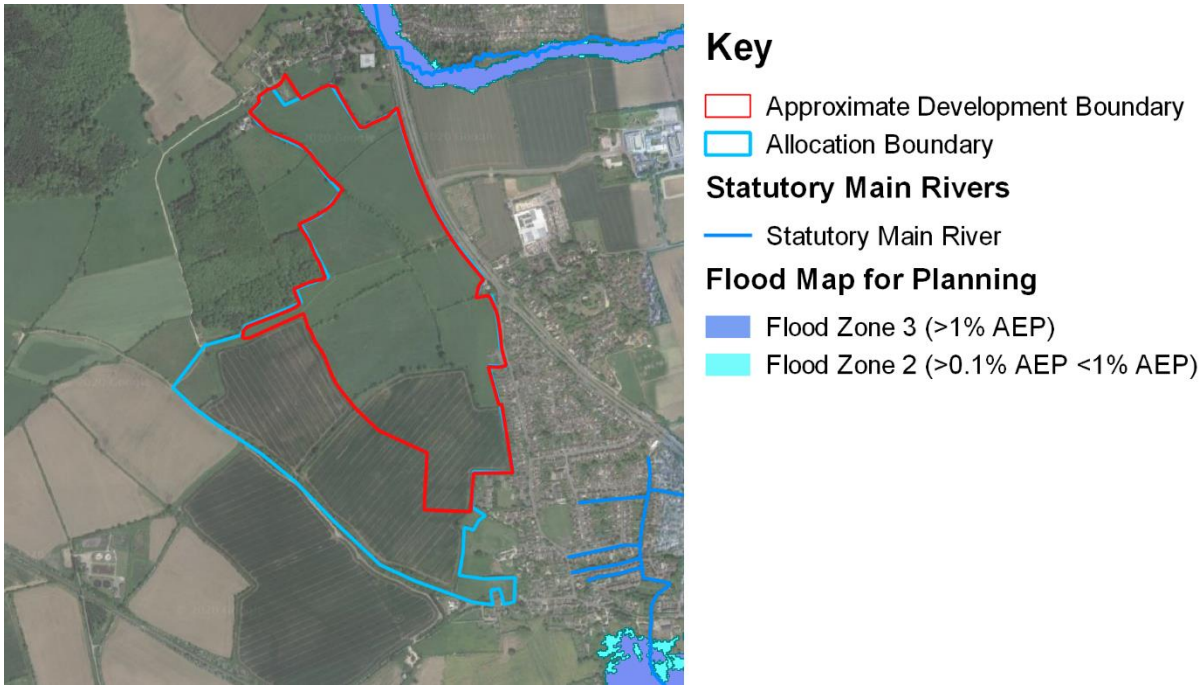
4.3.2. The nearest Main River to the site, with associated flood extents, has been identified on the publicly identified Flood Map for Planning. The Rowel Brook, an Environment Agency Main River, is located approximately 200m north of the site.

4.3.3. Additionally, a network of culverted and un-culverted ordinary watercourses has been identified within an existing residential development approximately 250m south east of the development boundary.

4.3.4. In the Cherwell Level 2 Strategic Flood Risk Assessment (SFRA) – May 2017 section on River Flood Risk for the site, it states that *"there are no recorded incidents of [river] flooding on this site".*

4.3.5. An extract of the Flood Map for Planning is set out below as Figure 7.

Figure 7 - Environment Agency Flood Map for Planning



Vulnerability Classification

4.3.6. The proposed 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"*

Sequential and Exception Test

4.3.7. Given the site is located wholly within Flood Zone 1, in accordance with current national guidance (PPG Table 3), the site is not required to undertake the Sequential and Exception Tests and is considered to be an appropriate location for development.

Table 5 - Flood Vulnerability and Flood Zone Compatibility (PPG Table 3)

Flood Risk Vulnerability Classification	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Flood Zone 1	✓	✓	✓	✓	✓
Flood Zone 2	✓	Exception Test Required	✓	✓	✓
Flood Zone 3a	Exception Test Required	Exception Test Required	Exception Test Required	✓	✓
Flood Zone 3b	Exception Test Required	Exception Test Required	x	x	✓

4.3.8. Given the proposed location of the proposed development site is wholly within Flood Zone 1, fluvial flood risk is considered low.

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

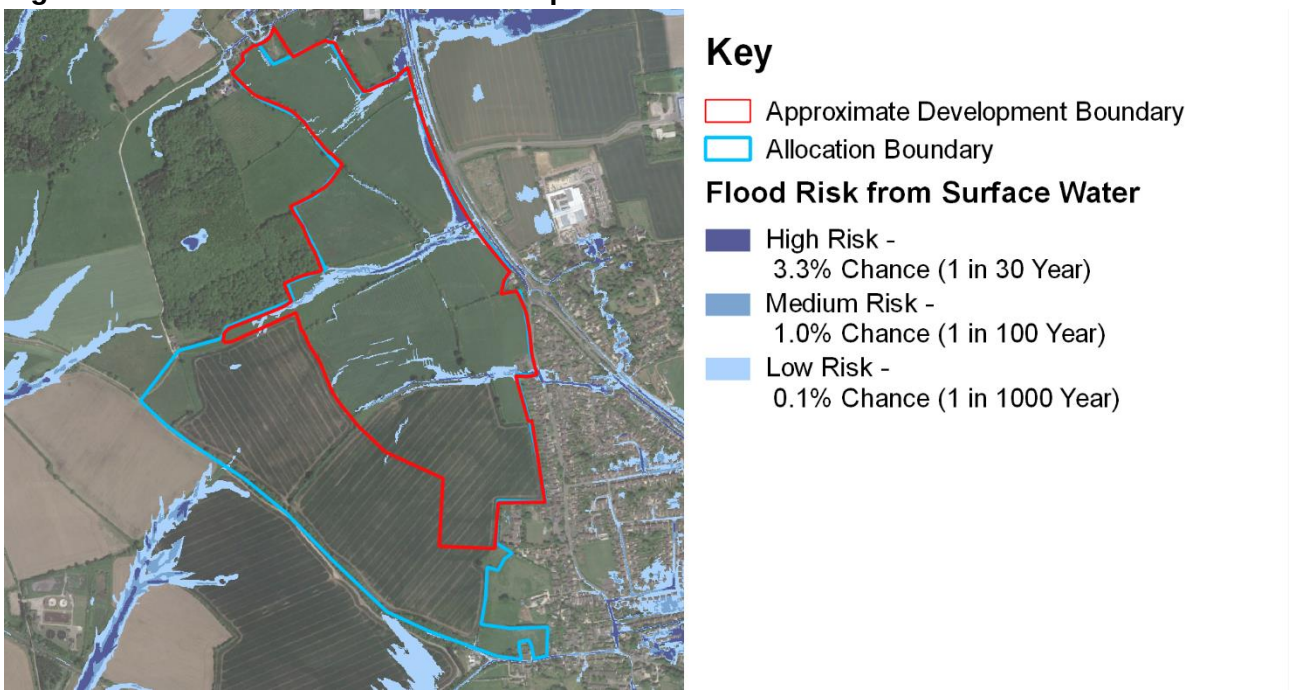
4.5. SURFACE WATER FLOOD RISK

4.5.1. The publicly available 'Long Term Flood Risk Information,' in particular relating to the 'Flood Risk from Surface Water,' has been reviewed and identifies the majority of the site to be at low risk from surface water flooding.

4.5.2. Given this, there are a number of localised areas throughout the site, that are identified to be at medium to high risk of potential surface water flooding. These areas may be considered to be consistent with unnamed ditches present throughout the existing site.

4.5.3. An Extract of the 'Long Term Flood Risk Information,' in particular relating to the 'Flood Risk from Surface Water,' mapping is available as Figure 8.

Figure 8 - 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.

High Level Surface Water Hydraulic modelling

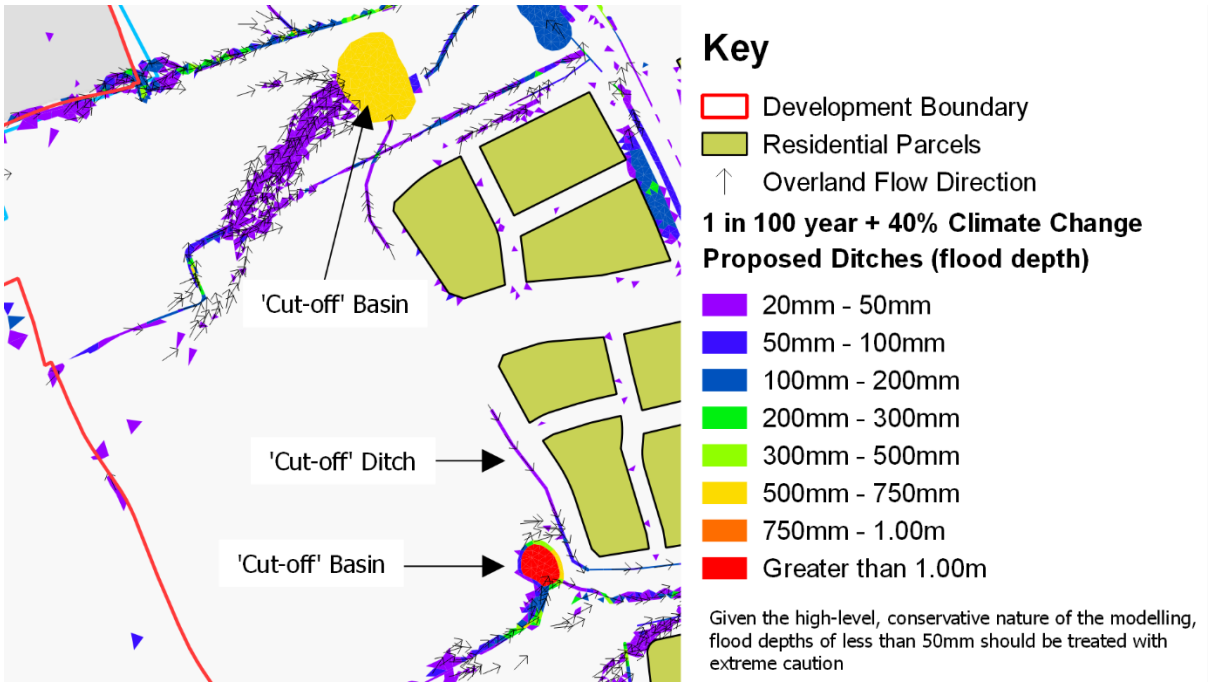
4.5.6. A high-level surface water hydraulic model has been developed using Innovyze InfoWorks ICM 9.0. The hydraulic model utilises ground elevation data and rainfall profiles to enhance understanding of the existing potential flood risk within and downstream of the site. The model further represents the proposed development to represent proposed surface water flow paths and post-development flood risk.

4.5.7. The modelling conducted is high level, with the aim of demonstrating the principles of the proposed surface water drainage strategy including the provision of surface water 'cut-off' ditches and basins to the west of the proposed residential development in the proposed surface water drainage strategy. This is commensurate with the level of detail required to support an outline planning application.

4.5.8. The modelling conducted is detailed in Appendix D. This outlines the representation of model features; rainfall used and provides an illustration and discussion of results.

4.5.9. Figure 9 (also discussed in Appendix D) illustrates the two proposed 'cut-off' basins intercepting flows from the upstream catchment. Alongside this, a number of 'cut-off' ditches capture and re-direct flows away from the residential development areas.

Figure 9 – 'Cut-off' ditch and Basin Performance



4.5.10. The baseline modelling indicates that shallow surface water flood depths occur across the existing site with some higher-depth areas of surface water ponding where there are low areas in topography, consistent with the existing ditches and flow routing.

4.5.11. The modelling demonstrates the principles of the proposed surface water drainage strategy including the use of 'cut-off' ditches, attenuation ponds and ditches, ensure that the site may be developed safely. The modelling indicates flows discharged off-site and peak flood depths within Rutten Lane downstream of the site are reduced as a result of the proposed 'cut-off' measures; the existing flood risk is not exacerbated; and post-development surface water flood risk is considered to be low.

4.5.12. 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, the indicative measures will be developed and integrated in the development, in accordance with best practice guidance to ensure any surface water is directed away from the existing and proposed properties.

4.5.13. Given the above, the proposed development is considered to be at predominantly low, with some localised areas of medium, risk of surface water flooding which is considered to be low with the inclusion of the identified, proposed ‘cut-off' features.

Identified Surface Water Flood Risk: Low

4.6. GROUNDWATER FLOOD RISK

4.6.1. The Cherwell District Council Level 2 SFRA analysed the Environment Agency's Areas Susceptible to Groundwater Flooding (AStGWF) map. This identifies that the north western half of the site lies within a 1 km grid square of which <25% of its area is considered to be susceptible to groundwater

emergence and the south eastern half lies within a 1 km grid square of which 25-50% of its area is considered to be susceptible to groundwater emergence.

4.6.2. Groundwater was not identified or recorded in the nearest borehole to the site (Borehole SP41SE14) which reached an approximate depth of 7.6m.

4.6.3. Given the localised geology encountered at the site; that the majority of the site lies within the <25% risk category for the AStGWF mapping; and that no groundwater was identified or recorded in the nearest borehole the development is considered to be at low risk of groundwater flooding.

Identified Groundwater Flood Risk: Low

4.7. SEWER FLOOD RISK

4.7.1. The Cherwell District Council Level 2 SFRA states that there have been between 20-25 incidents of sewer flooding experienced within the postcode area covering the site, (taken from the DG5 register). From public mapping, this OX5 1 postcode covers the village of Yarnton, the western half of Kidlington and extends to the north covering the village of Shipton on Cherwell. As such, while the number of incidents is considered high, there is no further information regarding the spatial arrangement of these incidents.

4.7.2. Assessment of the Thames Water Sewer maps reveals that there are three rising main sewers running from south-west to north east across the middle of the site, and one sewer running west to east across the bottom of the development boundary that are shown in the Thames Water Asset Location Search in Appendix C.

4.7.3. Given that adjacent sewers are at a lower elevation than the site, the development is considered to be at low risk of 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 Reservoir mapping shows that the site lies outside of the zone of influence for the nearby reservoirs. Given this, flood risk from reservoirs is considered low.

Identified Flood Risk from Reservoirs: Low

Canals

4.8.2. The nearest canal to the site, The Oxford Canal, is located approximately 1.4km to the east. Due to this distance, it is reasonable to assume that this canal does not pose a risk of flooding to the site.

4.8.3. Given the distance from the site to the nearest canal system, the development is considered to be at low risk of flooding from canals.

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 Sewerage Sector Guidance 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. At the property level, this includes measures such as ensuring finished floor levels are elevated 150mm above adjacent external ground levels. Or where this is not possible, such as the need to provide flush entrances, ground levels should fall way from any entrances to ensure surface water exceedance is not directed towards properties.

4.9.4. At a site wide level, the principal aim is to direct exceedance flows away from properties and along defined corridors. 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 is important in avoiding deep and high velocity flows that present a high risk.

4.9.5. 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.

4.9.6. Given the baseline site characteristics and further mitigation measures to be implemented, the risk of flooding from exceedance flows is considered low.

Identified Flood Risk from Exceedance Flows: Low

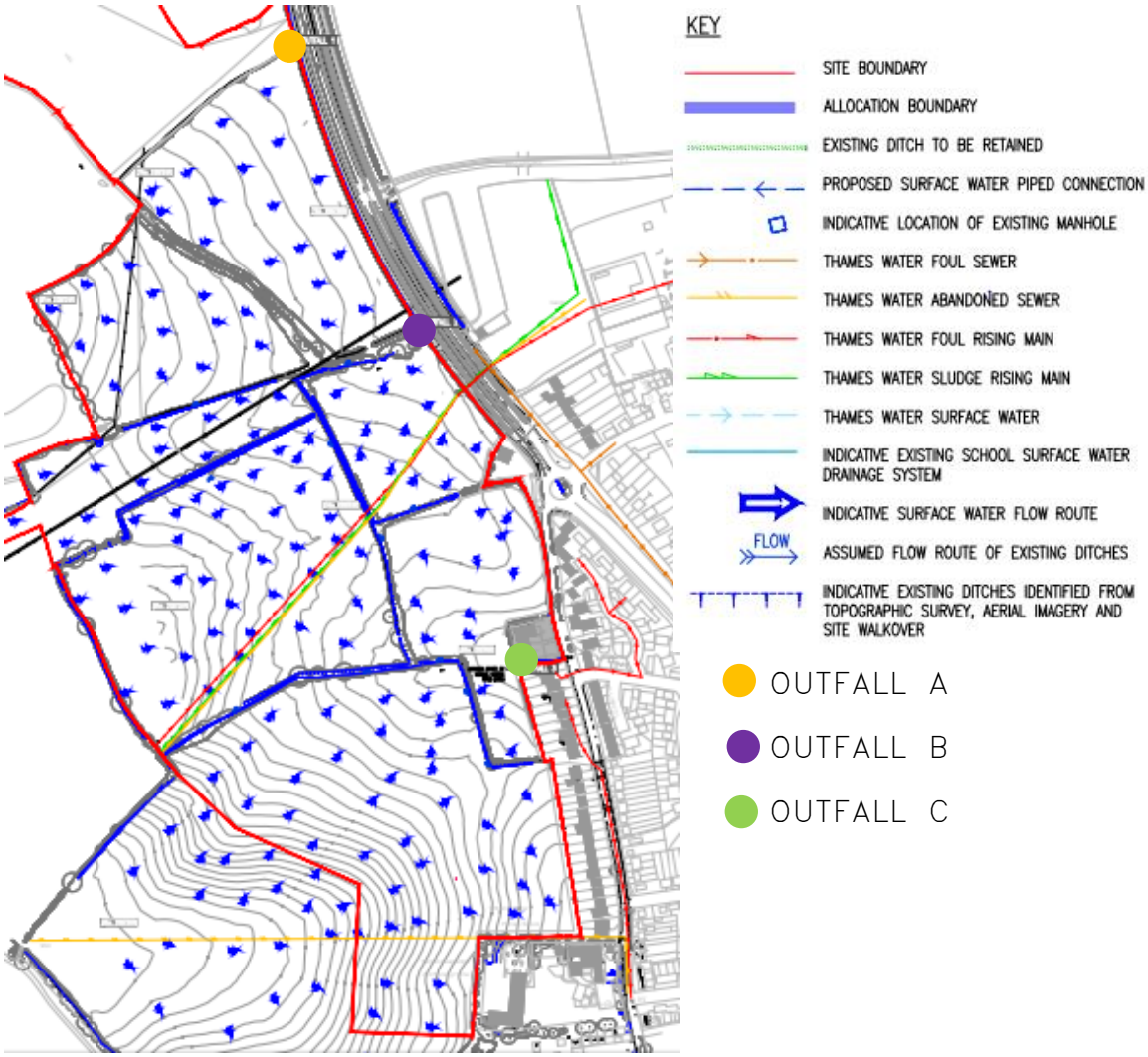
5. SURFACE WATER DRAINAGE

5.1. EXISTING SURFACE WATER DRAINAGE

5.1.1. The site is currently agricultural land which is assumed to drain through a series of ditches which convey surface water runoff throughout the site. These ditches were identified by the topographic survey alongside analysis of aerial images and the Flood Risk from Surface Water map.

5.1.2. Three outfalls from the site were identified through a site visit and have been labelled as Outfall A, Outfall B and Outfall C on the baseline drainage features plan, drawing MC-WSP-YARN-XXXX-SK-D-0504 contained in Appendix A, an extract of which is provided in Figure 10.

Figure 10 - Baseline Existing Surface Water Drainage Features

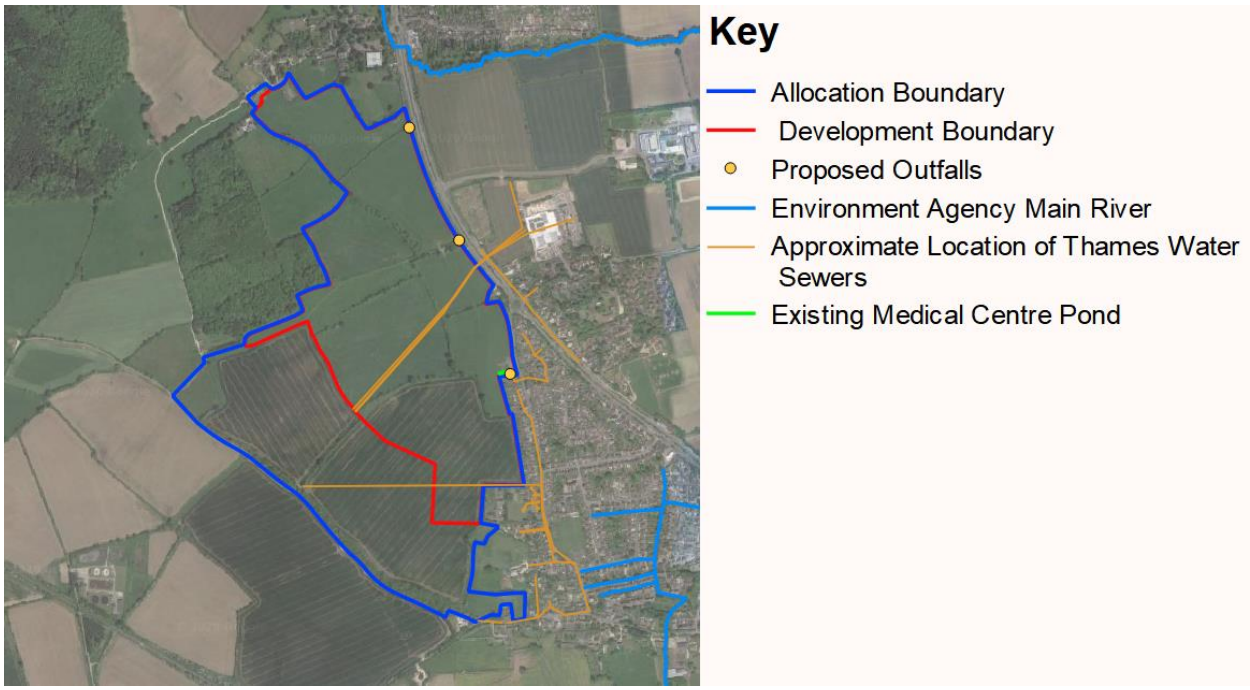


5.1.3. A positive surface water drainage system has been identified serving the existing school development south-east of the site, which is shown in Figure 10 and also included in Appendix A. This information has been provided by Cherwell District Council in a plan of the school's drainage system, drawn by CAPITA Architecture, named "Proposed Site Plan Drainage work" dated 01/09/2015.

5.1.4. Given the nature of Outfalls A and B, and the location of the Rowel Brook, it is assumed that these outfalls discharge into the Rowel Brook to the northeast of the site, while Outfall C is assumed to

discharge into the localised highway or sewer network to the south east of the site, as shown in Figure 11.

Figure 11 - Indicative drawing demonstrating identified outfalls, indicative existing sewers and surrounding watercourses.



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, paragraph 80 (revised March 2015), provides the following order of priority, supported by the Environment Agency, Cherwell District Council and Oxfordshire County Council.

Table 6 - SuDS Drainage Hierarchy

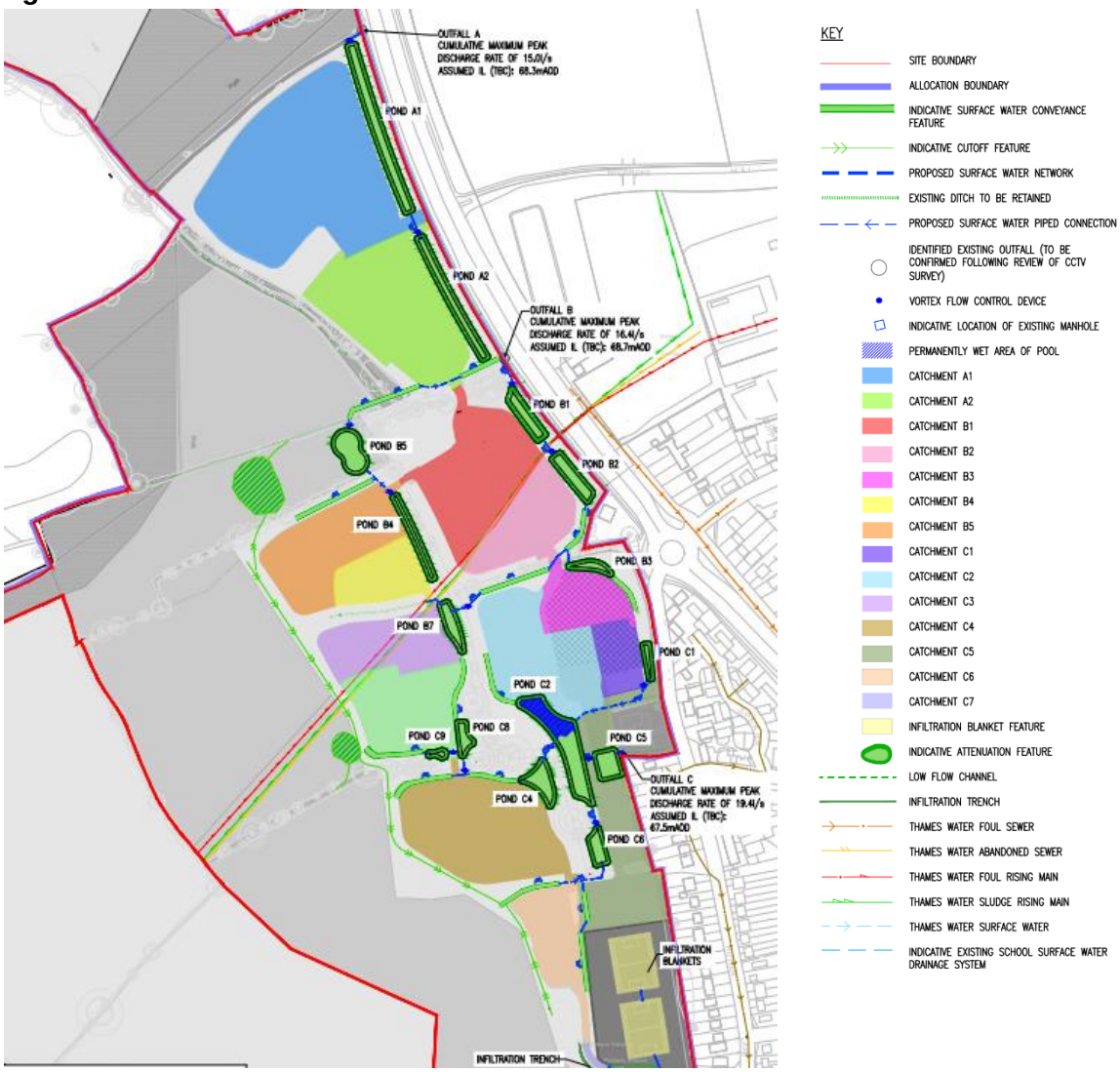
	Discharge Location	Availability	Comments
Search Sequence	Re-Use	×	Robust site design excluded the re-use at this stage.
	Infiltration	✓	Infiltration has been proposed for the access highway to the school and as an infiltration blanket under the proposed school pitches, with a high-level overflow into the existing surface water drainage system serving the school development.
	Watercourse	✓	The proposed surface water drainage strategy will discharge into the existing drainage ditches, where practicable, on site. These ditches connect to three identified outfalls, two of which are assumed to discharge into the Rowel Brook to the north east of the site.
	Surface Water Sewer	✓	As noted previously, the proposed surface water drainage strategy will discharge into the existing drainage ditches, where practicable, on site. These ditches connect to three identified outfalls, one of which is identified to connect to existing highway and/or sewers. Further to this, a high-level overflow is proposed into the surface water drainage network serving the school for the proposed school pitches and highway access for the school.
	Combined Sewer	-	
	Foul Sewer	-	

5.2.2. In accordance with the above search sequence, it is proposed to predominantly discharge surface water runoff to the existing ditches within the site boundary.

5.2.3. Given this, the proposed highway serving the school site and proposed sports pitches for the school will utilise infiltration to discharge surface water flows. Given that no infiltration testing has been undertaken to date, a conservative infiltration rate of 1 x 10 ^-6 m/s has been utilised to design these features which is proposed to contain a high-level overflow connecting into the surface water drainage system serving the existing school development. Should infiltration be considered unviable, surface water flows could be limited, using attenuation devices, which discharge at QBar greenfield runoff rate into the school network.

5.2.4. The remaining three catchments on site discharge into existing ditches within the site boundary as shown in drawing MC-WSP-YARN-XXXX-SK-D-0501 in Appendix A, and by an extract from the drawing in Figure 12.

Figure 12 - Extract from MC-WSP-YARN-XXXX-SK-D-0501



SUDS PROPOSALS

5.2.5. 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.

5.2.6. 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.”

5.2.7. At the proposed site, a surface water drainage strategy has been prepared in conjunction with the masterplan development thus making space for multi-function SuDS within the site boundary. Table 7 provides a summary of the SuDS selection process and confirms the features that are proposed as part of the site drainage strategy for each of the distinct character areas within the site.

Table 7 - 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.	× Due to the proposed residential nature of the development, green roofs have not been proposed.
Filter Strips	These are wide, gently sloping areas of grass or other dense vegetation that treat runoff from adjacent impermeable areas.	✓ / × A filter strip has been proposed to manage surface water flows for the proposed Highway Access to the school. Further features may be considered for use through the wider development 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.	✓ / × Permeable paving for driveways and communal parking areas, such as at the sport facilities may be considered 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 are incorporated within the surface water drainage strategy to convey water to the proposed attenuation basins. The proposed swale design aims to utilise and enhance existing ditches, in addition to creation of new swales.
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, particularly relevant to the golf course.	✓ / × Infiltration basins may be proposed at the next design stage, subject to infiltration testing.
Basins / 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 for use on site. The exact wet / dry nature will be confirmed during the next phase of design.
Underground Attenuation	Device Detention 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.	× Underground attenuation is not proposed for use within this site.

GREENFIELD RUN-OFF

5.2.8. Policy PR6A in the Cherwell District Council Local Plan (adopted September 2020) dictates that new developments control the peak discharge of storm water from a site to the baseline, undeveloped site conditions. Over very large development areas, the baseline rate of run-off is normally estimated using the Flood Estimation Handbook (FEH) methodologies. However, Paragraph 3.1.2 of the FEH guidance states:

5.2.9. "The frequency estimation procedures can be used on any catchment, gauged or ungauged, that drains an area of at least 0.5km2. The flood estimation procedure can be applied on smaller catchments only where the catchment is gauged and offers simple flood peak or flood event data"

5.2.10. On undeveloped and ungauged catchments of less than 0.5km in area, the accepted methodology is to complete baseline site discharge assessments using the nationally accepted Institute of Hydrology (IoH) 124 methodology for small rural catchments in a manner set out by the Environment Agency document SC030219 Rainfall Runoff Management for Developments.

5.2.11. This methodology requires that, for catchments of less than 50ha, the IoH assessment is completed for a 50ha area with the results linearly interpolated to determine the flow rate value based on the ratio of the development to 50ha.

5.2.12. The baseline IoH run-off rates are shown in Table 8 and contained in Appendix B.

Table 8 – Green Field Run-Off Rates

Event	50ha (l/s)	1ha (l/s)
1 Year	134.50	2.69
QBar	158.20	3.16
100 Year	504.80	10.10

DEVELOPMENT RUN-OFF & ATTENUATION

5.2.13. 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.

5.2.14. A surface water drainage strategy has been produced for the development proposals and is shown on drawing MC-WSP-YARN-XXXX-SK-D-0501 in Appendix A.

5.2.15. Sixteen surface water development catchments are included within the proposed surface water drainage strategy (illustrated on drawing MC-WSP-YARN-XXXX-SK-D-0501) is based on the site topography; these catchments are summarised in Table 9.

Table 9 – Site Run-Off Assessment

Catchment	Developed Area (ha)	Impermeable Area (ha)	Cumulative Discharge Rate (l/s)
A1	3.11	1.87	15.0
A2	1.67	0.97	
B1	1.33	0.80	16.5
B2	0.84	0.50	
B3	0.55	0.33	
B4	0.53	0.32	
B5	1.15	0.69	
B7	0.80	0.48	
C1	0.36	0.21	19.4
C2	1.22	0.73	
C4	1.68	1.10	
C5	1.26	0.75	
C6	0.65	0.39	
C8	0.58	0.35	
C9	0.39	0.23	
D1	0.02	0.02	Infiltration rate: 1 x 10^-6 & high-level overflow
D2	0.03	0.03	

5.2.16. As 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 should be attenuated to the mean annual flow (QBar). However, in accordance with SC030219 produced by the Environment Agency and DEFRA; "*A practicable minimum limit on the discharge rate from a flow attenuation device is often a compromise between attenuating to a satisfactory low flow rate whilst keeping the risk of blockage to an acceptable level. It is suggested that this is 5 litres per second".*

5.2.17. Recent developments have enabled vortex flow control devices to operate effectively to a reduced flow rate of 2.0l/s. Where the development run-off from each catchment falls below this practicable minimum limit, a minimum proposed peak discharge rate of 2.0l/s has been utilised.

5.2.18. 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 10. A summary of the nature of SuDS proposed is

summarised in Table 10, with the surface water drainage strategy shown on MC-WSP-YARN-XXXX-SK-D-0501 in Appendix A and Micro Drainage summary calculations contained in Appendix B.

Table 10 – Site Attenuation Requirements

Catchment	Storage Plan Area Required (m^2)	Storage Volume Required (m^3)	SuDS Controls
A1	3,010	1,330	Attenuation Basin
A2	2,020	790	
B1	1,130	540	
B2	1,130	490	
B3	600	200	
B4	1,150	230	
B5	1,450	530	
B7	930	350	
C1	490	130	
C2	3,040	1,170	
C4	1,150	530	
C5	960	480	
C6	790	280	
C8	640	260	
C9	250	80	
D1	160	40	Infiltration Trench
D2	5,520	380	Infiltration Blanket
Total	24,920	8,690	

5.2.19. The surface water drainage system will be designed in accordance with Design & Construction Guidance Appendix C (Sewer Sector Guidance published 2020) 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.

5.2.20. The 1 in 30 year criterion meets the requirements of BS EN 752 and is also in accordance with Sewer Sector Guidance published 2020. 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.

5.2.21. The surface water drainage strategy is based upon the parameter plans and framework plan prepared by Define Masterplanning, October 2020. 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

5.2.22. Given the outline nature of the proposals, each development parcel is assumed to comprise 60% impermeable area. Calculations have been run with an additional 10% impermeability to assess the potential impact of development creep on the proposed surface water drainage system. These calculations show that the system does not flood.

5.2.23. The proposed sports pitches and highway served by the infiltration blanket and trench respectively have been assumed 100% impermeable and as such, an assessment of development creep has not been undertaken for these catchments.

5.2.24. Further consideration of development creep, in light of proposed housing density will be undertaken during the next stages of design.

SUDS MANAGEMENT TRAIN

5.2.25. 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.

5.2.26. 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.

5.2.27. 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.

5.2.28. 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.

5.2.29. 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.

5.2.30. The proposed development will utilise attenuation basins and an infiltration blanket to provide ecological and opportunities and amenities. Further consideration may be given at the next stage of the design to incorporate localised source control features and other potential above-ground SuDS conveyance features, such as permeable paving.

HEALTH AND SAFETY

5.2.31. Good SuDS design and risk management processes follow the Construction, Design and Management (CDM) Regulations 2015 principles to design out risk using the hierarchy of eliminate, reduce, inform and control.

5.2.32. Much of this is to be reviewed and developed at the detailed design stages however consideration has been given at this stage to ensure the concept design suitably addresses potential hazards and risks associated with it.

5.2.33. The design risks and current mitigations are outlined in Table 11 along with further considerations for the detailed design stages.

5.2.34. 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.

Table 11 – Attenuation Basin Design Risk Consideration

Design Risks	Current Mitigation	Consideration for later stages
Water Depth	▪ Assumed 300mm freeboard above maximum 1 in 100 year + 40% climate change event. ▪ Attenuation basins are designed with a minimum 1 in 4 side slope.	▪ Means of preventing access into the basin such as knee rail fencing ▪ Passive surveillance of attenuation features ▪ Planting to discourage access
Access & Stability	▪ All basins designed with 1 in 4 side slopes in line with recommendations in the SuDS Manual (CIRIA C753) and Cherwell District Council.	▪ Temporary earthworks 'shelfs' or maintenance buffers for large embankments ▪ Means of preventing access into the basin such as knee rail fencing ▪ Planting to discourage access

6. OPERATION AND MAINTENANCE

6.1. SURFACE WATER FEATURES

6.1.1. Any forthcoming on-site surface water and foul drainage sewerage networks, including appropriate SuDS features, will be designed to Sewerage Sector Guidance (SSG) including the Design for Construction Guidance (DCG) and will be offered for adoption by Thames Water.

6.1.2. It is 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.

6.1.3. Alternatively, given the SSG and DCG which came into force on the 1st April 2020, there may be potential for the sewerage undertaker to adopt SuDS features under certain conditions such as conveying flows. There may therefore be the potential for SuDS features to be adopted by Thames Water.

6.1.4. A typical maintenance schedule of the attenuation basins, swales and flow control devices proposed on site are shown in Table 12, Table 13, Table 14 and Table 15.

Table 12 - 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 13 - Attenuation Basin 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	▪ 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.

Table 14 - 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 15 - Infiltration Blanket/ Trench 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	▪ 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.
As-Required	▪ Prune and trim trees and remove cuttings. ▪ Repair erosion or other damage by re-turfing or reseeding. ▪ Re-level uneven surfaces and reinstate design levels; scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface (typically once every 60 month period). ▪ Remove sediment from pre-treatment system (e.g. forebays) when 50% full. ▪ 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.

6.1.5. 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.

6.1.6. The details of the party responsible for maintenance of each feature will be confirmed prior to occupation of the proposed development.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1.1. The risk of flooding to and from the proposed development has been assessed in accordance with the NPPF July 2021.

7.1.2. 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 Local Planning Authority and the Environment Agency.

7.1.3. High level, surface water hydraulic modelling has been undertaken to demonstrate the principles of the proposed surface water drainage strategy. The proposed network of 'cut-off' ditches and swales may be considered to provide additional protection from overland flow from the upstream catchment. Further refinement of this modelling is recommended during the detailed design stage to ensure holistic integration of the identified 'cut-off' features into the development proposals.

7.1.4. Management of extreme event flood risk can 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.

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

7.1.6. The proposed surface water drainage strategy aims to mimic the behaviour of the site pre-development (greenfield) and where possible, improve, through the utilisation of attenuation basins, swales, and flow control devices (e.g. vortex flow control). The cumulative rate of discharge from the site will be 50.8l/s and the total storage volume required is 8,690m³ for the critical 1 in 100 year event plus climate change. In addition, infiltration-led surface water drainage has been proposed for the school pitches and highway to serve the existing school with a high-level overflow proposed into the existing surface water drainage system on the school site, subject to infiltration testing being undertaken at the next stage of design.

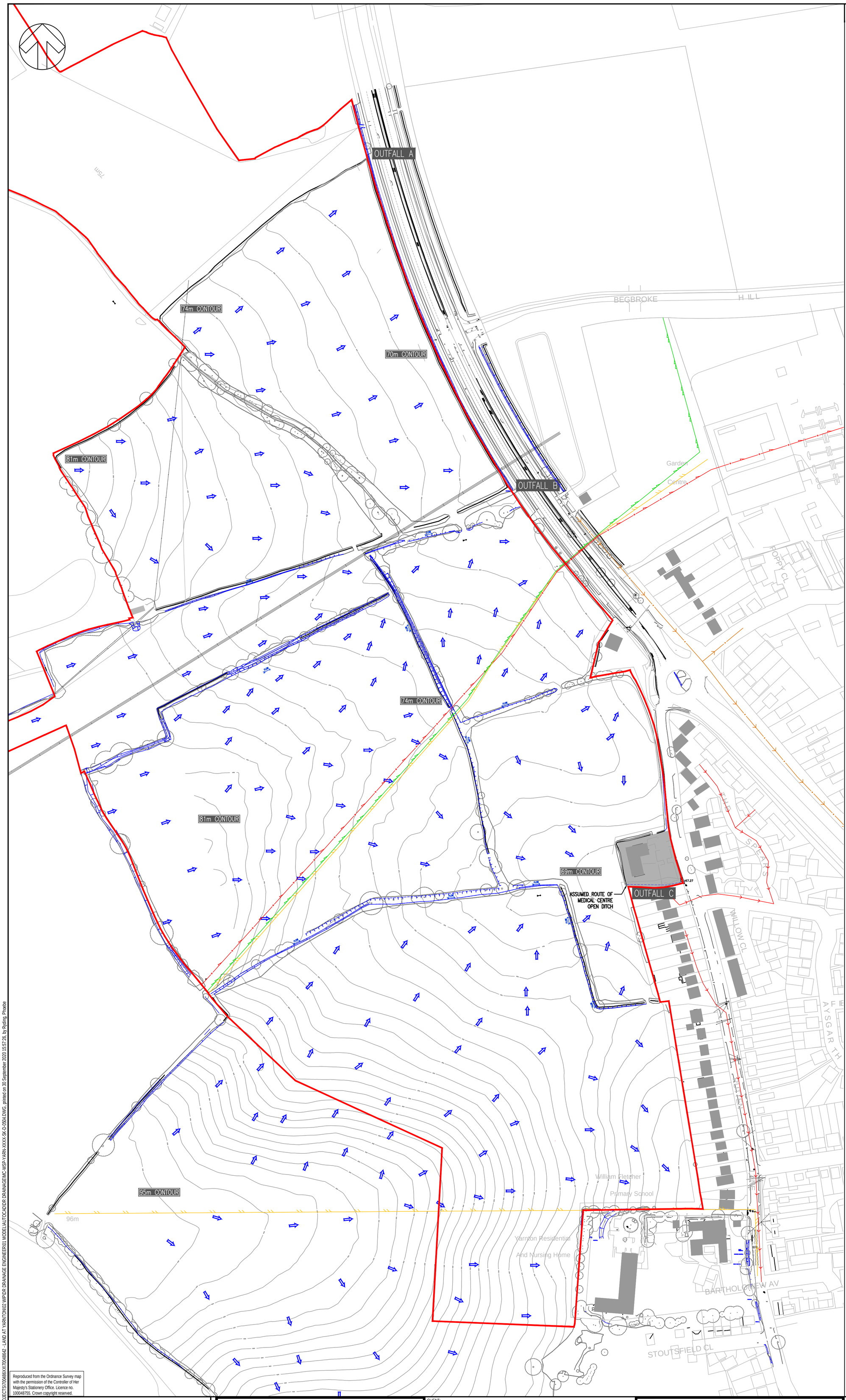
7.1.7. Safe access and egress will be available to and from the site for events up to and including the 1 in 100 year plus climate change (40%) rainfall events.

7.1.8. The responsibility for the operation and maintenance of each SuDS feature will be confirmed prior to the commencement of 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.

7.1.9. This report demonstrates that the proposed development may 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

DRAWINGS



Reproduced from the Ordnance Survey map with the permission of the Controller of Her Majesty's Stationery Office. Licence no. 100048755. Crown copyright reserved.

DO NOT SCALE

NOTES

1. ALL LEVELS ARE IN METERS ABOVE ORDNANCE DATUM.
2. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
3. THIS DRAWING IS NOT TO BE REPRODUCED IN ANY PART OR FORM WITHOUT THE CONSENT OF WSP UK LTD. ALL COPYRIGHT RESERVED.
4. REPRODUCED FROM ORDNANCE SURVEY MAP WITH PERMISSION OF HER MAJESTY'S STATIONARY OFFICE. LICENCE NO. 100048755. CROWN COPYRIGHT RESERVED.
5. DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT SCHEME DRAWINGS.
6. SIGNIFICANT VEGETATION OBSERVED DURING WALKOVER. UNOBSERVED DRAINAGE FEATURES MAY BE PRESENT.
8. ALL OUTFALLS HAVE BEEN VISUALLY IDENTIFIED DURING A SITE WALKOVER (TAKEN PLACE ON 05/12/2018) AND ARE ASSUMED VIABLE TO BE UTILISED AS SURFACE WATER OUTFALLS. DOWNSTREAM SURFACE WATER NETWORK TO BE CONFIRMED AT THE NEXT STAGE OF DESIGN.
9. CCTV SURVEY OF IDENTIFIED OUTFALLS TO BE UNDERTAKEN AT THE NEXT STAGE OF DESIGN.
10. ASSUMED ROUTE OF MEDICAL CENTRE OPEN DITCH BASED OFF OF GENERAL SITE LAYOUT DRAWINGS ASSOCIATED WITH PLANNING APPLICATION 03/01692/REM.

KEY

- SITE BOUNDARY
- INDICATIVE EXISTING DITCHES IDENTIFIED FROM TOPOGRAPHIC SURVEY, AERIAL IMAGERY AND SITE WALKOVER
- INDICATIVE SURFACE WATER FLOW PROPOSED INDICATIVE CUTOFF FEATURE
- FLOW — ASSUMED FLOW ROUTE OF EXISTING DITCHES
- 1m CONTOURS
- THAMES WATER COMBINED SEWER
- THAMES WATER FOUL SEWER
- THAMES WATER ABANDONED SEWER
- THAMES WATER FOUL RISING MAIN
- THAMES WATER SLUDGE RISING MAIN

REV	DATE	BY	DESCRIPTION	CHK	APP
P04	29/09/2020	PR	UPDATED RED LINE BOUNDARY	AC	AC
P03	16/07/2020	AD	UPDATED FROM INFORMATION	PR	AC
P02	09/01/2019	MTLW	ISSUED AS DRAFT FOR COMMENT WITH FRA	AC	DW
P01	17/12/2018	MTLW	FIRST ISSUE	AC	DW

DRAWING STATUS: S2 - FOR INFORMATION

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: MERTON COLLEGE

ARCHITECT: DEFINE

PROJECT: MERTON COLLEGE - YARNTON, OXFORDSHIRE

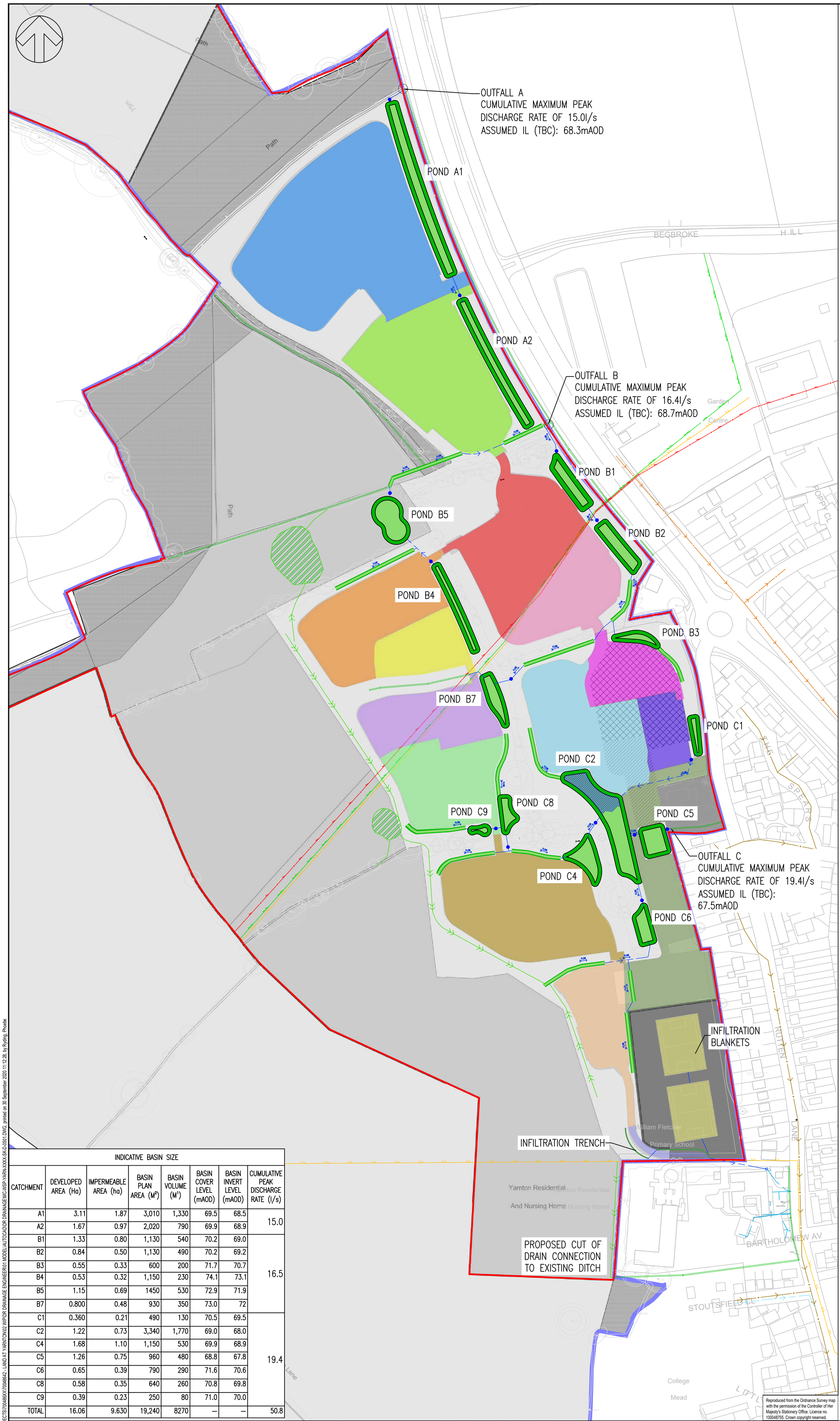
TITLE: INDICATIVE EXISTING SURFACE WATER DRAINAGE FEATURES

SCALE @ A1:	CHECKED:		APPROVED:
1:2000	PR		AC
PROJECT No:	DESIGNED:	DRAWN:	DATE:
70048642	AD	AD	August 20

DRAWING No: MC-WSP-YARN-XXXX-SK-D-0504 REV: P04

© WSP UK Ltd

File name \\UK.WSPGROUP.COM\CENTRAL DATA\PROJECTS\70048642\70048642 - LAND AT YARNTON\02 WIP\DR DRAINAGE\MC-WSP-YARN-XXXX-SK-D-0504.DWG, printed on 30 September 2020 15:57:26, by Rydling, Phoebe



Reproduced from the Ordnance Survey map with the permission of the Controller of Her Majesty's Stationery Office. Licence no. 100048755. Crown copyright reserved.

KEY

DO NOT SCALE

- SITE BOUNDARY
- ALLOCATION BOUNDARY
- INDICATIVE SURFACE WATER CONVEYANCE FEATURE
- INDICATIVE POTENTIAL CUTOFF FEATURE
- PROPOSED SURFACE WATER NETWORK
- EXISTING DITCH TO BE RETAINED
- PROPOSED SURFACE WATER PIPED CONNECTION
- IDENTIFIED EXISTING OUTFALL (TO BE CONFIRMED FOLLOWING REVIEW OF CCTV SURVEY)
- VORTEX FLOW CONTROL DEVICE
- INDICATIVE LOCATION OF EXISTING MANHOLE
- PERMANENTLY WET AREA OF POOL
- CATCHMENT A1
- CATCHMENT A2
- CATCHMENT B1
- CATCHMENT B2
- CATCHMENT B3
- CATCHMENT B4
- CATCHMENT B5
- CATCHMENT C1
- CATCHMENT C2
- CATCHMENT C3
- CATCHMENT C4
- CATCHMENT C5
- CATCHMENT C6
- CATCHMENT C7
- CATCHMENT C8
- INFILTRATION BLANKET FEATURE
- INDICATIVE ATTENUATION FEATURE
- INDICATIVE LOCATION OF PROPOSED CUT-OFF FEATURE
- INFILTRATION TRENCH
- THAMES WATER FOUL SEWER
- THAMES WATER ABANDONED SEWER
- THAMES WATER FOUL RISING MAIN
- THAMES WATER SLUDGE RISING MAIN
- THAMES WATER SURFACE WATER
- INDICATIVE EXISTING SCHOOL SURFACE WATER DRAINAGE SYSTEM

NOTES

1. ALL LEVELS ARE IN METERS ABOVE ORDNANCE DATUM.
2. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
3. THIS DRAWING IS NOT TO BE REPRODUCED IN ANY PART OR FORM WITHOUT THE CONSENT OF WSP UK LTD. ALL COPYRIGHT RESERVED.
4. REPRODUCED FROM ORDNANCE SURVEY MAP WITH PERMISSION OF HER MAJESTY'S STATIONARY OFFICE. LICENCE NO. 100048755. CROWN COPYRIGHT RESERVED.
5. SURFACE WATER STRATEGY IS INDICATIVE AND BASED ON MASTERPLANNING INFORMATION AT THE TIME OF PRODUCTION.
6. ALL SURFACE WATER CALCULATIONS WERE UNDERTAKEN USING MICRODRAINAGE SOFTWARE AND ARE SUBJECT TO DETAILED DESIGN.
7. DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT SCHEME DRAWINGS.
8. PUBLIC COMBINED SEWER LOCATION EXTRACTED FROM GROUNDWISE UTILITY REPORT 22630DM
9. ALL OUTFALLS HAVE BEEN VISUALLY IDENTIFIED DURING SITE WALKOVER AND ARE ASSUMED VIABLE TO BE UTILISED AS SURFACE WATER OUTFALLS. DOWNSTREAM SURFACE WATER NETWORK TO BE CONFIRMED AT THE NEXT STAGE OF DESIGN.
10. CCTV SURVEY OF IDENTIFIED OUTFALLS TO BE UNDERTAKEN AT THE NEXT STAGE OF DESIGN.
11. THE INDICATIVE SCHOOL SURFACE WATER DRAINAGE SYSTEM IS DRAWN IN ACCORDANCE WITH INFORMATION CONTAINED IN THE DRAWING "PROPOSED SITE PLAN DRAINAGE WORK" PROVIDED BY CHERWELL DISTRICT COUNCIL, DRAWN BY CAPITA ARCHITECTURE.
12. DESIGN ASSUMPTIONS:
    - 12.1. RESIDENTIAL CATCHMENTS ASSUMED 60% IMPERMEABLE AREA
    - 12.2. ATTENUATION PONDS ARE DESIGNED WITH A MINIMUM 1 IN 4 SIDE SLOPE
    - 12.3. ASSUMED 300mm FREEBOARD ABOVE MAXIMUM 1 IN 100 YEAR + 40% WATER LEVEL.
    - 12.4. DRAWING BASED ON DE234-14 PARAMETERS PLAN – LAND USE RECEIVED 23.09.2020.
    - 12.5. PROPOSED PITCHES TO INTEGRATE LOCALISED INFILTRATION BLANKET FEATURE WITH HIGH LEVEL OVERFLOW CONNECTION TO THE EXISTING PRIVATE SURFACE WATER SEWER WITHIN WILLIAM FLETCHER SCHOOL, SUBJECT TO SITE-SPECIFIC INFILTRATION TESTING AND CONFIRMATION OF OUTFALL LOCATION WHICH IS TO BE UNDERTAKEN AT THE NEXT STAGE OF DESIGN.
    - 12.6. INFILTRATION TRENCH IS DESIGNED TO BE 1.5m DEEP, 1.5m WIDE AND OUTFALL AT A CONSERVATIVE INFILTRATION RATE OF $1X10^{-6}$, SUBJECT TO INFILTRATION TESTING.

INDICATIVE BASIN SIZE

CATCHMENT	DEVELOPED AREA (Ha)	IMPERMEABLE AREA (ha)	BASIN PLAN AREA (M^2)	BASIN VOLUME (M^3)	BASIN COVER LEVEL (mAOD)	BASIN INVERT LEVEL (mAOD)	CUMULATIVE PEAK DISCHARGE RATE (l/s)
A1	3.11	1.87	3,010	1,330	69.5	68.5	15.0
A2	1.67	0.97	2,020	790	69.9	68.9	
B1	1.33	0.80	1,130	540	70.2	69.0	16.5
B2	0.84	0.50	1,130	490	70.2	69.2	
B3	0.55	0.33	600	200	71.7	70.7	
B4	0.53	0.32	1,150	230	74.1	73.1	
B5	1.15	0.69	1450	530	72.9	71.9	
B7	0.800	0.48	930	350	73.0	72	
C1	0.360	0.21	490	130	70.5	69.5	19.4
C2	1.22	0.73	3,340	1,770	69.0	68.0	
C4	1.68	1.10	1,150	530	69.9	68.9	
C5	1.26	0.75	960	480	68.8	67.8	
C6	0.65	0.39	790	290	71.6	70.6	
C8	0.58	0.35	640	260	70.8	69.8	
C9	0.39	0.23	250	80	71.0	70.0	
TOTAL	16.06	9.630	19,240	8270	–	–	50.8

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
P10	30/09/2020	PR	UPDATED FOR INCLUSION IN FRA	AC	AC
P09	29/09/2020	PR	REVISED RED LINE BOUNDARY	AC	AC
P08	29/09/2020	PR	UPDATED BASED ON ARCHITECT COMMENTS	AC	AC
P07	23/09/2020	AD	UPDATED BASED ON PARAMETERS PLAN	PS	AC
P06	01/09/2020	AD	UPDATED BASED ON TREE SURVEY	PS	AC
P05	18/08/2020	AD	UPDATED FROM FRAMEWORK PLAN	PS	AC
P01	17/12/2018	MTLW	FIRST ISSUE	AC	DW

DRAWING STATUS: S2 - FOR INFORMATION

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: MERTON COLLEGE

PROJECT: PR9 LAND WEST OF YARNTON

ARCHITECT: DEFINE

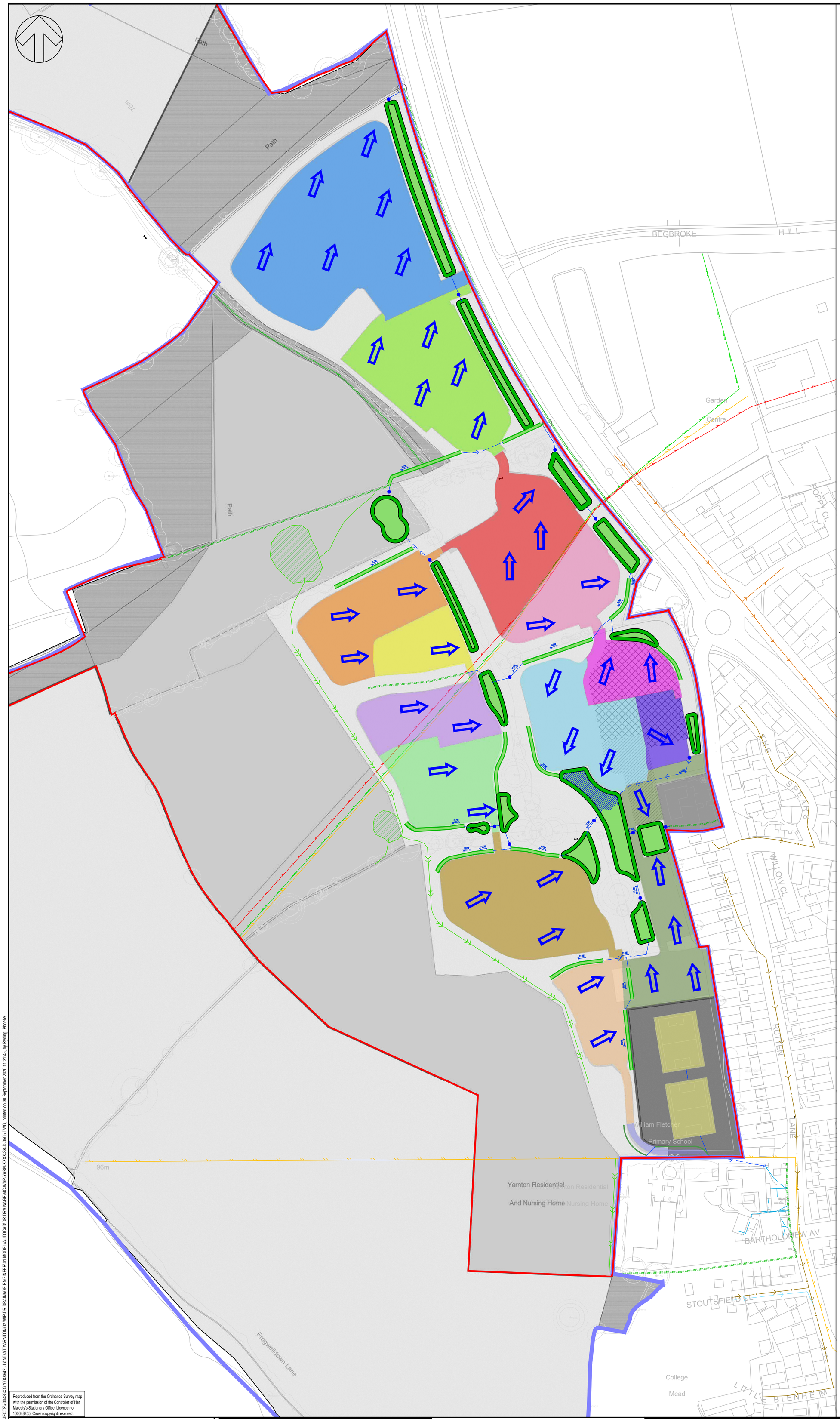
TITLE: INDICATIVE BASIN SIZES FOR PR9 AND PR9-DEVELOPMENTS

SCALE @ A1:	CHECKED:		APPROVED:
1:2000	PR		AC
PROJECT No:	DESIGNED:	DRAWN:	DATE:
70040339	AD	AD	September 20

DRAWING No: MC-WSP-YARN-XXXX-SK-D-0501 REV: P10

© WSP UK Ltd

File name \\UK.WSPGROUP.COM\CENTRAL DATA\PROJECTS\70040486X\70046642 - LAND AT YARNTON\02 WIP\DR DRAINAGE ENGINEER\01 MODEL\AUTOCAD\DR DRAINAGE\MC-WSP-YARN-XXXX-SK-D-0501.DWG, printed on 30 September 2020 11:12:28, by Ryding, Phoebe



KEY

DO NOT SCALE

- SITE BOUNDARY
- ALLOCATION BOUNDARY
- INDICATIVE SURFACE WATER CONVEYANCE FEATURE
- INDICATIVE POTENTIAL CUTOFF FEATURE
- PROPOSED SURFACE WATER NETWORK
- EXISTING DITCH TO BE RETAINED
- PROPOSED SURFACE WATER PIPED CONNECTION
- IDENTIFIED EXISTING OUTFALL (TO BE CONFIRMED FOLLOWING REVIEW OF CCTV SURVEY)
- VORTEX FLOW CONTROL DEVICE
- INDICATIVE LOCATION OF EXISTING MANHOLE
- PERMANENTLY WET AREA OF POOL
- CATCHMENT A1
- CATCHMENT A2
- CATCHMENT B1
- CATCHMENT B2
- CATCHMENT B3
- CATCHMENT B4
- CATCHMENT B5
- CATCHMENT C1
- CATCHMENT C2
- CATCHMENT C3
- CATCHMENT C4
- CATCHMENT C5
- CATCHMENT C6
- CATCHMENT C7
- CATCHMENT C8
- INFILTRATION BLANKET FEATURE
- INDICATIVE ATTENUATION FEATURE
- INDICATIVE LOCATION OF PROPOSED CUT-OFF FEATURE
- INFILTRATION TRENCH
- THAMES WATER FOUL SEWER
- THAMES WATER ABANDONED SEWER
- THAMES WATER FOUL RISING MAIN
- THAMES WATER SLUDGE RISING MAIN
- THAMES WATER SURFACE WATER
- INDICATIVE EXISTING SCHOOL SURFACE WATER DRAINAGE SYSTEM

NOTES

1. ALL LEVELS ARE IN METERS ABOVE ORDNANCE DATUM.
2. ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.
3. THIS DRAWING IS NOT TO BE REPRODUCED IN ANY PART OR FORM WITHOUT THE CONSENT OF WSP UK LTD. ALL COPYRIGHT RESERVED.
4. REPRODUCED FROM ORDNANCE SURVEY MAP WITH PERMISSION OF HER MAJESTY'S STATIONARY OFFICE. LICENCE NO. 100048755. CROWN COPYRIGHT RESERVED.
5. SURFACE WATER STRATEGY IS INDICATIVE AND BASED ON MASTERPLANNING INFORMATION AT THE TIME OF PRODUCTION.
6. ALL SURFACE WATER CALCULATIONS WERE UNDERTAKEN USING MICRODRAINAGE SOFTWARE AND ARE SUBJECT TO DETAILED DESIGN.
7. DRAWING SHOULD BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT SCHEME DRAWINGS.
8. PUBLIC COMBINED SEWER LOCATION EXTRACTED FROM GROUNDWISE UTILITY REPORT 22630DM
9. ALL OUTFALLS HAVE BEEN VISUALLY IDENTIFIED DURING SITE WALKOVER AND ARE ASSUMED VIABLE TO BE UTILISED AS SURFACE WATER OUTFALLS. DOWNSTREAM SURFACE WATER NETWORK TO BE CONFIRMED AT THE NEXT STAGE OF DESIGN.
10. CCTV SURVEY OF IDENTIFIED OUTFALLS TO BE UNDERTAKEN AT THE NEXT STAGE OF DESIGN.
11. THE INDICATIVE SCHOOL SURFACE WATER DRAINAGE SYSTEM IS DRAWN IN ACCORDANCE WITH INFORMATION CONTAINED IN THE DRAWING "PROPOSED SITE PLAN DRAINAGE WORK" PROVIDED BY CHERWELL DISTRICT COUNCIL, DRAWN BY CAPITA ARCHITECTURE.
12. DESIGN ASSUMPTIONS:
    - 12.1. RESIDENTIAL CATCHMENTS ASSUMED 60% IMPERMEABLE AREA
    - 12.2. ATTENUATION PONDS ARE DESIGNED WITH A MINIMUM 1 IN 4 SIDE SLOPE
    - 12.3. ASSUMED 300mm FREEBOARD ABOVE MAXIMUM 1 IN 100 YEAR + 40% WATER LEVEL.
    - 12.4. DRAWING BASED ON DE234-14 PARAMETERS PLAN – LAND USE RECEIVED 23.09.2020.
    - 12.5. PROPOSED PITCHES TO INTEGRATE LOCALISED INFILTRATION BLANKET FEATURE WITH HIGH LEVEL OVERFLOW CONNECTION TO THE EXISTING PRIVATE SURFACE WATER SEWER WITHIN WILLIAM FLETCHER SCHOOL, SUBJECT TO SITE-SPECIFIC INFILTRATION TESTING AND CONFIRMATION OF OUTFALL LOCATION WHICH IS TO BE UNDERTAKEN AT THE NEXT STAGE OF DESIGN.
    - 12.6. INFILTRATION TRENCH IS DESIGNED TO BE 1.5m DEEP, 1.5m WIDE AND OUTFALL AT A CONSERVATIVE INFILTRATION RATE OF $1X10^{-6}$, SUBJECT TO INFILTRATION TESTING.

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

Reproduced from the Ordnance Survey map with the permission of the Controller of Her Majesty's Stationery Office. Licence no. 100048755. Crown copyright reserved.

REV	DATE	BY	DESCRIPTION	CHK	APP
P01	30/09/2020	AD	FIRST ISSUE	PR	AC

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: MERTON COLLEGE

ARCHITECT: DEFINE

PROJECT: PR9 LAND WEST OF YARNTON

TITLE: INDICATIVE SURFACE WATER EXCEEDANCE STRATEGY

SCALE @ A1:	CHECKED:		APPROVED:
1:2000	PR		AC
PROJECT No: 70040339	DESIGNED: AD	DRAWN: AD	DATE: September 20

DRAWING No: MC-WSP-YARN-XXXX-SK-D-0501 REV: P01

© WSP UK Ltd

File name \\UK.WSPGROUP.COM\CENTRAL DATA\PROJECTS\70048XXX\70048642 - LAND AT YARNTON\02 WIP\DR DRAINAGE ENGINEER\01 MODEL\AUTOCAD\DR DRAINAGE\MC-WSP-YARN-XXXX-SK-D-0505.DWG, printed on 30 September 2020 11:31:45, by Ryding, Phoebe

Appendix B

CALCULATIONS

Appendix B.1

GREENFIELD RUN-OFF

IH 124 Mean Annual Flood

Input

Return Period (years)	100	Soil	0.400
Area (ha)	50.000	Urban	0.000
SAAR (mm)	658	Region Number	Region 6

Results	**l/s**
QBAR Rural	158.2
QBAR Urban	158.2
Q100 years	504.8
Q1 year	134.5
Q2 years	139.4
Q5 years	202.5
Q10 years	256.3
Q20 years	317.0
Q25 years	339.9
Q30 years	358.6
Q50 years	414.6
Q100 years	504.8
Q200 years	593.4
Q250 years	621.9
Q1000 years	816.5

©1982-2018 Innovyze

Appendix B.2

1 IN 100 YEAR + 40% CLIMATE CHANGE

Cascade Summary of Results for CATCHMENT A1.SRCX

Upstream Structures	Outflow To	Overflow To
CATCHMENT A2.SRCX	(None)	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	68.820	0.320	15.0	512.5	O K
30 min Summer	68.901	0.401	15.0	664.9	O K
60 min Summer	68.977	0.477	15.0	817.8	O K
120 min Summer	69.045	0.545	15.0	963.2	O K
180 min Summer	69.082	0.582	15.0	1046.1	O K
240 min Summer	69.105	0.605	15.0	1098.1	O K
360 min Summer	69.128	0.628	15.0	1152.1	O K
480 min Summer	69.135	0.635	15.0	1167.4	O K
600 min Summer	69.133	0.633	15.0	1162.3	O K
720 min Summer	69.126	0.626	15.0	1145.9	O K
960 min Summer	69.108	0.608	15.0	1105.9	O K
1440 min Summer	69.073	0.573	15.0	1025.9	O K
2160 min Summer	69.017	0.517	15.0	904.2	O K
2880 min Summer	68.964	0.464	15.0	792.1	O K
4320 min Summer	68.876	0.376	15.0	617.4	O K
5760 min Summer	68.809	0.309	15.0	492.4	O K
7200 min Summer	68.760	0.260	15.0	405.4	O K
8640 min Summer	68.725	0.225	14.9	344.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	657.6	22
30 min Summer	97.160	0.0	813.0	37
60 min Summer	60.480	0.0	1192.0	66
120 min Summer	36.400	0.0	1365.0	126
180 min Summer	26.929	0.0	1468.1	186
240 min Summer	21.665	0.0	1544.9	244
360 min Summer	15.820	0.0	1654.4	364
480 min Summer	12.552	0.0	1727.5	482
600 min Summer	10.442	0.0	1780.3	600
720 min Summer	8.960	0.0	1820.6	704
960 min Summer	7.003	0.0	1876.5	804
1440 min Summer	4.918	0.0	1934.9	1046
2160 min Summer	3.437	0.0	2457.4	1448
2880 min Summer	2.669	0.0	2489.4	1820
4320 min Summer	1.882	0.0	2526.3	2592
5760 min Summer	1.479	0.0	3004.5	3288
7200 min Summer	1.236	0.0	3136.8	3968
8640 min Summer	1.074	0.0	3264.2	4664

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT A1.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	68.700	0.200	14.7	302.7	O K
15 min Winter	68.854	0.354	15.0	575.0	O K
30 min Winter	68.942	0.442	15.0	746.3	O K
60 min Winter	69.024	0.524	15.0	919.3	O K
120 min Winter	69.099	0.599	15.0	1083.7	O K
180 min Winter	69.139	0.639	15.0	1178.0	O K
240 min Winter	69.165	0.665	15.0	1238.3	O K
360 min Winter	69.192	0.692	15.0	1303.4	O K
480 min Winter	69.201	0.701	15.0	1325.4	Flood Risk
600 min Winter	69.201	0.701	15.0	1325.1	Flood Risk
720 min Winter	69.195	0.695	15.0	1312.0	O K
960 min Winter	69.176	0.676	15.0	1264.3	O K
1440 min Winter	69.132	0.632	15.0	1160.8	O K
2160 min Winter	69.065	0.565	15.0	1007.8	O K
2880 min Winter	68.989	0.489	15.0	844.9	O K
4320 min Winter	68.857	0.357	15.0	581.5	O K
5760 min Winter	68.761	0.261	15.0	407.1	O K
7200 min Winter	68.703	0.203	14.7	307.2	O K
8640 min Winter	68.676	0.176	14.0	264.0	O K
10080 min Winter	68.663	0.163	12.9	243.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	3383.6	5344
15 min Winter	148.960	0.0	721.4	22
30 min Winter	97.160	0.0	888.4	37
60 min Winter	60.480	0.0	1300.0	66
120 min Winter	36.400	0.0	1480.0	124
180 min Winter	26.929	0.0	1599.0	182
240 min Winter	21.665	0.0	1688.1	240
360 min Winter	15.820	0.0	1815.6	356
480 min Winter	12.552	0.0	1901.0	470
600 min Winter	10.442	0.0	1962.3	582
720 min Winter	8.960	0.0	2008.0	692
960 min Winter	7.003	0.0	2067.4	900
1440 min Winter	4.917	0.0	2111.7	1114
2160 min Winter	3.437	0.0	2673.3	1580
2880 min Winter	2.669	0.0	2716.7	1992
4320 min Winter	1.882	0.0	2780.7	2728
5760 min Winter	1.479	0.0	3363.7	3352
7200 min Winter	1.236	0.0	3509.8	3968
8640 min Winter	1.074	0.0	3649.6	4576
10080 min Winter	0.957	0.0	3782.0	5248

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT A1.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 1.870

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.950	4	8	0.920

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT A1.SRCX

Storage is Online Cover Level (m) 69.500

Tank or Pond Structure

Invert Level (m) 68.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1379.2	1.000	3007.4

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0179-1500-0700-1500
Design Head (m)	0.700
Design Flow (l/s)	15.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	179
Invert Level (m)	68.500
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	15.0
Flush-Flo™	0.277	15.0
Kick-Flo®	0.531	13.2
Mean Flow over Head Range	-	12.2

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.3	1.200	19.4	3.000	30.1	7.000	45.3
0.200	14.7	1.400	20.9	3.500	32.4	7.500	46.6
0.300	15.0	1.600	22.2	4.000	34.5	8.000	48.1
0.400	14.6	1.800	23.5	4.500	36.5	8.500	49.6
0.500	13.7	2.000	24.7	5.000	38.5	9.000	51.1
0.600	13.9	2.200	25.9	5.500	40.3	9.500	52.5
0.800	16.0	2.400	27.0	6.000	42.0		
1.000	17.8	2.600	28.1	6.500	43.7		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT A2.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	CATCHMENT A1.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	68.299	0.299	2.7	268.5	O K
30 min Summer	68.373	0.373	2.7	349.4	O K
60 min Summer	68.443	0.443	2.7	432.5	O K
120 min Summer	68.508	0.508	2.7	515.2	O K
180 min Summer	68.545	0.545	2.7	565.9	O K
240 min Summer	68.571	0.571	2.7	601.0	O K
360 min Summer	68.602	0.602	2.7	645.6	O K
480 min Summer	68.619	0.619	2.7	670.0	O K
600 min Summer	68.628	0.628	2.7	683.6	O K
720 min Summer	68.633	0.633	2.7	690.6	O K
960 min Summer	68.635	0.635	2.7	692.8	O K
1440 min Summer	68.623	0.623	2.7	676.1	O K
2160 min Summer	68.593	0.593	2.7	632.6	O K
2880 min Summer	68.567	0.567	2.7	595.6	O K
4320 min Summer	68.526	0.526	2.7	539.2	O K
5760 min Summer	68.492	0.492	2.7	494.8	O K
7200 min Summer	68.463	0.463	2.7	457.4	O K
8640 min Summer	68.434	0.434	2.7	421.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	219.4	23
30 min Summer	97.160	0.0	227.1	38
60 min Summer	60.480	0.0	409.0	68
120 min Summer	36.400	0.0	431.8	128
180 min Summer	26.929	0.0	423.7	186
240 min Summer	21.665	0.0	417.9	246
360 min Summer	15.820	0.0	411.3	366
480 min Summer	12.552	0.0	407.4	486
600 min Summer	10.442	0.0	404.5	606
720 min Summer	8.960	0.0	402.1	724
960 min Summer	7.003	0.0	397.9	964
1440 min Summer	4.918	0.0	390.4	1442
2160 min Summer	3.437	0.0	809.4	1976
2880 min Summer	2.669	0.0	780.7	2308
4320 min Summer	1.882	0.0	712.7	3072
5760 min Summer	1.479	0.0	1027.9	3912
7200 min Summer	1.236	0.0	1073.4	4752
8640 min Summer	1.074	0.0	1117.4	5528

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT A2.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	68.409	0.409	2.7	391.5	O K
15 min Winter	68.329	0.329	2.7	301.0	O K
30 min Winter	68.409	0.409	2.7	391.7	O K
60 min Winter	68.484	0.484	2.7	485.3	O K
120 min Winter	68.555	0.555	2.7	578.5	O K
180 min Winter	68.596	0.596	2.7	635.9	O K
240 min Winter	68.623	0.623	2.7	676.0	O K
360 min Winter	68.658	0.658	2.7	727.5	O K
480 min Winter	68.677	0.677	2.7	756.5	O K
600 min Winter	68.688	0.688	2.7	773.3	O K
720 min Winter	68.694	0.694	2.7	782.8	O K
960 min Winter	68.697	0.697	2.7	788.4	O K
1440 min Winter	68.689	0.689	2.7	776.0	O K
2160 min Winter	68.663	0.663	2.7	735.0	O K
2880 min Winter	68.632	0.632	2.7	688.8	O K
4320 min Winter	68.583	0.583	2.7	618.2	O K
5760 min Winter	68.540	0.540	2.7	558.1	O K
7200 min Winter	68.500	0.500	2.7	505.6	O K
8640 min Winter	68.460	0.460	2.7	454.5	O K
10080 min Winter	68.417	0.417	2.7	401.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	1159.1	6256
15 min Winter	148.960	0.0	227.5	23
30 min Winter	97.160	0.0	224.2	37
60 min Winter	60.480	0.0	433.4	68
120 min Winter	36.400	0.0	425.1	126
180 min Winter	26.929	0.0	418.1	184
240 min Winter	21.665	0.0	414.7	244
360 min Winter	15.820	0.0	412.3	362
480 min Winter	12.552	0.0	412.3	478
600 min Winter	10.442	0.0	413.2	596
720 min Winter	8.960	0.0	414.5	712
960 min Winter	7.003	0.0	414.4	944
1440 min Winter	4.917	0.0	407.9	1400
2160 min Winter	3.437	0.0	817.3	2056
2880 min Winter	2.669	0.0	791.1	2652
4320 min Winter	1.882	0.0	735.9	3288
5760 min Winter	1.479	0.0	1150.9	4208
7200 min Winter	1.236	0.0	1201.3	5120
8640 min Winter	1.074	0.0	1249.6	6048
10080 min Winter	0.957	0.0	1295.5	6760

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT A2.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.970

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.450	4	8	0.520

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT A2.SRCX

Storage is Online Cover Level (m) 69.000

Tank or Pond Structure

Invert Level (m) 68.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	743.2	1.000	2022.4

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0083-2700-0700-2700
Design Head (m)	0.700
Design Flow (l/s)	2.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	83
Invert Level (m)	68.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	2.7
Flush-Flo™	0.208	2.7
Kick-Flo®	0.459	2.2
Mean Flow over Head Range	-	2.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.4	1.200	3.5	3.000	5.3	7.000	7.9
0.200	2.7	1.400	3.7	3.500	5.7	7.500	8.2
0.300	2.6	1.600	3.9	4.000	6.1	8.000	8.4
0.400	2.5	1.800	4.2	4.500	6.4	8.500	8.7
0.500	2.3	2.000	4.4	5.000	6.7	9.000	8.9
0.600	2.5	2.200	4.6	5.500	7.0	9.500	9.2
0.800	2.9	2.400	4.8	6.000	7.3		
1.000	3.2	2.600	4.9	6.500	7.6		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B1.SRCX

Upstream Structures	Outflow To	Overflow To
CATCHMENT B2.SRCX	(None)	(None)
CATCHMENT B3.SRCX		
CATCHMENT B7.SRCX		

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	69.426	0.426	11.1	218.0	O K
30 min Summer	69.526	0.526	11.1	283.0	O K
60 min Summer	69.616	0.616	11.1	346.3	O K
120 min Summer	69.690	0.690	11.1	402.4	O K
180 min Summer	69.726	0.726	11.3	431.5	O K
240 min Summer	69.746	0.746	11.4	447.3	O K
360 min Summer	69.760	0.760	11.5	459.1	O K
480 min Summer	69.757	0.757	11.5	456.4	O K
600 min Summer	69.748	0.748	11.4	448.9	O K
720 min Summer	69.738	0.738	11.4	440.6	O K
960 min Summer	69.715	0.715	11.2	422.5	O K
1440 min Summer	69.669	0.669	11.1	386.5	O K
2160 min Summer	69.602	0.602	11.1	336.5	O K
2880 min Summer	69.538	0.538	11.1	291.2	O K
4320 min Summer	69.403	0.403	11.1	203.6	O K
5760 min Summer	69.309	0.309	11.1	148.6	O K
7200 min Summer	69.245	0.245	11.1	114.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	536.8	22
30 min Summer	97.160	0.0	674.0	37
60 min Summer	60.480	0.0	930.7	66
120 min Summer	36.400	0.0	1112.2	126
180 min Summer	26.929	0.0	1217.8	184
240 min Summer	21.665	0.0	1277.8	244
360 min Summer	15.820	0.0	1328.7	362
480 min Summer	12.552	0.0	1354.7	478
600 min Summer	10.442	0.0	1372.2	524
720 min Summer	8.960	0.0	1384.4	584
960 min Summer	7.003	0.0	1398.3	708
1440 min Summer	4.918	0.0	1406.5	982
2160 min Summer	3.437	0.0	1936.7	1392
2880 min Summer	2.669	0.0	1999.9	1816
4320 min Summer	1.882	0.0	2085.3	2508
5760 min Summer	1.479	0.0	2240.8	3176
7200 min Summer	1.236	0.0	2340.8	3888

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B1.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
8640 min Summer	69.204	0.204	11.0	92.7	O K
10080 min Summer	69.178	0.178	10.8	79.9	O K
15 min Winter	69.469	0.469	11.1	244.9	O K
30 min Winter	69.576	0.576	11.1	317.7	O K
60 min Winter	69.672	0.672	11.1	389.0	O K
120 min Winter	69.753	0.753	11.5	453.1	O K
180 min Winter	69.794	0.794	11.8	487.0	O K
240 min Winter	69.817	0.817	11.9	507.0	O K
360 min Winter	69.837	0.837	12.1	524.6	O K
480 min Winter	69.838	0.838	12.1	525.3	O K
600 min Winter	69.830	0.830	12.0	517.8	O K
720 min Winter	69.816	0.816	11.9	506.2	O K
960 min Winter	69.789	0.789	11.7	482.7	O K
1440 min Winter	69.732	0.732	11.3	435.6	O K
2160 min Winter	69.644	0.644	11.1	367.1	O K
2880 min Winter	69.555	0.555	11.1	302.7	O K
4320 min Winter	69.343	0.343	11.1	167.9	O K
5760 min Winter	69.226	0.226	11.1	104.2	O K
7200 min Winter	69.170	0.170	10.8	75.9	O K
8640 min Winter	69.156	0.156	10.2	69.4	O K
10080 min Winter	69.149	0.149	9.7	65.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.074	0.0	2436.9	4504
10080 min Summer	0.957	0.0	2527.6	5240
15 min Winter	148.960	0.0	595.8	22
30 min Winter	97.160	0.0	722.2	37
60 min Winter	60.480	0.0	1039.2	66
120 min Winter	36.400	0.0	1227.9	124
180 min Winter	26.929	0.0	1312.2	180
240 min Winter	21.665	0.0	1350.5	238
360 min Winter	15.820	0.0	1401.7	352
480 min Winter	12.552	0.0	1435.4	464
600 min Winter	10.442	0.0	1459.2	570
720 min Winter	8.960	0.0	1476.6	670
960 min Winter	7.003	0.0	1499.6	752
1440 min Winter	4.917	0.0	1523.0	1060
2160 min Winter	3.437	0.0	2164.5	1520
2880 min Winter	2.669	0.0	2231.2	1988
4320 min Winter	1.882	0.0	2271.3	2596
5760 min Winter	1.479	0.0	2510.0	3200
7200 min Winter	1.236	0.0	2622.6	3752
8640 min Winter	1.074	0.0	2730.8	4408
10080 min Winter	0.957	0.0	2834.1	5144

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT B1.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.800

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.400	4	8	0.400

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT B1.SRCX

Storage is Online Cover Level (m) 70.200

Tank or Pond Structure

Invert Level (m) 69.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	407.4	1.200	1131.8

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0157-1110-0700-1110
Design Head (m)	0.700
Design Flow (l/s)	11.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	157
Invert Level (m)	69.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	11.1
Flush-Flo™	0.254	11.1
Kick-Flo®	0.518	9.6
Mean Flow over Head Range	-	9.2

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.6	1.200	14.3	3.000	22.2	7.000	33.3
0.200	11.0	1.400	15.4	3.500	23.9	7.500	34.3
0.300	11.0	1.600	16.4	4.000	25.4	8.000	35.5
0.400	10.7	1.800	17.4	4.500	26.9	8.500	36.6
0.500	9.9	2.000	18.2	5.000	28.3	9.000	37.6
0.600	10.3	2.200	19.1	5.500	29.7	9.500	38.7
0.800	11.8	2.400	19.9	6.000	30.9		
1.000	13.1	2.600	20.7	6.500	32.1		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B2.SRCX

Upstream Structures	Outflow To	Overflow To
CATCHMENT B3.SRCX CATCHMENT B7.SRCX	CATCHMENT B1.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	69.432	0.232	5.2	140.7	O K
30 min Summer	69.493	0.293	5.2	182.9	O K
60 min Summer	69.556	0.356	5.2	228.1	O K
120 min Summer	69.627	0.427	5.2	282.1	O K
180 min Summer	69.687	0.487	5.2	329.0	O K
240 min Summer	69.720	0.520	5.2	356.0	O K
360 min Summer	69.752	0.552	5.2	383.5	O K
480 min Summer	69.773	0.573	5.2	400.9	O K
600 min Summer	69.786	0.586	5.2	412.8	O K
720 min Summer	69.796	0.596	5.2	421.4	O K
960 min Summer	69.808	0.608	5.2	432.0	O K
1440 min Summer	69.821	0.621	5.2	443.4	O K
2160 min Summer	69.834	0.634	5.2	454.9	O K
2880 min Summer	69.804	0.604	5.2	427.9	O K
4320 min Summer	69.752	0.552	5.2	383.1	O K
5760 min Summer	69.701	0.501	5.2	340.8	O K
7200 min Summer	69.644	0.444	5.2	295.2	O K
8640 min Summer	69.596	0.396	5.2	257.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	330.7	334
30 min Summer	97.160	0.0	412.0	38
60 min Summer	60.480	0.0	576.8	68
120 min Summer	36.400	0.0	688.9	848
180 min Summer	26.929	0.0	753.9	966
240 min Summer	21.665	0.0	789.4	1046
360 min Summer	15.820	0.0	799.9	1174
480 min Summer	12.552	0.0	793.0	1276
600 min Summer	10.442	0.0	786.2	1358
720 min Summer	8.960	0.0	779.5	1434
960 min Summer	7.003	0.0	765.8	1568
1440 min Summer	4.918	0.0	737.0	1802
2160 min Summer	3.437	0.0	1201.6	2060
2880 min Summer	2.669	0.0	1240.7	2272
4320 min Summer	1.882	0.0	1294.2	2904
5760 min Summer	1.479	0.0	1391.0	3744
7200 min Summer	1.236	0.0	1453.0	4488
8640 min Summer	1.074	0.0	1512.6	5208

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B2.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	69.555	0.355	5.2	227.1	O K
15 min Winter	69.456	0.256	5.2	157.2	O K
30 min Winter	69.524	0.324	5.2	204.6	O K
60 min Winter	69.594	0.394	5.2	256.8	O K
120 min Winter	69.692	0.492	5.2	333.1	O K
180 min Winter	69.735	0.535	5.2	369.0	O K
240 min Winter	69.761	0.561	5.2	390.8	O K
360 min Winter	69.795	0.595	5.2	420.7	O K
480 min Winter	69.817	0.617	5.2	439.8	O K
600 min Winter	69.832	0.632	5.2	453.4	O K
720 min Winter	69.845	0.645	5.2	465.3	O K
960 min Winter	69.862	0.662	5.2	480.7	O K
1440 min Winter	69.873	0.673	5.2	490.8	O K
2160 min Winter	69.903	0.703	5.2	518.4	Flood Risk
2880 min Winter	69.874	0.674	5.2	491.8	O K
4320 min Winter	69.799	0.599	5.2	423.5	O K
5760 min Winter	69.731	0.531	5.2	365.3	O K
7200 min Winter	69.645	0.445	5.2	295.5	O K
8640 min Winter	69.566	0.366	5.2	235.7	O K
10080 min Winter	69.500	0.300	5.2	188.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	1568.6	5952
15 min Winter	148.960	0.0	366.5	399
30 min Winter	97.160	0.0	433.8	38
60 min Winter	60.480	0.0	643.9	776
120 min Winter	36.400	0.0	760.2	960
180 min Winter	26.929	0.0	806.7	1076
240 min Winter	21.665	0.0	808.9	1172
360 min Winter	15.820	0.0	804.4	1316
480 min Winter	12.552	0.0	800.7	1420
600 min Winter	10.442	0.0	797.2	742
720 min Winter	8.960	0.0	793.4	788
960 min Winter	7.003	0.0	784.8	964
1440 min Winter	4.917	0.0	767.3	1428
2160 min Winter	3.437	0.0	1342.8	2152
2880 min Winter	2.669	0.0	1383.8	2348
4320 min Winter	1.882	0.0	1400.4	3076
5760 min Winter	1.479	0.0	1558.1	4040
7200 min Winter	1.236	0.0	1628.0	4856
8640 min Winter	1.074	0.0	1695.1	5536
10080 min Winter	0.957	0.0	1758.9	6248

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT B2.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.500

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.250	4	8	0.250

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT B2.SRCX

Storage is Online Cover Level (m) 70.200

Tank or Pond Structure

Invert Level (m) 69.200

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	550.0	1.000	1140.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0112-5200-0700-5200
Design Head (m)	0.700
Design Flow (l/s)	5.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	112
Invert Level (m)	69.200
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	5.2
Flush-Flo™	0.214	5.2
Kick-Flo®	0.482	4.4
Mean Flow over Head Range	-	4.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.9	1.200	6.7	3.000	10.3	7.000	15.4
0.200	5.2	1.400	7.2	3.500	11.1	7.500	15.9
0.300	5.1	1.600	7.6	4.000	11.8	8.000	16.4
0.400	4.9	1.800	8.1	4.500	12.5	8.500	16.9
0.500	4.5	2.000	8.5	5.000	13.1	9.000	17.4
0.600	4.8	2.200	8.9	5.500	13.7	9.500	17.9
0.800	5.5	2.400	9.3	6.000	14.3		
1.000	6.1	2.600	9.6	6.500	14.9		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B3.SRCX

Upstream Structures	Outflow To	Overflow To
CATCHMENT B7.SRCX	CATCHMENT B2.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	71.084	0.384	5.3	89.2	O K
30 min Summer	71.166	0.466	5.3	115.4	O K
60 min Summer	71.238	0.538	5.3	140.6	O K
120 min Summer	71.293	0.593	5.3	161.5	O K
180 min Summer	71.318	0.618	5.3	171.7	O K
240 min Summer	71.331	0.631	5.3	176.6	O K
360 min Summer	71.335	0.635	5.3	178.4	O K
480 min Summer	71.326	0.626	5.3	174.6	O K
600 min Summer	71.314	0.614	5.3	169.9	O K
720 min Summer	71.301	0.601	5.3	164.9	O K
960 min Summer	71.275	0.575	5.3	154.6	O K
1440 min Summer	71.221	0.521	5.3	134.7	O K
2160 min Summer	71.130	0.430	5.3	103.5	O K
2880 min Summer	71.053	0.353	5.3	80.1	O K
4320 min Summer	70.938	0.238	5.3	49.1	O K
5760 min Summer	70.868	0.168	5.2	32.8	O K
7200 min Summer	70.834	0.134	5.1	25.4	O K
8640 min Summer	70.822	0.122	4.8	22.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	212.6	22
30 min Summer	97.160	0.0	268.9	37
60 min Summer	60.480	0.0	360.8	66
120 min Summer	36.400	0.0	432.2	124
180 min Summer	26.929	0.0	476.2	184
240 min Summer	21.665	0.0	505.4	242
360 min Summer	15.820	0.0	535.5	360
480 min Summer	12.552	0.0	547.1	434
600 min Summer	10.442	0.0	553.9	492
720 min Summer	8.960	0.0	558.3	556
960 min Summer	7.003	0.0	563.1	684
1440 min Summer	4.918	0.0	564.6	958
2160 min Summer	3.437	0.0	746.4	1340
2880 min Summer	2.669	0.0	771.5	1696
4320 min Summer	1.882	0.0	811.4	2380
5760 min Summer	1.479	0.0	861.0	3048
7200 min Summer	1.236	0.0	899.5	3680
8640 min Summer	1.074	0.0	936.8	4408

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B3.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	70.814	0.114	4.5	21.3	O K
15 min Winter	71.120	0.420	5.3	100.3	O K
30 min Winter	71.208	0.508	5.3	129.8	O K
60 min Winter	71.284	0.584	5.3	158.1	O K
120 min Winter	71.345	0.645	5.3	182.7	O K
180 min Winter	71.375	0.675	5.3	195.2	O K
240 min Winter	71.390	0.690	5.3	201.7	O K
360 min Winter	71.399	0.699	5.3	205.6	O K
480 min Winter	71.392	0.692	5.3	202.6	O K
600 min Winter	71.378	0.678	5.3	196.5	O K
720 min Winter	71.362	0.662	5.3	189.8	O K
960 min Winter	71.331	0.631	5.3	176.7	O K
1440 min Winter	71.262	0.562	5.3	149.9	O K
2160 min Winter	71.133	0.433	5.3	104.5	O K
2880 min Winter	71.013	0.313	5.3	68.8	O K
4320 min Winter	70.866	0.166	5.2	32.3	O K
5760 min Winter	70.822	0.122	4.8	22.9	O K
7200 min Winter	70.811	0.111	4.4	20.6	O K
8640 min Winter	70.803	0.103	4.1	19.0	O K
10080 min Winter	70.798	0.098	3.8	18.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	972.6	5136
15 min Winter	148.960	0.0	236.4	22
30 min Winter	97.160	0.0	289.4	37
60 min Winter	60.480	0.0	403.2	66
120 min Winter	36.400	0.0	480.4	122
180 min Winter	26.929	0.0	522.9	180
240 min Winter	21.665	0.0	544.0	238
360 min Winter	15.820	0.0	564.3	350
480 min Winter	12.552	0.0	576.5	460
600 min Winter	10.442	0.0	584.8	560
720 min Winter	8.960	0.0	590.8	584
960 min Winter	7.003	0.0	598.1	734
1440 min Winter	4.917	0.0	604.4	1042
2160 min Winter	3.437	0.0	834.8	1452
2880 min Winter	2.669	0.0	862.0	1764
4320 min Winter	1.882	0.0	896.4	2380
5760 min Winter	1.479	0.0	964.4	2944
7200 min Winter	1.236	0.0	1007.7	3672
8640 min Winter	1.074	0.0	1049.6	4408
10080 min Winter	0.957	0.0	1090.2	5144

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT B3.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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	0.170	4	8	0.160

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT B3.SRCX

Storage is Online Cover Level (m) 71.700

Tank or Pond Structure

Invert Level (m) 70.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	168.9	1.000	597.6

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0113-5300-0700-5300
Design Head (m)	0.700
Design Flow (l/s)	5.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	113
Invert Level (m)	70.700
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	5.3
Flush-Flo™	0.216	5.3
Kick-Flo®	0.485	4.5
Mean Flow over Head Range	-	4.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.9	1.200	6.8	3.000	10.5	7.000	15.7
0.200	5.3	1.400	7.3	3.500	11.3	7.500	16.2
0.300	5.2	1.600	7.8	4.000	12.0	8.000	16.7
0.400	5.0	1.800	8.2	4.500	12.7	8.500	17.3
0.500	4.5	2.000	8.7	5.000	13.4	9.000	17.8
0.600	4.9	2.200	9.1	5.500	14.0	9.500	18.3
0.800	5.6	2.400	9.4	6.000	14.6		
1.000	6.3	2.600	9.8	6.500	15.2		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B4.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	CATCHMENT B5.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	73.338	0.238	2.0	87.6	O K
30 min Summer	73.393	0.293	2.0	113.6	O K
60 min Summer	73.445	0.345	2.0	139.5	O K
120 min Summer	73.489	0.389	2.0	163.9	O K
180 min Summer	73.514	0.414	2.0	177.7	O K
240 min Summer	73.529	0.429	2.0	186.6	O K
360 min Summer	73.544	0.444	2.0	196.1	O K
480 min Summer	73.549	0.449	2.0	198.9	O K
600 min Summer	73.548	0.448	2.0	198.1	O K
720 min Summer	73.543	0.443	2.0	195.1	O K
960 min Summer	73.527	0.427	2.0	185.5	O K
1440 min Summer	73.497	0.397	2.0	168.0	O K
2160 min Summer	73.457	0.357	2.0	146.0	O K
2880 min Summer	73.422	0.322	2.0	127.7	O K
4320 min Summer	73.363	0.263	2.0	98.9	O K
5760 min Summer	73.314	0.214	2.0	77.3	O K
7200 min Summer	73.277	0.177	2.0	61.8	O K
8640 min Summer	73.249	0.149	2.0	50.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	85.8	23
30 min Summer	97.160	0.0	111.8	37
60 min Summer	60.480	0.0	143.5	66
120 min Summer	36.400	0.0	172.7	126
180 min Summer	26.929	0.0	191.6	186
240 min Summer	21.665	0.0	205.4	246
360 min Summer	15.820	0.0	224.7	364
480 min Summer	12.552	0.0	237.4	484
600 min Summer	10.442	0.0	246.5	602
720 min Summer	8.960	0.0	253.4	720
960 min Summer	7.003	0.0	263.1	860
1440 min Summer	4.918	0.0	274.1	1066
2160 min Summer	3.437	0.0	295.9	1448
2880 min Summer	2.669	0.0	306.2	1844
4320 min Summer	1.882	0.0	323.3	2596
5760 min Summer	1.479	0.0	340.2	3344
7200 min Summer	1.236	0.0	355.4	4032
8640 min Summer	1.074	0.0	370.2	4752

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B4.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	73.228	0.128	1.9	42.5	O K
15 min Winter	73.361	0.261	2.0	98.3	O K
30 min Winter	73.421	0.321	2.0	127.6	O K
60 min Winter	73.477	0.377	2.0	156.9	O K
120 min Winter	73.526	0.426	2.0	184.9	O K
180 min Winter	73.553	0.453	2.0	201.3	O K
240 min Winter	73.570	0.470	2.0	211.9	O K
360 min Winter	73.588	0.488	2.0	223.5	O K
480 min Winter	73.595	0.495	2.0	227.7	O K
600 min Winter	73.595	0.495	2.0	228.0	O K
720 min Winter	73.592	0.492	2.0	226.0	O K
960 min Winter	73.580	0.480	2.0	218.1	O K
1440 min Winter	73.544	0.444	2.0	195.7	O K
2160 min Winter	73.491	0.391	2.0	165.1	O K
2880 min Winter	73.442	0.342	2.0	138.4	O K
4320 min Winter	73.356	0.256	2.0	95.7	O K
5760 min Winter	73.286	0.186	2.0	65.3	O K
7200 min Winter	73.237	0.137	1.9	45.9	O K
8640 min Winter	73.205	0.105	1.9	34.3	O K
10080 min Winter	73.189	0.089	1.7	28.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	384.4	5352
15 min Winter	148.960	0.0	96.1	22
30 min Winter	97.160	0.0	124.8	37
60 min Winter	60.480	0.0	160.7	66
120 min Winter	36.400	0.0	193.4	124
180 min Winter	26.929	0.0	214.4	182
240 min Winter	21.665	0.0	229.7	242
360 min Winter	15.820	0.0	251.0	358
480 min Winter	12.552	0.0	264.7	474
600 min Winter	10.442	0.0	274.2	588
720 min Winter	8.960	0.0	281.1	700
960 min Winter	7.003	0.0	289.4	920
1440 min Winter	4.917	0.0	291.3	1186
2160 min Winter	3.437	0.0	331.4	1584
2880 min Winter	2.669	0.0	343.0	1996
4320 min Winter	1.882	0.0	362.3	2772
5760 min Winter	1.479	0.0	381.1	3464
7200 min Winter	1.236	0.0	398.2	4112
8640 min Winter	1.074	0.0	414.7	4752
10080 min Winter	0.957	0.0	430.8	5344

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT B4.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.320

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.160	4	8	0.160

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT B4.SRCX

Storage is Online Cover Level (m) 74.100

Tank or Pond Structure

Invert Level (m) 73.100

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	294.5	1.000	1153.4

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)	73.100
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		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B5.SRCX

	Upstream Structures	Outflow To	Overflow To
CATCHMENT B4.SRCX		(None)	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	72.049	0.199	5.3	190.4	O K
30 min Summer	72.104	0.254	5.3	247.3	O K
60 min Summer	72.160	0.310	5.3	305.3	O K
120 min Summer	72.212	0.362	5.3	361.9	O K
180 min Summer	72.243	0.393	5.3	395.6	O K
240 min Summer	72.263	0.413	5.3	418.3	O K
360 min Summer	72.287	0.437	5.3	445.4	O K
480 min Summer	72.299	0.449	5.3	458.2	O K
600 min Summer	72.303	0.453	5.3	463.2	O K
720 min Summer	72.303	0.453	5.3	463.5	O K
960 min Summer	72.296	0.446	5.3	455.2	O K
1440 min Summer	72.273	0.423	5.3	428.9	O K
2160 min Summer	72.240	0.390	5.3	392.2	O K
2880 min Summer	72.210	0.360	5.3	359.7	O K
4320 min Summer	72.160	0.310	5.3	305.6	O K
5760 min Summer	72.119	0.269	5.3	262.0	O K
7200 min Summer	72.085	0.235	5.3	227.0	O K
8640 min Summer	72.057	0.207	5.3	198.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	251.1	23
30 min Summer	97.160	0.0	326.7	37
60 min Summer	60.480	0.0	442.2	68
120 min Summer	36.400	0.0	532.3	126
180 min Summer	26.929	0.0	589.9	186
240 min Summer	21.665	0.0	631.5	246
360 min Summer	15.820	0.0	688.0	364
480 min Summer	12.552	0.0	723.2	484
600 min Summer	10.442	0.0	746.5	602
720 min Summer	8.960	0.0	762.1	722
960 min Summer	7.003	0.0	777.3	960
1440 min Summer	4.918	0.0	762.8	1184
2160 min Summer	3.437	0.0	926.3	1536
2880 min Summer	2.669	0.0	958.0	1932
4320 min Summer	1.882	0.0	1008.1	2724
5760 min Summer	1.479	0.0	1070.7	3464
7200 min Summer	1.236	0.0	1117.9	4248
8640 min Summer	1.074	0.0	1162.9	4928

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B5.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	72.034	0.184	5.3	175.7	O K
15 min Winter	72.071	0.221	5.3	213.4	O K
30 min Winter	72.133	0.283	5.3	277.4	O K
60 min Winter	72.194	0.344	5.3	342.6	O K
120 min Winter	72.253	0.403	5.3	406.4	O K
180 min Winter	72.287	0.437	5.3	444.9	O K
240 min Winter	72.310	0.460	5.3	471.2	O K
360 min Winter	72.339	0.489	5.3	504.2	O K
480 min Winter	72.353	0.503	5.3	520.8	O K
600 min Winter	72.360	0.510	5.3	528.5	O K
720 min Winter	72.362	0.512	5.3	530.8	O K
960 min Winter	72.357	0.507	5.3	525.7	O K
1440 min Winter	72.333	0.483	5.3	497.7	O K
2160 min Winter	72.288	0.438	5.3	446.5	O K
2880 min Winter	72.249	0.399	5.3	402.1	O K
4320 min Winter	72.176	0.326	5.3	322.9	O K
5760 min Winter	72.113	0.263	5.3	256.1	O K
7200 min Winter	72.061	0.211	5.3	202.5	O K
8640 min Winter	72.020	0.170	5.2	161.8	O K
10080 min Winter	71.990	0.140	5.1	132.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	1204.3	5648
15 min Winter	148.960	0.0	281.6	23
30 min Winter	97.160	0.0	362.9	37
60 min Winter	60.480	0.0	495.6	66
120 min Winter	36.400	0.0	595.6	124
180 min Winter	26.929	0.0	658.6	184
240 min Winter	21.665	0.0	703.3	242
360 min Winter	15.820	0.0	760.9	360
480 min Winter	12.552	0.0	791.8	476
600 min Winter	10.442	0.0	805.7	592
720 min Winter	8.960	0.0	807.1	706
960 min Winter	7.003	0.0	790.6	934
1440 min Winter	4.917	0.0	754.1	1370
2160 min Winter	3.437	0.0	1037.3	1668
2880 min Winter	2.669	0.0	1072.7	2108
4320 min Winter	1.882	0.0	1129.1	2944
5760 min Winter	1.479	0.0	1199.8	3744
7200 min Winter	1.236	0.0	1252.8	4400
8640 min Winter	1.074	0.0	1303.7	5024
10080 min Winter	0.957	0.0	1351.2	5640

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT B5.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.690

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.340	4	8	0.350

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT B5.SRCX

Storage is Online Cover Level (m) 72.850

Tank or Pond Structure

Invert Level (m) 71.850

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	910.0	1.000	1450.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0113-5300-0700-5300
Design Head (m)	0.700
Design Flow (l/s)	5.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	113
Invert Level (m)	71.850
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	5.3
Flush-Flo™	0.216	5.3
Kick-Flo®	0.485	4.5
Mean Flow over Head Range	-	4.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.9	1.200	6.8	3.000	10.5	7.000	15.7
0.200	5.3	1.400	7.3	3.500	11.3	7.500	16.2
0.300	5.2	1.600	7.8	4.000	12.0	8.000	16.7
0.400	5.0	1.800	8.2	4.500	12.7	8.500	17.3
0.500	4.5	2.000	8.7	5.000	13.4	9.000	17.8
0.600	4.9	2.200	9.1	5.500	14.0	9.500	18.3
0.800	5.6	2.400	9.4	6.000	14.6		
1.000	6.3	2.600	9.8	6.500	15.2		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B7.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	CATCHMENT B3.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	72.282	0.282	2.0	132.3	O K
30 min Summer	72.354	0.354	2.0	171.9	O K
60 min Summer	72.423	0.423	2.0	212.2	O K
120 min Summer	72.487	0.487	2.0	251.5	O K
180 min Summer	72.523	0.523	2.0	274.9	O K
240 min Summer	72.546	0.546	2.0	290.5	O K
360 min Summer	72.574	0.574	2.0	309.0	O K
480 min Summer	72.586	0.586	2.0	317.5	O K
600 min Summer	72.591	0.591	2.0	320.8	O K
720 min Summer	72.591	0.591	2.0	320.9	O K
960 min Summer	72.583	0.583	2.0	315.5	O K
1440 min Summer	72.555	0.555	2.0	296.2	O K
2160 min Summer	72.515	0.515	2.0	269.8	O K
2880 min Summer	72.481	0.481	2.0	247.8	O K
4320 min Summer	72.418	0.418	2.0	209.0	O K
5760 min Summer	72.365	0.365	2.0	178.3	O K
7200 min Summer	72.323	0.323	2.0	154.2	O K
8640 min Summer	72.286	0.286	2.0	134.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	124.5	23
30 min Summer	97.160	0.0	156.1	38
60 min Summer	60.480	0.0	213.1	68
120 min Summer	36.400	0.0	255.1	126
180 min Summer	26.929	0.0	280.6	186
240 min Summer	21.665	0.0	297.1	246
360 min Summer	15.820	0.0	310.6	366
480 min Summer	12.552	0.0	309.7	484
600 min Summer	10.442	0.0	306.7	604
720 min Summer	8.960	0.0	303.6	722
960 min Summer	7.003	0.0	297.0	962
1440 min Summer	4.918	0.0	283.6	1314
2160 min Summer	3.437	0.0	441.7	1664
2880 min Summer	2.669	0.0	456.5	2048
4320 min Summer	1.882	0.0	479.6	2812
5760 min Summer	1.479	0.0	510.1	3576
7200 min Summer	1.236	0.0	532.9	4328
8640 min Summer	1.074	0.0	554.9	5096

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B7.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	72.254	0.254	2.0	117.5	O K
15 min Winter	72.312	0.312	2.0	148.3	O K
30 min Winter	72.391	0.391	2.0	192.8	O K
60 min Winter	72.466	0.466	2.0	238.4	O K
120 min Winter	72.535	0.535	2.0	282.7	O K
180 min Winter	72.575	0.575	2.0	309.4	O K
240 min Winter	72.601	0.601	2.0	327.4	O K
360 min Winter	72.632	0.632	2.0	349.3	O K
480 min Winter	72.647	0.647	2.0	360.0	O K
600 min Winter	72.653	0.653	2.0	364.7	O K
720 min Winter	72.655	0.655	2.0	366.0	O K
960 min Winter	72.650	0.650	2.0	362.1	O K
1440 min Winter	72.624	0.624	2.0	343.9	O K
2160 min Winter	72.576	0.576	2.0	310.7	O K
2880 min Winter	72.536	0.536	2.0	283.6	O K
4320 min Winter	72.458	0.458	2.0	233.7	O K
5760 min Winter	72.376	0.376	2.0	184.6	O K
7200 min Winter	72.310	0.310	2.0	147.3	O K
8640 min Winter	72.254	0.254	2.0	117.4	O K
10080 min Winter	72.208	0.208	2.0	93.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	575.9	5840
15 min Winter	148.960	0.0	138.3	23
30 min Winter	97.160	0.0	164.8	37
60 min Winter	60.480	0.0	238.1	66
120 min Winter	36.400	0.0	283.1	124
180 min Winter	26.929	0.0	306.6	184
240 min Winter	21.665	0.0	314.3	242
360 min Winter	15.820	0.0	312.5	360
480 min Winter	12.552	0.0	309.4	476
600 min Winter	10.442	0.0	306.6	592
720 min Winter	8.960	0.0	303.9	708
960 min Winter	7.003	0.0	298.6	934
1440 min Winter	4.917	0.0	288.0	1372
2160 min Winter	3.437	0.0	494.0	1732
2880 min Winter	2.669	0.0	509.8	2192
4320 min Winter	1.882	0.0	528.1	3116
5760 min Winter	1.479	0.0	571.3	3872
7200 min Winter	1.236	0.0	597.0	4616
8640 min Winter	1.074	0.0	621.8	5360
10080 min Winter	0.957	0.0	645.6	6048

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT B7.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.480

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.240	4	8	0.240

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT B7.SRCX

Storage is Online Cover Level (m) 73.000

Tank or Pond Structure

Invert Level (m) 72.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	406.8	1.000	931.5

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)	72.000
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		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C1.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	CATCHMENT C2.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	69.848	0.348	2.0	56.8	O K
30 min Summer	69.921	0.421	2.0	73.4	O K
60 min Summer	69.985	0.485	2.0	89.6	O K
120 min Summer	70.036	0.536	2.0	103.4	O K
180 min Summer	70.060	0.560	2.0	110.3	O K
240 min Summer	70.072	0.572	2.0	113.8	O K
360 min Summer	70.077	0.577	2.0	115.4	O K
480 min Summer	70.069	0.569	2.0	113.1	O K
600 min Summer	70.057	0.557	2.0	109.6	O K
720 min Summer	70.045	0.545	2.0	106.0	O K
960 min Summer	70.020	0.520	2.0	98.9	O K
1440 min Summer	69.971	0.471	2.0	85.8	O K
2160 min Summer	69.893	0.393	2.0	66.9	O K
2880 min Summer	69.826	0.326	2.0	52.1	O K
4320 min Summer	69.719	0.219	2.0	31.6	O K
5760 min Summer	69.649	0.149	2.0	20.1	O K
7200 min Summer	69.610	0.110	1.9	14.3	O K
8640 min Summer	69.591	0.091	1.8	11.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	58.2	22
30 min Summer	97.160	0.0	75.9	37
60 min Summer	60.480	0.0	95.0	66
120 min Summer	36.400	0.0	114.4	126
180 min Summer	26.929	0.0	127.0	184
240 min Summer	21.665	0.0	136.2	244
360 min Summer	15.820	0.0	149.2	362
480 min Summer	12.552	0.0	157.8	472
600 min Summer	10.442	0.0	164.1	520
720 min Summer	8.960	0.0	169.0	580
960 min Summer	7.003	0.0	176.1	704
1440 min Summer	4.918	0.0	185.4	978
2160 min Summer	3.437	0.0	194.7	1360
2880 min Summer	2.669	0.0	201.6	1728
4320 min Summer	1.882	0.0	213.1	2420
5760 min Summer	1.479	0.0	223.5	3064
7200 min Summer	1.236	0.0	233.6	3744
8640 min Summer	1.074	0.0	243.4	4408

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C1.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	69.581	0.081	1.6	10.2	O K
15 min Winter	69.880	0.380	2.0	63.8	O K
30 min Winter	69.958	0.458	2.0	82.7	O K
60 min Winter	70.027	0.527	2.0	100.9	O K
120 min Winter	70.083	0.583	2.0	117.0	O K
180 min Winter	70.110	0.610	2.0	125.4	O K
240 min Winter	70.124	0.624	2.0	129.9	O K
360 min Winter	70.134	0.634	2.0	133.0	O K
480 min Winter	70.129	0.629	2.0	131.5	O K
600 min Winter	70.118	0.618	2.0	127.9	O K
720 min Winter	70.103	0.603	2.0	123.2	O K
960 min Winter	70.073	0.573	2.0	114.3	O K
1440 min Winter	70.013	0.513	2.0	97.0	O K
2160 min Winter	69.906	0.406	2.0	70.0	O K
2880 min Winter	69.805	0.305	2.0	47.8	O K
4320 min Winter	69.656	0.156	2.0	21.3	O K
5760 min Winter	69.592	0.092	1.8	11.8	O K
7200 min Winter	69.576	0.076	1.5	9.6	O K
8640 min Winter	69.567	0.067	1.3	8.3	O K
10080 min Winter	69.561	0.061	1.2	7.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	253.0	5144
15 min Winter	148.960	0.0	65.2	22
30 min Winter	97.160	0.0	85.1	37
60 min Winter	60.480	0.0	106.5	66
120 min Winter	36.400	0.0	128.2	122
180 min Winter	26.929	0.0	142.2	180
240 min Winter	21.665	0.0	152.6	238
360 min Winter	15.820	0.0	167.1	352
480 min Winter	12.552	0.0	176.8	464
600 min Winter	10.442	0.0	183.8	570
720 min Winter	8.960	0.0	189.3	664
960 min Winter	7.003	0.0	197.2	750
1440 min Winter	4.917	0.0	207.6	1056
2160 min Winter	3.437	0.0	218.1	1472
2880 min Winter	2.669	0.0	225.8	1824
4320 min Winter	1.882	0.0	238.7	2464
5760 min Winter	1.479	0.0	250.3	3000
7200 min Winter	1.236	0.0	261.6	3744
8640 min Winter	1.074	0.0	272.6	4416
10080 min Winter	0.957	0.0	283.4	5136

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT C1.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.210

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.110	4	8	0.100

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT C1.SRCX

Storage is Online Cover Level (m) 70.500

Tank or Pond Structure

Invert Level (m) 69.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	116.0	1.000	484.8

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)	69.500
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		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C2.SRCX

Upstream Structures	Outflow To	Overflow To
CATCHMENT C1.SRCX	CATCHMENT C5.SRCX	(None)
CATCHMENT C4.SRCX		
CATCHMENT C8.SRCX		
CATCHMENT C9.SRCX		
CATCHMENT C6.SRCX		

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	68.216	0.216	12.9	472.9	O K
30 min Summer	68.282	0.282	13.0	628.1	O K
60 min Summer	68.351	0.351	13.0	796.3	O K
120 min Summer	68.423	0.423	13.0	978.2	O K
180 min Summer	68.471	0.471	13.0	1102.1	O K
240 min Summer	68.506	0.506	13.0	1197.3	O K
360 min Summer	68.556	0.556	13.0	1331.1	O K
480 min Summer	68.587	0.587	13.0	1416.4	O K
600 min Summer	68.609	0.609	13.0	1477.4	O K
720 min Summer	68.624	0.624	13.0	1521.3	O K
960 min Summer	68.636	0.636	13.0	1553.7	O K
1440 min Summer	68.618	0.618	13.0	1503.3	O K
2160 min Summer	68.585	0.585	13.0	1410.0	O K
2880 min Summer	68.554	0.554	13.0	1326.2	O K
4320 min Summer	68.491	0.491	13.0	1156.3	O K
5760 min Summer	68.433	0.433	13.0	1004.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	689.7	232
30 min Summer	97.160	0.0	892.2	295
60 min Summer	60.480	0.0	1255.7	370
120 min Summer	36.400	0.0	1507.9	458
180 min Summer	26.929	0.0	1664.0	520
240 min Summer	21.665	0.0	1770.9	572
360 min Summer	15.820	0.0	1897.4	654
480 min Summer	12.552	0.0	1952.5	720
600 min Summer	10.442	0.0	1962.8	776
720 min Summer	8.960	0.0	1945.0	830
960 min Summer	7.003	0.0	1890.6	980
1440 min Summer	4.918	0.0	1776.2	1398
2160 min Summer	3.437	0.0	2653.8	1752
2880 min Summer	2.669	0.0	2737.9	2160
4320 min Summer	1.882	0.0	2860.6	2900
5760 min Summer	1.479	0.0	3088.5	3632

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C2.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Summer	68.384	0.384	13.0	879.7	O K
8640 min Summer	68.342	0.342	13.0	776.0	O K
10080 min Summer	68.307	0.307	13.0	690.1	O K
15 min Winter	68.242	0.242	13.0	533.2	O K
30 min Winter	68.315	0.315	13.0	708.0	O K
60 min Winter	68.391	0.391	13.0	898.0	O K
120 min Winter	68.473	0.473	13.0	1108.0	O K
180 min Winter	68.528	0.528	13.0	1254.4	O K
240 min Winter	68.566	0.566	13.0	1359.9	O K
360 min Winter	68.618	0.618	13.0	1503.8	O K
480 min Winter	68.650	0.650	13.0	1594.9	O K
600 min Winter	68.673	0.673	13.0	1659.0	O K
720 min Winter	68.690	0.690	13.0	1710.1	O K
960 min Winter	68.709	0.709	13.1	1764.5	Flood Risk
1440 min Winter	68.694	0.694	13.0	1720.2	O K
2160 min Winter	68.652	0.652	13.0	1599.4	O K
2880 min Winter	68.615	0.615	13.0	1493.4	O K
4320 min Winter	68.535	0.535	13.0	1273.5	O K
5760 min Winter	68.441	0.441	13.0	1025.8	O K
7200 min Winter	68.365	0.365	13.0	831.4	O K
8640 min Winter	68.301	0.301	13.0	675.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Summer	1.236	0.0	3223.2	4392
8640 min Summer	1.074	0.0	3349.8	5104
10080 min Summer	0.957	0.0	3461.5	5832
15 min Winter	148.960	0.0	773.4	254
30 min Winter	97.160	0.0	981.1	325
60 min Winter	60.480	0.0	1406.2	410
120 min Winter	36.400	0.0	1680.5	500
180 min Winter	26.929	0.0	1840.5	568
240 min Winter	21.665	0.0	1939.3	616
360 min Winter	15.820	0.0	2020.0	694
480 min Winter	12.552	0.0	2009.5	762
600 min Winter	10.442	0.0	1987.4	822
720 min Winter	8.960	0.0	1965.9	872
960 min Winter	7.003	0.0	1922.4	986
1440 min Winter	4.917	0.0	1828.9	1400
2160 min Winter	3.437	0.0	2968.9	1852
2880 min Winter	2.669	0.0	3059.4	2268
4320 min Winter	1.882	0.0	3171.5	3140
5760 min Winter	1.479	0.0	3461.4	3912
7200 min Winter	1.236	0.0	3613.4	4640
8640 min Winter	1.074	0.0	3757.1	5344

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C2.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Winter	68.250	0.250	13.0	554.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	0.957	0.0	3887.1	5976

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT C2.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.730

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.365	4	8	0.365

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT C2.SRCX

Storage is Online Cover Level (m) 69.000

Tank or Pond Structure

Invert Level (m) 68.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2070.0	1.000	3330.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0168-1300-0700-1300
Design Head (m)	0.700
Design Flow (l/s)	13.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	168
Invert Level (m)	68.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	13.0
Flush-Flo™	0.267	13.0
Kick-Flo®	0.526	11.4
Mean Flow over Head Range	-	10.7

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	6.0	1.200	16.8	3.000	26.0	7.000	39.1
0.200	12.8	1.400	18.1	3.500	28.0	7.500	40.3
0.300	13.0	1.600	19.2	4.000	29.9	8.000	41.6
0.400	12.6	1.800	20.4	4.500	31.6	8.500	42.9
0.500	11.8	2.000	21.4	5.000	33.3	9.000	44.2
0.600	12.1	2.200	22.4	5.500	34.8	9.500	45.4
0.800	13.8	2.400	23.4	6.000	36.3		
1.000	15.4	2.600	24.3	6.500	37.8		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C4.SRCX

Upstream Structures	Outflow To	Overflow To
CATCHMENT C8.SRCX	CATCHMENT C2.SRCX	(None)
CATCHMENT C9.SRCX		

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	69.291	0.391	37.5	266.3	O K
30 min Summer	69.384	0.484	37.5	340.6	O K
60 min Summer	69.463	0.563	37.5	408.3	O K
120 min Summer	69.514	0.614	37.5	454.0	O K
180 min Summer	69.527	0.627	37.5	465.1	O K
240 min Summer	69.529	0.629	37.5	467.0	O K
360 min Summer	69.518	0.618	37.5	457.2	O K
480 min Summer	69.495	0.595	37.5	436.3	O K
600 min Summer	69.464	0.564	37.5	408.8	O K
720 min Summer	69.434	0.534	37.5	382.7	O K
960 min Summer	69.373	0.473	37.5	332.1	O K
1440 min Summer	69.270	0.370	37.5	249.6	O K
2160 min Summer	69.165	0.265	36.4	172.0	O K
2880 min Summer	69.122	0.222	31.2	141.4	O K
4320 min Summer	69.080	0.180	23.1	112.9	O K
5760 min Summer	69.057	0.157	18.6	97.7	O K
7200 min Summer	69.042	0.142	15.8	88.0	O K
8640 min Summer	69.032	0.132	13.8	81.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	437.4	21
30 min Summer	97.160	0.0	572.3	36
60 min Summer	60.480	0.0	717.9	64
120 min Summer	36.400	0.0	864.7	122
180 min Summer	26.929	0.0	959.9	164
240 min Summer	21.665	0.0	1029.8	194
360 min Summer	15.820	0.0	1128.2	260
480 min Summer	12.552	0.0	1193.6	328
600 min Summer	10.442	0.0	1241.3	392
720 min Summer	8.960	0.0	1278.1	458
960 min Summer	7.003	0.0	1331.7	588
1440 min Summer	4.918	0.0	1401.6	826
2160 min Summer	3.437	0.0	1473.1	1152
2880 min Summer	2.669	0.0	1524.7	1500
4320 min Summer	1.882	0.0	1610.1	2212
5760 min Summer	1.479	0.0	1691.4	2944
7200 min Summer	1.236	0.0	1767.3	3672
8640 min Summer	1.074	0.0	1841.2	4408

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C4.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	69.024	0.124	12.4	75.8	O K
15 min Winter	69.334	0.434	37.5	299.7	O K
30 min Winter	69.436	0.536	37.5	384.4	O K
60 min Winter	69.523	0.623	37.5	461.5	O K
120 min Winter	69.580	0.680	37.5	514.2	O K
180 min Winter	69.596	0.696	37.5	529.3	O K
240 min Winter	69.594	0.694	37.5	527.8	O K
360 min Winter	69.579	0.679	37.5	513.2	O K
480 min Winter	69.547	0.647	37.5	484.0	O K
600 min Winter	69.508	0.608	37.5	448.2	O K
720 min Winter	69.464	0.564	37.5	409.4	O K
960 min Winter	69.375	0.475	37.5	333.0	O K
1440 min Winter	69.223	0.323	37.3	213.9	O K
2160 min Winter	69.120	0.220	31.0	140.4	O K
2880 min Winter	69.087	0.187	24.5	117.4	O K
4320 min Winter	69.051	0.151	17.5	93.7	O K
5760 min Winter	69.032	0.132	13.8	81.0	O K
7200 min Winter	69.019	0.119	11.6	73.0	O K
8640 min Winter	69.010	0.110	10.1	67.2	O K
10080 min Winter	69.004	0.104	9.0	63.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	1912.8	5136
15 min Winter	148.960	0.0	490.5	21
30 min Winter	97.160	0.0	641.6	35
60 min Winter	60.480	0.0	804.4	64
120 min Winter	36.400	0.0	968.8	120
180 min Winter	26.929	0.0	1075.4	174
240 min Winter	21.665	0.0	1153.8	222
360 min Winter	15.820	0.0	1264.0	278
480 min Winter	12.552	0.0	1337.2	354
600 min Winter	10.442	0.0	1390.6	430
720 min Winter	8.960	0.0	1431.9	500
960 min Winter	7.003	0.0	1492.1	630
1440 min Winter	4.917	0.0	1570.6	854
2160 min Winter	3.437	0.0	1650.1	1152
2880 min Winter	2.669	0.0	1708.1	1504
4320 min Winter	1.882	0.0	1804.2	2228
5760 min Winter	1.479	0.0	1894.6	2936
7200 min Winter	1.236	0.0	1979.7	3672
8640 min Winter	1.074	0.0	2062.5	4376
10080 min Winter	0.957	0.0	2143.3	5136

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT C4.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 1.010

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.505	4	8	0.505

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT C4.SRCX

Storage is Online Cover Level (m) 69.900

Tank or Pond Structure

Invert Level (m) 68.900

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	585.0	1.000	1140.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0264-3750-0700-3750
Design Head (m)	0.700
Design Flow (l/s)	37.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	264
Invert Level (m)	68.900
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	37.5
Flush-Flo™	0.377	37.5
Kick-Flo®	0.589	34.5
Mean Flow over Head Range	-	28.7

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	8.4	1.200	48.6	3.000	75.7	7.000	114.5
0.200	27.2	1.400	52.3	3.500	81.6	7.500	117.5
0.300	37.0	1.600	55.8	4.000	87.1	8.000	121.4
0.400	37.4	1.800	59.1	4.500	92.2	8.500	125.2
0.500	36.5	2.000	62.2	5.000	97.1	9.000	128.9
0.600	34.8	2.200	65.1	5.500	101.7	9.500	132.4
0.800	40.0	2.400	67.9	6.000	106.2		
1.000	44.5	2.600	70.6	6.500	110.4		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C5.SRCX

Upstream Structures	Outflow To	Overflow To
CATCHMENT C2.SRCX	(None)	(None)
CATCHMENT C1.SRCX		
CATCHMENT C4.SRCX		
CATCHMENT C8.SRCX		
CATCHMENT C9.SRCX		
CATCHMENT C6.SRCX		

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	68.077	0.327	19.4	198.4	O K
30 min Summer	68.163	0.413	19.4	257.1	O K
60 min Summer	68.245	0.495	19.4	316.1	O K
120 min Summer	68.316	0.566	19.4	370.0	O K
180 min Summer	68.353	0.603	19.4	398.1	O K
240 min Summer	68.373	0.623	19.4	414.2	O K
360 min Summer	68.390	0.640	19.4	427.5	O K
480 min Summer	68.388	0.638	19.4	426.5	O K
600 min Summer	68.381	0.631	19.4	420.8	O K
720 min Summer	68.374	0.624	19.4	414.8	O K
960 min Summer	68.357	0.607	19.4	401.3	O K
1440 min Summer	68.317	0.567	19.4	370.5	O K
2160 min Summer	68.240	0.490	19.4	312.5	O K
2880 min Summer	68.176	0.426	19.4	266.3	O K
4320 min Summer	68.080	0.330	19.4	200.1	O K
5760 min Summer	68.019	0.269	19.3	160.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	867.6	22
30 min Summer	97.160	0.0	1122.3	37
60 min Summer	60.480	0.0	1578.3	66
120 min Summer	36.400	0.0	1895.2	126
180 min Summer	26.929	0.0	2091.1	186
240 min Summer	21.665	0.0	2225.2	244
360 min Summer	15.820	0.0	2383.9	362
480 min Summer	12.552	0.0	2453.9	478
600 min Summer	10.442	0.0	2472.6	522
720 min Summer	8.960	0.0	2466.1	578
960 min Summer	7.003	0.0	2436.4	698
1440 min Summer	4.918	0.0	2356.3	980
2160 min Summer	3.437	0.0	3335.3	1344
2880 min Summer	2.669	0.0	3440.9	1728
4320 min Summer	1.882	0.0	3595.2	2428
5760 min Summer	1.479	0.0	3881.9	3120

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C5.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Summer	67.982	0.232	19.1	136.2	O K
8640 min Summer	67.959	0.209	18.9	121.8	O K
10080 min Summer	67.948	0.198	18.6	115.1	O K
15 min Winter	68.115	0.365	19.4	223.7	O K
30 min Winter	68.210	0.460	19.4	290.6	O K
60 min Winter	68.300	0.550	19.4	357.7	O K
120 min Winter	68.376	0.626	19.4	416.8	O K
180 min Winter	68.415	0.665	19.4	447.9	O K
240 min Winter	68.437	0.687	19.4	465.9	O K
360 min Winter	68.456	0.706	19.5	481.3	Flood Risk
480 min Winter	68.455	0.705	19.5	480.6	Flood Risk
600 min Winter	68.444	0.694	19.4	471.8	O K
720 min Winter	68.433	0.683	19.4	462.9	O K
960 min Winter	68.412	0.662	19.4	445.1	O K
1440 min Winter	68.366	0.616	19.4	408.5	O K
2160 min Winter	68.262	0.512	19.4	328.8	O K
2880 min Winter	68.157	0.407	19.4	252.7	O K
4320 min Winter	68.032	0.282	19.4	168.7	O K
5760 min Winter	67.968	0.218	19.0	127.4	O K
7200 min Winter	67.946	0.196	18.4	113.7	O K
8640 min Winter	67.938	0.188	17.6	109.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Summer	1.236	0.0	4051.3	3816
8640 min Summer	1.074	0.0	4210.6	4496
10080 min Summer	0.957	0.0	4351.5	5144
15 min Winter	148.960	0.0	972.8	22
30 min Winter	97.160	0.0	1234.6	36
60 min Winter	60.480	0.0	1767.3	66
120 min Winter	36.400	0.0	2111.9	124
180 min Winter	26.929	0.0	2312.6	182
240 min Winter	21.665	0.0	2436.5	238
360 min Winter	15.820	0.0	2542.7	352
480 min Winter	12.552	0.0	2558.0	460
600 min Winter	10.442	0.0	2560.7	552
720 min Winter	8.960	0.0	2558.8	574
960 min Winter	7.003	0.0	2544.6	740
1440 min Winter	4.917	0.0	2490.5	1072
2160 min Winter	3.437	0.0	3731.1	1516
2880 min Winter	2.669	0.0	3844.7	1792
4320 min Winter	1.882	0.0	3984.9	2468
5760 min Winter	1.479	0.0	4350.5	3112
7200 min Winter	1.236	0.0	4541.7	3744
8640 min Winter	1.074	0.0	4722.4	4488

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C5.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Winter	67.932	0.182	17.0	105.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	0.957	0.0	4886.2	5248

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT C5.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.750

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

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT C5.SRCX

Storage is Online Cover Level (m) 68.750

Tank or Pond Structure

Invert Level (m) 67.750

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	545.0	1.000	965.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0199-1940-0700-1940
Design Head (m)	0.700
Design Flow (l/s)	19.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	199
Invert Level (m)	67.750
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	19.4
Flush-Flo™	0.303	19.4
Kick-Flo®	0.545	17.2
Mean Flow over Head Range	-	15.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.9	1.200	25.1	3.000	39.0	7.000	58.7
0.200	18.7	1.400	27.0	3.500	42.0	7.500	60.4
0.300	19.4	1.600	28.8	4.000	44.8	8.000	62.4
0.400	19.1	1.800	30.5	4.500	47.4	8.500	64.4
0.500	18.1	2.000	32.0	5.000	49.9	9.000	66.3
0.600	18.0	2.200	33.5	5.500	52.2	9.500	68.1
0.800	20.7	2.400	35.0	6.000	54.5		
1.000	23.0	2.600	36.4	6.500	56.7		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C6.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	CATCHMENT C2.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	70.860	0.260	2.0	107.2	O K
30 min Summer	70.927	0.327	2.0	139.1	O K
60 min Summer	70.992	0.392	2.0	171.4	O K
120 min Summer	71.051	0.451	2.0	202.4	O K
180 min Summer	71.085	0.485	2.0	220.7	O K
240 min Summer	71.106	0.506	2.0	232.6	O K
360 min Summer	71.130	0.530	2.0	246.0	O K
480 min Summer	71.139	0.539	2.0	251.3	O K
600 min Summer	71.141	0.541	2.0	252.4	O K
720 min Summer	71.139	0.539	2.0	250.9	O K
960 min Summer	71.126	0.526	2.0	243.6	O K
1440 min Summer	71.094	0.494	2.0	225.6	O K
2160 min Summer	71.048	0.448	2.0	201.0	O K
2880 min Summer	71.006	0.406	2.0	178.8	O K
4320 min Summer	70.940	0.340	2.0	145.2	O K
5760 min Summer	70.886	0.286	2.0	119.3	O K
7200 min Summer	70.842	0.242	2.0	99.2	O K
8640 min Summer	70.807	0.207	2.0	83.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	102.8	23
30 min Summer	97.160	0.0	132.9	37
60 min Summer	60.480	0.0	173.9	68
120 min Summer	36.400	0.0	209.1	126
180 min Summer	26.929	0.0	231.6	186
240 min Summer	21.665	0.0	247.8	246
360 min Summer	15.820	0.0	269.8	364
480 min Summer	12.552	0.0	283.3	484
600 min Summer	10.442	0.0	291.7	602
720 min Summer	8.960	0.0	296.4	722
960 min Summer	7.003	0.0	297.3	960
1440 min Summer	4.918	0.0	284.6	1198
2160 min Summer	3.437	0.0	359.8	1560
2880 min Summer	2.669	0.0	372.4	1932
4320 min Summer	1.882	0.0	392.9	2684
5760 min Summer	1.479	0.0	414.5	3456
7200 min Summer	1.236	0.0	433.0	4176
8640 min Summer	1.074	0.0	450.9	4848

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C6.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	70.779	0.179	2.0	71.3	O K
15 min Winter	70.888	0.288	2.0	120.2	O K
30 min Winter	70.962	0.362	2.0	156.1	O K
60 min Winter	71.033	0.433	2.0	192.6	O K
120 min Winter	71.098	0.498	2.0	228.0	O K
180 min Winter	71.135	0.535	2.0	248.8	O K
240 min Winter	71.159	0.559	2.0	262.5	O K
360 min Winter	71.186	0.586	2.0	278.5	O K
480 min Winter	71.198	0.598	2.0	285.5	O K
600 min Winter	71.202	0.602	2.0	287.7	O K
720 min Winter	71.201	0.601	2.0	287.1	O K
960 min Winter	71.190	0.590	2.0	280.9	O K
1440 min Winter	71.156	0.556	2.0	260.9	O K
2160 min Winter	71.104	0.504	2.0	231.2	O K
2880 min Winter	71.053	0.453	2.0	203.6	O K
4320 min Winter	70.953	0.353	2.0	151.6	O K
5760 min Winter	70.872	0.272	2.0	112.7	O K
7200 min Winter	70.808	0.208	2.0	83.9	O K
8640 min Winter	70.761	0.161	2.0	63.5	O K
10080 min Winter	70.728	0.128	1.9	49.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	468.0	5552
15 min Winter	148.960	0.0	115.0	23
30 min Winter	97.160	0.0	146.8	37
60 min Winter	60.480	0.0	194.7	66
120 min Winter	36.400	0.0	233.8	124
180 min Winter	26.929	0.0	258.4	184
240 min Winter	21.665	0.0	275.7	242
360 min Winter	15.820	0.0	297.3	358
480 min Winter	12.552	0.0	306.6	474
600 min Winter	10.442	0.0	307.9	590
720 min Winter	8.960	0.0	305.7	704
960 min Winter	7.003	0.0	299.8	926
1440 min Winter	4.917	0.0	286.5	1344
2160 min Winter	3.437	0.0	402.9	1668
2880 min Winter	2.669	0.0	416.8	2136
4320 min Winter	1.882	0.0	439.8	2936
5760 min Winter	1.479	0.0	464.3	3688
7200 min Winter	1.236	0.0	485.1	4392
8640 min Winter	1.074	0.0	505.2	5016
10080 min Winter	0.957	0.0	524.6	5648

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT C6.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.390

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.190	4	8	0.200

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT C6.SRCX

Storage is Online Cover Level (m) 71.600

Tank or Pond Structure

Invert Level (m) 70.600

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	367.1	1.000	783.1

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)	70.600
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		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C8.SRCX

Upstream Structures	Outflow To	Overflow To
CATCHMENT C9.SRCX	CATCHMENT C4.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	70.081	0.331	15.5	101.2	O K
30 min Summer	70.168	0.418	15.5	134.0	O K
60 min Summer	70.258	0.508	15.5	171.2	O K
120 min Summer	70.333	0.583	15.5	204.4	O K
180 min Summer	70.370	0.620	15.5	221.7	O K
240 min Summer	70.376	0.626	15.5	224.2	O K
360 min Summer	70.357	0.607	15.5	215.6	O K
480 min Summer	70.326	0.576	15.5	201.2	O K
600 min Summer	70.288	0.538	15.5	183.9	O K
720 min Summer	70.243	0.493	15.5	164.7	O K
960 min Summer	70.160	0.410	15.5	130.8	O K
1440 min Summer	70.028	0.278	15.5	82.6	O K
2160 min Summer	69.931	0.181	14.7	50.8	O K
2880 min Summer	69.901	0.151	12.0	41.6	O K
4320 min Summer	69.871	0.121	8.7	32.9	O K
5760 min Summer	69.855	0.105	6.9	28.3	O K
7200 min Summer	69.845	0.095	5.8	25.4	O K
8640 min Summer	69.838	0.088	5.1	23.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	160.9	64
30 min Summer	97.160	0.0	210.2	88
60 min Summer	60.480	0.0	262.5	116
120 min Summer	36.400	0.0	316.1	156
180 min Summer	26.929	0.0	350.8	190
240 min Summer	21.665	0.0	376.4	220
360 min Summer	15.820	0.0	412.3	268
480 min Summer	12.552	0.0	436.2	324
600 min Summer	10.442	0.0	453.6	390
720 min Summer	8.960	0.0	467.0	454
960 min Summer	7.003	0.0	486.7	574
1440 min Summer	4.918	0.0	512.4	800
2160 min Summer	3.437	0.0	537.8	1124
2880 min Summer	2.669	0.0	556.7	1476
4320 min Summer	1.882	0.0	588.4	2208
5760 min Summer	1.479	0.0	617.3	2936
7200 min Summer	1.236	0.0	645.1	3672
8640 min Summer	1.074	0.0	672.2	4400

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C8.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	69.832	0.082	4.5	21.8	O K
15 min Winter	70.114	0.364	15.5	113.2	O K
30 min Winter	70.211	0.461	15.5	151.3	O K
60 min Winter	70.311	0.561	15.5	194.2	O K
120 min Winter	70.383	0.633	15.5	227.9	O K
180 min Winter	70.423	0.673	15.5	247.0	O K
240 min Winter	70.445	0.695	15.5	258.3	O K
360 min Winter	70.419	0.669	15.5	245.0	O K
480 min Winter	70.370	0.620	15.5	221.7	O K
600 min Winter	70.315	0.565	15.5	196.3	O K
720 min Winter	70.249	0.499	15.5	167.5	O K
960 min Winter	70.124	0.374	15.5	117.0	O K
1440 min Winter	69.954	0.204	15.2	58.1	O K
2160 min Winter	69.897	0.147	11.6	40.4	O K
2880 min Winter	69.874	0.124	9.0	33.7	O K
4320 min Winter	69.850	0.100	6.4	26.9	O K
5760 min Winter	69.837	0.087	5.0	23.3	O K
7200 min Winter	69.829	0.079	4.2	21.0	O K
8640 min Winter	69.823	0.073	3.7	19.3	O K
10080 min Winter	69.819	0.069	3.3	18.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	698.7	5112
15 min Winter	148.960	0.0	180.3	72
30 min Winter	97.160	0.0	235.5	98
60 min Winter	60.480	0.0	294.1	128
120 min Winter	36.400	0.0	354.1	166
180 min Winter	26.929	0.0	393.0	200
240 min Winter	21.665	0.0	421.6	232
360 min Winter	15.820	0.0	461.8	276
480 min Winter	12.552	0.0	488.6	348
600 min Winter	10.442	0.0	508.1	422
720 min Winter	8.960	0.0	523.2	488
960 min Winter	7.003	0.0	545.2	604
1440 min Winter	4.917	0.0	574.0	798
2160 min Winter	3.437	0.0	602.4	1128
2880 min Winter	2.669	0.0	623.6	1488
4320 min Winter	1.882	0.0	659.2	2208
5760 min Winter	1.479	0.0	691.4	2944
7200 min Winter	1.236	0.0	722.5	3640
8640 min Winter	1.074	0.0	752.9	4312
10080 min Winter	0.957	0.0	782.7	5120

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT C8.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.350

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.170	4	8	0.180

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT C8.SRCX

Storage is Online Cover Level (m) 70.750

Tank or Pond Structure

Invert Level (m) 69.750

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	253.0	1.000	641.6

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0181-1550-0700-1550
Design Head (m)	0.700
Design Flow (l/s)	15.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	181
Invert Level (m)	69.750
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	15.5
Flush-Flo™	0.282	15.5
Kick-Flo®	0.534	13.6
Mean Flow over Head Range	-	12.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.4	1.200	20.0	3.000	31.1	7.000	46.8
0.200	15.2	1.400	21.5	3.500	33.5	7.500	48.1
0.300	15.5	1.600	23.0	4.000	35.7	8.000	49.7
0.400	15.1	1.800	24.3	4.500	37.8	8.500	51.3
0.500	14.3	2.000	25.6	5.000	39.7	9.000	52.8
0.600	14.4	2.200	26.8	5.500	41.6	9.500	54.3
0.800	16.5	2.400	27.9	6.000	43.4		
1.000	18.4	2.600	29.0	6.500	45.1		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C9.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	CATCHMENT C8.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	70.565	0.565	16.5	51.1	O K
30 min Summer	70.629	0.629	16.5	60.9	O K
60 min Summer	70.642	0.642	16.5	63.0	O K
120 min Summer	70.609	0.609	16.5	57.8	O K
180 min Summer	70.565	0.565	16.5	51.3	O K
240 min Summer	70.512	0.512	16.5	43.8	O K
360 min Summer	70.399	0.399	16.5	30.1	O K
480 min Summer	70.300	0.300	16.5	20.2	O K
600 min Summer	70.228	0.228	16.3	14.0	O K
720 min Summer	70.187	0.187	15.8	11.0	O K
960 min Summer	70.155	0.155	12.8	8.7	O K
1440 min Summer	70.123	0.123	9.2	6.7	O K
2160 min Summer	70.100	0.100	6.5	5.2	O K
2880 min Summer	70.086	0.086	5.0	4.4	O K
4320 min Summer	70.071	0.071	3.6	3.6	O K
5760 min Summer	70.062	0.062	2.8	3.1	O K
7200 min Summer	70.057	0.057	2.3	2.8	O K
8640 min Summer	70.053	0.053	2.0	2.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	64.2	19
30 min Summer	97.160	0.0	83.8	31
60 min Summer	60.480	0.0	104.3	50
120 min Summer	36.400	0.0	125.6	84
180 min Summer	26.929	0.0	139.3	118
240 min Summer	21.665	0.0	149.5	150
360 min Summer	15.820	0.0	163.7	210
480 min Summer	12.552	0.0	173.2	266
600 min Summer	10.442	0.0	180.1	320
720 min Summer	8.960	0.0	185.4	372
960 min Summer	7.003	0.0	193.3	492
1440 min Summer	4.918	0.0	203.6	734
2160 min Summer	3.437	0.0	213.4	1100
2880 min Summer	2.669	0.0	220.9	1456
4320 min Summer	1.882	0.0	233.7	2172
5760 min Summer	1.479	0.0	244.9	2856
7200 min Summer	1.236	0.0	255.9	3576
8640 min Summer	1.074	0.0	266.7	4312

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C9.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	70.050	0.050	1.8	2.4	O K
15 min Winter	70.612	0.612	16.5	58.3	O K
30 min Winter	70.684	0.684	16.5	70.0	O K
60 min Winter	70.698	0.698	16.5	72.5	O K
120 min Winter	70.651	0.651	16.5	64.4	O K
180 min Winter	70.585	0.585	16.5	54.1	O K
240 min Winter	70.500	0.500	16.5	42.2	O K
360 min Winter	70.322	0.322	16.5	22.3	O K
480 min Winter	70.200	0.200	16.1	11.9	O K
600 min Winter	70.166	0.166	13.9	9.5	O K
720 min Winter	70.148	0.148	12.0	8.3	O K
960 min Winter	70.126	0.126	9.5	6.8	O K
1440 min Winter	70.101	0.101	6.6	5.3	O K
2160 min Winter	70.083	0.083	4.7	4.2	O K
2880 min Winter	70.072	0.072	3.7	3.6	O K
4320 min Winter	70.060	0.060	2.6	3.0	O K
5760 min Winter	70.053	0.053	2.0	2.6	O K
7200 min Winter	70.048	0.048	1.7	2.3	O K
8640 min Winter	70.044	0.044	1.5	2.2	O K
10080 min Winter	70.042	0.042	1.3	2.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	277.4	5096
15 min Winter	148.960	0.0	71.9	19
30 min Winter	97.160	0.0	93.8	32
60 min Winter	60.480	0.0	116.8	52
120 min Winter	36.400	0.0	140.6	90
180 min Winter	26.929	0.0	156.1	128
240 min Winter	21.665	0.0	167.4	160
360 min Winter	15.820	0.0	183.4	216
480 min Winter	12.552	0.0	194.0	260
600 min Winter	10.442	0.0	201.7	314
720 min Winter	8.960	0.0	207.7	374
960 min Winter	7.003	0.0	216.5	492
1440 min Winter	4.917	0.0	228.0	736
2160 min Winter	3.437	0.0	239.0	1080
2880 min Winter	2.669	0.0	247.5	1460
4320 min Winter	1.882	0.0	261.7	2148
5760 min Winter	1.479	0.0	274.2	2928
7200 min Winter	1.236	0.0	286.6	3656
8640 min Winter	1.074	0.0	298.7	4392
10080 min Winter	0.957	0.0	310.7	5064

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT C9.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.230

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.110	4	8	0.120

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT C9.SRCX

Storage is Online Cover Level (m) 71.000

Tank or Pond Structure

Invert Level (m) 70.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	45.9	1.000	257.8

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0186-1650-0700-1650
Design Head (m)	0.700
Design Flow (l/s)	16.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	186
Invert Level (m)	70.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	16.5
Flush-Flo™	0.287	16.5
Kick-Flo®	0.537	14.6
Mean Flow over Head Range	-	13.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.5	1.200	21.3	3.000	33.1	7.000	49.8
0.200	16.1	1.400	22.9	3.500	35.6	7.500	51.3
0.300	16.5	1.600	24.5	4.000	38.0	8.000	53.0
0.400	16.1	1.800	25.9	4.500	40.2	8.500	54.6
0.500	15.2	2.000	27.2	5.000	42.3	9.000	56.2
0.600	15.3	2.200	28.5	5.500	44.3	9.500	57.8
0.800	17.6	2.400	29.7	6.000	46.2		
1.000	19.5	2.600	30.9	6.500	48.1		

©1982-2019 Innovyze

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

Half Drain Time : 1155 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	68.285	0.085	2.8	140.4	O K
30 min Summer	68.311	0.111	2.8	183.5	O K
60 min Summer	68.337	0.137	2.8	226.9	O K
120 min Summer	68.362	0.162	2.8	268.4	O K
180 min Summer	68.375	0.175	2.8	289.8	O K
240 min Summer	68.383	0.183	2.8	302.5	O K
360 min Summer	68.392	0.192	2.8	317.4	O K
480 min Summer	68.397	0.197	2.8	325.1	O K
600 min Summer	68.399	0.199	2.8	328.3	O K
720 min Summer	68.399	0.199	2.8	328.7	O K
960 min Summer	68.396	0.196	2.8	324.7	O K
1440 min Summer	68.390	0.190	2.8	314.2	O K
2160 min Summer	68.379	0.179	2.8	296.4	O K
2880 min Summer	68.368	0.168	2.8	277.5	O K
4320 min Summer	68.346	0.146	2.8	240.6	O K
5760 min Summer	68.325	0.125	2.8	207.0	O K
7200 min Summer	68.307	0.107	2.8	177.4	O K
8640 min Summer	68.292	0.092	2.8	151.7	O K
10080 min Summer	68.279	0.079	2.8	130.2	O K
15 min Winter	68.295	0.095	2.8	157.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	138.153	0.0	23
30 min Summer	90.705	0.0	37
60 min Summer	56.713	0.0	66
120 min Summer	34.246	0.0	126
180 min Summer	25.149	0.0	186
240 min Summer	20.078	0.0	246
360 min Summer	14.585	0.0	364
480 min Summer	11.622	0.0	482
600 min Summer	9.738	0.0	602
720 min Summer	8.424	0.0	720
960 min Summer	6.697	0.0	894
1440 min Summer	4.839	0.0	1114
2160 min Summer	3.490	0.0	1496
2880 min Summer	2.766	0.0	1904
4320 min Summer	1.989	0.0	2724
5760 min Summer	1.573	0.0	3464
7200 min Summer	1.311	0.0	4248
8640 min Summer	1.129	0.0	4936
10080 min Summer	0.994	0.0	5648
15 min Winter	138.153	0.0	22

©1982-2019 Innovyze

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	68.325	0.125	2.8	205.9	O K
60 min Winter	68.354	0.154	2.8	254.9	O K
120 min Winter	68.383	0.183	2.8	302.1	O K
180 min Winter	68.398	0.198	2.8	326.8	O K
240 min Winter	68.407	0.207	2.8	341.8	O K
360 min Winter	68.418	0.218	2.8	360.0	O K
480 min Winter	68.424	0.224	2.8	370.2	O K
600 min Winter	68.427	0.227	2.8	375.5	O K
720 min Winter	68.428	0.228	2.8	377.7	O K
960 min Winter	68.427	0.227	2.8	376.1	O K
1440 min Winter	68.418	0.218	2.8	360.8	O K
2160 min Winter	68.404	0.204	2.8	337.0	O K
2880 min Winter	68.387	0.187	2.8	309.9	O K
4320 min Winter	68.354	0.154	2.8	255.0	O K
5760 min Winter	68.324	0.124	2.8	204.4	O K
7200 min Winter	68.297	0.097	2.8	160.6	O K
8640 min Winter	68.275	0.075	2.8	124.6	O K
10080 min Winter	68.259	0.059	2.8	97.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	90.705	0.0	37
60 min Winter	56.713	0.0	66
120 min Winter	34.246	0.0	124
180 min Winter	25.149	0.0	182
240 min Winter	20.078	0.0	242
360 min Winter	14.585	0.0	358
480 min Winter	11.622	0.0	474
600 min Winter	9.738	0.0	588
720 min Winter	8.424	0.0	700
960 min Winter	6.697	0.0	922
1440 min Winter	4.839	0.0	1298
2160 min Winter	3.490	0.0	1628
2880 min Winter	2.766	0.0	2080
4320 min Winter	1.989	0.0	2940
5760 min Winter	1.573	0.0	3744
7200 min Winter	1.311	0.0	4464
8640 min Winter	1.129	0.0	5104
10080 min Winter	0.994	0.0	5744

©1982-2019 Innovyze

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.551

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.275	4	8	0.276

©1982-2019 Innovyze

Model Details

Storage is Online Cover Level (m) 68.750

Infiltration Blanket Structure

Infiltration Coefficient Base (m/hr)	0.00360	Diameter/Width (m)	55.0
Safety Factor	2.0	Length (m)	100.2
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	68.200		

©1982-2019 Innovyze

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

Half Drain Time : 2441 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
15 min Summer	67.871	0.871	0.1	17.1	O K
30 min Summer	67.936	0.936	0.1	19.7	O K
60 min Summer	68.004	1.004	0.1	22.7	O K
120 min Summer	68.076	1.076	0.1	26.0	O K
180 min Summer	68.120	1.120	0.1	28.0	O K
240 min Summer	68.152	1.152	0.1	29.5	O K
360 min Summer	68.196	1.196	0.1	31.6	O K
480 min Summer	68.226	1.226	0.2	33.0	Flood Risk
600 min Summer	68.248	1.248	0.2	34.0	Flood Risk
720 min Summer	68.264	1.264	0.2	34.7	Flood Risk
960 min Summer	68.291	1.291	0.2	36.0	Flood Risk
1440 min Summer	68.317	1.317	0.2	37.2	Flood Risk
2160 min Summer	68.328	1.328	0.2	37.7	Flood Risk
2880 min Summer	68.332	1.332	0.2	37.9	Flood Risk
4320 min Summer	68.286	1.286	0.2	35.7	Flood Risk
5760 min Summer	68.242	1.242	0.2	33.7	Flood Risk
7200 min Summer	68.202	1.202	0.1	31.8	Flood Risk
8640 min Summer	68.164	1.164	0.1	30.1	O K
10080 min Summer	68.130	1.130	0.1	28.5	O K
15 min Winter	67.922	0.922	0.1	19.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
15 min Summer	182.843	0.0	23
30 min Summer	105.834	0.0	38
60 min Summer	61.259	0.0	68
120 min Summer	35.458	0.0	128
180 min Summer	25.752	0.0	186
240 min Summer	20.524	0.0	246
360 min Summer	14.906	0.0	366
480 min Summer	11.880	0.0	484
600 min Summer	9.963	0.0	604
720 min Summer	8.628	0.0	724
960 min Summer	6.934	0.0	962
1440 min Summer	5.095	0.0	1440
2160 min Summer	3.744	0.0	1816
2880 min Summer	3.009	0.0	2188
4320 min Summer	2.111	0.0	2980
5760 min Summer	1.641	0.0	3800
7200 min Summer	1.350	0.0	4608
8640 min Summer	1.151	0.0	5440
10080 min Summer	1.006	0.0	6248
15 min Winter	182.843	0.0	23

©1982-2019 Innovyze

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Volume (m³)	Status
30 min Winter	67.990	0.990	0.1	22.1	O K
60 min Winter	68.063	1.063	0.1	25.4	O K
120 min Winter	68.144	1.144	0.1	29.1	O K
180 min Winter	68.194	1.194	0.1	31.5	O K
240 min Winter	68.230	1.230	0.2	33.2	Flood Risk
360 min Winter	68.281	1.281	0.2	35.5	Flood Risk
480 min Winter	68.316	1.316	0.2	37.1	Flood Risk
600 min Winter	68.341	1.341	0.2	38.3	Flood Risk
720 min Winter	68.360	1.360	0.2	39.2	Flood Risk
960 min Winter	68.393	1.393	0.2	40.7	Flood Risk
1440 min Winter	68.428	1.428	0.2	42.3	Flood Risk
2160 min Winter	68.441	1.441	0.2	42.9	Flood Risk
2880 min Winter	68.440	1.440	0.2	42.9	Flood Risk
4320 min Winter	68.380	1.380	0.2	40.1	Flood Risk
5760 min Winter	68.321	1.321	0.2	37.4	Flood Risk
7200 min Winter	68.265	1.265	0.2	34.8	Flood Risk
8640 min Winter	68.213	1.213	0.2	32.4	Flood Risk
10080 min Winter	68.166	1.166	0.1	30.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Time-Peak (mins)
30 min Winter	105.834	0.0	37
60 min Winter	61.259	0.0	66
120 min Winter	35.458	0.0	126
180 min Winter	25.752	0.0	184
240 min Winter	20.524	0.0	242
360 min Winter	14.906	0.0	360
480 min Winter	11.880	0.0	478
600 min Winter	9.963	0.0	594
720 min Winter	8.628	0.0	710
960 min Winter	6.934	0.0	940
1440 min Winter	5.095	0.0	1388
2160 min Winter	3.744	0.0	2016
2880 min Winter	3.009	0.0	2280
4320 min Winter	2.111	0.0	3200
5760 min Winter	1.641	0.0	4096
7200 min Winter	1.350	0.0	4976
8640 min Winter	1.151	0.0	5800
10080 min Winter	1.006	0.0	6656

©1982-2019 Innovyze

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	1999
Site Location	GB 447800 213450 SP 47800 13450
C (1km)	-0.023
D1 (1km)	0.317
D2 (1km)	0.346
D3 (1km)	0.231
E (1km)	0.291
F (1km)	2.440
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) 0.050

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.025	4	8	0.025

©1982-2019 Innovyze

Model Details

Storage is Online Cover Level (m) 68.500

Infiltration Trench Structure

Infiltration Coefficient Base (m/hr)	0.00360	Trench Width (m)	1.5
Infiltration Coefficient Side (m/hr)	0.00360	Trench Length (m)	103.0
Safety Factor	2.0	Slope (1:X)	100.0
Porosity	0.30	Cap Volume Depth (m)	0.000
Invert Level (m)	67.000	Cap Infiltration Depth (m)	0.000

©1982-2019 Innovyze

Appendix B.3

DEVELOPMENT CREEP

Cascade Summary of Results for CATCHMENT A1.SRCX

Upstream Structures	Outflow To	Overflow To
CATCHMENT A2.SRCX	(None)	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	68.849	0.349	15.0	565.4	O K
30 min Summer	68.935	0.435	15.0	733.9	O K
60 min Summer	69.017	0.517	15.0	903.7	O K
120 min Summer	69.091	0.591	15.0	1065.7	O K
180 min Summer	69.131	0.631	15.0	1158.0	O K
240 min Summer	69.156	0.656	15.0	1216.6	O K
360 min Summer	69.182	0.682	15.0	1279.4	O K
480 min Summer	69.190	0.690	15.0	1299.5	O K
600 min Summer	69.189	0.689	15.0	1297.2	O K
720 min Summer	69.183	0.683	15.0	1282.0	O K
960 min Summer	69.165	0.665	15.0	1238.7	O K
1440 min Summer	69.129	0.629	15.0	1154.5	O K
2160 min Summer	69.077	0.577	15.0	1035.7	O K
2880 min Summer	69.026	0.526	15.0	923.3	O K
4320 min Summer	68.932	0.432	15.0	727.0	O K
5760 min Summer	68.858	0.358	15.0	582.7	O K
7200 min Summer	68.802	0.302	15.0	479.1	O K
8640 min Summer	68.760	0.260	15.0	404.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	711.9	23
30 min Summer	97.160	0.0	877.0	37
60 min Summer	60.480	0.0	1284.7	66
120 min Summer	36.400	0.0	1462.1	126
180 min Summer	26.929	0.0	1578.7	186
240 min Summer	21.665	0.0	1665.9	244
360 min Summer	15.820	0.0	1790.7	364
480 min Summer	12.552	0.0	1874.2	482
600 min Summer	10.442	0.0	1934.4	602
720 min Summer	8.960	0.0	1979.5	720
960 min Summer	7.003	0.0	2038.8	826
1440 min Summer	4.918	0.0	2084.1	1068
2160 min Summer	3.437	0.0	2640.6	1472
2880 min Summer	2.669	0.0	2681.1	1876
4320 min Summer	1.882	0.0	2736.2	2636
5760 min Summer	1.479	0.0	3307.6	3344
7200 min Summer	1.236	0.0	3450.6	4032
8640 min Summer	1.074	0.0	3584.9	4752

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT A1.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	68.728	0.228	14.9	350.1	O K
15 min Winter	68.885	0.385	15.0	634.3	O K
30 min Winter	68.979	0.479	15.0	823.7	O K
60 min Winter	69.068	0.568	15.0	1015.6	O K
120 min Winter	69.148	0.648	15.0	1197.8	O K
180 min Winter	69.192	0.692	15.0	1303.5	O K
240 min Winter	69.220	0.720	15.2	1371.8	Flood Risk
360 min Winter	69.250	0.750	15.5	1447.3	Flood Risk
480 min Winter	69.261	0.761	15.6	1475.3	Flood Risk
600 min Winter	69.262	0.762	15.6	1478.6	Flood Risk
720 min Winter	69.258	0.758	15.6	1467.4	Flood Risk
960 min Winter	69.239	0.739	15.4	1421.0	Flood Risk
1440 min Winter	69.195	0.695	15.0	1311.2	O K
2160 min Winter	69.131	0.631	15.0	1157.2	O K
2880 min Winter	69.065	0.565	15.0	1008.9	O K
4320 min Winter	68.926	0.426	15.0	714.2	O K
5760 min Winter	68.815	0.315	15.0	502.4	O K
7200 min Winter	68.739	0.239	14.9	368.4	O K
8640 min Winter	68.694	0.194	14.6	292.4	O K
10080 min Winter	68.675	0.175	13.9	261.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	3702.9	5352
15 min Winter	148.960	0.0	778.9	22
30 min Winter	97.160	0.0	956.5	37
60 min Winter	60.480	0.0	1390.8	66
120 min Winter	36.400	0.0	1591.9	124
180 min Winter	26.929	0.0	1726.8	182
240 min Winter	21.665	0.0	1828.4	240
360 min Winter	15.820	0.0	1973.7	356
480 min Winter	12.552	0.0	2068.4	472
600 min Winter	10.442	0.0	2133.1	584
720 min Winter	8.960	0.0	2178.8	696
960 min Winter	7.003	0.0	2230.6	908
1440 min Winter	4.917	0.0	2216.1	1128
2160 min Winter	3.437	0.0	2882.2	1584
2880 min Winter	2.669	0.0	2937.1	2048
4320 min Winter	1.882	0.0	3022.8	2812
5760 min Winter	1.479	0.0	3701.6	3512
7200 min Winter	1.236	0.0	3858.2	4104
8640 min Winter	1.074	0.0	3996.7	4672
10080 min Winter	0.957	0.0	4093.9	5248

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT A1.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 2.060

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	1.030	4	8	1.030

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT A1.SRCX

Storage is Online Cover Level (m) 69.500

Tank or Pond Structure

Invert Level (m) 68.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	1379.2	1.000	3007.4

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0179-1500-0700-1500
Design Head (m)	0.700
Design Flow (l/s)	15.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	179
Invert Level (m)	68.500
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	15.0
Flush-Flo™	0.277	15.0
Kick-Flo®	0.531	13.2
Mean Flow over Head Range	-	12.2

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.3	1.200	19.4	3.000	30.1	7.000	45.3
0.200	14.7	1.400	20.9	3.500	32.4	7.500	46.6
0.300	15.0	1.600	22.2	4.000	34.5	8.000	48.1
0.400	14.6	1.800	23.5	4.500	36.5	8.500	49.6
0.500	13.7	2.000	24.7	5.000	38.5	9.000	51.1
0.600	13.9	2.200	25.9	5.500	40.3	9.500	52.5
0.800	16.0	2.400	27.0	6.000	42.0		
1.000	17.8	2.600	28.1	6.500	43.7		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT A2.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	CATCHMENT A1.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	68.325	0.325	2.7	295.8	O K
30 min Summer	68.403	0.403	2.7	385.0	O K
60 min Summer	68.478	0.478	2.7	477.0	O K
120 min Summer	68.547	0.547	2.7	568.3	O K
180 min Summer	68.588	0.588	2.7	624.6	O K
240 min Summer	68.615	0.615	2.7	663.7	O K
360 min Summer	68.649	0.649	2.7	713.9	O K
480 min Summer	68.667	0.667	2.7	741.8	O K
600 min Summer	68.678	0.678	2.7	757.7	O K
720 min Summer	68.683	0.683	2.7	766.5	O K
960 min Summer	68.686	0.686	2.7	770.9	O K
1440 min Summer	68.677	0.677	2.7	756.2	O K
2160 min Summer	68.648	0.648	2.7	712.1	O K
2880 min Summer	68.621	0.621	2.7	672.2	O K
4320 min Summer	68.579	0.579	2.7	613.0	O K
5760 min Summer	68.547	0.547	2.7	568.1	O K
7200 min Summer	68.521	0.521	2.7	532.7	O K
8640 min Summer	68.498	0.498	2.7	502.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	226.9	23
30 min Summer	97.160	0.0	224.8	38
60 min Summer	60.480	0.0	431.5	68
120 min Summer	36.400	0.0	426.1	128
180 min Summer	26.929	0.0	418.7	186
240 min Summer	21.665	0.0	414.9	246
360 min Summer	15.820	0.0	411.9	366
480 min Summer	12.552	0.0	411.3	486
600 min Summer	10.442	0.0	411.5	606
720 min Summer	8.960	0.0	412.2	724
960 min Summer	7.003	0.0	412.3	964
1440 min Summer	4.918	0.0	406.1	1442
2160 min Summer	3.437	0.0	816.8	2060
2880 min Summer	2.669	0.0	788.7	2372
4320 min Summer	1.882	0.0	726.9	3116
5760 min Summer	1.479	0.0	1131.3	3928
7200 min Summer	1.236	0.0	1180.7	4760
8640 min Summer	1.074	0.0	1227.3	5616

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT A2.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	68.477	0.477	2.7	475.2	O K
15 min Winter	68.357	0.357	2.7	331.6	O K
30 min Winter	68.442	0.442	2.7	431.7	O K
60 min Winter	68.522	0.522	2.7	534.9	O K
120 min Winter	68.597	0.597	2.7	638.0	O K
180 min Winter	68.641	0.641	2.7	701.8	O K
240 min Winter	68.670	0.670	2.7	746.5	O K
360 min Winter	68.707	0.707	2.7	804.3	Flood Risk
480 min Winter	68.728	0.728	2.7	837.2	Flood Risk
600 min Winter	68.740	0.740	2.8	856.9	Flood Risk
720 min Winter	68.747	0.747	2.8	868.4	Flood Risk
960 min Winter	68.752	0.752	2.8	876.7	Flood Risk
1440 min Winter	68.746	0.746	2.8	867.0	Flood Risk
2160 min Winter	68.722	0.722	2.7	827.1	Flood Risk
2880 min Winter	68.692	0.692	2.7	780.6	O K
4320 min Winter	68.643	0.643	2.7	705.9	O K
5760 min Winter	68.602	0.602	2.7	645.6	O K
7200 min Winter	68.566	0.566	2.7	594.5	O K
8640 min Winter	68.533	0.533	2.7	548.7	O K
10080 min Winter	68.501	0.501	2.7	506.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	1268.1	6456
15 min Winter	148.960	0.0	228.4	23
30 min Winter	97.160	0.0	219.3	37
60 min Winter	60.480	0.0	432.4	68
120 min Winter	36.400	0.0	420.2	126
180 min Winter	26.929	0.0	416.5	184
240 min Winter	21.665	0.0	416.2	244
360 min Winter	15.820	0.0	420.2	362
480 min Winter	12.552	0.0	426.0	478
600 min Winter	10.442	0.0	429.4	596
720 min Winter	8.960	0.0	430.8	714
960 min Winter	7.003	0.0	430.4	946
1440 min Winter	4.917	0.0	423.1	1402
2160 min Winter	3.437	0.0	827.2	2072
2880 min Winter	2.669	0.0	804.4	2684
4320 min Winter	1.882	0.0	760.0	3328
5760 min Winter	1.479	0.0	1266.3	4264
7200 min Winter	1.236	0.0	1320.4	5184
8640 min Winter	1.074	0.0	1368.3	6056
10080 min Winter	0.957	0.0	1391.3	6960

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT A2.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 1.068

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.534	4	8	0.534

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT A2.SRCX

Storage is Online Cover Level (m) 69.000

Tank or Pond Structure

Invert Level (m) 68.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	743.2	1.000	2022.4

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0083-2700-0700-2700
Design Head (m)	0.700
Design Flow (l/s)	2.7
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	83
Invert Level (m)	68.000
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	2.7
Flush-Flo™	0.208	2.7
Kick-Flo®	0.459	2.2
Mean Flow over Head Range	-	2.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.4	1.200	3.5	3.000	5.3	7.000	7.9
0.200	2.7	1.400	3.7	3.500	5.7	7.500	8.2
0.300	2.6	1.600	3.9	4.000	6.1	8.000	8.4
0.400	2.5	1.800	4.2	4.500	6.4	8.500	8.7
0.500	2.3	2.000	4.4	5.000	6.7	9.000	8.9
0.600	2.5	2.200	4.6	5.500	7.0	9.500	9.2
0.800	2.9	2.400	4.8	6.000	7.3		
1.000	3.2	2.600	4.9	6.500	7.6		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B1.SRCX

Upstream Structures	Outflow To	Overflow To
CATCHMENT B2.SRCX	(None)	(None)
CATCHMENT B3.SRCX		
CATCHMENT B7.SRCX		

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	69.462	0.462	11.1	240.4	O K
30 min Summer	69.568	0.568	11.1	312.0	O K
60 min Summer	69.663	0.663	11.1	381.7	O K
120 min Summer	69.742	0.742	11.4	443.9	O K
180 min Summer	69.781	0.781	11.7	476.2	O K
240 min Summer	69.803	0.803	11.8	494.8	O K
360 min Summer	69.821	0.821	12.0	510.4	O K
480 min Summer	69.820	0.820	12.0	509.5	O K
600 min Summer	69.811	0.811	11.9	501.4	O K
720 min Summer	69.800	0.800	11.8	492.5	O K
960 min Summer	69.777	0.777	11.6	472.9	O K
1440 min Summer	69.730	0.730	11.3	434.4	O K
2160 min Summer	69.663	0.663	11.1	381.8	O K
2880 min Summer	69.603	0.603	11.1	336.9	O K
4320 min Summer	69.473	0.473	11.1	247.7	O K
5760 min Summer	69.364	0.364	11.1	180.6	O K
7200 min Summer	69.290	0.290	11.1	138.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	586.5	23
30 min Summer	97.160	0.0	715.5	37
60 min Summer	60.480	0.0	1021.7	66
120 min Summer	36.400	0.0	1210.9	126
180 min Summer	26.929	0.0	1299.6	184
240 min Summer	21.665	0.0	1339.1	244
360 min Summer	15.820	0.0	1388.7	362
480 min Summer	12.552	0.0	1421.2	480
600 min Summer	10.442	0.0	1443.9	548
720 min Summer	8.960	0.0	1460.5	602
960 min Summer	7.003	0.0	1481.8	724
1440 min Summer	4.918	0.0	1502.1	988
2160 min Summer	3.437	0.0	2127.4	1408
2880 min Summer	2.669	0.0	2192.9	1820
4320 min Summer	1.882	0.0	2227.6	2596
5760 min Summer	1.479	0.0	2466.0	3232
7200 min Summer	1.236	0.0	2576.5	3896

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B1.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
8640 min Summer	69.238	0.238	11.1	110.5	O K
10080 min Summer	69.203	0.203	11.0	92.6	O K
15 min Winter	69.507	0.507	11.1	270.0	O K
30 min Winter	69.621	0.621	11.1	350.0	O K
60 min Winter	69.723	0.723	11.3	428.8	O K
120 min Winter	69.809	0.809	11.9	499.8	O K
180 min Winter	69.853	0.853	12.2	538.5	O K
240 min Winter	69.879	0.879	12.4	561.8	O K
360 min Winter	69.903	0.903	12.5	583.4	Flood Risk
480 min Winter	69.906	0.906	12.5	586.1	Flood Risk
600 min Winter	69.899	0.899	12.5	579.5	O K
720 min Winter	69.886	0.886	12.4	568.1	O K
960 min Winter	69.857	0.857	12.2	542.2	O K
1440 min Winter	69.801	0.801	11.8	493.2	O K
2160 min Winter	69.715	0.715	11.2	422.0	O K
2880 min Winter	69.633	0.633	11.1	359.2	O K
4320 min Winter	69.431	0.431	11.1	220.7	O K
5760 min Winter	69.273	0.273	11.1	129.0	O K
7200 min Winter	69.197	0.197	11.0	89.3	O K
8640 min Winter	69.163	0.163	10.7	72.7	O K
10080 min Winter	69.155	0.155	10.1	68.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
8640 min Summer	1.074	0.0	2682.6	4584
10080 min Summer	0.957	0.0	2783.0	5248
15 min Winter	148.960	0.0	646.4	22
30 min Winter	97.160	0.0	753.2	37
60 min Winter	60.480	0.0	1137.6	66
120 min Winter	36.400	0.0	1309.4	124
180 min Winter	26.929	0.0	1369.8	182
240 min Winter	21.665	0.0	1412.6	238
360 min Winter	15.820	0.0	1475.0	354
480 min Winter	12.552	0.0	1517.2	466
600 min Winter	10.442	0.0	1548.0	574
720 min Winter	8.960	0.0	1571.7	676
960 min Winter	7.003	0.0	1603.9	764
1440 min Winter	4.917	0.0	1631.2	1070
2160 min Winter	3.437	0.0	2371.8	1536
2880 min Winter	2.669	0.0	2431.3	1992
4320 min Winter	1.882	0.0	2395.0	2768
5760 min Winter	1.479	0.0	2762.1	3232
7200 min Winter	1.236	0.0	2886.2	3888
8640 min Winter	1.074	0.0	3006.0	4408
10080 min Winter	0.957	0.0	3120.3	5144

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT B1.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.880

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.440	4	8	0.440

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT B1.SRCX

Storage is Online Cover Level (m) 70.200

Tank or Pond Structure

Invert Level (m) 69.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	407.4	1.200	1131.8

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0157-1110-0700-1110
Design Head (m)	0.700
Design Flow (l/s)	11.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	157
Invert Level (m)	69.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	11.1
Flush-Flo™	0.254	11.1
Kick-Flo®	0.518	9.6
Mean Flow over Head Range	-	9.2

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.6	1.200	14.3	3.000	22.2	7.000	33.3
0.200	11.0	1.400	15.4	3.500	23.9	7.500	34.3
0.300	11.0	1.600	16.4	4.000	25.4	8.000	35.5
0.400	10.7	1.800	17.4	4.500	26.9	8.500	36.6
0.500	9.9	2.000	18.2	5.000	28.3	9.000	37.6
0.600	10.3	2.200	19.1	5.500	29.7	9.500	38.7
0.800	11.8	2.400	19.9	6.000	30.9		
1.000	13.1	2.600	20.7	6.500	32.1		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B2.SRCX

Upstream Structures	Outflow To	Overflow To
CATCHMENT B3.SRCX CATCHMENT B7.SRCX	CATCHMENT B1.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	69.452	0.252	5.2	154.4	O K
30 min Summer	69.519	0.319	5.2	200.9	O K
60 min Summer	69.588	0.388	5.2	251.7	O K
120 min Summer	69.681	0.481	5.2	324.2	O K
180 min Summer	69.729	0.529	5.2	364.1	O K
240 min Summer	69.755	0.555	5.2	385.8	O K
360 min Summer	69.789	0.589	5.2	415.3	O K
480 min Summer	69.811	0.611	5.2	434.1	O K
600 min Summer	69.825	0.625	5.2	447.1	O K
720 min Summer	69.837	0.637	5.2	457.4	O K
960 min Summer	69.852	0.652	5.2	471.5	O K
1440 min Summer	69.860	0.660	5.2	478.7	O K
2160 min Summer	69.875	0.675	5.2	492.0	O K
2880 min Summer	69.861	0.661	5.2	479.3	O K
4320 min Summer	69.811	0.611	5.2	434.6	O K
5760 min Summer	69.765	0.565	5.2	394.1	O K
7200 min Summer	69.724	0.524	5.2	359.9	O K
8640 min Summer	69.681	0.481	5.2	324.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	361.0	389
30 min Summer	97.160	0.0	431.8	38
60 min Summer	60.480	0.0	633.3	766
120 min Summer	36.400	0.0	749.9	946
180 min Summer	26.929	0.0	801.4	1060
240 min Summer	21.665	0.0	807.8	1152
360 min Summer	15.820	0.0	802.8	1294
480 min Summer	12.552	0.0	798.7	1398
600 min Summer	10.442	0.0	794.6	1486
720 min Summer	8.960	0.0	790.3	788
960 min Summer	7.003	0.0	780.8	968
1440 min Summer	4.918	0.0	760.4	1952
2160 min Summer	3.437	0.0	1320.2	2244
2880 min Summer	2.669	0.0	1360.5	2436
4320 min Summer	1.882	0.0	1372.8	2964
5760 min Summer	1.479	0.0	1531.2	3712
7200 min Summer	1.236	0.0	1599.8	4576
8640 min Summer	1.074	0.0	1665.6	5448

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B2.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	69.632	0.432	5.2	285.3	O K
15 min Winter	69.478	0.278	5.2	172.5	O K
30 min Winter	69.552	0.352	5.2	225.0	O K
60 min Winter	69.637	0.437	5.2	289.4	O K
120 min Winter	69.732	0.532	5.2	366.7	O K
180 min Winter	69.771	0.571	5.2	399.3	O K
240 min Winter	69.798	0.598	5.2	422.8	O K
360 min Winter	69.835	0.635	5.2	455.7	O K
480 min Winter	69.863	0.663	5.2	480.9	O K
600 min Winter	69.882	0.682	5.2	498.7	O K
720 min Winter	69.896	0.696	5.2	512.0	O K
960 min Winter	69.915	0.715	5.3	529.6	Flood Risk
1440 min Winter	69.929	0.729	5.3	542.8	Flood Risk
2160 min Winter	69.929	0.729	5.3	543.1	Flood Risk
2880 min Winter	69.939	0.739	5.3	552.7	Flood Risk
4320 min Winter	69.870	0.670	5.2	487.8	O K
5760 min Winter	69.801	0.601	5.2	425.3	O K
7200 min Winter	69.744	0.544	5.2	376.2	O K
8640 min Winter	69.672	0.472	5.2	317.5	O K
10080 min Winter	69.593	0.393	5.2	255.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	1727.6	6136
15 min Winter	148.960	0.0	396.6	23
30 min Winter	97.160	0.0	434.9	38
60 min Winter	60.480	0.0	704.7	858
120 min Winter	36.400	0.0	807.0	1056
180 min Winter	26.929	0.0	813.4	1190
240 min Winter	21.665	0.0	812.6	1294
360 min Winter	15.820	0.0	813.2	676
480 min Winter	12.552	0.0	814.0	724
600 min Winter	10.442	0.0	814.3	772
720 min Winter	8.960	0.0	814.3	818
960 min Winter	7.003	0.0	813.1	966
1440 min Winter	4.917	0.0	798.6	1430
2160 min Winter	3.437	0.0	1471.5	2148
2880 min Winter	2.669	0.0	1507.2	2572
4320 min Winter	1.882	0.0	1434.3	3112
5760 min Winter	1.479	0.0	1715.1	3984
7200 min Winter	1.236	0.0	1792.1	4968
8640 min Winter	1.074	0.0	1866.4	5880
10080 min Winter	0.957	0.0	1937.1	6456

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT B2.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.550

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.275	4	8	0.275

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT B2.SRCX

Storage is Online Cover Level (m) 70.200

Tank or Pond Structure

Invert Level (m) 69.200

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	550.0	1.000	1140.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0112-5200-0700-5200
Design Head (m)	0.700
Design Flow (l/s)	5.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	112
Invert Level (m)	69.200
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	5.2
Flush-Flo™	0.214	5.2
Kick-Flo®	0.482	4.4
Mean Flow over Head Range	-	4.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.9	1.200	6.7	3.000	10.3	7.000	15.4
0.200	5.2	1.400	7.2	3.500	11.1	7.500	15.9
0.300	5.1	1.600	7.6	4.000	11.8	8.000	16.4
0.400	4.9	1.800	8.1	4.500	12.5	8.500	16.9
0.500	4.5	2.000	8.5	5.000	13.1	9.000	17.4
0.600	4.8	2.200	8.9	5.500	13.7	9.500	17.9
0.800	5.5	2.400	9.3	6.000	14.3		
1.000	6.1	2.600	9.6	6.500	14.9		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B3.SRCX

Upstream Structures	Outflow To	Overflow To
CATCHMENT B7.SRCX	CATCHMENT B2.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	71.115	0.415	5.3	98.7	O K
30 min Summer	71.202	0.502	5.3	127.8	O K
60 min Summer	71.277	0.577	5.3	155.6	O K
120 min Summer	71.337	0.637	5.3	179.3	O K
180 min Summer	71.365	0.665	5.3	191.1	O K
240 min Summer	71.380	0.680	5.3	197.2	O K
360 min Summer	71.387	0.687	5.3	200.3	O K
480 min Summer	71.378	0.678	5.3	196.7	O K
600 min Summer	71.367	0.667	5.3	191.7	O K
720 min Summer	71.354	0.654	5.3	186.4	O K
960 min Summer	71.328	0.628	5.3	175.5	O K
1440 min Summer	71.276	0.576	5.3	155.1	O K
2160 min Summer	71.199	0.499	5.3	126.7	O K
2880 min Summer	71.111	0.411	5.3	97.5	O K
4320 min Summer	70.985	0.285	5.3	61.2	O K
5760 min Summer	70.901	0.201	5.3	40.3	O K
7200 min Summer	70.854	0.154	5.2	29.6	O K
8640 min Summer	70.830	0.130	5.1	24.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	232.8	22
30 min Summer	97.160	0.0	286.9	37
60 min Summer	60.480	0.0	396.7	66
120 min Summer	36.400	0.0	473.2	126
180 min Summer	26.929	0.0	516.6	184
240 min Summer	21.665	0.0	539.7	242
360 min Summer	15.820	0.0	560.5	362
480 min Summer	12.552	0.0	572.4	458
600 min Summer	10.442	0.0	580.5	508
720 min Summer	8.960	0.0	586.2	570
960 min Summer	7.003	0.0	593.2	694
1440 min Summer	4.918	0.0	598.3	970
2160 min Summer	3.437	0.0	821.0	1384
2880 min Summer	2.669	0.0	847.7	1732
4320 min Summer	1.882	0.0	878.3	2420
5760 min Summer	1.479	0.0	948.2	3064
7200 min Summer	1.236	0.0	990.7	3744
8640 min Summer	1.074	0.0	1031.9	4408

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B3.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	70.821	0.121	4.8	22.7	O K
15 min Winter	71.152	0.452	5.3	110.9	O K
30 min Winter	71.246	0.546	5.3	143.6	O K
60 min Winter	71.327	0.627	5.3	175.1	O K
120 min Winter	71.393	0.693	5.3	202.9	O K
180 min Winter	71.425	0.725	5.4	217.2	Flood Risk
240 min Winter	71.442	0.742	5.4	225.1	Flood Risk
360 min Winter	71.454	0.754	5.5	230.6	Flood Risk
480 min Winter	71.449	0.749	5.5	228.4	Flood Risk
600 min Winter	71.437	0.737	5.4	222.6	Flood Risk
720 min Winter	71.420	0.720	5.4	215.1	Flood Risk
960 min Winter	71.390	0.690	5.3	201.7	O K
1440 min Winter	71.325	0.625	5.3	174.4	O K
2160 min Winter	71.221	0.521	5.3	134.7	O K
2880 min Winter	71.086	0.386	5.3	90.0	O K
4320 min Winter	70.906	0.206	5.3	41.5	O K
5760 min Winter	70.830	0.130	5.1	24.6	O K
7200 min Winter	70.817	0.117	4.6	21.8	O K
8640 min Winter	70.808	0.108	4.3	20.1	O K
10080 min Winter	70.803	0.103	4.1	18.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	1071.5	5136
15 min Winter	148.960	0.0	257.4	22
30 min Winter	97.160	0.0	302.9	37
60 min Winter	60.480	0.0	442.6	66
120 min Winter	36.400	0.0	520.8	122
180 min Winter	26.929	0.0	552.4	180
240 min Winter	21.665	0.0	569.0	238
360 min Winter	15.820	0.0	591.5	352
480 min Winter	12.552	0.0	606.3	462
600 min Winter	10.442	0.0	616.7	566
720 min Winter	8.960	0.0	624.6	650
960 min Winter	7.003	0.0	635.1	742
1440 min Winter	4.917	0.0	647.0	1054
2160 min Winter	3.437	0.0	916.9	1512
2880 min Winter	2.669	0.0	943.4	1848
4320 min Winter	1.882	0.0	943.3	2424
5760 min Winter	1.479	0.0	1062.0	2992
7200 min Winter	1.236	0.0	1109.8	3672
8640 min Winter	1.074	0.0	1156.1	4408
10080 min Winter	0.957	0.0	1200.9	5104

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT B3.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.364

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.182	4	8	0.182

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT B3.SRCX

Storage is Online Cover Level (m) 71.700

Tank or Pond Structure

Invert Level (m) 70.700

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	168.9	1.000	597.6

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0113-5300-0700-5300
Design Head (m)	0.700
Design Flow (l/s)	5.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	113
Invert Level (m)	70.700
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	5.3
Flush-Flo™	0.216	5.3
Kick-Flo®	0.485	4.5
Mean Flow over Head Range	-	4.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.9	1.200	6.8	3.000	10.5	7.000	15.7
0.200	5.3	1.400	7.3	3.500	11.3	7.500	16.2
0.300	5.2	1.600	7.8	4.000	12.0	8.000	16.7
0.400	5.0	1.800	8.2	4.500	12.7	8.500	17.3
0.500	4.5	2.000	8.7	5.000	13.4	9.000	17.8
0.600	4.9	2.200	9.1	5.500	14.0	9.500	18.3
0.800	5.6	2.400	9.4	6.000	14.6		
1.000	6.3	2.600	9.8	6.500	15.2		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B4.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	CATCHMENT B5.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	73.357	0.257	2.0	96.5	O K
30 min Summer	73.417	0.317	2.0	125.2	O K
60 min Summer	73.471	0.371	2.0	154.0	O K
120 min Summer	73.520	0.420	2.0	181.3	O K
180 min Summer	73.546	0.446	2.0	197.2	O K
240 min Summer	73.563	0.463	2.0	207.6	O K
360 min Summer	73.581	0.481	2.0	218.8	O K
480 min Summer	73.587	0.487	2.0	222.7	O K
600 min Summer	73.587	0.487	2.0	222.7	O K
720 min Summer	73.584	0.484	2.0	220.5	O K
960 min Summer	73.570	0.470	2.0	212.2	O K
1440 min Summer	73.539	0.439	2.0	192.9	O K
2160 min Summer	73.497	0.397	2.0	168.3	O K
2880 min Summer	73.461	0.361	2.0	148.5	O K
4320 min Summer	73.401	0.301	2.0	117.5	O K
5760 min Summer	73.351	0.251	2.0	93.6	O K
7200 min Summer	73.311	0.211	2.0	75.7	O K
8640 min Summer	73.278	0.178	2.0	62.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	94.4	23
30 min Summer	97.160	0.0	122.6	37
60 min Summer	60.480	0.0	157.8	66
120 min Summer	36.400	0.0	190.0	126
180 min Summer	26.929	0.0	210.6	186
240 min Summer	21.665	0.0	225.7	246
360 min Summer	15.820	0.0	246.6	364
480 min Summer	12.552	0.0	260.2	484
600 min Summer	10.442	0.0	269.7	602
720 min Summer	8.960	0.0	276.6	722
960 min Summer	7.003	0.0	285.3	954
1440 min Summer	4.918	0.0	288.8	1142
2160 min Summer	3.437	0.0	325.5	1476
2880 min Summer	2.669	0.0	336.9	1876
4320 min Summer	1.882	0.0	355.7	2640
5760 min Summer	1.479	0.0	374.3	3400
7200 min Summer	1.236	0.0	391.0	4104
8640 min Summer	1.074	0.0	407.3	4760

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B4.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	73.253	0.153	2.0	52.2	O K
15 min Winter	73.382	0.282	2.0	108.3	O K
30 min Winter	73.447	0.347	2.0	140.6	O K
60 min Winter	73.506	0.406	2.0	173.2	O K
120 min Winter	73.558	0.458	2.0	204.5	O K
180 min Winter	73.587	0.487	2.0	222.9	O K
240 min Winter	73.606	0.506	2.0	234.8	O K
360 min Winter	73.626	0.526	2.0	248.4	O K
480 min Winter	73.634	0.534	2.0	253.7	O K
600 min Winter	73.635	0.535	2.0	254.8	O K
720 min Winter	73.633	0.533	2.0	253.4	O K
960 min Winter	73.623	0.523	2.0	246.1	O K
1440 min Winter	73.591	0.491	2.0	225.0	O K
2160 min Winter	73.541	0.441	2.0	193.8	O K
2880 min Winter	73.491	0.391	2.0	164.7	O K
4320 min Winter	73.403	0.303	2.0	118.2	O K
5760 min Winter	73.328	0.228	2.0	83.3	O K
7200 min Winter	73.271	0.171	2.0	59.1	O K
8640 min Winter	73.230	0.130	1.9	43.4	O K
10080 min Winter	73.204	0.104	1.8	33.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	422.9	5448
15 min Winter	148.960	0.0	105.7	22
30 min Winter	97.160	0.0	136.5	37
60 min Winter	60.480	0.0	176.8	66
120 min Winter	36.400	0.0	212.6	124
180 min Winter	26.929	0.0	235.5	182
240 min Winter	21.665	0.0	252.1	242
360 min Winter	15.820	0.0	274.6	358
480 min Winter	12.552	0.0	288.4	474
600 min Winter	10.442	0.0	296.7	588
720 min Winter	8.960	0.0	300.9	702
960 min Winter	7.003	0.0	300.2	924
1440 min Winter	4.917	0.0	288.8	1328
2160 min Winter	3.437	0.0	364.5	1644
2880 min Winter	2.669	0.0	377.3	2048
4320 min Winter	1.882	0.0	398.5	2852
5760 min Winter	1.479	0.0	419.3	3576
7200 min Winter	1.236	0.0	438.0	4248
8640 min Winter	1.074	0.0	456.3	4848
10080 min Winter	0.957	0.0	474.0	5448

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT B4.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.352

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.176	4	8	0.176

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT B4.SRCX

Storage is Online Cover Level (m) 74.100

Tank or Pond Structure

Invert Level (m) 73.100

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	294.5	1.000	1153.4

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)	73.100
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		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B5.SRCX

	Upstream Structures	Outflow To	Overflow To
CATCHMENT B4.SRCX		(None)	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	72.068	0.218	5.3	209.6	O K
30 min Summer	72.128	0.278	5.3	272.3	O K
60 min Summer	72.189	0.339	5.3	336.5	O K
120 min Summer	72.246	0.396	5.3	399.2	O K
180 min Summer	72.280	0.430	5.3	436.9	O K
240 min Summer	72.303	0.453	5.3	462.6	O K
360 min Summer	72.330	0.480	5.3	494.7	O K
480 min Summer	72.345	0.495	5.3	511.1	O K
600 min Summer	72.351	0.501	5.3	518.6	O K
720 min Summer	72.353	0.503	5.3	520.6	O K
960 min Summer	72.348	0.498	5.3	514.8	O K
1440 min Summer	72.323	0.473	5.3	485.6	O K
2160 min Summer	72.286	0.436	5.3	444.0	O K
2880 min Summer	72.255	0.405	5.3	408.9	O K
4320 min Summer	72.203	0.353	5.3	351.4	O K
5760 min Summer	72.159	0.309	5.3	304.8	O K
7200 min Summer	72.123	0.273	5.3	267.1	O K
8640 min Summer	72.093	0.243	5.3	235.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	276.6	23
30 min Summer	97.160	0.0	357.0	37
60 min Summer	60.480	0.0	486.7	68
120 min Summer	36.400	0.0	585.1	126
180 min Summer	26.929	0.0	647.3	186
240 min Summer	21.665	0.0	691.5	246
360 min Summer	15.820	0.0	749.3	366
480 min Summer	12.552	0.0	781.3	484
600 min Summer	10.442	0.0	797.5	604
720 min Summer	8.960	0.0	801.7	722
960 min Summer	7.003	0.0	787.6	962
1440 min Summer	4.918	0.0	750.3	1288
2160 min Summer	3.437	0.0	1018.7	1600
2880 min Summer	2.669	0.0	1053.3	1964
4320 min Summer	1.882	0.0	1107.8	2768
5760 min Summer	1.479	0.0	1178.2	3528
7200 min Summer	1.236	0.0	1230.2	4320
8640 min Summer	1.074	0.0	1279.9	5016

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B5.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	72.067	0.217	5.3	209.1	O K
15 min Winter	72.092	0.242	5.3	234.9	O K
30 min Winter	72.160	0.310	5.3	305.4	O K
60 min Winter	72.226	0.376	5.3	377.5	O K
120 min Winter	72.290	0.440	5.3	448.3	O K
180 min Winter	72.328	0.478	5.3	491.8	O K
240 min Winter	72.354	0.504	5.3	521.9	O K
360 min Winter	72.386	0.536	5.3	559.0	O K
480 min Winter	72.401	0.551	5.3	577.9	O K
600 min Winter	72.409	0.559	5.3	587.2	O K
720 min Winter	72.412	0.562	5.3	590.7	O K
960 min Winter	72.409	0.559	5.3	587.2	O K
1440 min Winter	72.388	0.538	5.3	561.8	O K
2160 min Winter	72.345	0.495	5.3	511.5	O K
2880 min Winter	72.304	0.454	5.3	464.3	O K
4320 min Winter	72.229	0.379	5.3	380.0	O K
5760 min Winter	72.163	0.313	5.3	308.9	O K
7200 min Winter	72.107	0.257	5.3	249.7	O K
8640 min Winter	72.059	0.209	5.3	201.0	O K
10080 min Winter	72.022	0.172	5.3	163.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	1325.8	5744
15 min Winter	148.960	0.0	309.4	23
30 min Winter	97.160	0.0	393.5	37
60 min Winter	60.480	0.0	545.0	66
120 min Winter	36.400	0.0	653.4	124
180 min Winter	26.929	0.0	720.1	184
240 min Winter	21.665	0.0	765.0	242
360 min Winter	15.820	0.0	813.9	360
480 min Winter	12.552	0.0	823.6	476
600 min Winter	10.442	0.0	814.4	592
720 min Winter	8.960	0.0	803.7	708
960 min Winter	7.003	0.0	783.1	934
1440 min Winter	4.917	0.0	744.5	1372
2160 min Winter	3.437	0.0	1139.8	1756
2880 min Winter	2.669	0.0	1178.3	2168
4320 min Winter	1.882	0.0	1238.2	3028
5760 min Winter	1.479	0.0	1320.1	3808
7200 min Winter	1.236	0.0	1378.7	4544
8640 min Winter	1.074	0.0	1434.8	5192
10080 min Winter	0.957	0.0	1487.4	5848

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT B5.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.759

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.379	4	8	0.380

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT B5.SRCX

Storage is Online Cover Level (m) 72.850

Tank or Pond Structure

Invert Level (m) 71.850

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	910.0	1.000	1450.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0113-5300-0700-5300
Design Head (m)	0.700
Design Flow (l/s)	5.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	113
Invert Level (m)	71.850
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	5.3
Flush-Flo™	0.216	5.3
Kick-Flo®	0.485	4.5
Mean Flow over Head Range	-	4.5

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.9	1.200	6.8	3.000	10.5	7.000	15.7
0.200	5.3	1.400	7.3	3.500	11.3	7.500	16.2
0.300	5.2	1.600	7.8	4.000	12.0	8.000	16.7
0.400	5.0	1.800	8.2	4.500	12.7	8.500	17.3
0.500	4.5	2.000	8.7	5.000	13.4	9.000	17.8
0.600	4.9	2.200	9.1	5.500	14.0	9.500	18.3
0.800	5.6	2.400	9.4	6.000	14.6		
1.000	6.3	2.600	9.8	6.500	15.2		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B7.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	CATCHMENT B3.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	72.307	0.307	2.0	145.7	O K
30 min Summer	72.385	0.385	2.0	189.3	O K
60 min Summer	72.459	0.459	2.0	234.0	O K
120 min Summer	72.527	0.527	2.0	277.4	O K
180 min Summer	72.566	0.566	2.0	303.5	O K
240 min Summer	72.591	0.591	2.0	321.0	O K
360 min Summer	72.621	0.621	2.0	342.0	O K
480 min Summer	72.636	0.636	2.0	352.1	O K
600 min Summer	72.642	0.642	2.0	356.4	O K
720 min Summer	72.643	0.643	2.0	357.2	O K
960 min Summer	72.636	0.636	2.0	352.6	O K
1440 min Summer	72.609	0.609	2.0	333.1	O K
2160 min Summer	72.568	0.568	2.0	305.0	O K
2880 min Summer	72.534	0.534	2.0	282.3	O K
4320 min Summer	72.478	0.478	2.0	246.0	O K
5760 min Summer	72.424	0.424	2.0	212.9	O K
7200 min Summer	72.379	0.379	2.0	185.9	O K
8640 min Summer	72.340	0.340	2.0	164.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	136.1	23
30 min Summer	97.160	0.0	164.0	38
60 min Summer	60.480	0.0	234.0	68
120 min Summer	36.400	0.0	278.6	126
180 min Summer	26.929	0.0	303.0	186
240 min Summer	21.665	0.0	313.1	246
360 min Summer	15.820	0.0	312.6	366
480 min Summer	12.552	0.0	309.6	484
600 min Summer	10.442	0.0	306.7	604
720 min Summer	8.960	0.0	303.9	724
960 min Summer	7.003	0.0	298.4	962
1440 min Summer	4.918	0.0	286.9	1370
2160 min Summer	3.437	0.0	485.3	1692
2880 min Summer	2.669	0.0	500.8	2076
4320 min Summer	1.882	0.0	516.4	2896
5760 min Summer	1.479	0.0	561.1	3688
7200 min Summer	1.236	0.0	586.3	4400
8640 min Summer	1.074	0.0	610.5	5184

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT B7.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	72.307	0.307	2.0	145.4	O K
15 min Winter	72.339	0.339	2.0	163.3	O K
30 min Winter	72.423	0.423	2.0	212.4	O K
60 min Winter	72.504	0.504	2.0	262.7	O K
120 min Winter	72.578	0.578	2.0	311.8	O K
180 min Winter	72.621	0.621	2.0	341.5	O K
240 min Winter	72.649	0.649	2.0	361.7	O K
360 min Winter	72.683	0.683	2.0	386.5	O K
480 min Winter	72.700	0.700	2.0	399.1	O K
600 min Winter	72.708	0.708	2.0	405.1	Flood Risk
720 min Winter	72.710	0.710	2.0	407.2	Flood Risk
960 min Winter	72.707	0.707	2.0	404.3	Flood Risk
1440 min Winter	72.683	0.683	2.0	386.8	O K
2160 min Winter	72.636	0.636	2.0	352.0	O K
2880 min Winter	72.596	0.596	2.0	324.2	O K
4320 min Winter	72.524	0.524	2.0	275.6	O K
5760 min Winter	72.453	0.453	2.0	230.7	O K
7200 min Winter	72.379	0.379	2.0	186.3	O K
8640 min Winter	72.319	0.319	2.0	152.0	O K
10080 min Winter	72.267	0.267	2.0	124.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	633.8	5944
15 min Winter	148.960	0.0	149.9	23
30 min Winter	97.160	0.0	165.4	37
60 min Winter	60.480	0.0	260.9	66
120 min Winter	36.400	0.0	305.3	126
180 min Winter	26.929	0.0	316.3	184
240 min Winter	21.665	0.0	315.3	242
360 min Winter	15.820	0.0	312.6	360
480 min Winter	12.552	0.0	310.4	476
600 min Winter	10.442	0.0	308.5	594
720 min Winter	8.960	0.0	306.7	708
960 min Winter	7.003	0.0	303.1	936
1440 min Winter	4.917	0.0	296.2	1376
2160 min Winter	3.437	0.0	541.7	1780
2880 min Winter	2.669	0.0	556.7	2216
4320 min Winter	1.882	0.0	540.3	3120
5760 min Winter	1.479	0.0	628.4	4040
7200 min Winter	1.236	0.0	656.7	4760
8640 min Winter	1.074	0.0	684.1	5528
10080 min Winter	0.957	0.0	710.4	6248

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT B7.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.528

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.264	4	8	0.264

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT B7.SRCX

Storage is Online Cover Level (m) 73.000

Tank or Pond Structure

Invert Level (m) 72.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	406.8	1.000	931.5

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)	72.000
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		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C1.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	CATCHMENT C2.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	69.876	0.376	2.0	62.9	O K
30 min Summer	69.954	0.454	2.0	81.5	O K
60 min Summer	70.022	0.522	2.0	99.4	O K
120 min Summer	70.076	0.576	2.0	115.1	O K
180 min Summer	70.102	0.602	2.0	123.1	O K
240 min Summer	70.116	0.616	2.0	127.4	O K
360 min Summer	70.124	0.624	2.0	130.0	O K
480 min Summer	70.118	0.618	2.0	128.0	O K
600 min Summer	70.107	0.607	2.0	124.3	O K
720 min Summer	70.094	0.594	2.0	120.6	O K
960 min Summer	70.069	0.569	2.0	113.0	O K
1440 min Summer	70.022	0.522	2.0	99.6	O K
2160 min Summer	69.954	0.454	2.0	81.5	O K
2880 min Summer	69.882	0.382	2.0	64.4	O K
4320 min Summer	69.768	0.268	2.0	40.6	O K
5760 min Summer	69.686	0.186	2.0	26.0	O K
7200 min Summer	69.635	0.135	1.9	17.9	O K
8640 min Summer	69.605	0.105	1.9	13.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	64.3	22
30 min Summer	97.160	0.0	83.9	37
60 min Summer	60.480	0.0	105.0	66
120 min Summer	36.400	0.0	126.4	126
180 min Summer	26.929	0.0	140.3	184
240 min Summer	21.665	0.0	150.5	244
360 min Summer	15.820	0.0	164.8	362
480 min Summer	12.552	0.0	174.4	480
600 min Summer	10.442	0.0	181.3	540
720 min Summer	8.960	0.0	186.7	598
960 min Summer	7.003	0.0	194.5	720
1440 min Summer	4.918	0.0	204.8	984
2160 min Summer	3.437	0.0	215.1	1392
2880 min Summer	2.669	0.0	222.7	1760
4320 min Summer	1.882	0.0	235.4	2468
5760 min Summer	1.479	0.0	246.9	3120
7200 min Summer	1.236	0.0	258.1	3816
8640 min Summer	1.074	0.0	268.9	4488

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C1.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	69.590	0.090	1.8	11.5	O K
15 min Winter	69.910	0.410	2.0	70.7	O K
30 min Winter	69.993	0.493	2.0	91.6	O K
60 min Winter	70.066	0.566	2.0	112.0	O K
120 min Winter	70.125	0.625	2.0	130.2	O K
180 min Winter	70.155	0.655	2.0	139.8	O K
240 min Winter	70.171	0.671	2.0	145.3	O K
360 min Winter	70.184	0.684	2.0	149.5	O K
480 min Winter	70.181	0.681	2.0	148.6	O K
600 min Winter	70.171	0.671	2.0	145.3	O K
720 min Winter	70.157	0.657	2.0	140.6	O K
960 min Winter	70.128	0.628	2.0	131.0	O K
1440 min Winter	70.070	0.570	2.0	113.4	O K
2160 min Winter	69.981	0.481	2.0	88.4	O K
2880 min Winter	69.875	0.375	2.0	62.7	O K
4320 min Winter	69.707	0.207	2.0	29.6	O K
5760 min Winter	69.614	0.114	1.9	14.9	O K
7200 min Winter	69.585	0.085	1.7	10.8	O K
8640 min Winter	69.574	0.074	1.5	9.2	O K
10080 min Winter	69.566	0.066	1.3	8.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	279.6	5144
15 min Winter	148.960	0.0	72.0	22
30 min Winter	97.160	0.0	94.0	37
60 min Winter	60.480	0.0	117.6	66
120 min Winter	36.400	0.0	141.6	124
180 min Winter	26.929	0.0	157.1	182
240 min Winter	21.665	0.0	168.5	240
360 min Winter	15.820	0.0	184.6	354
480 min Winter	12.552	0.0	195.3	466
600 min Winter	10.442	0.0	203.0	574
720 min Winter	8.960	0.0	209.1	674
960 min Winter	7.003	0.0	217.8	762
1440 min Winter	4.917	0.0	229.2	1068
2160 min Winter	3.437	0.0	241.0	1516
2880 min Winter	2.669	0.0	249.5	1880
4320 min Winter	1.882	0.0	263.7	2548
5760 min Winter	1.479	0.0	276.6	3112
7200 min Winter	1.236	0.0	289.0	3720
8640 min Winter	1.074	0.0	301.2	4408
10080 min Winter	0.957	0.0	313.2	5136

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT C1.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.232

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.116	4	8	0.116

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT C1.SRCX

Storage is Online Cover Level (m) 70.500

Tank or Pond Structure

Invert Level (m) 69.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	116.0	1.000	484.8

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)	69.500
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		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C2.SRCX

Upstream Structures	Outflow To	Overflow To
CATCHMENT C1.SRCX	CATCHMENT C5.SRCX	(None)
CATCHMENT C4.SRCX		
CATCHMENT C8.SRCX		
CATCHMENT C9.SRCX		
CATCHMENT C6.SRCX		

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	68.248	0.248	13.0	547.2	O K
30 min Summer	68.322	0.322	13.0	725.3	O K
60 min Summer	68.399	0.399	13.0	918.7	O K
120 min Summer	68.482	0.482	13.0	1132.7	O K
180 min Summer	68.538	0.538	13.0	1281.7	O K
240 min Summer	68.577	0.577	13.0	1389.1	O K
360 min Summer	68.630	0.630	13.0	1535.8	O K
480 min Summer	68.662	0.662	13.0	1628.0	O K
600 min Summer	68.684	0.684	13.0	1691.0	O K
720 min Summer	68.700	0.700	13.0	1737.8	O K
960 min Summer	68.720	0.720	13.2	1795.8	Flood Risk
1440 min Summer	68.707	0.707	13.1	1758.3	Flood Risk
2160 min Summer	68.667	0.667	13.0	1643.0	O K
2880 min Summer	68.636	0.636	13.0	1553.7	O K
4320 min Summer	68.583	0.583	13.0	1404.6	O K
5760 min Summer	68.529	0.529	13.0	1257.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	784.1	258
30 min Summer	97.160	0.0	992.1	334
60 min Summer	60.480	0.0	1424.8	420
120 min Summer	36.400	0.0	1701.6	516
180 min Summer	26.929	0.0	1860.7	582
240 min Summer	21.665	0.0	1956.8	630
360 min Summer	15.820	0.0	2024.2	712
480 min Summer	12.552	0.0	2006.3	784
600 min Summer	10.442	0.0	1983.4	850
720 min Summer	8.960	0.0	1960.9	910
960 min Summer	7.003	0.0	1916.6	1026
1440 min Summer	4.918	0.0	1824.2	1428
2160 min Summer	3.437	0.0	3006.2	1776
2880 min Summer	2.669	0.0	3095.5	2164
4320 min Summer	1.882	0.0	3180.9	2988
5760 min Summer	1.479	0.0	3506.0	3760

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C2.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Summer	68.474	0.474	13.0	1111.3	O K
8640 min Summer	68.428	0.428	13.0	991.7	O K
10080 min Summer	68.389	0.389	13.0	891.0	O K
15 min Winter	68.277	0.277	13.0	616.7	O K
30 min Winter	68.359	0.359	13.0	817.0	O K
60 min Winter	68.446	0.446	13.0	1038.9	O K
120 min Winter	68.541	0.541	13.0	1290.1	O K
180 min Winter	68.600	0.600	13.0	1452.7	O K
240 min Winter	68.642	0.642	13.0	1570.0	O K
360 min Winter	68.697	0.697	13.0	1729.8	O K
480 min Winter	68.731	0.731	13.3	1830.1	Flood Risk
600 min Winter	68.755	0.755	13.5	1899.6	Flood Risk
720 min Winter	68.772	0.772	13.6	1950.5	Flood Risk
960 min Winter	68.795	0.795	13.8	2020.3	Flood Risk
1440 min Winter	68.792	0.792	13.8	2013.6	Flood Risk
2160 min Winter	68.745	0.745	13.4	1871.5	Flood Risk
2880 min Winter	68.708	0.708	13.1	1762.8	Flood Risk
4320 min Winter	68.637	0.637	13.0	1557.2	O K
5760 min Winter	68.560	0.560	13.0	1342.0	O K
7200 min Winter	68.475	0.475	13.0	1115.0	O K
8640 min Winter	68.402	0.402	13.0	924.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Summer	1.236	0.0	3660.0	4504
8640 min Summer	1.074	0.0	3805.0	5256
10080 min Summer	0.957	0.0	3934.0	5976
15 min Winter	148.960	0.0	873.6	285
30 min Winter	97.160	0.0	1064.8	372
60 min Winter	60.480	0.0	1591.5	464
120 min Winter	36.400	0.0	1879.1	564
180 min Winter	26.929	0.0	2017.6	626
240 min Winter	21.665	0.0	2060.6	676
360 min Winter	15.820	0.0	2045.2	760
480 min Winter	12.552	0.0	2030.3	830
600 min Winter	10.442	0.0	2016.3	894
720 min Winter	8.960	0.0	2002.1	956
960 min Winter	7.003	0.0	1972.9	1068
1440 min Winter	4.917	0.0	1911.1	1408
2160 min Winter	3.437	0.0	3357.1	1904
2880 min Winter	2.669	0.0	3446.9	2288
4320 min Winter	1.882	0.0	3432.0	3160
5760 min Winter	1.479	0.0	3928.3	4056
7200 min Winter	1.236	0.0	4102.3	4848
8640 min Winter	1.074	0.0	4267.0	5560

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C2.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Winter	68.339	0.339	13.0	768.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	0.957	0.0	4416.7	6256

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT C2.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.804

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.402	4	8	0.402

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT C2.SRCX

Storage is Online Cover Level (m) 69.000

Tank or Pond Structure

Invert Level (m) 68.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2070.0	1.000	3330.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0168-1300-0700-1300
Design Head (m)	0.700
Design Flow (l/s)	13.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	168
Invert Level (m)	68.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	13.0
Flush-Flo™	0.267	13.0
Kick-Flo®	0.526	11.4
Mean Flow over Head Range	-	10.7

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	6.0	1.200	16.8	3.000	26.0	7.000	39.1
0.200	12.8	1.400	18.1	3.500	28.0	7.500	40.3
0.300	13.0	1.600	19.2	4.000	29.9	8.000	41.6
0.400	12.6	1.800	20.4	4.500	31.6	8.500	42.9
0.500	11.8	2.000	21.4	5.000	33.3	9.000	44.2
0.600	12.1	2.200	22.4	5.500	34.8	9.500	45.4
0.800	13.8	2.400	23.4	6.000	36.3		
1.000	15.4	2.600	24.3	6.500	37.8		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C4.SRCX

Upstream Structures	Outflow To	Overflow To
CATCHMENT C8.SRCX	CATCHMENT C2.SRCX	(None)
CATCHMENT C9.SRCX		

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	69.360	0.460	37.5	321.0	O K
30 min Summer	69.468	0.568	37.5	412.8	O K
60 min Summer	69.560	0.660	37.5	495.4	O K
120 min Summer	69.619	0.719	38.0	551.6	Flood Risk
180 min Summer	69.635	0.735	38.4	567.2	Flood Risk
240 min Summer	69.638	0.738	38.4	569.8	Flood Risk
360 min Summer	69.628	0.728	38.2	560.7	Flood Risk
480 min Summer	69.607	0.707	37.7	540.2	Flood Risk
600 min Summer	69.580	0.680	37.5	514.7	O K
720 min Summer	69.551	0.651	37.5	487.7	O K
960 min Summer	69.495	0.595	37.5	436.8	O K
1440 min Summer	69.373	0.473	37.5	331.4	O K
2160 min Summer	69.233	0.333	37.3	221.9	O K
2880 min Summer	69.150	0.250	35.9	161.2	O K
4320 min Summer	69.099	0.199	26.9	125.7	O K
5760 min Summer	69.072	0.172	21.6	107.9	O K
7200 min Summer	69.056	0.156	18.4	96.7	O K
8640 min Summer	69.044	0.144	16.1	88.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	509.3	22
30 min Summer	97.160	0.0	666.1	36
60 min Summer	60.480	0.0	834.9	64
120 min Summer	36.400	0.0	1005.5	122
180 min Summer	26.929	0.0	1116.1	176
240 min Summer	21.665	0.0	1197.5	202
360 min Summer	15.820	0.0	1311.8	266
480 min Summer	12.552	0.0	1387.8	332
600 min Summer	10.442	0.0	1443.2	402
720 min Summer	8.960	0.0	1486.1	470
960 min Summer	7.003	0.0	1548.5	610
1440 min Summer	4.918	0.0	1630.0	856
2160 min Summer	3.437	0.0	1712.5	1192
2880 min Summer	2.669	0.0	1772.6	1504
4320 min Summer	1.882	0.0	1872.2	2208
5760 min Summer	1.479	0.0	1966.1	2944
7200 min Summer	1.236	0.0	2054.4	3672
8640 min Summer	1.074	0.0	2140.4	4408

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C4.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	69.035	0.135	14.4	83.0	O K
15 min Winter	69.408	0.508	37.5	361.3	O K
30 min Winter	69.527	0.627	37.5	465.0	O K
60 min Winter	69.625	0.725	38.1	557.6	Flood Risk
120 min Winter	69.693	0.793	39.8	625.1	Flood Risk
180 min Winter	69.715	0.815	40.3	647.1	Flood Risk
240 min Winter	69.717	0.817	40.4	648.8	Flood Risk
360 min Winter	69.702	0.802	40.0	634.1	Flood Risk
480 min Winter	69.674	0.774	39.3	605.7	Flood Risk
600 min Winter	69.637	0.737	38.4	569.6	Flood Risk
720 min Winter	69.598	0.698	37.5	531.3	O K
960 min Winter	69.523	0.623	37.5	461.5	O K
1440 min Winter	69.338	0.438	37.5	303.2	O K
2160 min Winter	69.149	0.249	35.8	160.6	O K
2880 min Winter	69.106	0.206	28.4	130.9	O K
4320 min Winter	69.066	0.166	20.3	103.3	O K
5760 min Winter	69.044	0.144	16.1	88.9	O K
7200 min Winter	69.030	0.130	13.4	79.7	O K
8640 min Winter	69.020	0.120	11.7	73.4	O K
10080 min Winter	69.012	0.112	10.4	68.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	2223.9	5136
15 min Winter	148.960	0.0	571.1	22
30 min Winter	97.160	0.0	746.7	36
60 min Winter	60.480	0.0	935.4	64
120 min Winter	36.400	0.0	1126.5	120
180 min Winter	26.929	0.0	1250.4	176
240 min Winter	21.665	0.0	1341.5	228
360 min Winter	15.820	0.0	1469.6	282
480 min Winter	12.552	0.0	1554.7	360
600 min Winter	10.442	0.0	1616.8	434
720 min Winter	8.960	0.0	1664.8	508
960 min Winter	7.003	0.0	1734.8	660
1440 min Winter	4.917	0.0	1826.3	906
2160 min Winter	3.437	0.0	1918.3	1156
2880 min Winter	2.669	0.0	1985.7	1504
4320 min Winter	1.882	0.0	2097.8	2224
5760 min Winter	1.479	0.0	2202.2	2936
7200 min Winter	1.236	0.0	2301.2	3672
8640 min Winter	1.074	0.0	2397.6	4408
10080 min Winter	0.957	0.0	2491.8	5144

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT C4.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 1.210

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.605	4	8	0.605

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT C4.SRCX

Storage is Online Cover Level (m) 69.900

Tank or Pond Structure

Invert Level (m) 68.900

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	585.0	1.000	1140.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0264-3750-0700-3750
Design Head (m)	0.700
Design Flow (l/s)	37.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	264
Invert Level (m)	68.900
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	37.5
Flush-Flo™	0.377	37.5
Kick-Flo®	0.589	34.5
Mean Flow over Head Range	-	28.7

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	8.4	1.200	48.6	3.000	75.7	7.000	114.5
0.200	27.2	1.400	52.3	3.500	81.6	7.500	117.5
0.300	37.0	1.600	55.8	4.000	87.1	8.000	121.4
0.400	37.4	1.800	59.1	4.500	92.2	8.500	125.2
0.500	36.5	2.000	62.2	5.000	97.1	9.000	128.9
0.600	34.8	2.200	65.1	5.500	101.7	9.500	132.4
0.800	40.0	2.400	67.9	6.000	106.2		
1.000	44.5	2.600	70.6	6.500	110.4		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C5.SRCX

Upstream Structures	Outflow To	Overflow To
CATCHMENT C2.SRCX	(None)	(None)
CATCHMENT C1.SRCX		
CATCHMENT C4.SRCX		
CATCHMENT C8.SRCX		
CATCHMENT C9.SRCX		
CATCHMENT C6.SRCX		

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	68.109	0.359	19.4	219.7	O K
30 min Summer	68.203	0.453	19.4	285.6	O K
60 min Summer	68.293	0.543	19.4	352.0	O K
120 min Summer	68.369	0.619	19.4	410.9	O K
180 min Summer	68.407	0.657	19.4	441.3	O K
240 min Summer	68.428	0.678	19.4	458.8	O K
360 min Summer	68.446	0.696	19.4	473.2	O K
480 min Summer	68.444	0.694	19.4	471.6	O K
600 min Summer	68.438	0.688	19.4	466.4	O K
720 min Summer	68.430	0.680	19.4	460.5	O K
960 min Summer	68.414	0.664	19.4	446.8	O K
1440 min Summer	68.376	0.626	19.4	417.0	O K
2160 min Summer	68.317	0.567	19.4	370.9	O K
2880 min Summer	68.235	0.485	19.4	309.1	O K
4320 min Summer	68.124	0.374	19.4	230.4	O K
5760 min Summer	68.053	0.303	19.4	182.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	979.2	22
30 min Summer	97.160	0.0	1239.0	37
60 min Summer	60.480	0.0	1779.4	66
120 min Summer	36.400	0.0	2124.6	126
180 min Summer	26.929	0.0	2322.6	184
240 min Summer	21.665	0.0	2441.9	244
360 min Summer	15.820	0.0	2533.0	362
480 min Summer	12.552	0.0	2544.0	460
600 min Summer	10.442	0.0	2545.8	510
720 min Summer	8.960	0.0	2542.8	566
960 min Summer	7.003	0.0	2527.3	686
1440 min Summer	4.918	0.0	2473.9	982
2160 min Summer	3.437	0.0	3754.7	1432
2880 min Summer	2.669	0.0	3866.0	1764
4320 min Summer	1.882	0.0	3970.9	2460
5760 min Summer	1.479	0.0	4380.0	3168

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C5.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
7200 min Summer	68.008	0.258	19.3	152.9	O K
8640 min Summer	67.978	0.228	19.1	134.1	O K
10080 min Summer	67.959	0.209	18.9	122.0	O K
15 min Winter	68.149	0.399	19.4	247.8	O K
30 min Winter	68.253	0.503	19.4	322.6	O K
60 min Winter	68.351	0.601	19.4	396.6	O K
120 min Winter	68.432	0.682	19.4	461.7	O K
180 min Winter	68.474	0.724	19.7	496.3	Flood Risk
240 min Winter	68.498	0.748	20.0	516.5	Flood Risk
360 min Winter	68.518	0.768	20.3	533.5	Flood Risk
480 min Winter	68.516	0.766	20.2	532.1	Flood Risk
600 min Winter	68.507	0.757	20.1	524.1	Flood Risk
720 min Winter	68.496	0.746	20.0	515.1	Flood Risk
960 min Winter	68.476	0.726	19.7	498.4	Flood Risk
1440 min Winter	68.434	0.684	19.4	463.7	O K
2160 min Winter	68.360	0.610	19.4	404.3	O K
2880 min Winter	68.241	0.491	19.4	313.3	O K
4320 min Winter	68.070	0.320	19.4	193.5	O K
5760 min Winter	67.992	0.242	19.2	142.6	O K
7200 min Winter	67.953	0.203	18.8	118.3	O K
8640 min Winter	67.944	0.194	18.2	112.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
7200 min Summer	1.236	0.0	4572.6	3824
8640 min Summer	1.074	0.0	4753.8	4504
10080 min Summer	0.957	0.0	4915.2	5176
15 min Winter	148.960	0.0	1090.9	22
30 min Winter	97.160	0.0	1332.4	37
60 min Winter	60.480	0.0	1987.4	66
120 min Winter	36.400	0.0	2345.5	124
180 min Winter	26.929	0.0	2518.1	182
240 min Winter	21.665	0.0	2580.9	238
360 min Winter	15.820	0.0	2619.3	352
480 min Winter	12.552	0.0	2643.0	458
600 min Winter	10.442	0.0	2657.5	562
720 min Winter	8.960	0.0	2665.6	582
960 min Winter	7.003	0.0	2669.4	742
1440 min Winter	4.917	0.0	2652.1	1084
2160 min Winter	3.437	0.0	4192.6	1576
2880 min Winter	2.669	0.0	4304.1	1964
4320 min Winter	1.882	0.0	4291.6	2468
5760 min Winter	1.479	0.0	4907.6	3128
7200 min Winter	1.236	0.0	5125.1	3744
8640 min Winter	1.074	0.0	5330.9	4408

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C5.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Winter	67.938	0.188	17.6	108.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Winter	0.957	0.0	5518.1	5152

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT C5.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.826

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.413	4	8	0.413

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT C5.SRCX

Storage is Online Cover Level (m) 68.750

Tank or Pond Structure

Invert Level (m) 67.750

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	545.0	1.000	965.0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0199-1940-0700-1940
Design Head (m)	0.700
Design Flow (l/s)	19.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	199
Invert Level (m)	67.750
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	19.4
Flush-Flo™	0.303	19.4
Kick-Flo®	0.545	17.2
Mean Flow over Head Range	-	15.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.9	1.200	25.1	3.000	39.0	7.000	58.7
0.200	18.7	1.400	27.0	3.500	42.0	7.500	60.4
0.300	19.4	1.600	28.8	4.000	44.8	8.000	62.4
0.400	19.1	1.800	30.5	4.500	47.4	8.500	64.4
0.500	18.1	2.000	32.0	5.000	49.9	9.000	66.3
0.600	18.0	2.200	33.5	5.500	52.2	9.500	68.1
0.800	20.7	2.400	35.0	6.000	54.5		
1.000	23.0	2.600	36.4	6.500	56.7		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C6.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	CATCHMENT C2.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	70.883	0.283	2.0	118.0	O K
30 min Summer	70.956	0.356	2.0	153.3	O K
60 min Summer	71.026	0.426	2.0	189.0	O K
120 min Summer	71.090	0.490	2.0	223.7	O K
180 min Summer	71.127	0.527	2.0	244.0	O K
240 min Summer	71.150	0.550	2.0	257.4	O K
360 min Summer	71.176	0.576	2.0	272.7	O K
480 min Summer	71.187	0.587	2.0	279.2	O K
600 min Summer	71.190	0.590	2.0	281.0	O K
720 min Summer	71.189	0.589	2.0	280.1	O K
960 min Summer	71.177	0.577	2.0	273.3	O K
1440 min Summer	71.145	0.545	2.0	254.4	O K
2160 min Summer	71.101	0.501	2.0	229.7	O K
2880 min Summer	71.063	0.463	2.0	208.7	O K
4320 min Summer	70.992	0.392	2.0	171.2	O K
5760 min Summer	70.935	0.335	2.0	142.9	O K
7200 min Summer	70.889	0.289	2.0	120.6	O K
8640 min Summer	70.850	0.250	2.0	102.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	113.0	23
30 min Summer	97.160	0.0	144.6	37
60 min Summer	60.480	0.0	191.3	68
120 min Summer	36.400	0.0	229.7	126
180 min Summer	26.929	0.0	254.0	186
240 min Summer	21.665	0.0	271.2	246
360 min Summer	15.820	0.0	293.2	364
480 min Summer	12.552	0.0	303.9	484
600 min Summer	10.442	0.0	306.8	604
720 min Summer	8.960	0.0	305.3	722
960 min Summer	7.003	0.0	299.4	960
1440 min Summer	4.918	0.0	285.1	1226
2160 min Summer	3.437	0.0	395.7	1588
2880 min Summer	2.669	0.0	409.3	1992
4320 min Summer	1.882	0.0	431.6	2764
5760 min Summer	1.479	0.0	456.0	3512
7200 min Summer	1.236	0.0	476.4	4256
8640 min Summer	1.074	0.0	496.1	5008

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C6.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	70.818	0.218	2.0	88.2	O K
15 min Winter	70.913	0.313	2.0	132.4	O K
30 min Winter	70.993	0.393	2.0	172.0	O K
60 min Winter	71.070	0.470	2.0	212.5	O K
120 min Winter	71.140	0.540	2.0	251.6	O K
180 min Winter	71.180	0.580	2.0	274.8	O K
240 min Winter	71.206	0.606	2.0	290.3	O K
360 min Winter	71.236	0.636	2.0	308.7	O K
480 min Winter	71.250	0.650	2.0	317.0	O K
600 min Winter	71.255	0.655	2.0	320.2	O K
720 min Winter	71.255	0.655	2.0	320.2	O K
960 min Winter	71.246	0.646	2.0	314.7	O K
1440 min Winter	71.214	0.614	2.0	294.9	O K
2160 min Winter	71.161	0.561	2.0	264.0	O K
2880 min Winter	71.115	0.515	2.0	237.3	O K
4320 min Winter	71.019	0.419	2.0	185.2	O K
5760 min Winter	70.931	0.331	2.0	141.1	O K
7200 min Winter	70.861	0.261	2.0	107.9	O K
8640 min Winter	70.805	0.205	2.0	82.6	O K
10080 min Winter	70.763	0.163	2.0	64.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	515.0	5656
15 min Winter	148.960	0.0	126.0	23
30 min Winter	97.160	0.0	157.5	37
60 min Winter	60.480	0.0	214.0	66
120 min Winter	36.400	0.0	256.3	124
180 min Winter	26.929	0.0	282.2	184
240 min Winter	21.665	0.0	299.1	242
360 min Winter	15.820	0.0	312.8	358
480 min Winter	12.552	0.0	312.0	476
600 min Winter	10.442	0.0	309.5	590
720 min Winter	8.960	0.0	306.7	706
960 min Winter	7.003	0.0	300.7	930
1440 min Winter	4.917	0.0	288.5	1356
2160 min Winter	3.437	0.0	442.9	1688
2880 min Winter	2.669	0.0	457.9	2140
4320 min Winter	1.882	0.0	482.2	3024
5760 min Winter	1.479	0.0	510.8	3752
7200 min Winter	1.236	0.0	533.7	4472
8640 min Winter	1.074	0.0	555.8	5184
10080 min Winter	0.957	0.0	577.2	5840

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT C6.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.429

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.214	4	8	0.215

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT C6.SRCX

Storage is Online Cover Level (m) 71.600

Tank or Pond Structure

Invert Level (m) 70.600

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	367.1	1.000	783.1

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)	70.600
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		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C8.SRCX

Upstream Structures	Outflow To	Overflow To
CATCHMENT C9.SRCX	CATCHMENT C4.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	70.108	0.358	15.5	111.1	O K
30 min Summer	70.204	0.454	15.5	148.5	O K
60 min Summer	70.304	0.554	15.5	191.3	O K
120 min Summer	70.375	0.625	15.5	224.0	O K
180 min Summer	70.412	0.662	15.5	241.7	O K
240 min Summer	70.429	0.679	15.5	250.0	O K
360 min Summer	70.414	0.664	15.5	242.7	O K
480 min Summer	70.387	0.637	15.5	229.8	O K
600 min Summer	70.352	0.602	15.5	212.9	O K
720 min Summer	70.313	0.563	15.5	195.4	O K
960 min Summer	70.227	0.477	15.5	157.9	O K
1440 min Summer	70.080	0.330	15.5	101.1	O K
2160 min Summer	69.953	0.203	15.2	57.6	O K
2880 min Summer	69.912	0.162	13.1	45.1	O K
4320 min Summer	69.879	0.129	9.6	35.2	O K
5760 min Summer	69.861	0.111	7.6	30.1	O K
7200 min Summer	69.850	0.100	6.4	26.9	O K
8640 min Summer	69.843	0.093	5.6	24.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	177.1	70
30 min Summer	97.160	0.0	231.3	96
60 min Summer	60.480	0.0	288.8	126
120 min Summer	36.400	0.0	347.8	166
180 min Summer	26.929	0.0	386.0	202
240 min Summer	21.665	0.0	414.1	238
360 min Summer	15.820	0.0	453.6	282
480 min Summer	12.552	0.0	479.8	332
600 min Summer	10.442	0.0	499.0	394
720 min Summer	8.960	0.0	513.8	460
960 min Summer	7.003	0.0	535.4	586
1440 min Summer	4.918	0.0	563.8	814
2160 min Summer	3.437	0.0	591.6	1136
2880 min Summer	2.669	0.0	612.5	1476
4320 min Summer	1.882	0.0	647.3	2208
5760 min Summer	1.479	0.0	679.0	2936
7200 min Summer	1.236	0.0	709.6	3672
8640 min Summer	1.074	0.0	739.4	4400

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C8.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	69.837	0.087	5.0	23.1	O K
15 min Winter	70.145	0.395	15.5	125.0	O K
30 min Winter	70.253	0.503	15.5	168.9	O K
60 min Winter	70.351	0.601	15.5	212.6	O K
120 min Winter	70.427	0.677	15.5	249.4	O K
180 min Winter	70.467	0.717	15.7	269.5	Flood Risk
240 min Winter	70.494	0.744	16.0	283.6	Flood Risk
360 min Winter	70.483	0.733	15.8	277.9	Flood Risk
480 min Winter	70.441	0.691	15.5	256.1	O K
600 min Winter	70.389	0.639	15.5	230.7	O K
720 min Winter	70.335	0.585	15.5	205.0	O K
960 min Winter	70.205	0.455	15.5	148.9	O K
1440 min Winter	70.000	0.250	15.4	73.1	O K
2160 min Winter	69.908	0.158	12.7	43.8	O K
2880 min Winter	69.882	0.132	10.0	36.1	O K
4320 min Winter	69.856	0.106	7.1	28.6	O K
5760 min Winter	69.842	0.092	5.5	24.7	O K
7200 min Winter	69.833	0.083	4.6	22.2	O K
8640 min Winter	69.827	0.077	4.1	20.4	O K
10080 min Winter	69.822	0.072	3.6	19.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	768.7	5136
15 min Winter	148.960	0.0	198.4	79
30 min Winter	97.160	0.0	259.1	107
60 min Winter	60.480	0.0	323.6	138
120 min Winter	36.400	0.0	389.6	178
180 min Winter	26.929	0.0	432.4	212
240 min Winter	21.665	0.0	463.8	244
360 min Winter	15.820	0.0	508.1	288
480 min Winter	12.552	0.0	537.5	350
600 min Winter	10.442	0.0	558.9	424
720 min Winter	8.960	0.0	575.5	498
960 min Winter	7.003	0.0	599.7	624
1440 min Winter	4.917	0.0	631.5	828
2160 min Winter	3.437	0.0	662.7	1128
2880 min Winter	2.669	0.0	686.0	1480
4320 min Winter	1.882	0.0	725.2	2208
5760 min Winter	1.479	0.0	760.5	2936
7200 min Winter	1.236	0.0	794.8	3672
8640 min Winter	1.074	0.0	828.2	4320
10080 min Winter	0.957	0.0	861.1	5144

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT C8.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.385

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.193	4	8	0.192

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT C8.SRCX

Storage is Online Cover Level (m) 70.750

Tank or Pond Structure

Invert Level (m) 69.750

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	253.0	1.000	641.6

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0181-1550-0700-1550
Design Head (m)	0.700
Design Flow (l/s)	15.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	181
Invert Level (m)	69.750
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	15.5
Flush-Flo™	0.282	15.5
Kick-Flo®	0.534	13.6
Mean Flow over Head Range	-	12.6

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.4	1.200	20.0	3.000	31.1	7.000	46.8
0.200	15.2	1.400	21.5	3.500	33.5	7.500	48.1
0.300	15.5	1.600	23.0	4.000	35.7	8.000	49.7
0.400	15.1	1.800	24.3	4.500	37.8	8.500	51.3
0.500	14.3	2.000	25.6	5.000	39.7	9.000	52.8
0.600	14.4	2.200	26.8	5.500	41.6	9.500	54.3
0.800	16.5	2.400	27.9	6.000	43.4		
1.000	18.4	2.600	29.0	6.500	45.1		

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C9.SRCX

Upstream Structures	Outflow To	Overflow To
(None)	CATCHMENT C8.SRCX	(None)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	70.605	0.605	16.5	57.1	O K
30 min Summer	70.675	0.675	16.5	68.4	O K
60 min Summer	70.691	0.691	16.5	71.2	O K
120 min Summer	70.661	0.661	16.5	66.1	O K
180 min Summer	70.622	0.622	16.5	59.8	O K
240 min Summer	70.577	0.577	16.5	53.0	O K
360 min Summer	70.467	0.467	16.5	38.1	O K
480 min Summer	70.360	0.360	16.5	26.0	O K
600 min Summer	70.273	0.273	16.5	17.8	O K
720 min Summer	70.213	0.213	16.2	12.9	O K
960 min Summer	70.167	0.167	14.0	9.5	O K
1440 min Summer	70.131	0.131	10.1	7.1	O K
2160 min Summer	70.105	0.105	7.1	5.5	O K
2880 min Summer	70.091	0.091	5.5	4.7	O K
4320 min Summer	70.075	0.075	3.9	3.8	O K
5760 min Summer	70.066	0.066	3.1	3.3	O K
7200 min Summer	70.060	0.060	2.6	3.0	O K
8640 min Summer	70.055	0.055	2.2	2.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	148.960	0.0	70.6	19
30 min Summer	97.160	0.0	92.1	31
60 min Summer	60.480	0.0	114.7	50
120 min Summer	36.400	0.0	138.1	84
180 min Summer	26.929	0.0	153.3	118
240 min Summer	21.665	0.0	164.4	152
360 min Summer	15.820	0.0	180.1	214
480 min Summer	12.552	0.0	190.5	272
600 min Summer	10.442	0.0	198.1	326
720 min Summer	8.960	0.0	204.0	378
960 min Summer	7.003	0.0	212.6	492
1440 min Summer	4.918	0.0	223.9	736
2160 min Summer	3.437	0.0	234.7	1088
2880 min Summer	2.669	0.0	243.0	1468
4320 min Summer	1.882	0.0	257.0	2192
5760 min Summer	1.479	0.0	269.3	2936
7200 min Summer	1.236	0.0	281.5	3664
8640 min Summer	1.074	0.0	293.4	4384

©1982-2019 Innovyze

Cascade Summary of Results for CATCHMENT C9.SRCX

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
10080 min Summer	70.052	0.052	2.0	2.6	O K
15 min Winter	70.655	0.655	16.5	65.0	O K
30 min Winter	70.732	0.732	16.8	78.5	Flood Risk
60 min Winter	70.751	0.751	17.0	82.1	Flood Risk
120 min Winter	70.710	0.710	16.6	74.5	Flood Risk
180 min Winter	70.651	0.651	16.5	64.4	O K
240 min Winter	70.583	0.583	16.5	53.8	O K
360 min Winter	70.404	0.404	16.5	30.7	O K
480 min Winter	70.250	0.250	16.4	15.9	O K
600 min Winter	70.181	0.181	15.3	10.5	O K
720 min Winter	70.159	0.159	13.3	9.0	O K
960 min Winter	70.134	0.134	10.4	7.3	O K
1440 min Winter	70.107	0.107	7.3	5.7	O K
2160 min Winter	70.087	0.087	5.1	4.5	O K
2880 min Winter	70.076	0.076	4.0	3.8	O K
4320 min Winter	70.063	0.063	2.8	3.1	O K
5760 min Winter	70.055	0.055	2.2	2.7	O K
7200 min Winter	70.050	0.050	1.9	2.5	O K
8640 min Winter	70.047	0.047	1.6	2.3	O K
10080 min Winter	70.044	0.044	1.4	2.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
10080 min Summer	0.957	0.0	305.1	5120
15 min Winter	148.960	0.0	79.1	19
30 min Winter	97.160	0.0	103.2	32
60 min Winter	60.480	0.0	128.5	54
120 min Winter	36.400	0.0	154.7	90
180 min Winter	26.929	0.0	171.7	128
240 min Winter	21.665	0.0	184.1	164
360 min Winter	15.820	0.0	201.7	224
480 min Winter	12.552	0.0	213.4	272
600 min Winter	10.442	0.0	221.9	314
720 min Winter	8.960	0.0	228.5	372
960 min Winter	7.003	0.0	238.1	492
1440 min Winter	4.917	0.0	250.8	736
2160 min Winter	3.437	0.0	262.9	1076
2880 min Winter	2.669	0.0	272.2	1428
4320 min Winter	1.882	0.0	287.9	2180
5760 min Winter	1.479	0.0	301.7	2936
7200 min Winter	1.236	0.0	315.3	3568
8640 min Winter	1.074	0.0	328.6	4264
10080 min Winter	0.957	0.0	341.8	5136

©1982-2019 Innovyze

Cascade Rainfall Details for CATCHMENT C9.SRCX

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 447800 213450 SP 47800 13450
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) 0.253

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.127	4	8	0.126

©1982-2019 Innovyze

Cascade Model Details for CATCHMENT C9.SRCX

Storage is Online Cover Level (m) 71.000

Tank or Pond Structure

Invert Level (m) 70.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	45.9	1.000	257.8

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0186-1650-0700-1650
Design Head (m)	0.700
Design Flow (l/s)	16.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	186
Invert Level (m)	70.000
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	16.5
Flush-Flo™	0.287	16.5
Kick-Flo®	0.537	14.6
Mean Flow over Head Range	-	13.4

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.5	1.200	21.3	3.000	33.1	7.000	49.8
0.200	16.1	1.400	22.9	3.500	35.6	7.500	51.3
0.300	16.5	1.600	24.5	4.000	38.0	8.000	53.0
0.400	16.1	1.800	25.9	4.500	40.2	8.500	54.6
0.500	15.2	2.000	27.2	5.000	42.3	9.000	56.2
0.600	15.3	2.200	28.5	5.500	44.3	9.500	57.8
0.800	17.6	2.400	29.7	6.000	46.2		
1.000	19.5	2.600	30.9	6.500	48.1		

©1982-2019 Innovyze