CAPITA SYMONDS

Planning, Environment & Design

NW Haverhill Development

Flood Risk Assessment

April 2013

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Quality Management

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Prepared by 1	Jim Tamblyn	Signature (for file)	
Prepared by 2		Signature (for file)	
Prepared by 3		Signature (for file)	
Checked by	Jerry Muscroft	Signature (for file)	
Checked by 1		Signature (for file)	
Authorised by	Mike Horsfall	Signature (for file)	

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1. Executive Summary

1.1 Overview

1.1.1 This Flood Risk Assessment (FRA) has been prepared by Capita Symonds, on behalf of Northwest Haverhill Consortium of Landowners, in relation to a planning application for the first phase of a residential development comprising circa 460 properties.

1.1.2 The Report presents an independent assessment of site specific flood risk in accordance with the documents 'National Planning Policy Framework' and 'Technical Guidance to the National Planning Policy Framework' published by the Department of Communities and Local Government in March 2012.

1.1.3 The proposed development is located on the northern extent of Haverhill, Suffolk with an approximate site centre National Grid Reference of TL 673 467.

1.1.4 The British Geological Survey maps identify the geology of the application area as the Lowestoft Formation comprising an extensive sheet of chalky till, together with outwash sands and gravels, silts and clays.

1.1.5 The River Stour, designated a primary river, is located approximately 450 m south west of the development site. Three culverted watercourses, which originate within the site boundary, outfall to the River Stour via two outfalls.

1.1.6 The scheme comprises circa 460 residential properties and associated highway infrastructure.

1.1.7 A review of the publically available Environment Agency Flood Data Map shows that the application site is within Flood Zone 1.

1.1.8 No historic flood events have been identified or recorded on the Environment Agency Historic Flood Map for either the culverted sections of watercourse or the watercourses themselves.

1.1.9 The surface water discharge from the site will be restricted to the 1 in 1 year Greenfield Runoff Rate for the site in its undeveloped form, the total rate for the first phase of development has been calculated at 37.4 l/s.

1.1.10 The development will incorporate a series of Sustainable Drainage Systems to attenuate and treat surface water runoff generated by the impermeable surfaces.

1.1.11 The strategy comprises restricting the rate of runoff, from the residential development cells, to the 1 in 1 year undeveloped Greenfield runoff rate. Surface water will be attenuated up to the 1 in 100 year plus climate change (30%) rainfall event

1.1.12 In summary the proposed development will not be subject to unacceptable flood risk and with careful design of surface water systems to current best practise should not increase the risk of flooding elsewhere.

2. Introduction

2.1 Commission

2.1.1 Capita Symonds has been commissioned by Northwest Haverhill Consortium of Landowners to provide supplementary information, for the planning application associated with the initial phase of the proposed residential development, in the form of a Level 2 Flood Risk Assessment (FRA).

2.2 Background

2.2.1 The site has historically been used for arable farming.

2.2.2 The 'Technical Guidance to the National Planning Policy Framework' (TGNPPF), published in March 2012 by the Department for Communities and Local Government, defines the requirement for a Flood Risk Assessment as sites comprising one hectare or more within Flood Zone 1 and all sites within Flood Zone 2 and 3.

2.2.3 The guidance document TGNPPF defines Flood Zone 1 as:

'land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%)'

2.2.4 A review of the publically available Environment Agency Flood Data Map indicates that the site is within Flood Zone 1, a copy of the Flood Data Map is reproduced within the appendices of this report. Considering the overall site area associated with the development a Flood Risk Assessment is required.

2.3 Methodology

2.3.1 The purpose of an FRA is to assess the risks of all forms of flooding to and arising from a development.

2.3.2 The Source-Pathway-Receptor model, used within this assessment, looks to initially identify the cause(s) or 'Source(s)' of flooding to and arising from a development. The identification is based on a review of local conditions and consideration of the effects of climate change.

2.3.3 The presence of a source of flooding does not always imply a risk. It is the flooding mechanism(s) or 'Pathway(s)' that determines the risk to the Receptor and the extent of any consequence.

2.3.4 Receptors include any people or structures within the range of the Source which are also connected to the Source by a viable Pathway. The varying effect of flooding on the 'Receptor' is subject to its sensitivity, for example if the Receptor is permanently occupied, such as a residential property, or partially occupied, such as an office building.

2.3.5 In order for there to be a flood risk, all elements of the model must be present and connected. It therefore follows that effective mitigation can be provided by removing one element of the model, for example removing the Pathway or Receptor.

2.4 Aims and Objectives

2.4.1 The purposes of the Report are as follows:

(i) To confirm that the proposed development will not be subject to unacceptable flood risk or to show that flood risk can be managed acceptably.

(ii) To demonstrate that the proposed development will not increase risk of flooding elsewhere.

(iii) To confirm that satisfactory strategies for disposal of wastewater and surface water runoff from the proposed development are achievable.

3. Site Description

3.1 Location

3.1.1 The proposed development is located on the northern extent of Haverhill, Suffolk. The approximate site centre is located at National Grid Reference TL 673 467.

3.1.2 A site location map is provided as Figure 3-1 with the approximate site boundary shown blue.

Contains Ordnance Survey data © Crown Copyright and database right 2013
Figure 3-1: Site Location Plan

3.2 Site Description

3.2.1 The site comprises an area of approximately 26.4 ha of gently sloping arable farm land with valleys.

3.2.2 It is bounded by residential development to the south, the A143 Wratting Road to the east and arable farmland to the north and west

3.2.3 From detailed topographical survey, contours indicate three distinct catchments with two watersheds. Elevations across the site range from 108 to 82 m AOD with the highest elevations located at the northern boundary and the lowest on the southern boundary.

3.2.4 The topographical survey is reproduced at **Appendix A** for reference.

3.3 Geology & Hydrogeology

3.3.1 The British Geological Survey maps identify the geology of the application area as the Lowestoft Formation comprising an extensive sheet of chalky till, together with outwash sands and gravels, silts and clays. The till is characterised by its chalk and flint content.

3.3.2 Ground conditions at the site are characterised by stiff gravelly Clay and it is considered that infiltration of surface water will not be viable.

3.3.3 A proportion of the site is within an area designated by the Environment Agency as the outer zone of a groundwater protection zone.

3.4 Local Water Features

3.4.1 The River Stour, designated a primary river, is located approximately 450 m south west of the development site.

3.4.2 A watercourse designated as an unnamed tertiary river, shown with a source located south of Norney Plantation, runs in a south westerly direction towards the existing residential development. Prior to reaching the development the watercourse passes into an extended culvert and continues beneath the development on a south westerly alignment. The culvert emerges into open watercourse, again designated as a unnamed tertiary river, for a short distance before returning to culvert. The lower section of culvert passes beneath Howe Road prior to reaching what is presumed to be its point of outfall with the River Stour. For the purposes of identification within this report the watercourse will be referred to as ‘watercourse one’.

3.4.3 Parallel to this watercourse, further to the east, a second unnamed tertiary river runs in a south westerly direction and forms the boundary of Phase 1 of the proposed development. As with the previous watercourse it enters an extended culvert that passes beneath the existing residential development prior to its presumed point of outfall with the River Stour. For the purposes of identification within this report the watercourse will be referred to as ‘watercourse two’.

3.4.4 A third watercourse, parallel to watercourse one and two and aligned in approximately the same direction, is designated as a tertiary river but referred to as a drain. The watercourse passes into an extended culvert at Chapel Farm which connects to the extended culvert section of watercourse two. For the purposes of identification within this report the watercourse will be referred to as ‘watercourse three’.

3.4.5 A series of field ditches connect to both watercourses two and three, each section of field ditch is shown with an individual source.

3.4.6 The site is located within an area designated by the Environment Agency as a ‘surface water safeguard zone’. These zones are currently indicative and subject to refinement, however the proposed development will look to incorporate water quality control measures where feasible to mitigate against pollution typically attributable to residential developments.

4. Development Proposals

4.1 Scheme Description

4.1.1 The scheme proposal comprises circa 460 residential units and associated highway infrastructure, playing fields / public open space and new relief road.

4.1.2 A copy of the masterplan plan is reproduced at **Appendix B** for reference.

5. Potential Sources of Flooding and Flood Risk Assessment

5.1 Coastal and Fluvial Flooding

5.1.1 Flood Zones shown on the publically available Environment Agency Flood Map represent annual probability of flooding. Zone 2 shows the theoretical extent of an extreme flood and is quantified as an area that has up to a 1 in 1000 (0.1%) chance of flooding. Similarly, Zone 3 shows the theoretical extent of flooding and is quantified as a risk that has a 1 in 100 (1%) or greater chance of occurrence each year for floods attributable to a river. For both zones the extent of the natural floodplain is shown as if there were no flood defences or other manmade structures or channel improvements.

5.1.2 A review of the publically available Environment Agency Flood Data Map indicates that the site is within Flood Zone 1.

5.1.3 A copy of the Environment Agency Flood Data Map is reproduced at **Appendix C** for reference.

5.2 Flood plain storage and flood flows

5.2.1 The site is located outside of the flood plain and will not impact on flood plain storage.

5.3 Historical Flooding

5.3.1 No historic flood events have been identified or recorded on the Environment Agency Historic Flood Map for either the culverted sections of watercourse or the watercourses themselves.

5.3.2 A copy of the Environment Agency Historic Flood Map is reproduced at **Appendix D** for reference.

5.4 Groundwater Flooding

5.4.1 Groundwater flooding can be highly disruptive as once triggered it can continue for several days or weeks depending on the catchment size.

5.4.2 The British Geological Society (BGS) Flood Data suggests negligible susceptibility to groundwater flooding across the entire site.

5.4.3 A copy of the BGS Flood Data is reproduced at **Appendix E** for reference.

5.5 Pluvial Flooding (overland flow)

5.5.1 Pluvial flooding occurs when the intensity of rainfall exceeds infiltration into the ground. Typically, this happens where the ground surface is impermeable, such as urban districts that have roads and paved areas. Pluvial flooding may occur where there are impermeable soils, such as clay.

5.5.2 The topography and geology of the site is such that either in its undeveloped or developed state a risk to the existing residential development, to the south exists, from overland flow.

5.5.3 It is recommended that careful consideration is given to exceedance routes for overland flow resulting from both the arable land at higher elevations and the development drainage. These routes should consider the existing adjacent residential development and look to utilise natural pathways where feasible.

5.6 Surface Water Runoff

5.6.1 Increased impermeable areas are associated with most forms of development and without careful control result in an increased rate and volume of surface water runoff.

5.6.2 The proposed development will incorporate sustainable drainage systems to restrict the rate of surface water runoff to the greenfield rate for a 1 in 1 year rainfall event of the undeveloped site. Refer to Section 6 of the report for details of the rainfall management train.

5.7 Artificial Sources & Structures

5.7.1 The Environment Agency Detailed River Network Data indicates four sections of extended culvert located to the south of the site with two inlets located within or adjacent to the boundary of Phase 1. The condition and size of these culvert pipes and inlets are unknown.

5.7.2 The Anglian Water Wastewater Asset Record Plan shows surface water sewers within Ann Suckling Road and Howe Road, the size and depth of these sewers are not recorded on the plan. Several of the sewer runs appear to coincide with the route of the extended culverts and the culverts may have been historically maintained by Anglian Water, however this will require confirmation by onsite investigation as it is unusual for a Water Authority to accept land drainage into their network.

5.7.3 An extract of the Anglian Water Wastewater Asset Record Plan is reproduced at **Appendix F** for reference.

5.7.4 A water tower and covered reservoir is shown located to the north of the development, the Environment Agency records do not identify any flood routes associated with a theoretical failure of the infrastructure.

6. Proposed Surface Water Drainage

6.1 Disposal principle

6.1.1 The proposed residential development will incorporate Sustainable Drainage Systems into the surface water drainage strategy.

6.1.2 The drainage strategy identifies nine development catchment areas each with their own surface water storage provision.

6.1.3 The surface water runoff from the residential development will be restricted to the 1 in 1 year Greenfield Runoff Rate, for the undeveloped site, calculated in accordance with the Institute of Hydrology Report 124 methodology. A rate has been calculated for each of the nine development catchment areas (A to I) and the highway corridor. The results are summarised in Table 6-1 below.

Catchment Area	1 in 1 year Greenfield Runoff Rate (l/s)
A	1.0
B	4.8
C	5.8
D	2.6
E	7.1
F	2.5
G	2.2
H	1.8
I	6.1
Highway	3.5 (9.6 l/s *1 in 30 yr*)
Total	37.4

Table 6-1*:* Greenfield Runoff Rates

6.1.4 A copy of the MicroDrainage calculations are reproduced in **Appendix G** for reference.

6.1.5 Surface water generated in each residential catchment (A-I) will be stored for rainfall events up to the 1 in 100 year plus climate change (30%) and released at the corresponding greenfield runoff rate above.

6.1.6 The volume of storage required for each catchment area has been calculated using the MicroDrainage source control module and the results summarised below in Table 6-2.

Catchment Area	1 in 100 year plus climate change storage volume (m^3)	Primary Storage Structure
A	141	Cellular Tank
B	795	Basin
C	959	Basin
D	427	Basin
E	1166	Basin
F	415	Basin
G	384	Cellular Tank
H	502	Cellular Tank
I	851	Basin
Highway	990 - 1296	Filter Trench / Basin / Swale
Total	6630 - 6936	

Table 6-2: Storage Volumes

6.1.7 A copy of the MicroDrainage calculations are reproduced in **Appendix H** for reference.

6.1.8 The basins and cellular tanks shown on the drainage strategy have been sized to accommodate the calculated 1 in 100 year plus climate change storage volumes with no allowance for storage within the upstream pipe network. With detailed scheme layouts the preliminary design can be rationalised and the storage structure footprint potentially reduced.

6.1.9 An opportunity to incorporate tanked permeable paving systems into parking courts would provide additional storage to further reduce the primary storage structure footprint. The use of permeable paving also offers the benefit of water quality control by intercepting and trapping / treating grits and hydrocarbons before they can enter the downstream watercourses.

6.1.10 Preliminary basin design comprises of a 1 in 4 side slope steepening to 1 in 3 where a 1.0 m wide ledge is provided. Storage depths range between 0.9 and 1.5 m with a freeboard of 0.2m.

6.1.11 Basin E, F and I along with Cellular Tank G and H outfall to Watercourse 2 via either a new section of ditch or swale.

6.1.12 Basin B, C, and D along with Cellular Tank A outfall to the field ditch forming the eastern boundary of the site.

6.1.13 To provide water quality management the surface water runoff from the main highway corridors will be conveyed to filter trenches and swales to intercept grits and other suspended pollutants.

6.1.14 Although a single theoretical greenfield runoff rate has been calculated for the overall estimated area of highway corridor, in practise the vertical alignment of the road may require several outfalls. To divide the 1 in 1 year greenfield runoff rate over several outfalls will result in low discharge rates that either cannot be physically provided by a vortex control or risk blockage of an orifice control. It is therefore recommended that the highway is restricted to a rate equivalent to the 1 in 30 year greenfield runoff rate, 9.6 l/s.

6.1.15 A copy of the drainage strategy is reproduced at **Appendix I**.

7. Summary & Conclusions

7.1 Flood Risk

7.1.1 A review of the publically available Environment Agency Flood Data Map shows that the application site is within Flood Zone 1.

7.1.2 No historic flood events have been identified or recorded on the Environment Agency Historic Flood Map for either the culverted sections of watercourse or the watercourses themselves.

7.1.3 The British Geological Society (BGS) Flood Data suggests negligible susceptibility to groundwater flooding across the entire site.

7.1.4 It is recommended that careful consideration is given to exceedance routes for overland flow resulting from both the arable land at higher elevations and the development drainage. These routes should consider the existing adjacent residential development and look to utilise natural pathways where feasible.

7.1.5 The proposed development will incorporate sustainable drainage systems to restrict the rate of surface water runoff to the greenfield rate for a 1 in 1 year rainfall event of the undeveloped site. Refer to Section 5 of the report for details of the rainfall management train.

7.1.6 The Anglian Water Wastewater Asset Record Plan shows surface water sewers within Ann Suckling Road and Howe Road, the size and depth of these sewers are not recorded on the plan. Several of the sewer runs appear to coincide with the route of the extended culverts and the culverts may have been historically maintained by Anglian Water, however this will require confirmation by onsite investigation as it is unusual for a Water Authority to accept land drainage into their network

7.1.7 A water tower and covered reservoir is shown located to the north of the development, the Environment Agency records do not identify any flood routes associated with a theoretical failure of the infrastructure

7.1.8 In conclusion the proposed extension of the existing quarry will not be subject to unacceptable flood risk and does not increase the risk of flooding elsewhere.

7.2 Surface Water Disposal

7.2.1 The proposed residential development will incorporate Sustainable Drainage Systems into the surface water drainage strategy.

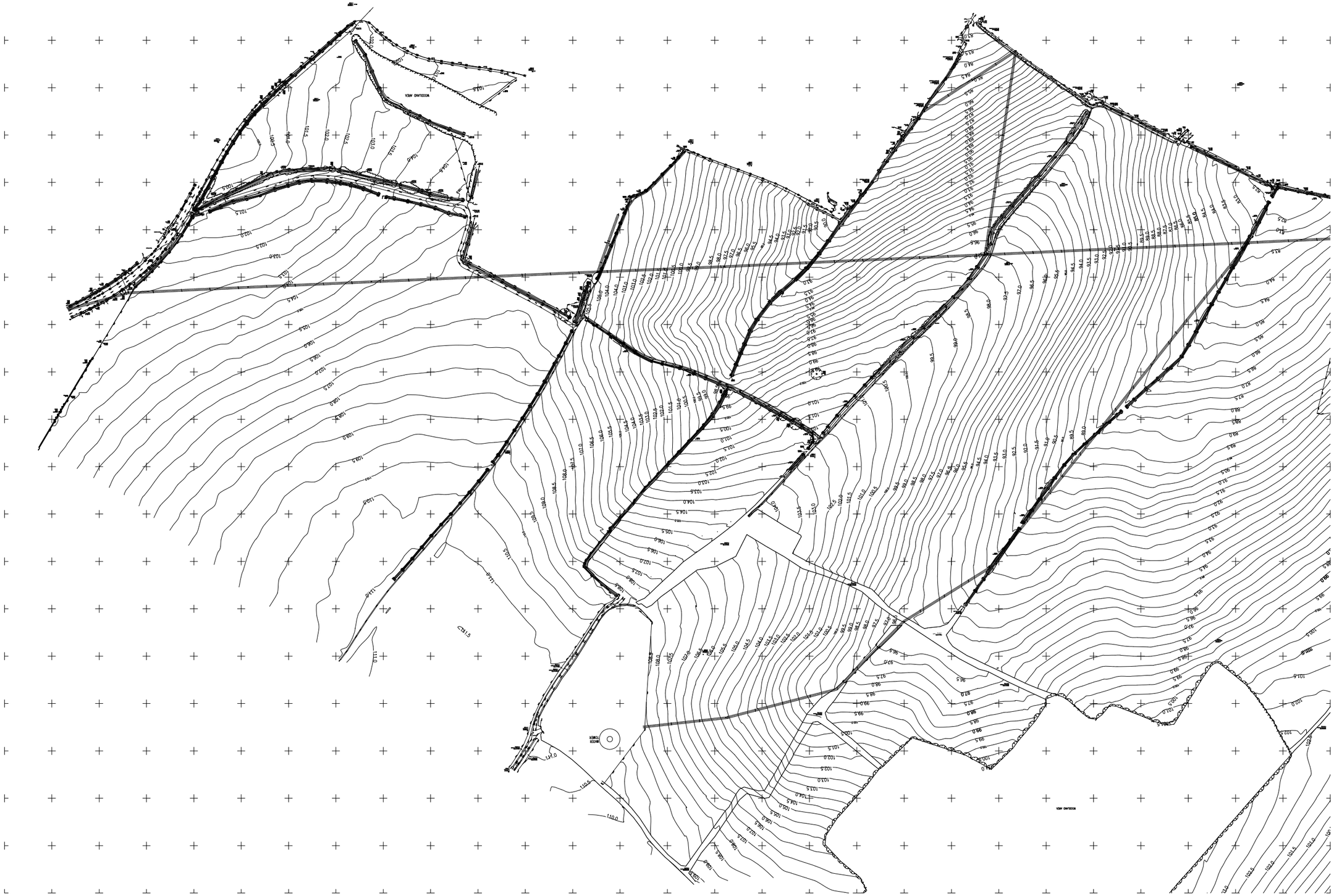
7.2.2 The strategy comprises restricting the rate of runoff, from the residential development cells, to the 1 in 1 year undeveloped Greenfield runoff rate. Surface water will be attenuated up to the 1 in 100 year plus climate change (30%) rainfall event.

7.2.3 The surface water will be discharged into watercourses within the site boundary via new sections of ditches.

7.2.4 The highway corridors will incorporate filter trenches and swales to manage water quality control.

7.2.5 In conclusion surface water runoff, generated within the boundaries of the site, will be intercepted and stored within either above or below ground structures to minimise any impact on the downstream watercourses.

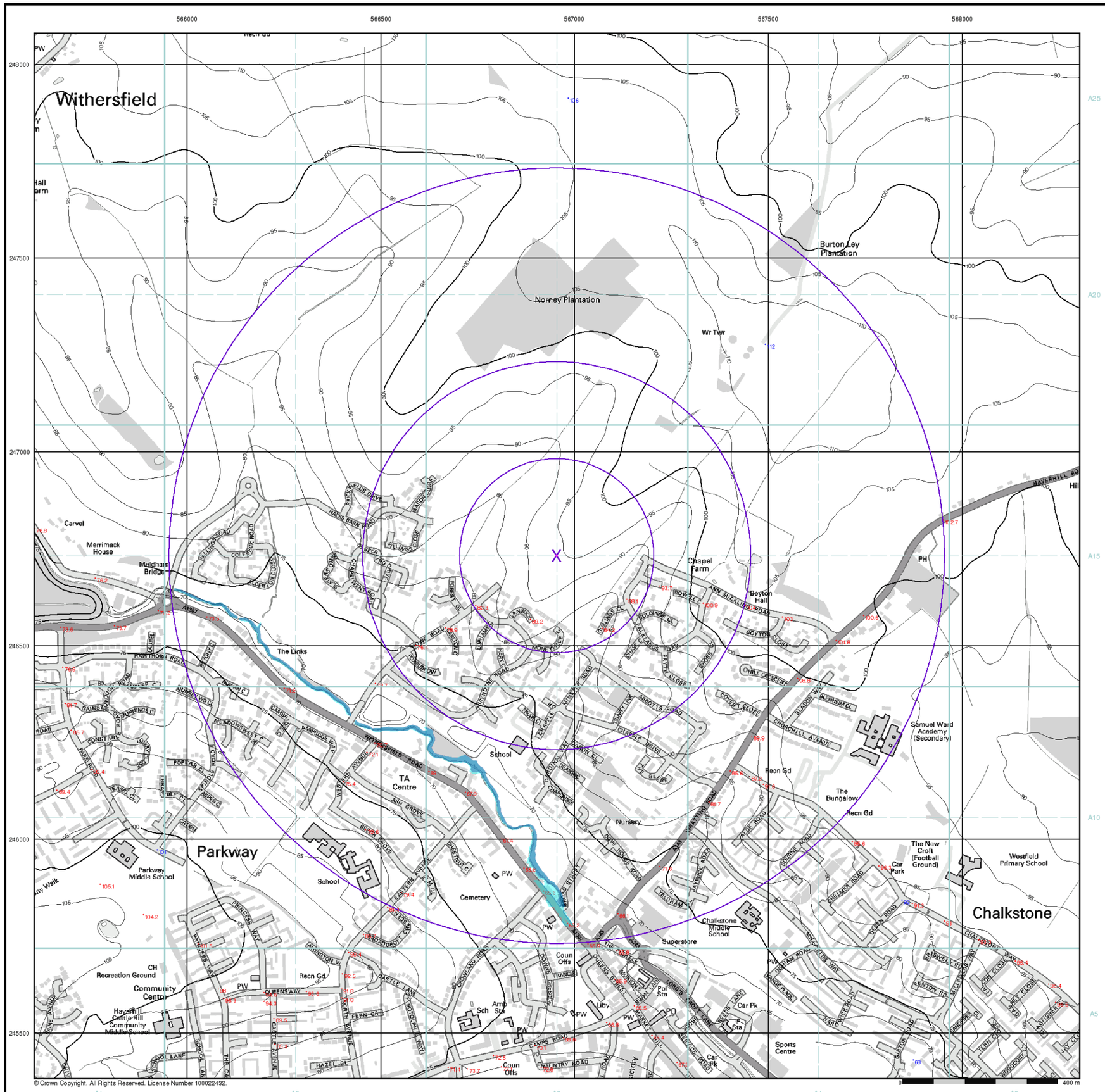
Appendix A
Topographical Survey



Appendix B
Development Masterplan


10
8
12
11
12
2
1
6
7
3
4
5

Appendix C
Environment Agency Flood Data Map



Envirocheck® Flood

EA Flood Data Map (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point

Environment Agency Flood Data

- Extreme Flooding from Rivers or Sea without Defences (Zone 2)
- Flooding from Rivers or Sea without Defences (Zone 3)
- Area Benefiting from Flood Defence
- Flood Water Storage Areas
- Flood Defence

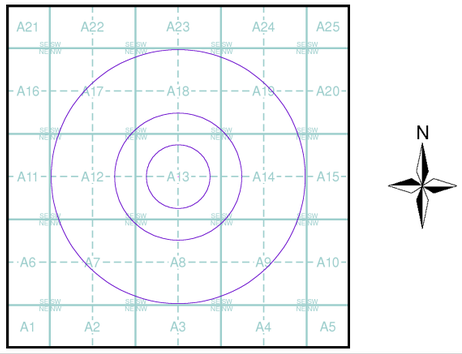
Contours (height in metres)

Standard Contour — Index Contour

*167.8 Spot Height

*45.8 Air Height

EA Flood Data Map - Slice A



Order Details

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Customer Ref:	HCE 0108
National Grid Reference:	566950, 246730
Slice:	A
Site Area (Ha):	0.01
Search Buffer (m):	1000

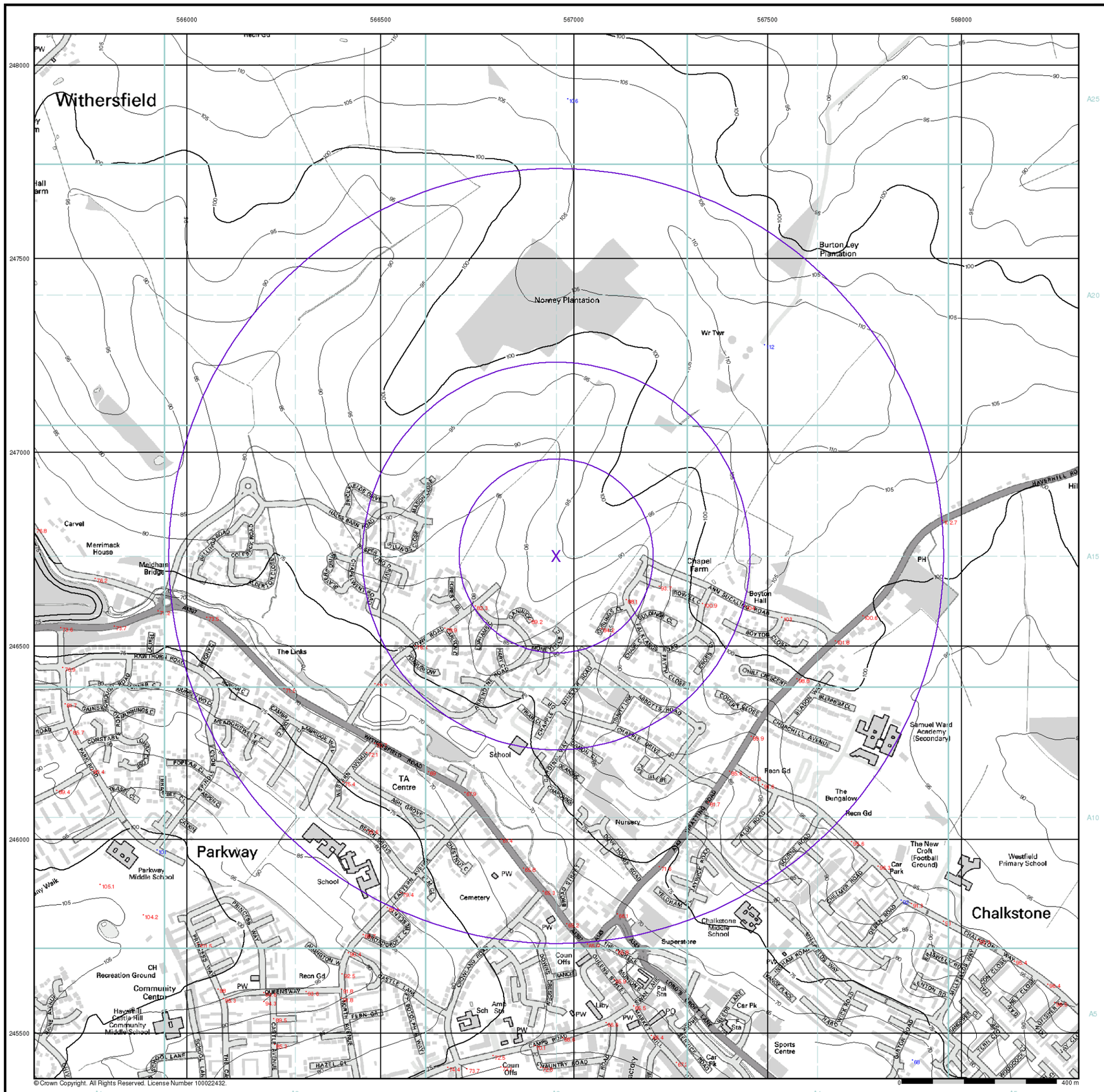
Site Details

82 Howe Road, HAVERHILL, Suffolk, CB9 9NJ

Landmark® Information Group

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

Appendix D
Environment Agency Historic Flood Map



Envirocheck® Flood

EA Historic Flood Map (1:10,000)

General

- Specified Site
- Specified Buffer(s)
- Bearing Reference Point
- Map ID

EA Historic Flood Events Data

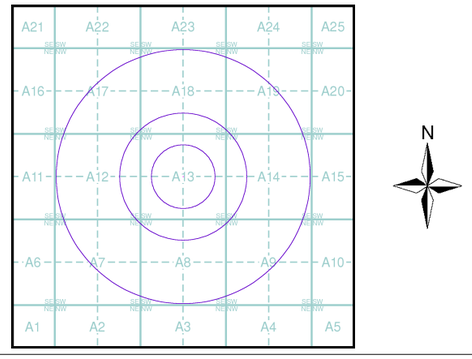
- Channel Capacity Exceeded (no raised defences)
- Groundwater/High Water Table
- Local Drainage/Surface Water
- Mechanical Failure
- Obstruction/Blockage - Bridge
- Obstruction/Blockage - Channel
- Obstruction/Blockage - Culvert
- Obstruction/Blockage - Debris Screen
- Operational Failure/ Breach of Defence
- Other
- Overtopping of Defences
- Unknown
- Historical Flood Liabilities

Contours (height in metres)

Standard Contour 105 100 95 — Spot Height 167.3

Index Contour — Air Height 45.8

EA Historic Flood Map - Slice A



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Slice:	A
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Search Buffer (m):	1000

Site Details

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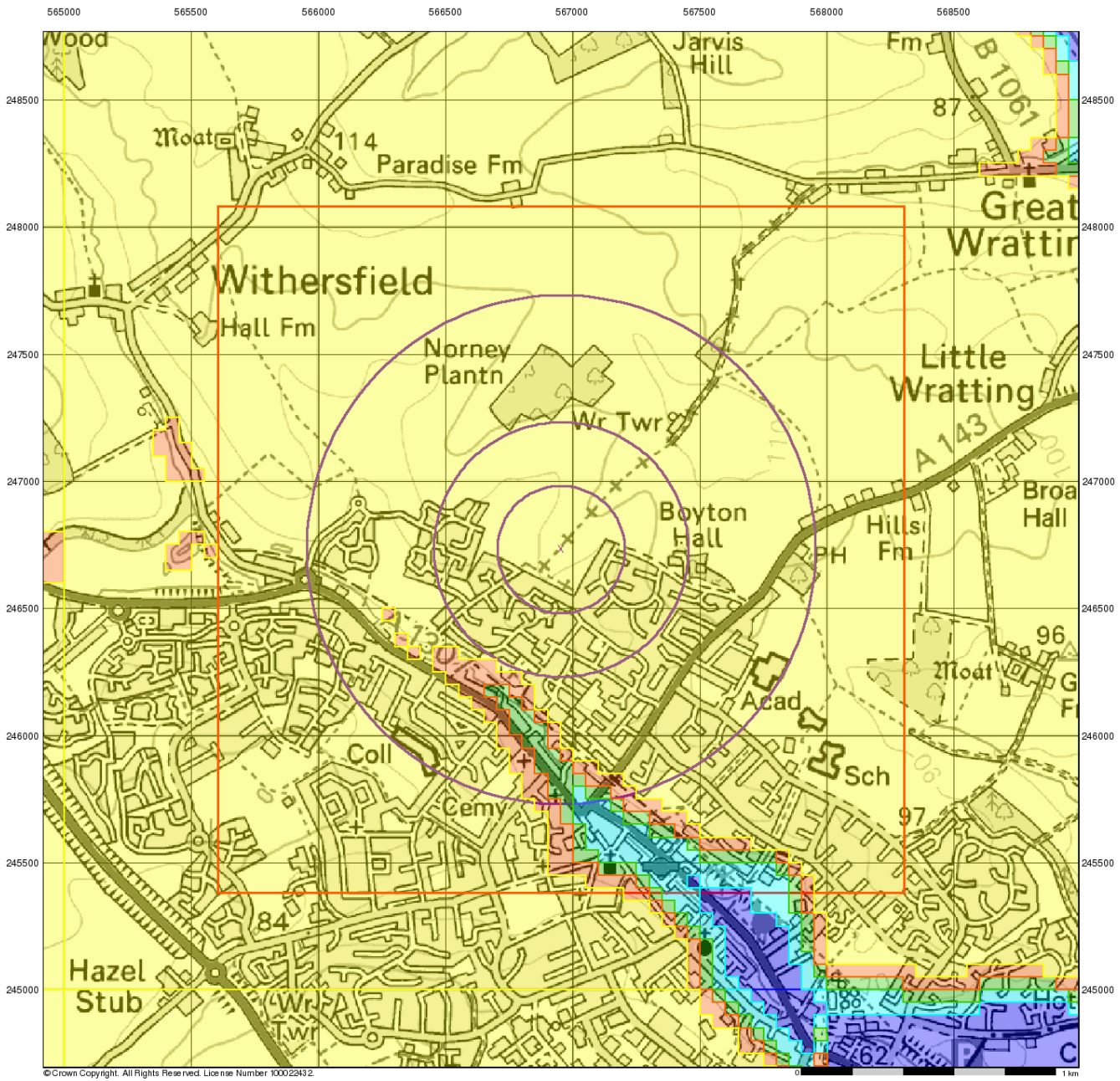
Landmark® Information Group

Tel: 0844 844 9952
Fax: 0844 844 9951
Web: www.envirocheck.co.uk

Appendix E
BGS Groundwater Flooding Susceptibility



Envirocheck® Flood

BGS Flood Data (1:50,000)

General

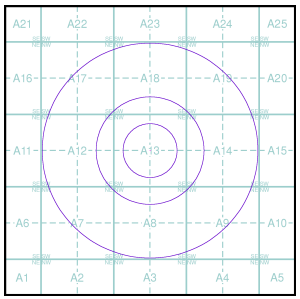
Specified Site | Specified Buffer(s) | Bearing Reference Point

Slice | Map ID

BGS Groundwater Flooding Susceptibility

- High Susceptibility
- Moderately High Susceptibility
- Moderate Susceptibility
- Low Susceptibility
- Negligible Susceptibility

BGS Flood Data Map - Slice A



Order Details

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Customer Ref:	HCE 0108
National Grid Reference:	566950, 246730
Slice:	A
Site Area (Ha):	0.01
Search Buffer (m):	1000

Site Details

82 Howe Road, HAVERHILL, Suffolk, CB9 9NJ

Appendix F
Wastewater Asset Record Plan

Chapel Farm Cottage
Track
ANN SUCKLING ROAD
Lee Close
GATWICK CLOSE
ARRENDENE ROAD
MINSTER ROAD
HILL CRESCENT
Rosskeen
The Willows
The Mount
Alberta
Falken
Fourie
Belmont
Shrubberies
Wicklow
Regained
Sagittaria
Beechwood
Albany House
Covert View

Appendix G
MicroDrainage Greenfield Runoff Calculation

ICP SUDS Mean Annual Flood

Input

Return Period (years) 2 SAAR (mm) 600 Urban 0.000
Area (ha) 0.420 Soil 0.400 Region Number Region 5

Results l/s

QBAR Rural 1.2
QBAR Urban 1.2

Q2 years 1.1

Q1 year 1.0
Q30 years 2.9
Q100 years 4.2

ICP SUDS Mean Annual Flood

Input

Return Period (years) 2 SAAR (mm) 600 Urban 0.000
Area (ha) 1.950 Soil 0.400 Region Number Region 5

Results l/s

QBAR Rural 5.5
QBAR Urban 5.5

Q2 years 5.0

Q1 year 4.8
Q30 years 13.3
Q100 years 19.7

ICP SUDS Mean Annual Flood

Input

Return Period (years) 2 SAAR (mm) 600 Urban 0.000
Area (ha) 2.360 Soil 0.400 Region Number Region 5

Results l/s

QBAR Rural	6.7
QBAR Urban	6.7
Q2 years	6.0
Q1 year	5.8
Q30 years	16.1
Q100 years	23.9

ICP SUDS Mean Annual Flood

Input

Return Period (years) 2 SAAR (mm) 600 Urban 0.000
Area (ha) 1.040 Soil 0.400 Region Number Region 5

Results l/s

QBAR Rural	3.0
QBAR Urban	3.0
Q2 years	2.6
Q1 year	2.6
Q30 years	7.1
Q100 years	10.5

ICP SUDS Mean Annual Flood

Input

Return Period (years) 2 SAAR (mm) 600 Urban 0.000
Area (ha) 2.860 Soil 0.400 Region Number Region 5

Results l/s

QBAR Rural 8.1
QBAR Urban 8.1

Q2 years 7.3

Q1 year 7.1
Q30 years 19.5
Q100 years 28.9

ICP SUDS Mean Annual Flood

Input

Return Period (years) 2 SAAR (mm) 600 Urban 0.000
Area (ha) 1.020 Soil 0.400 Region Number Region 5

Results l/s

QBAR Rural 2.9
QBAR Urban 2.9

Q2 years 2.6

Q1 year 2.5
Q30 years 7.0
Q100 years 10.3

ICP SUDS Mean Annual Flood

Input

Return Period (years) 2 SAAR (mm) 600 Urban 0.000
Area (ha) 0.910 Soil 0.400 Region Number Region 5

Results l/s

QBAR Rural 2.6
QBAR Urban 2.6

Q2 years 2.3

Q1 year 2.2
Q30 years 6.2
Q100 years 9.2

ICP SUDS Mean Annual Flood

Input

Return Period (years) 2 SAAR (mm) 600 Urban 0.000
Area (ha) 0.730 Soil 0.400 Region Number Region 5

Results l/s

QBAR Rural 2.1
QBAR Urban 2.1

Q2 years 1.9

Q1 year 1.8
Q30 years 5.0
Q100 years 7.4

ICP SUDS Mean Annual Flood

Input

Return Period (years) 2 SAAR (mm) 600 Urban 0.000
Area (ha) 2.480 Soil 0.400 Region Number Region 5

Results l/s

QBAR Rural 7.0
QBAR Urban 7.0

Q2 years 6.3

Q1 year 6.1
Q30 years 16.9
Q100 years 25.1

ICP SUDS Mean Annual Flood

Input

Return Period (years) 2 SAAR (mm) 600 Urban 0.000
Area (ha) 1.410 Soil 0.400 Region Number Region 5

Results l/s

QBAR Rural 4.0
QBAR Urban 4.0

Q2 years 3.6

Q1 year 3.5
Q30 years 9.6
Q100 years 14.3

Appendix H
MicroDrainage Storage Calculations

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 1439 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	101.883	0.283	0.0	0.6	0.6	53.8	O K
30 min Summer	101.966	0.366	0.0	0.7	0.7	69.6	O K
60 min Summer	102.049	0.449	0.0	0.7	0.7	85.2	O K
120 min Summer	102.126	0.526	0.0	0.8	0.8	100.0	O K
180 min Summer	102.166	0.566	0.0	0.8	0.8	107.5	O K
240 min Summer	102.190	0.590	0.0	0.9	0.9	112.1	O K
360 min Summer	102.221	0.621	0.0	0.9	0.9	117.9	O K
480 min Summer	102.237	0.637	0.0	0.9	0.9	121.1	O K
600 min Summer	102.246	0.646	0.0	0.9	0.9	122.7	O K
720 min Summer	102.249	0.649	0.0	0.9	0.9	123.4	O K
960 min Summer	102.246	0.646	0.0	0.9	0.9	122.8	O K
1440 min Summer	102.232	0.632	0.0	0.9	0.9	120.0	O K
2160 min Summer	102.207	0.607	0.0	0.9	0.9	115.4	O K
2880 min Summer	102.181	0.581	0.0	0.8	0.8	110.5	O K
4320 min Summer	102.131	0.531	0.0	0.8	0.8	100.9	O K
5760 min Summer	102.087	0.487	0.0	0.8	0.8	92.5	O K
7200 min Summer	102.047	0.447	0.0	0.7	0.7	85.0	O K
8640 min Summer	102.012	0.412	0.0	0.7	0.7	78.3	O K
10080 min Summer	101.981	0.381	0.0	0.7	0.7	72.3	O K
15 min Winter	101.917	0.317	0.0	0.6	0.6	60.3	O K
30 min Winter	102.011	0.411	0.0	0.7	0.7	78.0	O K
60 min Winter	102.103	0.503	0.0	0.8	0.8	95.6	O K
120 min Winter	102.191	0.591	0.0	0.9	0.9	112.3	O K
180 min Winter	102.237	0.637	0.0	0.9	0.9	121.0	O K
240 min Winter	102.264	0.664	0.0	0.9	0.9	126.2	O K
360 min Winter	102.301	0.701	0.0	0.9	0.9	133.2	O K
480 min Winter	102.322	0.722	0.0	0.9	0.9	137.2	O K
600 min Winter	102.334	0.734	0.0	1.0	1.0	139.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	137.759	0.0	43.4	20
30 min Summer	89.551	0.0	47.5	35
60 min Summer	55.351	0.0	84.5	66
120 min Summer	33.014	0.0	98.0	124
180 min Summer	24.067	0.0	103.4	184
240 min Summer	19.117	0.0	106.2	244
360 min Summer	13.842	0.0	109.8	362
480 min Summer	10.992	0.0	112.4	482
600 min Summer	9.186	0.0	114.3	602
720 min Summer	7.929	0.0	115.6	720
960 min Summer	6.282	0.0	117.0	952
1440 min Summer	4.519	0.0	116.6	1168
2160 min Summer	3.245	0.0	182.5	1544
2880 min Summer	2.563	0.0	190.6	1960
4320 min Summer	1.836	0.0	187.2	2772
5760 min Summer	1.448	0.0	218.7	3624
7200 min Summer	1.204	0.0	227.2	4400
8640 min Summer	1.035	0.0	234.3	5192
10080 min Summer	0.910	0.0	240.2	5960
15 min Winter	137.759	0.0	45.0	20
30 min Winter	89.551	0.0	50.2	34
60 min Winter	55.351	0.0	93.5	64
120 min Winter	33.014	0.0	105.4	122
180 min Winter	24.067	0.0	110.0	182
240 min Winter	19.117	0.0	113.0	240
360 min Winter	13.842	0.0	117.6	356
480 min Winter	10.992	0.0	120.7	472
600 min Winter	9.186	0.0	122.9	588

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
720 min Winter	102.340	0.740	0.0	1.0	1.0	140.6	O K
960 min Winter	102.342	0.742	0.0	1.0	1.0	140.9	O K
1440 min Winter	102.324	0.724	0.0	0.9	0.9	137.5	O K
2160 min Winter	102.294	0.694	0.0	0.9	0.9	131.8	O K
2880 min Winter	102.260	0.660	0.0	0.9	0.9	125.4	O K
4320 min Winter	102.190	0.590	0.0	0.9	0.9	112.1	O K
5760 min Winter	102.127	0.527	0.0	0.8	0.8	100.1	O K
7200 min Winter	102.071	0.471	0.0	0.8	0.8	89.5	O K
8640 min Winter	102.023	0.423	0.0	0.7	0.7	80.3	O K
10080 min Winter	101.980	0.380	0.0	0.7	0.7	72.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
720 min Winter	7.929	0.0	124.3	700
960 min Winter	6.282	0.0	125.8	922
1440 min Winter	4.519	0.0	125.1	1324
2160 min Winter	3.245	0.0	203.5	1644
2880 min Winter	2.563	0.0	210.0	2108
4320 min Winter	1.836	0.0	202.6	3024
5760 min Winter	1.448	0.0	245.0	3864
7200 min Winter	1.204	0.0	254.5	4688
8640 min Winter	1.035	0.0	262.4	5536
10080 min Winter	0.910	0.0	268.9	6352

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)	21.000	Shortest Storm (mins)	15
Ratio R	0.421	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.210

Time (mins) From:	To:	Area (ha)
0	5	0.210

Model Details

Storage is Online Cover Level (m) 103.000

Cellular Storage Structure

Invert Level (m) 101.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	200.0	0.0	3.600	0.0	0.0	7.200	0.0	0.0
0.400	200.0	0.0	4.000	0.0	0.0	7.600	0.0	0.0
0.800	200.0	0.0	4.400	0.0	0.0	8.000	0.0	0.0
1.200	0.0	0.0	4.800	0.0	0.0	8.400	0.0	0.0
1.600	0.0	0.0	5.200	0.0	0.0	8.800	0.0	0.0
2.000	0.0	0.0	5.600	0.0	0.0	9.200	0.0	0.0
2.400	0.0	0.0	6.000	0.0	0.0	9.600	0.0	0.0
2.800	0.0	0.0	6.400	0.0	0.0	10.000	0.0	0.0
3.200	0.0	0.0	6.800	0.0	0.0			

Hydro-Brake® Outflow Control

Design Head (m) 0.800 Hydro-Brake® Type Md5 SW Only Invert Level (m) 101.600
Design Flow (l/s) 1.0 Diameter (mm) 43

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.5	0.800	1.0	2.000	1.6	4.000	2.2	7.000	2.9
0.200	0.5	1.000	1.1	2.200	1.7	4.500	2.4	7.500	3.0
0.300	0.6	1.200	1.2	2.400	1.7	5.000	2.5	8.000	3.1
0.400	0.7	1.400	1.3	2.600	1.8	5.500	2.6	8.500	3.2
0.500	0.8	1.600	1.4	3.000	1.9	6.000	2.7	9.000	3.3
0.600	0.9	1.800	1.5	3.500	2.1	6.500	2.8	9.500	3.4

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	99.261	0.461	3.3	299.6	O K
30 min Summer	99.375	0.575	3.6	387.8	O K
60 min Summer	99.480	0.680	3.9	475.0	O K
120 min Summer	99.574	0.774	4.2	557.5	O K
180 min Summer	99.620	0.820	4.3	600.1	O K
240 min Summer	99.648	0.848	4.4	625.8	O K
360 min Summer	99.683	0.883	4.5	659.6	O K
480 min Summer	99.703	0.903	4.5	678.4	O K
600 min Summer	99.714	0.914	4.6	688.6	O K
720 min Summer	99.718	0.918	4.6	693.3	O K
960 min Summer	99.717	0.917	4.6	692.4	O K
1440 min Summer	99.700	0.900	4.5	675.1	O K
2160 min Summer	99.671	0.871	4.4	647.4	O K
2880 min Summer	99.641	0.841	4.4	619.2	O K
4320 min Summer	99.582	0.782	4.2	565.0	O K
5760 min Summer	99.528	0.728	4.1	516.7	O K
7200 min Summer	99.478	0.678	3.9	473.1	O K
8640 min Summer	99.431	0.631	3.8	433.9	O K
10080 min Summer	99.388	0.588	3.7	398.3	O K
15 min Winter	99.309	0.509	3.4	335.7	O K
30 min Winter	99.432	0.632	3.8	434.7	O K
60 min Winter	99.546	0.746	4.1	533.0	O K
120 min Winter	99.649	0.849	4.4	626.4	O K
180 min Winter	99.700	0.900	4.5	675.3	O K
240 min Winter	99.731	0.931	4.6	705.2	O K
360 min Winter	99.771	0.971	4.7	745.4	O K
480 min Winter	99.794	0.994	4.8	768.8	O K
600 min Winter	99.808	1.008	4.8	782.7	O K
720 min Winter	99.816	1.016	4.8	790.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	137.759	0.0	253.2	20
30 min Summer	89.551	0.0	271.6	35
60 min Summer	55.351	0.0	472.2	66
120 min Summer	33.014	0.0	548.8	124
180 min Summer	24.067	0.0	579.5	184
240 min Summer	19.117	0.0	592.5	244
360 min Summer	13.842	0.0	606.9	362
480 min Summer	10.992	0.0	616.4	482
600 min Summer	9.186	0.0	623.2	602
720 min Summer	7.929	0.0	627.8	722
960 min Summer	6.282	0.0	631.8	960
1440 min Summer	4.519	0.0	625.7	1216
2160 min Summer	3.245	0.0	1015.9	1584
2880 min Summer	2.563	0.0	1060.3	1992
4320 min Summer	1.836	0.0	1036.2	2812
5760 min Summer	1.448	0.0	1218.7	3632
7200 min Summer	1.204	0.0	1266.1	4464
8640 min Summer	1.035	0.0	1305.5	5264
10080 min Summer	0.910	0.0	1338.1	6048
15 min Winter	137.759	0.0	262.9	20
30 min Winter	89.551	0.0	281.6	34
60 min Winter	55.351	0.0	522.6	64
120 min Winter	33.014	0.0	589.2	122
180 min Winter	24.067	0.0	609.6	182
240 min Winter	19.117	0.0	621.6	240
360 min Winter	13.842	0.0	640.1	358
480 min Winter	10.992	0.0	652.6	474
600 min Winter	9.186	0.0	660.9	590
720 min Winter	7.929	0.0	666.2	702

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
960 min Winter	99.820	1.020	4.8	794.9	O K
1440 min Winter	99.805	1.005	4.8	779.4	O K
2160 min Winter	99.769	0.969	4.7	743.6	O K
2880 min Winter	99.733	0.933	4.6	707.6	O K
4320 min Winter	99.655	0.855	4.4	632.7	O K
5760 min Winter	99.580	0.780	4.2	563.4	O K
7200 min Winter	99.510	0.710	4.0	501.3	O K
8640 min Winter	99.445	0.645	3.8	446.0	O K
10080 min Winter	99.385	0.585	3.7	396.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
960 min Winter	6.282	0.0	670.3	926
1440 min Winter	4.519	0.0	662.6	1354
2160 min Winter	3.245	0.0	1131.2	1684
2880 min Winter	2.563	0.0	1161.6	2136
4320 min Winter	1.836	0.0	1108.9	3064
5760 min Winter	1.448	0.0	1365.0	3920
7200 min Winter	1.204	0.0	1418.0	4760
8640 min Winter	1.035	0.0	1461.9	5616
10080 min Winter	0.910	0.0	1498.7	6448

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)	21.000	Shortest Storm (mins)	15
Ratio R	0.421	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 1.170

Time (mins) From:	To:	Area (ha)
0	5	1.170

Model Details

Storage is Offline Cover Level (m) 100.025 Dividing Weir Level (m) 98.800

Tank or Pond Structure

Invert Level (m) 98.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	550.0	2.400	0.0	4.800	0.0	7.200	0.0	9.600	0.0
0.400	725.0	2.800	0.0	5.200	0.0	7.600	0.0	10.000	0.0
0.800	915.0	3.200	0.0	5.600	0.0	8.000	0.0		
1.200	1122.0	3.600	0.0	6.000	0.0	8.400	0.0		
1.600	0.0	4.000	0.0	6.400	0.0	8.800	0.0		
2.000	0.0	4.400	0.0	6.800	0.0	9.200	0.0		

Hydro-Brake® Outflow Control

Design Head (m) 1.000 Hydro-Brake® Type Md5 SW Only Invert Level (m) 98.800
Design Flow (l/s) 4.8 Diameter (mm) 89

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.4	0.800	4.3	2.000	6.7	4.000	9.5	7.000	12.6
0.200	3.0	1.000	4.8	2.200	7.1	4.500	10.1	7.500	13.1
0.300	2.9	1.200	5.2	2.400	7.4	5.000	10.7	8.000	13.5
0.400	3.1	1.400	5.6	2.600	7.7	5.500	11.2	8.500	13.9
0.500	3.4	1.600	6.0	3.000	8.3	6.000	11.7	9.000	14.3
0.600	3.7	1.800	6.4	3.500	8.9	6.500	12.2	9.500	14.7

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	101.126	0.526	4.2	363.4	O K
30 min Summer	101.238	0.638	4.5	470.3	O K
60 min Summer	101.340	0.740	4.9	575.8	O K
120 min Summer	101.429	0.829	5.2	675.4	O K
180 min Summer	101.473	0.873	5.3	726.6	O K
240 min Summer	101.498	0.898	5.4	757.3	O K
360 min Summer	101.531	0.931	5.5	797.5	O K
480 min Summer	101.549	0.949	5.5	819.6	O K
600 min Summer	101.558	0.958	5.5	831.2	O K
720 min Summer	101.562	0.962	5.6	836.2	O K
960 min Summer	101.560	0.960	5.5	833.7	O K
1440 min Summer	101.541	0.941	5.5	810.2	O K
2160 min Summer	101.512	0.912	5.4	773.5	O K
2880 min Summer	101.482	0.882	5.3	737.0	O K
4320 min Summer	101.424	0.824	5.1	668.9	O K
5760 min Summer	101.370	0.770	5.0	608.9	O K
7200 min Summer	101.321	0.721	4.8	555.0	O K
8640 min Summer	101.274	0.674	4.7	506.3	O K
10080 min Summer	101.230	0.630	4.5	462.1	O K
15 min Winter	101.173	0.573	4.3	407.3	O K
30 min Winter	101.294	0.694	4.7	527.3	O K
60 min Winter	101.404	0.804	5.1	646.3	O K
120 min Winter	101.500	0.900	5.4	759.2	O K
180 min Winter	101.548	0.948	5.5	818.1	O K
240 min Winter	101.576	0.976	5.6	854.1	O K
360 min Winter	101.613	1.013	5.7	902.2	O K
480 min Winter	101.634	1.034	5.8	929.9	O K
600 min Winter	101.646	1.046	5.8	946.2	O K
720 min Winter	101.653	1.053	5.8	955.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	137.759	0.0	317.6	20
30 min Summer	89.551	0.0	340.3	35
60 min Summer	55.351	0.0	579.5	66
120 min Summer	33.014	0.0	678.3	124
180 min Summer	24.067	0.0	719.5	184
240 min Summer	19.117	0.0	736.0	244
360 min Summer	13.842	0.0	753.2	362
480 min Summer	10.992	0.0	764.5	482
600 min Summer	9.186	0.0	772.5	602
720 min Summer	7.929	0.0	777.8	722
960 min Summer	6.282	0.0	782.2	960
1440 min Summer	4.519	0.0	774.1	1214
2160 min Summer	3.245	0.0	1238.0	1584
2880 min Summer	2.563	0.0	1297.1	1988
4320 min Summer	1.836	0.0	1284.8	2812
5760 min Summer	1.448	0.0	1479.7	3632
7200 min Summer	1.204	0.0	1537.3	4464
8640 min Summer	1.035	0.0	1585.4	5192
10080 min Summer	0.910	0.0	1625.9	6048
15 min Winter	137.759	0.0	329.3	20
30 min Winter	89.551	0.0	352.8	34
60 min Winter	55.351	0.0	643.7	64
120 min Winter	33.014	0.0	731.3	122
180 min Winter	24.067	0.0	756.1	182
240 min Winter	19.117	0.0	770.2	240
360 min Winter	13.842	0.0	792.0	358
480 min Winter	10.992	0.0	806.4	474
600 min Winter	9.186	0.0	815.8	590
720 min Winter	7.929	0.0	821.5	702

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
960 min Winter	101.656	1.056	5.8	959.2	O K
1440 min Winter	101.640	1.040	5.8	938.2	O K
2160 min Winter	101.605	1.005	5.7	891.3	O K
2880 min Winter	101.569	0.969	5.6	844.9	O K
4320 min Winter	101.493	0.893	5.4	750.3	O K
5760 min Winter	101.419	0.819	5.1	663.9	O K
7200 min Winter	101.350	0.750	4.9	586.7	O K
8640 min Winter	101.285	0.685	4.7	517.8	O K
10080 min Winter	101.224	0.624	4.5	456.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
960 min Winter	6.282	0.0	825.6	926
1440 min Winter	4.519	0.0	815.4	1354
2160 min Winter	3.245	0.0	1381.6	1684
2880 min Winter	2.563	0.0	1430.2	2136
4320 min Winter	1.836	0.0	1370.9	3064
5760 min Winter	1.448	0.0	1657.2	3920
7200 min Winter	1.204	0.0	1721.8	4760
8640 min Winter	1.035	0.0	1775.6	5616
10080 min Winter	0.910	0.0	1821.2	6360

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)	21.000	Shortest Storm (mins)	15
Ratio R	0.421	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 1.420

Time (mins) From:	To:	Area (ha)
0	5	1.420

Model Details

Storage is Offline Cover Level (m) 101.860 Dividing Weir Level (m) 100.600

Tank or Pond Structure

Invert Level (m) 100.600

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	488.0	1.200	1476.0	2.400	0.0	3.600	0.0	4.800	0.0
0.200	642.0	1.400	1654.0	2.600	0.0	3.800	0.0	5.000	0.0
0.400	801.0	1.600	0.0	2.800	0.0	4.000	0.0		
0.600	964.0	1.800	0.0	3.000	0.0	4.200	0.0		
0.800	1130.0	2.000	0.0	3.200	0.0	4.400	0.0		
1.000	1301.0	2.200	0.0	3.400	0.0	4.600	0.0		

Hydro-Brake® Outflow Control

Design Head (m) 1.020 Hydro-Brake® Type Md5 SW Only Invert Level (m) 100.600
Design Flow (l/s) 5.8 Diameter (mm) 97

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.7	0.800	5.1	2.000	8.0	4.000	11.3	7.000	15.0
0.200	3.7	1.000	5.7	2.200	8.4	4.500	12.0	7.500	15.5
0.300	3.6	1.200	6.2	2.400	8.8	5.000	12.7	8.000	16.0
0.400	3.8	1.400	6.7	2.600	9.1	5.500	13.3	8.500	16.5
0.500	4.1	1.600	7.2	3.000	9.8	6.000	13.9	9.000	17.0
0.600	4.4	1.800	7.6	3.500	10.6	6.500	14.4	9.500	17.5

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	104.418	0.418	1.6	158.8	O K
30 min Summer	104.517	0.517	1.8	205.6	O K
60 min Summer	104.608	0.608	2.0	252.0	O K
120 min Summer	104.690	0.690	2.1	296.0	O K
180 min Summer	104.730	0.730	2.2	318.9	O K
240 min Summer	104.754	0.754	2.2	332.8	O K
360 min Summer	104.786	0.786	2.3	351.4	O K
480 min Summer	104.804	0.804	2.3	362.0	O K
600 min Summer	104.814	0.814	2.3	368.1	O K
720 min Summer	104.819	0.819	2.3	371.2	O K
960 min Summer	104.820	0.820	2.3	371.9	O K
1440 min Summer	104.806	0.806	2.3	363.7	O K
2160 min Summer	104.783	0.783	2.3	349.7	O K
2880 min Summer	104.759	0.759	2.2	335.3	O K
4320 min Summer	104.710	0.710	2.1	307.5	O K
5760 min Summer	104.666	0.666	2.1	282.7	O K
7200 min Summer	104.625	0.625	2.0	260.6	O K
8640 min Summer	104.587	0.587	1.9	240.6	O K
10080 min Summer	104.551	0.551	1.9	222.5	O K
15 min Winter	104.459	0.459	1.7	178.0	O K
30 min Winter	104.567	0.567	1.9	230.5	O K
60 min Winter	104.666	0.666	2.1	282.7	O K
120 min Winter	104.754	0.754	2.2	332.5	O K
180 min Winter	104.798	0.798	2.3	358.8	O K
240 min Winter	104.825	0.825	2.3	375.0	O K
360 min Winter	104.861	0.861	2.4	397.0	O K
480 min Winter	104.881	0.881	2.4	410.1	O K
600 min Winter	104.894	0.894	2.4	418.1	O K
720 min Winter	104.902	0.902	2.4	422.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	137.759	0.0	123.1	20
30 min Summer	89.551	0.0	133.9	35
60 min Summer	55.351	0.0	248.4	66
120 min Summer	33.014	0.0	279.5	124
180 min Summer	24.067	0.0	289.5	184
240 min Summer	19.117	0.0	296.0	244
360 min Summer	13.842	0.0	305.9	364
480 min Summer	10.992	0.0	312.4	482
600 min Summer	9.186	0.0	316.6	602
720 min Summer	7.929	0.0	319.4	722
960 min Summer	6.282	0.0	321.6	960
1440 min Summer	4.519	0.0	318.1	1244
2160 min Summer	3.245	0.0	536.8	1620
2880 min Summer	2.563	0.0	552.3	2016
4320 min Summer	1.836	0.0	528.8	2852
5760 min Summer	1.448	0.0	645.9	3640
7200 min Summer	1.204	0.0	671.1	4472
8640 min Summer	1.035	0.0	691.9	5272
10080 min Summer	0.910	0.0	709.4	6056
15 min Winter	137.759	0.0	127.0	20
30 min Winter	89.551	0.0	140.9	34
60 min Winter	55.351	0.0	270.9	64
120 min Winter	33.014	0.0	294.2	122
180 min Winter	24.067	0.0	305.9	182
240 min Winter	19.117	0.0	313.9	240
360 min Winter	13.842	0.0	325.2	358
480 min Winter	10.992	0.0	332.1	474
600 min Winter	9.186	0.0	336.4	590
720 min Winter	7.929	0.0	339.0	704

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
960 min Winter	104.907	0.907	2.4	426.5	O K
1440 min Winter	104.898	0.898	2.4	420.4	O K
2160 min Winter	104.869	0.869	2.4	402.2	O K
2880 min Winter	104.840	0.840	2.3	384.3	O K
4320 min Winter	104.778	0.778	2.2	346.5	O K
5760 min Winter	104.716	0.716	2.2	311.0	O K
7200 min Winter	104.659	0.659	2.1	279.2	O K
8640 min Winter	104.606	0.606	2.0	250.9	O K
10080 min Winter	104.557	0.557	1.9	225.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
960 min Winter	6.282	0.0	340.7	930
1440 min Winter	4.519	0.0	336.0	1358
2160 min Winter	3.245	0.0	591.0	1708
2880 min Winter	2.563	0.0	590.2	2164
4320 min Winter	1.836	0.0	567.8	3072
5760 min Winter	1.448	0.0	723.4	3968
7200 min Winter	1.204	0.0	751.6	4824
8640 min Winter	1.035	0.0	774.8	5624
10080 min Winter	0.910	0.0	794.0	6456

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)	21.000	Shortest Storm (mins)	15
Ratio R	0.421	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.620

Time (mins) From:	To:	Area (ha)
0	5	0.620

Model Details

Storage is Offline Cover Level (m) 105.200 Dividing Weir Level (m) 104.000

Tank or Pond Structure

Invert Level (m) 104.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	310.0	2.400	0.0	4.800	0.0	7.200	0.0	9.600	0.0
0.400	448.0	2.800	0.0	5.200	0.0	7.600	0.0	10.000	0.0
0.800	601.0	3.200	0.0	5.600	0.0	8.000	0.0		
1.200	771.0	3.600	0.0	6.000	0.0	8.400	0.0		
1.600	0.0	4.000	0.0	6.400	0.0	8.800	0.0		
2.000	0.0	4.400	0.0	6.800	0.0	9.200	0.0		

Hydro-Brake® Outflow Control

Design Head (m) 1.000 Hydro-Brake® Type Md5 SW Only Invert Level (m) 104.000
Design Flow (l/s) 2.6 Diameter (mm) 65

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.3	0.800	2.3	2.000	3.6	4.000	5.1	7.000	6.7
0.200	1.3	1.000	2.5	2.200	3.8	4.500	5.4	7.500	7.0
0.300	1.4	1.200	2.8	2.400	3.9	5.000	5.7	8.000	7.2
0.400	1.6	1.400	3.0	2.600	4.1	5.500	6.0	8.500	7.4
0.500	1.8	1.600	3.2	3.000	4.4	6.000	6.2	9.000	7.6
0.600	2.0	1.800	3.4	3.500	4.8	6.500	6.5	9.500	7.8

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	91.232	0.732	5.0	440.3	O K
30 min Summer	91.396	0.896	5.5	569.8	O K
60 min Summer	91.545	1.045	5.9	697.7	O K
120 min Summer	91.675	1.175	6.3	818.7	O K
180 min Summer	91.740	1.240	6.4	881.1	O K
240 min Summer	91.777	1.277	6.5	918.6	O K
360 min Summer	91.826	1.326	6.7	968.0	O K
480 min Summer	91.852	1.352	6.7	995.3	O K
600 min Summer	91.866	1.366	6.8	1010.0	O K
720 min Summer	91.872	1.372	6.8	1016.6	O K
960 min Summer	91.870	1.370	6.8	1014.6	O K
1440 min Summer	91.846	1.346	6.7	988.6	O K
2160 min Summer	91.805	1.305	6.6	946.6	O K
2880 min Summer	91.762	1.262	6.5	903.6	O K
4320 min Summer	91.679	1.179	6.3	822.5	O K
5760 min Summer	91.604	1.104	6.1	751.8	O K
7200 min Summer	91.535	1.035	5.9	688.8	O K
8640 min Summer	91.471	0.971	5.7	632.6	O K
10080 min Summer	91.410	0.910	5.5	581.7	O K
15 min Winter	91.301	0.801	5.2	493.5	O K
30 min Winter	91.478	0.978	5.7	638.9	O K
60 min Winter	91.638	1.138	6.2	783.2	O K
120 min Winter	91.779	1.279	6.5	920.3	O K
180 min Winter	91.849	1.349	6.7	991.9	O K
240 min Winter	91.890	1.390	6.8	1035.7	O K
360 min Winter	91.945	1.445	6.9	1094.6	O K
480 min Winter	91.976	1.476	7.0	1128.7	O K
600 min Winter	91.995	1.495	7.1	1149.0	O K
720 min Winter	92.005	1.505	7.1	1160.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	137.759	0.0	356.6	20
30 min Summer	89.551	0.0	393.7	35
60 min Summer	55.351	0.0	700.6	66
120 min Summer	33.014	0.0	807.1	124
180 min Summer	24.067	0.0	842.1	184
240 min Summer	19.117	0.0	861.9	244
360 min Summer	13.842	0.0	892.0	362
480 min Summer	10.992	0.0	912.1	482
600 min Summer	9.186	0.0	925.5	602
720 min Summer	7.929	0.0	934.0	722
960 min Summer	6.282	0.0	941.4	960
1440 min Summer	4.519	0.0	932.1	1212
2160 min Summer	3.245	0.0	1499.5	1580
2880 min Summer	2.563	0.0	1566.5	1988
4320 min Summer	1.836	0.0	1528.9	2812
5760 min Summer	1.448	0.0	1792.4	3632
7200 min Summer	1.204	0.0	1862.4	4400
8640 min Summer	1.035	0.0	1920.7	5192
10080 min Summer	0.910	0.0	1970.1	6048
15 min Winter	137.759	0.0	370.5	20
30 min Winter	89.551	0.0	415.6	34
60 min Winter	55.351	0.0	773.5	64
120 min Winter	33.014	0.0	855.7	122
180 min Winter	24.067	0.0	891.2	182
240 min Winter	19.117	0.0	915.3	240
360 min Winter	13.842	0.0	949.5	358
480 min Winter	10.992	0.0	970.5	474
600 min Winter	9.186	0.0	983.6	588
720 min Winter	7.929	0.0	991.5	702

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
960 min Winter	92.010	1.510	7.1	1166.3	O K
1440 min Winter	91.989	1.489	7.1	1142.7	O K
2160 min Winter	91.940	1.440	6.9	1089.3	O K
2880 min Winter	91.890	1.390	6.8	1034.9	O K
4320 min Winter	91.781	1.281	6.5	922.9	O K
5760 min Winter	91.678	1.178	6.3	821.1	O K
7200 min Winter	91.582	1.082	6.0	731.3	O K
8640 min Winter	91.493	0.993	5.8	651.6	O K
10080 min Winter	91.410	0.910	5.5	581.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
960 min Winter	6.282	0.0	997.1	926
1440 min Winter	4.519	0.0	984.0	1354
2160 min Winter	3.245	0.0	1670.4	1684
2880 min Winter	2.563	0.0	1703.3	2136
4320 min Winter	1.836	0.0	1644.6	3032
5760 min Winter	1.448	0.0	2007.5	3920
7200 min Winter	1.204	0.0	2085.8	4760
8640 min Winter	1.035	0.0	2151.0	5544
10080 min Winter	0.910	0.0	2206.2	6360

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)	21.000	Shortest Storm (mins)	15
Ratio R	0.421	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 1.720

Time (mins) From:	To:	Area (ha)
0	5	1.720

Model Details

Storage is Offline Cover Level (m) 92.260 Dividing Weir Level (m) 90.500

Tank or Pond Structure

Invert Level (m) 90.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	460.0	1.200	969.0	2.400	0.0	3.600	0.0	4.800	0.0
0.200	535.0	1.400	1067.0	2.600	0.0	3.800	0.0	5.000	0.0
0.400	612.0	1.600	1170.0	2.800	0.0	4.000	0.0		
0.600	696.0	1.800	1170.0	3.000	0.0	4.200	0.0		
0.800	783.0	2.000	0.0	3.200	0.0	4.400	0.0		
1.000	874.0	2.200	0.0	3.400	0.0	4.600	0.0		

Hydro-Brake® Outflow Control

Design Head (m) 1.500 Hydro-Brake® Type Md5 SW Only Invert Level (m) 90.500
Design Flow (l/s) 7.1 Diameter (mm) 98

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.8	0.800	5.2	2.000	8.2	4.000	11.6	7.000	15.3
0.200	3.8	1.000	5.8	2.200	8.6	4.500	12.3	7.500	15.8
0.300	3.7	1.200	6.3	2.400	9.0	5.000	12.9	8.000	16.3
0.400	3.9	1.400	6.8	2.600	9.3	5.500	13.6	8.500	16.9
0.500	4.2	1.600	7.3	3.000	10.0	6.000	14.2	9.000	17.3
0.600	4.5	1.800	7.8	3.500	10.8	6.500	14.7	9.500	17.8

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	98.370	0.570	1.7	156.2	O K
30 min Summer	98.494	0.694	1.9	202.1	O K
60 min Summer	98.606	0.806	2.1	247.5	O K
120 min Summer	98.703	0.903	2.2	290.5	O K
180 min Summer	98.751	0.951	2.3	312.7	O K
240 min Summer	98.780	0.980	2.3	326.1	O K
360 min Summer	98.816	1.016	2.3	343.9	O K
480 min Summer	98.836	1.036	2.4	353.8	O K
600 min Summer	98.847	1.047	2.4	359.2	O K
720 min Summer	98.852	1.052	2.4	361.7	O K
960 min Summer	98.851	1.051	2.4	361.4	O K
1440 min Summer	98.834	1.034	2.4	352.6	O K
2160 min Summer	98.804	1.004	2.3	338.1	O K
2880 min Summer	98.773	0.973	2.3	322.9	O K
4320 min Summer	98.711	0.911	2.2	294.1	O K
5760 min Summer	98.656	0.856	2.1	269.1	O K
7200 min Summer	98.604	0.804	2.1	246.9	O K
8640 min Summer	98.557	0.757	2.0	227.2	O K
10080 min Summer	98.513	0.713	2.0	209.4	O K
15 min Winter	98.423	0.623	1.8	175.0	O K
30 min Winter	98.556	0.756	2.0	226.6	O K
60 min Winter	98.675	0.875	2.2	277.8	O K
120 min Winter	98.780	0.980	2.3	326.5	O K
180 min Winter	98.832	1.032	2.4	352.0	O K
240 min Winter	98.864	1.064	2.4	367.7	O K
360 min Winter	98.904	1.104	2.4	388.8	O K
480 min Winter	98.928	1.128	2.5	401.1	O K
600 min Winter	98.942	1.142	2.5	408.5	O K
720 min Winter	98.949	1.149	2.5	412.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	137.759	0.0	122.3	20
30 min Summer	89.551	0.0	138.3	35
60 min Summer	55.351	0.0	248.5	66
120 min Summer	33.014	0.0	281.5	124
180 min Summer	24.067	0.0	293.6	184
240 min Summer	19.117	0.0	301.9	244
360 min Summer	13.842	0.0	313.8	362
480 min Summer	10.992	0.0	321.3	482
600 min Summer	9.186	0.0	326.0	602
720 min Summer	7.929	0.0	328.9	722
960 min Summer	6.282	0.0	331.2	960
1440 min Summer	4.519	0.0	327.4	1224
2160 min Summer	3.245	0.0	532.1	1584
2880 min Summer	2.563	0.0	553.7	1988
4320 min Summer	1.836	0.0	538.6	2812
5760 min Summer	1.448	0.0	635.8	3632
7200 min Summer	1.204	0.0	660.6	4464
8640 min Summer	1.035	0.0	681.3	5192
10080 min Summer	0.910	0.0	699.0	6048
15 min Winter	137.759	0.0	128.7	20
30 min Winter	89.551	0.0	146.5	34
60 min Winter	55.351	0.0	272.4	64
120 min Winter	33.014	0.0	298.8	122
180 min Winter	24.067	0.0	313.0	182
240 min Winter	19.117	0.0	322.2	240
360 min Winter	13.842	0.0	334.5	358
480 min Winter	10.992	0.0	341.8	474
600 min Winter	9.186	0.0	346.2	590
720 min Winter	7.929	0.0	348.8	702

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
960 min Winter	98.954	1.154	2.5	415.3	O K
1440 min Winter	98.940	1.140	2.5	407.6	O K
2160 min Winter	98.905	1.105	2.4	389.0	O K
2880 min Winter	98.868	1.068	2.4	370.0	O K
4320 min Winter	98.788	0.988	2.3	330.4	O K
5760 min Winter	98.712	0.912	2.2	294.4	O K
7200 min Winter	98.641	0.841	2.1	262.8	O K
8640 min Winter	98.575	0.775	2.0	234.8	O K
10080 min Winter	98.515	0.715	2.0	210.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
960 min Winter	6.282	0.0	350.3	926
1440 min Winter	4.519	0.0	345.1	1356
2160 min Winter	3.245	0.0	591.1	1688
2880 min Winter	2.563	0.0	596.6	2136
4320 min Winter	1.836	0.0	579.5	3064
5760 min Winter	1.448	0.0	712.0	3920
7200 min Winter	1.204	0.0	739.8	4760
8640 min Winter	1.035	0.0	763.0	5616
10080 min Winter	0.910	0.0	782.7	6360

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)	21.000	Shortest Storm (mins)	15
Ratio R	0.421	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.610

Time (mins) From:	To:	Area (ha)
0	5	0.610

Model Details

Storage is Online Cover Level (m) 99.170

Tank or Pond Structure

Invert Level (m) 97.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	201.0	2.400	0.0	4.800	0.0	7.200	0.0	9.600	0.0
0.400	304.0	2.800	0.0	5.200	0.0	7.600	0.0	10.000	0.0
0.800	423.0	3.200	0.0	5.600	0.0	8.000	0.0		
1.200	557.0	3.600	0.0	6.000	0.0	8.400	0.0		
1.600	0.0	4.000	0.0	6.400	0.0	8.800	0.0		
2.000	0.0	4.400	0.0	6.800	0.0	9.200	0.0		

Hydro-Brake® Outflow Control

Design Head (m) 1.150 Hydro-Brake® Type Md5 SW Only Invert Level (m) 97.800
Design Flow (l/s) 2.5 Diameter (mm) 62

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.2	0.800	2.1	2.000	3.3	4.000	4.6	7.000	6.1
0.200	1.2	1.000	2.3	2.200	3.4	4.500	4.9	7.500	6.3
0.300	1.3	1.200	2.5	2.400	3.6	5.000	5.2	8.000	6.5
0.400	1.5	1.400	2.7	2.600	3.7	5.500	5.4	8.500	6.7
0.500	1.6	1.600	2.9	3.000	4.0	6.000	5.7	9.000	6.9
0.600	1.8	1.800	3.1	3.500	4.3	6.500	5.9	9.500	7.1

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 1754 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	89.642	0.442	0.0	1.3	1.3	141.1	O K
30 min Summer	89.772	0.572	0.0	1.5	1.5	182.7	O K
60 min Summer	89.902	0.702	0.0	1.6	1.6	224.0	O K
120 min Summer	90.026	0.826	0.0	1.8	1.8	263.5	O K
180 min Summer	90.091	0.891	0.0	1.8	1.8	284.3	O K
240 min Summer	90.131	0.931	0.0	1.9	1.9	297.0	O K
360 min Summer	90.185	0.985	0.0	1.9	1.9	314.3	O K
480 min Summer	90.216	1.016	0.0	2.0	2.0	324.4	O K
600 min Summer	90.235	1.035	0.0	2.0	2.0	330.5	O K
720 min Summer	90.246	1.046	0.0	2.0	2.0	334.0	O K
960 min Summer	90.252	1.052	0.0	2.0	2.0	336.0	O K
1440 min Summer	90.236	1.036	0.0	2.0	2.0	330.7	O K
2160 min Summer	90.205	1.005	0.0	2.0	2.0	320.9	O K
2880 min Summer	90.172	0.972	0.0	1.9	1.9	310.3	O K
4320 min Summer	90.103	0.903	0.0	1.9	1.9	288.1	O K
5760 min Summer	90.038	0.838	0.0	1.8	1.8	267.6	O K
7200 min Summer	89.981	0.781	0.0	1.7	1.7	249.3	O K
8640 min Summer	89.929	0.729	0.0	1.7	1.7	232.8	O K
10080 min Summer	89.883	0.683	0.0	1.6	1.6	217.9	O K
15 min Winter	89.695	0.495	0.0	1.4	1.4	158.1	O K
30 min Winter	89.841	0.641	0.0	1.6	1.6	204.7	O K
60 min Winter	89.987	0.787	0.0	1.7	1.7	251.3	O K
120 min Winter	90.127	0.927	0.0	1.9	1.9	295.9	O K
180 min Winter	90.201	1.001	0.0	2.0	2.0	319.6	O K
240 min Winter	90.247	1.047	0.0	2.0	2.0	334.3	O K
360 min Winter	90.311	1.111	0.0	2.1	2.1	354.5	O K
480 min Winter	90.349	1.149	0.0	2.1	2.1	366.7	O K
600 min Winter	90.373	1.173	0.0	2.1	2.1	374.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	137.759	0.0	93.5	20
30 min Summer	89.551	0.0	106.1	35
60 min Summer	55.351	0.0	205.5	66
120 min Summer	33.014	0.0	224.3	124
180 min Summer	24.067	0.0	235.3	184
240 min Summer	19.117	0.0	242.7	244
360 min Summer	13.842	0.0	253.3	364
480 min Summer	10.992	0.0	260.0	482
600 min Summer	9.186	0.0	264.4	602
720 min Summer	7.929	0.0	267.3	722
960 min Summer	6.282	0.0	269.9	960
1440 min Summer	4.519	0.0	267.5	1256
2160 min Summer	3.245	0.0	459.8	1624
2880 min Summer	2.563	0.0	458.9	2020
4320 min Summer	1.836	0.0	443.4	2852
5760 min Summer	1.448	0.0	572.8	3688
7200 min Summer	1.204	0.0	594.9	4472
8640 min Summer	1.035	0.0	613.0	5280
10080 min Summer	0.910	0.0	626.8	6056
15 min Winter	137.759	0.0	98.3	20
30 min Winter	89.551	0.0	113.1	35
60 min Winter	55.351	0.0	217.9	64
120 min Winter	33.014	0.0	240.0	122
180 min Winter	24.067	0.0	252.8	182
240 min Winter	19.117	0.0	261.0	240
360 min Winter	13.842	0.0	272.4	358
480 min Winter	10.992	0.0	279.5	474
600 min Winter	9.186	0.0	284.0	590

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
720 min Winter	90.388	1.188	0.0	2.1	2.1	379.3	O K
960 min Winter	90.402	1.202	0.0	2.1	2.1	383.5	O K
1440 min Winter	90.391	1.191	0.0	2.1	2.1	380.3	O K
2160 min Winter	90.350	1.150	0.0	2.1	2.1	367.0	O K
2880 min Winter	90.308	1.108	0.0	2.1	2.1	353.8	O K
4320 min Winter	90.215	1.015	0.0	2.0	2.0	324.1	O K
5760 min Winter	90.125	0.925	0.0	1.9	1.9	295.3	O K
7200 min Winter	90.044	0.844	0.0	1.8	1.8	269.3	O K
8640 min Winter	89.971	0.771	0.0	1.7	1.7	246.0	O K
10080 min Winter	89.906	0.706	0.0	1.6	1.6	225.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
720 min Winter	7.929	0.0	286.9	704
960 min Winter	6.282	0.0	289.2	932
1440 min Winter	4.519	0.0	286.0	1358
2160 min Winter	3.245	0.0	495.3	1708
2880 min Winter	2.563	0.0	496.2	2164
4320 min Winter	1.836	0.0	479.5	3072
5760 min Winter	1.448	0.0	641.4	3976
7200 min Winter	1.204	0.0	666.1	4824
8640 min Winter	1.035	0.0	686.1	5624
10080 min Winter	0.910	0.0	699.1	6456

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)	21.000	Shortest Storm (mins)	15
Ratio R	0.421	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.550

Time (mins) From:	To:	Area (ha)
0	5	0.550

Model Details

Storage is Offline Cover Level (m) 91.000 Dividing Weir Level (m) 89.200

Cellular Storage Structure

Invert Level (m) 89.200 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	336.0	0.0	3.600	0.0	0.0	7.200	0.0	0.0
0.400	336.0	0.0	4.000	0.0	0.0	7.600	0.0	0.0
0.800	336.0	0.0	4.400	0.0	0.0	8.000	0.0	0.0
1.200	336.0	0.0	4.800	0.0	0.0	8.400	0.0	0.0
1.600	0.0	0.0	5.200	0.0	0.0	8.800	0.0	0.0
2.000	0.0	0.0	5.600	0.0	0.0	9.200	0.0	0.0
2.400	0.0	0.0	6.000	0.0	0.0	9.600	0.0	0.0
2.800	0.0	0.0	6.400	0.0	0.0	10.000	0.0	0.0
3.200	0.0	0.0	6.800	0.0	0.0			

Hydro-Brake® Outflow Control

Design Head (m) 1.200 Hydro-Brake® Type Md5 SW Only Invert Level (m) 89.200
Design Flow (l/s) 2.2 Diameter (mm) 57

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.0	0.800	1.7	2.000	2.8	4.000	3.9	7.000	5.2
0.200	1.0	1.000	2.0	2.200	2.9	4.500	4.1	7.500	5.4
0.300	1.1	1.200	2.1	2.400	3.0	5.000	4.4	8.000	5.5
0.400	1.2	1.400	2.3	2.600	3.2	5.500	4.6	8.500	5.7
0.500	1.4	1.600	2.5	3.000	3.4	6.000	4.8	9.000	5.9
0.600	1.5	1.800	2.6	3.500	3.7	6.500	5.0	9.500	6.0

Summary of Results for 100 year Return Period (+30%)

Half Drain Time : 2778 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	91.599	0.399	0.0	1.0	1.0	169.7	O K
30 min Summer	91.717	0.517	0.0	1.2	1.2	220.1	O K
60 min Summer	91.836	0.636	0.0	1.3	1.3	270.6	O K
120 min Summer	91.951	0.751	0.0	1.4	1.4	319.8	O K
180 min Summer	92.014	0.814	0.0	1.5	1.5	346.6	O K
240 min Summer	92.055	0.855	0.0	1.5	1.5	363.8	O K
360 min Summer	92.113	0.913	0.0	1.6	1.6	388.5	O K
480 min Summer	92.151	0.951	0.0	1.6	1.6	404.6	O K
600 min Summer	92.177	0.977	0.0	1.6	1.6	415.8	O K
720 min Summer	92.196	0.996	0.0	1.6	1.6	423.9	O K
960 min Summer	92.219	1.019	0.0	1.6	1.6	433.9	O K
1440 min Summer	92.234	1.034	0.0	1.7	1.7	439.9	O K
2160 min Summer	92.219	1.019	0.0	1.6	1.6	433.5	O K
2880 min Summer	92.199	0.999	0.0	1.6	1.6	425.3	O K
4320 min Summer	92.157	0.957	0.0	1.6	1.6	407.4	O K
5760 min Summer	92.113	0.913	0.0	1.6	1.6	388.7	O K
7200 min Summer	92.070	0.870	0.0	1.5	1.5	370.3	O K
8640 min Summer	92.030	0.830	0.0	1.5	1.5	353.2	O K
10080 min Summer	91.992	0.792	0.0	1.4	1.4	337.2	O K
15 min Winter	91.647	0.447	0.0	1.1	1.1	190.1	O K
30 min Winter	91.779	0.579	0.0	1.2	1.2	246.6	O K
60 min Winter	91.913	0.713	0.0	1.4	1.4	303.3	O K
120 min Winter	92.043	0.843	0.0	1.5	1.5	358.8	O K
180 min Winter	92.114	0.914	0.0	1.6	1.6	389.1	O K
240 min Winter	92.160	0.960	0.0	1.6	1.6	408.8	O K
360 min Winter	92.227	1.027	0.0	1.6	1.6	437.0	O K
480 min Winter	92.271	1.071	0.0	1.7	1.7	455.7	O K
600 min Winter	92.302	1.102	0.0	1.7	1.7	469.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	137.759	0.0	77.9	20
30 min Summer	89.551	0.0	89.3	35
60 min Summer	55.351	0.0	179.0	66
120 min Summer	33.014	0.0	197.9	126
180 min Summer	24.067	0.0	207.7	184
240 min Summer	19.117	0.0	213.8	244
360 min Summer	13.842	0.0	221.9	364
480 min Summer	10.992	0.0	226.7	484
600 min Summer	9.186	0.0	229.6	604
720 min Summer	7.929	0.0	231.2	722
960 min Summer	6.282	0.0	232.1	962
1440 min Summer	4.519	0.0	228.1	1440
2160 min Summer	3.245	0.0	427.7	1964
2880 min Summer	2.563	0.0	425.1	2284
4320 min Summer	1.836	0.0	403.6	3068
5760 min Summer	1.448	0.0	679.6	3872
7200 min Summer	1.204	0.0	686.7	4688
8640 min Summer	1.035	0.0	670.4	5536
10080 min Summer	0.910	0.0	649.0	6352
15 min Winter	137.759	0.0	82.6	20
30 min Winter	89.551	0.0	95.1	35
60 min Winter	55.351	0.0	191.5	64
120 min Winter	33.014	0.0	211.9	124
180 min Winter	24.067	0.0	222.3	182
240 min Winter	19.117	0.0	228.7	242
360 min Winter	13.842	0.0	237.1	360
480 min Winter	10.992	0.0	242.1	476
600 min Winter	9.186	0.0	245.0	594

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
720 min Winter	92.325	1.125	0.0	1.7	1.7	478.8	O K
960 min Winter	92.355	1.155	0.0	1.7	1.7	491.5	O K
1440 min Winter	92.378	1.178	0.0	1.8	1.8	501.5	O K
2160 min Winter	92.371	1.171	0.0	1.8	1.8	498.5	O K
2880 min Winter	92.343	1.143	0.0	1.7	1.7	486.4	O K
4320 min Winter	92.292	1.092	0.0	1.7	1.7	464.9	O K
5760 min Winter	92.235	1.035	0.0	1.7	1.7	440.3	O K
7200 min Winter	92.176	0.976	0.0	1.6	1.6	415.3	O K
8640 min Winter	92.119	0.919	0.0	1.6	1.6	391.2	O K
10080 min Winter	92.066	0.866	0.0	1.5	1.5	368.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
720 min Winter	7.929	0.0	246.7	710
960 min Winter	6.282	0.0	247.3	942
1440 min Winter	4.519	0.0	242.6	1398
2160 min Winter	3.245	0.0	460.1	2052
2880 min Winter	2.563	0.0	456.4	2596
4320 min Winter	1.836	0.0	431.9	3284
5760 min Winter	1.448	0.0	750.0	4200
7200 min Winter	1.204	0.0	743.0	5112
8640 min Winter	1.035	0.0	728.6	5968
10080 min Winter	0.910	0.0	705.6	6856

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)	21.000	Shortest Storm (mins)	15
Ratio R	0.421	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 0.660

Time (mins) From:	To:	Area (ha)
0	5	0.660

Model Details

Storage is Offline Cover Level (m) 93.000 Dividing Weir Level (m) 91.200

Cellular Storage Structure

Invert Level (m) 91.200 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	448.0	0.0	3.600	448.0	0.0	7.200	448.0	0.0
0.400	448.0	0.0	4.000	448.0	0.0	7.600	448.0	0.0
0.800	448.0	0.0	4.400	448.0	0.0	8.000	448.0	0.0
1.200	448.0	0.0	4.800	448.0	0.0	8.400	448.0	0.0
1.600	448.0	0.0	5.200	448.0	0.0	8.800	448.0	0.0
2.000	448.0	0.0	5.600	448.0	0.0	9.200	448.0	0.0
2.400	448.0	0.0	6.000	448.0	0.0	9.600	448.0	0.0
2.800	448.0	0.0	6.400	448.0	0.0	10.000	448.0	0.0
3.200	448.0	0.0	6.800	448.0	0.0			

Hydro-Brake® Outflow Control

Design Head (m) 1.200 Hydro-Brake® Type Md5 SW Only Invert Level (m) 91.200
Design Flow (l/s) 1.8 Diameter (mm) 52

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.8	0.800	1.5	2.000	2.3	4.000	3.3	7.000	4.3
0.200	0.8	1.000	1.6	2.200	2.4	4.500	3.5	7.500	4.5
0.300	0.9	1.200	1.8	2.400	2.5	5.000	3.6	8.000	4.6
0.400	1.0	1.400	1.9	2.600	2.6	5.500	3.8	8.500	4.7
0.500	1.2	1.600	2.1	3.000	2.8	6.000	4.0	9.000	4.9
0.600	1.3	1.800	2.2	3.500	3.0	6.500	4.1	9.500	5.0

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	84.134	0.434	4.2	381.5	O K
30 min Summer	84.246	0.546	4.6	494.0	O K
60 min Summer	84.351	0.651	5.0	605.1	O K
120 min Summer	84.446	0.746	5.3	710.4	O K
180 min Summer	84.494	0.794	5.5	764.8	O K
240 min Summer	84.522	0.822	5.6	797.6	O K
360 min Summer	84.558	0.858	5.7	840.9	O K
480 min Summer	84.579	0.879	5.8	865.0	O K
600 min Summer	84.590	0.890	5.8	878.2	O K
720 min Summer	84.595	0.895	5.8	884.4	O K
960 min Summer	84.594	0.894	5.8	883.5	O K
1440 min Summer	84.576	0.876	5.7	862.1	O K
2160 min Summer	84.547	0.847	5.7	827.6	O K
2880 min Summer	84.517	0.817	5.6	792.2	O K
4320 min Summer	84.457	0.757	5.3	723.3	O K
5760 min Summer	84.402	0.702	5.2	661.0	O K
7200 min Summer	84.350	0.650	5.0	604.4	O K
8640 min Summer	84.303	0.603	4.8	553.2	O K
10080 min Summer	84.258	0.558	4.6	506.4	O K
15 min Winter	84.181	0.481	4.4	427.6	O K
30 min Winter	84.303	0.603	4.8	553.7	O K
60 min Winter	84.418	0.718	5.2	679.0	O K
120 min Winter	84.522	0.822	5.6	798.0	O K
180 min Winter	84.575	0.875	5.7	860.4	O K
240 min Winter	84.606	0.906	5.8	898.6	O K
360 min Winter	84.648	0.948	6.0	949.9	O K
480 min Winter	84.672	0.972	6.1	979.8	O K
600 min Winter	84.687	0.987	6.1	997.6	O K
720 min Winter	84.695	0.995	6.1	1007.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	137.759	0.0	326.9	20
30 min Summer	89.551	0.0	357.7	35
60 min Summer	55.351	0.0	597.9	66
120 min Summer	33.014	0.0	697.8	124
180 min Summer	24.067	0.0	742.8	184
240 min Summer	19.117	0.0	763.9	244
360 min Summer	13.842	0.0	782.3	362
480 min Summer	10.992	0.0	790.8	482
600 min Summer	9.186	0.0	796.3	602
720 min Summer	7.929	0.0	800.0	722
960 min Summer	6.282	0.0	802.6	960
1440 min Summer	4.519	0.0	792.8	1224
2160 min Summer	3.245	0.0	1290.4	1584
2880 min Summer	2.563	0.0	1346.6	1992
4320 min Summer	1.836	0.0	1326.4	2812
5760 min Summer	1.448	0.0	1551.4	3632
7200 min Summer	1.204	0.0	1611.6	4464
8640 min Summer	1.035	0.0	1661.4	5272
10080 min Summer	0.910	0.0	1702.0	6048
15 min Winter	137.759	0.0	345.6	20
30 min Winter	89.551	0.0	366.3	34
60 min Winter	55.351	0.0	662.8	64
120 min Winter	33.014	0.0	756.5	122
180 min Winter	24.067	0.0	787.0	182
240 min Winter	19.117	0.0	800.7	240
360 min Winter	13.842	0.0	819.0	358
480 min Winter	10.992	0.0	831.8	474
600 min Winter	9.186	0.0	840.6	590
720 min Winter	7.929	0.0	846.4	702

Summary of Results for 100 year Return Period (+30%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
960 min Winter	84.699	0.999	6.1	1013.3	O K
1440 min Winter	84.684	0.984	6.1	993.8	O K
2160 min Winter	84.647	0.947	6.0	948.8	O K
2880 min Winter	84.610	0.910	5.9	903.3	O K
4320 min Winter	84.531	0.831	5.6	808.0	O K
5760 min Winter	84.453	0.753	5.3	718.8	O K
7200 min Winter	84.381	0.681	5.1	638.2	O K
8640 min Winter	84.314	0.614	4.8	565.7	O K
10080 min Winter	84.252	0.552	4.6	499.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
960 min Winter	6.282	0.0	850.8	926
1440 min Winter	4.519	0.0	840.8	1354
2160 min Winter	3.245	0.0	1436.9	1684
2880 min Winter	2.563	0.0	1481.6	2136
4320 min Winter	1.836	0.0	1413.1	3064
5760 min Winter	1.448	0.0	1737.6	3920
7200 min Winter	1.204	0.0	1804.9	4760
8640 min Winter	1.035	0.0	1860.5	5616
10080 min Winter	0.910	0.0	1906.6	6448

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)	21.000	Shortest Storm (mins)	15
Ratio R	0.421	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+30

Time Area Diagram

Total Area (ha) 1.490

Time (mins) From:	To:	Area (ha)
0	5	1.490

Model Details

Storage is Offline Cover Level (m) 84.910 Dividing Weir Level (m) 83.700

Tank or Pond Structure

Invert Level (m) 83.700

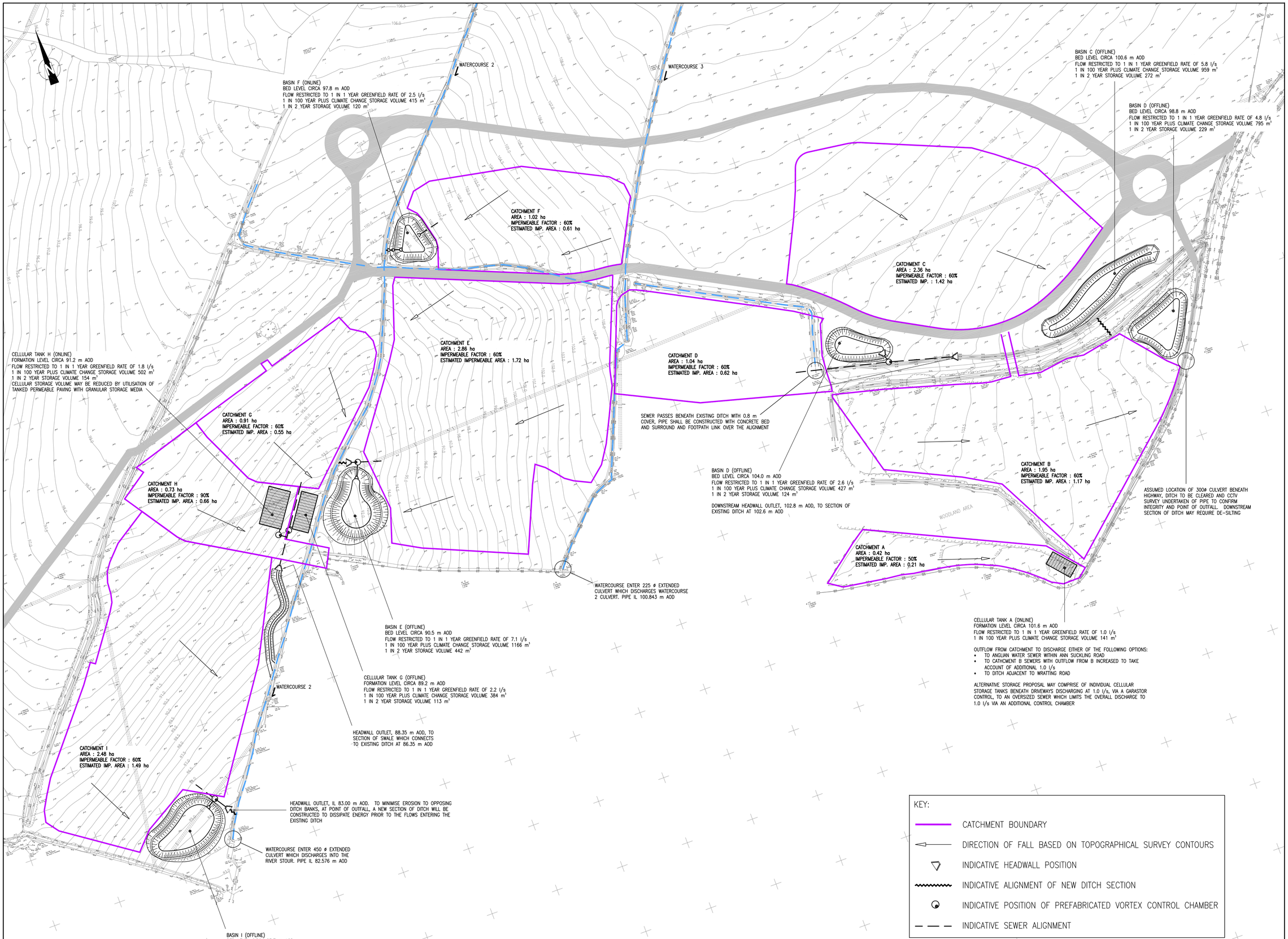
Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	780.9	2.400	0.0	4.800	0.0	7.200	0.0	9.600	0.0
0.400	963.3	2.800	0.0	5.200	0.0	7.600	0.0	10.000	0.0
0.800	1159.8	3.200	0.0	5.600	0.0	8.000	0.0		
1.200	1371.2	3.600	0.0	6.000	0.0	8.400	0.0		
1.600	0.0	4.000	0.0	6.400	0.0	8.800	0.0		
2.000	0.0	4.400	0.0	6.800	0.0	9.200	0.0		

Hydro-Brake® Outflow Control

Design Head (m) 0.950 Hydro-Brake® Type Md5 SW Only Invert Level (m) 83.700
Design Flow (l/s) 6.1 Diameter (mm) 101

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.9	0.800	5.5	2.000	8.7	4.000	12.3	7.000	16.2
0.200	4.1	1.000	6.1	2.200	9.1	4.500	13.0	7.500	16.8
0.300	4.0	1.200	6.7	2.400	9.5	5.000	13.7	8.000	17.4
0.400	4.1	1.400	7.3	2.600	9.9	5.500	14.4	8.500	17.9
0.500	4.4	1.600	7.8	3.000	10.6	6.000	15.0	9.000	18.4
0.600	4.8	1.800	8.2	3.500	11.5	6.500	15.7	9.500	18.9

Appendix I
Surface Water Drainage Strategy



KEY:

- CATCHMENT BOUNDARY
- DIRECTION OF FALL BASED ON TOPOGRAPHICAL SURVEY CONTOURS
- INDICATIVE HEADWALL POSITION
- INDICATIVE ALIGNMENT OF NEW DITCH SECTION
- INDICATIVE POSITION OF PREFABRICATED VORTEX CONTROL CHAMBER
- INDICATIVE SEWER ALIGNMENT

NOTES:

1. DO NOT SCALE FROM THIS DRAWING
2. ALL DIMENSIONS SHOWN ARE IN METRES
3. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL RELEVANT SCHEME DRAWINGS AND SPECIFICATIONS
4. CATCHMENT AREAS HAVE BEEN TRACED FROM A DIGITAL VERSION OF THE MASTER PLAN AND STATED AREAS MAY VARY WITH PROVISION OF OTHER MORE ACCURATE DIGITAL INFORMATION.
5. BASIN / CELLULAR TANK FOOTPRINTS AND STORAGE VOLUMES ARE BASED ON PRELIMINARY MASTER PLAN AND SHALL BE REVIEWED AS PART OF THE DETAILED DESIGN PROCESS. THE BASIN / CELLULAR TANK SIZES ARE BASED ON THE VOLUME REQUIRED FOR THE 1 IN 100 YEAR PLUS CLIMATE CHANGE RAINFALL EVENT, IF STORAGE IS PROVIDED WITHIN THE UPSTREAM PIPE NETWORK THE FOOT PRINT OF THE STORAGE STRUCTURE MAY BE REDUCED.
6. BASIN / CELLULAR STORAGE BED / FORMATION LEVELS ASSUME A MAXIMUM UPSTREAM PIPE DIAMETER OF 600ø.

Rev	Description	Drn	Chk	Date
	REVISIONS			

JOB TITLE
NORTH WEST HAVERHILL
SUFFOLK

DRAWING TITLE
SURFACE WATER
DRAINAGE STRATEGY

DATE	DRAWN	CHECKED
APRIL '13	JT	JM

DRAWING No	REV	SCALE	
0108.001	.	1:1250	@ A1

CAPITA SYMONDS

Capita Symonds Ltd
Clarendon House
Clarendon Road
Cambridge
CB2 8FH

Tel +44 (0)1223 326640
Fax+44 (0)1223 326650

www.capitasymonds.com