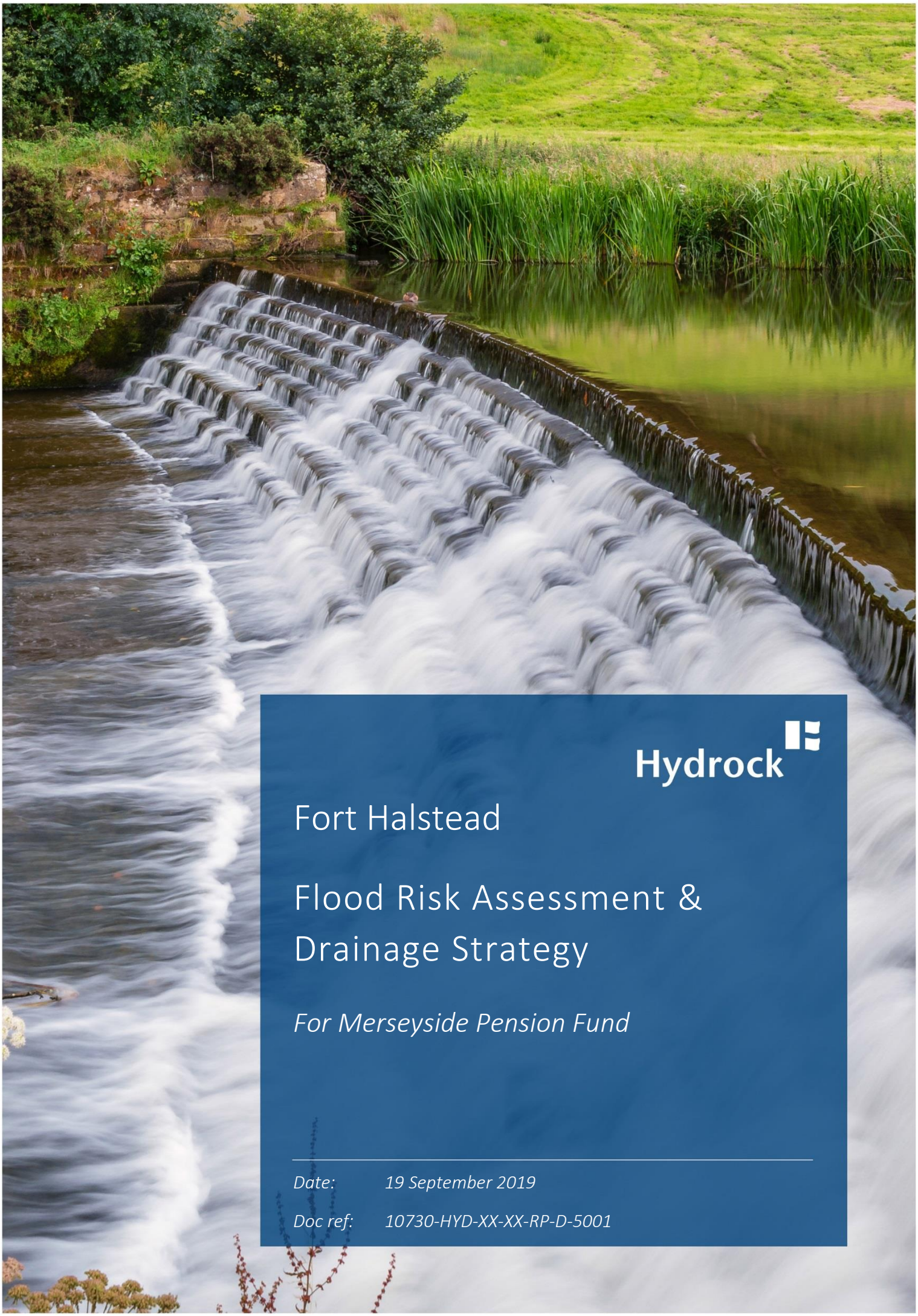
14. Water Resources & Flood Risk

Appendix 14.1

FLOOD RISK ASSESSMENT & DRAINAGE STRATEGY REPORT



Hydrock

Fort Halstead

Flood Risk Assessment & Drainage Strategy

For Merseyside Pension Fund

Date: *19 September 2019*

Doc ref: *10730-HYD-XX-XX-RP-D-5001*

DOCUMENT CONTROL SHEET

Issued by	Hydrock Consultants Limited Over Court Barns Over Lane Almondsbury Bristol BS32 4DF	Tel: 01454 619533 Fax: 01454 614125 www.hydrock.com
Client	Merseyside Pension Fund	
Project name	Fort Halstead	
Title	Flood Risk Assessment & Drainage Strategy	
Doc ref	10730-HYD-XX-XX-RP-D-5001	
Project no.	C-10730-C	
Status	S2 - For Information	
Date	19/09/2019	

Document Production Record		
Issue Number	P02	Name
FRA Prepared by		David Lloyd BSc, PhD
Drainage Strategy Prepared by		Sean Mitchinson
Checked by		Jon Cracknell BSc, MSc
Approved by		David Lloyd BSc, PhD

Document Revision Record			
Issue Number	Status	Date	Revision Details
P01	S2	05/09/2019	Draft
P02	S2	19/09/2019	Final

Hydrock Consultants Limited has prepared this report in accordance with the instructions of the above named client for their sole and specific use. Any third parties who may use the information contained herein do so at their own risk.

CONTENTS

Figures

Tables

Appendices

1. INTRODUCTION

This report has been prepared by Hydrock on behalf of Merseyside Pension Fund in support of a Planning Application to be submitted to Sevenoaks District Council (SDC) for the proposed redevelopment of Fort Halstead.

This Flood Risk Assessment report has been prepared to address the requirements of the National Planning Policy Framework (NPPF), through;

- Assessing whether the site is likely to be affected by flooding.
- Assessing whether the proposed development is appropriate in the suggested location.
- Presenting any flood risk mitigation measures necessary to ensure that the proposed development and occupants will be safe, whilst ensuring flood risk is not increased elsewhere.
- Presenting sustainable methods of surface water management.

The report considers the requirements for undertaking a Flood Risk Assessment and Drainage Strategy as detailed in the NPPF.

2. SITE INFORMATION

2.1 Location and Setting

The site extends to 74.49ha and is located to the immediate east of the village of Knockholt Pound. The A224 and the M25 pass just to the east of the site's eastern boundary in a north-south orientation. The site is bounded by woodland to the north and east, and farmland (of arable use) to the south and west. The site itself is predominantly developed and previously occupied by the Defence Science and Technology Laboratory (DSTL). Some demolition of decommissioned buildings has already taken place. The nearest postcode to the site is TN14 7BS, and grid reference TQ497594.

A site location plan is included in Appendix A.

2.2 Topography

The site is situated on locally high ground (on the crest of the North Downs) and has a high point at 219m AOD towards the site's southwestern limit. Levels on the site fall gently to the west, east and north from this highpoint, and more steeply to the southeast. The south-eastern limit of the site forms the scarp face of the North Downs.

A Topographical Survey of the site is included in Appendix A.

2.3 Proposed Development

The scheme is to be a hybrid Planning Application comprising:

In detail:

- Demolition of existing buildings.
- Change of use and works to buildings Q13 and Q14 (including landscaping and public realm).
- Primary and secondary accesses.

Outline approval is also to be sought for:

- Development of business areas (use classes B1a/b/c).
- Works within the 'X' enclave relating to energetic testing operations, including fencing, access, car parking.
- Development of up to 750 residential dwellings.
- Development of a mixed-use village centre (use classes A1/A3/A4/A5/B1a/D1/D2).
- Development of a one form entry primary school.
- Change of use of Fort Area and bunkers to Historic Interpretation Centre (use class D1) with workshop space.
- Roads, pedestrian and cycle routes, public transport infrastructure, car parking, utilities infrastructure and drainage.
- Landscaping, landforming and ecological mitigation works.

A proposed land use parameter plan is included in Appendix A.

3. ASSESSMENT OF FLOOD RISK

3.1 Flood Zone Mapping

The entirety of the site is shown to be within Flood Zone 1, i.e. land having a less than 1 in 1,000 annual probability of fluvial or tidal flooding. The Environment Agency's (EA's) Flood Zone mapping for the area is shown in Figure 1.

Figure 1. Flood Map for Planning (Flood Zones 2 and 3 shown as turquoise and blue respectively)

3.2 Fluvial and Tidal Flooding

The nearest watercourses to the site are the River Darent and the Twitton Brook which are approximately 1.5km and 1.1km due east of the site respectively. The floodplains to both these watercourses are at a level of around 57m AOD, some 120m lower than the lowest point of the site. At this location these watercourses are not tidal.

The site is therefore concluded to be at negligible risk of fluvial and tidal flooding.

3.3 Surface Water Flooding

The EA's Flood Risk from Surface Water mapping shows the majority of the site to be at 'very low' risk of surface water flooding, as shown in Figure 2 below.

The location of the site on the top of the North Downs scarp means that there is no catchment draining in to the site from higher ground. Couple this with the relatively permeable bedrock and expected low groundwater, any overland flows are likely to be negligible and associated only with the developed areas of the site where existing drainage is absent.

There are a number of localised areas within the site that are shown to be at potentially increased risk of surface water flooding. However, these areas are considered to be associated with existing impermeable hardstanding which is likely to be positively drained.

Sevenoaks District Council's Strategic Flood Risk Assessment (SFRA) does not record any previous surface water flooding incidents within the vicinity of the site.

The site is therefore concluded to be at low risk of surface water 'ponding' / flooding.

Figure 2. EA Flood Risk from Surface Water Mapping

3.4 Groundwater Flooding

British Geological Survey mapping shows the site to be underlain by Lewes Nodular, Seaford and Newhaven Chalk Formations, which are classified as Principal Aquifers, underlain by superficial deposits of Clay-with-Flints. Underlying bedrock is considered permeable, but the superficial deposits not, which is therefore likely to act as an aquiclude and prevent groundwater from the aquifer from rising to the surface.

Kent County Council's Preliminary Flood Risk Assessment (PFRA) and the SFRA indicates that the site is located in a 'negligible' groundwater flood risk area. Furthermore, groundwater has not been encountered at the application site during previous Site Investigations. Mapping contained within Kent County Council's Surface Water Management Plan (SWMP) shows that no groundwater flooding has occurred at or in the vicinity of the application site, with the closest recorded incident being approximately 4.6km to the southeast of the application site where ground levels are much lower.

As such, the site is concluded to be at low risk of groundwater flooding.

3.5 Infrastructure Failure Flooding

Similar to the assessment of surface water flooding, given the location of the site at the high point of the local area, there are no potential sources of artificial flood risk upstream of the site (such as canals, reservoirs and/or sewers). The only potential source of infrastructure failure flood risk posed to the site is therefore that posed by existing on-site sewers if they became surcharged and any resulting overland flows. However, such a scenario has not previously been recorded at the site, and as such is considered a 'residual' risk. Regardless, any overland flows would be directed away from the site to the surrounding lower-lying ground.

As such the site is concluded to be at low risk of infrastructure failure flooding and/or flooding from artificial sources.

4. NPPF REQUIREMENTS

4.1 Sequential Test

This assessment has demonstrated that the site is on land designated as Flood Zone 1 by the EA's Flood Zone Mapping, and at low risk of flooding from all other potential sources.

The NPPF Flood Risk Vulnerability and Flood Zone Compatibility matrix (Table 3) indicates that all forms of development are appropriate in Flood Zone 1 and accordingly the proposed development is concluded to meet the requirements of the Sequential Test.

4.2 Exception Test

Whilst an Exception Test is not explicitly required under the NPPF, due to the site being demonstrated to pass the Sequential Test, the following section details any measures necessary to mitigate any 'residual' flood risks, to ensure that the proposed development and occupants will be safe and that flood risk will not be increased elsewhere, akin to the requirements of the second section of the Exception Test.

4.2.1 Resistance and Resilience Measures

In order to afford the site additional protection from any potential 'residual' flood risks, it is recommended that finished floor levels be set a minimum 'standard' 150mm above adjacent infrastructure thoroughfare levels. This aims to ensure any design exceedance flows, should they occur, will be directed away for all new development.

A comprehensive Surface Water Drainage Strategy will be constructed as part of the proposed development (the details of which are provided in the following section). This is designed to intercept and manage rainfall. Furthermore, the proposed highway and building layout has been designed to create a preferential overland flow route through the site, to allow any overland flows (should the proposed drainage system fail or surcharge) to pass through the site, away from existing or proposed buildings, and continue away from the site, as per the existing situation (although it is noted that the proposed drainage system will be designed to intercept and therefore mitigate the risk of such overland flows being directed off-site).

4.2.2 Safe Access and Egress

Access to the site will be via the existing surrounding highway network which is indicated to be at low risk of flooding, based on the EA's Flood Zone and Flood Risk from Surface Water mapping.

As such, a safe / dry access and egress is considered to be possible to and from the site.

4.2.3 Flood Risk within Catchment

The proposed development is not considered to increase flood risk within the catchment through a loss of floodplain storage (as the site has been demonstrated as being outside a functioning floodplain).

5. DRAINAGE STRATEGY

5.1 Existing Surface Water Drainage

The site is currently largely developed (there are approximately 300 buildings present on the site along with associated infrastructure) and therefore there is an existing drainage system in place.

Existing records show surface water run-off from the site either infiltrates into the subsoil via shallow soakaways or is discharged into the surrounding woodland via private drainage systems. Whilst this method of surface water management offers sustainable benefits in terms of its ability to recharge the natural groundwater system, support biodiversity and facilitate improvements to water quality through filtration, it is not considered a sufficient robust solution to serve the proposed development and would be expected to be unacceptable to the Lead Local Flood Authority.

There are no surface water features present within the site, with the nearest watercourses being the River Darent and Twitton Brook (tributary of the River Darent) located approximately 1.5km and 1.1km to the east of the site, respectively. The site is located on a chalk escarpment ridge and is thereby significantly elevated above any surrounding surface water features.

5.2 Proposed Surface Water Drainage Strategy

The site is underlain by a layer of clay estimated to be between circa 0m and 12m in thickness. Upper, middle and lower chalk formations, classified as Principal Aquifers, are located beneath the clay.

The presence of clay on the site is not conducive to the use of shallow infiltration techniques. The next preferable option is to discharge to the nearest watercourse or surface water sewer. According to Thames Water sewer records there are no existing public surface water sewers within the site boundary and the nearest watercourse the Twitton Brook is approximately 1.1km away. As such, neither of these options are considered viable.

The presence of the upper chalk formations below the clay presents the possibility for the use of deep borehole soakaways. In a previous Flood Risk Assessment by Watermans (Planning Ref: 15/00628/OUT), falling head tests were carried out within three boreholes at depths of 10.5m below ground level (bgl) and 20.5m bgl in order to determine the potential for infiltration within the upper chalk layer. An average infiltration rate of 2.157×10^{-4} m/s (0.776m/hr) was obtained from the three boreholes based on the falling head tests at 20.5m bgl.

As such, a strategy for the disposal of surface water has been developed based on the infiltration rate achieved from these falling head tests. To minimise the number of borehole soakaways required, the flow rate to the boreholes shall be restricted to 5.0l/s via a hydro-brake flow control device. Flow in excess of this discharge rate will be attenuated within a combination of surface basins and below ground storage tanks.

The proposed catchments for each of the borehole and attention systems is based on the natural topography of the site and availability of open space that avoids any impact on the existing trees and the ancient woodland that bounds the site. Drawing 10730-HYD-XX-XX-DR-C-2201 in Appendix B shows the proposed borehole and attenuation locations.

The table below shows attenuation volumes and the number of boreholes required for each catchment. The Micro Drainage calculations for each catchment are provided in Appendix B.

Table 1. Catchment Areas and Storage Volumes

Storage Location	Catchment Area (ha)	Residential Imp. Area (ha)	Employment Imp. Area (ha)	Mixed Imp. Area (ha)	Total Impermeable Area (ha)	Attenuation Volume (m^3)	Borehole No.
A	2.02	1.036	-	-	1.036	1124	1
B	2.50	0.5	1.50	-	2.0	1699	4
C	1.24	0.62	-	-	0.62	500	2
D	1.226	-	0.984	-	0.984	950	2
E	0.97	-	0.93	-	0.93	800	2
F	1.521	0.612	0.451	-	1.063	1144	2
G	1.515	0.744		0.292	1.036	951	2
H	1.08	0.648	-	-	0.648	521	2
J	2.438	1.466	-	-	1.466	1399	3
K	0.707	0.422	-	-	0.422	301	2
L	1.461	0.956	-	-	0.956	891	2
M	2.593	1.556	-	-	1.556	1603	3

Residential catchment areas are based on a 50% to 60% impermeability rate depending on density and employment, and mixed-use areas are based on a 90% impermeability rate. The rates used for each catchment area are shown on the Drainage Strategy drawing in Appendix B.

5.3 Sustainable Drainage Systems

The sustainable credentials of the Drainage Strategy can be assessed in accordance with the guidance contained within the SUDS Manual (Ciria C753) which refers to four pillars of SUDS design.

5.3.1 Quantity

The proposal to utilise borehole soakaways ensures that the volume of run-off from the site can be reduced for rainfall events up to and including the 1 in 100 year + 40% storm event.

5.3.2 Quality

Surface water attenuation for the borehole soakaways will be via open storage areas. These could be constructed to allow for sedimentation before flows enter the infiltration component. The site is not located within a Source Protection Zone (SPZ) and therefore surface water run-off from the proposed development would be discharged to ground with minimal risk of contamination.

Permeable paving could also be used to reduce the levels of suspended solids, metals and hydro-carbons from residential driveways.

Areas of the proposed development that are identified as mixed-use or commercial may require additional treatment. This will be provided by the use of swales which will also provide a conveyance function.

5.3.3 Amenity

The value of basins will be enhanced with wetland planting footpaths and surrounding wildflower mixes to enhance their amenity contribution.

5.3.4 *Biodiversity*

Vegetated detention basins and swales will include a variety of structurally diverse planting that will help make a positive contribution to urban biodiversity by providing habitat and food for invertebrates and birds.

5.4 Maintenance

The primary means of conveying surface water from domestic surfaces will be via a network of below ground sewers and manholes. The network will be designed to comply with Thames Water standards so it can be offered for adoption under a Section 104 Agreement. With the advent of Sewers for Adoption 8th Edition (SfA8) the attenuation features may also be adopted by Thames Water. However, in the instance where the site is developed prior to the release of SfA8 the attenuation features and boreholes will be maintained by a private management company.

A typical maintenance regime for attenuation tank, swales, basins and permeable paving is outlined in the SUDS Manual, and summarised in Table 2 below.

Table 2. SUDS Operation and Maintenance Activity

Operation and Maintenance Activity		Attenuation Basins	Swales	Attenuation Storage Tanks	Tanked Permeable Paving
Regular Maintenance	Inspection	✓	✓	✓	
	Litter and debris removal	✓	✓	✓	
	Sediment removal	✓	✓	✓	
	Grass cutting	✓	✓		
	Inspect inlets/outlets	✓	✓		
	Brushing and vacuuming				✓
Occasional Maintenance	Sediment management	✓	✓		
	Weed removal	✓	✓	✓	✓
	Tree root control/removal	✓	✓		
	Repair inlets, outlets and vents			✓	
	Stabilise and mow contributing and adjacent areas				✓
Remedial Maintenance	Repair erosion by re-turfing	✓	✓	✓	
	Relevel uneven surfaces	✓		✓	✓
	Survey inside of tank for sediment			✓	
	Remediate any landscaping or broken blocks				✓

5.5 Proposed Foul Water Drainage Strategy

The existing foul sewer network discharges to a Thames Water foul sewer in Polhill Road (A224) via a single point of discharge in the northeastern corner of the site (see Figure 3). It is proposed to continue to utilise this connection. An existing pumping station and rising main located in the south of the site will need to be maintained to serve the existing retained buildings and scheduled ancient monument.

Due to the site topography it will be necessary for parts of the proposed development to be served by a pumped system that utilises the same point of discharge as the existing system. An initial assessment indicates that two new pumping stations will be required. One in the west and one in the northern most point.

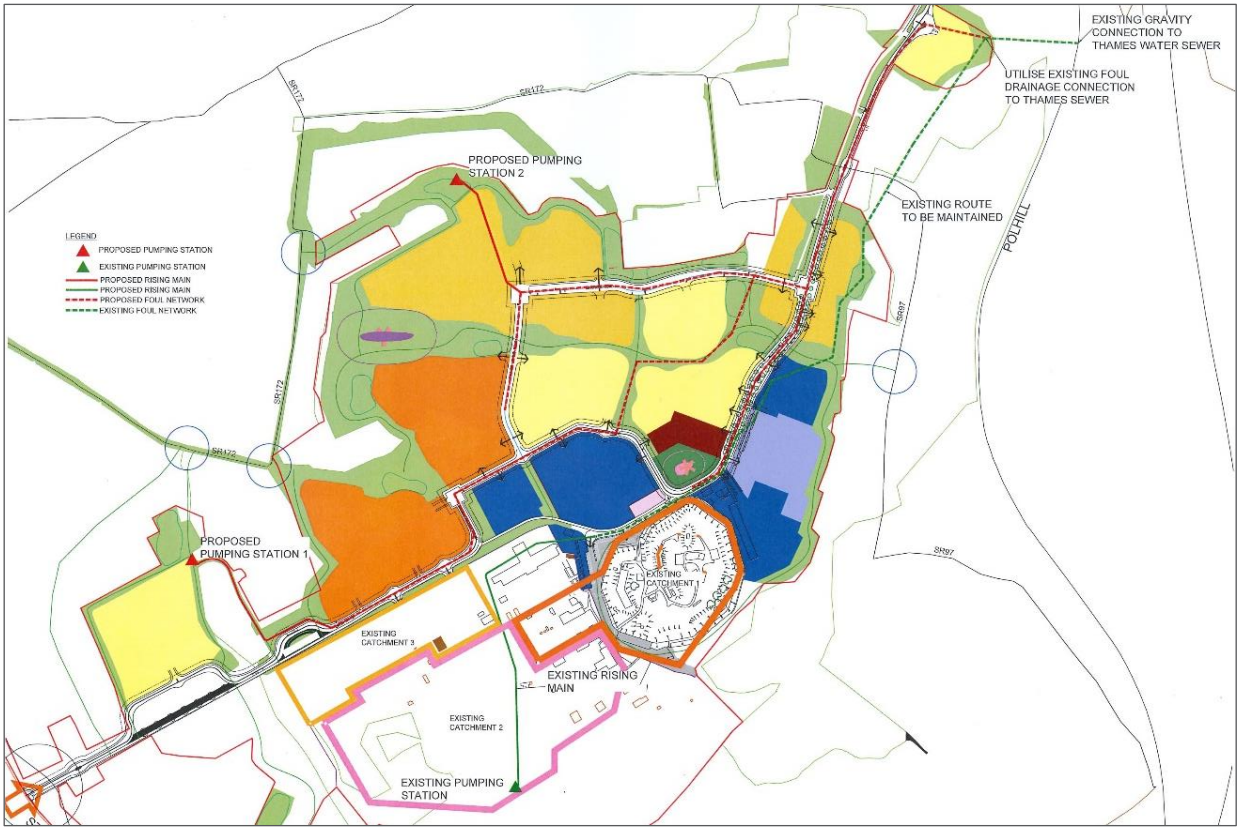


Figure 3. Proposed Foul Sewer Network Schematic

The proposed foul sewer network will be offered for adoption to Thames Water under a Section 104 Legal Agreement.

6. CONCLUSIONS

This report has considered the flood risk posed to the proposal site from a variety of sources of flooding.

The entirety of the site is confirmed to be within Flood Zone 1, and at low risk of flooding from all other sources.

The Application is concluded to meet the requirements of the Sequential and Exception Tests.

Finished floor levels will be set a minimum 150mm above adjacent infrastructure thoroughfare levels, and the proposed highway and building layout will be designed to accommodate any design exceedance overland flows through the site. Such measures are intended to afford the site additional protection from potential 'residual' flood risks.

Safe access and egress has also been demonstrated to and from the site, as well as the fact that the proposed scheme will not result in a loss of floodplain storage or redirect any surface water overland flows onto adjacent land / properties.

A Surface Water Drainage Strategy has been presented which advocates the use of Sustainable Drainage Systems (SUDS).

The use of borehole soakaways linked to attenuation basins will reduce the volume of surface water run-off to accommodate the 1 in 100 year + 40% storm event. A network of sewers and manholes leading to the attenuation basins will be designed to contain a 1 in 30 year storm event.

Foul drainage will be pumped to the public network on Polhill Road.

This report therefore demonstrates that the proposed development:

- Is suitable in the location proposed.
- Will be adequately flood resistant and resilient.
- Will not place additional persons at risk of flooding, and will offer a safe means of access and egress.
- Will not increase flood risk elsewhere as a result of the proposed development through the loss of floodplain storage or impedance of flood flows.
- Will put in place measures to ensure surface water is appropriately managed.

As such, the Application is concluded to meet the flood risk requirements of the NPPF.

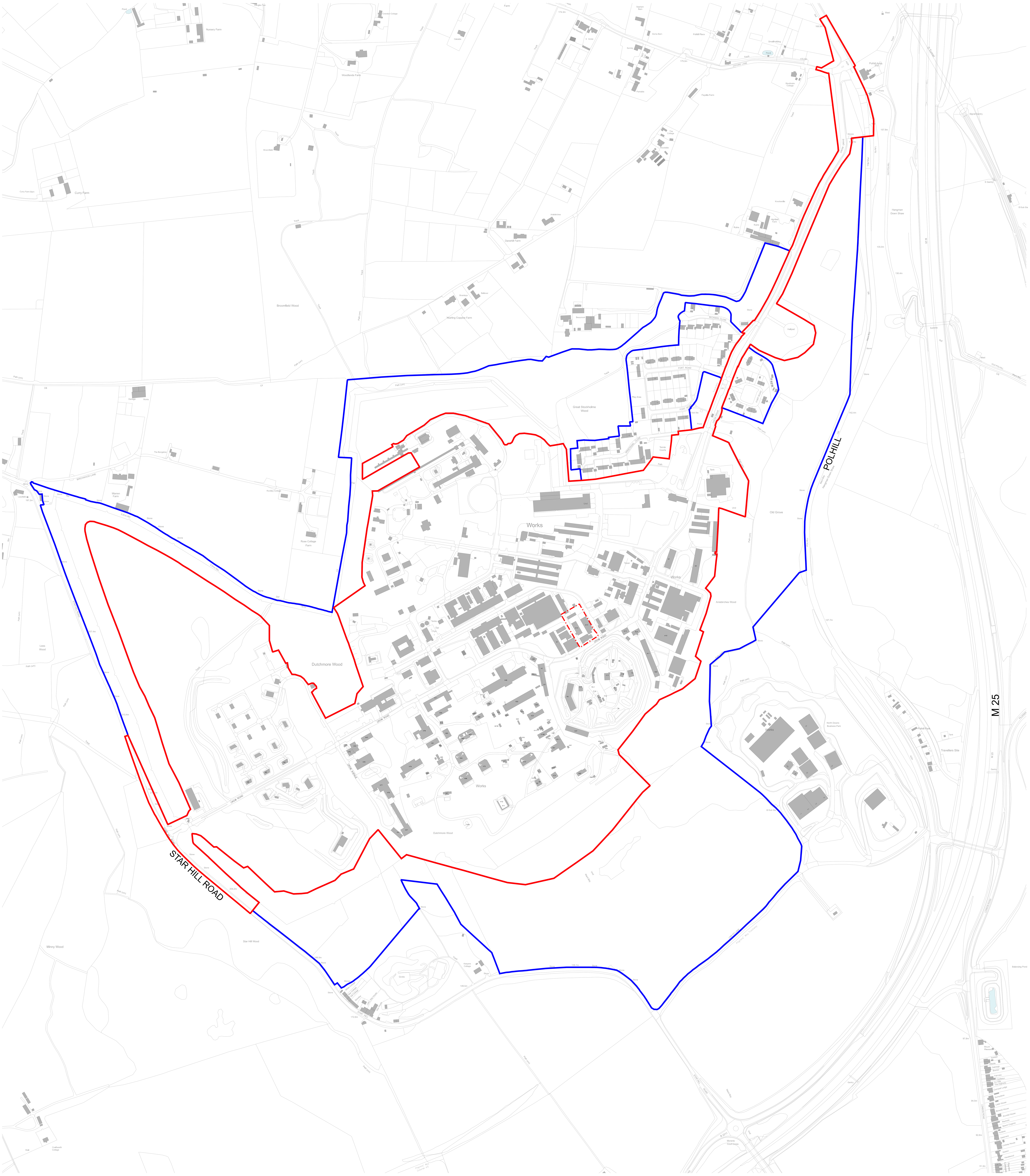
Hydrock Consultants Limited

Appendix A - Site Details

Reference	Title
00666I_S01	Site Location Plan
10323 Master	Topographical Survey
00556I_PP01	Land Use and Green Infrastructure Plan

Notes:
Do not scale from this drawing.
All contractors must visit the site and be responsible for taking and checking Dimensions.
All construction information should be taken from figured dimensions only.
Any discrepancies between drawings, specifications and site conditions must be brought to the attention of the supervising officer.

This drawing is for planning purposes only. It is not intended to be used for construction purposes. Whilst all reasonable efforts are used to ensure drawings are accurate, JTP accept no responsibility or liability for any reliance placed on, or use made of, this plan by anyone for purposes other than those stated above.



Key
- Outline Planning Application boundary
- Applicant's land ownership boundary
- Detailed Planning Application boundary

Rev	Date	Description	Drawn	Chkd
P1	23.08.19	Submitted for Planning	DZL	ECC

Drawing Status
FOR PLANNING

Client
Merseyside Pension Fund

JTP Studios
Unit 5, The Rum Warehouse
Pennington Street
London, E1W 2AP

+44 (0)20 7017 1780
www.jtp.co.uk

Project
Fort Halstead

Drawing Title
Site Location Plan

Scale @ A0: 1:2500
Job Ref.: 00556I
Drawing No.: 00556I_S01
Revision: P1
Scale Bar: 0 20 40 60 80 100m

Station Information:

Station	Easting (m)	Northing (m)	Level (m)
1	550352.511	150356.664	199.915
2	550375.378	150247.102	198.433
3	550356.739	150160.765	170.329
4	550299.640	150058.633	174.327
5	550273.584	150002.162	176.916
6	550220.149	149883.577	182.443
7	550183.195	149826.126	184.427
8	550146.593	149757.439	187.668
9	550119.947	149670.674	192.177
GH1	550065.951	150462.506	202.727
GH2	550007.979	150381.439	206.503
GH3	549963.736	150264.286	210.148
GH4	549887.581	150216.733	212.717
GH5	549795.720	150158.810	213.764
GH6	549725.242	150222.348	213.847
GH7	549601.725	150164.561	214.578
GH8	549481.213	150092.351	217.084
GH9	549363.777	150027.096	217.453
GH10	549263.579	150063.123	217.822
GH11	549151.926	150002.035	218.432

Legend:

Rev	Date	Description	Drawn	Auth'd

greenhatch group
Rowan House
Duffield Road
Little Eaton
Derby
DE21 5DR
Tel (01332) 830044 Fax (01332) 830055
admin@greenhatch-group.co.uk

CLIENT
Waterman Group

PROJECT
Fort Halstead

TITLE
Topographical Survey

SCALE	DATE	DRAWN	AUTH'D
1: 2500	14.08.07	RP	NJ

Level datum: OS GPS
Grid orientation: OS GPS
Job number: 10323
CAD File: D:\10323

Drawing No.: 10323 Master
Rev.:

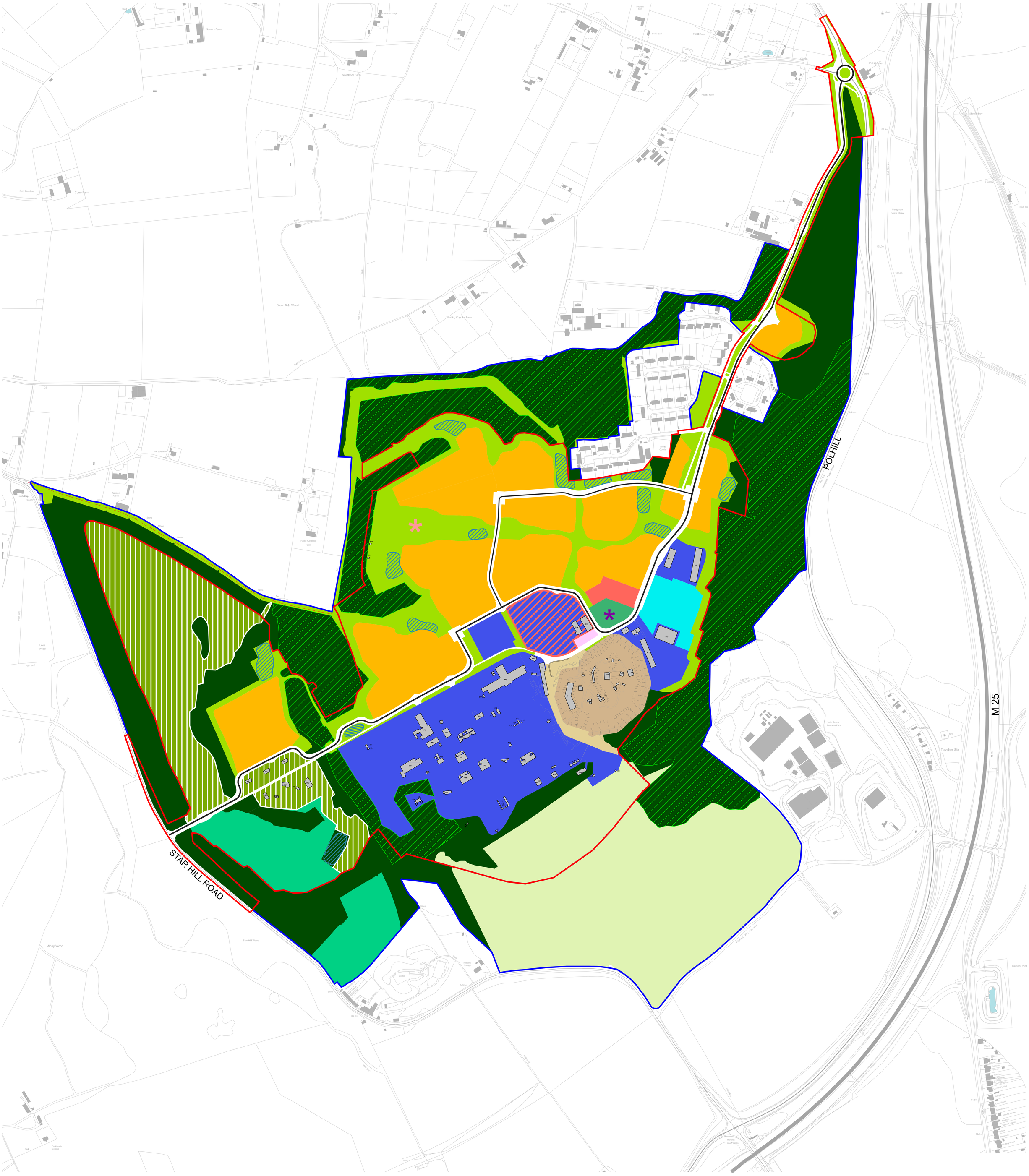
Comments
This plan should only be used for its original purpose. Greenhatch Ltd accepts no responsibility for this plan if supplied to any party other than the original client.
All dimensions should be checked on site prior to design and construction.
Drainage information (where applicable) has been visually inspected from the surface and therefore should be treated as approximate only.

Notes:

DO NOT SCALE

Notes:
Do not scale from this drawing.
All contractors must visit the site and be responsible for taking and checking Dimensions.
All construction information should be taken from figured dimensions only.
Any discrepancies between drawings, specifications and site conditions must be brought to the attention of the supervising officer.
This drawing and the works depicted are the copyright of JTP.

This drawing is for planning purposes only. It is not intended to be used for construction purposes. Whilst all reasonable efforts are used to ensure drawings are accurate, JTP accept no responsibility or liability for any reliance placed on, or use made of, this plan by anyone for purposes other than those stated above.



KEY

- Application boundary
- Applicant's land ownership boundary
- Existing buildings for retention
- Proposed vehicular routes
- Scheduled monument (The Fort)
- Residential
- Mixed Use
- Employment
- Employment / Mixed Use
- Primary school
- Village Square
- Hardstanding
- Village Green
- Public Open Space (incl. woodland buffer, SuDs, Children's play area)
- Community Recreation Area
- Existing Woodland
- Existing Ancient Woodland
- Ecologically Enhanced Grassland / Mitigation Zone
- Existing Chalk Grassland
- Indicative Neighbourhood Equipped Area for Play (NEAP)
- Indicative Local Equipped Area for Play (LEAP)
- Indicative location for SuDS ponds

Notes:
All land uses can deviate +/-3m within the application boundary, subject to on-site constraints.

*The shapes and sizes of the ponds as shown on the plan are indicative only.

Rev	Date	Description	Drawn	Chkd
P1	23.08.19	Submitted for Planning	DZL	ECC

Drawing Status
FOR PLANNING

Client
Merseyside Pension Fund

JTP Studios
Unit 5, The Rum Warehouse
Pennington Street
London, E1W 2AP
+44 (0)20 7017 1780
www.jtp.co.uk

Project
Fort Halstead

Drawing Title
Land Use and
Green Infrastructure Plan

Scale @ A0 1:2500
Job Ref. 00556I
Drawing No. 00556I_PP01
Revision P1
Scale Bar 0 20 40 60 80 100m

Appendix B - Drainage Strategy

Reference	Title
10730-HYD-XX-XX-DR-C-2201	Surface Water Drainage Strategy
-	Micro Drainage Calculations

OS NORTH

SR172

SR172

SR172

SR172

POLHILL

SR97

SR97

STAR HILL ROAD

MITCHELL ROAD

FENNARD-JONES

FENNARD-JONES

BASIN C
Drained Area = 0.62ha
Max volume = 500m³

STORAGE M
Drained Area = 1.556ha
BASIN - Max Volume = 1323m³
ATTENUATION TANK - Max Volume = 280m³

STORAGE J
Drained Area = 1.466ha
BASIN - Max Volume = 749m³
ATTENUATION TANK - Max Volume = 650m³

STORAGE B
Drained Area = 2.0ha
BASIN - Max Volume = 299m³
ATTENUATION TANK = 1400m³

BASIN K
Drained Area = 0.422ha
Max Volume = 301m³

BASIN G1+G2
Drained Area = 1.036ha
Max Volume = 951m³

BASIN L
Drained Area = 0.956
Max Volume = 891m³

BASIN H
Drained Area - 0.648ha
Max Volume = 521m³

BASIN A
Drained Area - 0.967ha
Max Volume1124m³

BASIN F - 1144m³

ATTENUATION TANK - D
Drained Area - 0.984ha
Max Volume = 950m³

ATTENUATION TANK - E
Drained Area - 0.93ha
Max Volume = 800m³

R8
1.24 ha. (0.62 ha.)
25 dph (50% imp)

R6
0.857 ha. (0.514 ha.)
30 dph (60% imp)

R1
0.63 ha. (0.38 ha.)
35 dph (60% imp)

R7
0.926 ha. (0.556 ha.)
35 dph (60% imp)

R5
0.81 ha. (0.486 ha.)
40 dph (60% imp)

R2
0.20 ha. (0.12 ha.)
40 dph (60% imp)

R4
0.95ha. (0.57ha)
45 dph

R11
0.287ha. (0.172ha.)
45 dph (60% imp)

R11
0.42ha. (0.25ha.)
45 dph (60% imp)

R10
0.56 ha. (0.34 ha.)
45 dph (60% imp)

R10
0.928ha. (0.556ha)
55 dph (70% imp)

R9
0.61ha. (0.366ha.)
45 dph (60% imp)

R9
0.54ha. (0.378ha.)
55 dph (70% imp)

R11
0.611ha. (0.366ha.)
45 dph (60% imp)

R11
0.85ha. (0.59ha.)
55 dph (70% imp)

M3
0.365ha. (0.292ha)
(80% imp)

M4
1.146ha. (0.92ha.)
(80% imp)

E3
0.501ha. (0.451ha.)
(90% imp)

M1
0.08ha. (0.064ha.)
(80% imp)

E1
1.67 ha. (1.34 ha.)
(90% imp)

R12
1.08ha. (0.648ha)
40 dph (60% imp)

R12
1.02ha. (0.612ha.)
40 dph (60% imp)

R12
0.31 ha. (0.186 ha.)
40 dph (60% imp)

R13
1.71 ha. (0.85 ha.)
20 dph (50% imp)

KEY PLAN

- Proposed soakaway borehole (with 10.0m offset to adjacent boreholes)
- Indicative primary flow route
- Proposed mixed use plot
- Proposed residential plot
- Village Green
- Proposed employment plot
- Approx 15.0m buffer zone from extent of Ancient Woodland
- Proposed attenuation pond
- Existing 'Category A' tree
- Below Ground Cellular Storage Tank

NOTES:

1. Borehole Infiltration test results used to produce the drainage strategy are taken from Watermans Report
2. Infiltration rates used for borehole design are an average of three tests taken across the site giving an average rate of 0.7700m/hr ($2.138x10^{-4}$ m/s)
3. The Drainage Strategy, infiltration rates and attenuation volumes quoted will need to be verified by additional on site borehole infiltration tests.
4. The quantity and location of boreholes currently shown are reliant on the results of additional tests. Additional boreholes may be required if rates obtained by additional testing are lower than those currently recommended in the Watermans Report
5. Maximum attenuation volumes quoted are based on the critical 1 in 100 year event plus 40% allowance for climate change.
6. The discharge rate from the attenuation basis has been restricted to 5l/s via a Hydro-Brake flow control device.
7. The purpose of this drawing is to demonstrate an intended approach to the drainage of the site. it does not purport to be a detailed design and should not be used for construction.

REVISIONS

P04	03/09/2019	Updated attenuation basin sizes and locations to suit updated layout.	SM	DB	DB
P03	04/03/2019	Update to attenuation features following Architects comments	SM	DB	DB
P02	05/02/2019	Updated attenuation sizing. Reviewed borehole locations and by resticting flow to boreholes to 5.0l/s	SM	DB	DB
P01	03/12/18	First Issue.	JLWI	DB	DB
Rev	Date	Description	By	Ckd	App

Hydrock
OVER COURT BARNS
OVER LANE
ALMONDSBURY
BRISTOL
BS32 4DF
t: +44 (0) 1454 619533
e: bristol@hydrock.com

CLIENT
CBRE

PROJECT
FORT HALSTEAD

TITLE
SURFACE WATER DRAINAGE STRATEGY

HYDROCK PROJECT NO.	SCALE @ A1
C-10730	1 : 2,000

STATUS DESCRIPTION	STATUS
INFORMATION	S2

DRAWING NO. (PROJECT CODE-ORGINATOR-ZONE-LEVEL-TYPE-ROLE-NUMBER)	REVISION
10730-HYD-XX-XX-DR-C-2201	P04

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Pond A

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	20.700	Add Flow / Climate Change (%)	0
Ratio R	0.370	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Pond A

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.745	4-8	0.291

Total Area Contributing (ha) = 1.036

Total Pipe Volume (m³) = 6.362

Network Design Table for Pond A

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	10.000	0.250	40.0	1.036	5.00	0.0	0.600	o	450	Pipe/Conduit	
S1.001	5.000	2.800	1.8	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.002	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.003	5.000	0.013	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.004	10.000	0.060	166.7	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.05	214.350	1.036	0.0	0.0	0.0	3.22	512.5	140.3
S1.001	50.00	5.06	214.100	1.036	0.0	0.0	0.0	15.30	2433.2	140.3
S1.002	50.00	5.22	211.300	1.036	0.0	0.0	0.0	1.03	163.9	140.3
S1.003	50.00	5.30	211.274	1.036	0.0	0.0	0.0	1.03	163.9	140.3
S1.004	50.00	5.41	211.261	1.036	0.0	0.0	0.0	1.57	250.0	140.3

Simulation Criteria for Pond A

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.700	Storm Duration (mins)	30
Ratio R	0.370		

Online Controls for Pond A

Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.003, Volume (m³): 6.3

Unit Reference	MD-SHE-0098-5000-1500-5000
Design Head (m)	1.500
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	98
Invert Level (m)	211.274
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	5.0	Kick-Flo®	0.878	3.9
Flush-Flo™	0.431	4.9	Mean Flow over Head Range	-	4.3

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)	Depth (m)	Flow (l/s)
0.100	3.2	0.800	4.3	2.000	5.7	4.000	7.9	7.000	10.3
0.200	4.4	1.000	4.1	2.200	6.0	4.500	8.4	7.500	10.7
0.300	4.8	1.200	4.5	2.400	6.2	5.000	8.8	8.000	11.0
0.400	4.9	1.400	4.8	2.600	6.5	5.500	9.2	8.500	11.3
0.500	4.9	1.600	5.1	3.000	6.9	6.000	9.6	9.000	11.6
0.600	4.8	1.800	5.4	3.500	7.4	6.500	10.0	9.500	11.9

Weir Manhole: S5, DS/PN: S1.004, Volume (m³): 0.6

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 214.600

Storage Structures for Pond A

Tank or Pond Manhole: S3, DS/PN: S1.002

Invert Level (m) 211.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	664.0	1.200	1174.8	2.400	1830.4	3.600	2630.8	4.800	3576.0
0.200	739.1	1.400	1274.1	2.600	1953.8	3.800	2778.3	5.000	3747.6
0.400	818.2	1.600	1377.3	2.800	2081.2	4.000	2929.8		
0.600	901.3	1.800	1484.6	3.000	2212.5	4.200	3085.3		
0.800	988.5	2.000	1595.8	3.200	2347.9	4.400	3244.8		
1.000	1079.6	2.200	1711.1	3.400	2487.4	4.600	3408.4		

Deep Bore Soakaway Manhole: S5, DS/PN: S1.004

Chamber Invert Level (m) 193.261 Infiltration Coefficient Base (m/hr) 0.77000
Chamber Diameter/Length (m) 1.350 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 18.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond A

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	1	+0%	30/15 Summer				214.581	-0.219
S1.001	S2	15 Winter	1	+0%					214.218	-0.332
S1.002	S3	2880 Winter	1	+0%	30/180 Winter				211.650	-0.100
S1.003	S4	2880 Winter	1	+0%	30/120 Winter				211.650	-0.074
S1.004	S5	2880 Winter	1	+0%	30/180 Winter				211.619	-0.092

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.51		144.0	OK	
S1.001	S2	0.000	0.15		143.9	OK	
S1.002	S3	0.000	0.01		1.1	OK	
S1.003	S4	0.000	0.01		1.1	OK	
S1.004	S5	0.000	0.00		0.0	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond A

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	30	+0%	30/15 Summer				214.937	0.137
S1.001	S2	15 Winter	30	+0%					214.291	-0.259
S1.002	S3	2880 Winter	30	+0%	30/180 Winter				212.033	0.283
S1.003	S4	2880 Winter	30	+0%	30/120 Winter				212.053	0.329
S1.004	S5	2880 Winter	30	+0%	30/180 Winter				212.002	0.291

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	1.25		353.1	SURCHARGED	
S1.001	S2	0.000	0.38		353.7	OK	
S1.002	S3	0.000	0.01		1.1	SURCHARGED	
S1.003	S4	0.000	0.01		1.1	SURCHARGED	
S1.004	S5	0.000	0.00		0.0	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond A

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	100	+40%	30/15 Summer				215.782	0.982
S1.001	S2	15 Winter	100	+40%					214.368	-0.182
S1.002	S3	2880 Winter	100	+40%	30/180 Winter				212.528	0.778
S1.003	S4	2880 Winter	100	+40%	30/120 Winter				212.548	0.824
S1.004	S5	2880 Winter	100	+40%	30/180 Winter				212.497	0.786

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	2.22		626.5	FLOOD RISK	
S1.001	S2	0.000	0.66		624.7	OK	
S1.002	S3	0.000	0.01		1.2	FLOOD RISK	
S1.003	S4	0.000	0.01		1.2	SURCHARGED	
S1.004	S5	0.000	0.00		0.0	SURCHARGED	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Pond B

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	20.700	Add Flow / Climate Change (%)	0
Ratio R	0.370	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Pond B

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.957	4-8	1.043

Total Area Contributing (ha) = 2.000

Total Pipe Volume (m³) = 45.482

Network Design Table for Pond B

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	25.090	0.190	132.1	2.000	5.00	0.0	0.600	o	750	Pipe/Conduit	
S1.001	42.790	0.230	186.0	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
S1.002	22.297	0.056	398.2	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.003	10.000	0.013	769.2	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.004	10.000	0.060	166.7	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.005	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.006	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.007	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.17	193.420	2.000	0.0	0.0	0.0	2.43	1075.2	270.8
S1.001	50.00	5.52	193.230	2.000	0.0	0.0	0.0	2.05	905.0	270.8
S1.002	50.00	5.83	193.000	2.000	0.0	0.0	0.0	1.21	343.3	270.8
S1.003	50.00	6.02	192.944	2.000	0.0	0.0	0.0	0.87	246.0«	270.8
S1.004	49.72	6.12	192.931	2.000	0.0	0.0	0.0	1.57	250.0«	270.8
S1.005	49.12	6.29	192.871	2.000	0.0	0.0	0.0	1.03	163.9«	270.8
S1.006	48.54	6.45	192.845	2.000	0.0	0.0	0.0	1.03	163.9«	270.8
S1.007	47.97	6.61	192.819	2.000	0.0	0.0	0.0	1.03	163.9«	270.8

Simulation Criteria for Pond B

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.700	Storm Duration (mins)	30
Ratio R	0.370		

Online Controls for Pond B

Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.003, Volume (m³): 34.9

Unit Reference	MD-SHE-0094-5000-1800-5000
Design Head (m)	1.800
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	94
Invert Level (m)	192.944
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	5.0	Kick-Flo®	0.838	3.5
Flush-Flo™	0.411	4.4	Mean Flow over Head Range	-	4.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.0	0.800	3.7	2.000	5.2	4.000	7.3	7.000	9.5
0.200	4.0	1.000	3.8	2.200	5.5	4.500	7.7	7.500	9.8
0.300	4.3	1.200	4.1	2.400	5.7	5.000	8.1	8.000	10.1
0.400	4.4	1.400	4.4	2.600	5.9	5.500	8.4	8.500	10.4
0.500	4.4	1.600	4.7	3.000	6.3	6.000	8.8	9.000	10.7
0.600	4.3	1.800	5.0	3.500	6.8	6.500	9.1	9.500	11.0

Weir Manhole: S195.7, DS/PN: S1.007, Volume (m³): 1.4

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 195.600

Storage Structures for Pond B

Tank or Pond Manhole: S3, DS/PN: S1.002

Invert Level (m) 193.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	500.0	1.200	500.0	2.400	500.0	3.600	330.9	4.800	603.7
0.200	500.0	1.400	500.0	2.600	500.0	3.800	370.7	5.000	657.1
0.400	500.0	1.600	500.0	2.800	500.0	4.000	412.8		
0.600	500.0	1.800	500.0	3.000	225.0	4.200	457.1		
0.800	500.0	2.000	500.0	3.200	258.0	4.400	503.7		
1.000	500.0	2.200	500.0	3.400	293.3	4.600	552.6		

Deep Bore Soakaway Manhole: S5, DS/PN: S1.004

Chamber Invert Level (m) 173.186 Infiltration Coefficient Base (m/hr) 0.77000
Chamber Diameter/Length (m) 1.500 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 18.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

Deep Bore Soakaway Manhole: S6, DS/PN: S1.005

Chamber Invert Level (m) 178.976 Infiltration Coefficient Base (m/hr) 0.77000
Chamber Diameter/Length (m) 1.350 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 18.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

Deep Bore Soakaway Manhole: S7, DS/PN: S1.006

Chamber Invert Level (m) 179.100 Infiltration Coefficient Base (m/hr) 0.77000
Chamber Diameter/Length (m) 1.350 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 18.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

Deep Bore Soakaway Manhole: S195.7, DS/PN: S1.007

Chamber Invert Level (m)	179.074	Infiltration Coefficient Base (m/hr)	0.77000
Chamber Diameter/Length (m)	1.350	Safety Factor	2.0
Borehole Diameter (m)	0.300		
Borehole Depth (m)	18.000		

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond B

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	1	+0%	30/60 Winter				193.757	-0.413
S1.001	S2	960 Winter	1	+0%	30/60 Winter				193.677	-0.303
S1.002	S3	960 Winter	1	+0%	1/360 Winter				193.677	0.077
S1.003	S4	960 Winter	1	+0%	1/240 Winter				193.700	0.156
S1.004	S5	960 Winter	1	+0%	1/240 Winter				193.513	0.132
S1.005	S6	960 Winter	1	+0%	1/180 Winter				193.513	0.192
S1.006	S7	960 Winter	1	+0%	1/120 Winter				193.513	0.218
S1.007	S195.7	960 Winter	1	+0%	1/120 Winter				193.513	0.244

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.41		279.7	OK	
S1.001	S2	0.000	0.03		23.1	OK	
S1.002	S3	0.000	0.02		6.6	SURCHARGED	
S1.003	S4	0.000	0.03		4.0	SURCHARGED	
S1.004	S5	0.000	0.02		3.2	SURCHARGED	
S1.005	S6	0.000	0.02		2.4	SURCHARGED	
S1.006	S7	0.000	0.02		1.5	SURCHARGED	
S1.007	S195.7	0.000	0.00		0.0	SURCHARGED	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond B

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	1440 Winter	30	+0%	30/60 Winter				194.731	0.561
S1.001	S2	1440 Winter	30	+0%	30/60 Winter				194.730	0.750
S1.002	S3	1440 Winter	30	+0%	1/360 Winter				194.730	1.130
S1.003	S4	1440 Winter	30	+0%	1/240 Winter				194.754	1.210
S1.004	S5	1440 Winter	30	+0%	1/240 Winter				194.743	1.362
S1.005	S6	1440 Winter	30	+0%	1/180 Winter				195.188	1.867
S1.006	S7	1440 Winter	30	+0%	1/120 Winter				195.624	2.329
S1.007	S195.7	1440 Winter	30	+0%	1/120 Winter				195.651	2.382

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.05		35.1	SURCHARGED	
S1.001	S2	0.000	0.05		35.1	SURCHARGED	
S1.002	S3	0.000	0.04		10.0	SURCHARGED	
S1.003	S4	0.000	0.03		3.8	SURCHARGED	
S1.004	S5	0.000	0.14		24.1	SURCHARGED	
S1.005	S6	0.000	0.18		17.7	SURCHARGED	
S1.006	S7	0.000	0.08		8.5	SURCHARGED	
S1.007	S195.7	0.000	0.01		0.9	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond B

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.700	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.369	Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	2160 Winter	100	+40%	30/60 Winter				196.703	2.533
S1.001	S2	2160 Winter	100	+40%	30/60 Winter				196.702	2.722
S1.002	S3	2160 Winter	100	+40%	1/360 Winter				196.703	3.103
S1.003	S4	2160 Winter	100	+40%	1/240 Winter				196.724	3.180
S1.004	S5	2160 Winter	100	+40%	1/240 Winter				194.836	1.455
S1.005	S6	1440 Winter	100	+40%	1/180 Winter				195.609	2.288
S1.006	S7	2880 Winter	100	+40%	1/120 Winter				195.731	2.436
S1.007	S195.7	2160 Winter	100	+40%	1/120 Winter				195.673	2.404

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.06		43.2	SURCHARGED	
S1.001	S2	0.000	0.06		42.9	SURCHARGED	
S1.002	S3	0.000	0.05		13.3	SURCHARGED	
S1.003	S4	0.000	0.04		5.6	SURCHARGED	
S1.004	S5	0.000	0.15		24.7	SURCHARGED	
S1.005	S6	0.000	0.19		18.8	SURCHARGED	
S1.006	S7	0.000	0.09		9.5	FLOOD RISK	
S1.007	S195.7	0.000	0.03		3.3	SURCHARGED	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Pond C

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	20.700	Add Flow / Climate Change (%)	0
Ratio R	0.370	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Pond C

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.386	4-8	0.234

Total Area Contributing (ha) = 0.620

Total Pipe Volume (m³) = 16.434

Network Design Table for Pond C

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	10.000	0.050	200.0	0.620	5.00	0.0	0.600	o	750	Pipe/Conduit	
S1.001	5.000	0.373	13.4	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.002	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.003	5.000	0.013	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.004	10.000	0.060	166.7	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.005	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.006	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.007	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.08	197.723	0.620	0.0	0.0	0.0	1.98	872.6	84.0
S1.001	50.00	5.10	197.673	0.620	0.0	0.0	0.0	6.67	1887.1	84.0
S1.002	50.00	5.23	197.225	0.620	0.0	0.0	0.0	1.24	349.4	84.0
S1.003	50.00	5.30	197.199	0.620	0.0	0.0	0.0	1.24	349.4	84.0
S1.004	50.00	5.41	197.186	0.620	0.0	0.0	0.0	1.57	250.0	84.0
S1.005	50.00	5.57	197.126	0.620	0.0	0.0	0.0	1.03	163.9	84.0
S1.006	50.00	5.73	197.100	0.620	0.0	0.0	0.0	1.03	163.9	84.0
S1.007	50.00	5.89	197.074	0.620	0.0	0.0	0.0	1.03	163.9	84.0

Simulation Criteria for Pond C

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.700	Storm Duration (mins)	30
Ratio R	0.370		

Online Controls for Pond C

Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.003, Volume (m³): 11.8

Unit Reference	MD-SHE-0103-5000-1200-5000
Design Head (m)	1.200
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	197.199
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.0	Kick-Flo®	0.745	4.0
Flush-Flo™	0.354	5.0	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)	Depth (m)	Flow (l/s)
0.100	3.4	0.800	4.1	2.000	6.3	4.000	8.8	7.000	11.5
0.200	4.7	1.000	4.6	2.200	6.6	4.500	9.3	7.500	11.8
0.300	5.0	1.200	5.0	2.400	6.9	5.000	9.8	8.000	12.2
0.400	5.0	1.400	5.4	2.600	7.2	5.500	10.2	8.500	12.6
0.500	4.9	1.600	5.7	3.000	7.7	6.000	10.7	9.000	12.9
0.600	4.7	1.800	6.0	3.500	8.3	6.500	11.1	9.500	13.3

Weir Manhole: S8, DS/PN: S1.007, Volume (m³): 3.8

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 198.750

Storage Structures for Pond C

Tank or Pond Manhole: S3, DS/PN: S1.002

Invert Level (m) 197.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	380.0	1.200	907.7	2.400	1661.6	3.600	2641.7	4.800	3848.0
0.200	452.2	1.400	1017.7	2.600	1809.3	3.800	2827.1	5.000	4071.1
0.400	530.8	1.600	1133.9	2.800	1963.2	4.000	3018.7		
0.600	615.6	1.800	1256.4	3.000	2123.4	4.200	3216.6		
0.800	706.7	2.000	1385.2	3.200	2289.9	4.400	3420.8		
1.000	804.1	2.200	1520.3	3.400	2462.7	4.600	3631.3		

Deep Bore Soakaway Manhole: S5, DS/PN: S1.004

Chamber Invert Level (m) 173.186 Infiltration Coefficient Base (m/hr) 0.77000
Chamber Diameter/Length (m) 1.500 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 18.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

Deep Bore Soakaway Manhole: S6, DS/PN: S1.005

Chamber Invert Level (m) 178.976 Infiltration Coefficient Base (m/hr) 0.77000
Chamber Diameter/Length (m) 1.350 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 18.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond C

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	1	+0%					197.933	-0.540
S1.001	S2	15 Winter	1	+0%					197.824	-0.449
S1.002	S3	600 Winter	1	+0%	100/60 Winter				197.487	-0.338
S1.003	S4	600 Winter	1	+0%	100/60 Summer				197.487	-0.312
S1.004	S5	600 Winter	1	+0%	30/180 Winter				197.426	-0.210
S1.005	S6	600 Winter	1	+0%	30/120 Winter				197.426	-0.150
S1.006	S7	600 Winter	1	+0%	30/120 Summer				197.426	-0.124
S1.007	S8	600 Winter	1	+0%	30/60 Winter				197.426	-0.098

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.17		86.0	OK	
S1.001	S2	0.000	0.14		86.5	OK	
S1.002	S3	0.000	0.02		3.0	OK	
S1.003	S4	0.000	0.01		2.9	OK	
S1.004	S5	0.000	0.01		1.9	OK	
S1.005	S6	0.000	0.01		0.9	OK	
S1.006	S7	0.000	0.01		0.7	OK	
S1.007	S8	0.000	0.00		0.0	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond C

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	30	+0%					198.066	-0.407
S1.001	S2	15 Winter	30	+0%					197.920	-0.353
S1.002	S3	960 Winter	30	+0%	100/60 Winter				197.786	-0.039
S1.003	S4	960 Winter	30	+0%	100/60 Summer				197.786	-0.013
S1.004	S5	960 Winter	30	+0%	30/180 Winter				197.726	0.090
S1.005	S6	960 Winter	30	+0%	30/120 Winter				197.726	0.150
S1.006	S7	960 Winter	30	+0%	30/120 Summer				197.726	0.176
S1.007	S8	960 Winter	30	+0%	30/60 Winter				197.726	0.202

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.42		212.3	OK	
S1.001	S2	0.000	0.35		211.5	OK	
S1.002	S3	0.000	0.01		2.6	OK	
S1.003	S4	0.000	0.01		2.6	OK	
S1.004	S5	0.000	0.01		1.6	SURCHARGED	
S1.005	S6	0.000	0.01		0.7	SURCHARGED	
S1.006	S7	0.000	0.01		0.6	SURCHARGED	
S1.007	S8	0.000	0.00		0.0	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond C

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	100	+40%					198.225	-0.248
S1.001	S2	1440 Winter	100	+40%					198.181	-0.092
S1.002	S3	1440 Winter	100	+40%	100/60 Winter				198.181	0.356
S1.003	S4	1440 Winter	100	+40%	100/60 Summer				198.182	0.383
S1.004	S5	1440 Winter	100	+40%	30/180 Winter				198.121	0.485
S1.005	S6	1440 Winter	100	+40%	30/120 Winter				198.122	0.546
S1.006	S7	1440 Winter	100	+40%	30/120 Summer				198.122	0.572
S1.007	S8	1440 Winter	100	+40%	30/60 Winter				198.122	0.598

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.77		385.9	OK	
S1.001	S2	0.000	0.03		19.0	OK	
S1.002	S3	0.000	0.02		2.9	SURCHARGED	
S1.003	S4	0.000	0.01		2.9	SURCHARGED	
S1.004	S5	0.000	0.01		1.7	SURCHARGED	
S1.005	S6	0.000	0.01		0.8	SURCHARGED	
S1.006	S7	0.000	0.01		0.6	SURCHARGED	
S1.007	S8	0.000	0.00		0.0	SURCHARGED	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Pond D

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	20.700	Add Flow / Climate Change (%)	0
Ratio R	0.370	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Pond D

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	10.000	0.050	200.0	0.984	5.00	0.0	0.600	o	600	Pipe/Conduit	
S1.001	5.000	0.373	13.4	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.002	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.003	5.000	0.013	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.004	10.000	0.060	166.7	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.005	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.006	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.007	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.10	197.723	0.984	0.0	0.0	0.0	1.72	485.8	133.2
S1.001	50.00	5.11	197.673	0.984	0.0	0.0	0.0	6.67	1887.1	133.2
S1.002	50.00	5.24	197.300	0.984	0.0	0.0	0.0	1.24	349.4	133.2
S1.003	50.00	5.31	197.274	0.984	0.0	0.0	0.0	1.24	349.4	133.2
S1.004	50.00	5.40	197.261	0.984	0.0	0.0	0.0	1.88	532.6	133.2
S1.005	50.00	5.54	197.201	0.984	0.0	0.0	0.0	1.24	349.4	133.2
S1.006	50.00	5.67	197.175	0.984	0.0	0.0	0.0	1.24	349.4	133.2
S1.007	50.00	5.80	197.149	0.984	0.0	0.0	0.0	1.24	349.4	133.2

Simulation Criteria for Pond D

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Return Period (years) 1

Synthetic Rainfall Details

Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.700	Cv (Winter)	0.840
Ratio R	0.370	Storm Duration (mins)	30
Profile Type	Summer		

Online Controls for Pond D

Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.003, Volume (m³): 11.4

Unit Reference	MD-SHE-0103-5000-1200-5000
Design Head (m)	1.200
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	197.274
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.0	Kick-Flo®	0.745	4.0
Flush-Flo™	0.354	5.0	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)	Depth (m)	Flow (l/s)
0.100	3.4	0.800	4.1	2.000	6.3	4.000	8.8	7.000	11.5
0.200	4.7	1.000	4.6	2.200	6.6	4.500	9.3	7.500	11.8
0.300	5.0	1.200	5.0	2.400	6.9	5.000	9.8	8.000	12.2
0.400	5.0	1.400	5.4	2.600	7.2	5.500	10.2	8.500	12.6
0.500	4.9	1.600	5.7	3.000	7.7	6.000	10.7	9.000	12.9
0.600	4.7	1.800	6.0	3.500	8.3	6.500	11.1	9.500	13.3

Weir Manhole: S8, DS/PN: S1.007, Volume (m³): 5.3

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 198.750

Storage Structures for Pond D

Tank or Pond Manhole: S3, DS/PN: S1.002

Invert Level (m) 197.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	950.0	1.010	0.0	2.400	0.0	3.600	0.0	4.800	0.0
0.200	950.0	1.400	0.0	2.600	0.0	3.800	0.0	5.000	0.0
0.400	950.0	1.600	0.0	2.800	0.0	4.000	0.0		
0.600	950.0	1.800	0.0	3.000	0.0	4.200	0.0		
0.800	950.0	2.000	0.0	3.200	0.0	4.400	0.0		
1.000	950.0	2.200	0.0	3.400	0.0	4.600	0.0		

Deep Bore Soakaway Manhole: S5, DS/PN: S1.004

Chamber Invert Level (m) 173.261 Infiltration Coefficient Base (m/hr) 0.77000
Chamber Diameter/Length (m) 1.350 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 18.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

Deep Bore Soakaway Manhole: S6, DS/PN: S1.005

Chamber Invert Level (m) 178.976 Infiltration Coefficient Base (m/hr) 0.77000
Chamber Diameter/Length (m) 1.350 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 18.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond D

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	1	+0%	30/15 Winter				198.008	-0.315
S1.001	S2	15 Winter	1	+0%	100/2880 Winter				197.866	-0.407
S1.002	S3	1440 Winter	1	+0%	100/180 Winter				197.496	-0.404
S1.003	S4	1440 Winter	1	+0%	100/120 Winter				197.496	-0.378
S1.004	S5	1440 Winter	1	+0%	100/180 Winter				197.441	-0.420
S1.005	S6	1440 Winter	1	+0%	100/120 Winter				197.441	-0.360
S1.006	S7	1440 Winter	1	+0%	100/120 Winter				197.441	-0.334
S1.007	S8	1440 Winter	1	+0%	100/120 Summer				197.441	-0.308

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.44		136.0	OK	
S1.001	S2	0.000	0.22		137.3	OK	
S1.002	S3	0.000	0.01		2.7	OK	
S1.003	S4	0.000	0.01		2.6	OK	
S1.004	S5	0.000	0.01		1.8	OK	
S1.005	S6	0.000	0.00		0.8	OK	
S1.006	S7	0.000	0.00		0.7	OK	
S1.007	S8	0.000	0.00		0.0	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond D

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	30	+0%	30/15 Winter				198.344	0.021
S1.001	S2	15 Winter	30	+0%	100/2880 Winter				197.987	-0.286
S1.002	S3	2160 Winter	30	+0%	100/180 Winter				197.787	-0.113
S1.003	S4	2160 Winter	30	+0%	100/120 Winter				197.787	-0.087
S1.004	S5	2160 Winter	30	+0%	100/180 Winter				197.731	-0.130
S1.005	S6	2160 Winter	30	+0%	100/120 Winter				197.731	-0.070
S1.006	S7	2160 Winter	30	+0%	100/120 Winter				197.731	-0.044
S1.007	S8	2160 Winter	30	+0%	100/120 Summer				197.731	-0.018

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	1.08		331.1	SURCHARGED	
S1.001	S2	0.000	0.54		331.0	OK	
S1.002	S3	0.000	0.01		2.3	OK	
S1.003	S4	0.000	0.01		2.3	OK	
S1.004	S5	0.000	0.00		1.4	OK	
S1.005	S6	0.000	0.00		0.5	OK	
S1.006	S7	0.000	0.00		0.4	OK	
S1.007	S8	0.000	0.00		0.0	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond D

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.700	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.369	Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	100	+40%	30/15 Winter				198.635	0.312
S1.001	S2	2880 Winter	100	+40%	100/2880 Winter				198.281	0.008
S1.002	S3	2880 Winter	100	+40%	100/180 Winter				198.280	0.380
S1.003	S4	2880 Winter	100	+40%	100/120 Winter				198.281	0.407
S1.004	S5	2880 Winter	100	+40%	100/180 Winter				198.228	0.367
S1.005	S6	2880 Winter	100	+40%	100/120 Winter				198.228	0.427
S1.006	S7	2880 Winter	100	+40%	100/120 Winter				198.228	0.453
S1.007	S8	2880 Winter	100	+40%	100/120 Summer				198.228	0.479

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	1.99		607.9	SURCHARGED	
S1.001	S2	0.000	0.03		17.5	SURCHARGED	
S1.002	S3	0.000	0.01		2.3	SURCHARGED	
S1.003	S4	0.000	0.01		2.1	SURCHARGED	
S1.004	S5	0.000	0.00		1.3	SURCHARGED	
S1.005	S6	0.000	0.00		0.4	SURCHARGED	
S1.006	S7	0.000	0.00		0.3	SURCHARGED	
S1.007	S8	0.000	0.00		0.0	SURCHARGED	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Pond E

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	20.700	Add Flow / Climate Change (%)	0
Ratio R	0.370	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Pond E

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	10.000	0.050	200.0	0.930	5.00	0.0	0.600	o	750	Pipe/Conduit	
S1.001	5.000	0.373	13.4	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.002	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.003	5.000	0.013	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.004	10.000	0.060	166.7	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.005	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.006	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.007	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.08	197.723	0.930	0.0	0.0	0.0	1.98	872.6	125.9
S1.001	50.00	5.10	197.673	0.930	0.0	0.0	0.0	6.67	1887.1	125.9
S1.002	50.00	5.23	197.225	0.930	0.0	0.0	0.0	1.24	349.4	125.9
S1.003	50.00	5.30	197.199	0.930	0.0	0.0	0.0	1.24	349.4	125.9
S1.004	50.00	5.41	197.186	0.930	0.0	0.0	0.0	1.57	250.0	125.9
S1.005	50.00	5.57	197.126	0.930	0.0	0.0	0.0	1.03	163.9	125.9
S1.006	50.00	5.73	197.100	0.930	0.0	0.0	0.0	1.03	163.9	125.9
S1.007	50.00	5.89	197.074	0.930	0.0	0.0	0.0	1.03	163.9	125.9

Simulation Criteria for Pond E

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Return Period (years) 1

Synthetic Rainfall Details

Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.700	Cv (Winter)	0.840
Ratio R	0.370	Storm Duration (mins)	30
Profile Type	Summer		

Online Controls for Pond E

Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.003, Volume (m³): 11.8

Unit Reference	MD-SHE-0103-5000-1200-5000
Design Head (m)	1.200
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	197.199
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.0	Kick-Flo®	0.745	4.0
Flush-Flo™	0.354	5.0	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)	Depth (m)	Flow (l/s)
0.100	3.4	0.800	4.1	2.000	6.3	4.000	8.8	7.000	11.5
0.200	4.7	1.000	4.6	2.200	6.6	4.500	9.3	7.500	11.8
0.300	5.0	1.200	5.0	2.400	6.9	5.000	9.8	8.000	12.2
0.400	5.0	1.400	5.4	2.600	7.2	5.500	10.2	8.500	12.6
0.500	4.9	1.600	5.7	3.000	7.7	6.000	10.7	9.000	12.9
0.600	4.7	1.800	6.0	3.500	8.3	6.500	11.1	9.500	13.3

Weir Manhole: S8, DS/PN: S1.007, Volume (m³): 3.8

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 198.750

Storage Structures for Pond E

Tank or Pond Manhole: S3, DS/PN: S1.002

Invert Level (m) 197.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	800.0	1.001	0.0	2.400	0.0	3.600	0.0	4.800	0.0
0.200	800.0	1.400	0.0	2.600	0.0	3.800	0.0	5.000	0.0
0.400	800.0	1.600	0.0	2.800	0.0	4.000	0.0		
0.600	800.0	1.800	0.0	3.000	0.0	4.200	0.0		
0.800	800.0	2.000	0.0	3.200	0.0	4.400	0.0		
1.000	800.0	2.200	0.0	3.400	0.0	4.600	0.0		

Deep Bore Soakaway Manhole: S5, DS/PN: S1.004

Chamber Invert Level (m) 173.186 Infiltration Coefficient Base (m/hr) 0.77000
Chamber Diameter/Length (m) 1.500 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 18.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

Deep Bore Soakaway Manhole: S6, DS/PN: S1.005

Chamber Invert Level (m) 178.976 Infiltration Coefficient Base (m/hr) 0.77000
Chamber Diameter/Length (m) 1.350 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 18.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond E

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.700	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.369	Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	1	+0%	100/15 Winter				197.984
S1.001	S2	15 Winter	1	+0%	100/1440 Winter				197.861
S1.002	S3	960 Winter	1	+0%	100/60 Winter				197.486
S1.003	S4	960 Winter	1	+0%	30/1440 Winter	100/2160 Winter			197.486
S1.004	S5	960 Winter	1	+0%	30/240 Winter				197.425
S1.005	S6	960 Winter	1	+0%	30/180 Winter				197.425
S1.006	S7	960 Winter	1	+0%	30/120 Winter				197.425
S1.007	S8	960 Winter	1	+0%	30/120 Summer				197.425

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.489	0.000	0.26		128.8	OK	
S1.001	S2	-0.412	0.000	0.21		129.7	OK	
S1.002	S3	-0.339	0.000	0.01		2.5	OK	2
S1.003	S4	-0.313	0.000	0.01		2.4	OK	2
S1.004	S5	-0.211	0.000	0.01		1.6	OK	
S1.005	S6	-0.151	0.000	0.01		0.7	OK	
S1.006	S7	-0.125	0.000	0.01		0.5	OK	
S1.007	S8	-0.099	0.000	0.00		0.0	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond E

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	15 Winter	30	+0%	100/15 Winter				198.163
S1.001	S2	15 Winter	30	+0%	100/1440 Winter				197.984
S1.002	S3	1440 Winter	30	+0%	100/60 Winter				197.803
S1.003	S4	1440 Winter	30	+0%	30/1440 Winter	100/2160 Winter			197.803
S1.004	S5	1440 Winter	30	+0%	30/240 Winter				197.742
S1.005	S6	1440 Winter	30	+0%	30/180 Winter				197.742
S1.006	S7	1440 Winter	30	+0%	30/120 Winter				197.742
S1.007	S8	1440 Winter	30	+0%	30/120 Summer				197.742

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	-0.310	0.000	0.63		317.2	OK	
S1.001	S2	-0.289	0.000	0.52		318.1	OK	
S1.002	S3	-0.022	0.000	0.01		2.8	OK	2
S1.003	S4	0.004	0.000	0.01		2.8	SURCHARGED	2
S1.004	S5	0.106	0.000	0.01		1.6	SURCHARGED	
S1.005	S6	0.166	0.000	0.01		0.7	SURCHARGED	
S1.006	S7	0.192	0.000	0.01		0.6	SURCHARGED	
S1.007	S8	0.218	0.000	0.00		0.0	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond E

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.700	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.369	Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
S1.000	S1	2880 Winter	100	+40%	100/15 Winter				198.773
S1.001	S2	2880 Winter	100	+40%	100/1440 Winter				198.773
S1.002	S3	2880 Winter	100	+40%	100/60 Winter				198.773
S1.003	S4	2880 Winter	100	+40%	30/1440 Winter	100/2160 Winter			198.772
S1.004	S5	2880 Winter	100	+40%	30/240 Winter				198.713
S1.005	S6	2880 Winter	100	+40%	30/180 Winter				198.713
S1.006	S7	2880 Winter	100	+40%	30/120 Winter				198.713
S1.007	S8	2880 Winter	100	+40%	30/120 Summer				198.713

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.300	0.000	0.03		16.5	SURCHARGED	
S1.001	S2	0.500	0.000	0.03		16.4	SURCHARGED	
S1.002	S3	0.948	0.000	0.02		3.0	FLOOD	2
S1.003	S4	0.973	12.422	0.01		2.7	FLOOD	2
S1.004	S5	1.077	0.000	0.01		1.6	FLOOD RISK	
S1.005	S6	1.137	0.000	0.01		0.7	FLOOD RISK	
S1.006	S7	1.163	0.000	0.01		0.5	FLOOD RISK	
S1.007	S8	1.189	0.000	0.00		0.0	FLOOD RISK	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Pond F

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	20.700	Add Flow / Climate Change (%)	0
Ratio R	0.370	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Pond F

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	10.000	0.050	200.0	1.063	5.00	0.0	0.600	o	750	Pipe/Conduit	
S1.001	5.000	0.373	13.4	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.002	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.003	5.000	0.013	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.004	10.000	0.060	166.7	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.005	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.006	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.007	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.08	197.723	1.063	0.0	0.0	0.0	1.98	872.6	143.9
S1.001	50.00	5.10	197.673	1.063	0.0	0.0	0.0	6.67	1887.1	143.9
S1.002	50.00	5.23	197.225	1.063	0.0	0.0	0.0	1.24	349.4	143.9
S1.003	50.00	5.30	197.199	1.063	0.0	0.0	0.0	1.24	349.4	143.9
S1.004	50.00	5.41	197.186	1.063	0.0	0.0	0.0	1.57	250.0	143.9
S1.005	50.00	5.57	197.126	1.063	0.0	0.0	0.0	1.03	163.9	143.9
S1.006	50.00	5.73	197.100	1.063	0.0	0.0	0.0	1.03	163.9	143.9
S1.007	50.00	5.89	197.074	1.063	0.0	0.0	0.0	1.03	163.9	143.9

Simulation Criteria for Pond F

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Return Period (years) 1

Synthetic Rainfall Details

Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.700	Cv (Winter)	0.840
Ratio R	0.370	Storm Duration (mins)	30
Profile Type	Summer		

Online Controls for Pond F

Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.003, Volume (m³): 11.8

Unit Reference	MD-SHE-0103-5000-1200-5000
Design Head (m)	1.200
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	197.199
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.0	Kick-Flo®	0.745	4.0
Flush-Flo™	0.354	5.0	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)	Depth (m)	Flow (l/s)
0.100	3.4	0.800	4.1	2.000	6.3	4.000	8.8	7.000	11.5
0.200	4.7	1.000	4.6	2.200	6.6	4.500	9.3	7.500	11.8
0.300	5.0	1.200	5.0	2.400	6.9	5.000	9.8	8.000	12.2
0.400	5.0	1.400	5.4	2.600	7.2	5.500	10.2	8.500	12.6
0.500	4.9	1.600	5.7	3.000	7.7	6.000	10.7	9.000	12.9
0.600	4.7	1.800	6.0	3.500	8.3	6.500	11.1	9.500	13.3

Weir Manhole: S8, DS/PN: S1.007, Volume (m³): 3.8

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 198.750

Storage Structures for Pond F

Tank or Pond Manhole: S3, DS/PN: S1.002

Invert Level (m) 197.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	600.0	1.200	1089.2	2.400	1723.1	3.600	2501.8	4.800	3425.3
0.200	671.5	1.400	1184.8	2.600	1842.8	3.800	2645.7	5.000	3593.3
0.400	747.0	1.600	1284.4	2.800	1966.6	4.000	2793.6		
0.600	826.5	1.800	1388.1	3.000	2094.4	4.200	2945.5		
0.800	910.0	2.000	1495.7	3.200	2226.2	4.400	3101.4		
1.000	997.6	2.200	1607.4	3.400	2362.0	4.600	3261.3		

Deep Bore Soakaway Manhole: S5, DS/PN: S1.004

Chamber Invert Level (m) 173.186 Infiltration Coefficient Base (m/hr) 0.77000
Chamber Diameter/Length (m) 1.500 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 18.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

Deep Bore Soakaway Manhole: S6, DS/PN: S1.005

Chamber Invert Level (m) 178.976 Infiltration Coefficient Base (m/hr) 0.77000
Chamber Diameter/Length (m) 1.350 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 18.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond F

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	1	+0%	100/15 Summer				198.004	-0.469
S1.001	S2	15 Winter	1	+0%	100/15 Summer				197.874	-0.399
S1.002	S3	960 Winter	1	+0%	30/240 Winter				197.577	-0.248
S1.003	S4	960 Winter	1	+0%	30/240 Winter				197.577	-0.222
S1.004	S5	960 Winter	1	+0%	30/120 Summer				197.516	-0.120
S1.005	S6	960 Winter	1	+0%	30/60 Winter				197.516	-0.060
S1.006	S7	960 Winter	1	+0%	30/60 Summer				197.516	-0.034
S1.007	S8	960 Winter	1	+0%	30/60 Summer				197.516	-0.008

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.29		146.8	OK	
S1.001	S2	0.000	0.24		148.4	OK	
S1.002	S3	0.000	0.01		2.5	OK	
S1.003	S4	0.000	0.01		2.4	OK	
S1.004	S5	0.000	0.01		1.6	OK	
S1.005	S6	0.000	0.01		0.7	OK	
S1.006	S7	0.000	0.01		0.5	OK	
S1.007	S8	0.000	0.00		0.0	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond F

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.700	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.369	Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	30	+0%	100/15 Summer				198.205	-0.268
S1.001	S2	15 Winter	30	+0%	100/15 Summer				198.011	-0.262
S1.002	S3	1440 Winter	30	+0%	30/240 Winter				197.957	0.132
S1.003	S4	1440 Winter	30	+0%	30/240 Winter				197.958	0.159
S1.004	S5	1440 Winter	30	+0%	30/120 Summer				197.897	0.261
S1.005	S6	1440 Winter	30	+0%	30/60 Winter				197.897	0.321
S1.006	S7	1440 Winter	30	+0%	30/60 Summer				197.897	0.347
S1.007	S8	1440 Winter	30	+0%	30/60 Summer				197.897	0.373

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.72		361.5	OK	
S1.001	S2	0.000	0.59		364.0	OK	
S1.002	S3	0.000	0.01		2.9	SURCHARGED	
S1.003	S4	0.000	0.01		2.8	SURCHARGED	
S1.004	S5	0.000	0.01		1.7	SURCHARGED	
S1.005	S6	0.000	0.01		0.8	SURCHARGED	
S1.006	S7	0.000	0.01		0.6	SURCHARGED	
S1.007	S8	0.000	0.00		0.0	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond F

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.700	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.369	Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	100	+40%	100/15 Summer				198.572	0.099
S1.001	S2	2880 Winter	100	+40%	100/15 Summer				198.484	0.211
S1.002	S3	2880 Winter	100	+40%	30/240 Winter				198.483	0.658
S1.003	S4	2880 Winter	100	+40%	30/240 Winter				198.484	0.685
S1.004	S5	2880 Winter	100	+40%	30/120 Summer				198.424	0.788
S1.005	S6	2880 Winter	100	+40%	30/60 Winter				198.424	0.848
S1.006	S7	2880 Winter	100	+40%	30/60 Summer				198.424	0.874
S1.007	S8	2880 Winter	100	+40%	30/60 Summer				198.424	0.900

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	1.33		665.8	SURCHARGED	
S1.001	S2	0.000	0.03		18.4	SURCHARGED	
S1.002	S3	0.000	0.01		2.9	FLOOD RISK	
S1.003	S4	0.000	0.01		2.8	FLOOD RISK	
S1.004	S5	0.000	0.01		1.6	SURCHARGED	
S1.005	S6	0.000	0.01		0.7	SURCHARGED	
S1.006	S7	0.000	0.01		0.6	SURCHARGED	
S1.007	S8	0.000	0.00		0.0	SURCHARGED	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Pond G

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	20.700	Add Flow / Climate Change (%)	0
Ratio R	0.370	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Pond G

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	10.000	0.050	200.0	1.036	5.00	0.0	0.600	o	750	Pipe/Conduit	
S1.001	5.000	0.373	13.4	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.002	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.003	5.000	0.013	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.004	10.000	0.060	166.7	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.005	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.006	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.007	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.08	197.723	1.036	0.0	0.0	0.0	1.98	872.6	140.3
S1.001	50.00	5.10	197.673	1.036	0.0	0.0	0.0	6.67	1887.1	140.3
S1.002	50.00	5.23	197.225	1.036	0.0	0.0	0.0	1.24	349.4	140.3
S1.003	50.00	5.30	197.199	1.036	0.0	0.0	0.0	1.24	349.4	140.3
S1.004	50.00	5.41	197.186	1.036	0.0	0.0	0.0	1.57	250.0	140.3
S1.005	50.00	5.57	197.126	1.036	0.0	0.0	0.0	1.03	163.9	140.3
S1.006	50.00	5.73	197.100	1.036	0.0	0.0	0.0	1.03	163.9	140.3
S1.007	50.00	5.89	197.074	1.036	0.0	0.0	0.0	1.03	163.9	140.3

Simulation Criteria for Pond G

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Return Period (years) 1

Synthetic Rainfall Details

Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.700	Cv (Winter)	0.840
Ratio R	0.370	Storm Duration (mins)	30
Profile Type	Summer		

Online Controls for Pond G

Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.003, Volume (m³): 11.8

Unit Reference	MD-SHE-0103-5000-1200-5000
Design Head (m)	1.200
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	197.199
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.0	Kick-Flo®	0.745	4.0
Flush-Flo™	0.354	5.0	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)	Depth (m)	Flow (l/s)
0.100	3.4	0.800	4.1	2.000	6.3	4.000	8.8	7.000	11.5
0.200	4.7	1.000	4.6	2.200	6.6	4.500	9.3	7.500	11.8
0.300	5.0	1.200	5.0	2.400	6.9	5.000	9.8	8.000	12.2
0.400	5.0	1.400	5.4	2.600	7.2	5.500	10.2	8.500	12.6
0.500	4.9	1.600	5.7	3.000	7.7	6.000	10.7	9.000	12.9
0.600	4.7	1.800	6.0	3.500	8.3	6.500	11.1	9.500	13.3

Weir Manhole: S8, DS/PN: S1.007, Volume (m³): 3.8

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 198.750

Storage Structures for Pond G

Tank or Pond Manhole: S3, DS/PN: S1.002

Invert Level (m) 197.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	577.0	1.200	1058.1	2.400	1684.0	3.600	2454.6	4.800	3370.0
0.200	647.1	1.400	1152.4	2.600	1802.4	3.800	2597.1	5.000	3536.7
0.400	721.3	1.600	1250.6	2.800	1924.8	4.000	2743.7		
0.600	799.5	1.800	1353.0	3.000	2051.2	4.200	2894.2		
0.800	881.7	2.000	1459.3	3.200	2181.7	4.400	3048.8		
1.000	967.9	2.200	1569.6	3.400	2316.1	4.600	3207.4		

Deep Bore Soakaway Manhole: S5, DS/PN: S1.004

Chamber Invert Level (m)	173.186	Infiltration Coefficient Base (m/hr)	0.77000
Chamber Diameter/Length (m)	1.500	Safety Factor	2.0
Borehole Diameter (m)	0.300		
Borehole Depth (m)	18.000		

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

Deep Bore Soakaway Manhole: S6, DS/PN: S1.005

Chamber Invert Level (m)	178.976	Infiltration Coefficient Base (m/hr)	0.77000
Chamber Diameter/Length (m)	1.350	Safety Factor	2.0
Borehole Diameter (m)	0.300		
Borehole Depth (m)	18.000		

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond G

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	1	+0%	100/15 Summer				197.999	-0.474
S1.001	S2	15 Winter	1	+0%	100/15 Winter				197.872	-0.401
S1.002	S3	960 Winter	1	+0%	30/240 Winter				197.577	-0.248
S1.003	S4	960 Winter	1	+0%	30/180 Winter				197.577	-0.222
S1.004	S5	960 Winter	1	+0%	30/120 Summer				197.515	-0.121
S1.005	S6	960 Winter	1	+0%	30/60 Winter				197.515	-0.061
S1.006	S7	960 Winter	1	+0%	30/60 Summer				197.515	-0.035
S1.007	S8	960 Winter	1	+0%	30/60 Summer				197.515	-0.009

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.28		143.1	OK	
S1.001	S2	0.000	0.24		144.6	OK	
S1.002	S3	0.000	0.01		2.5	OK	
S1.003	S4	0.000	0.01		2.4	OK	
S1.004	S5	0.000	0.01		1.6	OK	
S1.005	S6	0.000	0.01		0.7	OK	
S1.006	S7	0.000	0.01		0.5	OK	
S1.007	S8	0.000	0.00		0.0	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond G

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	30	+0%	100/15 Summer				198.196	-0.277
S1.001	S2	15 Winter	30	+0%	100/15 Winter				198.006	-0.267
S1.002	S3	1440 Winter	30	+0%	30/240 Winter				197.958	0.133
S1.003	S4	1440 Winter	30	+0%	30/180 Winter				197.959	0.160
S1.004	S5	1440 Winter	30	+0%	30/120 Summer				197.898	0.262
S1.005	S6	1440 Winter	30	+0%	30/60 Winter				197.898	0.322
S1.006	S7	1440 Winter	30	+0%	30/60 Summer				197.898	0.348
S1.007	S8	1440 Winter	30	+0%	30/60 Summer				197.898	0.374

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.70		352.5	OK	
S1.001	S2	0.000	0.58		354.7	OK	
S1.002	S3	0.000	0.01		2.9	SURCHARGED	
S1.003	S4	0.000	0.01		2.8	SURCHARGED	
S1.004	S5	0.000	0.01		1.7	SURCHARGED	
S1.005	S6	0.000	0.01		0.8	SURCHARGED	
S1.006	S7	0.000	0.01		0.6	SURCHARGED	
S1.007	S8	0.000	0.00		0.0	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond G

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.700	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.369	Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	100	+40%	100/15 Summer				198.563	0.090
S1.001	S2	2880 Winter	100	+40%	100/15 Winter				198.483	0.210
S1.002	S3	2880 Winter	100	+40%	30/240 Winter				198.483	0.658
S1.003	S4	2880 Winter	100	+40%	30/180 Winter				198.484	0.685
S1.004	S5	2880 Winter	100	+40%	30/120 Summer				198.424	0.788
S1.005	S6	2880 Winter	100	+40%	30/60 Winter				198.424	0.848
S1.006	S7	2880 Winter	100	+40%	30/60 Summer				198.424	0.874
S1.007	S8	2880 Winter	100	+40%	30/60 Summer				198.424	0.900

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	1.28		645.5	SURCHARGED	
S1.001	S2	0.000	0.03		18.0	SURCHARGED	
S1.002	S3	0.000	0.01		2.9	FLOOD RISK	
S1.003	S4	0.000	0.01		2.8	FLOOD RISK	
S1.004	S5	0.000	0.01		1.6	SURCHARGED	
S1.005	S6	0.000	0.01		0.7	SURCHARGED	
S1.006	S7	0.000	0.01		0.6	SURCHARGED	
S1.007	S8	0.000	0.00		0.0	SURCHARGED	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Pond H

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	20.700	Add Flow / Climate Change (%)	0
Ratio R	0.370	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Pond H

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	10.000	0.050	200.0	0.648	5.00	0.0	0.600	o	750	Pipe/Conduit	
S1.001	5.000	0.373	13.4	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.002	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.003	5.000	0.013	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.004	10.000	0.060	166.7	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.005	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.006	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.007	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.08	197.723	0.648	0.0	0.0	0.0	1.98	872.6	87.7
S1.001	50.00	5.10	197.673	0.648	0.0	0.0	0.0	6.67	1887.1	87.7
S1.002	50.00	5.23	197.225	0.648	0.0	0.0	0.0	1.24	349.4	87.7
S1.003	50.00	5.30	197.199	0.648	0.0	0.0	0.0	1.24	349.4	87.7
S1.004	50.00	5.41	197.186	0.648	0.0	0.0	0.0	1.57	250.0	87.7
S1.005	50.00	5.57	197.126	0.648	0.0	0.0	0.0	1.03	163.9	87.7
S1.006	50.00	5.73	197.100	0.648	0.0	0.0	0.0	1.03	163.9	87.7
S1.007	50.00	5.89	197.074	0.648	0.0	0.0	0.0	1.03	163.9	87.7

Simulation Criteria for Pond H

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Return Period (years) 1

Synthetic Rainfall Details

Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.700	Cv (Winter)	0.840
Ratio R	0.370	Storm Duration (mins)	30
Profile Type	Summer		

Online Controls for Pond H

Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.003, Volume (m³): 11.8

Unit Reference	MD-SHE-0103-5000-1200-5000
Design Head (m)	1.200
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	197.199
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.0	Kick-Flo®	0.745	4.0
Flush-Flo™	0.354	5.0	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)	Depth (m)	Flow (l/s)
0.100	3.4	0.800	4.1	2.000	6.3	4.000	8.8	7.000	11.5
0.200	4.7	1.000	4.6	2.200	6.6	4.500	9.3	7.500	11.8
0.300	5.0	1.200	5.0	2.400	6.9	5.000	9.8	8.000	12.2
0.400	5.0	1.400	5.4	2.600	7.2	5.500	10.2	8.500	12.6
0.500	4.9	1.600	5.7	3.000	7.7	6.000	10.7	9.000	12.9
0.600	4.7	1.800	6.0	3.500	8.3	6.500	11.1	9.500	13.3

Weir Manhole: S8, DS/PN: S1.007, Volume (m³): 3.8

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 198.750

Storage Structures for Pond H

Tank or Pond Manhole: S3, DS/PN: S1.002

Invert Level (m) 197.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	344.0	1.200	851.6	2.400	1585.4	3.600	2545.3	4.800	3731.5
0.200	412.9	1.400	958.2	2.600	1729.7	3.800	2727.3	5.000	3951.2
0.400	488.1	1.600	1071.0	2.800	1880.2	4.000	2915.6		
0.600	569.5	1.800	1190.2	3.000	2037.1	4.200	3110.2		
0.800	657.3	2.000	1315.6	3.200	2200.2	4.400	3311.0		
1.000	751.3	2.200	1447.4	3.400	2369.6	4.600	3518.1		

Deep Bore Soakaway Manhole: S5, DS/PN: S1.004

Chamber Invert Level (m) 173.186 Infiltration Coefficient Base (m/hr) 0.77000
Chamber Diameter/Length (m) 1.500 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 18.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

Deep Bore Soakaway Manhole: S6, DS/PN: S1.005

Chamber Invert Level (m) 178.976 Infiltration Coefficient Base (m/hr) 0.77000
Chamber Diameter/Length (m) 1.350 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 18.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond H

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	1	+0%					197.939	-0.534
S1.001	S2	15 Winter	1	+0%					197.828	-0.445
S1.002	S3	600 Winter	1	+0%	30/480 Winter				197.516	-0.309
S1.003	S4	600 Winter	1	+0%	30/360 Winter				197.516	-0.283
S1.004	S5	600 Winter	1	+0%	30/120 Winter				197.455	-0.181
S1.005	S6	600 Winter	1	+0%	30/60 Winter				197.455	-0.121
S1.006	S7	600 Winter	1	+0%	30/60 Winter				197.455	-0.095
S1.007	S8	600 Winter	1	+0%	30/60 Summer				197.456	-0.068

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.18		89.8	OK	
S1.001	S2	0.000	0.15		90.5	OK	
S1.002	S3	0.000	0.02		3.0	OK	
S1.003	S4	0.000	0.01		2.8	OK	
S1.004	S5	0.000	0.01		1.9	OK	
S1.005	S6	0.000	0.01		0.9	OK	
S1.006	S7	0.000	0.01		0.7	OK	
S1.007	S8	0.000	0.00		0.0	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond H

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	30	+0%					198.075	-0.398
S1.001	S2	15 Winter	30	+0%					197.925	-0.348
S1.002	S3	960 Winter	30	+0%	30/480 Winter				197.846	0.021
S1.003	S4	960 Winter	30	+0%	30/360 Winter				197.847	0.048
S1.004	S5	960 Winter	30	+0%	30/120 Winter				197.786	0.150
S1.005	S6	960 Winter	30	+0%	30/60 Winter				197.786	0.210
S1.006	S7	960 Winter	30	+0%	30/60 Winter				197.786	0.236
S1.007	S8	960 Winter	30	+0%	30/60 Summer				197.786	0.262

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.44		221.8	OK	
S1.001	S2	0.000	0.36		221.1	OK	
S1.002	S3	0.000	0.01		2.7	SURCHARGED	
S1.003	S4	0.000	0.01		2.7	SURCHARGED	
S1.004	S5	0.000	0.01		1.6	SURCHARGED	
S1.005	S6	0.000	0.01		0.7	SURCHARGED	
S1.006	S7	0.000	0.01		0.6	SURCHARGED	
S1.007	S8	0.000	0.00		0.0	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond H

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	1440 Winter	100	+40%					198.273	-0.200
S1.001	S2	1440 Winter	100	+40%					198.273	0.000
S1.002	S3	1440 Winter	100	+40%	30/480 Winter				198.271	0.446
S1.003	S4	1440 Winter	100	+40%	30/360 Winter				198.271	0.472
S1.004	S5	1440 Winter	100	+40%	30/120 Winter				198.211	0.575
S1.005	S6	1440 Winter	100	+40%	30/60 Winter				198.211	0.635
S1.006	S7	1440 Winter	100	+40%	30/60 Winter				198.211	0.661
S1.007	S8	1440 Winter	100	+40%	30/60 Summer				198.211	0.687

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.04		19.7	OK	
S1.001	S2	0.000	0.03		19.5	OK	
S1.002	S3	0.000	0.02		2.9	SURCHARGED	
S1.003	S4	0.000	0.01		2.9	SURCHARGED	
S1.004	S5	0.000	0.01		1.8	SURCHARGED	
S1.005	S6	0.000	0.01		0.9	SURCHARGED	
S1.006	S7	0.000	0.01		0.6	SURCHARGED	
S1.007	S8	0.000	0.00		0.0	SURCHARGED	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Pond J

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	20.700	Add Flow / Climate Change (%)	0
Ratio R	0.370	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Pond J

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	10.000	0.050	200.0	1.466	5.00	0.0	0.600	o	600	Pipe/Conduit	
S1.001	5.000	1.373	3.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.002	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	525	Pipe/Conduit	
S1.003	5.000	0.013	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.004	10.000	0.060	166.7	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.005	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.006	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.007	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.10	197.723	1.466	0.0	0.0	0.0	1.72	485.8	198.5
S1.001	50.00	5.10	197.673	1.466	0.0	0.0	0.0	12.82	3624.0	198.5
S1.002	50.00	5.25	196.300	1.466	0.0	0.0	0.0	1.14	245.9	198.5
S1.003	50.00	5.32	196.199	1.466	0.0	0.0	0.0	1.24	349.4	198.5
S1.004	50.00	5.41	196.186	1.466	0.0	0.0	0.0	1.88	532.6	198.5
S1.005	50.00	5.54	196.126	1.466	0.0	0.0	0.0	1.24	349.4	198.5
S1.006	50.00	5.68	196.100	1.466	0.0	0.0	0.0	1.24	349.4	198.5
S1.007	50.00	5.81	196.074	1.466	0.0	0.0	0.0	1.24	349.4	198.5

Simulation Criteria for Pond J

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 4 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Return Period (years) 1

Synthetic Rainfall Details

Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	20.700	Cv (Winter)	0.840
Ratio R	0.370	Storm Duration (mins)	30
Profile Type	Summer		

Online Controls for Pond J

Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.003, Volume (m³): 17.5

Unit Reference	MD-SHE-0103-5000-1200-5000
Design Head (m)	1.200
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	196.274
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.0	Kick-Flo®	0.745	4.0
Flush-Flo™	0.354	5.0	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)	Depth (m)	Flow (l/s)
0.100	3.4	0.800	4.1	2.000	6.3	4.000	8.8	7.000	11.5
0.200	4.7	1.000	4.6	2.200	6.6	4.500	9.3	7.500	11.8
0.300	5.0	1.200	5.0	2.400	6.9	5.000	9.8	8.000	12.2
0.400	5.0	1.400	5.4	2.600	7.2	5.500	10.2	8.500	12.6
0.500	4.9	1.600	5.7	3.000	7.7	6.000	10.7	9.000	12.9
0.600	4.7	1.800	6.0	3.500	8.3	6.500	11.1	9.500	13.3

Weir Manhole: S8, DS/PN: S1.007, Volume (m³): 7.1

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 198.760

Storage Structures for Pond J

Tank or Pond Manhole: S3, DS/PN: S1.002

Invert Level (m) 196.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	650.0	1.200	421.2	2.400	723.8	3.600	1107.9	4.800	1573.3
0.200	650.0	1.400	466.0	2.600	782.2	3.800	1179.8	5.000	1658.8
0.400	650.0	1.600	513.0	2.800	842.8	4.000	1254.0		
0.600	650.0	1.800	562.3	3.000	905.7	4.200	1330.4		
0.800	650.0	2.000	613.9	3.200	970.8	4.400	1409.1		
1.000	650.0	2.200	667.7	3.400	1038.2	4.600	1490.1		

Deep Bore Soakaway Manhole: S5, DS/PN: S1.004

Chamber Invert Level (m) 178.186 Infiltration Coefficient Base (m/hr) 0.77000
Chamber Diameter/Length (m) 1.500 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 18.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

Deep Bore Soakaway Manhole: S6, DS/PN: S1.005

Chamber Invert Level (m) 178.126 Infiltration Coefficient Base (m/hr) 0.77000
Chamber Diameter/Length (m) 1.350 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 18.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

Deep Bore Soakaway Manhole: S7, DS/PN: S1.006

Chamber Invert Level (m) 178.100 Infiltration Coefficient Base (m/hr) 0.77000
Chamber Diameter/Length (m) 1.500 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 18.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond J

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 4 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm) 300.0
Analysis Timestep 2.5 Second Increment (Extended)
DTS Status OFF
DVD Status ON
Inertia Status ON

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years) 1, 30, 100
Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	1	+0%	30/15 Summer				198.086	-0.237
S1.001	S2	15 Winter	1	+0%	100/720 Winter				197.841	-0.432
S1.002	S3	1440 Winter	1	+0%	30/60 Winter				196.717	-0.108
S1.003	S4	1440 Winter	1	+0%	30/60 Summer				196.716	-0.083
S1.004	S5	1440 Winter	1	+0%	30/120 Summer				196.629	-0.157
S1.005	S6	1440 Winter	1	+0%	30/60 Winter				196.628	-0.098
S1.006	S7	1440 Winter	1	+0%	30/60 Winter				196.629	-0.071
S1.007	S8	1440 Winter	1	+0%	30/60 Summer				196.629	-0.045

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.66		202.9	OK	
S1.001	S2	0.000	0.17		204.0	OK	
S1.002	S3	0.000	0.02		3.5	OK	
S1.003	S4	0.000	0.02		3.5	OK	
S1.004	S5	0.000	0.01		2.5	OK	
S1.005	S6	0.000	0.01		1.5	OK	
S1.006	S7	0.000	0.00		0.5	OK	
S1.007	S8	0.000	0.00		0.0	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond J

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 4 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.700	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.369	Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	30	+0%	30/15 Summer				198.507	0.184
S1.001	S2	15 Winter	30	+0%	100/720 Winter				197.950	-0.323
S1.002	S3	2160 Winter	30	+0%	30/60 Winter				197.348	0.523
S1.003	S4	2160 Winter	30	+0%	30/60 Summer				197.348	0.549
S1.004	S5	2160 Winter	30	+0%	30/120 Summer				197.264	0.478
S1.005	S6	2160 Winter	30	+0%	30/60 Winter				197.264	0.538
S1.006	S7	2160 Winter	30	+0%	30/60 Winter				197.264	0.564
S1.007	S8	2160 Winter	30	+0%	30/60 Summer				197.264	0.590

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	1.64		500.9	SURCHARGED	
S1.001	S2	0.000	0.43		504.7	OK	
S1.002	S3	0.000	0.02		3.4	SURCHARGED	
S1.003	S4	0.000	0.01		3.1	SURCHARGED	
S1.004	S5	0.000	0.01		2.2	SURCHARGED	
S1.005	S6	0.000	0.01		1.2	SURCHARGED	
S1.006	S7	0.000	0.00		0.3	SURCHARGED	
S1.007	S8	0.000	0.00		0.0	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond J

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 4 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.700	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.369	Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	100	+40%	30/15 Summer				199.080	0.757
S1.001	S2	2880 Winter	100	+40%	100/720 Winter				198.592	0.319
S1.002	S3	2880 Winter	100	+40%	30/60 Winter				198.592	1.767
S1.003	S4	2880 Winter	100	+40%	30/60 Summer				198.592	1.793
S1.004	S5	2880 Winter	100	+40%	30/120 Summer				198.508	1.722
S1.005	S6	2880 Winter	100	+40%	30/60 Winter				198.507	1.781
S1.006	S7	2880 Winter	100	+40%	30/60 Winter				198.508	1.808
S1.007	S8	2880 Winter	100	+40%	30/60 Summer				198.508	1.834

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	2.95		902.9	FLOOD RISK	
S1.001	S2	0.000	0.02		26.2	SURCHARGED	
S1.002	S3	0.000	0.03		3.6	FLOOD RISK	
S1.003	S4	0.000	0.01		3.2	FLOOD RISK	
S1.004	S5	0.000	0.01		2.3	FLOOD RISK	
S1.005	S6	0.000	0.01		1.3	FLOOD RISK	
S1.006	S7	0.000	0.00		0.4	FLOOD RISK	
S1.007	S8	0.000	0.00		0.0	FLOOD RISK	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Pond K

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	20.700	Add Flow / Climate Change (%)	0
Ratio R	0.370	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Pond K

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	10.000	0.050	200.0	0.422	5.00	0.0	0.600	o	750	Pipe/Conduit	
S1.001	5.000	0.373	13.4	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.002	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.003	5.000	0.013	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.004	10.000	0.060	166.7	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.005	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.006	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.08	197.723	0.422	0.0	0.0	0.0	1.98	872.6	57.1
S1.001	50.00	5.10	197.673	0.422	0.0	0.0	0.0	6.67	1887.1	57.1
S1.002	50.00	5.23	197.225	0.422	0.0	0.0	0.0	1.24	349.4	57.1
S1.003	50.00	5.30	197.199	0.422	0.0	0.0	0.0	1.24	349.4	57.1
S1.004	50.00	5.41	197.186	0.422	0.0	0.0	0.0	1.57	250.0	57.1
S1.005	50.00	5.57	197.126	0.422	0.0	0.0	0.0	1.03	163.9	57.1
S1.006	50.00	5.73	197.100	0.422	0.0	0.0	0.0	1.03	163.9	57.1

Simulation Criteria for Pond K

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Return Period (years)	1	Ratio R	0.370
Region	England and Wales	Profile Type	Summer

Synthetic Rainfall Details

Cv (Summer) 0.750 Storm Duration (mins) 30
Cv (Winter) 0.840

Online Controls for Pond K

Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.003, Volume (m³): 11.8

Unit Reference	MD-SHE-0103-5000-1200-5000
Design Head (m)	1.200
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	197.199
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.0	Kick-Flo®	0.745	4.0
Flush-Flo™	0.354	5.0	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)	Depth (m)	Flow (l/s)
0.100	3.4	0.800	4.1	2.000	6.3	4.000	8.8	7.000	11.5
0.200	4.7	1.000	4.6	2.200	6.6	4.500	9.3	7.500	11.8
0.300	5.0	1.200	5.0	2.400	6.9	5.000	9.8	8.000	12.2
0.400	5.0	1.400	5.4	2.600	7.2	5.500	10.2	8.500	12.6
0.500	4.9	1.600	5.7	3.000	7.7	6.000	10.7	9.000	12.9
0.600	4.7	1.800	6.0	3.500	8.3	6.500	11.1	9.500	13.3

Weir Manhole: S7, DS/PN: S1.006, Volume (m³): 3.8

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 198.750

Storage Structures for Pond K

Tank or Pond Manhole: S3, DS/PN: S1.002

Invert Level (m) 197.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	442.0	1.200	751.0	2.400	1141.5	3.600	1613.3	4.800	2166.6
0.200	487.8	1.400	810.4	2.600	1214.4	3.800	1699.9	5.000	2266.8
0.400	536.0	1.600	872.1	2.800	1289.7	4.000	1788.7		
0.600	586.3	1.800	936.1	3.000	1367.2	4.200	1879.8		
0.800	639.0	2.000	1002.3	3.200	1447.0	4.400	1973.2		
1.000	693.9	2.200	1070.7	3.400	1529.0	4.600	2068.8		

Deep Bore Soakaway Manhole: S5, DS/PN: S1.004

Chamber Invert Level (m)	173.186	Infiltration Coefficient Base (m/hr)	0.77000
Chamber Diameter/Length (m)	1.500	Safety Factor	2.0
Borehole Diameter (m)	0.300		
Borehole Depth (m)	18.000		

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

Deep Bore Soakaway Manhole: S6, DS/PN: S1.005

Chamber Invert Level (m)	178.976	Infiltration Coefficient Base (m/hr)	0.77000
Chamber Diameter/Length (m)	1.350	Safety Factor	2.0
Borehole Diameter (m)	0.300		
Borehole Depth (m)	18.000		

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond K

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	1	+0%					197.895	-0.578
S1.001	S2	15 Winter	1	+0%					197.799	-0.474
S1.002	S3	360 Winter	1	+0%	100/360 Winter				197.392	-0.433
S1.003	S4	360 Winter	1	+0%	100/240 Winter				197.392	-0.407
S1.004	S5	360 Winter	1	+0%	100/120 Summer				197.331	-0.305
S1.005	S6	360 Winter	1	+0%	100/60 Winter				197.331	-0.245
S1.006	S7	360 Winter	1	+0%	100/60 Summer				197.331	-0.219

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.12		58.8	OK	
S1.001	S2	0.000	0.10		58.8	OK	
S1.002	S3	0.000	0.02		3.3	OK	
S1.003	S4	0.000	0.01		3.2	OK	
S1.004	S5	0.000	0.01		2.2	OK	
S1.005	S6	0.000	0.01		1.0	OK	
S1.006	S7	0.000	0.00		0.0	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond K

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	30	+0%					197.999	-0.474
S1.001	S2	15 Winter	30	+0%					197.872	-0.401
S1.002	S3	600 Winter	30	+0%	100/360 Winter				197.587	-0.238
S1.003	S4	600 Winter	30	+0%	100/240 Winter				197.587	-0.212
S1.004	S5	600 Winter	30	+0%	100/120 Summer				197.526	-0.110
S1.005	S6	600 Winter	30	+0%	100/60 Winter				197.526	-0.050
S1.006	S7	600 Winter	30	+0%	100/60 Summer				197.526	-0.024

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Level Status	Exceeded
S1.000	S1	0.000	0.29		144.7	OK	
S1.001	S2	0.000	0.23		143.7	OK	
S1.002	S3	0.000	0.01		2.9	OK	
S1.003	S4	0.000	0.01		2.8	OK	
S1.004	S5	0.000	0.01		1.7	OK	
S1.005	S6	0.000	0.01		0.6	OK	
S1.006	S7	0.000	0.00		0.0	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond K

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	100	+40%					198.113	-0.360
S1.001	S2	15 Winter	100	+40%					197.951	-0.322
S1.002	S3	960 Winter	100	+40%	100/360 Winter				197.883	0.058
S1.003	S4	960 Winter	100	+40%	100/240 Winter				197.883	0.084
S1.004	S5	960 Winter	100	+40%	100/120 Summer				197.822	0.186
S1.005	S6	960 Winter	100	+40%	100/60 Winter				197.822	0.246
S1.006	S7	960 Winter	100	+40%	100/60 Summer				197.822	0.272

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.52		263.4	OK	
S1.001	S2	0.000	0.43		260.7	OK	
S1.002	S3	0.000	0.02		2.9	SURCHARGED	
S1.003	S4	0.000	0.01		2.9	SURCHARGED	
S1.004	S5	0.000	0.01		1.7	SURCHARGED	
S1.005	S6	0.000	0.01		0.6	SURCHARGED	
S1.006	S7	0.000	0.00		0.0	SURCHARGED	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Pond L

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	20.700	Add Flow / Climate Change (%)	0
Ratio R	0.370	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Pond L

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	10.000	0.050	200.0	0.956	5.00	0.0	0.600	o	750	Pipe/Conduit	
S1.001	5.000	0.873	5.7	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.002	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.003	5.000	0.013	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.004	10.000	0.060	166.7	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.005	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.006	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.08	197.723	0.956	0.0	0.0	0.0	1.98	872.6	129.5
S1.001	50.00	5.09	197.673	0.956	0.0	0.0	0.0	10.22	2889.0	129.5
S1.002	50.00	5.23	196.800	0.956	0.0	0.0	0.0	1.24	349.4	129.5
S1.003	50.00	5.29	196.774	0.956	0.0	0.0	0.0	1.24	349.4	129.5
S1.004	50.00	5.40	196.761	0.956	0.0	0.0	0.0	1.57	250.0	129.5
S1.005	50.00	5.56	196.701	0.956	0.0	0.0	0.0	1.03	163.9	129.5
S1.006	50.00	5.72	196.675	0.956	0.0	0.0	0.0	1.03	163.9	129.5

Simulation Criteria for Pond L

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Return Period (years)	1	Ratio R	0.370
Region	England and Wales	Profile Type	Summer

Synthetic Rainfall Details

Cv (Summer) 0.750 Storm Duration (mins) 30
Cv (Winter) 0.840

Online Controls for Pond L

Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.003, Volume (m³): 14.4

Unit Reference	MD-SHE-0103-5000-1200-5000
Design Head (m)	1.200
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	196.774
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.0	Kick-Flo®	0.745	4.0
Flush-Flo™	0.354	5.0	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)	Depth (m)	Flow (l/s)
0.100	3.4	0.800	4.1	2.000	6.3	4.000	8.8	7.000	11.5
0.200	4.7	1.000	4.6	2.200	6.6	4.500	9.3	7.500	11.8
0.300	5.0	1.200	5.0	2.400	6.9	5.000	9.8	8.000	12.2
0.400	5.0	1.400	5.4	2.600	7.2	5.500	10.2	8.500	12.6
0.500	4.9	1.600	5.7	3.000	7.7	6.000	10.7	9.000	12.9
0.600	4.7	1.800	6.0	3.500	8.3	6.500	11.1	9.500	13.3

Weir Manhole: S7, DS/PN: S1.006, Volume (m³): 4.4

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 198.750

Storage Structures for Pond L

Tank or Pond Manhole: S3, DS/PN: S1.002

Invert Level (m) 196.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	400.0	0.600	641.0	1.200	938.5	1.800	1292.6	2.400	1703.2
0.100	436.2	0.700	686.6	1.300	993.6	1.900	1357.1	2.500	1777.1
0.200	474.0	0.800	733.9	1.400	1050.2	2.000	1423.1		
0.300	513.4	0.900	782.7	1.500	1108.5	2.100	1490.8		
0.400	554.4	1.000	833.0	1.600	1168.2	2.200	1560.0		
0.500	596.9	1.100	885.0	1.700	1229.6	2.300	1630.8		

Deep Bore Soakaway Manhole: S5, DS/PN: S1.004

Chamber Invert Level (m) 173.186 Infiltration Coefficient Base (m/hr) 0.77000
Chamber Diameter/Length (m) 1.500 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 18.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

Deep Bore Soakaway Manhole: S6, DS/PN: S1.005

Chamber Invert Level (m) 178.976 Infiltration Coefficient Base (m/hr) 0.77000
Chamber Diameter/Length (m) 1.350 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 18.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond L

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	1	+0%	100/15 Summer				197.987	-0.486
S1.001	S2	15 Winter	1	+0%					197.825	-0.448
S1.002	S3	960 Winter	1	+0%	30/180 Winter				197.157	-0.243
S1.003	S4	960 Winter	1	+0%	30/180 Winter				197.157	-0.217
S1.004	S5	960 Winter	1	+0%	30/120 Summer				197.097	-0.114
S1.005	S6	960 Winter	1	+0%	30/60 Summer				197.097	-0.054
S1.006	S7	960 Winter	1	+0%	30/60 Summer				197.097	-0.028

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.26		132.3	OK	
S1.001	S2	0.000	0.14		133.3	OK	
S1.002	S3	0.000	0.02		2.9	OK	
S1.003	S4	0.000	0.01		2.8	OK	
S1.004	S5	0.000	0.01		2.0	OK	
S1.005	S6	0.000	0.01		1.1	OK	
S1.006	S7	0.000	0.00		0.0	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond L

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 20.700	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.369	Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	30	+0%	100/15 Summer				198.171	-0.302
S1.001	S2	15 Winter	30	+0%					197.920	-0.353
S1.002	S3	1440 Winter	30	+0%	30/180 Winter				197.579	0.179
S1.003	S4	1440 Winter	30	+0%	30/180 Winter				197.579	0.205
S1.004	S5	1440 Winter	30	+0%	30/120 Summer				197.518	0.307
S1.005	S6	1440 Winter	30	+0%	30/60 Summer				197.518	0.367
S1.006	S7	1440 Winter	30	+0%	30/60 Summer				197.518	0.393

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.65		326.0	OK	
S1.001	S2	0.000	0.35		326.5	OK	
S1.002	S3	0.000	0.01		2.4	SURCHARGED	
S1.003	S4	0.000	0.01		2.3	SURCHARGED	
S1.004	S5	0.000	0.01		1.5	SURCHARGED	
S1.005	S6	0.000	0.01		0.6	SURCHARGED	
S1.006	S7	0.000	0.00		0.0	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond L

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	100	+40%	100/15 Summer				198.538	0.065
S1.001	S2	2880 Winter	100	+40%					198.101	-0.172
S1.002	S3	2880 Winter	100	+40%	30/180 Winter				198.101	0.701
S1.003	S4	2880 Winter	100	+40%	30/180 Winter				198.101	0.727
S1.004	S5	2880 Winter	100	+40%	30/120 Summer				198.041	0.830
S1.005	S6	2880 Winter	100	+40%	30/60 Summer				198.041	0.890
S1.006	S7	2880 Winter	100	+40%	30/60 Summer				198.041	0.916

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	1.19		596.2	SURCHARGED	
S1.001	S2	0.000	0.02		17.1	OK	
S1.002	S3	0.000	0.01		2.4	SURCHARGED	
S1.003	S4	0.000	0.01		2.3	SURCHARGED	
S1.004	S5	0.000	0.01		1.4	SURCHARGED	
S1.005	S6	0.000	0.00		0.5	SURCHARGED	
S1.006	S7	0.000	0.00		0.0	SURCHARGED	

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Pond M

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	20.700	Add Flow / Climate Change (%)	0
Ratio R	0.370	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Pond M

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	10.000	0.050	200.0	1.690	5.00	0.0	0.600	o	750	Pipe/Conduit	
S1.001	5.000	1.373	3.6	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
S1.002	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	750	Pipe/Conduit	
S1.003	5.000	0.013	384.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit	
S1.004	10.000	0.060	166.7	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.005	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
S1.006	10.000	0.026	384.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.08	197.723	1.690	0.0	0.0	0.0	1.98	872.6	228.8
S1.001	50.00	5.09	197.673	1.690	0.0	0.0	0.0	14.72	6503.8	228.8
S1.002	50.00	5.21	196.300	1.690	0.0	0.0	0.0	1.42	627.7	228.8
S1.003	50.00	5.27	196.274	1.690	0.0	0.0	0.0	1.24	349.4	228.8
S1.004	50.00	5.38	196.261	1.690	0.0	0.0	0.0	1.57	250.0	228.8
S1.005	50.00	5.54	196.201	1.690	0.0	0.0	0.0	1.03	163.9«	228.8
S1.006	50.00	5.70	196.175	1.690	0.0	0.0	0.0	1.03	163.9«	228.8

Simulation Criteria for Pond M

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 4 Number of Real Time Controls 0

Synthetic Rainfall Details

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.700	Storm Duration (mins)	30
Ratio R	0.370		

Online Controls for Pond M

Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.003, Volume (m³): 18.7

Unit Reference	MD-SHE-0103-5000-1200-5000
Design Head (m)	1.200
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	196.274
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	5.0	Kick-Flo®	0.745	4.0
Flush-Flo™	0.354	5.0	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)	Depth (m)	Flow (l/s)
0.100	3.4	0.800	4.1	2.000	6.3	4.000	8.8	7.000	11.5
0.200	4.7	1.000	4.6	2.200	6.6	4.500	9.3	7.500	11.8
0.300	5.0	1.200	5.0	2.400	6.9	5.000	9.8	8.000	12.2
0.400	5.0	1.400	5.4	2.600	7.2	5.500	10.2	8.500	12.6
0.500	4.9	1.600	5.7	3.000	7.7	6.000	10.7	9.000	12.9
0.600	4.7	1.800	6.0	3.500	8.3	6.500	11.1	9.500	13.3

Weir Manhole: S7, DS/PN: S1.006, Volume (m³): 1.4

Discharge Coef 0.544 Width (m) 1.000 Invert Level (m) 198.750

Storage Structures for Pond M

Tank or Pond Manhole: S3, DS/PN: S1.002

Invert Level (m) 196.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	350.0	0.600	350.0	1.200	781.5	1.800	1107.1	2.400	1489.2
0.100	350.0	0.700	350.0	1.300	831.8	1.900	1166.8	2.500	1558.4
0.200	350.0	0.800	350.0	1.400	883.7	2.000	1228.2		
0.300	350.0	0.900	639.9	1.500	937.2	2.100	1291.1		
0.400	350.0	1.000	685.5	1.600	992.3	2.200	1355.5		
0.500	350.0	1.100	732.7	1.700	1048.9	2.300	1421.6		

Deep Bore Soakaway Manhole: S5, DS/PN: S1.004

Chamber Invert Level (m) 173.186 Infiltration Coefficient Base (m/hr) 0.77000
Chamber Diameter/Length (m) 1.500 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 18.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

Deep Bore Soakaway Manhole: S6, DS/PN: S1.005

Chamber Invert Level (m) 178.976 Infiltration Coefficient Base (m/hr) 0.77000
Chamber Diameter/Length (m) 1.350 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 18.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

Deep Bore Soakaway Manhole: S7, DS/PN: S1.006

Chamber Invert Level (m) 179.100 Infiltration Coefficient Base (m/hr) 0.77000
Chamber Diameter/Length (m) 1.350 Safety Factor 2.0
Borehole Diameter (m) 0.300
Borehole Depth (m) 18.000

Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)	Depth (m)	Side Infil. Coef. (m/hr)
0.000	0.77000	8.000	0.77000	8.001	0.00000	18.000	0.00000

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond M

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 4 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	1	+0%	30/15 Summer				198.087	-0.386
S1.001	S2	15 Winter	1	+0%	100/1440 Winter				197.852	-0.571
S1.002	S3	1440 Winter	1	+0%	1/360 Winter				197.168	0.118
S1.003	S4	1440 Winter	1	+0%	1/120 Winter				197.170	0.296
S1.004	S5	1440 Winter	1	+0%	1/120 Summer				197.075	0.364
S1.005	S6	1440 Winter	1	+0%	1/60 Winter				197.074	0.423
S1.006	S7	1440 Winter	1	+0%	1/60 Winter				197.074	0.449

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	0.47		233.9	OK	
S1.001	S2	0.000	0.13		235.3	OK	
S1.002	S3	0.000	0.01		3.3	SURCHARGED	
S1.003	S4	0.000	0.01		3.0	SURCHARGED	
S1.004	S5	0.000	0.01		2.1	SURCHARGED	
S1.005	S6	0.000	0.01		1.3	SURCHARGED	
S1.006	S7	0.000	0.00		0.0	SURCHARGED	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond M

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 4 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	30	+0%	30/15 Summer				198.502	0.029
S1.001	S2	15 Winter	30	+0%	100/1440 Winter				197.964	-0.459
S1.002	S3	2160 Winter	30	+0%	1/360 Winter				197.793	0.743
S1.003	S4	2160 Winter	30	+0%	1/120 Winter				197.797	0.923
S1.004	S5	2160 Winter	30	+0%	1/120 Summer				197.700	0.989
S1.005	S6	2160 Winter	30	+0%	1/60 Winter				197.700	1.049
S1.006	S7	2160 Winter	30	+0%	1/60 Winter				197.699	1.074

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	1.14		574.3	SURCHARGED	
S1.001	S2	0.000	0.31		577.2	OK	
S1.002	S3	0.000	0.01		3.6	SURCHARGED	
S1.003	S4	0.000	0.01		2.8	SURCHARGED	
S1.004	S5	0.000	0.01		2.0	SURCHARGED	
S1.005	S6	0.000	0.01		1.1	SURCHARGED	
S1.006	S7	0.000	0.00		0.0	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Pond M

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 2 Number of Storage Structures 4 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.700
Region	England and Wales	Ratio R	0.369
Cv (Summer)	0.750		
Cv (Winter)	0.840		

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	ON
Inertia Status	ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
S1.000	S1	15 Winter	100	+40%	30/15 Summer				198.858	0.385
S1.001	S2	2880 Winter	100	+40%	100/1440 Winter				198.500	0.077
S1.002	S3	2880 Winter	100	+40%	1/360 Winter				198.500	1.450
S1.003	S4	2880 Winter	100	+40%	1/120 Winter				198.503	1.629
S1.004	S5	2880 Winter	100	+40%	1/120 Summer				198.406	1.695
S1.005	S6	2880 Winter	100	+40%	1/60 Winter				198.406	1.755
S1.006	S7	2880 Winter	100	+40%	1/60 Winter				198.406	1.781

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
S1.000	S1	0.000	2.08		1046.9	SURCHARGED	
S1.001	S2	0.000	0.02		30.1	SURCHARGED	
S1.002	S3	0.000	0.01		3.6	FLOOD RISK	
S1.003	S4	0.000	0.01		3.0	FLOOD RISK	
S1.004	S5	0.000	0.01		2.2	SURCHARGED	
S1.005	S6	0.000	0.01		1.3	SURCHARGED	
S1.006	S7	0.000	0.00		0.0	SURCHARGED	

Appendix 14.2

UTILITIES ASSESSMENT REPORT

FORT HALSTEAD

Site Redevelopment

Utilities Statement

September 2019

Merseyside
PENSION FUND

CBRE

CONTENTS

CBRE

Prepared & Edited By:	Howard Vander Borght – Director – Building Consultancy For and on Behalf of CBRE Limited 	
Approved By:	Antonio Lemos - Senior Engineer – Building Consultancy For and on Behalf of CBRE Limited 	
Date of Issue: September 2019	File Name: 0281672 Document Ref:	Version: 1 Status: Issue

Introduction

1.1 General

The site is currently owned by the Merseyside Pension Fund (MPF) and is leased to the Defence Science and Technology Laboratory (DSTL) who are currently responsible for the operation, maintenance and security of the site. DSTL will have vacated the site prior to the commencement of the redevelopment, however QinetiQ, who are currently a sub tenant of DSTL will remain in a part of the site within a newly fenced enclosure to the Southwest of the fort.

This report outlines the existing utility services serving the site and the strategy required to serve the proposed development.

In considering the utilities strategy it is important to understand the utilities which serve the existing 77 residential properties, located in Beckman Close, Crow Drive, Fort Road and Armstrong Close all in the area off Crow Drive to the North of the main site; currently have some dependence on the utilities serving the main DSTL Site. The report explains the dependence, and how they will be affected by the development works.

The utility services covered in this report include the following:

- Water Supply. (Including Fire Mains where applicable)
- Foul Drainage.
- Surface Water Drainage.
- Electricity.
- Telecommunications.

It should be noted that there is no mains gas serving the current site and it not intended to provide a gas supply to the proposed development.

Existing Utility Services to Residential Properties

2.1 General

This section describes the current utility services serving the existing residential properties which are located at the Northern end of the site, on and around Crow Drive.

Each utility services currently feeding the existing residential properties is described in the following sections of this report.

2.2 Residential Water Supply

The water supply to each of the existing residential properties is fed from the main DSTL site infrastructure. Potable water is supplied via underground cold-water tanks located within the secured DSTL area near the North-West corner where the Thames Water main feeding the site enters. The underground tanks which are replenished by the incoming Thames Water supply also feed the buildings on the DSTL site.

The water supply to the residential properties is metered in four locations:

- Serving: 1 – 20 Armstrong Close Plus the Officers Club
- Serving: 17 – 46 Fort Road
- Serving: 1 – 16 Fort Road
- Serving: 1, 3, 5 & 7 Crow Drive and 1 - 7 Beckman Close

From the metering points the water is distributed to each property via underground pipework.

The management of the common parts of the existing residential areas is split between two companies who are billed by DSTL for the water used as measured by the meters. This cost is passed on to each of the residential properties as part of their service charges.

2.3 Fire Mains

The fire hydrants in the residential roads are fed from the DSTL boosted fire main system. This is a separate system to the potable water supply.

2.4 Foul Drainage

The existing foul drainage from the Northern areas of the site runs through the residential area, crossing Crow Drive between Fort Road and the main gate house before running through the woodland to the main sewer in Star Hill.

The drainage system downstream of the residential properties has been adopted by Thames Water, who are therefore now responsible for the maintenance and upkeep.

2.5 Surface Water Drainage

Surface water from the residential properties and the surrounding roads collects into a series of pipework networks which drain into the surrounding woodland, some of the outfalls are outside of the existing residential boundary.

There is no surface water connection to an offsite utility sewerage system.

Existing Utility Services to Residential Properties

2.6 Electrical Supply

Each residential property has a metered supply directly from UKPN energy infrastructure.

Two UKPN substations are located along Crow Drive, fed from a High Voltage network ring entering the site from Polhill to the North of the site and up the hill from the quarry to the East of the site.

- UKPN Substation 01: located near the Polhill entrance to the site and feeds the properties in Polhill around the former Polhill Arms, and via overhead wires to Beaumont Yard and the adjacent property to the west of Crow Drive.
- UKPN substation 02: is on foot path between Crow Drive trackway and Fort Road, West of Crow Drive. This substation supplies all the existing residential properties and the street lighting in the roads serving the houses.

Note, there is a separate High Voltage supply serving the main DSTL site, which has its own High Voltage and Low Voltage infrastructure. There is no interconnection between this supply and the supply currently feeding the existing residential properties.

2.7 Telecom Services

The existing residential properties are served by a below-ground BT infrastructure network from Polhill.

Beaumont Yard and the adjacent house is fed from overhead lines from Polhill.

2.8 Gas

Currently there is no mains gas supply to the site, however some of the residential properties are connected to a community bottled gas service.

All the equipment and pipework for this system is contained within the confines of the residential area.

Existing Utility Services to Main Site

3.1 General

This section describes the current utility services serving the main development area of the site currently occupied managed and maintained by DSTL.

3.2 Water Supply

The existing Thames Water supply enters the site at the North-Western corner near the end of the footpath leading from Knockholt Pound village.

The water supply is metered by Thames Water and from this point it becomes a private supply which is currently maintained and managed by DSTL.

The mains water feeds below ground storage tanks for both the potable water supply and the fire hydrant supply. Both these supplies are boosted downstream of the storage tanks.

The water distribution serves each of the buildings on the site as well as feeding the sub-metered supplies to the existing residential properties as described in the previous section.

3.3 Foul Drainage

Foul water drainage from the entire site is via a gravity system which connects to the main sewer in Polhill. The network of drainage generally flows towards, and combines with, the residential area system. From this point to the Polhill sewer the system has been adopted by Thames Water. The upstream part of the system within the DSTL secured area, is currently privately owned.

3.4 Rainwater Drainage

The surface water drainage system from each building and the road gullies, combines into a series of piped systems discharging into natural soakaways or into open culverts which discharge onto the open land or wooded areas around the perimeter of the site.

3.5 Electrical Supplies

The UKPN High Voltage electrical supply emanates from the A224 East of the site. Buried cables cut through the fields rising the hill to the South of the quarry before entering the secure area of the site just North of the fort. The High Voltage incomer and metering panel is located in building A23.

From this point, a private High Voltage network connects to several transformers generally located in compounds around the secured DSTL part of the site, each providing a low voltage network serving the various buildings in the area of the substation.

3.6 Telecom Services

Telecom services are distributed via a below ground network of cable ducts distributing both incoming telecom services and data services between buildings.

Proposed Utility Services (Existing Residential Properties)

4.1 General

The proposed Utility Supplies serving the existing residential properties are described in this section.

It is proposed to retain and maintain the existing Utility Supplies serving the site on a temporary basis whilst new and upgraded supplies are put in place to form the permeant infrastructure.

4.2 Residential Water Supply

A new metered Thames Water supply pipe will be laid to the boundary of each of the existing residential properties as soon as practicable at the start of the redevelopment. Whilst the new supply is being implemented the existing supply will be retained and operated.

It will be the responsibility of the owner of each of the existing residential properties to procure the installation of the water service pipe connection between the boundary meter location into their property. This supply pipe being the responsibility of the building owners and not the supply company.

Thames Water has advised that the existing water supply to the site has enough capacity to directly feed the existing residential accommodation as well as the commercial buildings which are to be retained. Depending on final programming therefore, either the new supply to existing residential properties will be connected directly to the existing incoming supply to the site, or it will be connected as part of the new feed to the site. Either way, once connected, the existing residential properties will be supplied with water directly from Thames Water who will then remain responsible for the supply of water to the existing residential properties.

The water main as it crosses the development site will be part of the new infrastructure which will eventually supply the new properties, so the route will be chosen along intended lines of road and footpaths.

4.3 Fire Mains

As part of the installation of Thames Water supplies to the existing residential properties, new roadway fire hydrants will be installed.

This will provide the required fire hydrant coverage to the existing residential properties to allow the existing private Fire Hydrant system fed from the existing DSTL infrastructure to be abandoned.

4.4 Drainage

The existing foul drainage system serving the existing residential properties has been adopted by Thames Water, therefore no further works are envisaged for the part of the system serving the existing residential properties although, local modifications will be required downstream to allow connection of the new properties proposed for the helicopter pad site.

4.5 Rainwater Drainage

The existing system of soakaways / run off, will be retained for the existing residential properties.

Proposed Utility Services (Existing Residential Properties)

4.6 Electrical Supplies

The existing residential properties all have metered supplies directly from UKPN, therefore the responsibility to maintain the electrical supply to the residential properties is with UKPN and thus there will be no change in this responsibility.

4.7 Telecoms

There is no anticipated change to the telecoms network in the area of the existing residential properties.

Proposed Utility Services (Development Site)

5.1 General

This section describes the Utility Services connections proposed for the main development area of the site.

5.2 Water Supply

A new water supply will be provided to the site by Thames Water.

The new water main will connect to the existing infrastructure in Knockholt Pound situated to the West of the site. The new main will run along Star Hill Road and enter the site at the Star Hill entrance.

New Thames Water distribution across the site following the road and footpath routes will supply all the new and existing properties.

There may be some off-site reinforcement of the network required as the result of this and other developments on the Thames Water network. If required, this will be part of Thames Water ongoing programme of renewing and reinforcing the network.

5.3 Foul Drainage

The existing Thames Water gravity foul drain system exits the eastern side of the site towards Polhill.

It has been advised by Thames Water that the existing outfall has sufficient capacity to serve the existing residential properties and the new proposed development.

A CCTV survey of the drainage system has indicated that the existing outfall is in a good and serviceable condition and suitable for re-use.

The gravity foul drainage system across the development site will be totally renewed to suit the layout of the new properties, all of which will be connected to the existing Thames Water network.

Once the new sections of the gravity drainage system are installed and operational, the system will be adopted by Thames Water.

5.4 Rainwater Drainage

The existing system of soakaways / run off, will be retained for the existing residential properties.

For the new and refurbished properties which form part of the planning application, new surface water drainage will be provided incorporating above and below ground attenuation ponds discharging into a series of drainage bore holes.

The existing surface water drainage system serving the newly formed QinetiQ area will be retained.

No surface water will be discharged into the foul drainage system.

Proposed Utility Services (Development Site)

5.5 Electrical Supplies

Separate to the infrastructure serving the existing residential properties, there is a High Voltage UKPN electrical supply which serves the existing DSTL site.

This supply Leaves the A224 and crosses the field South of the quarry and enters the development site East of the Fort.

UKPN will extend the High Voltage supply to feed a number of substations across the development site. The substations will each feed an area of residential and commercial properties depending on load and location.

All retained buildings will be provided with a new metered UKPN supply, which will allow the end users to choose and switch energy suppliers as required.

As part of the works it will be necessary to upgrade the supply to the site to meet the needs of the new development, the final design and timing of this reinforcement will depend on the final timescale and phasing of the development works.

5.6 Telecoms

There is an extensive existing telecoms cable network serving the existing site.

This telecoms network will be adapted and renewed as required to meet the requirements if the new development.

Conclusion

In conclusion, relatively early in the development process the existing residential properties will be provided with a new Thames Water supply which will allow them to be separate and not dependant on the existing DSTL site. This supply will also provide Fire Hydrants in the footpaths allowing the Fire Brigade access to water in the normal way.

The other utility services to the existing residential properties, including electricity, drainage, and telecoms, are supplied separately to the DSTL site and will remain unaffected by the development.

The development site will be provided with new utility services with power, water and foul drainage for each building being directly connected to the relevant utility provider.

All properties will have a utilities electrical meter which will allow the occupier to choose and switch – when required – their electricity provider.

All buildings (New and Existing) on the final development will be supported with new infrastructure directly by the Utility providers.