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SUDS DESIGN DOCUMENT

MAY 2023

the journey is the reward

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MAY 2023

Project Code:	**GTWVILLE_BSL**
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Approved by:	**RHA**
Issue Date:	**MAY 2023**
Status:	**Planning**
Document Ref:	**GTWVILLE_BSL-DOC_03_A**

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Issue Details

Issue	Date	Revision Details	Checked
1st	26/05/23	For Planning	RHA
A	03/04/24	For Planning	RHA
B	24/01/25	Post LLFA comments of 25/9/24	RHA

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1 Introduction

1.1 This document sets out the design principles for the drainage associated with the proposed Blue Star Land development (BSL).

1.2 The BSL site covers an area of 1.96Ha and is located between the Berewood development site and the A3/Maurepas Way (OS Grid Ref. SU678093). A location plan of the site is shown on Dwg. GTWVILLE_BSL_GA_01 in Appendix B.

1.3 The site historically contained public allotments which have since been relocated. Since then, it has mainly been vacant apart from the construction of a footway network providing access from Laxton Leaze and the Forest End estate to London Road.

1.4 The BSL development will comprise of up to 69 residential units with a primary highway access off Laxton Leaze to the west and an emergency/pedestrian access off Peasgood Lane in the north-west corner of the site.

1.5 The site will include a large open space area in the north east corner which will accommodate a play area and SuDs provision for the site.

2 Existing Condition

Topography

2.1 A topographical survey of the existing land was undertaken by Encompass Surveys Ltd in March 2023. The site slopes predominantly from the south to the northeast. Ground levels range from approximately from 38.00mAOD to 44.50mAOD. The site is predominantly overgrown grassed areas intersected by two 3m wide pedestrian paths running from Laxton Leaze (west side) and Forest End (south side) to London Rd (east side). A number of mature trees are situated along the northern and eastern boundaries with smaller trees dispersed within the site. A mature hedge borders the western boundary of the site.

2.2 A tree survey has been carried out by James Fuller in March 2023. Relevant extracts from the subsequent report (Ref. JFA9514) are contained in Appendix A.

2.3 There is a hard surfaced area in the southeast corner of the site, which used to serve as the allotment parking. It is not clear at the moment what the make up or extent of the parking area is due to the existing overgrowth.

Geology and Hydrogeology

2.4 The original land use was agricultural, before being utilised as public allotments approximately 80 years ago.

2.5 A geological survey is to be undertaken in the immediate future once ecological constraints have been addressed. However, there is extensive geological information from the adjacent Berewood sites to suggest the ground make up is topsoil overlying silty/clay subsoil overlying Oxford Clay head deposits, overlying chalk.

2.6 The Oxford clay and overlying sub-soil will be the main materials affecting the drainage strategy. Results from the adjacent Berewood ground investigations for Berewood Phases 1 and 3B indicate that the ground will be unsuitable for infiltration.

2.7 A ground investigation was undertaken in April 2023 (T & P Report Ref. P0841/CS-1725). Relevant extracts of the report are contained in Appendix A.

2.8 The ground investigation identified a general topsoil thickness of between 0.2 and 0.3m, underlain by firm going to stiff London Clay to a minimum depth of 4m bgl.

2.9 Ground water wasn't encountered during the investigation. However, further seasonal monitoring may be necessary to determine the level of risk.

2.10 The properties of the London clay make infiltration impractical.

Hydrology

2.11 The main recipient watercourse for site run-off will be the River Wallington, which flows east to west and is located approximately 250m to the north of the site.

2.12 The site is bordered on the south west and north side by field ditches typical of those on the adjacent Berewood site prior to development. An additional ditch also crosses the site from the southern boundary to the north east corner of the site. Dwg. GTWVILLE/DR/01 in Appendix B shows the general surface water flow routes for the site and the overland flood flow paths. Generally overland flows are collected and drain northwards via the ditches on the east and west sides of the site.

Arboricultural Assets

2.13 Appendix A contains an extract from the tree survey which was undertaken in March 2023 by James Fuller. The plan in Appendix A indicates that all of the trees within the proposed SuDs footprint are Category C (Trees of Low Quality). There are two Category B trees (Trees of Moderate Quality) on the northern boundary of the site. The pond has been located to ensure it sits outside the potential root zone of these trees.

3 Proposals

Proposed Drainage Network and SuDS Provision

3.1 Dwg GTWVILLE_BSL/DR/03 in Appendix B shows the proposed SuDS provision in context with the site and an outline drainage network.

3.2 The drainage layout indicated on Dwg. GTWVILLE_BSL/DR/03, is a preliminary layout used to test the available falls across the site. The proposed networks will need to be developed further once a more detailed layout of the development is available.

3.3 The stormwater drainage will comprise of one network including an interim storage tank with vortex flow control draining to a final storage basin also fitted with a vortex flow control. The storage provision, in effect, will work as a cascade system by slowing the discharge from a portion of the upstream catchment to reduce the load on the downstream storage basin.

3.4 The available storage provided by the basin is constrained by the limited available freeboard, surrounding protected trees and the requirement to provide an area of open space with play area, so it will not be possible to limit discharge to the (QBar) greenfield run off rate of 5.06l/s/Ha. Therefore, the flow control at the outfall will comprise of two flow control outlets mounted at different invert levels.

3.5 The discharge will be limited to 5.06l/s/Ha for all storm events up to and including a 1 in 30yr storm event. The discharge rate will increase to less than 13l/s/Ha for storm events greater than 1 in 30yr up to 1 in 100yr plus 45% climate change, by utilising the upper flow control in addition to the lower flow control.

3.6 The 13l/s/Ha assumes that the greenfield run off rate for 1 in 30yr storm events compared with the QBAR rate, will increase by a growth factor of 2.267.

3.7 Dwg. GTWVILLE_BSL/DR/04 in Appendix B shows the proposed SuDS basin in more detail and provides a cross-section of the basin to inform how it would sit within the existing topography. The basin will have a rim level of 39.50m AoD and a base level of 38.03m AoD.

3.8 Dwg GTWVILLE_BSL/DR/07 in Appendix B shows the proposed underground storage tank. The tank will be 1m deep and will have a minimum cover of 1m. The tank will comprise of proprietary PE modular storage units..

3.9 The drainage networks (including the storage tank but excluding the SuDs basin) will be adopted by LEEP under a S104 agreement. Any drainage solely draining public highway will be adopted by Hampshire County Council (HCC) under a S38 agreement..

3.10 The SuDs basin has been located to avoid tree root protection zones within the vicinity whilst optimising the remaining amenity space. The pond has been positioned a minimum 5m from the existing medium pressure gas main which runs along the eastern boundary of the site. This is more than the statutory minimum 3m clearance.

3.11 The SuDs basin will be maintained by an adopting authority as part of a wider open space maintenance agreement.

3.12 The outfalls from the basin and storage tank will be fitted with a Pollution Control Valve (PCV) and a vortex flow restrictor. The PCV's will enable routine maintenance of the flow control units and allow immediate detention of flow in the event of contamination spillages upstream.

3.13 Both storage facilities will be fitted with an overflow to avoid the risk of flooding due to an exceedance event.

3.14 The existing receiving ditch, which will receive discharge from the networks is heavily vegetated and silted. The ditch networks in the vicinity and downstream of the outfalls will be cleaned out beforehand to ensure the design outfall IL can be achieved.

3.15 The basin is to be designed to be dry during dry weather periods. Planting/landscaping of the basin will be in co-ordination with the wider open space.

3.16 Erosion control at the inlet to the SuDs basin will be provided as a combination of hessian erosion control matting and rip-rap stone.

3.17 The overflow for the SuDs basin will be a series of highway gullies set into the northern slope of the pond. With an outfall pipe connected to the outfall headwall. The overflow for the tank will be an integral weir within the vortex flow control chamber.

4 Design

Design Methodology

4.1 The design has been modelled using Microdrainage Network software to determine the size of the required SuDs basin. A preliminary network has been developed to ensure general falls across the site align with the general topography and to ensure the design water levels within the basin do not adversely affect the upstream network.

4.2 Current pipe sizing has been selected to ensure flooding does not occur for storm events of 1 in 30yrs and less. There is likely to be local flooding within the network for storm events over 1 in 30yrs. It is assumed that local flooding within the site will be routed along overland flow paths and captured at other receptacles downstream to ensure all rainfall is directed through the attenuation systems.

4.3 Overland flow paths through the residential development will be identified and preserved during the detailed design stage.

Design Parameters

4.4 For the purposes of the design, it is assumed there are no impermeable areas within the existing site.

Rainfall and Run-off Parameters

4.5 The discharge rate for the adjacent Berewood development has been agreed at the outline planning stage and is written into the Berewood S.106 Agreement. A QBAR greenfield run-off rate of 5.06l/s/ha has been assumed for the purposes of the BSL drainage design. This rate is considered to be representative for the BSL site.

4.6 The design has been tested for storm events 1 in 5yr, 1 in 30yr +45% (climate change allowance and 1 in 100yr+45% (climate change allowance). The design has also been tested for exceedance using a 1 in 200yr event. The exceedance event assumes the flow control is blocked for a period up to 48 hours (2880 mins) by which time a maintenance response is assumed to have happened.

4.7 Storm durations have been tested within the range between 15 minutes up to 10080 minutes to ensure worst case scenario is identified.

4.8 FEH rainfall parameters have been used to represent the worst case for the long duration rainfall events.

4.9 The FEH parameters relevant to the BSL site are:

C(1km) = -0.027	D1(1km) = 0.461	D2(1km) =0.293
D3(1km) = 0.380	E(1km) = 0.306	F(1km) = 2.247

Catchment Areas

4.10 Dwg. GTWVILLE_BSL/DR/03 shows the impermeable catchments based on the proving layout provided by Thrive as part of the planning application and a preliminary drainage network.

4.11 The site has a number of significant constraints affecting the number of units that can be accommodated (suds provision, public open space, existing utilities, existing open drainage courses). Therefore, the impermeable area will be less than the previous assumption of 65% of the total development area. Areas for residential units have been identified and used to inform the impermeable catchment for the site. The impermeable area has been increased by 10% to allow for 'urban creep'. Table 4.1 shows the design areas based on the figures above.

Description	
Total Development Area (TDA)*	1.96Ha
Total 'Built up' Area (including 10% allowance for 'urban creep') (0.987Ha x 1.1)	1.08Ha
SuDs basin Footprint	0.08Ha
SuDs basin Design Catchment (0.08 x0.9)	0.07Ha
Total Drained Area (1.08+0.07)	**1.15Ha**
QBar Greenfield Run Off Rate (5.06 x 1.15)	**5.8l/s**
1 in 30yr Greenfield Run Off Rate (5.06 x 1.15 x2.267)	**13.2l/s**

Table 4.1: Assumed Run-off Factors and Discharge Rate

4.12 Urban Creep can be described as future urban expansion within a development such as extensions to buildings and paving of gardens. These activities increase the impermeable area of a site and often sit outside of the development control process.

4.13 The SuDs basin is considered largely impermeable on the premise that that ground infiltration will be insignificant. The SuDs basin has an assigned permeability factor of 0.9.

Discharge Rates

4.14 The available storage provided by the basin is constrained by the limited available freeboard and other constraints so it will not be possible to limit discharge to the (QBar) greenfield run off rate of 5.06l/s/Ha. Therefore, the flow control at the outfall will comprise of two flow control outlets mounted at different invert levels.

4.15 With reference to 3.5 and 3.6 above, the discharge rate will be limited to 5.8l/s for all storm events up to and including a 1 in 30yr storm event. The discharge rate will then increase to less than 13.2l/s for storm events up to 1 in 100yr plus 45% climate change, by utilising the upper flow control in addition to the lower flow control.

Summary of Results

4.16 The model data output is contained in Appendix C. Details of the required storage and storm event water levels for each network is contained in Table 4.2 and 4.3 below.

Critical Event	Pond Flow Control IL/Max. Flow Rate	Pond Overflow Level (m)	Water Level (mAoD)	Depth (m)	Max. Discharge Rate (l/s)	Remaining Freeboard to Overflow (mm)
1 in 5yr (720min)	37.99m 5.8l/s and 39.09m 6.6l/s	39.30	38.470	0.0.470	5.8	1053
1 in 30yr +45% CC (720mins)			38.996	1.115	5.8	285
1 in 100yr+45% CC (720mins)			39.258	1.258	12.2	142
1 in 200yr (Exceedance Event) (2160mins)	37.99m 0.1l/s and 39.09m 6.6l/s and Weir O/flow 39.30m		39.315	1.315	11.4	-15

Table 4.2: SuDs Basin Operation Parameters

4.17 The overflow will be set at 39.300m to prevent the pond being breached during exceedance events. The network has been tested assuming the either of the flow controls have become blocked.

4.18 The pond overflow will exceed the QBAR greenfield run-off rate operate after 38hours (1223mins) of an exceedance event commencing.

Maintenance

4.19 A maintenance schedule is contained in Appendix D.

4.20 The outlet controls for the SuDs basin will be accessed via a 2m cinder surfaced path connected to the nearest adoptable highway.

5 Conclusion

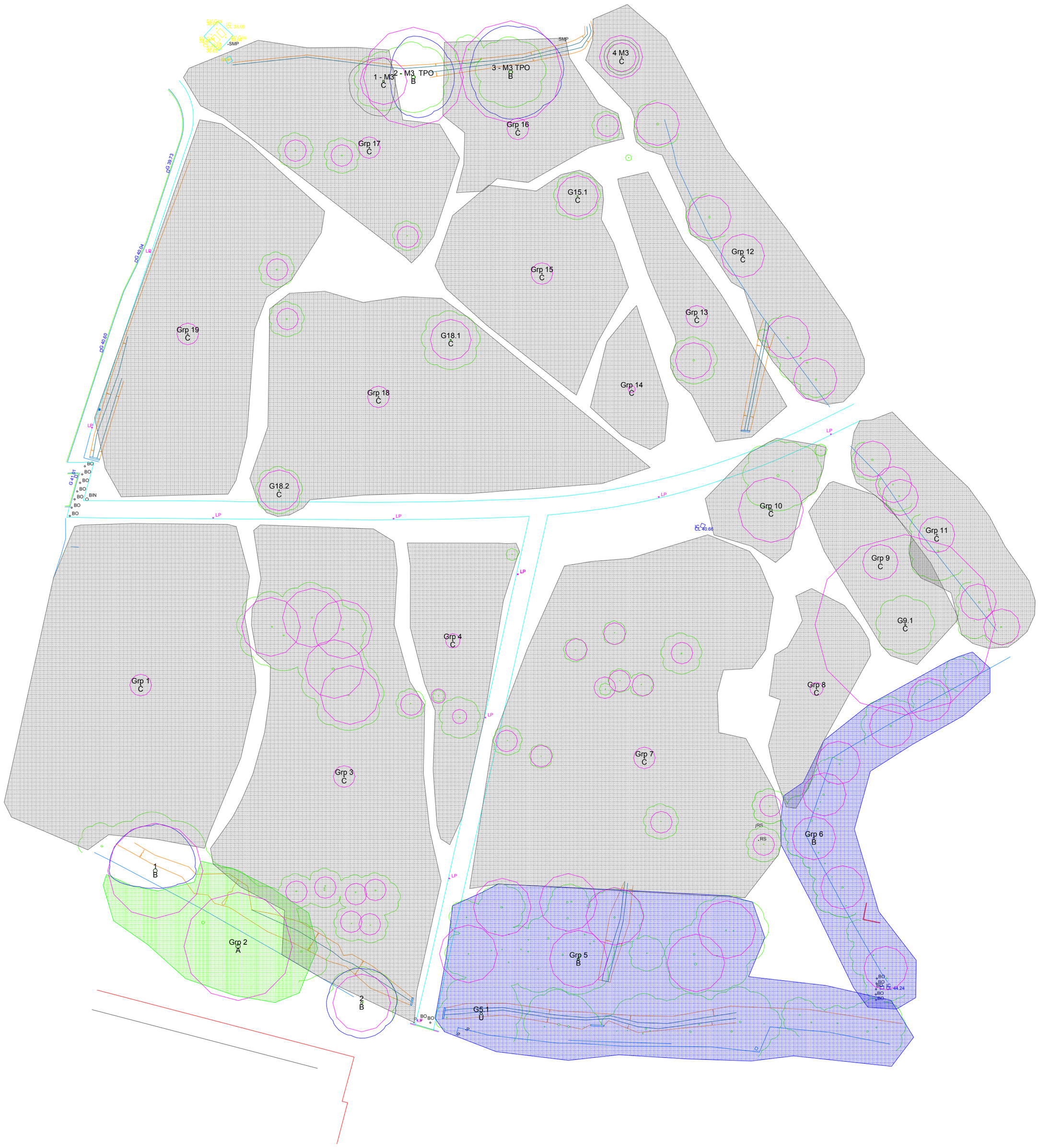
5.1 The maximum discharge from the site for storms up to and including 1in 30yr + 45% climate change will be 5.8l/s. All discharge will be from the lower of two hydrobrakes. Overflows from the tank and the SuDs basin will not operate during any 1 in 30yr + 45% events.

5.2 The maximum discharge from the site for storms up to and including 1in 100yr + 45% climate change will be 12.2l/s. Discharge will be via both of the two hydrobrakes. Overflows from the tank and the SuDs basin will not operate during any 1 in 100yr + 45% events.

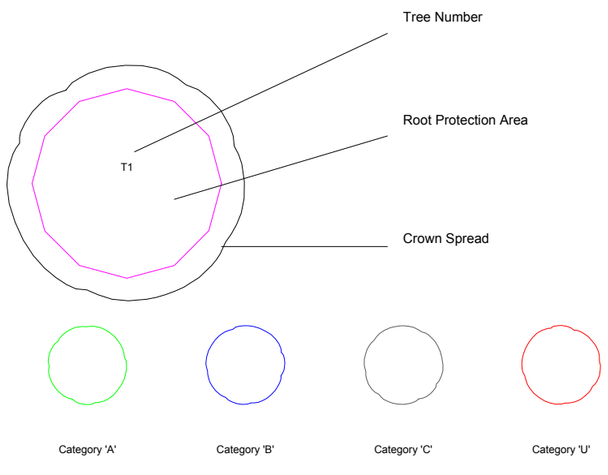
5.3 The maximum discharge volume from the tank over a six hour period will occur during a 720 storm duration event and will be 48.6cu.m. This will be less than the QBAR greenfield run-off volume of 125cu.m

5.4 The SuDs basin has been tested for an exceedance event whereby the flow control outlet or PCV are blocked/shut off during a 1 in 200yr event. In both locations the overflow facility is utilised. Maximum water level in the SuDs basin will be 39.315m.

APPENDIX A: Extracts from Tree Survey Report Ref. JFA9514 and Ground Investigation Report (Ref. P0841/CS-1725)



NOTES:
1. The site is not lcated within a Conservation Area.
2. Trees 2 M3 and 3 M3 are protected by a TPO, enforced by Havant Borough Council.



0 60m

JamesFuller Arboriculture

Tree Survey Plan

SITE: Blue Star

SCALE :	DATE :	N
1 : 500 @ A2	20/03/2023	
MAP FILENAME : JFA9514.01 TSP		

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EXECUTIVE SUMMARY

Project Information	
Project details	This Desk Study and Ground Investigation report has been prepared by T&P Regeneration Ltd on behalf of West Waterlooville Developments Ltd for Blue Star, Berewood, Waterlooville, PO7 3AY / NGR: 467830, 109340.
Site description and current land use	The site occupies an area of 20,000 square meters currently consists of an area of densely vegetated public open space with tarmacadam footpaths bisecting the site north-south and east-west. A number of corridors had been cleared of vegetation across the site prior to the T&P ground investigation attendance due to ecological constraints. The site elevation ranges between approximately 40 and 43 metres Above Ordnance Datum (mAOD) and is generally level.
Development	T&P understands that the proposed development is intended to comprise the construction of traditional two storey residential dwellings with associated areas of communal and private soft landscaping with hard landscaped access and parking.
Site Setting	
Environmental setting	The site is indicated to be entirely underlain by the London Clay Formation. The London Clay Formation is classified as an Unproductive Strata. The nearest surface water feature is an unnamed drain which runs north-south through the eastern portion of the site. The site is in a Flood Zone 1 with a low probability of flooding. However, as the site is over 1 hectare, a flood risk assessment will be required. The site is not located within an environmentally/ecologically sensitive area.
Radon	The site is in a low risk radon area. Radon protection measures are not necessary.
UXO	A UXO desk study and risk assessment was previously completed for the site by a third party which classified the site as being at low risk of unexploded bombs.
Site history	From the time of the earliest maps in the late 1800's, the site is shown to be undeveloped and comprised of agricultural land which is later marked as allotments with an area of woodland to the immediate south and west. A footpath is shown running across the northern portion of the site. Few significant changes were noted across the site, with the exception of a drain marked running north to south through the site on the 1955-1977 map and the addition of another footpath. A break in slope is marked along the eastern boundary of the site by 1977-1989 associated with the development of the A3 road. The present day site includes tarmacadam paths running through the central portion. The immediate area off site surrounding the site comprises agricultural land and small woods to the north and west with residential development to the south and east. By 1953-1965 the woods had been removed with additional residential development to the immediate south. The 1977-1989 map shows a fire station located to the immediate south-east of the site and A3 road along the eastern site boundary, with associated break in slope encroaching onto the site boundary.
Areas of potential concern at desk study stage	<u>On-site:</u> • Made ground associated with previous site use and adjacent land development. • Agricultural pest/weed control associated with former agricultural practices. <u>Off-site:</u> • Berewood fire station location immediately adjacent to the southern site boundary. • Commercial units within the wider area to the eats including a fuel station 39m to the north east.
Phase 2 Ground Investigation	
Scope of work	An intrusive ground investigation was undertaken on the 20th April 2023, comprising the following: • Excavation of 7Nº trial pits; • Drilling of 3Nº dynamic windowless soil sampling boreholes; • *In situ* vehicle mounted California Bearing Ratio (CBR) tests in 6Nº locations; • Installation of 3Nº boreholes as environmental monitoring wells.

Ground conditions	Made ground was only encountered in a single exploratory location (WS03) in the east of the site with a reported thickness of 0.5m. Made ground was found to comprise slightly silty gravelly sand, which included concrete, glass and brick fragments. A geotextile membrane was noted at the base of the made ground. Topsoil was encountered in all exploratory locations (excluding WS03) with a typical thickness ranging between 0.20 and 0.30m. The London Clay Formation was encountered within all exploratory hole locations to the base of the holes with a maximum depth of 4.00mbgl. In general, the London Clay comprised firm orangish brown silty clay which graded into a stiff bluish grey silty clay with depth. With the exception of made ground within WS03, no significant visible or olfactory evidence of any contamination was noted during the ground investigation.
Groundwater	Groundwater was not encountered during the ground investigation.
Principal Findings and Conclusions	
Human health and plant growth	A review of soil data has not identified any contaminants soil concentrations to be elevated against adopted phytotoxic screening levels or human health screening levels for a 'residential with homegrown produce' end use within topsoil or natural soils. While a full suite of contaminate testing was not undertaken within the limited made ground encountered, it is considered that this material will be physically unsuitable to remain within areas of soft landscaping in any case.
Controlled waters	Based on the findings of the ground investigation, and in consideration of the site conceptual model, it is concluded that the risks to Controlled Waters are low. No further work is considered to be required.
Gas protection	In consideration of the site conceptual model, and ground investigation findings no viable on- or off-site sources of ground gas have been identified. Therefore, it is considered that the site has a low ground gas generating potential and that risks to future residents associated with ground gases are low. No ground gas protection measures are deemed necessary within future development. Radon protection measures are not considered necessary for the proposed development.
Potable supply pipework	It is concluded that PVC pipework will likely be suitable for the majority of the buried potable water supply network on site. Further testing in line with the UKWIR criteria is recommended to confirm this assessment taking into account the minor exceedance noted in TP04.
Waste	All samples tested were classified as non-hazardous waste. Based on the initial chemical data the natural soils are anticipated to be treated as inert. However, further Waste Acceptance Criteria (WAC) testing may be required by the receiving site.
Engineering design	The cohesive soils have shown to be of high shrinkage potential and as a result will be highly susceptible to the influence of trees. it is considered that traditional shallow strip foundations placed at the minimum depth of 1.0mbgl within the firm clay may be designed for an allowable bearing capacity of 115kPa for acceptable settlement. Given the results of the foundation zonal plan however, it is likely that the majority of plots within the proposed development will require piled foundations due to the influence of nearby trees. Based on the test results a design CBR value of 1.5% is recommended subject to the cohesive soils of the London Clay Formation being encountered at formation level. Sulphate testing of selected soil samples indicates that a suitable design mix for concrete for buried structures is likely to be DS-3 AC-2s.
Considerations and Recommendations for Further Work	
Considerations	• Access across the site was significantly limited due to ecological constraints and vegetation cover. • The extent of the made ground in the east has not been delineated.

Recommendations	<u>Human health/plant growth</u> • It is recommended that further investigation and laboratory testing is undertaken once full access is available across the site to delineate areas of made ground and assess the potential for contamination within areas previous inaccessible due to ecological constraints. • Following supplementary ground investigation, a Remediation Strategy should be completed to defined remedial action required for the proposed development. <u>Potable water supply pipework</u> • Elevated contaminants within the made ground with respect to the UKWIR guidelines indicate that PVC pipework should be suitable across the site, although further testing in line with the UKWIR criteria should be undertaken to confirm this assessment given the localised elevated BaP recorded in TP04. <u>Engineering</u> • Further investigation comprising cable percussive boreholes should be undertaken to derive design parameters should a piled foundation solution be required due to overdeepening of foundations within the influence of trees. • Further in-situ CBR testing could be undertaken during more favourable weather conditions to potentially achieve a higher design value. <u>General</u> • A Flood Risk Assessment will be required to support future development. • Discussions should be held with local landfill/soil waste treatment facilities to agree material classification/pre-treatment required for any soils to be disposed off-site as a result of proposed construction works. • Ground workers should remain vigilant for visible and olfactory signs of contamination following demolition of on-site buildings. • Ground workers should be vigilant for potential UXO and seek immediate professional advice if anything suspicious is encountered during groundworks. • On-site monitoring wells should be protected from damage until such time as conclusions/recommendations within this report are agreed with the regulators. Monitoring installations should then be decommissioned in accordance with Environment Agency guidelines. • A site-specific health and safety plan should be prepared to inform on risks posed from the previous site use and mitigations for ground workers developing the site e.g. requirements for appropriate PPE, hygiene practices, environmental monitoring and requirements for mitigation measures during construction works. • A copy of this report should be provided to the relevant regulatory authorities to confirm that they are in agreement with the report findings.

APPENDIX B: Model Data

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

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	1.500
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 Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km)	0.461	F (1km)	2.247
FEH Rainfall Version	1999	D2 (1km)	0.293	Cv (Summer)	0.750
Site Location		D3 (1km)	0.380	Cv (Winter)	0.840
C (1km)	-0.027	E (1km)	0.306		

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)	120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1.0	120 Summer	1	+0%					40.837
1.001	1.1	120 Summer	1	+0%					40.066
1.002	1.2	120 Summer	1	+0%					39.560
2.000	2.0	120 Summer	1	+0%					41.842
3.000	3.0	120 Summer	1	+0%					40.843
2.001	2.1	120 Summer	1	+0%					40.457
4.000	4.0	120 Summer	1	+0%					40.884
2.002	2.2	120 Summer	1	+0%					40.165
5.000	5.0	120 Summer	1	+0%					41.169
2.003	2.3	120 Summer	1	+0%					39.867
2.004	2.4	120 Summer	1	+0%					39.381
6.000	7.0	120 Summer	1	+0%					40.071
2.005	2.5	480 Winter	1	+0%					39.202
7.000	7.0	120 Summer	1	+0%					39.840
2.006	2.6	120 Summer	1	+0%					39.028
2.007	2.7	120 Summer	1	+0%					38.924

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1.0	-0.188	0.000	0.07			4.5	OK	
1.001	1.1	-0.237	0.000	0.10			9.6	OK	
1.002	1.2	-0.227	0.000	0.14			13.9	OK	
2.000	2.0	-0.108	0.000	0.17			3.8	OK	
3.000	3.0	-0.107	0.000	0.18			3.8	OK	
2.001	2.1	-0.239	0.000	0.09			9.3	OK	
4.000	4.0	-0.116	0.000	0.11			2.5	OK	
2.002	2.2	-0.237	0.000	0.10			12.4	OK	
5.000	5.0	-0.131	0.000	0.04			0.8	OK	
2.003	2.3	-0.235	0.000	0.11			14.8	OK	
2.004	2.4	-0.231	0.000	0.12			15.8	OK	
6.000	7.0	-0.119	0.000	0.09			2.0	OK	
2.005	2.5	-0.130	0.000	0.06			3.1	OK	
7.000	7.0	-0.120	0.000	0.09			1.9	OK	
2.006	2.6	-0.253	0.000	0.06			4.5	OK	
2.007	2.7	-0.253	0.000	0.06			4.5	OK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
8.000	8.0	120 Summer	1	+0%					40.278
8.001	8.1	120 Summer	1	+0%					40.040
1.003	1.3	120 Summer	1	+0%					38.799
9.000	9.0	120 Summer	1	+0%					39.039
10.000	10.0	120 Summer	1	+0%					39.241
9.001	9.1	120 Summer	1	+0%					38.580
1.004	1.4	120 Summer	1	+0%					38.557
11.000	11.0	120 Summer	1	+0%					39.047
1.005	1.5	120 Summer	1	+0%					38.537
1.006	HW1.0	120 Summer	1	+0%					38.512
1.007	HW1.1	720 Winter	1	+0%	1/240 Winter				38.306
1.008	1.8	720 Winter	1	+0%	1/240 Winter				38.312

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
8.000	8.0	-0.122	0.000	0.08			1.7	OK	
8.001	8.1	-0.114	0.000	0.13			2.8	OK	
1.003	1.3	-0.262	0.000	0.20			23.6	OK	
9.000	9.0	-0.261	0.000	0.04			4.2	OK	
10.000	10.0	-0.214	0.000	0.01			1.0	OK	
9.001	9.1	-0.307	0.000	0.05			6.4	OK	
1.004	1.4	-0.123	0.000	0.26			28.6	OK	
11.000	11.0	-0.253	0.000	0.06			6.2	OK	
1.005	1.5	-0.065	0.000	0.51			33.9	OK	
1.006	HW1.0	-0.060	0.000	1.00			33.3	OK	
1.007	HW1.1	0.081	0.000	0.19			6.0	SURCHARGED	
1.008	1.8	0.097	0.000	0.15			5.7	SURCHARGED	

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5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Network

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 1.500
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 Storage Structures 2
Number of Online Controls 2 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.461 F (1km) 2.247
FEH Rainfall Version 1999 D2 (1km) 0.293 Cv (Summer) 0.750
Site Location D3 (1km) 0.380 Cv (Winter) 0.840
C (1km) -0.027 E (1km) 0.306

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) 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 5
Climate Change (%) 0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1.0	120 Summer	5	+0%					40.848
1.001	1.1	120 Summer	5	+0%					40.080
1.002	1.2	120 Summer	5	+0%					39.580
2.000	2.0	120 Summer	5	+0%					41.853
3.000	3.0	120 Summer	5	+0%					40.853
2.001	2.1	120 Summer	5	+0%					40.470
4.000	4.0	120 Summer	5	+0%					40.892
2.002	2.2	120 Summer	5	+0%					40.180
5.000	5.0	120 Summer	5	+0%					41.173
2.003	2.3	120 Summer	5	+0%					39.883
2.004	2.4	120 Summer	5	+0%					39.398
6.000	7.0	120 Summer	5	+0%					40.078
2.005	2.5	480 Winter	5	+0%					39.304
7.000	7.0	120 Summer	5	+0%					39.847
2.006	2.6	120 Summer	5	+0%					39.039
2.007	2.7	120 Summer	5	+0%					38.935

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5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Network

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1.0	-0.177	0.000	0.10			7.0	OK	
1.001	1.1	-0.223	0.000	0.15			14.8	OK	
1.002	1.2	-0.207	0.000	0.21			21.3	OK	
2.000	2.0	-0.097	0.000	0.27			5.9	OK	
3.000	3.0	-0.097	0.000	0.27			5.9	OK	
2.001	2.1	-0.226	0.000	0.14			14.4	OK	
4.000	4.0	-0.108	0.000	0.18			3.9	OK	
2.002	2.2	-0.222	0.000	0.15			19.1	OK	
5.000	5.0	-0.127	0.000	0.06			1.2	OK	
2.003	2.3	-0.219	0.000	0.17			22.8	OK	
2.004	2.4	-0.214	0.000	0.18			24.4	OK	
6.000	7.0	-0.112	0.000	0.14			3.1	OK	
2.005	2.5	-0.028	0.000	0.06			3.5	OK	
7.000	7.0	-0.113	0.000	0.14			3.0	OK	
2.006	2.6	-0.241	0.000	0.09			6.5	OK	
2.007	2.7	-0.242	0.000	0.08			6.5	OK	

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5 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Network

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
8.000	8.0	120 Summer	5	+0%					40.285
8.001	8.1	120 Summer	5	+0%					40.049
1.003	1.3	120 Summer	5	+0%					38.827
9.000	9.0	120 Summer	5	+0%					39.048
10.000	10.0	120 Summer	5	+0%					39.246
9.001	9.1	120 Summer	5	+0%					38.708
1.004	1.4	120 Summer	5	+0%	5/120 Summer				38.701
11.000	11.0	120 Summer	5	+0%					39.061
1.005	1.5	180 Summer	5	+0%					38.602
1.006	HW1.0	240 Summer	5	+0%					38.572
1.007	HW1.1	720 Winter	5	+0%	5/120 Summer				38.470
1.008	1.8	720 Winter	5	+0%	5/120 Summer				38.476

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
8.000	8.0	-0.115	0.000	0.12			2.7	OK	
8.001	8.1	-0.105	0.000	0.20			4.4	OK	
1.003	1.3	-0.234	0.000	0.31			35.9	OK	
9.000	9.0	-0.252	0.000	0.06			6.4	OK	
10.000	10.0	-0.209	0.000	0.02			1.6	OK	
9.001	9.1	-0.179	0.000	0.07			9.9	OK	
1.004	1.4	0.021	0.000	0.43			46.9	SURCHARGED	
11.000	11.0	-0.239	0.000	0.09			9.6	OK	
1.005	1.5	0.000	0.000	0.68			45.1	OK	
1.006	HW1.0	0.000	0.000	1.11			36.8	OK	
1.007	HW1.1	0.245	0.000	0.20			6.2	SURCHARGED	
1.008	1.8	0.261	0.000	0.15			5.8	SURCHARGED	

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 1.500
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 Storage Structures 2
Number of Online Controls 2 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.461 F (1km) 2.247
FEH Rainfall Version 1999 D2 (1km) 0.293 Cv (Summer) 0.750
Site Location D3 (1km) 0.380 Cv (Winter) 0.840
C (1km) -0.027 E (1km) 0.306

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) 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 30
Climate Change (%) 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1.0	120 Summer	30	+45%					40.876
1.001	1.1	120 Summer	30	+45%					40.132
1.002	1.2	120 Summer	30	+45%					39.644
2.000	2.0	120 Summer	30	+45%					41.890
3.000	3.0	120 Summer	30	+45%					40.892
2.001	2.1	120 Summer	30	+45%					40.519
4.000	4.0	120 Summer	30	+45%					40.919
2.002	2.2	120 Summer	30	+45%					40.231
5.000	5.0	120 Summer	30	+45%					41.188
2.003	2.3	120 Summer	30	+45%					39.937
2.004	2.4	720 Winter	30	+45%	30/120 Winter				39.904
6.000	7.0	120 Summer	30	+45%					40.102
2.005	2.5	720 Winter	30	+45%	30/120 Summer				39.902
7.000	7.0	120 Summer	30	+45%					39.871
2.006	2.6	1440 Winter	30	+45%					39.133
2.007	2.7	1440 Winter	30	+45%					39.129

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1.0	-0.149	0.000	0.25			17.4	OK	
1.001	1.1	-0.171	0.000	0.38			38.0	OK	
1.002	1.2	-0.143	0.000	0.54			55.0	OK	
2.000	2.0	-0.060	0.000	0.67			14.7	OK	
3.000	3.0	-0.058	0.000	0.68			14.7	OK	
2.001	2.1	-0.177	0.000	0.35			36.2	OK	
4.000	4.0	-0.081	0.000	0.44			9.8	OK	
2.002	2.2	-0.171	0.000	0.38			48.0	OK	
5.000	5.0	-0.112	0.000	0.15			2.9	OK	
2.003	2.3	-0.165	0.000	0.42			57.7	OK	
2.004	2.4	0.292	0.000	0.11			14.8	SURCHARGED	
6.000	7.0	-0.088	0.000	0.35			7.6	OK	
2.005	2.5	0.570	0.000	0.07			3.6	SURCHARGED	
7.000	7.0	-0.089	0.000	0.34			7.4	OK	
2.006	2.6	-0.147	0.000	0.07			5.1	OK	
2.007	2.7	-0.048	0.000	0.07			5.1	OK	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
8.000	8.0	120 Summer	30	+45%					40.307
8.001	8.1	120 Summer	30	+45%					40.080
1.003	1.3	1440 Winter	30	+45%	30/720 Winter				39.126
9.000	9.0	1440 Winter	30	+45%					39.123
10.000	10.0	120 Summer	30	+45%					39.258
9.001	9.1	1440 Winter	30	+45%	30/120 Summer				39.123
1.004	1.4	1440 Winter	30	+45%	30/120 Summer				39.123
11.000	11.0	1440 Winter	30	+45%					39.121
1.005	1.5	1440 Winter	30	+45%	30/120 Summer				39.121
1.006	HW1.0	1440 Winter	30	+45%	30/120 Summer				39.118
1.007	HW1.1	1440 Winter	30	+45%	30/120 Summer				39.115
1.008	1.8	1440 Winter	30	+45%	30/120 Summer				39.117

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
8.000	8.0	-0.093	0.000	0.31			6.7	OK	
8.001	8.1	-0.074	0.000	0.50			11.1	OK	
1.003	1.3	0.065	0.000	0.13			15.7	SURCHARGED	
9.000	9.0	-0.177	0.000	0.02			2.2	OK	
10.000	10.0	-0.197	0.000	0.04			3.9	OK	
9.001	9.1	0.236	0.000	0.03			3.5	SURCHARGED	
1.004	1.4	0.443	0.000	0.18			19.6	SURCHARGED	
11.000	11.0	-0.179	0.000	0.03			3.3	OK	
1.005	1.5	0.519	0.000	0.34			22.7	SURCHARGED	
1.006	HW1.0	0.546	0.000	0.68			22.6	SURCHARGED	
1.007	HW1.1	0.890	0.000	0.20			6.2	SURCHARGED	
1.008	1.8	0.902	0.000	0.15			5.8	SURCHARGED	

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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Network

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	5	PIMP (%)	100
M5-60 (mm)	19.100	Add Flow / Climate Change (%)	0
Ratio R	0.350	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
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 Network

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.544	4-8	0.606

Total Area Contributing (ha) = 1.150

Total Pipe Volume (m³) = 36.511

Network Design Table for Network

« - 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
1.000	36.118	0.722	50.0	0.089	4.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	59.065	0.516	114.5	0.106	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	34.982	0.350	99.9	0.088	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.000	21.717	0.371	58.5	0.075	4.00	0.0	0.600	o	150	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)
1.000	50.00	4.32	40.800	0.089	0.0	0.0	0.0	1.85	73.7	12.1
1.001	50.00	4.99	40.003	0.195	0.0	0.0	0.0	1.47	103.8	26.4
1.002	50.00	5.37	39.487	0.283	0.0	0.0	0.0	1.57	111.2	38.3
2.000	50.00	4.27	41.800	0.075	0.0	0.0	0.0	1.32	23.3	10.2

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Network Design Table for Network

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
3.000	14.848	0.254	58.5	0.075	4.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	27.688	0.294	94.2	0.035	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.000	30.866	0.528	58.5	0.050	4.00	0.0	0.600	o	150	Pipe/Conduit	
2.002	17.525	0.300	58.4	0.010	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.000	8.036	0.137	58.7	0.015	4.00	0.0	0.600	o	150	Pipe/Conduit	
2.003	25.681	0.490	52.4	0.035	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.004	12.715	0.280	45.4	0.021	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.000	15.569	0.267	58.3	0.039	4.00	0.0	0.600	o	150	Pipe/Conduit	
2.005	15.262	0.052	295.9	0.020	0.00	0.0	0.600	o	300	Pipe/Conduit	
7.000	15.649	0.271	57.7	0.038	4.00	0.0	0.600	o	150	Pipe/Conduit	
2.006	15.710	0.103	152.5	0.016	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.007	17.589	0.117	150.3	0.000	0.00	0.0	0.600	o	300	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)
3.000	50.00	4.19	40.800	0.075	0.0	0.0	0.0	1.32	23.3	10.2
2.001	50.00	4.56	40.396	0.185	0.0	0.0	0.0	1.62	114.5	25.1
4.000	50.00	4.39	40.850	0.050	0.0	0.0	0.0	1.32	23.3	6.8
2.002	50.00	4.70	40.102	0.245	0.0	0.0	0.0	2.06	145.7	33.2
5.000	50.00	4.10	41.150	0.015	0.0	0.0	0.0	1.32	23.3	2.0
2.003	50.00	4.90	39.802	0.295	0.0	0.0	0.0	2.18	153.9	39.9
2.004	50.00	4.99	39.312	0.316	0.0	0.0	0.0	2.34	165.4	42.8
6.000	50.00	4.20	40.040	0.039	0.0	0.0	0.0	1.32	23.3	5.3
2.005	50.00	5.27	39.032	0.375	0.0	0.0	0.0	0.91	64.2	50.8
7.000	50.00	4.20	39.810	0.038	0.0	0.0	0.0	1.33	23.4	5.1
2.006	50.00	5.47	38.980	0.429	0.0	0.0	0.0	1.27	89.8	58.1
2.007	50.00	5.70	38.877	0.429	0.0	0.0	0.0	1.28	90.5	58.1

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Network Design Table for Network

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
8.000	14.410	0.246	58.6	0.034	4.00	0.0	0.600	o	150	Pipe/Conduit	
8.001	23.393	0.400	58.5	0.023	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	18.991	0.095	199.9	0.050	0.00	0.0	0.600	o	375	Pipe/Conduit	
9.000	40.931	0.413	99.1	0.082	4.00	0.0	0.600	o	300	Pipe/Conduit	
10.000	9.660	0.550	17.6	0.020	4.00	0.0	0.600	o	225	Pipe/Conduit	
9.001	25.014	0.147	170.2	0.027	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.004	9.151	0.078	117.3	0.010	0.00	0.0	0.600	o	375	Pipe/Conduit	
11.000	44.472	0.448	99.3	0.122	4.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	11.953	0.030	398.4	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.006	19.816	0.020	990.8	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.007	6.607	0.050	132.1	0.070	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.008	11.764	0.090	130.7	0.000	0.00	0.0	0.600	o	225	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)
8.000	50.00	4.18	40.250	0.034	0.0	0.0	0.0	1.32	23.3	4.6
8.001	50.00	4.48	40.004	0.057	0.0	0.0	0.0	1.32	23.3	7.7
1.003	50.00	5.95	38.685	0.819	0.0	0.0	0.0	1.28	141.1	110.9
9.000	50.00	4.43	39.000	0.082	0.0	0.0	0.0	1.58	111.6	11.1
10.000	50.00	4.05	39.230	0.020	0.0	0.0	0.0	3.14	124.7	2.7
9.001	50.00	4.73	38.512	0.129	0.0	0.0	0.0	1.39	153.1	17.5
1.004	50.00	6.04	38.305	0.958	0.0	0.0	0.0	1.67	184.7	129.7
11.000	50.00	4.47	39.000	0.122	0.0	0.0	0.0	1.58	111.5	16.5
1.005	50.00	6.26	38.227	1.080	0.0	0.0	0.0	0.90	99.6«	146.2
1.006	50.00	6.85	38.197	1.080	0.0	0.0	0.0	0.57	62.7«	146.2
1.007	50.00	6.94	38.000	1.150	0.0	0.0	0.0	1.14	45.2«	155.7
1.008	50.00	7.11	37.990	1.150	0.0	0.0	0.0	1.14	45.4«	155.7

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Free Flowing Outfall Details for Network

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.008	1.11	38.200	37.900	37.900	0	0

Simulation Criteria for Network

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	1.500
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 Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	5	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.100	Storm Duration (mins)	30
Ratio R	0.350		

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Online Controls for Network

Hydro-Brake® Optimum Manhole: 2.5, DS/PN: 2.005, Volume (m³): 4.3

Unit Reference	MD-SHE-0086-4000-1580-4000
Design Head (m)	1.580
Design Flow (l/s)	4.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	86
Invert Level (m)	39.032
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.580	4.0
Flush-Flo™	0.376	3.6
Kick-Flo®	0.769	2.9
Mean Flow over Head Range	-	3.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.6	1.200	3.5	3.000	5.4	7.000	8.0
0.200	3.4	1.400	3.8	3.500	5.8	7.500	8.3
0.300	3.6	1.600	4.0	4.000	6.2	8.000	8.6
0.400	3.6	1.800	4.2	4.500	6.5	8.500	8.8
0.500	3.5	2.000	4.5	5.000	6.9	9.000	9.1
0.600	3.4	2.200	4.7	5.500	7.2	9.500	9.3
0.800	2.9	2.400	4.9	6.000	7.5		
1.000	3.2	2.600	5.0	6.500	7.8		

Complex Manhole: 1.8, DS/PN: 1.008, Volume (m³): 1.9

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0106-5800-1500-5800
Design Head (m)	1.500
Design Flow (l/s)	5.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	106
Invert Level (m)	37.990

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Hydro-Brake® Optimum

Minimum Outlet Pipe Diameter (mm) 150
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	5.8
Flush-Flo™	0.453	5.8
Kick-Flo®	0.926	4.6
Mean Flow over Head Range	-	5.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.6	1.200	5.2	3.000	8.0	7.000	12.0
0.200	5.2	1.400	5.6	3.500	8.6	7.500	12.4
0.300	5.6	1.600	6.0	4.000	9.2	8.000	12.8
0.400	5.8	1.800	6.3	4.500	9.7	8.500	13.1
0.500	5.8	2.000	6.6	5.000	10.2	9.000	13.5
0.600	5.7	2.200	6.9	5.500	10.7	9.500	13.9
0.800	5.3	2.400	7.2	6.000	11.1		
1.000	4.8	2.600	7.5	6.500	11.6		

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0129-7000-0600-7000
Design Head (m)	0.600
Design Flow (l/s)	7.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	129
Invert Level (m)	39.090
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	7.0
Flush-Flo™	0.209	7.0
Kick-Flo®	0.440	6.1
Mean Flow over Head Range	-	5.8

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

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Hydro-Brake® Optimum

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.6	1.200	9.7	3.000	15.0	7.000	22.4
0.200	7.0	1.400	10.4	3.500	16.1	7.500	23.2
0.300	6.9	1.600	11.1	4.000	17.2	8.000	24.0
0.400	6.5	1.800	11.7	4.500	18.2	8.500	24.7
0.500	6.4	2.000	12.3	5.000	19.1	9.000	25.5
0.600	7.0	2.200	12.9	5.500	20.0	9.500	26.2
0.800	8.0	2.400	13.5	6.000	20.9		
1.000	8.9	2.600	14.0	6.500	21.6		

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Storage Structures for Network

Tank or Pond Manhole: 2.5, DS/PN: 2.005

Invert Level (m) 39.032

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	220.0	1.200	220.0	1.201	0.0

Tank or Pond Manhole: HW1.1, DS/PN: 1.007

Invert Level (m) 38.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	362.9	1.500	755.3	1.501	0.0

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

Simulation Criteria

Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 1.500
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 Storage Structures 2
Number of Online Controls 2 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH D1 (1km) 0.461 F (1km) 2.247
FEH Rainfall Version 1999 D2 (1km) 0.293 Cv (Summer) 0.750
Site Location D3 (1km) 0.380 Cv (Winter) 0.840
C (1km) -0.027 E (1km) 0.306

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) 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years) 100
Climate Change (%) 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1.0	120 Summer	100	+45%					40.893
1.001	1.1	120 Summer	100	+45%					40.162
1.002	1.2	120 Summer	100	+45%					39.684
2.000	2.0	120 Summer	100	+45%					41.916
3.000	3.0	720 Winter	100	+45%	100/720 Winter				41.011
2.001	2.1	720 Winter	100	+45%	100/600 Winter				41.007
4.000	4.0	720 Winter	100	+45%	100/720 Winter				41.008
2.002	2.2	720 Winter	100	+45%	100/480 Winter				41.005
5.000	5.0	120 Summer	100	+45%					41.196
2.003	2.3	720 Winter	100	+45%	100/240 Winter				41.002
2.004	2.4	720 Winter	100	+45%	100/120 Summer				40.998
6.000	7.0	720 Winter	100	+45%	100/360 Winter				40.997
2.005	2.5	720 Winter	100	+45%	100/120 Summer				40.996
7.000	7.0	120 Summer	100	+45%					39.884
2.006	2.6	720 Winter	100	+45%	100/600 Winter				39.296
2.007	2.7	720 Winter	100	+45%	100/120 Summer				39.291

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

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1.0	-0.132	0.000	0.35			24.7	OK	
1.001	1.1	-0.141	0.000	0.55			53.8	OK	
1.002	1.2	-0.103	0.000	0.76			77.9	OK	
2.000	2.0	-0.034	0.000	0.95			20.8	OK	
3.000	3.0	0.061	0.000	0.22			4.8	SURCHARGED	
2.001	2.1	0.311	0.000	0.11			11.8	SURCHARGED	
4.000	4.0	0.008	0.000	0.14			3.2	SURCHARGED	
2.002	2.2	0.603	0.000	0.12			15.6	SURCHARGED	
5.000	5.0	-0.104	0.000	0.21			4.2	OK	
2.003	2.3	0.900	0.000	0.14			18.8	SURCHARGED	
2.004	2.4	1.386	0.000	0.15			19.7	SURCHARGED	
6.000	7.0	0.807	0.000	0.12			2.5	SURCHARGED	
2.005	2.5	1.664	0.000	0.08			4.1	SURCHARGED	
7.000	7.0	-0.076	0.000	0.49			10.6	OK	
2.006	2.6	0.016	0.000	0.09			7.0	SURCHARGED	
2.007	2.7	0.114	0.000	0.09			6.9	SURCHARGED	

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

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
8.000	8.0	120 Summer	100	+45%					40.320
8.001	8.1	120 Summer	100	+45%					40.099
1.003	1.3	720 Winter	100	+45%	100/120 Summer				39.287
9.000	9.0	720 Winter	100	+45%					39.282
10.000	10.0	720 Winter	100	+45%					39.279
9.001	9.1	720 Winter	100	+45%	100/120 Summer				39.279
1.004	1.4	720 Winter	100	+45%	100/120 Summer				39.276
11.000	11.0	720 Winter	100	+45%					39.272
1.005	1.5	720 Winter	100	+45%	100/120 Summer				39.271
1.006	HW1.0	720 Winter	100	+45%	100/120 Summer				39.265
1.007	HW1.1	720 Winter	100	+45%	100/120 Summer				39.258
1.008	1.8	720 Winter	100	+45%	100/120 Summer				39.247

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
8.000	8.0	-0.080	0.000	0.44			9.4	OK	
8.001	8.1	-0.055	0.000	0.72			15.8	OK	
1.003	1.3	0.226	0.000	0.26			30.8	SURCHARGED	
9.000	9.0	-0.018	0.000	0.05			5.2	OK	
10.000	10.0	-0.176	0.000	0.01			1.3	OK	
9.001	9.1	0.392	0.000	0.06			8.1	SURCHARGED	
1.004	1.4	0.596	0.000	0.35			38.6	SURCHARGED	
11.000	11.0	-0.028	0.000	0.07			7.8	OK	
1.005	1.5	0.669	0.000	0.69			45.8	SURCHARGED	
1.006	HW1.0	0.693	0.000	1.37			45.6	FLOOD RISK	
1.007	HW1.1	1.033	0.000	0.39			12.2	FLOOD RISK	
1.008	1.8	1.032	0.000	0.32			12.2	FLOOD RISK	

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Simulation Criteria for Network

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	1.500
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 Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	5	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.100	Storm Duration (mins)	30
Ratio R	0.350		

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Online Controls for Network

Hydro-Brake® Optimum Manhole: 2.5, DS/PN: 2.005, Volume (m³): 4.3

Unit Reference	MD-SHE-0086-4000-1580-4000
Design Head (m)	1.580
Design Flow (l/s)	4.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	86
Invert Level (m)	39.032
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.580	4.0
Flush-Flo™	0.376	3.6
Kick-Flo®	0.769	2.9
Mean Flow over Head Range	-	3.3

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.6	1.200	3.5	3.000	5.4	7.000	8.0
0.200	3.4	1.400	3.8	3.500	5.8	7.500	8.3
0.300	3.6	1.600	4.0	4.000	6.2	8.000	8.6
0.400	3.6	1.800	4.2	4.500	6.5	8.500	8.8
0.500	3.5	2.000	4.5	5.000	6.9	9.000	9.1
0.600	3.4	2.200	4.7	5.500	7.2	9.500	9.3
0.800	2.9	2.400	4.9	6.000	7.5		
1.000	3.2	2.600	5.0	6.500	7.8		

Complex Manhole: 1.8, DS/PN: 1.008, Volume (m³): 1.9

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0012-1000-1500-1000
Design Head (m)	1.500
Design Flow (l/s)	0.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	12

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Hydro-Brake® Optimum

Invert Level (m)	37.990
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	0.1
Flush-Flo™	0.044	0.0
Kick-Flo®	0.109	0.0
Mean Flow over Head Range	-	0.1

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.0	1.200	0.1	3.000	0.1	7.000	0.2
0.200	0.0	1.400	0.1	3.500	0.1	7.500	0.2
0.300	0.1	1.600	0.1	4.000	0.1	8.000	0.2
0.400	0.1	1.800	0.1	4.500	0.2	8.500	0.2
0.500	0.1	2.000	0.1	5.000	0.2	9.000	0.2
0.600	0.1	2.200	0.1	5.500	0.2	9.500	0.2
0.800	0.1	2.400	0.1	6.000	0.2		
1.000	0.1	2.600	0.1	6.500	0.2		

Hydro-Brake® Optimum

Unit Reference	MD-SHE-0126-6600-0600-6600
Design Head (m)	0.600
Design Flow (l/s)	6.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	126
Invert Level (m)	39.090
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.600	6.6
Flush-Flo™	0.206	6.6
Kick-Flo®	0.438	5.7
Mean Flow over Head Range	-	5.5

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

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Hydro-Brake® Optimum

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.5	1.200	9.1	3.000	14.1	7.000	21.1
0.200	6.6	1.400	9.8	3.500	15.2	7.500	21.9
0.300	6.5	1.600	10.5	4.000	16.2	8.000	22.6
0.400	6.1	1.800	11.1	4.500	17.1	8.500	23.3
0.500	6.1	2.000	11.6	5.000	18.0	9.000	24.0
0.600	6.6	2.200	12.2	5.500	18.8	9.500	24.6
0.800	7.5	2.400	12.7	6.000	19.6		
1.000	8.4	2.600	13.2	6.500	20.3		

Weir

Discharge Coef 0.544 Width (m) 1.500 Invert Level (m) 39.300

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200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Network

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	1.500
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 Storage Structures	2
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH	D1 (1km)	0.461	F (1km)	2.247
FEH Rainfall Version	1999	D2 (1km)	0.293	Cv (Summer)	0.750
Site Location		D3 (1km)	0.380	Cv (Winter)	0.840
C (1km)	-0.027	E (1km)	0.306		

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)	120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	200
Climate Change (%)	0

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	1.0	120 Summer	200	+0%				
1.001	1.1	120 Summer	200	+0%				
1.002	1.2	120 Summer	200	+0%				
2.000	2.0	120 Summer	200	+0%				
3.000	3.0	120 Summer	200	+0%				
2.001	2.1	120 Summer	200	+0%				
4.000	4.0	120 Summer	200	+0%				
2.002	2.2	120 Summer	200	+0%				
5.000	5.0	120 Summer	200	+0%				
2.003	2.3	600 Winter	200	+0%				
2.004	2.4	600 Winter	200	+0%	200/120 Summer			
6.000	7.0	120 Summer	200	+0%				
2.005	2.5	600 Winter	200	+0%	200/120 Summer			
7.000	7.0	120 Summer	200	+0%				
2.006	2.6	2160 Winter	200	+0%	200/720 Winter			
2.007	2.7	2160 Winter	200	+0%	200/360 Winter			

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200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Network

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	1.0	40.884	-0.141	0.000	0.30			20.8	OK
1.001	1.1	40.146	-0.157	0.000	0.46			45.3	OK
1.002	1.2	39.662	-0.125	0.000	0.64			65.7	OK
2.000	2.0	41.902	-0.048	0.000	0.80			17.5	OK
3.000	3.0	40.904	-0.046	0.000	0.82			17.5	OK
2.001	2.1	40.531	-0.165	0.000	0.42			43.2	OK
4.000	4.0	40.927	-0.073	0.000	0.52			11.7	OK
2.002	2.2	40.245	-0.157	0.000	0.46			57.3	OK
5.000	5.0	41.192	-0.108	0.000	0.17			3.5	OK
2.003	2.3	40.002	-0.100	0.000	0.13			17.3	OK
2.004	2.4	39.999	0.387	0.000	0.14			18.4	SURCHARGED
6.000	7.0	40.108	-0.082	0.000	0.42			9.1	OK
2.005	2.5	39.997	0.665	0.000	0.07			3.6	SURCHARGED
7.000	7.0	39.877	-0.083	0.000	0.41			8.9	OK
2.006	2.6	39.353	0.073	0.000	0.06			4.7	SURCHARGED
2.007	2.7	39.350	0.172	0.000	0.06			4.7	SURCHARGED

PN	US/MH Name	Level Exceeded
1.000	1.0	
1.001	1.1	
1.002	1.2	
2.000	2.0	
3.000	3.0	
2.001	2.1	
4.000	4.0	
2.002	2.2	
5.000	5.0	
2.003	2.3	
2.004	2.4	
6.000	7.0	
2.005	2.5	
7.000	7.0	
2.006	2.6	
2.007	2.7	

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200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Network

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
8.000	8.0	120 Summer	200	+0%				
8.001	8.1	120 Summer	200	+0%				
1.003	1.3	2160 Winter	200	+0%	200/120 Summer			
9.000	9.0	2160 Winter	200	+0%	200/720 Winter			
10.000	10.0	2160 Winter	200	+0%				
9.001	9.1	2160 Winter	200	+0%	200/120 Summer			
1.004	1.4	2160 Winter	200	+0%	200/120 Summer			
11.000	11.0	2160 Winter	200	+0%	200/720 Winter			
1.005	1.5	2160 Winter	200	+0%	200/120 Summer			
1.006	HW1.0	2160 Winter	200	+0%	200/120 Summer			
1.007	HW1.1	2160 Winter	200	+0%	200/120 Summer			
1.008	1.8	2160 Winter	200	+0%	200/120 Summer			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
8.000	8.0	40.313	-0.087	0.000	0.37			8.0	OK
8.001	8.1	40.088	-0.066	0.000	0.60			13.3	OK
1.003	1.3	39.346	0.285	0.000	0.11			12.6	SURCHARGED
9.000	9.0	39.343	0.043	0.000	0.02			1.7	SURCHARGED
10.000	10.0	39.342	-0.113	0.000	0.00			0.4	OK
9.001	9.1	39.342	0.455	0.000	0.02			2.4	SURCHARGED
1.004	1.4	39.341	0.661	0.000	0.14			15.1	SURCHARGED
11.000	11.0	39.339	0.039	0.000	0.02			2.5	SURCHARGED
1.005	1.5	39.337	0.735	0.000	0.26			17.3	SURCHARGED
1.006	HW1.0	39.332	0.760	0.000	0.52			17.2	FLOOD RISK
1.007	HW1.1	39.326	1.101	0.000	0.36			11.4	FLOOD RISK
1.008	1.8	39.315	1.100	0.000	0.29			11.4	FLOOD RISK

PN	US/MH Name	Level Exceeded
8.000	8.0	
8.001	8.1	
1.003	1.3	
9.000	9.0	
10.000	10.0	
9.001	9.1	
1.004	1.4	
11.000	11.0	
1.005	1.5	
1.006	HW1.0	
1.007	HW1.1	

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200 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Network

PN	US/MH Name	Level Exceeded
1.008	1.8	

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APPENDIX C: Drawings

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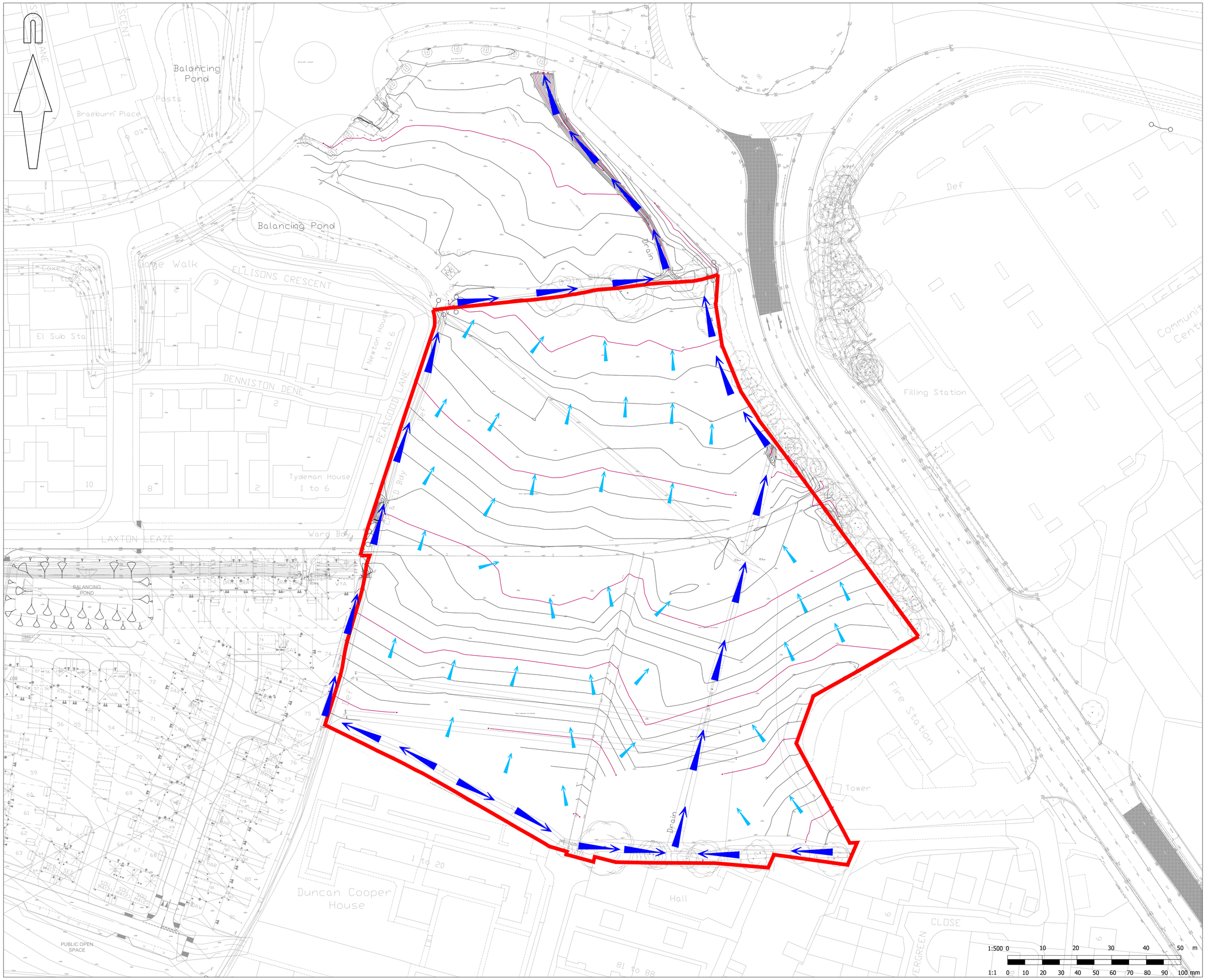
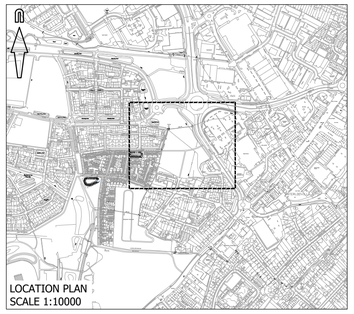
KEY

EXTENT OF DEVELOPMENT BOUNDARY

DIRECTION OF WATERCOURSE

DIRECTION OF OVERLAND WATER





FOR INFORMATION
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rev.	amendment	checked	date

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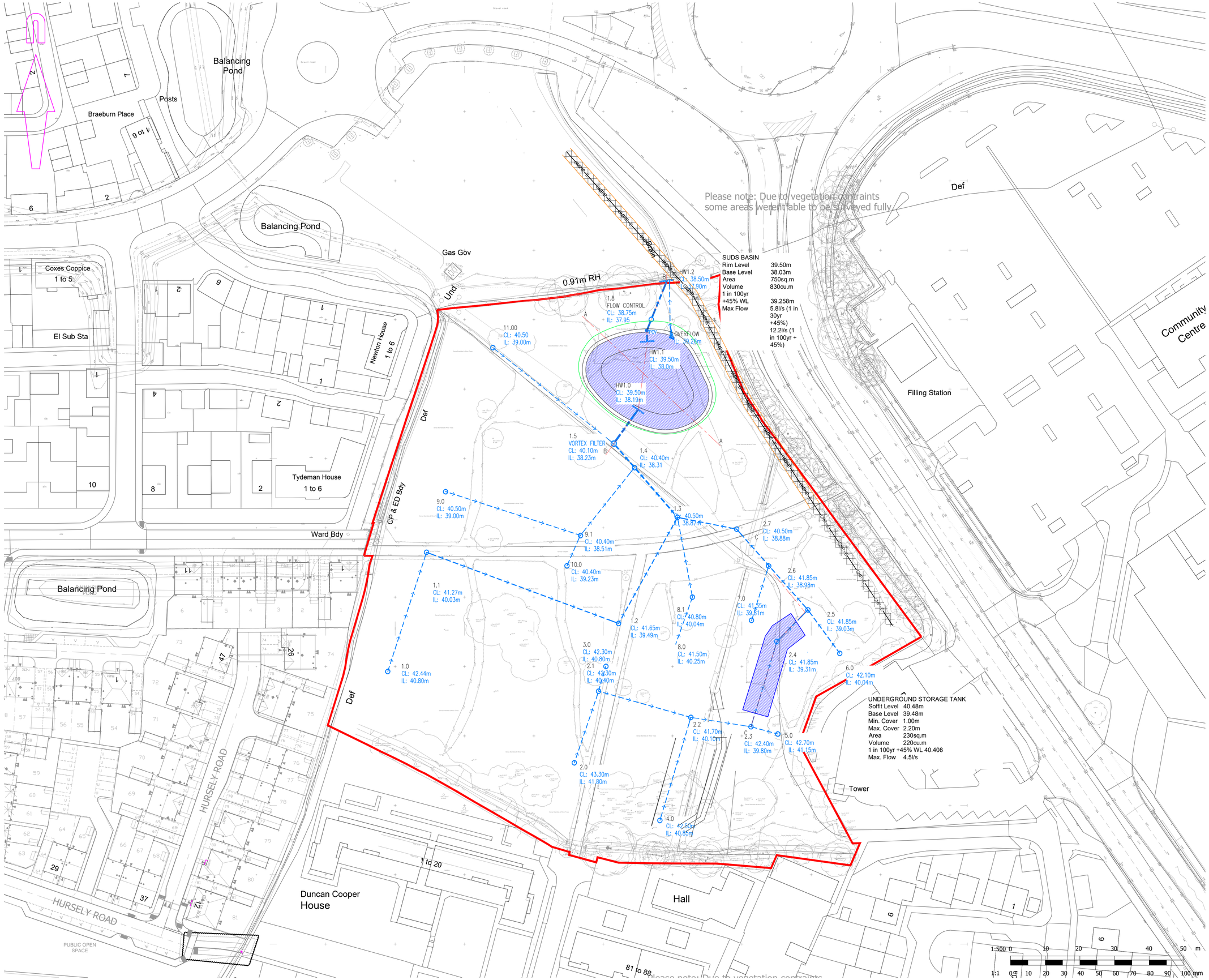
scale	1:500	drawn by	KD	checked by	WD
date	JANUARY 2023	cad file	DR_01.DWG		

title
EXISTING OVERLAND FLOOD FLOW PATH

drawing number
GTWVILLE_BSL/DR/01

rev.



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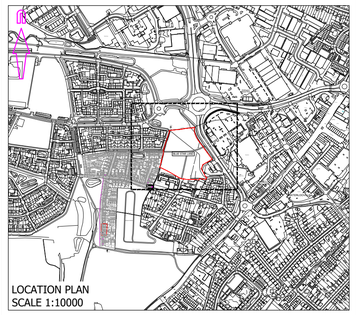
KEY

EXTENT OF DEVELOPMENT BOUNDARY

NOTES:

1. DRAINAGE NETWORK BASED ON CONCEPT LAYOUT. ANY SUBSEQUENT ALTERNATIVE LAYOUT WILL REQUIRE RE-ROUTING OF NETWORK BRANCHES WHERE NECESSARY.
2. REFER TO DWG. GTWVILLE_BSL/DR/04 FOR POND DETAILS.
3. REFER TO DWG. GTWVILLE_BSL/DR/08 FOR CATCHMENT DETAILS
4. REFER TO THE DRAINAGE STRATEGY REPORT (REF. GTWVILLE_BSL/DOC/03 FOR DRAINAGE NETWORK DETAILS AND MODEL OUTPUT.



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rev.	amendment	checked	date
B	Revised post LLFA Comments 25/9/24	RHA	27/01/2025
A	Issued for Planning - Pond Reduced/Tank Added	RHA	03/04/2024

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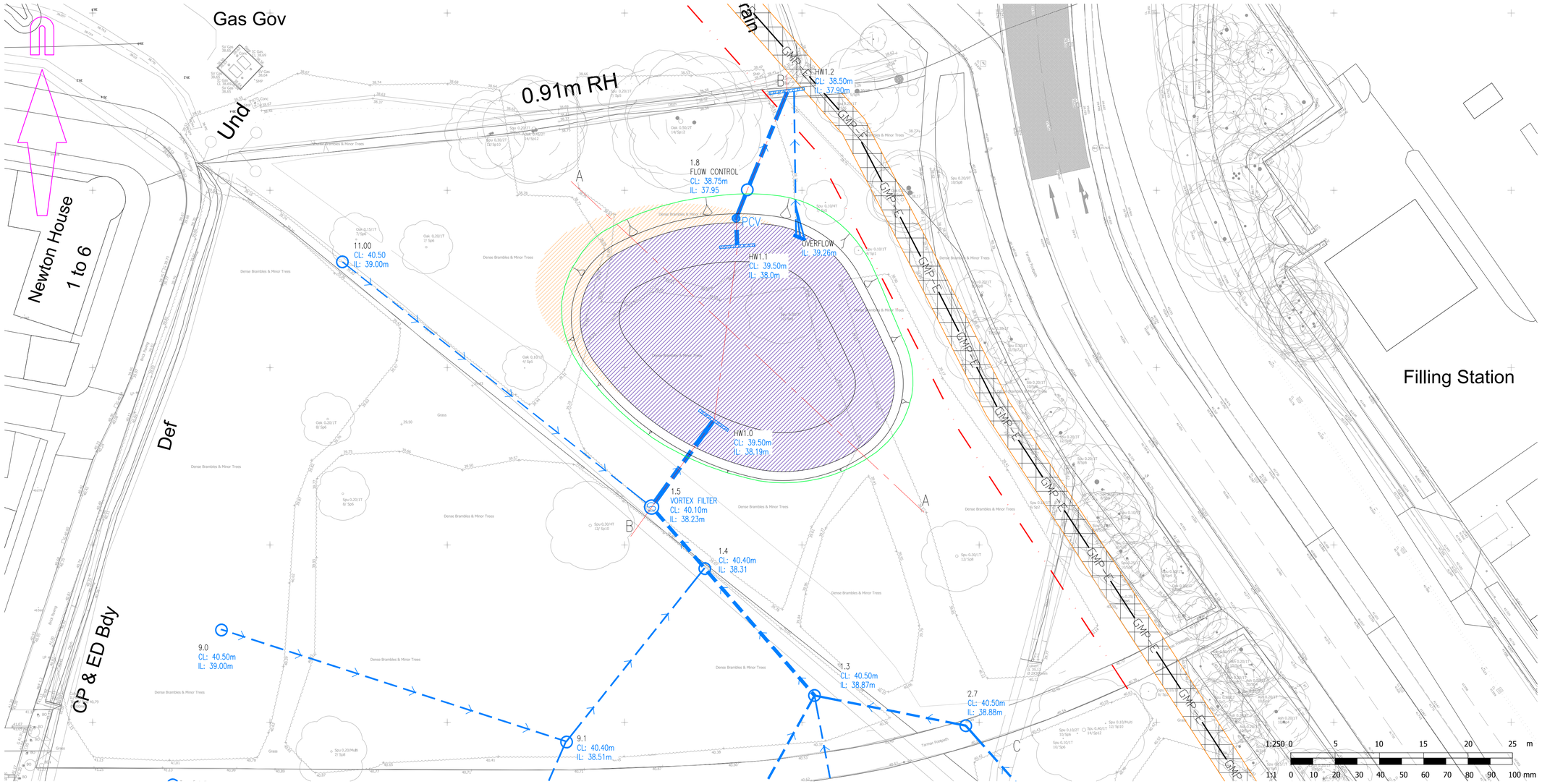
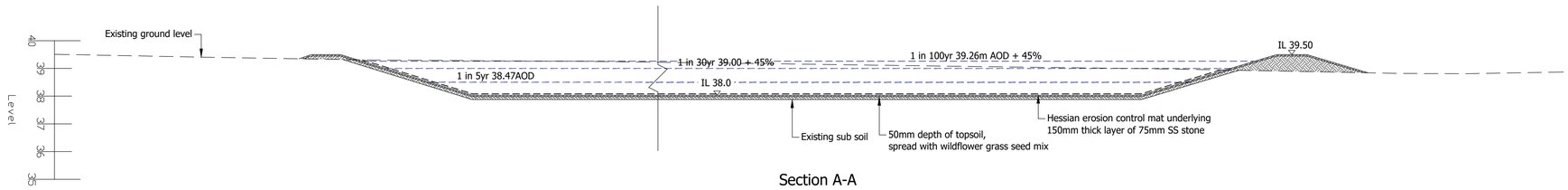
scale	1:500	drawn by	KD	checked by	RHA
date	JANUARY 2023	cad file	DR_03.DWG		

title
PRELIMINARY DRAINAGE NETWORK

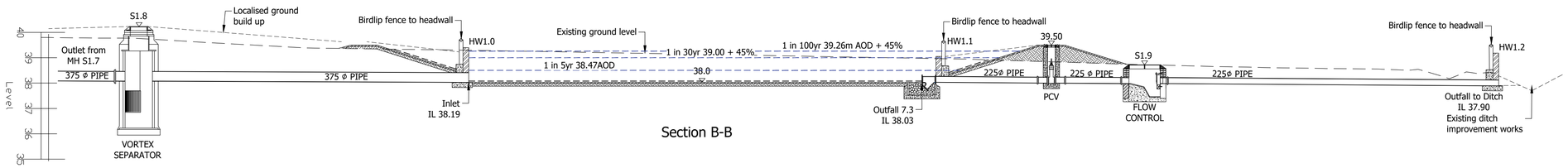
drawing number
GTWVILLE_BSL/DR/03

rev.
B





Section A-A



Section B-B

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NOTES:

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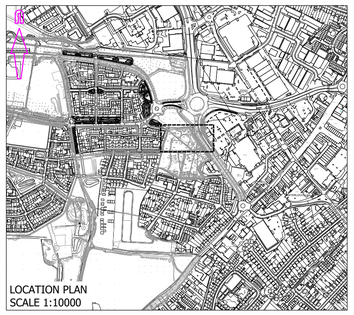
2. REFER TO DWG. GTWVILLE_BSL/DR/03 FOR FULL EXTENT OF DRAINAGE NETWORKS.
3. REFER TO THE DRAINAGE STRATEGY REPORT (REF. GTWVILLE_BSL/DOC/03 FOR DRAINAGE NETWORK DETAILS AND MODEL OUTPUT.

KEY

GMP - E — EXISTING GAS MAIN EASEMENT

GAS MAIN 5m CLEARANCE (INDICATIVE)



LOCATION PLAN
SCALE 1:10000

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rev.	amendment	checked	date
B	REVISED POST LLFA COMMENTS 25/9/24	RHA	24/01/2025
A	SUDS POND REDUCED/TANK ADDED	RHA	02/04/2024

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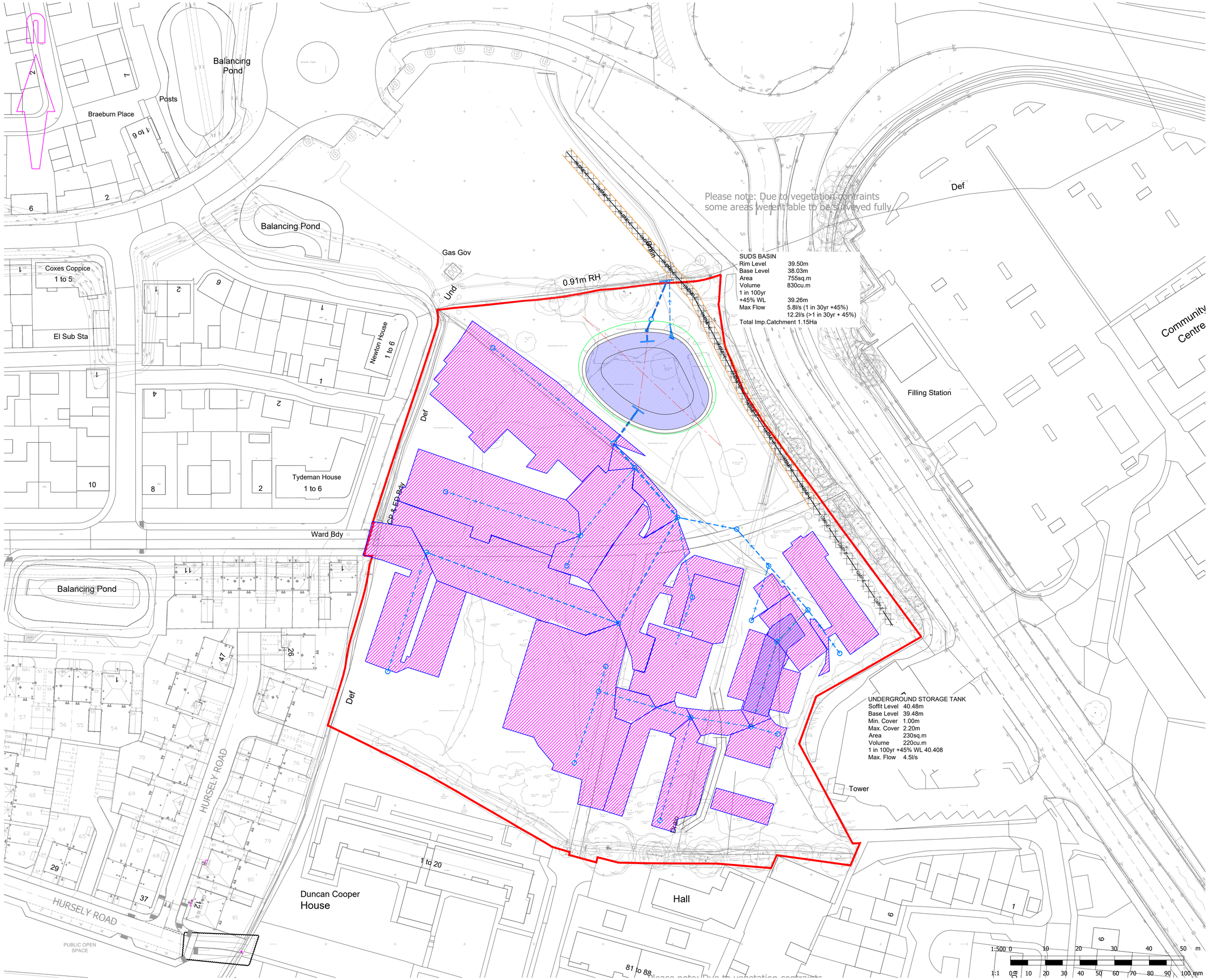
scale	1:250/1:100	drawn by	NT	checked by	RHA
date	MARCH 2023	cad file	DR_04.DWG		

title
SUDS POND DETAILS

drawing number
GTWVILLE_BSL/DR/04

rev.
B



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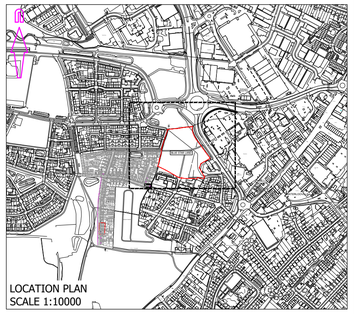
KEY

EXTENT OF DEVELOPMENT BOUNDARY

CATCHMENT AREAS

NOTES:

1. DRAINAGE NETWORK BASED ON CONCEPT LAYOUT. ANY SUBSEQUENT ALTERNATIVE LAYOUT WILL REQUIRE RE-ROUTING OF NETWORK BRANCHES WHERE NECESSARY.
2. REFER TO DWG. GTWVILLE_BSL/DR/03 AND 04 FOR FULL EXTENT OF DRAINAGE NETWORKS.
3. REFER TO THE DRAINAGE STRATEGY REPORT (REF. GTWVILLE_BSL/DOC/03 FOR DRAINAGE NETWORK DETAILS AND MODEL OUTPUT.



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rev.	amendment	checked	date
B	Catchment Areas Clarified	RHA	27/02/2025
A	Catchment Areas Clarified	RHA	13/02/2025

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scale	1:500	drawn by	KD	checked by	RHA
date	JANUARY 2023	cad file	DR_03.DWG		

title
PROPOSED CATCHMENT PLAN

drawing number
GTWVILLE_BSL/DR/08

rev.
B

APPENDIX D: Maintenance Schedule

Blue Star Land, Waterlooville
Drainage Maintenance Plan

Introduction

This document sets out the planned maintenance requirements for the (non-highways) Sustainable Drainage System (SuDS), which are associated with the Blue Star Land development, Waterlooville. This plan should be reviewed and updated periodically by the adopting authority as additional experience is gained. The SuDS consist of distribution pipework and an underground storage tank and a landscaped SuDs basin.

Schedule of Open Space SuDS Maintenance Requirements

Activity Breakdown

Flow Controls (HydroBrakes)

Frequency – 6 Monthly Inspections

Tasks

- Remove covers to chambers and enter where safe to do to. Staff to be appropriately trained and equipped for confined entry.
- Inspect visually for damage or corrosion.
- Check for and clear any obstructions. Wash down if required.
- Check correct operation of Bypass door and handle on HydroBrakes, grease lightly if required
- File Record of Visit and Actions Taken, report any defects for repair.

Shut-Off Valves

Frequency – 6 Monthly Inspections

Tasks

- Remove covers & attach operating tool
- Confirm valve was previously left in the open position
- Operate Valve to fully closed and reopen
- Repeat operation 3 times and leave in fully open position
- File Record of Visit and report any defect or stiff operation for repair.

Weirs (Kerb Gully Type)

Frequency – 6 monthly or where defects reported

Tasks

- Remove covers, remove any debris and rod through to junction
- File Record of Visit and report any defects for repair or blockage for jetting.

Rock Outlets

Frequency – 6 Monthly or where defects reported

Tasks

- Ensure that pipe and basket are covered by rocks as intended.
- Reposition or replace any rocks that have been removed.
- Check for and clear any debris or self sown vegetation caught between the rocks.
- File Record of Visit and report any defects for repair.

Landscape Maintenance

Frequency – As Specified in the Landscape Management Plan

- The Contractor shall regularly inspect and maintain SuDS features to ensure their effective operation as designed. Regular mowing in and around detention basins is required only along maintenance access routes, amenity areas (e.g. footpaths), across embankments and main storage area. The remaining areas can be managed as damp meadow grass, unless additional management is required for landscaping purposes.
- Management of vegetation and removal of nuisance plants.
- Remove sediment from inlets, outlet and fore bay. Tidy all dead growth before start of growing season.
- Repair erosion or other damage by re-seeding or re-turfing. Realignment of rip-rap, repair and rehabilitation of inlets, outlets and overflows, re-level uneven surfaces and reinstate design levels as required.

Silt Monitoring & Removal

Frequency – Monitor Annually, Remove as required (Assumed 5 yearly)

Tasks

- Take measurements and record depths of silt annually in pool areas of SuDS
- Arrange Removal of Silts in deep pools, where average depth is approximately 100mm, and a maximum not exceeding 300mm. Before de-silting a particular pond it should be trapped and netted out for amphibians and macro-invertebrates which should be transferred to a nearby pond assuming no fish are present. Not all ponds are to be de-silted in the
- Remove silts in dry basins where it threatens to restrict the capacity of inlets or outlets or is unsightly.

- NOTE - Sediments excavated from detention basins that receive runoff from residential or standard road and roof areas are generally not toxic or hazardous material and can therefore be safely disposed of by either land application or land filling. However, consultation should take place with the environmental regulator to confirm appropriate protocols. Sediment testing may be required before sediment excavation to determine its classification and appropriate disposal methods. In the majority of cases it will be acceptable to distribute the sediment on site if there is an appropriate safe and acceptable location to do so.

SuDS Ancillaries

In addition to the open space SuDS and associated maintenance activities as listed above, there are a number of other items requiring periodic inspection and maintenance as follows:

Pipes

Frequency –Annual visit initially, then adjust as necessary

Tasks

- CCTV survey and jetting of areas of sediment build-up, repeat after 1 year.
- Re-jet Jet identified sedimentation areas on a cycle as determined
- CCTV survey on a 10 year cycle to identify blockages and structural defects.

Underground Storage Tanks

Frequency –Annual visit initially, then adjust as necessary

Tasks

- CCTV survey and jetting of areas of sediment build-up, repeat after 1 year.
- Re-jet Jet identified sedimentation areas on a cycle as determined

- CCTV survey on a 10 year cycle to identify blockages and structural defects.
- Check surface above and around tank for signs of settlement

Chambers

Frequency –Annual Surface Inspection, below ground inspection as above
Tasks

- Visual inspection of covers and frames to identify defects on an annual basis
- View internal chamber structure when CCTV surveys of pipework are carried out to identify structural defects or maintenance issues.

Signage

Frequency – 6 monthly
Tasks

- Check that pollution shut-off signage is intact.
- Clean sign face with soapy water
- Report any defects for repair

Fencing

Frequency – 6 monthly
Tasks

- Check that fencing is intact and secure, check for signs of corrosion / rot.
- Report any defects for repair or replacement