FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY ADDENDUM REPORT

DATE:	15 November 2023	**CONFIDENTIALITY:**	Confidential
SUBJECT:	Flood Risk Assessment Addendum Report		
PROJECT:	70084844	**AUTHOR:**	JM
CHECKED:	BB	**APPROVED:**	KM

1. INTRODUCTION

1.1 Scope of Report

WSP has prepared this Flood Risk Assessment and Drainage Strategy Addendum report on behalf of Vistry Homes in order to address comments received from the LLFA (*23.10.12.H258.16.LLFA*) on the previously submitted Flood Risk Assessment and Drainage Strategy document, also prepared by WSP.

1.2 Site Description and Drainage Strategy Proposals

The Site is located on land to the west of Buntingford, Hertfordshire. The Site is bordered by an existing residential development in the north-east; to the west is the A10 and an existing watermill industrial estate is located to the south; the Buntingford Wastewater Treatment Works (WwTW) is to the south-east.

The outline planning application seeks approval (with all matters reserved except for access) for a development of 350 dwellings, with up to 4,400 sqm of commercial and services floorspace (Use Class E and B8), and up to 500 sqm of retail floorspace (Use Classes E) and other associated works including drainage, access into the site from the A10 and Luynes Rise (but not access within the site), allotments, public open space and landscaping.

It is proposed to discharge surface water from the Proposed Development to the existing Thames Water surface water sewer network located within Peasmead. The local surface water sewer network discharges to the River Rib via an existing outfall downstream of the development. Surface water will be attenuated to the Qbar Greenfield rate of 37.1 l/s via the provision of swales, permeable paving and detention basins prior to discharge to the local surface water sewer network in Peasmead (TWMH Ref: 0804). Surface water will be attenuated for all storms up to and including the design 1 in 100 year + 40% climate change event.

It is proposed that foul water from the development will discharge to the local foul sewer network via two connections, one to TWMH 8906 and one to TWMH 0802. Where the on-Site network is too low to discharge via gravity, the on-Site network will be pumped to a level to allow for a gravity discharge.

The LLFA comments have been replicated in italics within the report and addressed following each.

RAINWATER REUSE

1. ***Comment:*** *The applicant should provide technical justification of whether or not the first element of the drainage hierarchy, which is rainwater reuse, is possible to provide on the proposed development site. The ODS states this is currently not proposed, although suitable given the proposed end use. Further information is required to demonstrate the reason of its exclusion from the proposed design.*

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1.1 Approach to rainwater re-use

Water-butts are an appropriate form of water re-use for a low-density residential development. Water butts are proposed to be incorporated and a note on the outline drainage strategy has been added. Large scale water re-use is not feasible for the project due to the topography and spread-out nature of the development.

2. UPDATED SURFACE WATER DRAINAGE STRATEGY

2. ***Comment:*** *The MD drainage network has been modelled using the FEH99 rainfall data. This should be recalculated using the most recent FEH rainfall data. Further information is required.*
3. ***Comment:*** *The applicant is required confirm whether an urban creep was accounted for in the given contributing impermeable areas. Further information is required.*
4. ***Comment:*** *The surface water drainage plan should be resubmitted. All details should be consistent with the data shown in the report and the MD modelling results (e.g. right impermeable areas). SuDS design should be in accordance with the Ciria SuDS Manual C753. Further information is required.*

2.1 Greenfield Run-off Rate

FEH data for the site has been obtained from Wallingford HydroSolutions, which uses the latest FEH22 rainfall model, and the supporting drainage strategy calculations have been reverified with the FEH22 data.

This addendum report makes reference to FPCR Land Use Parameter Plan, Ref: 10537-FCPR-XX-XX-DR-A-1003-P05. This plan states that the development proposes 10.35 ha of residential use, 0.66ha of employment use, 0.55ha of local centre use and 15.50ha of green infrastructure (including footpaths, cycleways and recreational routes).

WSP has referred to www.UKSuDS.com guidance by HR Wallingford which states that "*the greenfield run-off rate which is to be used for assessing the requirements for limiting discharge flow rates should be calculated for the whole development area (paved and pervious surfaces - houses, gardens, roads, and other open space) that is within the area served by the drainage network*" (https://www.uksuds.com/training-support/frequently-asked-questions).

It is therefore taken that the total catchment for the greenfield run-off area is taken as the developable area of 10.35+0.66+0.55ha, plus an additional 1.05 of the 15.50 ha of green open space to account for the positively draining storage basins. This results in a total catchment area of 12.617 ha (previously 12.385 ha). Please refer to greenfield run-off calculations included within Appendix A.

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Table 1. Revised Greenfield Run-off Rates

Return Period	Previous Rate (l/s)	Revised Rate (l/s)
Qbar	36.95	37.11
1 in 1 Year	31.41	31.54
1 in 30 Year	84.99	85.35
1 in 100 Year	117.88	118.38
1 in 200 years	138.21	138.79

2.2 Updated MicroDrainage Modelling

The MicroDrainage modelling has been updated to account for an estimated 8% urban creep in addition to 70% impermeable surfaces within the residential areas. As detailed within the Flood Risk Assessment and Drainage Strategy Report, the site has been split into two drainage catchments, one served by the eastern basin (pumped discharge) and one served by the western basin (gravity discharge). This results in a total attenuated catchment of 2.858 ha for the Western Basin and 6.77 ha for the Eastern Basin). Please refer to Appendix B for MicroDrainage modelling results.

Based on a pro rata assessment based on the proportion of the total site catchment, the western basin is proposed to discharge at 10 l/s restricted via hydro-brake. An assessment of the water levels in the 1 in 100-year storm event for the central and upper climate allowance is provided below. Based on a catchment of 2.858 ha, the anticipated maximum water levels are as follow:

Table 2. Maximum Water Levels (Eastern Basin)

Water Level – Central Climate Change Allowance (25%)	
Maximum water level:	98.066
Cl:	98.6
Freeboard (m)	0.534

Water Level – Upper Climate Change Allowance (40%)	
Maximum water level:	98.149
Cl:	98.6
Freeboard (m)	0.451

Based on a pro rata assessment based on the proportion of the total site catchment, the eastern basin is proposed to discharge at 27.11 l/s restricted via pumping station. An assessment of the water levels in the 1 in 100-year storm event for the central and upper climate allowance is provided below. Based on a catchment of 6.77 ha, the anticipated maximum water levels are as follows:

Table 3. Maximum Water Levels (Eastern Basin)

Water Level – Central Climate Change Allowance (25%)	
Maximum water level:	89.298
Cl:	89.7
Freeboard (m)	0.402

Water Level – Upper Climate Change Allowance (40%)	
Maximum water level:	89.393
Cl:	89.7
Freeboard (m)	0.307

The Design and Construction Guidance by Water UK confirms that a detention basin should have a freeboard of minimum 400mm. The MicroDrainage modelling therefore confirms both that there is sufficient storage volume to account for the 1 in 100-year event plus 25% central climate change allowance, plus also ensures that there is no flooding in the 1 in 100-year event + 40% climate change event, as this is contained fully within the freeboard allowance for the basins. This confirms that the drainage network will not adversely affect the flood risk on or off site in the design storm event.

SURFACE WATER PUMP STATION

5. ***Comment:*** *Surface water pumping stations should only be used where there is no other practicable sustainable method of surface water drainage, and an adequate exceedance flood route is provided in the event of failure of the pumping station. Any pumping station should be designed in accordance with the latest Design and Construction Guidance (DCG). A safe and reasonable vehicular access should be provided to the pumping station at all hours for the purpose of repair and maintenance. The relevant storage provision should be provided as indicated in the DCG to account for the residual risk of the pump breaking down. The surface water flooding outline shown on the Environment Agency*

mapping is close to the location of the pumping station. This should be taken into account as described in the DCG document.

The Design and Construction Guidance applicable to the design of pumping stations that we surmise this comment references is summarised below:

"D4 General

Surface water pumping stations should only be used where there is no other practicable sustainable method of surface water drainage, and an adequate exceedance flood route is provided in the event of failure of the pumping station (see C6.5)

D5.1 Location

1. *The minimum distance from the wet well of the pumping station to any habitable buildings should be in accordance with Table D 1, in order to minimise the risk of odour, noise and nuisance. This dimension may be subject to change, depending on the local circumstances and submission of proposals.*

Table D 1
Minimum Distances of Wet Wells from Habitable Buildings

Pumping Station Type	Minimum Distance (m)
Type 1	5
Type 2	10
Type 3	15

2. *The pumping station should not be located where it might be susceptible to flooding at a frequency of more than 1:30 years. All electrical control equipment should be water resistant or sited above the 1:200 year flood level.*
3. *Pumping stations should be located so that they are accessible and visible to the water company at all times for use.*

D5.5 Storage

For surface water pumping stations, 125 m 3 of storage should be provided per hectare of impermeable surface draining to the pumping station (i.e., 15 minutes of rainfall at 50 mm per hour)."

D6.1 Hydraulic Design

An impermeability of 100% for the whole site area (including soft landscaped areas) should be used in all cases when determining exceedance flows.

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With regards to requirements noted in D5.1 Location, WSP notes that the proposed pumping station would class as a Type 3 pumping station (design flow rate >1 litre per second) and therefore the minimum distance of 15m to habitable dwellings would apply. This is satisfied by the proposed development layout. WSP proposes the pumping station to suit the DCG Typical Type 3 pumping station layout (compound size of 8x12m) including an area of impermeable hardstanding for tanker access. The pumping station will be provided with an access road suiting the requirements of DCG.

The proposed location is also sited within Flood Zone 1 as per EA Flood Map for Planning (refer to Figure 1) and is therefore site within land that has less that 0.1% chance of flooding per year, satisfying the requirement to not be located where it might be susceptible to flood at a frequency of 1:30 years.

Figure 1. Flood Risk to Proposed Pumping Station – Located within Flood Zone 1

In regards to surface water flooding for the area, as addressed within the FRA, the medium probability event corresponding to approximately the 1 in 100 year Average Return Interval rainfall, shows depths of less than 300mm, contained within the ditches at the boundary site. The catchment for which will reduce dramatically post development when runoff from all of the positively drained areas is directed towards the basins. Therefore the proposed basins would not overlap with areas at risk from surface water flooding, and in the

event that a spillway was activated, flow would be directed to the existing ditches. This is not likely to occur in the lifetime of the development and does not represent an increased or undue risk to neighbouring properties.

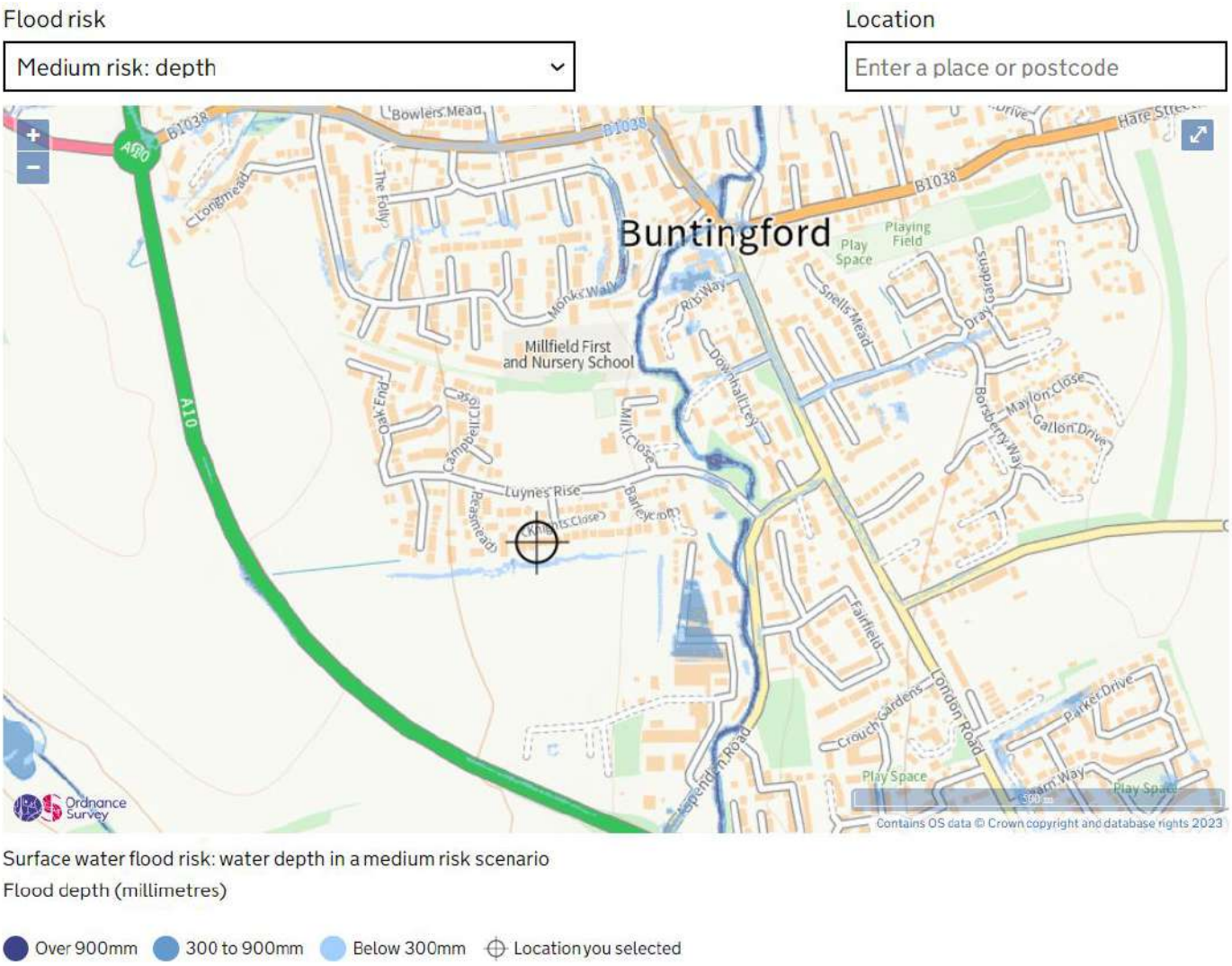

Figure 2. Medium risk of Surface Water flooding flood depth from EA website

To discharge surface water via gravity, the development site would require connection to TWMH2804, located north-east of the Eastern Attenuation Basin. This would require connection to be made through third-party owned land and therefore it is not possible to propose connection to this manhole as WSP cannot confirm that this connection point will be acceptable. WSP notes that Thames Water may be able to use their powers as a statutory undertaker to connect here if this is preferred by Thames Water. WSP have proposed to discharge surface water partially via gravity and partially pumped to the manhole TWMH0804 within

Peasmead. The proposed locations of the attenuation wetland basins allow the development to make use of land that cannot be used for residential purposes due to the proximity to the existing WWTW.
WSP notes the requirement of DCG to provide an additional volume of storage in the event of a pump failure equivalent to 125m^3 per hectare. This results in a volume of 846m^3 requirement for emergency storage based on a drainage catchment of 6.77 ha. The Eastern basin has a plan area of 6975m^2, therefore this additional storage volume could be provided within the spare 0.307m freeboard even in the 40% upper end climate change event (as detailed in the previous section).

In the event of a pump failure, it is likely to be obvious prior to the occurrence of a design event, however we also propose a spillway from the basin to the existing drainage ditch along the northern boundary of the site. The spillway will not be required in the design event but will provide an additional level of resilience and if the spillway operated there would not be undue risk to people or property.

In addition, for exceedance flow evaluation, and to address clause 6.1, the eastern basin was evaluated was run assuming 100% impermeable catchment (including for residential soft areas). The basin will still have enough capacity to attenuate and discharge the runoff, however the upstream network may limit the runoff from getting to the basin. Hydraulic modelling results and an exceedance flow plan are appended.

EXCEEDANCE FLOW PATH PLAN

6. ***Comment:*** *An exceedance flow path plan should be provided in the event of the drainage network failure. This should be accounted for the flow exceeding the 1 in 100 year plus climate change event and indicated on a plan showing finished site levels. More information is required.*

Please refer to the flow path exceedance plan included within Appendix C.

SUDS OPERATION AND MAINTENANCE

7. ***Comment:*** *The maintenance schedule provided lacks the inclusion of any remedial actions for the proposed surface water drainage elements. Additionally, not all SuDS and surface water drainage elements listed were relevant to the proposed ODS and some were missing. More information is required.*

Please refer to the proposed SuDS Operation and Maintenance Plan included within Appendix D.

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CONCLUSIONS

In conclusion, when the above verification and data is analysed within the hydraulic modelling and design, the drainage system should fulfil the requirements set out by LLFA in their reply to the last Flood Risk Assessment written by WSP.

Appendix A – Greenfield Runoff Calculation

Appendix B – Hydraulic Calculations

Appendix C – Catchment Plan, Drainage Layout & Exceedance Flow Plan

Appendix D – SuDS Maintenance Plan

Greenfield runoff rate estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	Callum Duce
Site name:	Buntingford West
Site location:	Buntingford, Hertfordshire

This is an estimation of the greenfield runoff rates that are used to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013) , the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site Details

Latitude:	51.94146° N
Longitude:	0.0259° W
Reference:	4257200630
Date:	Nov 07 2023 15:00

Runoff estimation approach

FEH Statistical

Site characteristics

Total site area (ha):	12.617

Methodology

Q_{MED} estimation method:	Calculate from BFI and SAAR
BFI and SPR method:	Specify BFI manually
HOST class:	N/A
BFI / BFIHOST:	0.43
Q_{MED} (l/s):	
Q_{BAR} / Q_{MED} factor:	1.14

Hydrological characteristics

	Default	Edited
SAAR (mm):	630	624
Hydrological region:	6	6
Growth curve factor 1 year:	0.85	0.85
Growth curve factor 30 years:	2.3	2.3
Growth curve factor 100 years:	3.19	3.19
Growth curve factor 200 years:	3.74	3.74

Notes

(1) Is Q_{BAR} < 2.0 l/s/ha?

When Q_{BAR} is < 2.0 l/s/ha then limiting discharge rates are set at 2.0 l/s/ha.

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consent for discharge is usually set at 5.0 l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set where the blockage risk is addressed by using appropriate drainage elements.

(3) Is SPR/SPRHOST ≤ 0.3?

Where groundwater levels are low enough the use of soakaways to avoid discharge offsite would normally be preferred for disposal of surface water runoff.

Greenfield runoff rates

	Default	Edited

Q_{BAR} (l/s):		37.11
1 in 1 year (l/s):		31.54
1 in 30 years (l/s):		85.35
1 in 100 year (l/s):		118.38
1 in 200 years (l/s):		138.79

Summary of Results for 100 year Return Period (+25%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	88.765	0.365	27.1	1467.7	O K
30 min Summer	88.862	0.462	27.1	1918.3	O K
60 min Summer	88.953	0.553	27.1	2368.2	O K
120 min Summer	89.067	0.667	27.1	2969.5	O K
180 min Summer	89.126	0.726	27.1	3296.9	O K
240 min Summer	89.161	0.761	27.1	3495.0	O K
360 min Summer	89.195	0.795	27.1	3690.3	O K
480 min Summer	89.206	0.806	27.1	3751.8	O K
600 min Summer	89.205	0.805	27.1	3749.5	O K
720 min Summer	89.199	0.799	27.1	3710.8	O K
960 min Summer	89.175	0.775	27.1	3571.9	O K
1440 min Summer	89.123	0.723	27.1	3276.6	O K
2160 min Summer	89.061	0.661	27.1	2934.4	O K
2880 min Summer	89.011	0.611	27.1	2670.4	O K
4320 min Summer	88.938	0.538	27.1	2291.3	O K
5760 min Summer	88.880	0.480	27.1	2004.4	O K
7200 min Summer	88.832	0.432	27.1	1775.3	O K
8640 min Summer	88.791	0.391	27.1	1587.9	O K
10080 min Summer	88.758	0.358	27.1	1436.5	O K
15 min Winter	88.804	0.404	27.1	1646.4	O K
30 min Winter	88.910	0.510	27.1	2153.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	117.701	0.0	1481.5	23
30 min Summer	77.341	0.0	1915.4	37
60 min Summer	48.336	0.0	2452.5	68
120 min Summer	30.913	0.0	3137.4	126
180 min Summer	23.318	0.0	3545.6	186
240 min Summer	18.886	0.0	3821.3	246
360 min Summer	13.792	0.0	4158.5	364
480 min Summer	10.913	0.0	4344.2	484
600 min Summer	9.058	0.0	4446.9	602
720 min Summer	7.758	0.0	4492.6	722
960 min Summer	6.051	0.0	4462.1	960
1440 min Summer	4.246	0.0	4313.9	1158
2160 min Summer	2.980	0.0	5445.0	1520
2880 min Summer	2.330	0.0	5677.8	1932
4320 min Summer	1.681	0.0	6144.0	2728
5760 min Summer	1.354	0.0	6598.4	3520
7200 min Summer	1.158	0.0	7051.1	4320
8640 min Summer	1.027	0.0	7509.2	5096
10080 min Summer	0.935	0.0	7977.7	5848
15 min Winter	117.701	0.0	1652.5	23
30 min Winter	77.341	0.0	2106.3	37

Summary of Results for 100 year Return Period (+25%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	89.010	0.610	27.1	2663.0	O K
120 min Winter	89.135	0.735	27.1	3346.7	O K
180 min Winter	89.201	0.801	27.1	3724.3	O K
240 min Winter	89.240	0.840	27.1	3957.5	O K
360 min Winter	89.280	0.880	27.1	4197.9	O K
480 min Winter	89.295	0.895	27.1	4288.2	O K
600 min Winter	89.298	0.898	27.1	4306.9	O K
720 min Winter	89.294	0.894	27.1	4284.6	O K
960 min Winter	89.276	0.876	27.1	4171.1	O K
1440 min Winter	89.221	0.821	27.1	3840.1	O K
2160 min Winter	89.144	0.744	27.1	3398.3	O K
2880 min Winter	89.079	0.679	27.1	3035.1	O K
4320 min Winter	88.971	0.571	27.1	2463.2	O K
5760 min Winter	88.880	0.480	27.1	2008.4	O K
7200 min Winter	88.802	0.402	27.1	1636.5	O K
8640 min Winter	88.735	0.335	27.1	1332.4	O K
10080 min Winter	88.678	0.278	27.1	1085.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	48.336	0.0	2747.0	66
120 min Winter	30.913	0.0	3510.5	124
180 min Winter	23.318	0.0	3957.4	184
240 min Winter	18.886	0.0	4243.6	242
360 min Winter	13.792	0.0	4530.0	358
480 min Winter	10.913	0.0	4582.5	474
600 min Winter	9.058	0.0	4558.5	590
720 min Winter	7.758	0.0	4533.4	704
960 min Winter	6.051	0.0	4479.8	928
1440 min Winter	4.246	0.0	4356.1	1342
2160 min Winter	2.980	0.0	6098.6	1648
2880 min Winter	2.330	0.0	6359.3	2104
4320 min Winter	1.681	0.0	6876.1	2980
5760 min Winter	1.354	0.0	7390.3	3800
7200 min Winter	1.158	0.0	7897.4	4544
8640 min Winter	1.027	0.0	8412.2	5352
10080 min Winter	0.935	0.0	8936.9	6048

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 535761 228934 TL 35761 28934
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+25

Time Area Diagram

Total Area (ha) 6.770

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	3.385	4	8	3.385

Model Details

Storage is Online Cover Level (m) 89.700

Tank or Pond Structure

Invert Level (m) 88.400

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	3536.7	1.000	6529.9

Pump Outflow Control

Invert Level (m) 88.400

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	27.1100	1.200	27.1100	3.000	27.1100	7.000	27.1100
0.200	27.1100	1.400	27.1100	3.500	27.1100	7.500	27.1100
0.300	27.1100	1.600	27.1100	4.000	27.1100	8.000	27.1100
0.400	27.1100	1.800	27.1100	4.500	27.1100	8.500	27.1100
0.500	27.1100	2.000	27.1100	5.000	27.1100	9.000	27.1100
0.600	27.1100	2.200	27.1100	5.500	27.1100	9.500	27.1100
0.800	27.1100	2.400	27.1100	6.000	27.1100		
1.000	27.1100	2.600	27.1100	6.500	27.1100		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	88.900	0.500	27.1	2105.5	O K
30 min Summer	89.027	0.627	27.1	2755.5	O K
60 min Summer	89.147	0.747	27.1	3413.3	O K
120 min Summer	89.297	0.897	27.1	4303.0	O K
180 min Summer	89.376	0.976	27.1	4803.7	O K
240 min Summer	89.425	1.025	27.1	5119.8	Flood Risk
360 min Summer	89.478	1.078	27.1	5464.1	Flood Risk
480 min Summer	89.501	1.101	27.1	5616.1	Flood Risk
600 min Summer	89.510	1.110	27.1	5676.1	Flood Risk
720 min Summer	89.511	1.111	27.1	5682.4	Flood Risk
960 min Summer	89.499	1.099	27.1	5602.0	Flood Risk
1440 min Summer	89.450	1.050	27.1	5284.6	Flood Risk
2160 min Summer	89.378	0.978	27.1	4812.3	O K
2880 min Summer	89.325	0.925	27.1	4477.7	O K
4320 min Summer	89.256	0.856	27.1	4053.0	O K
5760 min Summer	89.206	0.806	27.1	3756.2	O K
7200 min Summer	89.167	0.767	27.1	3530.0	O K
8640 min Summer	89.136	0.736	27.1	3349.2	O K
10080 min Summer	89.110	0.710	27.1	3207.5	O K
15 min Winter	88.951	0.551	27.1	2361.0	O K
30 min Winter	89.090	0.690	27.1	3092.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	131.826	0.0	2057.1	23
30 min Summer	86.622	0.0	2329.1	38
60 min Summer	54.137	0.0	3499.0	68
120 min Summer	34.623	0.0	4400.4	126
180 min Summer	26.116	0.0	4648.9	186
240 min Summer	21.152	0.0	4640.8	246
360 min Summer	15.447	0.0	4624.5	366
480 min Summer	12.223	0.0	4607.7	484
600 min Summer	10.144	0.0	4590.2	604
720 min Summer	8.689	0.0	4571.9	724
960 min Summer	6.777	0.0	4532.6	962
1440 min Summer	4.755	0.0	4439.2	1440
2160 min Summer	3.337	0.0	7771.2	1736
2880 min Summer	2.610	0.0	8081.9	2104
4320 min Summer	1.883	0.0	8055.4	2900
5760 min Summer	1.517	0.0	9421.3	3696
7200 min Summer	1.296	0.0	10067.6	4544
8640 min Summer	1.151	0.0	10721.6	5360
10080 min Summer	1.048	0.0	11390.6	6152
15 min Winter	131.826	0.0	2233.8	23
30 min Winter	86.622	0.0	2329.8	37

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	89.220	0.820	27.1	3834.1	O K
120 min Winter	89.382	0.982	27.1	4842.7	O K
180 min Winter	89.470	1.070	27.1	5415.4	Flood Risk
240 min Winter	89.526	1.126	27.1	5781.2	Flood Risk
360 min Winter	89.589	1.189	27.1	6190.8	Flood Risk
480 min Winter	89.619	1.219	27.1	6385.1	Flood Risk
600 min Winter	89.633	1.233	27.1	6475.6	Flood Risk
720 min Winter	89.637	1.237	27.1	6505.9	Flood Risk
960 min Winter	89.630	1.230	27.1	6462.5	Flood Risk
1440 min Winter	89.590	1.190	27.1	6197.9	Flood Risk
2160 min Winter	89.509	1.109	27.1	5672.1	Flood Risk
2880 min Winter	89.443	1.043	27.1	5235.6	Flood Risk
4320 min Winter	89.351	0.951	27.1	4640.7	O K
5760 min Winter	89.276	0.876	27.1	4171.4	O K
7200 min Winter	89.211	0.811	27.1	3783.2	O K
8640 min Winter	89.155	0.755	27.1	3456.5	O K
10080 min Winter	89.106	0.706	27.1	3180.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	54.137	0.0	3908.0	66
120 min Winter	34.623	0.0	4657.6	126
180 min Winter	26.116	0.0	4649.1	184
240 min Winter	21.152	0.0	4640.6	242
360 min Winter	15.447	0.0	4623.9	360
480 min Winter	12.223	0.0	4606.8	478
600 min Winter	10.144	0.0	4589.4	594
720 min Winter	8.689	0.0	4571.7	710
960 min Winter	6.777	0.0	4534.6	942
1440 min Winter	4.755	0.0	4452.8	1388
2160 min Winter	3.337	0.0	8648.2	2012
2880 min Winter	2.610	0.0	8780.1	2252
4320 min Winter	1.883	0.0	8287.9	3160
5760 min Winter	1.517	0.0	10552.1	4040
7200 min Winter	1.296	0.0	11275.9	4904
8640 min Winter	1.151	0.0	12008.4	5792
10080 min Winter	1.048	0.0	12757.6	6648

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 535761 228934 TL 35761 28934
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 8.630

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	4.315	4	8	4.315

Model Details

Storage is Online Cover Level (m) 89.700

Tank or Pond Structure

Invert Level (m) 88.400

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	3536.7	1.000	6529.9

Pump Outflow Control

Invert Level (m) 88.400

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	27.1100	1.200	27.1100	3.000	27.1100	7.000	27.1100
0.200	27.1100	1.400	27.1100	3.500	27.1100	7.500	27.1100
0.300	27.1100	1.600	27.1100	4.000	27.1100	8.000	27.1100
0.400	27.1100	1.800	27.1100	4.500	27.1100	8.500	27.1100
0.500	27.1100	2.000	27.1100	5.000	27.1100	9.000	27.1100
0.600	27.1100	2.200	27.1100	5.500	27.1100	9.500	27.1100
0.800	27.1100	2.400	27.1100	6.000	27.1100		
1.000	27.1100	2.600	27.1100	6.500	27.1100		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	88.804	0.404	27.1	1646.6	O K
30 min Summer	88.910	0.510	27.1	2153.0	O K
60 min Summer	89.009	0.609	27.1	2661.2	O K
120 min Summer	89.135	0.735	27.1	3343.1	O K
180 min Summer	89.200	0.800	27.1	3718.9	O K
240 min Summer	89.239	0.839	27.1	3949.8	O K
360 min Summer	89.278	0.878	27.1	4186.2	O K
480 min Summer	89.292	0.892	27.1	4272.8	O K
600 min Summer	89.294	0.894	27.1	4287.0	O K
720 min Summer	89.290	0.890	27.1	4260.2	O K
960 min Summer	89.270	0.870	27.1	4136.1	O K
1440 min Summer	89.216	0.816	27.1	3814.8	O K
2160 min Summer	89.152	0.752	27.1	3439.1	O K
2880 min Summer	89.102	0.702	27.1	3158.6	O K
4320 min Summer	89.029	0.629	27.1	2765.1	O K
5760 min Summer	88.973	0.573	27.1	2471.6	O K
7200 min Summer	88.927	0.527	27.1	2237.7	O K
8640 min Summer	88.888	0.488	27.1	2046.6	O K
10080 min Summer	88.856	0.456	27.1	1890.4	O K
15 min Winter	88.847	0.447	27.1	1846.9	O K
30 min Winter	88.962	0.562	27.1	2416.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	131.826	0.0	1652.5	23
30 min Summer	86.622	0.0	2106.2	37
60 min Summer	54.137	0.0	2747.0	68
120 min Summer	34.623	0.0	3510.5	126
180 min Summer	26.116	0.0	3957.5	186
240 min Summer	21.152	0.0	4244.0	246
360 min Summer	15.447	0.0	4532.0	364
480 min Summer	12.223	0.0	4587.9	484
600 min Summer	10.144	0.0	4564.9	604
720 min Summer	8.689	0.0	4540.5	722
960 min Summer	6.777	0.0	4487.0	960
1440 min Summer	4.755	0.0	4357.2	1228
2160 min Summer	3.337	0.0	6098.6	1580
2880 min Summer	2.610	0.0	6359.3	1964
4320 min Summer	1.883	0.0	6872.2	2772
5760 min Summer	1.517	0.0	7390.3	3576
7200 min Summer	1.296	0.0	7897.4	4392
8640 min Summer	1.151	0.0	8410.5	5184
10080 min Summer	1.048	0.0	8935.1	5944
15 min Winter	131.826	0.0	1837.4	23
30 min Winter	86.622	0.0	2269.5	37

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	89.071	0.671	27.1	2991.4	O K
120 min Winter	89.208	0.808	27.1	3765.9	O K
180 min Winter	89.280	0.880	27.1	4198.1	O K
240 min Winter	89.324	0.924	27.1	4468.2	O K
360 min Winter	89.369	0.969	27.1	4755.5	O K
480 min Winter	89.387	0.987	27.1	4874.5	O K
600 min Winter	89.393	0.993	27.1	4912.6	O K
720 min Winter	89.392	0.992	27.1	4904.4	O K
960 min Winter	89.377	0.977	27.1	4808.7	O K
1440 min Winter	89.327	0.927	27.1	4491.6	O K
2160 min Winter	89.249	0.849	27.1	4007.6	O K
2880 min Winter	89.185	0.785	27.1	3633.4	O K
4320 min Winter	89.082	0.682	27.1	3049.4	O K
5760 min Winter	88.994	0.594	27.1	2581.6	O K
7200 min Winter	88.918	0.518	27.1	2194.9	O K
8640 min Winter	88.852	0.452	27.1	1871.3	O K
10080 min Winter	88.794	0.394	27.1	1601.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	54.137	0.0	3076.9	66
120 min Winter	34.623	0.0	3920.0	124
180 min Winter	26.116	0.0	4376.7	184
240 min Winter	21.152	0.0	4592.7	242
360 min Winter	15.447	0.0	4612.1	360
480 min Winter	12.223	0.0	4591.2	476
600 min Winter	10.144	0.0	4569.6	592
720 min Winter	8.689	0.0	4547.2	706
960 min Winter	6.777	0.0	4499.6	934
1440 min Winter	4.755	0.0	4390.2	1368
2160 min Winter	3.337	0.0	6830.6	1692
2880 min Winter	2.610	0.0	7122.5	2140
4320 min Winter	1.883	0.0	7655.1	3028
5760 min Winter	1.517	0.0	8277.4	3864
7200 min Winter	1.296	0.0	8845.4	4688
8640 min Winter	1.151	0.0	9419.9	5456
10080 min Winter	1.048	0.0	10009.4	6256

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 535761 228934 TL 35761 28934
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 6.770

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	3.385	4	8	3.385

Model Details

Storage is Online Cover Level (m) 89.700

Tank or Pond Structure

Invert Level (m) 88.400

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	3536.7	1.000	6529.9

Pump Outflow Control

Invert Level (m) 88.400

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	27.1100	1.200	27.1100	3.000	27.1100	7.000	27.1100
0.200	27.1100	1.400	27.1100	3.500	27.1100	7.500	27.1100
0.300	27.1100	1.600	27.1100	4.000	27.1100	8.000	27.1100
0.400	27.1100	1.800	27.1100	4.500	27.1100	8.500	27.1100
0.500	27.1100	2.000	27.1100	5.000	27.1100	9.000	27.1100
0.600	27.1100	2.200	27.1100	5.500	27.1100	9.500	27.1100
0.800	27.1100	2.400	27.1100	6.000	27.1100		
1.000	27.1100	2.600	27.1100	6.500	27.1100		

Summary of Results for 100 year Return Period (+25%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	97.629	0.229	9.4	623.7	O K
30 min Summer	97.697	0.297	9.8	816.3	O K
60 min Summer	97.764	0.364	10.0	1011.9	O K
120 min Summer	97.854	0.454	10.0	1277.0	O K
180 min Summer	97.904	0.504	10.0	1426.6	O K
240 min Summer	97.935	0.535	10.0	1521.5	O K
360 min Summer	97.969	0.569	10.0	1625.9	O K
480 min Summer	97.984	0.584	10.0	1673.4	O K
600 min Summer	97.991	0.591	10.0	1693.3	O K
720 min Summer	97.992	0.592	10.0	1697.2	O K
960 min Summer	97.985	0.585	10.0	1676.8	O K
1440 min Summer	97.959	0.559	10.0	1595.9	O K
2160 min Summer	97.926	0.526	10.0	1494.3	O K
2880 min Summer	97.899	0.499	10.0	1413.1	O K
4320 min Summer	97.859	0.459	10.0	1292.7	O K
5760 min Summer	97.828	0.428	10.0	1199.6	O K
7200 min Summer	97.803	0.403	10.0	1126.1	O K
8640 min Summer	97.783	0.383	10.0	1067.1	O K
10080 min Summer	97.767	0.367	10.0	1020.0	O K
15 min Winter	97.656	0.256	9.6	699.1	O K
30 min Winter	97.731	0.331	9.9	915.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	117.701	0.0	486.2	23
30 min Summer	77.341	0.0	635.9	37
60 min Summer	48.336	0.0	943.7	68
120 min Summer	30.913	0.0	1202.0	126
180 min Summer	23.318	0.0	1345.8	186
240 min Summer	18.886	0.0	1434.7	246
360 min Summer	13.792	0.0	1526.3	366
480 min Summer	10.913	0.0	1559.9	484
600 min Summer	9.058	0.0	1566.1	604
720 min Summer	7.758	0.0	1557.8	722
960 min Summer	6.051	0.0	1527.9	962
1440 min Summer	4.246	0.0	1453.1	1254
2160 min Summer	2.980	0.0	2212.8	1600
2880 min Summer	2.330	0.0	2291.5	1988
4320 min Summer	1.681	0.0	2404.7	2772
5760 min Summer	1.354	0.0	2756.0	3584
7200 min Summer	1.158	0.0	2941.2	4392
8640 min Summer	1.027	0.0	3123.4	5184
10080 min Summer	0.935	0.0	3296.7	5952
15 min Winter	117.701	0.0	546.3	23
30 min Winter	77.341	0.0	701.1	37

Summary of Results for 100 year Return Period (+25%)

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	97.806	0.406	10.0	1135.6	O K
120 min Winter	97.906	0.506	10.0	1434.6	O K
180 min Winter	97.962	0.562	10.0	1604.6	O K
240 min Winter	97.997	0.597	10.0	1713.4	O K
360 min Winter	98.036	0.636	10.0	1835.6	O K
480 min Winter	98.055	0.655	10.0	1894.0	O K
600 min Winter	98.063	0.663	10.0	1921.7	O K
720 min Winter	98.066	0.666	10.0	1931.6	O K
960 min Winter	98.063	0.663	10.0	1920.2	O K
1440 min Winter	98.039	0.639	10.0	1843.9	O K
2160 min Winter	97.994	0.594	10.0	1702.9	O K
2880 min Winter	97.958	0.558	10.0	1593.8	O K
4320 min Winter	97.900	0.500	10.0	1414.6	O K
5760 min Winter	97.850	0.450	10.0	1265.8	O K
7200 min Winter	97.809	0.409	10.0	1142.4	O K
8640 min Winter	97.774	0.374	10.0	1041.1	O K
10080 min Winter	97.746	0.346	9.9	958.0	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	48.336	0.0	1057.4	66
120 min Winter	30.913	0.0	1336.2	124
180 min Winter	23.318	0.0	1480.9	184
240 min Winter	18.886	0.0	1558.8	242
360 min Winter	13.792	0.0	1611.0	360
480 min Winter	10.913	0.0	1608.8	476
600 min Winter	9.058	0.0	1596.5	592
720 min Winter	7.758	0.0	1581.1	708
960 min Winter	6.051	0.0	1546.6	936
1440 min Winter	4.246	0.0	1473.2	1372
2160 min Winter	2.980	0.0	2468.2	1712
2880 min Winter	2.330	0.0	2548.9	2164
4320 min Winter	1.681	0.0	2627.6	3032
5760 min Winter	1.354	0.0	3088.4	3912
7200 min Winter	1.158	0.0	3296.4	4688
8640 min Winter	1.027	0.0	3502.7	5528
10080 min Winter	0.935	0.0	3701.1	6256

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 535761 228934 TL 35761 28934
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+25

Time Area Diagram

Total Area (ha) 2.858

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	1.429	4	8	1.429

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 98.600

Tank or Pond Structure

Invert Level (m) 97.400

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2635.3	0.900	3368.3	1.200	3592.5

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0140-1000-1408-1000
Design Head (m)	1.408
Design Flow (l/s)	10.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	140
Invert Level (m)	97.400
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.408	10.0
Flush-Flo™	0.415	10.0
Kick-Flo®	0.885	8.0
Mean Flow over Head Range	-	8.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.0	1.200	9.3	3.000	14.3	7.000	21.4
0.200	9.2	1.400	10.0	3.500	15.4	7.500	22.2
0.300	9.8	1.600	10.6	4.000	16.4	8.000	22.9
0.400	10.0	1.800	11.2	4.500	17.4	8.500	23.5
0.500	9.9	2.000	11.8	5.000	18.2	9.000	24.2
0.600	9.8	2.200	12.3	5.500	19.1	9.500	24.8
0.800	8.9	2.400	12.9	6.000	19.9		
1.000	8.5	2.600	13.4	6.500	20.7		

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
15 min Summer	97.656	0.256	9.6	699.1	O K
30 min Summer	97.731	0.331	9.9	915.3	O K
60 min Summer	97.806	0.406	10.0	1135.5	O K
120 min Summer	97.906	0.506	10.0	1434.7	O K
180 min Summer	97.962	0.562	10.0	1604.8	O K
240 min Summer	97.997	0.597	10.0	1713.7	O K
360 min Summer	98.036	0.636	10.0	1835.8	O K
480 min Summer	98.055	0.655	10.0	1894.2	O K
600 min Summer	98.063	0.663	10.0	1921.8	O K
720 min Summer	98.066	0.666	10.0	1931.4	O K
960 min Summer	98.062	0.662	10.0	1919.0	O K
1440 min Summer	98.037	0.637	10.0	1838.6	O K
2160 min Summer	98.000	0.600	10.0	1722.7	O K
2880 min Summer	97.971	0.571	10.0	1634.1	O K
4320 min Summer	97.930	0.530	10.0	1508.0	O K
5760 min Summer	97.899	0.499	10.0	1412.1	O K
7200 min Summer	97.874	0.474	10.0	1336.7	O K
8640 min Summer	97.854	0.454	10.0	1276.8	O K
10080 min Summer	97.838	0.438	10.0	1229.7	O K
15 min Winter	97.685	0.285	9.7	783.5	O K
30 min Winter	97.769	0.369	10.0	1026.4	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	131.826	0.0	546.3	23
30 min Summer	86.622	0.0	701.0	38
60 min Summer	54.137	0.0	1057.3	68
120 min Summer	34.623	0.0	1336.0	126
180 min Summer	26.116	0.0	1480.5	186
240 min Summer	21.152	0.0	1557.8	246
360 min Summer	15.447	0.0	1608.8	366
480 min Summer	12.223	0.0	1605.5	484
600 min Summer	10.144	0.0	1592.2	604
720 min Summer	8.689	0.0	1575.8	724
960 min Summer	6.777	0.0	1539.3	962
1440 min Summer	4.755	0.0	1461.2	1376
2160 min Summer	3.337	0.0	2466.1	1672
2880 min Summer	2.610	0.0	2544.1	2048
4320 min Summer	1.883	0.0	2600.1	2856
5760 min Summer	1.517	0.0	3087.7	3680
7200 min Summer	1.296	0.0	3295.2	4472
8640 min Summer	1.151	0.0	3500.5	5272
10080 min Summer	1.048	0.0	3696.2	6056
15 min Winter	131.826	0.0	610.2	23
30 min Winter	86.622	0.0	761.1	37

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

Storm Event	Max Level (m)	Max Depth (m)	Max Control (l/s)	Max Volume (m³)	Status
60 min Winter	97.853	0.453	10.0	1274.1	O K
120 min Winter	97.964	0.564	10.0	1611.5	O K
180 min Winter	98.026	0.626	10.0	1804.7	O K
240 min Winter	98.066	0.666	10.0	1929.3	O K
360 min Winter	98.110	0.710	10.0	2071.8	O K
480 min Winter	98.133	0.733	10.0	2143.0	O K
600 min Winter	98.144	0.744	10.0	2179.8	O K
720 min Winter	98.149	0.749	10.0	2196.5	O K
960 min Winter	98.149	0.749	10.0	2194.7	O K
1440 min Winter	98.128	0.728	10.0	2129.2	O K
2160 min Winter	98.082	0.682	10.0	1979.4	O K
2880 min Winter	98.044	0.644	10.0	1860.8	O K
4320 min Winter	97.986	0.586	10.0	1678.3	O K
5760 min Winter	97.936	0.536	10.0	1525.2	O K
7200 min Winter	97.894	0.494	10.0	1396.5	O K
8640 min Winter	97.858	0.458	10.0	1288.7	O K
10080 min Winter	97.828	0.428	10.0	1199.9	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
60 min Winter	54.137	0.0	1181.5	66
120 min Winter	34.623	0.0	1472.4	126
180 min Winter	26.116	0.0	1596.3	184
240 min Winter	21.152	0.0	1634.6	242
360 min Winter	15.447	0.0	1631.7	360
480 min Winter	12.223	0.0	1614.2	478
600 min Winter	10.144	0.0	1594.3	594
720 min Winter	8.689	0.0	1574.3	710
960 min Winter	6.777	0.0	1536.0	940
1440 min Winter	4.755	0.0	1464.3	1386
2160 min Winter	3.337	0.0	2733.6	1988
2880 min Winter	2.610	0.0	2796.8	2220
4320 min Winter	1.883	0.0	2734.6	3116
5760 min Winter	1.517	0.0	3459.3	3984
7200 min Winter	1.296	0.0	3691.6	4832
8640 min Winter	1.151	0.0	3922.2	5624
10080 min Winter	1.048	0.0	4145.8	6456

Rainfall Details

Rainfall Model	FEH
Return Period (years)	100
FEH Rainfall Version	2013
Site Location	GB 535761 228934 TL 35761 28934
Data Type	Point
Summer Storms	Yes
Winter Storms	Yes
Cv (Summer)	0.750
Cv (Winter)	0.840
Shortest Storm (mins)	15
Longest Storm (mins)	10080
Climate Change %	+40

Time Area Diagram

Total Area (ha) 2.858

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	1.429	4	8	1.429

Time Area Diagram

Total Area (ha) 0.000

Time From:	(mins) To:	Area (ha)
0	4	0.000

Model Details

Storage is Online Cover Level (m) 98.600

Tank or Pond Structure

Invert Level (m) 97.400

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	2635.3	0.900	3368.3	1.200	3592.5

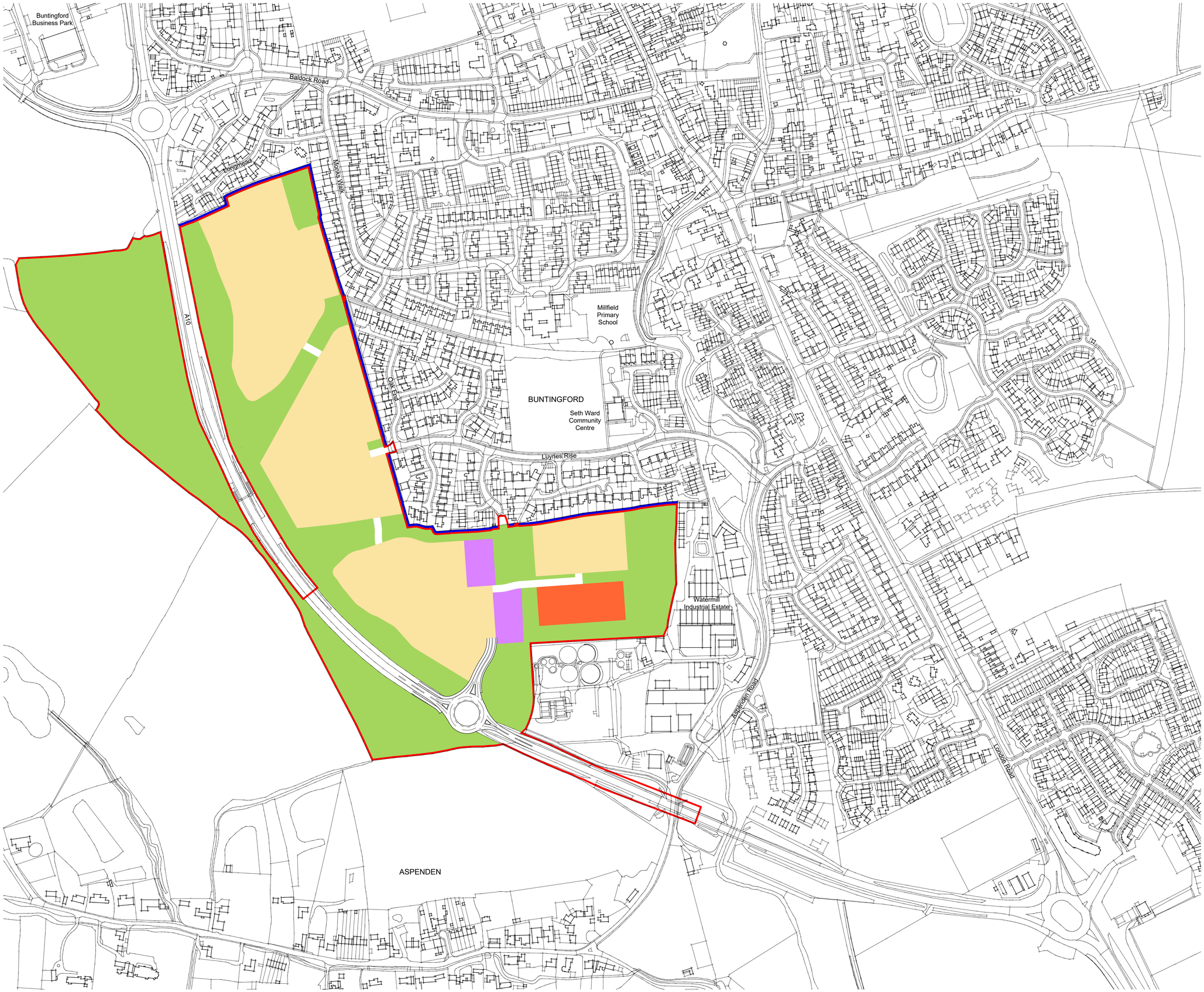
Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0140-1000-1408-1000
Design Head (m)	1.408
Design Flow (l/s)	10.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	140
Invert Level (m)	97.400
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.408	10.0
Flush-Flo™	0.415	10.0
Kick-Flo®	0.885	8.0
Mean Flow over Head Range	-	8.7

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.0	1.200	9.3	3.000	14.3	7.000	21.4
0.200	9.2	1.400	10.0	3.500	15.4	7.500	22.2
0.300	9.8	1.600	10.6	4.000	16.4	8.000	22.9
0.400	10.0	1.800	11.2	4.500	17.4	8.500	23.5
0.500	9.9	2.000	11.8	5.000	18.2	9.000	24.2
0.600	9.8	2.200	12.3	5.500	19.1	9.500	24.8
0.800	8.9	2.400	12.9	6.000	19.9		
1.000	8.5	2.600	13.4	6.500	20.7		



NOTES

0 50 100 150 200m

N

KEY

- Application boundary
- Land under the control of the applicant
- Residential 10.35ha
  Up to 350 dwellings
- Employment 0.66ha
  Use Classes E and B8
- Local Centre 0.55ha
  Use Class E
- Green Infrastructure 15.50ha
  Includes drainage features, children's equipped play areas, allotments, retained agricultural land, ecological enhancement area, footpaths, cycleways and recreational routes within green infrastructure

rev	date	description	drn	chk
P05	03/07/2023	Drawing title amended.	JMG	KMN
P04	08/06/2023	Roundabout added	CTH	KMN
P03	26/05/2023	Title block and key amended; minor amendments.	JMG	KMN
P02	19/05/2023	A10 access amended.	JMG	KMN
P01	21/04/2023	First issue.	JMG	KMN

masterplanning
environmental assessment
landscape design
urban design
ecology
architecture
arboriculture

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w: www.fpcr.co.uk

client
Countryside Partnerships and Vistry Homes

project
Buntingford West,
Buntingford, Hertfordshire

drawing title
PARAMETER PLAN 1:
LAND USE

scale	drn	chk	date created
1:2500 @ A1	JMG	KMN	April 2023

project number	status	issue
10537	S3	P05

document number
10537-FPCR-XX-XX-DR-A-1003
Project Code - Originator - Zone - Level - Type - Role - Drawing Number

File: L:\10500\10537\ARCH\Drawings\10537-FPCR-XX-XX-DR-A-1003-P05_ParameterPlan1LandUse.vwx

CATCHMENT DRAINAGE DESIGN SUBJECT TO FINAL LEVELS DESIGN. PUMPING MAY BE REQUIRED.

FOUL CONNECTION A
MH REF: 8906
CL: 104.81
IL: 100.47 (150ø)
CONNECTION IL: 100.47 (150ø)

FOUL CONNECTION B
TW MH REF: 0802
CL: 97.36
IL: 95.26 (150ø)
CONNECTION IL: 95.26 (150ø)

SURFACE WATER CONNECTION
DISCHARGE RATE 35.86 l/s
TW MH REF: 0804
CL: 97.48
IL: 95.52 (600ø)
CONNECTION IL: 95.82 (300ø)

SURFACE WATER PUMP STATION
FLOW RATE 26 l/s
FOUL WATER PUMP STATION FLOW RATE 1.25 l/s

DESIGN AND CONSTRUCTION GUIDANCE TYPE 3 PUMPING STATION. FOUL AND SURFACE WATER PUMPING STATION TO BE PROVIDED WITH ACCESS ROAD.

SPILLWAY TO BE PROVIDED TO EXISTING DRAINAGE DITCH. SPILLWAY TO BE FORMED 100mm BELOW CREST OF BASIN.

EASTERN ATTENUATION BASIN
CONTRIBUTING IMPERMEABLE AREA: 8.6 ha
TOP OF BANK LEVEL: 89.70
BOTTOM OF BASIN: 88.40
DEPTH: 1.0m + 0.3m FREEBOARD
SIDE SLOPES: 1:10
VOLUME PROVIDED: 4957m³
PEAK DISCHARGE RATE (PUMPED): 27.1 l/s
RISING MAIN DISCHARGE LOCATION: SURFACE WATER SEWER IN PEASMEAD

SPILLWAY TO BE PROVIDED TO EXISTING DRAINAGE DITCH. SPILLWAY TO BE FORMED 100mm BELOW CREST OF BASIN.

WESTERN ATTENUATION BASIN
CONTRIBUTING CATCHMENT AREA: 3.75 ha (70% IMP)
TOP OF BANK LEVEL: 98.60
BOTTOM OF BASIN: 97.40
DEPTH: 0.9m + 0.3m FREEBOARD
SIDE SLOPES: 1:3
VOLUME PROVIDED: 2694m³
PEAK DISCHARGE RATE (GRAVITY): 10 l/s
DISCHARGE LOCATION: SURFACE WATER SEWER IN PEASMEAD

DO NOT SCALE

NOTES:

1. LEVELS ARE IN METERS ABOVE ORDNANCE DATUM UNLESS OTHERWISE STATED.
2. DIMENSIONS ARE IN METERS UNLESS OTHERWISE STATED.
3. EXISTING THAMES WATER ASSETS BASED ON THAMES WATER ASSET RECORDS "ALS/ALS STANDARD/2013_2474942".
4. INFILTRATION TESTING CONFIRMED THAT THE SITE INFILTRATION RATES ARE INSUFFICIENT TO ACHIEVE DISCHARGE VIA INFILTRATION (REFER TO WSP INFILTRATION TESTING REPORT)
5. MODELLING UNDERTAKEN USING FEH RAINFALL DATA.
6. PROPOSED MASTERPLAN BASED ON 10537-FPCR-XX-XX-DR-A-1002_P05 PREPARED BY FPCR ENVIRONMENT AND DESIGN LTD.
7. SURFACE WATER FROM THE SITE WILL BE RESTRICTED TO THE QBAR GREENFIELD RATE FOR ALL STORMS UP TO & INCLUDING THE DESIGN 1 IN 100 YEAR + 40% CLIMATE CHANGE EVENT. A TOTAL OF 7971m³ OF ATTENUATION STORAGE IS CALCULATED TO BE REQUIRED, AND THE BASINS HAVE BEEN SIZED TO ATTENUATE THEIR CONTRIBUTING CATCHMENTS. THE ATTENUATION BASIN EXTENTS ARE SUBJECT TO DETAILED DESIGN.
8. THE TOTAL QBAR GREENFIELD RUN-OFF RATE FOR THE DEVELOPMENT IS 36.95 l/s.
9. LAND OUTSIDE THE CATCHMENTS IDENTIFIED, INCLUDING THE A10 AND LAND WEST OF THE A10 ARE NOT INCLUDED WITHIN THE DRAINAGE STRATEGY AND ARE ASSUMED TO DRAIN AS PER THE EXISTING ARRANGEMENT. THE CATCHMENT PARAMETERS OF THIS LAND IS NOT CHANGING AS A RESULT OF THE DEVELOPMENT.
10. A SEDIMENT FOREBAY IS PROPOSED TO BE INSTALLED AT THE BASIN INLETS. BASED ON CIRIA SUDS MANUAL C365 GUIDANCE. THE SEDIMENT FOREBAY ALLOWS SEDIMENT BUILD-UP TO BE EASILY MONITORED, AND CONCENTRATES ANY REQUIRED SEDIMENT REMOVAL ACTIVITIES WITHIN A SMALL AREA, THEREBY MINIMISING POTENTIAL DAMAGE TO THE REST OF THE POND OR WETLAND. THE PLAN AREA OF THE SEDIMENTATION BAY SHOULD BE AT LEAST 10% OF THE TOTAL BASIN AREA AND COULD CONSIST OF A SEPARATE BASIN OR BE FORMED BY BUILDING AN EARTH BERM, STONE-OR ROCK-FILLED GABION OR RIP-RAP ACROSS THE UPSTREAM PORTION OF THE BASIN.
11. PERMEABLE PAVING IS PROPOSED FOR INCORPORATION ACROSS ALL NON-ADOPTABLE ROADS AND PARKING AREAS WITH 300mm SUB-BASE. PERMEABLE PAVING PROVIDES A VOLUME OF STORAGE THAT WILL BE CONSIDERED AT DETAILED DESIGN STAGE AND IS NOT CONSIDERED WITHIN THE TOTAL ATTENUATION VOLUME REQUIREMENTS AT THIS STAGE. PERMEABLE PAVING SUPPORTS EVAPORATION POTENTIAL AND FORM PART OF THE SUDS TREATMENT TRAIN PRIOR TO DISCHARGE TO THE STORAGE BASINS. PERMEABLE PAVING IMPROVES FILTRATION OF SILTS, BIODEGRADATION OF POLLUTANTS AND RETENTION OF SOLIDS.
12. COVER LEVELS SHOWN ARE INDICATIVE AND SUBJECT TO DETAILED DESIGN.
13. CHECK DAMS TO BE INCORPORATED WHERE SWALE SLOPE IS GREATER THAN 3%.
14. DRAWING IS TO BE READ IN CONJUNCTION WITH WSP OUTLINE DRAINAGE STRATEGY AND FLOOD RISK ASSESSMENT.
15. WATER BUTTS TO BE PROVIDED TO ENCOURAGE RAINWATER RE-USE.

SURFACE WATER DISCHARGE AND STORAGE		
	DISCHARGE RATE (l/s)	REQUIRED STORAGE (m³)
EASTERN BASIN	27.11	4957
WESTERN BASIN	10	2984

KEY:

- SITE BOUNDARY
- EXISTING THAMES WATER FOUL SEWER AND MANHOLE
- EXISTING THAMES WATER SURFACE WATER SEWER AND MANHOLE
- EXISTING THAMES WATER STORM RELIEF
- 8402 EXISTING THAMES WATER MANHOLE REFERENCE AND PIPE DIAMETER
- PROPOSED FOUL SEWER AND MANHOLE
- PROPOSED SURFACE WATER SEWER AND MANHOLE
- PROPOSED FOUL RISING MAIN
- PROPOSED SURFACE WATER RISING MAIN
- PROPOSED SWALE
- PROPOSED ATTENUATION BASIN
- 95.00 PROPOSED CONTOUR AND LEVEL
- +113.04 EXISTING SPOT LEVEL
- FOUL CATCHMENT A (GRAVITY DISCHARGE TO TWMH8906)
- FOUL CATCHMENT B (GRAVITY DISCHARGE TO TWMH0802)
- FOUL CATCHMENT C (PUMPED DISCHARGE TO TWMH0802
- EXISTING DRAINAGE DITCH TO BE RETAINED

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

REV	DATE	BY	DESCRIPTION	CHK	APP
P03	15/11/2023	BB	UPDATED TO SUIT LLFA COMMENTS	KM	KM
P02	16/06/2023	BB	REVISED BACKGROUND	BH	BH
P01	30/06/2022	BB	FIRST ISSUE	KM	KM

DRAWING STATUS: S2 - FOR INFORMATION

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wsp.com

CLIENT: VISTRY

ARCHITECT: fpcr

PROJECT: BUNTINGFORD WEST, BUNTINGFORD, HERTFORDSHIRE

TITLE: FOUL AND SURFACE WATER DRAINAGE STRATEGY

SCALE @ A0:	CHECKED:	APPROVED:
1:500	KM	KM
PROJECT No: 70084844	DESIGNED: BB	DRAWN: BB
DRAWING No: 10537-WSP-XX-XX-DR-C-0001	DATE: November 23	REV: P03

DO NOT SCALE

NOTES

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2. DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED
3. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT SCHEME DRAWINGS AND SPECIFICATIONS
4. THIS DRAWING IS NOT BE REPRODUCED IN ANY PART OR FORM WITHOUT THE CONSENT OF WSP UK LTD. ALL COPYRIGHT RESERVED.
5. CULVERT CATCHMENT DELINEATED USING GIS AND ENVIRONMENT AGENCY 1m LIDAR

KEY

KEY:

- SITE BOUNDARY
- EXISTING THAMES WATER FOUL SEWER AND MANHOLE
- EXISTING THAMES WATER SURFACE WATER SEWER AND MANHOLE
- EXISTING THAMES WATER STORM RELIEF
- 8402 EXISTING THAMES WATER MANHOLE REFERENCE AND PIPE DIAMETER
- PROPOSED FOUL SEWER AND MANHOLE
- PROPOSED SURFACE WATER SEWER AND MANHOLE
- PROPOSED FOUL RISING MAIN
- PROPOSED SURFACE WATER RISING MAIN
- PROPOSED SWALE
- PROPOSED ATTENUATION BASIN
- --95.00--- PROPOSED CONTOUR AND LEVEL
- +113.04 EXISTING SPOT LEVEL
- FOUL CATCHMENT A (GRAVITY DISCHARGE TO TWMH8906)
- FOUL CATCHMENT B (GRAVITY DISCHARGE TO TWMH0802)
- FOUL CATCHMENT C (PUMPED DISCHARGE TO TWMH0802
- CULVERT CATCHMENT CONTRIBUTING TO FLOW THROUGH CULVERT
- 525mm DIAMETER A10 CULVERT
- EXISTING LAND DRAINAGE DITCHES
- EXISTING OVERLAND FLOW ROUTE
- HIGH (OR LOW) POINT MARKER

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

REV	DATE	BY	DESCRIPTION	CHK	APP
P01	15/11/2023	BB	FIRST ISSUE	KM	KM

DRAWING STATUS: S2 - FOR INFORMATION

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ARCHITECT: fpcr

PROJECT: BUNTINGFORD WEST, BUNTINGFORD, HERTFORDSHIRE

TITLE: FLOW ROUTE EXCEEDANCE PLAN

SCALE @ A0: 1:500	CHECKED: KM		APPROVED: KM
PROJECT No: 70084844	DESIGNED: BB	DRAWN: BB	DATE: November 23
DRAWING No: 10537-WSP-XX-XX-DR-C-0006			REV: P01

VISTRY HOMES

LAND AT BUNTINGFORD WEST

SuDS Maintenance and Management Plan

10537-WSP-SW-XX-RP-C-0004
NOVEMBER 2023

PUBLIC

Vistry Homes

LAND AT BUNTINGFORD WEST

SuDS Maintenance and Management Plan

PUBLIC

PROJECT NO. 70084844

OUR REF. NO. 10537-WSP-SW-XX-RP-C-0004

NOVEMBER 2023

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QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3
Remarks	First Issue			
Date	10.11.2023			
Prepared by	Julian Madams			
Signature				
Checked by	Bryony Bennett			
Signature				
Authorised by	Kate Mackay			
Signature				
Project number	70084844			
Report number	10537-WSP-SW-XX-RP-C-0004			
File reference	\\uk.wspgroup.com\central data\Projects\70084xxx\70084844 - Land at Buntingford West\03 WIP\DR Drainage Engineer\05 Reports\SuDS Maintenance and Management Plan			

CONTENTS

1

INTRODUCTION

1. INTRODUCTION

1.1.1. WSP has prepared this SuDS Maintenance and Management Plan on behalf of Vistry Homes in response to the comments made by the LLFA for the proposed development at the site west of Buntingford, Hertfordshire.

1.1.2. This report gives guidance on the management and frequency of maintenance of the Below Ground Drainage Systems on site, the responsibility of which lies with the appointed maintenance company assigned by Vistry Homes.

1.1.3. This maintenance plan should be read in conjunction with any specific maintenance requirements of existing assets.

1.1.4. It is recommended that a Below Ground Drainage Maintenance Plan is implemented. Reference should be made to Section 6.0 of BSEN 752:2017 but in general maintenance activities are likely to comprise of:

- Regular Maintenance – Litter collection, gardening to control vegetation growth, inlet checks.
- Occasional Tasks – Checking the drainage components and removing any silt that builds up.
- Remedial Work – Repairing damage where necessary.

2

METHOD STATEMENT

2. METHOD STATEMENT

2.1.0. This section of the report highlights the maintenance schedules for all relevant SuDS features and drainage components onsite, indicating the type and frequency of maintenance for each feature.

2.1. BELOW GROUND DRAINAGE MAINTENANCE PLAN

2.1.1. Below is an indication of the minimum expected undertakings to inspect and monitor the onsite below ground drainage of the development. The below list is not extensive and is to be read in conjunction with any specific inspection and maintenance requirements set by product manufacturers.

Table 2-1 – Below Ground Drainage Maintenance Plan

Regular Maintenance	Frequency	Responsibility
The inspection of drainage channels, gullies and sumps in manholes. All traps should be topped up with water where unused to prevent drying out.	Monthly. More regular in warm weather	Site Maintenance Contractor
Inspect below ground drainage components from the surface, removing obstructions and silt as necessary. Check there is no physical damage.	6 Monthly.	Site Maintenance Contractor
Regular sweeping or blowing of pavement to remove any debris that can clog.	Monthly.	Site Maintenance Contractor
Inspection of pump to identify any areas that are not operating correctly and clear out and debris from chamber.	Monthly for first 3 months then every 6 months	Site Maintenance Contractor
Inspect inlet structures such as RWP's, channel drains and gullies removing silt as necessary. Check for any physical damage.	Monthly	Site Maintenance Contractor
Inspect and identify any areas of pipework that isn't operating correctly, undertake remedial works if required.	Monthly for first 3 months then annually	Site Maintenance Contractor
Maintain vegetation to designed limits within the vicinity of all below ground drainage structures and pipes.	Annually or as required	Site Maintenance Contractor
Remove debris from catchment surface where it presents a risk to the performance of the below ground drainage system.	Monthly or as required	Site Maintenance Contractor

Pumps and associated ancillaries	Monthly and to manufacturer's guidance	Specialist Maintenance Contractor
Occasional Maintenance	**Frequency**	**Responsibility**
Inspect drainage runs using CCTV technology and undertaking cleaning when required with a high-powered jet cleaner.	Every 6-8 Years	Specialist Maintenance Contractor
Remove covers on inspection chambers and inspect, ensure that water is flowing freely and is unobstructed. Remove debris and silt as required.	Annually	Site Maintenance Contractor
Remedial Work	**Frequency**	**Responsibility**
Monitor the effectiveness of pumps, where water pools and does not discharge effectively advise Client of any remedial action required.	As required	Site Maintenance Contractor
Existing Drainage Ditch on Northern boundary to be kept free of vegetation preventing surface water flow within or to the channel	As required	Site Maintenance Contractor
Remedial works to be undertaken as necessary on below ground drainage systems following observations from regular and occasional maintenance tasks.	As required	Specialist Maintenance Contractor

Note:

- Special inspection and immediate appraisal may be required in the event of a structural accident, fire, flooding, reported structural distress or suspected inadequacy.
- It is recommended that in situations where an expected severe storm is to hit that all gullies, drainage channels and manhole sumps are cleared of any debris material.
- Refer to the manufactures of all attenuation systems, petrol interceptors and flow control devices for their specific inspection regime requirements for their products.
- All inspections should be carried out by the appropriate persons and they should be confined space trained if entering below ground structures such as manholes or attenuation tanks.

2.2. PIPED DRAINAGE AND MANHOLE CHAMBERS

2.2.1. Drainage infrastructure covered in this section includes all privately-owned manholes, manhole fittings and surrounding pipework, gullies and drainage channels. Correct operation of this drainage infrastructure allows collection and transportation of water but requires regular maintenance as outlined in Table 2-2 below.

Table 2-2 – Piped Drainage and Manhole Chambers Maintenance Schedule

Maintenance Schedule	Required Action	Frequency
Before Start up	Removal of any inappropriate material from within the chamber and dispose off-site to a suitable licenced site. All pipelines to be flushed with water to remove silt and check for blockages.	At Start At Start
Regular Maintenance	Removal of debris (which could include leaves, rubbish, branches) from areas served by drainage (where it may cause risk to performance).	Monthly
Remedial Actions	For blockages resulting in flooded manhole chambers, drain down manhole chamber and unblock. For pipe blockages, rod or jet clean between access points to unblock.	As required As required
Monitoring	Lift covers and inspect chambers. Inspect covers, surrounding gullies and drainage channels for signs of damage and incorrect operation. If required, undertake remedial action.	As required

2.3. PUMP

2.3.1. These are proprietary systems which are installed to discharge and control the onsite flows. A surface water pump is proposed on site for the discharge of surface water from the eastern attenuation basin. Note that any specific maintenance requirements from the manufacturer should also be undertaken as part of the maintenance schedule.

2.3.2. Typical operation and maintenance requirements are given in Table 2-4 below:

Table 2-3– Pumped Flow Control Maintenance Requirements

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Remove litter and debris and grass cutting and removal of cuttings from the upstream SuDS to prevent these being washed into the pump chamber. Inspection of upstream chamber and removal of any sediments, debris etc .	Quarterly or as required following Monitoring
Remedial Actions	Check the pump fixings to manhole chamber and access into the control chamber is functional.	Quarterly or as required following Monitoring
Monitoring	Inspect flow controls and overflows and check flows are not impeded.	Monthly or after periods of heavy rainfall

2.4. EXISTING DRAINAGE DITCH

2.4.1. There is an existing land drainage ditch that runs along the northern boundary which should be maintained as per Table 2-5.

Table 2-4 – Existing Ditch Maintenance Requirements

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Removal of debris (which could include leaves, rubbish, branches) from channel (where it may cause risk to performance).	Monthly
Remedial Actions	For blockages or damage to the structure of the ditch maintenance to retain the integrity is required.	As required
Monitoring	Inspect channel to check flows are not impeded.	As required

2.5. PERMEABLE PAVING

2.5.1. Pervious pavements provide a pavement suitable for pedestrian and/or vehicular traffic, while allowing rainwater to infiltrate through the surface and into the underlying structural layers. The water is temporarily stored beneath the overlying surface before or controlled discharge downstream. This type of paving requires maintenance, as stated in Table 2-6 as set out in the CIRIA SuDS Manual.

Table 2-6 – Permeable Paving Requirements

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent areas as this area is most likely to collect the sediment
Occasional Maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphosphate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken	As required

	blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material	
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

2.6. DETENTION BASIN

2.6.1. A detention basin is a depression made in the landscape, they are normally dry except during a storm or afterward of the storm event. Table 2-7 provides the information on the maintenance schedule for the detention basin as set out in the CIRIA SuDS Manual.

Table 2-7 – Detention Basin Requirements

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Remove litter and debris	Monthly or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Cut grass – meadow grass in and around basin	Half yearly (spring – before nesting season, and autumn)
	Manage other vegetation and remove nuisance plants	Monthly (at start, then as required)
	Inspect inlets, outlets and overflows for blockages, and clear if necessary	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and facility surface for silt accumulation. Establish appropriate silt removal frequencies	Monthly (for first year), then

		annually or as required
	Check any penstocks and other mechanical devices	Annually
	Tidy all dead growth before start of growing season	Annually
	Remove sediment from inlets, outlet pool – where provided	Annually (or as required)
	Manage wetland plants in outlet pool – where provided	Annually (as set out in Chapter 23)
Occasional Maintenance	Reseed areas of poor vegetation growth	As required
	Prune and trim any trees and remove cuttings	Every 2 years, or as required
	Remove sediment from inlets, outlets, forebay and main basin when required	Every 5 years, or as required (likely to be minimal requirements where effective upstream source control is provided)
Remedial Actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realignment of rip-rap	As required
	Repair/rehabilitation of inlets, outlets and overflows	As required
	Relevel uneven surfaces and reinstate design levels	As required

2.7. SWALES

2.7.1. Swales are long, landscaped ditches running along roads to collect rainwater and transport it away from roads. They require regular maintenance, which is provided by a landscaper. The type of maintenance is shown in Table 2-8

Table 2-8 – Operation and Maintenance Requirements for Swales

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Remove litter and debris	Monthly or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required

	Inspect inlets, outlets and overflows for blockages, and clear if necessary	Monthly
	Inspect infiltration surfaces for silt accumulation record areas where water is ponding for > 48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional Maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if soil is exposed over 10% or more of the swale treatment areas
Remedial Actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Reveal uneven surfaces and reinstate design levels	As required
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

DESIGN LIFE

2.8.1. The design life of the development may exceed the design life of each of the SuDS components listed above.

2.8.2. During the routine inspections of any drainage component it may become apparent that they have reached the end of their functional lifetime. In the interest of sustainability, repairs should be the first-choice solution where practicable. If this is not the case, then it will be necessary for the property owners to undertake complete replacement of the component in question.

2.8.3. Maintenance of the system will be the responsibility of a maintenance contractor appointed by the Hospital Trust.

2.8.4. The maintenance contractor must maintain yearly logs of maintenance which should be carried out in accordance with the Maintenance Plan. These must be available for inspection upon a request by the Local Planning Authority.

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