



Technical Note

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Woodgate Centre

20-061-TN-014 Rev -

Flooding and Drainage Clarifications

November 2021

Rev	Issue Purpose	Author	Checked	Reviewed	Approved	Date
	PLANNING	SAC	GAC	SAC	GAC	Nov 21

1 Introduction

- 1.1.1 This Technical Note has been prepared following receipt of consultation responses from Arun District Council (ADC) to a planning application reference AL/107/21/PL for residential development on Land at Woodgate Centre, Oak Tree Lane Woodgate in West Sussex.
- 1.1.2 An email dated 26th October 2021 from the Council sets out a number of points in relation to the FRA and Drainage Strategy which accompanied the planning application and seeks clarification on these matters. These are addressed below.

2 Responses to Drainage Queries

2.1.1 The points for clarification in ADC's email are replicated below with responses to each point in red.

We note the proposed location of the basin is very close to flood zone 2/3, all surface water storage must be located outside of future flood zones. We would request that the applicant provides further detail on the future flood zone extent, and the proposed elevation of the pond. Some more detailed drawings have been provided in an appendix, however the quality of these on the system is very poor. Please can separate surface water drainage layout and detail drawings be provided.

Drawing 20-061-017 Rev A, attached to this note shows a section through the proposed downstream attenuation pond. This demonstrates that the pond is outside of Flood Zone 2 based on levels provided by the EA. Some minor regrading of levels will be required around this pond but as demonstrated on the attached drawings this will not impact the flood zones.

A full review of calculations has not been completed due to our inability to read the drainage layout drawing; however, we do note the following which need to be adjusted within calculations:

FSR rainfall and a cv of 0.75 has been used. At least FEH 2013 rainfall must be used, ideally cv should also be set to 1.

The attached updated calculations have now been computed using FEH Rainfall

A surcharged outfall has not been modelled. This must be modelled with surcharged water level set to predicted future flood level.

The outfall from the pond to the adjacent watercourse has now been adjusted so it does not lie within either Flood Zones 2 or 3 so will not be surcharged.

The system must be designed for the 1 in 100 year plus 40% climate change event.

Both these updated calculations and the calculations included in the original FRA are designed for 1 in 100 year plus a 40% allowance for climate change.

Urban creep must be applied to impermeable areas.

An allowance for urban creep was included in the original submission and also in these updated calculations.

Numerous pipes are too slack. Minimum self-cleansing velocity of 1m/s must be achieved. For example, 450mm diameter pipes set at 1:545 are not suitable.

All revised calculations now have gradients with minimum self-cleansing velocities

It appears that discharge rate has been based upon developable area, rather than the area positively drained. Please re-assess discharge rate based upon the proposed positively drained area (taking account of neighbouring development if appropriately master planned). We expect discharge to be limited to QBar for all events up to and including the 1 in 100 year plus 40% climate change event, we expect QBar to be far closer to 5l/s. This will have a significant impact upon the storage area required.

Calculations have now been updated using a discharge rate based on positively drained areas. The resultant Qbar is 10.7l/s. Catchment areas are shown on attached drawing 20-061-003 Rev E

It is difficult to assess what conflict there may be between drainage and landscaping proposals, as the size of drainage features will likely need to increase. However, we would state that existing and proposed trees (root protection zones) must not conflict with suds features/pipework.

Drainage features have been designed to avoid any retained trees.

We would query whether widespread land raising is proposed here and would recommend the case officer carefully reviews this. If ground raising is proposed there is a risk that this will surcharge groundwater levels and result in groundwater flooding on adjacent land.

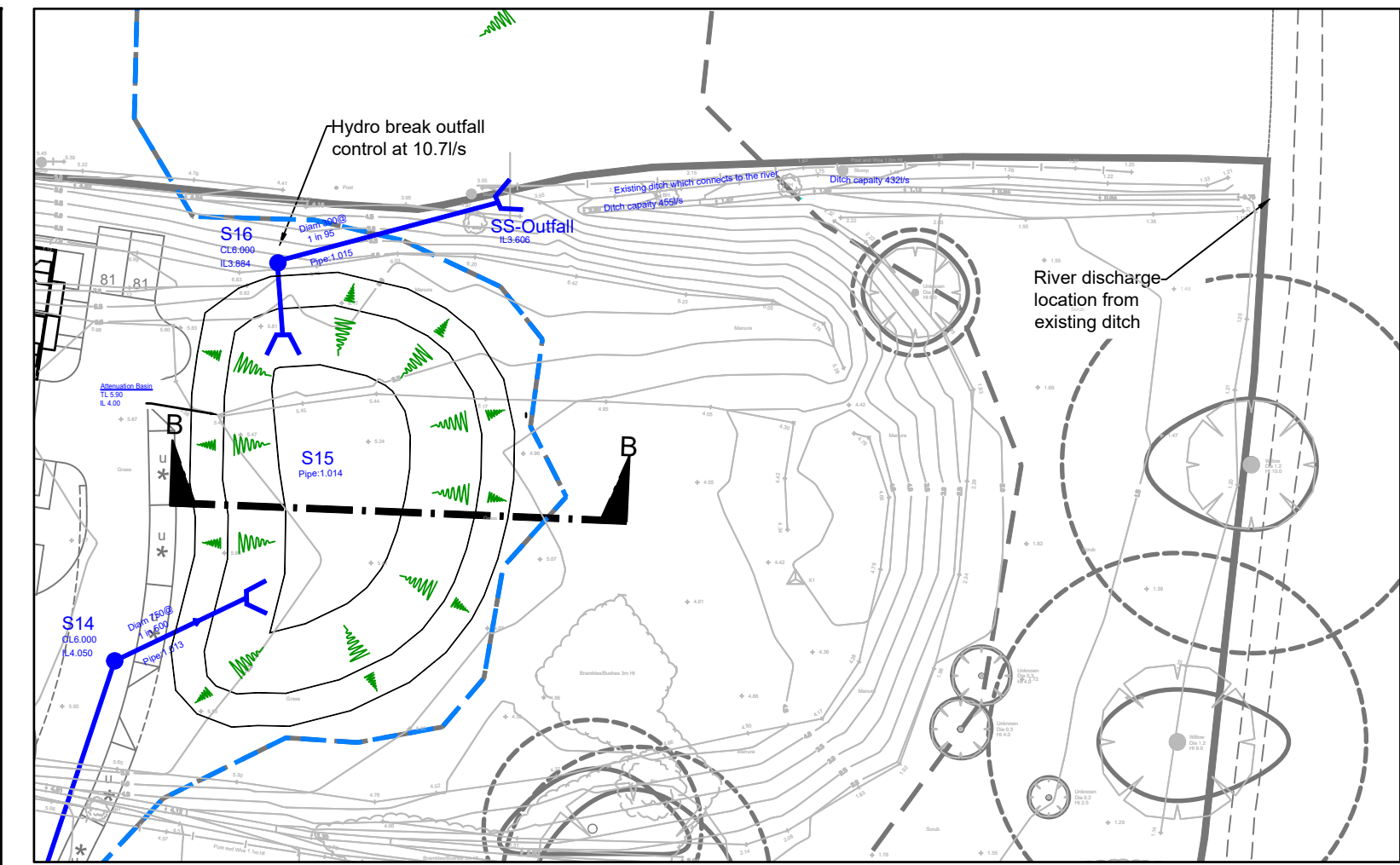
No ground raising is proposed as development levels will generally follow existing ground levels which are significantly above the maximum flood levels.

- 2.1.2 The ADC email also suggests that allowance be made within the drainage network of this development for an adjacent “landlocked” site which may be developed in the future. Whilst this development could be considered as part of an overall wider drainage strategy, the land does not form part of this application and it is not possible therefore to make any allowance for it at this stage within our scheme. It would be possible for the adjoining lands scheme promotor to either connect into the network of this development once adopted by the Water Authority or requisition and outfall via the Water Industry Act. As such should not be considered as part of this application.

Appendix A Drawing 20-061-007 Rev I Drainage Strategy

Drawing 20-061-017 Rev A SW Structures Standard Details

Drawing 20-061-003 Rev E Catchment Areas



- NOTES**
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH 20-061-017 AND ALL OTHER RELATED DRAWINGS ISSUED BY THE ENGINEER.
 - DO NOT SCALE FROM THIS DRAWING. WORK FROM FIGURED DIMENSIONS ONLY.
 - ALL DIMENSIONS SHOWN ON THIS DRAWING ARE IN METRES UNLESS OTHERWISE SHOWN.
 - ALL DIMENSIONS, LEVELS AND SURVEY GRID CO-ORDINATES ARE TO BE CHECKED ON SITE AND THE ENGINEER NOTIFIED IMMEDIATELY OF ANY DISCREPANCIES PRIOR TO THE COMMENCEMENT OF THE WORKS. DRAWING BASED ON TOPOGRAPHICAL SURVEY PROVIDED BY OTHERS. C&A ARE NOT RESPONSIBLE FOR ANY INACCURACIES.
 - SECTIONS CAN BE FOUND ON DRAWING 20-061-017

- LEGEND:**
- Surface Water Drainage
 - Flood zone 2 boundary
 - Existing 450 Ø potable water main W/ 3m Easement
 - SuDS Storage Structure (See Drawing 20-061-017)
 - Conveyance Swale
 - Headwall
 - Lined permeable paving
 - Lined permeable paving with cellular storage

I	Drainage Updates	SC	SAC	GAC	Nov 2021
H	Drainage Updates	SC	SAC	GAC	Aug 2021
G	Layout Updates	SC	SAC	GAC	Jul 2021
F	Discharge swale shown connecting to existing ditch	GW	SAC	GAC	Jul 2021
E	FFL's added & discharge swale updated	GW	SAC	GAC	Jul 2021
D	Drainage updated to suit, updated Layout	SC	SAC	GAC	Jul 2021
C	Drainage updated to suit, updated Layout	SC	SAC	GAC	Apr 2021
B	Drainage updated to suit, updated Layout (02L)	JT	MR	GAC	Feb 2021
A	Drg renamed, updated Layout (02K)	JT	MR	GAC	Jan 2021
Rev	Amendments	Drm	Chk	App	Date

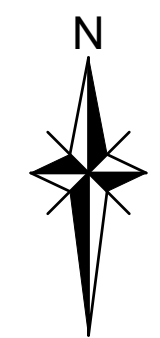
Issued by

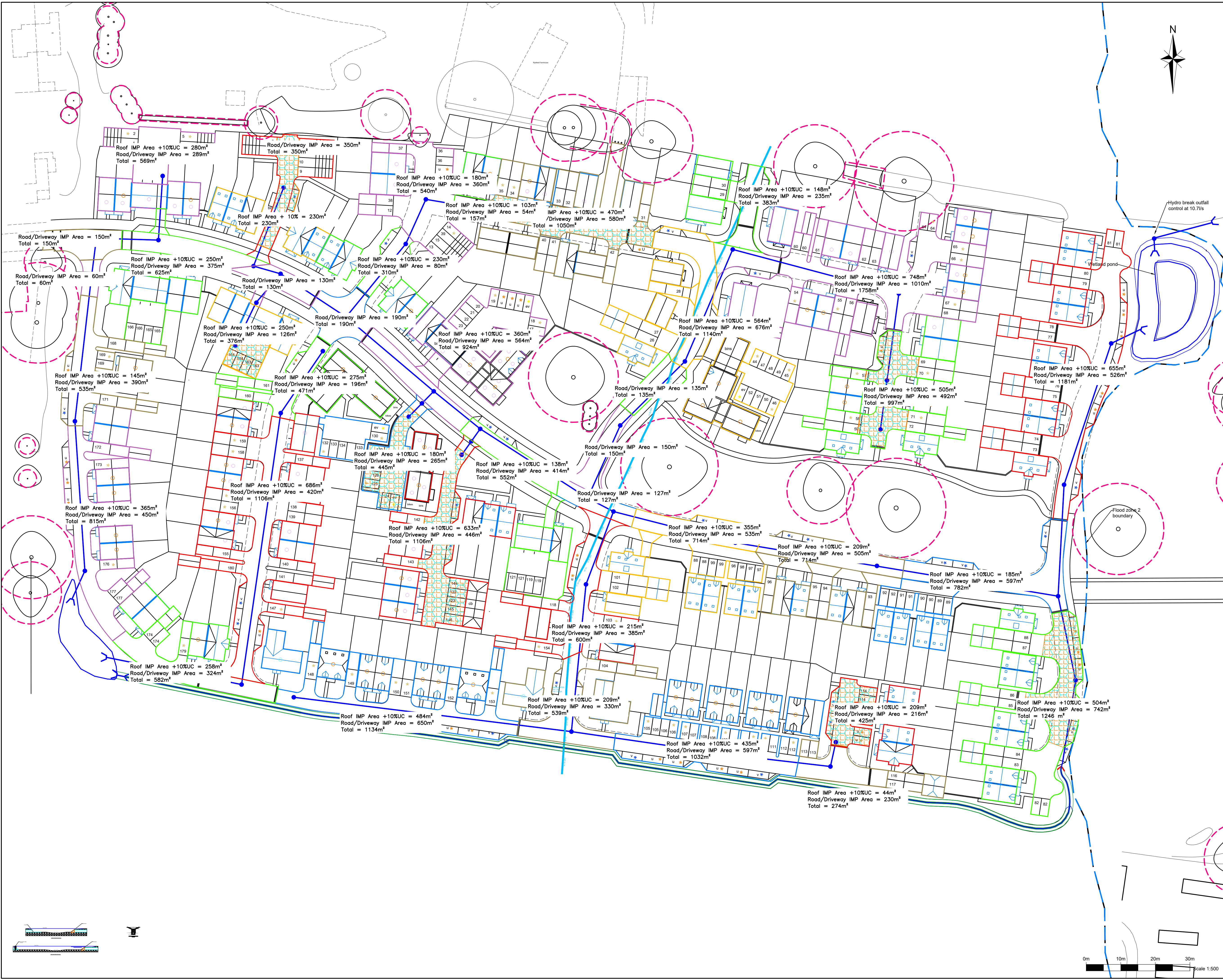
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Job Title	Land East of Woodgate Lane		
Drawing Title	Preliminary Drainage Strategy		
Client	Pye Homes		
Scale	1:500@A1	Date	Jan 21
Drawn	JT	Checked	TSH
Job No	20-061	Drawing No	20-061-007
Designed	JT	Approved	GAC
Rev	I		





NOTES

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LEGEND:

- Surface Water Drainage
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- SuDS Storage Structure (See Drawing 20-061-017)
- Conveyance Swale
- Headwall
- Lined permeable paving
- Lined permeable paving with cellular storage
- Catchment Area
- Impermeable Area

Total Impermeable Area (Ha) Inc 10% Urban Creep	Required Storage Structure Volume (m³)	
	Cellular Storage	Basin
2.30	1356	472
Outfall Discharge = 10.7l/s*		
* QBar = 10.7l/s		

B	Updated Layout, catchments amended.	SC	GW	GAC	Nov 2021
A	Updated Layout, catchments amended.	SC	GW	GAC	Aug 2021
Rev	Amendments	Dm	CHK	App	Date

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Job Title

Land East of Woodgate Lane

Drawing Title

Catchment Areas

Client

Pye Homes

Scale	1:500	Date	Apr 21	Designed	SC
Drawn	SC	Checked	SAC	Approved	GAC
Job No	20-061	Drawing No	20-061/003	Rev	B

Appendix B Updated Calculations

C & A Consulting Engineers Ltd		Page 1
Landmark House Station Road, Hook Hampshire RG27 9HA		
Date 08/11/2021 16:45 File tmpE27A.tmp	Designed by Scott Collis Checked by	
Innovyze		Source Control 2019.1
<u>ICP SUDS Mean Annual Flood</u> Input Return Period (years) 1 Soil 0.400 Area (ha) 2.302 Urban 0.000 SAAR (mm) 740 Region Number Region 7 Results l/s QBAR Rural 10.7 QBAR Urban 10.7 Q1 year 9.1 Q1 year 9.1 Q30 years 24.3 Q100 years 34.2		
©1982-2019 Innovyze		

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<u>STORM SEWER DESIGN by the Modified Rational Method</u> <u>Design Criteria for Storm</u> Pipe Sizes STANDARD Manhole Sizes STANDARD FEH Rainfall Model <table><tr><td>Return Period (years)</td><td>2</td></tr><tr><td>FEH Rainfall Version</td><td>2013</td></tr><tr><td>Site Location GB 494350 104100 SU 94350 04100</td><td></td></tr><tr><td>Data Type</td><td>Catchment</td></tr><tr><td>Maximum Rainfall (mm/hr)</td><td>50</td></tr><tr><td>Maximum Time of Concentration (mins)</td><td>30</td></tr><tr><td>Foul Sewage (l/s/ha)</td><td>0.000</td></tr><tr><td>Volumetric Runoff Coeff.</td><td>0.750</td></tr><tr><td>PIMP (%)</td><td>100</td></tr><tr><td>Add Flow / Climate Change (%)</td><td>0</td></tr><tr><td>Minimum Backdrop Height (m)</td><td>0.200</td></tr><tr><td>Maximum Backdrop Height (m)</td><td>1.500</td></tr><tr><td>Min Design Depth for Optimisation (m)</td><td>1.200</td></tr><tr><td>Min Vel for Auto Design only (m/s)</td><td>1.00</td></tr><tr><td>Min Slope for Optimisation (1:X)</td><td>500</td></tr></table> Designed with Level Soffits												Return Period (years)	2	FEH Rainfall Version	2013	Site Location GB 494350 104100 SU 94350 04100		Data Type	Catchment	Maximum Rainfall (mm/hr)	50	Maximum Time of Concentration (mins)	30	Foul Sewage (l/s/ha)	0.000	Volumetric Runoff Coeff.	0.750	PIMP (%)	100	Add Flow / Climate Change (%)	0	Minimum Backdrop Height (m)	0.200	Maximum Backdrop Height (m)	1.500	Min Design Depth for Optimisation (m)	1.200	Min Vel for Auto Design only (m/s)	1.00	Min Slope for Optimisation (1:X)	500																																																																																																																		
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<u>Network Design Table for Storm</u> « - Indicates pipe capacity < flow <table><tr><th>PN</th><th>Length (m)</th><th>Fall (m)</th><th>Slope (1:X)</th><th>I.Area (ha)</th><th>T.E. (mins)</th><th>Base Flow (l/s)</th><th>k (mm)</th><th>n</th><th>HYD SECT</th><th>DIA (mm)</th><th>Section Type</th><th>Auto Design</th></tr><tr><td>1.000</td><td>12.272</td><td>0.210</td><td>58.5</td><td>0.035</td><td>5.00</td><td>0.0</td><td>0.600</td><td></td><td>o</td><td>100</td><td>Pipe/Conduit</td><td></td></tr><tr><td>1.001</td><td>12.272</td><td>0.210</td><td>58.5</td><td>0.023</td><td>0.00</td><td>0.0</td><td>0.600</td><td></td><td>o</td><td>100</td><td>Pipe/Conduit</td><td></td></tr><tr><td>2.000</td><td>11.586</td><td>0.198</td><td>58.5</td><td>0.037</td><td>5.00</td><td>0.0</td><td>0.600</td><td></td><td>o</td><td>100</td><td>Pipe/Conduit</td><td></td></tr><tr><td>2.001</td><td>11.586</td><td>0.222</td><td>52.3</td><td>0.000</td><td>0.00</td><td>0.0</td><td>0.600</td><td></td><td>o</td><td>100</td><td>Pipe/Conduit</td><td></td></tr><tr><td>1.002</td><td>8.254</td><td>0.083</td><td>99.0</td><td>0.013</td><td>0.00</td><td>0.0</td><td>0.600</td><td></td><td>o</td><td>150</td><td>Pipe/Conduit</td><td></td></tr></table> <u>Network Results Table</u> <table><tr><th>PN</th><th>Rain (mm/hr)</th><th>T.C. (mins)</th><th>US/IL (m)</th><th>I.Area (ha)</th><th>Base Flow (l/s)</th><th>Foul (l/s)</th><th>Add Flow (l/s)</th><th>Vel (m/s)</th><th>Cap (l/s)</th><th>Flow (l/s)</th></tr><tr><td>1.000</td><td>50.00</td><td>5.20</td><td>7.900</td><td>0.035</td><td>0.0</td><td>0.0</td><td>0.0</td><td>1.01</td><td>7.9</td><td>4.7</td></tr><tr><td>1.001</td><td>50.00</td><td>5.41</td><td>7.690</td><td>0.058</td><td>0.0</td><td>0.0</td><td>0.0</td><td>1.01</td><td>7.9</td><td>7.9</td></tr><tr><td>2.000</td><td>50.00</td><td>5.19</td><td>7.900</td><td>0.037</td><td>0.0</td><td>0.0</td><td>0.0</td><td>1.01</td><td>7.9</td><td>5.0</td></tr><tr><td>2.001</td><td>50.00</td><td>5.37</td><td>7.702</td><td>0.037</td><td>0.0</td><td>0.0</td><td>0.0</td><td>1.07</td><td>8.4</td><td>5.0</td></tr><tr><td>1.002</td><td>50.00</td><td>5.54</td><td>7.430</td><td>0.108</td><td>0.0</td><td>0.0</td><td>0.0</td><td>1.01</td><td>17.8</td><td>14.6</td></tr></table> ©1982-2019 Innovyze												PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design	1.000	12.272	0.210	58.5	0.035	5.00	0.0	0.600		o	100	Pipe/Conduit		1.001	12.272	0.210	58.5	0.023	0.00	0.0	0.600		o	100	Pipe/Conduit		2.000	11.586	0.198	58.5	0.037	5.00	0.0	0.600		o	100	Pipe/Conduit		2.001	11.586	0.222	52.3	0.000	0.00	0.0	0.600		o	100	Pipe/Conduit		1.002	8.254	0.083	99.0	0.013	0.00	0.0	0.600		o	150	Pipe/Conduit		PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	I.Area (ha)	Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)	1.000	50.00	5.20	7.900	0.035	0.0	0.0	0.0	1.01	7.9	4.7	1.001	50.00	5.41	7.690	0.058	0.0	0.0	0.0	1.01	7.9	7.9	2.000	50.00	5.19	7.900	0.037	0.0	0.0	0.0	1.01	7.9	5.0	2.001	50.00	5.37	7.702	0.037	0.0	0.0	0.0	1.07	8.4	5.0	1.002	50.00	5.54	7.430	0.108	0.0	0.0	0.0	1.01	17.8	14.6
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Innovyze						Network 2019.1						
Network Design Table for Storm												
PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
1.003	22.767	0.230	99.0	0.013	0.00	0.0	0.600		o	150	Pipe/Conduit	
3.000	10.655	0.108	99.0	0.105	5.00	0.0	0.600		o	150	Pipe/Conduit	
3.001	10.655	0.108	99.0	0.015	0.00	0.0	0.600		o	150	Pipe/Conduit	
3.002	14.701	0.087	169.0	0.054	0.00	0.0	0.600		o	525	Pipe/Conduit	
3.003	27.020	0.230	117.3	0.031	0.00	0.0	0.600		o	525	Pipe/Conduit	
1.004	33.152	0.137	241.9	0.019	0.00	0.0	0.600		o	525	Pipe/Conduit	
4.000	5.182	0.089	58.5	0.044	5.00	0.0	0.600		o	100	Pipe/Conduit	
4.001	5.182	0.089	58.5	0.000	0.00	0.0	0.600		o	100	Pipe/Conduit	
1.005	17.243	0.071	241.9	0.092	0.00	0.0	0.600		o	525	Pipe/Conduit	
5.000	4.638	0.047	98.7	0.110	5.00	0.0	0.600		o	225	Pipe/Conduit	
5.001	4.638	0.047	99.0	0.000	0.00	0.0	0.600		o	225	Pipe/Conduit	
1.006	36.843	2.070	17.8	0.055	0.00	0.0	0.600		o	525	Pipe/Conduit	
6.000	15.018	1.020	14.7	0.000	5.00	0.0	0.600		o	300	Pipe/Conduit	
6.001	25.454	0.257	99.0	0.099	0.00	0.0	0.600		o	300	Pipe/Conduit	
6.002	50.069	0.299	167.5	0.017	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 Flow (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)		
1.003	50.00	5.92	7.347	0.121		0.0	0.0	0.0	1.01	17.8	16.4	
3.000	50.00	5.18	7.650	0.105		0.0	0.0	0.0	1.01	17.8	14.2	
3.001	50.00	5.35	7.542	0.120		0.0	0.0	0.0	1.01	17.8	16.2	
3.002	50.00	5.49	7.060	0.174		0.0	0.0	0.0	1.72	372.4	23.6	
3.003	50.00	5.71	6.973	0.205		0.0	0.0	0.0	2.07	447.5	27.8	
1.004	50.00	6.30	6.742	0.345		0.0	0.0	0.0	1.44	310.8	46.7	
4.000	50.00	5.09	7.830	0.044		0.0	0.0	0.0	1.01	7.9	6.0	
4.001	50.00	5.17	7.741	0.044		0.0	0.0	0.0	1.01	7.9	6.0	
1.005	50.00	6.50	6.605	0.481		0.0	0.0	0.0	1.44	310.8	65.1	
5.000	50.00	5.06	7.750	0.110		0.0	0.0	0.0	1.32	52.3	14.9	
5.001	50.00	5.12	7.703	0.110		0.0	0.0	0.0	1.31	52.2	14.9	
1.006	50.00	6.62	6.534	0.646		0.0	0.0	0.0	5.33	1153.2	87.5	
6.000	50.00	5.06	7.060	0.000		0.0	0.0	0.0	4.12	291.1	0.0	
6.001	50.00	5.33	6.040	0.099		0.0	0.0	0.0	1.58	111.7	13.4	
6.002	50.00	6.02	5.783	0.116		0.0	0.0	0.0	1.21	85.7	15.7	
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Network Design Table for Storm												
PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
6.003	35.599	0.240	148.3	0.038	0.00	0.0	0.600		o	525	Pipe/Conduit	
6.004	25.331	0.105	241.6	0.114	0.00	0.0	0.600		o	525	Pipe/Conduit	
6.005	24.390	0.450	54.2	0.013	0.00	0.0	0.600		o	525	Pipe/Conduit	
1.007	6.501	0.016	400.9	0.015	0.00	0.0	0.600		o	525	Pipe/Conduit	
7.000	80.776	0.816	99.0	0.113	5.00	0.0	0.600		o	450	Pipe/Conduit	
8.000	14.809	0.253	58.5	0.042	5.00	0.0	0.600		o	300	Pipe/Conduit	
8.001	28.507	0.287	99.3	0.027	0.00	0.0	0.600		o	300	Pipe/Conduit	
8.002	53.806	0.320	168.2	0.103	0.00	0.0	0.600		o	300	Pipe/Conduit	
7.001	31.452	0.130	242.2	0.053	0.00	0.0	0.600		o	450	Pipe/Conduit	
7.002	31.485	0.130	242.2	0.060	0.00	0.0	0.600		o	450	Pipe/Conduit	
1.008	38.857	0.079	490.6	0.012	0.00	0.0	0.600		o	525	Pipe/Conduit	
1.009	41.615	0.085	490.6	0.071	0.00	0.0	0.600		o	525	Pipe/Conduit	
1.010	50.674	0.103	490.0	0.071	0.00	0.0	0.600		o	525	Pipe/Conduit	
9.000	18.749	0.321	58.4	0.056	5.00	0.0	0.600		o	225	Pipe/Conduit	
9.001	18.334	0.185	99.0	0.062	0.00	0.0	0.600		o	225	Pipe/Conduit	
9.002	13.630	0.140	97.0	0.015	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)		
6.003	50.00	6.34	5.259	0.154	0.0	0.0	0.0	1.84	397.7	20.9		
6.004	50.00	6.63	5.019	0.268	0.0	0.0	0.0	1.44	311.0	36.3		
6.005	50.00	6.77	4.914	0.281	0.0	0.0	0.0	3.05	659.8	38.1		
1.007	50.00	6.87	4.464	0.942	0.0	0.0	0.0	1.11	240.8	127.6		
7.000	50.00	5.66	7.400	0.113	0.0	0.0	0.0	2.04	325.0	15.3		
8.000	50.00	5.12	6.600	0.042	0.0	0.0	0.0	2.06	145.5	5.7		
8.001	50.00	5.42	6.347	0.069	0.0	0.0	0.0	1.58	111.5	9.3		
8.002	50.00	6.16	6.060	0.172	0.0	0.0	0.0	1.21	85.5	23.3		
7.001	50.00	6.57	5.590	0.338	0.0	0.0	0.0	1.30	207.0	45.8		
7.002	50.00	6.97	5.460	0.398	0.0	0.0	0.0	1.30	207.0	53.9		
1.008	50.00	7.61	4.448	1.352	0.0	0.0	0.0	1.00	217.4	183.1		
1.009	50.00	8.30	4.368	1.423	0.0	0.0	0.0	1.00	217.4	192.7		
1.010	49.30	9.14	4.434	1.494	0.0	0.0	0.0	1.01	217.6	199.5		
9.000	50.00	5.18	8.020	0.056	0.0	0.0	0.0	1.71	68.2	7.6		
9.001	50.00	5.41	7.699	0.118	0.0	0.0	0.0	1.31	52.2	16.0		
9.002	50.00	5.59	7.514	0.133	0.0	0.0	0.0	1.33	52.8	18.0		
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Network Design Table for Storm												
PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
9.003	39.695	0.453	87.7	0.006	0.00	0.0	0.600		o	225	Pipe/Conduit	
9.004	43.137	0.257	168.2	0.053	0.00	0.0	0.600		o	225	Pipe/Conduit	
9.005	23.504	0.140	168.2	0.081	0.00	0.0	0.600		o	225	Pipe/Conduit	
10.000	21.610	0.369	58.6	0.047	5.00	0.0	0.600		o	450	Pipe/Conduit	
10.001	79.567	0.473	168.4	0.110	0.00	0.0	0.600		o	450	Pipe/Conduit	
10.002	47.697	0.283	168.4	0.058	0.00	0.0	0.600		o	450	Pipe/Conduit	
9.006	12.244	0.051	241.6	0.000	0.00	0.0	0.600		o	450	Pipe/Conduit	
9.007	66.556	0.611	109.0	0.000	0.00	0.0		0.035 →_/→			Swale	
9.008	72.027	0.661	109.0	0.000	0.00	0.0		0.035 →_/→			Swale	
9.009	149.621	0.855	175.0	0.000	0.00	0.0		0.035 →_/→			Swale	
9.010	35.070	0.540	64.9	0.000	0.00	0.0		0.035 →_/→			Swale	
9.011	41.219	0.129	319.5	0.124	0.00	0.0	0.600		o	750	Pipe/Conduit	
1.011	25.916	0.056	462.8	0.078	0.00	0.0	0.600		o	750	Pipe/Conduit	
1.012	48.097	0.096	501.0	0.059	0.00	0.0	0.600		o	750	Pipe/Conduit	
1.013	15.896	0.032	496.8	0.059	0.00	0.0	0.600		o	750	Pipe/Conduit	
1.014	18.776	0.038	494.1	0.000	0.00	0.0	0.600		o	750	Pipe/Conduit	
1.015	6.345	0.278	22.8	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)		
9.003	50.00	6.06	7.373	0.139	0.0	0.0	0.0	1.40	55.5	18.8		
9.004	50.00	6.77	6.921	0.192	0.0	0.0	0.0	1.01	40.0	26.0		
9.005	50.00	7.16	6.664	0.273	0.0	0.0	0.0	1.01	40.0	37.0		
10.000	50.00	5.14	7.900	0.047	0.0	0.0	0.0	2.66	423.2	6.4		
10.001	50.00	5.98	7.531	0.157	0.0	0.0	0.0	1.56	248.7	21.3		
10.002	50.00	6.49	7.058	0.215	0.0	0.0	0.0	1.56	248.7	29.1		
9.006	50.00	7.32	6.300	0.488	0.0	0.0	0.0	1.30	207.3	66.1		
9.007	50.00	7.86	7.127	0.488	0.0	0.0	0.0	2.05	11554.6	66.1		
9.008	50.00	8.27	6.516	0.488	0.0	0.0	0.0	2.95	49453.1	66.1		
9.009	46.97	10.05	5.855	0.488	0.0	0.0	0.0	1.40	5027.2	66.1		
9.010	46.36	10.31	5.000	0.488	0.0	0.0	0.0	2.29	8252.2	66.1		
9.011	45.36	10.75	4.460	0.612	0.0	0.0	0.0	1.56	689.2	75.2		
1.011	44.64	11.08	4.106	2.184	0.0	0.0	0.0	1.29	571.8	264.0		
1.012	43.31	11.73	4.050	2.243	0.0	0.0	0.0	1.24	549.3	264.0		
1.013	42.90	11.94	3.954	2.302	0.0	0.0	0.0	1.25	551.7	267.4		
1.014	42.42	12.19	3.922	2.302	0.0	0.0	0.0	1.25	553.2	267.4		
1.015	42.36	12.22	3.884	2.302	0.0	0.0	0.0	3.31	233.6	267.4		
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Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.015	S-Outfall	5.000	3.606	1.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	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	15
Number of Online Controls	10	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 494350 104100 SU 94350 04100
Data Type	Catchment
Summer Storms	Yes
Winter Storms	No
Cv (Summer)	1.000
Cv (Winter)	1.000
Storm Duration (mins)	30

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Online Controls for Storm Orifice Manhole: 2, DS/PN: 1.001, Volume (m³): 1.8 Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 7.690 Orifice Manhole: 18, DS/PN: 2.001, Volume (m³): 1.8 Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 7.702 Orifice Manhole: 20, DS/PN: 3.001, Volume (m³): 1.8 Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 7.542 Orifice Manhole: 24, DS/PN: 4.001, Volume (m³): 1.6 Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 7.741 Orifice Manhole: 7, DS/PN: 1.006, Volume (m³): 8.1 Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 6.534 Orifice Manhole: 29, DS/PN: 6.002, Volume (m³): 3.6 Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 5.783 Orifice Manhole: 9, DS/PN: 1.008, Volume (m³): 12.5 Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 4.448 Orifice Manhole: 40, DS/PN: 9.001, Volume (m³): 2.5 Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 7.699 Hydro-Brake® Optimum Manhole: 46, DS/PN: 9.007, Volume (m³): 101.0 <table><tr><td>Unit Reference</td><td>MD-SHE-0212-2500-1500-2500</td></tr><tr><td>Design Head (m)</td><td>1.500</td></tr><tr><td>Design Flow (l/s)</td><td>25.0</td></tr><tr><td>Flush-Flo™</td><td>Calculated</td></tr><tr><td>Objective</td><td>Minimise upstream storage</td></tr><tr><td>Application</td><td>Surface</td></tr><tr><td>Sump Available</td><td>Yes</td></tr><tr><td>Diameter (mm)</td><td>212</td></tr><tr><td>Invert Level (m)</td><td>7.127</td></tr><tr><td>Minimum Outlet Pipe Diameter (mm)</td><td>225</td></tr><tr><td>Suggested Manhole Diameter (mm)</td><td>1800</td></tr></table>			Unit Reference	MD-SHE-0212-2500-1500-2500	Design Head (m)	1.500	Design Flow (l/s)	25.0	Flush-Flo™	Calculated	Objective	Minimise upstream storage	Application	Surface	Sump Available	Yes	Diameter (mm)	212	Invert Level (m)	7.127	Minimum Outlet Pipe Diameter (mm)	225	Suggested Manhole Diameter (mm)	1800
Unit Reference	MD-SHE-0212-2500-1500-2500																							
Design Head (m)	1.500																							
Design Flow (l/s)	25.0																							
Flush-Flo™	Calculated																							
Objective	Minimise upstream storage																							
Application	Surface																							
Sump Available	Yes																							
Diameter (mm)	212																							
Invert Level (m)	7.127																							
Minimum Outlet Pipe Diameter (mm)	225																							
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<u>Hydro-Brake® Optimum Manhole: 46, DS/PN: 9.007, Volume (m³): 101.0</u> <table><tr><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th></tr><tr><td>Design Point (Calculated)</td><td>1.500</td><td>25.0</td></tr><tr><td>Flush-Flo™</td><td>0.455</td><td>25.0</td></tr><tr><td>Kick-Flo®</td><td>1.000</td><td>20.6</td></tr><tr><td>Mean Flow over Head Range</td><td>-</td><td>21.5</td></tr></table> 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 <table><tr><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr><tr><td>0.100</td><td>7.2</td><td>1.200</td><td>22.5</td><td>3.000</td><td>34.8</td><td>7.000</td><td>52.5</td></tr><tr><td>0.200</td><td>20.6</td><td>1.400</td><td>24.2</td><td>3.500</td><td>37.5</td><td>7.500</td><td>54.3</td></tr><tr><td>0.300</td><td>24.2</td><td>1.600</td><td>25.8</td><td>4.000</td><td>40.0</td><td>8.000</td><td>56.0</td></tr><tr><td>0.400</td><td>24.9</td><td>1.800</td><td>27.3</td><td>4.500</td><td>42.4</td><td>8.500</td><td>57.7</td></tr><tr><td>0.500</td><td>24.9</td><td>2.000</td><td>28.7</td><td>5.000</td><td>44.6</td><td>9.000</td><td>59.3</td></tr><tr><td>0.600</td><td>24.7</td><td>2.200</td><td>30.0</td><td>5.500</td><td>46.7</td><td>9.500</td><td>60.9</td></tr><tr><td>0.800</td><td>23.7</td><td>2.400</td><td>31.3</td><td>6.000</td><td>48.7</td><td></td><td></td></tr><tr><td>1.000</td><td>20.7</td><td>2.600</td><td>32.5</td><td>6.500</td><td>50.6</td><td></td><td></td></tr></table> <u>Hydro-Brake® Optimum Manhole: 16, DS/PN: 1.015, Volume (m³): 12.9</u> <table><tr><td>Unit Reference</td><td>MD-SHE-0142-9500-1000-9500</td></tr><tr><td>Design Head (m)</td><td>1.000</td></tr><tr><td>Design Flow (l/s)</td><td>9.5</td></tr><tr><td>Flush-Flo™</td><td>Calculated</td></tr><tr><td>Objective</td><td>Minimise upstream storage</td></tr><tr><td>Application</td><td>Surface</td></tr><tr><td>Sump Available</td><td>Yes</td></tr><tr><td>Diameter (mm)</td><td>142</td></tr><tr><td>Invert Level (m)</td><td>3.884</td></tr><tr><td>Minimum Outlet Pipe Diameter (mm)</td><td>225</td></tr><tr><td>Suggested Manhole Diameter (mm)</td><td>1200</td></tr></table> <table><tr><th>Control Points</th><th>Head (m)</th><th>Flow (l/s)</th></tr><tr><td>Design Point (Calculated)</td><td>1.000</td><td>9.5</td></tr><tr><td>Flush-Flo™</td><td>0.305</td><td>9.5</td></tr><tr><td>Kick-Flo®</td><td>0.675</td><td>7.9</td></tr><tr><td>Mean Flow over Head Range</td><td>-</td><td>8.2</td></tr></table> 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 <table><tr><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th><th>Depth (m)</th><th>Flow (l/s)</th></tr><tr><td>0.100</td><td>5.1</td><td>0.300</td><td>9.5</td><td>0.500</td><td>9.2</td><td>0.800</td><td>8.6</td></tr><tr><td>0.200</td><td>9.2</td><td>0.400</td><td>9.4</td><td>0.600</td><td>8.7</td><td>1.000</td><td>9.5</td></tr></table>			Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	1.500	25.0	Flush-Flo™	0.455	25.0	Kick-Flo®	1.000	20.6	Mean Flow over Head Range	-	21.5	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	7.2	1.200	22.5	3.000	34.8	7.000	52.5	0.200	20.6	1.400	24.2	3.500	37.5	7.500	54.3	0.300	24.2	1.600	25.8	4.000	40.0	8.000	56.0	0.400	24.9	1.800	27.3	4.500	42.4	8.500	57.7	0.500	24.9	2.000	28.7	5.000	44.6	9.000	59.3	0.600	24.7	2.200	30.0	5.500	46.7	9.500	60.9	0.800	23.7	2.400	31.3	6.000	48.7			1.000	20.7	2.600	32.5	6.500	50.6			Unit Reference	MD-SHE-0142-9500-1000-9500	Design Head (m)	1.000	Design Flow (l/s)	9.5	Flush-Flo™	Calculated	Objective	Minimise upstream storage	Application	Surface	Sump Available	Yes	Diameter (mm)	142	Invert Level (m)	3.884	Minimum Outlet Pipe Diameter (mm)	225	Suggested Manhole Diameter (mm)	1200	Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	1.000	9.5	Flush-Flo™	0.305	9.5	Kick-Flo®	0.675	7.9	Mean Flow over Head Range	-	8.2	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	0.100	5.1	0.300	9.5	0.500	9.2	0.800	8.6	0.200	9.2	0.400	9.4	0.600	8.7	1.000	9.5
Control Points	Head (m)	Flow (l/s)																																																																																																																																																				
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0.300	24.2	1.600	25.8	4.000	40.0	8.000	56.0																																																																																																																																															
0.400	24.9	1.800	27.3	4.500	42.4	8.500	57.7																																																																																																																																															
0.500	24.9	2.000	28.7	5.000	44.6	9.000	59.3																																																																																																																																															
0.600	24.7	2.200	30.0	5.500	46.7	9.500	60.9																																																																																																																																															
0.800	23.7	2.400	31.3	6.000	48.7																																																																																																																																																	
1.000	20.7	2.600	32.5	6.500	50.6																																																																																																																																																	
Unit Reference	MD-SHE-0142-9500-1000-9500																																																																																																																																																					
Design Head (m)	1.000																																																																																																																																																					
Design Flow (l/s)	9.5																																																																																																																																																					
Flush-Flo™	Calculated																																																																																																																																																					
Objective	Minimise upstream storage																																																																																																																																																					
Application	Surface																																																																																																																																																					
Sump Available	Yes																																																																																																																																																					
Diameter (mm)	142																																																																																																																																																					
Invert Level (m)	3.884																																																																																																																																																					
Minimum Outlet Pipe Diameter (mm)	225																																																																																																																																																					
Suggested Manhole Diameter (mm)	1200																																																																																																																																																					
Control Points	Head (m)	Flow (l/s)																																																																																																																																																				
Design Point (Calculated)	1.000	9.5																																																																																																																																																				
Flush-Flo™	0.305	9.5																																																																																																																																																				
Kick-Flo®	0.675	7.9																																																																																																																																																				
Mean Flow over Head Range	-	8.2																																																																																																																																																				
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)																																																																																																																																															
0.100	5.1	0.300	9.5	0.500	9.2	0.800	8.6																																																																																																																																															
0.200	9.2	0.400	9.4	0.600	8.7	1.000	9.5																																																																																																																																															
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Innovyze		Network 2019.1					
<u>Hydro-Brake® Optimum Manhole: 16, DS/PN: 1.015, Volume (m³): 12.9</u>							
Depth (m) Flow (l/s)		Depth (m) Flow (l/s)		Depth (m) Flow (l/s)		Depth (m) Flow (l/s)	
1.200 10.4		2.400 14.4		5.000 20.4		8.000 25.6	
1.400 11.1		2.600 14.9		5.500 21.4		8.500 26.3	
1.600 11.9		3.000 16.0		6.000 22.3		9.000 27.1	
1.800 12.5		3.500 17.2		6.500 23.1		9.500 27.8	
2.000 13.2		4.000 18.3		7.000 24.0			
2.200 13.8		4.500 19.4		7.500 24.8			

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Storage Structures for Storm

Complex Manhole: 1, DS/PN: 1.000

Cellular Storage

Invert Level (m) 7.400 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	187.0	0.0	1.151	187.0	0.0
1.150	187.0	0.0			

Porous Car Park

Infiltration Coefficient Base (m/hr) 0.00000 Width (m) 5.3
Membrane Percolation (mm/hr) 1000 Length (m) 35.0
Max Percolation (l/s) 51.5 Slope (1:X) 1000.0
Safety Factor 2.0 Depression Storage (mm) 5
Porosity 0.30 Evaporation (mm/day) 3
Invert Level (m) 8.550 Membrane Depth (mm) 260

Complex Manhole: 17, DS/PN: 2.000

Cellular Storage

Invert Level (m) 7.400 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	316.0	0.0	1.150	316.0	0.0

Porous Car Park

Infiltration Coefficient Base (m/hr) 0.00000 Width (m) 13.5
Membrane Percolation (mm/hr) 1000 Length (m) 23.0
Max Percolation (l/s) 86.3 Slope (1:X) 1000.0
Safety Factor 2.0 Depression Storage (mm) 5
Porosity 0.30 Evaporation (mm/day) 3
Invert Level (m) 8.550 Membrane Depth (mm) 0

Complex Manhole: 19, DS/PN: 3.000

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Porous Car Park

Infiltration Coefficient Base (m/hr) 0.00000	Width (m)	6.0
Membrane Percolation (mm/hr) 1000	Length (m)	34.0
Max Percolation (l/s) 56.7	Slope (1:X)	1000.0
Safety Factor 2.0	Depression Storage (mm)	5
Porosity 0.30	Evaporation (mm/day)	3
Invert Level (m) 7.359	Membrane Depth (mm)	260

Cellular Storage

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

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	208.0	0.0	0.991	208.0	0.0

Complex Manhole: 23, DS/PN: 4.000

Cellular Storage

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

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	219.0	0.0	1.291	219.0	0.0

Porous Car Park

Infiltration Coefficient Base (m/hr) 0.00000	Width (m)	7.0
Membrane Percolation (mm/hr) 1000	Length (m)	31.0
Max Percolation (l/s) 60.3	Slope (1:X)	1000.0
Safety Factor 2.0	Depression Storage (mm)	5
Porosity 0.30	Evaporation (mm/day)	3
Invert Level (m) 8.480	Membrane Depth (mm)	260

Complex Manhole: 25, DS/PN: 5.000

Cellular Storage

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

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<u>Cellular Storage</u>					
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	360.0	0.0	1.297	360.0	0.0
<u>Porous Car Park</u>					
Infiltration Coefficient Base (m/hr)	0.00000		Width (m)	4.8	
Membrane Percolation (mm/hr)	1000		Length (m)	75.0	
Max Percolation (l/s)	100.0		Slope (1:X)	1000.0	
Safety Factor	2.0	Depression Storage (mm)	5		
Porosity	0.30	Evaporation (mm/day)	3		
Invert Level (m)	8.450	Membrane Depth (mm)	260		
<u>Complex Manhole: 28, DS/PN: 6.001</u>					
<u>Porous Car Park</u>					
Infiltration Coefficient Base (m/hr)	0.00000		Width (m)	10.0	
Membrane Percolation (mm/hr)	1000		Length (m)	35.0	
Max Percolation (l/s)	97.2		Slope (1:X)	1000.0	
Safety Factor	2.0	Depression Storage (mm)	5		
Porosity	0.30	Evaporation (mm/day)	3		
Invert Level (m)	5.690	Membrane Depth (mm)	260		
<u>Cellular Storage</u>					
Invert Level (m)	5.690	Safety Factor	2.0		
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95		
Infiltration Coefficient Side (m/hr)	0.00000				
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	321.0	0.0	1.460	321.0	0.0
<u>Complex Manhole: 36, DS/PN: 8.000</u>					
<u>Cellular Storage</u>					
Invert Level (m)	6.600	Safety Factor	2.0		
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95		
Infiltration Coefficient Side (m/hr)	0.00000				
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	208.0	0.0	1.150	208.0	0.0
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Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	9.0
Membrane Percolation (mm/hr)	1000	Length (m)	23.0
Max Percolation (l/s)	57.5	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	7.750	Membrane Depth (mm)	260

Complex Manhole: 39, DS/PN: 9.000

Cellular Storage

Invert Level (m)	7.520	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	180.0	0.0	1.150	180.0	0.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	13.0
Membrane Percolation (mm/hr)	1000	Length (m)	13.0
Max Percolation (l/s)	46.9	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	8.670	Membrane Depth (mm)	0

Tank or Pond Manhole: 45, DS/PN: 9.006

Invert Level (m)	7.127
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Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	0.4	1.500	217.0

Swale Pipe: 9.007

Manning's N	0.035	Base Width (m)	0.6
Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	66.6
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	109.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	7.127	Cap Infiltration Depth (m)	0.000

Swale Pipe: 9.008

Manning's N	0.035	Infiltration Coefficient Side (m/hr)	0.00000
Infiltration Coefficient Base (m/hr)	0.00000	Safety Factor	2.0

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Innovyze	Network 2019.1									
Swale Pipe: 9.008 Porosity 1.00Side Slope (1:X) 3.0 Invert Level (m) 6.516Slope (1:X) 109.0 Base Width (m) 0.6Cap Volume Depth (m) 0.000 Length (m) 72.0Cap Infiltration Depth (m) 0.000 Swale Pipe: 9.009 Manning's N 0.035Base Width (m) 0.6 Infiltration Coefficient Base (m/hr) 0.00000Length (m) 149.6 Infiltration Coefficient Side (m/hr) 0.00000Side Slope (1:X) 3.0 Safety Factor 2.0Slope (1:X) 175.0 Porosity 1.00Cap Volume Depth (m) 0.000 Invert Level (m) 5.855Cap Infiltration Depth (m) 0.000 Swale Pipe: 9.010 Manning's N 0.035Base Width (m) 0.6 Infiltration Coefficient Base (m/hr) 0.00000Length (m) 35.1 Infiltration Coefficient Side (m/hr) 0.00000Side Slope (1:X) 3.0 Safety Factor 2.0Slope (1:X) 64.9 Porosity 1.00Cap Volume Depth (m) 0.000 Invert Level (m) 5.000Cap Infiltration Depth (m) 0.000 Porous Car Park Manhole: 50, DS/PN: 9.011 Infiltration Coefficient Base (m/hr) 0.00000Width (m) 8.0 Membrane Percolation (mm/hr) 1000Length (m) 25.0 Max Percolation (l/s) 55.6Slope (1:X) 0.0 Safety Factor 2.0Depression Storage (mm) 5 Porosity 0.30Evaporation (mm/day) 3 Invert Level (m) 3.932Membrane Depth (mm) 0 Tank or Pond Manhole: 15, DS/PN: 1.014 Invert Level (m) 3.997 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th></tr><tr><td>0.000</td><td>112.0</td><td>1.900</td><td>855.0</td></tr></table>			Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	112.0	1.900	855.0
Depth (m)	Area (m²)	Depth (m)	Area (m²)							
0.000	112.0	1.900	855.0							
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<u>Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>									
Simulation Criteria									
Areal Reduction Factor 1.000 Additional Flow - % of Total Flow 0.000									
Hot Start (mins) 0 MADD Factor * 10m³/ha Storage 2.000									
Hot Start Level (mm) 0 Inlet Coefficient 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 15									
Number of Online Controls 10 Number of Time/Area Diagrams 0									
Number of Offline Controls 0 Number of Real Time Controls 0									
Synthetic Rainfall Details									
Rainfall Model FEH									
FEH Rainfall Version 2013									
Site Location GB 494350 104100 SU 94350 04100									
Data Type Catchment									
Cv (Summer) 1.000									
Cv (Winter) 1.000									
Margin for Flood Risk Warning (mm) 300.0									
Analysis Timestep 2.5 Second Increment (Extended)									
DTS Status ON									
DVD Status OFF									
Inertia Status OFF									
Profile(s) Summer and Winter									
Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080									
Return Period(s) (years) 2, 30, 100									
Climate Change (%) 0, 0, 0									
Water Level									
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Level (m)
1.000	1	10080 Summer	100	+0%					7.689
1.001	2	30 Summer	100	+0%	2/15 Summer				8.478
2.000	17	10080 Winter	100	+0%					7.580
2.001	18	30 Summer	100	+0%	30/15 Summer				8.189
1.002	3	30 Summer	100	+0%	30/15 Summer				8.503
1.003	4	30 Summer	100	+0%	30/15 Summer				8.527
3.000	19	7200 Summer	100	+0%					7.673
3.001	20	30 Summer	100	+0%	30/15 Summer				7.991
3.002	21	30 Summer	100	+0%	30/15 Summer				8.534
3.003	22	30 Summer	100	+0%	30/15 Summer				8.531
1.004	5	30 Summer	100	+0%	30/15 Summer				8.524
4.000	23	10080 Summer	100	+0%					7.500
4.001	24	30 Summer	100	+0%	30/15 Summer				8.112
1.005	6	30 Summer	100	+0%	2/15 Summer				8.515
5.000	25	10080 Summer	100	+0%					7.629
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<u>Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>							

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Summary of Critical Results by Maximum Level (Rank 1) for Storm								
PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
5.001	26	30 Summer	100	+0%	30/15 Summer			
1.006	7	30 Summer	100	+0%	2/15 Summer			
6.000	27	10080 Winter	2	+0%				
6.001	28	360 Winter	100	+0%				
6.002	29	30 Summer	100	+0%	2/30 Summer			
6.003	30	60 Summer	100	+0%	2/15 Summer			
6.004	31	60 Summer	100	+0%	2/15 Summer			
6.005	32	60 Summer	100	+0%	2/15 Summer			
1.007	8	60 Summer	100	+0%	2/15 Summer			
7.000	33	30 Summer	100	+0%	100/30 Summer			
8.000	36	60 Winter	100	+0%	30/60 Summer			
8.001	37	60 Summer	100	+0%	30/15 Summer			
8.002	38	30 Summer	100	+0%	2/60 Summer			
7.001	34	30 Summer	100	+0%	2/30 Summer			
7.002	35	30 Summer	100	+0%	2/15 Summer			
1.008	9	60 Summer	100	+0%	2/15 Summer			
1.009	10	360 Winter	100	+0%	30/180 Summer			
1.010	11	480 Winter	100	+0%	30/240 Winter			
9.000	39	10080 Winter	100	+0%				
9.001	40	15 Summer	100	+0%	2/15 Summer			
9.002	41	30 Summer	100	+0%	100/15 Summer			
9.003	42	30 Summer	100	+0%	30/15 Summer			
9.004	43	30 Summer	100	+0%	2/120 Summer			
9.005	44	180 Summer	100	+0%	2/30 Summer			
10.000	51	15 Summer	100	+0%				
10.001	52	180 Summer	100	+0%				
10.002	53	180 Summer	100	+0%	30/120 Summer			
9.006	45	180 Summer	100	+0%	2/30 Summer			
9.007	46	180 Summer	100	+0%				
9.008	47	120 Summer	30	+0%				
9.009	48	120 Summer	30	+0%				
9.010	19	480 Winter	100	+0%				
9.011	50	480 Winter	100	+0%				
1.011	12	480 Winter	100	+0%	30/180 Summer			
1.012	13	480 Winter	100	+0%	30/120 Summer			
1.013	14	480 Winter	100	+0%	30/60 Summer			
1.014	15	720 Winter	100	+0%	30/60 Summer			
1.015	16	600 Winter	100	+0%	2/15 Summer			
PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Pipe Flow / Overflow Cap.	Pipe Flow (l/s)	Status	Level Exceeded
5.001	26	8.230	0.302	0.000	0.03	1.0	SURCHARGED	
1.006	7	8.499	1.440	0.000	0.02	22.0	SURCHARGED	
6.000	27	7.060	-0.300	0.000	0.00	0.0	OK	
6.001	28	6.176	-0.164	0.000	0.11	11.0	OK	
6.002	29	6.395	0.312	0.000	0.05	3.8	SURCHARGED	
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Summary of Critical Results by Maximum Level (Rank 1) for Storm									
PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
6.003	30	7.584	1.800	0.000	0.36		12.5		OK
6.004	31	7.829	2.285	0.000	0.39		56.9	SURCHARGED	
6.005	32	7.913	2.473	0.000	0.13		65.1	SURCHARGED	
1.007	8	7.910	2.922	0.000	0.39		58.1	SURCHARGED	
7.000	33	7.903	0.053	0.000	0.19		57.8	SURCHARGED	
8.000	36	7.122	0.222	0.000	0.24		29.1	SURCHARGED	
8.001	37	7.245	0.598	0.000	0.30		29.8	SURCHARGED	
8.002	38	7.658	1.298	0.000	0.55		44.2	SURCHARGED	
7.001	34	7.868	1.828	0.000	0.36		63.8	SURCHARGED	
7.002	35	7.856	1.946	0.000	0.34		61.0	SURCHARGED	
1.008	9	7.898	2.925	0.000	0.19		34.9	SURCHARGED	
1.009	10	5.159	0.266	0.000	0.18		34.4	SURCHARGED	
1.010	11	5.153	0.194	0.000	0.18		35.6	SURCHARGED	
9.000	39	8.003	-0.242	0.000	0.00		10.0		OK
9.001	40	8.320	0.396	0.000	0.33		15.6	SURCHARGED	
9.002	41	8.046	0.308	0.000	0.50		22.9	SURCHARGED	
9.003	42	8.020	0.421	0.000	0.43		22.9	SURCHARGED	
9.004	43	7.971	0.825	0.000	1.02		39.0	SURCHARGED	
9.005	44	7.762	0.872	0.000	1.00		36.6	SURCHARGED	
10.000	51	7.985	-0.365	0.000	0.08		27.3		OK
10.001	52	7.744	-0.237	0.000	0.14		31.9		OK
10.002	53	7.738	0.229	0.000	0.14		32.2	SURCHARGED	
9.006	45	7.732	0.982	0.000	0.40		60.3	SURCHARGED	
9.007	46	7.724	-0.676	0.000	0.00		24.8		OK
9.008	47	6.587	-2.193	0.000	0.00		24.8		OK
9.009	48	5.937	-3.043	0.000	0.00		24.8		OK
9.010	19	5.124	-0.876	0.000	0.00		23.7		OK
9.011	50	5.124	-0.086	0.000	0.04		24.2		OK
1.011	12	5.147	0.291	0.000	0.13		56.3	SURCHARGED	
1.012	13	5.144	0.344	0.000	0.13		58.4	SURCHARGED	
1.013	14	5.140	0.436	0.000	0.20		60.1	SURCHARGED	
1.014	15	5.138	0.466	0.000	0.40		32.7	SURCHARGED	
1.015	16	5.005	1.521	0.000	0.77		9.9		OK
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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FEH Rainfall Model

Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 494350 104100 SU 94350 04100
Data Type	Catchment
Maximum Rainfall (mm/hr)	50
Maximum Time of Concentration (mins)	30
Foul Sewage (l/s/ha)	0.000
Volumetric Runoff Coeff.	0.750
PIMP (%)	100
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.500
Min Design Depth for Optimisation (m)	1.200
Min Vel for Auto Design only (m/s)	1.00
Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	12.272	0.210	58.5	0.035	5.00	0.0	0.600		o	100	Pipe/Conduit	
1.001	12.272	0.210	58.5	0.023	0.00	0.0	0.600		o	100	Pipe/Conduit	
2.000	11.586	0.198	58.5	0.037	5.00	0.0	0.600		o	100	Pipe/Conduit	
2.001	11.586	0.222	52.3	0.000	0.00	0.0	0.600		o	100	Pipe/Conduit	
1.002	8.254	0.083	99.0	0.013	0.00	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	5.20	7.900	0.035	0.0	0.0	0.0	1.01	7.9	4.7
1.001	50.00	5.41	7.690	0.058	0.0	0.0	0.0	1.01	7.9	7.9
2.000	50.00	5.19	7.900	0.037	0.0	0.0	0.0	1.01	7.9	5.0
2.001	50.00	5.37	7.702	0.037	0.0	0.0	0.0	1.07	8.4	5.0
1.002	50.00	5.54	7.430	0.108	0.0	0.0	0.0	1.01	17.8	14.6

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Network Design Table for Storm												
PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
1.003	22.767	0.230	99.0	0.013	0.00	0.0	0.600		o	150	Pipe/Conduit	
3.000	10.655	0.108	99.0	0.105	5.00	0.0	0.600		o	150	Pipe/Conduit	
3.001	10.655	0.108	99.0	0.015	0.00	0.0	0.600		o	150	Pipe/Conduit	
3.002	14.701	0.087	169.0	0.054	0.00	0.0	0.600		o	525	Pipe/Conduit	
3.003	27.020	0.230	117.3	0.031	0.00	0.0	0.600		o	525	Pipe/Conduit	
1.004	33.152	0.137	241.9	0.019	0.00	0.0	0.600		o	525	Pipe/Conduit	
4.000	5.182	0.089	58.5	0.044	5.00	0.0	0.600		o	100	Pipe/Conduit	
4.001	5.182	0.089	58.5	0.000	0.00	0.0	0.600		o	100	Pipe/Conduit	
1.005	17.243	0.071	241.9	0.092	0.00	0.0	0.600		o	525	Pipe/Conduit	
5.000	4.638	0.047	98.7	0.110	5.00	0.0	0.600		o	225	Pipe/Conduit	
5.001	4.638	0.047	99.0	0.000	0.00	0.0	0.600		o	225	Pipe/Conduit	
1.006	36.843	2.070	17.8	0.055	0.00	0.0	0.600		o	525	Pipe/Conduit	
6.000	15.018	1.020	14.7	0.000	5.00	0.0	0.600		o	300	Pipe/Conduit	
6.001	25.454	0.257	99.0	0.099	0.00	0.0	0.600		o	300	Pipe/Conduit	
6.002	50.069	0.299	167.5	0.017	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)		
1.003	50.00	5.92	7.347	0.121	0.0	0.0	0.0	1.01	17.8	16.4		
3.000	50.00	5.18	7.650	0.105	0.0	0.0	0.0	1.01	17.8	14.2		
3.001	50.00	5.35	7.542	0.120	0.0	0.0	0.0	1.01	17.8	16.2		
3.002	50.00	5.49	7.060	0.174	0.0	0.0	0.0	1.72	372.4	23.6		
3.003	50.00	5.71	6.973	0.205	0.0	0.0	0.0	2.07	447.5	27.8		
1.004	50.00	6.30	6.742	0.345	0.0	0.0	0.0	1.44	310.8	46.7		
4.000	50.00	5.09	7.830	0.044	0.0	0.0	0.0	1.01	7.9	6.0		
4.001	50.00	5.17	7.741	0.044	0.0	0.0	0.0	1.01	7.9	6.0		
1.005	50.00	6.50	6.605	0.481	0.0	0.0	0.0	1.44	310.8	65.1		
5.000	50.00	5.06	7.750	0.110	0.0	0.0	0.0	1.32	52.3	14.9		
5.001	50.00	5.12	7.703	0.110	0.0	0.0	0.0	1.31	52.2	14.9		
1.006	50.00	6.62	6.534	0.646	0.0	0.0	0.0	5.33	1153.2	87.5		
6.000	50.00	5.06	7.060	0.000	0.0	0.0	0.0	4.12	291.1	0.0		
6.001	50.00	5.33	6.040	0.099	0.0	0.0	0.0	1.58	111.7	13.4		
6.002	50.00	6.02	5.783	0.116	0.0	0.0	0.0	1.21	85.7	15.7		
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Network Design Table for Storm													
PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design	
6.003	35.599	0.240	148.3	0.038	0.00	0.0	0.600		o	525	Pipe/Conduit		
6.004	25.331	0.105	241.6	0.114	0.00	0.0	0.600		o	525	Pipe/Conduit		
6.005	24.390	0.450	54.2	0.013	0.00	0.0	0.600		o	525	Pipe/Conduit		
1.007	6.501	0.016	400.9	0.015	0.00	0.0	0.600		o	525	Pipe/Conduit		
7.000	80.776	0.816	99.0	0.113	5.00	0.0	0.600		o	450	Pipe/Conduit		
8.000	14.809	0.253	58.5	0.042	5.00	0.0	0.600		o	300	Pipe/Conduit		
8.001	28.507	0.287	99.3	0.027	0.00	0.0	0.600		o	300	Pipe/Conduit		
8.002	53.806	0.320	168.2	0.103	0.00	0.0	0.600		o	300	Pipe/Conduit		
7.001	31.452	0.130	242.2	0.053	0.00	0.0	0.600		o	450	Pipe/Conduit		
7.002	31.485	0.130	242.2	0.060	0.00	0.0	0.600		o	450	Pipe/Conduit		
1.008	38.857	0.079	490.6	0.012	0.00	0.0	0.600		o	525	Pipe/Conduit		
1.009	41.615	0.085	490.6	0.071	0.00	0.0	0.600		o	525	Pipe/Conduit		
1.010	50.674	0.103	490.0	0.071	0.00	0.0	0.600		o	525	Pipe/Conduit		
9.000	18.749	0.321	58.4	0.056	5.00	0.0	0.600		o	225	Pipe/Conduit		
9.001	18.334	0.185	99.0	0.062	0.00	0.0	0.600		o	225	Pipe/Conduit		
9.002	13.630	0.140	97.0	0.015	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)			
6.003	50.00	6.34	5.259	0.154	0.0	0.0	0.0	1.84	397.7	20.9			
6.004	50.00	6.63	5.019	0.268	0.0	0.0	0.0	1.44	311.0	36.3			
6.005	50.00	6.77	4.914	0.281	0.0	0.0	0.0	3.05	659.8	38.1			
1.007	50.00	6.87	4.464	0.942	0.0	0.0	0.0	1.11	240.8	127.6			
7.000	50.00	5.66	7.400	0.113	0.0	0.0	0.0	2.04	325.0	15.3			
8.000	50.00	5.12	6.600	0.042	0.0	0.0	0.0	2.06	145.5	5.7			
8.001	50.00	5.42	6.347	0.069	0.0	0.0	0.0	1.58	111.5	9.3			
8.002	50.00	6.16	6.060	0.172	0.0	0.0	0.0	1.21	85.5	23.3			
7.001	50.00	6.57	5.590	0.338	0.0	0.0	0.0	1.30	207.0	45.8			
7.002	50.00	6.97	5.460	0.398	0.0	0.0	0.0	1.30	207.0	53.9			
1.008	50.00	7.61	4.448	1.352	0.0	0.0	0.0	1.00	217.4	183.1			
1.009	50.00	8.30	4.368	1.423	0.0	0.0	0.0	1.00	217.4	192.7			
1.010	49.30	9.14	4.434	1.494	0.0	0.0	0.0	1.01	217.6	199.5			
9.000	50.00	5.18	8.020	0.056	0.0	0.0	0.0	1.71	68.2	7.6			
9.001	50.00	5.41	7.699	0.118	0.0	0.0	0.0	1.31	52.2	16.0			
9.002	50.00	5.59	7.514	0.133	0.0	0.0	0.0	1.33	52.8	18.0			
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Network Design Table for Storm												
PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	n	HYD SECT	DIA (mm)	Section Type	Auto Design
9.003	39.695	0.453	87.7	0.006	0.00	0.0	0.600		o	225	Pipe/Conduit	
9.004	43.137	0.257	168.2	0.053	0.00	0.0	0.600		o	225	Pipe/Conduit	
9.005	23.504	0.140	168.2	0.081	0.00	0.0	0.600		o	225	Pipe/Conduit	
10.000	21.610	0.369	58.6	0.047	5.00	0.0	0.600		o	450	Pipe/Conduit	
10.001	79.567	0.473	168.4	0.110	0.00	0.0	0.600		o	450	Pipe/Conduit	
10.002	47.697	0.283	168.4	0.058	0.00	0.0	0.600		o	450	Pipe/Conduit	
9.006	12.244	0.051	241.6	0.000	0.00	0.0	0.600		o	450	Pipe/Conduit	
9.007	66.556	0.611	109.0	0.000	0.00	0.0		0.035 →_/→			Swale	
9.008	72.027	0.661	109.0	0.000	0.00	0.0		0.035 →_/→			Swale	
9.009	149.621	0.855	175.0	0.000	0.00	0.0		0.035 →_/→			Swale	
9.010	35.070	0.540	64.9	0.000	0.00	0.0		0.035 →_/→			Swale	
9.011	41.219	0.129	319.5	0.124	0.00	0.0	0.600		o	750	Pipe/Conduit	
1.011	25.916	0.056	462.8	0.078	0.00	0.0	0.600		o	750	Pipe/Conduit	
1.012	48.097	0.096	501.0	0.059	0.00	0.0	0.600		o	750	Pipe/Conduit	
1.013	15.896	0.032	496.8	0.059	0.00	0.0	0.600		o	750	Pipe/Conduit	
1.014	18.776	0.038	494.1	0.000	0.00	0.0	0.600		o	750	Pipe/Conduit	
1.015	6.345	0.278	22.8	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)		
9.003	50.00	6.06	7.373	0.139	0.0	0.0	0.0	1.40	55.5	18.8		
9.004	50.00	6.77	6.921	0.192	0.0	0.0	0.0	1.01	40.0	26.0		
9.005	50.00	7.16	6.664	0.273	0.0	0.0	0.0	1.01	40.0	37.0		
10.000	50.00	5.14	7.900	0.047	0.0	0.0	0.0	2.66	423.2	6.4		
10.001	50.00	5.98	7.531	0.157	0.0	0.0	0.0	1.56	248.7	21.3		
10.002	50.00	6.49	7.058	0.215	0.0	0.0	0.0	1.56	248.7	29.1		
9.006	50.00	7.32	6.300	0.488	0.0	0.0	0.0	1.30	207.3	66.1		
9.007	50.00	7.86	7.127	0.488	0.0	0.0	0.0	2.05	11554.6	66.1		
9.008	50.00	8.27	6.516	0.488	0.0	0.0	0.0	2.95	49453.1	66.1		
9.009	46.97	10.05	5.855	0.488	0.0	0.0	0.0	1.40	5027.2	66.1		
9.010	46.36	10.31	5.000	0.488	0.0	0.0	0.0	2.29	8252.2	66.1		
9.011	45.36	10.75	4.460	0.612	0.0	0.0	0.0	1.56	689.2	75.2		
1.011	44.64	11.08	4.106	2.184	0.0	0.0	0.0	1.29	571.8	264.0		
1.012	43.31	11.73	4.050	2.243	0.0	0.0	0.0	1.24	549.3	264.0		
1.013	42.90	11.94	3.954	2.302	0.0	0.0	0.0	1.25	551.7	267.4		
1.014	42.42	12.19	3.922	2.302	0.0	0.0	0.0	1.25	553.2	267.4		
1.015	42.36	12.22	3.884	2.302	0.0	0.0	0.0	3.31	233.6«	267.4		
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Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.015	S-Outfall	5.000	3.606	1.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coefficient	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	15
Number of Online Controls	10	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FEH
Return Period (years)	2
FEH Rainfall Version	2013
Site Location	GB 494350 104100 SU 94350 04100
Data Type	Catchment
Summer Storms	Yes
Winter Storms	No
Cv (Summer)	1.000
Cv (Winter)	1.000
Storm Duration (mins)	30

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Online Controls for Storm

Orifice Manhole: 2, DS/PN: 1.001, Volume (m³): 1.8

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 7.690

Orifice Manhole: 18, DS/PN: 2.001, Volume (m³): 1.8

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 7.702

Orifice Manhole: 20, DS/PN: 3.001, Volume (m³): 1.8

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 7.542

Orifice Manhole: 24, DS/PN: 4.001, Volume (m³): 1.6

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 7.741

Orifice Manhole: 7, DS/PN: 1.006, Volume (m³): 8.1

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 6.534

Orifice Manhole: 29, DS/PN: 6.002, Volume (m³): 3.6

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 5.783

Orifice Manhole: 9, DS/PN: 1.008, Volume (m³): 12.5

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 4.448

Orifice Manhole: 40, DS/PN: 9.001, Volume (m³): 2.5

Diameter (m) 0.100 Discharge Coefficient 0.600 Invert Level (m) 7.699

Hydro-Brake® Optimum Manhole: 46, DS/PN: 9.007, Volume (m³): 101.0

Unit Reference	MD-SHE-0212-2500-1500-2500
Design Head (m)	1.500
Design Flow (l/s)	25.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	212
Invert Level (m)	7.127
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1800

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<u>Hydro-Brake® Optimum Manhole: 46, DS/PN: 9.007, Volume (m³): 101.0</u>																																																																											
<table><tr><td>Control Points</td><td>Head (m)</td><td>Flow (l/s)</td></tr><tr><td>Design Point (Calculated)</td><td>1.500</td><td>25.0</td></tr><tr><td>Flush-Flo™</td><td>0.455</td><td>25.0</td></tr><tr><td>Kick-Flo®</td><td>1.000</td><td>20.6</td></tr><tr><td>Mean Flow over Head Range</td><td>-</td><td>21.5</td></tr></table>				Control Points	Head (m)	Flow (l/s)	Design Point (Calculated)	1.500	25.0	Flush-Flo™	0.455	25.0	Kick-Flo®	1.000	20.6	Mean Flow over Head Range	-	21.5																																																									
Control Points	Head (m)	Flow (l/s)																																																																									
Design Point (Calculated)	1.500	25.0																																																																									
Flush-Flo™	0.455	25.0																																																																									
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Landmark House Station Road, Hook Hampshire RG27 9HA							
Date 09/11/2021 14:51 File 20-061 SW NETWORK.MDX		Designed by Scott Collis Checked by					
Innovyze		Network 2019.1					
<u>Hydro-Brake® Optimum Manhole: 16, DS/PN: 1.015, Volume (m³): 12.9</u>							
Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	10.4	2.400	14.4	5.000	20.4	8.000	25.6
1.400	11.1	2.600	14.9	5.500	21.4	8.500	26.3
1.600	11.9	3.000	16.0	6.000	22.3	9.000	27.1
1.800	12.5	3.500	17.2	6.500	23.1	9.500	27.8
2.000	13.2	4.000	18.3	7.000	24.0		
2.200	13.8	4.500	19.4	7.500	24.8		
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Innovyze		Network 2019.1

Storage Structures for Storm

Complex Manhole: 1, DS/PN: 1.000

Cellular Storage

Invert Level (m) 7.400 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	187.0	0.0	1.151	187.0	0.0
1.150	187.0	0.0			

Porous Car Park

Infiltration Coefficient Base (m/hr) 0.00000 Width (m) 5.3
Membrane Percolation (mm/hr) 1000 Length (m) 35.0
Max Percolation (l/s) 51.5 Slope (1:X) 1000.0
Safety Factor 2.0 Depression Storage (mm) 5
Porosity 0.30 Evaporation (mm/day) 3
Invert Level (m) 8.550 Membrane Depth (mm) 260

Complex Manhole: 17, DS/PN: 2.000

Cellular Storage

Invert Level (m) 7.400 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	316.0	0.0	1.150	316.0	0.0

Porous Car Park

Infiltration Coefficient Base (m/hr) 0.00000 Width (m) 13.5
Membrane Percolation (mm/hr) 1000 Length (m) 23.0
Max Percolation (l/s) 86.3 Slope (1:X) 1000.0
Safety Factor 2.0 Depression Storage (mm) 5
Porosity 0.30 Evaporation (mm/day) 3
Invert Level (m) 8.550 Membrane Depth (mm) 0

Complex Manhole: 19, DS/PN: 3.000

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Innovyze		Network 2019.1

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	6.0
Membrane Percolation (mm/hr)	1000	Length (m)	34.0
Max Percolation (l/s)	56.7	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	7.359	Membrane Depth (mm)	260

Cellular Storage

Invert Level (m)	7.359	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	208.0	0.0	0.991	208.0	0.0

Complex Manhole: 23, DS/PN: 4.000

Cellular Storage

Invert Level (m)	7.189	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	219.0	0.0	1.291	219.0	0.0

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	7.0
Membrane Percolation (mm/hr)	1000	Length (m)	31.0
Max Percolation (l/s)	60.3	Slope (1:X)	1000.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	8.480	Membrane Depth (mm)	260

Complex Manhole: 25, DS/PN: 5.000

Cellular Storage

Invert Level (m)	7.153	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

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Innovyze		Network 2019.1			
<u>Cellular Storage</u>					
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	360.0	0.0	1.297	360.0	0.0
<u>Porous Car Park</u>					
Infiltration Coefficient Base (m/hr)	0.00000		Width (m)	4.8	
Membrane Percolation (mm/hr)	1000		Length (m)	75.0	
Max Percolation (l/s)	100.0		Slope (1:X)	1000.0	
Safety Factor	2.0	Depression Storage (mm)	5		
Porosity	0.30	Evaporation (mm/day)	3		
Invert Level (m)	8.450	Membrane Depth (mm)	260		
<u>Complex Manhole: 28, DS/PN: 6.001</u>					
<u>Porous Car Park</u>					
Infiltration Coefficient Base (m/hr)	0.00000		Width (m)	10.0	
Membrane Percolation (mm/hr)	1000		Length (m)	35.0	
Max Percolation (l/s)	97.2		Slope (1:X)	1000.0	
Safety Factor	2.0	Depression Storage (mm)	5		
Porosity	0.30	Evaporation (mm/day)	3		
Invert Level (m)	5.690	Membrane Depth (mm)	260		
<u>Cellular Storage</u>					
Invert Level (m)	5.690	Safety Factor	2.0		
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95		
Infiltration Coefficient Side (m/hr)	0.00000				
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	321.0	0.0	1.460	321.0	0.0
<u>Complex Manhole: 36, DS/PN: 8.000</u>					
<u>Cellular Storage</u>					
Invert Level (m)	6.600	Safety Factor	2.0		
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95		
Infiltration Coefficient Side (m/hr)	0.00000				
Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	208.0	0.0	1.150	208.0	0.0
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0.000	180.0	0.0	1.150	180.0	0.0																																																																																																													
Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	13.0																																																																																																															
Membrane Percolation (mm/hr)	1000	Length (m)	13.0																																																																																																															
Max Percolation (l/s)	46.9	Slope (1:X)	1000.0																																																																																																															
Safety Factor	2.0	Depression Storage (mm)	5																																																																																																															
Porosity	0.30	Evaporation (mm/day)	3																																																																																																															
Invert Level (m)	8.670	Membrane Depth (mm)	0																																																																																																															
Depth (m)	Area (m ²)	Depth (m)	Area (m ²)																																																																																																															
0.000	0.4	1.500	217.0																																																																																																															
Manning's N	0.035	Base Width (m)	0.6																																																																																																															
Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	66.6																																																																																																															
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	3.0																																																																																																															
Safety Factor	2.0	Slope (1:X)	109.0																																																																																																															
Porosity	1.00	Cap Volume Depth (m)	0.000																																																																																																															
Invert Level (m)	7.127	Cap Infiltration Depth (m)	0.000																																																																																																															
Manning's N	0.035	Infiltration Coefficient Side (m/hr)	0.00000																																																																																																															
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Date 09/11/2021 14:51 File 20-061 SW NETWORK.MDX	Designed by Scott Collis Checked by									
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Swale Pipe: 9.008 Porosity 1.00Side Slope (1:X) 3.0 Invert Level (m) 6.516Slope (1:X) 109.0 Base Width (m) 0.6Cap Volume Depth (m) 0.000 Length (m) 72.0Cap Infiltration Depth (m) 0.000 Swale Pipe: 9.009 Manning's N 0.035Base Width (m) 0.6 Infiltration Coefficient Base (m/hr) 0.00000Length (m) 149.6 Infiltration Coefficient Side (m/hr) 0.00000Side Slope (1:X) 3.0 Safety Factor 2.0Slope (1:X) 175.0 Porosity 1.00Cap Volume Depth (m) 0.000 Invert Level (m) 5.855Cap Infiltration Depth (m) 0.000 Swale Pipe: 9.010 Manning's N 0.035Base Width (m) 0.6 Infiltration Coefficient Base (m/hr) 0.00000Length (m) 35.1 Infiltration Coefficient Side (m/hr) 0.00000Side Slope (1:X) 3.0 Safety Factor 2.0Slope (1:X) 64.9 Porosity 1.00Cap Volume Depth (m) 0.000 Invert Level (m) 5.000Cap Infiltration Depth (m) 0.000 Porous Car Park Manhole: 50, DS/PN: 9.011 Infiltration Coefficient Base (m/hr) 0.00000Width (m) 8.0 Membrane Percolation (mm/hr) 1000Length (m) 25.0 Max Percolation (l/s) 55.6Slope (1:X) 0.0 Safety Factor 2.0Depression Storage (mm) 5 Porosity 0.30Evaporation (mm/day) 3 Invert Level (m) 3.932Membrane Depth (mm) 0 Tank or Pond Manhole: 15, DS/PN: 1.014 Invert Level (m) 3.997 <table><tr><th>Depth (m)</th><th>Area (m²)</th><th>Depth (m)</th><th>Area (m²)</th></tr><tr><td>0.000</td><td>112.0</td><td>1.900</td><td>855.0</td></tr></table>			Depth (m)	Area (m²)	Depth (m)	Area (m²)	0.000	112.0	1.900	855.0
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<u>Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>								
		Water	Surcharged	Flooded			Pipe	
	US/MH	Level	Depth	Volume	Flow /	Overflow	Pipe	Level
PN	Name	(m)	(m)	(m³)	Cap.	(l/s)	Flow	Exceeded
							(l/s)	Status
1.000	1	7.807	-0.193	0.000	0.00		0.0	OK
1.001	2	9.025	1.235	0.000	0.97		7.2	FLOOD RISK
2.000	17	7.654	-0.346	0.000	0.00		0.0	OK
2.001	18	8.382	0.580	0.000	0.14		1.1	SURCHARGED
1.002	3	9.050	1.470	0.000	0.63		9.8	FLOOD RISK
1.003	4	9.065	1.568	0.000	0.72		12.1	FLOOD RISK
3.000	19	7.790	-0.010	0.000	0.47		7.4	OK
3.001	20	8.162	0.470	0.000	0.40		6.5	SURCHARGED
3.002	21	9.004	1.419	0.000	0.24		48.9	OK
3.003	22	9.041	1.543	0.000	0.19		49.4	FLOOD RISK
1.004	5	9.035	1.768	0.000	0.28		54.0	FLOOD RISK
4.000	23	7.627	-0.303	0.000	0.00		0.0	OK
4.001	24	8.284	0.442	0.000	0.14		9.9	SURCHARGED
1.005	6	9.025	1.895	0.000	0.39		11.3	FLOOD RISK
5.000	25	7.757	-0.218	0.000	0.01		8.2	OK
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PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
6.003	30	7.628	1.844	0.000	0.43		46.2	OK	
6.004	31	7.982	2.438	0.000	0.43		37.7	SURCHARGED	
6.005	32	8.105	2.666	0.000	0.15		59.3	SURCHARGED	
1.007	8	8.145	3.156	0.000	0.49		42.9	SURCHARGED	
7.000	33	8.150	0.300	0.000	0.28		56.3	SURCHARGED	
8.000	36	7.443	0.543	0.000	0.26		31.1	SURCHARGED	
8.001	37	7.577	0.930	0.000	0.31		31.3	SURCHARGED	
8.002	38	7.949	1.589	0.000	0.76		61.7	SURCHARGED	
7.001	34	8.134	2.094	0.000	0.45		40.9	SURCHARGED	
7.002	35	8.156	2.246	0.000	0.64		15.2	SURCHARGED	
1.008	9	8.148	3.175	0.000	0.20		36.8	FLOOD RISK	
1.009	10	5.523	0.630	0.000	0.16		30.3	SURCHARGED	
1.010	11	5.518	0.559	0.000	0.17		33.9	SURCHARGED	
9.000	39	8.026	-0.219	0.000	0.01		0.3	OK	
9.001	40	8.521	0.597	0.000	0.34		15.8	SURCHARGED	
9.002	41	8.650	0.911	0.000	0.50		22.9	SURCHARGED	
9.003	42	8.648	1.050	0.000	0.40		20.9	SURCHARGED	
9.004	43	8.639	1.493	0.000	1.10		41.9	SURCHARGED	
9.005	44	8.326	1.436	0.000	2.61		55.8	FLOOD RISK	
10.000	51	8.107	-0.243	0.000	0.04		13.4	OK	
10.001	52	8.105	0.124	0.000	0.18		42.7	SURCHARGED	
10.002	53	8.099	0.591	0.000	0.21		46.5	SURCHARGED	
9.006	45	8.093	1.343	0.000	0.48		43.2	SURCHARGED	
9.007	46	8.086	-0.314	0.000	0.00		24.8	OK	
9.008	47	6.587	-2.193	0.000	0.00		24.8	OK	
9.009	48	5.937	-3.043	0.000	0.00		24.8	OK	
9.010	19	5.511	-0.489	0.000	0.00		22.2	OK	
9.011	50	5.511	0.301	0.000	0.06		32.0	FLOOD RISK	
1.011	12	5.511	0.656	0.000	0.15		55.4	OK	
1.012	13	5.528	0.728	0.000	0.14		32.7	SURCHARGED	
1.013	14	5.527	0.823	0.000	0.23		36.5	SURCHARGED	
1.014	15	5.526	0.854	0.000	0.49		33.2	SURCHARGED	
1.015	16	6.005	1.821	0.000	0.77		9.4	OK	
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