

Longacres, Eastergate Lane, Walberton, Arundel, BN18 0BA

30 May 2025

Drainage Technical Note

1. This Technical Note has been prepared to address the LLFA's objection comments – as set out in the "Engineers' Comments Regarding Surface Water Drainage" document dated 02/05/25, refer to Appendix C.

The LLFA's comments are set out as follows:

1. *The routing of pipework through the root protection zone of a mature tree. Given the species of tree, the roots could be detrimental to the operation of the pipeline in the future. Our tree officer will provide a consultation in this respect.*
2. *It is understood that the existing driveway will remain in its present form, however, it is noted the any new sections of driveway/hardstanding will be constructed with a permeable surface. The principle is acceptable, however, the new areas will need to be an engineered design. Thus, they will need to be incorporated within the overall drainage design.*
3. *The proposed discharge rate (QBAR) appears to have been calculated on the entire site area rather than just the impermeable area. This will need to be re-calculated accordingly (to also include the new driveway/hardstanding contributing areas) and a discharge rate agreed. Due to the low rate expected and potential orifice diameter, suitable measures will need to be put in place to reduce the risk of blockage.*
4. *The hydraulic calculations do not reflect the current design in terms of levels. However, the calculations need to be revisited as a result of the above, and must include the piped network and evidence of the impermeable areas used. Urban creep @ 10% also needs to be applied. Appropriate climate change allowance needs to be applied to all storm events. A surcharged outfall will need to be modelled. The surcharge level should be to the top of the bank if hydraulic modelling of the watercourse is not available.*
5. *An exceedance overland flow route plan needs to be provided.*
6. *No freeboard is being achieved between the proposed outfall pipe invert and the existing ditch bed. This is not acceptable as flood risk may be increased due to siltation and blockage of the outfall. Adequate freeboard needs to be achieved and agreed.*
7. *The proposed landscaping conflicts with the proposed drainage layout. For example, a tree is proposed in close proximity to the storage tank. The tree species and root protection zone at maturity will need to be shown to ensure no detriment to the structure. There is also new hedging proposed which could lead to root intrusion into the pipes beneath. This is important as tree roots could damage the liner and pipework, allowing groundwater to enter the system. This would consume storage that is set aside for surface water and thus increase flood risk.*
8. *Interception drainage has not been adequately considered by the submission. This is an important consideration as when the drainage system is designed in accordance with The SuDS Manual, runoff for the majority of small (frequent) events will be prevented from leaving the site. This is the first water quantity standard prescribed by the manual. Designing for interception is*

more challenging where infiltration is not viable as it must be provided via evapotranspiration only.

Each comment is responded to – as follows:

1. Following the tree officer's response to the application, the existing tree T1 (mature Eucalyptus tree) is to be removed as it is in poor condition and qualifies as 'unsuitable for retention' in the arboricultural report. On that basis, the proposed foul and surface water drain route can remain as shown without conflicts. The final leg of the surface water drain route to the existing ditch has been rerouted to resolve the conflict with the existing tree on the adjacent land. Appendix A includes the revised strategy layout.
2. The drainage strategy (in appendix A) has been revised to include the area of permeable paving. The drainage calculations are shown in Appendix B.
3. The offsite flow rate proposed in the submitted FRA report is based on the practical minimum limit of screened vortex devices. This rate is proposed because the Q_{bar} of 0.19l/s calculated for 1ha is considerably less. It is contended that a) there is no need for a greenfield calculation for the contributing area as this would show a lower rate, which would also be put to one side – and b) the risk of flooding would be increased if a screened vortex were designed for an offsite flow rate <1l/s. The orifice's diameter would be that small that buildup of twigs or other debris that manages to bypass the screen would increase the local flood risk – and this would be greater than any benefit of the reduction of flow rates <1l/s.
4. The drainage calculations have been updated to include 10% urban creep for the roofed area. The drainage calculations have been updated to reflect the complete proposed network as shown on the drainage layout in Appendix A. A 10% urban creep factor has been applied to all roof areas; an impermeable catchment plan is included in Appendix A. Climate change allowances have been applied to all events in accordance with the latest climate change guidance for the area. Additionally, a surcharged outfall scenario has been modelled for the 1 in 100-years +45% climate change event, to demonstrate that the network can cope when the ditch water levels are equal to top of bank levels – refer to the drainage calculation in Appendix B..
5. Exceedance flow arrows have been added to the drainage strategy layout – refer to Appendix A.
6. No freeboard is needed - because the SuDS drainage network has been designed to flow adequately in the surcharged condition – refer to the drainage calculation in Appendix B. The outfall has been designed to work in surcharged condition; and the drainage strategy now shows regrading of the ditch bed to achieve sufficient freeboard. This is shown on the layout plan and details will be covered by an OWC application in due course.
7. This item relates to the proposed landscaping. The proposed tank locations have been coordinated with the landscape proposals. Appropriate tree root barriers will be included as part of the works, in accordance with DCG recommendations for planting near drain pipes.

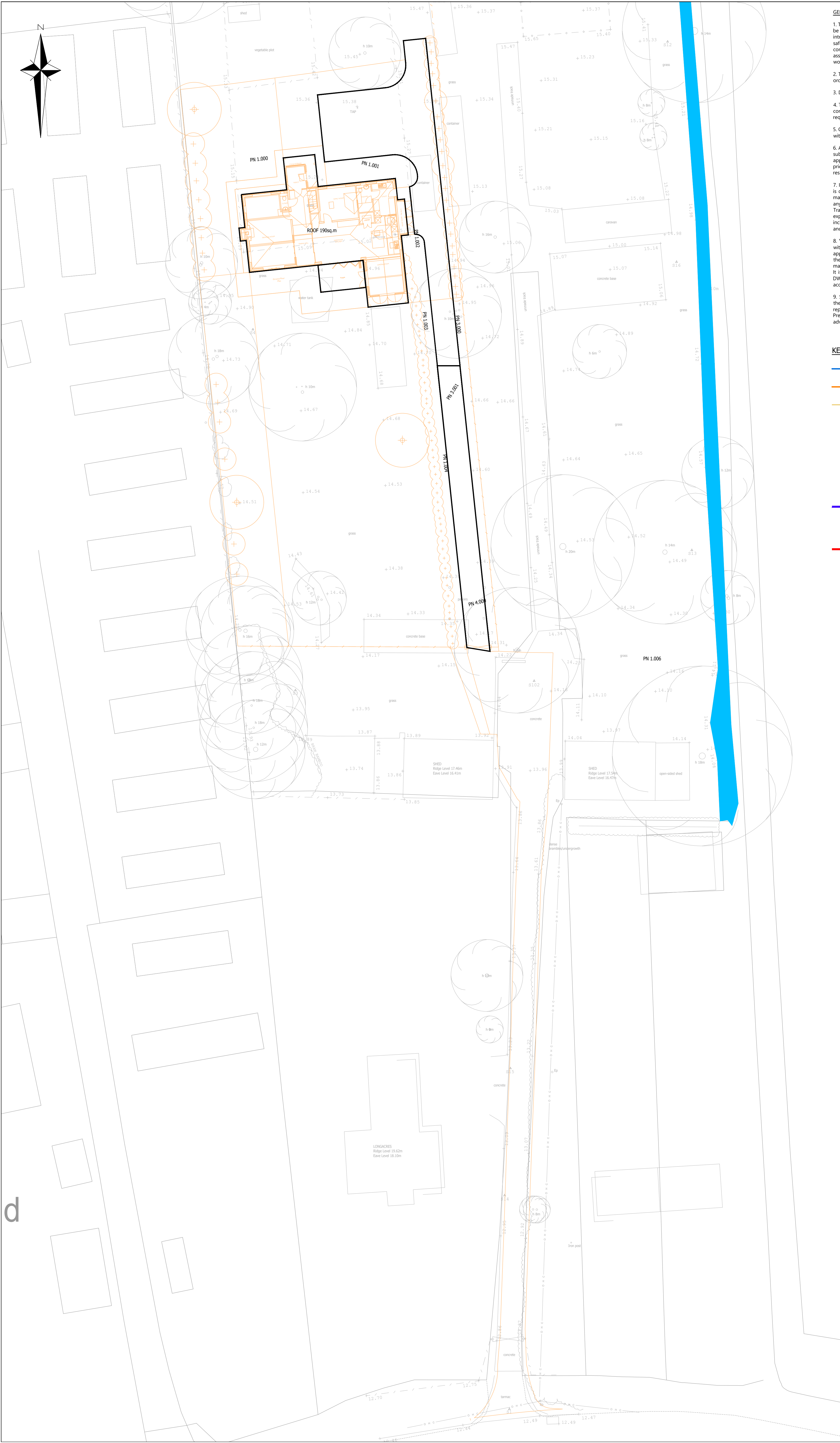
8. Water butts have been added to the drainage strategy. These are considered to be satisfactory interception features according to the CIRIA SuDS Manual (C753).

Conclusion: it is contended that all 8 of the LLFA's outstanding items have been addressed in full.

- End of Technical Note -

Appendix A

Drainage Strategy Layout & Catchment Areas Plan



- GENERAL NOTES**
- The location, size, depth and identification of existing services that may be shown or referred to on this drawing have been assessed from non intrusive observations , record drawings or the like. The contractor shall safely carry out intrusive investigations, trial holes or soundings prior to commencing work to satisfy himself that it is safe to proceed and that the assessments are accurate. Any discrepancies shall be notified to gta prior to works commencing.
 - Tender or billing drawings shall not be used for construction or the ordering of materials.
 - Do not scale. All dimensions and levels to be site confirmed.
 - This drawing shall be read in conjunction with all relevant architects, consultants drawings and specifications, together with H&S plan requirements.
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 - All drawings specifications and recommendations made by gta are subject to Local Authority and other relevant Statutory Authorities approval. Any works or services made abortive due to the client proceeding prior to these approvals is considered wholly at the Clients risk. gta hold no responsibility for resulting abortive works or costs.
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 - Should any apparent discrepancies between the data contained within the DWG file and the current contract drawings become evident, it must be reported back to GTA Civils & Transport as soon as reasonably practicable. Precedence should be given to the current contract drawings (PDF) unless advised otherwise.

KEY

- Surface water drain
- Foul drain
- Existing foul sewer (from records)
- SIC Surface water plastic IC 4500
- PPCP Surface water plastic catchpit 6000
- FIC Foul plastic IC 4500
- Existing watercourse (from topo)
- Existing watercourse (from OS plan)
- ExFSMH Existing foul sewer manhole (from records)
- Site boundary

ABBREVIATIONS

BL	BASE LEVEL
CL	COVER LEVEL
EXFSMH	EXISTING FOUL SEWER MANHOLE
EXFWS	EXISTING FOUL SEWER
FIC	FOUL INSPECTION CHAMBER
FWD	FOUL DRAIN
IC	INSPECTION CHAMBER
IL	INVERT LEVEL
LLFA	LEAD LOCAL FLOOD AUTHORITY
PPCP	POLYPROPYLENE CATCHPIT
SIC	SURFACE WATER INSPECTION CHAMBER
SL	SUMP LEVEL
SWD	SURFACE WATER DRAIN
TL	TOP LEVEL

CATCHMENT AREAS

ROOFED AREA = 190m²
URBAN CREEP = 19m²
EXTERNAL AREAS = 270m²

P2	Amended with external areas		30/05/25	JMW	JP
P1	INITIAL ISSUE		04/03/25	JR	FVV
Rev	Amendments		Date	Dsn	Chk
Status					
PRELIMINARY					
Client					
MR AND MRS PEARCE					
Architect					
DOUGLAS BRIGGS PARTNERSHIP					
Project					
LONGACRES EASTERGATE LANE					
Title					
IMPERMEABLE CATCHMENT PLAN					
Date		MARCH 2025		Scale @ A1	
				1:200	
Clients Ref.		Project Ref.		13467	
 Civils & Transport Maple House, 192-198 London Road, Burgess Hill, West Sussex, RH15 9RD Tel.01444 871444 Web: www.gtacivils.co.uk					
Drawing Number				Rev.	
13467/1102				P2	

Appendix B

Drainage Calculations for Normal and Surcharged Scenarios

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Manhole Type	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SIC1	0.005	5.00	15.150	Private	450	495775.282	106299.227	0.740
SIC2	0.005	5.00	15.150	Private	450	495784.228	106300.164	0.830
SIC3	0.005	5.00	15.150	Private	450	495794.671	106297.785	0.990
SIC4	0.008	5.00	14.820	Private	450	495776.807	106280.666	0.620
PPCP1	0.000		14.900	Private	600	495796.250	106282.702	0.895
PPCP2	0.000		14.670	Private	600	495797.355	106272.151	0.770
PPCP3	0.000		14.200	Private	600	495800.885	106243.301	0.486
PPCP4	0.000	5.00	15.440	Private	600	495795.904	106312.988	0.400
PPCP5	0.017	5.00	14.690	Private	600	495799.593	106275.790	0.400
PPCP6	0.008	5.00	14.310	Private	600	495802.418	106249.076	0.550
CONTROL IC	0.000		14.360	Private	600	495799.839	106248.414	0.615
OUTFALL	0.000		14.135			495829.277	106227.267	0.605

Links (Results)

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.769	6.0	0.7	0.640	0.730	0.005	0.0	23	0.511
1.001	0.779	6.1	1.4	0.730	0.840	0.010	0.0	32	0.622
1.002	0.777	6.1	2.0	0.890	0.795	0.015	0.0	39	0.696
2.000	0.778	6.1	1.1	0.520	0.795	0.008	0.0	29	0.586
1.003	0.765	6.0	3.1	0.795	0.670	0.023	0.0	51	0.772
3.000	1.101	8.6	0.0	0.300	0.300	0.000	0.0	0	0.000
3.001	2.500	19.6	2.3	0.300	0.670	0.017	0.0	23	1.670
1.004	0.816	14.4	5.4	0.620	0.465	0.040	0.0	64	0.758
1.005	0.812	14.3	6.5	0.465	0.336	0.048	0.0	71	0.791
1.006	0.817	14.4	6.3	0.336	0.455	0.048	0.0	69	0.790
4.000	0.638	5.0	1.1	0.450	0.515	0.008	0.0	32	0.509

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	8.995	99.9	100	Circular	15.150	14.410	0.640	15.150	14.320	0.730
1.001	10.711	97.4	100	Circular	15.150	14.320	0.730	15.150	14.210	0.840
1.002	15.165	97.8	100	Circular	15.150	14.160	0.890	14.900	14.005	0.795
2.000	19.030	97.6	100	Circular	14.820	14.200	0.520	14.900	14.005	0.795
1.003	10.609	101.0	100	Circular	14.900	14.005	0.795	14.670	13.900	0.670
3.000	36.940	49.3	100	Circular	15.440	15.040	0.300	14.690	14.290	0.300
3.001	3.770	9.7	100	Circular	14.690	14.290	0.300	14.670	13.900	0.670

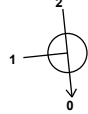
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	SIC1	450	Manhole	Private	SIC2	450	Manhole	Private
1.001	SIC2	450	Manhole	Private	SIC3	450	Manhole	Private
1.002	SIC3	450	Manhole	Private	PPCP1	600	Manhole	Private
2.000	SIC4	450	Manhole	Private	PPCP1	600	Manhole	Private
1.003	PPCP1	600	Manhole	Private	PPCP2	600	Manhole	Private
3.000	PPCP4	600	Manhole	Private	PPCP5	600	Manhole	Private
3.001	PPCP5	600	Manhole	Private	PPCP2	600	Manhole	Private

Pipeline Schedule

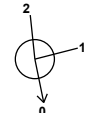
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.004	23.370	150.8	150	Circular	14.670	13.900	0.620	14.360	13.745	0.465
1.005	4.720	152.3	150	Circular	14.360	13.745	0.465	14.200	13.714	0.336
1.006	27.690	150.5	150	Circular	14.200	13.714	0.336	14.135	13.530	0.455
4.000	2.161	144.1	100	Circular	14.310	13.760	0.450	14.360	13.745	0.515

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.004	PPCP2	600	Manhole	Private	CONTROL IC	600	Manhole	Private
1.005	CONTROL IC	600	Manhole	Private	PPCP3	600	Manhole	Private
1.006	PPCP3	600	Manhole	Private	OUTFALL		Junction	
4.000	PPCP6	600	Manhole	Private	CONTROL IC	600	Manhole	Private

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SIC1	495775.282	106299.227	15.150	0.740	450				
						0	1.000	14.410	100
SIC2	495784.228	106300.164	15.150	0.830	450				
						0	1.001	14.320	100
SIC3	495794.671	106297.785	15.150	0.990	450				
						0	1.002	14.160	100
SIC4	495776.807	106280.666	14.820	0.620	450				
						0	2.000	14.200	100
PPCP1	495796.250	106282.702	14.900	0.895	600				
						1	2.000	14.005	100
						2	1.002	14.005	100
						0	1.003	14.005	100
PPCP2	495797.355	106272.151	14.670	0.770	600				
						1	3.001	13.900	100
						2	1.003	13.900	100
						0	1.004	13.900	150
PPCP3	495800.885	106243.301	14.200	0.486	600				
						1	1.005	13.714	150
						0	1.006	13.714	150
PPCP4	495795.904	106312.988	15.440	0.400	600				
						0	3.000	15.040	100
PPCP5	495799.593	106275.790	14.690	0.400	600				
						1	3.000	14.290	100
						0	3.001	14.290	100

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
PPCP6	495802.418	106249.076	14.310	0.550	600				
						0	4.000	13.760	100
CONTROL IC	495799.839	106248.414	14.360	0.615	600		1	4.000	13.745
						2	1.004	13.745	150
						0	1.005	13.745	150
OUTFALL	495829.277	106227.267	14.135	0.605			1	1.006	13.530
									150

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Detailed	Additional Storage (m³/ha)	0.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	240	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0

Node CONTROL IC Online Orifice Control

Flap Valve	x	Design Depth (m)	0.500	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	1.0		
Invert Level (m)	13.745	Diameter (m)	0.027		

Node CONTROL IC Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	13.870
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	50.0	0.0	0.400	50.0	0.0	0.401	0.0	0.0

Node CONTROL IC Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	13.890
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	57.5	0.0	0.400	57.5	0.0	0.401	0.0	0.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 87.36%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SIC1	11	14.436	0.026	0.9	0.0041	0.0000	OK
15 minute summer	SIC2	11	14.358	0.038	1.8	0.0061	0.0000	OK
15 minute summer	SIC3	11	14.206	0.046	2.7	0.0074	0.0000	OK
15 minute summer	SIC4	10	14.233	0.033	1.5	0.0053	0.0000	OK
15 minute summer	PPCP1	11	14.068	0.063	4.1	0.0178	0.0000	OK
600 minute winter	PPCP2	690	14.000	0.100	0.9	0.0282	0.0000	OK
1440 minute winter	PPCP3	1650	13.999	0.285	0.1	0.0808	0.0000	FLOOD RISK
15 minute summer	PPCP4	1	15.040	0.000	0.0	0.0000	0.0000	OK
15 minute summer	PPCP5	10	14.317	0.027	3.2	0.0077	0.0000	OK
600 minute winter	PPCP6	660	14.000	0.240	0.2	0.0678	0.0000	SURCHARGED
1440 minute winter	CONTROL IC	1200	13.999	0.254	0.7	12.2513	0.0000	SURCHARGED
15 minute summer	OUTFALL	1	14.110	0.580	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SIC1	1.000	SIC2	0.9	0.418	0.149	0.0197	
15 minute summer	SIC2	1.001	SIC3	1.8	0.667	0.293	0.0289	
15 minute summer	SIC3	1.002	PPCP1	2.7	0.625	0.440	0.0663	
15 minute summer	SIC4	2.000	PPCP1	1.5	0.430	0.239	0.0708	
15 minute summer	PPCP1	1.003	PPCP2	4.1	0.711	0.678	0.0606	
600 minute winter	PPCP2	1.004	CONTROL IC	0.9	0.189	0.062	0.3508	
1440 minute winter	PPCP3	1.006	OUTFALL	0.0	0.000	0.000	0.4875	0.0
15 minute summer	PPCP4	3.000	PPCP5	0.0	0.000	0.000	0.0320	
15 minute summer	PPCP5	3.001	PPCP2	3.2	0.953	0.162	0.0150	
600 minute winter	PPCP6	4.000	CONTROL IC	0.2	0.024	0.038	0.0169	
1440 minute winter	CONTROL IC	1.005	PPCP3	0.1	0.141	0.005	0.0831	

Nodes

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PPCP6	0.008	5.00	14.310	Private	600	495802.418	106249.076	0.550
CONTROL IC	0.000		14.360	Private	600	495799.839	106248.414	0.615
OUTFALL	0.000		14.135			495829.277	106227.267	0.605

Links (Results)

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
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1.001	0.779	6.1	1.4	0.730	0.840	0.010	0.0	32	0.622
1.002	0.777	6.1	2.0	0.890	0.795	0.015	0.0	39	0.696
2.000	0.778	6.1	1.1	0.520	0.795	0.008	0.0	29	0.586
1.003	0.765	6.0	3.1	0.795	0.670	0.023	0.0	51	0.772
3.000	1.101	8.6	0.0	0.300	0.300	0.000	0.0	0	0.000
3.001	2.500	19.6	2.3	0.300	0.670	0.017	0.0	23	1.670
1.004	0.816	14.4	5.4	0.620	0.465	0.040	0.0	64	0.758
1.005	0.812	14.3	6.5	0.465	0.336	0.048	0.0	71	0.791
1.006	0.817	14.4	6.3	0.336	0.455	0.048	0.0	69	0.790
4.000	0.638	5.0	1.1	0.450	0.515	0.008	0.0	32	0.509

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	8.995	99.9	100	Circular	15.150	14.410	0.640	15.150	14.320	0.730
1.001	10.711	97.4	100	Circular	15.150	14.320	0.730	15.150	14.210	0.840
1.002	15.165	97.8	100	Circular	15.150	14.160	0.890	14.900	14.005	0.795
2.000	19.030	97.6	100	Circular	14.820	14.200	0.520	14.900	14.005	0.795
1.003	10.609	101.0	100	Circular	14.900	14.005	0.795	14.670	13.900	0.670
3.000	36.940	49.3	100	Circular	15.440	15.040	0.300	14.690	14.290	0.300
3.001	3.770	9.7	100	Circular	14.690	14.290	0.300	14.670	13.900	0.670

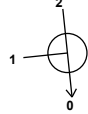
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	SIC1	450	Manhole	Private	SIC2	450	Manhole	Private
1.001	SIC2	450	Manhole	Private	SIC3	450	Manhole	Private
1.002	SIC3	450	Manhole	Private	PPCP1	600	Manhole	Private
2.000	SIC4	450	Manhole	Private	PPCP1	600	Manhole	Private
1.003	PPCP1	600	Manhole	Private	PPCP2	600	Manhole	Private
3.000	PPCP4	600	Manhole	Private	PPCP5	600	Manhole	Private
3.001	PPCP5	600	Manhole	Private	PPCP2	600	Manhole	Private

Pipeline Schedule

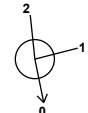
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.004	23.370	150.8	150	Circular	14.670	13.900	0.620	14.360	13.745	0.465
1.005	4.720	152.3	150	Circular	14.360	13.745	0.465	14.200	13.714	0.336
1.006	27.690	150.5	150	Circular	14.200	13.714	0.336	14.135	13.530	0.455
4.000	2.161	144.1	100	Circular	14.310	13.760	0.450	14.360	13.745	0.515

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.004	PPCP2	600	Manhole	Private	CONTROL IC	600	Manhole	Private
1.005	CONTROL IC	600	Manhole	Private	PPCP3	600	Manhole	Private
1.006	PPCP3	600	Manhole	Private	OUTFALL		Junction	
4.000	PPCP6	600	Manhole	Private	CONTROL IC	600	Manhole	Private

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SIC1	495775.282	106299.227	15.150	0.740	450				
						0	1.000	14.410	100
SIC2	495784.228	106300.164	15.150	0.830	450		1	1.000	14.320
						0	1.001	14.320	100
SIC3	495794.671	106297.785	15.150	0.990	450		1	1.001	14.210
						0	1.002	14.160	100
SIC4	495776.807	106280.666	14.820	0.620	450				
						0	2.000	14.200	100
PPCP1	495796.250	106282.702	14.900	0.895	600		1	2.000	14.005
						2	1.002	14.005	100
						0	1.003	14.005	100
PPCP2	495797.355	106272.151	14.670	0.770	600		1	3.001	13.900
						2	1.003	13.900	100
						0	1.004	13.900	150
PPCP3	495800.885	106243.301	14.200	0.486	600		1	1.005	13.714
						0	1.006	13.714	150
PPCP4	495795.904	106312.988	15.440	0.400	600				
						0	3.000	15.040	100
PPCP5	495799.593	106275.790	14.690	0.400	600		1	3.000	14.290
						0	3.001	14.290	100

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
PPCP6	495802.418	106249.076	14.310	0.550	600				
						0	4.000	13.760	100
CONTROL IC	495799.839	106248.414	14.360	0.615	600		1	4.000	13.745
						2	1.004	13.745	150
						0	1.005	13.745	150
OUTFALL	495829.277	106227.267	14.135	0.605			1	1.006	13.530
									150

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Detailed	Additional Storage (m³/ha)	0.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	240	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
10	0	0	0

Node CONTROL IC Online Orifice Control

Flap Valve	x	Design Depth (m)	0.500	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	1.0		
Invert Level (m)	13.745	Diameter (m)	0.027		

Node CONTROL IC Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	13.870
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	50.0	0.0	0.400	50.0	0.0	0.401	0.0	0.0

Node CONTROL IC Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	13.890
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	57.5	0.0	0.400	57.5	0.0	0.401	0.0	0.0

Results for 10 year Critical Storm Duration. Lowest mass balance: 91.64%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SIC1	10	14.447	0.037	1.8	0.0059	0.0000	OK
15 minute summer	SIC2	10	14.376	0.056	3.6	0.0090	0.0000	OK
15 minute summer	SIC3	12	14.288	0.128	5.3	0.0203	0.0000	SURCHARGED
15 minute summer	SIC4	10	14.248	0.048	2.9	0.0076	0.0000	OK
15 minute summer	PPCP1	12	14.187	0.182	7.7	0.0514	0.0000	SURCHARGED
2160 minute winter	PPCP2	1800	14.095	0.195	0.6	0.0551	0.0000	SURCHARGED
2160 minute winter	PPCP3	2340	14.094	0.380	0.1	0.1077	0.0000	FLOOD RISK
15 minute summer	PPCP4	1	15.040	0.000	0.0	0.0000	0.0000	OK
15 minute summer	PPCP5	10	14.329	0.039	6.2	0.0109	0.0000	OK
2160 minute winter	PPCP6	1980	14.095	0.335	0.1	0.0947	0.0000	FLOOD RISK
2160 minute winter	CONTROL IC	2400	14.094	0.349	0.7	21.9782	0.0000	FLOOD RISK
15 minute summer	OUTFALL	1	14.110	0.580	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SIC1	1.000	SIC2	1.8	0.493	0.293	0.0324	
15 minute summer	SIC2	1.001	SIC3	3.5	0.783	0.571	0.0560	
15 minute summer	SIC3	1.002	PPCP1	4.8	0.703	0.785	0.1187	
15 minute summer	SIC4	2.000	PPCP1	2.9	0.498	0.469	0.1099	
15 minute summer	PPCP1	1.003	PPCP2	7.0	0.893	1.163	0.0830	
2160 minute winter	PPCP2	1.004	CONTROL IC	0.6	0.124	0.041	0.4114	
2160 minute winter	PPCP3	1.006	OUTFALL	0.0	0.000	0.000	0.4875	0.0
15 minute summer	PPCP4	3.000	PPCP5	0.0	0.000	0.000	0.0514	
15 minute summer	PPCP5	3.001	PPCP2	6.2	1.145	0.313	0.0200	
2160 minute winter	PPCP6	4.000	CONTROL IC	0.1	0.012	0.019	0.0169	
2160 minute winter	CONTROL IC	1.005	PPCP3	0.1	0.044	0.006	0.0831	

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Manhole Type	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SIC1	0.005	5.00	15.150	Private	450	495775.282	106299.227	0.740
SIC2	0.005	5.00	15.150	Private	450	495784.228	106300.164	0.830
SIC3	0.005	5.00	15.150	Private	450	495794.671	106297.785	0.990
SIC4	0.008	5.00	14.820	Private	450	495776.807	106280.666	0.620
PPCP1	0.000		14.900	Private	600	495796.250	106282.702	0.895
PPCP2	0.000		14.670	Private	600	495797.355	106272.151	0.770
PPCP3	0.000		14.200	Private	600	495800.885	106243.301	0.486
PPCP4	0.000	5.00	15.440	Private	600	495795.904	106312.988	0.400
PPCP5	0.017	5.00	14.690	Private	600	495799.593	106275.790	0.400
PPCP6	0.008	5.00	14.310	Private	600	495802.418	106249.076	0.550
CONTROL IC	0.000		14.360	Private	600	495799.839	106248.414	0.615
OUTFALL	0.000		14.135			495829.277	106227.267	0.605

Links (Results)

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.769	6.0	0.7	0.640	0.730	0.005	0.0	23	0.511
1.001	0.779	6.1	1.4	0.730	0.840	0.010	0.0	32	0.622
1.002	0.777	6.1	2.0	0.890	0.795	0.015	0.0	39	0.696
2.000	0.778	6.1	1.1	0.520	0.795	0.008	0.0	29	0.586
1.003	0.765	6.0	3.1	0.795	0.670	0.023	0.0	51	0.772
3.000	1.101	8.6	0.0	0.300	0.300	0.000	0.0	0	0.000
3.001	2.500	19.6	2.3	0.300	0.670	0.017	0.0	23	1.670
1.004	0.816	14.4	5.4	0.620	0.465	0.040	0.0	64	0.758
1.005	0.812	14.3	6.5	0.465	0.336	0.048	0.0	71	0.791
1.006	0.817	14.4	6.3	0.336	0.455	0.048	0.0	69	0.790
4.000	0.638	5.0	1.1	0.450	0.515	0.008	0.0	32	0.509

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	8.995	99.9	100	Circular	15.150	14.410	0.640	15.150	14.320	0.730
1.001	10.711	97.4	100	Circular	15.150	14.320	0.730	15.150	14.210	0.840
1.002	15.165	97.8	100	Circular	15.150	14.160	0.890	14.900	14.005	0.795
2.000	19.030	97.6	100	Circular	14.820	14.200	0.520	14.900	14.005	0.795
1.003	10.609	101.0	100	Circular	14.900	14.005	0.795	14.670	13.900	0.670
3.000	36.940	49.3	100	Circular	15.440	15.040	0.300	14.690	14.290	0.300
3.001	3.770	9.7	100	Circular	14.690	14.290	0.300	14.670	13.900	0.670

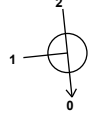
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	SIC1	450	Manhole	Private	SIC2	450	Manhole	Private
1.001	SIC2	450	Manhole	Private	SIC3	450	Manhole	Private
1.002	SIC3	450	Manhole	Private	PPCP1	600	Manhole	Private
2.000	SIC4	450	Manhole	Private	PPCP1	600	Manhole	Private
1.003	PPCP1	600	Manhole	Private	PPCP2	600	Manhole	Private
3.000	PPCP4	600	Manhole	Private	PPCP5	600	Manhole	Private
3.001	PPCP5	600	Manhole	Private	PPCP2	600	Manhole	Private

Pipeline Schedule

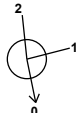
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.004	23.370	150.8	150	Circular	14.670	13.900	0.620	14.360	13.745	0.465
1.005	4.720	152.3	150	Circular	14.360	13.745	0.465	14.200	13.714	0.336
1.006	27.690	150.5	150	Circular	14.200	13.714	0.336	14.135	13.530	0.455
4.000	2.161	144.1	100	Circular	14.310	13.760	0.450	14.360	13.745	0.515

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.004	PPCP2	600	Manhole	Private	CONTROL IC	600	Manhole	Private
1.005	CONTROL IC	600	Manhole	Private	PPCP3	600	Manhole	Private
1.006	PPCP3	600	Manhole	Private	OUTFALL		Junction	
4.000	PPCP6	600	Manhole	Private	CONTROL IC	600	Manhole	Private

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SIC1	495775.282	106299.227	15.150	0.740	450				
						0	1.000	14.410	100
SIC2	495784.228	106300.164	15.150	0.830	450				
						0	1.001	14.320	100
SIC3	495794.671	106297.785	15.150	0.990	450				
						0	1.002	14.160	100
SIC4	495776.807	106280.666	14.820	0.620	450				
						0	2.000	14.200	100
PPCP1	495796.250	106282.702	14.900	0.895	600				
						1	2.000	14.005	100
						2	1.002	14.005	100
						0	1.003	14.005	100
PPCP2	495797.355	106272.151	14.670	0.770	600				
						1	3.001	13.900	100
						2	1.003	13.900	100
						0	1.004	13.900	150
PPCP3	495800.885	106243.301	14.200	0.486	600				
						1	1.005	13.714	150
						0	1.006	13.714	150
PPCP4	495795.904	106312.988	15.440	0.400	600				
						0	3.000	15.040	100
PPCP5	495799.593	106275.790	14.690	0.400	600				
						1	3.000	14.290	100
						0	3.001	14.290	100

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
PPCP6	495802.418	106249.076	14.310	0.550	600				
						0	4.000	13.760	100
CONTROL IC	495799.839	106248.414	14.360	0.615	600		1	4.000	13.745
						2	1.004	13.745	150
						0	1.005	13.745	150
OUTFALL	495829.277	106227.267	14.135	0.605			1	1.006	13.530
									150

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Detailed	Additional Storage (m³/ha)	0.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	240	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
30	45	0	0

Node CONTROL IC Online Orifice Control

Flap Valve	x	Design Depth (m)	0.500	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	1.0		
Invert Level (m)	13.745	Diameter (m)	0.027		

Node CONTROL IC Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	13.870
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	50.0	0.0	0.400	50.0	0.0	0.401	0.0	0.0

Node CONTROL IC Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	13.890
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	57.5	0.0	0.400	57.5	0.0	0.401	0.0	0.0

Results for 30 year +45% CC Critical Storm Duration. Lowest mass balance: 94.57%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute summer	SIC1	13	14.735	0.325	3.5	0.0517	0.0000	SURCHARGED
15 minute summer	SIC2	13	14.724	0.404	6.5	0.0643	0.0000	SURCHARGED
15 minute summer	SIC3	13	14.675	0.515	7.0	0.0818	0.0000	SURCHARGED
15 minute summer	SIC4	12	14.593	0.393	5.5	0.0624	0.0000	FLOOD RISK
15 minute summer	PPCP1	13	14.520	0.515	9.3	0.1458	0.0000	SURCHARGED
15 minute summer	PPCP2	12	14.241	0.341	18.8	0.0965	0.0000	SURCHARGED
120 minute summer	PPCP3	90	14.110	0.396	0.4	0.1122	0.0000	FLOOD RISK
15 minute summer	PPCP4	1	15.040	0.000	0.0	0.0000	0.0000	OK
15 minute summer	PPCP5	11	14.377	0.087	11.7	0.0245	0.0000	OK
600 minute winter	PPCP6	570	14.211	0.451	0.5	0.1276	0.0000	FLOOD RISK
600 minute winter	CONTROL IC	570	14.211	0.466	2.8	33.8921	0.0000	FLOOD RISK
15 minute summer	OUTFALL	1	14.110	0.580	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
15 minute summer	SIC1	1.000	SIC2	3.2	0.551	0.523	0.0704	
15 minute summer	SIC2	1.001	SIC3	4.3	0.811	0.701	0.0838	
15 minute summer	SIC3	1.002	PPCP1	5.7	0.733	0.939	0.1187	
15 minute summer	SIC4	2.000	PPCP1	3.8	0.552	0.628	0.1489	
15 minute summer	PPCP1	1.003	PPCP2	9.5	1.216	1.584	0.0830	
15 minute summer	PPCP2	1.004	CONTROL IC	18.4	1.045	1.276	0.4114	
120 minute summer	PPCP3	1.006	OUTFALL	0.3	0.015	0.019	0.4875	3.2
15 minute summer	PPCP4	3.000	PPCP5	0.0	0.000	0.000	0.1329	
15 minute summer	PPCP5	3.001	PPCP2	11.0	1.448	0.561	0.0283	
600 minute winter	PPCP6	4.000	CONTROL IC	0.5	0.110	0.095	0.0169	
600 minute winter	CONTROL IC	1.005	PPCP3	0.5	0.306	0.034	0.0831	

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Manhole Type	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SIC1	0.005	5.00	15.150	Private	450	495775.282	106299.227	0.740
SIC2	0.005	5.00	15.150	Private	450	495784.228	106300.164	0.830
SIC3	0.005	5.00	15.150	Private	450	495794.671	106297.785	0.990
SIC4	0.008	5.00	14.820	Private	450	495776.807	106280.666	0.620
PPCP1	0.000		14.900	Private	600	495796.250	106282.702	0.895
PPCP2	0.000		14.670	Private	600	495797.355	106272.151	0.770
PPCP3	0.000		14.200	Private	600	495800.885	106243.301	0.486
PPCP4	0.000	5.00	15.440	Private	600	495795.904	106312.988	0.400
PPCP5	0.017	5.00	14.690	Private	600	495799.593	106275.790	0.400
PPCP6	0.008	5.00	14.310	Private	600	495802.418	106249.076	0.550
CONTROL IC	0.000		14.360	Private	600	495799.839	106248.414	0.615
OUTFALL	0.000		14.135			495829.277	106227.267	0.605

Links (Results)

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.769	6.0	0.7	0.640	0.730	0.005	0.0	23	0.511
1.001	0.779	6.1	1.4	0.730	0.840	0.010	0.0	32	0.622
1.002	0.777	6.1	2.0	0.890	0.795	0.015	0.0	39	0.696
2.000	0.778	6.1	1.1	0.520	0.795	0.008	0.0	29	0.586
1.003	0.765	6.0	3.1	0.795	0.670	0.023	0.0	51	0.772
3.000	1.101	8.6	0.0	0.300	0.300	0.000	0.0	0	0.000
3.001	2.500	19.6	2.3	0.300	0.670	0.017	0.0	23	1.670
1.004	0.816	14.4	5.4	0.620	0.465	0.040	0.0	64	0.758
1.005	0.812	14.3	6.5	0.465	0.336	0.048	0.0	71	0.791
1.006	0.817	14.4	6.3	0.336	0.455	0.048	0.0	69	0.790
4.000	0.638	5.0	1.1	0.450	0.515	0.008	0.0	32	0.509

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	8.995	99.9	100	Circular	15.150	14.410	0.640	15.150	14.320	0.730
1.001	10.711	97.4	100	Circular	15.150	14.320	0.730	15.150	14.210	0.840
1.002	15.165	97.8	100	Circular	15.150	14.160	0.890	14.900	14.005	0.795
2.000	19.030	97.6	100	Circular	14.820	14.200	0.520	14.900	14.005	0.795
1.003	10.609	101.0	100	Circular	14.900	14.005	0.795	14.670	13.900	0.670
3.000	36.940	49.3	100	Circular	15.440	15.040	0.300	14.690	14.290	0.300
3.001	3.770	9.7	100	Circular	14.690	14.290	0.300	14.670	13.900	0.670

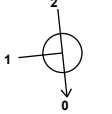
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	SIC1	450	Manhole	Private	SIC2	450	Manhole	Private
1.001	SIC2	450	Manhole	Private	SIC3	450	Manhole	Private
1.002	SIC3	450	Manhole	Private	PPCP1	600	Manhole	Private
2.000	SIC4	450	Manhole	Private	PPCP1	600	Manhole	Private
1.003	PPCP1	600	Manhole	Private	PPCP2	600	Manhole	Private
3.000	PPCP4	600	Manhole	Private	PPCP5	600	Manhole	Private
3.001	PPCP5	600	Manhole	Private	PPCP2	600	Manhole	Private

Pipeline Schedule

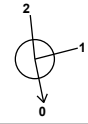
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.004	23.370	150.8	150	Circular	14.670	13.900	0.620	14.360	13.745	0.465
1.005	4.720	152.3	150	Circular	14.360	13.745	0.465	14.200	13.714	0.336
1.006	27.690	150.5	150	Circular	14.200	13.714	0.336	14.135	13.530	0.455
4.000	2.161	144.1	100	Circular	14.310	13.760	0.450	14.360	13.745	0.515

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.004	PPCP2	600	Manhole	Private	CONTROL IC	600	Manhole	Private
1.005	CONTROL IC	600	Manhole	Private	PPCP3	600	Manhole	Private
1.006	PPCP3	600	Manhole	Private	OUTFALL		Junction	
4.000	PPCP6	600	Manhole	Private	CONTROL IC	600	Manhole	Private

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SIC1	495775.282	106299.227	15.150	0.740	450				
						0	1.000	14.410	100
SIC2	495784.228	106300.164	15.150	0.830	450				
						0	1.001	14.320	100
SIC3	495794.671	106297.785	15.150	0.990	450				
						0	1.002	14.160	100
SIC4	495776.807	106280.666	14.820	0.620	450				
						0	2.000	14.200	100
PPCP1	495796.250	106282.702	14.900	0.895	600				
						1	2.000	14.005	100
						2	1.002	14.005	100
						0	1.003	14.005	100
PPCP2	495797.355	106272.151	14.670	0.770	600				
						1	3.001	13.900	100
						2	1.003	13.900	100
						0	1.004	13.900	150
PPCP3	495800.885	106243.301	14.200	0.486	600				
						1	1.005	13.714	150
						0	1.006	13.714	150
PPCP4	495795.904	106312.988	15.440	0.400	600				
						0	3.000	15.040	100
PPCP5	495799.593	106275.790	14.690	0.400	600				
						1	3.000	14.290	100
						0	3.001	14.290	100

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
PPCP6	495802.418	106249.076	14.310	0.550	600				
						0	4.000	13.760	100
CONTROL IC	495799.839	106248.414	14.360	0.615	600		1	4.000	13.745
						2	1.004	13.745	150
						0	1.005	13.745	150
OUTFALL	495829.277	106227.267	14.135	0.605			1	1.006	13.530
								150	

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Detailed	Additional Storage (m³/ha)	0.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	240	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	45	0	0

Node CONTROL IC Online Orifice Control

Flap Valve	x	Design Depth (m)	0.500	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	1.0		
Invert Level (m)	13.745	Diameter (m)	0.027		

Node CONTROL IC Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	13.870
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	50.0	0.0	0.400	50.0	0.0	0.401	0.0	0.0

Node CONTROL IC Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	13.890
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	57.5	0.0	0.400	57.5	0.0	0.401	0.0	0.0

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 98.73%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	SIC1	21	14.970	0.560	4.0	0.0891	0.0000	FLOOD RISK
30 minute summer	SIC2	21	14.957	0.637	5.8	0.1013	0.0000	FLOOD RISK
30 minute summer	SIC3	21	14.896	0.736	7.9	0.1170	0.0000	FLOOD RISK
30 minute summer	SIC4	20	14.796	0.596	6.4	0.0948	0.0000	FLOOD RISK
30 minute summer	PPCP1	21	14.706	0.701	10.5	0.1984	0.0000	FLOOD RISK
30 minute summer	PPCP2	20	14.350	0.450	20.6	0.1274	0.0000	SURCHARGED
180 minute winter	PPCP3	180	13.741	0.027	1.0	0.0075	0.0000	OK
15 minute summer	PPCP4	1	15.040	0.000	0.0	0.0000	0.0000	OK
15 minute summer	PPCP5	12	14.549	0.259	14.7	0.0734	0.0000	FLOOD RISK
180 minute winter	PPCP6	176	14.188	0.428	1.6	0.1212	0.0000	FLOOD RISK
180 minute winter	CONTROL IC	176	14.188	0.443	9.3	31.5766	0.0000	FLOOD RISK
180 minute winter	OUTFALL	180	13.556	0.026	1.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute summer	SIC1	1.000	SIC2	2.7	0.553	0.448	0.0704	
30 minute summer	SIC2	1.001	SIC3	5.0	0.787	0.816	0.0838	
30 minute summer	SIC3	1.002	PPCP1	6.3	0.804	1.030	0.1187	
30 minute summer	SIC4	2.000	PPCP1	4.5	0.580	0.743	0.1489	
30 minute summer	PPCP1	1.003	PPCP2	10.2	1.307	1.702	0.0830	
30 minute summer	PPCP2	1.004	CONTROL IC	20.3	1.151	1.405	0.4114	
180 minute winter	PPCP3	1.006	OUTFALL	1.0	0.469	0.068	0.0579	20.7
15 minute summer	PPCP4	3.000	PPCP5	0.0	0.000	0.000	0.1445	
15 minute summer	PPCP5	3.001	PPCP2	12.3	1.576	0.626	0.0295	
180 minute winter	PPCP6	4.000	CONTROL IC	1.5	0.257	0.303	0.0169	
180 minute winter	CONTROL IC	1.005	PPCP3	1.0	0.454	0.068	0.0102	

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Manhole Type	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
SIC1	0.005	5.00	15.150	Private	450	495775.282	106299.227	0.740
SIC2	0.005	5.00	15.150	Private	450	495784.228	106300.164	0.830
SIC3	0.005	5.00	15.150	Private	450	495794.671	106297.785	0.990
SIC4	0.008	5.00	14.820	Private	450	495776.807	106280.666	0.620
PPCP1	0.000		14.900	Private	600	495796.250	106282.702	0.895
PPCP2	0.000		14.670	Private	600	495797.355	106272.151	0.770
PPCP3	0.000		14.200	Private	600	495800.885	106243.301	0.486
PPCP4	0.000	5.00	15.440	Private	600	495795.904	106312.988	0.400
PPCP5	0.017	5.00	14.690	Private	600	495799.593	106275.790	0.400
PPCP6	0.008	5.00	14.310	Private	600	495802.418	106249.076	0.550
CONTROL IC	0.000		14.360	Private	600	495799.839	106248.414	0.615
OUTFALL	0.000		14.135			495829.277	106227.267	0.605

Links (Results)

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.769	6.0	0.7	0.640	0.730	0.005	0.0	23	0.511
1.001	0.779	6.1	1.4	0.730	0.840	0.010	0.0	32	0.622
1.002	0.777	6.1	2.0	0.890	0.795	0.015	0.0	39	0.696
2.000	0.778	6.1	1.1	0.520	0.795	0.008	0.0	29	0.586
1.003	0.765	6.0	3.1	0.795	0.670	0.023	0.0	51	0.772
3.000	1.101	8.6	0.0	0.300	0.300	0.000	0.0	0	0.000
3.001	2.500	19.6	2.3	0.300	0.670	0.017	0.0	23	1.670
1.004	0.816	14.4	5.4	0.620	0.465	0.040	0.0	64	0.758
1.005	0.812	14.3	6.5	0.465	0.336	0.048	0.0	71	0.791
1.006	0.817	14.4	6.3	0.336	0.455	0.048	0.0	69	0.790
4.000	0.638	5.0	1.1	0.450	0.515	0.008	0.0	32	0.509

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	8.995	99.9	100	Circular	15.150	14.410	0.640	15.150	14.320	0.730
1.001	10.711	97.4	100	Circular	15.150	14.320	0.730	15.150	14.210	0.840
1.002	15.165	97.8	100	Circular	15.150	14.160	0.890	14.900	14.005	0.795
2.000	19.030	97.6	100	Circular	14.820	14.200	0.520	14.900	14.005	0.795
1.003	10.609	101.0	100	Circular	14.900	14.005	0.795	14.670	13.900	0.670
3.000	36.940	49.3	100	Circular	15.440	15.040	0.300	14.690	14.290	0.300
3.001	3.770	9.7	100	Circular	14.690	14.290	0.300	14.670	13.900	0.670

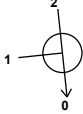
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	SIC1	450	Manhole	Private	SIC2	450	Manhole	Private
1.001	SIC2	450	Manhole	Private	SIC3	450	Manhole	Private
1.002	SIC3	450	Manhole	Private	PPCP1	600	Manhole	Private
2.000	SIC4	450	Manhole	Private	PPCP1	600	Manhole	Private
1.003	PPCP1	600	Manhole	Private	PPCP2	600	Manhole	Private
3.000	PPCP4	600	Manhole	Private	PPCP5	600	Manhole	Private
3.001	PPCP5	600	Manhole	Private	PPCP2	600	Manhole	Private

Pipeline Schedule

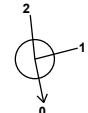
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.004	23.370	150.8	150	Circular	14.670	13.900	0.620	14.360	13.745	0.465
1.005	4.720	152.3	150	Circular	14.360	13.745	0.465	14.200	13.714	0.336
1.006	27.690	150.5	150	Circular	14.200	13.714	0.336	14.135	13.530	0.455
4.000	2.161	144.1	100	Circular	14.310	13.760	0.450	14.360	13.745	0.515

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.004	PPCP2	600	Manhole	Private	CONTROL IC	600	Manhole	Private
1.005	CONTROL IC	600	Manhole	Private	PPCP3	600	Manhole	Private
1.006	PPCP3	600	Manhole	Private	OUTFALL		Junction	
4.000	PPCP6	600	Manhole	Private	CONTROL IC	600	Manhole	Private

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
SIC1	495775.282	106299.227	15.150	0.740	450				
						0	1.000	14.410	100
SIC2	495784.228	106300.164	15.150	0.830	450				
						0	1.001	14.320	100
						1	1.001	14.210	100
SIC3	495794.671	106297.785	15.150	0.990	450				
						0	1.002	14.160	100
SIC4	495776.807	106280.666	14.820	0.620	450				
						0	2.000	14.200	100
PPCP1	495796.250	106282.702	14.900	0.895	600				
						1	2.000	14.005	100
						2	1.002	14.005	100
						0	1.003	14.005	100
PPCP2	495797.355	106272.151	14.670	0.770	600				
						1	3.001	13.900	100
						2	1.003	13.900	100
						0	1.004	13.900	150
PPCP3	495800.885	106243.301	14.200	0.486	600				
						1	1.005	13.714	150
						0	1.006	13.714	150
PPCP4	495795.904	106312.988	15.440	0.400	600				
						0	3.000	15.040	100
PPCP5	495799.593	106275.790	14.690	0.400	600				
						1	3.000	14.290	100
						0	3.001	14.290	100

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
PPCP6	495802.418	106249.076	14.310	0.550	600				
						0	4.000	13.760	100
CONTROL IC	495799.839	106248.414	14.360	0.615	600		1	4.000	13.745
						2	1.004	13.745	150
						0	1.005	13.745	150
OUTFALL	495829.277	106227.267	14.135	0.605			1	1.006	13.530
						1	1.006	13.530	150

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Detailed	Additional Storage (m³/ha)	0.0
Summer CV	1.000	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	1.000	Drain Down Time (mins)	240	Check Discharge Volume	x

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
100	45	0	0

Node OUTFALL Surcharged Outfall

Overrides Design Area	x	Depression Storage Area (m²)	0	Evapo-transpiration (mm/day)	0
Overrides Design Additional Inflow	x	Depression Storage Depth (mm)	0		

Applies to All storms

Time (mins)	Depth (m)	Time (mins)	Depth (m)
0	0.580	10080	0.580

Node CONTROL IC Online Orifice Control

Flap Valve	x	Design Depth (m)	0.500	Discharge Coefficient	0.600
Replaces Downstream Link	x	Design Flow (l/s)	1.0		
Invert Level (m)	13.745	Diameter (m)	0.027		

Node CONTROL IC Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	13.870
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	50.0	0.0	0.400	50.0	0.0	0.401	0.0	0.0

Node CONTROL IC Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	13.890
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	57.5	0.0	0.400	57.5	0.0	0.401	0.0	0.0

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 95.12%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute summer	SIC1	21	14.970	0.560	4.0	0.0891	0.0000	FLOOD RISK
30 minute summer	SIC2	21	14.957	0.637	5.8	0.1013	0.0000	FLOOD RISK
30 minute summer	SIC3	21	14.896	0.736	7.9	0.1170	0.0000	FLOOD RISK
30 minute summer	SIC4	20	14.796	0.596	6.4	0.0948	0.0000	FLOOD RISK
30 minute summer	PPCP1	21	14.706	0.701	10.5	0.1985	0.0000	FLOOD RISK
30 minute summer	PPCP2	20	14.350	0.450	20.6	0.1274	0.0000	SURCHARGED
60 minute winter	PPCP3	51	14.112	0.398	0.5	0.1126	0.0000	FLOOD RISK
15 minute summer	PPCP4	1	15.040	0.000	0.0	0.0000	0.0000	OK
15 minute summer	PPCP5	12	14.549	0.259	14.7	0.0734	0.0000	FLOOD RISK
600 minute summer	PPCP6	585	14.309	0.549	0.9	0.1553	0.0000	FLOOD RISK
600 minute summer	CONTROL IC	585	14.309	0.564	5.3	41.1117	0.0000	FLOOD RISK
15 minute summer	OUTFALL	1	14.110	0.580	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute summer	SIC1	1.000	SIC2	2.7	0.553	0.448	0.0704	
30 minute summer	SIC2	1.001	SIC3	5.0	0.787	0.816	0.0838	
30 minute summer	SIC3	1.002	PPCP1	6.3	0.804	1.030	0.1187	
30 minute summer	SIC4	2.000	PPCP1	4.5	0.580	0.743	0.1489	
30 minute summer	PPCP1	1.003	PPCP2	10.2	1.306	1.702	0.0830	
30 minute summer	PPCP2	1.004	CONTROL IC	20.3	1.151	1.405	0.4114	
60 minute winter	PPCP3	1.006	OUTFALL	0.3	0.020	0.024	0.4875	3.7
15 minute summer	PPCP4	3.000	PPCP5	0.0	0.000	0.000	0.1445	
15 minute summer	PPCP5	3.001	PPCP2	12.3	1.576	0.626	0.0295	
600 minute summer	PPCP6	4.000	CONTROL IC	0.9	0.109	0.170	0.0169	
600 minute summer	CONTROL IC	1.005	PPCP3	0.7	0.121	0.047	0.0831	

Appendix C

LLFA Correspondence

Engineers Comments Regarding Surface Water Drainage

Application Reference:	WA/101/24/PL	Reviewer Reference:	ADC/PC
Planning Officer:	Hannah Kersley	Date of Review:	02/05/2025
Site Name:	Longacres Eastergate Lane Walberton BN18 0BA		
Application Description:	Erection of 1 No. self-build dwelling with associated parking and landscaping. This application is in CIL zone 3 and is CIL liable as a new dwelling.		
Assessment Number:	1 of 1		

Policy and Guidance Information

Arun District Council Surface Water Drainage Guidance - <https://www.arun.gov.uk/surfacewater>

Land Drainage Consent – <https://www.westsussex.gov.uk/fire-emergencies-and-crime/dealing-with-extreme-weather/flooding/flood-risk-management/ordinary-watercourse-land-drainage-consent/>
and
<https://www.arun.gov.uk/land-drainage-consent/>

Arun District Council surface water pre-commencement conditions -
<https://www.arun.gov.uk/planning-pre-commencement-conditions>

The SuDs Manual [C753] by CIRIA

Sustainable drainage systems: non-statutory technical standards'
<https://assets.publishing.service.gov.uk/media/5a815646ed915d74e6231b43/sustainable-drainage-technical-standards.pdf>

Response	Objection
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Critical Items for Surface Water Drainage Design Conditions

The failure to adequately address the following items will result in an objection to a surface water drainage design.

If any of these items are inadequately addressed by the submission, then their correction may result in a redesign of the surface water drainage scheme. A redesign is likely to have site wide implications such as the potential for storage structures to increase in volume or plan area.

Critical Item	Reason	Status
Winter groundwater monitoring data.	Adequate winter groundwater monitoring data must be supplied to evidence that infiltration designs have sufficient freeboard from the base of structures and the peak groundwater level. The same data is necessary to ensure that the potential for buoyancy has been adequately considered in attenuation designs.	Sufficient

Winter infiltration testing data.	Adequate winter infiltration testing must be supplied to justify the proposed discharge method and design infiltration rates. Infiltration tests must be completed strictly in accordance with BRE DG 365, CIRIA R156 or a similar approved method. Testing depths must account for peak groundwater levels and correspond with the location and depth of proposed infiltration features. Designs must be based upon the <u>slowest</u> infiltration rate evidenced closest to a proposed infiltration feature. Average design rates will not be accepted. The results of incomplete tests should not be extrapolated to obtain design values for infiltration rates.	Sufficient, but only due to the inability to achieve one metre freeboard above peak groundwater levels and therefore infiltration is not viable. The applicant should note that if infiltration was feasible then the methodology employed in the infiltration testing would have been non-compliant ie. undertaken too deep, only one test, etc.
The hierarchy for sustainable drainage.	The proposed discharge method must accord with the SuDS hierarchy as given below. Evidence must be supplied to justify the proposed discharge method. 1. Rainwater reuse where possible. 2. Complete discharge into the ground (infiltration). 3. Hybrid infiltration and restricted discharge to an appropriate water body or surface water sewer. 4. Restricted discharge to an appropriate water body. 5. Restricted discharge to a surface water sewer. 6. Restricted discharge to a combined sewer. A water body may be defined as a river, watercourse, ditch, culverted watercourse, reservoir, wetland or the sea. Engineers cannot support any proposed connection of surface water to the foul sewer.	Insufficient - in respect to the proposed driveway/hardstanding areas
Calculations	Calculations for pre-development run off rates must be based upon the positively drained area only. Proposed discharge rates must not increase flood risk on site or elsewhere. Discharge	Insufficient

	rates must be restricted to QBAR or 2 l/s/ha, depending on whichever is higher.	
	Designs must be based on the most recently available rainfall data at the time of conditions being applied. <u>FSR rainfall data will not be accepted.</u> FEH rainfall data is based upon more recent records and continues to be updated.	Compliant
	Designs must use the correct climate change allowances at the time of determination of the outline or full planning application. CV values for all events must be set to 1. This includes summer, winter, design, and simulation events. The correct allowance for urban creep must be applied. Additional storage must be set to zero unless it can be evidenced where this is provided. Infiltration half-drain times must be less than 24 hours. Infiltration design rates must be applied to the sides of soakaways, or to the base of infiltration blankets. Design rates must not be applied to both the base and sides of infiltration structures. A surcharged outfall must be modelled.	Insufficient
Natural catchments design.	The submission must define the natural drainage characteristics within, and hydraulically linked to, the site and demonstrate that the drainage proposals will integrate with and not compromise the function of the natural and existing drainage systems. The condition, performance (including capacity where appropriate) and ownership of any existing site surface water drainage infrastructure must be accurately reported. Appropriate easements to watercourses and other services must be shown on all plans. Where there are areas of flood risk from any source on the site, it must be shown how a sustainable surface water drainage design	Sufficient

	can be accommodated on the site without conflicting with those areas of flood risk. Designs must replicate the natural drainage catchments of the site. All surface water drainage designs must therefore drain via gravity to corresponding points of discharge. The use of pumps for surface water drainage is not sustainable and will not be supported.	
Plans	Plan areas, depths and levels of drainage infrastructure must accurately correspond with the supporting calculations.	Non-Compliant
Water quality benefits.	An assessment of water quality is necessary to evidence that the proposed design provides adequate treatment of surface water.	Not Assessed
Biodiversity and amenity benefits.	The surface water drainage design must provide biodiversity and amenity benefits.	Not Assessed
Trees and planting	There should be no conflict between surface water drainage infrastructure and existing or proposed trees or planting. The design must consider the potential growth of proposed trees and adequate mitigation must be provided to protect drainage infrastructure where conflict cannot be avoided.	Insufficient

Drainage Impact on Other Planning Matters

This application has been assessed with regards to surface water drainage design only.

Other planning matters occasionally effect the surface water drainage design. If plans relating to other matters have been assessed for their impact on the proposed drainage, then it must not be assumed that they have been assessed for any other purpose. The planning officer is advised to check for conflicts with any existing approved plans and to consult any relevant consultees as appropriate.

It has been identified that the following consultees may have comments about the plans that have been submitted and reviewed for this application:

- ☒ **Landscaping officer (proposed trees and landscaping)**
- ☒ **Tree officer (existing trees)**
- ☒ **Ecology officer (proposed trees and landscaping)**

- ☐ Environment Agency (main rivers and fluvial/tidal flood risk, groundwater source protection zones)
- ☐ Southern Water (foul drainage and surface water disposal to public sewer network)
- ☐ Portsmouth Water (groundwater source protection zones)
- ☐ Lead local flood authority (all other sources of flooding and ordinary watercourses)
- ☐ Other:
- ☐ None

Additional comments to the planning officer

The NPPF states that when determining any planning application, local planning authorities should ensure that flood risk is not increased elsewhere (paragraph 181, 182 and 187e). The PPG guides local planning authorities to refer to 'Sustainable drainage systems: non-statutory technical standards' and detailed industry guidance like The SuDS Manual [C753] by CIRIA to guide decisions about the design, maintenance, and operation of sustainable drainage systems for non-major development.

This consultation has been primarily informed by The SuDS Manual.

The following documents have been submitted and assessed to inform this consultation with reference to surface water drainage:

- Flood Risk & Drainage Impact Assessment February 2025
- Site Drainage Strategy Drg. 13467/1101 Rev P1
- HR Wallingford Greenfield Runoff Rate Estimate For Sites
- Impermeable Catchment Plan Drg. 13467/1102 Rev P1
- Causeway Flow Attenuation System Storage Calculations March 2025
- Tree Survey & Arboricultural Impact Assessment November 2024
- Ashdown Site Investigation – Insitu Infiltration Test Report Ref; R16518 December 2024

Surface water drainage

Insufficient evidence has been submitted to demonstrate that the proposed development can be sustainably drained in accordance with national planning practice guidance.

Due to the high water table it is recognised that a compliant infiltration design is not possible, as one metre freeboard between peak groundwater levels and the base of any infiltration structure cannot be achieved. The proposal is therefore to discharge to the eastern boundary watercourse with a restricted flow rate. The site is noted to be in a groundwater source protection zone.

The proposed design raises a number of issues;

1. The routing of pipework through the root protection zone of a mature tree. Given the species of tree, the roots could be detrimental to the operation of the pipeline in the future. Our tree officer will provide a consultation in this respect.
2. It is understood that the existing driveway will remain in its present form, however, it is noted the any new sections of driveway/hardstanding will be constructed with a permeable surface.

The principle is acceptable, however, the new areas will need to be an engineered design. Thus, they will need to be incorporated within the overall drainage design.

3. The proposed discharge rate (QBAR) appears to have been calculated on the entire site area rather than just the impermeable area. This will need to be re-calculated accordingly (to also include the new driveway/hardstanding contributing areas) and a discharge rate agreed. Due to the low rate expected and potential orifice diameter, suitable measures will need to be put in place to reduce the risk of blockage.
4. The hydraulic calculations do not reflect the current design in terms of levels. However, the calculations need to be revisited as a result of the above, and must include the piped network and evidence of the impermeable areas used. Urban creep @ 10% also needs to be applied. Appropriate climate change allowance needs to be applied to all storm events. A surcharged outfall will need to be modelled. The surcharge level should be to the top of the bank if hydraulic modelling of the watercourse is not available.
5. An exceedance overland flow route plan needs to be provided.
6. No freeboard is being achieved between the proposed outfall pipe invert and the existing ditch bed. This is not acceptable as flood risk may be increased due to siltation and blockage of the outfall. Adequate freeboard needs to be achieved and agreed.
7. The proposed landscaping conflicts with the proposed drainage layout. For example, a tree is proposed in close proximity to the storage tank. The tree species and root protection zone at maturity will need to be shown to ensure no detriment to the structure. There is also new hedging proposed which could lead to root intrusion into the pipes beneath. This is important as tree roots could damage the liner and pipework, allowing groundwater to enter the system. This would consume storage that is set aside for surface water and thus increase flood risk.
8. Interception drainage has not been adequately considered by the submission. This is an important consideration as when the drainage system is designed in accordance with The SuDS Manual, runoff for the majority of small (frequent) events will be prevented from leaving the site. This is the first water quantity standard prescribed by the manual. Designing for interception is more challenging where infiltration is not viable as it must be provided via evapotranspiration only.

The proposed connection to the watercourse will either require Land Drainage Consent under the Land Drainage Act 1991, or consent under Arun District Councils Land Drainage Byelaws 2004. The consent required will depend upon the proposed construction details for the headwall.

Overcoming the objection

As this is not a holding objection or a request for further information, requested conditions are not listed. If you are minded to approve this application, please reconsult engineers for a list of suggested conditions to ensure that the development is adequately drained and does not increase flood risk elsewhere.

The imposition of conditions at this stage rather than overcoming the objection could result in a circumstance where the condition/s cannot be discharged. In the event of attaching a condition that cannot be discharged, permission may be invalid.

If the planning officer is minded to allow the applicant additional time to submit further documents to support this application, then the applicant must provide updated plans/evidence to address items 1 to 8 above, which may overcome the objection. The applicants attention is also drawn to the site-specific checklist below.

Please do not submit further documents without prior discussion with the planning officer as to whether it will be possible for these to be assessed or influence their determination.

A reduced **site-specific** version of our full surface water drainage design checklist is provided below. This has been edited to remove elements that are not applicable to this site, either due to the scale of the proposal or the method of disposal. The checklist is provided to assist the applicant and designer in preparing a revised design to meet our requirements. It is applicable to this site only.

- Items highlighted as must be provided prior to determination to overcome our objection.
- Additional comments or notes are provided by the reviewer **in bold**.
- If an item has been submitted this is checked: ☒
- Items not checked or highlighted are not considered applicable or required at this stage.
- For HH, OUT, RES and PL applications only: All other items are assumed to be handled via a condition applied to the permission if given.

Our requirements and comments are elaborated upon or condensed within a separate comment tracker where necessary. If a comment tracker is provided a designer is encouraged to refer to this and respond to comments to aid further review. Please request a .docx version of this document to by email to land.drainage@arun.gov.uk if needed.

The full unedited surface water design checklist is available on our website at <https://www.arun.gov.uk/surfacewater/>. **If the design is amended following receipt of our consultation the designer may need to refer to the full checklist to ensure that the revised design meets our requirements.**

Longacres, Eastergate Lane, Walberton Designer Checklist

Ground Investigation Results

Groundwater monitoring

- ☒ Plan showing location of monitoring points provided.
- ☒ Depths of holes detailed.
- ☒ Dates of observations and depth to groundwater recorded.
- ☒ Evidence of the strata within borehole or monitoring pits provided.

Requested to aid speed of assessment

- ☒ Plan showing the peak groundwater levels at each monitoring point in mAOD.
- ☐ Peak groundwater levels recorded in metres below ground level and mAOD.

Infiltration testing

- ☒ Completed strictly in accordance with BRE DG 365, CIRIA R156 or a similar approved method.

Refer to previous comments in critical items list, in respect to testing undertaken.

- ☒ Plan showing location of trial pits provided.
- ☒ Pit dimensions provided.
- ☒ Depths of testing provided.
- ☒ Dates, times and readings of each test recorded.
- ☐ Calculations for the infiltration rate for each test provided.
- ☒ Evidence of the strata within trial pits provided.
- ☐ Test locations, and depths correspond with the expected location and depths of proposed infiltration features.

Requested to aid speed of assessment

- ☐ Depths of testing provided in m below ground level and mAOD.

Other

As appropriate, dependent upon specific site conditions

- ☐ Geotechnical advice relating to the siting of infiltration features and risk of dissolution. (Usually where chalk strata is evidenced.)

Surface Water Drainage Statement

Disposal method (Select as appropriate)

- ☒ Rainwater reuse is proposed where possible.
- ☒ Infiltration is proposed and maximised wherever possible.
- ☒ Hybrid infiltration and restricted discharge to an appropriate water body or surface water sewer is proposed where a full infiltration design is not possible.
- ☒ Restricted discharge to a water body is proposed where a full infiltration design is not possible.

Disposal method justification

- ☒ Infiltration has been adequately investigated, in winter, at appropriate and varying depths where appropriate, above peak recorded winter groundwater levels at the given location.
- ☒ Onsite and boundary, open and culverted water bodies are investigated (location, mapping, network, flow direction, ownership/responsibility, depth, and condition).

☒ Any relevant permissions or legal agreements from asset or landowners that are needed are identified and evidence of consents provided. **Evidence of landowner permission to connect to watercourse. [Consents via condition].**

Requested to aid speed of assessment

☐ Any previous relevant correspondence or pre-application advice from the Local Planning Authority [LPA] or the Lead Local Flood Authority [LLFA] regarding the surface water drainage design is included with the statement.

Existing Site

Essential

- ☐ It is clear what the natural drainage characteristics of the site and hydraulically linked areas are.
- ☐ Natural flow paths are identified on a plan (where applicable).
- ☒ Existing site drainage features are investigated – condition, performance, and ownership.
- ☐ Any appropriate easements to watercourses or other infrastructure are investigated.
- ☐ Existing and future flood risk from any source is detailed.

It is suggested that the above is achieved with the following, which may be combined where appropriate:

- ☒ An existing topographical plan.
- ☒ Flood maps (fluvial, tidal, pluvial, groundwater, sewer, and reservoir) are supplied (or Flood Risk Assessment referred to).

Proposed Design

Essential

☒ Statement confirming the proposed design criteria including fixed design calculation inputs for the SuDS system. Examples include:

- Climate change allowances,
- Urban creep allowance,
- CV values,
- Rainfall data,
- MADD factor or additional storage.

- ☐ Natural catchments are followed.
- ☒ The design is gravity based with no use of pumps.
- ☐ Natural systems that deliver specific hydrological function, such as watercourses or wetlands, are preserved.
- ☐ Details of necessary off-site works and consents are provided.
- ☐ It is shown how a surface water drainage design will not conflict with additional areas of flood storage or compensation.
- ☐ Surface water flow entering the site from elsewhere is conveyed safely around or through the site without compromising the SuDS system.

☒ The design provides and evidences interception drainage and is able to capture and retain on site the first 5mm of the majority of all rainfall events.

☒ Water quality and treatment is adequately assessed – with an assessment appropriate for the scale and proposed use of the site.

☐ There are no clashes with other infrastructure.

☒ Self-cleansing velocities are achieved where pipes are proposed.

☐ 1m freeboard is provided between peak groundwater levels and the base of any infiltration feature.

☒ The proposed discharge rate is explained and justified (for attenuation designs). **To be recalculated.**

☐ Where there is a risk that the base of an attenuation feature may penetrate peak groundwater levels, additional mitigation measures to prevent groundwater ingress are incorporated into the design and construction method statement.

☐ Where there is a risk that the base of an attenuation feature may penetrate peak groundwater levels the effects of buoyancy have been considered in the design.

☐ Biodiversity benefits are provided by the drainage system (assessed by others).

☒ Landscaping has been designed to ensure ease of maintenance of drainage assets.

☒ The justification and criteria for tree root avoidance and mitigation measures is clear, referencing adopting body standards where applicable.

☒ Biodiversity and ecological enhancements do not impede the functionality, maintenance or capacity of the drainage system.

☐ It is confirmed what elements of the SuDS will be private.

☐ A construction method statement for the SuDS system, appropriate to the scale of the development, is submitted.

☐ A maintenance plan for the SuDS system, appropriate to the scale of the development, is submitted. [Please refer to our SuDS Maintenance Checklist where this is stipulated by condition.]

Preferred

☐ Ground raising is avoided where possible. [Minimal].

☐ The drainage system is considered by and contributes to the biodiversity net gain statement (assessed by others).

Impermeable Area/Catchment Plan

Essential

☒ An impermeable area plan is provided showing all positively drained areas including open surface water storage plan areas. **To include new sections of driveway/hardstanding.**

Preferred

☒ Impermeable areas are shown in m² on the impermeable areas plan(s). **To be adjusted.**

☒ Demarcated impermeable areas correspond with the distribution of those areas in the supporting calculations.

Surface Water Drainage Calculations

General

☒ The most recently applicable, or previously agreed FEH rainfall data is used.

☒ CV values for all events are set to 1. This includes summer, winter, design, and simulation events.

☒ The correct climate change allowances, appropriate for the full lifetime of the development, have been applied to all calculations.

☒ A 10% allowance for urban creep is applied to all residential roof areas.

☒ 100% Annual Exceedance Probability [AEP] + Climate Change Allowance [CCA] (1 in 1 year) event calculations provided.

☐ 3.33% AEP + CCA (1 in 30 year) event calculations provided showing that the full surface water volume is contained within the designed system without flooding.

☐ 1% AEP + CCA (1 in 100 year) event calculations provided showing that the full surface water volume is contained safely on site, without flooding any part of a building or utility plant susceptible to water or affecting safe access or egress.

All storm event calculations to be adjusted to suit an appropriate revised scheme.

Infiltration

☐ Half drain times do not exceed 24 hours for the 10% AEP + CCA and 1% AEP + CCA events.

☐ If half drain times exceed 24 hours for the 1% AEP + CCA event, then advice and agreement from the LPA has been sought and submitted.

☐ The most precautionary design infiltration rate is used.

☐ Design infiltration rates are applied to the sides of soakaways only.

☐ Design infiltration rates are applied to the base of permeable paving, infiltration blankets or basins only.

☐ Where the design infiltration rate is applied to the base an appropriate factor of safety is applied.

Attenuation and Restricted Discharge

☐ Greenfield run off rates are based upon the positively drained area of the site only.

☐ Discharge rates are restricted to QBAR or 2 l/s/ha, depending on whichever is higher, for all storms up to the 1% AEP + CCA event. **To be revised.**

☐ Half drain times and available capacity in the drainage system for subsequent storms are considered.

☐ A surcharged outfall to a watercourse or sewer has been modelled. The surcharge level is the 1% AEP + CCA flood event for the receiving watercourse, or to the top of the bank if appropriate hydraulic modelling is not available.

☐ A surcharged outfall to a tidal waterbody has been modelled. The surcharge level is based upon present day extreme sea levels with an allowance for sea level rise applied.

Requested to aid assessment

☐ FEH22 point descriptors for the site are provided.

Drainage Plans and Specifications

Essential

Plans are provided showing:

☐ The proposed design within the proposed site layout. **Design to be updated to suit comments.**

☐ Existing and proposed site levels. **To include finished ground levels, floor levels, new sections of driveway/hardstanding (finished & formation levels).**

☐ Long and cross sections for the proposed drainage system including final finished floor levels.

☐ Exceedance flow management routes.

☐ Details of connections to watercourses and sewers.

These plans must be of sufficient detail that a reviewer can be confident that the design can be constructed without flood risk being increased on site or elsewhere.

Specifications are required for all materials used in the design. We suggest that this is best achieved and illustrated with site specific construction detail drawings. The combination of construction details, with plans and sections, ensure that the proposed standard of construction will facilitate adoption and maintenance by an appropriate body and have structural integrity.

The following checklist is designed to demonstrate the level of detail required:

Easements

- ☐ 3m easements are shown from the top of the bank of all ordinary watercourses, and from the edge of all culverted watercourses on all plans. **Include west and north watercourses.**
- ☐ Infiltration features (aside from permeable paving that does not take any extra impermeable catchment such as a roof) are shown at least 5m from buildings or structures.
- ☒ Existing trees and their root protection zones are shown on any drainage layout.
- ☒ Proposed trees and appropriate easements are shown on any drainage layout.

Detail

- ☒ It can be clearly determined what a pipe's diameter, pipe materials, gradients, flow directions and invert levels are from the plans. **May need to be revised due to redesign.**
- ☒ It can be clearly determined what an inspection chamber or manhole's cover level, invert level, cover loading grade and sump depth (where applicable) are from the plans. **Adequate for this stage but may need to be revised.**
- ☒ All infiltration or attenuation features (including permeable paving) are clearly labelled with their dimensions, invert/base levels and cover levels. **May need to be revised.**
- ☒ Control structures are labelled with discharge rates, **hydraulic head**, invert and cover levels and ideally model number. **May need to be revised.**
- ☒ Measures to protect drainage from tree root damage are clearly shown on any drainage layout.
- ☐ Any areas of necessary ground raising are clearly justified and demarked on a plan, with depths and levels.
- ☐ Potential flow routes off site are shown. The plan also includes proposed external ground levels, finished floor levels of buildings and designed slopes on all impermeable surfaces such as highways or car parks.
- ☐ Construction detail drawings are site specific.
- ☐ Construction detail drawings are provided for all components including but not limited to:
 - ☐ Infiltration structures
 - ☒ Attenuation structures
 - ☐ Manholes/inspection chambers
 - ☐ Catchpits/silt traps
 - ☐ Flow control devices
 - ☒ Permeable paving
 - ☐ Headwalls
 - ☐ Channel drains
 - ☐ Gullies
 - ☐ Pipe bed and surround
 - ☐ Pipe to pipe connections
 - ☐ Filter strips or drains
 - ☐ Swales
 - ☐ Bio-retention systems
 - ☐ Ponds and wetlands
 - ☐ Tree pits and measures to protect drainage from root incursion
 - ☐ Water treatment features
 - ☐ Green roofs
 - ☐ Measures to protect drainage from tree roots.
 - ☐ Water butts or alternative methods of water reuse – also to be shown on plans.

The following items are requested to aid assessment or confidence in construction:

☐ Where features have a non-uniform plan area, a plan showing the coordinates of the perimeter is provided.

☒ All drainage infrastructure is labelled to correspond with the supporting calculations.

Other

☐ Open feature planting specification is provided (to be assessed by others).

This checklist is designed to aid an applicant with their submission. The list is not exhaustive, and our engineers may request additional information to enable them to review a proposal to their satisfaction.

The checklist may also request information that an applicant does not feel is relevant to their submission. In this case the applicant can provide an explanation as to why they have omitted certain information in their drainage statement. However, the appraising engineer reserves the right to request this information if they believe it is necessary for their review.



Civil Engineering - Transport Planning - Flood Risk

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