

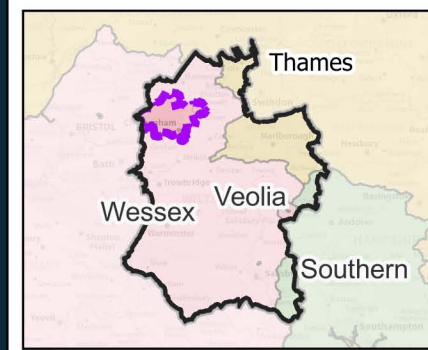
APPENDIX I: SFRA Sewer Flood Risk Map



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Wiltshire Council



Risk of Flooding from Sewers: Chippenham

Legend

- Wiltshire boundary
- Community Partnership Area

Sewer Flood Incidents

- 0
- 1 - 10
- 11 - 20
- 20 - 50
- 100 - 130
- >200



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APPENDIX J: Surface Water Drainage Strategy



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- NOTES:

1. The proposed drainage strategy is indicative and is subject to detailed design.
2. This drawing is based on the proposed layout issued by T & C on 26th June 2026, drawing number: TOR-SK009, REV. C.
3. C/L's are based on the topographic survey undertaken by Healer Surveys in June 2022.
4. The attenuation features shown on this drawing are based on the hardstanding surfaces in the development and will need to be reviewed if the layout is amended. A 10% allowance for urban creep has been allowed for drivings.
5. A 30% betterment allowance has been applied to Greenfield runoff rates as required by the Drainage and Betterment Strategy produced by Wiltshire Council.
6. It is proposed for Catchment Area 01 to discharge into Attenuation Basin's 01A and 02A, Catchment Area 02 to discharge into Attenuation Basin's 02A and 02B, and Catchment Areas 03, 04, and 05 will discharge into Attenuation Basin 03.
7. Catchment areas are assumed, and will need to be reviewed based on the latest layout, which may impact attenuation volumes.
8. Where roads / footpaths cross the ditch, suitably sized culverts will be provided and ordinary watercourse consent will be obtained.
9. The existing Wessex Water rising main shown on this drawing in red is proposed to be diverted under a S185 agreement with the water authority.
10. MH13 to MH18, MH28 and MH144 have been omitted from this drawing.

PRELIMINARY

P7	Updated Site Layout. (FA)	SL	30/06/2026
P6	Updated Site Layout. (FA)	SL	19/06/2026
P5	Updated Site Layout. (FA)	SL	26/03/2026
P4	Drainage updated to latest architect layout. (PO)	SL	20/01/2026
P3	Revised following updated spine road levels provided by I-Transport. (FA)	SL	25/04/2025
P2	Updated following updated to surface water flooding extents (GB)	SL	12/03/2025
P1	Initial Issue. (FA)	SL	20/01/2025

rev.	amendment	checked	date
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project

FOREST FARM, CHIPPENHAM

scale 1:1000	drawn by FA	checked by SL
date MARCH 2026	cad file MASTER.dwg	

PROPOSED SURFACE WATER DRAINAGE STRATEGY

Mayer Brown Limited Jobcode	suitability	revision
SL/GLFORESTFARM.23	-	P7

drawing number
GLFORESTFARM.23/23

APPENDIX K: Network Model Calculations

Design Settings

Rainfall Methodology	FEH-22	Maximum Time of Concentration (mins)	30.00	Preferred Cover Depth (m)	1.200
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0	Include Intermediate Ground	✓
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00	Enforce best practice design rules	x
CV	1.000	Connection Type	Level Soffits		
Time of Entry (mins)	5.00	Minimum Backdrop Height (m)	0.200		

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
Attenuation Basin 01A	4.490	5.00	55.000	1200	394208.576	171673.037	1.200	53.800
Attenuation Basin 01B	3.200	5.00	54.200	1200	394022.104	171595.317	1.150	53.050
Attenuation Basin 02A	0.248	5.00	54.400	1200	394104.203	171568.914	1.000	53.400
Attenuation Basin 02B	0.900	5.00	54.000	1200	393951.820	171480.311	1.200	52.800
Attenuation Basin 03	2.429	5.00	53.300	1200	393758.603	171357.248	1.200	52.100
Hydrobrake 01A			55.700	1800	394224.022	171626.392	2.064	53.636
Hydrobrake 01B			54.233	1200	394019.258	171578.571	1.233	53.000
Hydrobrake 02A			54.300	1200	394081.755	171577.937	1.050	53.250
Hydrobrake 02B			53.949	1200	393922.407	171471.316	1.249	52.700
Hydrobrake 03			53.051	1200	393762.262	171351.996	1.151	51.900
Outfall 01A			54.530	1200	394217.541	171589.800	1.000	53.530
Outfall 01B			54.000	1200	394019.810	171568.595	1.040	52.960
Outfall 02A			54.026	1200	394062.537	171583.808	0.826	53.200
Outfall 02B			53.500	1200	393904.538	171468.456	0.860	52.640
Outfall 03			52.800	1200	393761.954	171347.050	1.000	51.800

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	Attenuation Basin 01A	Hydrobrake 01A	49.136	0.600	53.800	53.636	0.164	300.0	300	5.91	50.0
1.001	Hydrobrake 01A	Outfall 01A	37.162	0.600	53.636	53.530	0.106	350.6	300	6.65	50.0
4.000	Attenuation Basin 01B	Hydrobrake 01B	16.986	0.600	53.050	53.000	0.050	339.7	450	5.26	50.0
4.001	Hydrobrake 01B	Outfall 01B	9.991	0.600	53.000	52.960	0.040	249.8	450	5.39	50.0
3.000	Attenuation Basin 02A	Hydrobrake 02A	24.194	0.600	53.400	53.250	0.150	161.3	225	5.39	50.0
3.001	Hydrobrake 02A	Outfall 02A	20.095	0.600	53.250	53.200	0.050	401.9	300	5.82	50.0
2.000	Attenuation Basin 02B	Hydrobrake 02B	30.758	0.600	52.800	52.700	0.100	307.6	225	5.69	50.0
2.001	Hydrobrake 02B	Outfall 02B	18.096	0.600	52.700	52.640	0.060	301.6	225	6.10	50.0
5.000	Attenuation Basin 03	Hydrobrake 03	6.401	0.600	52.100	51.900	0.200	32.0	225	5.05	50.0
5.001	Hydrobrake 03	Outfall 03	4.956	0.600	51.900	51.800	0.100	49.6	300	5.08	50.0

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	0.902	63.8	811.3	0.900	1.764	4.490	0.0	300	0.914
1.001	0.834	58.9	811.3	1.764	0.700	4.490	0.0	300	0.845
4.000	1.097	174.5	578.2	0.700	0.783	3.200	0.0	450	1.111
4.001	1.282	203.8	578.2	0.783	0.590	3.200	0.0	450	1.298
3.000	1.027	40.8	44.8	0.775	0.825	0.248	0.0	225	1.046
3.001	0.778	55.0	44.8	0.750	0.526	0.248	0.0	207	0.864
2.000	0.740	29.4	162.6	0.975	1.024	0.900	0.0	225	0.754
2.001	0.747	29.7	162.6	1.024	0.635	0.900	0.0	225	0.761
5.000	2.320	92.3	438.9	0.975	0.926	2.429	0.0	225	2.363
5.001	2.238	158.2	438.9	0.851	0.700	2.429	0.0	300	2.267

Simulation Settings

Rainfall Methodology	FEH-22	Winter CV	1.000	Drain Down Time (mins)	1440	Check Discharge Rate(s)	x
Rainfall Events	Singular	Analysis Speed	Normal	Additional Storage (m³/ha)	0.0	Check Discharge Volume	x
Summer CV	1.000	Skip Steady State	x	Starting Level (m)			

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440
----	----	----	-----	-----	-----	-----	-----	-----	-----	-----	------

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0	100	45	0	0
30	45	0	0				

Node Hydrobrake 01A Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	53.636	Product Number	CTL-SHE-0147-1270-2064-1270
Design Depth (m)	2.064	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	12.7	Min Node Diameter (mm)	1800

Node Hydrobrake 01B Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	53.000	Product Number	CTL-SHE-0159-1270-1200-1270
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.225
Design Flow (l/s)	12.7	Min Node Diameter (mm)	0

Node Hydrobrake 02A Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	53.250	Product Number	CTL-SHE-0063-1900-1150-1900
Design Depth (m)	1.150	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	1.9	Min Node Diameter (mm)	0

Node Hydrobrake 02B Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	52.700	Product Number	CTL-SHE-0061-1900-1300-1900
Design Depth (m)	1.300	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	1.9	Min Node Diameter (mm)	0

Node Hydrobrake 03 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	51.900	Product Number	CTL-SHE-0130-8200-1200-8200
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	8.2	Min Node Diameter (mm)	0

Node Attenuation Basin 01A Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	53.800
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	5506.0	0.0	1.200	6539.6	0.0

Node Attenuation Basin 01B Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	53.050
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	3798.0	0.0	1.150	4911.0	0.0

Node Attenuation Basin 02A Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	53.400
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	1320

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	334.0	0.0	1.000	586.0	0.0

Node Attenuation Basin 02B Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	52.800
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	1471.0	0.0	1.200	1938.0	0.0

Node Attenuation Basin 03 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	52.100
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	3579.6	0.0	1.200	4605.5	0.0

Results for 1 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	Attenuation Basin 01A	990	53.947	0.147	55.2	816.8169	0.0000	OK
960 minute summer	Attenuation Basin 01B	645	53.186	0.136	53.8	526.2881	0.0000	OK
480 minute summer	Attenuation Basin 02A	320	53.478	0.078	6.7	26.9042	0.0000	OK
1440 minute summer	Attenuation Basin 02B	1080	52.916	0.116	11.1	172.6865	0.0000	OK
960 minute summer	Attenuation Basin 03	660	52.205	0.105	40.8	381.1786	0.0000	OK
1440 minute summer	Hydrobrake 01A	990	53.942	0.306	11.7	0.7783	0.0000	SURCHARGED
960 minute summer	Hydrobrake 01B	645	53.184	0.184	11.8	0.2082	0.0000	OK
480 minute summer	Hydrobrake 02A	312	53.481	0.231	2.3	0.2607	0.0000	OK
1440 minute summer	Hydrobrake 02B	1080	52.915	0.215	1.6	0.2435	0.0000	OK
960 minute summer	Hydrobrake 03	660	52.240	0.340	19.4	0.3848	0.0000	SURCHARGED
15 minute summer	Outfall 01A	1	53.530	0.000	2.0	0.0000	0.0000	OK
15 minute summer	Outfall 01B	1	52.960	0.000	2.5	0.0000	0.0000	OK
15 minute summer	Outfall 02A	1	53.200	0.000	1.4	0.0000	0.0000	OK
15 minute summer	Outfall 02B	1	52.640	0.000	0.9	0.0000	0.0000	OK
15 minute summer	Outfall 03	1	51.800	0.000	3.5	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)
1440 minute summer	Attenuation Basin 01A	1.000	Hydrobrake 01A	11.7	0.378	0.184	2.5705	
960 minute summer	Attenuation Basin 01B	4.000	Hydrobrake 01B	11.8	0.314	0.067	0.8612	
480 minute summer	Attenuation Basin 02A	3.000	Hydrobrake 02A	2.3	0.203	0.057	0.6288	
1440 minute summer	Attenuation Basin 02B	2.000	Hydrobrake 02B	1.6	0.179	0.053	0.9176	
960 minute summer	Attenuation Basin 03	5.000	Hydrobrake 03	19.4	0.655	0.210	0.1855	
1440 minute summer	Hydrobrake 01A	Hydro-Brake®	Outfall 01A	11.7				1093.3
960 minute summer	Hydrobrake 01B	Hydro-Brake®	Outfall 01B	11.8				728.9
480 minute summer	Hydrobrake 02A	Hydro-Brake®	Outfall 02A	1.7				49.8
1440 minute summer	Hydrobrake 02B	Hydro-Brake®	Outfall 02B	1.6				216.6
960 minute summer	Hydrobrake 03	Hydro-Brake®	Outfall 03	8.2				577.5

Results for 30 year +45% CC Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	Attenuation Basin 01A	1410	54.458	0.658	135.2	3810.2480	0.0000	SURCHARGED
1440 minute winter	Attenuation Basin 01B	1380	53.662	0.612	96.3	2505.9510	0.0000	SURCHARGED
720 minute winter	Attenuation Basin 02A	705	53.807	0.407	12.6	157.2342	0.0000	SURCHARGED
1440 minute winter	Attenuation Basin 02B	1440	53.322	0.522	27.1	821.8970	0.0000	SURCHARGED
1440 minute winter	Attenuation Basin 03	1410	52.614	0.514	73.1	1954.4340	0.0000	SURCHARGED
1440 minute winter	Hydrobrake 01A	1410	54.451	0.815	12.7	2.0736	0.0000	SURCHARGED
1440 minute winter	Hydrobrake 01B	1380	53.662	0.662	12.8	0.7482	0.0000	SURCHARGED
720 minute winter	Hydrobrake 02A	705	53.807	0.557	1.9	0.6296	0.0000	SURCHARGED
1440 minute winter	Hydrobrake 02B	1440	53.322	0.622	1.6	0.7035	0.0000	SURCHARGED
1440 minute winter	Hydrobrake 03	1410	52.612	0.712	14.7	0.8054	0.0000	SURCHARGED
15 minute summer	Outfall 01A	1	53.530	0.000	12.2	0.0000	0.0000	OK
15 minute summer	Outfall 01B	1	52.960	0.000	12.5	0.0000	0.0000	OK
15 minute summer	Outfall 02A	1	53.200	0.000	1.7	0.0000	0.0000	OK
15 minute summer	Outfall 02B	1	52.640	0.000	1.6	0.0000	0.0000	OK
15 minute summer	Outfall 03	1	51.800	0.000	8.2	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)
1440 minute winter	Attenuation Basin 01A	1.000	Hydrobrake 01A	12.7	0.377	0.200	3.4601	
1440 minute winter	Attenuation Basin 01B	4.000	Hydrobrake 01B	12.8	0.312	0.073	2.6913	
720 minute winter	Attenuation Basin 02A	3.000	Hydrobrake 02A	1.9	0.203	0.047	0.9622	
1440 minute winter	Attenuation Basin 02B	2.000	Hydrobrake 02B	1.6	0.182	0.055	1.2233	
1440 minute winter	Attenuation Basin 03	5.000	Hydrobrake 03	14.7	0.505	0.160	0.2546	
1440 minute winter	Hydrobrake 01A	Hydro-Brake®	Outfall 01A	12.7				1926.9
1440 minute winter	Hydrobrake 01B	Hydro-Brake®	Outfall 01B	12.7				1883.3
720 minute winter	Hydrobrake 02A	Hydro-Brake®	Outfall 02A	1.7				198.4
1440 minute winter	Hydrobrake 02B	Hydro-Brake®	Outfall 02B	1.6				222.7
1440 minute winter	Hydrobrake 03	Hydro-Brake®	Outfall 03	8.2				1225.3

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	Attenuation Basin 01A	1440	54.699	0.899	179.2	5296.7130	0.0000	SURCHARGED
1440 minute winter	Attenuation Basin 01B	1410	53.900	0.850	127.7	3578.4540	0.0000	SURCHARGED
960 minute winter	Attenuation Basin 02A	930	53.963	0.563	13.6	228.3986	0.0000	SURCHARGED
1440 minute winter	Attenuation Basin 02B	1440	53.496	0.696	35.9	1118.2430	0.0000	SURCHARGED
1440 minute winter	Attenuation Basin 03	1410	52.811	0.711	96.9	2763.8810	0.0000	SURCHARGED
1440 minute winter	Hydrobrake 01A	1440	54.692	1.056	12.8	2.6884	0.0000	SURCHARGED
1440 minute winter	Hydrobrake 01B	1410	53.900	0.900	12.8	1.0174	0.0000	SURCHARGED
960 minute winter	Hydrobrake 02A	930	53.962	0.712	1.8	0.8056	0.0000	SURCHARGED
1440 minute winter	Hydrobrake 02B	1440	53.495	0.795	1.6	0.8995	0.0000	SURCHARGED
1440 minute winter	Hydrobrake 03	1410	52.809	0.909	14.0	1.0285	0.0000	FLOOD RISK
15 minute summer	Outfall 01A	1	53.530	0.000	12.4	0.0000	0.0000	OK
15 minute summer	Outfall 01B	1	52.960	0.000	12.7	0.0000	0.0000	OK
15 minute summer	Outfall 02A	1	53.200	0.000	1.7	0.0000	0.0000	OK
15 minute summer	Outfall 02B	1	52.640	0.000	1.6	0.0000	0.0000	OK
15 minute summer	Outfall 03	1	51.800	0.000	8.2	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)
1440 minute winter	Attenuation Basin 01A	1.000	Hydrobrake 01A	12.8	0.375	0.200	3.4601	
1440 minute winter	Attenuation Basin 01B	4.000	Hydrobrake 01B	12.8	0.312	0.073	2.6913	
960 minute winter	Attenuation Basin 02A	3.000	Hydrobrake 02A	1.8	0.204	0.044	0.9622	
1440 minute winter	Attenuation Basin 02B	2.000	Hydrobrake 02B	1.6	0.183	0.055	1.2233	
1440 minute winter	Attenuation Basin 03	5.000	Hydrobrake 03	14.0	0.477	0.152	0.2546	
1440 minute winter	Hydrobrake 01A	Hydro-Brake®	Outfall 01A	12.7				1893.6
1440 minute winter	Hydrobrake 01B	Hydro-Brake®	Outfall 01B	12.7				1761.3
960 minute winter	Hydrobrake 02A	Hydro-Brake®	Outfall 02A	1.7				210.1
1440 minute winter	Hydrobrake 02B	Hydro-Brake®	Outfall 02B	1.6				243.0
1440 minute winter	Hydrobrake 03	Hydro-Brake®	Outfall 03	8.2				1168.2

APPENDIX L: Q1 Year Greenfield Run-off Rate

Design Settings

Rainfall Methodology	FEH-22	Maximum Time of Concentration (mins)	30.00	Preferred Cover Depth (m)	1.200
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0	Include Intermediate Ground	✓
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00	Enforce best practice design rules	x
CV	1.000	Connection Type	Level Soffits		
Time of Entry (mins)	5.00	Minimum Backdrop Height (m)	0.200		

Simulation Settings

Rainfall Methodology	FEH-22	Winter CV	1.000	Drain Down Time (mins)	1440	Check Discharge Rate(s)	✓
Rainfall Events	Singular	Analysis Speed	Normal	Additional Storage (m³/ha)	0.0	1 year (l/s)	4.8
Summer CV	1.000	Skip Steady State	x	Starting Level (m)		Check Discharge Volume	x

Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0	100	45	0	0
30	45	0	0				

Pre-development Discharge Rate

Site Makeup	Greenfield	SAAR (mm)	697	Region	8	QBar	36.3
Greenfield Method	IH124	Soil Index	4	Growth Factor 1 year	0.78	Q 1 year (l/s)	28.3
Positively Drained Area (ha)	7.560	SPR	0.47	Betterment (%)	0		

Simulation Settings

Rainfall Methodology	FEH-22	Winter CV	1.000	Drain Down Time (mins)	1440	Check Discharge Rate(s)	✓
Rainfall Events	Singular	Analysis Speed	Normal	Additional Storage (m³/ha)	0.0	1 year (l/s)	4.3
Summer CV	1.000	Skip Steady State	x	Starting Level (m)		Check Discharge Volume	x

Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0	100	45	0	0
30	45	0	0				

Pre-development Discharge Rate

Site Makeup	Greenfield	SAAR (mm)	697	Region	8	QBar	5.5
Greenfield Method	IH124	Soil Index	4	Growth Factor 1 year	0.78	Q 1 year (l/s)	4.3
Positively Drained Area (ha)	1.148	SPR	0.47	Betterment (%)	0		

Simulation Settings

Rainfall Methodology	FEH-22	Winter CV	1.000	Drain Down Time (mins)	1440	Check Discharge Rate(s)	✓
Rainfall Events	Singular	Analysis Speed	Normal	Additional Storage (m³/ha)	0.0	1 year (l/s)	4.3
Summer CV	1.000	Skip Steady State	x	Starting Level (m)		Check Discharge Volume	x

Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0	100	45	0	0
30	45	0	0				

Pre-development Discharge Rate

Site Makeup	Greenfield	SAAR (mm)	697	Region	8	QBar	1.8
Greenfield Method	IH124	Soil Index	4	Growth Factor 1 year	0.78	Q 1 year (l/s)	1.4
Positively Drained Area (ha)	0.374	SPR	0.47	Betterment (%)	0		

Simulation Settings

Rainfall Methodology	FEH-22	Winter CV	1.000	Drain Down Time (mins)	1440	Check Discharge Rate(s)	✓
Rainfall Events	Singular	Analysis Speed	Normal	Additional Storage (m ³ /ha)	0.0	1 year (l/s)	4.3
Summer CV	1.000	Skip Steady State	x	Starting Level (m)		Check Discharge Volume	x

Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0	100	45	0	0
30	45	0	0				

Pre-development Discharge Rate

Site Makeup	Greenfield	SAAR (mm)	697	Region	8	QBar	3.7
Greenfield Method	IH124	Soil Index	4	Growth Factor 1 year	0.78	Q 1 year (l/s)	2.9
Positively Drained Area (ha)	0.765	SPR	0.47	Betterment (%)	0		

Simulation Settings

Rainfall Methodology	FEH-22	Winter CV	1.000	Drain Down Time (mins)	1440	Check Discharge Rate(s)	✓
Rainfall Events	Singular	Analysis Speed	Normal	Additional Storage (m ³ /ha)	0.0	1 year (l/s)	4.3
Summer CV	1.000	Skip Steady State	x	Starting Level (m)		Check Discharge Volume	x

Storm Durations

15 | 30 | 60 | 120 | 180 | 240 | 360 | 480 | 600 | 720 | 960 | 1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)	Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
1	0	0	0	100	45	0	0
30	45	0	0				

Pre-development Discharge Rate

Site Makeup	Greenfield	SAAR (mm)	697	Region	8	QBar	6.2
Greenfield Method	IH124	Soil Index	4	Growth Factor 1 year	0.78	Q 1 year (l/s)	4.8
Positively Drained Area (ha)	1.290	SPR	0.47	Betterment (%)	0		

APPENDIX M: FSR Network Model Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	21.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.400	Preferred Cover Depth (m)	1.200
CV	1.000	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)	Invert Level (m)
Attenuation Basin 01A	4.360	5.00	55.100	1200	394208.576	171673.037	1.200	53.900
Attenuation Basin 01B	3.330	5.00	54.200	1200	394022.104	171595.317	1.150	53.050
Attenuation Basin 02A	0.248	5.00	54.400	1200	394104.203	171568.914	1.000	53.400
Attenuation Basin 02B	0.900	5.00	54.000	1200	393951.820	171480.311	1.200	52.800
Attenuation Basin 03	2.429	5.00	53.300	1200	393758.603	171357.248	1.200	52.100
Hydrobrake 01A			55.400	1200	394224.022	171626.392	1.725	53.675
Hydrobrake 01B			54.233	1200	394019.258	171578.571	1.233	53.000
Hydrobrake 02A			54.300	1200	394081.755	171577.937	1.050	53.250
Hydrobrake 02B			53.949	1200	393922.407	171471.316	1.249	52.700
Hydrobrake 03			53.051	1200	393762.262	171351.996	1.151	51.900
Outfall 01A			54.530	1200	394217.541	171589.800	1.000	53.530
Outfall 01B			54.000	1200	394019.810	171568.595	1.040	52.960
Outfall 02A			54.026	1200	394062.537	171583.808	0.826	53.200
Outfall 02B			53.500	1200	393904.538	171468.456	0.860	52.640
Outfall 03			52.800	1200	393761.954	171347.050	1.000	51.800

Links

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	Attenuation Basin 01A	Hydrobrake 01A	49.136	0.600	53.900	53.675	0.225	218.4	300	5.77	50.0
1.001	Hydrobrake 01A	Outfall 01A	37.162	0.600	53.675	53.530	0.145	256.3	300	6.41	50.0
4.000	Attenuation Basin 01B	Hydrobrake 01B	16.986	0.600	53.050	53.000	0.050	339.7	450	5.26	50.0
4.001	Hydrobrake 01B	Outfall 01B	9.991	0.600	53.000	52.960	0.040	249.8	450	5.39	50.0
3.000	Attenuation Basin 02A	Hydrobrake 02A	24.194	0.600	53.400	53.250	0.150	161.3	225	5.39	50.0
3.001	Hydrobrake 02A	Outfall 02A	20.095	0.600	53.250	53.200	0.050	401.9	300	5.82	50.0
2.000	Attenuation Basin 02B	Hydrobrake 02B	30.758	0.600	52.800	52.700	0.100	307.6	225	5.69	50.0
2.001	Hydrobrake 02B	Outfall 02B	18.096	0.600	52.700	52.640	0.060	301.6	225	6.10	50.0
5.000	Attenuation Basin 03	Hydrobrake 03	6.401	0.600	52.100	51.900	0.200	32.0	225	5.05	50.0
5.001	Hydrobrake 03	Outfall 03	4.956	0.600	51.900	51.800	0.100	49.6	300	5.08	50.0

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	1.060	74.9	787.9	0.900	1.425	4.360	0.0	300	1.073
1.001	0.977	69.1	787.9	1.425	0.700	4.360	0.0	300	0.990
4.000	1.097	174.5	601.7	0.700	0.783	3.330	0.0	450	1.111
4.001	1.282	203.8	601.7	0.783	0.590	3.330	0.0	450	1.298
3.000	1.027	40.8	44.8	0.775	0.825	0.248	0.0	225	1.046
3.001	0.778	55.0	44.8	0.750	0.526	0.248	0.0	207	0.864
2.000	0.740	29.4	162.6	0.975	1.024	0.900	0.0	225	0.754
2.001	0.747	29.7	162.6	1.024	0.635	0.900	0.0	225	0.761
5.000	2.320	92.3	438.9	0.975	0.926	2.429	0.0	225	2.363
5.001	2.238	158.2	438.9	0.851	0.700	2.429	0.0	300	2.267

Simulation Settings

Rainfall Methodology	FSR	Summer CV	1.000	Additional Storage (m³/ha)	0.0
Rainfall Events	Singular	Winter CV	1.000	Starting Level (m)	
FSR Region	England and Wales	Analysis Speed	Normal	Check Discharge Rate(s)	x
M5-60 (mm)	21.000	Skip Steady State	x	Check Discharge Volume	x
Ratio-R	0.400	Drain Down Time (mins)	1440		

Storm Durations												
	15	30	60	120	180	240	360	480	600	720	960	1440
Return Period (years)	Climate Change (CC %)	Additional Area (A %)		Additional Flow (Q %)		Return Period (years)	Climate Change (CC %)	Additional Area (A %)		Additional Flow (Q %)		
1	0	0		0		100	45	0		0		
30	45	0		0								

Node Hydrobrake 02B Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	52.700	Product Number	CTL-SHE-0061-1900-1300-1900
Design Depth (m)	1.300	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	1.9	Min Node Diameter (mm)	0

Node Hydrobrake 03 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	51.900	Product Number	CTL-SHE-0130-8200-1200-8200
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	8.2	Min Node Diameter (mm)	0

Node Attenuation Basin 01A Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	53.900
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	5506.0	0.0	1.200	6539.6	0.0

Node Attenuation Basin 01B Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	53.050
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	4041.0	0.0	1.150	5157.0	0.0

Node Attenuation Basin 02A Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	53.400
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	1200

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	334.0	0.0	1.000	586.0	0.0

Node Attenuation Basin 02B Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	52.800
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	1471.0	0.0	1.200	1938.0	0.0

Node Attenuation Basin 03 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	52.100
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	3579.6	0.0	1.200	4605.5	0.0

Results for 1 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute summer	Attenuation Basin 01A	990	54.066	0.166	63.3	926.8898	0.0000	OK
960 minute summer	Attenuation Basin 01B	675	53.212	0.162	66.1	667.9645	0.0000	OK
240 minute summer	Attenuation Basin 02A	192	53.501	0.101	13.5	35.1365	0.0000	OK
1440 minute summer	Attenuation Basin 02B	1170	52.940	0.140	13.1	210.6288	0.0000	OK
960 minute summer	Attenuation Basin 03	690	52.228	0.128	48.2	465.6883	0.0000	OK
1440 minute summer	Hydrobrake 01A	990	54.061	0.386	13.6	0.4364	0.0000	SURCHARGED
960 minute summer	Hydrobrake 01B	675	53.211	0.211	12.1	0.2383	0.0000	OK
240 minute summer	Hydrobrake 02A	164	53.502	0.252	2.9	0.2848	0.0000	OK
1440 minute summer	Hydrobrake 02B	1170	52.940	0.240	1.6	0.2717	0.0000	SURCHARGED
480 minute winter	Hydrobrake 03	288	52.239	0.339	17.9	0.3832	0.0000	SURCHARGED
15 minute summer	Outfall 01A	1	53.530	0.000	7.4	0.0000	0.0000	OK
15 minute summer	Outfall 01B	1	52.960	0.000	6.6	0.0000	0.0000	OK
15 minute summer	Outfall 02A	1	53.200	0.000	1.7	0.0000	0.0000	OK
15 minute summer	Outfall 02B	1	52.640	0.000	1.5	0.0000	0.0000	OK
15 minute summer	Outfall 03	1	51.800	0.000	8.1	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)
1440 minute summer	Attenuation Basin 01A	1.000	Hydrobrake 01A	13.6	0.422	0.182	2.7136	
960 minute summer	Attenuation Basin 01B	4.000	Hydrobrake 01B	12.1	0.312	0.069	1.0549	
240 minute summer	Attenuation Basin 02A	3.000	Hydrobrake 02A	2.9	0.212	0.071	0.6899	
1440 minute summer	Attenuation Basin 02B	2.000	Hydrobrake 02B	1.6	0.179	0.054	1.0124	
960 minute summer	Attenuation Basin 03	5.000	Hydrobrake 03	15.8	0.492	0.171	0.2020	
1440 minute summer	Hydrobrake 01A	Hydro-Brake®	Outfall 01A	12.7				1286.6
960 minute summer	Hydrobrake 01B	Hydro-Brake®	Outfall 01B	12.1				892.9
240 minute summer	Hydrobrake 02A	Hydro-Brake®	Outfall 02A	1.7				50.2
1440 minute summer	Hydrobrake 02B	Hydro-Brake®	Outfall 02B	1.6				226.2
480 minute winter	Hydrobrake 03	Hydro-Brake®	Outfall 03	8.2				557.8

Results for 30 year +45% CC Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	Attenuation Basin 01A	1410	54.509	0.609	125.2	3511.3250	0.0000	SURCHARGED
1440 minute winter	Attenuation Basin 01B	1380	53.625	0.575	95.6	2486.7450	0.0000	SURCHARGED
600 minute winter	Attenuation Basin 02A	585	53.797	0.397	14.1	152.7760	0.0000	SURCHARGED
1440 minute winter	Attenuation Basin 02B	1440	53.297	0.497	25.8	779.7421	0.0000	SURCHARGED
1440 minute winter	Attenuation Basin 03	1410	52.585	0.485	69.8	1837.4080	0.0000	SURCHARGED
1440 minute winter	Hydrobrake 01A	1410	54.504	0.829	12.8	0.9371	0.0000	SURCHARGED
1440 minute winter	Hydrobrake 01B	1380	53.625	0.625	12.8	0.7069	0.0000	SURCHARGED
600 minute winter	Hydrobrake 02A	585	53.796	0.546	1.9	0.6181	0.0000	SURCHARGED
1440 minute winter	Hydrobrake 02B	1440	53.297	0.597	1.6	0.6750	0.0000	SURCHARGED
1440 minute winter	Hydrobrake 03	1410	52.583	0.683	11.4	0.7722	0.0000	SURCHARGED
15 minute summer	Outfall 01A	1	53.530	0.000	12.7	0.0000	0.0000	OK
15 minute summer	Outfall 01B	1	52.960	0.000	12.5	0.0000	0.0000	OK
15 minute summer	Outfall 02A	1	53.200	0.000	1.7	0.0000	0.0000	OK
15 minute summer	Outfall 02B	1	52.640	0.000	1.6	0.0000	0.0000	OK
15 minute summer	Outfall 03	1	51.800	0.000	8.2	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)
1440 minute winter	Attenuation Basin 01A	1.000	Hydrobrake 01A	12.8	0.421	0.170	3.4601	
1440 minute winter	Attenuation Basin 01B	4.000	Hydrobrake 01B	12.8	0.311	0.073	2.6913	
600 minute winter	Attenuation Basin 02A	3.000	Hydrobrake 02A	1.9	0.205	0.046	0.9622	
1440 minute winter	Attenuation Basin 02B	2.000	Hydrobrake 02B	1.6	0.182	0.055	1.2233	
1440 minute winter	Attenuation Basin 03	5.000	Hydrobrake 03	11.4	0.475	0.123	0.2546	
1440 minute winter	Hydrobrake 01A	Hydro-Brake®	Outfall 01A	12.7				1777.3
1440 minute winter	Hydrobrake 01B	Hydro-Brake®	Outfall 01B	12.7				1887.7
600 minute winter	Hydrobrake 02A	Hydro-Brake®	Outfall 02A	1.7				189.4
1440 minute winter	Hydrobrake 02B	Hydro-Brake®	Outfall 02B	1.6				221.0
1440 minute winter	Hydrobrake 03	Hydro-Brake®	Outfall 03	8.2				1237.3

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 99.99%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
1440 minute winter	Attenuation Basin 01A	1410	54.689	0.789	158.3	4614.4530	0.0000	SURCHARGED
1440 minute winter	Attenuation Basin 01B	1410	53.811	0.761	120.9	3359.3880	0.0000	SURCHARGED
600 minute winter	Attenuation Basin 02A	585	53.921	0.521	18.1	208.9296	0.0000	SURCHARGED
1440 minute winter	Attenuation Basin 02B	1440	53.433	0.633	32.7	1009.4580	0.0000	SURCHARGED
1440 minute winter	Attenuation Basin 03	1410	52.742	0.642	88.2	2474.8650	0.0000	SURCHARGED
1440 minute winter	Hydrobrake 01A	1410	54.683	1.008	12.8	1.1402	0.0000	SURCHARGED
1440 minute winter	Hydrobrake 01B	1410	53.811	0.811	12.8	0.9175	0.0000	SURCHARGED
600 minute winter	Hydrobrake 02A	585	53.921	0.671	2.0	0.7589	0.0000	SURCHARGED
1440 minute winter	Hydrobrake 02B	1440	53.433	0.732	1.6	0.8285	0.0000	SURCHARGED
1440 minute winter	Hydrobrake 03	1410	52.740	0.840	16.6	0.9500	0.0000	SURCHARGED
15 minute summer	Outfall 01A	1	53.530	0.000	12.7	0.0000	0.0000	OK
15 minute summer	Outfall 01B	1	52.960	0.000	12.7	0.0000	0.0000	OK
15 minute summer	Outfall 02A	1	53.200	0.000	1.7	0.0000	0.0000	OK
15 minute summer	Outfall 02B	1	52.640	0.000	1.6	0.0000	0.0000	OK
15 minute summer	Outfall 03	1	51.800	0.000	8.2	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)
1440 minute winter	Attenuation Basin 01A	1.000	Hydrobrake 01A	12.8	0.421	0.170	3.4601	
1440 minute winter	Attenuation Basin 01B	4.000	Hydrobrake 01B	12.8	0.311	0.073	2.6913	
600 minute winter	Attenuation Basin 02A	3.000	Hydrobrake 02A	2.0	0.209	0.048	0.9622	
1440 minute winter	Attenuation Basin 02B	2.000	Hydrobrake 02B	1.6	0.184	0.055	1.2233	
1440 minute winter	Attenuation Basin 03	5.000	Hydrobrake 03	16.6	0.562	0.180	0.2546	
1440 minute winter	Hydrobrake 01A	Hydro-Brake®	Outfall 01A	12.7				1774.3
1440 minute winter	Hydrobrake 01B	Hydro-Brake®	Outfall 01B	12.7				1791.4
600 minute winter	Hydrobrake 02A	Hydro-Brake®	Outfall 02A	1.7				180.1
1440 minute winter	Hydrobrake 02B	Hydro-Brake®	Outfall 02B	1.6				235.8
1440 minute winter	Hydrobrake 03	Hydro-Brake®	Outfall 03	8.2				1157.5