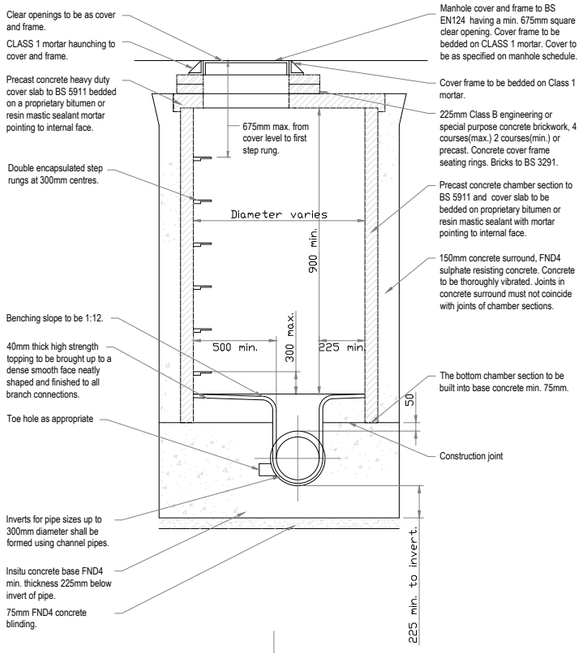
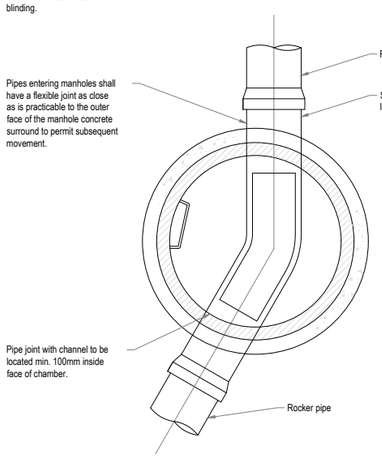
Appendix B – Drainage Details





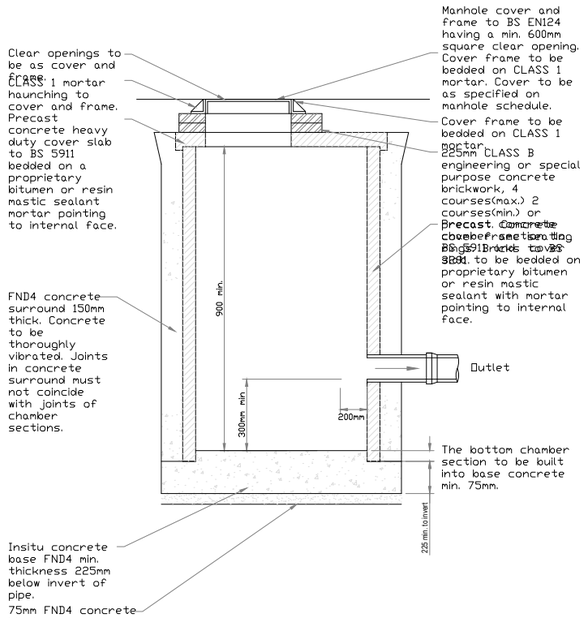
MH chamber sizes

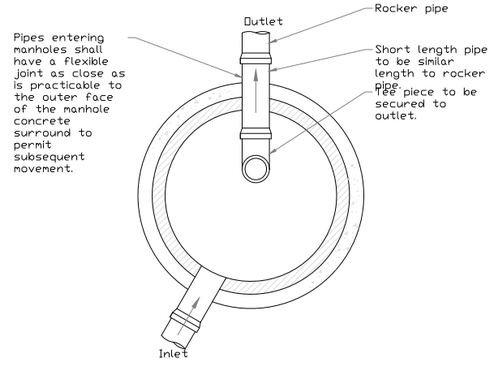
Diameter of Largest pipe in Manhole (mm)	Internal Diameter of Manhole (mm)
Less than 375	1200

Rocker Pipes

Pipe dia.	Rocker pipe length
100 - 450	0.6m

TYPE 2 MANHOLE
(Depth to soffit = 3.0m max.)
NTS

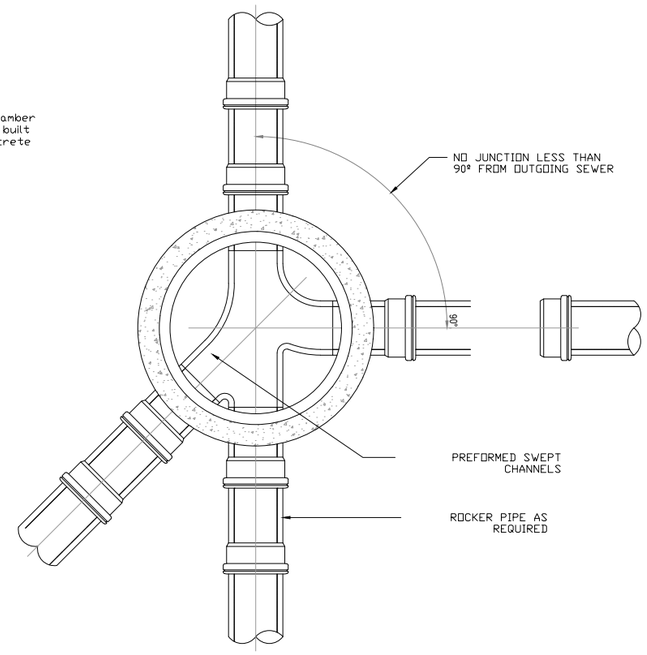




TYPE 2A TYPICAL SILT TRAP DETAIL
Scale: 1:20

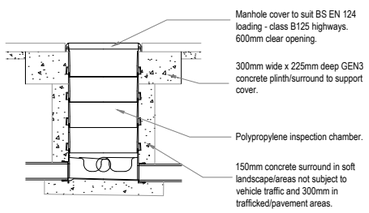
PIPES BUILT INTO MANHOLE SHOULD HAVE A FLEXIBLE JOINT AS CLOSE AS FEASIBLE TO THE EXTERNAL FACE OF THE STRUCTURE AND THE LENGTH OF THE NEXT ROCKER PIPE SHOULD BE AS SHOWN.

NOMINAL DIA.	MAXIMUM EFFECTIVE LENGTH
150-600	600
601-750	1000
OVER 750	1250

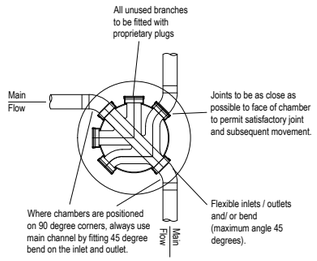


ALL PIPES ENTERING THE BOTTOM OF THE MANHOLE TO HAVE SOFFITS LEVEL.

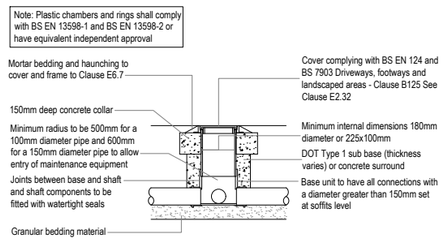
TYPICAL ARRANGEMENT OF PIPE JUNCTIONS WITHIN MANHOLES
Scale: 1:20



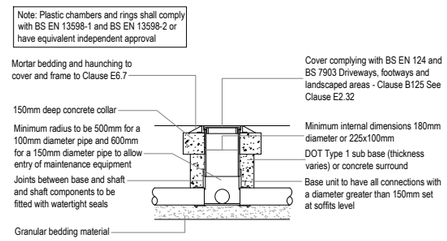
TYPE 3 (450 DIA) INSPECTION CHAMBER DETAIL
Scale 1:20



TYPE 3 (450 DIA) BASE DETAIL
Scale 1:20



TYPE 4 MINI ACCESS DETAIL



TYPE 4 MINI ACCESS DETAIL

NOTES

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5. All private drainage to comply with current Building Regulations, BS EN-752 Drain and Sewer systems outside Buildings and other relevant British Standards and Codes of Practices.
6. All external drainage within trafficked areas with less than 1.2m cover to have type Z concrete bed and surround. All external drainage within landscaped areas with cover less than 0.6m to have type Z concrete bed and surround. All drainage with greater cover than the minimum required to have type S bed and surround.
7. All drainage to be laid soffit to soffit unless otherwise shown.
8. The Contractor is to verify the line, level and diameter of existing sewers before commencing drainage works.
9. All foul drainage to be minimum 100mm diameter, all surface water drainage to be minimum 150mm diameter unless otherwise shown.
10. Cover levels shown on this drawing refer to approximate surface levels. It is the contractors responsibility to ensure that access covers and frames are set at the final surface levels.
11. Where possible the contractor is to orientate manhole biscuits and covers to locate them parallel to kerbs and paving.
12. The Contractor should comply with hs(g) 47 "Avoiding Danger from Underground Services" when excavating around existing services.
13. It is the contractors responsibility to determine the location and depth of all existing services, mains and cables prior to construction.
14. Contractor to provide temporary screens in each of the down stream manholes during the construction period of the development in accordance with SFA 2.9.10 and the local sewerage undertakers requirements.
15. All in-situ concrete and precast concrete components to be manufactured using Sulphate Resisting Portland Cement, (SRPC) to BS 4027, if required, subject to soil conditions. Manhole components to be to BS EN 1917:2002.
16. All ironwork to be kite marked by BSI or certified by equal inspection authority.
17. All redundant connections to be capped off and grouted from the down stream manhole.
18. All new drainage pipes to be jetted, CCTV surveyed with DVD recording and any defects highlighted to the supervising officer. Following the rectification of any defects, the drain is to be re-surveyed with CCTV and the recordings made available to the project manager/engineer.
19. Prior to commencing the works the contractor is to confirm details of the existing drainage system as noted on the drawing.
20. Prior to commencing the works the contractor is to undertake the drainage investigation work as noted on the drawing.
21. Cover levels of all drainage shown indicatively. Contractor to ensure cover levels are in accordance with proposed surface level plans.

REVISIONS

Rev.	Revision Notes	Date	Drawn By	Checked | Approved
P01	Preliminary Issue	19.12.23	GJ	RS | RS

Hydrock
Unit B1
Elmbridge Court
Gloucester
GL3 1JZ
t: +44(0)1452 783970
e: gloucester@hydrock.com

CLIENT
RICHARD PARR ASSOCIATES

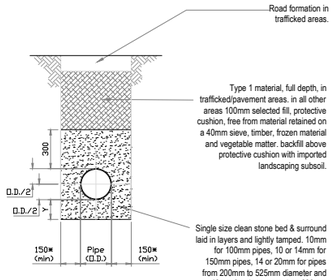
PROJECT
WEST BRADLEY HOUSE
GLASTONBURY

TITLE
DRAINAGE DETAILS
SHEET 1

HYDROCK PROJECT NO.	SCALE @ A1
28421	As shown

STATUS DESCRIPTION	STATUS
SUITABLE FOR INFORMATION	S2

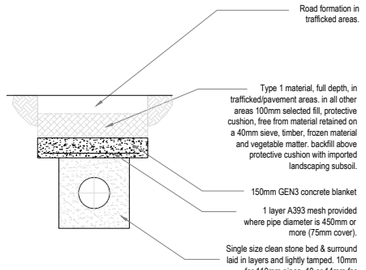
DRAWING NO.	REVISION
28421-HYD-XX-XX-DR-C-7010	P01



Notes:

1. Bedding beneath and at sides of pipe to be well compacted.
2. The first 300mm of fill above the crown of the pipe is to be lightly tamped by hand. Mechanical compaction may be used only above this level.
3. Geotextiles may be used where directed or approved by the engineer to contain bedding material in certain soils e.g. running sand.
4. In very wet conditions, where directed or approved by the engineer a temporary land drain may be laid within the granular bed.
5. * = 150mm for 300mm diameter pipes or less.
6. * = 200mm for pipe diameters over 300mm.
7. Y = 100mm for 100mm diameter pipes or less.
8. Y = 150mm for pipe diameters more than 100mm.
9. Y = 200mm for pipe trenches in rock.

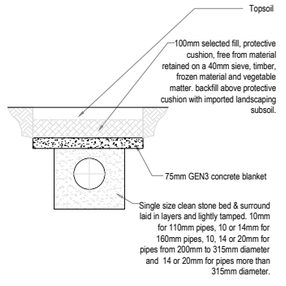
CLASS S BEDDING FOR DRAINS (WHERE COVER TO SOFFIT IS MORE THAN 1200mm IN TRAFFICTED AREAS OR 600mm ELSEWHERE)



Notes for C1 and C3 Bedding:

1. Bedding beneath and at sides of pipe to be well compacted.
2. The first 300mm of fill above the crown of the pipe is to be lightly tamped by hand. Mechanical compaction may be used only above this level.
3. Geotextiles may be used where directed or approved by the engineer to contain bedding material in certain soils e.g. running sand.
4. In very wet conditions, where directed or approved by the engineer a temporary land drain may be laid within the granular bed.
5. * = 150mm for 300mm diameter pipes or less.
6. * = 200mm for pipe diameters over 300mm.
7. Y = 100mm for 100mm diameter pipes or less.
8. Y = 150mm for pipe diameters more than 100mm.
9. Y = 200mm for pipe trenches in rock.
10. Where rigid pipes with flexible joints are used, the concrete protection is to be interrupted over its full cross section at intervals not exceeding 5m (or as indicated by the engineer) by a shaped former of bitumen impregnated compressible filler. These interuptions shall coincide with pipe joints.
11. Concrete to be GEN3 concrete.
12. Where flexible pipes are used care must be taken to prevent the pipes from floating.

CONCRETE SLAB PROTECTION BEDDING FOR PROTECTION TO FLEXIBLE PIPES WITHIN TRAFFICKED AREAS. (WHERE COVER TO SOFFIT IS LESS THAN 1200MM IN TRAFFICKED AREAS)



Notes:

1. Bedding beneath and at sides of pipe to be well compacted.
2. The first 300mm of fill above the crown of the pipe is to be lightly tamped by hand. Mechanical compaction may be used only above this level.
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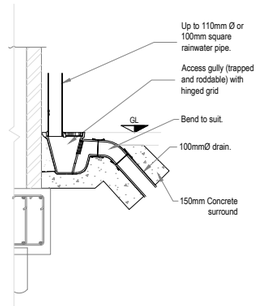
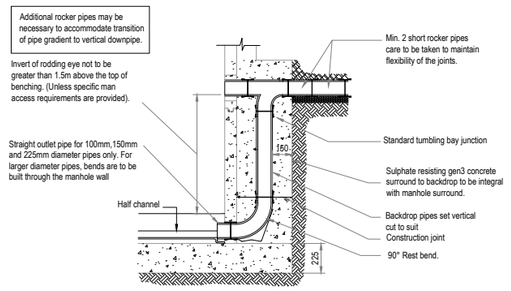
11. Concrete to be GEN3 concrete.
12. Where flexible pipes are used care must be taken to prevent the pipes from floating.

CLASS C1 BEDDING FOR PROTECTION TO FLEXIBLE DRAINS WITHIN SOFT LANDSCAPES (WHERE COVER TO SOFFIT IS LESS THAN 600M)



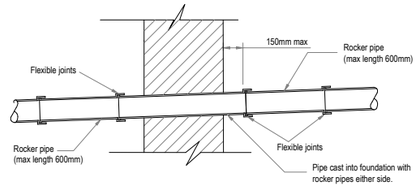
TYPICAL RWP DOWNPIPE/GULLY DETAIL

Scale 1:20



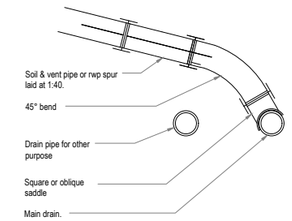
VERTICAL BACKDROP DETAIL

Scale 1:20

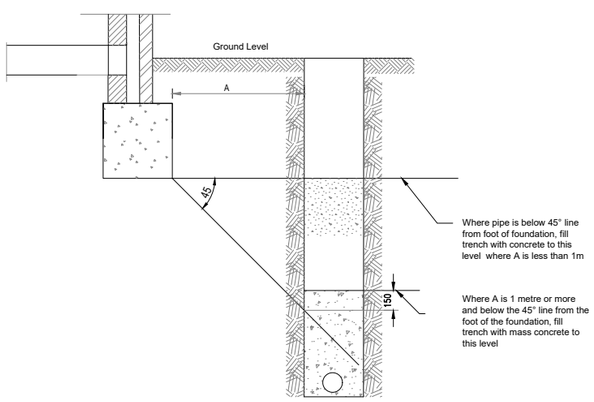


TYPICAL DETAIL FOR DRAINS PASSING THROUGH FOUNDATIONS

Scale: 1:20

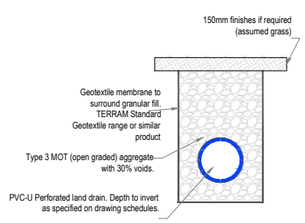


TYPICAL SADDLE CONNECTION DETAIL



TYPICAL DETAIL FOR PIPE RUNS NEAR FOUNDATIONS

Not to scale.



TYPICAL LAND DRAIN DETAIL

Depth to invert as specified on drawing

NOTE: FOR ATTENUATION TANK, DRAINAGE CHANNEL, FOUL TREATMENT PLANT, HEADWALLS AND ANY MANUFACTURER SPECIFIC ITEM PLEASE REFER TO MANUFACTURERS INSTALLATION DETAILS.

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P01	Preliminary Issue	19.12.23	GJ	RS | RS

Hydrock
Unit B1
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PROJECT
WEST BRADLEY HOUSE
GLASTONBURY

TITLE
DRAINAGE DETAILS
SHEET 2

HYDROCK PROJECT NO.	SCALE @ A1
28421	As shown

STATUS DESCRIPTION	STATUS
SUITABLE FOR INFORMATION	S2

DRAWING NO.	REVISION
28421-HYD-XX-XX-DR-C-7011	P01

Appendix C – Greenfield runoff

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.450
Area (ha)	0.308	Urban	0.300
SAAR (mm)	792	Region Number	Region 8

Results l/s

QBAR Rural	1.6
QBAR Urban	2.4
Q100 years	5.0
Q1 year	1.9
Q30 years	4.2
Q100 years	5.0

ICP SUDS Mean Annual Flood

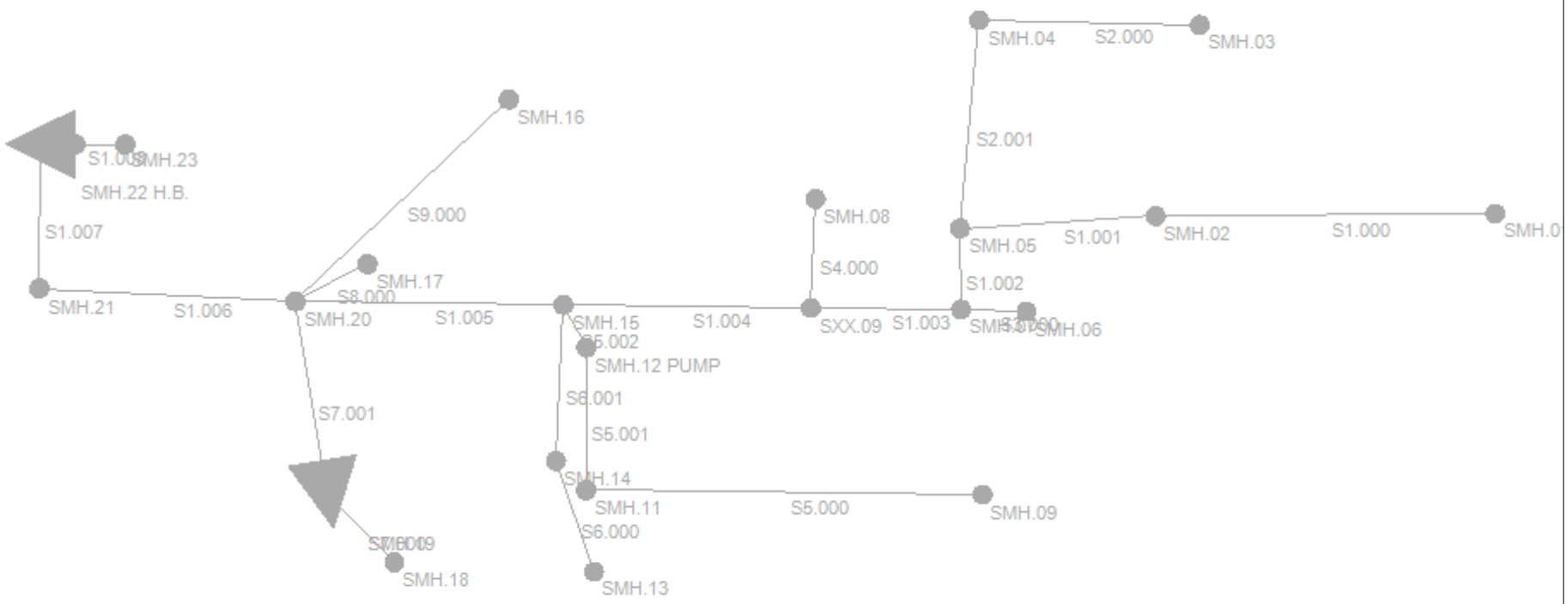
Input

Return Period (years)	100	Soil	0.400
Area (ha)	0.066	Urban	0.000
SAAR (mm)	800	Region Number	Region 8

Results l/s

QBAR Rural	0.3
QBAR Urban	0.3
Q100 years	0.6
Q1 year	0.2
Q30 years	0.5
Q100 years	0.6

Appendix D – Microdrainage calculations



STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for 28421-HYD-CAL-C-0001 WB STORM WATER MODEL_14.12.2023.SWS

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.500	Add Flow / Climate Change (%)	0
Ratio R	0.357	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	0.75
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for 28421-HYD-CAL-C-0001 WB STORM WATER MODEL_14.12.2023.SWS

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.207	4-8	0.101

Total Area Contributing (ha) = 0.308

Total Pipe Volume (m³) = 9.629

Network Design Table for 28421-HYD-CAL-C-0001 WB STORM WATER MODEL_14.12.2023.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	23.837	0.160	149.0	0.006	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	13.778	0.095	145.0	0.005	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.000	15.497	0.105	147.6	0.009	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	14.728	0.250	58.9	0.007	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.002	5.704	0.040	142.6	0.021	0.00	0.0	0.600	o	150	Pipe/Conduit	
S3.000	4.608	0.345	13.4	0.008	5.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.48	29.500	0.006	0.0	0.0	0.0	0.82	14.5	0.8
S1.001	50.00	5.76	29.340	0.011	0.0	0.0	0.0	0.83	14.7	1.5
S2.000	50.00	5.31	29.600	0.009	0.0	0.0	0.0	0.82	14.6	1.2
S2.001	50.00	5.50	29.495	0.016	0.0	0.0	0.0	1.31	23.2	2.2
S1.002	50.00	5.87	29.245	0.048	0.0	0.0	0.0	0.84	14.8	6.5
S3.000	50.00	5.03	29.550	0.008	0.0	0.0	0.0	2.77	49.0	1.1

Network Design Table for 28421-HYD-CAL-C-0001 WB STORM WATER MODEL_14.12.2023.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.003	10.536	0.075	140.5	0.020	0.00	0.0	0.600	o	225	Pipe/Conduit	
S4.000	7.682	0.365	21.0	0.080	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.004	17.391	0.120	144.9	0.015	0.00	0.0	0.600	o	225	Pipe/Conduit	
S5.000	27.800	0.185	150.3	0.016	5.00	0.0	0.600	o	150	Pipe/Conduit	
S5.001	10.048	0.095	105.8	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S5.002	3.410	0.050	68.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S6.000	8.250	0.055	150.0	0.005	5.00	0.0	0.600	o	150	Pipe/Conduit	
S6.001	11.004	0.105	104.8	0.012	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.005	18.826	0.075	250.0	0.007	0.00	0.0	0.600	o	300	Pipe/Conduit	
S7.000	6.653	0.045	147.8	0.008	5.00	0.0	0.600	o	150	Pipe/Conduit	
S7.001	13.812	0.580	23.8	0.040	0.00	0.0	0.600	o	150	Pipe/Conduit	
S8.000	5.700	0.730	7.8	0.012	5.00	0.0	0.600	o	150	Pipe/Conduit	
S9.000	20.670	0.880	23.5	0.008	5.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.003	50.00	6.03	29.130	0.076	0.0	0.0	0.0	1.10	43.8	10.3
S4.000	50.00	5.06	29.500	0.080	0.0	0.0	0.0	2.21	39.0	10.8
S1.004	50.00	6.30	29.060	0.171	0.0	0.0	0.0	1.08	43.1	23.2
S5.000	50.00	5.57	28.825	0.016	0.0	0.0	0.0	0.82	14.4	2.2
S5.001	50.00	5.74	28.640	0.016	0.0	0.0	0.0	0.98	17.3	2.2
S5.002	50.00	5.78	28.545	0.016	0.0	0.0	0.0	1.22	21.5	2.2
S6.000	50.00	5.17	29.250	0.005	0.0	0.0	0.0	0.82	14.5	0.7
S6.001	50.00	5.35	29.195	0.017	0.0	0.0	0.0	0.98	17.3	2.3
S1.005	50.00	6.62	28.345	0.211	0.0	0.0	0.0	0.99	70.0	28.6
S7.000	50.00	5.13	29.050	0.008	0.0	0.0	0.0	0.82	14.6	1.1
S7.001	50.00	5.25	29.005	0.048	0.0	0.0	0.0	2.07	36.6	6.5
S8.000	50.00	5.03	29.150	0.012	0.0	0.0	0.0	3.63	64.1	1.6
S9.000	50.00	5.17	29.300	0.008	0.0	0.0	0.0	2.09	36.9	1.1

Network Design Table for 28421-HYD-CAL-C-0001 WB STORM WATER MODEL_14.12.2023.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.006	18.015	0.070	257.4	0.029	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.007	10.175	0.045	226.1	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
S1.008	5.984	0.040	150.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.006	50.00	6.88	28.195	0.308	0.0	0.0	0.0	1.12	124.2	41.7
S1.007	50.00	7.03	28.125	0.308	0.0	0.0	0.0	1.20	132.6	41.7
S1.008	50.00	7.09	28.080	0.308	0.0	0.0	0.0	1.48	163.1	41.7

Manhole Schedules for 28421-HYD-CAL-C-0001 WB STORM WATER MODEL_14.12.2023.SWS

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Back (m)
SMH.01	30.100	0.600	Open Manhole	1200	S1.000	29.500	150				
SMH.02	30.100	0.760	Open Manhole	1200	S1.001	29.340	150	S1.000	29.340	150	
SMH.03	30.200	0.600	Open Manhole	1200	S2.000	29.600	150				
SMH.04	30.200	0.705	Open Manhole	1200	S2.001	29.495	150	S2.000	29.495	150	
SMH.05	30.100	0.855	Open Manhole	1200	S1.002	29.245	150	S1.001	29.245	150	
								S2.001	29.245	150	
SMH.06	30.300	0.750	Open Manhole	1200	S3.000	29.550	150				
SMH.07	30.300	1.170	Open Manhole	1200	S1.003	29.130	225	S1.002	29.205	150	
								S3.000	29.205	150	
SMH.08	30.100	0.600	Open Manhole	1200	S4.000	29.500	150				
SXX.09	30.100	1.045	Open Manhole	1200	S1.004	29.060	225	S1.003	29.055	225	
								S4.000	29.135	150	
SMH.09	29.550	0.725	Open Manhole	1200	S5.000	28.825	150				
SMH.11	29.750	1.110	Open Manhole	1200	S5.001	28.640	150	S5.000	28.640	150	
SMH.12 PUMP	29.850	1.305	Open Manhole	1200	S5.002	28.545	150	S5.001	28.545	150	
SMH.13	29.850	0.600	Open Manhole	1200	S6.000	29.250	150				
SMH.14	29.800	0.605	Open Manhole	1200	S6.001	29.195	150	S6.000	29.195	150	
SMH.15	29.900	1.555	Open Manhole	1200	S1.005	28.345	300	S1.004	28.940	225	
								S5.002	28.495	150	
								S6.001	29.090	150	
SMH.18	29.750	0.700	Open Manhole	1200	S7.000	29.050	150				
SMH.19	29.600	0.595	Open Manhole	1200	S7.001	29.005	150	S7.000	29.005	150	
SMH.17	29.900	0.750	Open Manhole	1200	S8.000	29.150	150				
SMH.16	30.000	0.700	Open Manhole	1200	S9.000	29.300	150				
SMH.20	29.700	1.505	Open Manhole	1350	S1.006	28.195	375	S1.005	28.270	300	
								S7.001	28.425	150	
								S8.000	28.420	150	
								S9.000	28.420	150	
SMH.21	29.650	1.525	Open Manhole	1350	S1.007	28.125	375	S1.006	28.125	375	
SMH.22 H.B.	29.700	1.620	Open Manhole	1350	S1.008	28.080	375	S1.007	28.080	375	
SMH.23	29.730	1.690	Open Manhole	450		OUTFALL		S1.008	28.040	375	

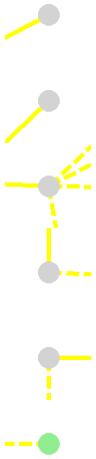
MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SMH.01	355900.035	136950.780	355900.035	136950.780	Required	

Manhole Schedules for 28421-HYD-CAL-C-0001 WB STORM WATER MODEL_14.12.2023.SWS

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SMH.02	355876.198	136950.598	355876.198	136950.598	Required	
SMH.03	355879.281	136964.075	355879.281	136964.075	Required	
SMH.04	355863.787	136964.406	355863.787	136964.406	Required	
SMH.05	355862.447	136949.739	355862.447	136949.739	Required	
SMH.06	355867.110	136943.891	355867.110	136943.891	Required	
SMH.07	355862.505	136944.035	355862.505	136944.035	Required	
SMH.08	355852.295	136951.805	355852.295	136951.805	Required	
SXX.09	355851.970	136944.130	355851.970	136944.130	Required	
SMH.09	355864.013	136930.973	355864.013	136930.973	Required	
SMH.11	355836.172	136931.284	355836.172	136931.284	Required	
SMH.12 PUMP	355836.172	136941.332	355836.172	136941.332	Required	
SMH.13	355836.718	136925.547	355836.718	136925.547	Required	
SMH.14	355834.059	136933.356	355834.059	136933.356	Required	
SMH.15	355834.580	136944.347	355834.580	136944.347	Required	
SMH.18	355822.700	136926.209	355822.700	136926.209	Required	
SMH.19	355818.041	136930.958	355818.041	136930.958	Required	

Manhole Schedules for 28421-HYD-CAL-C-0001 WB STORM WATER MODEL_14.12.2023.SWS

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SMH.17	355820.807	136947.220	355820.807	136947.220	Required	
SMH.16	355830.734	136958.824	355830.734	136958.824	Required	
SMH.20	355815.755	136944.579	355815.755	136944.579	Required	
SMH.21	355797.765	136945.507	355797.765	136945.507	Required	
SMH.22 H.B.	355797.811	136955.682	355797.811	136955.682	Required	
SMH.23	355803.795	136955.658			No Entry	



Free Flowing Outfall Details for 28421-HYD-CAL-C-0001 WB STORM WATER MODEL_14.12.2023.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.008	SMH.23	29.730	28.040	28.040	450	0

Simulation Criteria for 28421-HYD-CAL-C-0001 WB STORM WATER MODEL_14.12.2023.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.500	Storm Duration (mins)	30
Ratio R	0.357		

Online Controls for 28421-HYD-CAL-C-0001 WB STORM WATER MODEL_14.12.2023.SWS

Hydro-Brake® Optimum Manhole: SMH.22 H.B., DS/PN: S1.008, Volume (m³): 3.3

Unit Reference	MD-SHE-0069-2400-1300-2400
Design Head (m)	1.300
Design Flow (l/s)	2.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	69
Invert Level (m)	28.080
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.300	2.4
Flush-Flo™	0.306	2.1
Kick-Flo®	0.619	1.7
Mean Flow over Head Range	-	2.0

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.7	1.200	2.3	3.000	3.5	7.000	5.2
0.200	2.0	1.400	2.5	3.500	3.8	7.500	5.4
0.300	2.1	1.600	2.6	4.000	4.0	8.000	5.6
0.400	2.1	1.800	2.8	4.500	4.3	8.500	5.7
0.500	2.0	2.000	2.9	5.000	4.5	9.000	5.9
0.600	1.8	2.200	3.1	5.500	4.7	9.500	6.1
0.800	1.9	2.400	3.2	6.000	4.9		
1.000	2.1	2.600	3.3	6.500	5.1		

Storage Structures for 28421-HYD-CAL-C-0001 WB STORM WATER MODEL_14.12.2023.SWS

Porous Car Park Manhole: SMH.19, DS/PN: S7.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	15.0
Membrane Percolation (mm/hr)	1000	Length (m)	15.0
Max Percolation (l/s)	62.5	Slope (1:X)	150.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	29.005	Cap Volume Depth (m)	0.250

Cellular Storage Manhole: SMH.22 H.B., DS/PN: S1.008

Invert Level (m)	28.080	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000	Porosity	0.95
Infiltration Coefficient Side (m/hr)	0.00000		

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	169.0	169.0	1.001	0.0	234.0
1.000	169.0	234.0			

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 28421-HYD-CAL-C-0001 WB STORM WATER MODEL_14.12.2023.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.357
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.500	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S1.000	SMH.01	15 Winter	1	+0%	100/15 Summer		
S1.001	SMH.02	15 Winter	1	+0%	100/15 Summer		
S2.000	SMH.03	15 Winter	1	+0%	100/15 Summer		
S2.001	SMH.04	15 Winter	1	+0%	100/15 Summer		
S1.002	SMH.05	15 Winter	1	+0%	30/15 Summer		
S3.000	SMH.06	15 Winter	1	+0%			
S1.003	SMH.07	15 Winter	1	+0%	30/15 Summer		
S4.000	SMH.08	15 Winter	1	+0%	100/15 Summer	100/15 Summer	
S1.004	SXX.09	15 Winter	1	+0%	30/15 Summer		
S5.000	SMH.09	15 Winter	1	+0%	100/120 Winter		
S5.001	SMH.11	15 Winter	1	+0%	100/15 Summer		
S5.002	SMH.12 PUMP	15 Winter	1	+0%	100/15 Summer		
S6.000	SMH.13	15 Winter	1	+0%			
S6.001	SMH.14	15 Winter	1	+0%			
S1.005	SMH.15	15 Winter	1	+0%	100/15 Summer		
S7.000	SMH.18	15 Winter	1	+0%	100/360 Winter		
S7.001	SMH.19	30 Winter	1	+0%	100/360 Winter		
S8.000	SMH.17	15 Winter	1	+0%			
S9.000	SMH.16	15 Winter	1	+0%			

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 28421-HYD-CAL-C-0001 WB STORM WATER MODEL_14.12.2023.SWS

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	SMH.01		29.522	-0.128	0.000	0.05			0.7
S1.001	SMH.02		29.370	-0.120	0.000	0.09			1.2
S2.000	SMH.03		29.629	-0.121	0.000	0.08			1.1
S2.001	SMH.04		29.525	-0.120	0.000	0.09			1.8
S1.002	SMH.05		29.313	-0.082	0.000	0.42			5.2
S3.000	SMH.06		29.566	-0.134	0.000	0.03			1.0
S1.003	SMH.07		29.204	-0.151	0.000	0.22			8.2
S4.000	SMH.08		29.556	-0.094	0.000	0.29			9.9
S1.004	SXX.09		29.174	-0.111	0.000	0.51			19.5
S5.000	SMH.09		28.863	-0.112	0.000	0.14			1.9
S5.001	SMH.11		28.675	-0.115	0.000	0.13			1.9
S5.002	SMH.12 PUMP		28.582	-0.113	0.000	0.14			1.9
S6.000	SMH.13		29.271	-0.129	0.000	0.05			0.6
S6.001	SMH.14		29.230	-0.115	0.000	0.12			1.9
S1.005	SMH.15		28.475	-0.170	0.000	0.39			23.7
S7.000	SMH.18		29.078	-0.122	0.000	0.08			1.0
S7.001	SMH.19		29.039	-0.116	0.000	0.11		8	3.8
S8.000	SMH.17		29.167	-0.133	0.000	0.03			1.5
S9.000	SMH.16		29.317	-0.133	0.000	0.03			1.0

PN	US/MH Name	Status	Level Exceeded
S1.000	SMH.01	OK	
S1.001	SMH.02	OK	
S2.000	SMH.03	OK	
S2.001	SMH.04	OK	
S1.002	SMH.05	OK	
S3.000	SMH.06	OK	
S1.003	SMH.07	OK	
S4.000	SMH.08	OK	2
S1.004	SXX.09	OK	
S5.000	SMH.09	OK	
S5.001	SMH.11	OK	
S5.002	SMH.12 PUMP	OK	
S6.000	SMH.13	OK	
S6.001	SMH.14	OK	
S1.005	SMH.15	OK	
S7.000	SMH.18	OK	
S7.001	SMH.19	OK	
S8.000	SMH.17	OK	
S9.000	SMH.16	OK	

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 28421-HYD-CAL-C-0001 WB STORM WATER MODEL_14.12.2023.SWS

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S1.006	SMH.20	15 Winter	1	+0%	30/180 Winter			
S1.007	SMH.21	360 Winter	1	+0%	30/120 Winter			
S1.008	SMH.22 H.B.	360 Winter	1	+0%	30/60 Winter			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.006	SMH.20	28.336	-0.234	0.000	0.30			30.8	OK
S1.007	SMH.21	28.276	-0.224	0.000	0.06			6.3	OK
S1.008	SMH.22 H.B.	28.276	-0.179	0.000	0.02		224	2.0	OK

PN	US/MH Name	Level Exceeded
S1.006	SMH.20	
S1.007	SMH.21	
S1.008	SMH.22 H.B.	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 28421-HYD-CAL-C-0001 WB STORM WATER MODEL_14.12.2023.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.357
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.500	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S1.000	SMH.01	15 Winter	30	+0%	100/15 Summer		
S1.001	SMH.02	15 Winter	30	+0%	100/15 Summer		
S2.000	SMH.03	15 Winter	30	+0%	100/15 Summer		
S2.001	SMH.04	15 Winter	30	+0%	100/15 Summer		
S1.002	SMH.05	15 Winter	30	+0%	30/15 Summer		
S3.000	SMH.06	15 Winter	30	+0%			
S1.003	SMH.07	15 Winter	30	+0%	30/15 Summer		
S4.000	SMH.08	15 Winter	30	+0%	100/15 Summer	100/15 Summer	
S1.004	SXX.09	15 Winter	30	+0%	30/15 Summer		
S5.000	SMH.09	15 Winter	30	+0%	100/120 Winter		
S5.001	SMH.11	15 Winter	30	+0%	100/15 Summer		
S5.002	SMH.12 PUMP	15 Winter	30	+0%	100/15 Summer		
S6.000	SMH.13	15 Winter	30	+0%			
S6.001	SMH.14	15 Winter	30	+0%			
S1.005	SMH.15	360 Winter	30	+0%	100/15 Summer		
S7.000	SMH.18	15 Winter	30	+0%	100/360 Winter		

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 28421-HYD-CAL-C-0001 WB STORM WATER MODEL_14.12.2023.SWS

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	SMH.01		29.536	-0.114	0.000	0.13			1.8
S1.001	SMH.02		29.438	-0.052	0.000	0.26			3.6
S2.000	SMH.03		29.646	-0.104	0.000	0.20			2.7
S2.001	SMH.04		29.544	-0.101	0.000	0.23			4.9
S1.002	SMH.05		29.425	0.030	0.000	1.13			13.9
S3.000	SMH.06		29.575	-0.125	0.000	0.07			2.4
S1.003	SMH.07		29.381	0.026	0.000	0.58			21.2
S4.000	SMH.08		29.595	-0.055	0.000	0.72			24.2
S1.004	SXX.09		29.352	0.067	0.000	1.27			49.1
S5.000	SMH.09		28.887	-0.088	0.000	0.34			4.7
S5.001	SMH.11		28.697	-0.093	0.000	0.31			4.8
S5.002	SMH.12 PUMP		28.607	-0.088	0.000	0.34			4.7
S6.000	SMH.13		29.285	-0.115	0.000	0.12			1.5
S6.001	SMH.14		29.256	-0.089	0.000	0.34			5.4
S1.005	SMH.15		28.601	-0.044	0.000	0.16			9.7
S7.000	SMH.18		29.095	-0.105	0.000	0.19			2.4

PN	US/MH Name	Status	Level Exceeded
S1.000	SMH.01	OK	
S1.001	SMH.02	OK	
S2.000	SMH.03	OK	
S2.001	SMH.04	OK	
S1.002	SMH.05	SURCHARGED	
S3.000	SMH.06	OK	
S1.003	SMH.07	SURCHARGED	
S4.000	SMH.08	OK	2
S1.004	SXX.09	SURCHARGED	
S5.000	SMH.09	OK	
S5.001	SMH.11	OK	
S5.002	SMH.12 PUMP	OK	
S6.000	SMH.13	OK	
S6.001	SMH.14	OK	
S1.005	SMH.15	OK	
S7.000	SMH.18	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 28421-HYD-CAL-C-0001 WB STORM WATER MODEL_14.12.2023.SWS

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S7.001	SMH.19	15 Winter	30	+0%	100/360 Winter			
S8.000	SMH.17	15 Winter	30	+0%				
S9.000	SMH.16	15 Winter	30	+0%				
S1.006	SMH.20	360 Winter	30	+0%	30/180 Winter			
S1.007	SMH.21	360 Winter	30	+0%	30/120 Winter			
S1.008	SMH.22 H.B.	360 Winter	30	+0%	30/60 Winter			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S7.001	SMH.19	29.069	-0.086	0.000	0.37		5	12.5	OK
S8.000	SMH.17	29.176	-0.124	0.000	0.07			3.6	OK
S9.000	SMH.16	29.326	-0.124	0.000	0.07			2.4	OK
S1.006	SMH.20	28.599	0.029	0.000	0.14			13.9	SURCHARGED
S1.007	SMH.21	28.598	0.098	0.000	0.14			13.4	SURCHARGED
S1.008	SMH.22 H.B.	28.597	0.142	0.000	0.02			2.1	SURCHARGED

PN	US/MH Name	Level Exceeded
S7.001	SMH.19	
S8.000	SMH.17	
S9.000	SMH.16	
S1.006	SMH.20	
S1.007	SMH.21	
S1.008	SMH.22 H.B.	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 28421-HYD-CAL-C-0001 WB STORM WATER MODEL_14.12.2023.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	2
Number of Online Controls	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.357
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.500	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	ON
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S1.000	SMH.01	15 Winter	100	+40%	100/15 Summer		
S1.001	SMH.02	15 Winter	100	+40%	100/15 Summer		
S2.000	SMH.03	15 Winter	100	+40%	100/15 Summer		
S2.001	SMH.04	15 Winter	100	+40%	100/15 Summer		
S1.002	SMH.05	15 Winter	100	+40%	30/15 Summer		
S3.000	SMH.06	15 Winter	100	+40%			
S1.003	SMH.07	15 Winter	100	+40%	30/15 Summer		
S4.000	SMH.08	15 Winter	100	+40%	100/15 Summer	100/15 Summer	
S1.004	SXX.09	15 Winter	100	+40%	30/15 Summer		
S5.000	SMH.09	600 Winter	100	+40%	100/120 Winter		
S5.001	SMH.11	600 Winter	100	+40%	100/15 Summer		
S5.002	SMH.12 PUMP	600 Winter	100	+40%	100/15 Summer		
S6.000	SMH.13	15 Winter	100	+40%			
S6.001	SMH.14	15 Winter	100	+40%			
S1.005	SMH.15	600 Winter	100	+40%	100/15 Summer		
S7.000	SMH.18	600 Winter	100	+40%	100/360 Winter		

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 28421-HYD-CAL-C-0001 WB STORM WATER MODEL_14.12.2023.SWS

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	SMH.01		29.814	0.164	0.000	0.24			3.3
S1.001	SMH.02		29.803	0.313	0.000	0.62			8.4
S2.000	SMH.03		29.830	0.080	0.000	0.32			4.3
S2.001	SMH.04		29.814	0.169	0.000	0.40			8.5
S1.002	SMH.05		29.788	0.393	0.000	1.84			22.6
S3.000	SMH.06		29.697	-0.003	0.000	0.11			4.0
S1.003	SMH.07		29.690	0.335	0.000	0.85			31.3
S4.000	SMH.08		30.100	0.450	0.356	1.15			38.6
S1.004	SXX.09		29.633	0.348	0.000	1.98			76.1
S5.000	SMH.09		29.249	0.274	0.000	0.07			0.9
S5.001	SMH.11		29.249	0.459	0.000	0.06			0.9
S5.002	SMH.12 PUMP		29.249	0.554	0.000	0.06			0.8
S6.000	SMH.13		29.301	-0.099	0.000	0.22			2.7
S6.001	SMH.14		29.281	-0.064	0.000	0.62			9.7
S1.005	SMH.15		29.249	0.604	0.000	0.19			11.6
S7.000	SMH.18		29.245	0.045	0.000	0.04			0.5

PN	US/MH Name	Status	Level Exceeded
S1.000	SMH.01	FLOOD RISK	
S1.001	SMH.02	FLOOD RISK	
S2.000	SMH.03	SURCHARGED	
S2.001	SMH.04	SURCHARGED	
S1.002	SMH.05	SURCHARGED	
S3.000	SMH.06	OK	
S1.003	SMH.07	SURCHARGED	
S4.000	SMH.08	FLOOD	2
S1.004	SXX.09	SURCHARGED	
S5.000	SMH.09	SURCHARGED	
S5.001	SMH.11	SURCHARGED	
S5.002	SMH.12 PUMP	SURCHARGED	
S6.000	SMH.13	OK	
S6.001	SMH.14	OK	
S1.005	SMH.15	SURCHARGED	
S7.000	SMH.18	SURCHARGED	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 28421-HYD-CAL-C-0001 WB STORM WATER MODEL_14.12.2023.SWS

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
S7.001	SMH.19	600 Winter	100	+40%	100/360 Winter			
S8.000	SMH.17	600 Winter	100	+40%				
S9.000	SMH.16	15 Winter	100	+40%				
S1.006	SMH.20	600 Winter	100	+40%	30/180 Winter			
S1.007	SMH.21	600 Winter	100	+40%	30/120 Winter			
S1.008	SMH.22 H.B.	600 Winter	100	+40%	30/60 Winter			

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S7.001	SMH.19	29.245	0.090	0.000	0.08		79	2.7	SURCHARGED
S8.000	SMH.17	29.248	-0.052	0.000	0.01			0.7	OK
S9.000	SMH.16	29.335	-0.115	0.000	0.13			4.4	OK
S1.006	SMH.20	29.248	0.678	0.000	0.16			16.9	SURCHARGED
S1.007	SMH.21	29.248	0.748	0.000	0.17			16.8	SURCHARGED
S1.008	SMH.22 H.B.	29.247	0.792	0.000	0.02			2.3	SURCHARGED

PN	US/MH Name	Level Exceeded
S7.001	SMH.19	
S8.000	SMH.17	
S9.000	SMH.16	
S1.006	SMH.20	
S1.007	SMH.21	
S1.008	SMH.22 H.B.	

Hydrock Consultants Ltd		Page 1
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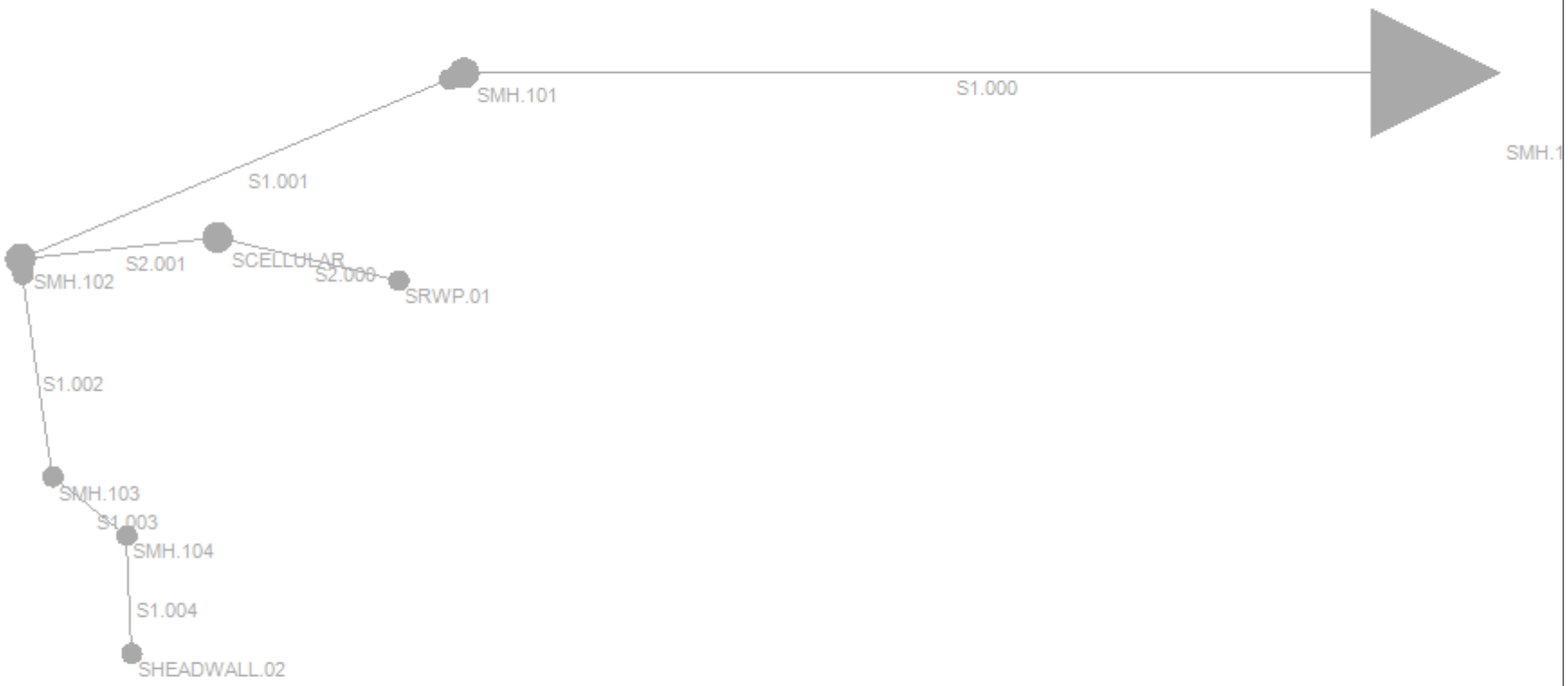


STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for 28421-HYD-CAL-C-0002 P01 WB STORM WATER MODEL_18.12.2023.SWS

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	18.500	Add Flow / Climate Change (%)	10
Ratio R	0.356	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	0.75
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for 28421-HYD-CAL-C-0002 P01 WB STORM WATER MODEL_18.12.2023.SWS

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.051	4-8	0.015

Total Area Contributing (ha) = 0.066

Total Pipe Volume (m³) = 1.539

Network Design Table for 28421-HYD-CAL-C-0002 P01 WB STORM WATER MODEL_18.12.2023.SWS

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
S1.000	37.237	0.250	148.9	0.028	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	18.445	0.500	36.9	0.028	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.000	7.151	0.700	10.2	0.004	5.00	0.0	0.600	o	150	Pipe/Conduit	
S2.001	7.592	0.050	151.8	0.003	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.002	8.478	0.370	22.9	0.003	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.003	3.627	0.330	11.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.004	4.544	1.600	2.8	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	50.00	5.76	31.250	0.028	0.0	0.0	0.4	0.82	14.5	4.2
S1.001	50.00	5.94	31.000	0.056	0.0	0.0	0.8	1.66	29.4	8.3
S2.000	50.00	5.04	31.250	0.004	0.0	0.0	0.1	3.17	56.0	0.6
S2.001	50.00	5.19	30.550	0.007	0.0	0.0	0.1	0.81	14.4	1.0
S1.002	50.00	6.01	30.500	0.066	0.0	0.0	0.9	2.11	37.3	9.8
S1.003	50.00	6.03	30.130	0.066	0.0	0.0	0.9	3.06	54.0	9.8
S1.004	50.00	6.04	29.800	0.066	0.0	0.0	0.9	6.03	106.5	9.8

Manhole Schedules for 28421-HYD-CAL-C-0002 P01 WB STORM WATER MODEL_18.12.2023.SWS

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam.,L*W (mm)	Pipe Out PN	Pipe Out Invert Level (m)	Pipe Out Diameter (mm)	Pipes In PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Bac
SMH.100	32.000	0.750	Open Manhole	450	S1.000	31.250	150				
SMH.101	32.000	1.000	Open Manhole	1200	S1.001	31.000	150	S1.000	31.000	150	
SRWP.01	31.850	0.600	Open Manhole	150	S2.000	31.250	150				
SCELLULAR	31.500	0.950	Open Manhole	1200	S2.001	30.550	150	S2.000	30.550	150	
SMH.102	31.500	1.000	Open Manhole	1200	S1.002	30.500	150	S1.001	30.500	150	
								S2.001	30.500	150	
SMH.103	30.880	0.750	Open Manhole	450	S1.003	30.130	150	S1.002	30.130	150	
SMH.104	30.500	0.700	Open Manhole	450	S1.004	29.800	150	S1.003	29.800	150	
SHEADWALL.02	28.500	0.300	Open Manhole	150		OUTFALL		S1.004	28.200	150	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
SMH.100	355882.262	136988.817	355882.262	136988.817	Required	
SMH.101	355845.026	136988.815	355845.026	136988.815	Required	
SRWP.01	355842.526	136980.827	355842.526	136980.827	Required	
SCELLULAR	355835.570	136982.486	355835.570	136982.486	Required	
SMH.102	355828.023	136981.665	355828.023	136981.665	Required	
SMH.103	355829.269	136973.279	355829.269	136973.279	Required	
SMH.104	355832.100	136971.014	355832.100	136971.014	Required	
SHEADWALL.02	355832.284	136966.473			No Entry	

Free Flowing Outfall Details for 28421-HYD-CAL-C-0002 P01 WB STORM WATER MODEL_18.12.2023.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.004	SHEADWALL.02	28.500	28.200	28.200	150	0

Simulation Criteria for 28421-HYD-CAL-C-0002 P01 WB STORM WATER MODEL_18.12.2023.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	0.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	2	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.500	Storm Duration (mins)	30
Ratio R	0.356		

Online Controls for 28421-HYD-CAL-C-0002 P01 WB STORM WATER MODEL_18.12.2023.SWS

Hydro-Brake® Optimum Manhole: SMH.101, DS/PN: S1.001, Volume (m³): 1.8

Unit Reference	MD-SHE-0047-1000-1000-1000
Design Head (m)	1.000
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	47
Invert Level (m)	31.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	1.0
Flush-Flo™	0.205	0.8
Kick-Flo®	0.415	0.7
Mean Flow over Head Range	-	0.8

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.8	1.200	1.1	3.000	1.6	7.000	2.4
0.200	0.8	1.400	1.2	3.500	1.8	7.500	2.5
0.300	0.8	1.600	1.2	4.000	1.9	8.000	2.6
0.400	0.7	1.800	1.3	4.500	2.0	8.500	2.7
0.500	0.7	2.000	1.4	5.000	2.1	9.000	2.7
0.600	0.8	2.200	1.4	5.500	2.2	9.500	2.8
0.800	0.9	2.400	1.5	6.000	2.3		
1.000	1.0	2.600	1.5	6.500	2.3		

Hydro-Brake® Optimum Manhole: SMH.102, DS/PN: S1.002, Volume (m³): 1.5

Unit Reference	MD-SHE-0047-1000-1000-1000
Design Head (m)	1.000
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	47
Invert Level (m)	30.500
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	1.0

Hydro-Brake® Optimum Manhole: SMH.102, DS/PN: S1.002, Volume (m³): 1.5

Control Points	Head (m)	Flow (l/s)
Flush-Flo™	0.205	0.8
Kick-Flo®	0.415	0.7
Mean Flow over Head Range	-	0.8

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.8	1.200	1.1	3.000	1.6	7.000	2.4
0.200	0.8	1.400	1.2	3.500	1.8	7.500	2.5
0.300	0.8	1.600	1.2	4.000	1.9	8.000	2.6
0.400	0.7	1.800	1.3	4.500	2.0	8.500	2.7
0.500	0.7	2.000	1.4	5.000	2.1	9.000	2.7
0.600	0.8	2.200	1.4	5.500	2.2	9.500	2.8
0.800	0.9	2.400	1.5	6.000	2.3		
1.000	1.0	2.600	1.5	6.500	2.3		

Storage Structures for 28421-HYD-CAL-C-0002 P01 WB STORM WATER MODEL_18.12.2023.SWS

Porous Car Park Manhole: SMH.100, DS/PN: S1.000

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	16.0
Membrane Percolation (mm/hr)	1000	Length (m)	35.0
Max Percolation (l/s)	155.6	Slope (1:X)	80.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	31.250	Cap Volume Depth (m)	0.350

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 28421-HYD-CAL-C-0002 P01 WB STORM WATER MODEL_18.12.2023.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.356
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.500	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S1.000	SMH.100	30 Winter	1	+0%	30/30 Winter		
S1.001	SMH.101	30 Winter	1	+0%	1/15 Summer	100/2160 Winter	
S2.000	SRWP.01	15 Winter	1	+0%	100/30 Summer		
S2.001	SCELLULAR	120 Winter	1	+0%	1/15 Winter	100/30 Winter	
S1.002	SMH.102	120 Winter	1	+0%	1/15 Summer	100/30 Winter	
S1.003	SMH.103	30 Winter	1	+0%			
S1.004	SMH.104	120 Summer	1	+0%			

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	SMH.100		31.282	-0.118	0.000	0.02		7	0.3
S1.001	SMH.101		31.307	0.157	0.000	0.03			0.8
S2.000	SRWP.01		31.257	-0.143	0.000	0.01			0.5
S2.001	SCELLULAR		30.819	0.119	0.000	0.02			0.3
S1.002	SMH.102		30.819	0.169	0.000	0.02			0.8
S1.003	SMH.103		30.145	-0.135	0.000	0.02			0.8
S1.004	SMH.104		29.807	-0.143	0.000	0.01			0.8

1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 28421-HYD-CAL-C-0002 P01 WB STORM WATER MODEL_18.12.2023.SWS

PN	US/MH Name	Status	Level Exceeded
S1.000	SMH.100	OK	
S1.001	SMH.101	SURCHARGED	
S2.000	SRWP.01	OK	
S2.001	SCELLULAR	SURCHARGED	11
S1.002	SMH.102	SURCHARGED	11
S1.003	SMH.103	OK	
S1.004	SMH.104	OK	

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 28421-HYD-CAL-C-0002 P01 WB STORM WATER MODEL_18.12.2023.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.356
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.500	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S1.000	SMH.100	180 Winter	30	+0%	30/30 Winter		
S1.001	SMH.101	15 Winter	30	+0%	1/15 Summer	100/2160 Winter	
S2.000	SRWP.01	180 Winter	30	+0%	100/30 Summer		
S2.001	SCELLULAR	180 Winter	30	+0%	1/15 Winter	100/30 Winter	
S1.002	SMH.102	180 Winter	30	+0%	1/15 Summer	100/30 Winter	
S1.003	SMH.103	180 Winter	30	+0%			
S1.004	SMH.104	180 Winter	30	+0%			

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	SMH.100		31.453	0.053	0.000	0.06		93	0.9
S1.001	SMH.101		31.577	0.427	0.000	0.03			0.8
S2.000	SRWP.01		31.338	-0.062	0.000	0.01			0.3
S2.001	SCELLULAR		31.338	0.638	0.000	0.02			0.2
S1.002	SMH.102		31.338	0.688	0.000	0.03			0.9
S1.003	SMH.103		30.146	-0.134	0.000	0.03			0.9
S1.004	SMH.104		29.808	-0.142	0.000	0.01			0.9

30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 28421-HYD-CAL-C-0002 P01 WB STORM WATER MODEL_18.12.2023.SWS

PN	US/MH Name	Status	Level Exceeded
S1.000	SMH.100	SURCHARGED	
S1.001	SMH.101	SURCHARGED	
S2.000	SRWP.01	OK	
S2.001	SCELLULAR	FLOOD RISK	11
S1.002	SMH.102	FLOOD RISK	11
S1.003	SMH.103	OK	
S1.004	SMH.104	OK	

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 28421-HYD-CAL-C-0002 P01 WB STORM WATER MODEL_18.12.2023.SWS

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	0.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	1
Number of Online Controls	2	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.356
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.500	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow
S1.000	SMH.100	240 Winter	100	+40%	30/30 Winter		
S1.001	SMH.101	15 Summer	100	+40%	1/15 Summer	100/2160 Winter	
S2.000	SRWP.01	60 Winter	100	+40%	100/30 Summer		
S2.001	SCELLULAR	120 Winter	100	+40%	1/15 Winter	100/30 Winter	
S1.002	SMH.102	120 Winter	100	+40%	1/15 Summer	100/30 Winter	
S1.003	SMH.103	360 Winter	100	+40%			
S1.004	SMH.104	360 Winter	100	+40%			

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.000	SMH.100		31.602	0.202	0.000	0.07			1.0
S1.001	SMH.101		31.805	0.655	0.000	0.03			0.9
S2.000	SRWP.01		31.503	0.103	0.000	0.02			1.2
S2.001	SCELLULAR		31.501	0.801	1.018	0.04			0.5
S1.002	SMH.102		31.500	0.850	0.118	0.03			1.0

100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for 28421-HYD-CAL-C-0002 P01 WB STORM WATER MODEL_18.12.2023.SWS

PN	US/MH Name	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)
S1.003	SMH.103		30.146	-0.134	0.000	0.03			1.0
S1.004	SMH.104		29.809	-0.141	0.000	0.01			1.0

PN	US/MH Name	Status	Level Exceeded
S1.000	SMH.100	SURCHARGED	
S1.001	SMH.101	FLOOD RISK	
S2.000	SRWP.01	SURCHARGED	
S2.001	SCELLULAR	FLOOD	11
S1.002	SMH.102	FLOOD	11
S1.003	SMH.103	OK	
S1.004	SMH.104	OK	

Appendix E – Surface Water Exceedance Routes

Key

Surface water exceedance route

KEY PLAN

NOTES

1. All dimensions are to be checked on site before the commencement of works. Any discrepancies are to be reported to the Architect & Engineer for verification. Figured dimensions only are to be taken from this drawing.
2. The DWG file is issued for the purposes of coordination only and do not represent formal drawing issue and are not to be reprinted in any form. Formal issue of drawings is via DWF, Adobe PDF files and/or hard copies and their associated information issue sheets.
3. Note that all care has been taken with the export of DWG files and their content, but we recommend that you make due dimensional checks before using any DWG file information. Any errors found are to be reported to Hydrock immediately.
4. Levels shown in metres above Ordnance Datum (mAOD).
5. All private drainage to comply with current Building Regulations, BS EN-752 Drain and Sewer systems outside Buildings and other relevant British Standards and Codes of Practices.
6. All external drainage within trafficked areas with less than 1.2m cover to have type Z concrete bed and surround. All external drainage within landscaped areas with cover less than 0.6m to have type Z concrete bed and surround. All drainage with greater cover than the minimum required to have type S bed and surround.
7. All drainage to be laid soffit to soffit unless otherwise shown.
8. The Contractor is to verify the line, level and diameter of existing sewers before commencing drainage works.
9. All foul drainage to be minimum 100mm diameter, all surface water drainage to be minimum 150mm diameter unless otherwise shown.
10. Cover levels shown on this drawing refer to approximate surface levels. It is the contractors responsibility to ensure that access covers and frames are set at the final surface levels.
11. Where possible the contractor is to orientate manhole biscuits and covers to locate them parallel to kerbs and paving.
12. The Contractor should comply with hs(g) 47 "Avoiding Danger from Underground Services" when excavating around existing services.
13. It is the contractors responsibility to determine the location and depth of all existing services, mains and cables prior to construction.
14. Contractor to provide temporary screens in each of the down stream manholes during the construction period of the development in accordance with SFA 2.9.10 and the local sewerage undertakers requirements.
15. All in-situ concrete and precast concrete components to be manufactured using Sulphate Resisting Portland Cement, (SRPC) to BS 4027, if required, subject to soil conditions. Manhole components to be to BS EN 1917:2002.
16. All ironwork to be kite marked by BSI or certified by equal inspection authority.
17. All redundant connections to be capped off and grouted from the down stream manhole.
18. All new drainage pipes to be jetted, CCTV surveyed with DVD recording and any defects highlighted to the supervising officer. Following the rectification of any defects, the drain is to be re-surveyed with CCTV and the recordings made available to the project manager/engineer.
19. Prior to commencing the works the contractor is to confirm details of the existing drainage system as noted on the drawing.
20. Prior to commencing the works the contractor is to undertake the drainage investigation work as noted on the drawing.
21. Cover levels of all drainage shown indicatively. Contractor to ensure cover levels are in accordance with proposed surface level plans.

REVISIONS

Rev.	Revision Notes	Date	Drawn By	Checked | Approved
P02	Site plan updated	15.03.24	GJ	GJ | DB
P01	Preliminary Issue	19.12.23	GJ	RS | RS

Hydrock
Unit B1
Elmbridge Court
Gloucester
GL3 1JZ
t: +44(0)1452 783970
e: gloucester@hydrock.com

CLIENT

RICHARD PARR ASSOCIATES

PROJECT

WEST BRADLEY HOUSE
GLASTONBURY

TITLE

STORM WATER EXCEEDANCE ROUTES

HYDROCK PROJECT NO.	SCALE @ A1
28421	1:500

STATUS DESCRIPTION	STATUS
SUITABLE FOR INFORMATION	S2

DRAWING NO.	REVISION
28421-HYD-XX-XX-DR-C-7025	P02

Appendix F – EA flood map

Flood map for planning

Your reference	Location (easting/northing)	Created
West Bradley	**355837/136961**	**19 Dec 2023 10:44**

Your selected location is in flood zone 1, an area with a low probability of flooding.

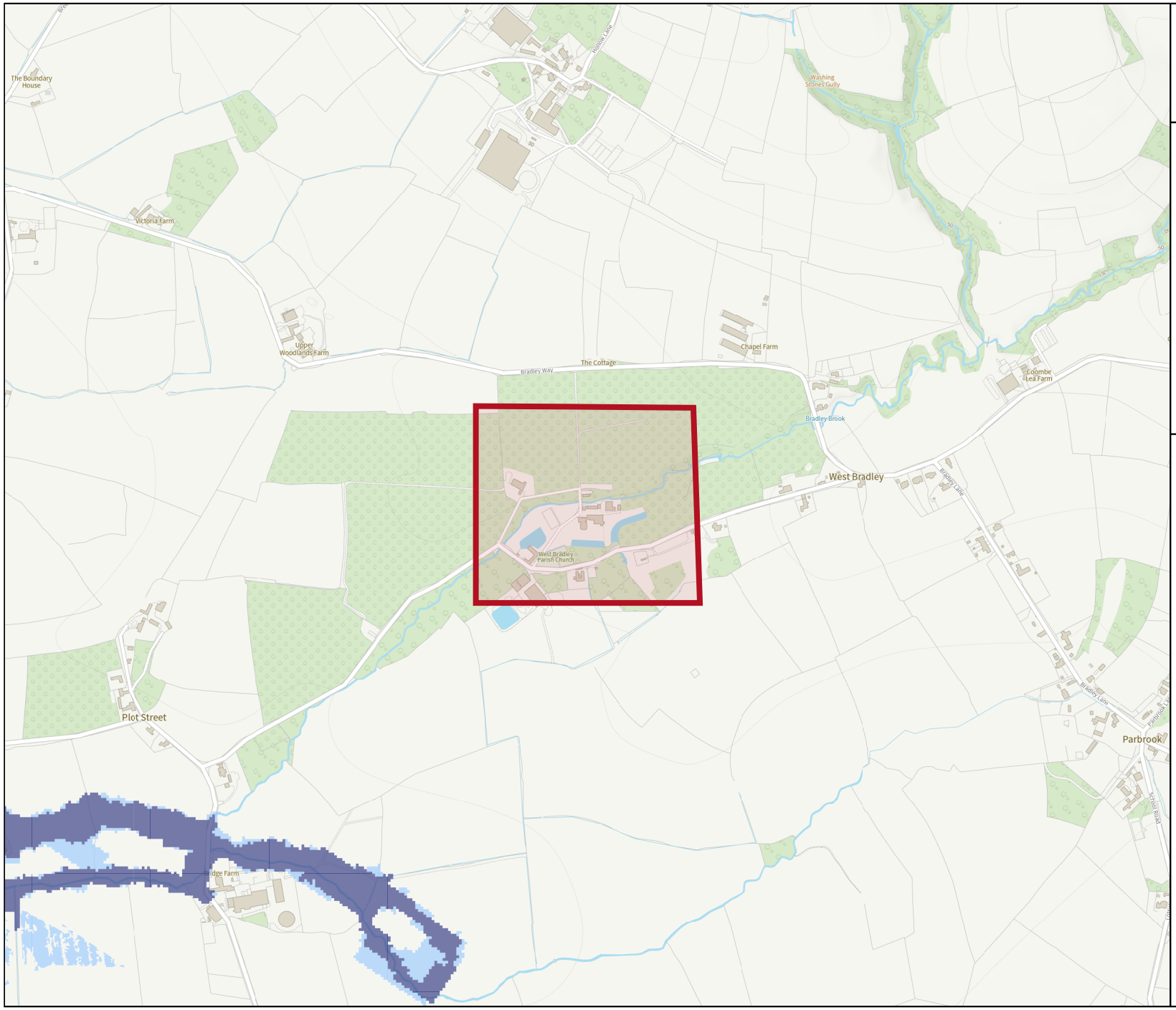
You will need to do a flood risk assessment if your site is **any of the following:**

- bigger that 1 hectare (ha)
- In an area with critical drainage problems as notified by the Environment Agency
- identified as being at increased flood risk in future by the local authority's strategic flood risk assessment
- at risk from other sources of flooding (such as surface water or reservoirs) and its development would increase the vulnerability of its use (such as constructing an office on an undeveloped site or converting a shop to a dwelling)

Notes

The flood map for planning shows river and sea flooding data only. It doesn't include other sources of flooding. It is for use in development planning and flood risk assessments.

This information relates to the selected location and is not specific to any property within it. The map is updated regularly and is correct at the time of printing.



Environment Agency

Flood map for planning

Your reference
West Bradley

Location (easting/northing)
355837/136961

Scale
1:10000

Created
19 Dec 2023 10:44

- Selected area
- Flood zone 3
- Flood zone 2
- Flood zone 1
- Flood defence
- Main river
- Water storage area

0 100 200 300m

Appendix G – Operation and Maintenance Manual

Hydrock

West Bradley House

Maintenance Strategy

For C/O Richard Parrs Associates

Date	*29 November 2023*
Doc ref	*28241-HYD-XX-XX-RP-C-0010*

Document control sheet

Issued by	Hydrock Consultants Limited Unit B1 Elmbridge Court Gloucester GL3 1JZ United Kingdom	T +44 (0)1452 793970 E gloucester@hydrock.com hydrock.com
Client	C/O Richard Parrs Associates	
Project name	West Bradley House	
Title	Maintenance Strategy	
Doc ref	28241-HYD-XX-XX-RP-C-0010	
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Status	S2	
Date	29/11/2023	

Document production record		
Issue number	P01	Name
Prepared by		R.Samuel MEng
Checked by		G.Jones IEng MICE
Approved by		G.Jones IEng MICE

Document revision record			
Issue number	Status	Date	Revision details
P01	S2	29/11/2023	First issue

Contents

1. Post Development Drainage

All drainage systems should be inspected at regular intervals then, if necessary, cleaned and repaired to ensure that system performance is maintained.

This guide includes recommendations on the methods and frequency of the inspection and cleaning but local factors may influence this, therefore this manual should be appended to include any revises or additional requirements determined during the life of the development.

2. Inspection And Cleaning of Foul Drainage

Inspection chambers, gullies and channels should be fully inspected regularly, at least annually, by removing covers and checking for obstructions, silt and damage.

The following should be carried out when cleaning a drainage system:

- Covers of inspection chambers and manholes should be removed and the sides, benching and channels cleaned.
- Main and branch drains should be cleaned and should be flushed with clean water afterwards. Any obstructions found should be removed and not flushed into the system.
- Periodically, accumulated deposits in gullies should be removed. The traps should then be plunged and thoroughly flushed out with clean water.
- Covers of inspection chambers and gullies should be replaced, bedded in suitable grease or other sealing material and/or bolted down as appropriate to the type. Missing bolts and broken items should be renewed.

3. Methods Of Cleaning

The drainage system should be cleaned, as appropriate, using one or more of the following methods:

3.1 Rodding

Appropriate cleaning tools and techniques should be chosen to avoid damage to the pipework during the cleaning process. A set of rods with appropriate ends is basic useful equipment.

It is important that correctly designed propriety ends are used on the rods. Makeshift devices attached to the ends of rods should be avoided, as they are not effective as the correctly designed article and could become detached and create a blockage which would be difficult to remove. Furthermore, is it possible that such devices could cause damage to the pipeline.

If the rods have brass ferrules, they should be checked to ensure that their fastenings are secure and that there are no protruding shoulders or fastenings, as these can cause damage to drain lines, especially when entering through rodding eyes.

3.2 Jetting

High pressure jetting techniques are suitable for use with all currently available pipe materials and should also be considered.

3.3 Hydraulic Rams, Compressed Air or Other Gases

Equipment is available for use with all sizes of drain likely to be encountered in building drainage and is suitable for use with all currently available pipe materials. The principle of operation is that a shock wave is induced and is transmitted by water to the point of blockage and the technique is effective where the pipe is surcharged or can be filled with water from the blockage to a point where the equipment can be used.

4. Inspection And Cleaning of Surface Water Drainage

Gutter, rainwater pipes, outlets and gratings should be inspected and thoroughly cleaned annually, or more frequently, where it is near trees or may be subjected to extreme temperatures. For a full statement on the cleaning and maintenance of gutters and rainwater pipes refer to the Mechanical services Operating and Maintenance Manual.

Gullies and channels should be inspected and cleaned out regularly. The frequency of inspection and cleaning should be based on local experience.

Defects should be remedied as soon as possible after being noted to prevent additional problems arising.

Methods for cleaning surface water drainage are the same as foul drains, as previously described.

The record drawings issued with the building's operating and maintenance manuals, should be kept in a safe place, preferably on the property concerned, so that in the event of drainage problems the drawings can be referenced.

Maintenance instructions for pumps, rainwater harvesting and other systems, where installed will be in accordance with the manufacturer's instructions. It is often sensible to enter into a maintenance contract with a trusted and suitable company, which would ensure specialist equipment is correctly maintained in addition to an emergency service in event of failure.

Table 1: Drainage Items - Ownership & Maintenance Responsibility Matrix

Drainage Items - Ownership & Maintenance Responsibility Matrix		
Feature	Maintenance	Frequency
Private Drains	Inspection	CCTV survey every 5-10 years.
	Regular Maintenance	Jet clean system fully every 5-10 years. (Recommend prior to CCTV drainage survey is)
	Remedial / Occasional Maintenance	Carry out remedial works as identified in CCTV survey.
Discharge orifice manholes/flow control devices	Inspection	Quarterly
	Regular Maintenance	Remove silt and debris as necessary to prevent build up.
Gully / Drainage Channels	Inspection	Quarterly
	Regular Maintenance	Remove silt and debris as necessary to prevent build up.

A formal review of the risks should be undertaken on an annual basis:

Table 2: Proposed Operational Schedule for Below Ground Drainage

Operation	Risks	Mitigating Measures
Access to manholes for Inspection and Maintenance.	1. Confined spaces	1. Entry to confined space to be minimised and, where unavoidable, to be carried out by appropriately trained personnel
Removal of silt from outfall	1. Risk to members of the public 2. Open Water	1. Access to hazardous areas by members of the public to be prohibited. 2. To be carried out by appropriately trained personnel
Removal of silt from drainage channel	1. Risk to members of the public	1. Access to hazardous areas by members of the public to be prohibited

All inspection and maintenance works should take into consideration the implications of 'lone working'. An assessment should be carried out and the risks mitigated accordingly.

5. Inspection And Cleaning of SUDS

Surface water from the development is drained through a series of pipes, manholes, gullies, channels and Sustainable Urban Drainage Systems (SUDS). SUDS systems comprise of various components that are designed to:

- Reduce flooding
- Improve water quality of the run-off
- Create a better environment

The SUDS components used across the site are indicated on the drainage layout drawings 28421-HYD-XX-XX-DR-C-7000 to 7005

The maintenance recommendations contained within the following pages are general and should be in addition to the manufacturer's recommendations of specialist material and method. The proposed SuDS features will require maintenance including litter and debris removal, sediment removal, vegetation maintenance and remediation to any damaged structures. The maintenance requirements will be the responsibility of a private maintenance company. All inspection and maintenance works should take into consideration the implications of 'lone working'. An assessment should be carried out and the risks mitigated accordingly.

The following matrices set out the various drainage items to be maintained, identifies who is responsible and the frequency of maintenance and should be passed to the development operator to ensure that future maintenance is carried out in a safe and proper manner.

Table 3: Permeable Paving

Permeable Paving - Operation and maintenance requirements in accordance with CIRIA C753 - The SuDS Manual		
Maintenance Schedule	**Required Action**	**Frequency**
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface).	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surfaces from adjacent impermeable areas as this area is most likely to collect the most sediment.
Occasional maintenance	Stabilise and mow contributing and adjacent areas.	As required.
	Removal of weeds or management using glyphosate applied directly into the weeds by an applicator rather than spraying.	As required – once per year on less frequently used pavements.
Remedial actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving.	As required.
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost jointing material.	As required.
	Rehabilitation of surface and upper substructure by remedial sweeping.	Every 10 to 15 years or as required (if infiltration performance is reduced due to significant clogging).
Monitoring	Initial inspection.	Monthly for three months after installation.
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action.	Three-monthly, 48 h after large storms in first six months.
	Inspect silt accumulation rates and establish appropriate brushing frequencies.	Annually.
	Monitor inspection chambers.	Annually.

Reference should be made to the manufacturer recommendations where applicable

Table 4: Permeable Paving by Type

Permeable Paving - Operation and maintenance requirements in accordance with CIRIA C753 - The SuDS Manual			
Type	**Clogging Mechanism**	**Likely Rates of Clogging**	**Rehabilitation Mechanisms**
Grass Reinforcement (Concrete Grids)	Sand-filled voids with grass overgrowth trap sediment close to surface.	Clogging depths 6-12mm, loss of 60-75% of initial infiltration rate over 35 years.	Clogged sang can be removed and replaced, and grass reseeded.
Porous Asphalt	Dust and sediment trapped in surface pores.	Clogging in top 25-75mm can occur rapidly without good design and maintenance. Loses serviceability after 8 years.	Rotating sweeper and jet wash.
Porous Concrete	Dust and sediment trapped in surface pores.	Clogging in top 25-75mm can occur rapidly without good design and maintenance.	Specialist rotating and oscillating sweeper.
Permeable Concrete Block Paving	Dust and sediment trapped in joints between blocks.	Penetration to 50mm over 6 years, loss of 70-90% of initial infiltration rate in first few years. Wheel track locations can be expected to fully clog in a few years.	Brushing and suction sweeping of the surface. Replacement of top 20mm of jointing material. Herbicide application and weed removal programmes.

Table 5: Underground Cellular Tanks

Underground Cellular Tanks - Operation and maintenance requirements in accordance with CIRIA C753 - The SuDS Manual		
Maintenance Schedule	**Required Action**	**Frequency**
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then annually.
	Remove debris from the catchment surface (where it may cause risks to performance).	Monthly.
	For systems where rainfall infiltrates into the tank from above, check surface or filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary	Annually.
	Remove sediment from pre-treatment structures and / or internal forebays.	Annually, or as required.
Remedial actions	Repair / rehabilitate inlets, outlet, overflows and vents.	As required.

Monitoring	Inspect / check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed.	Annually.
	Survey inside of tank for sediment build-up and remove if necessary.	Every 5 years or as required.
Reference should be made to the manufacturer recommendations where applicable		

Table 5: Filter Strip

Filter Strip - Operation and maintenance requirements in accordance with CIRIA C753 - The SuDS Manual		
Maintenance Schedule	**Required Action**	**Frequency**
Regular maintenance	Remove litter and debris	Monthly, (or as required).
	Cut grass - to retain height within specified design range	Monthly (during growing season), or as required.
	Manage other vegetation and remove nuisance plants.	Monthly (at start, then as required).
	Inspect filter strip surface to identify evidence of erosion, poor vegetation growth, compaction, ponding, sedimentation and contamination (e.g. oils).	Monthly (at start, then half yearly).
	Check flow spreader and filter strip surface for evens gradients.	Monthly (at start, then half yearly).
	Inspect gravel flow spreader upstream of filter strip for clogging.	Monthly (at start, then half yearly).
	Inspect silt accumulation rate and establish appropriate removal frequencies.	Monthly (at start, then half yearly).
Occasional maintenance	Re-seed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if bare soil is exposed over > 10% of the filter strip area.
Remedial actions	Repair erosion or other damage by re-turfing or reseeding.	As required.
	Relevel uneven surfaces and reinstate design levels	As required.
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface.	As required.
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip.	As required.
	Remove and dispose of oils or petrol residues using safe standard practices.	As required.