STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for WEST BOLDON - 30.03.21.SWS

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	2	PIMP (%)	100
M5-60 (mm)	20.000	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	200	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

Network Design Table for WEST BOLDON - 30.03.21.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	26.203	0.155	169.0	0.037	5.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S1.000	67.78	5.44	40.100	0.037	0.0	0.0	0.0	1.00	39.9	6.8

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Network Design Table for WEST BOLDON - 30.03.21.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
S2.000	16.895	0.845	20.0	0.006	5.00	0.0	0.600	o	225	Pipe/Conduit	
S1.001	11.857	0.070	169.0	0.016	0.00	0.0	0.600	o	225	Pipe/Conduit	
S1.002	6.867	0.041	167.5	0.040	0.00	0.0	0.600	o	300	Pipe/Conduit	
S3.000	5.328	0.032	166.5	0.000	5.00	0.0	0.600	o	225	Pipe/Conduit	
S1.003	21.055	0.125	168.4	0.033	0.00	0.0	0.600	o	300	Pipe/Conduit	
S1.004	9.636	0.057	169.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
S2.000	69.69	5.10	41.060	0.006	0.0	0.0	0.0	2.94	116.9	1.1
S1.001	66.72	5.63	39.945	0.059	0.0	0.0	0.0	1.00	39.9	10.7
S1.002	66.23	5.73	39.800	0.099	0.0	0.0	0.0	1.21	85.7	17.8
S3.000	69.74	5.09	39.600	0.000	0.0	0.0	0.0	1.01	40.2	0.0
S1.003	64.76	6.02	39.493	0.132	0.0	0.0	0.0	1.21	85.4	23.2
S1.004	63.98	6.18	39.368	0.132	0.0	0.0	0.0	1.00	39.9	23.2

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Manhole Schedules for WEST BOLDON - 30.03.21.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)	Backdrop (mm)
S1	41.360	1.260	Open Manhole	1200	S1.000	40.100	225				
S8	41.834	0.774	Open Manhole	1200	S2.000	41.060	225				
S3	41.240	1.295	Open Manhole	1200	S1.001	39.945	225	S1.000	39.945	225	
								S2.000	40.215	225	270
S4	40.983	1.183	Open Manhole	1200	S1.002	39.800	300	S1.001	39.875	225	
S9	40.872	1.272	Open Manhole	1200	S3.000	39.600	225				
S5	40.891	1.398	Open Manhole	1200	S1.003	39.493	300	S1.002	39.759	300	266
								S3.000	39.568	225	
S6	39.972	0.604	Open Manhole	1200	S1.004	39.368	225	S1.003	39.368	300	
S7	39.697	0.386	Open Manhole	0		OUTFALL		S1.004	39.311	225	

Free Flowing Outfall Details for WEST BOLDON - 30.03.21.SWS

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
S1.004	S7	39.697	39.311	0.000	0	0

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Simulation Criteria for WEST BOLDON - 30.03.21.SWS

Volumetric Runoff Coeff	0.750	Manhole Headloss Coeff (Global)	0.500	Inlet Coeffiecient	0.800
Areal Reduction Factor	1.000	Foul Sewage per hectare (l/s)	0.000	Flow per Person per Day (l/per/day)	0.000
Hot Start (mins)	0	Additional Flow - % of Total Flow	0.000	Run Time (mins)	60
Hot Start Level (mm)	0	MADD Factor * 10m³/ha Storage	2.000	Output Interval (mins)	1

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

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm)	20.000	Cv (Summer)	0.750
Return Period (years)	2	Ratio R	0.400	Cv (Winter)	0.840
Region	England and Wales	Profile Type	Summer	Storm Duration (mins)	30

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Online Controls for WEST BOLDON - 30.03.21.SWS

Hydro-Brake® Optimum Manhole: S5, DS/PN: S1.003, Volume (m³): 2.1

Unit Reference	MD-SHE-0098-5000-1500-5000	Sump Available	Yes
Design Head (m)	1.500	Diameter (mm)	98
Design Flow (l/s)	5.0	Invert Level (m)	39.568
Flush-Flo™	Calculated	Minimum Outlet Pipe Diameter (mm)	150
Objective	Minimise upstream storage	Suggested Manhole Diameter (mm)	1200
Application	Surface		

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	5.0	Kick-Flo®	0.878	3.9
Flush-Flo™	0.431	4.9	Mean Flow over Head Range	-	4.3

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)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.2	0.600	4.8	1.600	5.1	2.600	6.5	5.000	8.8	7.500	10.7
0.200	4.4	0.800	4.3	1.800	5.4	3.000	6.9	5.500	9.2	8.000	11.0
0.300	4.8	1.000	4.1	2.000	5.7	3.500	7.4	6.000	9.6	8.500	11.3
0.400	4.9	1.200	4.5	2.200	6.0	4.000	7.9	6.500	10.0	9.000	11.6
0.500	4.9	1.400	4.8	2.400	6.2	4.500	8.4	7.000	10.3	9.500	11.9

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Storage Structures for WEST BOLDON - 30.03.21.SWS

Cellular Storage Manhole: S9, DS/PN: S3.000

Invert Level (m) 39.600 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	40.0	0.0	0.800	40.0	0.0	0.801	0.0	0.0

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for WEST BOLDON - 30.03.21.SWS

Simulation Criteria

Areal Reduction Factor 1.000 Manhole Headloss Coeff (Global) 0.500 MADD Factor * 10m³/ha Storage 2.000
Hot Start (mins) 0 Foul Sewage per hectare (l/s) 0.000 Inlet Coeffiecient 0.800
Hot Start Level (mm) 0 Additional Flow - % of Total Flow 0.000 Flow per Person per Day (l/per/day) 0.000

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

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 17.200 Cv (Summer) 0.750
Region England and Wales Ratio R 0.350 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
Duration(s) (mins) 15, 30, 60, 120, 240, 360, 480, 960, 1440
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	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
S1.000	S1	15 Winter	1	+0%	100/30 Winter				40.151	-0.174	0.000	0.11		4.1
S2.000	S8	15 Winter	1	+0%					41.067	-0.218	0.000	0.01		0.7
S1.001	S3	15 Winter	1	+0%	100/15 Winter				40.011	-0.159	0.000	0.19		6.4

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for WEST BOLDON - 30.03.21.SWS

PN	US/MH Name	Status	Level Exceeded
S1.000	S1	OK	
S2.000	S8	OK	
S1.001	S3	OK	

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for WEST BOLDON - 30.03.21.SWS

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)
S1.002	S4	15 Winter	1	+0%	100/15 Summer				39.882	-0.218	0.000	0.17		10.2
S3.000	S9	30 Winter	1	+0%	30/15 Summer				39.688	-0.137	0.000	0.08		2.5
S1.003	S5	15 Winter	1	+0%	1/15 Summer				39.828	0.035	0.000	0.06		4.7
S1.004	S6	15 Winter	1	+0%					39.424	-0.169	0.000	0.14		4.7

PN	US/MH Name	Status	Level Exceeded
S1.002	S4	OK	
S3.000	S9	OK	
S1.003	S5	SURCHARGED	
S1.004	S6	OK	

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