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

« - Indicates pipe capacity < flow

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	39.875	0.205	194.5	0.037	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.001	20.775	0.978	21.2	0.022	0.00	0.0	0.600	o	150	Pipe/Conduit	
S2.000	1.665	0.003	500.0	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
S1.002	20.751	0.137	151.5	0.073	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.003	8.400	0.806	10.4	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
S1.004	4.453	0.069	64.5	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	65.21	5.93	40.279	0.037	0.0	0.0	0.0	0.72	12.7	6.5
S1.001	64.43	6.08	40.010	0.059	0.0	0.0	0.0	2.19	38.8	10.3
S2.000	69.89	5.06	39.035	0.000	0.0	0.0	0.0	0.44	7.8	0.0
S1.002	62.44	6.51	39.032	0.132	0.0	0.0	0.0	0.81	14.4«	22.3
S1.003	62.24	6.55	38.895	0.132	0.0	0.0	0.0	3.14	55.5	22.3
S1.004	61.98	6.61	38.089	0.132	0.0	0.0	0.0	1.25	22.2«	22.3

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PIPELINE SCHEDULES for WEST BOLDON - 30.03.21.SWS

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	150	S1	41.450	40.279	1.021	Open Manhole	450
S1.001	o	150	S2	41.648	40.010	1.488	Open Manhole	450
S2.000	o	150	S7	40.416	39.035	1.231	Open Manhole	1200
S1.002	o	150	S4	40.612	39.032	1.430	Open Manhole	450
S1.003	o	150	S5	40.240	38.895	1.195	Open Manhole	450
S1.004	o	150	SC1	40.250	38.089	2.011	Open Manhole	450

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	39.875	194.5	S2	41.648	40.074	1.424	Open Manhole	450
S1.001	20.775	21.2	S4	40.612	39.032	1.430	Open Manhole	450
S2.000	1.665	500.0	S4	40.612	39.032	1.430	Open Manhole	450
S1.002	20.751	151.5	S5	40.240	38.895	1.195	Open Manhole	450
S1.003	8.400	10.4	SC1	40.250	38.089	2.011	Open Manhole	450
S1.004	4.453	64.5	SEXCW	39.720	38.020	1.550	Open Manhole	1200

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	SEXCW	39.720	38.020	0.000	1200	0

Simulation Criteria for WEST BOLDON - 30.03.21.SWS

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet 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	1	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

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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)	20.000	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for WEST BOLDON - 30.03.21.SWS

Hydro-Brake® Optimum Manhole: S4, DS/PN: S1.002, Volume (m³): 0.6

Unit Reference	MD-SHE-0100-5000-1400-5000
Design Head (m)	1.400
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	100
Invert Level (m)	39.032
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.400	5.0
Flush-Flo™	0.416	5.0
Kick-Flo®	0.855	4.0
Mean Flow over Head Range	-	4.4

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	3.3	1.200	4.7	3.000	7.1	7.000	10.7
0.200	4.6	1.400	5.0	3.500	7.7	7.500	11.0
0.300	4.9	1.600	5.3	4.000	8.2	8.000	11.4
0.400	5.0	1.800	5.6	4.500	8.6	8.500	11.7
0.500	5.0	2.000	5.9	5.000	9.1	9.000	12.0
0.600	4.9	2.200	6.2	5.500	9.5	9.500	12.3
0.800	4.3	2.400	6.4	6.000	9.9		
1.000	4.3	2.600	6.7	6.500	10.3		

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Storage Structures for WEST BOLDON - 30.03.21.SWS

Cellular Storage Manhole: S7, DS/PN: S2.000

Invert Level (m) 39.043 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	44.0	0.0	0.801	0.0	0.0
0.800	44.0	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	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
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	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	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.200	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	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.
S1.000	S1	15 Winter	1	+0%	100/15 Summer			
S1.001	S2	15 Winter	1	+0%	100/15 Summer			
S2.000	S7	30 Winter	1	+0%	30/15 Summer	100/60 Winter		
S1.002	S4	15 Winter	1	+0%	1/15 Summer			
S1.003	S5	15 Winter	1	+0%				
S1.004	SC1	15 Winter	1	+0%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1	40.340	-0.089	0.000	0.35			4.2	OK
S1.001	S2	40.052	-0.108	0.000	0.17			6.3	OK
S2.000	S7	39.130	-0.055	0.000	0.21		21	2.3	OK
S1.002	S4	39.212	0.030	0.000	0.33			4.5	SURCHARGED
S1.003	S5	38.926	-0.119	0.000	0.09			4.5	OK
S1.004	SC1	38.142	-0.097	0.000	0.27			4.5	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	Level Exceeded
S1.000	S1	
S1.001	S2	
S2.000	S7	2
S1.002	S4	
S1.003	S5	
S1.004	SC1	

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30 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	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
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	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	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.200	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	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.
S1.000	S1	15 Winter	30	+0%	100/15 Summer			
S1.001	S2	15 Winter	30	+0%	100/15 Summer			
S2.000	S7	60 Winter	30	+0%	30/15 Summer	100/60 Winter		
S1.002	S4	15 Winter	30	+0%	1/15 Summer			
S1.003	S5	15 Winter	30	+0%				
S1.004	SC1	15 Winter	30	+0%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1	40.385	-0.044	0.000	0.85			10.4	OK
S1.001	S2	40.081	-0.079	0.000	0.44			16.1	OK
S2.000	S7	39.398	0.213	0.000	0.44		39	4.7	SURCHARGED
S1.002	S4	39.471	0.289	0.000	0.37			5.0	SURCHARGED
S1.003	S5	38.927	-0.118	0.000	0.10			5.0	OK
S1.004	SC1	38.145	-0.094	0.000	0.30			5.0	OK

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

PN	US/MH Name	Level Exceeded
S1.000	S1	
S1.001	S2	
S2.000	S7	2
S1.002	S4	
S1.003	S5	
S1.004	SC1	

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100 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	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
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	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	0.350
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	17.200	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	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.
S1.000	S1	15 Winter	100	+40%	100/15 Summer			
S1.001	S2	15 Winter	100	+40%	100/15 Summer			
S2.000	S7	120 Winter	100	+40%	30/15 Summer	100/60 Winter		
S1.002	S4	120 Winter	100	+40%	1/15 Summer			
S1.003	S5	120 Winter	100	+40%				
S1.004	SC1	120 Winter	100	+40%				

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
S1.000	S1	40.917	0.488	0.000	1.30			16.0	SURCHARGED
S1.001	S2	40.566	0.406	0.000	0.69			25.1	SURCHARGED
S2.000	S7	40.417	1.232	0.721	0.45		94	4.9	FLOOD
S1.002	S4	40.427	1.245	0.000	0.37			5.0	FLOOD RISK
S1.003	S5	38.927	-0.118	0.000	0.10			5.0	OK
S1.004	SC1	38.145	-0.094	0.000	0.30			5.0	OK

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

PN	US/MH Name	Level Exceeded
S1.000	S1	
S1.001	S2	
S2.000	S7	2
S1.002	S4	
S1.003	S5	
S1.004	SC1	

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