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7 Regents Court Far Moor Lane Redditch B98 0SD		
Date 22/11/2024 17:56	Designed by AlirezaAhmadi	
File STORM.MDX	Checked by	
XP Solutions		Network 2014.1.1

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	5	Add Flow / Climate Change (%)	0
M5-60 (mm)	19.000	Minimum Backdrop Height (m)	0.200
Ratio R	0.400	Maximum Backdrop Height (m)	1.500
Maximum Rainfall (mm/hr)	50	Min Design Depth for Optimisation (m)	1.200
Maximum Time of Concentration (mins)	30	Min Vel for Auto Design only (m/s)	1.00
Foul Sewage (l/s/ha)	0.000	Min Slope for Optimisation (1:X)	500
Volumetric Runoff Coeff.	0.750		

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.246	4-8	0.125

Total Area Contributing (ha) = 0.371

Total Pipe Volume (m³) = 6.220

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Auto Design
1.000	53.000	0.500	106.0	0.271	5.00	0.0	0.600	o	300	
1.001	30.000	0.150	200.0	0.100	0.00	0.0	0.600	o	300	
1.002	5.000	0.050	100.0	0.000	0.00	0.0	0.600	o	300	

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E I.Area (ha)	E Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	50.00	5.58	91.900	0.271	0.0	0.0	0.0	1.53	107.9	36.7
1.001	50.00	6.03	91.400	0.371	0.0	0.0	0.0	1.11	78.3	50.2
1.002	50.00	6.08	91.250	0.371	0.0	0.0	0.0	1.57	111.1	50.2

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PIPELINE SCHEDULES for Storm

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)
1.000	o	300	1	93.000	91.900	0.800	Open Manhole	1200
1.001	o	300	2	93.000	91.400	1.300	Open Manhole	1200
1.002	o	300	3	92.700	91.250	1.150	Open Manhole	1200

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)
1.000	53.000	106.0	2	93.000	91.400	1.300	Open Manhole	1200
1.001	30.000	200.0	3	92.700	91.250	1.150	Open Manhole	1200
1.002	5.000	100.0	Ex MH	92.300	91.200	0.800	Open Manhole	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D, L (mm)	W (mm)
1.002	Ex MH	92.300	91.200	0.000	0	0

Simulation Criteria for Storm

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 Coefficient	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 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	Profile Type	Summer
Return Period (years)	5	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for Storm

Hydro-Brake Optimum® Manhole: 3, DS/PN: 1.002, Volume (m³): 3.7

Unit Reference MD-SHE-0160-1290-1200-1290
Design Head (m) 1.200
Design Flow (l/s) 12.9
Flush-Flo™ Calculated
Objective Minimise upstream storage
Diameter (mm) 160
Invert Level (m) 91.250
Minimum Outlet Pipe Diameter (mm) 225
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	12.9	Kick-Flo®	0.791	10.6
Flush-Flo™	0.358	12.9	Mean Flow over Head Range	-	11.1

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	5.7	1.200	12.9	3.000	19.9	7.000	29.9
0.200	12.1	1.400	13.8	3.500	21.4	7.500	30.9
0.300	12.8	1.600	14.7	4.000	22.8	8.000	31.9
0.400	12.8	1.800	15.6	4.500	24.2	8.500	32.8
0.500	12.6	2.000	16.4	5.000	25.4	9.000	33.7
0.600	12.3	2.200	17.2	5.500	26.6	9.500	34.6
0.800	10.6	2.400	17.9	6.000	27.7		
1.000	11.8	2.600	18.6	6.500	28.8		

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Storage Structures for Storm

Cellular Storage Manhole: 2, DS/PN: 1.001

Invert Level (m) 91.405 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
 Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	210.0	0.0	0.801	0.0	0.0
0.800	210.0	0.0			

Manhole Headloss for Storm

PN	US/MH	US/MH
Name	Headloss	
1.000	1	0.500
1.001	2	0.500
1.002	3	0.500

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

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 Coefficient 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 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 Ratio R 0.400
 Region England and Wales Cv (Summer) 0.750
 M5-60 (mm) 19.000 Cv (Winter) 0.840

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

Profile(s) Summer and Winter
 Duration(s) (mins) 15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 5760, 7200, 8640, 10080
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 45

PN	Storm	Return Period	Climate Change	First X Surchage	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	1	0%	100/15 Summer				
1.001	60 Winter	1	0%	100/15 Summer				
1.002	60 Winter	1	0%	30/15 Summer				

PN	US/MH Name	Water		Flooded		Pipe		Status
		Level (m)	Surch'd Depth (m)	Volume (m³)	Flow / Cap. (l/s)	O'flow (l/s)	Flow	
1.000	1	92.023	-0.177	0.000	0.34	0.0	35.1	OK
1.001	2	91.499	-0.201	0.000	0.19	0.0	13.4	OK
1.002	3	91.464	-0.086	0.000	0.20	0.0	12.3	OK

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

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 Coefficient	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 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	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 45

PN	Storm	Return Period	Climate Change	First X Surchage	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	30	0%	100/15 Summer				
1.001	60 Winter	30	0%	100/15 Summer				
1.002	60 Winter	30	0%	30/15 Summer				

PN	US/MH Name	Water		Flooded		Pipe		Status
		Level (m)	Surch'd Depth (m)	Volume (m³)	Flow / Cap. (l/s)	O'flow (l/s)	Pipe Flow (l/s)	
1.000	1	92.117	-0.083	0.000	0.84	0.0	85.9	OK
1.001	2	91.688	-0.012	0.000	0.23	0.0	16.6	OK
1.002	3	91.655	0.105	0.000	0.21	0.0	12.8	SURCHARGED

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1)
for Storm

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 Coefficient	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 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	Ratio R	0.400
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.000	Cv (Winter)	0.840

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

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 5760, 7200, 8640, 10080
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 45

PN	Storm	Return Period	Climate Change	First X Surge	First Y Flood	First Z Overflow	O/F Act.	Lvl Exc.
1.000	15 Winter	100	+45%	100/15	Summer			
1.001	120 Winter	100	+45%	100/15	Summer			
1.002	120 Winter	100	+45%	30/15	Summer			

PN	US/MH Name	Water		Flooded		Pipe		Status
		Level (m)	Surch'd Depth (m)	Volume (m³)	Flow / Cap. (l/s)	O'flow (l/s)	Pipe Flow (l/s)	
1.000	1	92.811	0.611	0.000	1.46	0.0	149.4	FLOOD RISK
1.001	2	92.069	0.369	0.000	0.43	0.0	30.8	SURCHARGED
1.002	3	92.404	0.854	0.000	0.21	0.0	12.8	FLOOD RISK

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User Report C:\Users\AlirezaAhmadi\Downloads\volume calcs.SPDX for Storm

USMH	USMH Dia (mm)	US MH Depth (m)	Dia (mm)	Length (m)
1	1200	1.100	300	53.000
2	1200	1.600	300	30.000
3	1200	1.450	300	5.000

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