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Sheppard Lockton House	11974	
Cafferata Way	Hilljet Quadring	
Newark, NG24 2TN	FEH	
Date 31/10/2019	Designed by PAE	
File 19.10.31 750 5ls feh.MDX	Checked by	
Innovyze	Network 2019.1	

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)	2	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.400	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	100	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	60	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

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)	Section Type	Auto Design
S1.000	24.701	0.050	494.0	0.074	5.00	0.0	0.600	o	750	Pipe/Conduit	
S1.001	23.046	0.050	460.9	0.055	0.00	0.0	0.600	o	750	Pipe/Conduit	
S2.000	32.000	0.065	492.3	0.039	5.00	0.0	0.600	o	750	Pipe/Conduit	
S1.002	32.117	0.065	494.1	0.025	0.00	0.0	0.600	o	750	Pipe/Conduit	
S1.003	3.818	0.050	76.4	0.037	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)
S1.000	64.95	5.33	2.340	0.074	0.0	0.0	0.0	1.25	553.2	13.0
S1.001	63.42	5.62	2.290	0.129	0.0	0.0	0.0	1.30	572.9	22.2
S2.000	64.44	5.43	2.305	0.039	0.0	0.0	0.0	1.25	554.2	6.8
S1.002	61.36	6.05	2.240	0.193	0.0	0.0	0.0	1.25	553.2	32.1
S1.003	61.16	6.09	2.175	0.229	0.0	0.0	0.0	1.50	59.6	38.0

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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m ³ /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 Offline Controls 0 Number of Time/Area Diagrams 0
 Number of Online Controls 1 Number of Storage Structures 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)	19.000	Storm Duration (mins)	30
Ratio R	0.400		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: SS5, DS/PN: S1.003, Volume (m³): 17.4

Unit Reference	MD-SHE-0103-5000-1156-5000
Design Head (m)	1.156
Design Flow (l/s)	5.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	103
Invert Level (m)	2.175
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.156	5.0	Kick-Flo®	0.721	4.0
Flush-Flo™	0.341	5.0	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	3.5	1.200	5.1	3.000	7.8	7.000	11.7
0.200	4.8	1.400	5.5	3.500	8.4	7.500	12.1
0.300	5.0	1.600	5.8	4.000	8.9	8.000	12.4
0.400	5.0	1.800	6.1	4.500	9.5	8.500	12.8
0.500	4.9	2.000	6.5	5.000	9.9	9.000	13.2
0.600	4.6	2.200	6.8	5.500	10.4	9.500	13.5
0.800	4.2	2.400	7.0	6.000	10.8		
1.000	4.7	2.600	7.3	6.500	11.3		

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2 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 0.000
 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 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FEH
 FEH Rainfall Version 1999
 Site Location GB 522850 333500 TF 22850 33500
 C (1km) -0.020
 D1 (1km) 0.291
 D2 (1km) 0.308
 D3 (1km) 0.210
 E (1km) 0.304
 F (1km) 2.524
 Cv (Summer) 0.750
 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 450.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status OFF
 DVD Status OFF
 Inertia Status OFF

Profile(s) Summer and Winter
 Duration(s) (mins) 60, 120, 180, 240, 360, 480, 600, 720, 960,
 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
 Return Period(s) (years) 2, 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)
S1.000	SS1	60 Winter	2	+0%	100/60 Summer				2.547
S1.001	SS2	60 Winter	2	+0%	100/60 Summer				2.547
S2.000	SS3	60 Winter	2	+0%	100/60 Summer				2.547
S1.002	SS4	60 Winter	2	+0%	100/60 Summer				2.547
S1.003	SS5	60 Winter	2	+0%	2/60 Summer	100/60 Summer			2.547

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

PN	US/MH Name	Surcharged		Flooded		Pipe		Status	Level Exceeded
		Depth (m)	Volume (m ³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)			
S1.000	SS1	-0.543	0.000	0.01		6.0		OK	
S1.001	SS2	-0.493	0.000	0.02		8.3		OK	
S2.000	SS3	-0.508	0.000	0.01		2.8		OK	
S1.002	SS4	-0.443	0.000	0.02		7.1		OK	
S1.003	SS5	0.147	0.000	0.16		5.0	SURCHARGED		16

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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 0.000
 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 0 Number of Real Time Controls 0

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 E (1km) 0.304
 F (1km) 2.524
 Cv (Summer) 0.750
 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 450.0
 Analysis Timestep 2.5 Second Increment (Extended)
 DTS Status OFF
 DVD Status OFF
 Inertia Status OFF

Profile(s) Summer and Winter
 Duration(s) (mins) 60, 120, 180, 240, 360, 480, 600, 720, 960,
 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
 Return Period(s) (years) 2, 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)
S1.000	SS1	60 Winter	30	+0%	100/60 Summer				2.982
S1.001	SS2	60 Winter	30	+0%	100/60 Summer				2.982
S2.000	SS3	60 Winter	30	+0%	100/60 Summer				2.982
S1.002	SS4	60 Winter	30	+0%	100/60 Summer				2.982
S1.003	SS5	60 Winter	30	+0%	2/60 Summer	100/60 Summer			2.980

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

PN	US/MH Name	Surcharged		Flooded		Pipe Flow (l/s)	Status	Level Exceeded
		Depth (m)	Volume (m ³)	Flow / Cap.	Overflow (l/s)			
S1.000	SS1	-0.108	0.000	0.03		13.5	OK	
S1.001	SS2	-0.058	0.000	0.04		15.9	OK	
S2.000	SS3	-0.073	0.000	0.02		6.5	OK	
S1.002	SS4	-0.008	0.000	0.02		9.0	OK	
S1.003	SS5	0.580	0.000	0.16		5.0	SURCHARGED	16

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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 0.000
 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 0 Number of Real Time Controls 0

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 1440, 2160, 2880, 4320, 5760, 7200, 8640, 10080
 Return Period(s) (years) 2, 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)
S1.000	SS1	120 Winter	100	+40%	100/60	Summer			3.820
S1.001	SS2	120 Winter	100	+40%	100/60	Summer			3.820
S2.000	SS3	120 Winter	100	+40%	100/60	Summer			3.819
S1.002	SS4	120 Winter	100	+40%	100/60	Summer			3.819
S1.003	SS5	120 Winter	100	+40%	2/60	Summer	100/60	Summer	3.819

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

PN	US/MH Name	Surcharged		Flooded		Pipe		Level Exceeded
		Depth (m)	Volume (m ³)	Flow / Cap.	Overflow (l/s)	Flow (l/s)	Status	
S1.000	SS1	0.730	0.000	0.04		16.9	FLOOD RISK	
S1.001	SS2	0.780	0.000	0.07		29.3	FLOOD RISK	
S2.000	SS3	0.764	0.000	0.02		8.8	FLOOD RISK	
S1.002	SS4	0.829	0.000	0.10		43.2	FLOOD RISK	
S1.003	SS5	1.419	53.707	0.18		5.8	FLOOD	16