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The Charles Parker Building Midland Road Northants NN10 8DN	190305 Low Road Crowland	
Date 13/06/2019	Designed by HMA	
File 190305 STORM NETWORK CALCS..MDX	Checked by SDP	
Micro Drainage	Network 2018.1	

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)	100	PIMP (%)	100
M5-60 (mm)	19.000	Add Flow / Climate Change (%)	0
Ratio R	0.421	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
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)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	0.297	4-8	0.162

Total Area Contributing (ha) = 0.459

Total Pipe Volume (m³) = 18.168

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
1.000	12.448	0.058	214.6	0.000	5.00	0.0	0.600	o	375	Pipe/Conduit	
1.001	26.287	0.082	320.6	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.002	31.128	0.104	299.3	0.106	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.003	29.788	0.092	323.8	0.124	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.004	42.301	0.131	322.9	0.229	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.005	7.494	0.023	325.8	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)
1.000	50.00	5.17	2.350	0.000	0.0	0.0	0.0	1.23	136.2	0.0
1.001	50.00	5.60	2.292	0.000	0.0	0.0	0.0	1.01	111.2	0.0
1.002	50.00	6.10	2.210	0.106	0.0	0.0	0.0	1.04	115.1	14.4
1.003	50.00	6.60	2.106	0.230	0.0	0.0	0.0	1.00	110.6	31.1
1.004	50.00	7.30	2.014	0.459	0.0	0.0	0.0	1.00	110.8	62.2
1.005	50.00	7.43	1.883	0.459	0.0	0.0	0.0	1.00	110.3	62.2

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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
2.000	4.115	0.294	14.0	0.000	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.006	13.569	0.045	301.5	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)
2.000	50.00	5.02	2.154	0.000	0.0	0.0	0.0	3.52	139.8	0.0
1.006	50.00	7.64	1.860	0.459	0.0	0.0	0.0	1.04	114.7	62.2

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	PN	Pipe Out Invert Level (m)	Diameter (mm)	PN	Pipes In Invert Level (m)	Diameter (mm)	Backdrop (mm)
S1-PND1	3.350	1.000	Open Manhole	1350	1.000	2.350	375				
S2	3.760	1.468	Open Manhole	1350	1.001	2.292	375	1.000	2.292	375	
S3	3.580	1.370	Open Manhole	1500	1.002	2.210	375	1.001	2.210	375	
S4	3.600	1.494	Open Manhole	1500	1.003	2.106	375	1.002	2.106	375	
S5	3.400	1.386	Open Manhole	1500	1.004	2.014	375	1.003	2.014	375	
S6	3.100	1.217	Open Manhole	1500	1.005	1.883	375	1.004	1.883	375	
S7-PND2	3.150	0.996	Open Manhole	1200	2.000	2.154	225				
S8-HYD	3.150	1.290	Open Manhole	2700	1.006	1.860	375	1.005	1.860	375	
								2.000	1.860	225	
	2.480	0.665	Open Manhole	0		OUTFALL		1.006	1.815	375	

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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	375	S1-PND1	3.350	2.350	0.625	Open Manhole	1350
1.001	o	375	S2	3.760	2.292	1.093	Open Manhole	1350
1.002	o	375	S3	3.580	2.210	0.995	Open Manhole	1500
1.003	o	375	S4	3.600	2.106	1.119	Open Manhole	1500
1.004	o	375	S5	3.400	2.014	1.011	Open Manhole	1500
1.005	o	375	S6	3.100	1.883	0.842	Open Manhole	1500
2.000	o	225	S7-PND2	3.150	2.154	0.771	Open Manhole	1200
1.006	o	375	S8-HYD	3.150	1.860	0.915	Open Manhole	2700

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	12.448	214.6	S2	3.760	2.292	1.093	Open Manhole	1350
1.001	26.287	320.6	S3	3.580	2.210	0.995	Open Manhole	1500
1.002	31.128	299.3	S4	3.600	2.106	1.119	Open Manhole	1500
1.003	29.788	323.8	S5	3.400	2.014	1.011	Open Manhole	1500
1.004	42.301	322.9	S6	3.100	1.883	0.842	Open Manhole	1500
1.005	7.494	325.8	S8-HYD	3.150	1.860	0.915	Open Manhole	2700
2.000	4.115	14.0	S8-HYD	3.150	1.860	1.065	Open Manhole	2700
1.006	13.569	301.5		2.480	1.815	0.290	Open Manhole	0

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.000	0.000	0.000
1.001	-	-	100	0.000	0.000	0.000
1.002	-	-	100	0.106	0.106	0.106
1.003	-	-	100	0.124	0.124	0.124
1.004	-	-	100	0.229	0.229	0.229
1.005	-	-	100	0.000	0.000	0.000
2.000	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				0.459	0.459	0.459

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)
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1.006		2.480	1.815	1.820	0	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	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	5	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	19.000	Storm Duration (mins)	30
Ratio R	0.421		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S8-HYD, DS/PN: 1.006, Volume (m³): 8.1

Unit Reference MD-SHE-0068-2200-1150-2200
Design Head (m) 1.150
Design Flow (l/s) 2.2
Flush-Flo™ Calculated
Objective Minimise upstream storage
Application Surface
Sump Available Yes
Diameter (mm) 68
Invert Level (m) 1.860
Minimum Outlet Pipe Diameter (mm) 100
Suggested Manhole Diameter (mm) 1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.150	2.2	Kick-Flo®	0.609	1.7
Flush-Flo™	0.301	2.0	Mean Flow over Head Range	-	1.8

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)	Depth (m)	Flow (l/s)
0.100	1.7	0.800	1.9	2.000	2.8	4.000	3.9	7.000	5.1
0.200	2.0	1.000	2.1	2.200	3.0	4.500	4.1	7.500	5.3
0.300	2.0	1.200	2.2	2.400	3.1	5.000	4.3	8.000	5.4
0.400	2.0	1.400	2.4	2.600	3.2	5.500	4.5	8.500	5.6
0.500	1.9	1.600	2.6	3.000	3.4	6.000	4.7	9.000	5.7
0.600	1.7	1.800	2.7	3.500	3.7	6.500	4.9	9.500	5.9

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Storage Structures for Storm

Tank or Pond Manhole: S1-PND1, DS/PN: 1.000

Invert Level (m) 2.350

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	64.2	1.000	312.5

Porous Car Park Manhole: S3, DS/PN: 1.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	44.0
Max Percolation (l/s)	122.2	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.890	Membrane Depth (mm)	0

Porous Car Park Manhole: S4, DS/PN: 1.003

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	30.5
Max Percolation (l/s)	84.7	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.790	Membrane Depth (mm)	0

Porous Car Park Manhole: S5, DS/PN: 1.004

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	63.0
Max Percolation (l/s)	175.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	2.700	Membrane Depth (mm)	0

Tank or Pond Manhole: S7-PND2, DS/PN: 2.000

Invert Level (m) 2.154

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	10.0	0.500	33.9

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Volume Summary (Static)

Length Calculations based on True Length

Pipe Number	USMH Name	Manhole Volume (m³)	Pipe Volume (m³)	Storage Structure Volume (m³)	Total Volume (m³)
1.000	S1-PND1	1.431	1.226	172.781	175.438
1.001	S2	2.101	2.746	0.000	4.847
1.002	S3	2.421	3.272	91.080	96.773
1.003	S4	2.640	3.124	74.115	79.879
1.004	S5	2.449	4.506	132.300	139.256
1.005	S6	2.151	0.596	0.000	2.746
2.000	S7-PND2	1.126	0.086	27.186	28.398
1.006	S8-HYD	7.386	1.350	0.000	8.736
Total		21.706	16.906	497.462	536.074

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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 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.421 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
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	S1-PND1	240 Winter	1	+0%	30/60 Winter				2.513	-0.212
1.001	S2	240 Winter	1	+0%	30/15 Summer				2.514	-0.153
1.002	S3	120 Winter	1	+0%	30/15 Summer				2.515	-0.070
1.003	S4	120 Winter	1	+0%	1/60 Winter				2.523	0.042
1.004	S5	120 Winter	1	+0%	1/30 Summer				2.526	0.137
1.005	S6	120 Winter	1	+0%	1/15 Summer				2.525	0.267
2.000	S7-PND2	120 Winter	1	+0%	1/30 Summer				2.524	0.145
1.006	S8-HYD	120 Winter	1	+0%	1/15 Summer				2.524	0.289

PN	US/MH Name	Flooded		Pipe		Status	Level Exceeded
		Volume (m ³)	Flow / Overflow Cap. (l/s)	Flow (l/s)			
1.000	S1-PND1	0.000	0.01	1.6	OK		
1.001	S2	0.000	0.01	1.4	OK		
1.002	S3	0.000	0.03	3.5	OK		
1.003	S4	0.000	0.07	6.4	SURCHARGED		
1.004	S5	0.000	0.13	12.9	SURCHARGED		
1.005	S6	0.000	0.17	12.5	SURCHARGED		
2.000	S7-PND2	0.000	0.01	0.9	SURCHARGED		

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

PN	US/MH Name	Flooded	Flow / Overflow		Pipe	Status	Level
		Volume (m³)	Cap.	(l/s)	Flow (l/s)		Exceeded
1.006	S8-HYD	0.000	0.02		2.0	SURCHARGED	

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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 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.421 Cv (Winter) 0.840

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 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
 Return Period(s) (years) 1, 30, 100
 Climate Change (%) 0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth
									(m)	(m)
1.000	S1-PND1	360 Winter	30	+0%	30/60 Winter				2.828	0.103
1.001	S2	360 Winter	30	+0%	30/15 Summer				2.829	0.162
1.002	S3	360 Winter	30	+0%	30/15 Summer				2.829	0.244
1.003	S4	360 Winter	30	+0%	1/60 Winter				2.829	0.348
1.004	S5	360 Winter	30	+0%	1/30 Summer				2.828	0.439
1.005	S6	480 Winter	30	+0%	1/15 Summer				2.828	0.570
2.000	S7-PND2	360 Winter	30	+0%	1/30 Summer				2.826	0.447
1.006	S8-HYD	360 Winter	30	+0%	1/15 Summer				2.827	0.592

PN	US/MH Name	Flooded Volume (m ³)	Flow / Overflow Cap. (l/s)	Pipe Flow (l/s)	Status	Level
						Exceeded
1.000	S1-PND1	0.000	0.01	1.2	SURCHARGED	
1.001	S2	0.000	0.01	1.1	SURCHARGED	
1.002	S3	0.000	0.02	1.6	SURCHARGED	
1.003	S4	0.000	0.04	3.4	SURCHARGED	
1.004	S5	0.000	0.08	8.0	SURCHARGED	
1.005	S6	0.000	0.09	6.3	FLOOD RISK	
2.000	S7-PND2	0.000	0.01	0.4	SURCHARGED	

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

PN	US/MH Name	Flooded	Flow / Overflow		Pipe	Status	Level
		Volume (m³)	Cap.	(l/s)	Flow (l/s)		Exceeded
1.006	S8-HYD	0.000	0.02		2.0	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 5 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 19.000 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.421 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0
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 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
 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	Surcharged
									Level (m)	Depth (m)
1.000	S1-PND1	720 Winter	100	+40%	30/60 Winter				3.061	0.336
1.001	S2	600 Winter	100	+40%	30/15 Summer				3.061	0.394
1.002	S3	720 Winter	100	+40%	30/15 Summer				3.062	0.477
1.003	S4	600 Winter	100	+40%	1/60 Winter				3.062	0.581
1.004	S5	600 Winter	100	+40%	1/30 Summer				3.061	0.672
1.005	S6	600 Winter	100	+40%	1/15 Summer				3.060	0.802
2.000	S7-PND2	600 Winter	100	+40%	1/30 Summer				3.058	0.679
1.006	S8-HYD	600 Winter	100	+40%	1/15 Summer				3.060	0.825

PN	US/MH Name	Flooded Volume (m ³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1-PND1	0.000	0.01		1.1	FLOOD RISK	
1.001	S2	0.000	0.01		1.0	SURCHARGED	
1.002	S3	0.000	0.01		1.4	SURCHARGED	
1.003	S4	0.000	0.03		3.0	SURCHARGED	
1.004	S5	0.000	0.06		6.2	SURCHARGED	
1.005	S6	0.000	0.08		6.0	FLOOD RISK	
2.000	S7-PND2	0.000	0.02		1.6	FLOOD RISK	

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Micro Drainage	Network 2018.1	

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

PN	US/MH Name	Flooded	Flow / Overflow		Pipe	Status	Level
		Volume (m³)	Cap.	(l/s)	Flow (l/s)		Exceeded
1.006	S8-HYD	0.000	0.02		2.2	FLOOD RISK	