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Park House Sandpiper Court Chester CH4 9QU	Victoria Garage Ellesmere Surface Water Design	
Date 31/08/2023 File 8194 SW04 APPROVAL.MDX	Designed by Coopers Checked by AJ	
Micro Drainage	Network 2020.1.3	

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)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.340	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	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)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits


Network Design Table for Storm

« - 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
1.000	11.000	0.049	224.5	0.004	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	19.000	0.084	226.2	0.018	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	7.200	0.288	25.0	0.016	5.00	0.0	0.600	o	225	Pipe/Conduit	
3.000	19.000	0.127	149.6	0.021	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	5.000	0.033	151.5	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.000	5.000	0.100	50.0	0.029	5.00	0.0	0.600	o	150	Pipe/Conduit	
4.001	5.000	0.100	50.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.002	5.000	-1.362	-3.7	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)	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	5.21	90.645	0.004	0.0	0.0	0.0	0.87	34.5	0.5
1.001	50.00	5.58	90.596	0.022	0.0	0.0	0.0	0.87	34.4	3.0
2.000	50.00	5.05	90.800	0.016	0.0	0.0	0.0	2.63	104.5	2.2
3.000	50.00	5.39	90.747	0.021	0.0	0.0	0.0	0.82	14.5	2.8
3.001	50.00	5.49	90.620	0.021	0.0	0.0	0.0	0.81	14.4	2.8
4.000	50.00	5.06	89.350	0.029	0.0	0.0	0.0	1.43	25.2	3.9
4.001	50.00	5.12	89.250	0.029	0.0	0.0	0.0	1.43	25.2	3.9
4.002	50.00	6.02	89.150	0.029	0.0	0.0	0.0	0.09	1.6«	3.9

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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
1.002	2.000	0.237	8.4	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)
1.002	50.00	6.03	90.512	0.088	0.0	0.0	0.0	3.49	61.7	11.9

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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)	Pipe Out Diameter (mm)	PN	Pipes In Invert Level (m)	Pipes In Diameter (mm)	Backdrop (mm)
S1	91.900	1.255	Open Manhole	1050	1.000	90.645	225				
S2	91.800	1.204	Open Manhole	1050	1.001	90.596	225	1.000	90.596	225	
S3	91.850	1.050	Open Manhole	1050	2.000	90.800	225				
S4	92.050	1.303	Open Manhole	1050	3.000	90.747	150				
S5	92.100	1.480	Open Manhole	1050	3.001	90.620	150	3.000	90.620	150	
S22	91.000	1.650	Open Manhole	450	4.000	89.350	150				
S23	91.100	1.850	Open Manhole	600	4.001	89.250	150	4.000	89.250	150	
S24	91.200	2.050	Open Manhole	1200	4.002	89.150	150	4.001	89.150	150	
S6	91.900	1.388	Open Manhole	1500	1.002	90.512	150	1.001	90.512	225	
								2.000	90.512	225	
								3.001	90.587	150	75
								4.002	90.512	150	
S8	92.000	1.725	Open Manhole	0		OUTFALL		1.002	90.275	150	

No coordinates have been specified, layout information cannot be produced.

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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	225	S1	91.900	90.645	1.030	Open Manhole	1050
1.001	o	225	S2	91.800	90.596	0.979	Open Manhole	1050
2.000	o	225	S3	91.850	90.800	0.825	Open Manhole	1050
3.000	o	150	S4	92.050	90.747	1.153	Open Manhole	1050
3.001	o	150	S5	92.100	90.620	1.330	Open Manhole	1050
4.000	o	150	S22	91.000	89.350	1.500	Open Manhole	450
4.001	o	150	S23	91.100	89.250	1.700	Open Manhole	600
4.002	o	150	S24	91.200	89.150	1.900	Open Manhole	1200
1.002	o	150	S6	91.900	90.512	1.238	Open Manhole	1500

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	11.000	224.5	S2	91.800	90.596	0.979	Open Manhole	1050
1.001	19.000	226.2	S6	91.900	90.512	1.163	Open Manhole	1500
2.000	7.200	25.0	S6	91.900	90.512	1.163	Open Manhole	1500
3.000	19.000	149.6	S5	92.100	90.620	1.330	Open Manhole	1050
3.001	5.000	151.5	S6	91.900	90.587	1.163	Open Manhole	1500
4.000	5.000	50.0	S23	91.100	89.250	1.700	Open Manhole	600
4.001	5.000	50.0	S24	91.200	89.150	1.900	Open Manhole	1200
4.002	5.000	-3.7	S6	91.900	90.512	1.238	Open Manhole	1500
1.002	2.000	8.4	S8	92.000	90.275	1.575	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	S8	92.000	90.275	0.000	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 <sup>3</sup> /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 3    Number of Storage Structures 2    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)	18.000	Storm Duration (mins)	30
Ratio R	0.340		

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Online Controls for Storm

Orifice Manhole: S23, DS/PN: 4.001, Volume (m<sup>3</sup>): 0.6

Diameter (m) 0.023 Discharge Coefficient 0.600 Invert Level (m) 89.250

Pump Manhole: S24, DS/PN: 4.002, Volume (m<sup>3</sup>): 2.4

Invert Level (m) 89.150

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.0000	0.900	1.0000	1.700	1.0000	2.500	1.0000
0.200	1.0000	1.000	1.0000	1.800	1.0000	2.600	1.0000
0.300	1.0000	1.100	1.0000	1.900	1.0000	2.700	1.0000
0.400	1.0000	1.200	1.0000	2.000	1.0000	2.800	1.0000
0.500	1.0000	1.300	1.0000	2.100	1.0000	2.900	1.0000
0.600	1.0000	1.400	1.0000	2.200	1.0000	3.000	1.0000
0.700	1.0000	1.500	1.0000	2.300	1.0000		
0.800	1.0000	1.600	1.0000	2.400	1.0000		


Hydro-Brake® Optimum Manhole: S6, DS/PN: 1.002, Volume (m<sup>3</sup>): 3.5

Unit Reference	MD-SHE-0071-2000-0700-2000
Design Head (m)	0.700
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	71
Invert Level (m)	90.512
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)	0.700	2.0	Kick-Flo®	0.450	1.6
Flush-Flo™	0.207	2.0	Mean Flow over Head Range	-	1.7


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	1.8	1.000	2.4	2.400	3.5	5.500	5.2
0.200	2.0	1.200	2.6	2.600	3.7	6.000	5.4
0.300	2.0	1.400	2.7	3.000	3.9	6.500	5.6
0.400	1.8	1.600	2.9	3.500	4.2	7.000	5.8
0.500	1.7	1.800	3.1	4.000	4.5	7.500	6.0
0.600	1.9	2.000	3.2	4.500	4.7	8.000	6.2
0.800	2.1	2.200	3.4	5.000	5.0	8.500	6.4

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Hydro-Brake® Optimum Manhole: S6, DS/PN: 1.002, Volume (m³): 3.5

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
9.000	6.6	9.500	6.8				

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Storage Structures for Storm

Cellular Storage Manhole: S3, DS/PN: 2.000

Invert Level (m) 90.800 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 <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	40.0	28.0	0.401	0.0	36.8
0.400	40.0	36.8			

Cellular Storage Manhole: S23, DS/PN: 4.001

Invert Level (m) 89.250 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 <sup>2</sup> )	Inf. Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf. Area (m <sup>2</sup> )
0.000	18.0	18.0	0.801	0.0	32.4
0.800	18.0	32.4			



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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 \* 10m<sup>3</sup>/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 3 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 0.750  
Region England and Wales Ratio R 0.340 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0  
Analysis Timestep 2.5 Second Increment (Extended)  
DTS Status OFF  
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, 45

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)
1.000	S1	30 Winter	1	+0%	30/15 Summer				90.752	-0.118
1.001	S2	30 Winter	1	+0%	30/15 Summer				90.752	-0.069
2.000	S3	30 Winter	1	+0%	100/15 Winter				90.813	-0.212
3.000	S4	15 Winter	1	+0%	30/15 Summer				90.790	-0.107
3.001	S5	30 Winter	1	+0%	30/15 Summer				90.752	-0.018
4.000	S22	15 Winter	1	+0%	30/30 Winter				89.392	-0.108
4.001	S23	120 Winter	1	+0%	30/15 Summer				89.374	-0.026
4.002	S24	120 Winter	1	+0%					89.187	-0.113
1.002	S6	30 Winter	1	+0%	1/15 Summer				90.751	0.089

PN	US/MH Name	Flooded Volume (m <sup>3</sup> )	Flow / Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	0.000	0.01		0.3	OK	
1.001	S2	0.000	0.04		1.3	OK	
2.000	S3	0.000	0.01	14	0.9	OK	
3.000	S4	0.000	0.18		2.4	OK	
3.001	S5	0.000	0.15		1.8	OK	
4.000	S22	0.000	0.17		3.4	OK	

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

PN	US/MH Name	Flooded		Half Drain Pipe		Status	Level Exceeded
		Volume (m <sup>3</sup> )	Flow / Overflow Cap. (l/s)	Time (mins)	Flow (l/s)		
4.001	S23	0.000	0.02	81	0.4	OK	
4.002	S24	0.000	0.04		0.4	OK	
1.002	S6	0.000	0.06		1.9	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 3    Number of Storage Structures 2    Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model    FSR M5-60 (mm) 18.000 Cv (Summer) 0.750  
Region England and Wales    Ratio R 0.340 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)    300.0  
Analysis Timestep 2.5 Second Increment (Extended)  
DTS Status    OFF  
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, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	S1	30 Winter	30	+0%	30/15 Summer				91.001	0.131
1.001	S2	30 Winter	30	+0%	30/15 Summer				91.000	0.179
2.000	S3	60 Winter	30	+0%	100/15 Winter				90.946	-0.079
3.000	S4	30 Winter	30	+0%	30/15 Summer				91.016	0.119
3.001	S5	30 Winter	30	+0%	30/15 Summer				91.000	0.230
4.000	S22	180 Winter	30	+0%	30/30 Winter				89.576	0.076
4.001	S23	180 Winter	30	+0%	30/15 Summer				89.575	0.175
4.002	S24	180 Winter	30	+0%					89.212	-0.088
1.002	S6	30 Winter	30	+0%	1/15 Summer				90.993	0.331

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap. (l/s)	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	0.000	0.02			0.6	SURCHARGED	
1.001	S2	0.000	0.10			3.1	SURCHARGED	
2.000	S3	0.000	0.02		49	1.2	OK	
3.000	S4	0.000	0.31			4.2	SURCHARGED	
3.001	S5	0.000	0.30			3.4	SURCHARGED	
4.000	S22	0.000	0.11			2.2	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		Half Drain Pipe		Status	Level Exceeded
		Volume (m <sup>3</sup> )	Flow / Overflow Cap. (l/s)	Time (mins)	Flow (l/s)		
4.001	S23	0.000	0.03	126	0.6	SURCHARGED	
4.002	S24	0.000	0.07		0.6	OK	
1.002	S6	0.000	0.06		1.9	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 (1/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 3 Number of Storage Structures 2 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR M5-60 (mm) 18.000 Cv (Summer) 0.750  
Region England and Wales Ratio R 0.340 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0  
Analysis Timestep 2.5 Second Increment (Extended)  
DTS Status OFF  
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, 45

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	S1	120 Winter	100	+45%	30/15 Summer				91.536	0.666
1.001	S2	120 Winter	100	+45%	30/15 Summer				91.536	0.715
2.000	S3	120 Winter	100	+45%	100/15 Winter				91.535	0.510
3.000	S4	120 Winter	100	+45%	30/15 Summer				91.539	0.642
3.001	S5	120 Winter	100	+45%	30/15 Summer				91.536	0.766
4.000	S22	180 Winter	100	+45%	30/30 Winter				89.933	0.433
4.001	S23	180 Winter	100	+45%	30/15 Summer				89.931	0.531
4.002	S24	180 Winter	100	+45%					89.240	-0.060
1.002	S6	120 Winter	100	+45%	1/15 Summer				91.535	0.873

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap. (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	S1	0.000	0.03		0.8	SURCHARGED	
1.001	S2	0.000	0.14		4.2	FLOOD RISK	
2.000	S3	0.000	0.02	166	1.3	SURCHARGED	
3.000	S4	0.000	0.30		4.0	SURCHARGED	
3.001	S5	0.000	0.35		4.0	SURCHARGED	
4.000	S22	0.000	0.21		4.1	SURCHARGED	

Park House  
Sandpiper Court  
Chester CH4 9QU

Victoria Garage  
Ellesmere  
Surface Water Design



Date 31/08/2023  
File 8194 SW04 APPROVAL.MDX

Designed by Coopers  
Checked by AJ

Micro Drainage

Network 2020.1.3

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

PN	US/MH Name	Flooded		Half Drain Pipe		Status	Level Exceeded
		Volume (m <sup>3</sup> )	Flow / Overflow Cap. (l/s)	Time (mins)	Flow (l/s)		
4.001	S23	0.000	0.05	165	0.9	SURCHARGED	
4.002	S24	0.000	0.10		0.9	OK	
1.002	S6	0.000	0.08		2.4	SURCHARGED	