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20 East Sands	19320	
Burbage Marlborough	Ageas Bowl	
Wiltshire SN8 3AN	CA5.3	
Date 21/09/2023	Designed by Robbie Parnham	
File 13920 - AGAES BOWL - CHARACTER ...	Checked by	
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)	19.800	Add Flow / Climate Change (%)	0
Ratio R	0.350	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

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	57.948	2.432	23.8	0.083	5.00	0.0	0.600	o	150	Pipe/Conduit	
1.001	10.600	0.098	108.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.000	30.264	0.329	92.0	0.050	5.00	0.0	0.600	o	150	Pipe/Conduit	
2.001	15.813	1.691	9.4	0.081	0.00	0.0	0.600	o	150	Pipe/Conduit	
2.002	8.318	0.084	99.0	0.053	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.002	79.114	3.570	22.2	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)
1.000	50.00	5.47	48.940	0.083	0.0	0.0	0.0	2.07	36.6	11.2
1.001	50.00	5.58	46.508	0.083	0.0	0.0	0.0	1.51	106.8	11.2
2.000	50.00	5.48	48.539	0.050	0.0	0.0	0.0	1.05	18.5	6.8
2.001	50.00	5.56	48.210	0.131	0.0	0.0	0.0	3.31	58.6	17.7
2.002	50.00	5.65	46.494	0.184	0.0	0.0	0.0	1.58	111.7	24.9
1.002	50.00	6.26	46.410	0.267	0.0	0.0	0.0	2.15	38.0	36.2

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Manhole Schedules for Storm

MH Name	MH CL (m)	MH Depth (m)	MH Connection	MH Diam., L*W (mm)	Pipe Out PN Invert Level (m)	Diameter (mm)	Pipes In PN Invert Level (m)	Diameter (mm)	Backdrop (mm)
S55	49.645	0.705	Open Manhole	1200	1.000	48.940			
S56	47.500	0.992	Open Manhole	1200	1.001	46.508	1.000	46.508	150
S57	49.889	1.350	Open Manhole	1200	2.000	48.539			
S58	49.998	1.788	Open Manhole	1200	2.001	48.210	2.000	48.210	150
S59	47.400	0.906	Open Manhole	1200	2.002	46.494	2.001	46.519	150
S60	47.150	0.740	Open Manhole	1200	1.002	46.410	1.001	46.410	300
							2.002	46.410	300
	43.140	0.300	Open Manhole	0		OUTFALL	1.002	42.840	150

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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	150	S55	49.645	48.940	0.555	Open Manhole	1200
1.001	o	300	S56	47.500	46.508	0.692	Open Manhole	1200
2.000	o	150	S57	49.889	48.539	1.200	Open Manhole	1200
2.001	o	150	S58	49.998	48.210	1.638	Open Manhole	1200
2.002	o	300	S59	47.400	46.494	0.606	Open Manhole	1200
1.002	o	150	S60	47.150	46.410	0.590	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	57.948	23.8	S56	47.500	46.508	0.842	Open Manhole	1200
1.001	10.600	108.2	S60	47.150	46.410	0.440	Open Manhole	1200
2.000	30.264	92.0	S58	49.998	48.210	1.638	Open Manhole	1200
2.001	15.813	9.4	S59	47.400	46.519	0.731	Open Manhole	1200
2.002	8.318	99.0	S60	47.150	46.410	0.440	Open Manhole	1200
1.002	79.114	22.2		43.140	42.840	0.150	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		43.140	42.840	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	Ratio R	0.350
Return Period (years)	100	Profile Type	Summer
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	19.800	Cv (Winter)	0.840

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Synthetic Rainfall Details

Storm Duration (mins) 30

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S60, DS/PN: 1.002, Volume (m³): 2.0

Unit Reference	MD-SHE-0071-2000-0740-2000
Design Head (m)	0.740
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	71
Invert Level (m)	46.410
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)	0.740	2.0	Kick-Flo®	0.471	1.6
Flush-Flo™	0.220	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)	Depth (m)	Flow (l/s)
0.100	1.8	0.800	2.1	2.000	3.2	4.000	4.4	7.000	5.7
0.200	2.0	1.000	2.3	2.200	3.3	4.500	4.6	7.500	5.8
0.300	2.0	1.200	2.5	2.400	3.4	5.000	4.8	8.000	6.0
0.400	1.8	1.400	2.7	2.600	3.6	5.500	5.1	8.500	6.2
0.500	1.7	1.600	2.8	3.000	3.8	6.000	5.3	9.000	6.4
0.600	1.8	1.800	3.0	3.500	4.1	6.500	5.5	9.500	6.6

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Storage Structures for Storm

Porous Car Park Manhole: S60, DS/PN: 1.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	18.0
Membrane Percolation (mm/hr)	1000	Length (m)	48.0
Max Percolation (l/s)	240.0	Slope (1:X)	0.0
Safety Factor	1.5	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	46.410	Membrane Depth (mm)	0

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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 M5-60 (mm) 19.800 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.350 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 OFF

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, 40, 45

PN	US/MH		Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water	Surcharged	Flooded
	Name	Storm							Level (m)	Depth (m)	Volume (m³)
1.000	S55	15 Winter	1	+0%	30/15 Winter				48.997	-0.093	0.000
1.001	S56	15 Winter	1	+0%	30/120 Winter				46.582	-0.226	0.000
2.000	S57	15 Winter	1	+0%	30/15 Summer				48.602	-0.087	0.000
2.001	S58	15 Winter	1	+0%	30/15 Summer				48.265	-0.095	0.000
2.002	S59	15 Winter	1	+0%	30/15 Summer				46.606	-0.188	0.000
1.002	S60	360 Winter	1	+0%	30/15 Summer				46.534	-0.026	0.000

PN	US/MH Name	Pipe		Level Exceeded
		Flow / Cap.	Overflow (l/s)	
1.000	S55	0.30	10.8	OK
1.001	S56	0.14	10.8	OK
2.000	S57	0.36	6.5	OK
2.001	S58	0.29	15.5	OK
2.002	S59	0.30	21.4	OK
1.002	S60	0.05	1.9	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 M5-60 (mm) 19.800 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.350 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 OFF

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, 40, 45

PN	US/MH		Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth	Flooded Volume
	Name	Storm							(m)	(m)	(m³)
1.000	S55	15 Winter	30	+40%	30/15 Winter				49.093	0.003	0.000
1.001	S56	480 Winter	30	+40%	30/120 Winter				46.904	0.096	0.000
2.000	S57	15 Winter	30	+40%	30/15 Summer				48.907	0.218	0.000
2.001	S58	15 Winter	30	+40%	30/15 Summer				48.470	0.110	0.000
2.002	S59	480 Winter	30	+40%	30/15 Summer				46.904	0.110	0.000
1.002	S60	480 Winter	30	+40%	30/15 Summer				46.903	0.343	0.000

		Pipe				Level	
PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Exceeded	
1.000	S55	1.00		35.8	SURCHARGED		
1.001	S56	0.06		4.6	SURCHARGED		
2.000	S57	1.17		20.8	SURCHARGED		
2.001	S58	0.99		53.9	SURCHARGED		
2.002	S59	0.14		10.2	SURCHARGED		
1.002	S60	0.05		2.0	FLOOD RISK		

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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 M5-60 (mm) 19.800 Cv (Summer) 0.750
 Region England and Wales Ratio R 0.350 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 OFF

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, 40, 45

PN	US/MH		Return Period	Climate Change	First (X) Surchage	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level	Surcharged Depth	Flooded Volume
	Name	Storm							(m)	(m)	(m³)
1.000	S55	15 Winter	100	+45%	30/15 Winter				49.609	0.519	0.000
1.001	S56	480 Winter	100	+45%	30/120 Winter				47.103	0.295	0.000
2.000	S57	15 Winter	100	+45%	30/15 Summer				49.693	1.004	0.000
2.001	S58	15 Winter	100	+45%	30/15 Summer				49.143	0.783	0.000
2.002	S59	480 Winter	100	+45%	30/15 Summer				47.104	0.310	0.000
1.002	S60	480 Winter	100	+45%	30/15 Summer				47.103	0.543	0.000

		Pipe				Level	
PN	US/MH Name	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Exceeded	
1.000	S55	1.10		39.3	FLOOD RISK		
1.001	S56	0.08		6.1	SURCHARGED		
2.000	S57	1.47		26.2	FLOOD RISK		
2.001	S58	1.16		62.8	SURCHARGED		
2.002	S59	0.19		13.6	FLOOD RISK		
1.002	S60	0.05		2.0	FLOOD RISK		