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7 St James Crescent Swansea Wales SA1 6DP	SUDS APPROVAL BODY S6 Orifice Plate	
Date 01/11/2019 File C1996 - Housing Site St...	Designed by DH Checked by GT	
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STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for S1 - HB












Pipe Sizes SW 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	0.282	Minimum Backdrop Height (m)	0.650
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.900
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 S1 - HB


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	18.809	0.730	25.8	0.008	5.00	0.0	0.600	o	100	Pipe/Conduit	
1.001	17.846	0.535	33.4	0.073	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	21.571	0.680	31.7	0.041	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.003	16.195	0.615	26.3	0.047	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	11.640	0.200	58.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.005	13.250	0.200	66.3	0.057	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	10.799	0.250	43.2	0.038	5.00	0.0	0.600	o	225	Pipe/Conduit	
2.001	10.650	0.250	42.6	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.006	11.775	0.300	39.3	0.072	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.007	18.325	0.600	30.5	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.008	23.860	0.725	32.9	0.085	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)
1.000	50.00	5.21	83.710	0.008	0.0	0.0	0.0	1.53	12.0	1.1
1.001	50.00	5.38	82.930	0.081	0.0	0.0	0.0	1.75	30.9	11.0
1.002	50.00	5.58	82.395	0.122	0.0	0.0	0.0	1.79	31.7	16.5
1.003	50.00	5.68	81.640	0.169	0.0	0.0	0.0	2.56	101.8	22.9
1.004	49.91	5.79	81.025	0.169	0.0	0.0	0.0	1.72	68.3	22.9
1.005	49.45	5.93	80.825	0.226	0.0	0.0	0.0	1.61	64.0	30.3
2.000	50.00	5.09	81.125	0.038	0.0	0.0	0.0	2.00	79.4	5.1
2.001	50.00	5.18	80.875	0.038	0.0	0.0	0.0	2.01	79.9	5.1
1.006	49.14	6.03	80.625	0.336	0.0	0.0	0.0	2.09	83.3	44.7
1.007	48.72	6.15	80.325	0.336	0.0	0.0	0.0	2.38	94.5	44.7
1.008	48.17	6.33	79.725	0.421	0.0	0.0	0.0	2.29	91.0	54.9

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Network Design Table for S1 - HB

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
1.009	6.612	1.000	6.6	0.000	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)
1.009	48.10	6.35	79.000	0.421	0.0	0.0	0.0	5.12	203.6	54.9


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





Manhole Schedules for S1 - HB

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)	Diameter (mm)	Backdr (mm)
S1-Gully	84.760	1.050	Open Manhole	600 x 450	1.000	83.710	100				
S2	84.030	1.100	Open Manhole	600 x 450	1.001	82.930	150	1.000	82.980	100	
S3	83.495	1.100	Open Manhole	600 x 450	1.002	82.395	150	1.001	82.395	150	
S4	82.990	1.350	Open Manhole	600 x 450	1.003	81.640	225	1.002	81.715	150	
Phase 2 S1	82.650	1.625	Open Manhole	1200	1.004	81.025	225	1.003	81.025	225	
Phase 2 S2	82.450	1.625	Open Manhole	600 x 450	1.005	80.825	225	1.004	80.825	225	
Phase 2 S7	82.750	1.625	Open Manhole	1200	2.000	81.125	225				
Phase 2 S8	82.500	1.625	Open Manhole	600 x 450	2.001	80.875	225	2.000	80.875	225	
Phase 2 S3	82.250	1.625	Open Manhole	1200	1.006	80.625	225	1.005	80.625	225	
								2.001	80.625	225	
Phase 2 S4	81.950	1.625	Open Manhole	1200	1.007	80.325	225	1.006	80.325	225	
Phase 2 S5	81.350	1.625	Open Manhole	600 x 450	1.008	79.725	225	1.007	79.725	225	
Phase 2 S6	80.100	1.100	Open Manhole	1200	1.009	79.000	225	1.008	79.000	225	
HEADWALL	79.400	1.400	Open Manhole	0		OUTFALL		1.009	78.000	225	

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
S1-Gully	201341.674	238933.422	201340.454	0.000	Required	
S2	201340.115	238952.166	201340.115	238952.166	Required	
S3	201333.131	238968.498	201333.131	238968.498	Required	
S4	201323.745	238987.920	201323.745	238987.920	Required	
Phase 2 S1	201315.075	239001.599	201315.075	239001.599	Required	
Phase 2 S2	201307.647	239010.561	201307.647	239010.561	Required	
Phase 2 S7	201289.068	239039.867	201289.068	239039.867	Required	

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Manhole Schedules for S1 - HB

MH Name	Manhole Easting (m)	Manhole Northing (m)	Intersection Easting (m)	Intersection Northing (m)	Manhole Access	Layout (North)
Phase 2 S8	201294.850	239030.746	201294.850	239030.746	Required	
Phase 2 S3	201300.552	239021.751	201300.552	239021.751	Required	
Phase 2 S4	201310.497	239028.056	201310.497	239028.056	Required	
Phase 2 S5	201325.974	239037.868	201325.974	239037.868	Required	
Phase 2 S6	201334.770	239060.048	201334.770	239060.048	Required	
HEADWALL	201340.948	239062.404			No Entry	

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PIPELINE SCHEDULES for S1 - HB

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	100	S1-Gully	84.760	83.710	0.950	Open Manhole	600 x 450
1.001	o	150	S2	84.030	82.930	0.950	Open Manhole	600 x 450
1.002	o	150	S3	83.495	82.395	0.950	Open Manhole	600 x 450
1.003	o	225	S4	82.990	81.640	1.125	Open Manhole	600 x 450
1.004	o	225	Phase 2 S1	82.650	81.025	1.400	Open Manhole	1200
1.005	o	225	Phase 2 S2	82.450	80.825	1.400	Open Manhole	600 x 450
2.000	o	225	Phase 2 S7	82.750	81.125	1.400	Open Manhole	1200
2.001	o	225	Phase 2 S8	82.500	80.875	1.400	Open Manhole	600 x 450
1.006	o	225	Phase 2 S3	82.250	80.625	1.400	Open Manhole	1200
1.007	o	225	Phase 2 S4	81.950	80.325	1.400	Open Manhole	1200
1.008	o	225	Phase 2 S5	81.350	79.725	1.400	Open Manhole	600 x 450
1.009	o	225	Phase 2 S6	80.100	79.000	0.875	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	18.809	25.8	S2	84.030	82.980	0.950	Open Manhole	600 x 450
1.001	17.846	33.4	S3	83.495	82.395	0.950	Open Manhole	600 x 450
1.002	21.571	31.7	S4	82.990	81.715	1.125	Open Manhole	600 x 450
1.003	16.195	26.3	Phase 2 S1	82.650	81.025	1.400	Open Manhole	1200
1.004	11.640	58.2	Phase 2 S2	82.450	80.825	1.400	Open Manhole	600 x 450
1.005	13.250	66.3	Phase 2 S3	82.250	80.625	1.400	Open Manhole	1200
2.000	10.799	43.2	Phase 2 S8	82.500	80.875	1.400	Open Manhole	600 x 450
2.001	10.650	42.6	Phase 2 S3	82.250	80.625	1.400	Open Manhole	1200
1.006	11.775	39.3	Phase 2 S4	81.950	80.325	1.400	Open Manhole	1200
1.007	18.325	30.5	Phase 2 S5	81.350	79.725	1.400	Open Manhole	600 x 450
1.008	23.860	32.9	Phase 2 S6	80.100	79.000	0.875	Open Manhole	1200
1.009	6.612	6.6	HEADWALL	79.400	78.000	1.175	Open Manhole	0

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Network Classifications for S1 - HB

PN	USMH Name	Pipe Dia (mm)	Min Cover Depth (m)	Max Cover Depth (m)	Pipe Type	MH Dia (mm)	MH Width (mm)	MH Ring Depth (m)	MH Type
1.000	S1-Gully	100	0.950	0.950	Unclassified	600	450	0.950	Unclassified
1.001	S2	150	0.950	0.950	Unclassified	600	450	0.950	Unclassified
1.002	S3	150	0.950	1.125	Unclassified	600	450	0.950	Unclassified
1.003	S4	225	1.125	1.400	Unclassified	600	450	1.125	Unclassified
1.004	Phase 2 S1	225	1.400	1.400	Unclassified	1200	0	1.400	Unclassified
1.005	Phase 2 S2	225	1.400	1.400	Unclassified	600	450	1.400	Unclassified
2.000	Phase 2 S7	225	1.400	1.400	Unclassified	1200	0	1.400	Unclassified
2.001	Phase 2 S8	225	1.400	1.400	Unclassified	600	450	1.400	Unclassified
1.006	Phase 2 S3	225	1.400	1.400	Unclassified	1200	0	1.400	Unclassified
1.007	Phase 2 S4	225	1.400	1.400	Unclassified	1200	0	1.400	Unclassified
1.008	Phase 2 S5	225	0.875	1.400	Unclassified	600	450	1.400	Unclassified
1.009	Phase 2 S6	225	0.875	1.175	Unclassified	1200	0	0.875	Unclassified

Free Flowing Outfall Details for S1 - HB


Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.009	HEADWALL	79.400	78.000	0.000	0	0

Simulation Criteria for S1 - HB

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 Storage Structures	9
Number of Online Controls	8	Number of Time/Area Diagrams	0
Number of Offline Controls	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)	18.000	Storm Duration (mins)	30
Ratio R	0.282		

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Storage Structures for S1 - HB

Porous Car Park Manhole: S2, DS/PN: 1.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	9.0
Membrane Percolation (mm/hr)	1000	Length (m)	20.5
Max Percolation (l/s)	51.3	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	83.480	Cap Volume Depth (m)	0.350

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

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	9.0
Membrane Percolation (mm/hr)	1000	Length (m)	16.0
Max Percolation (l/s)	40.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	82.795	Cap Volume Depth (m)	0.500

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

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	9.0
Membrane Percolation (mm/hr)	1000	Length (m)	17.0
Max Percolation (l/s)	42.5	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	82.290	Cap Volume Depth (m)	0.500

Porous Car Park Manhole: Phase 2 S2, DS/PN: 1.005


Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	6.0
Membrane Percolation (mm/hr)	1000	Length (m)	15.0
Max Percolation (l/s)	25.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.25	Evaporation (mm/day)	3
Invert Level (m)	81.450	Cap Volume Depth (m)	0.800

Porous Car Park Manhole: Phase 2 S8, DS/PN: 2.001

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	6.0
Membrane Percolation (mm/hr)	1000	Length (m)	15.0
Max Percolation (l/s)	25.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.25	Evaporation (mm/day)	3
Invert Level (m)	81.950	Cap Volume Depth (m)	0.350

Porous Car Park Manhole: Phase 2 S3, DS/PN: 1.006

Infiltration Coefficient Base (m/hr)	0.00000	Max Percolation (l/s)	43.3
Membrane Percolation (mm/hr)	1000	Safety Factor	2.0

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Porous Car Park Manhole: Phase 2 S3, DS/PN: 1.006

Porosity 0.30 Slope (1:X) 0.0
 Invert Level (m) 80.950 Depression Storage (mm) 5
 Width (m) 6.0 Evaporation (mm/day) 3
 Length (m) 26.0 Cap Volume Depth (m) 0.800

Complex Manhole: Phase 2 S4, DS/PN: 1.007

Infiltration Blanket

Infiltration Coefficient Base (m/hr) 0.00000 Diameter/Width (m) 6.0
 Safety Factor 2.0 Length (m) 10.0
 Porosity 0.30 Cap Volume Depth (m) 0.600
 Invert Level (m) 80.600

Infiltration Basin

Invert Level (m) 81.350 Safety Factor 2.0
 Infiltration Coefficient Base (m/hr) 0.00000 Porosity 1.00
 Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	5.0	0.400	38.0	0.600	64.0


Porous Car Park Manhole: Phase 2 S5, DS/PN: 1.008

Infiltration Coefficient Base (m/hr) 0.00000 Width (m) 6.0
 Membrane Percolation (mm/hr) 1000 Length (m) 15.0
 Max Percolation (l/s) 25.0 Slope (1:X) 0.0
 Safety Factor 2.0 Depression Storage (mm) 5
 Porosity 0.30 Evaporation (mm/day) 3
 Invert Level (m) 80.350 Cap Volume Depth (m) 0.800

Tank or Pond Manhole: Phase 2 S6, DS/PN: 1.009

Invert Level (m) 79.200

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	21.5	0.300	33.5	0.600	67.5	0.900	106.0

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Summary of Critical Results by Maximum Level (Rank 1) for S1 - HB

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 Storage Structures 9
Number of Online Controls 8 Number of Time/Area Diagrams 0
Number of Offline Controls 0 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR Ratio R 0.278
Region England and Wales Cv (Summer) 0.750
M5-60 (mm) 18.000 Cv (Winter) 0.840

Margin for Flood Risk Warning (mm) 300.0 DVD Status ON
Analysis Timestep Fine Inertia Status ON
DTS 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) 100
Climate Change (%) 30

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	S1-Gully	120 Winter	100	+30%				
1.001	S2	120 Winter	100	+30%	100/15 Summer			
1.002	S3	180 Winter	100	+30%	100/15 Summer			
1.003	S4	240 Winter	100	+30%	100/15 Summer			
1.004	Phase 2 S1	480 Winter	100	+30%	100/15 Summer			
1.005	Phase 2 S2	480 Winter	100	+30%	100/15 Summer			
2.000	Phase 2 S7	120 Winter	100	+30%	100/15 Summer			
2.001	Phase 2 S8	120 Winter	100	+30%	100/15 Summer			
1.006	Phase 2 S3	480 Winter	100	+30%	100/15 Summer			
1.007	Phase 2 S4	480 Winter	100	+30%	100/15 Summer			
1.008	Phase 2 S5	180 Winter	100	+30%	100/15 Summer			
1.009	Phase 2 S6	360 Winter	100	+30%	100/15 Summer			

PN	US/MH Name	Water Surcharged Flooded				Half Drain Pipe		Status
		Level (m)	Depth (m)	Volume (m ³)	Flow / Cap. (l/s)	Time (mins)	Flow (l/s)	
1.000	S1-Gully	83.808	-0.002	0.000	0.12		1.4	OK
1.001	S2	83.803	0.723	0.000	0.14	68	4.2	FLOOD RISK
1.002	S3	83.252	0.707	0.000	0.14	108	4.1	FLOOD RISK

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Summary of Critical Results by Maximum Level (Rank 1) for S1 - HB

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded		Half Drain Time (mins)	Pipe Flow (l/s)	Status
				Volume (m³)	Flow / Overflow Cap. (l/s)			
1.003	S4	82.638	0.773	0.000	0.07	148	6.0	SURCHARGED
1.004	Phase 2 S1	82.294	1.044	0.000	0.10		5.7	SURCHARGED
1.005	Phase 2 S2	82.287	1.237	0.000	0.11	176	6.1	FLOOD RISK
2.000	Phase 2 S7	82.267	0.917	0.000	0.10		6.4	SURCHARGED
2.001	Phase 2 S8	82.264	1.164	0.000	0.03	76	1.8	FLOOD RISK
1.006	Phase 2 S3	81.868	1.018	0.000	0.13	256	9.2	SURCHARGED
1.007	Phase 2 S4	81.859	1.309	0.000	0.07	240	6.1	FLOOD RISK
1.008	Phase 2 S5	81.297	1.347	0.000	0.13	93	10.9	FLOOD RISK
1.009	Phase 2 S6	79.770	0.545	0.000	0.06		7.8	SURCHARGED

PN	US/MH Name	Level Exceeded
1.000	S1-Gully	
1.001	S2	
1.002	S3	
1.003	S4	
1.004	Phase 2 S1	
1.005	Phase 2 S2	
2.000	Phase 2 S7	
2.001	Phase 2 S8	
1.006	Phase 2 S3	
1.007	Phase 2 S4	
1.008	Phase 2 S5	
1.009	Phase 2 S6	