

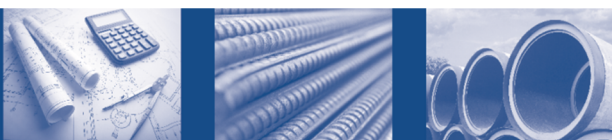
FELPHAM DEVELOPMENT PHASES 1 – 5

SURFACE WATER ATTENUATION BASIN AS-BUILT CALCULATIONS



BARRATT
DEVELOPMENTS PLC

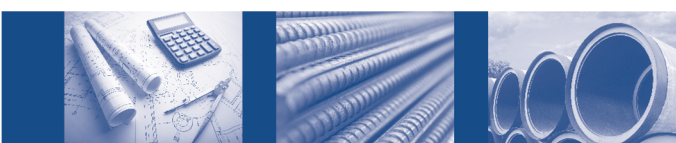
Date: 7th May 2019
Ref: AMc/19/**4180**
Rev: -



DOCUMENT CONTROL RECORD

Document Issue:

Rev	Date	Issue Status	Prepared by	Checked by
-	07.05.19	First Issue	A. Mcshane	



As-Built SW Attenuation Basins

Arun District Council Drainage & Coastal Team has requested confirmation that the surface water attenuation basins at the Barratt David Wilson Development, Felpham are suitable. The Micro Drainage calculations provided within this document are based on the as-built survey information.

The as-built attenuation basin design has been tested for the 1 in 100 year storm events including the original 30% uplift for Climate Change as well as the current uplift of 40%.

The calculations shown that the as-built attenuation system is suitable and conforms to the original design proposals.



As-Built SW Attenuation Basins

SW Attenuation
1 in 100 year + 30% CC

ARUN DISTRICT COUNCIL FP/85/19/DOC

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Monarch House Barton Lane OX14 3NB	Felpham, Bognor Regis Attenuation Pond System As-Built May 2019	
Date 02/05/2019 File Pond system - May 19 si...	Designed by C.Pendle Checked by	
Innovyze	Network 2017.1.2	

Existing Network Details for Storm

- * - Indicates pipe has been modified outside of System 1
- Indicates pipe length does not match coordinates

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	k (mm)	HYD SECT	DIA (mm)	Section Type
* S1.000	34.567	0.100	345.7	1.997	5.00	0.600	o	600	Pipe/Conduit
S1.001	120.086	0.070	1715.5	0.000	0.00	0.600	o	600	Pipe/Conduit
* S2.000	10.571	0.080	132.1	1.764	5.00	0.600	o	600	Pipe/Conduit
S2.001	50.863	0.030	1695.4	0.000	0.00	0.600	o	600	Pipe/Conduit
* S3.000	8.410	0.710	11.8	4.200	5.00	0.600	o	600	Pipe/Conduit
S3.001	23.005	0.270	85.2	0.000	0.00	0.600	o	600	Pipe/Conduit
* S1.002	3.500#	1.360	2.6	0.000	0.00	0.600	ooo	600	Triple Pipe
* S1.003	3.500#	0.000	0.0	0.000	0.00	0.600	ooo	600	Triple Pipe
* S1.004	3.500#	-1.500	-2.3	0.000	0.00	0.600	ooo	600	Triple Pipe
* S1.005	101.434	0.120	845.3	0.000	0.00	0.600	o	-1	Pipe/Conduit
* S4.000	3.121	0.020	156.1	0.000	5.00	0.600	o	600	Pipe/Conduit
* S4.001	9.858	0.020	492.9	0.000	0.00	0.600	o	600	Pipe/Conduit
* S4.002	32.814	0.030	1093.8	0.000	0.00	0.600	o	600	Pipe/Conduit
* S4.003	62.662	0.060	1044.4	0.000	0.00	0.600	o	600	Pipe/Conduit
* S4.004	5.092	0.080	63.6	0.000	0.00	0.600	o	600	Pipe/Conduit

PN	US/MH Name	US/CL (m)	US/IL (m)	US C.Depth (m)	DS/CL (m)	DS/IL (m)	DS C.Depth (m)	Ctrl	US/MH (mm)
* S1.000	1	5.200	2.800	1.800	4.250	2.700	0.950		1500
S1.001	2	4.250	2.700	0.950	4.500	2.630	1.270		1500
* S2.000	3	5.130	2.740	1.790	4.950	2.660	1.690		1500
S2.001	4	4.950	2.660	1.690	4.500	2.630	1.270		1500
* S3.000	5	4.860	3.340	0.920	4.750	2.630	1.520		1500
S3.001	6	4.750	2.630	1.520	4.500	2.360	1.540		1500
* S1.002	3	4.500	2.360	1.540	4.500	1.000	2.900	1800 x 3200	
* S1.003	8	4.500	1.000	2.900	4.500	1.000	2.900		0
* S1.004	9	4.500	1.000	2.900	4.480	2.500	1.380		0
* S1.005	4	4.480	2.500	0.880	4.200	2.380	0.720	1800 x 3200	
* S4.000	9	4.000	2.590	0.810	4.030	2.570	0.860		1500
* S4.001	10	4.030	2.570	0.860	4.030	2.550	0.880		1500
* S4.002	11	4.030	2.550	0.880	4.660	2.520	1.540		1500
* S4.003	12	4.660	2.520	1.540	4.450	2.460	1.390		1500
* S4.004	13	4.450	2.460	1.390	4.200	2.380	1.220		1500

MJA Consulting		Page 2																																																																																																																																																												
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Date 02/05/2019 File Pond system - May 19 si...	Designed by C.Pendle Checked by	
Innovyze	Network 2017.1.2	

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	5.200	2.400	Open Manhole	1500	S1.000	2.800	600				
S2	4.250	1.550	Open Manhole	1500	S1.001	2.700	600	S1.000	2.700	600	
S3	5.130	2.390	Open Manhole	1500	S2.000	2.740	600				
S4	4.950	2.290	Open Manhole	1500	S2.001	2.660	600	S2.000	2.660	600	
S5	4.860	1.520	Open Manhole	1500	S3.000	3.340	600				
S6	4.750	2.120	Open Manhole	1500	S3.001	2.630	600	S3.000	2.630	600	
S3	4.500	2.140	Open Manhole		S1.002	2.360	600	S1.001	2.630	600	270
								S2.001	2.630	600	270
								S3.001	2.360	600	
S8	4.500	3.500	Junction		S1.003	1.000	600	S1.002	1.000	600	
S9	4.500	3.500	Junction	0	S1.004	1.000	600	S1.003	1.000	600	
S4	4.480	1.980	Open Manhole	1800 x 3200	S1.005	2.500	-1	S1.004	2.500	600	
S9	4.000	1.410	Open Manhole	1500	S4.000	2.590	600				
S10	4.030	1.460	Open Manhole	1500	S4.001	2.570	600	S4.000	2.570	600	
S11	4.030	1.480	Open Manhole	1500	S4.002	2.550	600	S4.001	2.550	600	
S12	4.660	2.140	Open Manhole	1500	S4.003	2.520	600	S4.002	2.520	600	
S13	4.450	1.990	Open Manhole	1500	S4.004	2.460	600	S4.003	2.460	600	
S5	4.200	1.820	Open Manhole	1500	S1.006	2.380	600	S1.005	2.380	-1	
								S4.004	2.380	600	
S6	4.060	1.810	Open Manhole	1500	S1.007	2.250	600	S1.006	2.250	600	
S7	4.080	1.790	Open Manhole	1500	S5.000	2.290	600				
S8	4.000	1.850	Open Manhole	1500	S5.001	2.150	600	S5.000	2.150	600	
S7	4.100	2.590	Open Manhole	1500	S1.008	1.510	600	S1.007	1.510	600	
								S5.001	1.510	600	
S8	4.070	2.570	Open Manhole	1500	S1.009	1.500	600	S1.008	1.500	600	
S	3.700	2.360	Open Manhole	0		OUTFALL		S1.009	1.340	600	

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Monarch House Barton Lane OX14 3NB	Felpham, Bognor Regis Attenuation Pond System As-Built May 2019	
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Innovyze	Network 2017.1.2	

PIPELINE SCHEDULES for Storm

Upstream Manhole

- Indicates pipe length does not match coordinates

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	600	S1	5.200	2.800	1.800	Open Manhole	1500
S1.001	o	600	S2	4.250	2.700	0.950	Open Manhole	1500
S2.000	o	600	S3	5.130	2.740	1.790	Open Manhole	1500
S2.001	o	600	S4	4.950	2.660	1.690	Open Manhole	1500
S3.000	o	600	S5	4.860	3.340	0.920	Open Manhole	1500
S3.001	o	600	S6	4.750	2.630	1.520	Open Manhole	1500
S1.002	ooo	600	S3	4.500	2.360	1.540	Open Manhole	1800 x 3200
S1.003	ooo	600	S8	4.500	1.000	2.900	Junction	
S1.004	ooo	600	S9	4.500	1.000	2.900	Junction	
S1.005	o	-1	S4	4.480	2.500	0.880	Open Manhole	1800 x 3200
S4.000	o	600	S9	4.000	2.590	0.810	Open Manhole	1500
S4.001	o	600	S10	4.030	2.570	0.860	Open Manhole	1500
S4.002	o	600	S11	4.030	2.550	0.880	Open Manhole	1500
S4.003	o	600	S12	4.660	2.520	1.540	Open Manhole	1500
S4.004	o	600	S13	4.450	2.460	1.390	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)
S1.000	34.567	345.7	S2	4.250	2.700	0.950	Open Manhole	1500
S1.001	120.086	1715.5	S3	4.500	2.630	1.270	Open Manhole	1800 x 3200
S2.000	10.571	132.1	S4	4.950	2.660	1.690	Open Manhole	1500
S2.001	50.863	1695.4	S3	4.500	2.630	1.270	Open Manhole	1800 x 3200
S3.000	8.410	11.8	S6	4.750	2.630	1.520	Open Manhole	1500
S3.001	23.005	85.2	S3	4.500	2.360	1.540	Open Manhole	1800 x 3200
S1.002	3.500#	2.6	S8	4.500	1.000	2.900	Junction	
S1.003	3.500#	0.0	S9	4.500	1.000	2.900	Junction	
S1.004	3.500#	-2.3	S4	4.480	2.500	1.380	Open Manhole	1800 x 3200
S1.005	101.434	845.3	S5	4.200	2.380	0.720	Open Manhole	1500
S4.000	3.121	156.1	S10	4.030	2.570	0.860	Open Manhole	1500
S4.001	9.858	492.9	S11	4.030	2.550	0.880	Open Manhole	1500
S4.002	32.814	1093.8	S12	4.660	2.520	1.540	Open Manhole	1500
S4.003	62.662	1044.4	S13	4.450	2.460	1.390	Open Manhole	1500
S4.004	5.092	63.6	S5	4.200	2.380	1.220	Open Manhole	1500

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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)
S1.006	o	600	S5	4.200	2.380	1.220	Open Manhole	1500
S1.007	o	600	S6	4.060	2.250	1.210	Open Manhole	1500
S5.000	o	600	S7	4.080	2.290	1.190	Open Manhole	1500
S5.001	o	600	S8	4.000	2.150	1.250	Open Manhole	1500
S1.008	o	600	S7	4.100	1.510	1.990	Open Manhole	1500
S1.009	o	600	S8	4.070	1.500	1.970	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)
S1.006	7.233	55.6	S6	4.060	2.250	1.210	Open Manhole	1500
S1.007	94.712	128.0	S7	4.100	1.510	1.990	Open Manhole	1500
S5.000	15.733	112.4	S8	4.000	2.150	1.250	Open Manhole	1500
S5.001	35.822	56.0	S7	4.100	1.510	1.990	Open Manhole	1500
S1.008	6.240	624.0	S8	4.070	1.500	1.970	Open Manhole	1500
S1.009	12.387	77.4	S	3.700	1.340	1.760	Open Manhole	0

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<u>Setting Out Information - True Coordinates (Storm)</u>						
# - Indicates pipe length does not match coordinates						
PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Layout (North)
S1.000	S1	1500		5815.635	904.069	
S1.001	S2	1500		5793.769	930.841	
S2.000	S3	1500		5747.202	969.414	
S2.001	S4	1500		5744.684	979.681	
S3.000	S5	1500		5708.983	987.492	
S3.001	S6	1500		5714.031	994.219	
S1.002	S3	1800	3200	5709.978 #	1016.863 #	
S1.003	S8					
S1.004	S9					
S1.005	S4	1800	3200	5701.352	1027.920	
S4.000	S9	1500		5710.943	1080.562	
S4.001	S10	1500		5708.354	1082.303	
S4.002	S11	1500		5700.617	1076.194	
S4.003	S12	1500		5675.322	1055.291	
S4.004	S13	1500		5630.368	1098.945	
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<u>Setting Out Information - True Coordinates (Storm)</u>							
PN	USMH Name	Dia/Len (mm)	Width (mm)	US Easting (m)	US Northing (m)	Layout (North)	
S1.006	S5	1500		5626.190	1096.033		
S1.007	S6	1500		5621.428	1101.478		
S5.000	S7	1500		5537.441	1130.193		
S5.001	S8	1500		5546.681	1142.927		
S1.008	S7	1500		5562.064	1175.278		
S1.009	S8	1500		5562.542	1181.500		
# - Indicates pipe length does not match coordinates							
PN	DSMH Name	Dia/Len (mm)	Width (mm)	DS Easting (m)	DS Northing (m)	Layout (North)	
S1.009	S	0		5561.092	1193.802		
<u>Free Flowing Outfall Details for Storm</u>							
Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)	
S1.009	S	3.700	1.340	0.000	0	0	
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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S7, DS/PN: S1.008, Volume (m³): 40.6

Unit Reference	MD-SHE-0365-8750-1650-8750
Design Head (m)	1.650
Design Flow (l/s)	87.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	365
Invert Level (m)	1.510
Minimum Outlet Pipe Diameter (mm)	450
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.650	87.5
Flush-Flo™	0.597	87.4
Kick-Flo®	1.203	75.1
Mean Flow over Head Range	-	72.9

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	10.4	1.200	75.3	3.000	117.0	7.000	176.9
0.200	36.6	1.400	80.8	3.500	126.1	7.500	183.0
0.300	68.6	1.600	86.2	4.000	134.6	8.000	188.9
0.400	84.9	1.800	91.3	4.500	142.6	8.500	194.6
0.500	86.9	2.000	96.1	5.000	150.1	9.000	200.1
0.600	87.4	2.200	100.6	5.500	157.2	9.500	205.5
0.800	86.1	2.400	104.9	6.000	164.1		
1.000	83.0	2.600	109.1	6.500	170.6		

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Storage Structures for Storm

Tank or Pond Manhole: S3, DS/PN: S1.002

Invert Level (m) 2.500

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	1329.0	0.700	1866.0	1.400	2433.0	2.100	0.0
0.100	1404.0	0.800	1946.0	1.500	2516.0	2.200	0.0
0.200	1480.0	0.900	2025.0	1.600	0.0	2.300	0.0
0.300	1556.0	1.000	2106.0	1.700	0.0	2.400	0.0
0.400	1633.0	1.100	2187.0	1.800	0.0	2.500	0.0
0.500	1710.0	1.200	2268.0	1.900	0.0		
0.600	1788.0	1.300	2350.0	2.000	0.0		

Tank or Pond Manhole: S9, DS/PN: S4.000

Invert Level (m) 2.590

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	2595.0	0.700	3236.0	1.400	4110.0	2.100	0.0
0.100	2683.0	0.800	3332.0	1.500	4208.0	2.200	0.0
0.200	2772.0	0.900	3429.0	1.501	0.0	2.300	0.0
0.300	2862.0	1.000	3528.0	1.700	0.0	2.400	0.0
0.400	2954.0	1.100	3879.0	1.800	0.0	2.500	0.0
0.500	3047.0	1.200	3915.0	1.900	0.0		
0.600	3141.0	1.300	4012.0	2.000	0.0		

Tank or Pond Manhole: S7, DS/PN: S1.008

Invert Level (m) 2.500

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	3015.0	0.700	3894.0	1.400	4666.0	2.100	0.0
0.100	3162.0	0.800	4022.0	1.500	4752.0	2.200	0.0
0.200	3280.0	0.900	4150.0	1.600	4838.0	2.300	0.0
0.300	3400.0	1.000	4281.0	1.601	0.0	2.400	0.0
0.400	3521.0	1.100	4413.0	1.800	0.0	2.500	0.0
0.500	3644.0	1.200	4497.0	1.900	0.0		
0.600	3769.0	1.300	4581.0	2.000	0.0		

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<u>100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>						
<u>Simulation Criteria</u>						
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 Coeffiecient 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 3				
Number of Online Controls 1		Number of Time/Area Diagrams 4				
Number of Offline Controls 1		Number of Real Time Controls 0				
<u>Synthetic Rainfall Details</u>						
Rainfall Model		FSR		Ratio R 0.350		
Region England and Wales		Cv (Summer)		0.750		
M5-60 (mm)		19.000		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, 2160, 2880				
Return Period(s) (years)		100				
Climate Change (%)		30				
PN	Event	US/CL (m)	Water Level (m)	Flooded Volume (m³)	Pipe Flow (l/s)	Status
S1.000	60 minute 100 year Winter I+30%	5.200	3.701	0.000	355.1	SURCHARGED
S1.001	60 minute 100 year Winter I+30%	4.250	3.568	0.000	352.1	SURCHARGED
S2.000	60 minute 100 year Winter I+30%	5.130	3.417	0.000	296.9	SURCHARGED
S2.001	480 minute 100 year Winter I+30%	4.950	3.364	0.000	111.5	SURCHARGED
S3.000	120 minute 100 year Winter I+30%	4.860	3.739	0.000	500.5	OK
S3.001	480 minute 100 year Winter I+30%	4.750	3.527	0.000	258.9	SURCHARGED
S1.002	480 minute 100 year Winter I+30%	4.500	3.360	0.000	174.4	SURCHARGED
S1.003	180 minute 100 year Winter I+30%	4.500	1.600	0.000	619.7	SURCHARGED*
S1.004	180 minute 100 year Winter I+30%	4.500	1.600	0.000	618.0	SURCHARGED*
S1.005	600 minute 100 year Winter I+30%	4.480	3.316	0.000	222.7	OK
S4.000	480 minute 100 year Winter I+30%	4.000	3.356	0.000	181.6	SURCHARGED
S4.001	600 minute 100 year Winter I+30%	4.030	3.301	0.000	131.9	SURCHARGED
S4.002	600 minute 100 year Winter I+30%	4.030	3.297	0.000	127.6	SURCHARGED
S4.003	600 minute 100 year Winter I+30%	4.660	3.291	0.000	124.8	SURCHARGED
S4.004	600 minute 100 year Winter I+30%	4.450	3.282	0.000	122.5	SURCHARGED
S1.006	600 minute 100 year Winter I+30%	4.200	3.280	0.000	190.9	SURCHARGED
S1.007	600 minute 100 year Winter I+30%	4.060	3.220	0.000	190.5	SURCHARGED
S5.000	240 minute 100 year Winter I+30%	4.080	3.349	0.000	269.7	SURCHARGED
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Innovyze				Network 2017.1.2																																	
<u>100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>																																					
<table><thead><tr><th>PN</th><th>Event</th><th>US/CL (m)</th><th>Water Level (m)</th><th>Flooded Volume (m³)</th><th>Pipe Flow (l/s)</th><th>Status</th></tr></thead><tbody><tr><td>S5.001</td><td>240 minute 100 year Winter I+30%</td><td>4.000</td><td>3.224</td><td>0.000</td><td>269.6</td><td>SURCHARGED</td></tr><tr><td>S1.008</td><td>600 minute 100 year Winter I+30%</td><td>4.100</td><td>3.028</td><td>0.000</td><td>87.2</td><td>SURCHARGED</td></tr><tr><td>S1.009</td><td>2880 minute 100 year Winter I+30%</td><td>4.070</td><td>1.689</td><td>0.000</td><td>87.2</td><td>OK</td></tr></tbody></table>										PN	Event	US/CL (m)	Water Level (m)	Flooded Volume (m³)	Pipe Flow (l/s)	Status	S5.001	240 minute 100 year Winter I+30%	4.000	3.224	0.000	269.6	SURCHARGED	S1.008	600 minute 100 year Winter I+30%	4.100	3.028	0.000	87.2	SURCHARGED	S1.009	2880 minute 100 year Winter I+30%	4.070	1.689	0.000	87.2	OK
PN	Event	US/CL (m)	Water Level (m)	Flooded Volume (m³)	Pipe Flow (l/s)	Status																															
S5.001	240 minute 100 year Winter I+30%	4.000	3.224	0.000	269.6	SURCHARGED																															
S1.008	600 minute 100 year Winter I+30%	4.100	3.028	0.000	87.2	SURCHARGED																															
S1.009	2880 minute 100 year Winter I+30%	4.070	1.689	0.000	87.2	OK																															
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As-Built SW Attenuation Basins

SW Attenuation
1 in 100 year + 40% CC

[illegible]

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Time Area Diagram for Storm

Time (mins)	Area (ha)	Time (mins)	Area (ha)	Time (mins)	Area (ha)
0-4	3.659	4-8	5.716	8-12	1.337

Total Area Contributing (ha) = 10.711

Total Pipe Volume (m³) = 352.484

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Existing Network Details for Storm

- Indicates pipe length does not match coordinates

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
S1.000	34.567	0.100	345.7	1.997	5.00	0.0	0.600	o	600	Pipe/Conduit
S1.001	120.086	0.070	1715.5	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit
S2.000	10.571	0.080	132.1	1.764	5.00	0.0	0.600	o	600	Pipe/Conduit
S2.001	50.863	0.030	1695.4	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit
S3.000	8.410	0.710	11.8	4.200	5.00	0.0	0.600	o	600	Pipe/Conduit
S3.001	23.005	0.270	85.2	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit
S1.002	3.500#	1.360	2.6	0.000	0.00	0.0	0.600	ooo	600	Triple Pipe
S1.003	3.500#	0.000	0.0	0.000	0.00	0.0	0.600	ooo	600	Triple Pipe
S1.004	3.500#	-1.500	-2.3	0.000	0.00	0.0	0.600	ooo	600	Triple Pipe
S1.005	101.434	0.120	845.3	0.000	0.00	0.0	0.600	o	-1	Pipe/Conduit
S4.000	3.121	0.020	156.1	0.000	5.00	0.0	0.600	o	600	Pipe/Conduit
S4.001	9.858	0.020	492.9	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit
S4.002	32.814	0.030	1093.8	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit
S4.003	62.662	0.060	1044.4	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit
S4.004	5.092	0.080	63.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit

Network Results Table

PN	US/IL (m)	I.Area (ha)	Base Flow (l/s)	Vel (m/s)	Cap (l/s)
S1.000	2.800	1.997	0.0	1.30	368.7
S1.001	2.700	1.997	0.0	0.58	163.7
S2.000	2.740	1.764	0.0	2.12	598.6
S2.001	2.660	1.764	0.0	0.58	164.6
S3.000	3.340	4.200	0.0	7.10	2007.8
S3.001	2.630	4.200	0.0	2.64	746.3
S1.002	2.360	7.961	0.0	15.25	12935.2
S1.003	1.000	7.961	0.0	0.00	0.0
S1.004	1.000	7.961	0.0	0.00	0.0
S1.005	2.500	7.961	0.0	1.85	3525.9
S4.000	2.590	0.000	0.0	1.95	550.5
S4.001	2.570	0.000	0.0	1.09	308.2
S4.002	2.550	0.000	0.0	0.73	205.8
S4.003	2.520	0.000	0.0	0.75	210.7
S4.004	2.460	0.000	0.0	3.06	864.0

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Existing Network Details 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
S1.006	7.233	0.130	55.6	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit
S1.007	94.712	0.740	128.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit
S5.000	15.733	0.140	112.4	2.750	5.00	0.0	0.600	o	600	Pipe/Conduit
S5.001	35.822	0.640	56.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit
S1.008	6.240	0.010	624.0	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit
S1.009	12.387	0.160	77.4	0.000	0.00	0.0	0.600	o	600	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Vel (m/s)	Cap (l/s)
S1.006	2.380	7.961	0.0	3.27	924.4
S1.007	2.250	7.961	0.0	2.15	608.2
S5.000	2.290	2.750	0.0	2.30	649.3
S5.001	2.150	2.750	0.0	3.26	921.6
S1.008	1.510	10.711	0.0	0.97	273.5
S1.009	1.500	10.711	0.0	2.77	783.1

Conduit Sections for Storm

NOTE: Diameters less than 66 refer to section numbers of hydraulic conduits. These conduits are marked by the symbols:- [] box culvert, \ / open channel, oo dual pipe, ooo triple pipe, O egg.

Section numbers < 0 are taken from user conduit table

Section Number	Conduit Type	Major Dimn. (mm)	Minor Dimn. (mm)	Side Slope (Deg)	Corner Splay (mm)	4*Hyd Radius (m)	XSect Area (m ²)
-1	o	2200	1100			2.200	1.901

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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	5.200	2.400	Open Manhole	1500	S1.000	2.800	600				
S2	4.250	1.550	Open Manhole	1500	S1.001	2.700	600	S1.000	2.700	600	
S3	5.130	2.390	Open Manhole	1500	S2.000	2.740	600				
S4	4.950	2.290	Open Manhole	1500	S2.001	2.660	600	S2.000	2.660	600	
S5	4.860	1.520	Open Manhole	1500	S3.000	3.340	600				
S6	4.750	2.120	Open Manhole	1500	S3.001	2.630	600	S3.000	2.630	600	
S3	4.500	2.140	Open Manhole		S1.002	2.360	600	S1.001	2.630	600	270
								S2.001	2.630	600	270
								S3.001	2.360	600	
S8	4.500	3.500	Junction		S1.003	1.000	600	S1.002	1.000	600	
S9	4.500	3.500	Junction	0	S1.004	1.000	600	S1.003	1.000	600	
S4	4.480	1.980	Open Manhole	1800 x 3200	S1.005	2.500	-1	S1.004	2.500	600	
S9	4.000	1.410	Open Manhole	1500	S4.000	2.590	600				
S10	4.030	1.460	Open Manhole	1500	S4.001	2.570	600	S4.000	2.570	600	
S11	4.030	1.480	Open Manhole	1500	S4.002	2.550	600	S4.001	2.550	600	
S12	4.660	2.140	Open Manhole	1500	S4.003	2.520	600	S4.002	2.520	600	
S13	4.450	1.990	Open Manhole	1500	S4.004	2.460	600	S4.003	2.460	600	
S5	4.200	1.820	Open Manhole	1500	S1.006	2.380	600	S1.005	2.380	-1	
								S4.004	2.380	600	
S6	4.060	1.810	Open Manhole	1500	S1.007	2.250	600	S1.006	2.250	600	
S7	4.080	1.790	Open Manhole	1500	S5.000	2.290	600				
S8	4.000	1.850	Open Manhole	1500	S5.001	2.150	600	S5.000	2.150	600	
S7	4.100	2.590	Open Manhole	1500	S1.008	1.510	600	S1.007	1.510	600	
								S5.001	1.510	600	
S8	4.070	2.570	Open Manhole	1500	S1.009	1.500	600	S1.008	1.500	600	
S	3.700	2.360	Open Manhole	0		OUTFALL		S1.009	1.340	600	

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PIPELINE SCHEDULES for Storm

Upstream Manhole

- Indicates pipe length does not match coordinates

PN	Hyd Sect	Diam (mm)	MH Name	C.Level (m)	I.Level (m)	D.Depth (m)	MH Connection	MH DIAM., L*W (mm)
S1.000	o	600	S1	5.200	2.800	1.800	Open Manhole	1500
S1.001	o	600	S2	4.250	2.700	0.950	Open Manhole	1500
S2.000	o	600	S3	5.130	2.740	1.790	Open Manhole	1500
S2.001	o	600	S4	4.950	2.660	1.690	Open Manhole	1500
S3.000	o	600	S5	4.860	3.340	0.920	Open Manhole	1500
S3.001	o	600	S6	4.750	2.630	1.520	Open Manhole	1500
S1.002	ooo	600	S3	4.500	2.360	1.540	Open Manhole	1800 x 3200
S1.003	ooo	600	S8	4.500	1.000	2.900	Junction	
S1.004	ooo	600	S9	4.500	1.000	2.900	Junction	
S1.005	o	-1	S4	4.480	2.500	0.880	Open Manhole	1800 x 3200
S4.000	o	600	S9	4.000	2.590	0.810	Open Manhole	1500
S4.001	o	600	S10	4.030	2.570	0.860	Open Manhole	1500
S4.002	o	600	S11	4.030	2.550	0.880	Open Manhole	1500
S4.003	o	600	S12	4.660	2.520	1.540	Open Manhole	1500
S4.004	o	600	S13	4.450	2.460	1.390	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)
S1.000	34.567	345.7	S2	4.250	2.700	0.950	Open Manhole	1500
S1.001	120.086	1715.5	S3	4.500	2.630	1.270	Open Manhole	1800 x 3200
S2.000	10.571	132.1	S4	4.950	2.660	1.690	Open Manhole	1500
S2.001	50.863	1695.4	S3	4.500	2.630	1.270	Open Manhole	1800 x 3200
S3.000	8.410	11.8	S6	4.750	2.630	1.520	Open Manhole	1500
S3.001	23.005	85.2	S3	4.500	2.360	1.540	Open Manhole	1800 x 3200
S1.002	3.500#	2.6	S8	4.500	1.000	2.900	Junction	
S1.003	3.500#	0.0	S9	4.500	1.000	2.900	Junction	
S1.004	3.500#	-2.3	S4	4.480	2.500	1.380	Open Manhole	1800 x 3200
S1.005	101.434	845.3	S5	4.200	2.380	0.720	Open Manhole	1500
S4.000	3.121	156.1	S10	4.030	2.570	0.860	Open Manhole	1500
S4.001	9.858	492.9	S11	4.030	2.550	0.880	Open Manhole	1500
S4.002	32.814	1093.8	S12	4.660	2.520	1.540	Open Manhole	1500
S4.003	62.662	1044.4	S13	4.450	2.460	1.390	Open Manhole	1500
S4.004	5.092	63.6	S5	4.200	2.380	1.220	Open Manhole	1500

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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)
S1.006	o	600	S5	4.200	2.380	1.220	Open Manhole	1500
S1.007	o	600	S6	4.060	2.250	1.210	Open Manhole	1500
S5.000	o	600	S7	4.080	2.290	1.190	Open Manhole	1500
S5.001	o	600	S8	4.000	2.150	1.250	Open Manhole	1500
S1.008	o	600	S7	4.100	1.510	1.990	Open Manhole	1500
S1.009	o	600	S8	4.070	1.500	1.970	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)
S1.006	7.233	55.6	S6	4.060	2.250	1.210	Open Manhole	1500
S1.007	94.712	128.0	S7	4.100	1.510	1.990	Open Manhole	1500
S5.000	15.733	112.4	S8	4.000	2.150	1.250	Open Manhole	1500
S5.001	35.822	56.0	S7	4.100	1.510	1.990	Open Manhole	1500
S1.008	6.240	624.0	S8	4.070	1.500	1.970	Open Manhole	1500
S1.009	12.387	77.4	S	3.700	1.340	1.760	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)
S1.009	S	3.700	1.340	0.000	0	0

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: S7, DS/PN: S1.008, Volume (m³): 40.6

Unit Reference	MD-SHE-0365-8750-1650-8750
Design Head (m)	1.650
Design Flow (l/s)	87.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	365
Invert Level (m)	1.510
Minimum Outlet Pipe Diameter (mm)	450
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.650	87.5
Flush-Flo™	0.597	87.4
Kick-Flo®	1.203	75.1
Mean Flow over Head Range	-	72.9

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	10.4	1.200	75.3	3.000	117.0	7.000	176.9
0.200	36.6	1.400	80.8	3.500	126.1	7.500	183.0
0.300	68.6	1.600	86.2	4.000	134.6	8.000	188.9
0.400	84.9	1.800	91.3	4.500	142.6	8.500	194.6
0.500	86.9	2.000	96.1	5.000	150.1	9.000	200.1
0.600	87.4	2.200	100.6	5.500	157.2	9.500	205.5
0.800	86.1	2.400	104.9	6.000	164.1		
1.000	83.0	2.600	109.1	6.500	170.6		

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Storage Structures for Storm

Tank or Pond Manhole: S3, DS/PN: S1.002

Invert Level (m) 2.500

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	1329.0	0.700	1866.0	1.400	2433.0	2.100	0.0
0.100	1404.0	0.800	1946.0	1.500	2516.0	2.200	0.0
0.200	1480.0	0.900	2025.0	1.600	0.0	2.300	0.0
0.300	1556.0	1.000	2106.0	1.700	0.0	2.400	0.0
0.400	1633.0	1.100	2187.0	1.800	0.0	2.500	0.0
0.500	1710.0	1.200	2268.0	1.900	0.0		
0.600	1788.0	1.300	2350.0	2.000	0.0		

Tank or Pond Manhole: S9, DS/PN: S4.000

Invert Level (m) 2.590

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	2595.0	0.700	3236.0	1.400	4110.0	2.100	0.0
0.100	2683.0	0.800	3332.0	1.500	4208.0	2.200	0.0
0.200	2772.0	0.900	3429.0	1.501	0.0	2.300	0.0
0.300	2862.0	1.000	3528.0	1.700	0.0	2.400	0.0
0.400	2954.0	1.100	3879.0	1.800	0.0	2.500	0.0
0.500	3047.0	1.200	3915.0	1.900	0.0		
0.600	3141.0	1.300	4012.0	2.000	0.0		

Tank or Pond Manhole: S7, DS/PN: S1.008

Invert Level (m) 2.500

Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)	Depth (m)	Area (m ²)
0.000	3015.0	0.700	3894.0	1.400	4666.0	2.100	0.0
0.100	3162.0	0.800	4022.0	1.500	4752.0	2.200	0.0
0.200	3280.0	0.900	4150.0	1.600	4838.0	2.300	0.0
0.300	3400.0	1.000	4281.0	1.601	0.0	2.400	0.0
0.400	3521.0	1.100	4413.0	1.800	0.0	2.500	0.0
0.500	3644.0	1.200	4497.0	1.900	0.0		
0.600	3769.0	1.300	4581.0	2.000	0.0		

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Felpham, Bognor Regis

Attenuation Pond System

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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 Storage Structures 3

Number of Online Controls 1

Number of Time/Area Diagrams 4

Number of Offline Controls 1

Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model FSR

Ratio R 0.350

Region England and Wales Cv (Summer) 0.750

M5-60 (mm) 19.000

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, 2160, 2880

Return Period(s) (years) 100

Climate Change (%) 40

PN	Event	US/CL (m)	Water Level (m)	Flooded Volume (m³)	Pipe Flow (l/s)	Status
S1.000	60 minute 100 year Winter I+40%	5.200	3.781	0.000	382.3	SURCHARGED
S1.001	60 minute 100 year Winter I+40%	4.250	3.626	0.000	379.1	SURCHARGED
S2.000	60 minute 100 year Winter I+40%	5.130	3.433	0.000	319.5	SURCHARGED
S2.001	600 minute 100 year Winter I+40%	4.950	3.427	0.000	99.9	SURCHARGED
S3.000	60 minute 100 year Winter I+40%	4.860	3.855	0.000	549.5	OK
S3.001	480 minute 100 year Winter I+40%	4.750	3.591	0.000	278.8	SURCHARGED
S1.002	600 minute 100 year Winter I+40%	4.500	3.424	0.000	232.9	SURCHARGED
S1.003	180 minute 100 year Winter I+40%	4.500	1.600	0.000	430.6	SURCHARGED*
S1.004	180 minute 100 year Winter I+40%	4.500	1.600	0.000	429.0	SURCHARGED*
S1.005	720 minute 100 year Winter I+40%	4.480	3.373	0.000	202.2	OK
S4.000	600 minute 100 year Winter I+40%	4.000	3.420	0.000	158.6	SURCHARGED
S4.001	240 minute 100 year Winter I+40%	4.030	3.367	0.000	126.6	SURCHARGED
S4.002	240 minute 100 year Winter I+40%	4.030	3.362	0.000	120.2	SURCHARGED
S4.003	240 minute 100 year Winter I+40%	4.660	3.354	0.000	87.6	SURCHARGED
S4.004	720 minute 100 year Winter I+40%	4.450	3.333	0.000	140.4	SURCHARGED
S1.006	720 minute 100 year Winter I+40%	4.200	3.330	0.000	171.3	SURCHARGED
S1.007	720 minute 100 year Winter I+40%	4.060	3.263	0.000	170.9	SURCHARGED
S5.000	480 minute 100 year Winter I+40%	4.080	3.389	0.000	184.2	SURCHARGED

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<u>100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm</u>					
PN	Event	US/CL (m)	Water Level (m)	Flooded Volume (m³)	Pipe Flow (l/s) Status
S5.001	480 minute 100 year Winter I+40%	4.000	3.264	0.000	184.2 SURCHARGED
S1.008	720 minute 100 year Winter I+40%	4.100	3.070	0.000	87.2 SURCHARGED
S1.009	960 minute 100 year Summer I+40%	4.070	1.689	0.000	87.2 OK
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