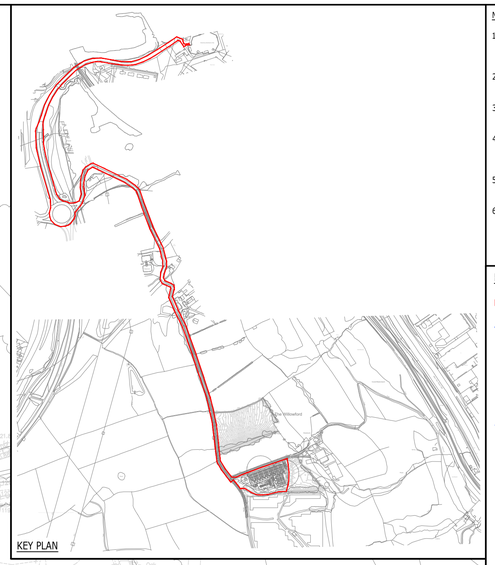
Appendix C

N



NOTES:

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE RELEVANT SPECIFICATION, INC. RISK ASSESSMENTS AND ALL OTHER RELATED DRAWINGS ISSUED BY THE ENGINEER.
2. DO NOT SCALE FROM THIS DRAWING. WORK FROM FIGURED DIMENSIONS ONLY.
3. ALL DIMENSIONS SHOWN ON THIS DRAWING ARE IN METRES UNLESS OTHERWISE STATED.
4. ALL DIMENSIONS, LEVELS AND SURVEY GRID CO-ORDINATES ARE TO BE CHECKED ON SITE AND THE ENGINEER NOTIFIED IMMEDIATELY OF ANY DISCREPANCIES PRIOR TO THE COMMENCEMENT OF THE WORKS.
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KEY

- SITE BOUNDARY
- PROPOSED SURFACE WATER SEWER & MANHOLE
- PROPOSED PENSTOCK CHAMBER
- PROPOSED DOWNSTREAM DEFENDER
- PROPOSED SURFACE WATER PUMPING CHAMBER
- PROPOSED SURFACE WATER RISING MAIN
- PROPOSED SURFACE WATER SILT TRAP
- PCC HEADWALL
- PROPOSED PERMEABLE PAVING (30% VOIDS)
- PROPOSED SWALE
- GEOCELLULAR 'ATTENUATION TANK'

0m 5m 25m

Scale: 1:500 @ A1

WORK IN PROGRESS

NOT YET APPROVED

Rev	Description	Drn	Chk	App	Date
-	FOR COMMENT	JH	NC	DM	05.11.24
-	FOR COMMENT	JH	NC	DM	28.10.24

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Client

NET ZERO TWENTY FIVE LTD

Project Title:

MAES BACH, PONTYPRIDD

Drawing Title:

SURFACE WATER DRAINAGE STRATEGY

Drawn by	Checked by	Approved by
JH	NC	DM
A1 Scale: 1:500	Date: OCT 2024	Revision: -

Drawing Number

2405430-ACE-XX-XX-DR-C-0601

File Location: y:\ardent projects\2405430 - maes back, upper boat, pontypridd 70mw\technical\acad\drawings\2405430-ace-xx-xx-dr-c-0601 surface water drainage strategy.dwg

Appendix D

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.400
Area (ha)	1.371	Urban	0.000
SAAR (mm)	1353	Region Number	Region 9

Results l/s

QBAR Rural	10.1
QBAR Urban	10.1
Q100 years	22.0
Q1 year	8.9
Q30 years	17.8
Q100 years	22.0

PRELIMINARY DRAINAGE CALCULATIONS

Existing Site Information:

Site Boundary Area	5.012 ha
Development Area	1.371 ha
Impermeable Area	0.485 ha

Modified Rational Method Equation:

$Q_n = 2.78\ CiA$

Where:

C	*Runoff Coefficient = 1 (in this case as using impermeable area)*
i_n	*Rainfall intensity for n return period (mm/hr)*
A	*Impermeable area (ha)*
Q_n	*Runoff for n return period (l/s)*

Rainfall Intensity:

The rainfall intensity for the site was determined using the site location information to establish the rate for various return periods taken from MicroDrainage

i_1	32.8 mm/hr
i_{30}	69.7 mm/hr
i_{100}	87.7 mm/hr

Existing Surface Water Runoff:

Therefore:

			C		i_n		A		Q_n	
Q_1	2.78	x	1	x	32.8	x	0.485	=	44.2	l/s
Q_{30}	2.78	x	1	x	69.7	x	0.485	=	94.0	l/s
Q_{100}	2.78	x	1	x	87.7	x	0.485	=	118.2	l/s

Appendix E

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	0.200
Ratio-R	0.200	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	x
Time of Entry (mins)	5.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
S1	0.021	10.00	121.250	1200	310316.048	185646.626	0.650
S2	0.021	10.00	121.950	1200	310358.424	185661.772	2.050
S3	0.015	10.00	120.000	1200	310400.798	185676.918	1.350
S4	0.015	10.00	119.750	1200	310418.821	185683.360	1.180
Tank 1			119.800		310459.312	185697.833	1.550
S5	0.036	10.00	119.750	1200	310461.452	185698.598	1.550
Tank 2			118.140		310473.890	185663.198	2.825
S6	0.019	10.00	116.640	1200	310475.540	185658.780	1.350
Tank 3			116.900		310475.121	185632.064	1.800
S7	0.010	10.00	116.950	1200	310475.049	185627.448	1.870
Tank 4			117.900		310432.037	185622.517	2.450
S8	0.055	10.00	121.120	1200	310338.921	185631.421	0.900
S9	0.038	10.00	121.310	1200	310365.556	185615.739	1.350
S10	0.064	10.00	119.070	1200	310399.742	185604.543	0.840
S11	0.050	10.00	120.400	1200	310360.797	185627.209	1.350
S12	0.054	10.00	118.850	1200	310391.796	185638.281	1.350
S13	0.035	10.00	117.750	1200	310422.634	185649.032	1.350
Tank - Emergency		5.00	117.100		310417.242	185609.512	1.750
S14	0.038	10.00	117.950	1200	310434.446	185615.684	2.550
S15	0.002	10.00	117.880	1200	310438.437	185616.977	2.500
S16	0.004	10.00	117.830	1200	310444.076	185616.486	2.480
S17	0.007	10.00	117.500	1200	310457.277	185621.107	2.500
PPIC1			121.200	600	310336.589	185627.572	1.000
Swale 1A			121.200	600	310339.797	185625.629	1.000
Swale 1B			120.500	600	310361.368	185612.609	1.000
PPIC2			120.500	600	310363.417	185611.321	1.000
Swale 2A			120.500	600	310365.782	185610.562	1.000
Swale 2B			119.200	600	310396.525	185600.690	1.000
PPIC3			119.200	600	310399.845	185599.624	1.000
Swale 3A			119.200	600	310402.671	185600.633	1.000
Swale 3B			118.090	600	310432.525	185611.294	1.000
PPIC4			118.090	600	310435.586	185612.385	1.000
Swale 4A			118.090	600	310438.814	185612.008	1.000
Swale 4B			118.000	600	310441.542	185611.682	1.000
PPIC5			118.000	600	310444.769	185611.301	1.000
Swale 5A			118.000	600	310447.833	185612.385	1.000
Swale 5B			117.650	600	310455.434	185615.075	0.920
PPIC6		5.00	117.260	600	310479.457	185623.577	1.000
Swale 6A			117.260	600	310476.276	185622.451	1.000
Swale 6B			117.640		310462.504	185617.577	1.410
SWPS			117.640	1200	310458.969	185616.326	2.660

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Dummy			118.250	1200	310462.469	185606.465	3.300
HW1			118.200		310463.160	185604.485	0.240

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	45.001	64.3	225	Circular	121.250	120.600	0.425	121.950	119.900	1.825
1.001	45.000	36.0	225	Circular	121.950	119.900	1.825	120.000	118.650	1.125
1.002	19.140	239.2	225	Circular	120.000	118.650	1.125	119.750	118.570	0.955
1.003	43.000	134.4	225	Circular	119.750	118.570	0.955	119.800	118.250	1.325
1.004	2.273	45.5	225	Circular	119.800	118.250	1.325	119.750	118.200	1.325
1.005	37.522	13.0	225	Circular	119.750	118.200	1.325	118.140	115.315	2.600
1.006	4.716	188.6	225	Circular	118.140	115.315	2.600	116.640	115.290	1.125
1.007	26.719	140.6	225	Circular	116.640	115.290	1.125	116.900	115.100	1.575
1.008	4.617	230.8	225	Circular	116.900	115.100	1.575	116.950	115.080	1.645
1.009	18.869	235.9	300	Circular	116.950	115.080	1.570	117.500	115.000	2.200
2.000	32.917	21.2	150	Circular	120.400	119.050	1.200	118.850	117.500	1.200
2.001	32.658	29.7	150	Circular	118.850	117.500	1.200	117.750	116.400	1.200
2.002	28.133	29.6	225	Circular	117.750	116.400	1.125	117.900	115.450	2.225
2.003	7.245	144.9	225	Circular	117.900	115.450	2.225	117.950	115.400	2.325
3.000	18.278	-365.6	225	Circular	117.100	115.350	1.525	117.950	115.400	2.325
4.000	3.751	0.0	150	Circular	121.200	120.200	0.850	121.200	120.200	0.850
4.001	25.196	36.0	500	Swale	121.200	120.200	0.500	120.500	119.500	0.500
4.002	2.420	0.0	150	Circular	120.500	119.500	0.850	120.500	119.500	0.850

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	S1	1200	Manhole	Adoptable	S2	1200	Manhole	Adoptable
1.001	S2	1200	Manhole	Adoptable	S3	1200	Manhole	Adoptable
1.002	S3	1200	Manhole	Adoptable	S4	1200	Manhole	Adoptable
1.003	S4	1200	Manhole	Adoptable	Tank 1		Junction	
1.004	Tank 1		Junction		S5	1200	Manhole	Adoptable
1.005	S5	1200	Manhole	Adoptable	Tank 2		Junction	
1.006	Tank 2		Junction		S6	1200	Manhole	Adoptable
1.007	S6	1200	Manhole	Adoptable	Tank 3		Junction	
1.008	Tank 3		Junction		S7	1200	Manhole	Adoptable
1.009	S7	1200	Manhole	Adoptable	S17	1200	Manhole	Adoptable
2.000	S11	1200	Manhole	Adoptable	S12	1200	Manhole	Adoptable
2.001	S12	1200	Manhole	Adoptable	S13	1200	Manhole	Adoptable
2.002	S13	1200	Manhole	Adoptable	Tank 4		Junction	
2.003	Tank 4		Junction		S14	1200	Manhole	Adoptable
3.000	Tank - Emergency		Junction		S14	1200	Manhole	Adoptable
4.000	PPIC1	600	Manhole	Adoptable	Swale 1A	600	Manhole	Adoptable
4.001	Swale 1A	600	Manhole	Adoptable	Swale 1B	600	Manhole	Adoptable
4.002	Swale 1B	600	Manhole	Adoptable	PPIC2	600	Manhole	Adoptable

Pipeline Schedule

Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
4.003	2.484	0.0	150	Circular	120.500	119.500	0.850	120.500	119.500	0.850
4.004	32.289	24.8	500	Swale	120.500	119.500	0.500	119.200	118.200	0.500
4.005	3.487	0.0	150	Circular	119.200	118.200	0.850	119.200	118.200	0.850
4.006	3.001	0.0	225	Circular	119.200	118.200	0.775	119.200	118.200	0.775
4.007	31.700	28.6	500	Swale	119.200	118.200	0.500	118.090	117.090	0.500
4.008	3.250	0.0	225	Circular	118.090	117.090	0.775	118.090	117.090	0.775
4.009	3.250	0.0	225	Circular	118.090	117.090	0.775	118.090	117.090	0.775
4.010	2.747	30.5	500	Swale	118.090	117.090	0.500	118.000	117.000	0.500
4.011	3.249	0.0	225	Circular	118.000	117.000	0.775	118.000	117.000	0.775
4.012	3.250	0.0	225	Circular	118.000	117.000	0.775	118.000	117.000	0.775
4.013	8.063	29.9	500	Swale	118.000	117.000	0.500	117.650	116.730	0.420
4.014	3.750	2.1	150	Circular	117.650	116.730	0.770	117.640	114.980	2.510
2.004	4.195	209.8	300	Circular	117.950	115.400	2.250	117.880	115.380	2.200
2.005	5.660	188.7	300	Circular	117.880	115.380	2.200	117.830	115.350	2.180
2.006	13.986	40.0	300	Circular	117.830	115.350	2.180	117.500	115.000	2.200
5.000	4.500	225.0	150	Circular	121.120	120.220	0.750	121.200	120.200	0.850
6.000	4.909	10.7	150	Circular	121.310	119.960	1.200	120.500	119.500	0.850
7.000	4.920	164.0	150	Circular	119.070	118.230	0.690	119.200	118.200	0.850
8.000	3.374	0.0	150	Circular	117.260	116.260	0.850	117.260	116.260	0.850
8.001	14.609	487.0	500	Swale	117.260	116.260	0.500	117.640	116.230	0.910
8.002	3.750	3.0	150	Circular	117.640	116.230	1.260	117.640	114.980	2.510

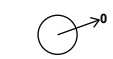
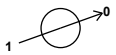
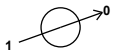
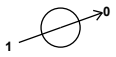
Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
4.003	PPIC2	600	Manhole	Adoptable	Swale 2A	600	Manhole	Adoptable
4.004	Swale 2A	600	Manhole	Adoptable	Swale 2B	600	Manhole	Adoptable
4.005	Swale 2B	600	Manhole	Adoptable	PPIC3	600	Manhole	Adoptable
4.006	PPIC3	600	Manhole	Adoptable	Swale 3A	600	Manhole	Adoptable
4.007	Swale 3A	600	Manhole	Adoptable	Swale 3B	600	Manhole	Adoptable
4.008	Swale 3B	600	Manhole	Adoptable	PPIC4	600	Manhole	Adoptable
4.009	PPIC4	600	Manhole	Adoptable	Swale 4A	600	Manhole	Adoptable
4.010	Swale 4A	600	Manhole	Adoptable	Swale 4B	600	Manhole	Adoptable
4.011	Swale 4B	600	Manhole	Adoptable	PPIC5	600	Manhole	Adoptable
4.012	PPIC5	600	Manhole	Adoptable	Swale 5A	600	Manhole	Adoptable
4.013	Swale 5A	600	Manhole	Adoptable	Swale 5B	600	Manhole	Adoptable
4.014	Swale 5B	600	Manhole	Adoptable	SWPS	1200	Manhole	Adoptable
2.004	S14	1200	Manhole	Adoptable	S15	1200	Manhole	Adoptable
2.005	S15	1200	Manhole	Adoptable	S16	1200	Manhole	Adoptable
2.006	S16	1200	Manhole	Adoptable	S17	1200	Manhole	Adoptable
5.000	S8	1200	Manhole	Adoptable	PPIC1	600	Manhole	Adoptable
6.000	S9	1200	Manhole	Adoptable	PPIC2	600	Manhole	Adoptable
7.000	S10	1200	Manhole	Adoptable	PPIC3	600	Manhole	Adoptable
8.000	PPIC6	600	Manhole	Adoptable	Swale 6A	600	Manhole	Adoptable
8.001	Swale 6A	600	Manhole	Adoptable	Swale 6B		Junction	
8.002	Swale 6B		Junction		SWPS	1200	Manhole	Adoptable

Pipeline Schedule

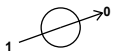
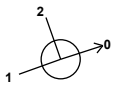
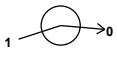
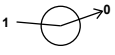
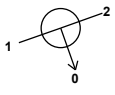
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.010	5.072	253.6	300	Circular	117.500	115.000	2.200	117.640	114.980	2.360
1.011	10.464	348.8	300	Circular	117.640	114.980	2.360	118.250	114.950	3.000
1.012	2.097	104.9	225	Circular	118.250	117.980	0.045	118.200	117.960	0.015

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.010	S17	1200	Manhole	Adoptable	SWPS	1200	Manhole	Adoptable
1.011	SWPS	1200	Manhole	Adoptable	Dummy	1200	Manhole	Adoptable
1.012	Dummy	1200	Manhole	Adoptable	HW1		Junction	

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S1	310316.048	185646.626	121.250	0.650	1200	 0	1.000	120.600	225
S2	310358.424	185661.772	121.950	2.050	1200	1  0	1.000 1.001	119.900 119.900	225 225
S3	310400.798	185676.918	120.000	1.350	1200	1  0	1.001 1.002	118.650 118.650	225 225
S4	310418.821	185683.360	119.750	1.180	1200	1  0	1.002 1.003	118.570 118.570	225 225
Tank 1	310459.312	185697.833	119.800	1.550		1  0	1.003 1.004	118.250 118.250	225 225
S5	310461.452	185698.598	119.750	1.550	1200	1  0	1.004 1.005	118.200 118.200	225 225
Tank 2	310473.890	185663.198	118.140	2.825		 1 0	1.005 1.006	115.315 115.315	225 225
S6	310475.540	185658.780	116.640	1.350	1200	 1 0	1.006 1.007	115.290 115.290	225 225
Tank 3	310475.121	185632.064	116.900	1.800		 1 0	1.007 1.008	115.100 115.100	225 225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
S7	310475.049	185627.448	116.950	1.870	1200	 1	1.008	115.080	225
						0	1.009	115.080	300
Tank 4	310432.037	185622.517	117.900	2.450		 1	2.002	115.450	225
						0	2.003	115.450	225
S8	310338.921	185631.421	121.120	0.900	1200	 0	5.000	120.220	150
S9	310365.556	185615.739	121.310	1.350	1200	 0	6.000	119.960	150
S10	310399.742	185604.543	119.070	0.840	1200	 0	7.000	118.230	150
S11	310360.797	185627.209	120.400	1.350	1200	 0	2.000	119.050	150
S12	310391.796	185638.281	118.850	1.350	1200	 1	2.000	117.500	150
						0	2.001	117.500	150
S13	310422.634	185649.032	117.750	1.350	1200	 1	2.001	116.400	150
						0	2.002	116.400	225
Tank - Emergency	310417.242	185609.512	117.100	1.750		 0	3.000	115.350	225
S14	310434.446	185615.684	117.950	2.550	1200	 1	3.000	115.400	225
						2	2.003	115.400	225
						0	2.004	115.400	300
S15	310438.437	185616.977	117.880	2.500	1200	 1	2.004	115.380	300
						0	2.005	115.380	300
S16	310444.076	185616.486	117.830	2.480	1200	 1	2.005	115.350	300
						0	2.006	115.350	300
S17	310457.277	185621.107	117.500	2.500	1200	 1	2.006	115.000	300
						2	1.009	115.000	300
						0	1.010	115.000	300

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
PPIC1	310336.589	185627.572	121.200	1.000	600	1	5.000	120.200	150
						0	4.000	120.200	150
Swale 1A	310339.797	185625.629	121.200	1.000	600	1	4.000	120.200	150
						0	4.001	120.200	500
Swale 1B	310361.368	185612.609	120.500	1.000	600	1	4.001	119.500	500
						0	4.002	119.500	150
PPIC2	310363.417	185611.321	120.500	1.000	600	1	6.000	119.500	150
						2	4.002	119.500	150
						0	4.003	119.500	150
Swale 2A	310365.782	185610.562	120.500	1.000	600	1	4.003	119.500	150
						0	4.004	119.500	500
Swale 2B	310396.525	185600.690	119.200	1.000	600	1	4.004	118.200	500
						0	4.005	118.200	150
PPIC3	310399.845	185599.624	119.200	1.000	600	1	7.000	118.200	150
						2	4.005	118.200	150
						0	4.006	118.200	225
Swale 3A	310402.671	185600.633	119.200	1.000	600	1	4.006	118.200	225
						0	4.007	118.200	500
Swale 3B	310432.525	185611.294	118.090	1.000	600	1	4.007	117.090	500
						0	4.008	117.090	225
PPIC4	310435.586	185612.385	118.090	1.000	600	1	4.008	117.090	225
						0	4.009	117.090	225
Swale 4A	310438.814	185612.008	118.090	1.000	600	1	4.009	117.090	225
						0	4.010	117.090	500
Swale 4B	310441.542	185611.682	118.000	1.000	600	1	4.010	117.000	500
						0	4.011	117.000	225
PPIC5	310444.769	185611.301	118.000	1.000	600	1	4.011	117.000	225
						0	4.012	117.000	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
Swale 5A	310447.833	185612.385	118.000	1.000	600	1	4.012	117.000	225
						0	4.013	117.000	500
Swale 5B	310455.434	185615.075	117.650	0.920	600	1	4.013	116.730	500
						0	4.014	116.730	150
PPIC6	310479.457	185623.577	117.260	1.000	600	0	8.000	116.260	150
Swale 6A	310476.276	185622.451	117.260	1.000	600	1	8.000	116.260	150
						0	8.001	116.260	500
Swale 6B	310462.504	185617.577	117.640	1.410		1	8.001	116.230	500
						0	8.002	116.230	150
SWPS	310458.969	185616.326	117.640	2.660	1200	1	8.002	114.980	150
						2	4.014	114.980	150
						3	1.010	114.980	300
						0	1.011	114.980	300
Dummy	310462.469	185606.465	118.250	3.300	1200	1	1.011	114.950	300
						0	1.012	117.980	225
HW1	310463.160	185604.485	118.200	0.240		1	1.012	117.960	225

Simulation Settings

Rainfall Methodology	FEH-22	Check Discharge Rate(s)	✓
Summer CV	0.750	1 year (l/s)	2.7
Winter CV	0.840	30 year (l/s)	5.4
Analysis Speed	Detailed	100 year (l/s)	6.6
Skip Steady State	x	Check Discharge Volume	✓
Drain Down Time (mins)	240	100 year +40% 1440 minute (m³)	373
Additional Storage (m³/ha)	0.0		

Storm Durations

15	60	180	360	600	960	2160	4320	7200	10080
30	120	240	480	720	1440	2880	5760	8640	

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0

Pre-development Discharge Rate

Site Makeup	Greenfield	Growth Factor 30 year	1.80
Greenfield Method	IH124	Growth Factor 100 year	2.18
Positively Drained Area (ha)	0.485	Betterment (%)	0
SAAR (mm)	1356	QBar	3.0
Soil Index	3	Q 1 year (l/s)	2.7
SPR	0.37	Q 30 year (l/s)	5.4
Region	9	Q 100 year (l/s)	6.6
Growth Factor 1 year	0.88		

Pre-development Discharge Volume

Site Makeup	Greenfield	Return Period (years)	100
Greenfield Method	FSR/FEH	Climate Change (%)	40
Positively Drained Area (ha)	0.485	Storm Duration (mins)	1440
Soil Index	3	Betterment (%)	0
SPR	0.37	PR	0.497
CWI	125.890	Runoff Volume (m^3)	373

Node S2 Online Orifice Control

Flap Valve	x	Design Depth (m)	1.350	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	1.0		
Invert Level (m)	119.900	Diameter (m)	0.050		

Node S4 Online Orifice Control

Flap Valve	x	Design Depth (m)	1.600	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	1.0		
Invert Level (m)	118.570	Diameter (m)	0.050		

Node S5 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	118.200	Product Number	CTL-SHE-0042-1000-1550-1000
Design Depth (m)	1.550	Min Outlet Diameter (m)	0.075
Design Flow (l/s)	1.0	Min Node Diameter (mm)	1200

Node S7 Online Orifice Control

Flap Valve	✓	Design Depth (m)	1.870	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	1.0		
Invert Level (m)	115.080	Diameter (m)	0.080		

Node S11 Online Orifice Control

Flap Valve	x	Design Depth (m)	1.350	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	1.0		
Invert Level (m)	119.050	Diameter (m)	0.050		

Node S12 Online Orifice Control

Flap Valve	x	Design Depth (m)	1.350	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	1.0		
Invert Level (m)	117.500	Diameter (m)	0.080		

Node S13 Online Orifice Control

Flap Valve	x	Design Depth (m)	1.350	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	1.0		
Invert Level (m)	116.400	Diameter (m)	0.080		

Node S14 Online Orifice Control

Flap Valve	x	Invert Level (m)	115.400	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Diameter (m)	0.080		

Node S15 Online Orifice Control

Flap Valve	x	Design Depth (m)	2.500	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	1.0		
Invert Level (m)	115.380	Diameter (m)	0.080		

Node S16 Online Orifice Control

Flap Valve	✓	Design Depth (m)	2.480	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	1.0		
Invert Level (m)	115.350	Diameter (m)	0.080		

Node S17 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	115.000	Product Number	CTL-SHE-0104-5000-1100-5000
Design Depth (m)	1.100	Min Outlet Diameter (m)	0.150
Design Flow (l/s)	5.0	Min Node Diameter (mm)	1200

Node SWPS Online Pump Control

Flap Valve	x	Design Depth (m)	2.660	Switch off depth (m)	0.100
Replaces Downstream Link	✓	Design Flow (l/s)	10.1		
Invert Level (m)	114.980	Switch on depth (m)	0.300		

Depth (m)	Flow (l/s)
2.660	10.100

Node PPIC1 Online Orifice Control

Flap Valve	x	Design Depth (m)	1.000	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	1.0		
Invert Level (m)	120.200	Diameter (m)	0.050		

Node PPIC2 Online Orifice Control

Flap Valve	x	Design Depth (m)	1.000	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	1.0		
Invert Level (m)	119.500	Diameter (m)	0.050		

Node PPIC3 Online Orifice Control

Flap Valve	x	Design Depth (m)	1.000	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	1.0		
Invert Level (m)	118.200	Diameter (m)	0.050		

Node PPIC4 Online Orifice Control

Flap Valve	x	Design Depth (m)	1.000	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	1.0		
Invert Level (m)	117.090	Diameter (m)	0.050		

Node PPIC5 Online Orifice Control

Flap Valve	x	Design Depth (m)	1.000	Discharge Coefficient	0.600
Replaces Downstream Link	✓	Design Flow (l/s)	1.0		
Invert Level (m)	117.000	Diameter (m)	0.050		

Node S1 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	120.680	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	
Safety Factor	2.0	Width (m)	10.000	Inf Depth (m)	
Porosity	0.30	Length (m)	21.400		

Node S2 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	121.380	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	
Safety Factor	2.0	Width (m)	10.000	Inf Depth (m)	
Porosity	0.30	Length (m)	20.500		

Node S3 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	119.430	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	
Safety Factor	2.0	Width (m)	10.000	Inf Depth (m)	
Porosity	0.30	Length (m)	15.000		

Node S4 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	119.180	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	44	Depth (m)	
Safety Factor	2.0	Width (m)	10.000	Inf Depth (m)	
Porosity	0.30	Length (m)	15.400		

Node Tank 1 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	118.250
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	120.0	0.0	0.800	120.0	0.0	0.801	0.0	0.0

Node S5 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	119.180	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	
Safety Factor	2.0	Width (m)	10.000	Inf Depth (m)	
Porosity	0.30	Length (m)	20.700		

Node Tank 2 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	115.315
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	1440

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	108.0	0.0	0.800	108.0	0.0	0.801	0.0	0.0

Node S6 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	116.070	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	
Safety Factor	2.0	Width (m)	10.000	Inf Depth (m)	
Porosity	0.30	Length (m)	19.300		

Node Tank 3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	115.100
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	2040

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	75.0	0.0	1.000	75.0	0.0	1.001	0.0	0.0

Node S7 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	116.380	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	
Safety Factor	2.0	Width (m)	10.000	Inf Depth (m)	
Porosity	0.30	Length (m)	10.400		

Node Tank 4 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	115.450
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	75.0	0.0	1.500	75.0	0.0	1.501	0.0	0.0

Node S8 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	120.550	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	34	Depth (m)	
Safety Factor	2.0	Width (m)	10.000	Inf Depth (m)	
Porosity	0.30	Length (m)	29.600		

Node S9 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	120.740	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	
Safety Factor	2.0	Width (m)	10.000	Inf Depth (m)	
Porosity	0.30	Length (m)	18.700		

Node S10 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	118.500	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	208	Depth (m)	
Safety Factor	2.0	Width (m)	10.000	Inf Depth (m)	
Porosity	0.30	Length (m)	17.900		

Node S11 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	119.830	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	20	Depth (m)	
Safety Factor	2.0	Width (m)	10.000	Inf Depth (m)	
Porosity	0.30	Length (m)	21.800		

Node S12 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	118.280	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	14	Depth (m)	
Safety Factor	2.0	Width (m)	10.000	Inf Depth (m)	
Porosity	0.30	Length (m)	14.700		

Node S13 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	117.180	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	28	Depth (m)	
Safety Factor	2.0	Width (m)	10.000	Inf Depth (m)	
Porosity	0.30	Length (m)	15.000		

Node S14 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	117.380	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	
Safety Factor	2.0	Width (m)	10.000	Inf Depth (m)	
Porosity	0.30	Length (m)	16.300		

Node S15 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	117.310	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	
Safety Factor	2.0	Width (m)	10.000	Inf Depth (m)	
Porosity	0.30	Length (m)	2.000		

Node S16 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	117.260	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	
Safety Factor	2.0	Width (m)	10.000	Inf Depth (m)	
Porosity	0.30	Length (m)	4.200		

Node S17 Carpark Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	116.930	Slope (1:X)	300.0
Side Inf Coefficient (m/hr)	0.00000	Time to half empty (mins)	0	Depth (m)	
Safety Factor	2.0	Width (m)	10.000	Inf Depth (m)	
Porosity	0.30	Length (m)	7.400		

Node Tank - Emergency Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	115.350
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	90.0	0.0	1.500	90.0	0.0	1.501	0.0	0.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 98.33%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	S1	21	120.626	0.026	1.9	0.0299	0.0000	OK
30 minute winter	S2	26	120.138	0.238	3.8	0.2692	0.0000	SURCHARGED
30 minute winter	S3	28	119.009	0.359	3.5	0.4061	0.0000	SURCHARGED
30 minute winter	S4	28	119.009	0.439	3.9	0.4961	0.0000	SURCHARGED
720 minute winter	Tank 1	525	118.416	0.166	3.5	18.9290	0.0000	OK
720 minute winter	S5	525	118.416	0.216	3.9	0.2443	0.0000	OK
2880 minute winter	Tank 2	2100	115.544	0.229	0.6	23.5355	0.0000	SURCHARGED
2880 minute winter	S6	2100	115.544	0.254	0.8	0.2877	0.0000	SURCHARGED
2880 minute winter	Tank 3	2100	115.544	0.444	0.8	31.6579	0.0000	SURCHARGED
2880 minute winter	S7	2100	115.544	0.464	1.1	0.5251	0.0000	SURCHARGED
960 minute winter	Tank 4	735	115.712	0.262	2.8	19.6566	0.0000	SURCHARGED
30 minute winter	S8	25	120.581	0.361	4.9	0.8505	0.0000	SURCHARGED
30 minute winter	S9	20	119.985	0.025	3.4	0.0287	0.0000	OK
240 minute winter	S10	184	118.556	0.326	2.6	1.7882	0.0000	SURCHARGED
30 minute winter	S11	23	119.616	0.566	4.5	0.6405	0.0000	SURCHARGED
30 minute winter	S12	22	117.919	0.419	8.5	0.4737	0.0000	SURCHARGED
30 minute winter	S13	23	117.088	0.688	11.2	0.7778	0.0000	SURCHARGED
960 minute winter	Tank - Emergency	735	115.712	0.362	1.8	30.9586	0.0000	SURCHARGED
960 minute winter	S14	735	115.712	0.312	2.1	0.3530	0.0000	SURCHARGED
960 minute winter	S15	735	115.709	0.329	1.8	0.3724	0.0000	SURCHARGED
960 minute winter	S16	720	115.707	0.357	1.8	0.4035	0.0000	SURCHARGED
960 minute winter	S17	720	115.705	0.705	1.8	0.7969	0.0000	SURCHARGED
30 minute winter	PPIC1	25	120.579	0.379	3.6	0.1073	0.0000	SURCHARGED
30 minute winter	Swale 1A	26	120.217	0.017	3.1	0.0047	0.0000	OK
120 minute winter	Swale 1B	88	119.804	0.304	2.8	0.0861	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute winter	S1	1.000	S2	1.9	0.223	0.029	0.9458	
30 minute winter	S2	Orifice	S3	2.4				
30 minute winter	S3	1.002	S4	2.9	0.198	0.088	0.7612	
30 minute winter	S4	Orifice	Tank 1	3.4				
720 minute winter	Tank 1	1.004	S5	3.9	-0.196	0.051	0.0803	
720 minute winter	S5	Hydro-Brake®	Tank 2	0.6				
2880 minute winter	Tank 2	1.006	S6	0.8	0.339	0.020	0.1876	
2880 minute winter	S6	1.007	Tank 3	0.8	0.295	0.017	1.0626	
2880 minute winter	Tank 3	1.008	S7	1.1	0.047	0.033	0.1836	
2880 minute winter	S7	Orifice	S17	1.1				
960 minute winter	Tank 4	2.003	S14	1.6	0.421	0.037	0.2881	
30 minute winter	S8	5.000	PPIC1	3.6	0.365	0.308	0.0792	
30 minute winter	S9	6.000	PPIC2	3.4	0.850	0.062	0.0480	
240 minute winter	S10	7.000	PPIC3	2.5	0.304	0.182	0.0866	
30 minute winter	S11	Orifice	S12	3.8				
30 minute winter	S12	Orifice	S13	8.2				
30 minute winter	S13	Orifice	Tank 4	10.8				
960 minute winter	Tank - Emergency	3.000	S14	-1.8	-0.337	-0.045	0.7269	
960 minute winter	S14	Orifice	S15	1.8				
960 minute winter	S15	Orifice	S16	1.8				
960 minute winter	S16	Orifice	S17	1.8				
960 minute winter	S17	Hydro-Brake®	SWPS	1.8				
30 minute winter	PPIC1	Orifice	Swale 1A	3.1				
30 minute winter	Swale 1A	4.001	Swale 1B	3.1	0.146	0.001	4.2244	
120 minute winter	Swale 1B	4.002	PPIC2	2.2	-0.174	0.122	0.0426	

Results for 2 year Critical Storm Duration. Lowest mass balance: 98.33%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
120 minute winter	PPIC2	88	119.804	0.304	2.8	0.0859	0.0000	SURCHARGED
120 minute winter	Swale 2A	88	119.514	0.014	2.8	0.0039	0.0000	OK
240 minute winter	Swale 2B	184	118.557	0.357	2.6	0.1011	0.0000	SURCHARGED
240 minute winter	PPIC3	184	118.556	0.356	3.0	0.1008	0.0000	SURCHARGED
240 minute winter	Swale 3A	184	118.215	0.015	3.0	0.0043	0.0000	OK
360 minute winter	Swale 3B	336	117.443	0.353	3.0	0.0999	0.0000	SURCHARGED
360 minute winter	PPIC4	336	117.443	0.353	2.4	0.0998	0.0000	SURCHARGED
360 minute winter	Swale 4A	344	117.233	0.143	2.4	0.0405	0.0000	OK
360 minute winter	Swale 4B	344	117.233	0.233	2.4	0.0660	0.0000	SURCHARGED
360 minute winter	PPIC5	344	117.233	0.233	2.4	0.0660	0.0000	SURCHARGED
360 minute winter	Swale 5A	344	117.014	0.013	2.4	0.0038	0.0000	OK
360 minute winter	Swale 5B	344	116.744	0.014	2.4	0.0040	0.0000	OK
15 minute summer	PPIC6	1	116.260	0.000	0.0	0.0000	0.0000	OK
15 minute summer	Swale 6A	1	116.260	0.000	0.0	0.0000	0.0000	OK
15 minute summer	Swale 6B	1	116.230	0.000	0.0	0.0000	0.0000	OK
720 minute winter	SWPS	570	115.674	0.694	2.6	0.7844	0.0000	SURCHARGED
720 minute winter	Dummy	570	118.017	3.067	2.6	3.4682	0.0000	OK
720 minute winter	HW1	570	117.995	0.035	2.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
120 minute winter	PPIC2	Orifice	Swale 2A	2.8				
120 minute winter	Swale 2A	4.004	Swale 2B	2.8	0.068	0.001	8.5114	
240 minute winter	Swale 2B	4.005	PPIC3	2.5	-0.178	0.143	0.0614	
240 minute winter	PPIC3	Orifice	Swale 3A	3.0				
240 minute winter	Swale 3A	4.007	Swale 3B	3.0	0.075	0.001	8.5529	
360 minute winter	Swale 3B	4.008	PPIC4	2.4	0.124	0.060	0.1293	
360 minute winter	PPIC4	Orifice	Swale 4A	2.4				
360 minute winter	Swale 4A	4.010	Swale 4B	2.4	0.049	0.001	0.5675	
360 minute winter	Swale 4B	4.011	PPIC5	2.4	0.135	0.060	0.1292	
360 minute winter	PPIC5	Orifice	Swale 5A	2.4				
360 minute winter	Swale 5A	4.013	Swale 5B	2.4	0.318	0.001	0.0604	
360 minute winter	Swale 5B	4.014	SWPS	2.4	0.217	0.019	0.0346	
15 minute summer	PPIC6	8.000	Swale 6A	0.0	0.000	0.000	0.0000	
15 minute summer	Swale 6A	8.001	Swale 6B	0.0	0.000	0.000	0.0002	
15 minute summer	Swale 6B	8.002	SWPS	0.0	0.000	0.000	0.0330	
720 minute winter	SWPS	Pump	Dummy	2.6				
720 minute winter	Dummy	1.012	HW1	2.6	0.656	0.052	0.0084	98.3

Results for 30 year Critical Storm Duration. Lowest mass balance: 98.33%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
30 minute winter	S1	27	120.704	0.104	4.7	0.3696	0.0000	OK
30 minute winter	S2	26	120.711	0.811	9.4	0.9168	0.0000	SURCHARGED
60 minute winter	S3	58	119.315	0.665	7.0	0.7516	0.0000	SURCHARGED
60 minute winter	S4	59	119.313	0.743	9.6	5.7911	0.0000	SURCHARGED
600 minute winter	Tank 1	585	118.646	0.396	3.7	45.1489	0.0000	SURCHARGED
600 minute winter	S5	585	118.646	0.446	2.7	0.5045	0.0000	SURCHARGED
4320 minute winter	Tank 2	2940	115.724	0.409	0.6	41.9197	0.0000	SURCHARGED
4320 minute winter	S6	2940	115.724	0.434	0.9	0.4904	0.0000	SURCHARGED
4320 minute winter	Tank 3	2940	115.724	0.623	0.9	44.4243	0.0000	SURCHARGED
4320 minute winter	S7	2940	115.724	0.643	1.2	0.7278	0.0000	SURCHARGED
960 minute winter	Tank 4	870	115.983	0.533	4.2	39.9417	0.0000	SURCHARGED
60 minute winter	S8	49	120.664	0.444	9.9	6.2464	0.0000	SURCHARGED
240 minute winter	S9	180	120.040	0.080	2.9	0.0908	0.0000	OK
240 minute winter	S10	236	118.724	0.494	5.0	10.9890	0.0000	SURCHARGED
30 minute winter	S11	28	119.914	0.864	11.2	4.0974	0.0000	SURCHARGED
30 minute winter	S12	26	118.348	0.848	16.8	2.8609	0.0000	SURCHARGED
60 minute winter	S13	51	117.325	0.925	18.1	6.4566	0.0000	SURCHARGED
960 minute winter	Tank - Emergency	870	115.983	0.633	2.7	54.0817	0.0000	SURCHARGED
960 minute winter	S14	870	115.983	0.583	3.0	0.6588	0.0000	SURCHARGED
960 minute winter	S15	855	115.978	0.598	2.6	0.6758	0.0000	SURCHARGED
960 minute winter	S16	840	115.973	0.623	2.6	0.7048	0.0000	SURCHARGED
960 minute winter	S17	825	115.969	0.969	2.7	1.0961	0.0000	SURCHARGED
60 minute winter	PPIC1	49	120.661	0.461	3.7	0.1306	0.0000	SURCHARGED
60 minute winter	Swale 1A	50	120.218	0.018	3.4	0.0050	0.0000	OK
240 minute winter	Swale 1B	180	120.042	0.542	3.2	0.1533	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
30 minute winter	S1	1.000	S2	4.7	0.255	0.072	1.2962	
30 minute winter	S2	Orifice	S3	4.6				
60 minute winter	S3	1.002	S4	6.9	0.203	0.207	0.7612	
60 minute winter	S4	Orifice	Tank 1	4.4				
600 minute winter	Tank 1	1.004	S5	2.3	0.293	0.030	0.0904	
600 minute winter	S5	Hydro-Brake®	Tank 2	0.6				
4320 minute winter	Tank 2	1.006	S6	0.9	0.338	0.025	0.1876	
4320 minute winter	S6	1.007	Tank 3	0.9	0.295	0.022	1.0626	
4320 minute winter	Tank 3	1.008	S7	1.2	0.047	0.034	0.1836	
4320 minute winter	S7	Orifice	S17	1.2				
960 minute winter	Tank 4	2.003	S14	1.9	0.412	0.043	0.2881	
60 minute winter	S8	5.000	PPIC1	3.7	0.389	0.318	0.0792	
240 minute winter	S9	6.000	PPIC2	2.9	0.581	0.053	0.0667	
240 minute winter	S10	7.000	PPIC3	3.4	0.354	0.247	0.0866	
30 minute winter	S11	Orifice	S12	4.8				
30 minute winter	S12	Orifice	S13	12.0				
60 minute winter	S13	Orifice	Tank 4	12.6				
960 minute winter	Tank - Emergency	3.000	S14	-2.7	-0.399	-0.068	0.7269	
960 minute winter	S14	Orifice	S15	2.6				
960 minute winter	S15	Orifice	S16	2.6				
960 minute winter	S16	Orifice	S17	2.7				
960 minute winter	S17	Hydro-Brake®	SWPS	2.7				
60 minute winter	PPIC1	Orifice	Swale 1A	3.4				
60 minute winter	Swale 1A	4.001	Swale 1B	3.4	0.162	0.001	12.6044	
240 minute winter	Swale 1B	4.002	PPIC2	3.0	0.169	0.169	0.0426	

Results for 30 year Critical Storm Duration. Lowest mass balance: 98.33%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	PPIC2	180	120.040	0.540	3.8	0.1529	0.0000	SURCHARGED
240 minute winter	Swale 2A	184	119.517	0.017	3.7	0.0047	0.0000	OK
240 minute winter	Swale 2B	236	118.726	0.526	3.7	0.1489	0.0000	SURCHARGED
240 minute winter	PPIC3	236	118.724	0.524	3.7	0.1483	0.0000	SURCHARGED
240 minute winter	Swale 3A	236	118.217	0.017	3.7	0.0049	0.0000	OK
480 minute winter	Swale 3B	520	117.658	0.567	3.6	0.1606	0.0000	SURCHARGED
480 minute winter	PPIC4	520	117.657	0.567	2.9	0.1605	0.0000	SURCHARGED
480 minute winter	Swale 4A	536	117.341	0.250	2.9	0.0709	0.0000	OK
480 minute winter	Swale 4B	536	117.341	0.340	2.9	0.0964	0.0000	SURCHARGED
480 minute winter	PPIC5	536	117.340	0.340	2.9	0.0963	0.0000	SURCHARGED
480 minute winter	Swale 5A	536	117.015	0.015	2.9	0.0043	0.0000	OK
480 minute winter	Swale 5B	536	116.746	0.016	2.9	0.0044	0.0000	OK
15 minute summer	PPIC6	1	116.260	0.000	0.0	0.0000	0.0000	OK
15 minute summer	Swale 6A	1	116.260	0.000	0.0	0.0000	0.0000	OK
15 minute summer	Swale 6B	1	116.230	0.000	0.0	0.0000	0.0000	OK
960 minute winter	SWPS	810	115.930	0.950	3.6	1.0742	0.0000	SURCHARGED
960 minute winter	Dummy	810	118.023	3.073	3.6	3.4754	0.0000	OK
960 minute winter	HW1	810	118.000	0.040	3.6	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
240 minute winter	PPIC2	Orifice	Swale 2A	3.7				
240 minute winter	Swale 2A	4.004	Swale 2B	3.7	0.046	0.001	17.7782	
240 minute winter	Swale 2B	4.005	PPIC3	3.2	-0.233	0.182	0.0614	
240 minute winter	PPIC3	Orifice	Swale 3A	3.7				
240 minute winter	Swale 3A	4.007	Swale 3B	3.7	0.101	0.001	18.1860	
480 minute winter	Swale 3B	4.008	PPIC4	2.9	0.126	0.074	0.1293	
480 minute winter	PPIC4	Orifice	Swale 4A	2.9				
480 minute winter	Swale 4A	4.010	Swale 4B	2.9	0.050	0.001	1.1421	
480 minute winter	Swale 4B	4.011	PPIC5	2.9	0.131	0.074	0.1292	
480 minute winter	PPIC5	Orifice	Swale 5A	2.9				
480 minute winter	Swale 5A	4.013	Swale 5B	2.9	0.347	0.001	0.0680	
480 minute winter	Swale 5B	4.014	SWPS	2.9	0.264	0.024	0.0348	
15 minute summer	PPIC6	8.000	Swale 6A	0.0	0.000	0.000	0.0000	
15 minute summer	Swale 6A	8.001	Swale 6B	0.0	0.000	0.000	0.0002	
15 minute summer	Swale 6B	8.002	SWPS	0.0	0.000	0.000	0.0330	
960 minute winter	SWPS	Pump	Dummy	3.6				
960 minute winter	Dummy	1.012	HW1	3.6	0.716	0.071	0.0106	173.0

Results for 100 year Critical Storm Duration. Lowest mass balance: 98.33%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute winter	S1	46	120.743	0.143	5.4	1.9327	0.0000	OK
60 minute winter	S2	45	120.746	0.846	9.1	0.9565	0.0000	SURCHARGED
60 minute winter	S3	65	119.378	0.728	8.1	0.8236	0.0000	SURCHARGED
60 minute winter	S4	65	119.377	0.807	11.5	8.7710	0.0000	SURCHARGED
720 minute winter	Tank 1	690	118.768	0.518	4.2	59.0320	0.0000	SURCHARGED
720 minute winter	S5	690	118.768	0.568	2.1	0.6422	0.0000	SURCHARGED
5760 minute winter	Tank 2	3720	115.785	0.470	0.6	48.2231	0.0000	SURCHARGED
5760 minute winter	S6	3720	115.785	0.495	1.0	0.5598	0.0000	SURCHARGED
5760 minute winter	Tank 3	3720	115.785	0.685	1.0	48.8017	0.0000	SURCHARGED
5760 minute winter	S7	3660	115.785	0.705	1.2	0.7973	0.0000	SURCHARGED
960 minute winter	Tank 4	870	116.105	0.655	5.1	49.1563	0.0000	SURCHARGED
60 minute winter	S8	51	120.701	0.481	12.7	9.6000	0.0000	SURCHARGED
180 minute winter	S9	168	120.120	0.160	4.4	0.1812	0.0000	SURCHARGED
360 minute winter	S10	328	118.805	0.575	4.7	15.4303	0.0000	FLOOD RISK
60 minute winter	S11	47	119.950	0.900	11.6	6.4538	0.0000	SURCHARGED
30 minute winter	S12	27	118.392	0.892	20.2	4.8720	0.0000	SURCHARGED
60 minute winter	S13	60	117.389	0.988	20.1	9.3767	0.0000	SURCHARGED
960 minute winter	Tank - Emergency	870	116.105	0.755	3.3	64.5867	0.0000	SURCHARGED
960 minute winter	S14	870	116.105	0.705	3.6	0.7978	0.0000	SURCHARGED
960 minute winter	S15	870	116.100	0.720	2.9	0.8141	0.0000	SURCHARGED
720 minute winter	S16	690	116.095	0.745	2.8	0.8422	0.0000	SURCHARGED
720 minute winter	S17	675	116.090	1.090	2.8	1.2329	0.0000	SURCHARGED
60 minute winter	PPIC1	51	120.698	0.498	3.6	0.1410	0.0000	SURCHARGED
60 minute winter	Swale 1A	52	120.218	0.018	3.6	0.0051	0.0000	OK
240 minute winter	Swale 1B	192	120.122	0.622	3.5	0.1760	0.0000	SURCHARGED

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute winter	S1	1.000	S2	4.5	0.237	0.070	1.4920	
60 minute winter	S2	Orifice	S3	4.7				
60 minute winter	S3	1.002	S4	8.0	0.222	0.238	0.7612	
60 minute winter	S4	Orifice	Tank 1	4.6				
720 minute winter	Tank 1	1.004	S5	1.7	0.235	0.023	0.0904	
720 minute winter	S5	Hydro-Brake®	Tank 2	0.6				
5760 minute winter	Tank 2	1.006	S6	1.0	0.330	0.026	0.1876	
5760 minute winter	S6	1.007	Tank 3	1.0	0.295	0.022	1.0626	
5760 minute winter	Tank 3	1.008	S7	1.2	0.047	0.035	0.1836	
5760 minute winter	S7	Orifice	S17	1.2				
960 minute winter	Tank 4	2.003	S14	2.7	0.408	0.063	0.2881	
60 minute winter	S8	5.000	PPIC1	3.6	0.383	0.307	0.0792	
180 minute winter	S9	6.000	PPIC2	4.4	0.454	0.080	0.0864	
360 minute winter	S10	7.000	PPIC3	2.8	0.341	0.203	0.0866	
60 minute winter	S11	Orifice	S12	4.9				
30 minute winter	S12	Orifice	S13	12.3				
60 minute winter	S13	Orifice	Tank 4	13.0				
960 minute winter	Tank - Emergency	3.000	S14	-3.3	-0.417	-0.083	0.7269	
960 minute winter	S14	Orifice	S15	2.9				
960 minute winter	S15	Orifice	S16	2.9				
720 minute winter	S16	Orifice	S17	2.8				
720 minute winter	S17	Hydro-Brake®	SWPS	2.8				
60 minute winter	PPIC1	Orifice	Swale 1A	3.6				
60 minute winter	Swale 1A	4.001	Swale 1B	3.6	0.149	0.002	15.9777	
240 minute winter	Swale 1B	4.002	PPIC2	3.3	0.189	0.188	0.0426	

Results for 100 year Critical Storm Duration. Lowest mass balance: 98.33%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
180 minute winter	PPIC2	168	120.120	0.620	4.4	0.1755	0.0000	SURCHARGED
180 minute winter	Swale 2A	168	119.517	0.017	4.0	0.0049	0.0000	OK
360 minute winter	Swale 2B	328	118.807	0.607	4.0	0.1718	0.0000	SURCHARGED
360 minute winter	PPIC3	328	118.805	0.605	4.0	0.1712	0.0000	SURCHARGED
360 minute winter	Swale 3A	328	118.218	0.018	4.0	0.0051	0.0000	OK
480 minute winter	Swale 3B	560	117.747	0.657	4.0	0.1860	0.0000	SURCHARGED
480 minute winter	PPIC4	560	117.747	0.657	3.1	0.1859	0.0000	SURCHARGED
480 minute winter	Swale 4A	576	117.385	0.295	3.1	0.0836	0.0000	OK
480 minute winter	Swale 4B	576	117.385	0.385	3.1	0.1091	0.0000	SURCHARGED
480 minute winter	PPIC5	576	117.385	0.385	3.1	0.1090	0.0000	SURCHARGED
480 minute winter	Swale 5A	576	117.016	0.016	3.1	0.0045	0.0000	OK
480 minute winter	Swale 5B	576	116.746	0.016	3.1	0.0046	0.0000	OK
15 minute summer	PPIC6	1	116.260	0.000	0.0	0.0000	0.0000	OK
15 minute summer	Swale 6A	1	116.260	0.000	0.0	0.0000	0.0000	OK
15 minute summer	Swale 6B	1	116.230	0.000	0.0	0.0000	0.0000	OK
720 minute winter	SWPS	675	116.047	1.067	4.1	1.2069	0.0000	SURCHARGED
720 minute winter	Dummy	675	118.026	3.075	4.1	3.4783	0.0000	OK
720 minute winter	HW1	675	118.003	0.043	4.1	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
180 minute winter	PPIC2	Orifice	Swale 2A	4.0				
180 minute winter	Swale 2A	4.004	Swale 2B	4.0	0.064	0.001	21.4095	
360 minute winter	Swale 2B	4.005	PPIC3	3.4	0.191	0.191	0.0614	
360 minute winter	PPIC3	Orifice	Swale 3A	4.0				
360 minute winter	Swale 3A	4.007	Swale 3B	4.0	0.075	0.002	24.9651	
480 minute winter	Swale 3B	4.008	PPIC4	3.1	0.127	0.079	0.1293	
480 minute winter	PPIC4	Orifice	Swale 4A	3.1				
480 minute winter	Swale 4A	4.010	Swale 4B	3.1	0.051	0.001	1.4389	
480 minute winter	Swale 4B	4.011	PPIC5	3.1	0.127	0.079	0.1292	
480 minute winter	PPIC5	Orifice	Swale 5A	3.1				
480 minute winter	Swale 5A	4.013	Swale 5B	3.1	0.357	0.001	0.0707	
480 minute winter	Swale 5B	4.014	SWPS	3.1	0.282	0.026	0.0349	
15 minute summer	PPIC6	8.000	Swale 6A	0.0	0.000	0.000	0.0000	
15 minute summer	Swale 6A	8.001	Swale 6B	0.0	0.000	0.000	0.0002	
15 minute summer	Swale 6B	8.002	SWPS	0.0	0.000	0.000	0.0330	
720 minute winter	SWPS	Pump	Dummy	4.1				
720 minute winter	Dummy	1.012	HW1	4.1	0.740	0.080	0.0115	165.1

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 98.33%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
60 minute winter	S1	49	120.802	0.202	9.7	5.7795	0.0000	OK
60 minute winter	S2	48	120.802	0.902	10.4	1.0202	0.0000	SURCHARGED
120 minute winter	S3	120	119.483	0.833	7.9	2.2069	0.0000	SURCHARGED
120 minute winter	S4	120	119.481	0.911	10.9	13.7139	0.0000	FLOOD RISK
720 minute winter	Tank 1	705	119.026	0.776	5.7	88.4660	0.0000	SURCHARGED
720 minute winter	S5	705	119.026	0.826	2.5	0.9342	0.0000	SURCHARGED
5760 minute winter	Tank 2	3840	116.004	0.689	0.7	70.6801	0.0000	SURCHARGED
5760 minute winter	S6	3840	116.004	0.714	1.2	0.8074	0.0000	SURCHARGED
5760 minute winter	Tank 3	3840	116.004	0.904	1.2	64.3963	0.0000	SURCHARGED
5760 minute winter	S7	3840	116.004	0.924	1.4	1.0448	0.0000	SURCHARGED
960 minute winter	Tank 4	885	116.393	0.943	7.2	70.7341	0.0000	SURCHARGED
60 minute winter	S8	54	120.773	0.553	17.8	16.0069	0.0000	SURCHARGED
240 minute winter	S9	200	120.248	0.288	5.1	0.3254	0.0000	SURCHARGED
480 minute winter	S10	448	118.972	0.742	5.4	24.5551	0.0000	FLOOD RISK
60 minute winter	S11	50	120.029	0.978	16.2	11.7036	0.0000	SURCHARGED
60 minute winter	S12	46	118.486	0.986	22.4	9.1239	0.0000	SURCHARGED
60 minute winter	S13	62	117.499	1.099	23.8	14.4954	0.0000	FLOOD RISK
960 minute winter	Tank - Emergency	885	116.393	1.043	4.5	89.1824	0.0000	SURCHARGED
960 minute winter	S14	885	116.393	0.993	5.2	1.1232	0.0000	SURCHARGED
960 minute winter	S15	900	116.381	1.001	1.9	1.1323	0.0000	SURCHARGED
960 minute winter	S16	915	116.369	1.019	2.0	1.1529	0.0000	SURCHARGED
960 minute winter	S17	915	116.358	1.357	2.0	1.5353	0.0000	SURCHARGED
60 minute winter	PPIC1	54	120.769	0.569	3.9	0.1611	0.0000	SURCHARGED
240 minute winter	Swale 1A	200	120.249	0.049	3.7	0.0140	0.0000	OK
240 minute winter	Swale 1B	200	120.249	0.749	4.5	0.2121	0.0000	FLOOD RISK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
60 minute winter	S1	1.000	S2	5.1	0.255	0.078	1.7417	
60 minute winter	S2	Orifice	S3	4.9				
120 minute winter	S3	1.002	S4	7.7	0.206	0.231	0.7612	
120 minute winter	S4	Orifice	Tank 1	4.9				
720 minute winter	Tank 1	1.004	S5	2.1	0.253	0.027	0.0904	
720 minute winter	S5	Hydro-Brake®	Tank 2	0.8				
5760 minute winter	Tank 2	1.006	S6	1.1	0.297	0.029	0.1876	
5760 minute winter	S6	1.007	Tank 3	1.2	0.295	0.027	1.0626	
5760 minute winter	Tank 3	1.008	S7	1.4	0.047	0.042	0.1836	
5760 minute winter	S7	Orifice	S17	1.4				
960 minute winter	Tank 4	2.003	S14	3.3	0.418	0.075	0.2881	
60 minute winter	S8	5.000	PPIC1	3.9	0.405	0.329	0.0792	
240 minute winter	S9	6.000	PPIC2	4.9	0.486	0.090	0.0864	
480 minute winter	S10	7.000	PPIC3	2.5	0.325	0.178	0.0866	
60 minute winter	S11	Orifice	S12	5.1				
60 minute winter	S12	Orifice	S13	13.0				
60 minute winter	S13	Orifice	Tank 4	13.8				
960 minute winter	Tank - Emergency	3.000	S14	-4.5	-0.465	-0.114	0.7269	
960 minute winter	S14	Orifice	S15	1.9				
960 minute winter	S15	Orifice	S16	2.0				
960 minute winter	S16	Orifice	S17	2.0				
960 minute winter	S17	Hydro-Brake®	SWPS	2.0				
60 minute winter	PPIC1	Orifice	Swale 1A	3.9				
240 minute winter	Swale 1A	4.001	Swale 1B	3.7	0.111	0.002	26.3551	
240 minute winter	Swale 1B	4.002	PPIC2	4.4	0.247	0.246	0.0426	

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 98.33%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
240 minute winter	PPIC2	200	120.248	0.747	4.9	0.2115	0.0000	FLOOD RISK
240 minute winter	Swale 2A	200	119.518	0.018	4.4	0.0052	0.0000	OK
480 minute winter	Swale 2B	440	118.974	0.774	4.4	0.2190	0.0000	FLOOD RISK
480 minute winter	PPIC3	448	118.971	0.771	4.5	0.2183	0.0000	FLOOD RISK
480 minute winter	Swale 3A	448	118.219	0.019	4.5	0.0055	0.0000	OK
720 minute winter	Swale 3B	780	117.929	0.839	4.4	0.2375	0.0000	FLOOD RISK
720 minute winter	PPIC4	780	117.929	0.839	3.5	0.2374	0.0000	FLOOD RISK
720 minute winter	Swale 4A	810	117.476	0.386	3.5	0.1093	0.0000	OK
720 minute winter	Swale 4B	810	117.476	0.476	3.5	0.1348	0.0000	SURCHARGED
720 minute winter	PPIC5	810	117.476	0.476	3.5	0.1347	0.0000	SURCHARGED
720 minute winter	Swale 5A	810	117.017	0.017	3.5	0.0048	0.0000	OK
720 minute winter	Swale 5B	810	116.747	0.017	3.5	0.0048	0.0000	OK
960 minute winter	PPIC6	915	116.301	0.041	0.0	0.0116	0.0000	OK
960 minute winter	Swale 6A	915	116.301	0.041	0.1	0.0116	0.0000	OK
960 minute winter	Swale 6B	915	116.301	0.071	0.1	0.0000	0.0000	OK
960 minute winter	SWPS	915	116.301	1.321	5.0	1.4939	0.0000	SURCHARGED
960 minute winter	Dummy	915	118.031	3.081	5.0	3.4843	0.0000	OK
960 minute winter	HW1	915	118.008	0.048	5.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)	Discharge Vol (m³)
240 minute winter	PPIC2	Orifice	Swale 2A	4.4				
240 minute winter	Swale 2A	4.004	Swale 2B	4.4	0.075	0.002	32.5499	
480 minute winter	Swale 2B	4.005	PPIC3	3.8	0.217	0.216	0.0614	
480 minute winter	PPIC3	Orifice	Swale 3A	4.5				
480 minute winter	Swale 3A	4.007	Swale 3B	4.5	0.074	0.002	39.2735	
720 minute winter	Swale 3B	4.008	PPIC4	3.5	0.126	0.089	0.1293	
720 minute winter	PPIC4	Orifice	Swale 4A	3.5				
720 minute winter	Swale 4A	4.010	Swale 4B	3.5	0.050	0.001	2.1415	
720 minute winter	Swale 4B	4.011	PPIC5	3.5	0.128	0.088	0.1292	
720 minute winter	PPIC5	Orifice	Swale 5A	3.5				
720 minute winter	Swale 5A	4.013	Swale 5B	3.5	0.374	0.001	0.0756	
720 minute winter	Swale 5B	4.014	SWPS	3.5	0.313	0.029	0.0351	
960 minute winter	PPIC6	8.000	Swale 6A	0.0	-0.070	-0.001	0.0131	
960 minute winter	Swale 6A	8.001	Swale 6B	-0.1	0.004	0.000	0.5544	
960 minute winter	Swale 6B	8.002	SWPS	0.1	0.008	0.001	0.0483	
960 minute winter	SWPS	Pump	Dummy	5.0				
960 minute winter	Dummy	1.012	HW1	5.0	0.786	0.099	0.0134	252.2

Appendix F

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydrocarbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/industrial roofs)	Low	0.3	0.2	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, home zones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4
Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail), all roads except low traffic roads and trunk roads/motorways	**Medium**	**0.7**	**0.6**	**0.7**
Sites with heavy pollution (e.g. haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways	High	0.8	0.8	0.9

Table 1: Pollution hazard indices for different land use classifications

(land use in bold applicable for the development).

	Mitigation indices		
Type of SuDS component	**TSS**	**Metals**	**Hydrocarbons**
Filter strip	0.4	0.4	0.5
Filter drain	0.4	0.4	0.4
Swale	**0.5**	**0.6**	**0.6**
Bio retention system	0.8	0.8	0.8
Permeable pavement	**0.7**	**0.6**	**0.7**
Detention basin	0.5	0.5	0.6
Vortex Plus	0.5	0.4	0.5
Pond	0.7	0.7	0.5
Wetland	0.8	0.8	0.8
Proprietary treatment systems	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

Table 2: Indicative SuDS mitigation indices for discharges to surface waters

(bold text is applicable to this development).

For surface water discharge from Residential Parking Areas and Low Traffic Roads <300 traffic movements/day			
	Required mitigation indices		
Source	**TSS**	**Metals**	**Hydrocarbons**
Medium	**0.7**	**0.6**	**0.7**
Type of SuDS component provided			
Permeable Pavement	0.7	0.6	0.7
Swale	0.25	0.3	0.3
Total	**0.95**	**0.9**	**1.0**
Check	**+0.25**	**+0.3**	**+0.3**

Table 3: SuDS mitigation indices provided

Appendix G

1.0 INTRODUCTION

1.1 The development at Maes Bach, Pontypridd, CF38 1SL includes a number of Sustainable Drainage Systems (SuDS) as part of the surface water drainage system including a swale and permeable pavement in sequence with flow control features such as pumping chambers and penstocks. This Technical Note sets out an outline management plan for the SuDS components.

1.2 The maintenance of all SuDS components will be in accordance with the best practices and CIRIA document C753 "The SuDS Manual". Typical maintenance activities for the proposed SuDS components have been reproduced from Table 32.1 of "The SuDS Manual" in **Table 1** below.

1.3 The drainage features will be maintained and managed by a private management company responsible to the owner of the site.

Table 1: Typical SuDS Maintenance Activities

Operation and maintenance activity	SuDS component	
	Swale	**Permeable Pavement**
Regular maintenance		
Inspection	■	■
Litter and debris removal	■	■
Grass cutting	■	□
Weed and invasive plant control		□
Shrub management	□	□
Inspection of Perforated Pipework	□	□
Inspection of inlet and outlet pipes and chambers	□	□
Aquatic vegetation management		
Occasional maintenance		
Sediment management	■	■
Vegetation replacement	□	
Vacuum sweeping and brushing		□
Remedial maintenance		
Structure rehabilitation / repair	□	□
■ will be required □ may be required		

2.0 SuDS MANAGEMENT PLAN

2.1 This long-term Management Plan for the Sustainable Drainage System (SuDS) should be implemented at the site to ensure that the drainage network functions as designed. Maintenance and cleaning of catchpit manholes, connecting pipework and SuDS components will ensure adequate hydraulic performance.

2.2 This plan is intended to cover all on-site drainage structures. The Site Management Team should oversee and implement the SuDS Management Plan and designate a qualified person who will be responsible for the proper operation and maintenance of the surface water drainage structures.

Water Quality Management

2.3 The surface drainage network has been designed to protect and enhance the quality of surface water runoff through the removal of sediment and pollutants, in accordance with guidance presented in CIRIA C753 'The SuDS Manual'.

2.4 The 'Simple Index Method' has been utilised to demonstrate that the proposed permeable paving provides sufficient treatment of surface water runoff for a site of this nature and intended use.

2.5 Catchpit manholes will add further treatment by reducing the amount of pollutants conveyed through the system. Preventive maintenance of the system will include a comprehensive source reduction program of regular sweeping and litter removal, prohibitions on the use of pesticides and provision of best practices.

Maintenance Program

2.6 The Site Management Team and will conduct the SuDS Management Plan set out in this document. The responsible party will ensure that inspections and record keeping are timely and accurate.

2.7 Inspection & Maintenance Log Forms (attached) should include the date and physical conditions of the structures, depth of sediment in structures / features, evidence of overtopping or debris blockage and maintenance required of each structure.

2.8 Records of maintenance will be kept on file on-site and copies of Inspection & Maintenance Log sheets indicating all work and inspections will be available to the Council upon request.

Regular maintenance should include:

- Inspect paving surfacing and sweep any debris every 6 months, or as determined to be reasonable based on experience with the installed systems, to ensure that the permeable paving is working in the intended fashion.

- All litter shall be picked up and removed from access roads, paving and soft landscaping.

- The inlets, outlet and vents and overflows of SuDS components should be checked annually and after large storms to ensure that they are in good condition and operating as designed. Regular maintenance includes inspection and identification of any areas that are not operating correctly monthly for the first 3 months and then every 6 months after.

Winter Maintenance Program

2.9 Ensure that drainage structures are not blocked by ice, snow, debris or rubbish during winter months. Inspections and maintenance should be carried out on a more regular basis due to likely adverse weather conditions.

2.10 Avoid de-icing agents wherever possible to allow bio-remediation of pollutants in SuDS features.

Fertiliser Use

2.11 Only slow-release organic low-phosphorous fertilisers will be used in any landscaped areas in order to limit the amount of nutrients that could enter the surface water drainage system.

2.12 Avoid use of weed killers and pesticides to prevent chemical pollution.

Operation and Maintenance requirements

2.13 Recommendations for the operation and maintenance including typical frequencies are included in **Table 2, 3 and 4** below.

Table 2: Typical SuDS Maintenance Activity Frequencies: Swale

SuDS Element	**Swales**	
Maintenance Period	**Maintenance Task**	**Frequency**
Regular Maintenance	Remove litter and debris	Monthly, or as required
	Cut the grass – to retain grass height within specified design range	Monthly (during growing season) or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or when required
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional Maintenance	Reseed areas of poor vegetation growth; alter plant types to better suit conditions, if required	As required or if bare soil is exposed over > 10% of the filter strip area
Remedial Actions	Repair erosion or other damage by re-turfing or reseeding	As required
	Relevel uneven surfaces and reinstate design levels	As required

	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	As required
	Remove build-up of sediment on upstream gravel trench, flow spreader or at top of filter strip	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

Table 3: Typical SuDS Maintenance Activity Frequencies: Permeable Paving

SUDS Element	**Permeable Paving**	
Maintenance Period	**Maintenance Task**	**Frequency**
Regular Maintenance	Brushing and vacuuming	Once a year or as required
Occasional Maintenance	Stabilise and mow contributing adjacent area	As required
	Removal of weed or management using glyphospate applied directly into weeds by an applicator rather than spraying	As required
Remedial Work	Remediate any landscaping which has been raised to within 50mm of the level of the paving	As required.
	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to structural performance or a hazard to users.	As required.
	Rehabilitation of surface or upper structure by remedial sweeping	Every 10 to 15 years, or as required

Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	3 monthly, 48hrs after large storms in first 6 months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Table 4: Typical SuDS Maintenance Activity Frequencies: Penstock and Chambers

SUDS Element	**Penstock and Chambers**	
Maintenance Period	**Maintenance Task**	**Frequency**
Regular Maintenance	Remove sediment and debris from inspection chambers	Monthly and immediately before and after large storm event
	Clean out debris and grit by hosing down the penstock unit	Monthly and immediately before and after large storm event
	Check the operating equipment for damage and freedom of movement and ensure that there are no damaged or worn parts	Annually (or as required)
Occasional maintenance	Check the tightness of the connecting bolts and nuts to ensure no damage or plain of weakness	Annually.
	Lightly oil all moving parts	As required

Remedial actions	Repair damage parts and /or entire unit	As required
	Repair / rehabilitate inlets, outlets and overflows	As required

Pipework and Outfall Flap Valves

2.14 The connecting pipework under the site roads and outfall pipework, should be regularly checked to ensure there is no significant damage affecting the function of the proposed drainage system. This would include:

- Quarterly visual inspection of the upstream and downstream chambers / outfalls to ensure surface water flows through the network (also to be undertaken after severe storms);
- CCTV survey on an annual basis to inspect condition of pipework;
- Jetting of the pipework to remove sediment / blockages, as required; and
- Reparations / replacement of damaged or collapsed pipework, as required.

2.15 Flap valves are constructed in a way that minimum maintenance is required. To ensure correct functioning of the flap valve it is recommended to carry the following maintenance:

- Half yearly visual check of the flap valve;
- Half yearly visual inspection of the material sealing and replacement / cleaning, as required;
- Replacement / reparation of damaged flap valve, as required.

Exclusions

2.16 This SuDS Management and Maintenance Strategy does not allow for the maintenance of the pumping station or proprietary treatment structures. The manufacturer's guidance and expertise should be used.

Additional Support

2.17 In the event of concern or failure of a SuDS feature, it is recommended that Ardent Consulting Engineers are contacted to provide expert advice.

Drainage Operation and Maintenance Log

Site Maintenance Supervisor:_____ Date:_____

☐ Routine ☐ Response to rainfall event ☐ Other:_____

Maintenance Area	Frequency	Date Performed	Comments
Catchpit Manholes and Pipework	Monthly Inspections of condition and operation		
	Monthly (for the first 3 months) then as required; removal of silt accumulation		
	Reparation of physical damage to pipes and chambers		
Inlet, outlets and Headwalls	Inspect and identify areas not operating property every 3 months (for the first 3 months) and every 6 months after.		
	Monthly trash screens inspection and remove debris		

	Monthly trash screens inspection and remove debris		
Pavement Areas/Hard Surfaces (parking, driveways, service areas)	Rubbish, litter & debris removal on a monthly basis		
	Specialist sweeping, jetting and vacuuming, as required		
	Remediation of any depressions, rutting or broken paving elements, as required		
Landscaped & Vegetated Areas	Maintenance as necessary		