

# **Ski Tyres 73 New Street**

## **CAPE HOMES LTD**

Technical Note – Discharge of Planning Condition 3  
(Surface Water Drainage)

231097-KTN-TN-01-A

3<sup>rd</sup> February 2024



The Site  
24 Chosen View Road  
Cheltenham  
GL51 9LT

## DOCUMENT CONTROL

### Document Status

Revision	Date	Document Author	Status
<b>A</b>	<b>03.02.24</b>	<b>Kris Tovey</b>	<b>FINAL</b>

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## 1.0 INTRODUCTION

- 1.1 K-Ten Consulting Ltd (K-Ten) provide professional Flood Risk, Infrastructure and Drainage services throughout the UK.
- 1.2 The project consists of the construction of 7 residential dwellings.
- 1.3 Planning has been granted by Cheltenham Borough Council on 17<sup>th</sup> February 2023 ref 22/01585/FUL.
- 1.4 Pre commencement condition 3 relates to surface water drainage.
- 1.5 K-Ten have been commissioned by Cape Homes Ltd (applicant) to prepare technical design information to discharge planning condition 3.

## 2.0 PLANNING CONDITION 3 (SURFACE WATER DRAINAGE)

### 2.1 Planning Condition 3 states:

*Prior to the commencement of development, a full surface water drainage scheme shall be submitted to and approved in writing by the Local Planning Authority. The scheme shall include a programme for implementation of the works; and proposals for maintenance and management. The development shall not be carried out unless in accordance with the approved surface water drainage scheme.*

*Reason: To ensure sustainable drainage of the development, having regard to adopted policy INF2 of the Joint Core Strategy (2017). Approval is required upfront because the design of the drainage is an integral part of the development and its acceptability.*

### 3.0 PROPOSED SURFACE WATER DRAINAGE STRATEGY

- 3.1 A drainage strategy has been submitted to support the planning application and a development surface and foul combined discharge to existing public drainage assets approved.
- 3.2 The planning strategy proposed a surface water discharge rate to be limited to 6.18 l/s for all storms up to and including a 40% allowance for climate change.
- 3.3 The development surface water discharge will be split into two outlets to suit the different floor and external levels between Plots 1-3 and the rest of the site. The proposed connections will be to the same public asset at two locations.
- 3.4 Plots 1-3 will discharge to the Combined asset in New Street via a flow control chamber limiting flows to 3.0 l/s with attenuation provided within a 0.90m x 1.2m x 2.0m deep chamber (S4)
- 3.5 Plots 4-7 will discharge to the Combined asset in Grove Street via a flow control chamber limiting flows to 3.18 l/s with attenuation provided within a 3m x 5m x 0.4m deep cellular storage device located beneath private parking areas.
- 3.6 Both outfalls will utilise existing combined connections from site.
- 3.7 Causeway Flow drainage design software has been used to simulate the attenuation based on the following design principles:
  - Rainfall data – FEH-22
  - Time of entry – 4 mins
  - Storm durations – 15 mins to 8640 mins
- 3.8 Refer to **Appendix A** for proposed drainage layout.
- 3.9 The 100yr event with 40% climate change will be retained on site.
- 3.10 Any exceedance flows above this event will be directed to New Street and Grove Street.
- 3.11 Refer to **Appendix B** for surface water drainage calculations.
- 3.12 S016 connection applications will be required for indirect connections via existing outlets from site to the combined public asset.

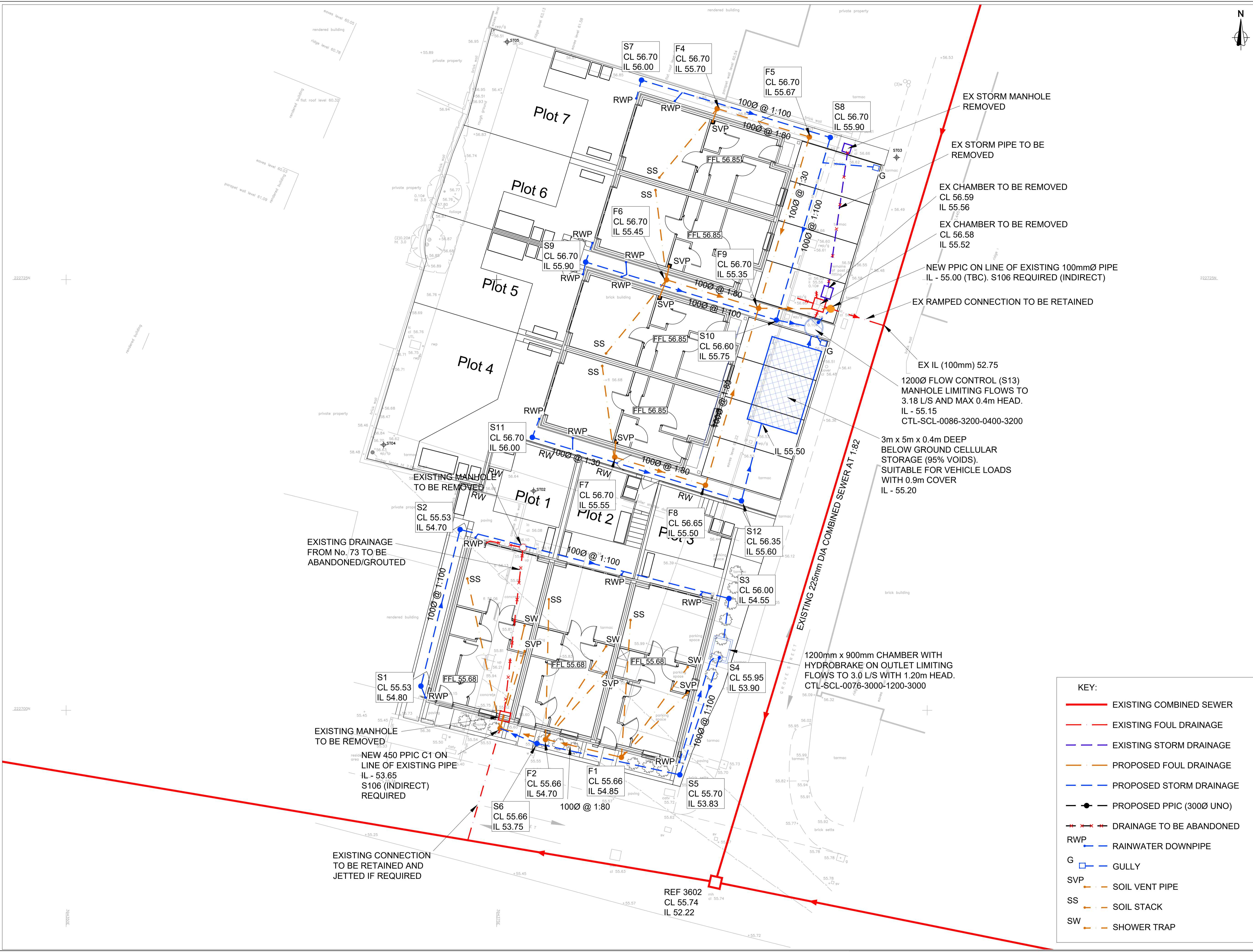
## 4.0 MAINTENANCE AND MANAGEMENT

- 4.1 The development will commence on site as soon as all pre commencement conditions have been discharged.
- 4.2 Maintenance of SuDS features is required in order to ensure that the surface water drainage system operates effectively, and the risk of flooding of the site and surrounding areas is reduced.
- 4.3 A maintenance schedule should be undertaken to ensure that the drainage system remains fully operational for the design lifetime. The below table summarises a maintenance plan for the drainage systems and components within the development.
- 4.4 The SuDS Manual (CIRIA C753) and specific product suppliers guidelines should also be referred to for further information on maintenance and frequency.
- 4.5 All on site drainage will be maintained and managed through a management company.

Drainage Component	Required Action	Typical Frequency
<b>General pipework, manholes, chambers, silt traps and headwalls</b>	Stabilise adjacent areas	As required
	Remove weeds and vegetation	As required
	Clear/Jet any poor performing structures	As required
	Inspect all drainage features for poor operation	3 monthly, 48 hours after large storms in first six months
	Monitor inspection chambers and silt traps. Inspect silt accumulation and determine silt clearance frequencies	Annually
<b>Attenuation</b>	Inspection of inlets, outlets, orifice and silt traps	As required
	Silt removal	Annually

**APPENDIX A**  
SURFACE WATER DRAINAGE LAYOUT





- Notes:**
1. Do not scale from this drawing. All dimensions are in metres unless noted otherwise.
  2. Drawing to be read in conjunction with all other consultants drawings. Any discrepancies are to be reported to the engineer immediately.
  3. Position of existing services/statutory undertakers apparatus are to be checked by the contractor prior to starting work.

**KEY:**

- EXISTING COMBINED SEWER
- - - EXISTING FOUL DRAINAGE
- - - EXISTING STORM DRAINAGE
- - - PROPOSED FOUL DRAINAGE
- - - PROPOSED STORM DRAINAGE
- PROPOSED PPIC (300Ø UNO)
- x-x- DRAINAGE TO BE ABANDONED
- RWP — RAINWATER DOWNPIPE
- G □ GULLY
- SVP — SOIL VENT PIPE
- SS — SOIL STACK
- SW — SHOWER TRAP

C	03.02.24	LAYOUT UPDATED. ISSUED TO DISCHARGE CONDITION	KT
B	30.01.24	LEVELS AND DRAINAGE REVISED	KT
A	22.01.24	ISSUED TO CLIENT FOR COMMENT	KT
Rev	Date	Details	Drawn



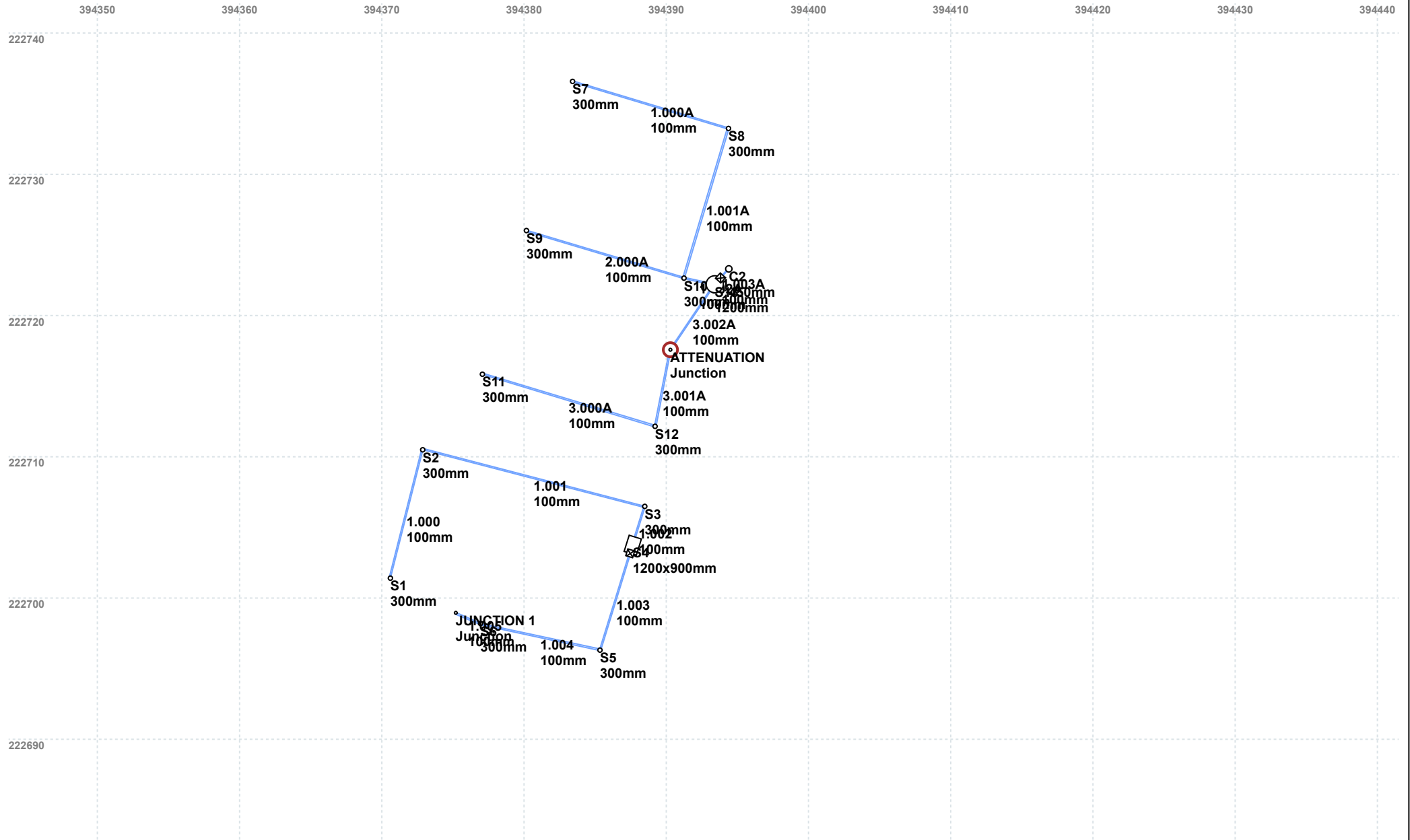
CLIENT:  
**CAPE HOMES LTD**

PROJECT:  
**73-75 NEW STREET  
CHELTHENHAM**

TITLE:  
**BELOW GROUND DRAINAGE  
LAYOUT**

SCALE @ A1:	DATE:	DRAWN:	STATUS:
1:100	20.01.24	KT	INFORMATION
JOB NO:	DRAWING NO:	REVISION:	
23-1097	C001	C	

**APPENDIX B**  
DRAINAGE CALCULATIONS





**Design Settings**

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	2	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	0.750	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	4.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	✓
Maximum Rainfall (mm/hr)	50.0		

**Circular Link Type**

Shape	Circular	Auto Increment (mm)	75
Barrels	1	Follow Ground	x

**Available Diameters (mm)**

100 | 150

**Nodes**

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Width (mm)	Easting (m)	Northing (m)	Depth (m)
S1	0.004	4.00	55.530	300		394370.602	222701.408	0.730
S2	0.008	4.00	55.530	300		394372.875	222710.497	0.824
S3	0.000		56.000	300		394388.487	222706.490	1.455
S4	0.004	4.00	55.950	1200	900	394387.643	222703.740	2.050
S5	0.000		55.700	300		394385.339	222696.313	1.870
S6	0.000		55.660	300		394376.941	222698.193	1.910
JUNCTION 1	0.000		55.660			394375.202	222698.952	2.010
S11	0.007	4.00	56.700	300		394377.072	222715.845	0.700
S12	0.000		56.500	300		394389.212	222712.157	0.900
ATTENUATION	0.000		56.600			394390.290	222717.579	1.400
S9	0.014	4.00	56.700	300		394380.168	222726.017	0.800
S7	0.007	4.00	56.700	300		394383.411	222736.578	0.700
S8	0.000		56.700	300		394394.374	222733.247	0.800
S10	0.000		56.600	300		394391.245	222722.650	0.850
S13	0.000		56.550	1200		394393.409	222722.218	1.400
C2	0.000		56.500	450		394394.398	222723.304	1.500

**Links**

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.000	S1	S2	9.369	0.600	54.800	54.706	0.094	100.0	100	4.20	50.0
1.001	S2	S3	16.118	0.600	54.706	54.545	0.161	100.0	100	4.55	50.0
1.002	S3	S4	2.877	0.600	54.545	53.900	0.645	4.5	100	4.57	50.0
1.003	S4	S5	7.776	0.600	53.900	53.830	0.070	111.1	100	4.74	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	0.769	6.0	0.5	0.630	0.724	0.004	0.0	21	0.479
1.001	0.769	6.0	1.6	0.724	1.355	0.012	0.0	36	0.653
1.002	3.687	29.0	1.6	1.355	1.950	0.012	0.0	16	1.975
1.003	0.729	5.7	2.2	1.950	1.770	0.016	0.0	43	0.677



**Links**

Name	US Node	DS Node	Length (m)	ks (mm) / n	US IL (m)	DS IL (m)	Fall (m)	Slope (1:X)	Dia (mm)	T of C (mins)	Rain (mm/hr)
1.004	S5	S6	8.606	0.600	53.830	53.750	0.080	107.6	100	4.94	50.0
1.005	S6	JUNCTION 1	1.897	0.600	53.750	53.650	0.100	19.0	100	4.95	50.0
1.000A	S7	S8	11.458	0.600	56.000	55.900	0.100	114.6	100	4.27	50.0
1.001A	S8	S10	11.049	0.600	55.900	55.750	0.150	73.7	100	4.47	50.0
2.000A	S9	S10	11.577	0.600	55.900	55.750	0.150	77.2	100	4.22	50.0
1.002A	S10	S13	2.207	0.600	55.750	55.550	0.200	11.0	100	4.49	50.0
3.000A	S11	S12	12.688	0.600	56.000	55.600	0.400	31.7	100	4.15	50.0
3.001A	S12	ATTENUATION	5.528	0.600	55.600	55.500	0.100	55.3	100	4.24	50.0
3.002A	ATTENUATION	S13	5.590	0.600	55.200	55.150	0.050	111.8	100	4.37	50.0
1.003A	S13	C2	1.469	0.600	55.150	55.000	0.150	9.8	100	4.50	50.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.004	0.741	5.8	2.2	1.770	1.810	0.016	0.0	43	0.689
1.005	1.781	14.0	2.2	1.810	1.910	0.016	0.0	27	1.302
1.000A	0.717	5.6	0.9	0.600	0.700	0.007	0.0	28	0.531
1.001A	0.898	7.1	0.9	0.700	0.750	0.007	0.0	25	0.621
2.000A	0.877	6.9	1.9	0.700	0.750	0.014	0.0	36	0.745
1.002A	2.339	18.4	2.8	0.750	0.900	0.021	0.0	27	1.711
3.000A	1.374	10.8	0.9	0.600	0.800	0.007	0.0	20	0.839
3.001A	1.038	8.2	0.9	0.800	1.000	0.007	0.0	23	0.691
3.002A	0.726	5.7	0.9	1.300	1.300	0.007	0.0	28	0.538
1.003A	2.484	19.5	3.8	1.300	1.400	0.028	0.0	30	1.932

**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	9.369	100.0	100	Circular	55.530	54.800	0.630	55.530	54.706	0.724
1.001	16.118	100.0	100	Circular	55.530	54.706	0.724	56.000	54.545	1.355
1.002	2.877	4.5	100	Circular	56.000	54.545	1.355	55.950	53.900	1.950
1.003	7.776	111.1	100	Circular	55.950	53.900	1.950	55.700	53.830	1.770
1.004	8.606	107.6	100	Circular	55.700	53.830	1.770	55.660	53.750	1.810
1.005	1.897	19.0	100	Circular	55.660	53.750	1.810	55.660	53.650	1.910
1.000A	11.458	114.6	100	Circular	56.700	56.000	0.600	56.700	55.900	0.700
1.001A	11.049	73.7	100	Circular	56.700	55.900	0.700	56.600	55.750	0.750

Link	US Node	Dia (mm)	Width (mm)	Node Type	MH Type	DS Node	Dia (mm)	Width (mm)	Node Type	MH Type
1.000	S1	300		Manhole	Adoptable	S2	300		Manhole	Adoptable
1.001	S2	300		Manhole	Adoptable	S3	300		Manhole	Adoptable
1.002	S3	300		Manhole	Adoptable	S4	1200	900	Manhole	Adoptable
1.003	S4	1200	900	Manhole	Adoptable	S5	300		Manhole	Adoptable
1.004	S5	300		Manhole	Adoptable	S6	300		Manhole	Adoptable
1.005	S6	300		Manhole	Adoptable	JUNCTION 1			Junction	
1.000A	S7	300		Manhole	Adoptable	S8	300		Manhole	Adoptable
1.001A	S8	300		Manhole	Adoptable	S10	300		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)
2.000A	11.577	77.2	100	Circular	56.700	55.900	0.700	56.600	55.750	0.750
1.002A	2.207	11.0	100	Circular	56.600	55.750	0.750	56.550	55.550	0.900
3.000A	12.688	31.7	100	Circular	56.700	56.000	0.600	56.500	55.600	0.800
3.001A	5.528	55.3	100	Circular	56.500	55.600	0.800	56.600	55.500	1.000
3.002A	5.590	111.8	100	Circular	56.600	55.200	1.300	56.550	55.150	1.300
1.003A	1.469	9.8	100	Circular	56.550	55.150	1.300	56.500	55.000	1.400






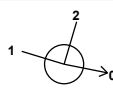
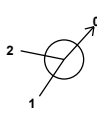

Link	US Node	Dia (mm)	Width (mm)	Node Type	MH Type	DS Node	Dia (mm)	Width (mm)	Node Type	MH Type
2.000A	S9	300		Manhole	Adoptable	S10	300		Manhole	Adoptable
1.002A	S10	300		Manhole	Adoptable	S13	1200		Manhole	Adoptable
3.000A	S11	300		Manhole	Adoptable	S12	300		Manhole	Adoptable
3.001A	S12	300		Manhole	Adoptable	ATTENUATION			Junction	
3.002A	ATTENUATION			Junction		S13	1200		Manhole	Adoptable
1.003A	S13	1200		Manhole	Adoptable	C2	450		Manhole	Adoptable

**Manhole Schedule**

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Connections	Link	IL (m)	Dia (mm)
S1	394370.602	222701.408	55.530	0.730	300					
							0	1.000	54.800	100
S2	394372.875	222710.497	55.530	0.824	300					
							0	1.001	54.706	100
S3	394388.487	222706.490	56.000	1.455	300					
							0	1.002	54.545	100
S4	394387.643	222703.740	55.950	2.050	1200	900				
							0	1.003	53.900	100
S5	394385.339	222696.313	55.700	1.870	300					
							0	1.004	53.830	100
S6	394376.941	222698.193	55.660	1.910	300					
							0	1.005	53.750	100
JUNCTION 1	394375.202	222698.952	55.660	2.010						
							1	1.005	53.650	100
S11	394377.072	222715.845	56.700	0.700	300					
							0	3.000A	56.000	100



**Manhole Schedule**

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Width (mm)	Connections	Link	IL (m)	Dia (mm)
S12	394389.212	222712.157	56.500	0.900	300			1 3.000A	55.600	100
								0 3.001A	55.600	100
ATTENUATION	394390.290	222717.579	56.600	1.400				1 3.001A	55.500	100
								0 3.002A	55.200	100
S9	394380.168	222726.017	56.700	0.800	300			0 2.000A	55.900	100
S7	394383.411	222736.578	56.700	0.700	300			0 1.000A	56.000	100
S8	394394.374	222733.247	56.700	0.800	300			1 1.000A	55.900	100
								0 1.001A	55.900	100
S10	394391.245	222722.650	56.600	0.850	300			1 2.000A	55.750	100
								2 1.001A	55.750	100
								0 1.002A	55.750	100
S13	394393.409	222722.218	56.550	1.400	1200			1 3.002A	55.150	100
								2 1.002A	55.550	100
								0 1.003A	55.150	100
C2	394394.398	222723.304	56.500	1.500	450			1 1.003A	55.000	100

**Simulation Settings**

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m <sup>3</sup> /ha)	20.0
Summer CV	0.750	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.840	Drain Down Time (mins)	240	Check Discharge Volume	x

**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
10	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0



**Node S4 Online Hydro-Brake® Control**

Flap Valve	x	Objective	(CL) Minimise blockage risk
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	53.900	Product Number	CTL-SCL-0076-3000-1200-3000
Design Depth (m)	1.200	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	3.0	Min Node Diameter (mm)	1200

**Node S13 Online Hydro-Brake® Control**

Flap Valve	x	Objective	(CL) Minimise blockage risk
Replaces Downstream Link	✓	Sump Available	✓
Invert Level (m)	55.150	Product Number	CTL-SCL-0086-3200-0400-3200
Design Depth (m)	0.400	Min Outlet Diameter (m)	0.100
Design Flow (l/s)	3.2	Min Node Diameter (mm)	1200

**Node ATTENUATION Depth/Area Storage Structure**

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	55.200
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	22

Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )	Depth (m)	Area (m <sup>2</sup> )	Inf Area (m <sup>2</sup> )
0.000	15.0	0.0	0.400	15.0	0.0	0.401	0.0	0.0

**Other (defaults)**

Entry Loss (manhole)	0.250	Entry Loss (junction)	0.000	Apply Recommended Losses	x
Exit Loss (manhole)	0.250	Exit Loss (junction)	0.000	Flood Risk (m)	0.300

**Approval Settings**

Node Size	✓	Minimum Full Bore Velocity (m/s)	
Node Losses	✓	Maximum Full Bore Velocity (m/s)	3.000
Link Size	✓	Proportional Velocity	✓
Minimum Diameter (mm)	150	Return Period (years)	
Link Length	✓	Minimum Proportional Velocity (m/s)	0.750
Maximum Length (m)	100.000	Maximum Proportional Velocity (m/s)	3.000
Coordinates	✓	Surcharged Depth	✓
Accuracy (m)	1.000	Return Period (years)	
Crossings	✓	Maximum Surcharged Depth (m)	0.100
Cover Depth	✓	Flooding	✓
Minimum Cover Depth (m)		Return Period (years)	30
Maximum Cover Depth (m)	3.000	Time to Half Empty	x
Backdrops	✓	Discharge Rates	✓
Minimum Backdrop Height (m)		Discharge Volume	✓
Maximum Backdrop Height (m)	1.500	100 year 360 minute (m <sup>3</sup> )	
Full Bore Velocity	✓		





**Rainfall**

<b>Event</b>	<b>Peak Intensity (mm/hr)</b>	<b>Average Intensity (mm/hr)</b>
2 year 15 minute summer	103.801	29.372
2 year 15 minute winter	72.843	29.372
2 year 30 minute summer	67.980	19.236
2 year 30 minute winter	47.705	19.236
2 year 60 minute summer	45.854	12.118
2 year 60 minute winter	30.465	12.118
2 year 120 minute summer	30.961	8.182
2 year 120 minute winter	20.570	8.182
2 year 180 minute summer	24.693	6.354
2 year 180 minute winter	16.051	6.354
2 year 240 minute summer	19.944	5.270
2 year 240 minute winter	13.250	5.270
2 year 360 minute summer	15.597	4.014
2 year 360 minute winter	10.139	4.014
2 year 480 minute summer	12.432	3.286
2 year 480 minute winter	8.260	3.286
2 year 600 minute summer	10.247	2.803
2 year 600 minute winter	7.002	2.803
2 year 720 minute summer	9.166	2.456
2 year 720 minute winter	6.160	2.456
2 year 960 minute summer	7.544	1.987
2 year 960 minute winter	4.997	1.987
2 year 1440 minute summer	5.485	1.470
2 year 1440 minute winter	3.686	1.470
2 year 2160 minute summer	3.931	1.086
2 year 2160 minute winter	2.708	1.086
2 year 2880 minute summer	3.283	0.880
2 year 2880 minute winter	2.206	0.880
2 year 4320 minute summer	2.534	0.662
2 year 4320 minute winter	1.669	0.662
2 year 5760 minute summer	2.140	0.548
2 year 5760 minute winter	1.385	0.548
2 year 7200 minute summer	1.872	0.478
2 year 7200 minute winter	1.208	0.478
2 year 8640 minute summer	1.685	0.430
2 year 8640 minute winter	1.088	0.430
2 year 10080 minute summer	1.551	0.396
2 year 10080 minute winter	1.001	0.396
10 year 15 minute summer	203.362	57.544
10 year 15 minute winter	142.710	57.544
10 year 30 minute summer	133.791	37.858
10 year 30 minute winter	93.888	37.858
10 year 60 minute summer	90.763	23.986
10 year 60 minute winter	60.301	23.986
10 year 120 minute summer	55.937	14.783
10 year 120 minute winter	37.163	14.783
10 year 180 minute summer	43.021	11.071
10 year 180 minute winter	27.965	11.071
10 year 240 minute summer	34.084	9.007
10 year 240 minute winter	22.644	9.007
10 year 360 minute summer	26.185	6.738
10 year 360 minute winter	17.021	6.738



**Rainfall**

<b>Event</b>	<b>Peak Intensity (mm/hr)</b>	<b>Average Intensity (mm/hr)</b>
10 year 480 minute summer	20.742	5.482
10 year 480 minute winter	13.781	5.482
10 year 600 minute summer	17.061	4.667
10 year 600 minute winter	11.657	4.667
10 year 720 minute summer	15.257	4.089
10 year 720 minute winter	10.254	4.089
10 year 960 minute summer	12.585	3.314
10 year 960 minute winter	8.336	3.314
10 year 1440 minute summer	9.132	2.448
10 year 1440 minute winter	6.138	2.448
10 year 2160 minute summer	6.476	1.790
10 year 2160 minute winter	4.462	1.790
10 year 2880 minute summer	5.340	1.431
10 year 2880 minute winter	3.589	1.431
10 year 4320 minute summer	3.996	1.045
10 year 4320 minute winter	2.632	1.045
10 year 5760 minute summer	3.288	0.842
10 year 5760 minute winter	2.128	0.842
10 year 7200 minute summer	2.825	0.721
10 year 7200 minute winter	1.823	0.721
10 year 8640 minute summer	2.508	0.640
10 year 8640 minute winter	1.618	0.640
10 year 10080 minute summer	2.283	0.582
10 year 10080 minute winter	1.473	0.582
30 year 15 minute summer	267.607	75.724
30 year 15 minute winter	187.795	75.724
30 year 30 minute summer	178.044	50.380
30 year 30 minute winter	124.943	50.380
30 year 60 minute summer	121.523	32.115
30 year 60 minute winter	80.737	32.115
30 year 120 minute summer	73.045	19.304
30 year 120 minute winter	48.529	19.304
30 year 180 minute summer	55.858	14.374
30 year 180 minute winter	36.309	14.374
30 year 240 minute summer	44.206	11.682
30 year 240 minute winter	29.369	11.682
30 year 360 minute summer	34.005	8.751
30 year 360 minute winter	22.104	8.751
30 year 480 minute summer	27.038	7.145
30 year 480 minute winter	17.964	7.145
30 year 600 minute summer	22.310	6.102
30 year 600 minute winter	15.243	6.102
30 year 720 minute summer	19.995	5.359
30 year 720 minute winter	13.438	5.359
30 year 960 minute summer	16.517	4.349
30 year 960 minute winter	10.941	4.349
30 year 1440 minute summer	11.957	3.205
30 year 1440 minute winter	8.036	3.205
30 year 2160 minute summer	8.402	2.322
30 year 2160 minute winter	5.790	2.322
30 year 2880 minute summer	6.857	1.838
30 year 2880 minute winter	4.609	1.838



**Rainfall**

<b>Event</b>	<b>Peak Intensity (mm/hr)</b>	<b>Average Intensity (mm/hr)</b>
30 year 4320 minute summer	5.019	1.312
30 year 4320 minute winter	3.305	1.312
30 year 5760 minute summer	4.056	1.038
30 year 5760 minute winter	2.625	1.038
30 year 7200 minute summer	3.439	0.877
30 year 7200 minute winter	2.220	0.877
30 year 8640 minute summer	3.022	0.771
30 year 8640 minute winter	1.951	0.771
30 year 10080 minute summer	2.730	0.696
30 year 10080 minute winter	1.762	0.696
100 year 15 minute summer	342.150	96.817
100 year 15 minute winter	240.105	96.817
100 year 30 minute summer	229.337	64.894
100 year 30 minute winter	160.938	64.894
100 year 60 minute summer	158.134	41.790
100 year 60 minute winter	105.061	41.790
100 year 120 minute summer	94.022	24.847
100 year 120 minute winter	62.466	24.847
100 year 180 minute summer	71.828	18.484
100 year 180 minute winter	46.690	18.484
100 year 240 minute summer	56.924	15.043
100 year 240 minute winter	37.819	15.043
100 year 360 minute summer	43.973	11.316
100 year 360 minute winter	28.584	11.316
100 year 480 minute summer	35.020	9.255
100 year 480 minute winter	23.267	9.255
100 year 600 minute summer	28.892	7.903
100 year 600 minute winter	19.741	7.903
100 year 720 minute summer	25.867	6.933
100 year 720 minute winter	17.384	6.933
100 year 960 minute summer	21.286	5.605
100 year 960 minute winter	14.100	5.605
100 year 1440 minute summer	15.283	4.096
100 year 1440 minute winter	10.271	4.096
100 year 2160 minute summer	10.633	2.939
100 year 2160 minute winter	7.326	2.939
100 year 2880 minute summer	8.597	2.304
100 year 2880 minute winter	5.778	2.304
100 year 4320 minute summer	6.179	1.616
100 year 4320 minute winter	4.069	1.616
100 year 5760 minute summer	4.921	1.260
100 year 5760 minute winter	3.185	1.260
100 year 7200 minute summer	4.123	1.052
100 year 7200 minute winter	2.661	1.052
100 year 8640 minute summer	3.588	0.915
100 year 8640 minute winter	2.315	0.915
100 year 10080 minute summer	3.216	0.820
100 year 10080 minute winter	2.076	0.820
100 year +40% CC 15 minute summer	479.009	135.543
100 year +40% CC 15 minute winter	336.147	135.543
100 year +40% CC 30 minute summer	321.071	90.852
100 year +40% CC 30 minute winter	225.313	90.852



**Rainfall**

<b>Event</b>	<b>Peak Intensity (mm/hr)</b>	<b>Average Intensity (mm/hr)</b>
100 year +40% CC 60 minute summer	221.388	58.506
100 year +40% CC 60 minute winter	147.085	58.506
100 year +40% CC 120 minute summer	131.630	34.786
100 year +40% CC 120 minute winter	87.452	34.786
100 year +40% CC 180 minute summer	100.559	25.877
100 year +40% CC 180 minute winter	65.366	25.877
100 year +40% CC 240 minute summer	79.694	21.061
100 year +40% CC 240 minute winter	52.947	21.061
100 year +40% CC 360 minute summer	61.562	15.842
100 year +40% CC 360 minute winter	40.017	15.842
100 year +40% CC 480 minute summer	49.028	12.957
100 year +40% CC 480 minute winter	32.573	12.957
100 year +40% CC 600 minute summer	40.449	11.064
100 year +40% CC 600 minute winter	27.637	11.064
100 year +40% CC 720 minute summer	36.213	9.706
100 year +40% CC 720 minute winter	24.338	9.706
100 year +40% CC 960 minute summer	29.801	7.847
100 year +40% CC 960 minute winter	19.740	7.847
100 year +40% CC 1440 minute summer	21.396	5.734
100 year +40% CC 1440 minute winter	14.379	5.734
100 year +40% CC 2160 minute summer	14.886	4.114
100 year +40% CC 2160 minute winter	10.257	4.114
100 year +40% CC 2880 minute summer	12.035	3.226
100 year +40% CC 2880 minute winter	8.089	3.226
100 year +40% CC 4320 minute summer	8.651	2.262
100 year +40% CC 4320 minute winter	5.697	2.262
100 year +40% CC 5760 minute summer	6.890	1.764
100 year +40% CC 5760 minute winter	4.460	1.764
100 year +40% CC 7200 minute summer	5.772	1.472
100 year +40% CC 7200 minute winter	3.725	1.472
100 year +40% CC 8640 minute summer	5.023	1.281
100 year +40% CC 8640 minute winter	3.242	1.281
100 year +40% CC 10080 minute summer	4.502	1.149
100 year +40% CC 10080 minute winter	2.906	1.149



**Results for 2 year Critical Storm Duration. Lowest mass balance: 99.80%**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m <sup>3</sup> )	Flood (m <sup>3</sup> )	Status
15 minute winter	S1	10	54.821	0.021	0.6	0.0038	0.0000	OK
15 minute winter	S2	10	54.747	0.041	1.7	0.0108	0.0000	OK
15 minute winter	S3	10	54.561	0.016	1.7	0.0012	0.0000	OK
15 minute winter	S4	11	53.991	0.091	2.3	0.1018	0.0000	OK
15 minute winter	S5	11	53.875	0.045	2.2	0.0032	0.0000	OK
15 minute winter	S6	11	53.778	0.028	2.1	0.0020	0.0000	OK
15 minute winter	JUNCTION 1	11	53.677	0.027	2.1	0.0000	0.0000	OK
15 minute winter	S11	10	56.021	0.021	1.0	0.0056	0.0000	OK
15 minute winter	S12	10	55.624	0.024	1.0	0.0017	0.0000	OK
15 minute winter	ATTENUATION	13	55.228	0.028	1.7	0.4203	0.0000	OK
15 minute summer	S9	10	55.939	0.039	2.0	0.0165	0.0000	OK
15 minute summer	S7	10	56.030	0.030	1.0	0.0080	0.0000	OK
15 minute winter	S8	10	55.925	0.025	1.0	0.0018	0.0000	OK
15 minute winter	S10	10	55.780	0.030	3.0	0.0021	0.0000	OK
15 minute winter	S13	13	55.228	0.078	3.0	0.0879	0.0000	OK
15 minute summer	C2	1	55.000	0.000	2.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m <sup>3</sup> )	Discharge Vol (m <sup>3</sup> )
15 minute winter	S1	1.000	S2	0.6	0.290	0.099	0.0197	
15 minute winter	S2	1.001	S3	1.7	0.913	0.277	0.0307	
15 minute winter	S3	1.002	S4	1.7	0.453	0.057	0.0119	
15 minute winter	S4	Hydro-Brake®	S5	2.2				
15 minute winter	S5	1.004	S6	2.1	0.830	0.370	0.0225	
15 minute winter	S6	1.005	JUNCTION 1	2.1	1.237	0.153	0.0033	1.0
15 minute winter	S11	3.000A	S12	1.0	0.782	0.093	0.0165	
15 minute winter	S12	3.001A	ATTENUATION	1.0	0.694	0.121	0.0078	
15 minute winter	ATTENUATION	3.002A	S13	0.9	0.234	0.158	0.0233	
15 minute summer	S9	2.000A	S10	2.0	0.838	0.291	0.0279	
15 minute summer	S7	1.000A	S8	1.0	0.579	0.178	0.0199	
15 minute winter	S8	1.001A	S10	1.0	0.551	0.138	0.0195	
15 minute winter	S10	1.002A	S13	3.0	1.589	0.161	0.0041	
15 minute winter	S13	Hydro-Brake®	C2	2.2				1.7



**Results for 10 year Critical Storm Duration. Lowest mass balance: 99.80%**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m <sup>3</sup> )	Flood (m <sup>3</sup> )	Status
15 minute winter	S1	10	54.829	0.029	1.1	0.0052	0.0000	OK
15 minute winter	S2	10	54.766	0.060	3.3	0.0158	0.0000	OK
15 minute winter	S3	10	54.568	0.023	3.3	0.0016	0.0000	OK
15 minute winter	S4	12	54.221	0.321	4.4	0.3592	0.0000	SURCHARGED
15 minute summer	S5	12	53.884	0.054	3.0	0.0039	0.0000	OK
15 minute winter	S6	12	53.784	0.034	3.0	0.0024	0.0000	OK
15 minute winter	JUNCTION 1	12	53.682	0.032	3.0	0.0000	0.0000	OK
15 minute winter	S11	10	56.028	0.028	1.9	0.0077	0.0000	OK
15 minute winter	S12	10	55.634	0.034	1.9	0.0024	0.0000	OK
15 minute winter	ATTENUATION	14	55.283	0.083	4.3	1.2467	0.0000	OK
15 minute summer	S9	10	55.957	0.057	3.9	0.0241	0.0000	OK
15 minute summer	S7	10	56.042	0.042	1.9	0.0113	0.0000	OK
15 minute winter	S8	10	55.935	0.035	1.9	0.0025	0.0000	OK
15 minute winter	S10	10	55.795	0.045	5.8	0.0032	0.0000	OK
15 minute winter	S13	14	55.281	0.131	5.8	0.1483	0.0000	SURCHARGED
15 minute summer	C2	1	55.000	0.000	3.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m <sup>3</sup> )	Discharge Vol (m <sup>3</sup> )
15 minute winter	S1	1.000	S2	1.1	0.329	0.182	0.0315	
15 minute winter	S2	1.001	S3	3.3	1.079	0.542	0.0499	
15 minute winter	S3	1.002	S4	3.3	0.592	0.113	0.0132	
15 minute winter	S4	Hydro-Brake®	S5	3.0				
15 minute summer	S5	1.004	S6	3.0	0.902	0.515	0.0287	
15 minute winter	S6	1.005	JUNCTION 1	3.0	1.352	0.214	0.0042	1.9
15 minute winter	S11	3.000A	S12	1.9	0.925	0.176	0.0263	
15 minute winter	S12	3.001A	ATTENUATION	1.9	0.833	0.232	0.0126	
15 minute winter	ATTENUATION	3.002A	S13	-2.4	0.404	-0.425	0.0413	
15 minute summer	S9	2.000A	S10	3.9	0.971	0.567	0.0467	
15 minute summer	S7	1.000A	S8	1.9	0.686	0.338	0.0318	
15 minute winter	S8	1.001A	S10	1.9	0.645	0.268	0.0326	
15 minute winter	S10	1.002A	S13	5.8	1.857	0.314	0.0069	
15 minute winter	S13	Hydro-Brake®	C2	3.2				3.4



**Results for 30 year Critical Storm Duration. Lowest mass balance: 99.80%**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m <sup>3</sup> )	Flood (m <sup>3</sup> )	Status
15 minute winter	S1	10	54.834	0.034	1.5	0.0061	0.0000	OK
15 minute winter	S2	10	54.778	0.072	4.4	0.0191	0.0000	OK
15 minute winter	S3	14	54.578	0.033	4.4	0.0024	0.0000	OK
15 minute winter	S4	14	54.584	0.684	5.8	0.7652	0.0000	SURCHARGED
15 minute summer	S5	17	53.884	0.054	3.0	0.0039	0.0000	OK
30 minute winter	S6	26	53.784	0.034	3.0	0.0024	0.0000	OK
30 minute winter	JUNCTION 1	26	53.682	0.032	3.0	0.0000	0.0000	OK
15 minute winter	S11	10	56.034	0.034	2.6	0.0091	0.0000	OK
15 minute winter	S12	10	55.640	0.040	2.6	0.0028	0.0000	OK
30 minute winter	ATTENUATION	24	55.341	0.141	4.3	2.1159	0.0000	SURCHARGED
15 minute summer	S9	10	55.969	0.069	5.1	0.0288	0.0000	OK
15 minute summer	S7	10	56.050	0.050	2.6	0.0135	0.0000	OK
15 minute winter	S8	10	55.942	0.042	2.6	0.0030	0.0000	OK
15 minute winter	S10	10	55.804	0.054	7.7	0.0039	0.0000	OK
30 minute winter	S13	24	55.339	0.189	5.8	0.2141	0.0000	SURCHARGED
15 minute summer	C2	1	55.000	0.000	3.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m <sup>3</sup> )	Discharge Vol (m <sup>3</sup> )
15 minute winter	S1	1.000	S2	1.5	0.356	0.248	0.0392	
15 minute winter	S2	1.001	S3	4.4	1.141	0.722	0.0618	
15 minute winter	S3	1.002	S4	4.3	0.766	0.150	0.0146	
15 minute winter	S4	Hydro-Brake®	S5	3.0				
15 minute summer	S5	1.004	S6	3.0	0.902	0.515	0.0287	
30 minute winter	S6	1.005	JUNCTION 1	3.0	1.351	0.214	0.0042	3.4
15 minute winter	S11	3.000A	S12	2.6	1.007	0.241	0.0331	
15 minute winter	S12	3.001A	ATTENUATION	2.6	0.906	0.318	0.0158	
30 minute winter	ATTENUATION	3.002A	S13	2.8	0.417	0.493	0.0437	
15 minute summer	S9	2.000A	S10	5.1	1.019	0.741	0.0583	
15 minute summer	S7	1.000A	S8	2.6	0.741	0.462	0.0403	
15 minute winter	S8	1.001A	S10	2.6	0.691	0.367	0.0414	
15 minute winter	S10	1.002A	S13	7.7	1.970	0.417	0.0086	
30 minute winter	S13	Hydro-Brake®	C2	3.2				5.9



**Results for 100 year Critical Storm Duration. Lowest mass balance: 99.80%**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m <sup>3</sup> )	Flood (m <sup>3</sup> )	Status
15 minute winter	S1	10	54.838	0.038	1.9	0.0069	0.0000	OK
15 minute summer	S2	10	54.793	0.087	5.6	0.0229	0.0000	OK
15 minute winter	S3	14	54.776	0.231	5.7	0.0164	0.0000	SURCHARGED
15 minute winter	S4	14	54.771	0.871	7.0	0.9747	0.0000	SURCHARGED
60 minute winter	S5	33	53.884	0.054	3.0	0.0039	0.0000	OK
60 minute winter	S6	33	53.784	0.034	3.0	0.0024	0.0000	OK
60 minute winter	JUNCTION 1	33	53.682	0.032	3.0	0.0000	0.0000	OK
15 minute summer	S11	10	56.038	0.038	3.3	0.0103	0.0000	OK
15 minute winter	S12	10	55.646	0.046	3.3	0.0033	0.0000	OK
30 minute winter	ATTENUATION	26	55.427	0.227	6.4	3.4048	0.0000	SURCHARGED
15 minute summer	S9	10	55.984	0.084	6.5	0.0353	0.0000	OK
15 minute summer	S7	10	56.058	0.058	3.3	0.0156	0.0000	OK
15 minute winter	S8	10	55.949	0.049	3.3	0.0035	0.0000	OK
15 minute winter	S10	10	55.815	0.065	9.8	0.0046	0.0000	OK
30 minute winter	S13	25	55.426	0.276	7.4	0.3122	0.0000	SURCHARGED
15 minute summer	C2	1	55.000	0.000	3.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m <sup>3</sup> )	Discharge Vol (m <sup>3</sup> )
15 minute winter	S1	1.000	S2	1.9	0.381	0.314	0.0463	
15 minute summer	S2	1.001	S3	5.6	1.152	0.931	0.0991	
15 minute winter	S3	1.002	S4	5.1	0.833	0.177	0.0225	
15 minute winter	S4	Hydro-Brake®	S5	3.0				
60 minute winter	S5	1.004	S6	3.0	0.901	0.515	0.0287	
60 minute winter	S6	1.005	JUNCTION 1	3.0	1.352	0.214	0.0042	5.6
15 minute summer	S11	3.000A	S12	3.3	1.072	0.306	0.0395	
15 minute winter	S12	3.001A	ATTENUATION	3.3	0.963	0.404	0.0189	
30 minute winter	ATTENUATION	3.002A	S13	-3.9	-0.504	-0.691	0.0437	
15 minute summer	S9	2.000A	S10	6.5	1.051	0.944	0.0715	
15 minute summer	S7	1.000A	S8	3.3	0.782	0.586	0.0484	
15 minute winter	S8	1.001A	S10	3.3	0.718	0.466	0.0505	
15 minute winter	S10	1.002A	S13	9.8	2.059	0.531	0.0104	
30 minute winter	S13	Hydro-Brake®	C2	3.2				7.6





**Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 99.80%**

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m <sup>3</sup> )	Flood (m <sup>3</sup> )	Status
30 minute winter	S1	23	55.059	0.259	2.0	0.0466	0.0000	SURCHARGED
30 minute winter	S2	23	55.057	0.351	6.0	0.0929	0.0000	SURCHARGED
30 minute winter	S3	24	55.030	0.485	5.7	0.0344	0.0000	SURCHARGED
30 minute winter	S4	24	55.023	1.123	6.5	1.2572	0.0000	SURCHARGED
60 minute winter	S5	28	53.884	0.054	3.0	0.0039	0.0000	OK
60 minute winter	S6	28	53.784	0.034	3.0	0.0024	0.0000	OK
120 minute winter	JUNCTION 1	68	53.682	0.032	3.0	0.0000	0.0000	OK
15 minute summer	S11	10	56.046	0.046	4.6	0.0124	0.0000	OK
15 minute winter	S12	10	55.656	0.056	4.6	0.0040	0.0000	OK
30 minute winter	ATTENUATION	26	55.572	0.372	10.2	5.5774	0.0000	SURCHARGED
15 minute winter	S9	10	56.105	0.205	9.1	0.0863	0.0000	SURCHARGED
15 minute winter	S7	10	56.072	0.072	4.6	0.0196	0.0000	OK
15 minute summer	S8	10	55.961	0.061	4.6	0.0043	0.0000	OK
15 minute winter	S10	10	55.833	0.083	13.2	0.0059	0.0000	OK
30 minute winter	S13	26	55.571	0.421	10.4	0.4756	0.0000	SURCHARGED
15 minute summer	C2	1	55.000	0.000	3.2	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m <sup>3</sup> )	Discharge Vol (m <sup>3</sup> )
30 minute winter	S1	1.000	S2	2.0	0.381	0.331	0.0733	
30 minute winter	S2	1.001	S3	5.7	1.131	0.948	0.1261	
30 minute winter	S3	1.002	S4	4.7	0.790	0.161	0.0225	
30 minute winter	S4	Hydro-Brake®	S5	3.0				
60 minute winter	S5	1.004	S6	3.0	0.902	0.515	0.0287	
60 minute winter	S6	1.005	JUNCTION 1	3.0	1.351	0.214	0.0042	7.8
15 minute summer	S11	3.000A	S12	4.6	1.158	0.426	0.0508	
15 minute winter	S12	3.001A	ATTENUATION	4.6	1.043	0.564	0.0244	
30 minute winter	ATTENUATION	3.002A	S13	-6.7	-0.859	-1.178	0.0437	
15 minute winter	S9	2.000A	S10	8.6	1.114	1.252	0.0855	
15 minute winter	S7	1.000A	S8	4.6	0.834	0.816	0.0630	
15 minute summer	S8	1.001A	S10	4.6	0.771	0.654	0.0655	
15 minute winter	S10	1.002A	S13	13.1	2.143	0.710	0.0133	
30 minute winter	S13	Hydro-Brake®	C2	3.3				10.6



Node Name	S1	S2	S3	S4	S5	S6	JUNCTION 1
A4 drawing							
Hor Scale 500							
Ver Scale 100							
Datum (m) 49.000							
Link Name	1.000	1.001	1.002	1.003	1.004	1.005	
Section Type	100mm	100mm	100	100mm	100mm	100	
Slope (1:X)	100.0	100.0	4.5	111.1	107.6	19	
Cover Level (m)	55.530	55.530	56.000	55.950	55.700	55.660	55.660
Invert Level (m)	54.800	54.706	54.545	53.900	53.830	53.750	53.650
Length (m)	9.369	16.118	2.87	7.776	8.606	1.8	



Node Name	S7	S8	S10	S102
A4 drawing				
Hor Scale 500				
Ver Scale 100				
Datum (m) 50.000				
Link Name	1.000A	1.001A	1.01.	
Section Type	100mm	100mm	10(10	
Slope (1:X)	114.6	73.7	11.9.	
Cover Level (m)	56.700	56.700	56.600 56.550 56.500	
Invert Level (m)	56.000	55.900 55.900	55.750 55.750 55.900	
Length (m)	11.458	11.049	2.21.	



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 The Site  
 24 Chosen View Road  
 Cheltenham

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 Network: Storm Network  
 Kris Tovey  
 03.02.24

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Node Name	S9	S10
A4 drawing		
Hor Scale 500		
Ver Scale 100		
Datum (m) 50.000		
Link Name	2.000A	
Section Type	100mm	
Slope (1:X)	77.2	
Cover Level (m)	56.700	56.600
Invert Level (m)	55.900	55.750
Length (m)	11.577	



Node Name	S11	S12	ATTENUATION	STATION
A4 drawing				
Hor Scale 500				
Ver Scale 100				
Datum (m) 50.000				
Link Name	3.000A	3.001A	3.002A	
Section Type	100mm	100mm	100mm	
Slope (1:X)	31.7	55.3	111.8	
Cover Level (m)	56.700	56.500	56.600	56.550
Invert Level (m)	56.000	55.600	55.200	55.150
Length (m)	12.688	5.528	5.590	