



Technical Note

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Great Cauldham Park, Capel Le Ferne

18-027-010 Rev -

Second Technical Note in response to KCC Consultation

July 2024

Rev	Issue Purpose	Author	Checked	Reviewed	Approved	Date
-	Final	TSH	GAC	TSH	GAC	July 2024

1 Introduction

1.1 Overview

- 1.1.1 Kent County Council (KCC) as the Lead Local Flood Authority (LLFA) have provided a second consultation response related to Charles & Associates Consulting Engineers Ltd's (C&A's) Technical Note (referenced 18-027-009) that provided additional information relating to the Flood Risk Assessment and surface water drainage design included as part of an Outline planning application (24/00257) for the erection of up to 90 dwellings with associated parking and infrastructure following demolition of existing dwelling; with all matters reserved except access. KCC's second consultation response has been provided in **Appendix A** for completeness.
- 1.1.2 This Technical Note has been provided to address the comments raised in the second consultation response. Each query/request for clarification within the consultation response has been outlined below with information provided beneath to enable KCC to finalise their response to the Local Planning Authority (LPA), thus ultimately allowing the holding objection to be removed for the Outline planning application at Great Cauldham Park, Capel le Ferne.

2 Consultation Response Points

2.1.1 The **first** item within KCC’s consultation response states that:

“We note that for events below the 1:100 critical rainfall event for both of the networks analysed that no half drain times have been provided for the 2 and 30 year critical events and that for the 100 year event the times provided are far in excess of 24hrs (>4days). Inline with the recommendations of BRE 365 we would ask for the lesser events half drain times to be submitted and it demonstrated that the basin features half drain in less than 24 hours and for a 10 year critical storm to be run ‘back to back’ with the 100 year event to demonstrate possible flood risk and exceedance flows.”

2.1.2 Additional calculations have been provided in **Appendix B**. The calculations show the half drain times for the 2, 30 and 100 year storm events including an allowance for climate change, where required, are less than or equal to 24 hours (1440 mins). The half drain times for both network outfalls are summarised below:

Table 2.1: Half Drain Time Summary

Network	2-year event	30-year event +40%CC	100-year event +45%CC
Network 1	280 mins	840 mins	1380 mins
Network 2	256 mins	840 mins	1440 mins

2.1.3 As has been demonstrated above half drain times of less than or equal to 24 hours can be achieved within the infiltration structures for all storm events.

2.1.4 As the half drain times are less than or equal to 24 hours simulating ‘back-to-back’ storm events is not required, however, to provide comfort to the LLFA these calculations have been undertaken. The maximum water depth within the outfall structure has been identified for the 100year + 45%CC event and the 10year event. These water depths have been combined and compared against the overall structure depth. The results of this comparison has been summarised below. Full calculations have been provided in **Appendix B**.

Table 2.2: Results of ‘back to back’ Storm Events Summary

Network	Max Water Depth 100 yr +45%CC Event	Max Water Depth 10 yr Event	Combined Water Depth	Infiltration Feature Depth
Network 1	0.834m	0.229m	1.063m	4.2m
Network 2	0.746m	0.204m	0.950m	4.2m

2.1.5 As can be seen the infiltration structures are capable of attenuating and discharging the 100 year + 45% climate change event with the 10 year event following immediately afterwards without overtopping or flooding.

2.1.6 The **second** item within KCC's consultation response states that:

“given that the drainage design “has been designed to collect surface water runoff from the hardstanding areas of the proposed development” we require for the Cv value used within the hydraulic analysis to be set to 1”

2.1.7 The proposed calculations have been updated to reflect this requirement and are provided in **Appendix B**. An updated surface water drainage strategy has been included in **Appendix C** for completeness.

3 Conclusion

3.1.1 As has been demonstrated above and within the Appendices the information requested by KCC has been provided and should allow KCC to remove the holding objection on this outline planning application.

Appendix A KCC's Consultation Letter



Rachel Morgan
Dover District Council
White Cliffs Business Park
Dover
Kent
CT16 3PJ

Flood and Water Management

Invicta House
Maidstone
Kent
ME14 1XX

Website: www.kent.gov.uk/flooding
Email: suds@kent.gov.uk
Tel: 03000 41 41 41
Our Ref: DDC/2024/099699
Date: 10 July 2024

Application No: 24/00257

Location: Land South East Of Great Cauldham Farm, Cauldham Lane, Capel Le Ferne, CT18 7HQ

Proposal: Outline planning application for the erection of up to 90 dwellings with associated parking and infrastructure following demolition of existing dwelling; with all matters reserved except access.

Thank you for your consultation on the above referenced planning application.

Kent County Council as Lead Local Flood Authority have the following comments:

Having reviewed the latest information submitted and whilst accepting of the arguments there in and being pleased to note the changes previously requested as being made there are unfortunately still concerns which prevent us from being able to recommend the approval of the proposals.

We note that for events below the 1:100 critical rainfall event for both of the networks analysed that no half drain times have been provided for the 2 and 30 year critical events and that for the 100 year event the times provided are far in excess of 24hrs (> 4days). Inline with the recommendations of BRE365 we would ask for the lesser events half drain times to be submitted and it demonstrated that the basin features half drain in less than 24 hours and for a 10 year critical storm to be run 'back to back' with the 100 year event to demonstrate possible flood risk and exceedance flows.

Further to this, given that the drainage design "has been designed to collect surface water runoff from the hard standing areas of the proposed development" we require for the Cv value used within the hydraulic analysis to be set to 1 and not 0.75 as submitted.

Until the above matters have been addressed to our satisfaction we would recommend that our holding objection remains.

This response has been provided using the best knowledge and information submitted as part of the planning application at the time of responding and is reliant on the accuracy of that information.

Yours faithfully,

Neil Clarke

Sustainable Drainage Team Leader
Flood and Water Management

Appendix B Updated Network Calculations

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	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

complex Link Type Group

Link Type	Link Type
Circular	Swale

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m ³ /ha)	20.0
Summer CV	0.750	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.840	Drain Down Time (mins)	1440	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

Node Basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.03604	Safety Factor	2.0	Invert Level (m)	151.800
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	280

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	230.0	230.0	2.700	230.0	230.0	2.701	30.0	230.0	4.200	220.0	230.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
480 minute winter	Basin	360	151.924	-2.577	4.1	26.9774	0.0000	OK
15 minute summer	5	1	154.474	0.000	0.0	0.0000	0.0000	OK
15 minute winter	1	10	157.424	0.044	11.9	0.0786	0.0000	OK
15 minute winter	2	10	155.838	0.066	24.2	0.1345	0.0000	OK
15 minute winter	3	11	154.967	0.069	23.8	0.1747	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)	Discharge Vol (m ³)
480 minute winter	Basin	1.003	5	0.0	0.000	0.000	0.0000	0.0
480 minute winter	Basin	Infiltration		1.2				
15 minute winter	1	1.000	2	11.7	1.065	0.020	0.5385	
15 minute winter	2	1.001	3	23.8	1.615	0.046	0.5158	
15 minute winter	3	1.002	Basin	23.9	1.629	0.047	0.2338	

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	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

complex Link Type Group

Link Type	Link Type
Circular	Swale

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.840	Drain Down Time (mins)	1440	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 %)
30	40	0	0

Node Basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.03604	Safety Factor	2.0	Invert Level (m)	151.800
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	840

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	230.0	230.0	2.700	230.0	230.0	2.701	30.0	230.0	4.200	220.0	230.0

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
960 minute winter	Basin	900	152.295	-2.205	7.1	108.1367	0.0000	OK
15 minute summer	5	1	154.474	0.000	0.0	0.0000	0.0000	OK
15 minute winter	1	10	157.461	0.081	43.5	0.1468	0.0000	OK
15 minute winter	2	10	155.901	0.129	89.1	0.2616	0.0000	OK
15 minute winter	3	10	155.035	0.137	88.0	0.3492	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)	Discharge Vol (m ³)
960 minute winter	Basin	1.003	5	0.0	0.000	0.000	0.0000	0.0
960 minute winter	Basin	Infiltration		1.2				
15 minute winter	1	1.000	2	43.2	1.536	0.073	1.3743	
15 minute winter	2	1.001	3	88.0	2.246	0.172	1.3703	
15 minute winter	3	1.002	Basin	87.4	2.298	0.171	0.6057	

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	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
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complex Link Type Group

Link Type	Link Type
Circular	Swale

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m ³ /ha)	20.0
Summer CV	0.750	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.840	Drain Down Time (mins)	1440	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	40	0	0
100	45	0	0

Node Basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.03604	Safety Factor	2.0	Invert Level (m)	151.800
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	1380

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	230.0	230.0	2.700	230.0	230.0	2.701	30.0	230.0	4.200	220.0	230.0

Results for 2 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
480 minute winter	Basin	360	151.924	-2.577	4.1	26.9774	0.0000	OK
15 minute summer	5	1	154.474	0.000	0.0	0.0000	0.0000	OK
15 minute winter	1	10	157.424	0.044	11.9	0.0786	0.0000	OK
15 minute winter	2	10	155.838	0.066	24.2	0.1345	0.0000	OK
15 minute winter	3	11	154.967	0.069	23.8	0.1747	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)	Discharge Vol (m ³)
480 minute winter	Basin	1.003	5	0.0	0.000	0.000	0.0000	0.0
480 minute winter	Basin	Infiltration		1.2				
15 minute winter	1	1.000	2	11.7	1.065	0.020	0.5385	
15 minute winter	2	1.001	3	23.8	1.615	0.046	0.5158	
15 minute winter	3	1.002	Basin	23.9	1.629	0.047	0.2338	

Results for 10 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
480 minute winter	Basin	440	152.029	-2.471	6.5	49.9734	0.0000	OK
15 minute summer	5	1	154.474	0.000	0.0	0.0000	0.0000	OK
15 minute winter	1	10	157.441	0.060	23.7	0.1092	0.0000	OK
15 minute winter	2	10	155.866	0.094	48.4	0.1903	0.0000	OK
15 minute winter	3	11	154.996	0.098	47.7	0.2498	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)	Discharge Vol (m ³)
480 minute winter	Basin	1.003	5	0.0	0.000	0.000	0.0000	0.0
480 minute winter	Basin	Infiltration		1.2				
15 minute winter	1	1.000	2	23.4	1.299	0.040	0.8823	
15 minute winter	2	1.001	3	47.7	1.936	0.093	0.8613	
15 minute winter	3	1.002	Basin	47.7	1.965	0.093	0.3858	

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
960 minute winter	Basin	900	152.295	-2.205	7.1	108.1367	0.0000	OK
15 minute summer	5	1	154.474	0.000	0.0	0.0000	0.0000	OK
15 minute winter	1	10	157.461	0.081	43.5	0.1468	0.0000	OK
15 minute winter	2	10	155.901	0.129	89.1	0.2616	0.0000	OK
15 minute winter	3	10	155.035	0.137	88.0	0.3492	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)	Discharge Vol (m ³)
960 minute winter	Basin	1.003	5	0.0	0.000	0.000	0.0000	0.0
960 minute winter	Basin	Infiltration		1.2				
15 minute winter	1	1.000	2	43.2	1.536	0.073	1.3743	
15 minute winter	2	1.001	3	88.0	2.246	0.172	1.3703	
15 minute winter	3	1.002	Basin	87.4	2.298	0.171	0.6057	

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
1440 minute winter	Basin	1380	152.634	-1.866	7.8	182.3187	0.0000	OK
15 minute summer	5	1	154.474	0.000	0.0	0.0000	0.0000	OK
15 minute winter	1	10	157.473	0.093	57.5	0.1682	0.0000	OK
15 minute winter	2	10	155.922	0.150	117.8	0.3045	0.0000	OK
15 minute winter	3	10	155.059	0.161	116.4	0.4102	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)	Discharge Vol (m ³)
1440 minute winter	Basin	1.003	5	0.0	0.000	0.000	0.0000	0.0
1440 minute winter	Basin	Infiltration		1.2				
15 minute winter	1	1.000	2	57.1	1.653	0.096	1.6882	
15 minute winter	2	1.001	3	116.4	2.393	0.227	1.7014	
15 minute winter	3	1.002	Basin	115.4	2.459	0.225	0.7482	

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
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

Swale Link Type

Shape	Trapezoidal	Side Slope (1:X)	3.0	Follow Ground	✓
Barrels	1	Auto Increment (mm)	50	Velocity	Manning
Height (mm)	1000	Preferred Cover (m)	0.000	ks (mm) / n	0.035

Available Diameters (mm)

500

(Trench) Link Type

Shape	Rectangular	Height (mm)	2000	Follow Ground	x
Barrels	1	Auto Increment (mm)	75		

Available Diameters (mm)

100

complex Link Type Group

Link Type	Link Type
Swale	Land drain

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Normal	Additional Storage (m ³ /ha)	20.0
Summer CV	0.750	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.840	Drain Down Time (mins)	2160	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

Node 19 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Downstream Link	1.009	Sump Available	✓
Replaces Downstream Link	✓	Product Number	CTL-SHE-0038-1000-2500-1000
Invert Level (m)	151.700	Min Outlet Diameter (m)	0.075
Design Depth (m)	2.500	Min Node Diameter (mm)	1200
Design Flow (l/s)	1.0		

Node basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.03604	Safety Factor	2.0	Invert Level (m)	146.800
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	256

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	1150.0	1150.0	2.700	1150.0	1150.0	2.701	390.0	1150.0	4.200	840.0	1150.0

Node Swale 1 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.90	Link	4.006
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	152.000	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)	4620	Diameter (mm)	2000

Results for 2 year Critical Storm Duration. Lowest mass balance: 96.89%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	1	11	156.360	0.060	6.8	0.1032	0.0000	OK
15 minute winter	9	11	152.461	0.101	96.9	0.2263	0.0000	OK
15 minute winter	10	11	151.168	0.168	104.8	0.3700	0.0000	OK
15 minute winter	2	11	156.156	0.146	66.2	0.2908	0.0000	OK
15 minute winter	3	11	155.700	0.108	80.4	0.2577	0.0000	OK
15 minute winter	4	11	153.852	0.110	86.7	0.2192	0.0000	OK
15 minute winter	5	10	161.062	0.062	18.0	0.1832	0.0000	OK
15 minute winter	7	10	158.422	0.097	42.5	0.1810	0.0000	OK
15 minute winter	8	10	157.411	0.086	44.7	0.1062	0.0000	OK
15 minute winter	6	10	159.321	0.071	24.3	0.1004	0.0000	OK
360 minute winter	basin	280	146.910	-2.590	22.5	120.5758	0.0000	OK
15 minute winter	12	10	159.527	0.027	4.4	0.0403	0.0000	OK
15 minute winter	17	11	154.029	0.122	70.6	0.1896	0.0000	OK
15 minute winter	11	10	160.583	0.083	21.4	0.2762	0.0000	OK
15 minute winter	13	10	160.089	0.089	26.0	0.1336	0.0000	OK
15 minute winter	14	10	159.901	0.101	34.2	0.1832	0.0000	OK
15 minute winter	15	11	159.642	0.072	45.6	0.1836	0.0000	OK
15 minute winter	16	10	156.087	0.087	63.0	0.2329	0.0000	OK
10080 minute winter	Swale 1	7560	152.621	0.621	1.8	3.2788	0.0000	OK
15 minute winter	18	11	153.166	0.086	73.0	0.1460	0.0000	OK
10080 minute winter	19	7560	152.621	0.921	1.3	0.0000	0.0000	SURCHARGED
15 minute winter	20	10	157.795	0.045	14.2	0.0948	0.0000	OK
15 minute winter	21	10	155.566	0.066	25.1	0.1344	0.0000	OK
15 minute winter	22	10	153.269	0.069	27.8	0.0964	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)	Discharge Vol (m ³)
15 minute winter	1	2.000	2	6.5	0.320	0.091	1.4057	
15 minute winter	9	1.007	10	96.9	3.947	0.091	0.2772	
15 minute winter	10	1.010	basin	104.5	1.631	0.167	1.2814	
15 minute winter	2	1.004	3	66.2	1.804	0.205	1.5438	
15 minute winter	3	1.005	4	80.8	2.727	0.125	1.3706	
15 minute winter	4	1.006	9	86.7	3.020	0.120	0.7126	
15 minute winter	5	1.000	6	17.8	1.824	0.165	0.4030	
15 minute winter	7	1.002	8	42.2	2.785	0.338	0.2665	
15 minute winter	8	1.003	2	44.4	3.357	0.268	0.1580	
15 minute winter	6	1.001	7	24.0	1.779	0.216	0.2785	
360 minute winter	basin	1.011	26	0.0	0.000	0.000	0.0000	0.0
360 minute winter	basin	Infiltration		5.8				
15 minute winter	12	3.000	20	4.4	1.078	0.029	0.0896	
15 minute winter	17	4.005	18	70.5	2.837	0.192	0.6206	
15 minute winter	11	4.000	13	21.0	1.262	0.165	0.6379	
15 minute winter	13	4.001	14	25.6	1.345	0.168	0.2038	
15 minute winter	14	4.002	15	34.0	2.018	0.193	0.1563	
15 minute winter	15	4.003	16	45.3	3.543	0.122	0.4018	
15 minute winter	16	4.004	17	62.5	2.498	0.121	0.7912	
10080 minute winter	Swale 1	1.007_1	J1	1.4	0.053	0.000	133.6352	
15 minute winter	18	4.006	Swale 1	73.2	3.384	0.117	0.3273	
10080 minute winter	19	Hydro-Brake®	10	0.6				
15 minute winter	20	3.001	21	14.0	1.855	0.089	0.1878	
15 minute winter	21	3.002	22	24.7	2.627	0.177	0.2930	
15 minute winter	22	3.003	24	27.7	2.007	0.118	0.3423	

Results for 2 year Critical Storm Duration. Lowest mass balance: 96.89%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
10080 minute winter	23	7560	152.621	0.121	0.2	0.2206	0.0000	OK
10080 minute winter	24	7560	152.621	0.521	1.1	0.9318	0.0000	SURCHARGED
15 minute winter	25	10	152.941	0.041	5.2	0.0709	0.0000	OK
10080 minute winter	J1	7560	152.621	0.921	2.4	0.0000	0.0000	OK
15 minute summer	26	1	149.043	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)	Discharge Vol (m ³)
10080 minute winter	23	5.000	24	0.2	0.239	0.001	1.1234	
10080 minute winter	24	5.002	J1	1.1	0.015	0.002	1.8758	
15 minute winter	25	5.001	24	5.1	0.583	0.073	0.4065	
10080 minute winter	J1	1.008	19	1.3	0.024	0.000	243.1825	

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
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

Swale Link Type

Shape	Trapezoidal	Side Slope (1:X)	3.0	Follow Ground	✓
Barrels	1	Auto Increment (mm)	50	Velocity	Manning
Height (mm)	1000	Preferred Cover (m)	0.000	ks (mm) / n	0.035

Available Diameters (mm)

500

(Trench) Link Type

Shape	Rectangular	Height (mm)	2000	Follow Ground	x
Barrels	1	Auto Increment (mm)	75		

Available Diameters (mm)

100

complex Link Type Group

Link Type	Link Type
Swale	Land drain

Simulation Settings

Rainfall Methodology	FEH-13	Analysis Speed	Normal	Additional Storage (m ³ /ha)	20.0
Summer CV	0.750	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.840	Drain Down Time (mins)	2160	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 %)
30	40	0	0

Node 19 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Downstream Link	1.009	Sump Available	✓
Replaces Downstream Link	✓	Product Number	CTL-SHE-0038-1000-2500-1000
Invert Level (m)	151.700	Min Outlet Diameter (m)	0.075
Design Depth (m)	2.500	Min Node Diameter (mm)	1200
Design Flow (l/s)	1.0		

Node basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.03604	Safety Factor	2.0	Invert Level (m)	146.800
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	840

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	1150.0	1150.0	2.700	1150.0	1150.0	2.701	390.0	1150.0	4.200	840.0	1150.0

Node Swale 1 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.90	Link	4.006
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	152.000	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)		Diameter (mm)	2000

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 98.79%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	1	10	156.418	0.118	24.9	0.2018	0.0000	OK
15 minute winter	9	11	152.570	0.210	339.1	0.4718	0.0000	OK
15 minute winter	10	11	151.338	0.338	367.1	0.7440	0.0000	OK
15 minute winter	2	10	156.307	0.297	224.7	0.5937	0.0000	OK
15 minute winter	3	11	155.803	0.212	276.1	0.5039	0.0000	OK
15 minute winter	4	11	153.967	0.225	299.4	0.4489	0.0000	OK
15 minute winter	5	10	161.126	0.126	66.1	0.3748	0.0000	OK
15 minute winter	7	12	159.223	0.898	142.1	1.6785	0.0000	SURCHARGED
15 minute winter	8	12	157.668	0.343	145.8	0.4225	0.0000	SURCHARGED
15 minute winter	6	12	159.816	0.566	89.4	0.8025	0.0000	SURCHARGED
720 minute winter	basin	690	147.240	-2.260	39.1	481.1855	0.0000	OK
15 minute winter	12	10	159.550	0.050	16.3	0.0760	0.0000	OK
15 minute winter	17	10	154.182	0.275	261.4	0.4275	0.0000	OK
15 minute winter	11	10	160.676	0.176	78.5	0.5826	0.0000	OK
15 minute winter	13	10	160.210	0.210	95.7	0.3161	0.0000	OK
15 minute winter	14	10	160.032	0.232	125.9	0.4200	0.0000	OK
15 minute winter	15	10	159.720	0.150	168.2	0.3802	0.0000	OK
15 minute winter	16	10	156.173	0.173	232.5	0.4637	0.0000	OK
8640 minute winter	Swale 1	8280	153.277	1.277	4.9	14.0092	0.0000	SURCHARGED
8640 minute winter	18	8280	153.277	0.197	4.6	0.3356	0.0000	OK
8640 minute winter	19	8280	153.277	1.577	2.7	0.0000	0.0000	SURCHARGED
15 minute winter	20	10	157.838	0.088	52.1	0.1850	0.0000	OK
15 minute winter	21	10	155.641	0.141	92.4	0.2883	0.0000	OK
15 minute winter	22	10	153.345	0.145	102.8	0.2019	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)	Discharge Vol (m ³)
15 minute winter	1	2.000	2	23.9	0.474	0.335	3.2223	
15 minute winter	9	1.007	10	339.5	5.063	0.319	0.7621	
15 minute winter	10	1.010	basin	367.9	2.276	0.589	3.2329	
15 minute winter	2	1.004	3	222.1	2.418	0.687	3.8621	
15 minute winter	3	1.005	4	277.8	3.637	0.428	3.5324	
15 minute winter	4	1.006	9	301.7	4.109	0.416	1.8217	
15 minute winter	5	1.000	6	65.6	2.383	0.610	1.2950	
15 minute winter	7	1.002	8	137.2	3.451	1.101	0.6994	
15 minute winter	8	1.003	2	143.9	4.120	0.870	0.4350	
15 minute winter	6	1.001	7	78.6	2.108	0.710	0.8200	
720 minute winter	basin	1.011	26	0.0	0.000	0.000	0.0000	0.0
720 minute winter	basin	Infiltration		5.8				
15 minute winter	12	3.000	20	16.2	1.570	0.109	0.2270	
15 minute winter	17	4.005	18	258.8	3.719	0.706	1.7245	
15 minute winter	11	4.000	13	77.6	1.619	0.610	1.8278	
15 minute winter	13	4.001	14	94.3	1.704	0.617	0.5915	
15 minute winter	14	4.002	15	125.1	2.656	0.710	0.4314	
15 minute winter	15	4.003	16	167.0	4.972	0.449	1.0561	
15 minute winter	16	4.004	17	231.7	3.370	0.447	2.1428	
8640 minute winter	Swale 1	1.007_1	J1	3.2	0.056	0.001	422.8712	
8640 minute winter	18	4.006	Swale 1	4.6	0.935	0.007	0.9465	
8640 minute winter	19	Hydro-Brake®	10	0.8				
15 minute winter	20	3.001	21	51.8	2.556	0.327	0.4982	
15 minute winter	21	3.002	22	91.3	3.637	0.653	0.7809	
15 minute winter	22	3.003	24	102.4	2.876	0.436	1.0041	

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 98.79%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
8640 minute winter	23	8340	153.277	0.777	0.4	1.4172	0.0000	SURCHARGED
8640 minute winter	24	8340	153.277	1.177	2.8	2.1055	0.0000	SURCHARGED
8640 minute winter	25	8340	153.277	0.377	0.3	0.6504	0.0000	SURCHARGED
8640 minute winter	J1	8280	153.277	1.577	6.0	0.0000	0.0000	SURCHARGED
15 minute summer	26	1	149.043	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)	Discharge Vol (m ³)
8640 minute winter	23	5.000	24	0.4	0.239	0.003	1.6311	
8640 minute winter	24	5.002	J1	2.8	0.017	0.005	1.8758	
8640 minute winter	25	5.001	24	0.3	0.233	0.004	1.8156	
8640 minute winter	J1	1.008	19	2.7	0.027	0.001	669.6536	

Design Settings

Rainfall Methodology	FEH-22	Minimum Velocity (m/s)	1.00
Return Period (years)	100	Connection Type	Level Soffits
Additional Flow (%)	0	Minimum Backdrop Height (m)	0.200
CV	1.000	Preferred Cover Depth (m)	1.200
Time of Entry (mins)	5.00	Include Intermediate Ground	✓
Maximum Time of Concentration (mins)	30.00	Enforce best practice design rules	x
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

Swale Link Type

Shape	Trapezoidal	Side Slope (1:X)	3.0	Follow Ground	✓
Barrels	1	Auto Increment (mm)	50	Velocity	Manning
Height (mm)	1000	Preferred Cover (m)	0.000	ks (mm) / n	0.035

Available Diameters (mm)

1000

(Trench) Link Type

Shape	Rectangular	Height (mm)	2000	Follow Ground	x
Barrels	1	Auto Increment (mm)	75		

Available Diameters (mm)

100

complex Link Type Group

Link Type	Link Type
Swale	Land drain

Simulation Settings

Rainfall Methodology	FEH-22	Analysis Speed	Normal	Additional Storage (m ³ /ha)	20.0
Summer CV	0.750	Skip Steady State	x	Check Discharge Rate(s)	x
Winter CV	0.840	Drain Down Time (mins)	10080	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	40	0	0
100	45	0	0

Node 19 Online Hydro-Brake® Control

Flap Valve	x	Objective	(HE) Minimise upstream storage
Downstream Link	1.009	Sump Available	✓
Replaces Downstream Link	✓	Product Number	CTL-SHE-0038-1000-2500-1000
Invert Level (m)	151.700	Min Outlet Diameter (m)	0.075
Design Depth (m)	2.500	Min Node Diameter (mm)	1200
Design Flow (l/s)	1.0		

Node basin Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.03604	Safety Factor	2.0	Invert Level (m)	146.800
Side Inf Coefficient (m/hr)	0.00000	Porosity	0.95	Time to half empty (mins)	1440

Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)	Depth (m)	Area (m ²)	Inf Area (m ²)
0.000	1150.0	1150.0	2.700	1150.0	1150.0	2.701	390.0	1150.0	4.200	840.0	1150.0

Node Swale 1 Link Surround Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Porosity	0.90	Link	4.006
Side Inf Coefficient (m/hr)	0.00000	Invert Level (m)	152.000	Surround Shape	(Trench)
Safety Factor	2.0	Time to half empty (mins)		Diameter (mm)	2000

Results for 2 year Critical Storm Duration. Lowest mass balance: 97.89%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	1	11	156.360	0.060	6.8	0.1032	0.0000	OK
15 minute winter	9	11	152.461	0.101	96.9	0.2263	0.0000	OK
15 minute winter	10	11	151.168	0.168	104.8	0.3701	0.0000	OK
15 minute winter	2	11	156.156	0.146	66.2	0.2908	0.0000	OK
15 minute winter	3	11	155.700	0.108	80.4	0.2577	0.0000	OK
15 minute winter	4	11	153.852	0.110	86.7	0.2192	0.0000	OK
15 minute winter	5	10	161.062	0.062	18.0	0.1832	0.0000	OK
15 minute winter	7	10	158.422	0.097	42.5	0.1810	0.0000	OK
15 minute winter	8	10	157.411	0.086	44.7	0.1062	0.0000	OK
15 minute winter	6	10	159.321	0.071	24.3	0.1004	0.0000	OK
360 minute winter	basin	280	146.910	-2.590	22.5	120.4609	0.0000	OK
15 minute winter	12	10	159.527	0.027	4.4	0.0403	0.0000	OK
15 minute winter	17	11	154.029	0.122	70.6	0.1893	0.0000	OK
15 minute winter	11	10	160.583	0.083	21.4	0.2762	0.0000	OK
15 minute winter	13	10	160.089	0.089	26.0	0.1336	0.0000	OK
15 minute winter	14	10	159.901	0.101	34.2	0.1832	0.0000	OK
15 minute winter	15	11	159.642	0.072	45.6	0.1836	0.0000	OK
15 minute winter	16	10	156.087	0.087	63.0	0.2329	0.0000	OK
10080 minute winter	Swale 1	7560	152.576	0.576	1.8	2.8036	0.0000	OK
15 minute winter	18	10	153.167	0.086	73.0	0.1473	0.0000	OK
10080 minute winter	19	7560	152.576	0.876	1.3	0.0000	0.0000	SURCHARGED
15 minute winter	20	10	157.795	0.045	14.2	0.0948	0.0000	OK
15 minute winter	21	10	155.566	0.066	25.1	0.1344	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)	Discharge Vol (m ³)
15 minute winter	1	2.000	2	6.5	0.320	0.091	1.4057	
15 minute winter	9	1.007	10	96.9	3.947	0.091	0.2772	
15 minute winter	10	1.010	basin	104.5	1.631	0.167	1.2815	
15 minute winter	2	1.004	3	66.2	1.804	0.205	1.5438	
15 minute winter	3	1.005	4	80.8	2.727	0.125	1.3706	
15 minute winter	4	1.006	9	86.7	3.020	0.120	0.7126	
15 minute winter	5	1.000	6	17.8	1.824	0.165	0.4030	
15 minute winter	7	1.002	8	42.2	2.785	0.338	0.2665	
15 minute winter	8	1.003	2	44.4	3.357	0.268	0.1580	
15 minute winter	6	1.001	7	24.0	1.779	0.216	0.2785	
360 minute winter	basin	1.011	26	0.0	0.000	0.000	0.0000	0.0
360 minute winter	basin	Infiltration		5.8				
15 minute winter	12	3.000	20	4.4	1.078	0.029	0.0896	
15 minute winter	17	4.005	18	70.5	2.827	0.192	0.6221	
15 minute winter	11	4.000	13	21.0	1.262	0.165	0.6379	
15 minute winter	13	4.001	14	25.6	1.345	0.168	0.2038	
15 minute winter	14	4.002	15	34.0	2.018	0.193	0.1563	
15 minute winter	15	4.003	16	45.3	3.543	0.122	0.4018	
15 minute winter	16	4.004	17	62.5	2.505	0.121	0.7901	
10080 minute winter	Swale 1	1.007_1	J1	0.9	0.050	0.000	119.7743	
10080 minute winter	Swale 1	6.000	J1	0.8	0.112	0.002	17.2700	
15 minute winter	18	4.006	Swale 1	73.3	3.421	0.117	0.2616	
10080 minute winter	19	Hydro-Brake®	10	0.6				
15 minute winter	20	3.001	21	14.0	1.855	0.089	0.1878	
15 minute winter	21	3.002	22	24.7	2.627	0.177	0.2930	

Results for 2 year Critical Storm Duration. Lowest mass balance: 97.89%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	22	10	153.269	0.069	27.8	0.0964	0.0000	OK
10080 minute winter	23	7560	152.576	0.076	0.2	0.1392	0.0000	OK
10080 minute winter	24	7560	152.576	0.476	1.1	0.8521	0.0000	SURCHARGED
15 minute winter	25	10	152.941	0.041	5.2	0.0709	0.0000	OK
10080 minute winter	J1	7560	152.576	0.876	2.4	0.0000	0.0000	OK
15 minute summer	26	1	149.043	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)	Discharge Vol (m ³)
15 minute winter	22	3.003	24	27.7	2.007	0.118	0.3424	
10080 minute winter	23	5.000	24	0.2	0.239	0.001	0.9788	
10080 minute winter	24	5.002	J1	1.1	0.018	0.002	1.8758	
15 minute winter	25	5.001	24	5.1	0.583	0.073	0.4065	
10080 minute winter	J1	1.008	19	0.9	0.021	0.000	221.7912	
10080 minute winter	J1	6.001	19	0.6	0.041	0.002	22.7618	

Results for 10 year Critical Storm Duration. Lowest mass balance: 97.89%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	1	11	156.386	0.086	13.5	0.1464	0.0000	OK
15 minute winter	9	11	152.511	0.151	195.3	0.3390	0.0000	OK
15 minute winter	10	11	151.244	0.244	210.7	0.5370	0.0000	OK
15 minute winter	2	11	156.224	0.214	133.3	0.4272	0.0000	OK
15 minute winter	3	11	155.748	0.157	161.2	0.3721	0.0000	OK
15 minute winter	4	11	153.904	0.162	174.2	0.3227	0.0000	OK
15 minute winter	5	10	161.089	0.089	36.0	0.2638	0.0000	OK
15 minute winter	7	10	158.477	0.152	85.4	0.2833	0.0000	OK
15 minute winter	8	10	157.459	0.134	89.7	0.1649	0.0000	OK
15 minute winter	6	10	159.353	0.103	48.6	0.1463	0.0000	OK
360 minute winter	basin	344	147.004	-2.496	36.1	222.3254	0.0000	OK
15 minute winter	12	10	159.537	0.037	8.9	0.0564	0.0000	OK
15 minute winter	17	10	154.089	0.182	142.1	0.2820	0.0000	OK
15 minute winter	11	10	160.621	0.121	42.7	0.4010	0.0000	OK
15 minute winter	13	10	160.135	0.135	52.0	0.2031	0.0000	OK
15 minute winter	14	10	159.953	0.153	68.5	0.2761	0.0000	OK
15 minute winter	15	10	159.675	0.105	91.6	0.2665	0.0000	OK
15 minute winter	16	10	156.124	0.124	126.5	0.3329	0.0000	OK
10080 minute winter	Swale 1	7980	152.772	0.772	2.6	5.1721	0.0000	OK
15 minute winter	18	10	153.207	0.127	145.6	0.2160	0.0000	OK
10080 minute winter	19	7980	152.772	1.072	1.6	0.0000	0.0000	SURCHARGED
15 minute winter	20	10	157.814	0.064	28.3	0.1343	0.0000	OK
15 minute winter	21	10	155.596	0.096	50.2	0.1967	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)	Discharge Vol (m ³)
15 minute winter	1	2.000	2	13.0	0.383	0.182	2.3014	
15 minute winter	9	1.007	10	195.5	4.662	0.184	0.4738	
15 minute winter	10	1.010	basin	210.8	1.979	0.338	2.1304	
15 minute winter	2	1.004	3	132.7	2.158	0.411	2.5819	
15 minute winter	3	1.005	4	162.5	3.238	0.250	2.3195	
15 minute winter	4	1.006	9	174.9	3.617	0.241	1.1999	
15 minute winter	5	1.000	6	35.6	2.207	0.331	0.6675	
15 minute winter	7	1.002	8	84.7	3.193	0.680	0.4664	
15 minute winter	8	1.003	2	89.2	3.926	0.539	0.2715	
15 minute winter	6	1.001	7	48.1	2.077	0.435	0.4763	
360 minute winter	basin	1.011	26	0.0	0.000	0.000	0.0000	0.0
360 minute winter	basin	Infiltration		5.8				
15 minute winter	12	3.000	20	8.8	1.328	0.059	0.1467	
15 minute winter	17	4.005	18	140.7	3.315	0.384	1.0621	
15 minute winter	11	4.000	13	42.1	1.470	0.331	1.0962	
15 minute winter	13	4.001	14	51.3	1.545	0.336	0.3550	
15 minute winter	14	4.002	15	68.1	2.362	0.386	0.2670	
15 minute winter	15	4.003	16	90.8	4.271	0.244	0.6680	
15 minute winter	16	4.004	17	125.9	2.981	0.243	1.3309	
10080 minute winter	Swale 1	1.007_1	J1	1.2	0.050	0.000	186.2966	
10080 minute winter	Swale 1	6.000	J1	0.9	0.112	0.003	17.3823	
15 minute winter	18	4.006	Swale 1	146.2	3.829	0.234	0.4410	
10080 minute winter	19	Hydro-Brake®	10	0.7				
15 minute winter	20	3.001	21	28.1	2.226	0.178	0.3126	
15 minute winter	21	3.002	22	49.6	3.157	0.354	0.4883	

Results for 10 year Critical Storm Duration. Lowest mass balance: 97.89%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	22	10	153.301	0.101	55.8	0.1406	0.0000	OK
10080 minute winter	23	7980	152.773	0.272	0.2	0.4970	0.0000	OK
10080 minute winter	24	7980	152.772	0.672	1.4	1.2029	0.0000	SURCHARGED
15 minute winter	25	10	152.958	0.058	10.4	0.1004	0.0000	OK
10080 minute winter	J1	7980	152.772	1.072	3.3	0.0000	0.0000	OK
15 minute summer	26	1	149.043	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)	Discharge Vol (m ³)
15 minute winter	22	3.003	24	55.6	2.440	0.236	0.5652	
10080 minute winter	23	5.000	24	0.2	0.239	0.001	1.5941	
10080 minute winter	24	5.002	J1	1.4	0.016	0.002	1.8758	
15 minute winter	25	5.001	24	10.2	0.727	0.148	0.6491	
10080 minute winter	J1	1.008	19	1.3	0.035	0.000	323.1655	
10080 minute winter	J1	6.001	19	0.6	0.082	0.002	22.7618	

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 97.89%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	1	10	156.418	0.118	24.9	0.2018	0.0000	OK
15 minute winter	9	11	152.570	0.210	339.1	0.4719	0.0000	OK
15 minute winter	10	11	151.338	0.338	367.1	0.7440	0.0000	OK
15 minute winter	2	10	156.307	0.297	224.7	0.5937	0.0000	OK
15 minute winter	3	11	155.803	0.212	276.1	0.5039	0.0000	OK
15 minute winter	4	11	153.967	0.225	299.4	0.4489	0.0000	OK
15 minute winter	5	10	161.126	0.126	66.1	0.3748	0.0000	OK
15 minute winter	7	12	159.223	0.898	142.1	1.6785	0.0000	SURCHARGED
15 minute winter	8	12	157.668	0.343	145.8	0.4225	0.0000	SURCHARGED
15 minute winter	6	12	159.816	0.566	89.4	0.8025	0.0000	SURCHARGED
720 minute winter	basin	690	147.240	-2.260	39.1	480.7989	0.0000	OK
15 minute winter	12	10	159.550	0.050	16.3	0.0760	0.0000	OK
15 minute winter	17	10	154.182	0.274	261.4	0.4260	0.0000	OK
15 minute winter	11	10	160.676	0.176	78.5	0.5826	0.0000	OK
15 minute winter	13	10	160.210	0.210	95.7	0.3161	0.0000	OK
15 minute winter	14	10	160.032	0.232	125.9	0.4200	0.0000	OK
15 minute winter	15	10	159.720	0.150	168.2	0.3802	0.0000	OK
15 minute winter	16	10	156.173	0.173	232.5	0.4637	0.0000	OK
8640 minute winter	Swale 1	8280	153.251	1.251	4.6	13.5325	0.0000	SURCHARGED
15 minute winter	18	10	153.264	0.184	268.1	0.3129	0.0000	OK
8640 minute winter	19	8280	153.251	1.551	2.7	0.0000	0.0000	SURCHARGED
15 minute winter	20	10	157.838	0.088	52.1	0.1850	0.0000	OK
15 minute winter	21	10	155.641	0.141	92.4	0.2883	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)	Discharge Vol (m ³)
15 minute winter	1	2.000	2	23.9	0.474	0.335	3.2223	
15 minute winter	9	1.007	10	339.5	5.063	0.319	0.7620	
15 minute winter	10	1.010	basin	367.9	2.276	0.589	3.2328	
15 minute winter	2	1.004	3	222.1	2.418	0.687	3.8621	
15 minute winter	3	1.005	4	277.8	3.637	0.428	3.5323	
15 minute winter	4	1.006	9	301.7	4.109	0.416	1.8216	
15 minute winter	5	1.000	6	65.6	2.383	0.610	1.2950	
15 minute winter	7	1.002	8	137.2	3.451	1.101	0.6994	
15 minute winter	8	1.003	2	143.9	4.120	0.870	0.4350	
15 minute winter	6	1.001	7	78.6	2.108	0.710	0.8200	
720 minute winter	basin	1.011	26	0.0	0.000	0.000	0.0000	0.0
720 minute winter	basin	Infiltration		5.8				
15 minute winter	12	3.000	20	16.2	1.570	0.109	0.2270	
15 minute winter	17	4.005	18	258.8	3.693	0.706	1.7375	
15 minute winter	11	4.000	13	77.6	1.619	0.610	1.8278	
15 minute winter	13	4.001	14	94.3	1.704	0.617	0.5915	
15 minute winter	14	4.002	15	125.1	2.656	0.710	0.4314	
15 minute winter	15	4.003	16	167.0	4.972	0.449	1.0561	
15 minute winter	16	4.004	17	231.7	3.378	0.447	2.1379	
8640 minute winter	Swale 1	1.007_1	J1	2.8	0.052	0.001	408.3376	
8640 minute winter	Swale 1	6.000	J1	1.0	0.116	0.003	17.3823	
15 minute winter	18	4.006	Swale 1	268.6	4.447	0.430	0.6902	
8640 minute winter	19	Hydro-Brake®	10	0.8				
15 minute winter	20	3.001	21	51.8	2.556	0.327	0.4982	
15 minute winter	21	3.002	22	91.3	3.637	0.653	0.7809	

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 97.89%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	22	10	153.342	0.142	102.8	0.1972	0.0000	OK
8640 minute winter	23	8340	153.251	0.751	0.4	1.3696	0.0000	SURCHARGED
8640 minute winter	24	8340	153.251	1.151	2.8	2.0589	0.0000	SURCHARGED
8640 minute winter	25	8340	153.251	0.351	0.3	0.6052	0.0000	SURCHARGED
8640 minute winter	J1	8280	153.251	1.551	6.0	0.0000	0.0000	SURCHARGED
15 minute summer	26	1	149.043	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)	Discharge Vol (m ³)
15 minute winter	22	3.003	24	102.3	2.761	0.435	0.9492	
8640 minute winter	23	5.000	24	0.4	0.239	0.003	1.6311	
8640 minute winter	24	5.002	J1	2.7	0.018	0.005	1.8758	
8640 minute winter	25	5.001	24	0.3	0.233	0.004	1.8156	
8640 minute winter	J1	1.008	19	2.5	0.024	0.001	648.7222	
8640 minute winter	J1	6.001	19	0.6	0.041	0.002	22.7618	

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 97.89%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
15 minute winter	1	10	156.438	0.138	32.9	0.2365	0.0000	OK
15 minute winter	9	11	152.598	0.238	421.4	0.5350	0.0000	OK
15 minute winter	10	11	151.391	0.391	457.9	0.8611	0.0000	OK
15 minute winter	2	11	156.355	0.345	273.8	0.6898	0.0000	OK
15 minute winter	3	11	155.834	0.243	342.6	0.5760	0.0000	OK
15 minute winter	4	11	154.001	0.259	371.5	0.5165	0.0000	OK
15 minute winter	5	12	161.962	0.962	87.4	2.8592	0.0000	SURCHARGED
15 minute winter	7	12	160.416	2.091	173.7	3.9078	0.0000	SURCHARGED
15 minute winter	8	12	158.171	0.846	173.1	1.0418	0.0000	SURCHARGED
15 minute winter	6	12	161.201	1.951	106.6	2.7649	0.0000	SURCHARGED
1440 minute winter	basin	1380	147.546	-1.954	35.4	815.3219	0.0000	OK
15 minute winter	12	10	159.558	0.058	21.5	0.0874	0.0000	OK
15 minute winter	17	11	154.406	0.498	338.2	0.7736	0.0000	SURCHARGED
15 minute winter	11	10	160.715	0.215	103.9	0.7141	0.0000	OK
15 minute winter	13	11	160.372	0.372	129.7	0.5589	0.0000	SURCHARGED
15 minute winter	14	11	160.157	0.357	162.8	0.6456	0.0000	SURCHARGED
15 minute winter	15	11	159.748	0.177	217.0	0.4502	0.0000	OK
15 minute winter	16	11	156.202	0.201	299.4	0.5394	0.0000	OK
10080 minute winter	Swale 1	9780	153.596	1.596	17.2	20.1806	0.0000	SURCHARGED
10080 minute winter	18	9840	153.596	0.516	10.7	0.8789	0.0000	SURCHARGED
10080 minute winter	19	9780	153.596	1.896	5.0	0.0000	0.0000	FLOOD RISK
15 minute winter	20	10	157.853	0.103	68.9	0.2161	0.0000	OK
15 minute winter	21	10	155.675	0.175	122.3	0.3594	0.0000	OK

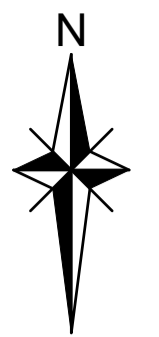
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)	Discharge Vol (m ³)
15 minute winter	1	2.000	2	31.8	0.539	0.446	3.4514	
15 minute winter	9	1.007	10	421.6	5.095	0.396	0.9672	
15 minute winter	10	1.010	basin	458.4	2.387	0.734	3.8419	
15 minute winter	2	1.004	3	273.5	2.513	0.846	4.5581	
15 minute winter	3	1.005	4	342.9	3.777	0.529	4.1973	
15 minute winter	4	1.006	9	371.9	4.288	0.513	2.1506	
15 minute winter	5	1.000	6	76.8	2.365	0.715	1.6437	
15 minute winter	7	1.002	8	163.2	4.105	1.310	0.6994	
15 minute winter	8	1.003	2	173.2	4.355	1.047	0.4753	
15 minute winter	6	1.001	7	93.8	2.359	0.848	0.8200	
1440 minute winter	basin	1.011	26	0.0	0.000	0.000	0.0000	0.0
1440 minute winter	basin	Infiltration		5.8				
15 minute winter	12	3.000	20	21.4	1.687	0.144	0.2782	
15 minute winter	17	4.005	18	335.2	3.753	0.915	2.1948	
15 minute winter	11	4.000	13	105.6	1.642	0.830	2.3799	
15 minute winter	13	4.001	14	123.5	1.754	0.809	0.7481	
15 minute winter	14	4.002	15	163.4	2.666	0.927	0.5238	
15 minute winter	15	4.003	16	217.7	5.273	0.586	1.2965	
15 minute winter	16	4.004	17	300.0	3.437	0.578	2.6783	
10080 minute winter	Swale 1	1.007_1	J1	12.2	0.054	0.003	621.0437	
10080 minute winter	Swale 1	6.000	J1	1.0	0.119	0.003	17.3823	
10080 minute winter	18	4.006	Swale 1	13.2	1.067	0.021	1.2358	
10080 minute winter	19	Hydro-Brake®	10	0.9				
15 minute winter	20	3.001	21	68.5	2.660	0.433	0.6261	
15 minute winter	21	3.002	22	120.6	3.807	0.862	0.9850	

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 97.89%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m ³)	Flood (m ³)	Status
10080 minute winter	22	9720	153.596	0.396	2.0	0.5503	0.0000	SURCHARGED
10080 minute winter	23	9720	153.596	1.096	0.5	1.9988	0.0000	SURCHARGED
10080 minute winter	24	9720	153.596	1.496	3.2	2.6760	0.0000	SURCHARGED
10080 minute winter	25	9720	153.596	0.696	0.4	1.2000	0.0000	SURCHARGED
10080 minute winter	J1	9780	153.596	1.896	15.8	0.0000	0.0000	SURCHARGED
15 minute summer	26	1	149.043	0.000	0.0	0.0000	0.0000	OK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m ³)	Discharge Vol (m ³)
10080 minute winter	22	3.003	24	2.0	0.522	0.009	1.7464	
10080 minute winter	23	5.000	24	0.5	0.239	0.004	1.6311	
10080 minute winter	24	5.002	J1	3.2	0.022	0.005	1.8758	
10080 minute winter	25	5.001	24	0.4	0.233	0.006	1.8156	
10080 minute winter	J1	1.008	19	4.6	0.035	0.001	952.3354	
10080 minute winter	J1	6.001	19	0.5	0.080	0.002	22.7618	

Appendix C Surface Water Drainage Strategy



5.7m

Little
Cauldham
Farmhouse

Swale and Filter Drain
1m deep swale with 1 in 3 side
slopes and 1.0m base width
1m deep x 2m filter trench

Network 2 Outfall
Attenuation Basin
CL - 151.00
IL - 149.500
Depth (m) - 1.50 m

Bottom Area (m²) - 390m²
Top Area (m²) - 840 m²
1 in 3 Side Slopes

Infiltrating Tank
30m x 13m x 2.7m deep
IL - 146.800
Infiltration Rate - 0.036036m/hr
Water Depth - 1.953m
Attenuation Volume - 820m³
Half Drain time - 1440 minutes

Flow Control restricting
flow to 1.0l/s

Pump Station

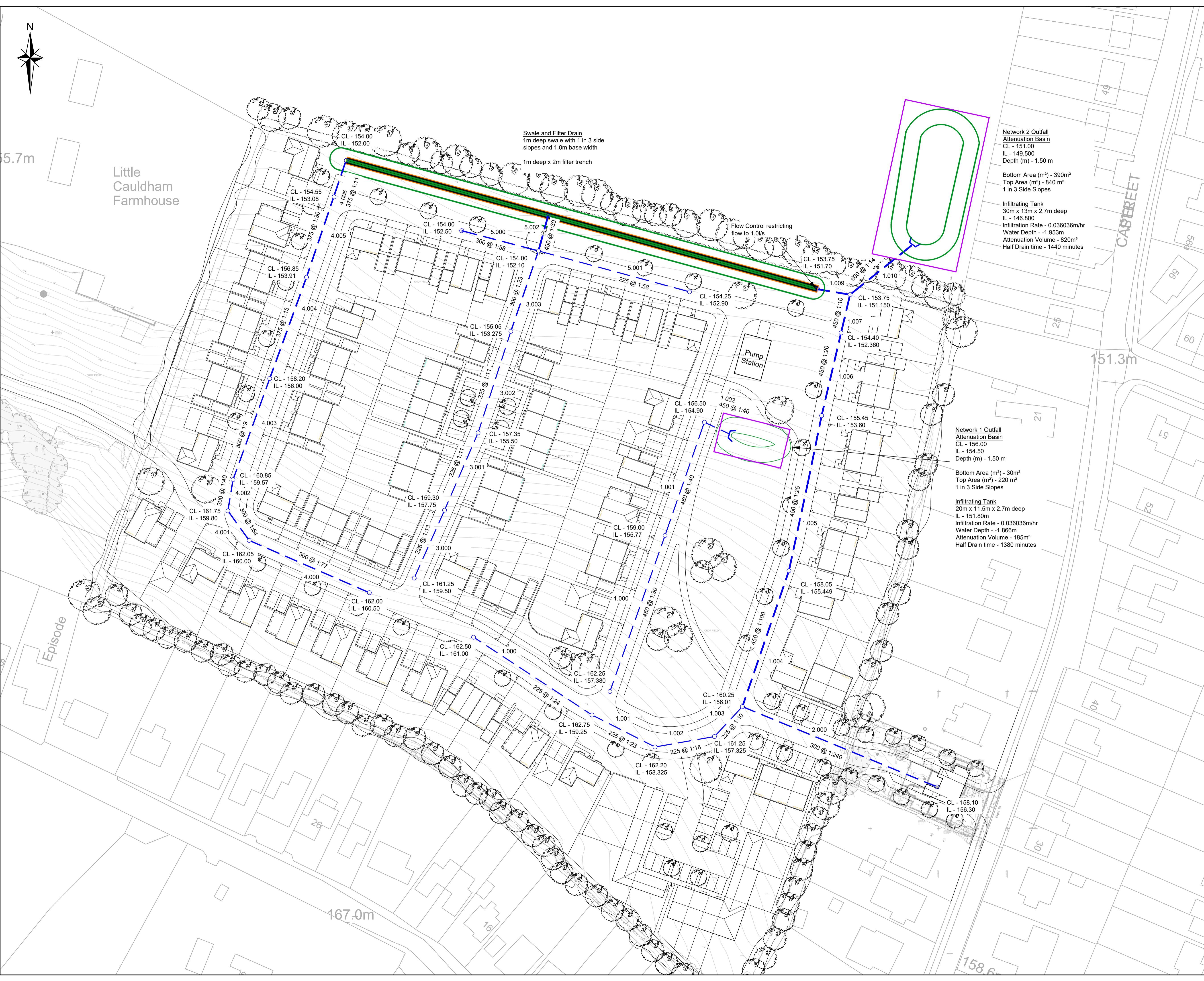
Network 1 Outfall
Attenuation Basin
CL - 156.00
IL - 154.50
Depth (m) - 1.50 m

Bottom Area (m²) - 30m²
Top Area (m²) - 220 m²
1 in 3 Side Slopes

Infiltrating Tank
20m x 11.5m x 2.7m deep
IL - 151.80m
Infiltration Rate - 0.036036m/hr
Water Depth - 1.866m
Attenuation Volume - 185m³
Half Drain time - 1380 minutes

- NOTES
1. Do not scale from this drawing.
 2. All measurements are in metres unless stated otherwise.
 3. Topographical Survey provided by others. C&A accept no liability for any inaccuracies.
 4. C&A Consulting Engineers Ltd cannot guarantee the authenticity or reliability of any data and/or records provided by third parties.
 5. The suitability of the proposed basin location is subject to receiving detailed topographical survey, arboricultural and ecological constraints by others.
 6. Levels shown for features outside of the area of topographical survey have been taken from Lidar Data.

- Key
- Proposed Attenuation Basin
 - Proposed Infiltrating Tank
 - Proposed Swale and Filter Drain
 - Proposed Surface Water pipe and chamber



E	Amended to suit KCC Comments	MT	TSH	GAC	July 24
D	Amended to suit new site layout	MT	TSH	GAC	June 24
C	Amended to suit KCC Comments	MT	TSH	GAC	Apr 24
B	Redline boundary amended	TH	TSH	GAC	Feb 24
A	Amended to suit client comments and updated redline boundary	TH	TSH	GAC	Feb 24

Charles & Associates

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Landmark House
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Heak
Hampshire
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01256 638420

Park House
Park Farm
East Mallory Farm Estate
Bradbourne Lane
Aylesford
Kent
ME20 6BN
01732 448120

Job Title
Capel Le Ferne

Drawing Title
Indicative Surface Water Drainage

Client
Quinn Estates

Scale	1:500 @A1	Date	Feb 24	Designed	MT
Drawn	MT	Checked	TSH	Approved	GAC

Job No	18-027	Drawing No	18-027-007	Rev	E
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