M & P Gadsden
Consulting Engineers Ltd

Drainage Strategy

Proposed Extension

at CGP, Mainsgate Road, Millom, Cumbria

On behalf of CGP Ltd

Document Reference	**CN 20198**
Version	**V1**
Date Released	**12th April 2021**
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Checked:	**Michael Gadsden BSc (Hons), MSc, CEng, MICE** [redacted]

1. Introduction

M & P Gadsden Consulting Engineers Ltd have been appointed to undertake the necessary drainage design work in support of the planning application to erect a three story extension to the existing Ivory Building at CGP, Mainsgate Road, Millom, Cumbria.

The Non-Statutory Technical Standards for Sustainable Drainage Systems published in March 2015 has been used as a basis for the design along with best practice guidance from Ciria SuDS Manual (C753). A list of the appendices enclosed with this report are as follows:

- Appendix A - Drainage scheme drawings
- Appendix B – Maintenance Pack
- Appendix C – Runoff Calculations

2. Existing Drainage

The existing Ivory Building surface water drainage is gravity fed and discharges into the existing watercourse to the eastern boundary of the site in two locations. This ultimately discharges into Crook Pool downstream. The existing watercourse to the east only serves the ivory building and this drainage strategy will include the ivory building as a whole as part of the design.

3. Surface Water Discharge Destination

Planning Policy guidance suggests the following hierarchy for surface water discharge: -

1. Into the ground (Infiltration)
2. To a surface water body;
3. To a surface water sewer;
4. To a combined sewer.

Groundsolve Ltd produced a Phase 2 Site Investigation Report (November 2016) in which they confirmed that groundwater was encountered during two borehole investigations at a depth of 2.20-

2.30m. Standing water is often present in landscaped areas of the site during wet periods of the year. As a result of this, infiltration drainage has been discounted.

There is an existing watercourse circa 45m from the existing Ivory Building. As this watercourse currently serves the existing Ivory Building, it is proposed to construct an attenuation pond along part of this. The pond will serve the existing Ivory Building at existing runoff rates, along with the proposed development at a controlled rate. The pond will then discharge into the existing watercourse downstream and ultimately into Crook Pool.

Due to the topography of the site and the existing levels of the car park area, the surface water drainage network cannot reach the outfall whilst conforming with the guidelines. The extension is to be served by a piped system gravity fed to a landscaped area, before being pumped to the east of the site and discharge into attenuation pond, designed to provide attenuation for upto and including the 100 year return period plus 40% climate change.

The attenuation basin is oversized due to client requirements for aesthetics.

Discharge rates for the proposed development are to be restricted to 1 in 1 year greenfield rate for the 1 year return period and Qbar for all return periods above this up to and including the 1 in 100 year plus 40% climate change event.

The existing and proposed runoff rates can be seen in the table below.

		1 Year	30 Year	100 Year	100 Year + 40%	Qbar
Existing Brownfield	North	5.90	15.00	19.40	27.40	
	South	21.00	51.70	66.80	93.70	
Existing Greenfield - Proposed Extension Area		0.42	0.81	0.99	1.39	0.48
Total Existing		27.32	67.51	87.19	122.49	
Allowable		27.32	67.18	86.68	121.58	
Proposed		7.80	21.60	24.10	25.50	
% Improvement		71.45%	67.85%	72.20%	79.03%	

See Appendix C for runoff rate calculations.

4. Technical Standards for SuDS

The Non-Statutory Technical Standards for Sustainable Drainage Systems has 14 points that have to be satisfied if they are applicable (S1 – S14).

- S1 – Uncontrolled surface water discharge - N/A
- S2 – Greenfield development runoff rate – N/A
- S3 – Brownfield development runoff rate – Attenuation designed for storms up to and including 1 in 100 year plus 40% climate change events. The runoff rate is to be restricted to 1 in 1 year greenfield rate for the 1 year return period and Qbar for all return periods above this up to and including the 1 in 100 year plus 40% climate change event. This will result in a significant reduction to the existing runoff rate from the site.
- S4 – Greenfield development volume control - N/A
- S5 – Brownfield development volume control - Attenuation designed for storms up to and including 1 in 100 year plus 40% climate change events. The runoff rate is to be restricted to 1 in 1 year greenfield rate for the 1 year return period and Qbar for all return periods above this up to and including the 1 in 100 year plus 40% climate change event. As a result flood risk will not be adversely affected.
- S6 – Volume control where S4 & S5 are not possible – N/A
- S7 – Flood risk within development (30 year storm) - the drainage system does not flood any part of the site during a 30 year storm condition. This is achieved using attenuation in the form of the stone layer beneath the porous car park.
- S8 – Flood risk within development (100 year storm) - no flooding will occur in any part of a building or utility plant during 100 year storm condition. This is achieved using attenuation in the form of the stone layer beneath the porous car park.
- S9 – Flood risk within development (exceedance routes) - the technical standards suggest “where practicable” exceedance routes for storms in excess of 100 years should be provided. In the event of a storm in excess of the attenuation pond capacity or upon failure of the pump, the flood would occur at manhole S3. A rill will be installed to guide exceedance water away from the buildings and towards the existing watercourse.
- S10 – Structural Integrity - all drainage works have been specified in accordance with Sewers For Adoption.
- S11 - Structural Integrity - all drainage works have been specified in accordance with Sewers For Adoption.
- S12 – Pumping – Due to the topography of the site, pumping is being used to facilitate drainage as it is not practicable to drain by gravity.
- S13 – Construction (connection) – N/A.
- S14 – Construction (damage) – N/A

5. Maintenance

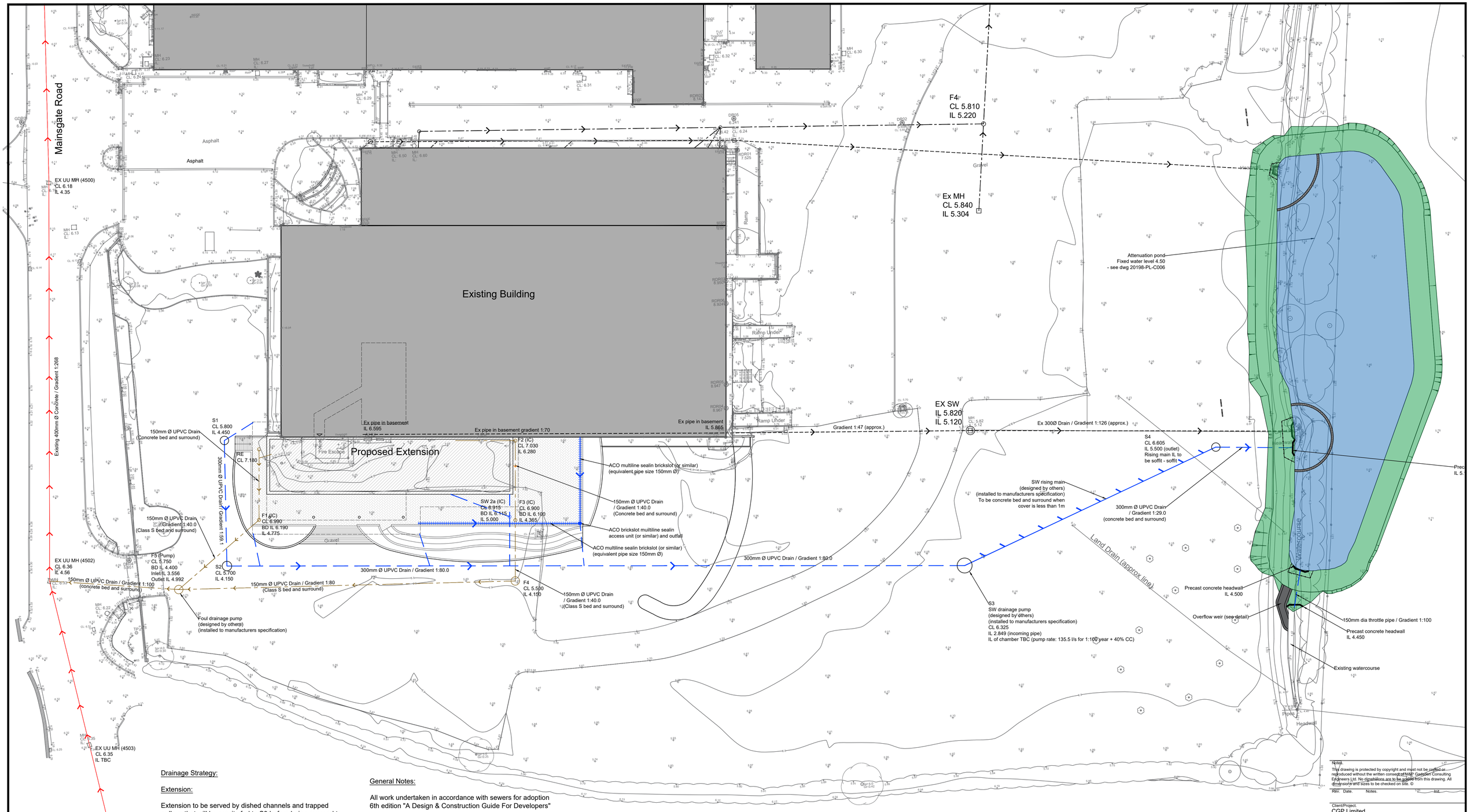
The maintenance of the drainage network and the attenuation pond serving the extension will be the responsibility of the applicant. Maintenance will include removing debris, grass cuttings, litter and other items from gullies and manholes on a regular basis (or when required), to prevent blockages and allow water to enter the system. Maintenance of the pond will include cutting grass, ensuring inlets and outlets are clear of debris and blockages, and maintaining designed levels.

For further information on maintenance refer to the maintenance pack in Appendix B.

6. Conclusion

The proposed extension can be drained effectively in line with the Non-Statutory Technical Standards for Sustainable Drainage Systems guidance. It is our professional opinion that the site is suitable for development from a drainage perspective.

Appendix A



Drainage Strategy:

Extension:

Extension to be served by dished channels and trapped gulleys that will be gravity fed to S3 before being pumped to the east of the site and discharge into attenuation pond to the further to the east, designed to provide attenuation for upto and including the 100 year return period plus 40% climate change.

Discharge rates to be restricted to 1 in 1 year greenfield rate for the 1 year return period and Qbar for all return periods above this up to and including the 1 in 100 year plus 40% climate change event.

The surface water will then discharge into the existing watercourse to the south east of the site.

Foul:

Foul drainage to be gravity fed to manhole F5 and then pumped before discharging into existing United Utilities adopted sewers in Mainsgate Road.

General Notes:

All work undertaken in accordance with sewers for adoption 6th edition "A Design & Construction Guide For Developers"

All pipes to be ultra-rib UPVC unless specified (Thermoplastic structured walled pipes to comply with WIS 4-35-01 and achieve class 8 kN/m2 nominal short term ring stiffness)

All drains to be 150mm Ø and set in Class S pipe bed and surround unless otherwise specified

All manholes excluding patio area to be 1200Ø precast concrete with D400 frame and cover (excluding pump chambers - to be designed by others).

All inspection chambers to be PPIC

Maintenance:

- Maintenance of foul and Surface water drainage to be maintained by applicant (refer to maintenance pack)

Key:

- Foul Drainage
- Surface Water Rising Main
- Surface Water Drainage
- Combined Drainage
- ACO drain (or similar)
- RE Rodding Eye
- IC Inspection Chamber
- Existing Surface Water Drainage
- Existing Foul Drainage

Rev.	Date.	Notes.	Init.

Client/Project.
CGP Limited
Civil/Structural/Architectural Design - Office & Cafeteria Extension - Phase 3 @
Mainsgate Road
Millom, Cumbria, LA18 4JZ

Drawing Title.
DRAINAGE LAYOUT (OPTION 1)

Status.
TENDER

Date.	Drawn.	Scale.
07/01/2021	RB	1:250 - A1

Drawing No. 20198-PL-C005 | Revision.

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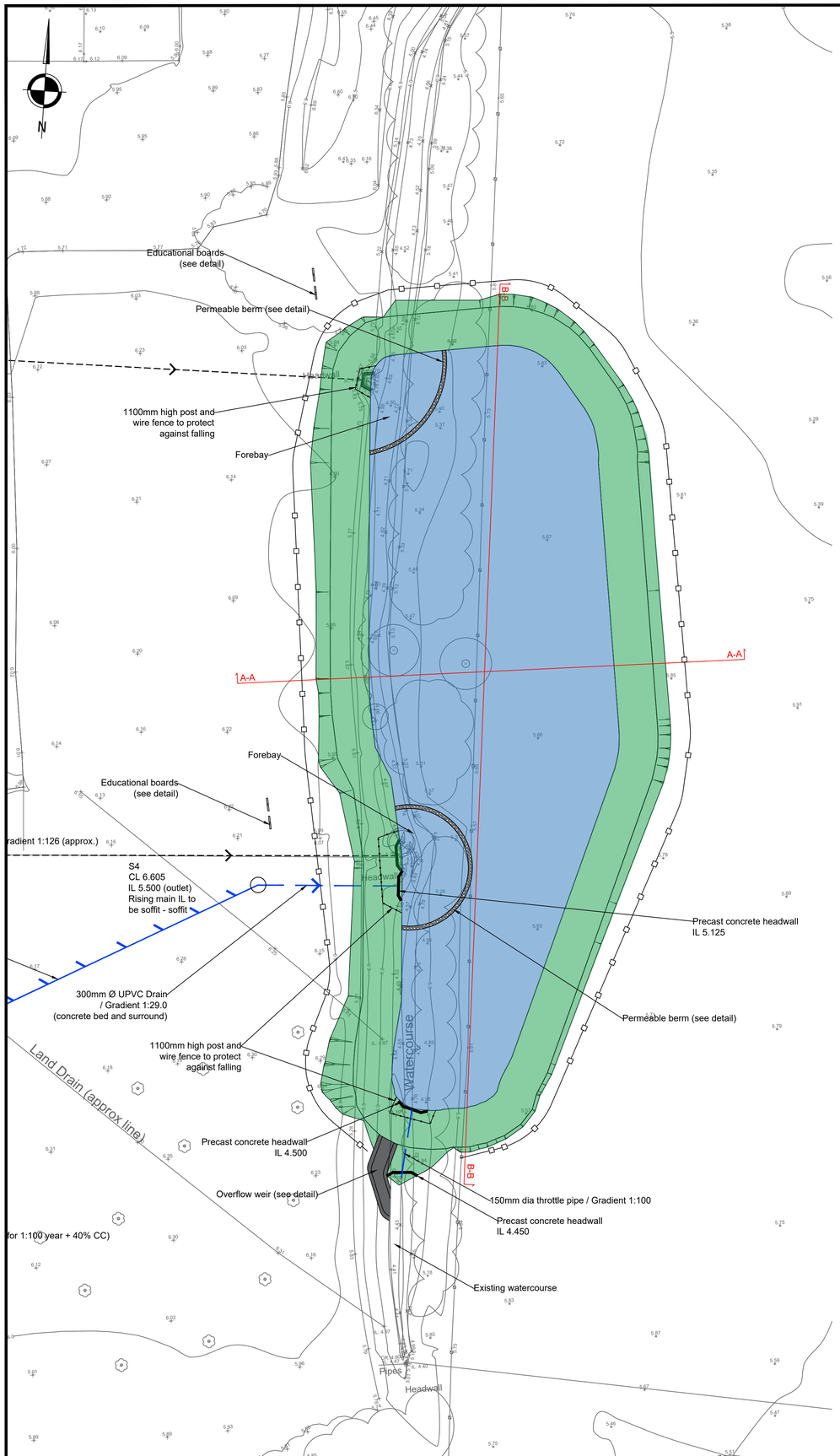
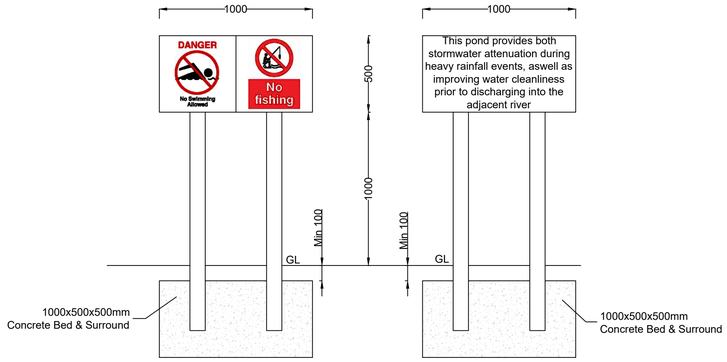


Key:

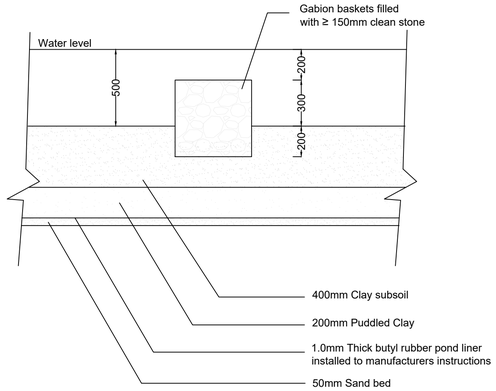
- Foul Drainage
- Perforated Surface Water Drainage
- Surface Water Drainage
- Foul Drainage
- RE Rodding Eye
- IC Inspection Chamber
- Existing Surface Water Drainage
- Existing Foul Drainage

Notes:

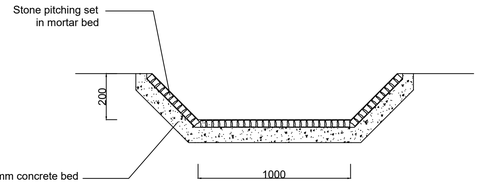
For pond sections see dwg 20198-PL-C007



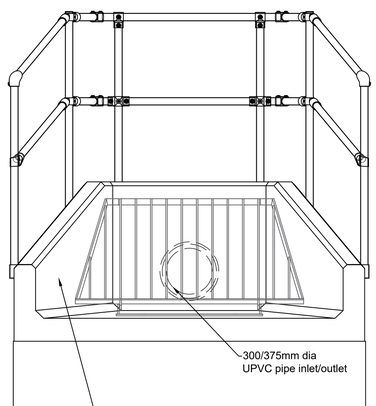
Educational Boards

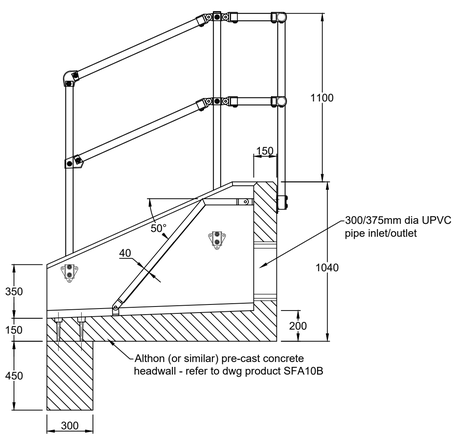


Permeable Berm Detail



Weir





Typical Headwall Detail

Rev.	Date:	Notes.	Init.

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Drawing Title.
POND LAYOUT AND DETAILS

Status.
TENDER

Date.	Drawn.	Scale.
01/04/2021	RB	1:200 - A1

Drawing No.	Revision.
20198-PL-C007	

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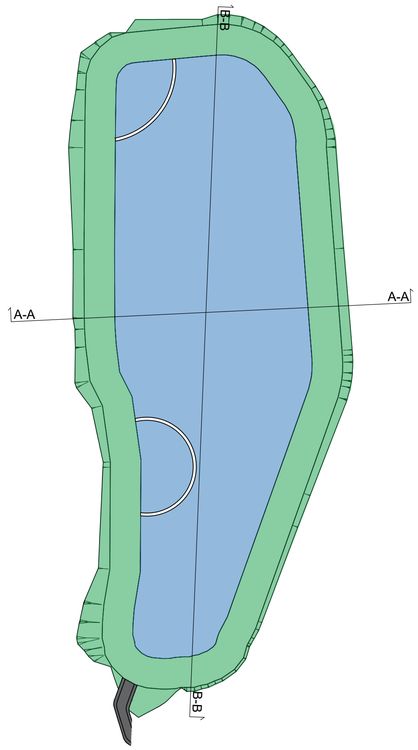
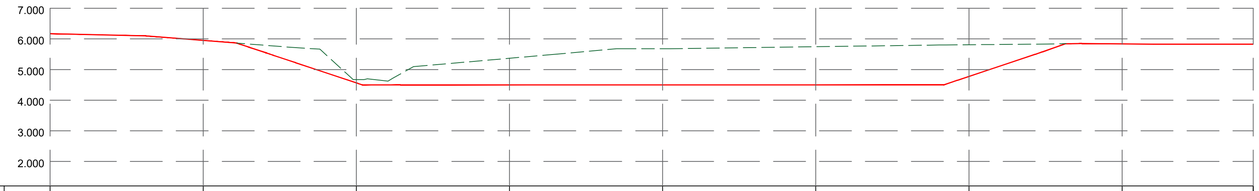
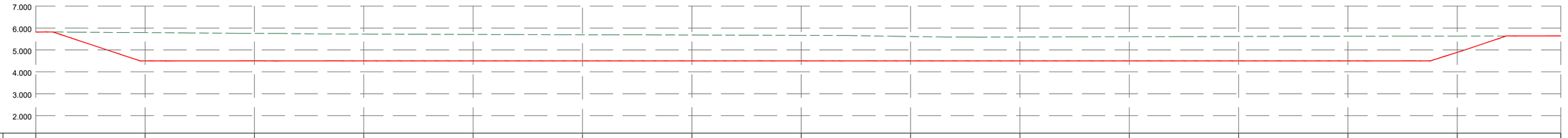




A-A

CHAINAGE	0.000	5.000	10.000	15.000	20.000	25.000	30.000	35.000	39.282
EXISTING LEVEL	6.170	5.951	4.674	5.369	5.680	5.746	5.811	5.837	5.829
PROPOSED LEVEL	6.170	5.951	4.564	4.500	4.500	4.500	4.775	5.837	5.829



B-B

CHAINAGE	0.000	5.000	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000	55.000	60.000	65.000	69.732
EXISTING LEVEL	5.815	5.793	5.756	5.721	5.706	5.691	5.680	5.665	5.612	5.589	5.602	5.614	5.624	5.631	5.639
PROPOSED LEVEL	5.815	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.500	4.889	5.639

Rev.	Date.	Notes.	Init.

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Drawing Title.
POND SECTIONS

Status.
TENDER

Date.	Drawn.	Scale.
01/04/2021	RB	1:200 - A1

Drawing No.	Revision.
20198-PL-C008	

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Mainsgate Road

Existing 400mm Ø Concrete / Gradient 1:268

Asphalt

Existing Building

Proposed Extension

Ramp

Ramp Under

Fire Escape

Gravel

Grass

EX UU MH (4500)
CL 6.18
IL 4.35

EX UU MH (4502)
CL 6.36
IL 4.56

EX UU MH (4503)
CL 6.35
IL TBC

Ex MH
CL 5.840
IL 5.304

F4
CL 5.810
IL 5.220

EX SW
IL 5.820
IL 5.120

S1
CL 5.800
IL 4.450

S2
CL 5.700
IL 4.150

F1 (IC)
CL 6.990
BD IL 6.190
IL 4.775

F2 (IC)
CL 7.030
IL 6.280

SW 2a (IC)
CL 6.915
BD IL 5.115
IL 5.000

F3 (IC)
CL 6.900
BD IL 6.100
IL 4.365

F5 (Pump)
CL 5.750
BD IL 4.400
Inlet IL 3.556
Outlet IL 4.992

S3
SW drainage pump
(designed by others)
(installed to manufacturers specification)
CL 6.325
IL 2.849 (incoming pipe)
IL of chamber TBC (pump rate: 135.5 l/s for 1:100 year + 40% CC)

S4
CL 6.605
IL 5.500 (outlet)
Rising main IL to be soffit - soffit

Ex pipe in basement
IL 6.595

Ex pipe in basement gradient 1:70

Ex pipe in basement
IL 5.865

Gradient 1:47 (approx.)

Ex 300Ø Drain / Gradient 1:126 (approx.)

150mm Ø UPVC Drain
(Concrete bed and surround)

300mm Ø UPVC Drain / Gradient 1:95

150mm Ø UPVC Drain / Gradient 1:40.0
(Class S bed and surround)

150mm Ø UPVC Drain / Gradient 1:100
(concrete bed and surround)

300mm Ø UPVC Drain / Gradient 1:80.0

150mm Ø UPVC Drain / Gradient 1:80
(Class S bed and surround)

150mm Ø UPVC Drain
/ Gradient 1:40.0
(Class S bed and surround)

ACO multiline sealin brickslot (or similar)
(equivalent pipe size 150mm Ø)

150mm Ø UPVC Drain
/ Gradient 1:40.0
(Concrete bed and surround)

ACO brickslot muiltiline sealin
access unit (or similar) and outfall

ACO multiline sealin brickslot (or similar)
(equivalent pipe size 150mm Ø)

Foul drainage pump
(designed by others)
(installed to manufacturers specification)

SW rising main
(designed by others)
(installed to manufacturers specification)
To be concrete bed and surround when cover is less than 1m

300mm Ø UPVC Drain
/ Gradient 1:29.0
(concrete bed and surround)

Land Drain (approx line)

Educational boards
(see detail)

Permeable berm (see detail)

1100mm high post and
wire fence to protect
against falling

Forebay

Attenuation pond
Fixed water level 4.50
- see dwg 20198-PL-C006

Precast concrete
IL 5.125

Precast concrete headwall
IL 4.500

Overflow weir (see detail)

150mm dia throttle pipe / Gradient 1:100

Precast concrete headwall
IL 4.450

Existing watercourse

Headwall

Key:

Exceedance route

Rill (see detail)

600

Min 200

Rill/depression - land to be profiled with a minimum gradient of 1:200 to be achieved

Typical Rill Detail
(Scale 1:10)

General Notes:

All work undertaken in accordance with sewers for adoption 6th edition "A Design & Construction Guide For Developers"

Notes.

Rev.	Date.	Notes.	Init.

Client/Project.
CGP Limited
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Drawing Title.
EXCEEDANCE ROUTE

Status.
TENDER

Date.	Drawn.	Scale.
07/01/2021	RB	1:250 - A1

Drawing No.	Revision.
20198-PL-C006	

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Appendix B

HR Wallingford
Working with water

Greenfield runoff estimation for sites

www.uksuds.com | Greenfield runoff tool

Calculated by:	
Site name:	CGP
Site location:	Millom

This is an estimation of the greenfield runoff rate limits that are needed to meet normal best practice criteria in line with Environment Agency guidance "Preliminary rainfall runoff management for developments", W5-074/A/TR1/1 rev. E (2012) and the SuDS Manual, C753 (Ciria, 2015). This information on greenfield runoff rates may be the basis for setting consents for the drainage of surface water runoff from sites.

Site coordinates

Latitude:	54.20482° N
Longitude:	3.26609° W

Reference:	
Date:	2021-04-09 09:54

Methodology	IH124

Site characteristics

Total site area (ha)	0.1

Methodology

Qbar estimation method	Calculate from SPR and SAAR
SPR estimation method	Calculate from SOIL type

	Default	Edited
SOIL type	4	4
HOST class	---	---
SPR/SPRHOST	0.47	0.47

Hydrological characteristics

	Default	Edited
SAAR (mm)	1040	1040
Hydrological region	10	10
Growth curve factor: 1 year	0.87	0.87
Growth curve factor: 30 year	1.7	1.7
Growth curve factor: 100 year	2.08	2.08

Notes:

(1) Is Q_{BAR} < 2.0 l/s/ha?

(2) Are flow rates < 5.0 l/s?

Where flow rates are less than 5.0 l/s consents are usually set at 5.0l/s if blockage from vegetation and other materials is possible. Lower consent flow rates may be set in which case blockage work must be addressed by using appropriate drainage elements

(3) Is SPR/SPRHOST ≤ 0.3?

Greenfield runoff rates

	Default	Edited
Qbar (l/s)	0.77	0.77
1 in 1 year (l/s)	0.67	0.67
1 in 30 years (l/s)	1.3	1.3
1 in 100 years (l/s)	1.6	1.6

Calculation Sheet	M & P Gadsden Consulting Engineers Ltd		
Project: CGP Limited, Mainsgate Road, Millom, Cumbria, LA18 4JZ			
Calculations for: Runoff Rates			
Originator: RB	Date: 12/04/2021	Page 1 of 1	Revision
Reference	20198		Output

Refer to HR Wallingford greenfield runoff estimation.

Minimum site area for their calculation is 0.1ha.

This has been used as a basis and scaled to suit this site.

Area	1 year	30 Year	100 Year	100 Year + 40% CC	Qbar
0.100ha	0.67	1.30	1.60	2.24	0.77
0.062ha	0.42	0.81	0.99	1.39	0.48

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	75.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	18.100	Minimum Backdrop Height (m)	0.200
Ratio-R	0.303	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Building DS 1	0.094	5.00	7.180	300	2820.373	170.384	0.585
Building DS 2	0.094	5.00	7.180	300	2871.373	170.587	1.315
EX MH South			5.820	1200	2906.087	170.928	0.700
Headwall 2			5.500	1	2951.438	170.864	0.740

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	Building DS 1	Building DS 2	51.000	0.600	6.595	5.865	0.730	69.9	300	5.45	53.3
1.001	Building DS 2	EX MH South	34.716	0.600	5.865	5.120	0.745	46.6	300	5.70	52.3
1.002	EX MH South	Headwall 2	45.351	0.600	5.120	4.760	0.360	126.0	300	6.24	50.4

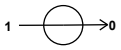
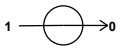
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.883	133.1	13.6	0.285	1.015	0.094	0.0	64	1.223
1.001	2.309	163.2	26.7	1.015	0.400	0.188	0.0	82	1.719
1.002	1.399	98.9	25.7	0.400	0.440	0.188	0.0	104	1.181

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	51.000	69.9	300	Circular	7.180	6.595	0.285	7.180	5.865	1.015
1.001	34.716	46.6	300	Circular	7.180	5.865	1.015	5.820	5.120	0.400
1.002	45.351	126.0	300	Circular	5.820	5.120	0.400	5.500	4.760	0.440

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	Building DS 1	300	Manhole	Adoptable	Building DS 2	300	Manhole	Adoptable
1.001	Building DS 2	300	Manhole	Adoptable	EX MH South	1200	Manhole	Adoptable
1.002	EX MH South	1200	Manhole	Adoptable	Headwall 2	1	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
Building DS 1	2820.373	170.384	7.180	0.585	300				
						0	1.000	6.595	300
Building DS 2	2871.373	170.587	7.180	1.315	300	1	1.000	5.865	300
									
						0	1.001	5.865	300
EX MH South	2906.087	170.928	5.820	0.700	1200	1	1.001	5.120	300
									
						0	1.002	5.120	300
Headwall 2	2951.438	170.864	5.500	0.740	1	1	1.002	4.760	300
									

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	18.000	Drain Down Time (mins)	240
Ratio-R	0.300	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	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 %)
1	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0

Results for 1 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	Building DS 1	10	6.652	0.057	10.8	0.1862	0.0000	OK
15 minute winter	Building DS 2	11	5.937	0.072	21.3	0.1079	0.0000	OK
15 minute winter	EX MH South	11	5.216	0.095	20.9	0.1080	0.0000	OK
15 minute winter	Headwall 2	11	4.853	0.093	21.0	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)
15 minute winter	Building DS 1	1.000	Building DS 2	10.5	0.953	0.079	0.5651	
15 minute winter	Building DS 2	1.001	EX MH South	20.9	1.324	0.128	0.5594	
15 minute winter	EX MH South	1.002	Headwall 2	21.0	1.111	0.213	0.8582	9.9

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

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	Building DS 1	10	6.684	0.089	26.4	0.2924	0.0000	OK
15 minute winter	Building DS 2	10	5.980	0.115	52.3	0.1721	0.0000	OK
15 minute winter	EX MH South	11	5.279	0.159	51.3	0.1796	0.0000	OK
15 minute winter	Headwall 2	11	4.912	0.152	51.7	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)
15 minute winter	Building DS 1	1.000	Building DS 2	25.9	1.230	0.195	1.0774	
15 minute winter	Building DS 2	1.001	EX MH South	51.3	1.659	0.315	1.0822	
15 minute winter	EX MH South	1.002	Headwall 2	51.7	1.404	0.523	1.6720	24.3

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

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	Building DS 1	10	6.697	0.102	34.0	0.3340	0.0000	OK
15 minute winter	Building DS 2	10	5.998	0.133	67.4	0.1989	0.0000	OK
15 minute winter	EX MH South	11	5.308	0.188	66.4	0.2121	0.0000	OK
15 minute winter	Headwall 2	11	4.938	0.178	66.8	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)
15 minute winter	Building DS 1	1.000	Building DS 2	33.4	1.313	0.251	1.3017	
15 minute winter	Building DS 2	1.001	EX MH South	66.4	1.752	0.407	1.3156	
15 minute winter	EX MH South	1.002	Headwall 2	66.8	1.486	0.676	2.0396	31.3

Results for 100 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 (m³)	Flood (m³)	Status
15 minute winter	Building DS 1	10	6.717	0.122	47.6	0.4003	0.0000	OK
15 minute winter	Building DS 2	10	6.029	0.164	94.5	0.2462	0.0000	OK
15 minute winter	EX MH South	11	5.366	0.246	93.1	0.2787	0.0000	OK
15 minute winter	Headwall 2	11	4.988	0.228	93.7	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)
15 minute winter	Building DS 1	1.000	Building DS 2	46.9	1.416	0.352	1.6906	
15 minute winter	Building DS 2	1.001	EX MH South	93.1	1.842	0.571	1.7406	
15 minute winter	EX MH South	1.002	Headwall 2	93.7	1.571	0.947	2.7092	43.9

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	75.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	18.100	Minimum Backdrop Height (m)	0.200
Ratio-R	0.303	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Building MH 1	0.028	5.00	6.530	1200	2821.434	211.687	0.590
Building MH 2	0.028	5.00	6.240	1200	2872.778	211.858	0.692
Headwall 1			5.500	1	2948.823	207.690	0.660

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	Building MH 1	Building MH 2	51.344	0.600	5.940	5.548	0.392	131.0	225	5.75	52.2
1.001	Building MH 2	Headwall 1	76.159	0.600	5.548	4.840	0.708	107.6	225	6.76	48.7

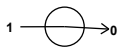
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.141	45.4	4.0	0.365	0.467	0.028	0.0	44	0.702
1.001	1.260	50.1	7.4	0.467	0.435	0.056	0.0	58	0.909

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	51.344	131.0	225	Circular	6.530	5.940	0.365	6.240	5.548	0.467
1.001	76.159	107.6	225	Circular	6.240	5.548	0.467	5.500	4.840	0.435

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	Building MH 1	1200	Manhole	Adoptable	Building MH 2	1200	Manhole	Adoptable
1.001	Building MH 2	1200	Manhole	Adoptable	Headwall 1	1	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
Building MH 1	2821.434	211.687	6.530	0.590	1200				
						0	1.000	5.940	225
Building MH 2	2872.778	211.858	6.240	0.692	1200	1	1.000	5.548	225
									
						0	1.001	5.548	225

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
Headwall 1	2948.823	207.690	5.500	0.660	1	1  	1.001	4.840	225

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	18.000	Drain Down Time (mins)	240
Ratio-R	0.300	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	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 %)
1	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0

Results for 1 year Critical Storm Duration. Lowest mass balance: 100.00%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	Building MH 1	11	5.979	0.039	3.2	0.0820	0.0000	OK
15 minute winter	Building MH 2	11	5.600	0.052	6.2	0.1012	0.0000	OK
15 minute winter	Headwall 1	11	4.892	0.052	5.9	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)
15 minute winter	Building MH 1	1.000	Building MH 2	3.1	0.543	0.068	0.2981	
15 minute winter	Building MH 2	1.001	Headwall 1	5.9	0.848	0.117	0.5259	3.0

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

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	Building MH 1	10	6.002	0.062	7.9	0.1289	0.0000	OK
15 minute winter	Building MH 2	11	5.633	0.085	15.5	0.1652	0.0000	OK
15 minute winter	Headwall 1	11	4.924	0.084	15.0	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)
15 minute winter	Building MH 1	1.000	Building MH 2	7.6	0.690	0.167	0.5797	
15 minute winter	Building MH 2	1.001	Headwall 1	15.0	1.105	0.300	1.0369	7.2

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

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	Building MH 1	10	6.011	0.071	10.1	0.1467	0.0000	OK
15 minute winter	Building MH 2	11	5.646	0.098	19.9	0.1901	0.0000	OK
15 minute winter	Headwall 1	11	4.936	0.096	19.4	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)
15 minute winter	Building MH 1	1.000	Building MH 2	9.8	0.735	0.215	0.6966	
15 minute winter	Building MH 2	1.001	Headwall 1	19.4	1.182	0.387	1.2497	9.3

Results for 100 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 (m³)	Flood (m³)	Status
15 minute winter	Building MH 1	10	6.025	0.085	14.2	0.1758	0.0000	OK
15 minute winter	Building MH 2	11	5.668	0.120	28.0	0.2326	0.0000	OK
15 minute winter	Headwall 1	11	4.957	0.117	27.4	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)
15 minute winter	Building MH 1	1.000	Building MH 2	13.8	0.799	0.304	0.8973	
15 minute winter	Building MH 2	1.001	Headwall 1	27.4	1.288	0.546	1.6173	13.1

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	2	Maximum Rainfall (mm/hr)	75.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	18.100	Minimum Backdrop Height (m)	0.200
Ratio-R	0.303	Preferred Cover Depth (m)	1.200
CV	0.750	Include Intermediate Ground	✓
Time of Entry (mins)	5.00	Enforce best practice design rules	✓

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
Building MH 1	0.028	5.00	6.530	1200	2821.434	211.687	0.590
Building MH 2	0.028	5.00	6.240	1200	2872.778	211.858	0.692
Headwall 1			5.500	300	2948.823	207.690	0.740
Building DS 1	0.095	5.00	7.180	300	2809.304	170.340	0.585
Building DS 2	0.095	5.00	7.180	300	2871.373	170.587	1.315
EX MH South			5.820	1200	2906.087	170.928	0.775
Headwall 2			5.500	1200	2951.438	170.864	0.832
SW 1	0.300	5.00	6.230	3000	2940.821	168.593	0.730
Headwall 3			5.500	1350	2951.545	168.404	0.838
Pond			5.500	1350	2951.863	147.728	1.000
Outfall			5.500	1350	2951.919	132.269	1.100

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	Building MH 1	Building MH 2	51.344	0.600	5.940	5.548	0.392	131.0	225	5.75	52.2
1.001	Building MH 2	Headwall 1	76.159	0.600	5.548	4.840	0.708	107.6	225	6.76	48.7
2.000	Building DS 1	Building DS 2	62.069	0.600	6.595	5.865	0.730	85.0	300	5.61	52.7
2.001	Building DS 2	EX MH South	34.716	0.600	5.865	5.120	0.745	46.6	300	5.86	51.8
2.002	EX MH South	Headwall 2	45.351	0.600	5.045	4.760	0.285	159.1	300	6.46	49.7
1.002	Headwall 1	Headwall 2	36.919	0.600	4.760	4.668	0.092	401.3	300	7.55	46.4
1.003	Headwall 2	Headwall 3	2.462	0.600	4.668	4.662	0.006	410.4	300	7.60	46.3
3.000	SW 1	Headwall 3	10.726	0.600	5.500	4.662	0.838	12.8	375	5.04	55.0
1.004	Headwall 3	Pond	20.678	0.600	4.662	4.524	0.138	150.0	375	7.83	45.6
1.005	Pond	Outfall	15.459	0.600	4.500	4.400	0.100	154.6	150	8.15	44.8

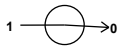
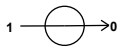
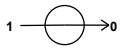
Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)
1.000	1.141	45.4	4.0	0.365	0.467	0.028	0.0
1.001	1.260	50.1	7.4	0.467	0.435	0.056	0.0
2.000	1.706	120.6	13.6	0.285	1.015	0.095	0.0
2.001	2.309	163.2	26.7	1.015	0.400	0.190	0.0
2.002	1.244	87.9	25.6	0.475	0.440	0.190	0.0
1.002	0.779	55.0	7.0	0.440	0.532	0.056	0.0
1.003	0.770	54.4	30.9	0.532	0.538	0.246	0.0
3.000	5.087	561.8	44.7	0.355	0.463	0.300	0.0
1.004	1.477	163.1	67.6	0.463	0.601	0.546	0.0
1.005	0.806	14.2	66.3	0.850	0.950	0.546	0.0

Pipeline Schedule

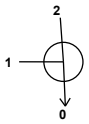
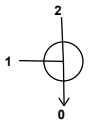
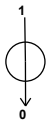
Link	Length (m)	Slope (1:X)	Dia (mm)	Link Type	US CL (m)	US IL (m)	US Depth (m)	DS CL (m)	DS IL (m)	DS Depth (m)
1.000	51.344	131.0	225	Circular	6.530	5.940	0.365	6.240	5.548	0.467
1.001	76.159	107.6	225	Circular	6.240	5.548	0.467	5.500	4.840	0.435
2.000	62.069	85.0	300	Circular	7.180	6.595	0.285	7.180	5.865	1.015
2.001	34.716	46.6	300	Circular	7.180	5.865	1.015	5.820	5.120	0.400
2.002	45.351	159.1	300	Circular	5.820	5.045	0.475	5.500	4.760	0.440
1.002	36.919	401.3	300	Circular	5.500	4.760	0.440	5.500	4.668	0.532
1.003	2.462	410.4	300	Circular	5.500	4.668	0.532	5.500	4.662	0.538
3.000	10.726	12.8	375	Circular	6.230	5.500	0.355	5.500	4.662	0.463
1.004	20.678	150.0	375	Circular	5.500	4.662	0.463	5.500	4.524	0.601
1.005	15.459	154.6	150	Circular	5.500	4.500	0.850	5.500	4.400	0.950

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	Building MH 1	1200	Manhole	Adoptable	Building MH 2	1200	Manhole	Adoptable
1.001	Building MH 2	1200	Manhole	Adoptable	Headwall 1	300	Manhole	Adoptable
2.000	Building DS 1	300	Manhole	Adoptable	Building DS 2	300	Manhole	Adoptable
2.001	Building DS 2	300	Manhole	Adoptable	EX MH South	1200	Manhole	Adoptable
2.002	EX MH South	1200	Manhole	Adoptable	Headwall 2	1200	Manhole	Adoptable
1.002	Headwall 1	300	Manhole	Adoptable	Headwall 2	1200	Manhole	Adoptable
1.003	Headwall 2	1200	Manhole	Adoptable	Headwall 3	1350	Manhole	Adoptable
3.000	SW 1	3000	Manhole	Adoptable	Headwall 3	1350	Manhole	Adoptable
1.004	Headwall 3	1350	Manhole	Adoptable	Pond	1350	Manhole	Adoptable
1.005	Pond	1350	Manhole	Adoptable	Outfall	1350	Manhole	Adoptable

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
Building MH 1	2821.434	211.687	6.530	0.590	1200	 0	1.000	5.940	225
Building MH 2	2872.778	211.858	6.240	0.692	1200	1  0	1.000 1.001	5.548 5.548	225 225
Headwall 1	2948.823	207.690	5.500	0.740	300	1  0	1.001 1.002	4.840 4.760	225 300
Building DS 1	2809.304	170.340	7.180	0.585	300	 0	2.000	6.595	300
Building DS 2	2871.373	170.587	7.180	1.315	300	1  0	2.000 2.001	5.865 5.865	300 300
EX MH South	2906.087	170.928	5.820	0.775	1200	1  0	2.001 2.002	5.120 5.045	300 300

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
Headwall 2	2951.438	170.864	5.500	0.832	1200		1	2.002	4.760	300
							2	1.002	4.668	300
							0	1.003	4.668	300
SW 1	2940.821	168.593	6.230	0.730	3000					
							0	3.000	5.500	375
Headwall 3	2951.545	168.404	5.500	0.838	1350		1	3.000	4.662	375
							2	1.003	4.662	300
							0	1.004	4.662	375
Pond	2951.863	147.728	5.500	1.000	1350		1	1.004	4.524	375
							0	1.005	4.500	150
Outfall	2951.919	132.269	5.500	1.100	1350		1	1.005	4.400	150

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	18.000	Drain Down Time (mins)	240
Ratio-R	0.300	Additional Storage (m³/ha)	20.0
Summer CV	0.750	Check Discharge Rate(s)	x
Winter CV	0.840	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 %)
1	0	0	0
30	0	0	0
100	0	0	0
100	40	0	0

Node Headwall 3 Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Safety Factor	2.0	Invert Level (m)	4.662
Side Inf Coefficient (m/hr)	0.00000	Porosity	1.00	Time to half empty (mins)	0

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	893.0	0.0	1.000	1340.0	0.0

Results for 1 year Critical Storm Duration. Lowest mass balance: 99.80%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	Building MH 1	11	5.979	0.039	3.2	0.0820	0.0000	OK
15 minute winter	Building MH 2	11	5.599	0.051	6.2	0.0985	0.0000	OK
15 minute winter	Headwall 1	11	4.916	0.156	7.3	0.0110	0.0000	OK
15 minute winter	Building DS 1	10	6.654	0.059	10.9	0.1972	0.0000	OK
15 minute winter	Building DS 2	11	5.939	0.074	21.4	0.1124	0.0000	OK
15 minute winter	EX MH South	11	5.144	0.099	21.1	0.1117	0.0000	OK
15 minute summer	Headwall 2	11	4.909	0.241	28.1	0.2721	0.0000	OK
15 minute summer	SW 1	10	5.679	0.179	32.8	2.7386	0.0000	OK
240 minute winter	Headwall 3	164	4.719	0.057	15.6	51.2560	0.0000	OK
240 minute winter	Pond	164	4.583	0.083	7.8	0.1185	0.0000	OK
240 minute winter	Outfall	164	4.479	0.079	7.8	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)
15 minute winter	Building MH 1	1.000	Building MH 2	3.1	0.586	0.068	0.2912	
15 minute winter	Building MH 2	1.001	Headwall 1	5.7	0.820	0.113	0.7001	
15 minute winter	Headwall 1	1.002	Headwall 2	14.2	0.354	0.258	1.7772	
15 minute winter	Building DS 1	2.000	Building DS 2	10.5	0.913	0.087	0.7251	
15 minute winter	Building DS 2	2.001	EX MH South	21.1	1.587	0.129	0.4608	
15 minute winter	EX MH South	2.002	Headwall 2	21.0	0.926	0.239	1.2133	
15 minute summer	Headwall 2	1.003	Headwall 3	34.8	1.595	0.640	0.0752	
15 minute summer	SW 1	3.000	Headwall 3	42.5	3.496	0.076	0.2801	
240 minute winter	Headwall 3	1.004	Pond	7.8	0.731	0.048	0.2212	
240 minute winter	Pond	1.005	Outfall	7.8	0.807	0.549	0.1496	73.5

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 (m³)	Flood (m³)	Status
15 minute winter	Building MH 1	10	6.002	0.062	7.9	0.1286	0.0000	OK
15 minute winter	Building MH 2	11	5.631	0.083	15.5	0.1617	0.0000	OK
15 minute summer	Headwall 1	10	5.002	0.242	17.3	0.0172	0.0000	OK
15 minute winter	Building DS 1	10	6.689	0.094	26.7	0.3113	0.0000	OK
15 minute winter	Building DS 2	11	5.985	0.120	52.7	0.1821	0.0000	OK
15 minute winter	EX MH South	11	5.211	0.166	51.7	0.1879	0.0000	OK
15 minute winter	Headwall 2	10	4.990	0.322	73.1	0.3647	0.0000	SURCHARGED
15 minute summer	SW 1	9	5.784	0.284	80.1	4.3440	0.0000	OK
120 minute winter	Headwall 3	90	4.770	0.108	58.0	98.8494	0.0000	OK
180 minute winter	Pond	124	4.795	0.295	27.9	0.4226	0.0000	SURCHARGED
120 minute winter	Outfall	88	4.533	0.133	21.7	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)
15 minute winter	Building MH 1	1.000	Building MH 2	7.6	0.705	0.167	0.5698	
15 minute winter	Building MH 2	1.001	Headwall 1	14.9	1.045	0.297	1.5929	
15 minute summer	Headwall 1	1.002	Headwall 2	24.9	0.444	0.452	2.4193	
15 minute winter	Building DS 1	2.000	Building DS 2	26.0	1.159	0.216	1.3964	
15 minute winter	Building DS 2	2.001	EX MH South	51.7	2.022	0.317	0.8879	
15 minute winter	EX MH South	2.002	Headwall 2	50.8	1.232	0.578	2.1880	
15 minute winter	Headwall 2	1.003	Headwall 3	80.5	2.216	1.479	0.0919	
15 minute summer	SW 1	3.000	Headwall 3	103.5	4.263	0.184	0.4849	
120 minute winter	Headwall 3	1.004	Pond	29.6	0.743	0.181	1.1510	
180 minute winter	Pond	1.005	Outfall	21.6	1.231	1.520	0.2637	165.9

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 (m³)	Flood (m³)	Status
15 minute winter	Building MH 1	10	6.010	0.070	10.1	0.1463	0.0000	OK
15 minute winter	Building MH 2	11	5.644	0.096	19.8	0.1859	0.0000	OK
15 minute winter	Headwall 1	10	5.051	0.291	19.2	0.0207	0.0000	OK
15 minute winter	Building DS 1	10	6.702	0.107	34.4	0.3559	0.0000	OK
15 minute winter	Building DS 2	11	6.004	0.139	68.0	0.2109	0.0000	OK
15 minute winter	EX MH South	11	5.245	0.200	66.6	0.2260	0.0000	OK
15 minute summer	Headwall 2	10	5.038	0.370	88.4	0.4179	0.0000	SURCHARGED
15 minute winter	SW 1	8	5.827	0.327	108.5	4.9918	0.0000	OK
120 minute winter	Headwall 3	94	4.807	0.145	76.0	134.2847	0.0000	OK
180 minute winter	Pond	136	4.872	0.372	43.6	0.5324	0.0000	SURCHARGED
120 minute winter	Outfall	96	4.538	0.138	24.1	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)
15 minute winter	Building MH 1	1.000	Building MH 2	9.8	0.751	0.215	0.6843	
15 minute winter	Building MH 2	1.001	Headwall 1	19.2	1.060	0.383	2.0649	
15 minute winter	Headwall 1	1.002	Headwall 2	28.9	0.532	0.524	2.5896	
15 minute winter	Building DS 1	2.000	Building DS 2	33.6	1.235	0.279	1.6916	
15 minute winter	Building DS 2	2.001	EX MH South	66.6	2.154	0.408	1.0734	
15 minute winter	EX MH South	2.002	Headwall 2	66.7	1.307	0.758	2.5951	
15 minute summer	Headwall 2	1.003	Headwall 3	96.1	2.344	1.765	0.0968	
15 minute winter	SW 1	3.000	Headwall 3	128.1	4.583	0.228	0.5504	
120 minute winter	Headwall 3	1.004	Pond	45.6	0.749	0.279	1.5004	
180 minute winter	Pond	1.005	Outfall	24.1	1.367	1.690	0.2668	221.1

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 (m³)	Flood (m³)	Status
15 minute winter	Building MH 1	10	6.024	0.084	14.2	0.1754	0.0000	OK
15 minute winter	Building MH 2	11	5.665	0.117	28.0	0.2267	0.0000	OK
15 minute winter	Headwall 1	9	5.209	0.449	27.9	0.0319	0.0000	FLOOD RISK
15 minute winter	Building DS 1	10	6.724	0.129	48.1	0.4278	0.0000	OK
15 minute summer	Building DS 2	10	6.029	0.164	90.8	0.2488	0.0000	OK
15 minute winter	EX MH South	10	5.550	0.505	93.9	0.5716	0.0000	FLOOD RISK
15 minute winter	Headwall 2	9	5.169	0.501	130.8	0.5669	0.0000	SURCHARGED
15 minute winter	SW 1	8	6.079	0.579	151.9	8.8466	0.0000	FLOOD RISK
180 minute winter	Headwall 3	136	4.873	0.211	77.5	198.5131	0.0000	OK
60 minute winter	Pond	48	4.929	0.429	49.3	0.6145	0.0000	SURCHARGED
180 minute winter	Outfall	116	4.540	0.140	25.6	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)
15 minute winter	Building MH 1	1.000	Building MH 2	13.8	0.817	0.303	0.8800	
15 minute winter	Building MH 2	1.001	Headwall 1	27.1	1.070	0.541	2.3073	
15 minute winter	Headwall 1	1.002	Headwall 2	34.4	0.572	0.624	2.5998	
15 minute winter	Building DS 1	2.000	Building DS 2	47.1	1.391	0.391	2.1050	
15 minute summer	Building DS 2	2.001	EX MH South	92.6	2.207	0.567	1.8672	
15 minute winter	EX MH South	2.002	Headwall 2	97.5	1.417	1.109	3.1936	
15 minute winter	Headwall 2	1.003	Headwall 3	132.6	2.692	2.436	0.1098	
15 minute winter	SW 1	3.000	Headwall 3	220.5	4.810	0.392	0.6088	
180 minute winter	Headwall 3	1.004	Pond	44.6	0.739	0.273	1.7941	
60 minute winter	Pond	1.005	Outfall	25.5	1.451	1.794	0.2680	207.7

Appendix C

Unit 20
Meetings Industrial Estate
Park Road
Barrow-in-Furness
Cumbria
LA14 4TL

M & P Gadsden
Consulting Engineers Ltd

Sustainable Drainage Management Plan

Proposed Extension at

CGP, Mainsgate Road, Millom, Cumbria

1.0 Introduction

Sustainable drainage systems or SuDS are an environmentally friendly approach to managing rainfall that uses the landscape. SuDS aim to: -

- Control the flow, volume and frequency of water leaving a development site
- Prevent pollution by intercepting silt and cleaning runoff from hard surfaces
- Provide attractive surroundings for the community
- Create opportunities for wildlife

2.0 SuDS at CGP, Mainsgate Road, Millom

The SuDS are designed to prevent flooding of the extension and control the flow of water from the site. This site utilises infiltration techniques to disperse surface water with attenuation provided within the infiltration features.

The proposed extension and patio area are served by drainage channels and trapped gulleys before entering an attenuation basin that discharges into the existing watercourse at a controlled rate. The maintenance of the drainage system and attenuation pond will be the responsibility of the applicant.

The attenuation basin includes the following:

- Inlet(s) including a headwall detail with a non-return valve and grill cover over them to prevent entry by small animals.
- A forebay to allow any sediment to settle.

- A permeable berm splitting the basin will be constructed to aid filtration of the water.
- Grass and shrubs across the basin
- The controlled outlet from the pond allows water in a heavy rainfall to be stored within the ponds.
- Headwalls will be surrounded by permanent fencing.

3.0 Managing the SuDS

The SuDS have been designed for easy maintenance to comprise: -

- Regular day to day care -litter collection, grass cutting and checking inlets and outlets where water enters or leaves a feature.
- Occasional tasks – managing pond vegetation and removing any silt build up.
- Remedial work – repairing damage as necessary.

The surface water drainage and SuDS requiring management and maintenance for this site are summarized in Table 1 below: -

Table 1 – Maintenance Schedule

	Maintenance Item	**Action**	**Regularity**
1	Monitoring Generally	Initial inspection of everything below to ensure the system is working effectively	After large storms and quarterly during first year
2	ACO or similar Channel Drains	Remove debris, grass cuttings etc from inside the channel itself	Annually
3	Manholes, Pipes etc	Lift manhole covers, visual inspection. If debris/silt has built up arrange jetting. Arrange CCTV survey if performance deteriorates.	Annually and/or as required

4	Flow Control	Lift manhole cover, clear silt from silt trap, inspect for blockages	Annually
5	Litter Management	Pick up all litter in SuDS and landscape areas and remove from site	Monthly
6	Grass Maintenance	Cut grass to side slopes and surrounding areas at 100mm	As required or monthly
7	Basin Vegetation Maintenance	Monitor basin vegetation and cut 30% of edge at 100mm each year if necessary in September-November	Annually
8	Wildflower Maintenance	Wildflower areas strimmed to 50mm on 3 year rotation (30% per year)	Annually
9	Inlet	Inspect and remove silt, litter and debris. Strim for 1m around	Monthly
10	Basin Silt Management	a)Inspect berm for silt accumulation	Annually
		b)Excavate silt taking care not to damage basin integrity. Set a side silt and allow to dry within 10m of SuDS feature. Spread, rake and overseed.	As necessary
11	Basin Monitoring	Check and reinstate design levels. Check for ponding and inspect for structural issues, repairing as required.	Within first 12 months and then as necessary
12	Outlets	Inspect and remove silt, litter and debris. Strim for 1m around	Monthly

13	Exceedance Rills	Remove litter, debris and silt build up along its length. Ensure vegetation is maintained and not affecting the performance.	Every six months