GODSELL • ARNOLD
PARTNERSHIP LTD
Consulting Civil and Structural Engineers

Gardner's Farm Barn, Romsey

Foul & Surface Water Drainage Strategy and Maintenance Plan

Prepared for

Clydesdale Group

March 2024

Job No: 23811

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Revision	Amendments	Prepared By	Checked	Status	Date
1	First Issue	JLB	JHW	Planning	Jan 2024
2	Revised	JLB	JHW	Planning	March 2024

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FIGURES

APPENDICES

1.0 Introduction

1.1 Development Background

The site is located off Flowers Lane, near Romsey, SO51 6HH.

(National Grid Reference SU 28590 20878).

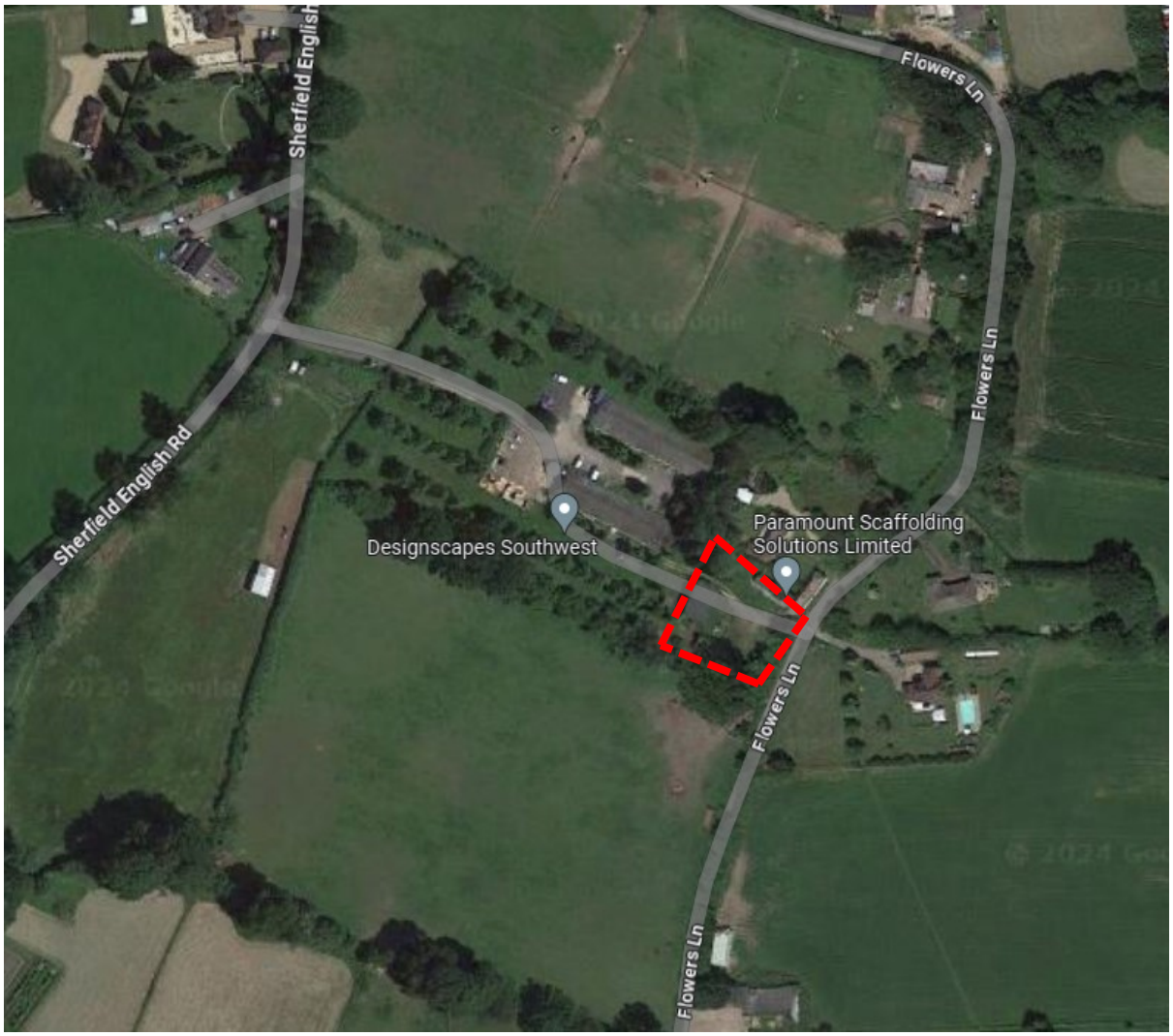


Figure 1: Aerial view of Site (approximate site boundary in red)

Part Q planning permission is being sought to convert an existing barn into residential use. The proposals are shown on the Architects drawings included in Appendix A.

This report summarises the proposed foul and surface water drainage strategy for the site.

1.2 Site Location

The site is situated on an area of land used for agricultural purposes and covers an area of 1,280m². The site is occupied by two barns/sheds, with the northwestern barn due to be converted. The ground is a mix of soft landscaping and paved surface areas, and the general topography of the land is relatively level.

1.3 Flood Zone (UK Government Indicative Flood Mapping)

Table 1 Flood Zones, from Planning Practice Guidance – Flood risk and coastal change, reproduced in Figure 2 below, defines the flood zones shown on the UK Government's Indicative Flood Map for planning -

Flood Zone	Description
Zone 1 Low Probability	Land having a less than 0.1% annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map for Planning – all land outside Zones 2, 3a and 3b)
Zone 2 Medium Probability	Land having between a 1% and 0.1% annual probability of river flooding; or land having between a 0.5% and 0.1% annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a High Probability	Land having a 1% or greater annual probability of river flooding; or Land having a 0.5% or greater annual probability of sea. (Land shown in dark blue on the Flood Map)
Zone 3b Functional Floodplain	Functional floodplain will normally comprise: • land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or • land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding).

Figure 2: Planning Practice Guidance, Flood risk and coastal change.
Table 1 – Flood Zones (August 2022)

The site can be identified from Figure 3 as being located within Flood Zone 1, and therefore at low risk of flooding from fluvial sources and not at risk of flooding from the sea.

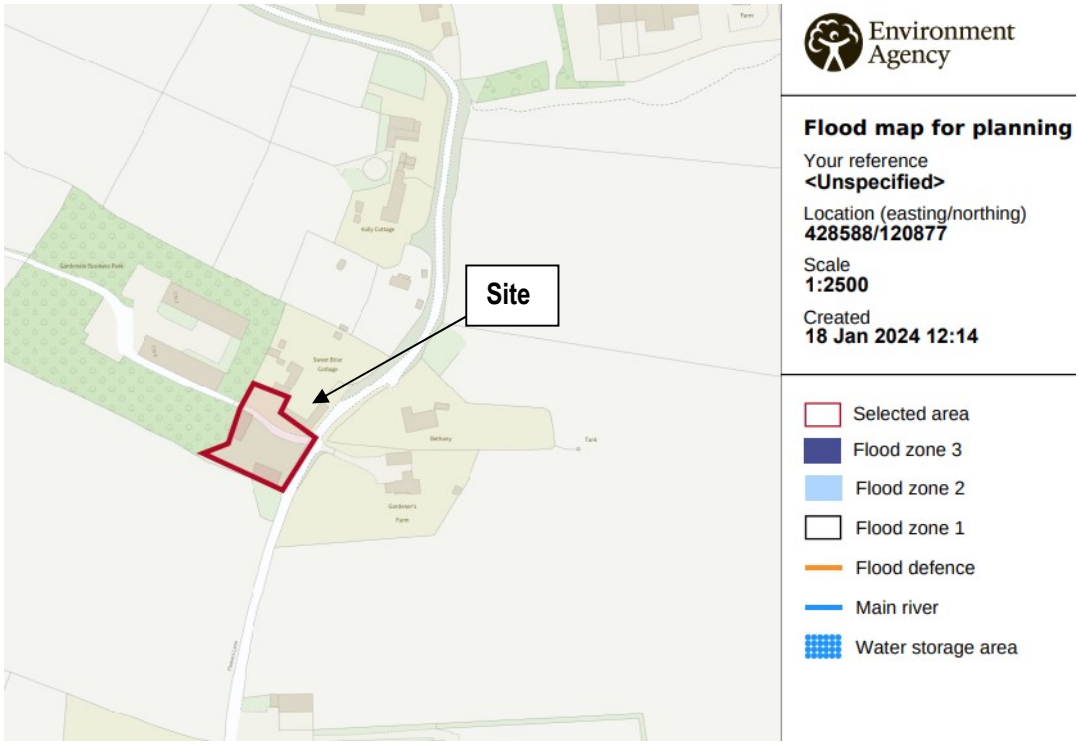


Figure 3: UK Government Indicative Flood mapping from rivers and sea

2.0 Flood Risk Vulnerability and Flood Zone Compatibility

2.1 Flood Zone Vulnerability

In accordance with 'Annex 3: Flood risk vulnerability classification' of the National Planning Policy Framework, the proposed development can be classed as "More Vulnerable".

More Vulnerable:

- Hospitals
- Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.
- Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels.
- Non–residential uses for health services, nurseries and educational establishments.
- Landfill* and sites used for waste management facilities for hazardous waste.
- Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.

Figure 4: Extract from National Planning Policy Framework Annex 3, (March 2012)

2.2 Flood Zone Compatibility

Table 2 (Flood risk vulnerability and flood zone 'compatibility), from Planning Practice Guidance – Flood risk and coastal change, reproduced in Figure below, shows that 'More Vulnerable' development in Flood Zone 1 (equivalent to the non-shaded areas of the UK Government Flood Map) is appropriate, without requiring the Sequential Test and Exception Test.

Flood risk Vulnerability classification		Essential infrastructure	Highly Vulnerable	More Vulnerable	Less vulnerable	Water compatible
Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	Exception test required	✓	✓	✓
	Zone 3a†	Exception test required †	×	Exception test required	✓	✓
	Zone 3b*	Exception test required *	×	×	×	✓*

Figure 5: Planning Practice Guidance – Flood risk and coastal change, Table 2 (August 2022)

3.0 Potential Sources of Flooding

3.1 River Flooding

UK Government mapping (Figure 3) shows the area of the site where the new building is proposed, to lie outside of the shaded areas and therefore not at risk of flooding from rivers or sea.

3.2 Sewer, surface water and ground water flooding

An extract of the UK Government's Indicative Map showing risk of flooding from surface water is shown in Figure 6 below. The site can be identified as being at very low risk of flooding from surface water.

Figure 6: UK Government Indicative map indicating flood risk from surface water

3.3 Flooding from Reservoirs

The site is indicated on the UK Government maps as not being at risk of flooding from reservoirs.

4.0 Existing Surface Water Drainage Arrangements

4.1 Existing Surface Water Drainage

There is no drainage network currently servicing the site. It is assumed that surface water from roof/hardstanding areas falls to soft landscaped areas and drains into the ground via infiltration.

4.2 Site Geology

The British Geological Survey (BGS) map for the area indicates the ground conditions to be Whitecliff Sand Member. Percolation testing will be undertaken during detailed design stages, to ascertain the depth of permeable ground and its infiltration rate.

5.0 Proposed Surface Water and Sustainable Drainage (SuDS)

For sustainable best practice the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable:

1. into the ground (infiltration);
2. to a surface water body;
3. to a surface water sewer, highway drain, or another drainage system;
4. to a combined sewer.

Due to the potential good ground permeability, it is intended to discharge surface water flows into the ground via infiltration, using an assumed percolation rate of 0.036mm/hr ($1x10^{-5}$ m/s). Roof areas will be channelled into a soakaway located beneath the hardstanding area to the southeast of the dwelling. The access driveway and hardstanding area will be constructed using permeable materials. A copy of the proposed drainage plan can be found in Appendix B.

Drainage design software 'Flow', by Causeway Ltd., has been used to prepare the strategy layout using the following criteria:

Return Period	100 years
Climate Change	+45%
Storm Durations	15,30,60,120,180,240,360,480,600,720,960 & 1,440 minutes
Rainfall Methodology	FSR
M5 – 60	20
r	0.3
C_v	1.00

The drainage strategy layout has been designed to accommodate a 1 in 100 years event with 45% uplift for climate change below ground. A copy of the drainage design calculations can be found in Appendix C.

6.0 Proposed Foul Water Drainage

6.1 Existing Foul Water Drainage

There are no public sewers accessible from the site.

6.2 Proposed Foul Water Drainage

It is proposed to use a package treatment plant to serve the single domestic dwelling, discharging less than 2m³ per day. Effluent from the plant will discharge into the ground via a drainage field. The ground has been assumed to have a Vp value of 82 (representing a low but workable infiltration rate) when sizing the drainage field. This rate puts the plant within the limits of the Environment Agency's general binding rules. Should the rate fall outside the limits set by the general binding rules, an application would need to be made to the Environment Agency for a bespoke permit, and additional engineering measures may be required in order to obtain such a permit. A copy of the proposed drainage plan can be found in Appendix C.

7.0 Drainage Maintenance

The following is a list of components included within the foul and surface water drainage system which will need to be regularly inspected and maintained:

- Surface/foul water pipework
- Surface/foul water chambers and catchpits
- Drainage channels/gullies
- Soakaways
- Permeable paving
- Package treatment plant

Refer to appendix D for the recommended frequency of inspection works. This will be a live document and any changes to the inspection periods should be recorded and reason given for future reference and review.

Appropriate consideration to Health & Safety for all maintenance items should be undertaken with appropriate measures to protect the users of the site, visitors, environment & operatives undertaking the works. Under the prevailing Health & Safety / Construction Design & Management Regulations method statements should be provided by the maintenance contractor and retained as part of the Management & Maintenance procedures for the site, these should be provided to owner/client for record purposes (O&M records).

Where possible timing for these maintenance works should be programmed when the users are likely to be least inconvenienced. In the event emergency maintenance is required during busy times of the day, appropriate notifications and/or warnings should be given to the users.

Attention should be paid to General Binding Rules: Small sewage discharge to ground rules 11,12,13, and 14 with regards to the foul package treatment plant. These rules can be found in Appendix D.

8.0 Flood Risk Management Measures

8.1 Flood Mitigation Measures

Existing ground levels are to be largely maintained. Surface water will be managed within the development site via the use of soakaways and permeable paving, with attenuation provided below ground. The drainage design will manage surface water on site below ground for events up to 1 in 100 year (+45% climate change) with no flood risk to the development, or off site.

8.2 Off Site Impacts

Exceedance flows for events above the 1 in 100 year (+45% climate change) would pond on the hardstanding surface outside the property. Any flows leaving the site will follow the profile of the land, and flow south-westwards onto agricultural land.

9.0 Water Quality

9.1 Potential Receptors

The extract from the DEFRA map shows the site to be in an area classed as a secondary aquifer; this can support water at a local level.

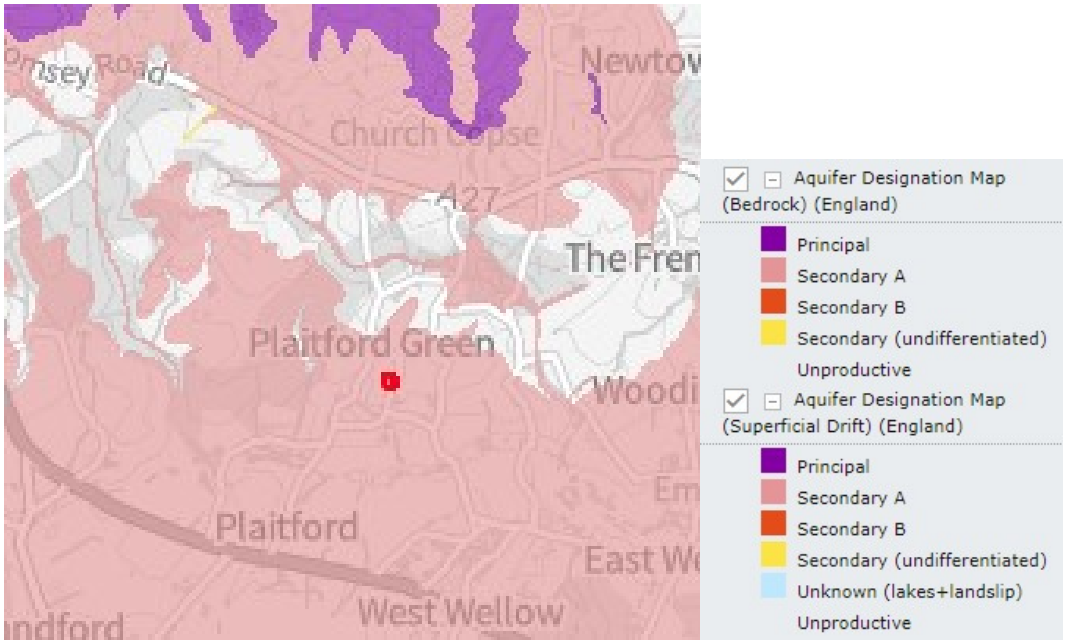


Figure 7: DEFRA Aquifer Designation Map

The extract from the Environment Agency map shows the site to be outside of a source protection zone for public potable groundwater abstraction sites.

Firgure 8: Environment Agency Source Protetion Zone Map

9.2 Minimum Water Quality Management

Table 4.3 of CIRIA C753 defines the minimum water quality management for discharges to receiving waters. For this site, this will be into the ground. Referring to table 4.3 from CIRIA C753 (extract below), the land use is classified as 'Individual property driveways, residential car parks and low traffic roads.

TABLE 4.3 Minimum water quality management requirements for discharges to receiving surface waters and groundwater

Land use	Pollution hazard level	Requirements for discharge to surface waters, including coasts and estuaries[2]	Requirements for discharge to groundwater
Residential roofs	Very low	Removal of gross solids and sediments only	
Individual property driveways, roofs (excluding residential), residential car parks, low traffic roads (eg cul de sacs, home zones, general access roads), non-residential car parking with infrequent change (eg schools, offices)	Low	Simple index approach[3] *Note: extra measures may be required for discharges to protected resources[1]*	

Figure 9: Water Quality Management Requirements (CIRIA C753 – Table 4.3 - Extract)

On this basis, a simple index approach can be adopted, as detailed in Box 26.2 in CIRIA C753.

Table 26.2 of CIRIA C753 defines the pollution hazard indices for the proposed land use for total suspended solids (TSS), metals and hydrocarbons.

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4

Figure 10: Pollution Hazards Indicies (CIRIA C753 – Table 26.2 - Extract)

For this development, the following pollution hazard indices will be applied:

Land use (Table 4.3)	**Total suspended solids**	**Metals**	**Hydrocarbons**
individual property driveways, residential car parks, low traffic roads	0.5	0.4	0.4

Table 26.3 of CIRIA C753 indicates the SuDS mitigation indices for discharges to surface waters.

TABLE 26.4 Indicative SuDS mitigation indices for discharges to groundwater

Characteristics of the material overlying the proposed infiltration surface, through which the runoff percolates[1]	TSS	Metals	Hydrocarbons
A layer of dense vegetation underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.6[4]	0.5	0.6
A soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.4[4]	0.3	0.3
Infiltration trench (where a suitable depth of filtration material is included that provides treatment, ie graded gravel with sufficient smaller particles but not single size coarse aggregate such as 20 mm gravel) underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.4[4]	0.4	0.4
Constructed permeable pavement (where a suitable filtration layer is included that provides treatment, and including a geotextile at the base separating the foundation from the subgrade) underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.7	0.6	0.7
Bioretention underlain by a soil with good contaminant attenuation potential[2] of at least 300 mm in depth[3]	0.8[4]	0.8	0.8
Proprietary treatment systems[5, 6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for inflow concentrations relevant to the contributing drainage area.		

Figure 11: Indicative SuDS Mitigation Indices (CIRIA C753 - Table 26.4)

For this development permeable paving will be used to wherever possible to filter surface water flows from hardstanding areas. Catchpits will be used to collect silt and debris from roof areas, before surface water can discharge into the soakaway.

Type of SuDS component	**Total suspended solids**	**Metals**	**Hydrocarbons**
Permeable paving	0.7	0.6	0.7

For these areas, the mitigation indices are greater than the pollution indices and so the surface water runoff quality criteria have been met.

9.3 Foul Water Package Treatment Plant Discharge

General Binding Rule 7 specifies that you cannot discharge within a groundwater source protection zone 1. The map shown in Figure 8 shows that the site is outside of this zone, and therefore complies with this rule.

General Binding Rule 18 specifies the following:

You cannot meet the general binding rules if the new discharge will be in an ancient woodland or in or within 50 metres of any:

- special areas of conservation
- special protection areas
- Ramsar wetland sites
- biological sites of special scientific interest (SSSI)

Using information from publicly available records, the site is not inside, or within 50m, of the areas mentioned in Rule 18.

10.0 Residual Risks

There are no residual flood risks associated with the development proposals.

11.0 Conclusion

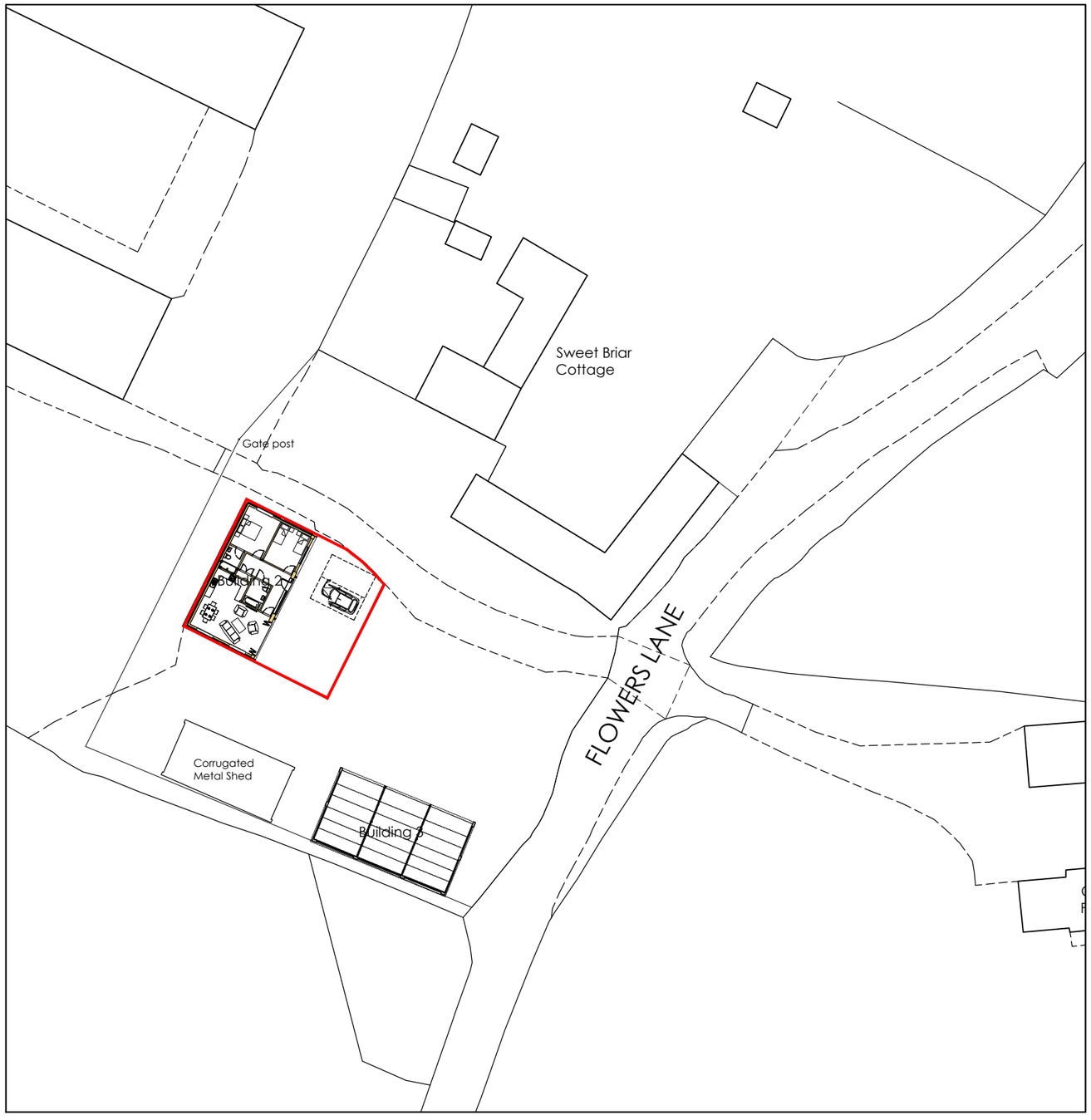
This report presents the surface water drainage strategy proposed for this site. The developed area of the site lies within Flood Zone 1 and is therefore at low risk of fluvial flooding.

The report demonstrates that the proposed development will have a minimal impact on flood risk, both within the site and off-site. Flood risk will be minimised with surface water flows being stored and discharge below ground, and to an overall design will be to a 1 in 100 year (+45% climate change) standard.

Areas within the proposed drainage system that will require regular maintenance have been highlighted by this report. If regular maintenance is not put in action, this can result in system failure and environmental effects.

The use of permeable materials, and other control methods, provides sufficient mitigation to remove pollution hazards from surface water before discharging into ground water. Foul water treatment will be compliant with the General Binding Rules, and therefore the site will not impact on water quality.

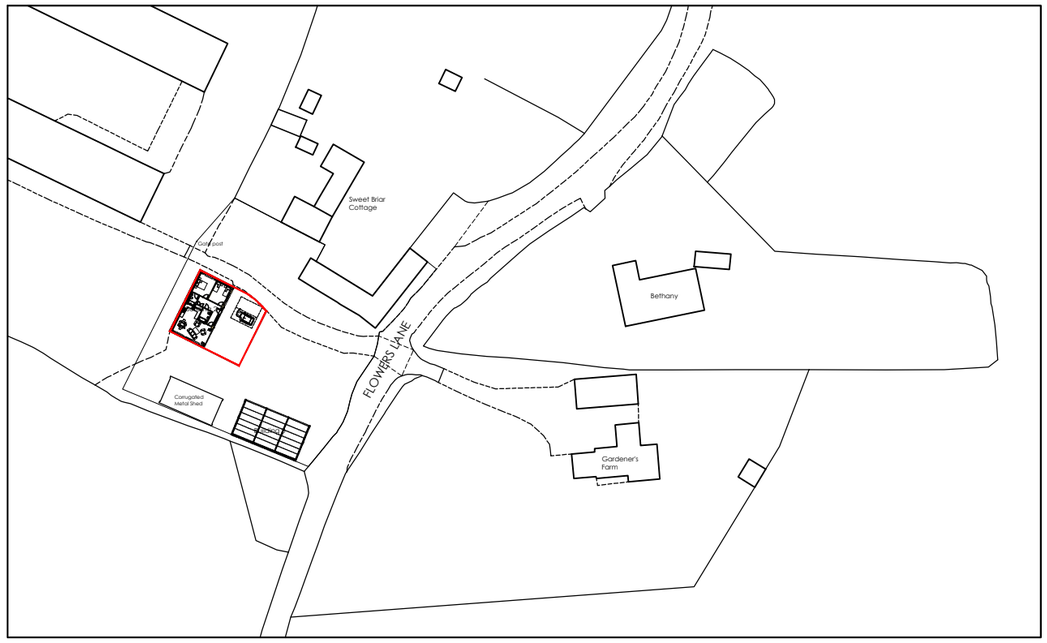
Appendix A: Architect's Layout Drawing



Site Plan Scale 1:500

20 10 5 0 10 20 30 40 50

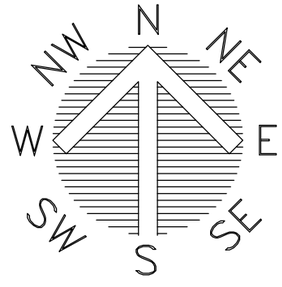
Metres



Site Location Plan Scale 1:1250

20 0 20 40 60 80 100

Metres



B	25/01/24	Boundary corrected.
A	17/01/24	Building 3 to remain as existing.

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Issue
Preliminary

Client
Clydesdale Group Ltd

Project
Gardeners Farm Barn
Flowers Lane, Plaitford
SO51 6HH

Drawing Title
Proposed Site Plan

Scale	Date	Drawing Ref.	Rev
1:500 & 1:1250 @ A3	July 2023	B23-1305-P-001	B

Appendix B: Proposed Drainage Strategy

DRAINAGE LEGEND

- Existing surface water sewer (& manhole)
- Existing foul water sewer (& manhole)
- Existing combined sewer (& manhole)
- Proposed surface water sewer (& catchpit)
- Proposed foul water sewer (& manhole)
- Proposed 300Ø access chamber (AC / IC)
- Proposed 450Ø inspection chamber (AC / IC)
- Foul drainage field
- RWP — Rainwater collection pipe
- RE — Rodding eye (refer to plan for invert level)
- SVP — Soil & vent pipe
- Aquacell soakaway
- Permeable gravel paving

Refer to Architects / M&E Drawings for exact positions of internal connections & RWP's
Unless otherwise noted all drainage to be 100 Ø

NOTES

1. This drawing is to be read in conjunction with all relevant architects, engineers and specialist sub-contractors drawings and specifications.
2. All setting out to be in accordance with the Architects drawings. Dimensions must not be scaled from the drawing.
3. Existing surface water and foul water network is assumed and should be checked and surveyed.
4. Where connections are to be made to existing manholes/sewers, invert levels, pipe sizes and orientation should be checked prior to the commencement of the works and any variance reported to the engineer immediately.
5. Discharge flow rates to be agreed with relevant authority body prior to connection.

THIS DRAWING IS FOR PLANNING PURPOSES ONLY

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NOT FOR CONSTRUCTION

Rev	Date	Revision Description	Issued by
P02	15.03.24	Drainage field amended	JLB
P01	18.01.24	Preliminary Issue	JLB

Drawing Status: S0 - Work in Progress

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Client: Clydesdale Group

Project: Gardners Farm Bar, Romsey

Drawing Title: Drainage Strategy

Scale: 1:100 @ A1 | Drawn: JLB | Checked: JHW

Project-Originator-Zone-Level-Type-Role: 23811-GAP-XX-XX-DR-C | Drawing No.: 9000 | Revision: P02

Appendix C: Site Drainage Strategy Design Calculations

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	50.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	20.000	Minimum Backdrop Height (m)	1.200
Ratio-R	0.300	Preferred Cover Depth (m)	0.500
CV	1.000	Include Intermediate Ground	✓
Time of Entry (mins)	4.00	Enforce best practice design rules	x

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Sump (m)	Easting (m)	Northing (m)	Depth (m)
2	0.006	4.00	44.610	450		428834.097	120837.883	0.963
5			44.000	900	0.500	428834.304	120823.281	2.000
SOAKAWAY			44.000			428834.304	120818.920	1.800
4	0.005	4.00	44.100	450		428827.351	120823.281	0.653
3		4.00	44.200	150		428819.035	120826.986	0.600
1		4.00	44.400	150		428825.886	120841.813	0.600
DUMMY NODE			44.500	300		428837.148	120818.930	0.300

Links (Input)

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)
1.001	2	5	14.603	0.600	43.647	42.500	1.147	12.7	100	4.26	50.0
1.002	5	SOAKAWAY	4.361	0.600	42.500	42.200	0.300	14.5	100	4.30	50.0
2.001	4	5	6.953	0.600	43.447	42.500	0.947	7.3	100	4.19	50.0
2.000	3	4	9.104	0.600	43.600	43.447	0.153	59.5	100	4.15	50.0
1.000	1	2	9.103	0.600	43.800	43.647	0.153	59.5	100	4.15	50.0
1.003	SOAKAWAY	DUMMY NODE	2.844	0.600	43.700	44.200	-0.500	-5.7	50	4.35	50.0

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)
1.001	14.603	12.7	100	Circular	44.610	43.647	0.863	44.000	42.500	1.400
1.002	4.361	14.5	100	Circular	44.000	42.500	1.400	44.000	42.200	1.700
2.001	6.953	7.3	100	Circular	44.100	43.447	0.553	44.000	42.500	1.400
2.000	9.104	59.5	100	Circular	44.200	43.600	0.500	44.100	43.447	0.553
1.000	9.103	59.5	100	Circular	44.400	43.800	0.500	44.610	43.647	0.863
1.003	2.844	-5.7	50	Circular	44.000	43.700	0.250	44.500	44.200	0.250

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.001	2	450	Manhole	INSPECTION CHAMBER	5	900	Manhole	INSPECTION CHAMBER
1.002	5	900	Manhole	INSPECTION CHAMBER	SOAKAWAY		Junction	
2.001	4	450	Manhole	INSPECTION CHAMBER	5	900	Manhole	INSPECTION CHAMBER
2.000	3	150	Manhole	ACCESS CHAMBER	4	450	Manhole	INSPECTION CHAMBER
1.000	1	150	Manhole	ACCESS CHAMBER	2	450	Manhole	INSPECTION CHAMBER
1.003	SOAKAWAY		Junction		DUMMY NODE	300	Manhole	INSPECTION CHAMBER

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections	Link	IL (m)	Dia (mm)
2	428834.097	120837.883	44.610	0.963	450	1	1.000	43.647	100
						0	1.001	43.647	100
5	428834.304	120823.281	44.000	2.000	900	1	2.001	42.500	100
						2	1.001	42.500	100
						0	1.002	42.500	100
SOAKAWAY	428834.304	120818.920	44.000	1.800		1	1.002	42.200	100
						0	1.003	43.700	50
4	428827.351	120823.281	44.100	0.653	450	1	2.000	43.447	100
						0	2.001	43.447	100
3	428819.035	120826.986	44.200	0.600	150	0	2.000	43.600	100
1	428825.886	120841.813	44.400	0.600	150	0	1.000	43.800	100
DUMMY NODE	428837.148	120818.930	44.500	0.300	300	1	1.003	44.200	50

Simulation Settings

Rainfall Methodology	FSR	Skip Steady State	x
FSR Region	England and Wales	Drain Down Time (mins)	240
M5-60 (mm)	20.000	Additional Storage (m³/ha)	20.0
Ratio-R	0.300	Check Discharge Rate(s)	x
Winter CV	1.000	Check Discharge Volume	x
Analysis Speed	Normal		

Storm Durations

15	30	60	120	180	240	360	480	600	720	960	1440

Return Period (years)	Climate Change (CC %)	Additional Area (A %)	Additional Flow (Q %)
2	0	0	0
5	0	0	0
10	0	0	0
30	0	0	0
30	10	0	0
30	40	0	0
100	0	0	0
100	25	0	0
100	45	0	0

Node SOAKAWAY Soakaway Storage Structure

Base Inf Coefficient (m/hr)	0.00000	Invert Level (m)	42.200	Depth (m)	0.800
Side Inf Coefficient (m/hr)	0.03600	Time to half empty (mins)		Inf Depth (m)	0.800
Safety Factor	2.0	Pit Width (m)	2.500	Number Required	1
Porosity	0.90	Pit Length (m)	6.000		

Results for 2 year Critical Storm Duration. Lowest mass balance: 93.61%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	2	10	43.664	0.017	1.1	0.0047	0.0000	OK
15 minute winter	5	9	42.526	0.026	2.2	0.0163	0.0000	OK
1440 minute winter	SOAKAWAY	930	42.495	0.295	0.2	3.9818	0.0000	OK
15 minute winter	4	10	43.462	0.015	1.1	0.0049	0.0000	OK
15 minute winter	3	1	43.600	0.000	0.0	0.0000	0.0000	OK
15 minute winter	1	1	43.800	0.000	0.0	0.0000	0.0000	OK
15 minute winter	DUMMY NODE	1	44.200	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 (m³)	Discharge Vol (m³)
15 minute winter	2	1.001	5	1.1	0.908	0.064	0.0181	
15 minute winter	5	1.002	SOAKAWAY	2.2	1.611	0.138	0.0135	
1440 minute winter	SOAKAWAY	1.003	DUMMY NODE	0.0	0.000	0.000	0.0000	0.0
1440 minute winter	SOAKAWAY	Infiltration		0.0				
15 minute winter	4	2.001	5	1.1	0.980	0.049	0.0081	
15 minute winter	3	2.000	4	0.0	0.000	0.000	0.0034	
15 minute winter	1	1.000	2	0.0	0.000	0.000	0.0041	

Results for 5 year Critical Storm Duration. Lowest mass balance: 93.61%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	2	10	43.667	0.020	1.5	0.0055	0.0000	OK
1440 minute winter	5	960	42.536	0.036	0.2	0.0228	0.0000	OK
1440 minute winter	SOAKAWAY	960	42.536	0.336	0.2	4.5349	0.0000	OK
15 minute winter	4	10	43.465	0.018	1.5	0.0057	0.0000	OK
15 minute winter	3	1	43.600	0.000	0.0	0.0000	0.0000	OK
15 minute winter	1	1	43.800	0.000	0.0	0.0000	0.0000	OK
15 minute winter	DUMMY NODE	1	44.200	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 (m³)	Discharge Vol (m³)
15 minute winter	2	1.001	5	1.5	0.995	0.088	0.0222	
1440 minute winter	5	1.002	SOAKAWAY	0.2	0.505	0.013	0.0226	
1440 minute winter	SOAKAWAY	1.003	DUMMY NODE	0.0	0.000	0.000	0.0000	0.0
1440 minute winter	SOAKAWAY	Infiltration		0.0				
15 minute winter	4	2.001	5	1.5	1.072	0.067	0.0099	
15 minute winter	3	2.000	4	0.0	0.000	0.000	0.0042	
15 minute winter	1	1.000	2	0.0	0.000	0.000	0.0051	

Results for 10 year Critical Storm Duration. Lowest mass balance: 93.61%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	2	10	43.668	0.021	1.7	0.0058	0.0000	OK
1440 minute winter	5	990	42.575	0.075	0.2	0.0474	0.0000	OK
1440 minute winter	SOAKAWAY	990	42.575	0.375	0.2	5.0559	0.0000	OK
15 minute winter	4	10	43.466	0.019	1.7	0.0061	0.0000	OK
15 minute winter	3	1	43.600	0.000	0.0	0.0000	0.0000	OK
15 minute winter	1	1	43.800	0.000	0.0	0.0000	0.0000	OK
15 minute winter	DUMMY NODE	1	44.200	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 (m³)	Discharge Vol (m³)
15 minute winter	2	1.001	5	1.7	1.031	0.099	0.0243	
1440 minute winter	5	1.002	SOAKAWAY	0.2	0.505	0.013	0.0307	
1440 minute winter	SOAKAWAY	1.003	DUMMY NODE	0.0	0.000	0.000	0.0000	0.0
1440 minute winter	SOAKAWAY	Infiltration		0.0				
15 minute winter	4	2.001	5	1.7	1.111	0.075	0.0108	
15 minute winter	3	2.000	4	0.0	0.000	0.000	0.0046	
15 minute winter	1	1.000	2	0.0	0.000	0.000	0.0056	

Results for 30 year Critical Storm Duration. Lowest mass balance: 93.61%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	2	10	43.671	0.024	2.2	0.0066	0.0000	OK
960 minute winter	5	720	42.643	0.143	0.4	0.0908	0.0000	SURCHARGED
960 minute winter	SOAKAWAY	720	42.643	0.443	0.4	5.9785	0.0000	OK
15 minute winter	4	10	43.468	0.021	2.2	0.0069	0.0000	OK
15 minute winter	3	1	43.600	0.000	0.0	0.0000	0.0000	OK
15 minute winter	1	1	43.800	0.000	0.0	0.0000	0.0000	OK
15 minute winter	DUMMY NODE	1	44.200	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 (m³)	Discharge Vol (m³)
15 minute winter	2	1.001	5	2.2	1.110	0.129	0.0292	
960 minute winter	5	1.002	SOAKAWAY	0.4	0.870	0.025	0.0341	
960 minute winter	SOAKAWAY	1.003	DUMMY NODE	0.0	0.000	0.000	0.0000	0.0
960 minute winter	SOAKAWAY	Infiltration		0.0				
15 minute winter	4	2.001	5	2.2	1.199	0.098	0.0130	
15 minute winter	3	2.000	4	0.0	0.000	0.000	0.0055	
15 minute winter	1	1.000	2	0.0	0.000	0.000	0.0067	

Results for 30 year +10% CC Critical Storm Duration. Lowest mass balance: 93.61%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	2	10	43.672	0.025	2.4	0.0069	0.0000	OK
480 minute winter	5	456	42.710	0.210	0.6	0.1334	0.0000	SURCHARGED
480 minute winter	SOAKAWAY	456	42.710	0.510	0.6	6.8815	0.0000	OK
15 minute winter	4	10	43.469	0.022	2.4	0.0072	0.0000	OK
15 minute winter	3	1	43.600	0.000	0.0	0.0000	0.0000	OK
15 minute winter	1	1	43.800	0.000	0.0	0.0000	0.0000	OK
15 minute winter	DUMMY NODE	1	44.200	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 (m³)	Discharge Vol (m³)
15 minute winter	2	1.001	5	2.4	1.135	0.140	0.0311	
480 minute winter	5	1.002	SOAKAWAY	0.6	1.101	0.038	0.0341	
480 minute winter	SOAKAWAY	1.003	DUMMY NODE	0.0	0.000	0.000	0.0000	0.0
480 minute winter	SOAKAWAY	Infiltration		0.0				
15 minute winter	4	2.001	5	2.4	1.232	0.106	0.0138	
15 minute winter	3	2.000	4	0.0	0.000	0.000	0.0058	
15 minute winter	1	1.000	2	0.0	0.000	0.000	0.0071	

Results for 30 year +40% CC Critical Storm Duration. Lowest mass balance: 93.61%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	2	10	43.675	0.028	3.0	0.0078	0.0000	OK
720 minute winter	5	675	42.891	0.391	0.6	0.2485	0.0000	SURCHARGED
720 minute winter	SOAKAWAY	675	42.891	0.691	0.6	9.3250	0.0000	OK
15 minute winter	4	10	43.472	0.025	3.0	0.0081	0.0000	OK
15 minute winter	3	1	43.600	0.000	0.0	0.0000	0.0000	OK
15 minute winter	1	1	43.800	0.000	0.0	0.0000	0.0000	OK
15 minute winter	DUMMY NODE	1	44.200	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 (m³)	Discharge Vol (m³)
15 minute winter	2	1.001	5	3.0	1.206	0.175	0.0366	
720 minute winter	5	1.002	SOAKAWAY	0.6	0.870	0.037	0.0341	
720 minute winter	SOAKAWAY	1.003	DUMMY NODE	0.0	0.000	0.000	0.0000	0.0
720 minute winter	SOAKAWAY	Infiltration		0.1				
15 minute winter	4	2.001	5	3.0	1.306	0.133	0.0163	
15 minute winter	3	2.000	4	0.0	0.000	0.000	0.0068	
15 minute winter	1	1.000	2	0.0	0.000	0.000	0.0083	

Results for 100 year Critical Storm Duration. Lowest mass balance: 93.61%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	2	10	43.674	0.027	2.8	0.0075	0.0000	OK
600 minute winter	5	570	42.792	0.292	0.6	0.1855	0.0000	SURCHARGED
600 minute winter	SOAKAWAY	570	42.792	0.592	0.6	7.9885	0.0000	OK
15 minute winter	4	10	43.471	0.024	2.8	0.0078	0.0000	OK
15 minute winter	3	1	43.600	0.000	0.0	0.0000	0.0000	OK
15 minute winter	1	1	43.800	0.000	0.0	0.0000	0.0000	OK
15 minute winter	DUMMY NODE	1	44.200	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 (m³)	Discharge Vol (m³)
15 minute winter	2	1.001	5	2.8	1.184	0.164	0.0348	
600 minute winter	5	1.002	SOAKAWAY	0.6	0.870	0.038	0.0341	
600 minute winter	SOAKAWAY	1.003	DUMMY NODE	0.0	0.000	0.000	0.0000	0.0
600 minute winter	SOAKAWAY	Infiltration		0.1				
15 minute winter	4	2.001	5	2.8	1.283	0.124	0.0155	
15 minute winter	3	2.000	4	0.0	0.000	0.000	0.0065	
15 minute winter	1	1.000	2	0.0	0.000	0.000	0.0079	

Results for 100 year +25% CC Critical Storm Duration. Lowest mass balance: 93.61%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	2	10	43.678	0.031	3.5	0.0084	0.0000	OK
720 minute winter	5	690	42.952	0.452	0.6	0.2873	0.0000	SURCHARGED
720 minute winter	SOAKAWAY	690	42.952	0.752	0.6	10.1479	0.0000	OK
15 minute winter	4	10	43.474	0.027	3.5	0.0087	0.0000	OK
15 minute winter	3	1	43.600	0.000	0.0	0.0000	0.0000	OK
15 minute winter	1	1	43.800	0.000	0.0	0.0000	0.0000	OK
15 minute winter	DUMMY NODE	1	44.200	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 (m³)	Discharge Vol (m³)
15 minute winter	2	1.001	5	3.5	1.256	0.205	0.0409	
720 minute winter	5	1.002	SOAKAWAY	0.6	0.870	0.038	0.0341	
720 minute winter	SOAKAWAY	1.003	DUMMY NODE	0.0	0.000	0.000	0.0000	0.0
720 minute winter	SOAKAWAY	Infiltration		0.1				
15 minute winter	4	2.001	5	3.5	1.360	0.155	0.0182	
15 minute winter	3	2.000	4	0.0	0.000	0.000	0.0076	
15 minute winter	1	1.000	2	0.0	0.000	0.000	0.0093	

Results for 100 year +45% CC Critical Storm Duration. Lowest mass balance: 93.61%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
15 minute winter	2	10	43.680	0.033	4.1	0.0091	0.0000	OK
960 minute winter	5	900	43.643	1.143	0.6	0.7270	0.0000	SURCHARGED
960 minute winter	SOAKAWAY	900	43.643	1.443	0.5	10.8068	0.0000	OK
960 minute winter	4	900	43.643	0.196	0.3	0.0641	0.0000	SURCHARGED
960 minute winter	3	900	43.643	0.043	0.0	0.0008	0.0000	OK
15 minute winter	1	1	43.800	0.000	0.0	0.0000	0.0000	OK
15 minute winter	DUMMY NODE	1	44.200	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 (m³)	Discharge Vol (m³)
15 minute winter	2	1.001	5	4.1	1.309	0.240	0.0464	
960 minute winter	5	1.002	SOAKAWAY	0.5	0.821	0.034	0.0341	
960 minute winter	SOAKAWAY	1.003	DUMMY NODE	0.0	0.000	0.000	0.0000	0.0
960 minute winter	SOAKAWAY	Infiltration		0.1				
960 minute winter	4	2.001	5	0.3	0.592	0.013	0.0544	
960 minute winter	3	2.000	4	0.0	-0.007	-0.005	0.0503	
15 minute winter	1	1.000	2	0.0	0.000	0.000	0.0104	

Appendix D: Drainage Maintenance Schedule

Pipes and chambers

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Inspection of pipes and chambers	Monthly (and following poor performance)
	Cleaning of pipes and chambers, emptying silt traps	Annually (and following poor performance)
Occasional maintenance	Cleaning and/or servicing of flow control devices	As per manufacturer's guidance
Remedial actions	Repair of pipes/chambers	As required
	Repairs to flow control devices	As required

Proprietary Treatment systems (Table 14.2 SuDS C753)

Maintenance Schedule	Required Action	Typical Frequency
Routine maintenance	Remove litter and debris and inspect for sediment, oil and grease accumulation	Six monthly
	Change the filter media	As recommended by manufacturer
	Remove sediment, oil, grease and floatables	As necessary – indicated by system inspections or immediately following a significant spill
Remedial actions	Replace malfunctioning parts or structures	As required
Monitoring	Inspect for evidence of poor operation	Six monthly
	Inspect filter media and replace appropriate replacement frequencies	Six monthly
	Inspect sediment accumulation rates and establish appropriate removal frequencies	Monthly during first half year of operation, then every six months

Cellular Storage (Table 21.3 SuDS C753)

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risks to performance	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface of filter for blockage by sediment, algae or other matter; remove and replace as surface infiltration medium as necessary	Annually
	Remove sediment from pre-treatment structures and internal forebays	Annually, or as required
Remedial actions	Repair / rehabilitate inlets, outlets, overflows & vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5years or as required

Pervious Pavements (Table 20.15 SuDS C753)

Maintenance Schedule	Required Action	Typical Frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole service)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturers recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this is most likely to cause the most sediment
Occasional maintenance	Stabilise and mow contributing adjacent areas	As required
	Removal of weeds or management using glyphosphate applied directly to the weeds by an applicator rather than spraying	As required – once a per year on less frequently used pavements

Remedial actions	Remediate any landscape which, through vegetation maintenance or soil slip, has been raised to within the 50mm of the level of the paving	As required
	Remedial work to any depressions rutting and cracked blocks considered detrimental to the structural performance or a hazard to users , and replace lost jointing material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10- 15years or as required (if infiltration performance is reduced due to clogging)
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48hours after a large storm in first 6months
	Inspect for silt accumulation rates and establish appropriate brushing frequencies	Annually
	Minor Inspection chambers	Annually