Land at 19 Underhill Road, Matson, Gloucester GL4 6HB Residential development Surface and Foul Water Drainage Strategy Reference CWC166

Corner Water
CONSULTING

Contents

Quality assurance record

Contributors for Corner Water Consulting:

Name	Role
[redacted]	Project Director

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1. Introduction

1.1 Purpose of this Report

This report presents a Surface Water Management Plan (SWMP) and Foul Water Drainage Strategy (FDS) for the construction of a new dwelling at the rear of 19 Underhill Road, Matson, Gloucester, GL4 6HB. The report has been prepared for RRA Architects Ltd working with Lee Williams.

1.1.1 Sources of Information and Consultation

This Report has been informed by the following:

- Location and site plans;
- The National Planning Policy Framework (NPPF);
- DEFRA's non-statutory technical standards for SuDS;
- The Building Regulations Part H;
- Gloucestershire County Council Strategic Flood Risk Assessment for Minerals and Waste Development Framework (2008)
- Gloucestershire County Council Strategic Flood Risk Assessment Level 1 Executive Summary (2008)
- Gloucestershire Local Flood Risk Management Strategy: Summary Document (2014)
- Gloucestershire Local Flood Risk Management Strategy: Main Document (Summer 2014)
- CIRIA 'SuDS Manual' C753;
- Government published flood data.

1.2 Structure of this Report

The Report has been structured in order to deal with key flood, surface water and foul drainage related issues, and also relate to the NPPF Practice Guide. The structure of the report is as follows:

- Section 1 presents the purpose and structure of the report.
- Section 2 refers to spatial planning considerations.
- Section 3 details the existing site arrangements.
- Section 4 presents the proposed redevelopment plans and the SWMP for the site.
- Section 5 describes foul water management strategy.
- Section 6 provides a summary of findings.
- Section 7 details the documents referenced.

Additional Appendices are provided that deal with the following.

- Appendix A – Soil Testing Calculations
- Appendix B – Gloucester City Drainage Comments
- Appendix C – Drainage Design outputs

2. Spatial Planning Considerations

2.1 Location and Background

The proposals comprise:

i) a new dwelling with parking at the rear of 19 Underhill Road;
ii) a new driveway past 19 Underhill Road within the garden of number 19.

The site is located within the residential curtilage of 19 Underhill Road, Matson, Gloucester GL4 6HB. The Location Plan, Aerial View and Development Block Plan are shown in Figure 1, Figure 2 and Figure 3 respectively. The site application boundary is shown in red and land owned by the applicant is outlined in blue. The site is in Flood Zone 1 and is thus appropriate for housing.

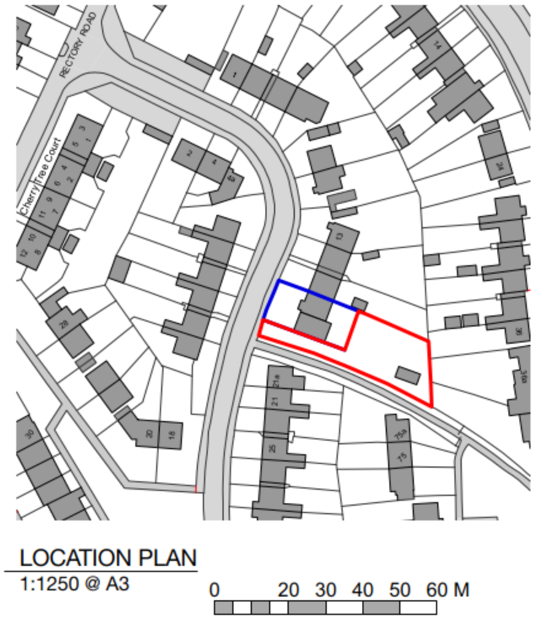


Figure 1: Location Plan

Figure 2: Site location plan (Aerial View)
Microsoft product screen shot(s) reprinted with permission from Microsoft Corporation. Source: Bing Maps

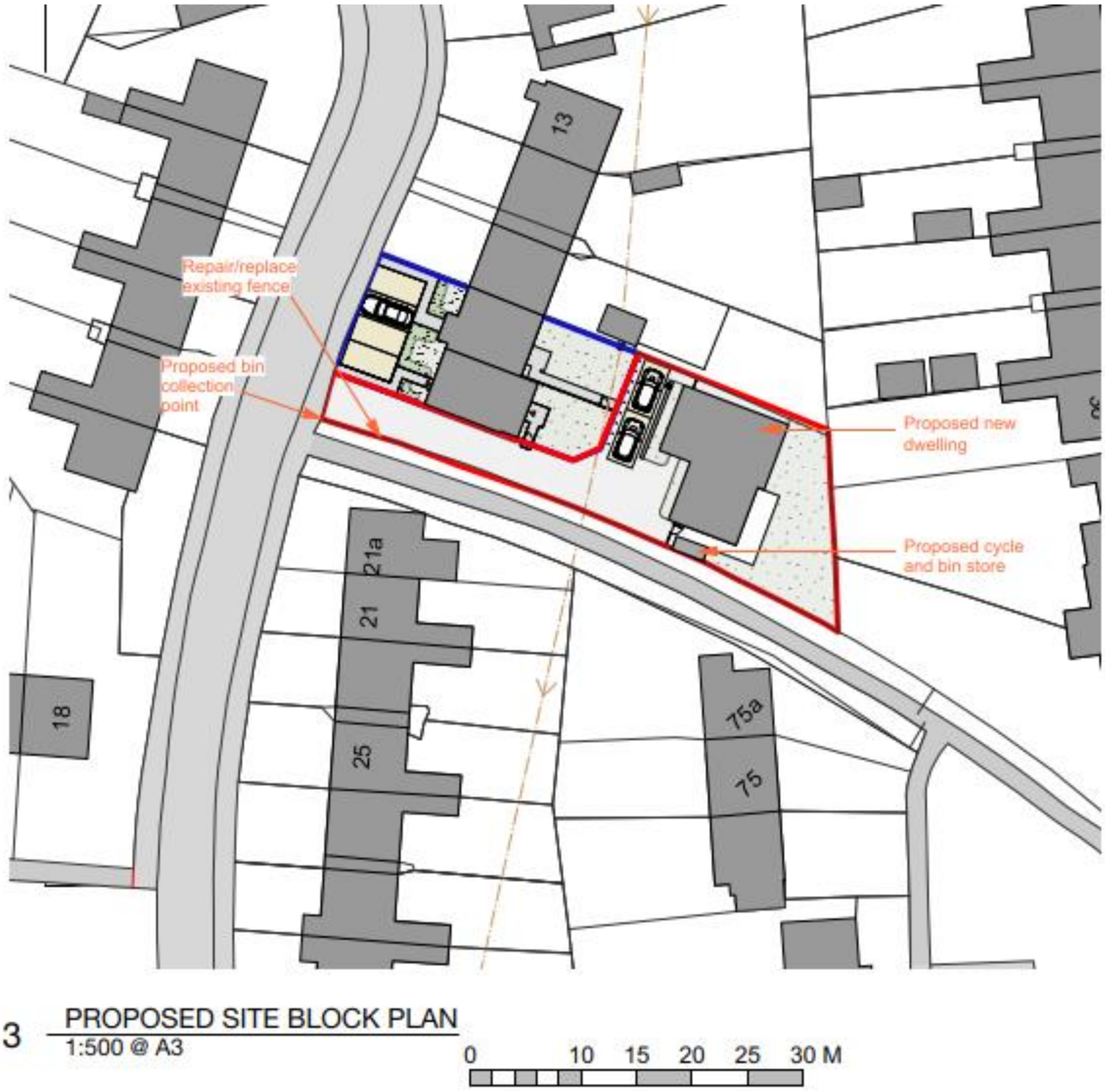


Figure 3: Proposed Block Plan

3. Existing Arrangements

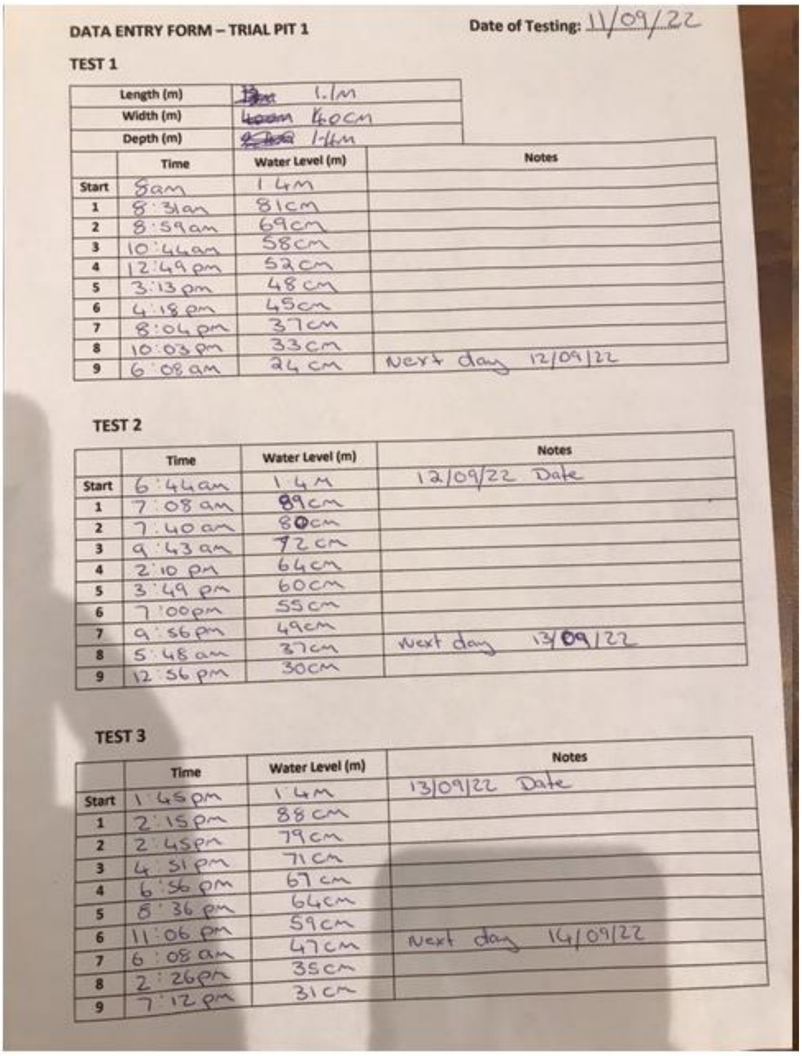
3.1 Flood Risk

Gloucester City Council have agreed:

- that the site is located in Flood Zone 1 and considered to be at low risk from both fluvial and pluvial flooding. A Flood Risk Assessment is not required.
- to ensure that flood risk elsewhere is not compromised, a drainage strategy will be required. This needs to detail surfacing details of any hardstanding areas (pavements, parking, access roads - the use of permeable paving will be preferrable) in additional to showing and documenting how the additional run-off from the site is managed to greenfield rates.

3.2 Site-specific ground investigations

A water table test pit was dug at 2.4 m deep and no water was found. Two BRE365 tests were undertaken each being 1.4m deep, 0.4m wide and 1.1m long. Infiltration testing and a groundwater level assessment were carried out on site in September 2022. The ground investigations both showed the same permeability in the soil. The ground investigation data may be found in Appendix A.



DATA ENTRY FORM – TRIAL PIT 1 Date of Testing: 11/09/22

TEST 1

Length (m)	~~[illegible]~~ 1.1M
Width (m)	~~400m~~ 40CM
Depth (m)	~~[illegible]~~ 1.4M

	Time	Water Level (m)	Notes
Start	8am	1.4M	
1	8:31am	81cm	
2	8:59am	69cm	
3	10:44am	58cm	
4	12:49pm	52cm	
5	3:13pm	48cm	
6	4:18pm	45cm	
7	8:04pm	37cm	
8	10:03pm	33cm	
9	6:08am	24cm	Next day 12/09/22

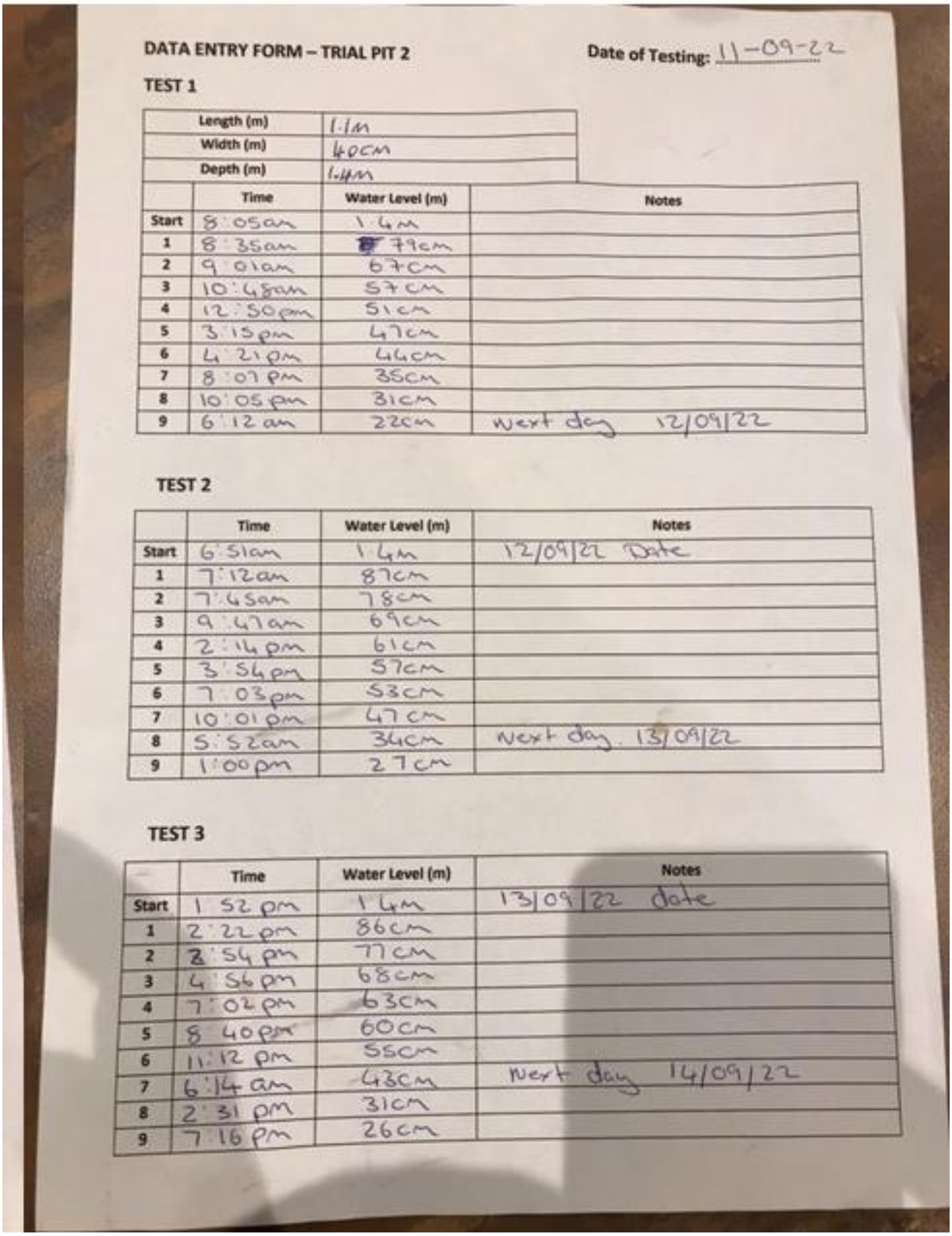
TEST 2

	Time	Water Level (m)	Notes
Start	6:44am	1.4M	12/09/22 Date
1	7:08am	89cm	
2	7:40am	80cm	
3	9:43am	72cm	
4	2:10pm	64cm	
5	3:49pm	60cm	
6	7:00pm	55cm	
7	9:56pm	49cm	
8	5:48am	37cm	Next day 13/09/22
9	12:56pm	30cm	

TEST 3

	Time	Water Level (m)	Notes
Start	1:45pm	1.4M	13/09/22 Date
1	2:15pm	88cm	
2	2:45pm	79cm	
3	4:51pm	71cm	
4	6:56pm	67cm	
5	8:36pm	64cm	
6	11:06pm	59cm	
7	6:08am	47cm	Next day 14/09/22
8	2:26pm	35cm	
9	7:12pm	31cm	

Figure 4: BRE Test Pit 1 Measurements



DATA ENTRY FORM – TRIAL PIT 2

Date of Testing: 11-09-22

TEST 1

Length (m)	1.1m
Width (m)	40cm
Depth (m)	1.4m

	Time	Water Level (m)	Notes
Start	8:05am	1.4m	
1	8:35am	79cm	
2	9:01am	67cm	
3	10:48am	57cm	
4	12:50pm	51cm	
5	3:15pm	47cm	
6	4:21pm	44cm	
7	8:07pm	35cm	
8	10:05pm	31cm	
9	6:12am	22cm	Next day 12/09/22

TEST 2

	Time	Water Level (m)	Notes
Start	6:51am	1.4m	12/09/22 Date
1	7:12am	87cm	
2	7:45am	78cm	
3	9:47am	69cm	
4	2:14pm	61cm	
5	3:54pm	57cm	
6	7:03pm	53cm	
7	10:01pm	47cm	
8	5:52am	34cm	Next day. 13/09/22
9	1:00pm	27cm	

TEST 3

	Time	Water Level (m)	Notes
Start	1:52pm	1.4m	13/09/22 date
1	2:22pm	86cm	
2	3:54pm	77cm	
3	4:56pm	68cm	
4	7:02pm	63cm	
5	8:40pm	60cm	
6	11:12pm	55cm	
7	6:14am	43cm	Next day 14/09/22
8	2:31pm	31cm	
9	7:16pm	26cm	

Figure 5: BRE Test Pit 2 Measurements

Table 1 - Summary of ground investigations

Trial pit test	Infiltration rate (m/hr)
INF1-1	0.0095
INF1-2	0.0049
INF1-3	0.005
Average	**0.0065**
INF2-1	0.01
INF2-2	0.0054
INF2-3	0.0056
Average	**0.007**

3.3 Site-specific Area and Topography

The site covers around 390m^2, and the existing site levels fall about 1.1m from Underhill Road along the driveway to the rear of the existing dwelling. The area where the new dwelling is located falls from the northern tip to the southern tip – with a level difference of some 1.7m, see Figure 6. There are no finished levels but it is expected that the new driveway will fall as existing, with finished levels around the new dwelling being relatively flat.

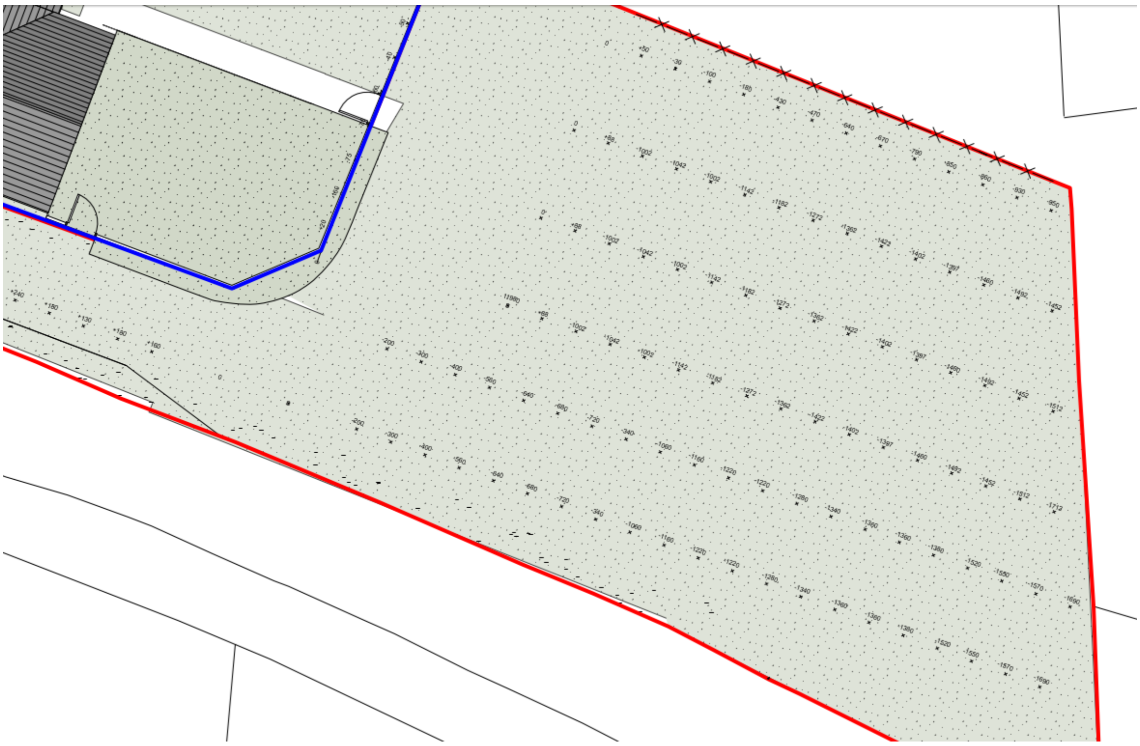


Figure 6 – Topographic Data

4. SURFACE WATER MANAGEMENT PLAN

4.1 Development proposals

The development comprises:

- the construction of a new residential dwelling (roof area 100m^2);
- permeable parking area 110m^2 and 400mm deep voided stone sub-base for additional strength due to turning, which also provides additional storage;
- new section of permeable driveway - 50m^2 and 300mm deep voided stone sub-base, with regular check dams.

The proposed site plan and details are shown in Figure 8 and Figure 9 which are extracts of RRA Architects' drawings ref. 3754-P(1)-01 to 02, plus P(2)-01 to 02.

To allow the drainage to be designed a nominal datum of 100m has been taken at the southern tip of the garden and all other levels have been taken from the topographic survey. As the existing garden slopes up from the southeast tip all other levels are higher. Around the dwelling it is assumed there will be some earthworks to create a level of around 100.7m.

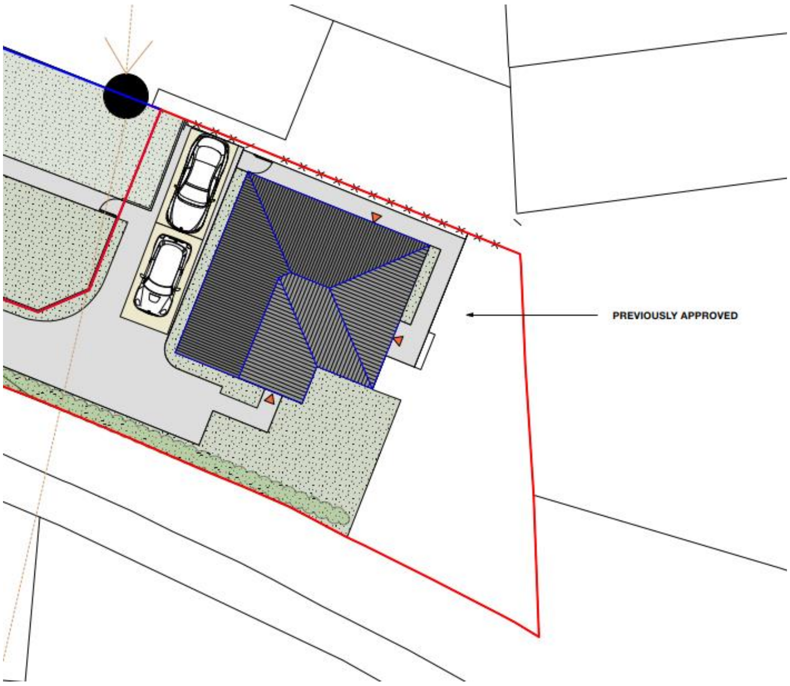


Figure 7 – Previously Approved Development

Figure 8 – Proposed Site Layout

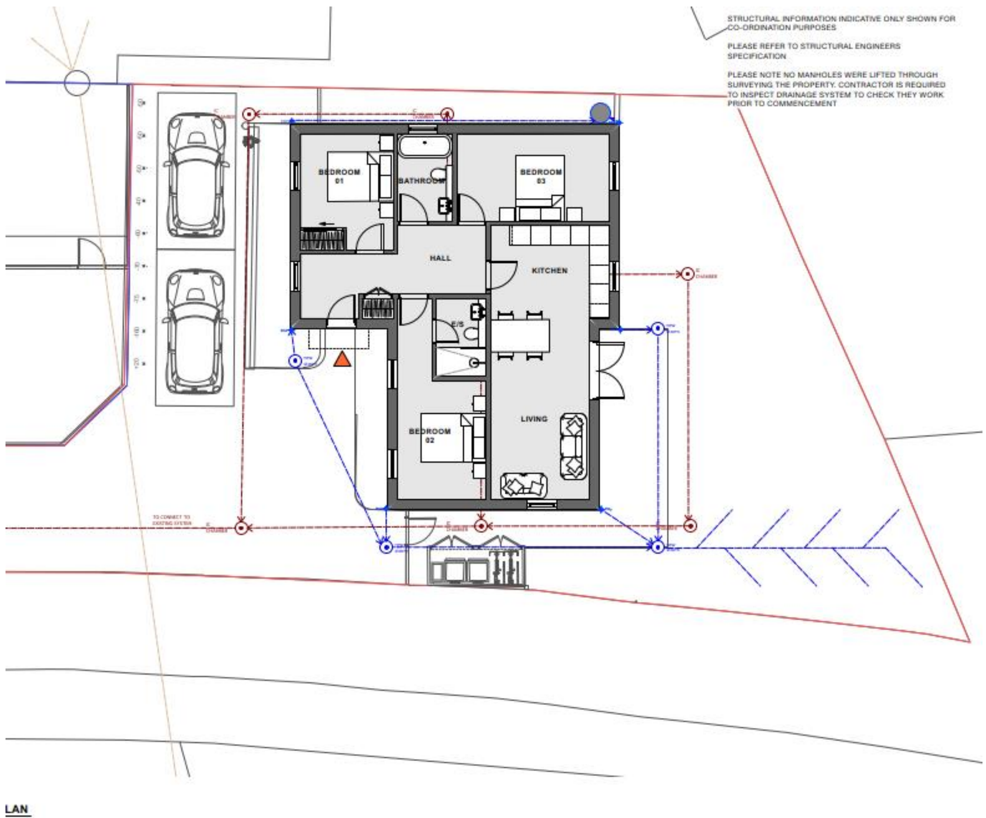


Figure 9 – Proposed Layout Including Internal Arrangement and Preliminary Drainage

4.2 Design Soil Infiltration Rate

According to the ground investigations undertaken on site the soil is similar and is viable for soakaways, even at 1.4m deep. Nearer the surface the soil shows greater capacity but as a specific shallow test pit was not undertaken the design values use the 1.4m deep twin test pits, taking the lower of the two averages. An infiltration rate of 0.0065 m/hr has therefore been adopted as the design value.

4.3 Mitigation of Off-Site Impacts (Surface Water Management Plan)

According to the National Planning Policy Framework, surface water drainage from new developments should be discharged in the following order of priority:

- Into the ground (infiltration);
- To a surface water body;
- To a surface water sewer, highway drain, or other drainage system;

The philosophy to manage surface water runoff from the new dwelling is to infiltrate runoff into the soil.

As with all soakaway designs a factor of safety has been allowed, using FoS of 2.0. Also the infiltration features include a freeboard amount as they have all been designed to be larger than required to accommodate the 1 in 100 year plus climate change event. The parking area soakaway has a peak water level of 370mm and the stone sub-base layer is 400mm deep below 100mm of block paving. It half drains 552 minutes, or a little over 9 hours, and is thus a completely viable SuDS solution. The drive has a peak water level of 168mm within 300mm of stone sub-base and half drains in 277 minutes or 4.6 hours. The raingarden stores 9.8m^3 at a peak water level of 87mm within 150mm of open storage and has an outflow of 0.1 l/s, so it will half drain in around 14 hours. As the parking and the raingarden are downslope of the drive any exceedance rainfall would first fill each of the storage areas before flowing overland into the raingarden on the eastern side of the garden and this is the route that excess rainfall currently takes.

Node Parking S-A Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00650	Safety Factor	2.0	Invert Level (m)	100.200
Side Inf Coefficient (m/hr)	0.00650	Porosity	0.30	Time to half empty (mins)	552

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	110.0	110.0	0.400	110.0	112.0	0.401	0.0	112.0	0.500	0.0	112.0

Node Rain Garden Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00650	Safety Factor	2.0	Invert Level (m)	100.300
Side Inf Coefficient (m/hr)	0.00650	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	110.0	110.0	0.250	120.0	113.0

Node Drive Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00650	Safety Factor	2.0	Invert Level (m)	101.600
Side Inf Coefficient (m/hr)	0.00650	Porosity	0.30	Time to half empty (mins)	277

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	50.0	50.0	0.300	50.0	50.0	0.301	0.0	50.0	0.400	0.0	50.0

Figure 10 – SuDS Storage Details

In terms of the drainage arrangements to manage runoff arising from the increase in impermeable areas, the strategy is divided in three parts:

- a permeable paved driveway that accepts incident rainfall and discharges it into the soil below the driveway;

- the new building roof discharges partly into the parking area by the dwelling. This is permeable paving so as well as the roof inflows it accepts incident rainfall and discharges it into the soil below the driveway;
- the new building roof discharges partly into the rain garden area East of the dwelling. This is a slightly sunken area that allows rainwater to gather, be retained and enter the soil. It is shown to have a peak water level of 87mm in the 1 in 100-year plus 40% Climate Change event so should be constructed 150mm deep. To allow the rainwater to follow SuDS approach the rainwater downpipes will be fitted with 45 degree shoes to provide downpipe disconnection and direct inflows into the raingarden.

In line with the drainage hierarchy set out in the National Planning Policy Framework, the proposals for the finishing materials of the driveway and parking will comprise permeable paving to promote infiltration of rainfall and runoff generated within this area into the surrounding soil. To the east of the dwelling a second diffuse soakaway area via a rain-garden will be present.

The driveway is to be constructed of a permeable block paving plus a permeable block paved car parking area is proposed, such as detailed in Chapter 25 of the SuDS Manual 2015. Using information published by Interpave, who are the Precast Concrete Paving and Kerb Association, which is compatible with the SuDS Manual 2015, the sub-base for structural requirements would be at least 300mm assuming cars and light commercial vehicles.

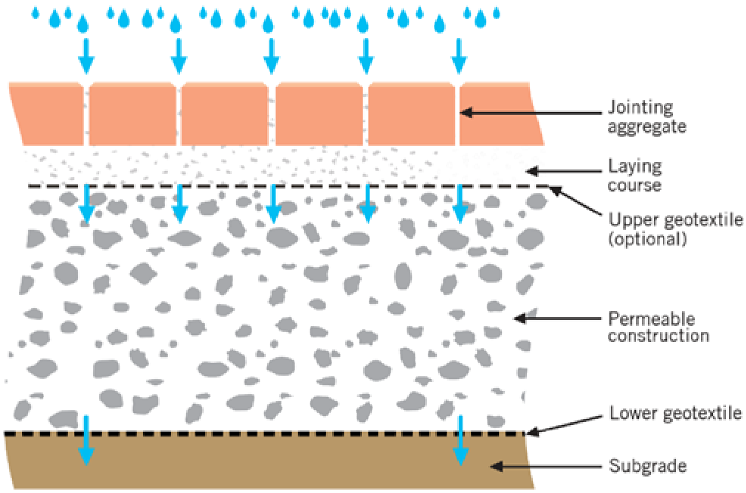


Figure 11: Permeable Block Paving Construction Details

The characteristics of the attenuation storage was analysed using the Flow module of the industry leading Causeway Drainage Design suite of software developed by Causeway Technologies Ltd. The following conservative assumptions and design parameters were applied within the design process.

- Point rainfalls were obtained using the FSR methodology and increased by 40% to allow for climate change, in line with the requirements of NPPF and the council.

- The impermeable areas proposed on site were measured and connected to the infiltration SuDS elements.

- The parking and driveways are permeable surfaced, however as they absorb all of the rainfall landing directly upon them and then discharge it through the base they have been assessed as impermeable/part of the contributing area.

- 100% of rainfall is taken as runoff from the proposed impermeable plus permeable surfaces and is routed into the storage.
- A 30% void ratio has been used as appropriate for Type 3 sub-base, corresponding to stone filled trenches and pervious surfaces sub-base.

As recommended by Interpave energy dissipation will be taken into account. As such under the downpipes there will be a larger slab than the blocks. The block paving will then be laid at the same level up to the edge of the slab.

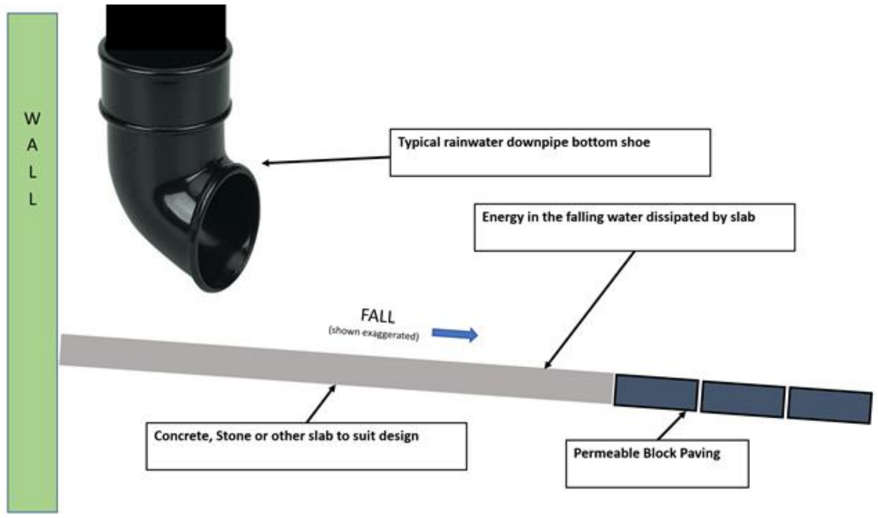


Figure 12: Downpipe Energy Dissipation and Direct Flow to Paving

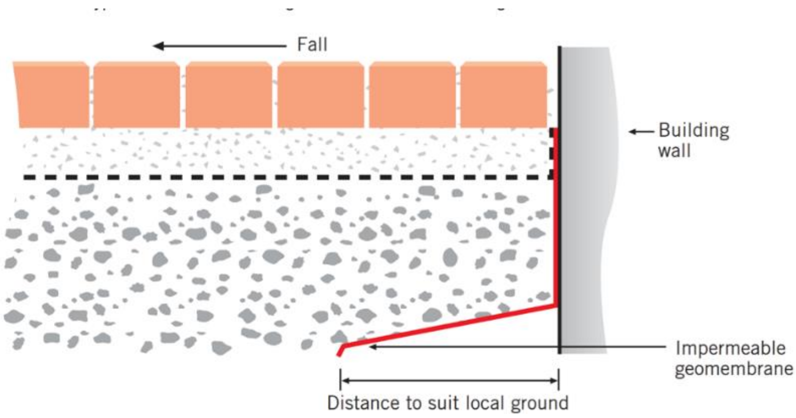


Figure 13: Permeable Paving Close to Buildings

The new driveway plus parking will all be permeable paving, the grassed area will function as a rain-garden, and as such both of these SuDS elements are diffuse soakaways that can be positioned close to a building, as detailed by Steve Wilson and SusDrain in publication "1209 Fact Sheet Using SuDS Close to Buildings" September 2012 and the SuDS Manual.

If the structural engineer requires an impermeable membrane can be introduced near the building wall – although this should not be required according to SuDS principles and Susdrain factsheet Using SuDS Close to Buildings published September 2021.

The design details of the drainage networks elements are shown in Figure 14 to Figure 17.

Figure 14: Drive and Parking Catchments and SuDS

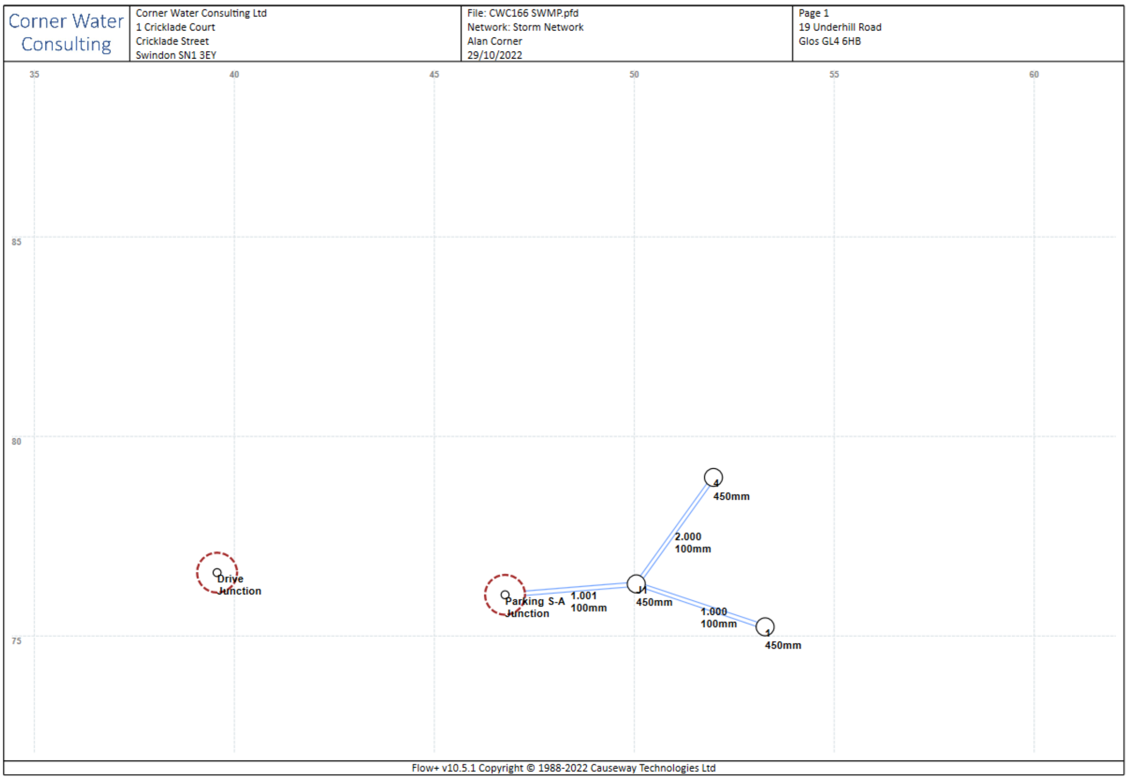


Figure 15: Plan of Storage plus Infiltration SuDS in Drive and Parking

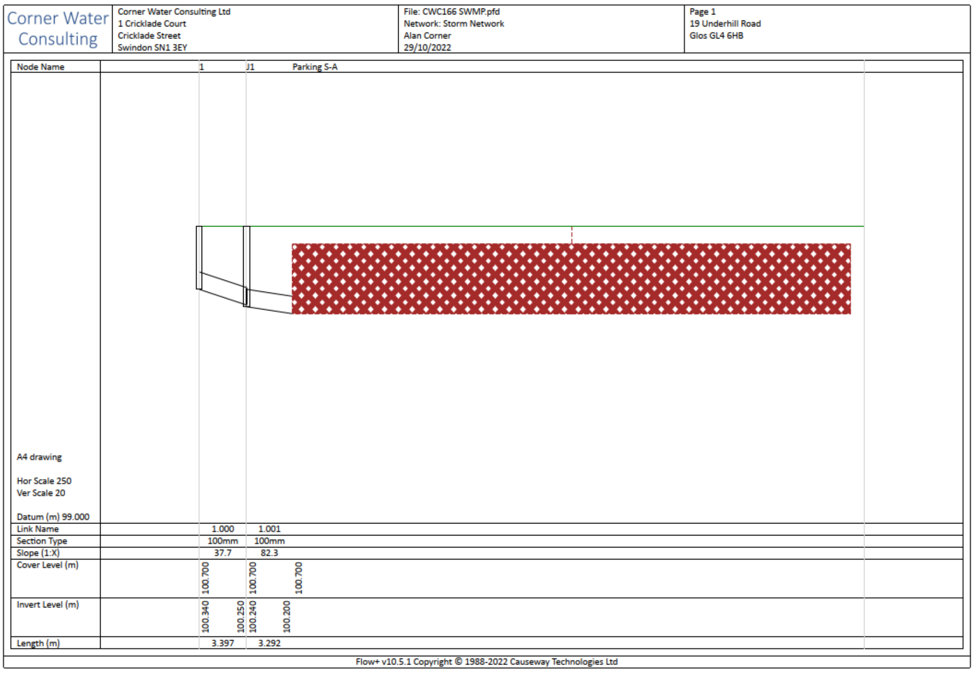


Figure 16: Long Section of Storage plus Infiltration SuDS in Parking

Figure 17: East Part of Roof to Rain Garden - Catchments and SuDS

Regarding the drainage arrangements to manage runoff from the roof of the new replacement dwelling these follow DEFRA's ''Non-Statutory Technical Standards for Sustainable Drainage Systems (SuDS)'' plus Gloucestershire County Council SuDS Guidance. According to these sources, post-development runoff should be attenuated to greenfield runoff rates up to the 1% AEP, including a 40% climate change allowance in line with the latest guidance of the National Planning Policy Framework. In addition to the 40% climate change allowance, the design has additional capacity to cater for any urban creep, noting that due to the small plot this is very limited given that there is only a small grassed area – the rain garden - and this is already acting as a soakaway and is therefore dealing will all incident rainfall anyway.

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 98.16%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	1	464	100.571	0.230	0.2	0.0751	0.0000	FLOOD RISK
480 minute winter	Parking S-A	464	100.570	0.370	1.4	12.4886	0.0000	OK
480 minute winter	J1	464	100.570	0.330	0.4	0.0525	0.0000	FLOOD RISK
480 minute winter	Rain Garden	472	100.387	0.087	1.0	9.8073	0.0000	OK
360 minute winter	Drive	352	101.768	0.168	0.4	2.5523	0.0000	OK
480 minute winter	4	472	100.570	0.230	0.2	0.0751	0.0000	FLOOD RISK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
480 minute winter	1	1.000	J1	0.2	0.400	0.020	0.0266
480 minute winter	Parking S-A	Infiltration		0.1			
480 minute winter	J1	1.001	Parking S-A	0.3	0.115	0.052	0.0258
480 minute winter	Rain Garden	Infiltration		0.1			
360 minute winter	Drive	Infiltration		0.0			
480 minute winter	4	2.000	J1	0.2	0.404	0.019	0.0258

Figure 18: Results of 1 in 100-year plus 40% Climate Change Rainfall Event

The Flow Causeway hydraulic drainage design reports and outputs for the surface water drainage system serving the dwelling can be found in Appendix C.

From a water quality point of view, the greatest source of pollution is the traffic in the internal access road of the development. Any pollutants arising from traffic within the site will however be removed as surface water runoff percolates through the various layers of the pervious pavement. Regarding any debris carried in roof drainage, silt traps will ensure the removal of any suspended solids.

The surface water drainage strategy for the proposed development is therefore in line with the Gloucestershire County Council SuDS guide, plus Policy INF2 of the Joint Core Strategy to Gloucester, Cheltenham and Tewkesbury, by ensuring adverse impacts on water quantity, plus water quality are avoided and the development includes appropriate sustainable urban drainage systems.

The operation and maintenance requirements for permeable paving and a dry basin are shown in Table 2 and Table 3.

Table 2 – CIRIA SuDS Operation and maintenance for permeable paving

TABLE 20.15 Operation and maintenance requirements for pervious pavements

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required, based on site-specific observations of clogging or manufacturer's recommendations – pay particular attention to areas where water runs onto pervious surface from adjacent impermeable areas as this area is most likely to collect the most sediment
Occasional maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds or management using glyphospate applied directly into the weeds by an applicator rather than spraying	As required – once per year on less frequently used pavements
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50 mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked or broken 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 to 15 years or as required (if infiltration performance is reduced due to significant 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, 48 h after large storms in first six months
	Inspect silt accumulation rates and establish appropriate brushing frequencies	Annually
	Monitor inspection chambers	Annually

Table 3 – CIRIA SuDS Operation and maintenance for infiltration basin

TABLE 13.2 Operation and maintenance requirements for infiltration basins

Maintenance schedule	Required action	Typical frequency
Regular maintenance	Remove litter, debris and trash	Monthly
	Cut grass – for landscaped areas and access routes	Monthly (during growing season) or as required
	Cut grass – meadow grass in and around basin	Half yearly: spring (before nesting season) and autumn
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
Occasional maintenance	Reseed areas of poor vegetation growth	Annually, or as required
	Prune and trim trees and remove cuttings	As required
	Remove sediment from pre-treatment system when 50% full	As required
Remedial actions	Repair erosion or other damage by reseeding or re-turfing	As required
	Realign the rip-rap	As required
	Repair or rehabilitate inlets, outlets and overflows	As required
	Rehabilitate infiltration surface using scarifying and spiking techniques if performance deteriorates	As required
	Relevel uneven surfaces and reinstate design levels	As required
Monitoring	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect banksides, structures, pipework etc for evidence of physical damage	Monthly
	Inspect inlets and pre-treatment systems for silt accumulation; establish appropriate silt removal frequencies	Half yearly
	Inspect infiltration surfaces for compaction and ponding	Monthly

5. Foul Water Strategy

5.1 General considerations

According to The Building Regulations (2010), foul water drainage from new developments should be discharged into the following, in order of priority:

- A public sewer, or:
- A private sewer communicating with a public sewer, or;
- A septic tank which has an appropriate form of secondary treatment, or;
- A cesspool.

This new dwelling will be connected to a public foul sewer.

6. Summary and Conclusions

The main conclusions of the surface and foul water drainage strategies are summarised below.

- The site is located in Flood Zone 1, meaning a yearly chance of flooding of less than 0.1% and has no Surface Water Flood Risk so it is suitable for housing;
- Site-specific infiltration and percolation testing was undertaken in September 2022. This determined that the site is suitable for infiltration by soakaways;
- The surface water runoff generated from the roof of the new building is proposed to be conveyed to SuDS elements under the permeable parking and also to a rain-garden;
- Any exceedance flows will first fill the various amounts of freeboard and then pass to the eastern boundary as at present;
- The driveway and parking will be formed of permeable materials, with the capacity of promoting infiltration of surface water runoff into the local soil directly below;
- The new surface water drainage system was designed to cater for rainfall occurring during the 1 in 100 year return period plus allowance for climate change, or 1%AEP40CC rainfall event, from the new additional impermeable areas. This philosophy is in accordance with the County Council's SuDS Guidance, plus Policy INF2 of the Joint Core Strategy to Gloucester, Cheltenham and Tewkesbury;
- Foul drainage will connect to the public sewers;
- The foul water drainage strategy ensures flows are kept separate from surface water runoff;
- The foul water drainage strategy for the development is therefore deemed to be in line with the Building Regulations Part H, plus Policy SD3 of the Joint Core Strategy to Gloucester, Cheltenham and Tewkesbury, by ensuring the local surface water and groundwater quality is not adversely affected;
- In terms of maintenance, it is advisable that the surface water drainage system is kept free of debris by cleaning silt traps and catchpit manholes. Note that the responsibility of maintaining non-adoptable drainage systems falls with the property owners.

7. References

Author	Date	Title/Description
HM Government	2022	The Flood Map for Planning Flood map for planning - GOV.UK (flood-map-for-planning.service.gov.uk)
CIRIA	2015	The SUDS Manual – CIRIA Report C753
DEFRA	2015	National SuDS Standards
Gloucestershire County Council	2015	SuDS Design & Maintenance Guide
DCLG	2012	Technical Guidance to the National Planning Policy Framework.
Ministry of Housing, Communities and Local Government	2021	National Planning Policy Framework
HM Government	2015	The Building Regulations 2010 – Drainage and Waste Disposal Approved Document H, 2015 Edition

Appendix A – Soil Testing

Calculation sheet

Created by:	Alan Corner	Client:	RRA with Lee
Date:	28/10/2022	Project code:	CWC166
Verified by:	-	Sheet no:	2
Date:	-	Revision:	0

Calculation title: Infiltration and percolation testing

Subject: Infiltration test INF2

Soakaway test results:

Project Name:	19 Underhill Road
Location:	Matson, Gloucester
Project Ref:	CWC166
Date of Test	11/09/2022
BRE 365 test?	Yes
Percolation test ?	No

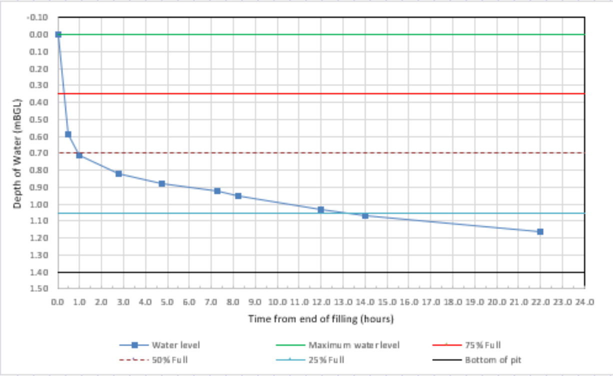
Pit ref.: INF 1 Test ref.: 1

Time (hours)	Water level (mBGL)	Effective depth (mAIL)
0.0	0.00	1.40
0.5	0.59	0.81
1.0	0.71	0.69
2.75	0.82	0.58
4.75	0.88	0.52
7.25	0.92	0.48
8.25	0.95	0.45
12.00	1.03	0.37
14.00	1.07	0.33
22.00	1.16	0.24

Trial pit dimensions:

Length: 1.1 (m) Width: 0.4 (m)

Depth: 1.4 (m)



BRE 365 auxiliary calculations:

Eff depth:	1.4	(m)
Eff depth @ 75%:	1.1	(m)
Eff depth @ 25%:	0.4	(m)
Time @ 75%:	17.8	(min)
Time @ 25%:	780.0	(min)
t_{p75-25} :	762.2	(min)
a_{p50} :	2.5	(m^2)
V_{p75-25} :	0.3	(m^3)

The Building Regs auxiliary calculations:

Eff depth:	-	(m)
Eff depth @ 75%:	-	(mm)
Eff depth @ 25%:	-	(mm)
Time @ 75%:	-	(min)
Time @ 25%:	-	(min)
t_{p75-25} :	-	(s)

Infiltration testing results:

f	2.7E-06	(m/s)	Infiltration rate calculate in accordance to the procedure outlined in the BRE Digest 365 Soakaway design
	9.5E-03	(m/hr)	Infiltration rate calculated in accordance to the procedure outlined in the BRE Digest 365 Soakaway design
V_p	N/A	(s/mm)	Average time required for water to drop 1mm, in accordance to the methodology outlined in "The Building Regulations 2010"

Rev 0 (01/2019) Infiltration and percolation testing

Calculation sheet

Created by:	Alan Corner	Client:	RRA with Lee
Date:	28/10/2022	Project code:	CWC166
Verified by:	-	Sheet no:	2
Date:	-	Revision:	0

Calculation title: Infiltration and percolation testing

Subject: Infiltration test INF2

Soakaway test results:

Project Name:	19 Underhill Road
Location:	Matson, Gloucester
Project Ref:	CWC166
Date of Test	11/09/2022
BRE 365 test?	Yes
Percolation test ?	No

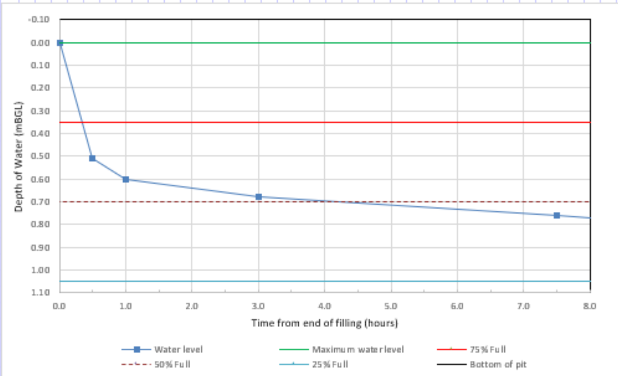
Pit ref.: INF 1 Test ref.: 2

Time (hours)	Water level (mBGL)	Effective depth (mAIL)
0.0	0.00	1.40
0.50	0.51	0.89
1.00	0.60	0.80
3.00	0.68	0.72
7.50	0.76	0.64
9.25	0.80	0.60
12.25	0.85	0.55
15.25	0.91	0.49
23.25	1.03	0.37
30.25	1.10	0.30

Trial pit dimensions:

Length: 1.1 (m) Width: 0.4 (m)

Depth: 1.4 (m)



BRE 365 auxiliary calculations:

Eff depth:	1.4	(m)
Eff depth @ 75%:	1.1	(m)
Eff depth @ 25%:	0.4	(m)
Time @ 75%:	20.6	(min)
Time @ 25%:	1515.0	(min)
t_{p75-25} :	1494.4	(min)
a_{p50} :	2.5	(m^2)
V_{p75-25} :	0.3	(m^3)

The Building Regs auxiliary calculations:

Eff depth:	-	(m)
Eff depth @ 75%:	-	(mm)
Eff depth @ 25%:	-	(mm)
Time @ 75%:	-	(min)
Time @ 25%:	-	(min)
t_{p75-25} :	-	(s)

Infiltration testing results:

f	1.4E-06	(m/s)	Infiltration rate calculate in accordance to the procedure outlined in the BRE Digest 365 Soakaway design
	4.9E-03	(m/hr)	Infiltration rate calculated in accordance to the procedure outlined in the BRE Digest 365 Soakaway design
V_p	N/A	(s/mm)	Average time required for water to drop 1mm, in accordance to the methodology outlined in "The Building Regulations 2010"

Rev 0 (01/2019) Infiltration and percolation testing

Calculation sheet

Calculation title:	Infiltration and percolation testing	Created by:	Alan Comer	Client:	RRA with Lee
		Date:	28/10/2022	Project code:	CWC166
Subject:	Infiltration test INF2	Verified by:	-	Sheet no:	2
		Date:	-	Revision:	0

Soakaway test results:

Project Name:	19 Underhill Road
Location:	Matson, Gloucester
Project Ref:	CWC166
Date of Test	11/09/2022
BRE 365 test?	Yes
Percolation test ?	No

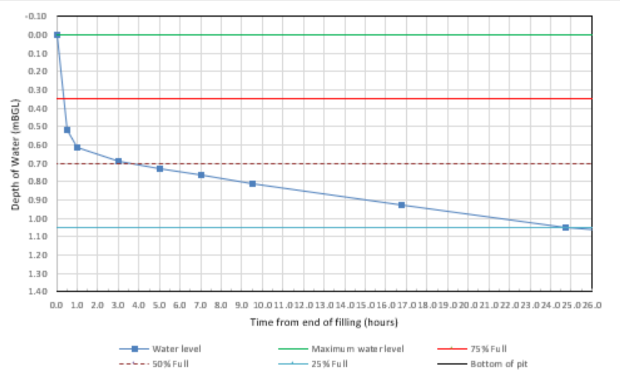
Pit ref.: INF 1 Test ref.: 3

Time (hours)	Water level (mBGL)	Effective depth (mAIL)
0.0	0.00	1.40
0.50	0.52	0.88
1.00	0.61	0.79
3.00	0.69	0.71
5.00	0.73	0.67
7.00	0.76	0.64
9.50	0.81	0.59
16.75	0.93	0.47
24.75	1.05	0.35
29.50	1.09	0.31

Trial pit dimensions:

Length: 1.1 (m) Width: 0.4 (m)

Depth: 1.4 (m)



Infiltration testing results:

f	1.4E-06	(m/s)	Infiltration rate calculate in accordance to the procedure outlined in the BRE Digest 365 Soakaway design
f	5.0E-03	(m/hr)	Infiltration rate calculated in accordance to the procedure outlined in the BRE Digest 365 Soakaway design
V_p	N/A	(s/mm)	Average time required for water to drop 1mm, in accordance to the methodology outlined in 'The Building Regulations 2010'

BRE 365 auxiliary calculations:

Eff depth:	1.4	(m)
Eff depth @ 75%:	1.1	(m)
Eff depth @ 25%:	0.4	(m)
Time @ 75%:	20.2	(min)
Time @ 25%:	1485.0	(min)
t_{p75-25} = :	1464.8	(min)
a_{p50} :	2.5	(m^2)
V_{p75-25} :	0.3	(m^3)

The Building Regs auxiliary calculations:

Eff depth:	-	(m)
Eff depth @ 75%:	-	(mm)
Eff depth @ 25%:	-	(mm)
Time @ 75%:	-	(min)
Time @ 25%:	-	(min)
t_{p75-25} = :	-	(s)

Rev 0 (01/2019) Infiltration and percolation testing

Calculation sheet

Calculation title:	Infiltration and percolation testing	Created by:	Alan Comer	Client:	RRA with Lee
		Date:	28/10/2022	Project code:	CWC166
Subject:	Infiltration test INF1	Verified by:	-	Sheet no:	1
		Date:	-	Revision:	0

Soakaway test results:

Project Name:	19 Underhill Road
Location:	Matson, Gloucester
Project Ref:	CWC166
Date of Test	11/09/2022
BRE 365 test?	Yes
Percolation test ?	No

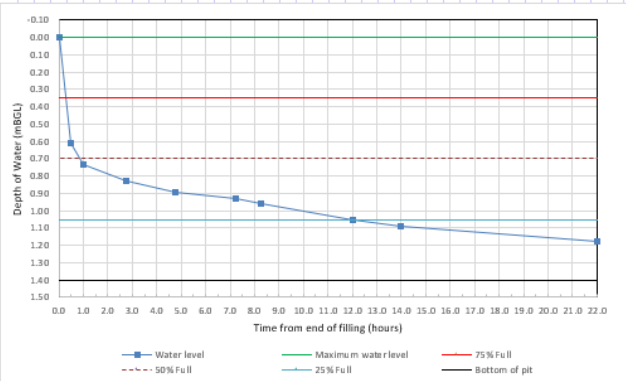
Pit ref.: INF 2 Test ref.: 1

Time (hours)	Water level (mBGL)	Effective depth (mAIL)
0.0	0.00	1.40
0.50	0.61	0.79
1.00	0.73	0.67
2.75	0.83	0.57
4.75	0.89	0.51
7.25	0.93	0.47
8.25	0.96	0.44
12.00	1.05	0.35
14.00	1.09	0.31
22.00	1.18	0.22

Trial pit dimensions:

Length: 1.1 (m) Width: 0.4 (m)

Depth: 1.4 (m)



Infiltration testing results:

f	2.9E-06	(m/s)	Infiltration rate calculated in accordance to the procedure outlined in the BRE Digest 365 Soakaway design
f	1.04E-02	(m/hr)	Infiltration rate calculated in accordance to the procedure outlined in the BRE Digest 365 Soakaway design
V_p	N/A	(s/mm)	Average time required for water to drop 1mm, in accordance to the methodology outlined in 'The Building Regulations 2010'

BRE 365 auxiliary calculations:

Eff depth:	1.4	(m)
Eff depth @ 75%:	1.1	(m)
Eff depth @ 25%:	0.4	(m)
Time @ 75%:	17.2	(min)
Time @ 25%:	720.0	(min)
t_{p75-25} = :	702.8	(min)
a_{p50} :	2.5	(m^2)
V_{p75-25} :	0.3	(m^3)

The Building Regs auxiliary calculations:

Eff depth:	-	(m)
Eff depth @ 75%:	-	(mm)
Eff depth @ 25%:	-	(mm)
Time @ 75%:	-	(min)
Time @ 25%:	-	(min)
t_{p75-25} = :	-	(s)

Rev 1 (03/2022) Infiltration and percolation testing

Calculation sheet

Calculation title:	Infiltration and percolation testing	Created by:	Alan Comer	Client:	RRA with Loo
		Date:	28/10/2022	Project code:	CWC166
Subject:	Infiltration test INF1	Verified by:	-	Sheet no.:	1
		Date:	-	Revision:	0

Soakaway test results:

Project Name:	19 Underhill Road
Location:	Matson, Gloucester
Project Ref:	CWC166
Date of Test	11/09/2022
BRE 365 test?	Yes
Percolation test ?	No

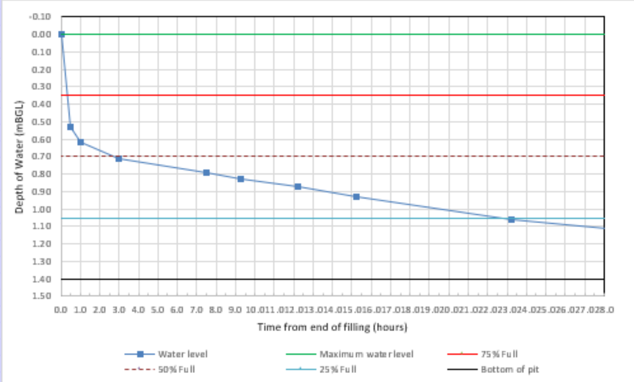
Pit ref.: INF 2   Test ref.: 2

Time (hours)	Water level (mBGL)	Effective depth (mAIL)
0.0	0.00	1.40
0.50	0.53	0.87
1.00	0.62	0.78
3.00	0.71	0.69
7.50	0.79	0.61
9.25	0.83	0.57
12.25	0.87	0.53
15.25	0.93	0.47
23.25	1.06	0.34
30.25	1.13	0.27

Trial pit dimensions:

Length: 1.1 (m)   Width: 0.4 (m)

Depth: 1.4 (m)



BRE 365 auxiliary calculations:

Eff depth:	1.4	(m)
Eff depth @ 75%:	1.1	(m)
Eff depth @ 25%:	0.4	(m)
Time @ 75%:	19.8	(min)
Time @ 25%:	1358.1	(min)
t_{p75-25} = :	1338.3	(min)
a_{p50} :	2.5	(m^2)
V_{p75-25} :	0.3	(m^3)

The Building Regs auxiliary calculations:

Eff depth:	-	(m)
Eff depth @ 75%:	-	(mm)
Eff depth @ 25%:	-	(mm)
Time @ 75%:	-	(min)
Time @ 25%:	-	(min)
t_{p75-25} = :	-	(s)

Infiltration testing results:

f	1.5E-06	(m/s)	Infiltration rate calculated in accordance to the procedure outlined in the BRE Digest 365 Soakaway design
f	5.44E-03	(m/hr)	Infiltration rate calculated in accordance to the procedure outlined in the BRE Digest 365 Soakaway design
V_p	N/A	(s/mm)	Average time required for water to drop 1mm, in accordance to the methodology outlined in 'The Building Regulations 2010'

Rev 1 (03/2022)   Infiltration and percolation testing

Calculation sheet

Calculation title:	Infiltration and percolation testing	Created by:	Alan Comer	Client:	RRA with Loo
		Date:	28/10/2022	Project code:	CWC166
Subject:	Infiltration test INF1	Verified by:	-	Sheet no.:	1
		Date:	-	Revision:	0

Soakaway test results:

Project Name:	19 Underhill Road
Location:	Matson, Gloucester
Project Ref:	CWC166
Date of Test	11/09/2022
BRE 365 test?	Yes
Percolation test ?	No

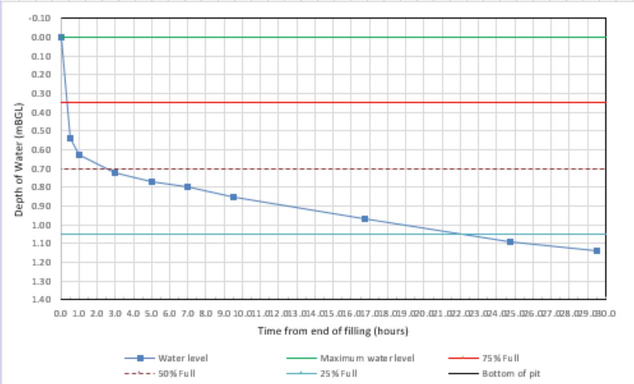
Pit ref.: INF 2   Test ref.: 3

Time (hours)	Water level (mBGL)	Effective depth (mAIL)
0.0	0.00	1.40
0.50	0.54	0.86
1.00	0.63	0.77
3.00	0.72	0.68
5.00	0.77	0.63
7.00	0.80	0.60
9.50	0.85	0.55
16.75	0.97	0.43
24.75	1.09	0.31
29.50	1.14	0.26

Trial pit dimensions:

Length: 1.1 (m)   Width: 0.4 (m)

Depth: 1.4 (m)



BRE 365 auxiliary calculations:

Eff depth:	1.4	(m)
Eff depth @ 75%:	1.1	(m)
Eff depth @ 25%:	0.4	(m)
Time @ 75%:	19.4	(min)
Time @ 25%:	1325.0	(min)
t_{p75-25} = :	1305.6	(min)
a_{p50} :	2.5	(m^2)
V_{p75-25} :	0.3	(m^3)

The Building Regs auxiliary calculations:

Eff depth:	-	(m)
Eff depth @ 75%:	-	(mm)
Eff depth @ 25%:	-	(mm)
Time @ 75%:	-	(min)
Time @ 25%:	-	(min)
t_{p75-25} = :	-	(s)

Infiltration testing results:

f	1.5E-06	(m/s)	Infiltration rate calculated in accordance to the procedure outlined in the BRE Digest 365 Soakaway design
f	5.6E-03	(m/hr)	Infiltration rate calculated in accordance to the procedure outlined in the BRE Digest 365 Soakaway design
V_p	N/A	(s/mm)	Average time required for water to drop 1mm, in accordance to the methodology outlined in 'The Building Regulations 2010'

Rev 1 (03/2022)   Infiltration and percolation testing

Appendix B – Gloucester City Drainage Comments

From: [redacted]
Sent: Monday, June 13, 2022 4:25 PM
To: Development Control <Development.Control@gloucester.gov.uk>
Cc: [redacted]
Subject: FW: Consultation request for 22/00241/FUL (19 Underhill Rd) [MATSON]

Comments in relation to above development.

Site is located in Flood Zone 1 and considered to be at low risk from both fluvial and pluvial flooding. A Flood Risk Assessment is not required.

To ensure that flood risk elsewhere is not compromised, a drainage strategy will be required. This needs to detail surfacing details of any hardstanding areas (pavements, parking, access roads - the use of permeable paving will be preferrable) in additional to showing and documenting how the additional run-off from the site is managed to greenfield rates.

From the outline plan the proposal is to construct what appears to be a soakaway field. This will need to be proven that the ground can accept the run-off (percolation test to BRE365 supported by site photographs of the test) and that it is designed to manage the 100yr +40% climate change design rainfall for it's critical duration. Furthermore, it must be demonstrated that it will meet building regulations (5m from any property or road) and have a maintenance schedule.

If the soakaway is not feasible alternative SUDS designs will need to be submitted and approved; this will again require to meet the LPA criteria of 100yr +40% climate change design rainfall for it's critical duration. Alternatives could include the use of any permeable pavement to have storage (crates or stone) however any design needs to be supported by design calculations.

Unfortunately, this needs to be agreed upfront; until I receive this information and design calculations I am unable to fully assess the flood risk.

Overall I have no objections to the development but a robust and workable drainage strategy needs to be agreed up front.

Regards,

[redacted]

Environment Officer - Flood Management

Place	[redacted]
Gloucester City Council	
Shire Hall	[redacted]
Westgate Street	www.gloucester.gov.uk
Gloucester, GL1 2TG	

Appendix C – Drainage Design Outputs

Corner Water Consulting	Corner Water Consulting Ltd 1 Cricklade Court Cricklade Street Swindon SN1 3EY	File: CWC166 SWMP.pfd Network: Storm Network [redacted] 29/10/2022	Page 1 19 Underhill Road Glos GL4 6HB

Design Settings

Rainfall Methodology	FSR	Maximum Time of Concentration (mins)	30.00
Return Period (years)	100	Maximum Rainfall (mm/hr)	100.0
Additional Flow (%)	0	Minimum Velocity (m/s)	1.00
FSR Region	England and Wales	Connection Type	Level Soffits
M5-60 (mm)	14.000	Minimum Backdrop Height (m)	0.800
Ratio-R	0.400	Preferred Cover Depth (m)	0.300
CV	0.750	Include Intermediate Ground	√
Time of Entry (mins)	4.00	Enforce best practice design rules	√

Nodes

Name	Area (ha)	T of E (mins)	Cover Level (m)	Diameter (mm)	Easting (m)	Northing (m)	Depth (m)
1	0.003	4.00	100.700	450	53.271	75.230	0.360
Parking S-A	0.018	4.00	100.700		46.769	76.033	0.500
J1			100.700	450	50.049	76.306	0.460
Rain Garden	0.017	4.00	100.550		63.843	73.143	0.250
Drive	0.005		102.000	1200	39.568	76.589	0.400
4	0.003	4.00	100.700	450	51.980	78.974	0.360

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	1	J1	3.397	0.600	100.340	100.250	0.090	37.7	100	4.04	100.0
2.000	4	J1	3.293	0.600	100.340	100.250	0.090	36.6	100	4.04	100.0
1.001	J1	Parking S-A	3.292	0.600	100.240	100.200	0.040	82.3	100	4.11	100.0

Name	Vel (m/s)	Cap (l/s)	Flow (l/s)	US Depth (m)	DS Depth (m)	Σ Area (ha)	Σ Add Inflow (l/s)	Pro Depth (mm)	Pro Velocity (m/s)
1.000	1.259	9.9	0.8	0.260	0.350	0.003	0.0	19	0.750
2.000	1.279	10.0	0.8	0.260	0.350	0.003	0.0	19	0.762
1.001	0.849	6.7	1.6	0.360	0.400	0.006	0.0	34	0.704

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	3.397	37.7	100	Circular	100.700	100.340	0.260	100.700	100.250	0.350
2.000	3.293	36.6	100	Circular	100.700	100.340	0.260	100.700	100.250	0.350
1.001	3.292	82.3	100	Circular	100.700	100.240	0.360	100.700	100.200	0.400

Link	US Node	Dia (mm)	Node Type	MH Type	DS Node	Dia (mm)	Node Type	MH Type
1.000	1	450	Manhole	HCD Catchpit	J1	450	Manhole	HCD Catchpit
2.000	4	450	Manhole	HCD Catchpit	J1	450	Manhole	HCD Catchpit
1.001	J1	450	Manhole	HCD Catchpit	Parking S-A		Junction	

Corner Water Consulting	Corner Water Consulting Ltd 1 Cricklade Court Cricklade Street Swindon SN1 3EY	File: CWC166 SWMP.pfd Network: Storm Network [redacted] 29/10/2022	Page 2 19 Underhill Road Glos GL4 6HB

Manhole Schedule

Node	Easting (m)	Northing (m)	CL (m)	Depth (m)	Dia (mm)	Connections		Link	IL (m)	Dia (mm)
1	53.271	75.230	100.700	0.360	450		0	1.000	100.340	100
Parking S-A	46.769	76.033	100.700	0.500			1	1.001	100.200	100
J1	50.049	76.306	100.700	0.460	450		1	2.000	100.250	100
							2	1.000	100.250	100
							0	1.001	100.240	100
Rain Garden	63.843	73.143	100.550	0.250						
Drive	39.568	76.589	102.000	0.400	1200					
4	51.980	78.974	100.700	0.360	450		0	2.000	100.340	100

Simulation Settings

Rainfall Methodology	FSR	Analysis Speed	Normal
FSR Region	England and Wales	Skip Steady State	x
M5-60 (mm)	17.000	Drain Down Time (mins)	240
Ratio-R	0.400	Additional Storage (m^3/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 %)
30	0	0	0
100	40	0	0

Node Parking S-A Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00650	Safety Factor	2.0	Invert Level (m)	100.200
Side Inf Coefficient (m/hr)	0.00650	Porosity	0.30	Time to half empty (mins)	552

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	110.0	110.0	0.400	110.0	112.0	0.401	0.0	112.0	0.500	0.0	112.0

Corner Water Consulting	Corner Water Consulting Ltd 1 Cricklade Court Cricklade Street Swindon SN1 3EY	File: CWC166 SWMP.pfd Network: Storm Network [redacted] 29/10/2022	Page 3 19 Underhill Road Glos GL4 6HB

Node Rain Garden Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00650	Safety Factor	2.0	Invert Level (m)	100.300
Side Inf Coefficient (m/hr)	0.00650	Porosity	1.00	Time to half empty (mins)	

Depth (m)	Area (m²)	Inf Area (m²)	Depth (m)	Area (m²)	Inf Area (m²)
0.000	110.0	110.0	0.250	120.0	113.0

Node Drive Depth/Area Storage Structure

Base Inf Coefficient (m/hr)	0.00650	Safety Factor	2.0	Invert Level (m)	101.600
Side Inf Coefficient (m/hr)	0.00650	Porosity	0.30	Time to half empty (mins)	277

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	50.0	50.0	0.300	50.0	50.0	0.301	0.0	50.0	0.400	0.0	50.0

Corner Water Consulting	Corner Water Consulting Ltd 1 Cricklade Court Cricklade Street Swindon SN1 3EY	File: CWC166 SWMP.pfd Network: Storm Network [redacted] 29/10/2022	Page 4 19 Underhill Road Glos GL4 6HB

Results for 30 year Critical Storm Duration. Lowest mass balance: 98.16%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m^3)	Flood (m^3)	Status
720 minute winter	1	585	100.385	0.045	0.1	0.0147	0.0000	OK
720 minute winter	Parking S-A	630	100.385	0.185	0.9	6.2330	0.0000	OK
720 minute winter	J1	690	100.385	0.145	0.2	0.0230	0.0000	SURCHARGED
960 minute winter	Rain Garden	900	100.347	0.047	0.3	5.3039	0.0000	OK
180 minute winter	Drive	172	101.680	0.080	0.3	1.2250	0.0000	OK
720 minute winter	4	585	100.385	0.045	0.1	0.0147	0.0000	OK

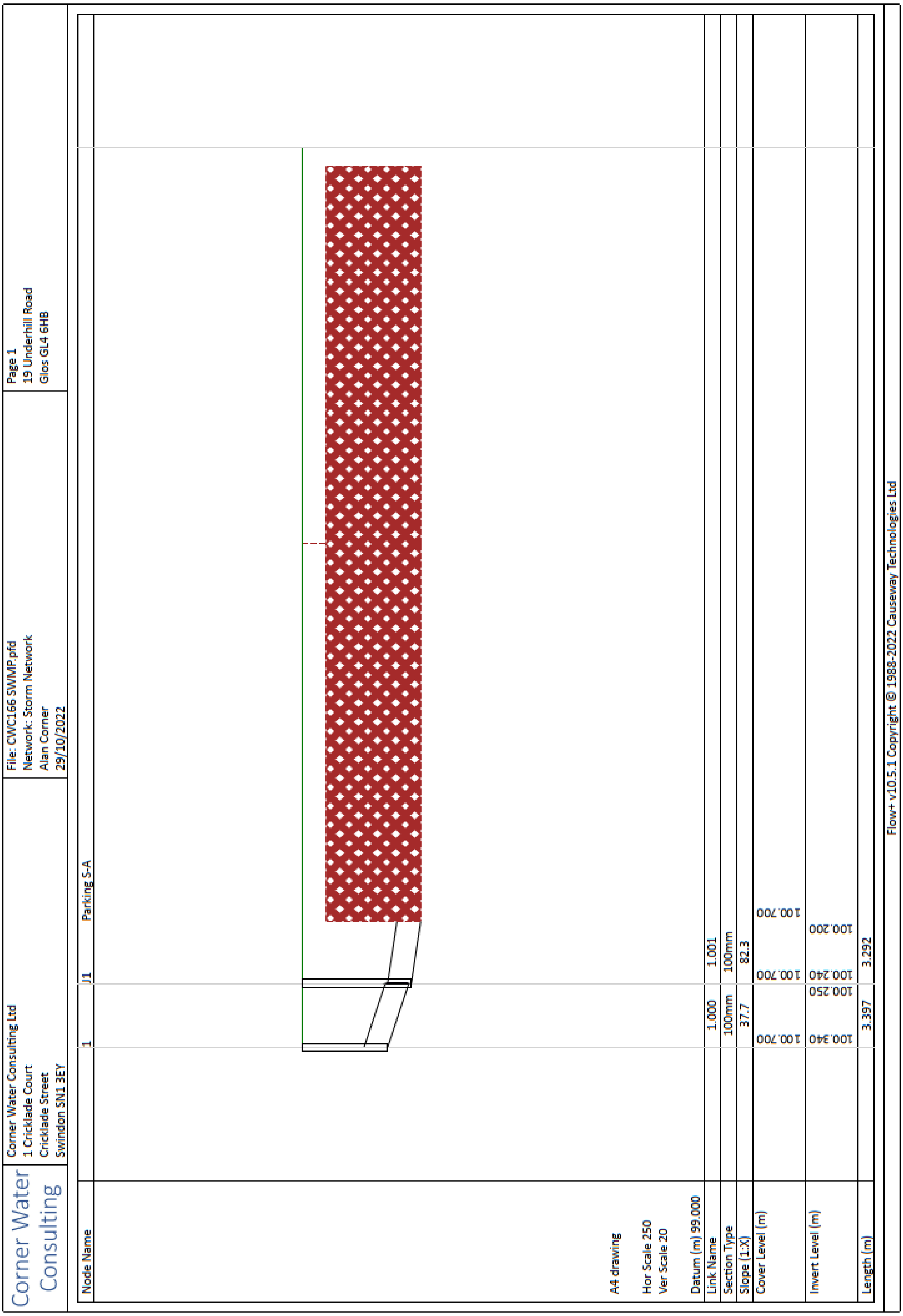
Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m^3)
720 minute winter	1	1.000	J1	0.1	0.395	0.010	0.0191
720 minute winter	Parking S-A	Infiltration		0.1			
720 minute winter	J1	1.001	Parking S-A	0.5	0.153	0.069	0.0258
960 minute winter	Rain Garden	Infiltration		0.1			
180 minute winter	Drive	Infiltration		0.0			
720 minute winter	4	2.000	J1	0.1	0.399	0.010	0.0185

Corner Water Consulting	Corner Water Consulting Ltd 1 Cricklade Court Cricklade Street Swindon SN1 3EY	File: CWC166 SWMP.pfd Network: Storm Network [redacted] 29/10/2022	Page 5 19 Underhill Road Glos GL4 6HB

Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 98.16%

Node Event	US Node	Peak (mins)	Level (m)	Depth (m)	Inflow (l/s)	Node Vol (m³)	Flood (m³)	Status
480 minute winter	1	464	100.571	0.230	0.2	0.0751	0.0000	FLOOD RISK
480 minute winter	Parking S-A	464	100.570	0.370	1.4	12.4886	0.0000	OK
480 minute winter	J1	464	100.570	0.330	0.4	0.0525	0.0000	FLOOD RISK
480 minute winter	Rain Garden	472	100.387	0.087	1.0	9.8073	0.0000	OK
360 minute winter	Drive	352	101.768	0.168	0.4	2.5523	0.0000	OK
480 minute winter	4	472	100.570	0.230	0.2	0.0751	0.0000	FLOOD RISK

Link Event (Upstream Depth)	US Node	Link	DS Node	Outflow (l/s)	Velocity (m/s)	Flow/Cap	Link Vol (m³)
480 minute winter	1	1.000	J1	0.2	0.400	0.020	0.0266
480 minute winter	Parking S-A	Infiltration		0.1			
480 minute winter	J1	1.001	Parking S-A	0.3	0.115	0.052	0.0258
480 minute winter	Rain Garden	Infiltration		0.1			
360 minute winter	Drive	Infiltration		0.0			
480 minute winter	4	2.000	J1	0.2	0.404	0.019	0.0258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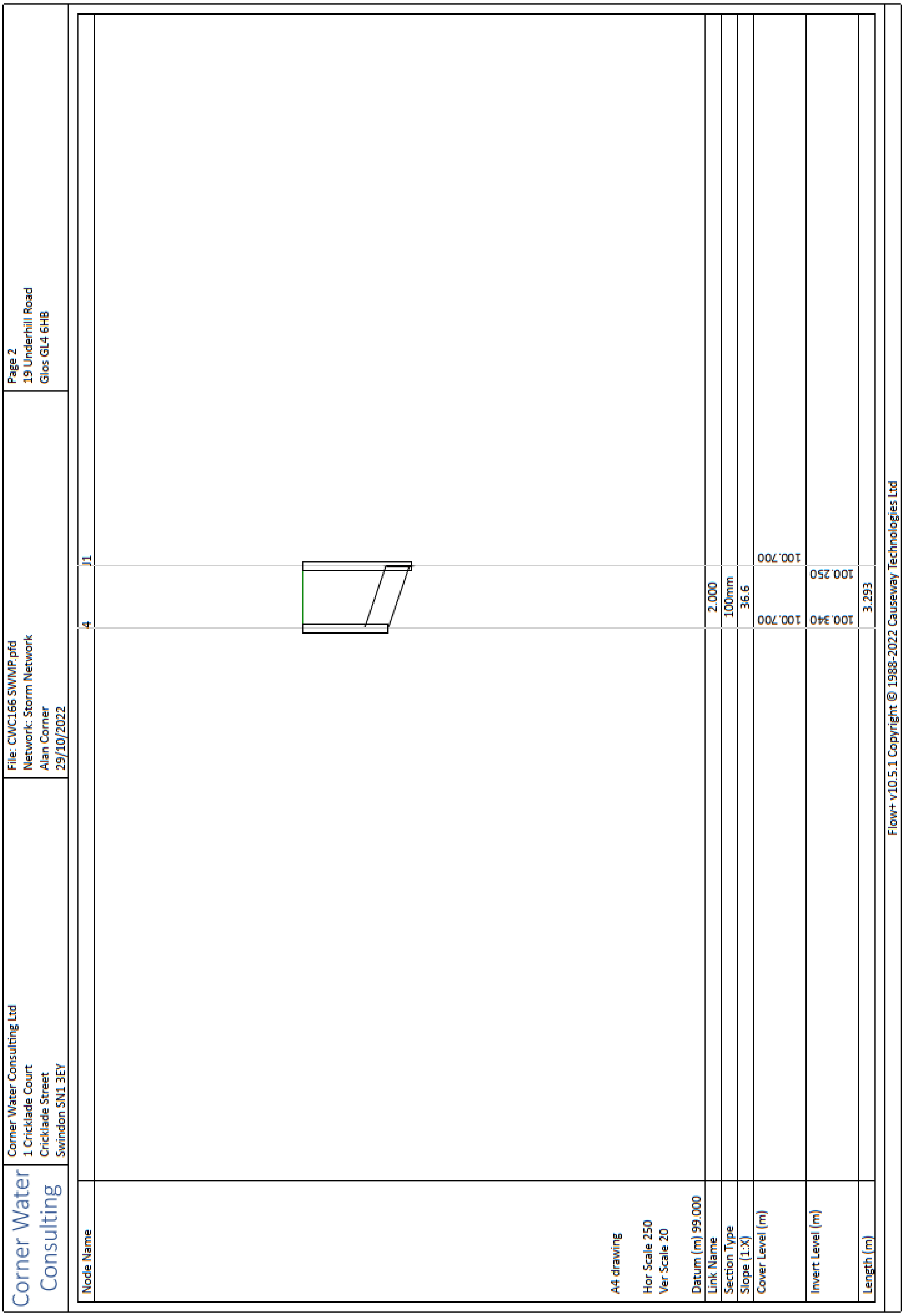
Cricklade Street
Swindon SN1 3EY
File: CWC166 SWMP.pfd
Network: Storm Network
Alan Corner
29/10/2022
Page 1
19 Underhill Road
Glos GL4 6HB
Node Name
1
J1
Parking S-A
A4 drawing
Hor Scale 250
Ver Scale 20
Datum (m) 99.000
Link Name
1.000
1.001
Section Type
100mm
100mm
Slope (1:X)
37.7
82.3
Cover Level (m)
100.700
100.700
100.700
Invert Level (m)
100.340
100.250
100.240
100.200
Length (m)
3.397
3.292
Flow+ v10.5.1 Copyright © 1988-2022 Causeway Technologies Ltd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Swindon SN1 3EY
File: CWC166 SWMP.pfd
Network: Storm Network
Alan Corner
29/10/2022
Page 2
19 Underhill Road
Glos GL4 6HB
Node Name
4
J1
A4 drawing
Hor Scale 250
Ver Scale 20
Datum (m) 99.000
Link Name
2.000
Section Type
100mm
Slope (1:X)
36.6
Cover Level (m)
100.700
100.700
Invert Level (m)
100.340
100.250
Length (m)
3.293
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HR Wallingford
Working with water

Surface water storage requirements for sites

www.uksuds.com | Storage estimation tool

Calculated by:	[redacted]
Site name:	19 Underhill Road
Site location:	CWC166

Site Details

Latitude:	51.83936° N
Longitude:	2.21668° W
Reference:	286820959
Date:	Oct 28 2022 16:27

This is an estimation of the storage volume requirements that are needed to meet normal best practice criteria in line with Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (Ciria, 2015) and the non-statutory standards for SuDS (Defra, 2015). It is not to be used for detailed design of drainage systems. It is recommended that hydraulic modelling software is used to calculate volume requirements and design details before finalising the design of the drainage scheme.

Site characteristics

Total site area (ha):	0.036
Significant public open space (ha):	0.01
Area positively drained (ha):	0.0259999999
Impermeable area (ha):	0.0259
Percentage of drained area that is impermeable (%):	100
Impervious area drained via infiltration (ha):	0.0259
Return period for infiltration system design (year):	100
Impervious area drained to rainwater harvesting (ha):	0
Return period for rainwater harvesting system (year):	10
Compliance factor for rainwater harvesting system (%):	66
Net site area for storage volume design (ha):	0.02
Net impermable area for storage volume design (ha):	0.01
Pervious area contribution to runoff (%):	30

* where rainwater harvesting or infiltration has been used for managing surface water runoff such that the effective impermeable area is less than 50% of the 'area positively drained', the 'net site area' and the estimates of Q_{BAR} and other flow rates will have been reduced accordingly.

Design criteria

Climate change allowance factor:	1.4
Urban creep allowance factor:	1.1
Volume control approach	Use long term storage
Interception rainfall depth (mm):	5
Minimum flow rate (l/s):	2

Methodology

esti	IH124
Q_{BAR} estimation method:	Calculate from SPR and SAAR
SPR estimation method:	Calculate from SOIL type

Soil characteristics

	Default	Edited
SOIL type:	3	3
SPR:	0.37	0.37

Hydrological characteristics

	Default	Edited
Rainfall 100 yrs 6 hrs:	--	55
Rainfall 100 yrs 12 hrs:	--	69.93
FEH / FSR conversion factor:	1.11	1.11
SAAR (mm):	684	684
M5-60 Rainfall Depth (mm):	17	17
'r' Ratio M5-60/M5-2 day:	0.4	0.4
Hydological region:	4	4
Growth curve factor 1 year:	0.83	0.83
Growth curve factor 10 year:	1.49	1.49
Growth curve factor 30 year:	2	2
Growth curve factor 100 years:	2.57	2.57
Q_{BAR} for total site area (l/s):	0.1	0.1
Q_{BAR} for net site area (l/s):	0.06	0.06

Site discharge rates	Default	Edited
1 in 1 year (l/s):	2	2
1 in 30 years (l/s):	2	2
1 in 100 year (l/s):	2	2

Estimated storage volumes	Default	Edited
Attenuation storage 1/100 years (m^3):	0	0
Long term storage 1/100 years (m^3):	0	0
Total storage 1/100 years (m^3):	0	0

Corner Water Consulting

Registered office:

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Swindon SN1 3EY

Registered in England

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Contact

[redacted]