SuDS Strategy Report and Flood Risk Assessment

Land at 1 Dukes Close, Shabbington, HP18 9HW

Project Reference: SD2106121

Contents

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Revisions and Additional Material

Document History and Status

Revision	Date	Purpose/Status
-	June 2021	First Issue

Document Details

Project Number	SD2106121
Project Director	David Brunning

Preamble

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1 Introduction

1.0.1 SuDS Designs have been appointed to prepare a drainage strategy to accompany a planning application for validation purposes. As part of the proposals, this report will assess the potential impact from alterations to the site drainage, and the surface water characteristics are considered within the scope of the parameters set out in the National Planning Policy Framework (NPPF) and Technical Guidance to the NPPF

1.0.2 This report will also review the requirements set out by Aylesbury Vale District, and the report will consider the use of SuDS wherever possible.

2 Location & Existing Conditions

2.0.2 The site is specifically located on Dukes Close and equates to a total area of 0.0525ha

2.0.3 As per British Geological Survey (BGS) records the naturally occurring subsoil Kimmeridge Clay. A local borehole shows evidence of clay throughout the strata below made ground, with ground water being recorded at approximately 6m below ground level.

2.0.5 There are existing drainage connections within the site boundary, and Thames Water will need to be contacted for indirect connection approval.

2.1 Site Proposals

2.1.1 The proposals at the time of writing can be seen in the appended drawing, which consists of the erection of one new dwelling widening of existing access and creation of new access.

2.1.2 Underlying geology does not account for infiltration as a surface water drainage solution, and therefore the existing regime will be followed which is outfall into public sewer., and within the site boundary.

2.2 Existing Drainage Regime

2.2.1 The existing greenfield runoff rates, as found below.

	QBAR	1:1 Year Storm Event	1:30 Year Storm Event	1:100 Year Storm Event	1:100 Year Storm Event (+40% Climate Change)
Greenfield Runoff Rate (l/s)	0.2	0.2	0.5	0.7	-

3 Flood Risk

3.1 National Planning Policy

3.1.0 The National Planning Policy Framework (NPPF) includes government policy on development and in this case meeting the challenge of climate change and flood risk. The policy states; *"Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk….".*

3.1.1 The location of new developments should consider climate change by planning to avoid increasing the vulnerability on development from the impacts of climate change. Where locations are considered vulnerable from the impacts of climate change, these risks should be managed and where possible mitigated to limit the risk.

3.1.2 Development in areas at risk of flooding should be made safe without increasing the flood risk elsewhere. Local Plans should be based on evidence, through a Sequential Test, in selecting the appropriate location for new development within the plan period and thus avoiding where possible flood risk to people and property.

3.1.3 Development priorities are based on the specific flood risk zones outlined within Table 1 of the technical guidance, as per **Figure 1** below. For Flood Zone 1 – Low probability. Land assessed as having a less than 1 in 1,000-year annual probability of river and sea flooding (<0.1%) in any year.

Flood Zones	Definition
Zone 1 Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on Flood Map)
Zone 3a High Probability	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding (Land shown in dark blue on the Flood Map)
Zone 3b The Functional Floodplain	**This zone comprises land where water must flow or be stored in times of flood.** Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

Figure 1 - Flood Zone Definitions

3.1.4 The Environment Agency (EA) website confirms the site location to be within Flood Zone 1. Further guidance in NPPF classifies residential development schemes to be a 'more vulnerable' land class use in terms of flood risk.

Flood Risk Vulnerability Classification: 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, drink 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 2 - Flood Risk Vulnerability Classifications

3.1.6 NPPG Table 3 (para 67 ID 7-067-20140306) determines the appropriate uses by flood zone, in this case a more vulnerable use for residential dwellings are appropriate for a Zone 1.

Flood Zones	Flood Risk Vulnerability Classification				
	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Zone 1	√	√	√	√	√
Zone 2	√	Exception Test Required	√	√	√
Zone 3a	Exception Test Required	x	Exception Test Requires	√	√
Zone 3b	Exception Test Required	x	x	x	√
√ Development is appropriate x Development should not be permitted					

Figure 3 - Flood Risk Vulnerability and Flood Zone 'Compatibility'

3.1.7 The EA mapping indicates the proposed developable area of the site is located within Flood Zone 1 and therefore is located to meet the requirements of NPPF.

3.2 Flooding Assessment

3.2.1 Fluvial flooding is a result of the capacity of rivers being exceeded by the river flow. In general, rivers have a natural flood plain, which can sometimes be encroached upon by development.

3.2.2 Tidal flooding is a result from the sea where high tides and storm surges raise the level of tidal waters above the level of the shore or river bank. These can be sudden and severe.

3.2.3 In the case of the proposed development; the site is located within Flood Zone 1 as indicated in the flood mapping as illustrated below.

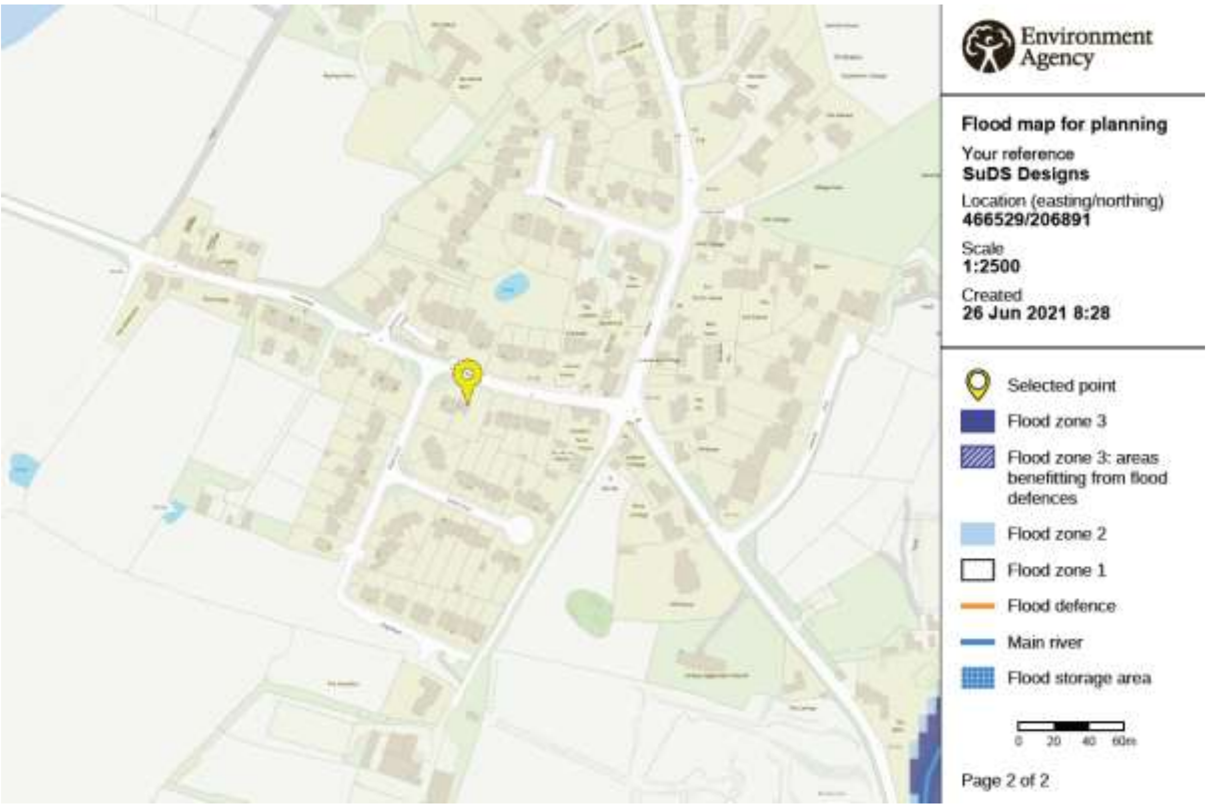


Figure 4 - Floodplain Mapping

3.3 Flooding from Surface Water

3.3.1 Surface water over land flooding is present in **Figure 5**, however the extent of flooding is not within the site boundary and therefore the risk of surface water flooding is indicated as being low.

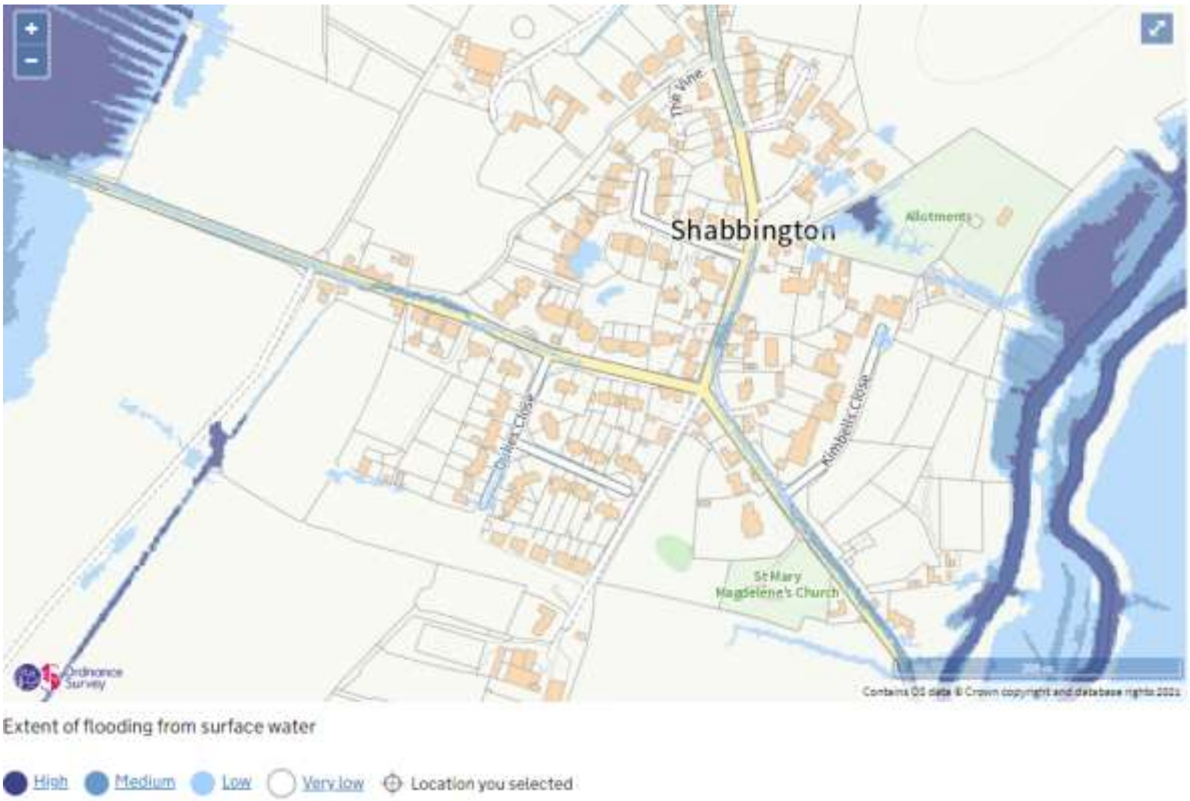


Figure 5 - Flood Depth

3 SuDS Considerations

3.0.1 Consideration of SuDS are a planning requirement for new developments. SuDS are designed to replicate the natural course of drainage as closely as possible with a view to reducing the impact of flooding, removing pollutants at source, and combining water management with green space.

Developments should utilise SuDS where possible and ensure that surface water run-off is managed as close to its source as possible in line with the following hierarchy:

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

3.0.2 Sustainable Drainage Systems should be included in the design to manage surface water flood risk. SuDS should be inspired by natural drainage processes and manage water as close to its source as possible whilst offering pollution control and landscape benefits.

4.1 SuDS Incorporation

Component Type	Description	Design Criteria							
			Water Quantity (Chapter 3)						
				Runoff Volumes					
		Collection Mechanism	Peak Runoff Rate	Events (Interceptions)	Large Events	Water Quality (Chapter 4)	Amenity (Chapter 5)	Biodiversity (Chapter 6)	Further Information (Chapter Ref)
Rainwater Harvesting Systems	Systems that collect runoff from the roof of a building or other paved surface for use	P		●	●		●		11
Green roofs	Planted soil layers on the roof of buildings that slow and store runoff	S	○	●		●	●	●	12
Infiltration systems	Systems that collect and store runoff, allowing it to infiltrate into the ground	P	●	●	●	●	●	●	13
Proprietary treatment systems	Subsurface structures design to provide treatment to runoff	P				●			14

Filter strips	Grass strips hat promote sedimentation and filtration as runoff is conveyed over the surface	L		●		●	○	○	15
Filter drains	Shallow stone-filled trenches that provide attenuation, conveyance and treatment of runoff	L	●	○		●	○	○	16
Swales	Shallow landscaped depressions that allow runoff to pond temporarily on the surface, before filtering through vegetation and underlying soils	L	●	●	●	●	●	●	17
Bioretention systems	Trees with soil-filled tree pits, tree planters or structural soils used to collect, store and treat runoff	P	●	●	●	●	●	●	18
Trees	Structural paving through which runoff can soak and subsequently be stored in the sub-base beneath, and/or allowed to infiltrate into the ground below	P	●	●		●	●	●	19
Pervious pavements	Structural paving through which runoff can soak and subsequently be stored in the sub-base beneath, and/or allowed to infiltrate into the ground below	S	●	●	●	●	○	○	20
Attenuation storage tanks	Large, below-ground voided spaces used to temporarily store runoff before infiltration-controlled release or use	P	●						21
Detention basins	Vegetated depressions that store and treat runoff	P	●	●		●	●	●	22
Ponds and wetlands	Permanent pools of water used to facilitate treatment of runoff – runoff can also be stored in an attenuation zone above the pool	P	●			●	●	●	23

P-Point L-Lateral S-Surface

● – likely valuable contribution to delivery of design criterion

○ - some potential contribution to delivery of design criterion, if specifically included in the design

Figure 6 CIRIA Table 7.1 SuDS Components

3.1.2 The above table gives examples of various SuDS components, which may offer source control in accordance with the requirements. Water-butts and or rainwater harvesting can be implemented within the design. Section 9.2 of BS 8582:2013 states that the use of rainwater harvesting systems should be evaluated to deliver both water supply and surface water management. Rainwater harvesting can be used for landscaping irrigation purposes as well as other grey water uses and will contribute towards a reduction in runoff volume entering the sewer network. Rainwater harvesting units can incorporate an overflow to the drainage system to cater for extreme events.

3.1.3 Section 3.3 of the EA document *Rainfall runoff management for developments* Report SC030219 states that a minimum flow of 5 l/s per second should be used. On that basis, a flow rate should be engineered that reduces flow sufficiently while providing an outflow orifice diameter which is not susceptible to blockage. i.e 1.0 l/s.

3.1.4 Consideration has been given to the ODPM document Preparing for Floods which is a *"guide intended for use by developers, local planning authorities and others involved in construction of new buildings,* *and renovation of existing buildings at risk of flooding. If adopted the principles set out within this guide should help reduce the stress and disruption of flooding and provide a more sustainable approach to flood risk*".

3.1.5 Private roads, and drives offer an opportunity to apply permeable surfacing which can be considered a method of source control. As per table 7.1 (**Figure 1**), surface water is slowed at source by soaking through the surfacing before discharging to the drainage network. Permeable surfacing offers the added benefit of filtering the runoff as it drains through, hence improving the quality.

3.1.6 In accordance with Table 26.2 of CIRIA Report C753, the pollution hazard level can be classified as 'Low'. Using table 26.3 of the same document, the mitigation indices values for permeable surfacing exceed the pollution hazard values taken from the previous table. This ensures that proposals offer enough pollution risk mitigation.

3.1.7 Despite low levels of permeability, permeable surfacing can offer the opportunity for both infiltration and attenuation. The flow control is to be set to an allowable discharge rate with the attenuation sized appropriately.

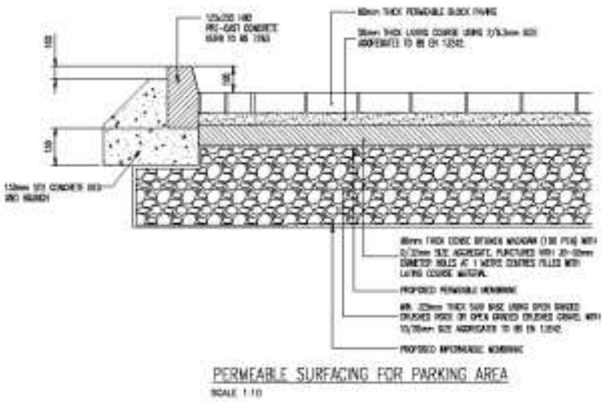


Figure 7 Typical car park permeable surfacing

3.1.8 Where flow controls are applied attenuation volume is required to provide storage during varying storm events.

3.1.9 The **Figure 1** proposals ensure that an 'at source' SuDS measure is applied, and betterment is provided in terms of surface water runoff velocity and quality. Pollution indices from different land types can be found per as per table 26.15 CIRIA SuDS Manual 2015, below.

Land use surface type (Lust)	Impermeability (IMP_{RF})	Total suspended solids pollution index (PI_{TSS})	Organic pollution index (PI_{Orgl})	Hydrocarbon pollution index (PI_{PAD})	Metals Pollution index (PI)
Roofs					
Industrial / Commercial	1.0	0.3	0.3-0.4	0.2	0.4-0.8
Residential	0.9	0.4-0.5	0.6-0.7	0.1	0.2-0.5
Highways					
Motorways	0.8-0.9	0.9	0.7	0.9	0.8
Major arterial highways	0.7-0.8	0.8	0.7	0.8	0.8
Urban distributor roads	0.6-0.7	0.7-0.8	0.5	0.8	0.7
Residential Street	0.4-0.6	0.4	0.6	0.6	0.6
Pavements	0.5-0.6	0.4	0.6	0.3	0.3
Car Parks / Hardstanding					
Industrial/Commercial	0.6-0.8	0.6-0.7	0.6-0.7	0.7	0.4-0.5
Driveways (Residential)	0.5	0.5	0.6	0.4	0.3
Open Areas					
Gardens (All types)	0.1	0.3	0.2-0.3	0	0.01
Parks/Golf Courses	0.2	0.2-0.3	0.2	0	0.02
Grassed Areas (including verges, all types)	0.1	0.2-0.3	0.2-0.3	0.05	0.05
Note 1 Pollution index values are based on reported land use type EMC distributions and impact potential thresholds from House et al (1991), Luker and Montague (1994), Butler and Clark (1995), D'Arcy et al (2000), Mitchell (2005) and Moy et al (2003)					

Figure 8 Impermeability and pollution indices for different land use types

3.1.10 The appended drainage calculation allows for a 1:100-year storm plus 40% climate change. Safety factors have been cautiously applied to demonstrate the effectiveness of this development in reducing flood risk. The safety factors that have been applied are referenced from Table 25.2 of CIRIA SuDS Manual 2015.

5 Surface Water Strategy

The surface water strategy is based upon the SuDS implementation as outlined above along with the hierarchy for surface water disposal as follows:

A. Store rainwater for later use:

Rainwater storage is to be utilised where possible. The layout offers an opportunity to utilise rainwater storage for landscape irrigation with the added benefit of reducing the volume of runoff entering the public drainage network.

B. Use infiltration techniques, such as porous surfaces:

The ground strata does not permit the use of infiltration, and is not inline with the current outfall regime

C. Attenuate rainwater in ponds or open water features for gradual release:

The site layout does not permit the use of open water features.

D. Attenuate rainwater by storing in tanks or sealed water features for gradual release:

As per the appended greenfield run-off calculations, an outfall rate of QBAR 0.2 l/s is not suitable for this development, therefore a proposal of 1.0 l/s has been made.

In addition to this, the appended exceedance calculations show that the system can accommodate a critical event of the 1 in 200 year storm, plus 40% climate change allowance.

E. Direct rainwater direct to the watercourse:

N/A

F. Discharge rainwater to a surface water sewer/drain

N/A

G. Discharge rainwater to combined sewer:

N/A

H. Discharge rainwater to foul sewer:

Following existing regime, throttled to 1.0 l/s as above

5.1 Designing for Exceedance

4.1.0 Consideration should be given to external levels to ensure they are set above overland flood risk levels, and low points are created to direct water away from the building footprints during exceedance events. Please see appended drawing for exceedance flow directions.

4.1.1 CIRIA document C635 *Designing for exceedance in urban drainage – good practice* states that "at present there are no guidelines on the return period of event (extreme event) that should be used for design exceedance". However, Section 3.4 also states that "it is suggested that return periods of 1 in 30, to 1 in 100 or 1 in 200-year events would form a suitable framework for most applications".

4.1.2 In accordance with the above, the drainage network has been modelled using a 1 in 200-year event, and the calculations are appended to show the capability and resilience of the network.

4.1.3 Whilst the development proposal will limit the potential for extension to the dwellings, an allowance of 10% to the building area has been added to the impermeable area in line with BS8582:2013 Code of practice for surface water management for development sites for urban creep.

6 Building and Detailed Design

5.0.2 Consideration should be given to external levels to ensure they are set above overland flood risk levels. Therefore, low points are required to direct water away from the building footprints during exceedance events (above the 100yr +40% (cc) event)

6.1 Pollution, Water Quality, and Control Measures

5.1.0 Consideration for surface water needs to be taken during the construction process, and how it is managed including flood risk and pollution control.

5.1.1 For the permeable surfacing surface water is slowed at source by soaking through the surfacing before discharging to the drainage solution. Permeable surfacing offers the added benefit of filtering the runoff as it drains through, hence improving the quality. Furthermore, the sub-base can be used to attenuate surface water when used in conjunction with controlled discharge rates.

5.1.2 On completion of the permanent drainage system the network will be relied upon to control pollution and water quality for the remainder of the construction works.

5.1.3 Wheel and plant washing will take place at the temporary entrance to minimise the pollutants being transferred to, or from site, and is also located to minimise the risk of pollutants entering the permeable surfacing and other drainage elements.

5.1.4 Pollution incident potential involving plant and machinery can be contained by simple measures:

- Use of drip trays
- Emergency spill kits
- Regular maintenance/checks of plant and machinery including checks for wear, oil leaks and immediate decommissioning when faults occur
- Procedures for refuelling areas, with spillage kits

7 Surface Water Drainage Maintenance Schedules

6.0.1 This section of the report gives guidance on the maintenance of the drainage system and outlines the responsible party as the freeholder within plot boundaries.

6.0.2 The design life of the development is likely to exceed the design life of each of the SuDS components listed above. During the routine inspections of any drainage components, it may become apparent that they have reached the end of their functional lifetime. In the interest of sustainability, repairs should be the first-choice solution where practicable. If this is not the case, then it will be necessary for the property owners to undertake complete replacement of the component in question.

7.1 Rainwater Pipes, and Chambers

Table 1– Rainwater Pipes, and Chambers: System storage operation and maintenance requirements

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Inspection of silt trap chamber and removal of debris when necessary	Quarterly or as required following monitoring
Remedial Actions	Check for blockages in manholes and pipes. Rodding and jetting of pipes to be carried out. CCTV survey can be carried out to inspect condition of pipework	Quarterly or as required following monitoring
Monitoring	Inspect collection apparatus for debris and litter. Remove where necessary to prevent blockages in the system.	Monthly or after periods of heavy rainfall

7.2 Flow Control

Table 2– Flow Control: System storage operation and maintenance requirements

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Remove litter and debris and grass cuttings from upstream to prevent being washed into the flow control. Inspection of the flow control chamber and the removal of any sediment/debris when required.	Quarterly or as required following monitoring
Remedial Actions	Check flow control is functional	Quarterly or as required following monitoring
Monitoring	Inspect flow control and check flows are not impeded	Monthly or after periods of heavy rainfall

7.3 Permeable Paving

Table 3 – Permeable Paving: System operation and maintenance requirements

Maintenance Schedule	Required Action	Recommended Frequency
Regular Maintenance	Sweeping. [NOTE: Any jointing material between the blocks that is lost or displaced as a result of sweeping must be replaced. New jointing material must be the same type as that removed or a suitable replacement]	3 no. times a year: - • At the end of Winter; • Mid-summer; and • After autumn leaf fall. required based on site specific observations
Occasional Maintenance	Stabilise and mow contributing and adjacent areas to prevent excess sediment being washed into the paving	As required
Remedial actions	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users	As required

8 Conclusions

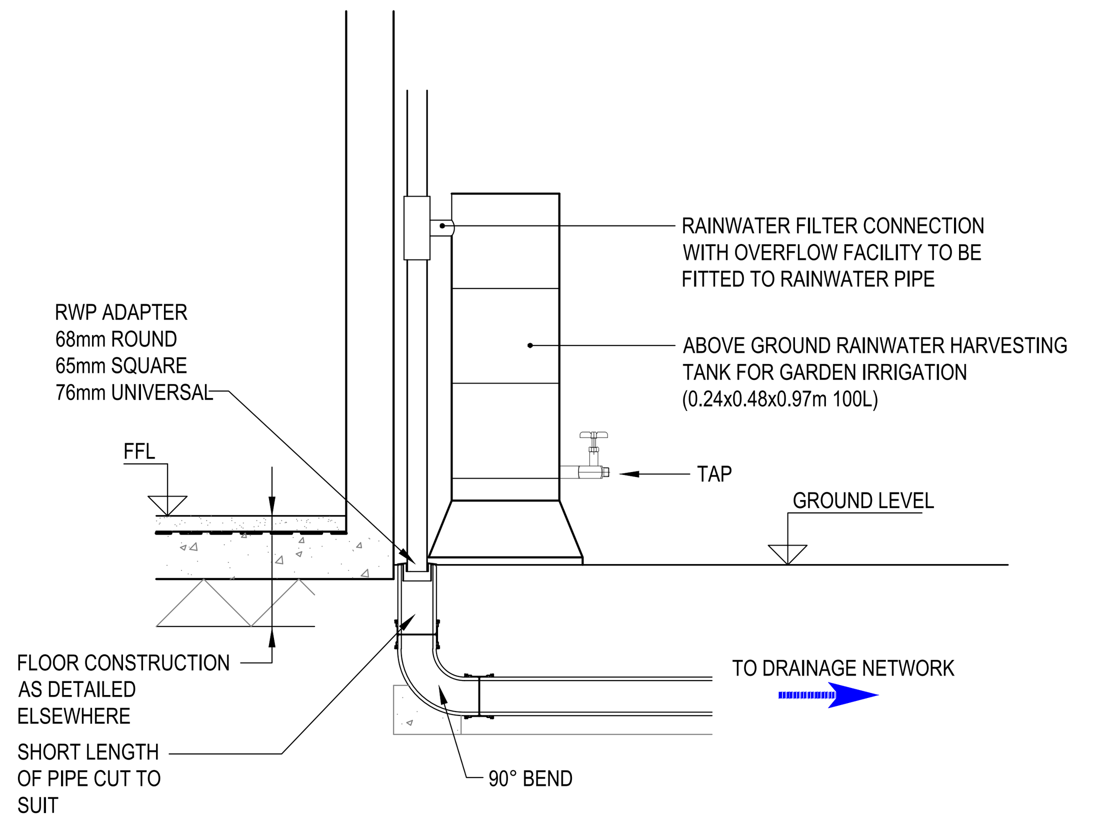
7.0.1 An existing combined sewer provides an outfall in accordance with the hierarchy.

7.0.2 Connection should be made subject to Thames Water approval.

7.0.3 It can be concluded that the above sustainable drainage strategy is compliant with local and national policy and can be accommodated within the site boundary.

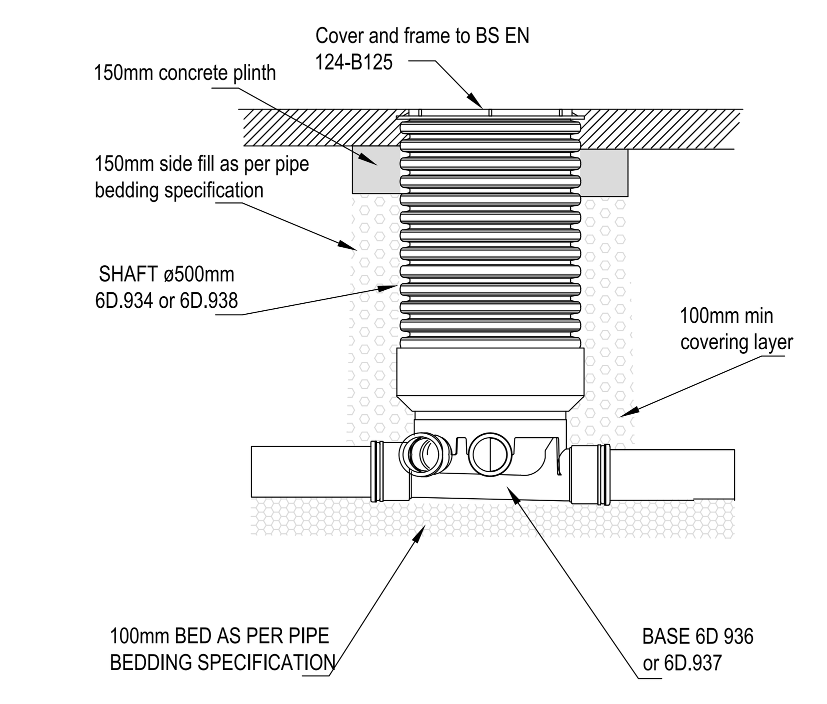
9 Appendices

9.1 Drainage Drawings



RAINWATER HARVESTING DETAIL

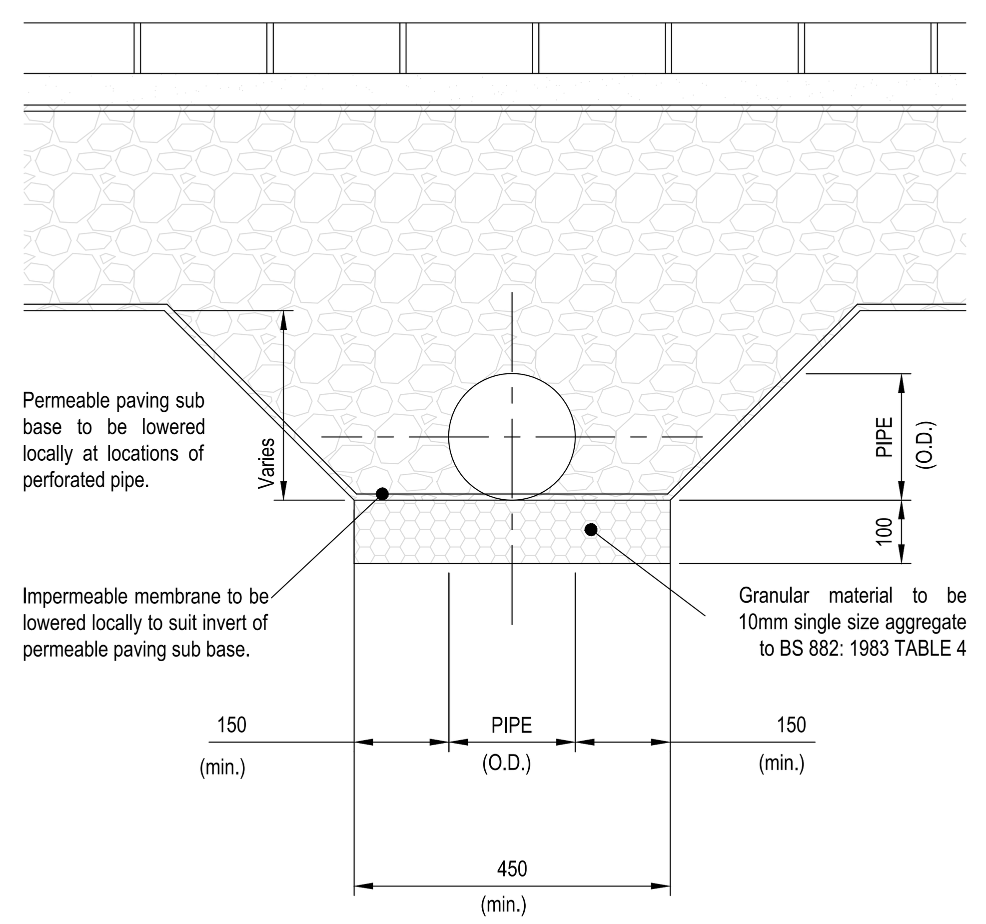
SCALE 1:20



Polypropylene Shallow Inspection Chamber Ø450mm (Light Loading B125)

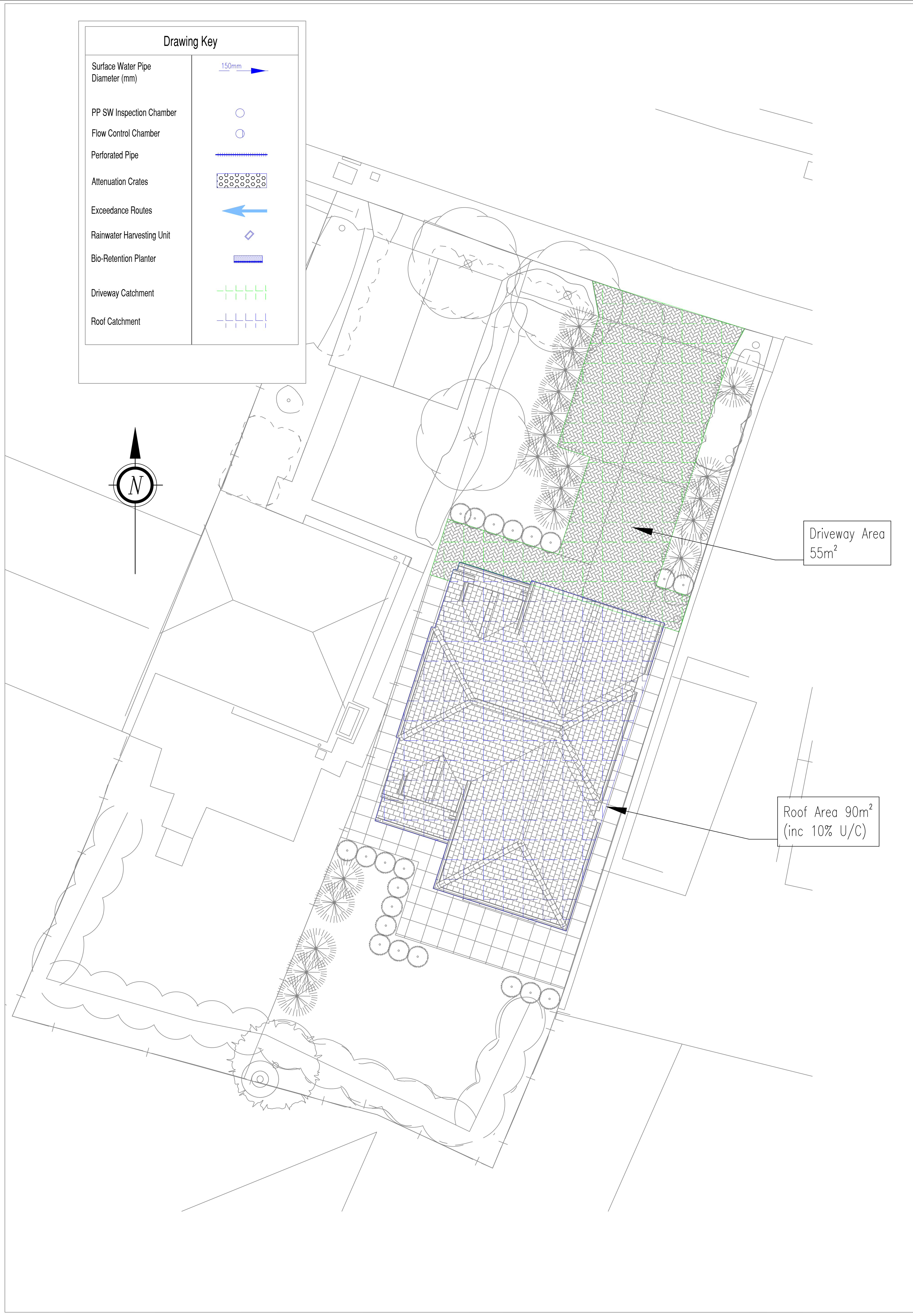
Scale 1:20

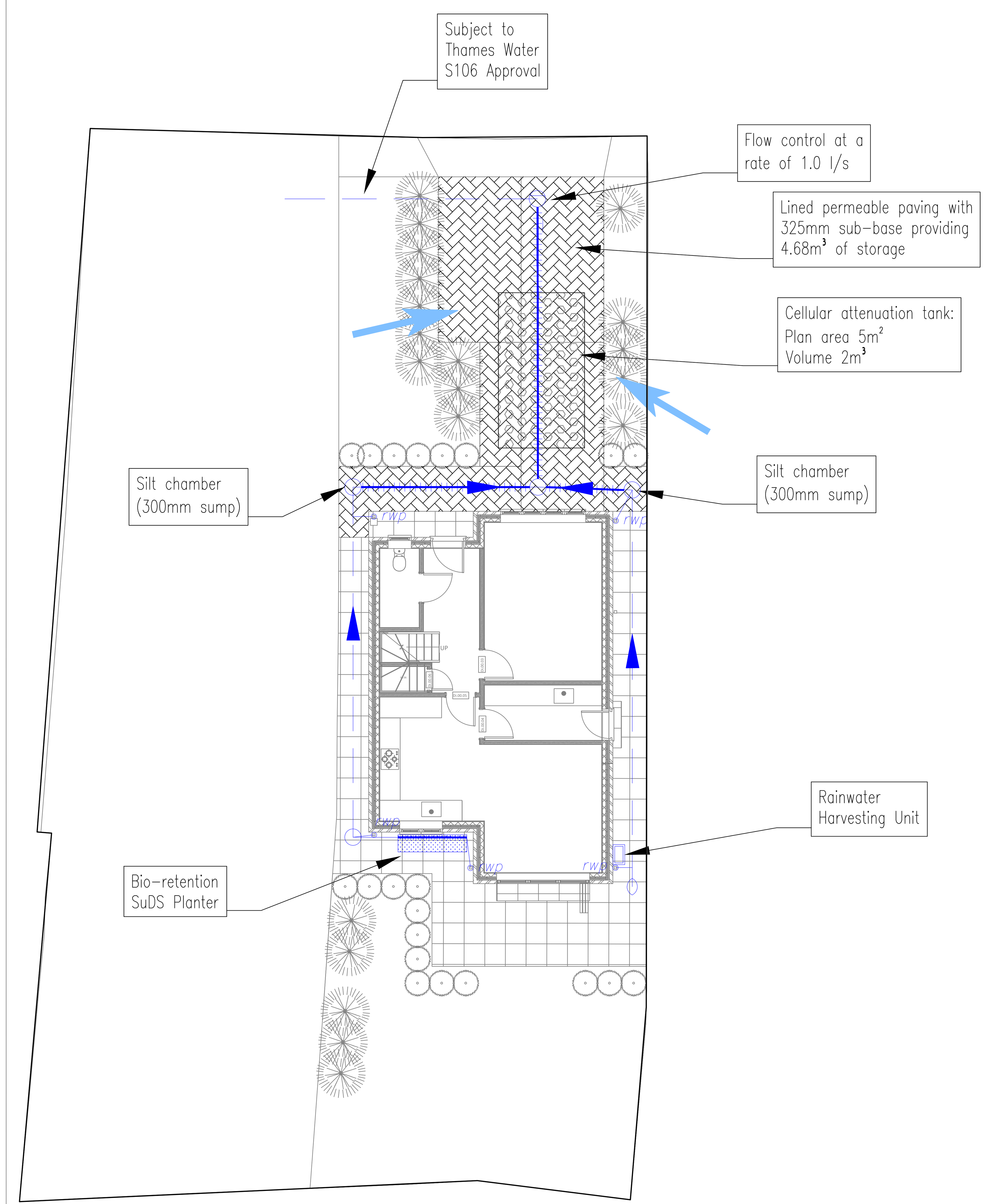
Note:
3m maximum depth. Up to Ø150mm pipework for 450mm shaft, or up to 300mm pipework on 500mm shaft. B125 maximum Loading, suitable for car parks and private drives

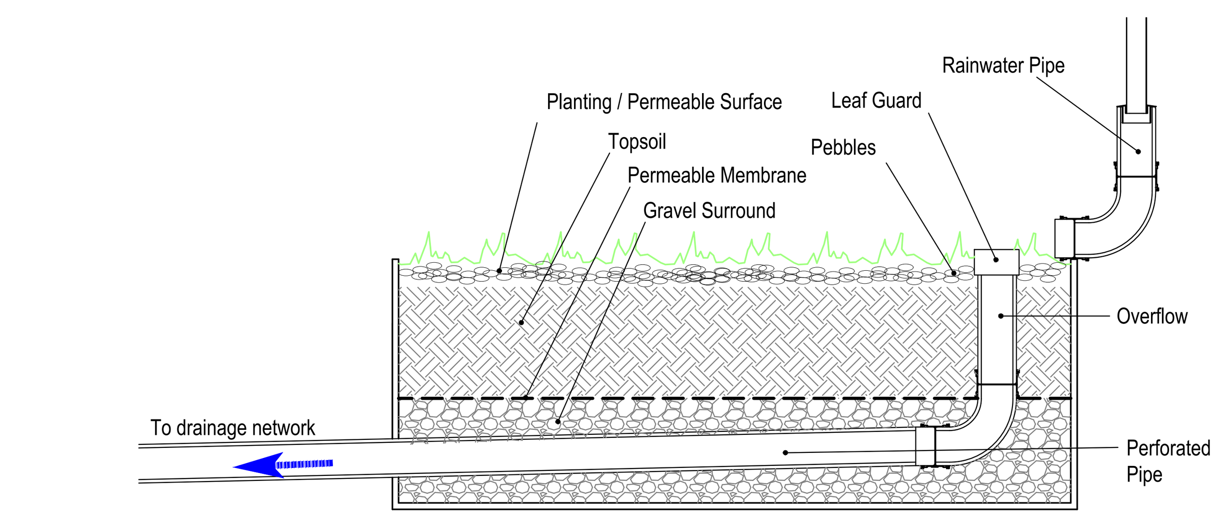


Perforated Pipe Bedding

Scale 1:10

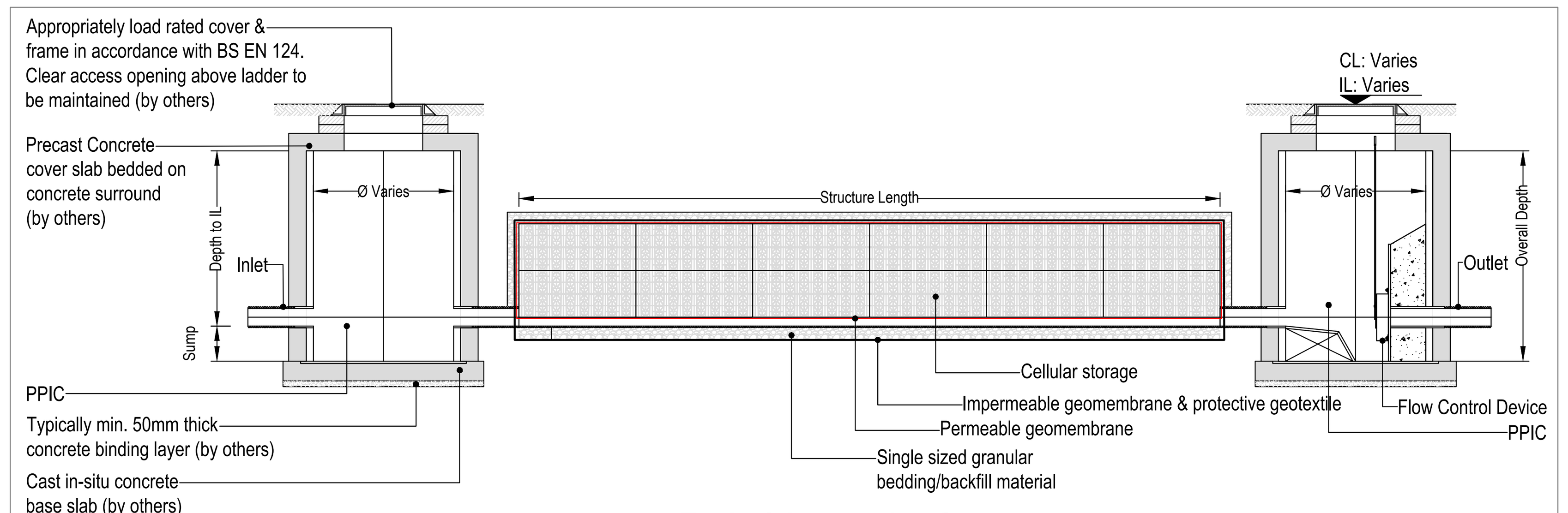






Bio-Retention Area Detail

Scale 1:20



Typical Attenuation System

1:50

Issue	Notes	Drawn	Approved	Date
P1	Preliminary Issue	DB	JMS	26.06.2021

SuDS DESIGNS Sustainable Drainage Designs

jms Group

Issuing Office:
JMS East Anglia (Ipswich): Unit 27, Brightwell Barns
Brightwell, Suffolk, United Kingdom, IP10 0BJ, Tel: 01473 487047

Project
Land Adjacent to 1 Dukes Close
Shabbington HP18 9HW

Drawing Title
SuDS Designs
Drainage Strategy Layout

Project No.	Drawing No.	Issue
SD2106121	200	P1

STRATEGY

Original Sheet Size: A1

9.2 Surface Water Calculations

ICP SUDS Mean Annual Flood

Input

Return Period (years)	1	SAAR (mm)	648	Urban	0.000
Area (ha)	0.053	Soil	0.450	Region Number	Region 6

Results	**l/s**
QBAR Rural	0.2
QBAR Urban	0.2
Q1 year	0.2
Q1 year	0.2
Q30 years	0.5
Q100 years	0.7

Summary of Results for 100 year Return Period (+40%)

Half Drain Time : 55 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	9.609	0.609	0.0	0.8	0.8	3.1	O K
30 min Summer	9.655	0.655	0.0	0.8	0.8	3.7	O K
60 min Summer	9.670	0.670	0.0	0.8	0.8	4.0	O K
120 min Summer	9.656	0.656	0.0	0.8	0.8	3.7	O K
180 min Summer	9.631	0.631	0.0	0.8	0.8	3.4	O K
240 min Summer	9.604	0.604	0.0	0.8	0.8	3.0	O K
360 min Summer	9.548	0.548	0.0	0.8	0.8	2.3	O K
480 min Summer	9.340	0.340	0.0	0.8	0.8	1.6	O K
600 min Summer	9.233	0.233	0.0	0.8	0.8	1.1	O K
720 min Summer	9.165	0.165	0.0	0.8	0.8	0.8	O K
960 min Summer	9.095	0.095	0.0	0.7	0.7	0.5	O K
1440 min Summer	9.058	0.058	0.0	0.6	0.6	0.3	O K
2160 min Summer	9.042	0.042	0.0	0.4	0.4	0.2	O K
2880 min Summer	9.035	0.035	0.0	0.3	0.3	0.2	O K
4320 min Summer	9.028	0.028	0.0	0.2	0.2	0.1	O K
5760 min Summer	9.025	0.025	0.0	0.2	0.2	0.1	O K
7200 min Summer	9.022	0.022	0.0	0.2	0.2	0.1	O K
8640 min Summer	9.020	0.020	0.0	0.1	0.1	0.1	O K
10080 min Summer	9.019	0.019	0.0	0.1	0.1	0.1	O K
15 min Winter	9.640	0.640	0.0	0.8	0.8	3.5	O K
30 min Winter	9.695	0.695	0.0	0.8	0.8	4.3	O K
60 min Winter	9.715	0.715	0.0	0.9	0.9	4.6	Flood Risk
120 min Winter	9.693	0.693	0.0	0.8	0.8	4.3	O K
180 min Winter	9.655	0.655	0.0	0.8	0.8	3.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	138.153	0.0	3.6	17
30 min Summer	90.705	0.0	4.9	31
60 min Summer	56.713	0.0	6.1	50
120 min Summer	34.246	0.0	7.5	84
180 min Summer	25.149	0.0	8.2	118
240 min Summer	20.078	0.0	8.8	152
360 min Summer	14.585	0.0	9.6	216
480 min Summer	11.622	0.0	10.2	276
600 min Summer	9.738	0.0	10.7	330
720 min Summer	8.424	0.0	11.1	384
960 min Summer	6.697	0.0	11.7	494
1440 min Summer	4.839	0.0	12.7	734
2160 min Summer	3.490	0.0	13.7	1084
2880 min Summer	2.766	0.0	14.4	1456
4320 min Summer	1.989	0.0	15.4	2188
5760 min Summer	1.573	0.0	16.2	2848
7200 min Summer	1.311	0.0	16.7	3568
8640 min Summer	1.129	0.0	17.2	4320
10080 min Summer	0.994	0.0	17.5	5000
15 min Winter	138.153	0.0	4.1	17
30 min Winter	90.705	0.0	5.5	31
60 min Winter	56.713	0.0	6.9	56
120 min Winter	34.246	0.0	8.4	90
180 min Winter	25.149	0.0	9.2	128

Summary of Results for 100 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	9.614	0.614	0.0	0.8	0.8	3.1	O K
360 min Winter	9.518	0.518	0.0	0.8	0.8	2.1	O K
480 min Winter	9.224	0.224	0.0	0.8	0.8	1.1	O K
600 min Winter	9.126	0.126	0.0	0.8	0.8	0.6	O K
720 min Winter	9.082	0.082	0.0	0.7	0.7	0.4	O K
960 min Winter	9.058	0.058	0.0	0.6	0.6	0.3	O K
1440 min Winter	9.042	0.042	0.0	0.4	0.4	0.2	O K
2160 min Winter	9.033	0.033	0.0	0.3	0.3	0.2	O K
2880 min Winter	9.028	0.028	0.0	0.2	0.2	0.1	O K
4320 min Winter	9.023	0.023	0.0	0.2	0.2	0.1	O K
5760 min Winter	9.021	0.021	0.0	0.1	0.1	0.1	O K
7200 min Winter	9.019	0.019	0.0	0.1	0.1	0.1	O K
8640 min Winter	9.017	0.017	0.0	0.1	0.1	0.1	O K
10080 min Winter	9.016	0.016	0.0	0.1	0.1	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	20.078	0.0	9.9	164
360 min Winter	14.585	0.0	10.7	232
480 min Winter	11.622	0.0	11.4	280
600 min Winter	9.738	0.0	12.0	328
720 min Winter	8.424	0.0	12.4	378
960 min Winter	6.697	0.0	13.2	490
1440 min Winter	4.839	0.0	14.2	722
2160 min Winter	3.490	0.0	15.4	1068
2880 min Winter	2.766	0.0	16.2	1420
4320 min Winter	1.989	0.0	17.4	2176
5760 min Winter	1.573	0.0	18.2	2904
7200 min Winter	1.311	0.0	18.9	3592
8640 min Winter	1.129	0.0	19.4	4392
10080 min Winter	0.994	0.0	19.8	4952

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.015

Time (mins) From:	**To:**	**Area (ha)**
0	4	0.015

Model Details

Storage is Online Cover Level (m) 10.000

Complex Structure

Cellular Storage

Invert Level (m) 9.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	5.0	5.0	0.400	5.0	8.6	0.401	0.0	8.6

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.8
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	13.3	Slope (1:X)	80.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	9.465	Cap Volume Depth (m)	0.325

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0047-1000-1000-1000
Design Head (m)	1.000
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	47
Invert Level (m)	9.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	1.0	Kick-Flo®	0.415	0.7
Flush-Flo™	0.205	0.8	Mean Flow over Head Range	-	0.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.8	0.800	0.9	2.000	1.4	4.000	1.9	7.000	2.4
0.200	0.8	1.000	1.0	2.200	1.4	4.500	2.0	7.500	2.5
0.300	0.8	1.200	1.1	2.400	1.5	5.000	2.1	8.000	2.6
0.400	0.7	1.400	1.2	2.600	1.5	5.500	2.2	8.500	2.7
0.500	0.7	1.600	1.2	3.000	1.6	6.000	2.3	9.000	2.7
0.600	0.8	1.800	1.3	3.500	1.8	6.500	2.3	9.500	2.8

9.3 Exceedance Calculations

Summary of Results for 200 year Return Period (+40%)

Half Drain Time : 65 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	9.650	0.650	0.0	0.8	0.8	3.7	O K
30 min Summer	9.709	0.709	0.0	0.9	0.9	4.5	Flood Risk
60 min Summer	9.733	0.733	0.0	0.9	0.9	4.9	Flood Risk
120 min Summer	9.720	0.720	0.0	0.9	0.9	4.7	Flood Risk
180 min Summer	9.694	0.694	0.0	0.8	0.8	4.3	O K
240 min Summer	9.665	0.665	0.0	0.8	0.8	3.9	O K
360 min Summer	9.611	0.611	0.0	0.8	0.8	3.1	O K
480 min Summer	9.562	0.562	0.0	0.8	0.8	2.4	O K
600 min Summer	9.382	0.382	0.0	0.8	0.8	1.8	O K
720 min Summer	9.264	0.264	0.0	0.8	0.8	1.3	O K
960 min Summer	9.142	0.142	0.0	0.8	0.8	0.7	O K
1440 min Summer	9.069	0.069	0.0	0.7	0.7	0.3	O K
2160 min Summer	9.047	0.047	0.0	0.5	0.5	0.2	O K
2880 min Summer	9.038	0.038	0.0	0.4	0.4	0.2	O K
4320 min Summer	9.031	0.031	0.0	0.3	0.3	0.1	O K
5760 min Summer	9.027	0.027	0.0	0.2	0.2	0.1	O K
7200 min Summer	9.024	0.024	0.0	0.2	0.2	0.1	O K
8640 min Summer	9.022	0.022	0.0	0.2	0.2	0.1	O K
10080 min Summer	9.020	0.020	0.0	0.1	0.1	0.1	O K
15 min Winter	9.686	0.686	0.0	0.8	0.8	4.2	O K
30 min Winter	9.757	0.757	0.0	0.9	0.9	5.2	Flood Risk
60 min Winter	9.790	0.790	0.0	0.9	0.9	5.7	Flood Risk
120 min Winter	9.771	0.771	0.0	0.9	0.9	5.4	Flood Risk
180 min Winter	9.731	0.731	0.0	0.9	0.9	4.8	Flood Risk

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	160.526	0.0	4.3	17
30 min Summer	105.910	0.0	5.7	31
60 min Summer	66.391	0.0	7.2	52
120 min Summer	40.078	0.0	8.8	86
180 min Summer	29.375	0.0	9.7	120
240 min Summer	23.398	0.0	10.3	154
360 min Summer	16.938	0.0	11.2	220
480 min Summer	13.466	0.0	11.8	284
600 min Summer	11.262	0.0	12.4	346
720 min Summer	9.727	0.0	12.8	398
960 min Summer	7.712	0.0	13.5	502
1440 min Summer	5.551	0.0	14.6	734
2160 min Summer	3.987	0.0	15.7	1088
2880 min Summer	3.149	0.0	16.5	1468
4320 min Summer	2.254	0.0	17.6	2160
5760 min Summer	1.776	0.0	18.4	2920
7200 min Summer	1.476	0.0	19.0	3624
8640 min Summer	1.268	0.0	19.4	4360
10080 min Summer	1.114	0.0	19.8	4984
15 min Winter	160.526	0.0	4.8	17
30 min Winter	105.910	0.0	6.4	31
60 min Winter	66.391	0.0	8.1	58
120 min Winter	40.078	0.0	9.8	92
180 min Winter	29.375	0.0	10.8	130

Summary of Results for 200 year Return Period (+40%)

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
240 min Winter	9.688	0.688	0.0	0.8	0.8	4.2	O K
360 min Winter	9.607	0.607	0.0	0.8	0.8	3.0	O K
480 min Winter	9.514	0.514	0.0	0.8	0.8	2.0	O K
600 min Winter	9.225	0.225	0.0	0.8	0.8	1.1	O K
720 min Winter	9.132	0.132	0.0	0.8	0.8	0.6	O K
960 min Winter	9.069	0.069	0.0	0.7	0.7	0.3	O K
1440 min Winter	9.048	0.048	0.0	0.5	0.5	0.2	O K
2160 min Winter	9.036	0.036	0.0	0.4	0.4	0.2	O K
2880 min Winter	9.031	0.031	0.0	0.3	0.3	0.1	O K
4320 min Winter	9.025	0.025	0.0	0.2	0.2	0.1	O K
5760 min Winter	9.022	0.022	0.0	0.2	0.2	0.1	O K
7200 min Winter	9.020	0.020	0.0	0.1	0.1	0.1	O K
8640 min Winter	9.018	0.018	0.0	0.1	0.1	0.1	O K
10080 min Winter	9.017	0.017	0.0	0.1	0.1	0.1	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
240 min Winter	23.398	0.0	11.5	166
360 min Winter	16.938	0.0	12.5	236
480 min Winter	13.466	0.0	13.3	302
600 min Winter	11.262	0.0	13.9	346
720 min Winter	9.727	0.0	14.4	392
960 min Winter	7.712	0.0	15.2	490
1440 min Winter	5.551	0.0	16.4	736
2160 min Winter	3.987	0.0	17.6	1092
2880 min Winter	3.149	0.0	18.5	1444
4320 min Winter	2.254	0.0	19.8	2160
5760 min Winter	1.776	0.0	20.7	2936
7200 min Winter	1.476	0.0	21.4	3600
8640 min Winter	1.268	0.0	21.9	4472
10080 min Winter	1.114	0.0	22.3	4856

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	200	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.015

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.015

Model Details

Storage is Online Cover Level (m) 10.000

Complex Structure

Cellular Storage

Invert Level (m) 9.000 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	5.0	5.0	0.400	5.0	8.6	0.401	0.0	8.6

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.8
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	13.3	Slope (1:X)	80.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	9.465	Cap Volume Depth (m)	0.325

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0047-1000-1000-1000
Design Head (m)	1.000
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	47
Invert Level (m)	9.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	1.0	Kick-Flo®	0.415	0.7
Flush-Flo™	0.205	0.8	Mean Flow over Head Range	-	0.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.8	0.800	0.9	2.000	1.4	4.000	1.9	7.000	2.4
0.200	0.8	1.000	1.0	2.200	1.4	4.500	2.0	7.500	2.5
0.300	0.8	1.200	1.1	2.400	1.5	5.000	2.1	8.000	2.6
0.400	0.7	1.400	1.2	2.600	1.5	5.500	2.2	8.500	2.7
0.500	0.7	1.600	1.2	3.000	1.6	6.000	2.3	9.000	2.7
0.600	0.8	1.800	1.3	3.500	1.8	6.500	2.3	9.500	2.8

9.4 Architectural Layout

The use of this data by the recipient acts as an agreement of the following statements. Do not use this data if you do not agree with any of the following statements:-

All drawings are based upon site information supplied by third parties and as such their accuracy cannot be guaranteed. All features are approximate and subject to clarification by a detailed topographical survey, statutory service enquiries and confirmation of the legal boundaries.

The controlled version of this drawing should be viewed in DWF or PDF format not DWG or other formats. All prints of this drawing must be made in full colour.

Check all dimensions on site. Report any discrepancies in writing to CBLS Consultants before proceeding.

Proposed Site Location Plan

1 : 200

Revision	Date	Drawn By
C01	04.05.2021	LS

Amendment

Status

Construction

Project

Mr Matthew Phillips
New Build Residential
Land at 1 Dukes Close, HP18 9HW

Drawing

Proposed Site Information
Proposed Site Location Plan

Drawing No.

Project ID		Originator	Zone Level Type Role Number
DUKE1	-	CBLS	-00-ZZ-DR-A-0005

CBLS Project No.	Scale at A3	Drawn By	Status	Revision
D_0191-	1 : 200	LS	A1	C01

info@cblsconsultants.co.uk
www.cblsconsultants.co.uk

Proposed Landscape Plan

1 : 50

LANDSCAPE KEY

	COBBLE BLOCK PAVING - BRACKEN
	INDIAN SANDSTONE MIXED SIZED PAVING SLABS WITH MORTAR JOINTS
	TURF AREAS

Revision	Date	Drawn By
C01 Construction Issue	04.05.2021	LS

Amendment

Purpose of Issue
Construction

Project
Mr Matthew Phillips
New Build Residential
Land at 1 Dukes Close, HP18 9HW

Drawing
Proposed Site Information
Proposed Landscaping Plan

Drawing No.

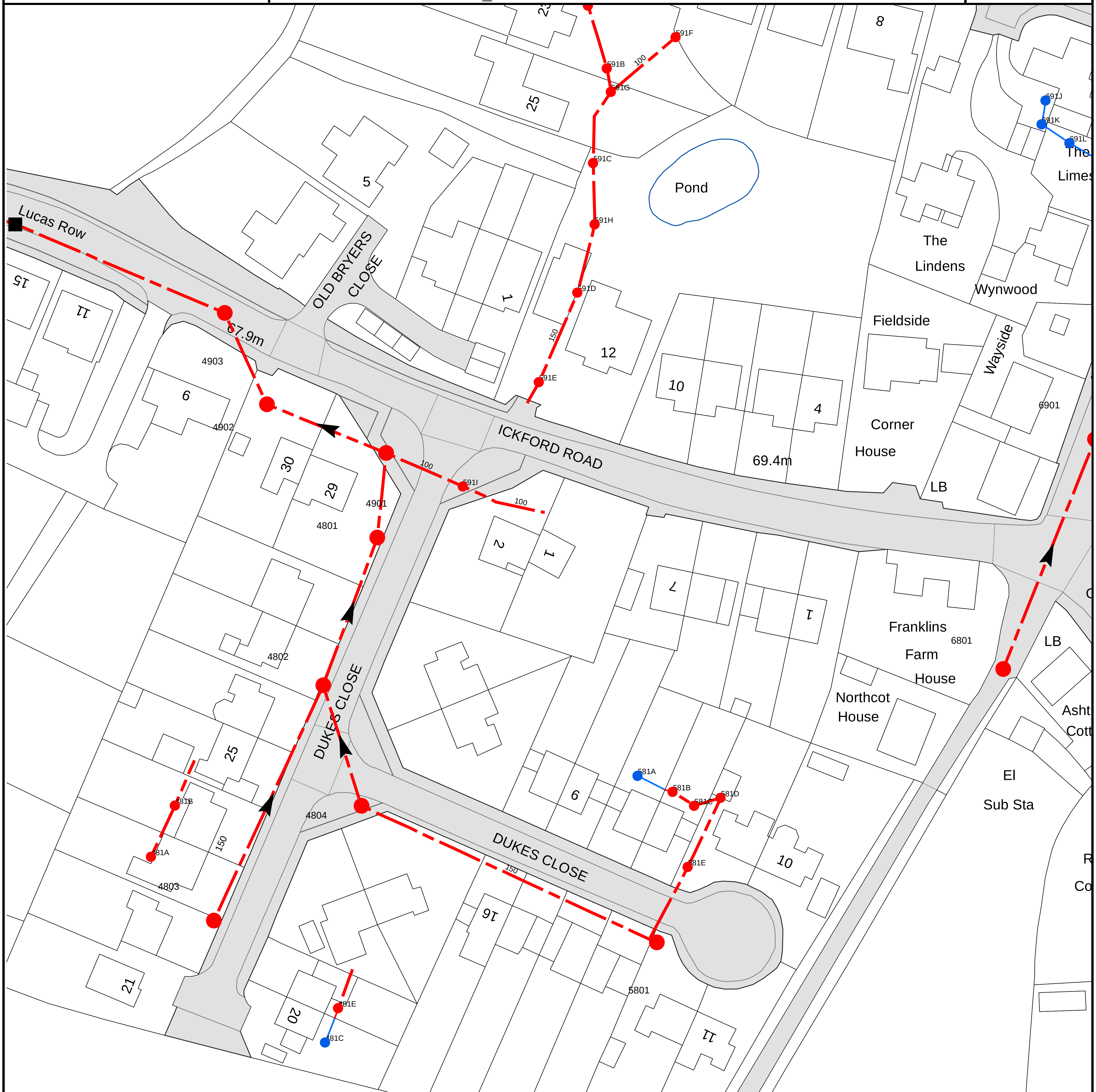
Project ID		Originator	Zone	Level	Type	Role	Number
DUKE1	-	CBLS	- 00	- ZZ	- DR -	A	-0010

CBLS Project No.	Scale at A0	Drawn By	Status	Revision
D_0191-	1 : 50	LS	A1	C01

info@cblsconsultants.co.uk
www.cblsconsultants.co.uk

9.5 Drainage Records

Asset Location Search Sewer Map - ALS/ALS Standard/2021_4455979



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 466526,206891

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

NB. Levels quoted in metres Ordnance Newlyn Datum. The value -9999.00 indicates that no survey information is available

Manhole Reference	Manhole Cover Level	Manhole Invert Level
691K	n/a	n/a
691J	n/a	n/a
591G	n/a	n/a
591B	n/a	n/a
591F	n/a	n/a
591A	n/a	n/a
481C	n/a	n/a
4803	68.54	66.89
481A	n/a	n/a
481B	n/a	n/a
4802	69.27	n/a
4902	68.46	65.9
4903	67.44	65.85
581D	n/a	n/a
581B	n/a	n/a
581A	n/a	n/a
6801	69.83	n/a
4801	69.39	66.14
4901	69.13	66.04
6901	69.31	66.75
591E	n/a	n/a
591D	n/a	n/a
591H	n/a	n/a
591C	n/a	n/a
691L	n/a	n/a
481E	n/a	n/a
5801	69.76	68.36
581E	n/a	n/a
4804	69.16	67.66
581C	n/a	n/a
591I	n/a	n/a

The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

Foul: A sewer designed to convey waste water from domestic and industrial sources to a treatment works.

Surface Water: A sewer designed to convey surface water (e.g. rain water from roofs, yards and car parks) to rivers or watercourses.

Combined: A sewer designed to convey both waste water and surface water from domestic and industrial sources to a treatment works.

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

A feature in a sewer that does not affect the flow in the pipe. Example: a vent is a fitting as the function of a vent is to release excess gas.

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

A feature in a sewer that changes or diverts the flow in the sewer. Example: A hydrobrake limits the flow passing downstream.

Control Valve

Drop Pipe

Ancillary

Weir

End Items

End symbols appear at the start or end of a sewer pipe. Examples: an Undefined End at the start of a sewer indicates that Thames Water has no knowledge of the position of the sewer upstream of that symbol, Outfall on a surface water sewer indicates that the pipe discharges into a stream or river.

Outfall

Undefined End

Inlet

Other Symbols

Symbols used on maps which do not fall under other general categories

Public/Private Pumping Station

Change of characteristic indicator (C.O.C.I.)

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

Other Sewer Types (Not Operated or Maintained by Thames Water)

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

Proposed

Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plans are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole level indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Searches on 0800 009 4540.

9.6 BGS Borehole Record

LOCATION : *Dukes Close, Shabbington*

BOREHOLE No. *One*

DATE OF BORING: *27.07.1983*

Description of Strata	Strata Change Depth M	S.P.T. C.P.T. N-Value	Samples Depth M	Samples Type	Water Level M	Depth of Casing M
TOPSOIL						
KIMMERIDGE CLAY Firm dark brown silty CLAY with occasional shell fragments	1.00		1.00	J		
- dark grey	2.00		2.00	U.100		
- stiff blue/grey	3.00		3.00	J		
- shell fragments with occasional shell partings	4.00		4.00	B		
	5.00		5.00	B		
- shell partings	6.00		6.00	J	▽	

BOREHOLE DIAMETER : 150mm
LINING TUBES : 150mm
GROUND LEVEL :
REMARKS : slight seepage of ground water at 6.10m.

Ʊ - Water strike
Ʊ - Water (standing level)
W - Water Sample
B/J - Bulk/Jar Sample
S.P.T. - Standard Penetration Test
C.P.T. - Cone Penetration Test
(U) - Undisturbed Sample (38mm & 100mm)

Date. August, 1983

BOREHOLE LOG

Report No. 5.426