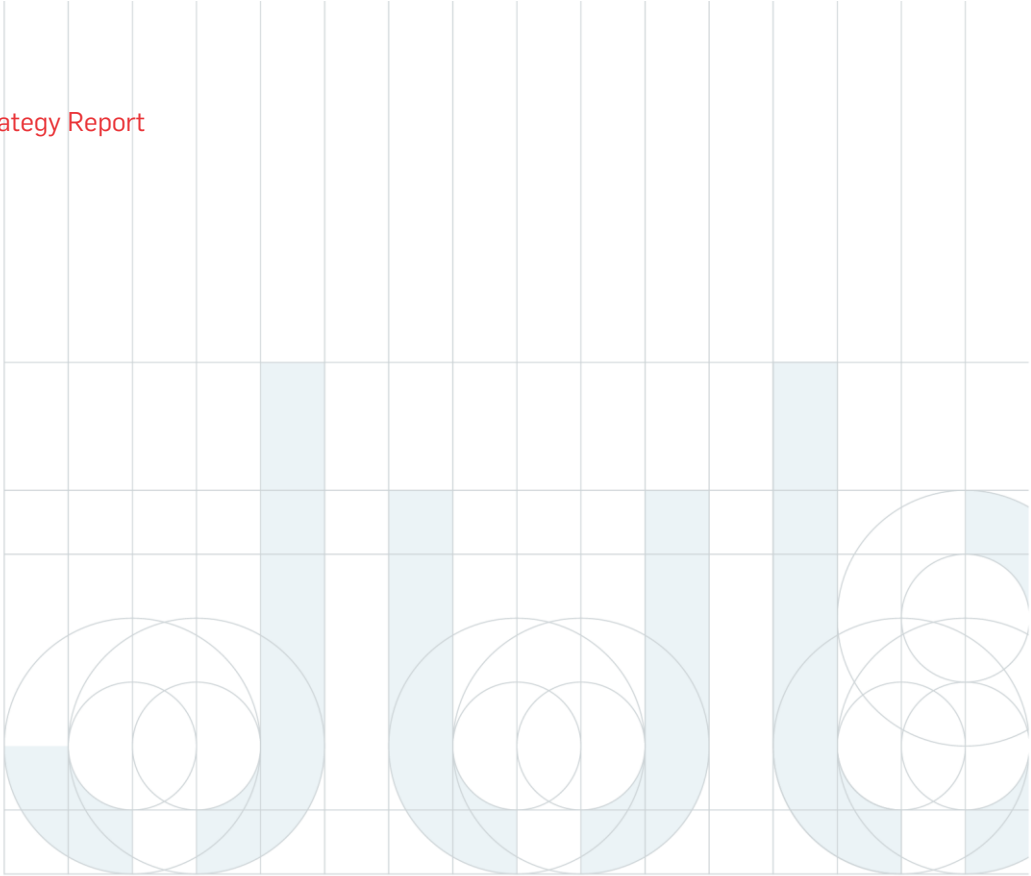




# Flood Risk Assessment & Drainage Strategy Report

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1 Project Information

1.1 Project Information

**Client** The Trustees of The Mulberry Investment Pension Scheme

1.2 Project Details

**Project Name** Land off Cobbett Way, Botley

**Location** Botley Parish

**Jubb Project Number** 23233

1.3 Report Details

**Version** 4.0

**Status** For Planning

**Date** 19/01/24

1.4 Project Authorisation

ISSUE HISTORY:

| Version | Date     | Detail       |
|---------|----------|--------------|
| 1.0     | 25/07/23 | First Issue  |
| 2.0     | 14/11/23 | For Planning |
| 3.0     | 21/12/23 | For Planning |
| 4.0     | 18/01/24 | For Planning |

AUTHORISATION:

| Prepared By | Approved By |
|-------------|-------------|
| AH          | RL          |
| AH          | RL          |
| AH          | RL          |
| AH          | RL          |

## 2 Introduction

### 2.1 Instruction

- 2.1.1 Jubb has been commissioned on behalf of the trustees of The Mulberry Investment Pension Scheme to undertake a Flood Risk Assessment and Drainage Strategy report in support of a Outline planning application submission for the Land off Cobbett Way located in Botley.

### 2.2 Brief

- 2.2.1 This Flood Risk Assessment is prepared in accordance with the requirements of the National Planning Policy Framework (NPPF) published by the Department of Communities and Local Government. The NPPF sets out the government's national policies to protect people and property from flooding in both existing and future situations as a result of development.
- 2.2.2 Section 14 of the NPPF and the associated Planning Practice Guidance for Flood Risk and Coastal Change sets out the framework for planning decisions made by the local, regional and national government and the Environment Agency (EA). In order for planning authorities to make informed decisions on the Development of sites in areas at risk of flooding, NPPF requires the developer to carry out an assessment of flood risk.
- 2.2.3 This report addresses the requirements given in Section 14 of the NPPF and other issues which are deemed relevant to flood risk. These requirements include the following:
- Assessment of the magnitude and severity of flood risk to the Site, including consideration of current and future impacts of climate change;
  - Assess suitability of Site and future development through the application of the Sequential Test and Exception Test (where required);
  - Assess the impacts of current and future development of the site on flood risk to adjacent developments;
  - Determine ability of existing and proposed drainage to accommodate development flows with respect to surface water runoff and flood risk;
  - Demonstrate that appropriate mitigation measures have been taken to prevent flooding;
  - Demonstrate that appropriate emergency situations have been considered e.g. overland flow path and evacuation routes.
- 2.2.4 This report also considers the disposal of wastewater generated by the proposed Development. Existing infrastructure will be reviewed to identify potential options for the disposal of foul and surface water runoff for future development.

### 3 Site Location & Description

#### 3.1 Background

- 3.1.1 The Site is 2.81ha in size and is located adjacent on the west edge of Botley, within the parish of Botley Parish Council.
- 3.1.2 The current proposals comprise the erection of 34 dwellings (including 35% affordable housing) together with associated access, parking, pedestrian and cycle routes, landscaping, green infrastructure and drainage.



Figure 1: Site Masterplan

#### 3.2 Site location & land use

- 3.2.1 Land off Cobbett Way is located in Botley, adjacent to the A334, in Hampshire (coordinates: 450,439E, 113,103N), the nearest postcode is SO30 2EU.
- 3.2.2 The Site comprises agricultural land adjacent to the south of the A334. The Site is located to the east of Cobbett Way and directly north of The Bridleway.).

3.2.3 Refer to Appendix A for a Site Location Plan.

### 3.3 Site Topography

3.3.1 General site levels vary from 12.63mAOD at the north of the site to 13.57mAOD at the south. Then to the east of the site the levels vary from 13.50mAOD to 15.43mAOD to the west of the site. The overall site follows the natural topography with the higher levels being to the west of the site and low points being to the east of the site, with an approximate gradient of 1:67. The site also falls south to north direction, with an approximately fall of 1:177.

3.3.2 Refer to Appendix B for topographical survey.

### 3.4 Site Geology

3.4.1 Datasets have been obtained from the British Geological Survey (BGS) website to provide a high-level geology across the district. An extract of the BGS mapping is displayed in Figure 2 below. It indicates that the site is underlain by the Earnley Sand formation – Clay, Silt and Sand. Superficial deposits are not recorded across the site.

3.4.2 A review of the boreholes from the ground investigation that has been done on the Land off Cobbett Way site. They confirm presence of Dark grey very silty Clay (Earnley Sand Formation) within the area and indicate groundwater 2.6-5m below ground level.

3.4.3 EA maps (<https://magic.defra.gov.uk/>) were used to confirm that the site is not located within a Source Protection zone and is not within an Aquifer Designation (Bedrock & Superficial Drift).

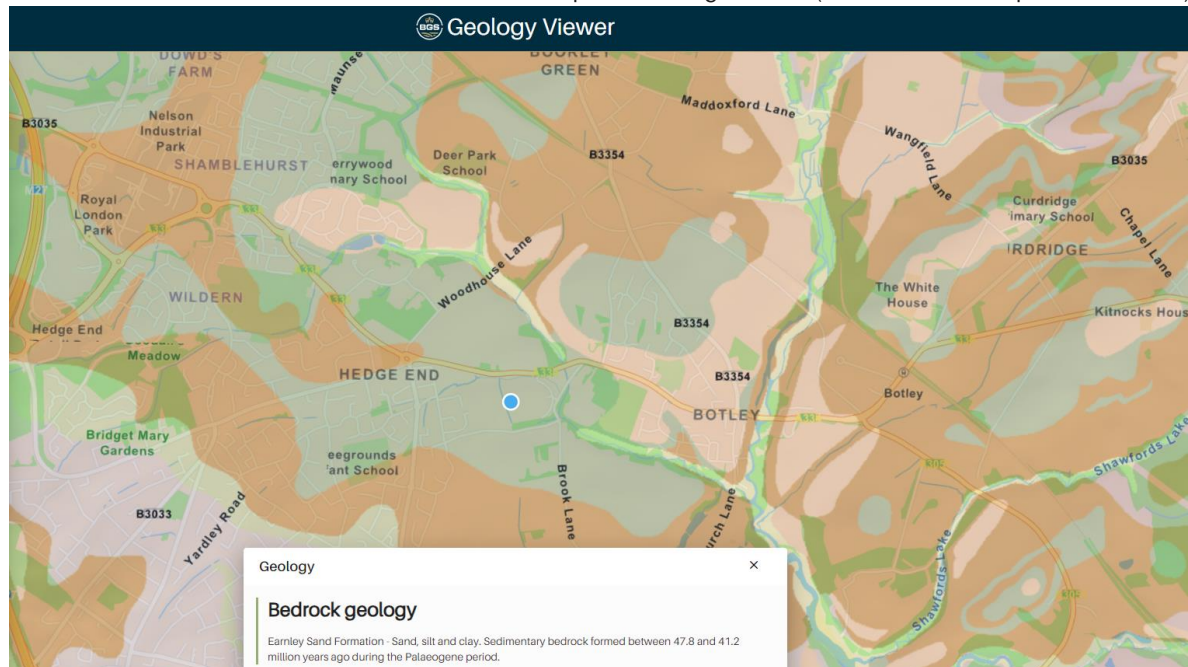


Figure 2: Extract of British Geological Survey mapping indicating Bedrock Geology

### 3.5 Local Watercourses

- 3.5.1 Hamble river, a designated main river and a tributary of the Hamble River is approximately 200m east of the Site. This watercourse flows 200m east before joining the Hamble River.
- 3.5.2 An unnamed ordinary watercourse located to the north, west and south of the site which drains towards the River Hamble (approximately 1.3km north of the site).

### 3.6 Existing Drainage

- 3.6.1 The application Site is classified as a greenfield site and currently drains via natural overland runoff towards the unnamed ordinary existing watercourses that surrounds the site. The topographical survey (Appendix B) indicates that there is a dry ditch running alongside the A33 to the west of the site.
- 3.6.2 Comprehensive below ground drainage records for the whole site are not available. The topographical survey of the site (Appendix B) undertaken by Encompass Surveys in April 2023 recorded all private drainage features including ditches, headwalls, pipe diameters.

## 4 Flood Risk to The Existing Site

### 4.1 Fluvial Flooding

- 4.1.1 The Environment Agency (EA) produces floodplain maps for the UK, which show the area at risk of fluvial and tidal flooding. The EA flood zone maps identify undefended floodplain, giving the horizontal extent of low (Zone 1), medium (Zone 2) and high-risk flood zones (Zones 3a and 3b) depending on the severity of the flood event.
- 4.1.2 The EA's Flood Map for Planning (Figure 3) indicates the site to be located within Flood Zone 1 (Low Probability) and therefore defined as having less than a 1 in 1,000 annual probability of river flooding.

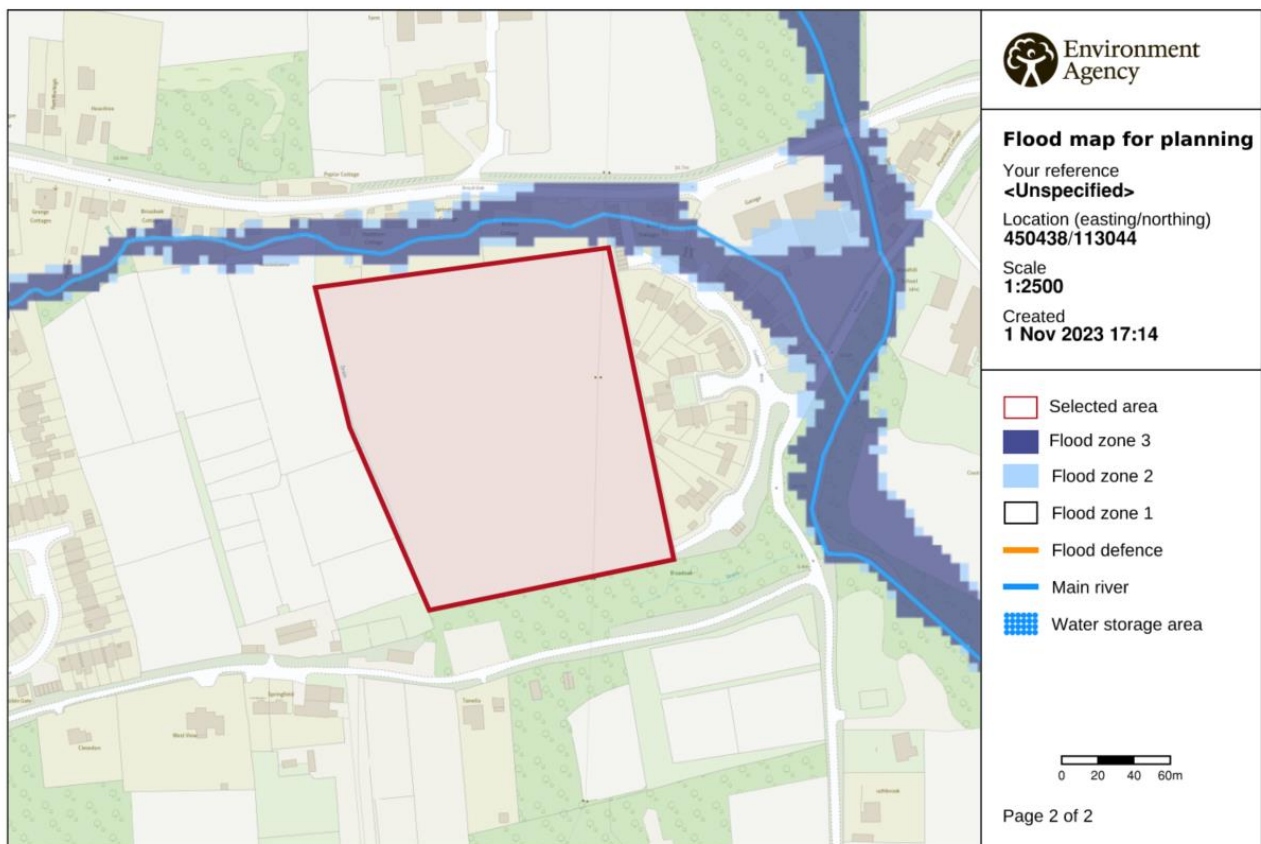


Figure 3: Extract from Environment Agency Tidal and Fluvial Flood Risk Map

- 4.1.3 Table 2 of the NPPF Planning Practice Guidance for Flood Risk and Coastal Change states in terms of flood risk vulnerability, that all types of development are suitable within this flood zone.

### 4.2 Overland (Surface Water) Flooding

- 4.2.1 The EA also produces maps which highlight the risk of flooding from surface water flows. The Long-Term Flood Risk Information maps can illustrate when the capacity of existing surface water drainage networks or channels are exceeded in extreme rainfall events. These maps are produced, as with fluvial modelling, based on generalised information, and need to be verified in terms of topographical ground levels and indicated flow routes.

- 4.2.2 Figure 4 indicates that the site will not be affected by surface water flooding, therefore it is in the low risk scenarios. This flood risk reflects the localised topography.
- 4.2.3 The development Site indicates to be at risk of surface water flooding, hence developing and changing the topography of this area will have a minimal impact on the surrounding overland flow routes.

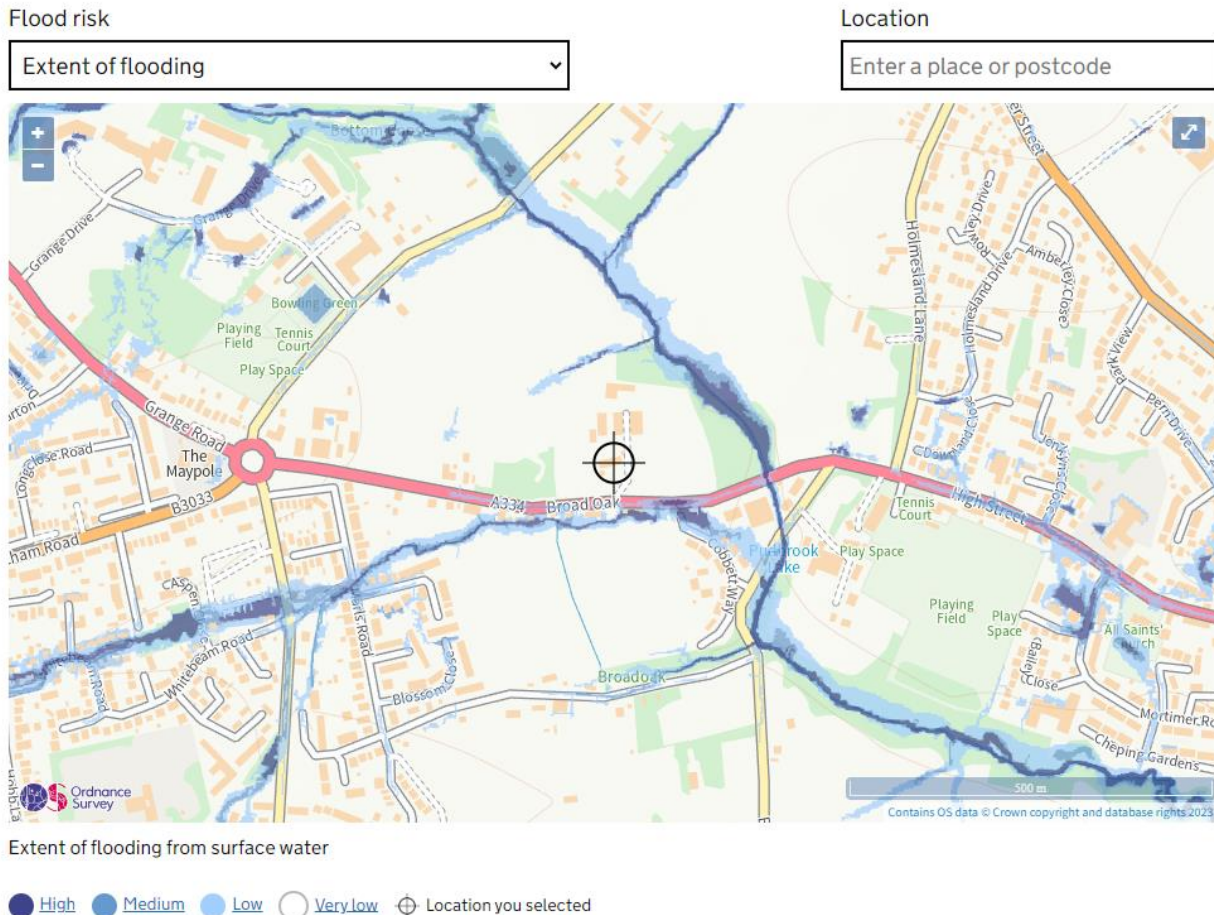


Figure 4: Extract from Environment Agency's Long-Term Flood Risk mapping indicating Surface Water Flood Risk

### 4.3 Flooding from Groundwater

- 4.3.1 PUSH (Partnership for Urban South Hampshire) Strategic Flood Risk Assessment (SFRA) prepared by Wallingford HydroSolutions Limited and dated December 2016 states groundwater in Botley is typically caused by three main mechanisms:
- Rising water levels in superficial deposits;
  - Groundwater flooding and fluvial flooding interactions; and
  - Rising water levels in aquifers.
- 4.3.2 As previously detailed, there are no identified superficial deposits beneath the site. The bedrock strata is classified as a 'unproductive strata'. The Site area is not located within a groundwater Source Protection Zone.
- 4.3.3 A site-specific ground investigation has been undertaken which showed there to be no soakage.

4.3.4 In view of the above information, the Site is considered to be at low risk of flooding from groundwater.

#### 4.4 Flooding from Sewers

4.4.1 There have been no recorded historic incidents of flooding resulting from sewers within the site boundary. Similarly, there are no recorded historic incidents of sewer flooding outside of the site boundary resulting in flooding of the Site. No other recorded information or anecdotal evidence regarding sewer flooding has been obtained.

4.4.2 The topography of the surrounding area and road network serves to naturally convey flood waters away from the Site. Therefore, the proposed site is considered to be at very low risk of flooding from sewers.

#### 4.5 Flooding from Artificial Sources

4.5.1 The EA's Long-Term Flood Risk Information mapping also indicates the potential extent of flooding from reservoir breach/failure. The proposed site is not identified to be at risk of flooding from artificial sources.

## 5 Proposed Development

### 5.1 Development Description

- 5.1.1 As previously detailed, the current proposals comprise the erection of 34 dwellings (including 35% affordable housing) together with associated access, parking, pedestrian and cycle routes, landscaping, green infrastructure and drainage. The architect's masterplan is included in Appendix C.

### 5.2 Development Suitability

- 5.2.1 The NPPF aims to direct development to suitable areas with low probability of flooding. The table below illustrates the acceptable classifications of development within each flood zone.

| Flood Risk Vulnerability Classification                 | Essential Infrastructure | Water Compatible | Highly Vulnerable | More Vulnerable | Less Vulnerable |
|---------------------------------------------------------|--------------------------|------------------|-------------------|-----------------|-----------------|
| Flood Zone 1<br>(<1 in 1000)                            | ✓                        | ✓                | ✓                 | ✓               | ✓               |
| Flood Zone 2<br>(up to 1 in 1000)                       | ✓                        | ✓                | Exception Test    | ✓               | ✓               |
| Flood Zone 3a<br>(1 in 100 fluvial)<br>(1 in 200 tidal) | Exception Test           | ✓                | X                 | Exception Test  | ✓               |
| Flood Zone 3b<br>(functional floodplain)                | Exception Test           | ✓                | X                 | X               | X               |

*Table 1: Flood Risk Vulnerability Classification*

- 5.2.2 Proposals within the Masterplan are classified as 'More Vulnerable' within Table 2 of the NPPF Planning Practice Guidance, and therefore is deemed acceptable for location within Flood Zone 1.

## 6 Proposed Drainage Strategy

### 6.1 Surface Water Drainage

- 6.1.1 New surface water drainage will be required to drain surface water runoff from any proposed buildings, carriageways, and associated car parking and pedestrian hard standing areas.
- 6.1.2 It is a requirement of the Eastleigh Borough Council SFRA that any development should not result in an increase in surface water runoff, and where possible, should demonstrate betterment in terms of rate and volumes of surface water runoff. Generally, the aim should be to discharge surface water run-off in accordance with the following hierarchy of surface water disposal options wherever reasonably practicable, (in order of preference):
- Into the ground (infiltration);
  - To a surface water body;
  - To a surface water sewer, highway drain, or another drainage system; or
  - To a combined sewer.
- 6.1.3 Furthermore, Sustainable Drainage Systems (SuDS) should be used to reduce and manage surface water run-off to and from proposed developments as near to source as possible. In line with the Eastleigh Borough Council Local Plan, SuDS must be implemented for all development sites unless it is demonstrated that SuDS are not suitable.
- 6.1.4 As detailed previously, infiltration measures in the form of traditional soakaways, cellular below ground tanks and infiltration basins will be ruled out due to poor ground conditions.
- 6.1.5 In consideration of the drainage hierarchy, discharge to a surface water body should be considered next, following ruling out infiltration. As detailed previously, there is a watercourse located along the western and southern boundaries. These will be reviewed for their suitability to accept the surface water discharge from the site.
- 6.1.6 The proposed development of the site in line with Masterplan will increase the impervious area within the overall development. Due to this increase in impermeable areas, the surface water runoff will need to be restricted to prevent an increase of surface water discharging off the site. Due to the greenfield nature of the site, the runoff rate will be restricted to Qbar. The site layout currently included within the planning application is illustrative as per the outline nature of the overall submission. The current layout shows a developable area of 1.65ha, this figure will be used for calculating the greenfield runoff rate.
- 6.1.7 In order to enable discharge to the watercourse at a restricted discharge equivalent to the existing Greenfield runoff rate in line with Eastleigh Borough Council requirements, any increase in impervious area within the site boundary will need to be suitably attenuated prior to discharge. Attenuation will be designed and positioned in relation to the Phase of the development coming forward and will interact with existing drainage systems and SuDS as appropriate. Any proposed attenuation systems will be designed to accommodate a 1 in 100-year storm return period plus a 45% allowance for climate change.
- 6.1.8 The Qbar rate for the developable site has been calculated as 10.9l/s. Calculations are included within Appendix D.
- 6.1.9 The surface water drainage strategy for the site is to attenuate within 2 detention basins, located in the western portion of the site and southwest of the area. The basins will provide min. 500m<sup>3</sup> of storage,

allowing for the restriction of runoff to greenfield rates for all storms up to and including a 1 in 100-year storm plus 45% climate change allowance.

6.1.10 The site will continue to discharge towards the ditch / watercourse to the west and south of the site.

6.1.11 Proposed drainage design can be found in Appendix E, extract shown in Figure 5 below. MicroDrainage network calculations for all storms of up to and including 1 in 100 + 45% CC can be found in Appendix D. FEH Storm data has been used for the modelling.



Figure 5, Proposed Drainage Strategy

6.1.12 To keep drainage shallow, roadside swales could be used to convey surface water flows to detention basins. This would allow levels on the site to remain similar to existing. Figure 6 below shows a cross section of a what the swales could look like. These swales would provide source control cleansing and also avoid the need for positive surface water drainage.

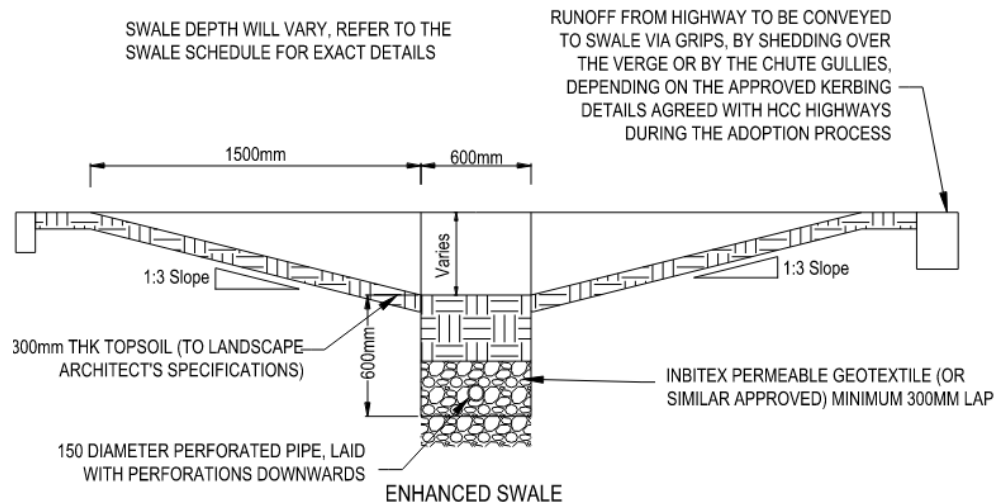


Figure 6, Roadside Swale

## 6.2 Proposed Site Levels

- 6.2.1 The existing levels of the site show a fall from west to east. On the proposed drainage layout, included in Appendix E, some indicative proposed levels have been included. These levels show, with some earth moving on site, the site levels can be adjusted to ensure sufficient falls are provided to drain to the designated attenuation basins. The maximum raise in levels is c1.3m to create a high point in the centre of the site. These level changes provide falls of c1:40 for the roads and keep the SuDS locations at their existing levels and do not compromise the IL of the proposed discharge points. The shown proposed levels also ensure the overland flows can access green areas and keep away from habitable areas.
- 6.2.2 There is an isolated area in the north east corner which shows a fall away from the rest of the site. This level fall is to ensure the overland flows continue to flow away from the habitable areas and match existing levels. The drainage in this area could be dealt with permeable paving with a sub base which falls in the opposite direction to the surface flows and would ensure IL stay shallow when going against the grain of the site levels.

## 7 Water Quality

### 7.1 Water Quality Principles

- 7.1.1 Surface water management should incorporate sustainable drainage techniques to restrict surface water discharge from the Site, in addition to improving water quality of runoff. Runoff from the proposed development may contain hydrocarbons, pollutants and nutrients which may be harmful if discharged directly to the ground. Whilst there is no UK wide legislation, the EBC local plan policy DM 6 requires three levels of filtration prior to discharge. This strategy complies with this requirement.
- 7.1.2 It is proposed to use attenuation in the form of swales/detention basins and permeable paving discharging to the watercourse system off-site, as a means of surface water management in relation to delivery of the proposed Masterplan. Sizing and positions of any proposed drainage will be confirmed through detailed design and intrusive site investigation for each phase of development.
- 7.1.3 All roof water downpipes will be sealed against pollutants entering the system from polluted surface runoff, effluent disposal or other forms of discharge, and will discharge to a catchpit manhole upstream of any proposed attenuation tanks to ensure all sediment and silts are removed upstream of discharging to the watercourse system.

### 7.2 Simple Index Method

- 7.2.1 The SuDS Manual (CIRIA C753) recommends that the Simple Index Approach is used to ensure that there is adequate treatment proposed. This approach assigns pollution hazard indices to land types (see Table 3), and SuDS mitigation indices to different SuDS components (see Table 4).
- 7.2.2 As infiltration has been found to not be feasible, only SuDS mitigation indices for discharging to surface water are considered.

| Land Use          | Pollution Hazard Level | Total Suspended Solids (TSS) | Metals | Hydrocarbons |
|-------------------|------------------------|------------------------------|--------|--------------|
| Residential Roofs | Very Low               | 0.2                          | 0.2    | 0.05         |

*Table 2: Pollution Hazard Indices for applicable land use classifications (from Table 26.2 CIRIA SuDS Manual 2015, C753)*

- 7.2.3 Indicative SuDS mitigation indices for discharges to surface water sewers are indicated in Table 6 below for the types of SuDS proposed within the development.

| Type of SuDS Component | Mitigation Indices |         |              |
|------------------------|--------------------|---------|--------------|
|                        | TSS                | Metals  | Hydrocarbons |
| Swale/Detention Basin  | 0.5                | 0.6/0.5 | 0.6          |

*Table 3: Indicative SuDS Mitigation Indices for discharges to XX (from Table 26.3 CIRIA SuDS Manual 2015, C753)*

- 7.2.4 To ensure adequate treatment, the SuDS components used should, for each contaminant type, ensure:

**Total SuDS Mitigation Index  $\geq$  Pollution Hazard Index**

- 7.2.5 It is anticipated that the SuDS incorporated within the proposed drainage strategy will deliver a treatment train approach, with runoff being intercepted and conveyed through the SuDS features.
- 7.2.6 Based on the values indicated in Tables 3 and 4 above, the SuDS Mitigation Index is greater than the Pollution Hazard Index, and therefore it is anticipated that the proposed strategy will provide sufficient mitigation against the pollution hazards expected on-site.

## **8 SuDS Management & Maintenance**

- 8.1.1 All main drainage runs within the proposed development will be offered up for adoption to Southern Water and have been designed in line with the relevant adoptable standards.
- 8.1.2 All SuDS and private drainage within the proposed development site will be privately owned and is not proposed to be adopted by the local water authority Southern Water, in accordance with their policies. These systems will be managed and maintained privately by the landowner, either through an internal maintenance team or an external site management company.
- 8.1.3 As the Masterplan is developed and individual phases progressed, management and maintenance practices for any proposed SuDS/drainage infrastructure will be determined, and continually reviewed and updated with a final confirmed plan to be detailed at the completion of the construction.
- 8.1.4 SuDS features will be managed in accordance with the guidelines outlined within The SuDS Manual (CIRIA C753, Chapter 32). Given the nature of the development and the status of the planning process, final details of the SuDS system and exact maintenance requirements are yet to be fully determined.

## **9 Management of Residual Risk**

- 9.1.1 The Site is not considered to be at risk of fluvial flooding in the future, however the development of the different phases within the Masterplan and the delivery of Masterplan overall, should be designed to further mitigate the potential surface water flood risk posed to and from the site as rainfall intensities increase.

### **9.2 Flood Resistance**

- 9.2.1 It has been identified there are no areas on the Site at risk from surface water flooding.
- 9.2.2 The proposed drainage and levels strategy for the site ensures that during all phases, surface water within the Site boundary will be captured and any low points drained. The proposed attenuation measures incorporated to manage surface water flows are appropriately sized with an allowance for future flows and climate change.
- 9.2.3 Finished external levels will direct surface water away from any proposed or existing buildings to lower risk areas of the Site such as car park and open space.
- 9.2.4 The risk of surface water flooding will be mitigated as highlighted above, therefore surface water flooding is considered low risk.

### 9.3 Flood Resilience

9.3.1 In addition to flood resistance measures, any ground flood, or below ground structures should be designed to be resilient against flooding. Potential measures could include:

- Building facades to be constructed with water resilience materials;
- Construction materials to be waterproof and washable wherever possible;
- Below ground infrastructure to be waterproofed in accordance with Building Regulations guidelines.

9.3.2 Potential pollutants (plan fuels, oils, petrols etc.) should also be stored securely and bunded where required.

### 9.4 Access and Egress

9.4.1 Safe access and egress are required to enable the evacuation of people from the development and to provide the emergency services with access to the development during times of flood.

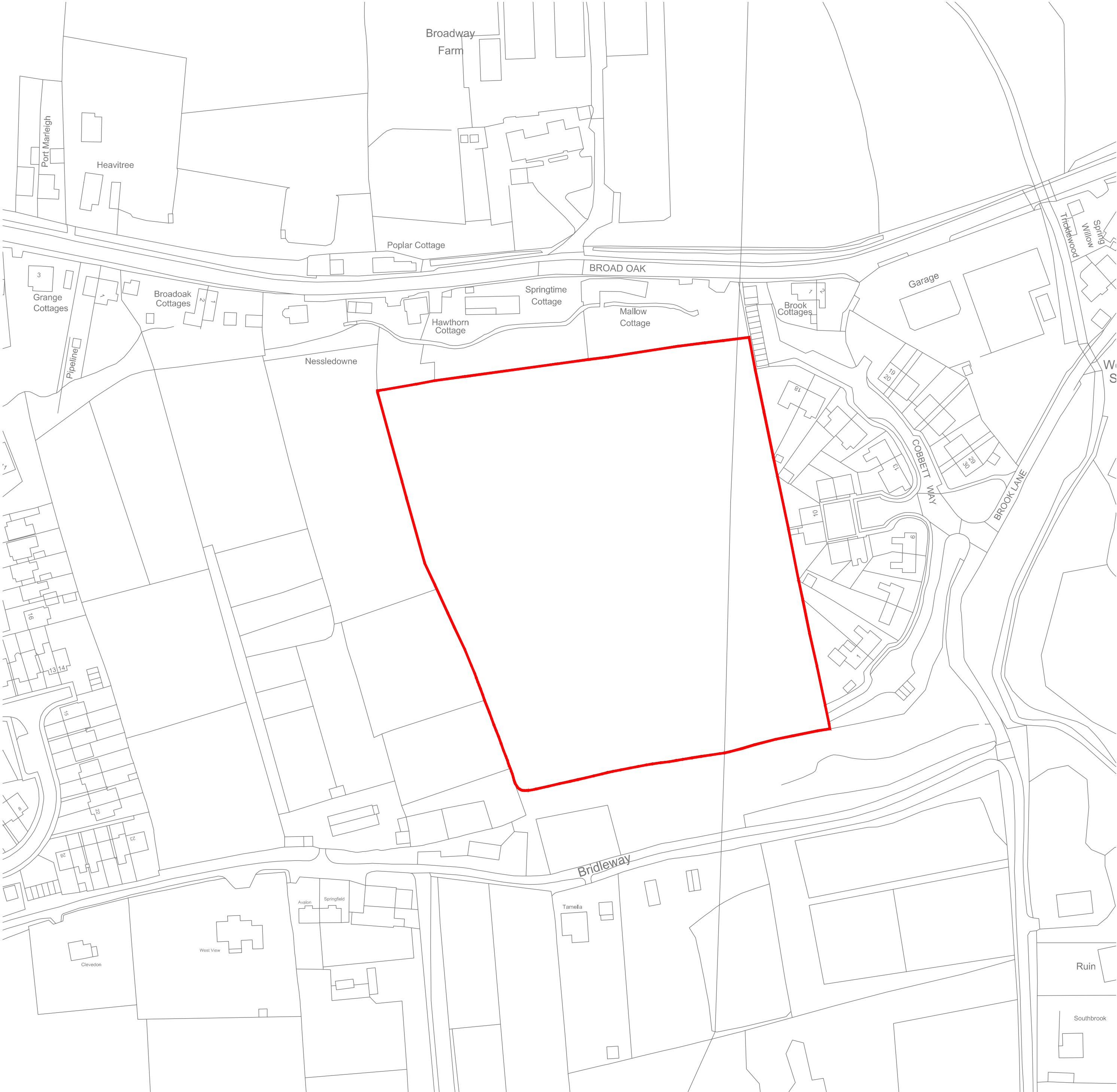
9.4.2 The site access is contained within an area with a very low flood risk. This will provide a safe and dry access and egress in times of emergency.

## 10 Conclusions and Recommendations

10.1.1 It is considered that this assessment represents a comprehensive and robust analysis of the flood impact of the current Masterplan proposals on the Site itself and on adjacent properties. In addition, this report demonstrates that the proposed Masterplan can be delivered sustainably in terms of flood risk, which can be summaries as follows:

| Subject                               | Conclusion                                                                                                                                                                                                                                                                                                                                                                                  |
|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>TIDAL &amp; FLUVIAL FLOOD RISK</b> | Flood Zone 1 - Low Risk                                                                                                                                                                                                                                                                                                                                                                     |
| <b>FLOOD RISK FROM OTHER SOURCES</b>  | Low Risk from all other sources,                                                                                                                                                                                                                                                                                                                                                            |
| <b>DEVELOPMENT SUITABILITY</b>        | Development suitable in line with table 2 of the NPPF.                                                                                                                                                                                                                                                                                                                                      |
| <b>EXISTING DRAINAGE</b>              | There are existing FW and SW sewers near the site. Existing site drains overland towards an unnamed ordinary watercourse to the north of the site.                                                                                                                                                                                                                                          |
| <b>PROPOSED DRAINAGE</b>              | Foul water will flow towards the existing Southern Water network. Surface water will continue to discharge towards the ordinary watercourses to the west and south.                                                                                                                                                                                                                         |
| <b>SURFACE WATER MANAGEMENT</b>       | Runoff rates will be limited to greenfield rates for all storms up to and including 1 in 100 + 45% Climate Change. Attenuation will be provided via detention basins to the west of the site. Inline with the CIRIA guidance, the detention basins will provide suitable levels of treatment but additional will be provided to meet the Eastleigh Borough Council Local Plan requirements. |
| <b>FOUL WATER DISPOSAL</b>            | It is proposed to discharge the foul water from the site to the existing adopted foul water network. It is proposed to discharge this via gravity.                                                                                                                                                                                                                                          |

## Appendix A: Site Location Plan



 SITE BOUNDARY  
6.945ac / 2.810ha

what3words:  
///shelters.dragonfly.various

Scale @ A2:  
  
Scale 1:1250



| Rev                           | Date     | Drawn | Checked |
|-------------------------------|----------|-------|---------|
| A                             | 19.10.23 | BL    | BB      |
| RED LINE UPDATED TO HIGHWAY   |          |       |         |
| B                             | 24.10.23 | BL    | BB      |
| HIGHWAY REMOVED FROM RED LINE |          |       |         |

Date: JUNE 2023

Drawn by : BL Checked by : BB

Drg No: CB\_63\_311\_PARAM\_000 Rev: B

Project:  
BROAD OAK, BOTLEY,  
SOUTHAMPTON

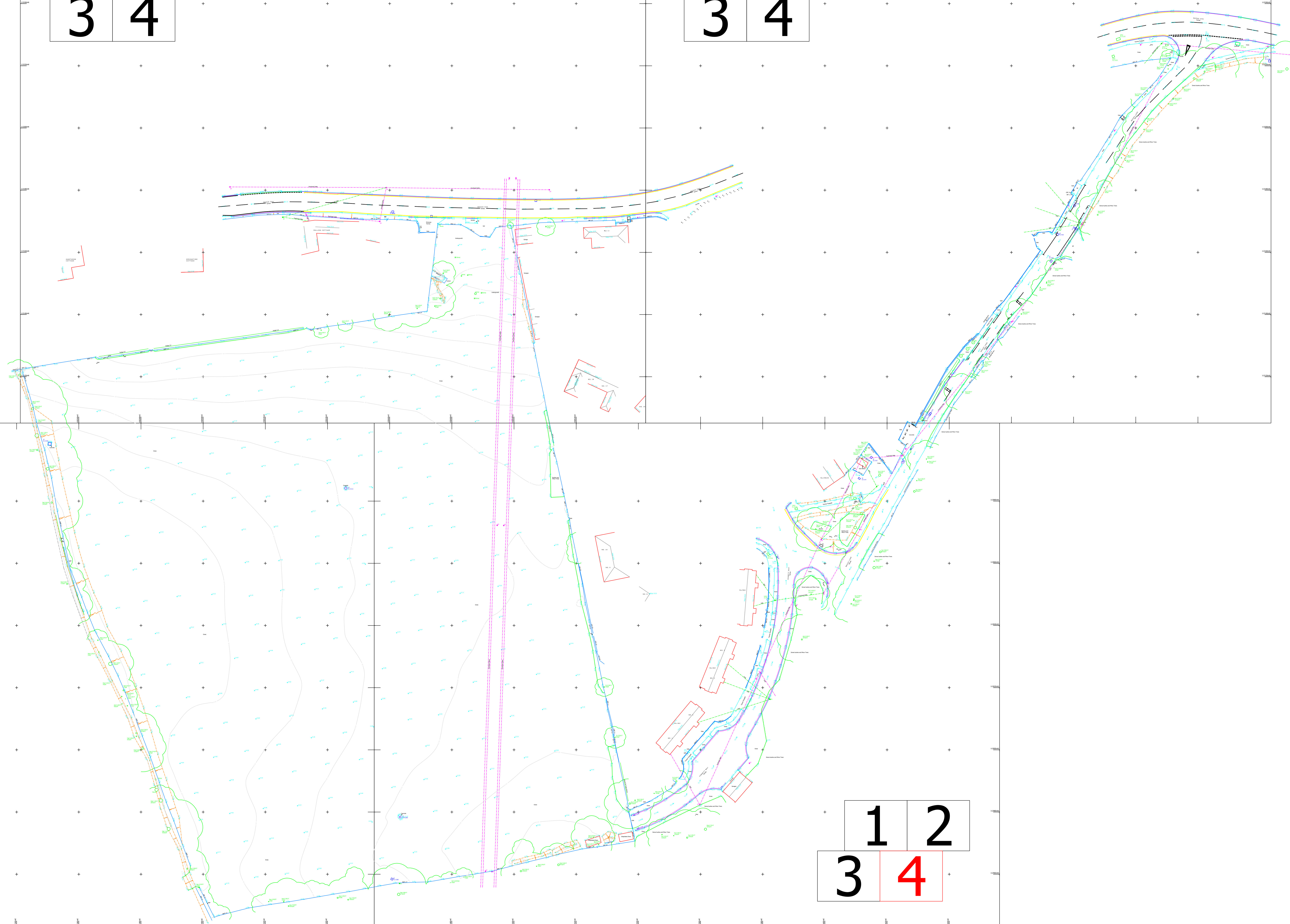
Title:  
SITE LOCATION  
PLAN



## Appendix B: Topographical Survey

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| 3 | 4 |

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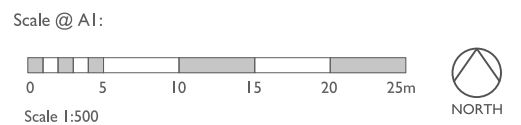
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| 1 | 2 |
| 3 | 4 |

## Appendix C: Illustrative Masterplan



- KEY
- SITE BOUNDARY
  - SITE ACCESS
  - POTENTIAL PEDESTRIAN ACCESS
  - POTENTIAL PEDESTRIAN CONNECTION
  - PROPOSED BUILDINGS
  - PROPOSED ROAD
  - PRIVATE DRIVE
  - FOOTPATH
  - OPEN SPACE PATH
  - PUBLIC OPEN SPACE
  - FOCAL SPACE
  - EXISTING TREES
  - PROPOSED TREES
  - INDICATIVE SuDS



| Rev | Date | Drawn | Checked |
|-----|------|-------|---------|
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REV C

|                             |                           |
|-----------------------------|---------------------------|
| Date: JUNE 2023             |                           |
| Drawn by: BL                | Checked by: BB            |
| Dwg No: CB_63_311_PARAM_001 | Rev: <input type="text"/> |

Project: LAND OFF COBBETT WAY, BOTLEY, SOUTHAMPTON

Title: ILLUSTRATIVE MASTERPLAN



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## Appendix D: Surface Water Calculations

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                            |                                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|-------------------------------------------------------------------------------------|
| Jubb Consulting Engineers Ltd (Bristol)                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                            | Page 1                                                                              |
| St James's Court, Suite B<br>Ground Floor West, St James ...<br>Bristol, BS1 3LH                                                                                                                                                                                                                                                                                                                                                                                                         | 23233<br>Land off Cobbett Way<br>Broad Oak |  |
| Date 16/01/2024<br>File tmpFE3E.tmp                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Designed by AH<br>Checked by RL            |                                                                                     |
| Innovyze                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                            | Source Control 2020.1                                                               |
| <p style="text-align: center;"><u>ICP SUDS Mean Annual Flood</u></p> <p style="text-align: center;">Input</p> <p>Return Period (years)      1                      Soil      0.480<br/> Area (ha) 1.650                      Urban      0.000<br/> SAAR (mm)    880 Region Number Region 7</p> <p style="text-align: center;"><b>Results    1/s</b></p> <p>QBAR Rural 10.9<br/> QBAR Urban 10.9</p> <p>Q1 year    9.3</p> <p>Q1 year    9.3<br/> Q30 years 24.7<br/> Q100 years 34.8</p> |                                            |                                                                                     |
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Bristol, BS1 3LH

23233  
Land off Cobbett Way  
Swale 1 Volume

Date 16/01/2024  
File 23233-JUB-XX-XX-CA-C-00...

Designed by AH  
Checked by RL

Innovyze

Source Control 2020.1

Micro Drainage

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 604 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    | 14.524        | 0.524         | 0.0                    | 6.0               | 6.0                 | 188.5           | O K        |
| 30 min Summer    | 14.659        | 0.659         | 0.0                    | 6.0               | 6.0                 | 251.1           | O K        |
| 60 min Summer    | 14.792        | 0.792         | 0.0                    | 6.0               | 6.0                 | 317.0           | Flood Risk |
| 120 min Summer   | 14.849        | 0.849         | 0.0                    | 6.0               | 6.0                 | 346.7           | Flood Risk |
| 180 min Summer   | 14.874        | 0.874         | 0.0                    | 6.0               | 6.0                 | 360.0           | Flood Risk |
| 240 min Summer   | 14.885        | 0.885         | 0.0                    | 6.0               | 6.0                 | 366.2           | Flood Risk |
| 360 min Summer   | 14.889        | 0.889         | 0.0                    | 6.0               | 6.0                 | 368.0           | Flood Risk |
| 480 min Summer   | 14.878        | 0.878         | 0.0                    | 6.0               | 6.0                 | 362.4           | Flood Risk |
| 600 min Summer   | 14.860        | 0.860         | 0.0                    | 6.0               | 6.0                 | 353.0           | Flood Risk |
| 720 min Summer   | 14.844        | 0.844         | 0.0                    | 6.0               | 6.0                 | 344.2           | Flood Risk |
| 960 min Summer   | 14.813        | 0.813         | 0.0                    | 6.0               | 6.0                 | 328.3           | Flood Risk |
| 1440 min Summer  | 14.761        | 0.761         | 0.0                    | 6.0               | 6.0                 | 301.5           | Flood Risk |
| 2160 min Summer  | 14.692        | 0.692         | 0.0                    | 6.0               | 6.0                 | 266.8           | O K        |
| 2880 min Summer  | 14.629        | 0.629         | 0.0                    | 6.0               | 6.0                 | 236.6           | O K        |
| 4320 min Summer  | 14.521        | 0.521         | 0.0                    | 6.0               | 6.0                 | 187.3           | O K        |
| 5760 min Summer  | 14.436        | 0.436         | 0.0                    | 6.0               | 6.0                 | 150.1           | O K        |
| 7200 min Summer  | 14.372        | 0.372         | 0.0                    | 6.0               | 6.0                 | 123.6           | O K        |
| 8640 min Summer  | 14.323        | 0.323         | 0.0                    | 5.9               | 5.9                 | 104.2           | O K        |
| 10080 min Summer | 14.286        | 0.286         | 0.0                    | 5.8               | 5.8                 | 89.5            | O K        |
| 15 min Winter    | 14.576        | 0.576         | 0.0                    | 6.0               | 6.0                 | 211.8           | O K        |

| Storm Event      | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|------------------|--------------|---------------------|-----------------------|------------------|
| 15 min Summer    | 138.891      | 0.0                 | 195.3                 | 26               |
| 30 min Summer    | 93.163       | 0.0                 | 262.0                 | 41               |
| 60 min Summer    | 59.777       | 0.0                 | 336.2                 | 70               |
| 120 min Summer   | 34.009       | 0.0                 | 382.6                 | 128              |
| 180 min Summer   | 24.443       | 0.0                 | 412.5                 | 188              |
| 240 min Summer   | 19.342       | 0.0                 | 435.2                 | 246              |
| 360 min Summer   | 13.922       | 0.0                 | 469.9                 | 364              |
| 480 min Summer   | 11.046       | 0.0                 | 497.1                 | 482              |
| 600 min Summer   | 9.241        | 0.0                 | 519.8                 | 562              |
| 720 min Summer   | 7.993        | 0.0                 | 539.6                 | 608              |
| 960 min Summer   | 6.367        | 0.0                 | 573.0                 | 720              |
| 1440 min Summer  | 4.643        | 0.0                 | 626.8                 | 982              |
| 2160 min Summer  | 3.407        | 0.0                 | 689.9                 | 1384             |
| 2880 min Summer  | 2.752        | 0.0                 | 743.1                 | 1772             |
| 4320 min Summer  | 2.063        | 0.0                 | 835.6                 | 2552             |
| 5760 min Summer  | 1.702        | 0.0                 | 919.2                 | 3280             |
| 7200 min Summer  | 1.483        | 0.0                 | 1000.8                | 3968             |
| 8640 min Summer  | 1.334        | 0.0                 | 1080.8                | 4672             |
| 10080 min Summer | 1.228        | 0.0                 | 1160.5                | 5360             |
| 15 min Winter    | 138.891      | 0.0                 | 218.8                 | 26               |

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23233  
Land off Cobbett Way  
Swale 1 Volume

Date 16/01/2024  
File 23233-JUB-XX-XX-CA-C-00...

Designed by AH  
Checked by RL

Innovyze

Source Control 2020.1

Micro Drainage

Summary of Results for 100 year Return Period (+45%)

| Storm Event      | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max E Outflow (l/s) | Max Volume (m³) | Status     |
|------------------|---------------|---------------|------------------------|-------------------|---------------------|-----------------|------------|
| 30 min Winter    | 14.724        | 0.724         | 0.0                    | 6.0               | 6.0                 | 282.7           | Flood Risk |
| 60 min Winter    | 14.869        | 0.869         | 0.0                    | 6.0               | 6.0                 | 357.8           | Flood Risk |
| 120 min Winter   | 14.936        | 0.936         | 0.0                    | 6.0               | 6.0                 | 393.8           | Flood Risk |
| 180 min Winter   | 14.967        | 0.967         | 0.0                    | 6.0               | 6.0                 | 411.1           | Flood Risk |
| 240 min Winter   | 14.983        | 0.983         | 0.0                    | 6.0               | 6.0                 | 420.3           | Flood Risk |
| 360 min Winter   | 14.994        | 0.994         | 0.0                    | 6.0               | 6.0                 | 426.6           | Flood Risk |
| 480 min Winter   | 14.992        | 0.992         | 0.0                    | 6.0               | 6.0                 | 425.0           | Flood Risk |
| 600 min Winter   | 14.981        | 0.981         | 0.0                    | 6.0               | 6.0                 | 418.9           | Flood Risk |
| 720 min Winter   | 14.966        | 0.966         | 0.0                    | 6.0               | 6.0                 | 410.3           | Flood Risk |
| 960 min Winter   | 14.927        | 0.927         | 0.0                    | 6.0               | 6.0                 | 388.7           | Flood Risk |
| 1440 min Winter  | 14.851        | 0.851         | 0.0                    | 6.0               | 6.0                 | 348.1           | Flood Risk |
| 2160 min Winter  | 14.742        | 0.742         | 0.0                    | 6.0               | 6.0                 | 291.9           | Flood Risk |
| 2880 min Winter  | 14.641        | 0.641         | 0.0                    | 6.0               | 6.0                 | 242.5           | O K        |
| 4320 min Winter  | 14.469        | 0.469         | 0.0                    | 6.0               | 6.0                 | 164.4           | O K        |
| 5760 min Winter  | 14.343        | 0.343         | 0.0                    | 5.9               | 5.9                 | 111.9           | O K        |
| 7200 min Winter  | 14.260        | 0.260         | 0.0                    | 5.7               | 5.7                 | 79.5            | O K        |
| 8640 min Winter  | 14.205        | 0.205         | 0.0                    | 5.4               | 5.4                 | 59.3            | O K        |
| 10080 min Winter | 14.170        | 0.170         | 0.0                    | 5.2               | 5.2                 | 46.5            | O K        |

| Storm Event      | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|------------------|--------------|---------------------|-----------------------|------------------|
| 30 min Winter    | 93.163       | 0.0                 | 293.5                 | 40               |
| 60 min Winter    | 59.777       | 0.0                 | 376.6                 | 70               |
| 120 min Winter   | 34.009       | 0.0                 | 428.5                 | 126              |
| 180 min Winter   | 24.443       | 0.0                 | 462.0                 | 184              |
| 240 min Winter   | 19.342       | 0.0                 | 487.4                 | 242              |
| 360 min Winter   | 13.922       | 0.0                 | 526.3                 | 356              |
| 480 min Winter   | 11.046       | 0.0                 | 556.7                 | 470              |
| 600 min Winter   | 9.241        | 0.0                 | 582.2                 | 582              |
| 720 min Winter   | 7.993        | 0.0                 | 604.3                 | 688              |
| 960 min Winter   | 6.367        | 0.0                 | 641.8                 | 884              |
| 1440 min Winter  | 4.643        | 0.0                 | 702.0                 | 1082             |
| 2160 min Winter  | 3.407        | 0.0                 | 772.7                 | 1512             |
| 2880 min Winter  | 2.752        | 0.0                 | 832.3                 | 1912             |
| 4320 min Winter  | 2.063        | 0.0                 | 935.8                 | 2680             |
| 5760 min Winter  | 1.702        | 0.0                 | 1029.5                | 3352             |
| 7200 min Winter  | 1.483        | 0.0                 | 1120.9                | 4040             |
| 8640 min Winter  | 1.334        | 0.0                 | 1210.5                | 4688             |
| 10080 min Winter | 1.228        | 0.0                 | 1299.7                | 5352             |

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| St James's Court, Suite B<br>Ground Floor West, St James ...<br>Bristol, BS1 3LH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       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| Date 16/01/2024<br>File 23233-JUB-XX-XX-CA-C-00...                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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|----------------------------------------------------------------------------------|-------------------------------------------------|-------------------------------------------------------------------------------------|
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| St James's Court, Suite B<br>Ground Floor West, St James ...<br>Bristol, BS1 3LH | 23233<br>Land off Cobbett Way<br>Swale 1 Volume |  |
| Date 16/01/2024<br>File 23233-JUB-XX-XX-CA-C-00...                               | Designed by AH<br>Checked by RL                 |                                                                                     |
| Innovyze                                                                         | Source Control 2020.1                           |                                                                                     |

#### Model Details

Storage is Online Cover Level (m) 15.000

#### Swale Structure

|                                      |         |                            |       |
|--------------------------------------|---------|----------------------------|-------|
| Infiltration Coefficient Base (m/hr) | 0.00000 | Length (m)                 | 32.0  |
| Infiltration Coefficient Side (m/hr) | 0.00000 | Side Slope (1:X)           | 4.0   |
| Safety Factor                        | 2.0     | Slope (1:X)                | 500.0 |
| Porosity                             | 1.00    | Cap Volume Depth (m)       | 0.000 |
| Invert Level (m)                     | 14.000  | Cap Infiltration Depth (m) | 0.000 |
| Base Width (m)                       | 10.0    |                            |       |

#### Hydro-Brake® Optimum Outflow Control

|                                   |                            |
|-----------------------------------|----------------------------|
| Unit Reference                    | MD-SHE-0108-6000-1500-6000 |
| Design Head (m)                   | 1.500                      |
| Design Flow (l/s)                 | 6.0                        |
| Flush-Flo™                        | Calculated                 |
| Objective                         | Minimise upstream storage  |
| Application                       | Surface                    |
| Sump Available                    | Yes                        |
| Diameter (mm)                     | 108                        |
| Invert Level (m)                  | 14.000                     |
| Minimum Outlet Pipe Diameter (mm) | 150                        |
| Suggested Manhole Diameter (mm)   | 1200                       |

| Control Points            | Head (m) | Flow (l/s) |
|---------------------------|----------|------------|
| Design Point (Calculated) | 1.500    | 6.0        |
| Flush-Flo™                | 0.448    | 6.0        |
| Kick-Flo®                 | 0.918    | 4.8        |
| Mean Flow over Head Range | -        | 5.3        |

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) |
|-----------|------------|-----------|------------|-----------|------------|-----------|------------|
| 0.100     | 3.7        | 1.200     | 5.4        | 3.000     | 8.3        | 7.000     | 12.4       |
| 0.200     | 5.4        | 1.400     | 5.8        | 3.500     | 8.9        | 7.500     | 12.8       |
| 0.300     | 5.8        | 1.600     | 6.2        | 4.000     | 9.5        | 8.000     | 13.2       |
| 0.400     | 6.0        | 1.800     | 6.5        | 4.500     | 10.1       | 8.500     | 13.6       |
| 0.500     | 6.0        | 2.000     | 6.9        | 5.000     | 10.6       | 9.000     | 14.0       |
| 0.600     | 5.9        | 2.200     | 7.2        | 5.500     | 11.1       | 9.500     | 14.4       |
| 0.800     | 5.4        | 2.400     | 7.5        | 6.000     | 11.5       |           |            |
| 1.000     | 5.0        | 2.600     | 7.8        | 6.500     | 12.0       |           |            |

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23233  
Land off Cobbett Way  
Swale 2 Volume

Date 16/01/2024  
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Designed by AH  
Checked by RL

Innovyze

Source Control 2020.1

Micro Drainage

Summary of Results for 100 year Return Period (+45%)

Half Drain Time : 1030 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    | 13.494        | 0.494         | 0.0                    | 4.6               | 4.6                 | 228.9           | O K        |
| 30 min Summer    | 13.620        | 0.620         | 0.0                    | 4.6               | 4.6                 | 305.7           | O K        |
| 60 min Summer    | 13.747        | 0.747         | 0.0                    | 4.6               | 4.6                 | 388.1           | Flood Risk |
| 120 min Summer   | 13.809        | 0.809         | 0.0                    | 4.6               | 4.6                 | 430.5           | Flood Risk |
| 180 min Summer   | 13.842        | 0.842         | 0.0                    | 4.6               | 4.6                 | 453.2           | Flood Risk |
| 240 min Summer   | 13.862        | 0.862         | 0.0                    | 4.6               | 4.6                 | 467.6           | Flood Risk |
| 360 min Summer   | 13.884        | 0.884         | 0.0                    | 4.6               | 4.6                 | 483.3           | Flood Risk |
| 480 min Summer   | 13.893        | 0.893         | 0.0                    | 4.6               | 4.6                 | 490.1           | Flood Risk |
| 600 min Summer   | 13.896        | 0.896         | 0.0                    | 4.6               | 4.6                 | 491.7           | Flood Risk |
| 720 min Summer   | 13.893        | 0.893         | 0.0                    | 4.6               | 4.6                 | 489.9           | Flood Risk |
| 960 min Summer   | 13.879        | 0.879         | 0.0                    | 4.6               | 4.6                 | 480.1           | Flood Risk |
| 1440 min Summer  | 13.844        | 0.844         | 0.0                    | 4.6               | 4.6                 | 454.8           | Flood Risk |
| 2160 min Summer  | 13.800        | 0.800         | 0.0                    | 4.6               | 4.6                 | 424.3           | Flood Risk |
| 2880 min Summer  | 13.764        | 0.764         | 0.0                    | 4.6               | 4.6                 | 399.8           | Flood Risk |
| 4320 min Summer  | 13.704        | 0.704         | 0.0                    | 4.6               | 4.6                 | 359.4           | Flood Risk |
| 5760 min Summer  | 13.652        | 0.652         | 0.0                    | 4.6               | 4.6                 | 326.0           | O K        |
| 7200 min Summer  | 13.610        | 0.610         | 0.0                    | 4.6               | 4.6                 | 299.3           | O K        |
| 8640 min Summer  | 13.574        | 0.574         | 0.0                    | 4.6               | 4.6                 | 276.9           | O K        |
| 10080 min Summer | 13.544        | 0.544         | 0.0                    | 4.6               | 4.6                 | 258.5           | O K        |
| 15 min Winter    | 13.541        | 0.541         | 0.0                    | 4.6               | 4.6                 | 257.0           | O K        |

| Storm Event      | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|------------------|--------------|---------------------|-----------------------|------------------|
| 15 min Summer    | 138.891      | 0.0                 | 234.4                 | 26               |
| 30 min Summer    | 93.163       | 0.0                 | 313.8                 | 41               |
| 60 min Summer    | 59.777       | 0.0                 | 403.5                 | 70               |
| 120 min Summer   | 34.009       | 0.0                 | 459.1                 | 130              |
| 180 min Summer   | 24.443       | 0.0                 | 495.0                 | 188              |
| 240 min Summer   | 19.342       | 0.0                 | 522.2                 | 248              |
| 360 min Summer   | 13.922       | 0.0                 | 563.8                 | 366              |
| 480 min Summer   | 11.046       | 0.0                 | 596.5                 | 486              |
| 600 min Summer   | 9.241        | 0.0                 | 623.6                 | 604              |
| 720 min Summer   | 7.993        | 0.0                 | 646.9                 | 722              |
| 960 min Summer   | 6.367        | 0.0                 | 681.7                 | 960              |
| 1440 min Summer  | 4.643        | 0.0                 | 688.2                 | 1184             |
| 2160 min Summer  | 3.407        | 0.0                 | 827.9                 | 1536             |
| 2880 min Summer  | 2.752        | 0.0                 | 891.7                 | 1936             |
| 4320 min Summer  | 2.063        | 0.0                 | 1002.7                | 2732             |
| 5760 min Summer  | 1.702        | 0.0                 | 1103.1                | 3528             |
| 7200 min Summer  | 1.483        | 0.0                 | 1201.0                | 4328             |
| 8640 min Summer  | 1.334        | 0.0                 | 1297.0                | 5104             |
| 10080 min Summer | 1.228        | 0.0                 | 1392.5                | 5856             |
| 15 min Winter    | 138.891      | 0.0                 | 262.5                 | 26               |

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Source Control 2020.1

Micro Drainage

Summary of Results for 100 year Return Period (+45%)

| Storm Event      | Max Level (m) | Max Depth (m) | Max Infiltration (l/s) | Max Control (l/s) | Max E Outflow (l/s) | Max Volume (m³) | Status     |
|------------------|---------------|---------------|------------------------|-------------------|---------------------|-----------------|------------|
| 30 min Winter    | 13.679        | 0.679         | 0.0                    | 4.6               | 4.6                 | 343.5           | O K        |
| 60 min Winter    | 13.818        | 0.818         | 0.0                    | 4.6               | 4.6                 | 436.9           | Flood Risk |
| 120 min Winter   | 13.888        | 0.888         | 0.0                    | 4.6               | 4.6                 | 486.6           | Flood Risk |
| 180 min Winter   | 13.926        | 0.926         | 0.0                    | 4.6               | 4.6                 | 513.8           | Flood Risk |
| 240 min Winter   | 13.950        | 0.950         | 0.0                    | 4.6               | 4.6                 | 531.3           | Flood Risk |
| 360 min Winter   | 13.977        | 0.977         | 0.0                    | 4.6               | 4.6                 | 551.6           | Flood Risk |
| 480 min Winter   | 13.990        | 0.990         | 0.0                    | 4.6               | 4.6                 | 561.9           | Flood Risk |
| 600 min Winter   | 13.996        | 0.996         | 0.0                    | 4.6               | 4.6                 | 566.4           | Flood Risk |
| 720 min Winter   | 13.997        | 0.997         | 0.0                    | 4.6               | 4.6                 | 567.2           | Flood Risk |
| 960 min Winter   | 13.990        | 0.990         | 0.0                    | 4.6               | 4.6                 | 561.5           | Flood Risk |
| 1440 min Winter  | 13.958        | 0.958         | 0.0                    | 4.6               | 4.6                 | 537.3           | Flood Risk |
| 2160 min Winter  | 13.906        | 0.906         | 0.0                    | 4.6               | 4.6                 | 499.1           | Flood Risk |
| 2880 min Winter  | 13.855        | 0.855         | 0.0                    | 4.6               | 4.6                 | 462.6           | Flood Risk |
| 4320 min Winter  | 13.749        | 0.749         | 0.0                    | 4.6               | 4.6                 | 389.6           | Flood Risk |
| 5760 min Winter  | 13.656        | 0.656         | 0.0                    | 4.6               | 4.6                 | 328.5           | O K        |
| 7200 min Winter  | 13.578        | 0.578         | 0.0                    | 4.6               | 4.6                 | 279.3           | O K        |
| 8640 min Winter  | 13.511        | 0.511         | 0.0                    | 4.6               | 4.6                 | 238.9           | O K        |
| 10080 min Winter | 13.454        | 0.454         | 0.0                    | 4.6               | 4.6                 | 205.9           | O K        |

| Storm Event      | Rain (mm/hr) | Flooded Volume (m³) | Discharge Volume (m³) | Time-Peak (mins) |
|------------------|--------------|---------------------|-----------------------|------------------|
| 30 min Winter    | 93.163       | 0.0                 | 348.7                 | 41               |
| 60 min Winter    | 59.777       | 0.0                 | 451.9                 | 70               |
| 120 min Winter   | 34.009       | 0.0                 | 514.2                 | 128              |
| 180 min Winter   | 24.443       | 0.0                 | 554.4                 | 186              |
| 240 min Winter   | 19.342       | 0.0                 | 584.9                 | 244              |
| 360 min Winter   | 13.922       | 0.0                 | 631.4                 | 360              |
| 480 min Winter   | 11.046       | 0.0                 | 666.8                 | 476              |
| 600 min Winter   | 9.241        | 0.0                 | 692.3                 | 590              |
| 720 min Winter   | 7.993        | 0.0                 | 704.9                 | 704              |
| 960 min Winter   | 6.367        | 0.0                 | 703.7                 | 928              |
| 1440 min Winter  | 4.643        | 0.0                 | 680.4                 | 1348             |
| 2160 min Winter  | 3.407        | 0.0                 | 927.3                 | 1688             |
| 2880 min Winter  | 2.752        | 0.0                 | 998.7                 | 2160             |
| 4320 min Winter  | 2.063        | 0.0                 | 1123.0                | 2988             |
| 5760 min Winter  | 1.702        | 0.0                 | 1235.4                | 3808             |
| 7200 min Winter  | 1.483        | 0.0                 | 1345.1                | 4608             |
| 8640 min Winter  | 1.334        | 0.0                 | 1452.7                | 5360             |
| 10080 min Winter | 1.228        | 0.0                 | 1559.6                | 6056             |

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|                                         |                       |                                                                                     |
|-----------------------------------------|-----------------------|-------------------------------------------------------------------------------------|
| Jubb Consulting Engineers Ltd (Bristol) |                       | Page 4                                                                              |
| St James's Court, Suite B               | 23233                 |  |
| Ground Floor West, St James ...         | Land off Cobbett Way  |                                                                                     |
| Bristol, BS1 3LH                        | Swale 2 Volume        |                                                                                     |
| Date 16/01/2024                         | Designed by AH        |                                                                                     |
| File 23233-JUB-XX-XX-CA-C-00...         | Checked by RL         |                                                                                     |
| Innovyze                                | Source Control 2020.1 |                                                                                     |

Model Details

Storage is Online Cover Level (m) 14.000

Swale Structure

|                                      |         |                            |       |
|--------------------------------------|---------|----------------------------|-------|
| Infiltration Coefficient Base (m/hr) | 0.00000 | Length (m)                 | 43.0  |
| Infiltration Coefficient Side (m/hr) | 0.00000 | Side Slope (1:X)           | 4.0   |
| Safety Factor                        | 2.0     | Slope (1:X)                | 500.0 |
| Porosity                             | 1.00    | Cap Volume Depth (m)       | 0.000 |
| Invert Level (m)                     | 13.000  | Cap Infiltration Depth (m) | 0.000 |
| Base Width (m)                       | 10.0    |                            |       |

Hydro-Brake® Optimum Outflow Control

|                                   |                            |
|-----------------------------------|----------------------------|
| Unit Reference                    | MD-SHE-0096-4800-1500-4800 |
| Design Head (m)                   | 1.500                      |
| Design Flow (l/s)                 | 4.8                        |
| Flush-Flo™                        | Calculated                 |
| Objective                         | Minimise upstream storage  |
| Application                       | Surface                    |
| Sump Available                    | Yes                        |
| Diameter (mm)                     | 96                         |
| Invert Level (m)                  | 13.000                     |
| Minimum Outlet Pipe Diameter (mm) | 150                        |
| Suggested Manhole Diameter (mm)   | 1200                       |

| Control Points            | Head (m) | Flow (l/s) |
|---------------------------|----------|------------|
| Design Point (Calculated) | 1.500    | 4.8        |
| Flush-Flo™                | 0.423    | 4.6        |
| Kick-Flo®                 | 0.860    | 3.7        |
| Mean Flow over Head Range | -        | 4.1        |

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) |
|-----------|------------|-----------|------------|-----------|------------|-----------|------------|
| 0.100     | 3.1        | 1.200     | 4.3        | 3.000     | 6.6        | 7.000     | 9.9        |
| 0.200     | 4.2        | 1.400     | 4.6        | 3.500     | 7.1        | 7.500     | 10.2       |
| 0.300     | 4.5        | 1.600     | 4.9        | 4.000     | 7.6        | 8.000     | 10.5       |
| 0.400     | 4.6        | 1.800     | 5.2        | 4.500     | 8.0        | 8.500     | 10.8       |
| 0.500     | 4.6        | 2.000     | 5.5        | 5.000     | 8.4        | 9.000     | 11.1       |
| 0.600     | 4.5        | 2.200     | 5.7        | 5.500     | 8.8        | 9.500     | 11.4       |
| 0.800     | 4.0        | 2.400     | 6.0        | 6.000     | 9.2        |           |            |
| 1.000     | 4.0        | 2.600     | 6.2        | 6.500     | 9.5        |           |            |

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## Appendix E: Drainage Layout

