

# whitby wood

Hayes Park West

Drainage Strategy Report

Client: Shall Do Hayes Developments Ltd

Date: November 2025

P451907-WW-XX-XX-RP-C-0002

**whitby wood**

[whitbywood.com](http://whitbywood.com)

LEVEL 1, FRIARS YARD, 160 BLACKFRIARS ROAD  
LONDON SE1 8EZ, UNITED KINGDOM

+44 (0)20 7442 2216

## REVISION RECORD

| Rev | Date       | Description   | Prepared | Reviewed | Approved |
|-----|------------|---------------|----------|----------|----------|
| 01  | 01/09/2025 | Draft Issue   | TC       | RS       | RW       |
| 02  | 21/10/2025 | Updated Issue | TC       | RS       | RW       |
| 03  | 06/11/2025 | Updated Issue | TC       | RS       | RW       |

This report is to be regarded as confidential to our client and is intended for their use only. Any liability to any third party in respect of the whole or any part of its contents is hereby expressly excluded. Before reproduction of its content, circulation or use by any third-party, our written approval and disclosure must be obtained.

Prepared by:



Tom Connolly

Design Engineer - Civils

Reviewed by:



Ryan Saunders

Senior Engineer - Civils

Approved by:



Ryan Williams

Associate Director - Civils

## TABLE OF CONTENTS

|          |  |           |
|----------|--|-----------|
| <b>1</b> | <b>INTRODUCTION .....</b>                        | <b>1</b>  |
| 1.1      | SITE LOCATION AND DESCRIPTION .....              | 1         |
| 1.2      | EXISTING DRAINAGE .....                          | 2         |
| 1.3      | GEOLOGY .....                                    | 2         |
| 1.4      | PROPOSED DEVELOPMENT .....                       | 2         |
| <b>2</b> | <b>DRAINAGE DESIGN POLICIES .....</b>            | <b>4</b>  |
| 2.1      | OVERALL SITE DRAINAGE REQUIREMENTS .....         | 4         |
| 2.2      | PLANNING POLICY REQUIREMENTS .....               | 5         |
| 2.3      | LONDON PLAN .....                                | 6         |
| 2.4      | LOCAL PLAN .....                                 | 6         |
| 2.4.1    | <i>Local Plan part one (2012) .....</i>          | 6         |
| 2.4.2    | <i>Local Plan part two (2020) .....</i>          | 7         |
| 2.5      | STRATEGIC FLOOD RISK ASSESSMENT .....            | 8         |
| <b>3</b> | <b>SURFACE WATER MANAGEMENT .....</b>            | <b>11</b> |
| 3.1      | GREENFIELD RUNOFF RATES AND VOLUMES .....        | 11        |
| 3.1.1    | <i>Proposed Discharge Rates .....</i>            | 11        |
| 3.2      | DELIVERING A SUDS SCHEME .....                   | 11        |
| 3.2.1    | <i>SuDS Component Performance .....</i>          | 12        |
| <b>4</b> | <b>DRAINAGE DESIGN PROPOSAL .....</b>            | <b>14</b> |
| 4.1      | SURFACE WATER .....                              | 14        |
| 4.1.1    | <i>Drainage Hierarchy .....</i>                  | 14        |
| 4.1.2    | <i>Water Cycle .....</i>                         | 15        |
| 4.1.3    | <i>Water Quality Management .....</i>            | 15        |
| 4.2      | FOUL WATER .....                                 | 16        |
| 4.3      | INTERNAL DRAINAGE .....                          | 16        |
| <b>5</b> | <b>ADOPTION AND MAINTENANCE .....</b>            | <b>17</b> |
| 5.1.1    | <i>Pipework .....</i>                            | 17        |
| 5.1.2    | <i>Bioretention Systems (Rain Gardens) .....</i> | 17        |
| 5.1.3    | <i>Flow Controls .....</i>                       | 18        |
| 5.1.4    | <i>Timetable .....</i>                           | 18        |
| <b>6</b> | <b>RISKS AND UNCERTAINTIES .....</b>             | <b>19</b> |
| <b>7</b> | <b>CONCLUSIONS AND RECOMMENDATIONS .....</b>     | <b>20</b> |

## APPENDICES

- APPENDIX A – SITE LOCATION
- APPENDIX B – THAMES WATER ASSET LOCATION MAP
- APPENDIX C – GREENFIELD & EXISTING RUNOFF RATES
- APPENDIX D – SURFACE WATER DRAINAGE STRATEGY
- APPENDIX E – CAUSEWAY FLOW+ MODEL RESULTS
- APPENDIX F – CONVEYANCE ROUTE DRAWING

## TABLES

|   |    |
|---|----|
| TABLE 1 – REQUIREMENTS FOR THE PROPOSED DRAINAGE SYSTEM .....                   | 4  |
| TABLE 2 – GREENFIELD RUNOFF AND EXISTING DISCHARGE RATES.....                   | 11 |
| TABLE 3 – SUDS TREATMENT TRAIN.....   | 12 |
| TABLE 4 – POLLUTION HAZARD INDICES FOR DIFFERENT LAND USE CLASSIFICATIONS ..... | 15 |
| TABLE 5 – SUDS MITIGATION INDICES FOR DISCHARGES TO SURFACE WATERS .....        | 16 |
| TABLE 6 – OPERATION AND MAINTENANCE REQUIREMENTS FOR BIORETENTION SYSTEMS.....  | 17 |

## FIGURES

|                                     |   |
|-------------------------------------|---|
| FIGURE 1 – SITE LOCATION PLAN ..... | 2 |
|-------------------------------------|---|

## 1 INTRODUCTION

Whitby Wood have been commissioned for the design of the below ground foul and surface water drainage systems for the development at Hayes Park West (hereafter referred to as “the Site”).

This Drainage Strategy Report (DSR) has been prepared in accordance with National Planning Policy Framework (NPPF) in support of the detailed planning being submitted Shall Do Hayes Developments Ltd ('the Applicant'). The application will be submitted to London Borough of Hillingdon ('the Council'). This report has been undertaken to ascertain the constraints of below ground drainage in order to redevelop the Site and allow to the introduction of Sustainable Drainage Systems (SuDS) to manage surface water.

Sources of Information:

A review of the relevant information from a range of sources has been undertaken and includes the following:

- BS EN12056-2:2000, Gravity drainage systems inside buildings (2010);
- CIRIA, The SuDS Manual (2016);
- Building Regulations Part H;
- BS EN 752:2017, Drainage & Sewer Systems Outside Buildings;
- Design and Construction Guidance (DCG) – Sewerage Sector Guidance (for adopted connections);
- Hillingdon Borough Council, Local Plan part one (2012) and two (2020).
- Hillingdon Borough Council, Local Flood Risk Management Strategy (2015).
- West London, Strategic Flood Risk Assessment (2017).
- British Geology Survey [Accessed August 2025];
- National Planning Policy Framework (2025);

### 1.1 Site Location and Description

The Site is located at Hayes Park West, Hayes Park, Uxbridge, UB4 8FE in the London Borough of Hillingdon. The Site is centred on a National Grid Reference Number of 508815E, 182574N. A Site Location Plan is shown in Figure 1, which can also be found in **Appendix A**. The existing Site is comprised of 2 storey car park.



**FIGURE 1 – SITE LOCATION PLAN**

## 1.2 Existing Drainage

A Thames Water Asset search has demonstrated that there are surface and foul water sewers Hayes Site Road and Mead House Lane to the South of the Site as shown in **Appendix B**. The Asset map does not include the diameter of either the foul or surface water sewers. The cover level and invert level of the manholes are also not provided. There is private drainage within the Site boundary, a CCTV survey was conducted which provides information on the line and level of the existing drainage.

## 1.3 Geology

Information published by the British Geological Survey indicates that the bedrock geology of the Site is London Clay which consists of clay and silt. The Site belongs to soilscape 18 – slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils.

## 1.4 Proposed Development

Partial demolition and redevelopment of the existing multi storey car park to provide new homes (Use Class C3), landscaping, car and cycle parking, and other associated works.

In summary, this application is seeking to deliver the following:

- The partial demolition of the existing multistorey car park and construction of new 4 storey residential development.

- 52 new homes (Class C3) comprising a mix of 1-bedroom and 3-bedroom homes.
- A high proportion of open space and amenity space across the site totalling 3599 sqm, including the provision of private gardens, terraces and balconies, new play spaces, internal ancillary facilities, and extensive communal areas surrounding the building. This includes:
- The proposed development will seek to promote sustainable modes of transport and will provide the following:
  - 46 sqm internal communal amenity
  - 1733 sqm external communal amenity
  - 1655 sqm private external amenity
  - 161 sqm play space (doorstep play for children aged 0-4 years)
- The proposed development will seek to promote sustainable modes of transport and will provide the following:
  - 107 cycle parking spaces allocated as follows:
  - 97 cycle parking spaces allocated to the new homes.
  - 10 cycle parking spaces allocated to visitors to the site.
  - 52 vehicle parking spaces allocated as follows:
  - 52 (49 standard and 3 accessible) vehicle parking spaces allocated to the new homes.

## 2 DRAINAGE DESIGN POLICIES

The following design guidance will need to be adhered to for the proposed foul and surface water drainage system that will serve the Site.

- Building Regulations Part H.
- National Planning Policy Framework (NPPF).
- Design and Construction Guidance (DCG) – Sewerage Sector Guidance (for adopted connections).
- BS EN 752:2017, Drainage & Sewer Systems Outside Buildings.
- BS EN 12056-1:2000, Gravity Drainage Inside Buildings.

### 2.1 Overall Site Drainage Requirements

There are a range of requirements which the proposed drainage system is expected to meet. These have been set out by various guidance documents and stakeholders. The main requirements from each guidance document or stakeholder have been set out in the table below.

**TABLE 1 – REQUIREMENTS FOR THE PROPOSED DRAINAGE SYSTEM**

| Source/Stakeholder   | Requirements   |
|--|--|
| National standards for sustainable drainage systems (SuDS) | <ul style="list-style-type: none"> <li>• Where runoff from the development is to an above ground surface water body that can accommodate uncontrolled surface water discharges without any associated environmental impact, then the peak flow control and volume control standards may not need to apply, subject to written approval by the relevant risk management authority.</li> <li>• The first 5mm of rainfall for the majority of rainfall events should not result in runoff from the site to surface waters or piped drainage systems.</li> <li>• When discharging to an above ground surface water body, sewer or other piped drainage system, the surface water runoff rate for the 1 in 2-year event shall be controlled to ensure development runoff from an event of this magnitude has no negative impact, and the 1 in 100-year event shall be controlled to ensure the runoff from the development does not increase flood risk elsewhere.</li> <li>• Any flooding from the surface water drainage system for events up to the 1 in 100-year event shall be managed within the development.</li> <li>• The risks (both on and off the development) associated with flooding from the surface water drainage system for exceedance events greater than the 1 in 100-year event shall be appropriately managed.</li> <li>• The peak allowable discharge rate from the development to surface waters or sewers for the 1 in 2-year event shall be limited to the equivalent 1 in 2-year greenfield runoff rate, or 3 l/s/ha, whichever is the greater.</li> <li>• Where the volume of runoff discharged from the development to surface waters or sewers for the 1 in 100-year, 6-hour rainfall event is greater than the volume of greenfield runoff for the same rainfall event, the peak allowable discharge rate from the development for the 1 in 100-year event shall be limited to the 1 in 2-year greenfield runoff rate or 3l/s/ha, whichever is the greater.</li> <li>• Where the volume of runoff discharged from the development to surface waters or sewers for the 1 in 100-year, 6-hour rainfall event is less than or</li> </ul> |

|  |  |
|--|--|
|  | <p>equivalent to the volume of greenfield runoff for the same event, the peak allowable discharge rate from the development for the 1 in 100-year event shall be limited to the 1 in 100-year greenfield runoff rate or 3l/s/ha, whichever is the greater.</p> <ul style="list-style-type: none"> <li>For previously developed sites a 'relaxation factor' shall be applied to the target 1 in 2-year and 1 in 100-year greenfield runoff rates where evidence is provided that demonstrates why greenfield runoff or 3l/s/ha rates cannot be achieved and this is agreed with the approving body. This relaxation factor shall be no greater than 5 times the greenfield runoff rate</li> </ul>   |
| <b>Design and Construction Guidance – Sewerage Sector Guidance Appendix C (2020)</b> | <ul style="list-style-type: none"> <li>Where a component is designed to convey or store flows in excess of the 1 in 30-year return period event, the designer should demonstrate that the upstream system (including any inlets such as gullies or pervious paving) has the capacity to allow the flows to reach the component.</li> <li>Where an overland flow route is used, it should not be designed to operate more frequently than in a 1 in 30-year return period design rainfall event.</li> <li>Design foul water peak flow rates should be 4000L per dwelling per day.</li> </ul>  |
| <b>Building Regulations Approved Document H</b>                                      | <ul style="list-style-type: none"> <li>Surface water shall discharge to one of the following listed in order of priority:             <ol style="list-style-type: none"> <li>An adequate soakaway or some other adequate infiltration system; or, where that is not reasonably practicable,</li> <li>A watercourse; or where that is not reasonably practicable,</li> <li>A sewer.</li> </ol> </li> </ul>  |
| <b>Sewerage Undertaker (Thames Water)</b>  | <ul style="list-style-type: none"> <li>A pre-development application is required to check the public sewer has capacity for the proposed discharge rates. No final consent has been received at the time of drafting the report.</li> <li>A section 106 application to connect to the public sewer will need to be submitted for any new connections to the public sewer.</li> <li>If the network is to be adopted, then a S104 application will need to be made in this instance.</li> <li>If any existing sewers require diverting, then an application to Thames Water to divert a public sewer under section 185 will need to be made.</li> <li>A section 116 application for the removal of public sewers will be required for any abandoned public sewers.</li> <li>A build-over agreement is required to build over any existing assets.</li> </ul> |
| <b>Hillingdon Borough Council (LLFA)</b>   | <ul style="list-style-type: none"> <li>Acting as the LLFA, any guidelines and policies outlined in the local Surface Water Management Plan or Local Plan should be adhered to.</li> <li>Where possible the proposed discharge rates should be discussed and approved with the LLFA as early as possible. Conversations with the LLFA to agree discharge rates are ongoing.</li> </ul>  |

## 2.2 Planning Policy Requirements

The NPPF (National Planning Policy Framework) specifies that surface water arising from a developed site should, as far as is practicable, be managed in a sustainable manner to mimic the surface water flows arising from the Site prior to the Proposed Development. Opportunities to reduce the flood risk to the Site itself and elsewhere, taking climate change into account, should be investigated. The drainage proposals within this strategy have been prepared to meet planning policy requirements.

## 2.3 London Plan

The London Plan is a framework which should be used for all developments within London. Policy SI 12 of the London Plan 2021 is specific to flood risk management and all development proposals should adhere to; the policy has been reproduced below.

- A. Current and expected flood risk from all sources across London should be managed in a sustainable and cost-effective way in collaboration with the Environment Agency, the Lead Local Flood Authorities, developers, and infrastructure providers.
- B. Development Plans should use the Mayor's Regional Flood Risk Appraisal and their Strategic Flood Risk Assessment as well as Local Flood Risk Management Strategies, where necessary, to identify areas where particular and cumulative flood risk issues exist and develop actions and policy approaches aimed at reducing these risks. Boroughs should cooperate and jointly address cross-boundary flood risk issues including with authorities outside London.
- C. Development proposals should ensure that flood risk is minimised and mitigated, and that residual risk is addressed. This should include, where possible, making space for water and aiming for development to be set back from the banks of watercourses.
- D. Development Plans and development proposals should contribute to the delivery of the measures set out in Thames Estuary 2100 Plan. The Mayor will work with the Environment Agency and relevant local planning authorities, including authorities outside London, to safeguard an appropriate location for a new Thames Barrier.
- E. Development proposals for utility services should be designed to remain operational under flood conditions and buildings should be designed for quick recovery following a flood.
- F. Development proposals adjacent to flood defences will be required to protect the integrity of flood defences and allow access for future maintenance and upgrading. Unless exceptional circumstances are demonstrated for not doing so, development proposals should be set back from flood defences to allow for any foreseeable future maintenance and upgrades in a sustainable and cost-effective way.
- G. Natural flood management methods should be employed in development proposals due to their multiple benefits including increasing flood storage and creating recreational areas and habitat.

## 2.4 Local Plan

Hillingdon's Local Plan is a framework which should be used for all developments within the borough. Within this document are Policies that outline the strategic principles, spatial strategy and technical criteria to follow and implement when considering flood risk management:

### 2.4.1 Local Plan part one (2012)

The Council will require new development to be directed away from Flood Zones 2 and 3 in accordance with the principles of the National Planning Policy Framework (NPPF). The subsequent Hillingdon Local Plan: Part 2 -Site Specific Allocations LDD will be subjected to the Sequential Test in accordance with the NPPF. Sites will only be allocated within Flood Zones 2 or 3 where there are overriding issues that outweigh flood risk. In these instances, policy criteria will be set requiring future applicants of these sites to demonstrate that flood risk can be suitably mitigated. The Council will require all development across the borough to use sustainable

urban drainage systems (SUDS) unless demonstrated that it is not viable. The Council will encourage SUDS to be linked to water efficiency methods. The Council may require developer contributions to guarantee the long-term maintenance and performance of SUDS is to an appropriate standard.

## 2.4.2 Local Plan part two (2020)

Management of Flood Risk:

- A. Development proposals in Flood Zones 2 and 3a will be required to demonstrate that there are no suitable sites available in areas of lower flood risk. Where no appropriate sites are available, development should be located on the areas of lowest flood risk within the site. Flood defences should provide protection for the lifetime of the development. Finished floor levels should reflect the Environment Agency's latest guidance on climate change.
- B. Development proposals in these areas will be required to submit an appropriate level Flood Risk Assessment (FRA) to demonstrate that the development is resilient to all sources of flooding.
- C. Development in Flood Zone 3b will be refused in principle unless identified as an appropriate development in Flood Risk Planning Policy Guidance. Development for appropriate uses in Flood Zone 3b London Borough of Hillingdon Local Plan Part 2 - Development Management Policies 80 will only be approved if accompanied by an appropriate FRA that demonstrates the development will be resistant and resilient to flooding and suitable warning and evacuation methods are in place.
- D. Developments may be required to make contributions (through legal agreements) to previously identified flood improvement works that will benefit the development site.
- E. Proposals that fail to make appropriate provision for flood risk mitigation, or which would increase the risk or consequences of flooding, will be refused.

Water Management, Efficiency, and Quality:

- A. Applications for all new build developments (not conversions, change of use, or refurbishment) are required to include a drainage assessment demonstrating that appropriate sustainable drainage systems (SuDS) have been incorporated in accordance with the London Plan Hierarchy (Policy 5.13: Sustainable drainage).
- B. All major new build developments, as well as minor developments in Critical Drainage Areas or an area identified at risk from surface water flooding must be designed to reduce surface water run-off rates to no higher than the pre-development greenfield run-off rate in a 1:100 year storm scenario, plus an appropriate allowance for climate change for the worst storm duration. The assessment is required regardless of the changes in impermeable areas and the fact that a site has an existing high run-off rate will not constitute justification.
- C. Rain Gardens and non householder development should be designed to reduce surface water run-off rates to Greenfield run-off rates.
- D. Schemes for the use of SuDS must be accompanied by adequate arrangements for the management and maintenance of the measures used, with appropriate contributions made to the Council where necessary.

- E. Proposals that would fail to make adequate provision for the control and reduction of surface water run-off rates will be refused.
- F. Developments should be drained by a SuDS system and must include appropriate methods to avoid pollution of the water environment. Preference should be given to utilising the drainage options in the SuDS hierarchy which remove the key pollutants that hinder improving water quality in Hillingdon. Major development should adopt a 'treatment train' approach where water flows through different SuDS to ensure resilience in the system.
- G. All new development proposals (including refurbishments and conversions) will be required to include water efficiency measures, including the collection and reuse of rainwater and grey water.
- H. All new residential development should demonstrate water usage London Borough of Hillingdon Local Plan Part 2 - Development Management Policies 83 rates of no more than 105 litres/person/day. I) It is expected that major development<sup>8</sup> proposals will provide an integrated approach to surface water run-off attenuation, water collection, recycling and reuse.
- I. All new development proposals will be required to demonstrate that there is sufficient capacity in the water and wastewater infrastructure network to support the proposed development. Where there is a capacity constraint the local planning authority will require the developer to provide a detailed water and/or drainage strategy to inform what infrastructure is required, where, when and how it will be delivered.

## 2.5 Strategic Flood Risk Assessment

- 1. Boroughs should adopt a sequential approach for planning and development to identify areas that are not susceptible to flood risk impacts posed by climate change. Development should be encouraged in these identified areas to make properties more resilient to increasing flood risk and reduce the reliance on property level protection methods.
- 2. Boroughs should apply the Sequential Test to Allocated Sites within the LPA area at an early stage in the Local Plan development process to help identify any lower flood risk areas that may not be suitable for development. This can be used to inform spatial planning and identify key growth locations, increasing the possibility of facilitating development which is not exposed to flood risk whilst meeting development objectives.
- 3. Boroughs should implement measures through their Local Plans to deal with the Sequential Test acceptability of windfall site development proposals at the strategic level. The measure could set out locations and quantities of windfall sites that would or would not be acceptable in Sequential Test terms (to provide input to the process defined in Section 4.2.1). This would help create efficiencies in the process.
- 4. If it is determined by evidence that there are insufficient sites within Flood Zone 1 to meet the borough's housing development targets, then windfall developments in Flood Zone 2 or 3 might be acceptable and should be considered (preferably with support of a Level 2 SFRA). This would inform an approach determining locations where the Sequential Test would be passed. Conversely, if the borough has sufficient land available in Flood Zone 1 to accommodate windfall development sites,

then it may not be possible or prudent to consider windfall development in Flood Zone 2 or 3 as acceptable.

5. Existing and planned flood alleviation schemes should be incorporated into Borough Infrastructure Delivery Plans (IDPs). Where these IDPs, or similar corporate work programmes (e.g. planned highway improvement works or Green Infrastructure Plans), identify predicted or actual flood risks, new potential strategic level flood alleviation schemes should be developed.
6. Boroughs should make space for water storage by identifying strategic locations that are required for current and future flood risk management. These identified areas of land should be safeguarded via Local Plans to facilitate links between flood risk management and other environmental priorities.
7. Boroughs should adopt a Catchment Based Approach to ensure recognition of catchment wide flood issues to justify the collection and use of S106 funding to investigate and develop flood alleviation schemes within the catchment the development falls within. CDAs defined by the Borough SWMPs (for surface water flooding) or policy sub-areas defined by EA CFMPs (for fluvial / tidal flooding) provide an established technical basis for this approach.
8. Boroughs should set up mechanisms to enable the use of CIL charges to be used for flood alleviation schemes across the borough to address the cumulative impact of development on flood risk.
9. Boroughs should use their Local Plans to ensure developments within CDAs (as defined by SWMPs) provide increased surface water drainage requirements. Examples could include increased storage through the use of SuDS to restrict off-site runoff rates to greenfield (or lower) conditions.
10. Boroughs should develop standing advice for the assessment of minor development planning applications with surface water implications. This will aid LPAs in making informed and consistent decisions where the EA and / or LLFA has no statutory duty to provide comments as part of an application's review exercise.
11. Boroughs should review the benefits of removing Permitted Development rights for sites which fall within Flood Zones 3a and / or 3b, collaborating on Article 4 Directions where justifiable, defendable and beneficial. This could include provisions around sub-divisions, extensions and paving of gardens in specific areas.
12. Boroughs should use their Local Plans to ensure developments with a high susceptibility to groundwater flooding (as identified in the Sewer, Groundwater & Artificial Flood Risk Interactive Web Map and other available data) demonstrate that increased groundwater mitigation and management measures have been implemented to protect people from groundwater flooding. Any known groundwater and flow routes should be safeguarded to ensure ground water flood risk is not increased on site or elsewhere.
13. Boroughs should consider implementation of further surface water flood risk mitigation requirements for proposed developments within Flood Zone 3a (surface water) where the development is also within the 1 in 30yr RoFSW mapped extents. These requirements could be similar to those adopted for Flood Zone 3b (fluvial / tidal) Functional Floodplain with modifications as follows:

- A. Development within the 1 in 30yr RoFSW mapped extent will be treated as if it were Flood Zone 3b (Functional Floodplain) as defined in PPG Table 1 (Paragraph 065).
- B. Development may be possible within the 1 in 30yr RoFSW mapped extents outside of existing infrastructure or solid building footprints.
- C. To enable development, the proposals must provide mitigation and resilience against flood risks (taking advice from the LLFA as appropriate) and provide appropriate compensation on existing flood risk levels (addressing the predicted 1 in 30yr and 1 in 100yr RoFSW mapped depths as a minimum), supported by detailed flood risk modelling if appropriate.
- D. The development must not increase flood risk elsewhere and where possible reduce flood risk overall.
- E. Where beneficial to flood risk and/or other planning requirements, it may also be possible for development to occur within the functional floodplain through the relocation (but not increase of footprint size) of an existing building's footprint within a site.

### 3 SURFACE WATER MANAGEMENT

#### 3.1 Greenfield Runoff Rates and Volumes

Greenfield runoff rates have been calculated using FEH 22 catchment data method and a 6-hour rainfall event, these can be found in **Appendix C**. The table below shows the greenfield runoff rates for the entire Site (approximately 0.9 ha) and factored to provide a runoff rate per hectare. The table also illustrates the current discharge rates based on existing Site conditions. The existing discharge rates have been calculated using the Modified Rational Method as recommended in table 24.1 of the CIRIA SuDS manual. A percentage of impermeable area (PIMP) of 100% and a time of concentration of 5 minutes were assumed. A runoff coefficient of 1 has been used.

**TABLE 2 – GREENFIELD RUNOFF AND EXISTING DISCHARGE RATES**

| Return Period | Greenfield runoff rates |                      | Existing Discharge Rates (l/s) |
|---------------|-------------------------|----------------------|--------------------------------|
|               | Site Area [0.9ha] (l/s) | Per hectare (l/s/ha) |                                |
| QBAR          | 4.4                     | 4.9                  | -                              |
| 1-year        | 3.7                     | 4.1                  | 179.9                          |
| 30-year       | 10.5                    | 11.7                 | 425.3                          |
| 100-year      | 13.9                    | 15.4                 | 539.1                          |

##### 3.1.1 Proposed Discharge Rates

It is proposed that surface water runoff from the site is 4.4l/s (QBar), a vortex flow control device will restrict the outflow for the corresponding storm event, up to a maximum rate 1 in 100 year storm event (including an allowance of 40% for climate change).

#### 3.2 Delivering a SuDS Scheme

The philosophy of SuDS is about maximising the benefits and minimising the negative impacts of surface water runoff from developed areas. The ‘four pillars’ of SuDS design as described by the SuDS Manual are;

- Water Quantity;
- Water Quality;
- Amenity; and
- Biodiversity.

SuDS deliver high quality drainage while supporting areas to cope better with severe rainfall both now and in the future. SuDS can improve the quality of life in developments by making them more vibrant, visually attractive, sustainable and more resilient to change, by improving urban air quality, regulating building temperatures, reducing noise and delivering recreation and education opportunities.

SuDS design should maximise the use of the available space by delivering efficient drainage together with other functions to help meet the objectives of the Site. The SuDS design should, as much as possible, be based around the following;

- Using surface water runoff as a resource;
- Managing rainwater close to where it falls;
- Managing runoff on the surface;
- Allowing rainfall to soak into the ground;
- Promoting evapotranspiration;
- Slowing and storing runoff to mimic natural runoff characteristics;
- Reducing contamination of runoff through pollution prevention and controlling the runoff at source; and
- Treating runoff to reduce the risk of urban contaminants causing environmental pollution.

Any Proposed Development on the Site has the potential to maximise SuDS and conform to SuDS best practice. Ultimately a well designed and constructed SuDS scheme will provide a robust and reliable surface water drainage network, whilst providing increased amenity and biodiversity.

### 3.2.1 SuDS Component Performance

The effectiveness of SuDS components in improving development surface water runoff quality is summarised in table 3 below. Combinations of treatments can be used to reduce potential pollutants from reaching the receiving course.

**TABLE 3 – SUDS TREATMENT TRAIN**

| SuDS Component                | Interception | Peak flow control: Low | Peak flow control: High | Volume reduction | Volume control | Gross sediments | Fine sediments | Hydrocarbons/PAHs | Metals | Nutrients |
|-------------------------------|--------------|------------------------|-------------------------|------------------|----------------|-----------------|----------------|-------------------|--------|-----------|
| Rainwater Harvesting          | Y            | Y                      | S                       | Y                | N              | N               | N              | N                 | N      | N         |
| Pervious Pavement             | Y            | Y                      | Y                       | Y                | Y              | Y               | Y              | Y                 | Y      | Varies    |
| Filter Strips                 | Y            | N                      | N                       | N                | N              | Y               | N              | Y                 | Y      | Varies    |
| Swales                        | Y            | Y                      | S                       | Y(*)             | N              | Y               | Y(+)           | Y                 | Y      | Y(-)      |
| Trenches                      | Y            | Y                      | S                       | Y(*)             | N              | N               | N              | Y                 | Y      | Y(-)      |
| Detention Basins              | Y            | Y                      | Y                       | N                | Y              | Y               | Y(+)           | Y                 | Y      | Varies    |
| Ponds                         | N            | Y                      | Y                       | N                | Y              | N (~)           | Y              | Limited           | Y      | Varies    |
| Wetlands                      | N            | Y                      | S                       | N                | Y              | N (~)           | Y              | Limited           | Y      | Y         |
| Green Roofs                   | Y            | Y                      | N                       | N                | N              | N               | N              | Y                 | N      | N         |
| Bioretention Systems          | Y            | Y                      | S                       | Y(*)             | N              | N (~)           | Y              | Y                 | Y      | Y         |
| Proprietary Treatment Systems | N            | N                      | N                       | N                | N              | Y               | Y              | Y (I)             | Y (I)  | Y (I)     |
| Subsurface Storage            | N            | Y                      | Y                       | N                | Y              | N (~)           | N              | N                 | N      | N         |
| Subsurface Conveyance Pipes   | N            | N                      | N                       | N                | Y              | N (~)           | N              | N                 | N      | N         |

Notes:

- S: Not normally with standard designs, but possible where space is available, and designs mitigate impact of high flow rates.
- Y (\*): Where infiltration is facilitated by the design.

- N (~): Gross sediment retention is possible, but not recommended due to negative maintenance and performance implications.
- Y (+): Where designs minimise the risk of fine sediment mobilisation during larger events.
- Y (!): Where designs specifically promote the trapping and breakdown of soils and PAH based constituents.
- Y (‘): Where subsurface soil structure facilitates the trapping and breakdown of oils and PAH based constituents.
- Varies: The nutrient removal performance is variable and can be negative in some situations.
- Y (~): Good nutrient removal performance where subsurface bio-filtration system with a permanently saturated zone included within the design.

## 4 DRAINAGE DESIGN PROPOSAL

### 4.1 Surface Water

The design of a surface water drainage system to serve the Proposed Development considers both water treatment and on-Site attenuation in accordance with CIRIA C753. The SuDS components proposed aim to emulate the natural drainage system of the Site through attenuation of flows and imitating natural percolation where possible. This has the added benefit of alleviating water quality issues associated with urban drainage runoff.

The current proposal for the surface water drainage strategy for the development can be found in [Appendix D](#).

Permeable paving is proposed on the ground floor level in parking areas and the central courtyard area as well as areas of planting with rain gardens. This not only provides a biodiversity benefit but also provides treatment of surface water runoff as it percolates through the growing medium within the rain garden build-up and therefore provides water quality enhancement. Finally there are a series of attenuation tanks near the outfall which provide the majority of the attenuation provided. The system will ultimately discharge, via a vortex flow control, at 4.4 l/s, into the Thames Water Sewer. A pre-planning enquiry has been submitted to Thames Water to agree the discharge location and rates. At the time of writing, we have yet to receive a response.

A computational model of the proposed system has been developed using Causeway Flow+. The model results indicate no pluvial flooding of the Proposed Development up to and including the 1 in 100 year event + 40% climate change allowance. The results are presented in [Appendix E](#).

#### 4.1.1 Drainage Hierarchy

The drainage hierarchy that should be considered for any new development. The following list details these requirements and which elements can be achieved for this Site. Where possible elements as high up the hierarchy have been selected:

- Rainwater use as a resource (for example rainwater harvesting, green roofs for irrigation);
  - Rainwater will be harvested passively for the inclusion of rain gardens. No active rainwater harvesting is currently proposed for the scheme.
- Rainwater infiltration to ground at or close to source;
  - Infiltration is not currently deemed feasible due to the presence of Clay.
- Rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens);
  - Rain gardens are currently part of the proposed scheme.
- Attenuate rainwater by storing in tanks or sealed water features for gradual release;
  - Attenuation tanks are part of the proposed strategy, a hydrobrake flow control will gradually release the water stored inside.
- Discharge rainwater direct to a watercourse;

- Discharging into a watercourse is not feasible as it would require excavation through third party land.
- Discharge rainwater to a surface water sewer/drain;
  - This is the current proposal for the scheme.
- Discharge rainwater to the combined sewer;
  - This is not required as a surface water sewer is available near the Site.

#### 4.1.2 Water Cycle

The water cycle strategy puts emphasis on four key areas of interest:

- Consumption;
- Quality;
- Re-use; and
- Re-cycle.

Rainwater will be heavily 'treated' through its discharge process by passing through numerous stages through its cycle. Soft landscaping and rain gardens will provide water treatment. As a result of the rain gardens, rainwater is harvested passively, and used to support plant growth and biodiversity.

#### 4.1.3 Water Quality Management

Wherever possible, when discharging runoff from the Site to surface waters, SuDS should be designed to intercept runoff for most rainfall events up to approximately 5 mm in depth in allowance for treatment for pollutants.

This approach has been taken to minimise the impact of the Proposed Development on the environment. Techniques that control pollution close to the source, offer a suitable means of treatment for run-off from low-risk areas such as roofs and non-operational areas as currently proposed.

Table 4 has been extracted from the CIRIA SuDS Manual 26.2 and can be used to provide an understanding of the pollution hazard for the proposed land use. The land use within the Proposed Development is categorised as a very low pollution hazard. With the introduction of the permeable paving and rain gardens this will mitigate any residual risk. No formal interceptor or treatment system is deemed required for the scheme.

**TABLE 4 – POLLUTION HAZARD INDICES FOR DIFFERENT LAND USE CLASSIFICATIONS**

| Land use  | Pollution hazard level | Total suspended solids (TTS) | Metals | Hydro-carbons |
|---|------------------------|------------------------------|--------|---------------|
| Residential roofs   | Very low               | 0.2                          | 0.2    | 0.05          |
| Other roofs (typically commercial/ industrial roofs)  | Low                    | 0.3                          | 0.2    | 0.05          |
| Individual property driveways, residential car parks, low traffic roads (e.g. cul-de-sacs, home zones and general access roads) and non-residential car parking with infrequent change (e.g. schools, offices) i.e. < 300 traffic movements/day | Low                    | 0.5                          | 0.4    | 0.4           |

|   |        |     |     |     |
|---|--------|-----|-----|-----|
| Commercial yard and delivery areas, non-residential car parking with frequent change (e.g. hospitals, retail), all roads except low traffic roads and trunk roads/motorways <sup>1</sup>  | Medium | 0.7 | 0.6 | 0.7 |
| Sites with heavy pollution (e.g. haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites; trunk roads and motorways | High   | 0.8 | 0.8 | 0.9 |

TABLE 5 – SUDS MITIGATION INDICES FOR DISCHARGES TO SURFACE WATERS

| Land use            | Mitigation Indices           |        |              |
|---------------------|------------------------------|--------|--------------|
|                     | Total suspended solids (TTS) | Metals | Hydrocarbons |
| Filter strip        | 0.4                          | 0.4    | 0.5          |
| Filter drain        | 0.4                          | 0.4    | 0.4          |
| Swale               | 0.5                          | 0.6    | 0.6          |
| Bioretention system | 0.8                          | 0.8    | 0.8          |
| Permeable pavement  | 0.7                          | 0.6    | 0.7          |
| Green Roof          | 0.8-0.9                      | 0.9    | 0.5          |
| Detention basin     | 0.5                          | 0.5    | 0.6          |
| Pond                | 0.7                          | 0.7    | 0.5          |
| Wetland             | 0.8                          | 0.8    | 0.8          |

#### 4.2 Foul Water

Foul Water is expected to drain via gravity towards the outfall at the western end of the Site into an existing Thames Water foul water sewer. The peak design foul water flow rate has been estimated based on the recommendation of 0.05 l/s per dwelling as set out in the Sewerage Sector Guidance Appendix C. Based on 52 dwellings proposed this equates to a rate of 2.6 l/s. A pre-planning enquiry has been submitted to Thames Water to agree the discharge location and rates. At the time of writing, we have yet to receive a response.

#### 4.3 Internal Drainage

Foul water stacks and rainwater pipes dropping below slab level internal to the buildings will be picked up by inspection chambers situated outside the building. Where this is not possible, due to Site constraints and building foundations, inspection chambers may need to be positioned internally. In this instance, the chambers will be double sealed and situated within areas that are publicly accessible to ensure the system can be inspected or accessed at all times. Any internal chambers will be positioned at the next design stage once a set of frozen MEP drawings are available.

## 5 ADOPTION AND MAINTENANCE

It is assumed that drainage on Site will not be adopted by Thames Water. However, where applicable, drainage will be designed to adoptable standards set out by the Design and Construction Guidance, Sewerage Sector guidance Appendix C.

### 5.1.1 Pipework

Pipework should usually be jetted and cleaned as and when blockages appear to have occurred. Pipes should be checked for build-up of debris and other waste that could cause blockages or damage to the pipework. Occasional maintenance should be carried out annually or as required.

### 5.1.2 Bioretention Systems (Rain Gardens)

Bioretention systems (including rain gardens) are shallow landscaped depressions that can reduce runoff rates and volumes and treat pollution through the use of engineered soils and vegetation. Table 7 below is extracted from table 18.3 of the SuDS manual and provides guidance on the type of operational and maintenance requirements that may be appropriate. The list of actions is not exhaustive, and some actions may not always be required.

**TABLE 6 – OPERATION AND MAINTENANCE REQUIREMENTS FOR BIORETENTION SYSTEMS**

| Maintenance Schedule   | Required Action   | Typical Frequency   |
|------------------------|---|---|
| Regular Inspections    | Inspect infiltration surfaces for silting and ponding, record de-watering time of the facility and assess standing water levels in underdrain (if appropriate) to determine if maintenance is necessary | Quarterly   |
|                        | Check operation of underdrains by inspection of flows after rain  | Annually  |
|                        | Assess plants for disease infection, poor growth, invasive species etc and replace as necessary   | Quarterly   |
|                        | Inspect inlets and outlets for blockages  | Quarterly   |
| Regular Maintenance    | Remove litter and surface debris and leaves   | Quarterly (or more frequently for tidiness and aesthetic reasons) |
|                        | Replace and plants, to maintain planting density  | As required   |
|                        | Remove sediment, litter and debris build-up from around inlets and from forebays  | Quarterly or biannually   |
| Occasional Maintenance | Infill any holes or scour in the filter medium, improve erosion protection if required  | As required   |

|                  |   |   |
|------------------|---|---|
|                  | Repair minor accumulations of silt by raking away surface mulch, scarifying of medium and replacing mulch | As required                             |
| Remedial Actions | Remove and replace filter medium and vegetation above   | As required but likely to be > 20 years |

### 5.1.3 Flow Controls

Maintenance is required within the Flow Control. Experience has shown that if blockages occur, they do so at the intake. Maintenance for the pumping station should be in alignment to manufacturers recommendations. It is recommended that a service and maintenance contract is taken out with the provider.

Following the installation of the Flow Control it is vitally important that any extraneous material i.e. building materials are removed from the unit and the chamber. After the system is made live, and assuming that the chamber design is satisfactory, it is recommended that each unit be inspected monthly for three months and thereafter at six monthly intervals with hose down if required. If problems are experienced contact the manufacturer so that an investigation may be made.

All Flow Control units are typically manufactured from grade 304 Stainless Steel, and if required they can also be manufactured in grade 316 Stainless Steel. Both materials have an estimated life span in excess of the design life of drainage systems.

### 5.1.4 Timetable

Maintenance should be carried out and timetabled from the date of installation. Each feature a recommended and typical frequency for inspection which should be adhered to as close as practically possible. Where not adopted, the landowner or private management company are responsible for its implementation.

## 6 RISKS AND UNCERTAINTIES

The following outlines the current uncertainties and associated risks for aspects related to drainage for this Proposed Development.

- **MEP Coordination** – The proposed drainage layout is subject to change upon receipt of a proposed above ground drainage plan from the appointed MEP engineer. Any amendments made to the above ground drainage design will likely to cause subsequent changes to the below ground drainage.
- **Connection Levels** – The network is designed on the assumption that foul water will discharge into the existing Thames Water network and levels will allow for connection.
- **Thames Water Capacity** – A pre-planning enquiry has been submitted to Thames Water to agree the discharge location and rates. At the time of writing, we have yet to receive a response.

## 7 CONCLUSIONS AND RECOMMENDATIONS

The main conclusions from this drainage strategy report are detailed below.

- Currently the surface water is proposed to discharge at 4.4 l/s, which is QBar, with foul water unrestricted.
- Ultimately, the proposed foul and surface water networks will discharge into separate Thames Water public networks.
- A pre-planning enquiry has been submitted to Thames Water to agree the discharge location and rates. At the time of writing, we have yet to receive a response.
- The surface water network will utilise green roofs, rain gardens and permeable paving to attenuate peak flows and provide water quality, biodiversity and amenity enhancements.
- A model has been developed using Causeway Flow+ to verify no pluvial flooding of the Proposed Development up to and including the 1 in 100year storm event + 40% climate change allowance.
- Typical maintenance for the drainage network has been identified in Section 5.

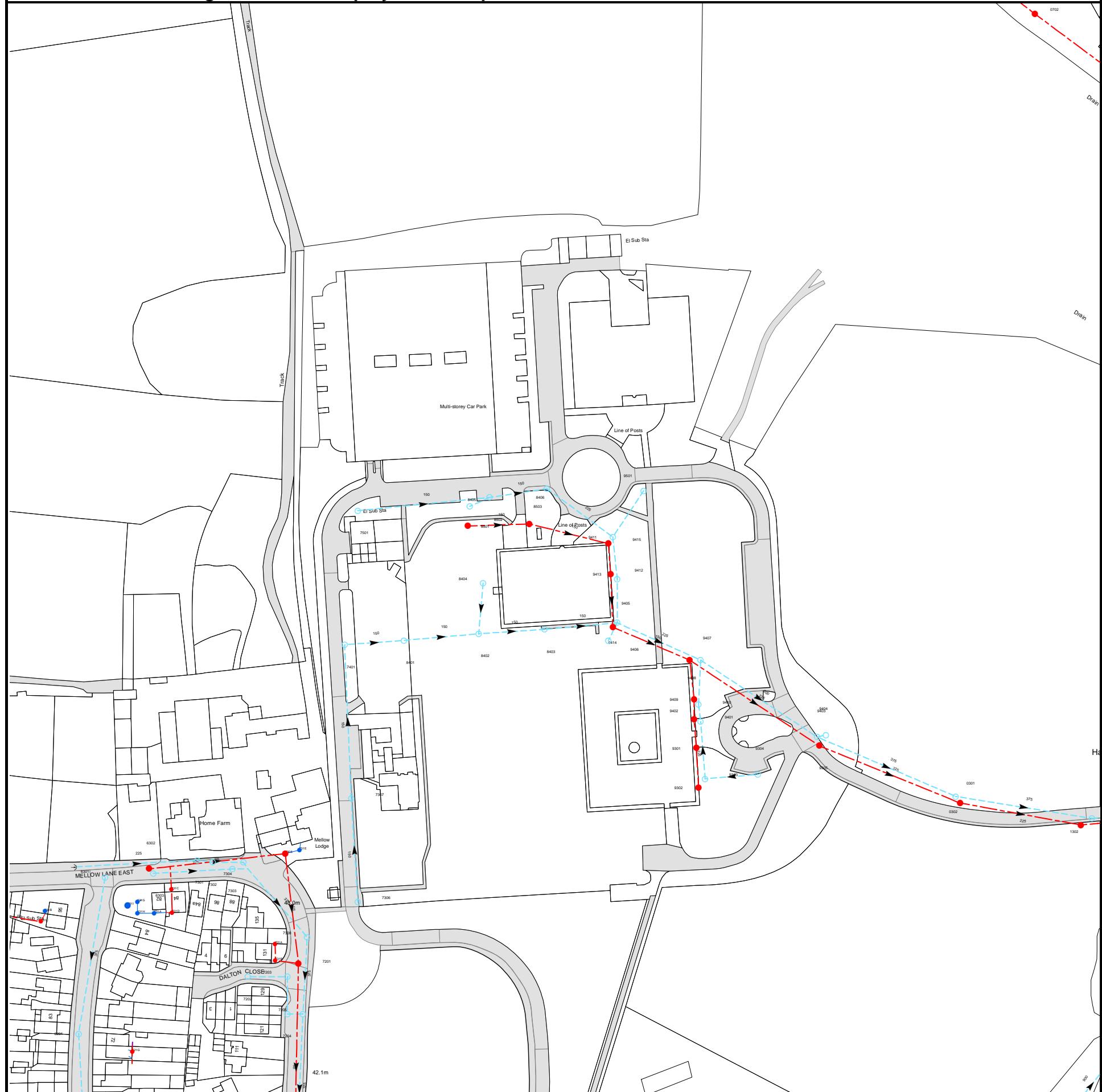
**Appendix A – SITE LOCATION**

SITE LOCATION PLAN



**Appendix B – THAMES WATER ASSET LOCATION MAP**

CommercialDW Drainage and Water Enquiry Sewer Map- CDWS/CDWS Standard/2021\_4522806



The width of the displayed area is 500m

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.

Based on the Ordnance Survey Map with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.

**Appendix C – GREENFIELD & EXISTING RUNOFF RATES**

## GREENFIELD RUNOFF RATE

Pre-development discharge

|                                     |               |         |
|-------------------------------------|---------------|---------|
| Site Makeup                         | Greenfield    |         |
| Greenfield Method                   | FEH           |         |
| Positively Drained Area (ha)        | 0.900         |         |
| SAAR (mm)                           | 629           |         |
| Host                                | 1             |         |
| BFI Host                            | 0.175         |         |
| Region                              | 6             |         |
| QBar/QMed conversion factor         | 1.136         |         |
| Betterment (%)                      | 0             |         |
| <input type="button" value="Calc"/> |               |         |
| QMed (l/s)                          | 3.8           |         |
| QBar (l/s)                          | 4.4           |         |
| Return Period (years)               | Growth Factor | Q (l/s) |
| 1                                   | 0.85          | 3.7     |
| 30                                  | 2.40          | 10.5    |
| 100                                 | 3.19          | 13.9    |

## 81% BETTERMENT RUNOFF RATE

Pre-development discharge

|                                     |            |
|-------------------------------------|------------|
| Site Makeup                         | Brownfield |
| Brownfield Method                   | MRM        |
| Contributing Area (ha)              | 0.900      |
| PIMP (%)                            | 100        |
| CV                                  | 1.000      |
| Time of Concentration (mins)        | 5.00       |
| Betterment (%)                      | 81         |
| <input type="button" value="Calc"/> |            |
| Return Period (years)               | Q (l/s)    |
| 1                                   | 33.8       |
| 30                                  | 79.9       |
| 100                                 | 101.3      |

## 100 l/s STORAGE CALCULATION

Storage Estimate

|   |                                     |
|---|-------------------------------------|
| Return Period (years)   | 100                                 |
| Climate Change (%)  | 40                                  |
| Impermeable Area (ha)   | 0.900                               |
| Peak Discharge (l/s)  | 100.000                             |
| Infiltration Coefficient (m/hr)<br>(leave blank if no infiltration) |                                     |
| Required Storage (m <sup>3</sup> )                                  | <input type="button" value="Calc"/> |
| from  | 294                                 |
| to  | 510                                 |

## BROWNFIELD RUNOFF RATE

Pre-development discharge

|                                     |            |
|-------------------------------------|------------|
| Site Makeup                         | Brownfield |
| Brownfield Method                   | MRM        |
| Contributing Area (ha)              | 0.900      |
| PIMP (%)                            | 100        |
| CV                                  | 1.000      |
| Time of Concentration (mins)        | 5.00       |
| Betterment (%)                      | 0          |
| <input type="button" value="Calc"/> |            |

| Return Period (years) | Q (l/s) |
|-----------------------|---------|
| 1                     | 178.0   |
| 30                    | 420.6   |
| 100                   | 533.1   |

## QBAR STORAGE CALCULATION

Storage Estimate

|   |                                     |
|---|-------------------------------------|
| Return Period (years)   | 100                                 |
| Climate Change (%)  | 40                                  |
| Impermeable Area (ha)   | 0.900                               |
| Peak Discharge (l/s)  | 4.400                               |
| Infiltration Coefficient (m/hr)<br>(leave blank if no infiltration) |                                     |
| Required Storage (m <sup>3</sup> )                                  | <input type="button" value="Calc"/> |
| from  | 852                                 |
| to  | 1010                                |

## 50% BETTERMENT STORAGE CALCULATION

Storage Estimate

|   |                                     |
|---|-------------------------------------|
| Return Period (years)   | 100                                 |
| Climate Change (%)  | 40                                  |
| Impermeable Area (ha)   | 0.900                               |
| Peak Discharge (l/s)  | 269.500                             |
| Infiltration Coefficient (m/hr)<br>(leave blank if no infiltration) |                                     |
| Required Storage (m <sup>3</sup> )                                  | <input type="button" value="Calc"/> |
| from  | 160                                 |
| to  | 326                                 |

## 50% BETTERMENT RUNOFF RATE

Pre-development discharge

|                                     |            |
|-------------------------------------|------------|
| Site Makeup                         | Brownfield |
| Brownfield Method                   | MRM        |
| Contributing Area (ha)              | 0.900      |
| PIMP (%)                            | 100        |
| CV                                  | 1.000      |
| Time of Concentration (mins)        | 5.00       |
| Betterment (%)                      | 50         |
| <input type="button" value="Calc"/> |            |

| Return Period (years) | Q (l/s) |
|-----------------------|---------|
| 1                     | 89.0    |
| 30                    | 210.3   |
| 100                   | 266.6   |

## GREENFIELD STORAGE CALCULATION

Storage Estimate

|   |                                     |
|---|-------------------------------------|
| Return Period (years)   | 100                                 |
| Climate Change (%)  | 40                                  |
| Impermeable Area (ha)   | 0.900                               |
| Peak Discharge (l/s)  | 13.900                              |
| Infiltration Coefficient (m/hr)<br>(leave blank if no infiltration) |                                     |
| Required Storage (m <sup>3</sup> )                                  | <input type="button" value="Calc"/> |
| from  | 664                                 |
| to  | 860                                 |

## BROWNFIELD STORAGE CALCULATION

Storage Estimate

|   |                                     |
|---|-------------------------------------|
| Return Period (years)   | 100                                 |
| Climate Change (%)  | 40                                  |
| Impermeable Area (ha)   | 0.900                               |
| Peak Discharge (l/s)  | 539.100                             |
| Infiltration Coefficient (m/hr)<br>(leave blank if no infiltration) |                                     |
| Required Storage (m <sup>3</sup> )                                  | <input type="button" value="Calc"/> |
| from  | 72                                  |
| to  | 230                                 |

## HAYES PARK WEST

# PRELIMINARY ATTENUATION CALCULATIONS

### GENERAL NOTES:

whitby wood

|                |                            |          |      |
|----------------|----------------------------|----------|------|
| Project Title: | HAYES PARK WEST            |          |      |
| Project No:    | P451907                    |          |      |
| Sketch No:     | P451907-WW-XX-XX-SK-C-1001 |          |      |
| Title:         | ATTENUATION CALCULATIONS   |          |      |
| Scale:         | Rev:                       | Date:    | Eng: |
| NTS            | P3                         | 06/11/25 | RW   |

**Appendix D – SURFACE WATER DRAINAGE STRATEGY**

## HEALTH AND SAFETY INFORMATION

CONSTRUCTION  
THIS DRAWING SHOULD NOT BE USED FOR CONSTRUCTION PURPOSES.

IN ADDITION TO THE HAZARDS/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING:

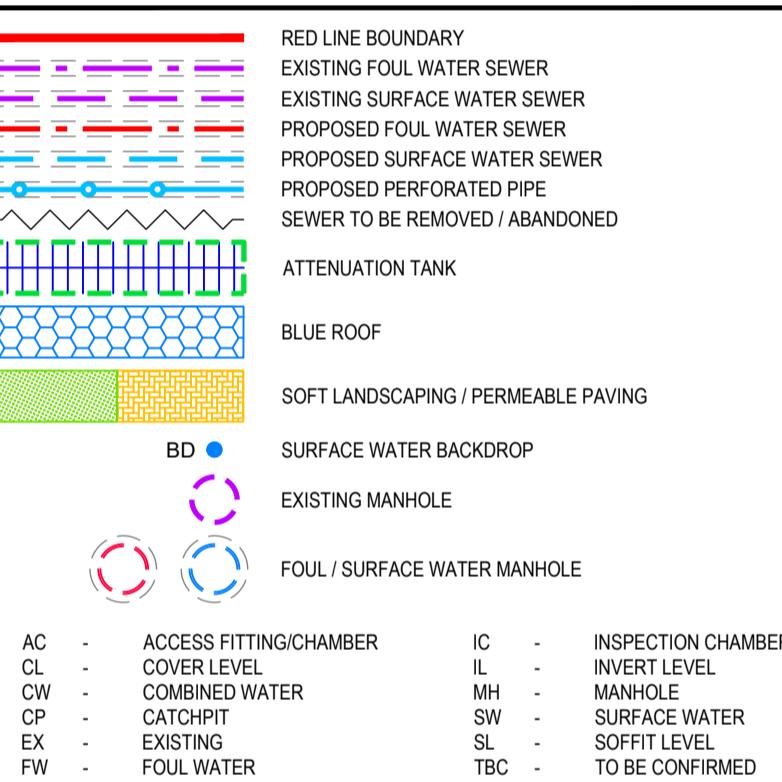
Maintenance/Cleaning/Operation  
MAINTENANCE OF SUDS FEATURES AND THE DRAINAGE SYSTEM SHOULD BE CARRIED OUT IN ACCORDANCE WITH THE CIRIA SUDS MANUAL AND MANUFACTURERS SPECIFICATIONS

Decommissioning/Demolition  
REFER TO DRAWING FOR EXTENT OF EXISTING SITE DRAINAGE TO BE ABANDONED/REMOVED

## NOTES

- DO NOT SCALE FROM THIS DRAWING. ONLY FIGURED DIMENSIONS ARE TO BE USED.
- ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
- ALL LEVELS ARE IN METRES ABOVE ORDNANCE Datum UNLESS NOTED OTHERWISE.
- THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
- ALL FOUL AND SURFACE WATER PIPEWORK TO BE LAID AT MINIMUM GRADIENTS OF 1:40 AND 1:100 RESPECTIVELY UNLESS NOTED OTHERWISE.
- ALL DRAINS TO BE CIRCULAR UNLESS NOTED OTHERWISE.
- ROOFER PIPES TO BE INSTALLED AT CONNECTION POINTS TO STRUCTURES TO ALLOW FOR MOVEMENT CAUSED BY SETTLEMENT.
- ALL DRAINAGE IS DESIGNED TO ADOPTABLE STANDARDS WHERE POSSIBLE, AND BUILDING REGULATIONS PART H.
- INVERT LEVEL REFERS TO THE INTERNAL BASE OF THE CHAMBER, INCLUDING SUMP DEPTH WHERE APPLICABLE.

## KEY



P03 UPDATED ISSUE  
P02 UPDATED ISSUE  
P01 FIRST ISSUE  
REV DESCRIPTION  
TC RS RW DATE  
DR CHK APP DATE

**whitby wood**  
whitbywood.com

LEVEL 1, FRIARS YARD, 160 BLACKFRIARS ROAD  
LONDON SE1 8EZ, UNITED KINGDOM  
+44 (0)20 7442 2226

## CLIENT

SHALL DO HAYES DEVELOPMENT LTD

## PROJECT

HAYES PARK WEST

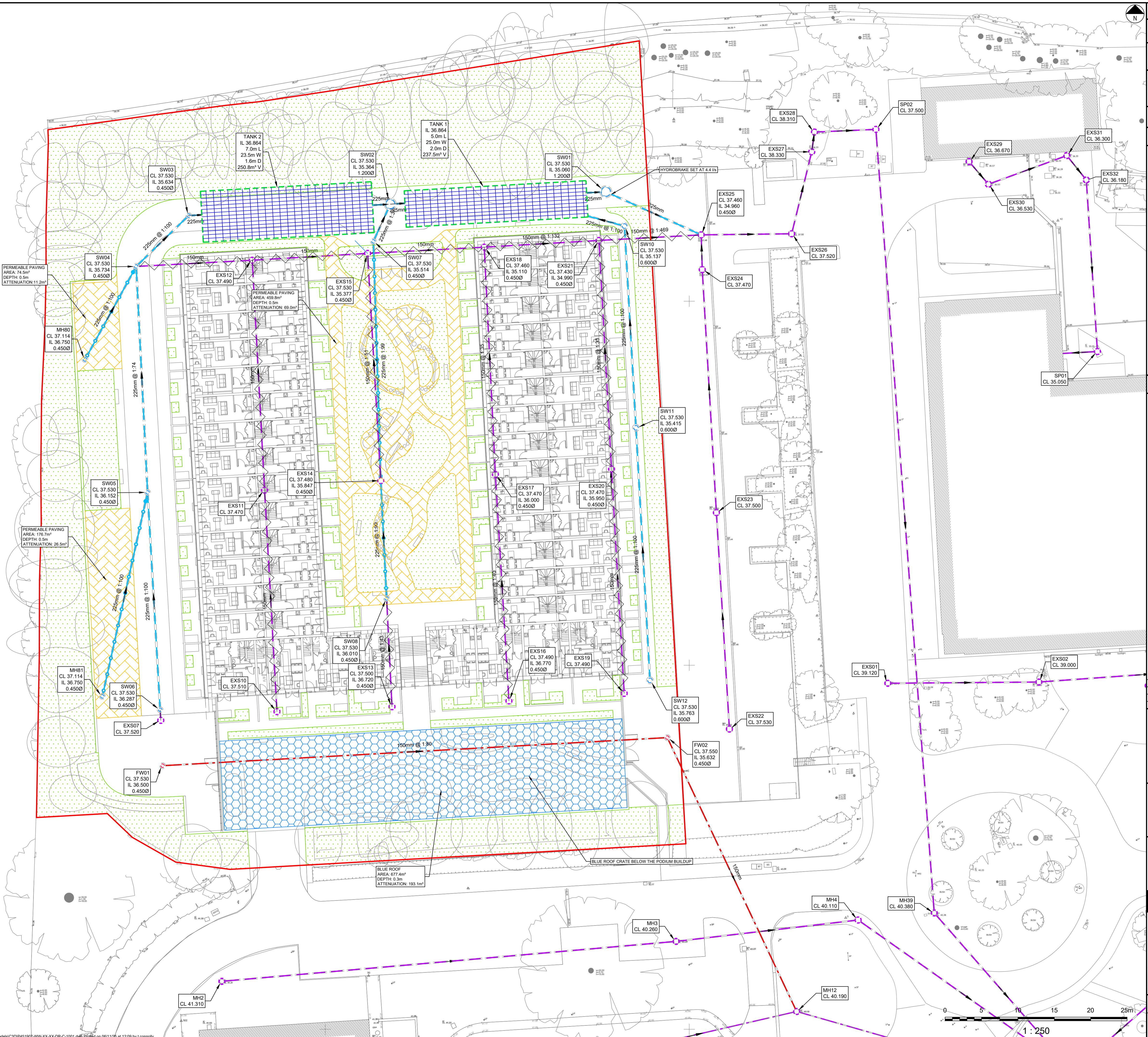
## PRELIMINARY

### DRAWING TITLE

SITEWIDE DRAINAGE GENERAL ARRANGEMENT

DATE 06.11.25 SCALES @ A1 1:250 DRAWN BY TC DRAWN BY RS CHECKED RW APPROVED RW

DRAWING NUMBER P451907-WW-XX-XX-DR-C-1001 REVISION P03



**Appendix E – CAUSEWAY FLOW+ MODEL RESULTS**

Design Settings

|                                      |        |                                    |               |
|--------------------------------------|--------|------------------------------------|---------------|
| Rainfall Methodology                 | FEH-22 | Minimum Velocity (m/s)             | 1.00          |
| Return Period (years)                | 100    | Connection Type                    | Level Soffits |
| Additional Flow (%)                  | 40     | Minimum Backdrop Height (m)        | 0.200         |
| CV                                   | 1.000  | Preferred Cover Depth (m)          | 1.200         |
| Time of Entry (mins)                 | 5.00   | Include Intermediate Ground        | ✓             |
| Maximum Time of Concentration (mins) | 30.00  | Enforce best practice design rules | ✓             |
| Maximum Rainfall (mm/hr)             | 50.0   |                                    |               |

Nodes

| Name    | Area (ha) | T of E (mins) | Cover Level (m) | Diameter (mm) | Easting (m) | Northing (m) | Depth (m) |
|---------|-----------|---------------|-----------------|---------------|-------------|--------------|-----------|
| R01     | 0.038     | 5.00          | 52.500          | 450           | 44.125      | 101.949      | 1.300     |
| R02     | 0.037     | 5.00          | 52.500          | 450           | 70.060      | 84.350       | 1.300     |
| R03     | 0.038     | 5.00          | 52.500          | 450           | 94.061      | 104.735      | 1.300     |
| R04     | 0.036     | 5.00          | 49.500          | 450           | 52.340      | 97.700       | 1.300     |
| R05     | 0.037     | 5.00          | 49.500          | 450           | 84.667      | 98.655       | 1.300     |
| EXS14   | 0.030     | 5.00          | 37.500          | 450           | 65.528      | 109.018      | 1.653     |
| P01     | 0.084     | 5.00          | 40.500          | 450           | 74.408      | 68.096       | 1.300     |
| SW06    | 0.023     | 5.00          | 37.500          | 450           | 35.253      | 77.569       | 1.050     |
| SW05    | 0.025     | 5.00          | 37.500          | 450           | 33.509      | 107.364      | 1.348     |
| SW04    | 0.027     | 5.00          | 37.500          | 450           | 31.890      | 138.462      | 1.766     |
| SW03    | 0.008     | 5.00          | 37.500          | 450           | 39.113      | 145.411      | 1.866     |
| SW08    | 0.005     | 5.00          | 37.500          | 450           | 66.344      | 92.745       | 1.490     |
| SW07    | 0.056     | 5.00          | 37.500          | 450           | 63.577      | 142.247      | 1.986     |
| SW02    | 0.017     | 5.00          | 37.500          | 1200          | 66.195      | 146.954      | 2.136     |
| SW12    | 0.013     | 5.00          | 37.500          | 600           | 102.546     | 81.526       | 1.737     |
| SW11    | 0.017     | 5.00          | 37.500          | 600           | 100.627     | 116.257      | 2.085     |
| SW01    | 0.022     | 5.00          | 37.500          | 1200          | 96.504      | 148.761      | 2.440     |
| OUTFALL |           |               | 37.500          | 450           | 109.502     | 142.843      | 2.540     |
| SW09    | 0.003     | 5.00          | 37.530          | 600           | 95.116      | 145.688      | 2.436     |
| SW10    | 0.013     | 5.00          | 37.530          | 600           | 99.064      | 143.980      | 2.393     |
| PP01    | 0.007     | 5.00          | 37.530          | 450           | 26.808      | 130.131      | 0.780     |
| PP02    | 0.018     | 5.00          | 37.530          | 450           | 28.828      | 90.612       | 0.780     |

Links

| Name  | US Node | DS Node | Length (m) | ks (mm) / n | US IL (m) | DS IL (m) | Fall (m) | Slope (1:X) | Dia (mm) | T of C (mins) | Rain (mm/hr) |
|-------|---------|---------|------------|-------------|-----------|-----------|----------|-------------|----------|---------------|--------------|
| 6.000 | R01     | SW05    | 11.917     | 0.600       | 51.200    | 36.152    | 15.048   | 0.8         | 150      | 5.02          | 50.0         |
| 2.000 | R04     | P01     | 36.924     | 0.600       | 48.200    | 39.200    | 9.000    | 4.1         | 150      | 5.12          | 50.0         |
| 8.002 | EXS14   | SW07    | 33.286     | 0.600       | 35.847    | 35.514    | 0.333    | 100.0       | 225      | 5.67          | 50.0         |
| 4.002 | SW04    | SW03    | 10.023     | 0.600       | 35.734    | 35.634    | 0.100    | 100.2       | 225      | 5.85          | 50.0         |
| 1.001 | P01     | SW12    | 31.179     | 0.600       | 39.200    | 35.763    | 3.437    | 9.1         | 150      | 5.28          | 50.0         |

| Name  | Vel (m/s) | Cap (l/s) | Flow (l/s) | US Depth (m) | DS Depth (m) | Σ Area (ha) | Σ Add Inflow (l/s) |
|-------|-----------|-----------|------------|--------------|--------------|-------------|--------------------|
| 6.000 | 11.420    | 201.8     | 9.6        | 1.150        | 1.198        | 0.038       | 0.0                |
| 2.000 | 5.010     | 88.5      | 9.1        | 1.150        | 1.150        | 0.036       | 0.0                |
| 8.002 | 1.307     | 52.0      | 18.2       | 1.428        | 1.761        | 0.072       | 0.0                |
| 4.002 | 1.306     | 51.9      | 35.2       | 1.541        | 1.641        | 0.139       | 0.0                |
| 1.001 | 3.365     | 59.5      | 49.3       | 1.150        | 1.587        | 0.195       | 0.0                |

Links

| Name  | US<br>Node | DS<br>Node | Length<br>(m) | ks (mm) /<br>n | US IL<br>(m) | DS IL<br>(m) | Fall<br>(m) | Slope<br>(1:X) | Dia<br>(mm) | T of C<br>(mins) | Rain<br>(mm/hr) |
|-------|------------|------------|---------------|----------------|--------------|--------------|-------------|----------------|-------------|------------------|-----------------|
| 4.000 | SW06       | SW05       | 29.846        | 0.600          | 36.450       | 36.152       | 0.298       | 100.0          | 225         | 5.38             | 50.0            |
| 4.001 | SW05       | SW04       | 31.140        | 0.600          | 36.152       | 35.734       | 0.418       | 74.5           | 225         | 5.72             | 50.0            |
| 4.003 | SW03       | SW02       | 27.126        | 0.600          | 35.634       | 35.364       | 0.270       | 100.5          | 225         | 6.20             | 50.0            |
| 1.002 | SW12       | SW11       | 34.784        | 0.600          | 35.763       | 35.415       | 0.348       | 100.0          | 225         | 5.72             | 50.0            |
| 3.000 | R02        | P01        | 16.826        | 0.600          | 51.200       | 39.200       | 12.000      | 1.4            | 150         | 5.03             | 50.0            |
| 8.001 | SW08       | EXS14      | 16.293        | 0.600          | 36.010       | 35.847       | 0.163       | 100.0          | 225         | 5.25             | 50.0            |
| 1.000 | R03        | P01        | 41.577        | 0.600          | 51.200       | 39.200       | 12.000      | 3.5            | 150         | 5.13             | 50.0            |
| 8.000 | R05        | SW08       | 19.253        | 0.600          | 48.200       | 36.010       | 12.190      | 1.6            | 150         | 5.04             | 50.0            |
| 1.003 | SW11       | SW10       | 27.767        | 0.600          | 35.415       | 35.137       | 0.278       | 99.9           | 225         | 6.08             | 50.0            |
| 1.006 | SW01       | OUTFALL    | 14.282        | 0.600          | 35.060       | 34.960       | 0.100       | 142.8          | 225         | 6.80             | 50.0            |
| 1.004 | SW10       | SW09       | 4.302         | 0.600          | 35.137       | 35.094       | 0.043       | 100.0          | 225         | 6.13             | 50.0            |
| 8.003 | SW07       | SW02       | 5.386         | 0.600          | 35.514       | 35.364       | 0.150       | 35.9           | 225         | 5.71             | 50.0            |
| 4.004 | SW02       | SW01       | 30.363        | 0.600          | 35.364       | 35.060       | 0.304       | 99.9           | 225         | 6.58             | 50.0            |
| 1.005 | SW09       | SW01       | 3.372         | 0.600          | 35.094       | 35.060       | 0.034       | 100.0          | 225         | 6.18             | 50.0            |
| 7.000 | PP01       | SW04       | 9.759         | 0.600          | 36.750       | 35.734       | 1.016       | 9.6            | 225         | 5.04             | 50.0            |
| 5.000 | PP02       | SW05       | 17.394        | 0.600          | 36.750       | 36.152       | 0.598       | 29.1           | 225         | 5.12             | 50.0            |

| Name  | Vel<br>(m/s) | Cap<br>(l/s) | Flow<br>(l/s) | US<br>Depth<br>(m) | DS<br>Depth<br>(m) | Σ Area<br>(ha) | Σ Add<br>Inflow<br>(l/s) |
|-------|--------------|--------------|---------------|--------------------|--------------------|----------------|--------------------------|
| 4.000 | 1.307        | 52.0         | 5.8           | 0.825              | 1.123              | 0.023          | 0.0                      |
| 4.001 | 1.516        | 60.3         | 26.4          | 1.123              | 1.541              | 0.104          | 0.0                      |
| 4.003 | 1.304        | 51.9         | 37.2          | 1.641              | 1.911              | 0.147          | 0.0                      |
| 1.002 | 1.307        | 52.0         | 52.7          | 1.512              | 1.860              | 0.208          | 0.0                      |
| 3.000 | 8.580        | 151.6        | 9.4           | 1.150              | 1.150              | 0.037          | 0.0                      |
| 8.001 | 1.307        | 52.0         | 10.6          | 1.265              | 1.428              | 0.042          | 0.0                      |
| 1.000 | 5.453        | 96.4         | 9.5           | 1.150              | 1.150              | 0.038          | 0.0                      |
| 8.000 | 8.083        | 142.8        | 9.3           | 1.150              | 1.340              | 0.037          | 0.0                      |
| 1.003 | 1.308        | 52.0         | 57.0          | 1.860              | 2.168              | 0.225          | 0.0                      |
| 1.006 | 1.092        | 43.4         | 140.5         | 2.215              | 2.315              | 0.556          | 0.0                      |
| 1.004 | 1.307        | 52.0         | 60.3          | 2.168              | 2.211              | 0.238          | 0.0                      |
| 8.003 | 2.190        | 87.1         | 32.4          | 1.761              | 1.911              | 0.128          | 0.0                      |
| 4.004 | 1.308        | 52.0         | 73.9          | 1.911              | 2.215              | 0.292          | 0.0                      |
| 1.005 | 1.307        | 52.0         | 61.1          | 2.211              | 2.215              | 0.241          | 0.0                      |
| 7.000 | 4.246        | 168.8        | 1.9           | 0.555              | 1.541              | 0.007          | 0.0                      |
| 5.000 | 2.435        | 96.8         | 4.5           | 0.555              | 1.123              | 0.018          | 0.0                      |

Pipeline Schedule

| Link  | Length<br>(m) | Slope<br>(1:X) | Dia<br>(mm) | Link<br>Type | US CL<br>(m) | US IL<br>(m) | US Depth<br>(m) | DS CL<br>(m) | DS IL<br>(m) | DS Depth<br>(m) |
|-------|---------------|----------------|-------------|--------------|--------------|--------------|-----------------|--------------|--------------|-----------------|
| 6.000 | 11.917        | 0.8            | 150         | Circular     | 52.500       | 51.200       | 1.150           | 37.500       | 36.152       | 1.198           |
| 2.000 | 36.924        | 4.1            | 150         | Circular     | 49.500       | 48.200       | 1.150           | 40.500       | 39.200       | 1.150           |
| 8.002 | 33.286        | 100.0          | 225         | Circular     | 37.500       | 35.847       | 1.428           | 37.500       | 35.514       | 1.761           |
| 4.002 | 10.023        | 100.2          | 225         | Circular     | 37.500       | 35.734       | 1.541           | 37.500       | 35.634       | 1.641           |

| Link  | US<br>Node | Dia<br>(mm) | Node<br>Type | MH<br>Type | DS<br>Node | Dia<br>(mm) | Node<br>Type | MH<br>Type |
|-------|------------|-------------|--------------|------------|------------|-------------|--------------|------------|
| 6.000 | R01        | 450         | Manhole      | Adoptable  | SW05       | 450         | Manhole      | Adoptable  |
| 2.000 | R04        | 450         | Manhole      | Adoptable  | P01        | 450         | Manhole      | Adoptable  |
| 8.002 | EXS14      | 450         | Manhole      | Adoptable  | SW07       | 450         | Manhole      | Adoptable  |
| 4.002 | SW04       | 450         | Manhole      | Adoptable  | SW03       | 450         | Manhole      | Adoptable  |

Pipeline Schedule

| Link  | Length<br>(m) | Slope<br>(1:X) | Dia<br>(mm) | Link<br>Type | US CL<br>(m) | US IL<br>(m) | US Depth<br>(m) | DS CL<br>(m) | DS IL<br>(m) | DS Depth<br>(m) |
|-------|---------------|----------------|-------------|--------------|--------------|--------------|-----------------|--------------|--------------|-----------------|
| 1.001 | 31.179        | 9.1            | 150         | Circular     | 40.500       | 39.200       | 1.150           | 37.500       | 35.763       | 1.587           |
| 4.000 | 29.846        | 100.0          | 225         | Circular     | 37.500       | 36.450       | 0.825           | 37.500       | 36.152       | 1.123           |
| 4.001 | 31.140        | 74.5           | 225         | Circular     | 37.500       | 36.152       | 1.123           | 37.500       | 35.734       | 1.541           |
| 4.003 | 27.126        | 100.5          | 225         | Circular     | 37.500       | 35.634       | 1.641           | 37.500       | 35.364       | 1.911           |
| 1.002 | 34.784        | 100.0          | 225         | Circular     | 37.500       | 35.763       | 1.512           | 37.500       | 35.415       | 1.860           |
| 3.000 | 16.826        | 1.4            | 150         | Circular     | 52.500       | 51.200       | 1.150           | 40.500       | 39.200       | 1.150           |
| 8.001 | 16.293        | 100.0          | 225         | Circular     | 37.500       | 36.010       | 1.265           | 37.500       | 35.847       | 1.428           |
| 1.000 | 41.577        | 3.5            | 150         | Circular     | 52.500       | 51.200       | 1.150           | 40.500       | 39.200       | 1.150           |
| 8.000 | 19.253        | 1.6            | 150         | Circular     | 49.500       | 48.200       | 1.150           | 37.500       | 36.010       | 1.340           |
| 1.003 | 27.767        | 99.9           | 225         | Circular     | 37.500       | 35.415       | 1.860           | 37.530       | 35.137       | 2.168           |
| 1.006 | 14.282        | 142.8          | 225         | Circular     | 37.500       | 35.060       | 2.215           | 37.500       | 34.960       | 2.315           |
| 1.004 | 4.302         | 100.0          | 225         | Circular     | 37.530       | 35.137       | 2.168           | 37.530       | 35.094       | 2.211           |
| 8.003 | 5.386         | 35.9           | 225         | Circular     | 37.500       | 35.514       | 1.761           | 37.500       | 35.364       | 1.911           |
| 4.004 | 30.363        | 99.9           | 225         | Circular     | 37.500       | 35.364       | 1.911           | 37.500       | 35.060       | 2.215           |
| 1.005 | 3.372         | 100.0          | 225         | Circular     | 37.530       | 35.094       | 2.211           | 37.500       | 35.060       | 2.215           |
| 7.000 | 9.759         | 9.6            | 225         | Circular     | 37.530       | 36.750       | 0.555           | 37.500       | 35.734       | 1.541           |
| 5.000 | 17.394        | 29.1           | 225         | Circular     | 37.530       | 36.750       | 0.555           | 37.500       | 36.152       | 1.123           |

| Link  | US<br>Node | Dia<br>(mm) | Node<br>Type | MH<br>Type | DS<br>Node | Dia<br>(mm) | Node<br>Type | MH<br>Type |
|-------|------------|-------------|--------------|------------|------------|-------------|--------------|------------|
| 1.001 | P01        | 450         | Manhole      | Adoptable  | SW12       | 600         | Manhole      | Adoptable  |
| 4.000 | SW06       | 450         | Manhole      | Adoptable  | SW05       | 450         | Manhole      | Adoptable  |
| 4.001 | SW05       | 450         | Manhole      | Adoptable  | SW04       | 450         | Manhole      | Adoptable  |
| 4.003 | SW03       | 450         | Manhole      | Adoptable  | SW02       | 1200        | Manhole      | Adoptable  |
| 1.002 | SW12       | 600         | Manhole      | Adoptable  | SW11       | 600         | Manhole      | Adoptable  |
| 3.000 | R02        | 450         | Manhole      | Adoptable  | P01        | 450         | Manhole      | Adoptable  |
| 8.001 | SW08       | 450         | Manhole      | Adoptable  | EXS14      | 450         | Manhole      | Adoptable  |
| 1.000 | R03        | 450         | Manhole      | Adoptable  | P01        | 450         | Manhole      | Adoptable  |
| 8.000 | R05        | 450         | Manhole      | Adoptable  | SW08       | 450         | Manhole      | Adoptable  |
| 1.003 | SW11       | 600         | Manhole      | Adoptable  | SW10       | 600         | Manhole      | Adoptable  |
| 1.006 | SW01       | 1200        | Manhole      | Adoptable  | OUTFALL    | 450         | Manhole      | Adoptable  |
| 1.004 | SW10       | 600         | Manhole      | Adoptable  | SW09       | 600         | Manhole      | Adoptable  |
| 8.003 | SW07       | 450         | Manhole      | Adoptable  | SW02       | 1200        | Manhole      | Adoptable  |
| 4.004 | SW02       | 1200        | Manhole      | Adoptable  | SW01       | 1200        | Manhole      | Adoptable  |
| 1.005 | SW09       | 600         | Manhole      | Adoptable  | SW01       | 1200        | Manhole      | Adoptable  |
| 7.000 | PP01       | 450         | Manhole      | Adoptable  | SW04       | 450         | Manhole      | Adoptable  |
| 5.000 | PP02       | 450         | Manhole      | Adoptable  | SW05       | 450         | Manhole      | Adoptable  |

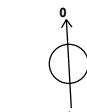
Manhole Schedule

| Node | Easting<br>(m) | Northing<br>(m) | CL<br>(m) | Depth<br>(m) | Dia<br>(mm) | Connections | Link | IL<br>(m) | Dia<br>(mm) |     |
|------|----------------|-----------------|-----------|--------------|-------------|-------------|------|-----------|-------------|-----|
| R01  | 44.125         | 101.949         | 52.500    | 1.300        | 450         |             |      | 6.000     | 51.200      | 150 |
| R02  | 70.060         | 84.350          | 52.500    | 1.300        | 450         |             |      | 3.000     | 51.200      | 150 |

**Manhole Schedule**

| Node  | Easting (m) | Northing (m) | CL (m) | Depth (m) | Dia (mm) | Connections   | Link             | IL (m)                           | Dia (mm)   |
|-------|-------------|--------------|--------|-----------|----------|---|------------------|----------------------------------|--|
| R03   | 94.061      | 104.735      | 52.500 | 1.300     | 450      |    | 0                | 1.000                            | 51.200 150   |
| R04   | 52.340      | 97.700       | 49.500 | 1.300     | 450      |    | 0                | 2.000                            | 48.200 150   |
| R05   | 84.667      | 98.655       | 49.500 | 1.300     | 450      |    | 0                | 8.000                            | 48.200 150   |
| EXS14 | 65.528      | 109.018      | 37.500 | 1.653     | 450      |    | 1                | 8.001                            | 35.847 225   |
| P01   | 74.408      | 68.096       | 40.500 | 1.300     | 450      |    | 1<br>2<br>3<br>0 | 3.000<br>2.000<br>1.000<br>1.001 | 39.200 150<br>39.200 150<br>39.200 150<br>39.200 150 |
| SW06  | 35.253      | 77.569       | 37.500 | 1.050     | 450      |  | 0                | 4.000                            | 36.450 225   |
| SW05  | 33.509      | 107.364      | 37.500 | 1.348     | 450      |  | 1<br>2<br>3<br>0 | 6.000<br>5.000<br>4.000<br>4.001 | 36.152 150<br>36.152 225<br>36.152 225<br>36.152 225 |
| SW04  | 31.890      | 138.462      | 37.500 | 1.766     | 450      |  | 1<br>2<br>0      | 7.000<br>4.001<br>4.002          | 35.734 225<br>35.734 225<br>35.734 225               |
| SW03  | 39.113      | 145.411      | 37.500 | 1.866     | 450      |  | 1<br>0           | 4.002<br>4.003                   | 35.634 225<br>35.634 225                             |
| SW08  | 66.344      | 92.745       | 37.500 | 1.490     | 450      |  | 1<br>0           | 8.000<br>8.001                   | 36.010 150<br>36.010 225                             |
| SW07  | 63.577      | 142.247      | 37.500 | 1.986     | 450      |  | 1<br>0           | 8.002<br>8.003                   | 35.514 225<br>35.514 225                             |
| SW02  | 66.195      | 146.954      | 37.500 | 2.136     | 1200     |  | 1<br>2<br>0      | 8.003<br>4.003<br>4.004          | 35.364 225<br>35.364 225<br>35.364 225               |
| SW12  | 102.546     | 81.526       | 37.500 | 1.737     | 600      |  | 1<br>0           | 1.001<br>1.002                   | 35.763 150<br>35.763 225                             |

### Manhole Schedule

| Node    | Easting (m) | Northing (m) | CL (m) | Depth (m) | Dia (mm) | Connections   | Link | IL (m) | Dia (mm)   |
|---------|-------------|--------------|--------|-----------|----------|---|------|--------|------------|
| SW11    | 100.627     | 116.257      | 37.500 | 2.085     | 600      |    | 1    | 1.002  | 35.415 225 |
| SW01    | 96.504      | 148.761      | 37.500 | 2.440     | 1200     |    | 1    | 1.003  | 35.415 225 |
|         |             |              |        |           |          |    | 2    | 4.004  | 35.060 225 |
|         |             |              |        |           |          |    | 0    | 1.005  | 35.060 225 |
| OUTFALL | 109.502     | 142.843      | 37.500 | 2.540     | 450      |    | 1    | 1.006  | 35.060 225 |
| SW09    | 95.116      | 145.688      | 37.530 | 2.436     | 600      |    | 1    | 1.004  | 35.094 225 |
| SW10    | 99.064      | 143.980      | 37.530 | 2.393     | 600      |   | 0    | 1.005  | 35.094 225 |
| PP01    | 26.808      | 130.131      | 37.530 | 0.780     | 450      |  | 1    | 1.003  | 35.137 225 |
| PP02    | 28.828      | 90.612       | 37.530 | 0.780     | 450      |  | 0    | 1.004  | 35.137 225 |
|         |             |              |        |           |          |  | 0    | 7.000  | 36.750 225 |
|         |             |              |        |           |          |  | 0    | 5.000  | 36.750 225 |

### Simulation Settings

|                            |          |                               |      |
|----------------------------|----------|-------------------------------|------|
| Rainfall Methodology       | FEH-22   | Starting Level (m)            |      |
| Rainfall Events            | Singular | Check Discharge Rate(s)       | ✓    |
| Summer CV                  | 1.000    | 1 year (l/s)                  | 0.0  |
| Winter CV                  | 1.000    | 30 year (l/s)                 | 41.2 |
| Analysis Speed             | Detailed | 100 year (l/s)                | 51.9 |
| Skip Steady State          | x        | Check Discharge Volume        | ✓    |
| Drain Down Time (mins)     | 240      | 100 year +40% 360 minute (m³) | 1447 |
| Additional Storage (m³/ha) | 20.0     |                               |      |

### Storm Durations

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

| Return Period (years) | Climate Change (CC %) | Additional Area (A %) | Additional Flow (Q %) |
|-----------------------|-----------------------|-----------------------|-----------------------|
| 1                     | 0                     | 0                     | 0                     |
| 30                    | 0                     | 0                     | 0                     |
| 100                   | 40                    | 0                     | 0                     |

Pre-development Discharge Rate

|                        |            |                              |      |
|------------------------|------------|------------------------------|------|
| Site Makeup            | Brownfield | Time of Concentration (mins) | 5.00 |
| Brownfield Method      | MRM        | Betterment (%)               | 0    |
| Contributing Area (ha) | 0.900      | Q 1 year (l/s)               |      |
| PIMP (%)               | 100        | Q 30 year (l/s)              | 41.2 |
| CV                     | 1.000      | Q 100 year (l/s)             | 51.9 |

Pre-development Discharge Volume

|                        |            |                       |       |                    |       |
|------------------------|------------|-----------------------|-------|--------------------|-------|
| Site Makeup            | Brownfield | CV                    | 1.000 | Betterment (%)     | 0     |
| Brownfield Method      | MRM        | Return Period (years) | 100   | PR                 | 1.000 |
| Contributing Area (ha) | 0.900      | Climate Change (%)    | 40    | Runoff Volume (m³) | 930   |
| PIMP (%)               | 100        | Storm Duration (mins) | 360   |                    |       |

Node SW01 Online Hydro-Brake® Control

|                          |        |                         |                                |
|--------------------------|--------|-------------------------|--------------------------------|
| Flap Valve               | x      | Objective               | (HE) Minimise upstream storage |
| Replaces Downstream Link | x      | Sump Available          | ✓                              |
| Invert Level (m)         | 35.060 | Product Number          | CTL-SHE-0082-4400-2440-4400    |
| Design Depth (m)         | 2.440  | Min Outlet Diameter (m) | 0.100                          |
| Design Flow (l/s)        | 4.4    | Min Node Diameter (mm)  | 1200                           |

Node P01 Online Depth/Flow Control

|            |   |                          |   |                  |        |
|------------|---|--------------------------|---|------------------|--------|
| Flap Valve | x | Replaces Downstream Link | ✓ | Invert Level (m) | 39.200 |
|------------|---|--------------------------|---|------------------|--------|

| Depth | Flow  | Depth | Flow  | Depth | Flow  | Depth | Flow  |
|-------|-------|-------|-------|-------|-------|-------|-------|
| (m)   | (l/s) | (m)   | (l/s) | (m)   | (l/s) | (m)   | (l/s) |
| 0.010 | 1.800 | 0.050 | 3.000 | 0.090 | 4.200 | 0.130 | 4.800 |
| 0.020 | 1.800 | 0.060 | 3.000 | 0.100 | 4.200 | 0.140 | 4.800 |
| 0.030 | 2.400 | 0.070 | 3.600 | 0.110 | 4.200 | 0.150 | 4.800 |
| 0.040 | 2.400 | 0.080 | 3.600 | 0.120 | 4.200 | 0.160 | 5.400 |

Node SW02 Online Hydro-Brake® Control

|                          |        |                         |                                |
|--------------------------|--------|-------------------------|--------------------------------|
| Flap Valve               | x      | Objective               | (HE) Minimise upstream storage |
| Replaces Downstream Link | x      | Sump Available          | ✓                              |
| Invert Level (m)         | 35.364 | Product Number          | CTL-SHE-0069-3000-2136-3000    |
| Design Depth (m)         | 2.136  | Min Outlet Diameter (m) | 0.100                          |
| Design Flow (l/s)        | 3.0    | Min Node Diameter (mm)  | 1200                           |

Node PP01 Depth/Area Storage Structure

|                             |         |               |      |                           |        |
|-----------------------------|---------|---------------|------|---------------------------|--------|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0  | Invert Level (m)          | 36.830 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity      | 0.30 | Time to half empty (mins) |        |

| Depth | Area | Inf Area | Depth | Area | Inf Area | Depth | Area | Inf Area |
|-------|------|----------|-------|------|----------|-------|------|----------|
| (m)   | (m²) | (m²)     | (m)   | (m²) | (m²)     | (m)   | (m²) | (m²)     |
| 0.000 | 70.0 | 70.0     | 0.500 | 70.0 | 84.8     | 0.501 | 0.0  | 84.8     |

Node PP02 Depth/Area Storage Structure

|                             |         |               |      |                           |        |
|-----------------------------|---------|---------------|------|---------------------------|--------|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0  | Invert Level (m)          | 36.830 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity      | 0.30 | Time to half empty (mins) |        |



| Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) |
|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|
| 0.000        | 180.0                     | 180.0                         | 0.500        | 180.0                     | 203.8                         | 0.501        | 0.0                       | 203.8                         |

Node P01 Depth/Area Storage Structure

|                             |         |               |      |                           |        |
|-----------------------------|---------|---------------|------|---------------------------|--------|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0  | Invert Level (m)          | 39.700 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity      | 0.95 | Time to half empty (mins) |        |

| Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) |
|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|
| 0.000        | 680.0                     | 680.0                         | 0.300        | 680.0                     | 707.7                         | 0.301        | 0.0                       | 707.7                         |

Node P01 Depth/Area Storage Structure

|                             |         |               |      |                           |        |
|-----------------------------|---------|---------------|------|---------------------------|--------|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0  | Invert Level (m)          | 40.000 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity      | 0.30 | Time to half empty (mins) | 0      |

| Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) |
|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|
| 0.000        | 240.0                     | 240.0                         | 0.200        | 240.0                     | 251.0                         | 0.201        | 0.0                       | 251.0                         |

Node EXS14 Depth/Area Storage Structure

|                             |         |               |      |                           |        |
|-----------------------------|---------|---------------|------|---------------------------|--------|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0  | Invert Level (m)          | 36.800 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity      | 0.30 | Time to half empty (mins) |        |

| Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) |
|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|
| 0.000        | 150.0                     | 150.0                         | 0.500        | 150.0                     | 171.7                         | 0.501        | 0.0                       | 171.7                         |

Node SW07 Depth/Area Storage Structure

|                             |         |               |      |                           |        |
|-----------------------------|---------|---------------|------|---------------------------|--------|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0  | Invert Level (m)          | 36.800 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity      | 0.30 | Time to half empty (mins) |        |

| Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) |
|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|
| 0.000        | 310.0                     | 310.0                         | 0.500        | 310.0                     | 341.2                         | 0.501        | 0.0                       | 341.2                         |

Node SW01 Depth/Area Storage Structure

|                             |         |               |      |                           |        |
|-----------------------------|---------|---------------|------|---------------------------|--------|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0  | Invert Level (m)          | 35.060 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity      | 0.95 | Time to half empty (mins) |        |

| Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) |
|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|
| 0.000        | 125.0                     | 125.0                         | 2.000        | 125.0                     | 204.3                         | 2.001        | 0.0                       | 204.3                         |

Node SW02 Depth/Area Storage Structure

|                             |         |               |      |                           |        |
|-----------------------------|---------|---------------|------|---------------------------|--------|
| Base Inf Coefficient (m/hr) | 0.00000 | Safety Factor | 2.0  | Invert Level (m)          | 35.364 |
| Side Inf Coefficient (m/hr) | 0.00000 | Porosity      | 0.95 | Time to half empty (mins) |        |



| Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) | Depth<br>(m) | Area<br>(m <sup>2</sup> ) | Inf Area<br>(m <sup>2</sup> ) |
|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|--------------|---------------------------|-------------------------------|
| 0.000        | 165.0                     | 165.0                         | 1.600        | 165.0                     | 237.9                         | 1.601        | 0.0                       | 237.9                         |

Results for 1 year Critical Storm Duration. Lowest mass balance: 97.04%

| Node Event        | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status   |
|-------------------|---------|-------------|-----------|-----------|--------------|---------------|------------|--|
| 15 minute summer  | R01     | 10          | 51.215    | 0.015     | 3.9          | 0.0239        | 0.0000     | OK   |
| 15 minute summer  | R02     | 10          | 51.215    | 0.015     | 3.8          | 0.0241        | 0.0000     | OK   |
| 15 minute summer  | R03     | 10          | 51.220    | 0.020     | 3.9          | 0.0333        | 0.0000     | OK   |
| 15 minute summer  | R04     | 10          | 48.221    | 0.021     | 3.7          | 0.0149        | 0.0000     | OK   |
| 15 minute summer  | R05     | 10          | 48.216    | 0.016     | 3.8          | 0.0116        | 0.0000     | OK   |
| 15 minute summer  | EXS14   | 11          | 35.903    | 0.056     | 7.3          | 0.0295        | 0.0000     | OK   |
| 240 minute summer | P01     | 148         | 39.703    | 0.503     | 9.8          | 2.9046        | 0.0000     | <span style="color: orange;">SURCHARGED</span> |
| 15 minute summer  | SW06    | 10          | 36.482    | 0.032     | 2.4          | 0.0194        | 0.0000     | OK   |
| 15 minute summer  | SW05    | 11          | 36.215    | 0.063     | 10.6         | 0.0338        | 0.0000     | OK   |
| 15 minute summer  | SW04    | 11          | 35.820    | 0.086     | 13.8         | 0.0402        | 0.0000     | OK   |
| 15 minute summer  | SW03    | 11          | 35.727    | 0.093     | 14.7         | 0.0226        | 0.0000     | OK   |
| 15 minute summer  | SW08    | 10          | 36.053    | 0.043     | 4.3          | 0.0099        | 0.0000     | OK   |
| 480 minute summer | SW07    | 312         | 35.595    | 0.081     | 4.9          | 0.0587        | 0.0000     | OK   |
| 480 minute summer | SW02    | 328         | 35.595    | 0.231     | 11.2         | 36.4692       | 0.0000     | <span style="color: orange;">SURCHARGED</span> |
| 15 minute summer  | SW12    | 10          | 35.820    | 0.057     | 7.4          | 0.0250        | 0.0000     | OK   |
| 15 minute summer  | SW11    | 11          | 35.478    | 0.063     | 9.2          | 0.0282        | 0.0000     | OK   |
| 480 minute summer | SW01    | 392         | 35.430    | 0.370     | 9.2          | 44.3682       | 0.0000     | <span style="color: orange;">SURCHARGED</span> |
| 480 minute summer | OUTFALL | 392         | 35.001    | 0.041     | 3.1          | 0.0000        | 0.0000     | OK   |
| 480 minute summer | SW09    | 392         | 35.430    | 0.336     | 6.9          | 0.1030        | 0.0000     | <span style="color: orange;">SURCHARGED</span> |
| 480 minute summer | SW10    | 392         | 35.430    | 0.293     | 7.0          | 0.1150        | 0.0000     | <span style="color: orange;">SURCHARGED</span> |
| 15 minute summer  | PP01    | 10          | 36.761    | 0.011     | 0.8          | 0.0039        | 0.0000     | OK   |
| 15 minute summer  | PP02    | 10          | 36.771    | 0.021     | 1.8          | 0.0130        | 0.0000     | OK   |

| Link Event<br>(Upstream Depth) | US Node | Link       | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|--------------------------------|---------|------------|---------|---------------|----------------|----------|---------------|--------------------|
| 15 minute summer               | R01     | 6.000      | SW05    | 3.9           | 1.416          | 0.019    | 0.0467        |                    |
| 15 minute summer               | R02     | 3.000      | P01     | 3.8           | 1.482          | 0.025    | 0.1559        |                    |
| 15 minute summer               | R03     | 1.000      | P01     | 3.9           | 0.955          | 0.040    | 0.3957        |                    |
| 15 minute summer               | R04     | 2.000      | P01     | 3.7           | 1.073          | 0.041    | 0.3522        |                    |
| 15 minute summer               | R05     | 8.000      | SW08    | 3.8           | 1.862          | 0.027    | 0.0498        |                    |
| 15 minute summer               | EXS14   | 8.002      | SW07    | 7.2           | 0.810          | 0.139    | 0.3143        |                    |
| 240 minute summer              | P01     | Depth/Flow | SW12    | 6.0           |                |          |               |                    |
| 15 minute summer               | SW06    | 4.000      | SW05    | 2.4           | 0.388          | 0.045    | 0.1872        |                    |
| 15 minute summer               | SW05    | 4.001      | SW04    | 10.4          | 0.911          | 0.172    | 0.3578        |                    |
| 15 minute summer               | SW04    | 4.002      | SW03    | 13.9          | 0.950          | 0.268    | 0.1476        |                    |
| 15 minute summer               | SW03    | 4.003      | SW02    | 14.9          | 1.613          | 0.288    | 0.2798        |                    |
| 15 minute summer               | SW08    | 8.001      | EXS14   | 4.2           | 0.653          | 0.081    | 0.1061        |                    |
| 480 minute summer              | SW07    | 8.003      | SW02    | 7.8           | 0.832          | 0.090    | 0.1419        |                    |
| 480 minute summer              | SW02    | 4.004      | SW01    | 2.0           | 0.123          | 0.039    | 0.7506        |                    |
| 15 minute summer               | SW12    | 1.002      | SW11    | 7.4           | 0.885          | 0.142    | 0.2958        |                    |
| 15 minute summer               | SW11    | 1.003      | SW10    | 9.1           | 0.842          | 0.175    | 0.3031        |                    |
| 480 minute summer              | SW01    | 1.006      | OUTFALL | 3.1           | 0.631          | 0.072    | 0.0712        | 96.1               |
| 480 minute summer              | SW09    | 1.005      | SW01    | 6.8           | 0.684          | 0.130    | 0.1341        |                    |
| 480 minute summer              | SW10    | 1.004      | SW09    | 6.8           | 0.584          | 0.130    | 0.1711        |                    |
| 15 minute summer               | PP01    | 7.000      | SW04    | 0.8           | 0.193          | 0.005    | 0.0713        |                    |
| 15 minute summer               | PP02    | 5.000      | SW05    | 1.8           | 0.355          | 0.018    | 0.0947        |                    |

Results for 30 year Critical Storm Duration. Lowest mass balance: 97.04%

| Node Event        | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status            |
|-------------------|---------|-------------|-----------|-----------|--------------|---------------|------------|-------------------|
| 60 minute summer  | R01     | 33          | 51.232    | 0.032     | 20.5         | 0.0530        | 0.0000     | OK                |
| 60 minute summer  | R02     | 33          | 51.233    | 0.033     | 19.6         | 0.0531        | 0.0000     | OK                |
| 60 minute summer  | R03     | 33          | 51.246    | 0.046     | 20.4         | 0.0755        | 0.0000     | OK                |
| 15 minute summer  | R04     | 10          | 48.246    | 0.046     | 18.3         | 0.0329        | 0.0000     | OK                |
| 15 minute summer  | R05     | 10          | 48.234    | 0.034     | 18.6         | 0.0249        | 0.0000     | OK                |
| 720 minute winter | EXS14   | 735         | 36.378    | 0.531     | 2.6          | 0.2784        | 0.0000     | <b>SURCHARGED</b> |
| 180 minute summer | P01     | 164         | 39.829    | 0.629     | 44.8         | 84.2685       | 0.0000     | <b>SURCHARGED</b> |
| 15 minute summer  | SW06    | 12          | 36.524    | 0.074     | 11.7         | 0.0445        | 0.0000     | OK                |
| 15 minute summer  | SW05    | 12          | 36.510    | 0.358     | 52.7         | 0.1924        | 0.0000     | <b>SURCHARGED</b> |
| 720 minute winter | SW04    | 735         | 36.378    | 0.644     | 7.1          | 0.3014        | 0.0000     | <b>SURCHARGED</b> |
| 720 minute winter | SW03    | 735         | 36.378    | 0.744     | 7.2          | 0.1801        | 0.0000     | <b>SURCHARGED</b> |
| 720 minute winter | SW08    | 735         | 36.378    | 0.368     | 1.5          | 0.0843        | 0.0000     | <b>SURCHARGED</b> |
| 720 minute winter | SW07    | 735         | 36.378    | 0.864     | 7.9          | 0.6230        | 0.0000     | <b>SURCHARGED</b> |
| 720 minute winter | SW02    | 735         | 36.378    | 1.014     | 15.1         | 160.2747      | 0.0000     | <b>SURCHARGED</b> |
| 600 minute winter | SW12    | 645         | 36.417    | 0.654     | 6.6          | 0.2864        | 0.0000     | <b>SURCHARGED</b> |
| 600 minute winter | SW11    | 645         | 36.412    | 0.997     | 7.3          | 0.4445        | 0.0000     | <b>SURCHARGED</b> |
| 600 minute winter | SW01    | 645         | 36.409    | 1.349     | 10.5         | 161.9644      | 0.0000     | <b>SURCHARGED</b> |
| 600 minute winter | OUTFALL | 645         | 35.002    | 0.042     | 3.3          | 0.0000        | 0.0000     | OK                |
| 600 minute winter | SW09    | 645         | 36.409    | 1.315     | 7.6          | 0.4038        | 0.0000     | <b>SURCHARGED</b> |
| 600 minute winter | SW10    | 645         | 36.410    | 1.273     | 7.6          | 0.5001        | 0.0000     | <b>SURCHARGED</b> |
| 15 minute summer  | PP01    | 10          | 36.773    | 0.023     | 3.8          | 0.0082        | 0.0000     | OK                |
| 15 minute summer  | PP02    | 10          | 36.796    | 0.046     | 9.0          | 0.0282        | 0.0000     | OK                |

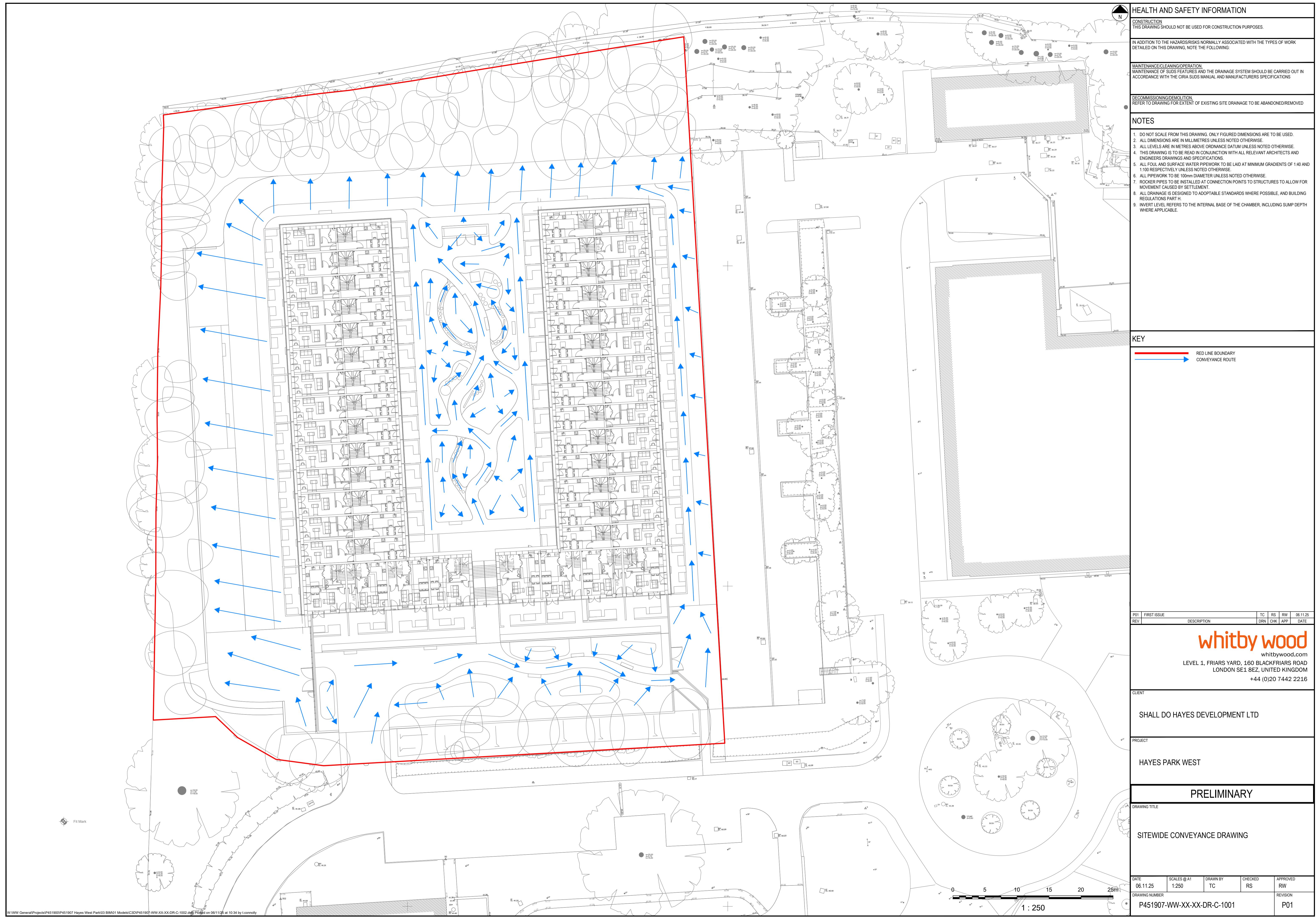
| Link Event<br>(Upstream Depth) | US Node | Link       | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|--------------------------------|---------|------------|---------|---------------|----------------|----------|---------------|--------------------|
| 60 minute summer               | R01     | 6.000      | SW05    | 20.4          | 2.014          | 0.101    | 0.1207        |                    |
| 60 minute summer               | R02     | 3.000      | P01     | 19.5          | 1.575          | 0.128    | 0.1726        |                    |
| 60 minute summer               | R03     | 1.000      | P01     | 20.3          | 1.528          | 0.210    | 0.4620        |                    |
| 15 minute summer               | R04     | 2.000      | P01     | 18.2          | 1.378          | 0.206    | 0.4094        |                    |
| 15 minute summer               | R05     | 8.000      | SW08    | 18.6          | 2.308          | 0.130    | 0.1567        |                    |
| 720 minute winter              | EXS14   | 8.002      | SW07    | 2.6           | 0.563          | 0.050    | 1.3238        |                    |
| 180 minute summer              | P01     | Depth/Flow | SW12    | 6.0           |                |          |               |                    |
| 15 minute summer               | SW06    | 4.000      | SW05    | 11.6          | 0.562          | 0.223    | 0.7639        |                    |
| 15 minute summer               | SW05    | 4.001      | SW04    | 45.1          | 1.210          | 0.749    | 1.2385        |                    |
| 720 minute winter              | SW04    | 4.002      | SW03    | 6.9           | 0.832          | 0.132    | 0.3986        |                    |
| 720 minute winter              | SW03    | 4.003      | SW02    | 7.0           | 0.670          | 0.134    | 1.0788        |                    |
| 720 minute winter              | SW08    | 8.001      | EXS14   | 1.5           | 0.476          | 0.029    | 0.6480        |                    |
| 720 minute winter              | SW07    | 8.003      | SW02    | 9.3           | 0.893          | 0.106    | 0.2142        |                    |
| 720 minute winter              | SW02    | 4.004      | SW01    | 2.0           | 0.120          | 0.039    | 1.2076        |                    |
| 600 minute winter              | SW12    | 1.002      | SW11    | 6.6           | 0.869          | 0.127    | 1.3834        |                    |
| 600 minute winter              | SW11    | 1.003      | SW10    | 7.1           | 0.653          | 0.136    | 1.1043        |                    |
| 600 minute winter              | SW01    | 1.006      | OUTFALL | 3.3           | 0.639          | 0.076    | 0.0736        | 128.8              |
| 600 minute winter              | SW09    | 1.005      | SW01    | 7.6           | 0.846          | 0.146    | 0.1341        |                    |
| 600 minute winter              | SW10    | 1.004      | SW09    | 7.5           | 0.595          | 0.145    | 0.1711        |                    |
| 15 minute summer               | PP01    | 7.000      | SW04    | 3.8           | 0.273          | 0.022    | 0.2046        |                    |
| 15 minute summer               | PP02    | 5.000      | SW05    | 9.0           | 0.514          | 0.092    | 0.3953        |                    |

**Results for 100 year +40% CC Critical Storm Duration. Lowest mass balance: 97.04%**

| Node Event         | US Node | Peak (mins) | Level (m) | Depth (m) | Inflow (l/s) | Node Vol (m³) | Flood (m³) | Status     |
|--------------------|---------|-------------|-----------|-----------|--------------|---------------|------------|------------|
| 30 minute summer   | R01     | 18          | 51.249    | 0.049     | 47.0         | 0.0810        | 0.0000     | OK         |
| 30 minute summer   | R02     | 18          | 51.251    | 0.051     | 44.9         | 0.0812        | 0.0000     | OK         |
| 30 minute summer   | R03     | 18          | 51.273    | 0.073     | 46.6         | 0.1186        | 0.0000     | OK         |
| 15 minute summer   | R04     | 10          | 48.263    | 0.063     | 33.2         | 0.0452        | 0.0000     | OK         |
| 15 minute summer   | R05     | 10          | 48.247    | 0.047     | 33.8         | 0.0337        | 0.0000     | OK         |
| 1440 minute winter | EXS14   | 1380        | 37.446    | 1.599     | 2.5          | 23.3826       | 0.0000     | FLOOD RISK |
| 240 minute winter  | P01     | 236         | 40.073    | 0.873     | 48.5         | 201.0307      | 0.0000     | SURCHARGED |
| 1440 minute winter | SW06    | 1380        | 37.443    | 0.993     | 0.8          | 0.5946        | 0.0000     | FLOOD RISK |
| 1440 minute winter | SW05    | 1380        | 37.443    | 1.291     | 5.8          | 0.6934        | 0.0000     | FLOOD RISK |
| 1440 minute winter | SW04    | 1380        | 37.443    | 1.709     | 6.9          | 0.8000        | 0.0000     | FLOOD RISK |
| 1440 minute winter | SW03    | 1380        | 37.443    | 1.809     | 7.0          | 0.4378        | 0.0000     | FLOOD RISK |
| 1440 minute winter | SW08    | 1380        | 37.445    | 1.435     | 1.5          | 0.3287        | 0.0000     | FLOOD RISK |
| 1440 minute winter | SW07    | 1380        | 37.444    | 1.930     | 4.4          | 47.9848       | 0.0000     | FLOOD RISK |
| 1440 minute winter | SW02    | 1380        | 37.444    | 2.080     | 11.8         | 253.5701      | 0.0000     | FLOOD RISK |
| 1440 minute winter | SW12    | 1350        | 37.481    | 1.718     | 6.5          | 0.7526        | 0.0000     | FLOOD RISK |
| 1440 minute winter | SW11    | 1350        | 37.476    | 2.061     | 7.0          | 0.9191        | 0.0000     | FLOOD RISK |
| 1440 minute winter | SW01    | 1350        | 37.469    | 2.409     | 10.0         | 240.7171      | 0.0000     | FLOOD RISK |
| 1440 minute winter | OUTFALL | 1350        | 35.008    | 0.048     | 4.3          | 0.0000        | 0.0000     | OK         |
| 1440 minute winter | SW09    | 1350        | 37.470    | 2.376     | 7.5          | 0.7294        | 0.0000     | FLOOD RISK |
| 1440 minute winter | SW10    | 1350        | 37.471    | 2.334     | 7.5          | 0.9173        | 0.0000     | FLOOD RISK |
| 1440 minute winter | PP01    | 1380        | 37.444    | 0.694     | 0.4          | 10.7638       | 0.0000     | FLOOD RISK |
| 1440 minute winter | PP02    | 1380        | 37.442    | 0.692     | 1.2          | 27.4782       | 0.0000     | FLOOD RISK |

| Link Event<br>(Upstream Depth) | US Node | Link       | DS Node | Outflow (l/s) | Velocity (m/s) | Flow/Cap | Link Vol (m³) | Discharge Vol (m³) |
|--------------------------------|---------|------------|---------|---------------|----------------|----------|---------------|--------------------|
| 30 minute summer               | R01     | 6.000      | SW05    | 47.0          | 3.486          | 0.233    | 0.1350        |                    |
| 30 minute summer               | R02     | 3.000      | P01     | 44.8          | 3.300          | 0.296    | 0.1925        |                    |
| 30 minute summer               | R03     | 1.000      | P01     | 46.5          | 3.108          | 0.483    | 0.5420        |                    |
| 15 minute summer               | R04     | 2.000      | P01     | 33.1          | 2.303          | 0.374    | 0.4551        |                    |
| 15 minute summer               | R05     | 8.000      | SW08    | 33.8          | 2.553          | 0.236    | 0.2143        |                    |
| 1440 minute winter             | EXS14   | 8.002      | SW07    | 2.4           | 0.483          | 0.047    | 1.3238        |                    |
| 240 minute winter              | P01     | Depth/Flow | SW12    | 6.0           |                |          |               |                    |
| 1440 minute winter             | SW06    | 4.000      | SW05    | 0.8           | 0.230          | 0.015    | 1.1870        |                    |
| 1440 minute winter             | SW05    | 4.001      | SW04    | 5.6           | 0.756          | 0.093    | 1.2385        |                    |
| 1440 minute winter             | SW04    | 4.002      | SW03    | 6.7           | 0.725          | 0.129    | 0.3986        |                    |
| 1440 minute winter             | SW03    | 4.003      | SW02    | 6.9           | 0.625          | 0.134    | 1.0788        |                    |
| 1440 minute winter             | SW08    | 8.001      | EXS14   | 1.4           | 0.434          | 0.027    | 0.6480        |                    |
| 1440 minute winter             | SW07    | 8.003      | SW02    | 7.5           | 0.787          | 0.086    | 0.2142        |                    |
| 1440 minute winter             | SW02    | 4.004      | SW01    | 2.2           | 0.114          | 0.041    | 1.2076        |                    |
| 1440 minute winter             | SW12    | 1.002      | SW11    | 6.4           | 0.811          | 0.124    | 1.3834        |                    |
| 1440 minute winter             | SW11    | 1.003      | SW10    | 7.0           | 0.601          | 0.134    | 1.1043        |                    |
| 1440 minute winter             | SW01    | 1.006      | OUTFALL | 4.3           | 0.691          | 0.100    | 0.0895        | 312.1              |
| 1440 minute winter             | SW09    | 1.005      | SW01    | 7.5           | 0.716          | 0.144    | 0.1341        |                    |
| 1440 minute winter             | SW10    | 1.004      | SW09    | 7.4           | 0.553          | 0.143    | 0.1711        |                    |
| 1440 minute winter             | PP01    | 7.000      | SW04    | 0.5           | 0.084          | 0.003    | 0.3881        |                    |
| 1440 minute winter             | PP02    | 5.000      | SW05    | 1.2           | 0.203          | 0.013    | 0.6918        |                    |

**Appendix F – CONVEYANCE ROUTE DRAWING**



P451907-WW-XX-XX-RP-C-0002

whitby wood

whitby wood

[whitbywood.com](http://whitbywood.com)

LEVEL 1, FRIARS YARD, 160 BLACKFRIARS ROAD  
LONDON SE1 8EZ, UNITED KINGDOM

+44 (0)20 7442 2216