Transport for London | MORGAN SINDALL INFRASTRUCTURE | ATKINS Member of the SNC-Lavalin Group

ELLE - Surrey Quays Station

Drainage Strategy

13 September 2023

LR23-MOS-ZZZ-E029-STR-DR-80001- Drainage Strategy_ P01
MDL Ref: SQ-PLC-016

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1. Introduction

1.1. General

Atkins Limited (Atkins) has been commissioned to design new facilities for Surrey Quays Station (the Site) that falls within the Canada Water Opportunity area, and to produce a drainage strategy report relating to the drainage works for the development.

This report has been prepared to:

- Fulfil the requirements for the Reserved Matters Permission Condition 4
- Aid the Thames Water Discharge application
- Obtain planning approval.

A site location plan is included in Figure 1-1.

Surrey Quays Station is owned and maintained by Transport for London (TfL).

The application site is situated on the East London Line branch of the London Overground, it is located at grid reference 535606E, 179000N. The pre-development site includes the existing Surrey Quays Station entrance on Lower Road, platforms 1 & 2, and trackside assets.

Figure 1-1 - Site Location Plan and boundaries

Proposed works for the Surrey Quays Station can be summarised as:

- A new northern ticket hall constructed to the South of Deal Porters Way.
- A new step free access and stepped access to Platform 1 from the northern ticket hall.
- New accommodation building to the south.
- A new step free access and stepped access to Platform 2 from the southern accommodation building.
- Footbridge connecting platform 1 and 2
- British Land Interim Works

Figure 1-2 below shows the existing Surrey Quays Station Layout.

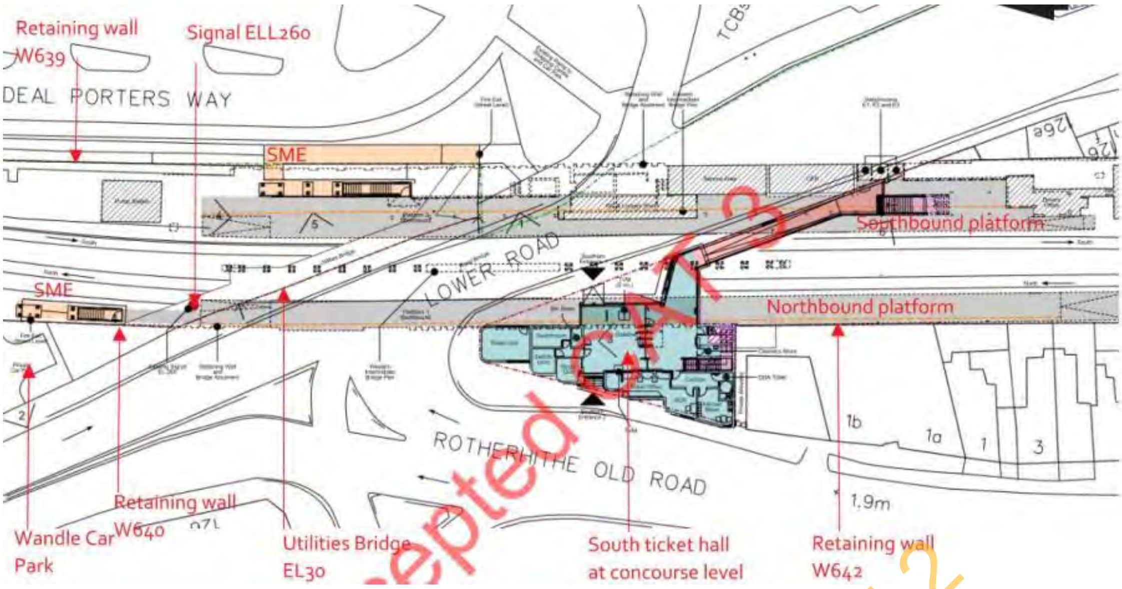

Figure 1-2 - Existing Surrey Quays Station Layout

Site Constraints are illustrated in Figure 1-3 and can be summarised as:

1. Existing retaining walls.
2. Adjacent residential properties.
3. Existing station interface and tie in.
4. Existing overbridge and services bridge.
5. Tie in with Canada Water Masterplan
6. Second means of escape staircases
7. Existing trackside assets (signalling cable, utilities and services, Thames Water)
8. Platform 1
9. Platform 2

Figure 1-3 - Site Constraints

The proposed development involves the provision of a green roof with a rainwater harvesting system. It also involves the extension of platform 1 by 0.016 ha. The extension will facilitate the creation of additional user capacity on platform 1, provision of a footbridge between platforms 1 and 2, and the creation of a new back of house facility.

Platform 2 will be extended from 0.046 ha to 0.064 ha the extended area will provide additional user capacity; it will facilitate the creation of the proposed northern ticket hall as well as provide footbridge access to platform 1.

The existing British land area abutting platform 2 will be landscaped with hard paved areas. This proposal will cover an area of 0.176 ha.

The proposed development area covered by the drainage strategy is 0.31 ha. Refer to Appendix A for the development area.

1.2. Planning Legislation

The following local plans/policies and regulations have been reviewed and considered within the proposed drainage strategy:

- National Planning Policy Framework (NPPF) - 2021
- National Planning Practice Guidance (NPPG) - 2021
- The London Plan - 2021
- DEFRA Non-statutory Technical Standards for Sustainable Drainage Systems - 2015
- The Southwark Plan (2019 – 2036) – 2022
- Southwark Council LLFA Developers' Guide for Surface Water Management

The requirements applicable to the site are summarised below:

1.2.1. National Planning Policy Framework - 2021

The National Planning Policy Framework sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally prepared plans for housing and other development can be produced, and states the following related to flood risk:

- *167. When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood risk assessment. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:*

a. *within the site, the most vulnerable developments are in areas of lowest flood risk, unless there are overriding reasons to prefer a different location.*
b. *the development is appropriately flood resistant and resilient such that, in the event of a flood, it could be quickly brought back into use without significant refurbishment.*
c. *it **incorporates sustainable drainage systems,** unless there is clear evidence that this would be inappropriate.*
d. *any residual risk can be safely managed; and*
e. *safe access and escape routes are included where appropriate, as part of an agreed emergency plan.*

- 168. Applications for some minor development and changes of use should not be subject to the sequential or exception tests but should still meet the requirements for site-specific flood risk assessments set out in footnote 55

1.2.2. National Planning Practice Guidance (NPPG) - 2021

The National Planning Practice Guidance states the following about planning for climate change:

a. *avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure*
b. *can help to reduce greenhouse gas emissions, such as through its location, orientation, and design. Any local requirements for the sustainability of buildings should reflect the Government's policy for national technical standards*

A comprehensive breakdown of the standards can be found in the document from the Ministry of Housing, Communities & Local Government.

1.2.3. The London Plan - 2021

The 2021 London Plan is the Spatial Development Strategy for Greater London, and it states the following related to Policy SI 13 Sustainable Drainage:

> *B. Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. There should also be a preference for green over grey features, in line with the following drainage hierarchy:*
>
> 1. *rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation)*
> 2. *rainwater infiltration to ground at or close to source*
> 3. *rainwater attenuation in green infrastructure features for gradual release (for example, green roofs, rain gardens)*
> 4. *rainwater discharge direct to a watercourse (unless not appropriate)*
> 5. *controlled rainwater discharge to a surface water sewer or drain*
> 6. *controlled rainwater discharge to a combined sewer.*

1.2.4. DEFRA Non-statutory Technical Standards for Sustainable Drainage Systems – 2015

The Sustainable Drainage Systems non-statutory technical standards (2015) state the following:

- *S3: For developments which were previously developed, the **peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1-year rainfall event and the 1 in 100-year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event** but should never exceed the rate of discharge from the development prior to redevelopment for that event.*
- *S5: Where reasonably practicable, for developments which have been previously developed, **the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100-year, 6-hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event** but should never exceed the runoff volume from the development site prior to redevelopment for that event.*
- *S6: Where it is not reasonably practicable to constrain the volume of runoff to any drain, sewer or surface water body in accordance with S5 above, the runoff volume must be discharged at a rate that does not adversely affect flood risk.*
- *S7: The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, **flooding does not occur on any part of the site for a 1 in 30-year rainfall event**.*
- *S8: The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding **does not occur during a 1 in 100-year rainfall event in any part** of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development.*
- *S9: The design of the site must ensure that, as far as is reasonably practicable, **flows resulting from rainfall in excess of a 1 in 100-year rainfall event are managed in exceedance routes** that minimise the risks to people and property.*
- *S12: Pumping should only be used to facilitate drainage for those parts of the site where it is not reasonably practicable to drain water by gravity.*

1.2.5. Southwark Council LLFA: The Southwark Plan (2019 – 2036) – 2022

The Southwark Plan outlines the policies that must be taken into consideration during planning, and it states the following:

P68 Reducing Flood Risk

1. *Development must not increase flood risk on or off site, by ensuring that:*

   a) It is designed to be safe and resilient to flooding; and *b) Finished floor levels are set no lower than 300mm above the predicted maximum water level where they are located within an area at risk of flooding; and*

c) Major development reduces surface water run-off to greenfield run-off rates. This must be through the application of water sensitive urban design and Sustainable Urban Drainage Systems (SUDS), in accordance with the following drainage hierarchy:

1. Store rainwater for later use; then
2. Use infiltration techniques; then
3. Attenuate rainwater in ponds or open water features for gradual release; then
4. Discharge rainwater direct to a watercourse; then
5. Discharge rainwater to a surface water sewer/drain; then
6. Discharge rainwater to the combined sewer; and
7. Hard surfacing of any gardens is permeable.

2. Development located on sites on or adjacent to the River Thames frontage should be set back from the river defence wall by 10m. This space should be designed and delivered for dual purposes by incorporating the required flood defence measures and providing an enhanced public amenity and environmental benefit.

1.2.6. Southwark Council LLFA Developers' Guide for Surface Water Management

The Developers' Guide for Surface Water Management outlines the main requirements for planning submissions to the Southwark Council and it states the following about the guidelines for Hydraulic calculations:

- ***3.1 Calculation of Existing Site Runoff Rates***

  An assessment of the both the existing and equivalent greenfield rates of discharge from the site should be calculated using the annual exceedance probability (AEP) in the table below.

Table 1: Annual Exceedance Probabilities for Surface Water Runoff Calculation

Site Characteristic	*Annual Exceedance Probability (AEP)*	*Equivalent Return Period*
Average site ground slope greater than 1%	*100%*	*1 in 1 year*
Average site ground slope 1% or less	*50%*	*1 in 2 years*

The methods used for calculating the runoff rates should be confirmed and explained in the Drainage Strategy, e.g. modified rational method, as well as details of any computer software packages used (e.g.) Microdrainage.

1.2.7. Network Rail Drainage Systems Manual NR/L2/CIV/005/09 Drainage Design

Network Rail Drainage Systems Manual NR/L2/CIV/005/09 drainage design guideline outlines the principal requirement for drainage design, and it states:

7.1 Return Period

drainage systems shall be designed so that no safety or operational performance loss occurs on the railway. Water level shall not exceed the bottom sleeper during a rainfall event of 1 in 50 years for London and southeast commuter route.

Drainage system shall be designed to run full without surcharge for the peak flow of a 1 in 25-year design return period.

7.3 Climate Change Allowance

New railway assets in small and urban catchment with a design life extending beyond 100 years from the present, the design shall be tested with +20% and +40% allowance on peak rainfall intensity to understand the range of impact.

1.3. Existing Site Features

1.3.1. Existing Layout

The site is currently the Surrey Quays Station which is classified as brownfield and is an operational railway station with tracks situated in a cutting that is approximately 4m below existing ground level. The station has two platforms (Platform 1 and Platform 2), trackside assets, an overbridge, and a services bridge. At the cess level (i.e. designated refuge area along the trackside), the site contains existing drainage assets and utility assets. This section of the site is designated as belonging to TFL. The main station building stretches over three levels with the highest one at ground level. A site survey is included in **Appendix B**.

1.3.2. Existing Drainage

A Ground Penetrating Radar (GPR) survey was carried out by Plowman Craven on January 2023 (**Appendix B**). From the review of the GPR survey it was identified that there are 2 catchments at the cess level which consisted of the northern and southern catchment.

The southern catchment is drained through pumping station PS to a manhole in the northern catchment which discharges by gravity to the northern pumping station PS47. The northern catchment is drained through a gravity drainage network which discharges to pumping station PS47. Pumping station PS47 pumps surface water runoff at 25l/s and discharges into the existing Thames Water sewer within the proximity of the site. A layout plan showing the location of the pumping stations is provided in Figure 1-2.

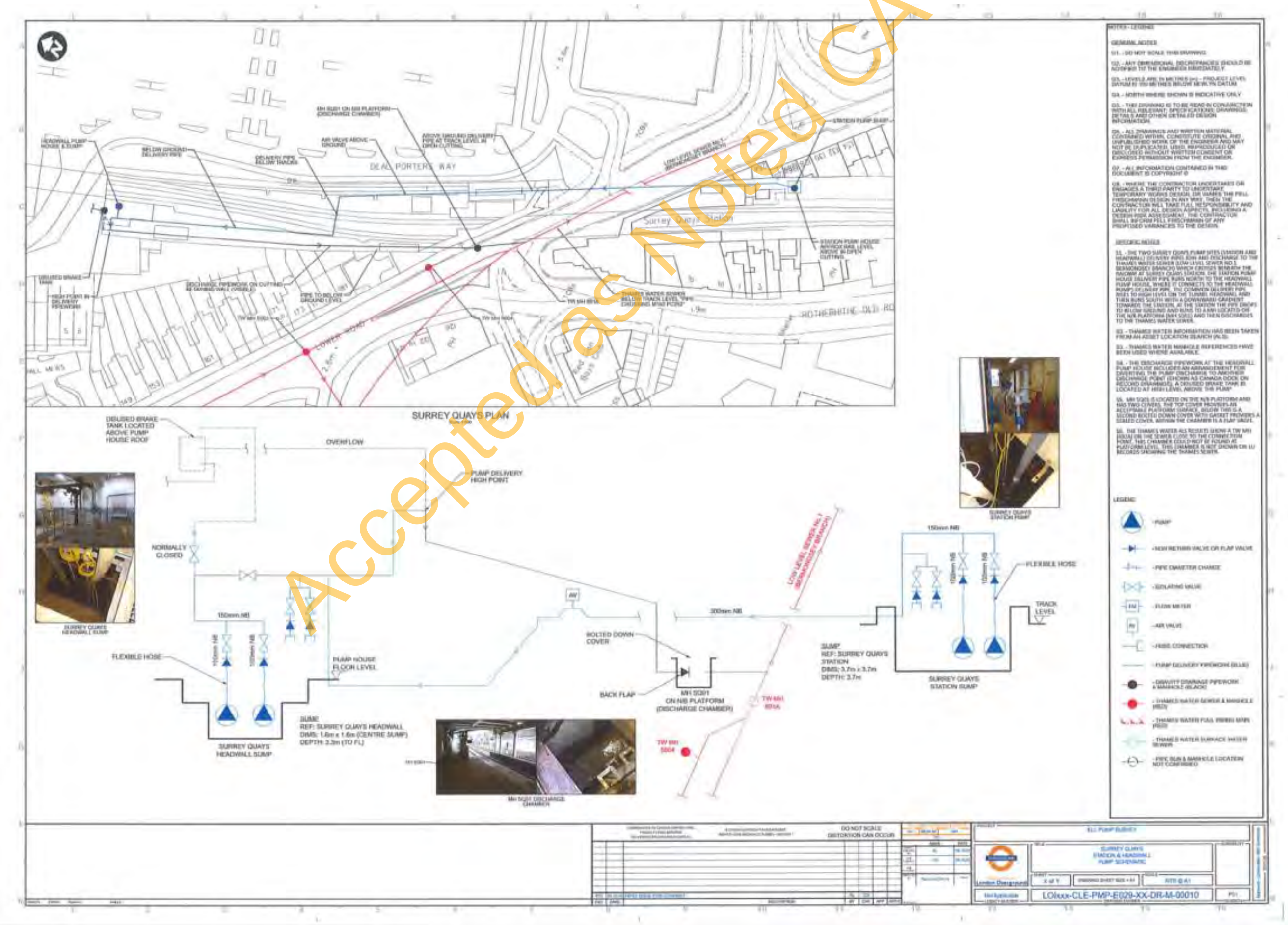

Figure 1-4 - Pump Location Layout Plan

Surface water drainage from both platforms 1,2 and the area around the northern catchment discharges into the existing pumping station (PS47) in the northern catchment of the site.

The area abutting platform 2 currently identified for the creation of green space (also known as the British Land interim area) along the existing access road is not shown as having any surface water connection. However, it is noted that the access road adjacent to the green space area has two existing gullies within the proximity of the proposed green space area with an unknown outfall.

A review of the available data showed no recorded evidence of foul water drainage connection on platform 1. The foul drainage identified on platform 2 currently discharges to the existing manhole on platform 2. The manhole on platform 2 discharges to the Thames Water sewer in Lower Road.

1.3.3. Ground Investigations

A geotechnical interpretive report (GIR) (Doc. Ref: LR23-MOS-BAS-E029-RPT-GE-80004) was carried out by Atkins and it stated the following relevant to made ground:

Made Ground was encountered in all boreholes on site (BH101, BH102 and BH103) from ground level to a maximum of 3.0mbgl.

The Made Ground encountered in BH101 and BH102, located to the west of Surrey Quays Station within the footprint of the new back-of-house building, is proven to a maximum depth of 2.60mbgl and is composed as a mixture of cohesive of and granular materials described as loose dark brown sandy GRAVEL with brick fragments and soft dark brown CLAY with coarse brick, concrete and chert limestone fragments.

The Made Ground in BH103 is proven to have a maximum depth of 3.10m located to the east of Surrey Quays Station, behind retaining wall W639. It is composed of predominantly cohesive materials described as orangish brown soft gravelly CLAY with brick fragments. Occasional bands of peat and wood were recorded from approximately 2.10mbgl indicating that between 2.10mbgl and 3.10mbgl the Made Ground could be composed of re-worked alluvium.

Indicative location of boreholes BH101, BH102 and BH103 are depicted in Figure 1- 3 below:

Figure 1-5 - GI Exploratory Hole Location Plan (Source: GIR, Doc. Ref: LR23-MOS-BAS-E029-RPT-GE-80004)

Superficial deposits, Alluvium and Kempton Park gravel member, were recorded in all three boreholes on site. The Alluvium found consisted of bands of sandy silty clay and clayey peat. This presence of the deposits indicates that the ground conditions on the site are unfavourable for surface water disposal by means of a soakaway.

2. Surface Water Drainage Strategy

2.1. Overview

This section provides details of the justification for the selected Surface Water Drainage strategy for the Surrey Quays Station. The drainage strategy will review and provide justification for platform 1, platform 2, and the British Land interim area drainage proposal.

2.2. Design Standards

The surface water drainage system has been designed in accordance with;

- CIRIA C753 – SuDS Manual 2015
- BS EN 752:2017 – Drain and Sewer System Outside Buildings
- Building Regulations Approved Document H: Drainage and Waste Disposal, 2015
- Sewerage Sector Guidance Appendix C: Design and Construction Guidance for foul and surface water sewers, June 2022
- Planning Legislation as described in Section 1.2
- Climate change allowances for peak rainfall in England – Department for Environment Food & Rural Affairs (Climate change allowances for peak river flow in England (data.gov.uk))
- Network Rail Drainage Systems Manual: Drainage Design (NR-L2-CIV-005-09)

As a result, the following design criteria has been applied:

- No surcharging in a 1 in 25-year storm event.
- Flooding not exceed bottom of sleeper in a 1 in 50-year storm event.
- Tested to understand range of impact for a 1 in 100-year storm event (plus 40% climate change for a 1% annual exceedance rainfall event, upper end allowance, with a 2070s epoch for a development with a lifetime between 2061 and 2125) and no flows to offsite areas; and
- The proposed network is also assessed for the impact of 1 in 200 year event, so that the implications of the extreme event on the operation of railway is understood. The RAM drainage shall review the potential risk and determine further action required.
- Minimum pipework pipe self-cleaning velocity 1 m/s

2.3. Outfall Strategy

A drainage hierarchy evaluation has been determined for the site in line with Southwark Council LLFA: The Southwark Plan Policy for the surface water runoff not collected for use and the results are indicated in Table 2-1 below.

Table 2-1 - Surface Water Discharge Hierarchy

	Discharge Hierarchy	Evaluation Comments
1	**Rainwater Harvesting**	**Platform 1** **Viable – Not proposed due to design constrictions** **Platform 2** **Viable – The proposed surface water runoff from the roof drainage will be harvested via a rainwater harvesting tank.** **British Land Area**

		Not Viable – Proposed green space rainwater harvesting is not feasible.
2	Use Infiltration techniques	Platform 1 Not Viable – The area is constrained by existing site-specific critical infrastructure and structure. Platform 2 Not Viable – The area is constrained by existing site-specific critical infrastructure and structure. British Land Interim Area Not Viable – Area is constrained by existing structure which could be compromised by water infiltration.
3	Attenuate rainwater in ponds or open water features or below ground storage medium for gradual release	Platform 1 Viable – Attenuation tank storage could be provided at cess level to manage existing and proposed additional discharge into existing drainage network. Platform 2 Viable – Attenuation pipe storage could be provided at cess level to manage existing and proposed additional discharge into existing drainage network. British Land Interim Area Viable – surface water could be attenuated within existing green space before discharging into existing surface water drainage network.
4	Discharge rainwater to direct watercourse	Platform 1 Not Viable – The nearest watercourse is approximately 3km away. Platform 2 Not Viable – The nearest watercourse is approximately 3km away. British Land Interim Area Not Viable – The nearest watercourse is approximately 3km away.
5	Discharge to surface water sewer or drain	Platform 1 Not Viable – Existing surface water connection at cess level can be reused but the outfall of the site network is the Thames Water combined sewers. Platform 2

		Not Viable – Existing surface water connection at cess level can be reused but the outfall of the site network is the Thames Water combined sewers. **British Land Interim Area** **Viable – Connection can be made to existing surface water network.**
6	**Discharge rainwater to combined sewer**	**Platform 1** **Viable – Connection to be made to the existing site network which outfalls into the combined sewers** **Platform 2** **Viable – Connection to be made to the existing site network which outfalls into the combined sewers** **British Land Interim Area** **Not Required**
7	**Hard Surfacing of any gardens is permeable**	**Not Required**

The results of the evaluation concluded that it is viable to attenuate surface water runoff from platform 1 and discharge into existing cess manhole (ref MH162/0246) which connects to existing 300 mm diameter pipe.

Similarly, it is viable to attenuate surface water runoff from platform 2 and discharge into existing cess drain manhole (ref MH. 162/0223) which connects to existing 300 mm diameter pipe.

It is proposed that the British Land interim area green space discharges into the existing Thames Water surface water drainage network (connection details in **Section 2.5**).

2.4. SuDS Evaluation

A full suite of SuDS options was evaluated for the Surface Water Drainage system. The evaluation considered the following.

- Attenuation, amenity, biodiversity, and treatment properties of each SuDS element; and
- Planning Legislation (as described in Section 1.2).

The results of the evaluation and proposed solution are summarised in **Table 2-2**.

Table 2-2 - SuDS Evaluation

SuDS Type	Evaluation Comments	Conclusion
Pervious surfacing	The train station platform extension is raised platform area proposed for ticketing and passenger access to the stopping train pervious surfacing is not a feasible option	Not Viable
Green/Bioretention areas	Infeasible due to space constraints, and health and safety risks	Not Viable

Filter Drains	Can be implemented as part of a wider SuDS chain. It is considered that the filter drain will be filled with porous material. Stormwater flows through the drain to the outfall while particulate and some dissolved pollutants are retained in the porous material. Proposed in the British Land area	Viable - Proposed
Attenuation tanks	An attenuation tank is considered the main viable option to provide sufficient attenuation to limit peak flows.	Viable – Proposed
Tree pits	The tree pits absorb water from the soil, which can contribute to reducing surface water runoff volumes. This can be utilized within the proposed green space.	Viable
Rainwater Harvesting Systems	Rainwater is collected from the roof of the ticket hall building over-ground tank for use on site, the system includes treatment elements and reuse the grey water.	Viable-proposed
Green Roof	A planted soil layer is constructed on the roof of a building to create a living surface. Water is stored in the soil layer and absorbed by vegetation. Green roof provided at the roof of Ticket Hall and Platform 2, to allow interception.	Viable-proposed
Wet Swales	A vegetated channel is used to convey and treat surface water runoff (via filtration). These can be "wet," where water is designed to remain permanently at the base of the swale, or "dry" where water is only present in the channel after rainfall events. It can be lined, or unlined to allow infiltration Provided in the British land as a conveyance mechanism	Viable - Proposed
Wetlands	Insufficient space to implement on site.	Not viable
Infiltration Basin	Unsuitable for this site due to poor soil permeability.	Not viable
Proprietary treatment systems	Higher maintenance requirements and costs. High level of treatment is unlikely to be required given site usage. These benefits can be obtained from other SuDS systems.	Not viable

2.5. Proposed Discharge Rate

The greenfield flow rates for the sites are estimated using the Environment Agency (EA) guidance (Rainfall runoff management for developments – Report – SC030219) which refers to the 'Institute of Hydrology Report No. 124 (IH124) methodology for the Flood Estimation for Small Catchments'. The IH124 method was developed for catchments over 50 ha. Greenfield run-off rates have therefore been estimated using a catchment area of 50 ha before being linearly scaled based on the proposed site area of 0.176 ha for the British Land Interim Area. The results are summarised in, **Table 2-3** and calculations are provided in **Appendix C**.

Table 2-3 - Greenfield runoff rates

Return Period	British Land Interim Area (Green Space Area) 0.176 ha
QBAR	0.3 l/s
Q1	0.6 l/s
Q100	0.9 l/s

(Standard Average Annual Rainfall (SAAR) = 600 mm, Soil = 0.3, Region 6)

Station Platforms with cess areas

The surface water drainage on platform 1 currently discharges into the existing drainage network which drains to the existing pumping station (PS47).

To assess the surface water runoff from the existing site condition an initial assessment using both the FSR (Flood Studies Report) data and the FEH (Flood Estimation Handbook) data was carried out to determine the most conservative rainfall estimate whereby producing a lower discharge rate for the existing site.

It was determined from the assessment that the FSR data produced a more conservative surface water discharge rate for the site and was a more appropriate result for the determination of the surface water runoff for the existing site. The FEH date has been used for the determination of the proposed site surface water runoff due to its larger rainfall estimate relative to the FSR estimate.

Hydraulic model was carried out for existing platform 1 inclusive of its surrounding area (**Appendix D**). The discharge rate for the rainfall event return periods is shown in **Table 2-4**.

The extension of platform 1 will create more hardstanding area which will increase the surface water runoff from the platform. By using the FEH data a hydraulic model has been produced for this section of the site.

A summary of the discharge rate from the hydraulic model (**Appendix E**) for 1 in 50 years plus 40% climate change (CC) and 1 in 100 years plus 40% climate change is shown in **Table 2-4.**

The proposed drainage layout for this section of the site is shown in **Appendix F**.

Table 2-4 - Platform 1 Surface Water Discharge Rate with Betterment to the Existing Network

Return Period	Platform 1 + Surrounding area	Platform 1 + Surrounding area attenuated discharge (+40%CC)	Betterment (%)
Discharge Rate (1 in 50 years return period)	20 l/s	15 l/s	25
Discharge Rate (1 in 100 years return period)	22.5 l/s	15.5 l/s	31.1

From the proposed surface water drainage strategy for platform 1 a relative betterment of 25% will be achieved in the event of a 1 in 50 years plus 40% climate change rainfall event.

Similarly, a betterment of 31.1% will be achieved for a 1 in 100 return period plus 40% climate change rainfall event (**Table 2-4**).

A similar drainage strategy is considered for platform 2. The surface water drainage on platform 2 discharges into the existing drainage network which drains to the existing pumping station (PS47). It is proposed to extend platform 2 to facilitate the provision of ticket machines and provision of increased pedestrian capacity on the platform.

The hydraulic model for the existing surface water runoff for platform 2 inclusive of its surrounding areas is provided in **Appendix D**.

As a result of the proposed platform extension, there will be an increase in the hardstanding area on platform 2, the increase in hardstanding area will increase the surface water runoff from the platform.

To manage the additional surface water runoff, it is proposed to discharge surface water runoff from the newly extended platform 2 through a proposed attenuation pipe located in platform 2.

The proposed attenuation pipe discharge rate will be restricted to 2l/s. This will drain into the existing drainage network.

The hydraulic model for the surface water runoff for the extended platform 2 inclusive of its surrounding areas is provided in **Appendix E**.

A summary of the discharge rate from the hydraulic model calculation for the 1 in 50 years plus 40% climate change and the 1 in 100 years plus 40% climate change rainfall events for platform 2 is shown in Table 2-5.

The proposed drainage layout is shown in **Appendix F**.

Table 2-5 - Platform 2 Surface Water Discharge Rate with Betterment to the Existing Network

Return Period	Platform 2 + Surrounding area	Attenuated discharge from Platform 2 + Surrounding area discharge (+40%CC)	Betterment (%)
Discharge Rate (1 in 50 years return period)	18 l/s	13.2 l/s	26.67
Discharge Rate (1 in 100 years return period)	20 l/s	15 l/s	27.18

The results of the hydraulic model calculation for platform 2 proposed drainage strategy, will provide betterment of 26. 67% for a 1 in 50 year plus 40% climate change rainfall event.

Similarly, a betterment of 27.18% will be achieved in the event of a 1 in 100 plus 40% rainfall event **Table 2-5.**

As a result of the proposed improvement to platform 1 and platform 2 surface runoff discharge rate from the existing platforms inclusive of the surrounding area (i.e. overall Surrey Quays station) and the proposed improvements discharge rate summary is shown in **Table 2-6.**

The hydraulic model for the existing surface water runoff for platform 1 and platform 2 inclusive of its surrounding areas is provided in **Appendix D**.

The hydraulic model for the surface water runoff for the extended platform 1 and platform 2 inclusive of its surrounding areas is provided in **Appendix E**.

The results of the hydraulic model calculation for the improvement to platform 1 and platform will provide an overall site betterment of 20.83% for a 1 in 50 years plus 40% climate change rainfall event.

Similarly, a betterment of 24.24% will be achieved in the event of a 1 in 100 plus 40% rainfall event **Table 2-6.**

Table 2-6 - Overall Station platform discharge rate with Betterment to the Existing Network

Return Period	Overall Surrey Quays Station (existing scenario)	Overall Surrey Quays Station (Inclusive of platform extension) (+40%CC)	Betterment (%)
Discharge Rate (1 in 50 years return period)	36 l/s	28.5 l/s	20.83
Discharge Rate (1 in 100 years return period)	39.6 l/s	30 l/s	24.24

British Land Interim Area

The proposed British Land interim area abutting platform 2 is proposed to be converted to a mixture of a landscape area and hard paved area along the station access of platform 2.

The landscaped area will be made up of a combination of green space and swale.

By using the modified ratio method, the existing 1 in 1 year and 1 in 100 years plus climate change brownfield surface water runoff rainfall event is shown in **Table 2-7**.

The green field runoff rate for a 1 in 1 year and a 1 in 100 years climate change allowance is shown in **Table 2.3.** discharging at this rate will lead to operations and maintenance issues in the drainage network, hence, it proposed that a controlled discharge of 2 l/s is maintained instead of the greenfield flow rates. The proposed drainage layout is shown in **Appendix F**.

Table 2-7 - British Land Green Space Area

Return Period	British Land interim area existing Hard paved area surface water discharge rate	British Land interim area proposed green space surface water	British Land interim area proposed green space surface water

		discharge rate (40% CC)	discharge rate (40% CC) Restricted Discharge
Discharge Rate (1 in 1)	23.50 l/s	16.4 l/s	2.1 l/s
Discharge Rate (1 in 100 years return period)	26.70 l/s	18.6 l/s	2.1 l/s

Based on the flood risk technical note carried out in August 2021. The proposed scheme would be defended agains tidal flooding to a very high standard of protection, and therefore flooding could happen only in an extreme breach scenario(2100-year modelled scenario) impacting the site with flood waters depths upto 4.5mAOD.

The hydraulic model is analysed for 2-year, 5 year and 100 year return period with 0%, 20% and 40% climate change respectively. There was no surcharge observed for 2 and 5 years return period and surcharge was observed for 100 year rain fall event with 40% climate change and the outfall pipe was observed with 6m^3 of flooding.

Water discharge from the British Land Interim is designed at a rate of 2 l/s. The outfall from the proposed swales is connected to manhole SW-01 flowing south to the stormwater drain located at Redriff road. Design has progressed on the assumption that the outfall connection is possible to the Thames Water network. Refer to **Figure 2-1** for the assumed connection point.

The Utilities Survey conducted in the area by Plowman Craven (Job no. 47159) indicate that SW-01 connects to both SW-02 and SW-03 shown in **Figure 2-2**. It is worth noting that the survey data shows that manhole SW-02 is blocked with silt.

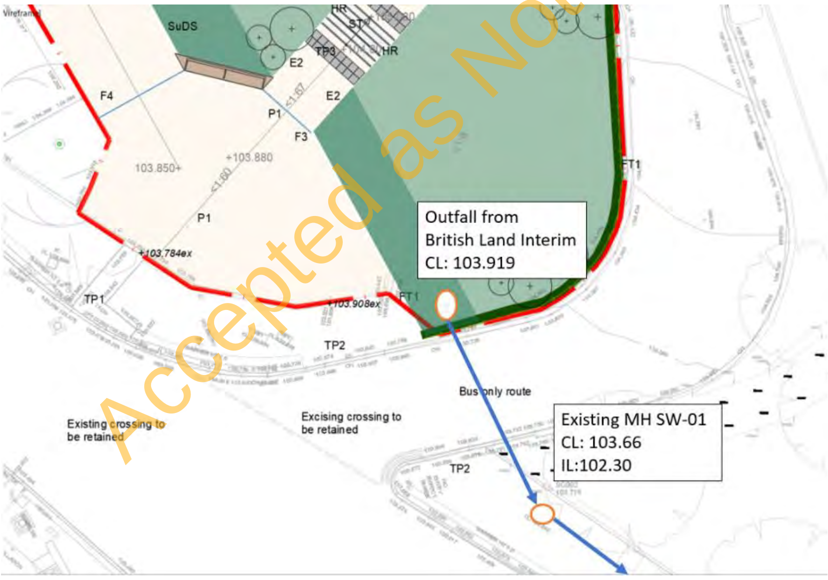

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Figure 2-1 - British Land interim area Connection

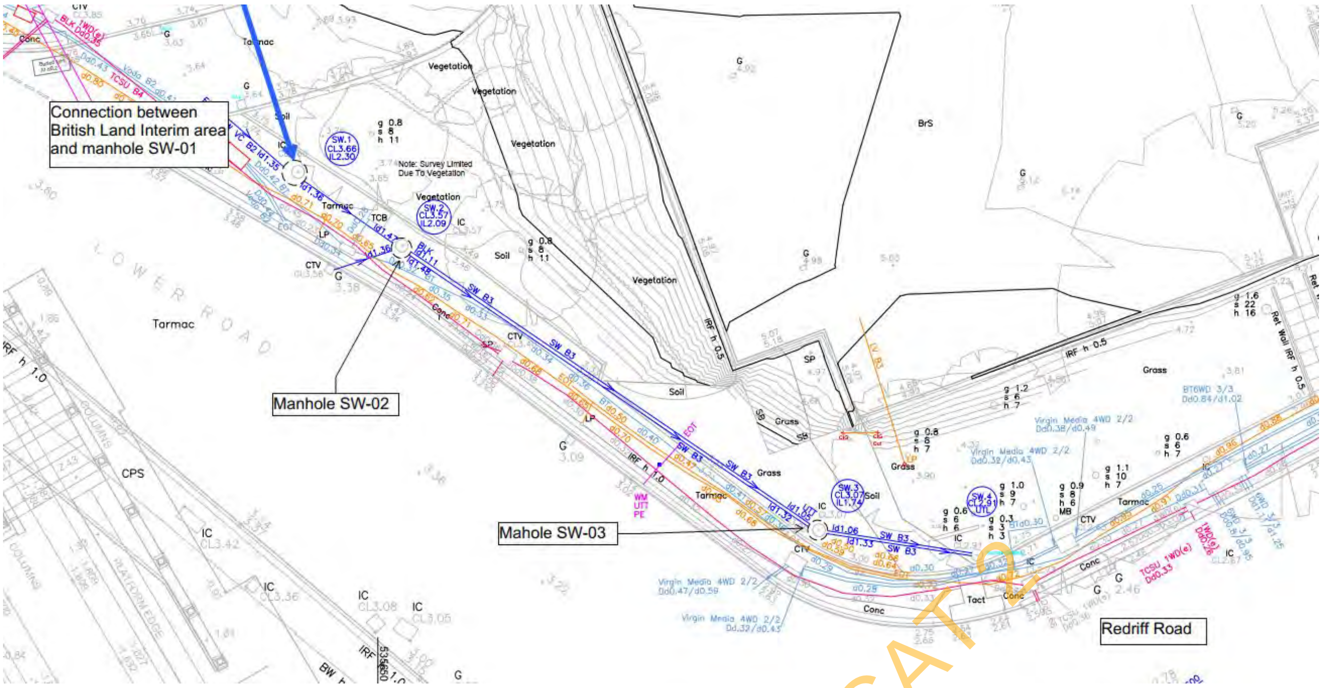

Figure 2-2 - Thames Water Surface Water Drainage Network Identified in the Utilities Survey

2.6. Attenuation Volume Assessment

From the hydraulic model, it was identified that remedial storage will be required in the cess area of platform 1 and within platform 2 to achieve the proposed betterment. The proposed storage requirements are shown in **Table 2-8**

Similarly, the creation of a green space on the British Land interim area will require remedial storage to facilitate the proposed discharge restriction the proposed storage for the area is shown in **Table 2-8.**

Table 2-8 - Storage Volume Assessment

Catchment	Discharge Rate	Storage Volume
Platform 1 extension works (Western)	15.00 l/s	11.57 m^3
Platform 2 extension works (Eastern)	2.00 l/s	7.27 m^3
British Land Interim area	2.00 l/s	99 – 129 m^3

40% Climate Change included

2.7. Proposed Drainage Solution

The proposed method of attenuation identified for the purposes of managing surface water runoff from the site is described below:

- Attenuation tanks / oversized pipe
- Rainwater Harvesting
- Swales
- Green Roof

Swales

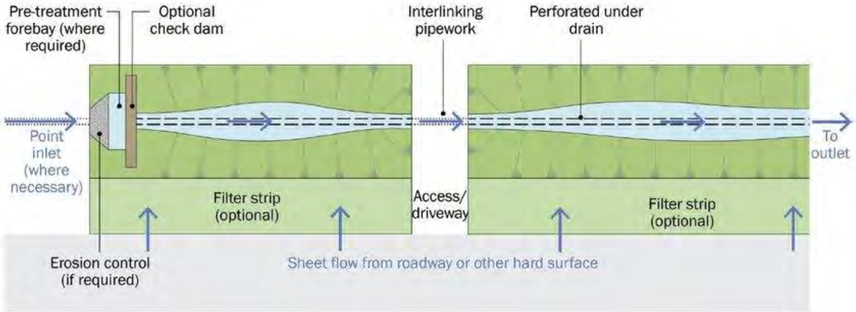

Figure 2-3 - Typical plan of a swale (CIRIA C753 figure 17.5)

A swale is a shallow, gently sloping vegetated channel or depression that collects and transports rainwater runoff. It often includes grass, shrubs, or other vegetation to improve infiltration and clean water before discharging it into downstream watercourses or storage systems.

Swales are proposed in the British Land Interim area of the site.

Attenuation Tank

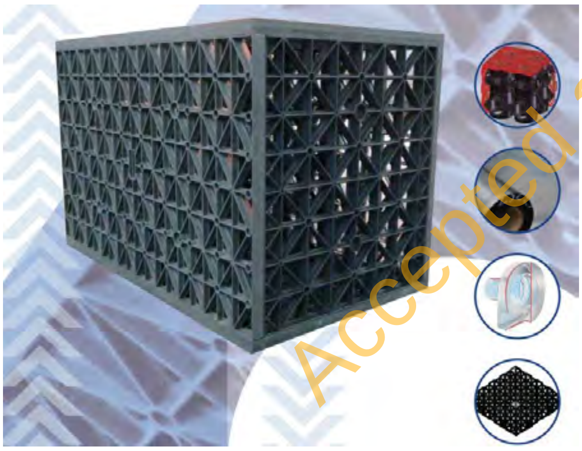

Figure 2-4 - Typical Attenuation Crate

Attenuation crates are plastic geo-cellular stormwater management systems for attenuation (such as the ESS Eco-cell geo-cellular system illustrated).

The key principles for this system include:

- High porosity of 95%
- Effective source control

Attenuation tank is proposed for this site north of platform 1 and oversized pipe is proposed for platform 2. The drawings, that shows the details, are provided in the appendices.

Rainwater Harvesting

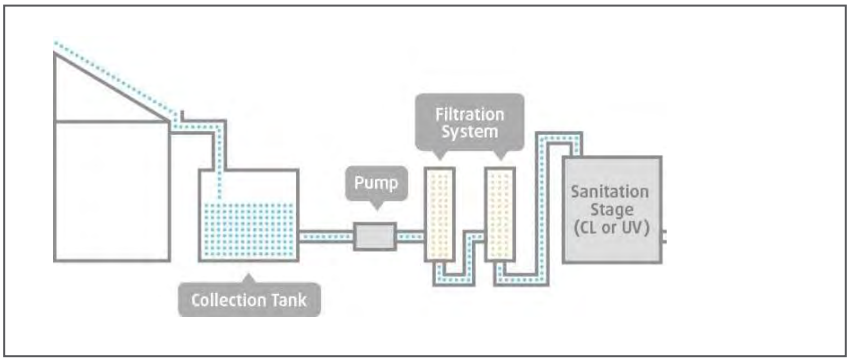

Figure 2-5 - Typical Rainwater Harvesting Mechanisms

These store rainwater for repurposing elsewhere.

- Surface runoff rates will be reduced
- Reduce the demand for mains water

A rainwater harvesting tank is being proposed for the ticket hall roof area and sits at the backside of Platform 2.

Green Roof

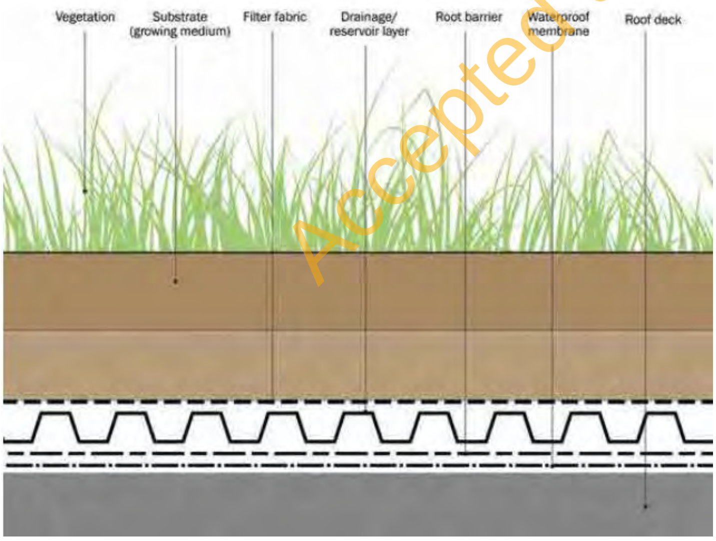

Figure 2-6 - Section showing typical extensive green roof components (CIRIA C753 figure 12.1)

Green roofs are areas of vegetation that are planted on the rooftops of buildings for a variety of reasons such as aesthetic appeal, ecological value, improved building performance, and reduced surface water runoff.

Green roofs are proposed for the ticket hall roof.

2.8. Water Quality

Impacts on water quality can be improved using source control measures and a SUDS treatment- train. As discussed in Section 2.7, the proposed SuDS will enhance the Water Quality as follows:

- Filter Drains - Provides limited treatment (mainly sediment and heavy metal removal)
- Attenuation Storage Tanks – No water quality enhancement but other SuDS elements will provide water quality enhancement.
- Rainwater harvesting – All rainwater recycled rainwater to be used will have to go through a filtration and sanitation system. The reduction of total surface runoff via the use of this mechanism will also reduce the overall volume of pollutants discharged into the environment.
- Dry Swales – settlement of medium/coarse particles and associated pollutants (such a nutrients, free oil/grease and metals), through the vegetation. Fine particles and associated contaminants are removed by infiltration, filtration, dissolved pollutant removal and some biological uptake by the vegetation and subsoil. Organic particles are removed through photolysis and volatilization.
- Green Roofs - treatment is provided as the rainwater percolates through the green roof substrata (including physical, biological, and chemical treatment through the soil and root up-take zone)

Interception has been considered for the site, which involves capturing the first 5mm/hour of a rainfall event for frequent small events that cause the most pollution instances. A description of the interception provided by the proposed SuDS features in accordance with CIRIA C753 is summarised below:

- Attenuation Storage Tanks – no interception provided.
- Rainwater Harvesting – as the fundamental basis of rainwater harvesting is the capture and repurposing of rainwater. Simply, the amount of interception provided is determined by the size of the rainwater storage tank adopted.
- Swales – Improves quality of water discharges into the surface water network through the capture of hydrocarbon and filtration through vegetation.
- Green Roofs – reduce volume of water being discharged into the surface water network and provides localised attenuation for surface water runoff

It is considered that partial interception will be provided by the proposed SuDS features which have been maximised as far as possible.

2.9. Amenity and Biodiversity

Amenity and biodiversity benefits can also be enhanced by the implementation of SuDS. **Table 2-9** below highlights which SuDS techniques selected as part of the drainage strategy will provide amenity and biodiversity benefits.

Table 2-9 - Proposed SuDS and their benefits

SuDS Type	Amenity Benefits	Biodiversity Benefits
Filter Drains	Filter drains can be designed creatively to provide attractive boundary lines or edging and can be covered in grass.	Gravel media can host microorganisms and provide a breeding ground for insects and amphibians and can provide additional benefits if covered in grass.
Attenuation Storage Tanks	Attenuation tanks do not provide any direct amenity benefits, but the large surface area above the tanks can be used to enhance the amenity value.	Attenuation tanks do not provide any direct biodiversity benefits, but the large surface area left consequently above the tanks can be used to enhance biodiversity.
Rainwater Harvesting	Access to recycled rainwater will reduce the running costs for the tenant.	Whilst this does not offer direct biodiversity benefits, reducing runoff will reduce pollutants, protect habitats and erosion of streams, rivers, etc.

Swales	They provide significant aesthetic benefits by incorporating vegetation in streetscape and general landscape features.	Swales promotes biodiversity that includes a variety of planting that make a positive contribution to urban biodiversity.
Green Roofs	Green roof provides a first line of filtration for surface water runoff as well as slow the surface water which reduces the likelihood of overwhelming the drainage network	Green roofs provide ecology value by creating an environment for natural habitat for insects, birds and quality habitat for wildlife which enhances biodiversity

2.10. Exceedance Assessment

The proposed hardstanding areas and the surface water runoff from the site are being designed to reduce the existing surface water discharge rate into the existing surface water network. This will be achieved through the attenuation of surface water runoff from the site. Additional surface water runoff because of the increase in hardstanding area on the station platform will be managed through the attenuation of the hardstanding areas of platform 2 and the whole section of platform 1. It is also proposed to manage surface water runoff in the British Land interim area through the attenuation of surface water within the proposed green space.

3. Foul Drainage Network

From the available survey information, there is no known foul drainage network on platform 1. A similar review of the site information for foul drainage in platform 2 revealed the presence of the existing foul that connects to Thames Water combined sewer on Lower Road.

It is proposed to retain the existing foul network in platform 2 as the toilets will be refurbished and arranged, however, the network will remain the same. Additional foul drainage will be provided in platform 1. The proposed foul drainage in platform 1 will connect to existing Thames Water foul manhole MH09 (CL:102.45m, IL:101.03).

The total flow rate from the BoH building and platform1 is calculated in accordance with BS EN 752:2017.

The peak discharge flow for the sanitary appliances at concourse level (gravity drains) is calculated using the discharge unit method (as per BS EN 752:2017) and the pumped flow rate (as per BS EN 12056-4) from the platform level and the lift pit sump is added to calculate the total design flow rate. (see **Error! Reference source not found.**)

Qtot (Total Flowrate l/s) = Qww (Wastewater flowrate, l/s) +Qp (Pumped flowrate l/s)

Table 3-1 - Foul Water Design Flow Rates

Tenant	Discharge Units (DU)	Frequency Factor (K)	Flow Q (l/s)
Staff WCs at concourse level (Pipe 1)	2DU	0.5	0.7
Mess Room at concourse level (Pipe 2)	1.5DU	0.5	0.6
Pumped flow (Lift pit sump, Staff PRM pump, pump condensate)	-	-	3
Q total			4.3

4. Maintenance and Operation

The maintenance of the proposed drainage systems is summarised below:

- Filter Drains (Table 16.1 in CIRIA C753) – Regular maintenance should remove litter, surface debris and weeds (monthly). Regular inspections will be carried out to check the operation of underdrains and inlets and outlets for blockages (six monthly).
- Attenuation Tanks (Table 21.3 in CIRIA C753) – Periodic biannual/annual maintenance will be required to clear out any debris from the roof catchment. A unit will be selected that has full maintenance access to allow the unit to be flushed out. Additionally, a silt trap must be incorporated in the pipe work at the inlet of the tank. And regular cleaning of the trap must be ensured.
- Rainwater Harvesting (Table 11.6 in CIRIA C753) – Regular inspections will be carried out to check the operation of underdrains and inlets and outlets for blockages, regular maintenance should remove litter, surface debris and weeds. Annual removal of silt build-up from inlets and surface and replace will be undertaken as much as necessary.
- Swales (Table 17.1 in CIRIA C753) – Monthly maintenance is required initially; regular maintenance should be carried out half yearly or as required including litter removal, vegetation management, inlet/outlet inspections.
- Green Roof (Table 12.5 in CIRIA C753) – Monthly maintenance during establishment (i.e year one) to replace dead plant. Post establishment replacement of dead plants as required (annually) inspection of substrate, irrigation systems (if applicable), membranes and roof structural integrity (annually or after severe storm), inspection of drain inlets as required. Additional inspections and maintenance in accordance with the manufacturer's guidelines.
- Pipework System - Litter, debris removal and periodical jetting. The surface water drainage has been designed for a self-cleansing velocity and foul pipework in accordance will the minimum falls in BS EN 752:2017, allowing for the appliances connected.