LONDON

TUNNELS

The London Tunnels

24. Flood Risk Assessment and Outline Drainage Strategy (including SuDs Statement and Proforma)

PROJECT NO. 70087403
REF NO. TLT-WSP-XX-XX-RP-DR-00001

30 November 2023

wsp

The London Tunnels PLC

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(Incl. SuDS Statement and Proforma)

CONFIDENTIAL

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FLOOD RISK ASSESSMENT AND OUTLINE DRAINAGE STRATEGY (INCL. SUDS STATEMENT & PROFORMA)

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Location	38-41 Furnival Street EC4A 1JQ & 31-33 High Holborn WC1V 6AX
Scale of Development	The tunnel network extends from Brownlow Street in the west to Fetter Lane in the East, with the two access shafts located at Fulwood Place and Furnival Street. The total Gross Internal Area (GIA) of the proposed tunnel network is 7,869m^2, while the GIA of the proposed floor space above ground is 1,883m^2.
Current Land Use	Brownfield
Type of Application	Full Planning Application

FLOOD RISK

ITEM	COMMENT
Land-Use Flood Vulnerability Classification	Less Vulnerable
Site Levels	Levels in the Tunnels vary from approximately -33.06mAOD to -21.28 mAOD, while levels at Fulwood Place and Furnival Street are +21.564mAOD and +19.80mAOD respectively.
Access and Egress	Access to the Tunnels will be available via both shaft Sites located at Furnival Street and Fulwood Place.

Source of flooding	Baseline Risk	Mitigation Overview	Residual Risk
Coastal / Tidal	Very Low (FZ1)	No mitigation measures	Very Low
Fluvial	Very Low (FZ1)	No mitigation measures	Very Low
Pluvial	Low	Surface Water Drainage Strategy	Very Low
Groundwater	Low	Waterproofing measures to prevent groundwater seepage.	Very Low
Sewers and Drainage Infrastructure	Low	Surface Water Drainage Strategy	Very Low
Artificial	Negligible	No mitigation measures	Negligible

Despite the Low to Negligible flood risk and Less Vulnerable proposed land-use classification, it is recommended that, due to the restrictive and inherent subterranean nature of the tunnels, a Flood Evacuation Plan is prepared as part of future design stages to help mitigate residual risks associated with any flood events in and around the Proposed Development.

DRAINAGE STRATEGY

ITEM	COMMENT
Allowance for Climate Change	Tidal: Higher Central up to 2121 Surface water: 100 Year + 40% Climate Change
Surface Water Drainage	The proposed drainage strategy at Furnival Street will comprise of SuDS features, including a blue roof system & a below slab attenuation tank. These features have been sized to store the 1 in 100 year storm event with a 40% allowance for climate change. The proposed strategy will restrict the Site's discharge to a maximum of 1.50l/s.
Foul Water Drainage	The proposed foul drainage strategy will comprise of a traditional gravity piped systems for ground floor and above at Furnival Street and Fulwood Place, while foul flows from below ground will be pumped up to ground level and gravity discharged into the combined sewer networks adjacent to the Proposed Development.

1. INTRODUCTION

1.1. APPOINTMENT AND BRIEF

1.1.1. This Flood Risk Assessment and Outline Drainage Strategy (FRA and ODS) has been prepared by WSP on behalf of The London Tunnels PLC to support the Planning Application for the redevelopment of the Kingsway Exchange Tunnels ('the Site'), at 38-41 Furnival Street EC4A 1JQ & 31-33 High Holborn WC1V 6AX and below ground, as part of The London Tunnels project ('the Project').

1.1.2. Through this report the buildings 38-39 Furnival Street and 40-41 Furnival Street EC4A 1JQ shall hereby be referred to as 'Furnival Street', while the buildings 31-33 High Holborn WC1V 6AX shall hereby be referred to as 'Fulwood Place'.

1.1.3. Although this report was prepared using the degree of skill and care ordinarily exercised by engineers practicing under similar circumstances, please note that WSP cannot take responsibility for errors in the information provided by third parties.

1.2. OBJECTIVE OF STUDY & METHODOLOGY

1.2.1. This report evaluates flood risk in the vicinity of the Site from all potential sources to help manage this risk by informing design development through the adoption of mitigation measures, where deemed necessary, to promote the safe use, operation, and maintenance of the Proposed Development over its lifetime. This report also outlines the proposed surface water and foul water drainage strategies for the Proposed Development, a key planning consideration in all major developments.

1.2.2. This FRA and ODS has been produced in line with the requirements of the National Planning Policy Framework (NPPF, 2023) and the Environment Agency's (EA) Standing Advice. In addition, consultations were made with Thames Water (TW) as the statutory drainage undertaker in London, and the London Borough of Camden (LBC) and the City of London (CoL), who act as the Lead Local Flood Authorities (LLFA) within this area. A desktop review of local flood risk and drainage policies has also been undertaken to help inform the production of this report.

1.3. STUDY METHODOLOGY

1.3.1. The appraisal process has comprised a desktop study, data research, consultation with regulatory bodies and a review of third-party standing advice.

1.3.2. The following documents, policies and resources have been used to produce this FRA and ODS:

- CoL Local Plan (2015) & Draft City Plan (2036);
- CoL Strategic Flood Risk Assessment (SFRA) (2017);
- CoL Local Flood Risk Management Strategy (LFRMS) (2021);
- CoL Preliminary Flook Risk Assessment (PFRA) (2011);
- LBC Local Plan (2017);
- LBC SFRA (2014);
- LBC LFRMS (undated);
- LBC PFRA (2011);
- The National Planning Policy Framework (NPPF 2023);
- British Geological Society (BGS) Online Viewer, 1:50,000 Bedrock and Superficial deposits; and
- Defra's Online Magic Map.

1.3.3. This FRA and ODS makes partial use of third-party information and contains EA information © EA.

2. EXISTING SITE

2.1. SITE LOCATION

2.1.1. The Site is located to the west of Holborn Circus (A40) and north of Fetter Lane.

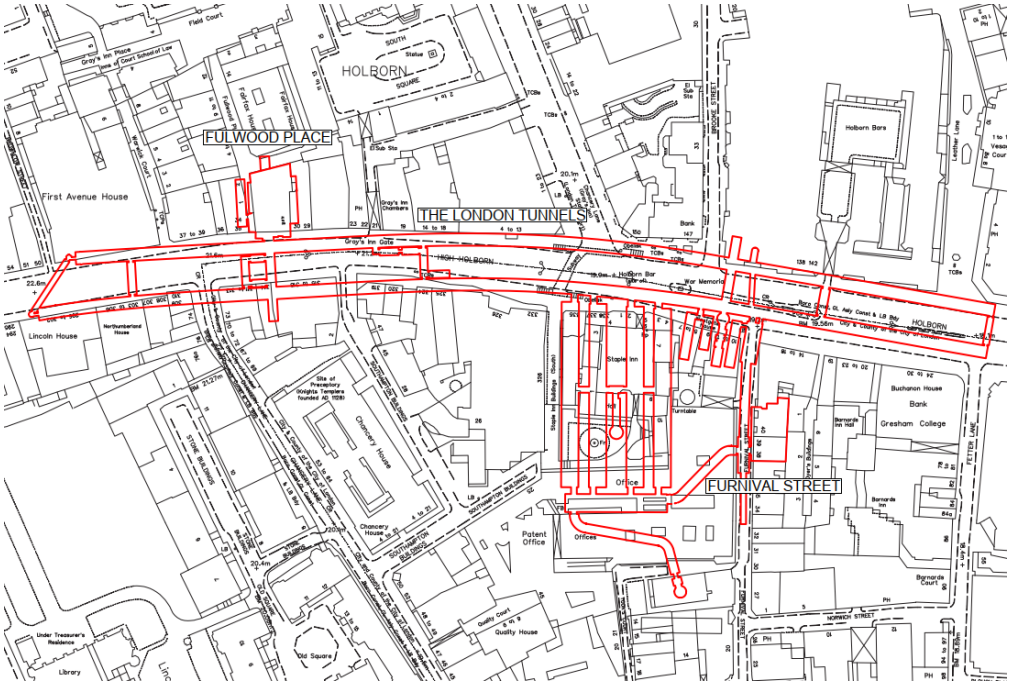


Figure 1 - Indicative Site Location Plan

2.1.2. Refer to Figure 1 above and to the location plan in **Appendix A** for more details of the extent of the Planning Application Site.

2.2. SITE DESCRIPTION

2.2.1. The existing Site comprises disused tunnels running beneath High Holborn and two access shafts which are located at Fulwood Place and Furnival Street, highlighted in Figure 1 above. The shaft at Fulwood Place arises in a building, currently consisting of existing office space while the shaft at Furnival Street arises in a purpose-built shaft building (38-39 Furnival St). The Site also includes the adjacent office building at 40-41 Furnival Street. The Site is surrounded by mixed use buildings on all sides of, and above, the Tunnels. The overall extent of the tunnel network occupies approximately 1.42ha of space beneath High Holborn, while the Proposed Development at Fulwood Place and Furnival Street have approximate areas of 0.046ha and 0.039ha respectively.

2.2.2. A review of the Site's topography and the surrounding areas, provided by the City of London SFRA (**Appendix B**), shows ground levels at and surrounding the Site, and north of the River Thames, fall towards the South-East, generally towards the river. Levels in the Tunnels vary from approximately -33.06mAOD to -21.28 mAOD, while levels at Fulwood Place and Furnival Street are +21.564mAOD and +19.80mAOD respectively.

Figure 2 - Street View of Fulwood Place

Figure 3 - Street View of Furnival Street

2.3. GEOLOGY AND HYDROGEOLOGY

2.3.1. This section of the report has been informed by mapping from the British Geological Survey (BGS) Geology of Britain viewer, DEFRA's Magic Map.

2.3.2. It is understood from the BGS 'Geology of Britain viewer' that the underlying bedrock geology of the Site comprises London Clay formation (clay, silt, and sand). There are superficial deposits of Hackney Gravel Member (sand and gravel) Lynch Hill Gravel Member (sand and gravel) recorded at the Site. The bedrock underlying the Site is designated an unproductive strata while the superficial deposits are designated as a Secondary A strata.

2.3.3. DEFRA's Magic Map indicates that the Site is not located within a groundwater Source Protection Zone.

2.3.4. DEFRA's Magic Map notes that the Site is partially located within an area designated as Medium-Low Groundwater Vulnerability and Low Groundwater Vulnerability. The Groundwater Vulnerability Maps

show *"the vulnerability of groundwater to a pollutant discharged at ground level based on the hydrological, geological, hydrogeological and soil properties within a single square kilometre."*

2.3.5. A borehole log (BGS 1067061) generally corroborates the recorded geological conditions. Groundwater was struck in the borehole at approximately -33mAOD, significantly below the depth of the tunnels.

2.4. EXISTING WATERCOURSES

2.4.1. The Site is located approximated 0.85km North of the River Thames.

2.4.2. The Site is in the catchment area of the historic River Fleet, now culverted as the Fleet Sewer running under Farringdon Street according to *The History of the River Fleet* (UCL) document, extract provided below in Figure 4, and to the CoL SFRA 'Farringdon Street Sewer' map (**Appendix B**). The Fleet Storm Relief Sewer was built in the 1870s to provide extra capacity for the Fleet Sewer in high flow events.

There are no other watercourses or flood defences in the vicinity of the Site.

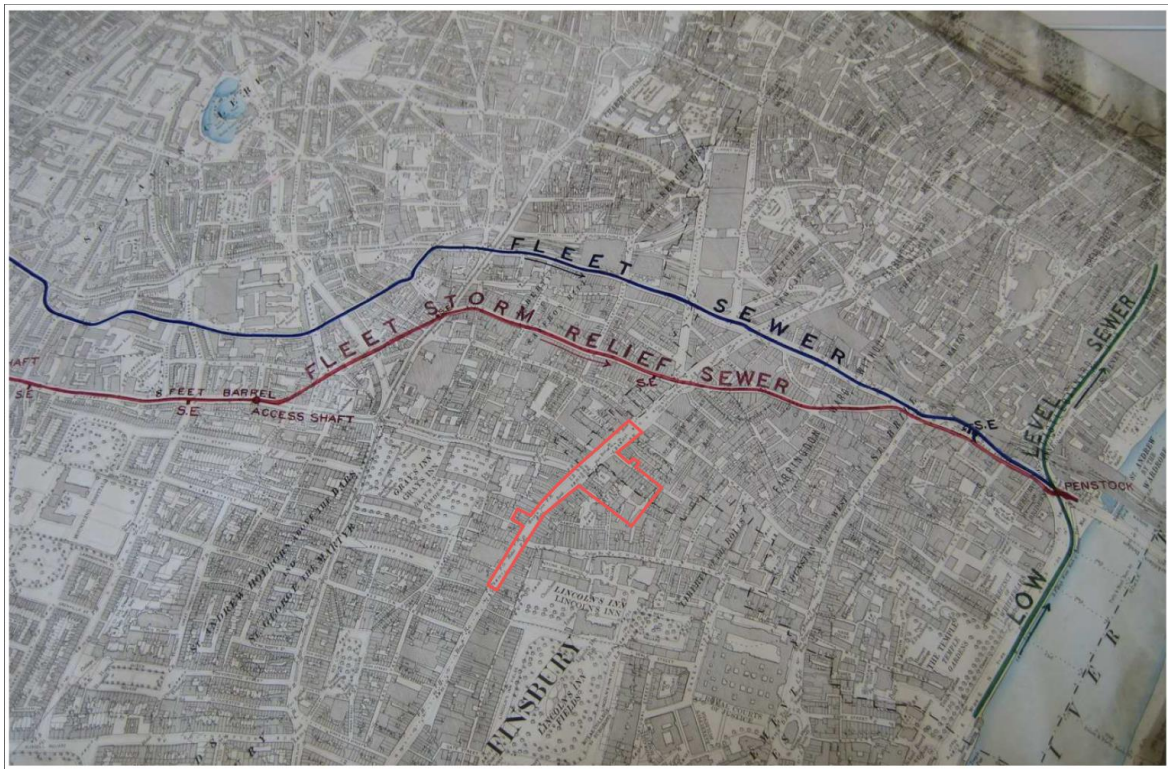


Figure 4 - UCL's Map of the Fleet Sewer & Fleet Storm Relief Sewer

2.5. EXISTING SEWERS AND DRAINAGE

PUBLIC SEWERS

2.5.1. Along with the Fleet Sewer and Storm Relief Sewer highlighted above in Section 2.4, TW asset records (**Appendix C**) highlight the extents of public sewers within the vicinity of the Proposed Development.

2.5.2. A combined trunk sewer flows in an easterly direction through High Holborn, starting at Southampton Row and measuring 1372x914mm. This then changes into a 1550x1372mm sewer at the junction with Brooke Street and then again into 1676x1372mm before reaching Holborn Circus.

2.5.3. A 1067x610mm combined sewer runs in a southernly direction within Fulwood Place, while a 1219x762mm combined sewer runs northwards in Furnival Street, both eventually connecting into the combined trunk sewer in High Holborn.

Figure 5 - TW Asset Records with the shaft Sites at Fulwood Place (left) and Furnival Street (right) shown in red

PRIVATE SEWERS

2.5.4. There is currently no information available about the private sewers (if any) at the Site. However, given the existing development at both shaft Sites, it is reasonable to assume there are existing lateral drains connecting these properties to the proximate TW sewers.

2.5.5. Surveys of the existing on-site and lateral drains at Furnival Street and Fulwood Place have been requested and should be undertaken in subsequent design stages to establish their condition, levels and locations.

3. PROPOSED DEVELOPMENT

3.1. DEVELOPMENT PROPOSALS

3.1.1. The Proposed Development for which planning permission is being sought comprises:

Change of use of existing deep level tunnels (Sui Generis) to visitor and cultural attraction, including bar (F1); demolition and reconstruction of existing building at 38-39 Furnival Street; redevelopment of 40-41 Furnival Street, for the principle visitor attraction pedestrian entrance at ground floor, with retail at first and second floor levels and ancillary offices at third and fourth levels and excavation of additional basement levels; creation of new, pedestrian entrance at 31-33 High Holborn, to provide secondary visitor attraction entrance (including principle bar entrance); provision of ancillary cycle parking, substation, servicing and plant, and other associated works.

3.2. VULNERABILITY CLASSIFICATION

3.2.1. Based on Table 2 in the Planning Practice Guidance (PPG), the Proposed Development will have uses which are classed as 'Less Vulnerable'. While the Proposed Development includes a drinking establishment, this land-use is subordinate to the primary land-use as a visitor and cultural attraction.

3.3. SEQUENTIAL AND EXCEPTION TEST

3.3.1. As stated in the NPPF, a sequential risk-based approach to determine the suitability of land for development in flood risk areas should be applied at all stages of the planning process giving precedence to low flood risk areas wherever possible.

Table 3-1 – Flood Risk Vulnerability and Flood Zone 'Compatibility'

FLOOD RISK VULNERABILITY CLASSIFICATION		ESSENTIAL INFRASTRUCTURE	WATER COMPATIBLE	HIGHLY VULNERABLE	MORE VULNERABLE	LESS VULNERABLE
Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test Required	✓	✓
	Zone 3a	Exception Test Required	✓	✘	Exception Test Required	✓
	Zone 3b	Exception Test Required	✓	✘	✘	✘

✓ Development is appropriate

✘ Development should not be permitted

3.3.2. Based on the Flood Map for Planning, the Site is located within Flood Zone 1 and as such is deemed to be sequentially acceptable in accordance with the NPPF and the exception test need not be applied.

4. PLANNING POLICY AND GUIDANCE

4.1.1. This section of the report summaries local policy and guidance relevant to this Flood Risk Assessment and Drainage Strategy for the Site.

4.2. NATIONAL PLANNING POLICY FRAMEWORK (2023)

4.2.1. The National Planning Policy Framework (NPPF) was published in February 2019 (revised in September 2023) with the aim of protecting the environment and to promote sustainable growth. There is an overarching presumption in favour of sustainable development that should be the basis of every plan and every decision.

4.2.2. The following paragraphs/policies within the NPPF are considered relevant to this assessment:

- Paragraph 159: Requires that "Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere.";
- Paragraph 162: Explains that "the aim of the Sequential Test is to steer development to areas with the lowest probability of flooding"; and
- Paragraph 167: Explains that "When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere […];
- Paragraph 169: Recommends that "major development should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:

    a) take account of advice from the lead local flood authority;
    b) have appropriate proposed minimum operational standards;
    c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and
    d) where possible, provide multifunctional benefits".

4.3. PLANNING PRACTICE GUIDANCE (2022)

4.3.1. The PPG is to support the NPPF and is published online. The PPG was updated on 25 August 2022. The updated PPG requires all sources of flood risk to be treated consistently with river and tidal flooding in mapping probability and assessing vulnerability of the development.

4.3.2. This includes the use of the sequential approach for all sources of flooding (Paragraph 023).

4.3.3. The design flood event for surface water is set out under the updated PPG to be the 1 in 100 year plus climate change event.

4.3.4. In addition, the Environment Agency's climate change guidance was updated in May 2022. The updated included changes to the climate change allowances used in surface water drainage design and guidance on how surface water flooding should be considered.

4.3.5. The following paragraphs/policies within the PPG are considered relevant to this assessment:

- Greater detail on the purpose and application of both the Sequential Test and Exception Test, including details on key terms such as "reasonably available" and "wider sustainable development objective";

- Surface water flood risk and how it should be considered and addressed;
- Further detail on flood risk in relation to neighbourhood plans, Design Codes, articles 4 direction 6, permitted development/change of use, and the call in process;
- The use of Sustainable Drainage Systems (SuDS), advocating their multi-functional benefits including for water quantity, water quality, biodiversity, and amenity and a clearer requirement for SuDS information with planning applications;
- Guidance on the need for other permits for SuDS;
- Guidance on natural flood management and other ways to reduce the impacts of flooding;
- The latest supporting tools and guidance such as the CIRIA property Flood Resilience Code of Practise; and
- Updated to Table 1, Flood Zones, which confirm that Flood Zone 3b, The Functional Floodplain, has been redefined as "land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or … "as opposed to the previous 5% annual exceedance probability (1 in 20 years). This may mean that extents of functional flood plains at locations may increase.

4.4. THE LONDON PLAN (2021)

4.4.1. Under the legislation establishing the Greater London Authority (GLA), the Mayor is required to publish a Spatial Development Strategy (SDS) and keep it under review. The SDS is known as the London Plan. As the overall strategic plan for London, it sets out an integrated economic, environmental, transport and social framework for the development of London over the next 20-25 years. The following policies are considered relevant to this assessment:

- Policy SI12 Flood Risk Management:
  - "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.
  - 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. […].
  - 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.
  - Developments 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.
  - 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.
  - Development proposals adjacent to flood defences will be required to protect the integrity of flood defences and allow access for future maintenance and upgrading. […].

- 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"

- Policy SI13 Sustainable Drainage:
  - "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 in line with the following drainage hierarchy:
    1. Rainwater harvesting (including a combination of green and blue roofs);
    2. Infiltration techniques and green roofs;
    3. Rainwater attenuation in open water features for gradual release;
    4. Rainwater discharge direct to a watercourse (unless not appropriate);
    5. Rainwater attenuation above ground (including blue roofs);
    6. Rainwater attenuation below ground;
    7. Rainwater discharge to a surface water sewer or drain;
    8. Rainwater discharge to a combined sewer."
- Development proposals for impermeable paving should be refused where appropriate, including on small surfaces such as front gardens and driveways.
- Drainage should be designed and implemented in ways that address issues of water use efficiency, river water quality, biodiversity, amenity and recreation.

4.5. CITY PLAN (2036)

4.5.1. The City Plan is the CoL draft Local Plan, a plan for the future development of the CoL, setting out what type of development the City Corporation expects to take place and where. The new Local Plan will cover a period to 2036. The following policies are relevant to this assessment:

- Strategic Policy S15: Climate Resilience and Flood Risk:
  - "Buildings and the public realm must be designed to be adaptable to future climate conditions and resilient to more frequent extreme weather events.

    a) Development must minimise the risk of overheating and any adverse contribution to the urban heat island effect;
    b) Development must avoid placing people or essential infrastructure at increased risk from river, surface water, sewer or groundwater flooding;
    c) Flood defence structures must be safeguarded and enhanced to maintain protection from sea level rise."
- Policy CR2: Flood Risk:
  - "All development within the City Flood Risk Area, and major development elsewhere, must be accompanied by a site-specific flood risk assessment demonstrating that:
    a) the site is suitable for the intended use, in accordance with the Sequential and Exception tests (see tables 4 and 5) and with Environment Agency and Lead Local Flood Authority advice;
    b) the development will be safe for occupants and visitors and will not compromise the safety of other premises or increase the risk of flooding elsewhere;
    c) safe access and egress routes are identified; and
    d) flood resistance and resilience have been designed into the proposal."

- Policy CR3: Sustainable Drainage Systems (SuDS):
  - "All development, transportation and public realm proposals must incorporate SuDS principles and be designed to minimise the volume and discharge rate of rainwater run-off into the combined drainage network in the City […].
  - The design of the surface water drainage system should be integrated into the design of proposed buildings and landscaping, unless there are exceptional circumstances […].
  - SuDS designs must take account of the City's archaeological and other heritage assets, complex underground utilities, […].
  - SuDS should be designed, where possible, to maximise contributions to water resource efficiency, water quality, biodiversity enhancement and the provision of multifunctional open spaces.
  - An operation and maintenance plan will be required to ensure that the SuDS elements will remain viable for the lifetime of the building."

4.6. CITY OF LONDON LOCAL PLAN (2015)

4.6.1. The CoL Local Plan sets out the City Corporation's vision, strategy, objectives, and policies for planning in the CoL. It provides the strategy and policies for shaping the City until 2026 after which it will be replaced by the City Plan. The following policies have been deemed relevant to this assessment:

- Core Strategic Policy CS18: Flood Risk:
- "To ensure that the City remains at low risk from all types of flooding, by:

  a) Minimising river flooding risk, requiring development in the City Flood Risk Area to seek opportunities to deliver a reduction in flood risk compared with the existing situation:

     I. applying the sequential test and exception test as set out in the NPPF and Planning Practice Guidance and requiring Flood Risk Assessments to be submitted, in support of all planning applications in the City Flood Risk Area […];

     II. protecting and enhancing existing flood defences along the riverside, particularly those identified as fair or poor in the current City of London SFRA […].

  b) Reducing the risks of flooding from surface water throughout the City, ensuring that development proposals minimise water use and reduce demands on the combined surface water and sewerage network by applying the London Plan drainage hierarchy.

  c) Reducing rainwater run-off, through the use of suitable Sustainable Drainage Systems (SuDS), such as green roofs and rainwater attenuation measures throughout the City.

  d) ensuring that wider flood defences afford the highest category of protection for the city, participating in the development and implementation of the environment agency's thames estuary 2100 project.

  e) reviewing and updating the city of London's strategic flood risk assessment at least every 5 years or more frequently if circumstances require […].

- Policy DM 18.1 Development in the City Flood Risk Area:

- "Where development is proposed within the City Flood Risk Area evidence must be presented to demonstrate that:

  a) the site is suitable for the intended use (see table 18.1), in accordance with Environment Agency and Lead Local Flood Authority advice;
  b) the benefits of the development outweigh the flood risk to future occupants;
  c) the development will be safe for occupants and visitors and will not compromise the safety of other premises or increase the risk of flooding elsewhere.

- Development proposals, including change of use, must be accompanied by a site-specific flood risk assessment for:

  a) all sites within the City Flood Risk Area as shown on the Policies Map; and
  b) all major development elsewhere in the City.

- Site-specific flood risk assessments must address the risk of flooding from all sources and take account of the City of London Strategic Flood Risk Assessment. Necessary mitigation measures must be designed into and integrated with the development […].
- Where development is within the City Flood Risk Area, the most vulnerable uses must be located in those parts of the development which are at least risk. Safe access and egress routes must be identified.
- For minor development outside the City Flood Risk Area, an appropriate flood risk statement may be included in the Design and Access Statement.
- Flood resistant and resilient designs which reduce the impact of flooding and enable efficient recovery and business continuity will be encouraged."

- Policy DM 18.2 Sustainable drainage systems (SuDS)

- "The design of the surface water drainage system should be integrated into the design of proposed buildings or landscaping, where feasible and practical, and should follow the SuDS management train and London Plan drainage hierarchy.
- SuDS designs must take account of the City's archaeological heritage, complex underground utilities, transport infrastructure and other underground structures, incorporating suitable SuDS elements for the City's high density urban situation.
- SuDS should be designed, where possible, to maximise contributions to water resource efficiency, biodiversity enhancement and the provision of multifunctional open spaces."

4.7. CAMDEN LOCAL PLAN (2017)

4.7.1. The Camden Local Plan sets out the Council's planning policies and replaces the Core Strategy and Development Policies planning documents (adopted in 2010). The Local Plan will cover the period from 2016-2031. The following strategies have been deemed relevant to this assessment:

- Policy CC3 Water and Flooding:

  - "The Council will seek to ensure that development does not increase flood risk and reduces the risk of flooding where possible. We will require development to:

    a. incorporate water efficiency measures;

    b. avoid harm to the water environment and improve water quality;

c. consider the impact of development in areas at risk of flooding (including drainage);

d. incorporate flood resilient measures in areas prone to flooding;

e. utilise Sustainable Drainage Systems (SuDS) in line with the drainage hierarchy to achieve a greenfield run-off rate where feasible; and

f. not locate vulnerable development in flood-prone areas.

- Where an assessment of flood risk is required, developments should consider surface water flooding in detail and groundwater flooding where applicable.
- The Council will protect the borough's existing drinking water and foul water infrastructure, including the reservoirs at Barrow Hill, Hampstead Heath, Highgate and Kidderpore.

5. DEFINITION OF FLOOD HAZARD

5.1. SOURCES AND MECHANISMS OF FLOODING

5.1.1. Reference to gov.uk 'Flood Map for Planning' and 'long term flood risk information' maps (which makes use of EA data) is made where appropriate, along with reference to the CoL and LBC documents referenced in Section 1.3 of this report.

5.2. FLUVIAL AND TIDAL FLOODING

5.2.1. Fluvial flooding is caused by rivers, watercourses or ditches overflowing. Tidal flooding is caused by elevated sea levels or overtopping by wave action.

5.2.2. Based on the Flood Map for Planning response from the EA and the online GOV.UK Flood Map for Planning, shown in Figure 5, the Site is located in Flood Zone 1. Flood Zone 1 is classified as land having a less than 0.1% annual probability of river (fluvial) or sea (tidal) flooding (1 in 1000-year return period event). In consistency with the above, the Site is classified as having a 'very low' probability of flooding from fluvial or tidal sources.

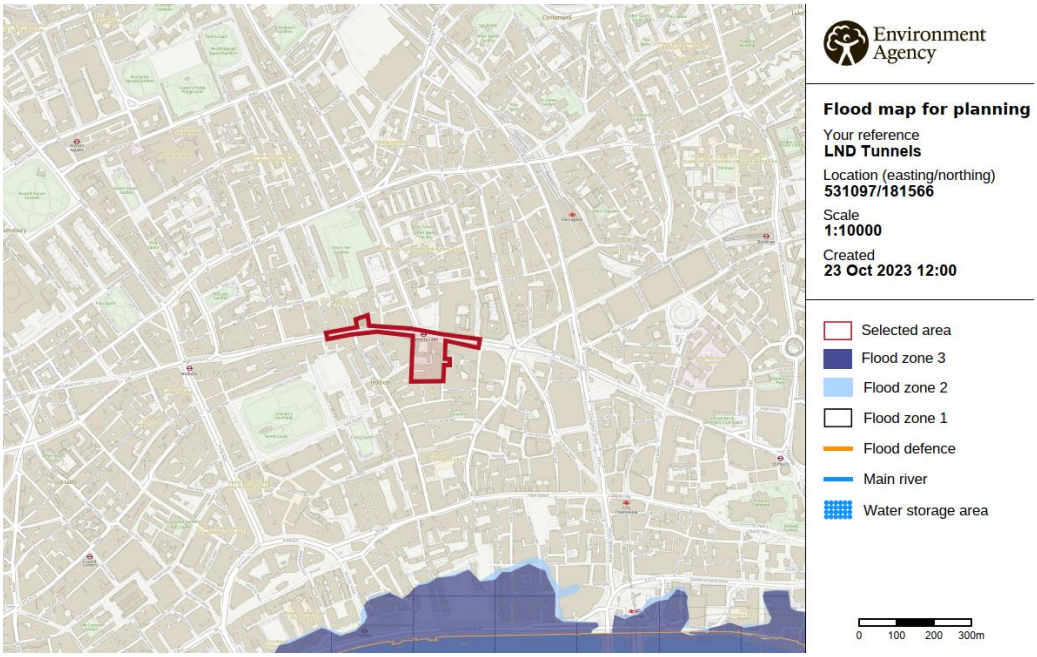


Figure 6 - Extract from EA's Flood Map for Planning - Flood Zones

5.2.3. Mapping within CoL's SFRA, attached in **Appendix B**, highlights areas within the Borough that have historically been affected by flooding along with future modelling scenarios, including tidal break extents up to the 2100 Epoch.

5.2.4. Historical mapping highlights flooding events which occurred in 1928 along the bank of the River Thames. This flooding is over 600m from the Site and there have been no other recorded instances of tidal flooding in the area since.

5.2.5. CoL's SFRA mapping also highlights that the Proposed Development is not at direct risk of flooding and is outside the flooding extents for the 2100 Epoch event. This is reiterated within Figures 2 & 3 of the CoL's LFRMS.

5.2.6. Therefore, based on the available information, flooding from fluvial and tidal sources at the Proposed Development can be considered **Very Low.**

5.3. GROUNDWATER FLOODING

5.3.1. Groundwater flooding occurs as a result of water rising up from underlying rocks, typically after long periods of sustanained rainfall. It is most likely to occur in low-lying areas underlain by aquifers.

5.3.2. Mapping within the CoL's SFRA, attached in **Appendix B**, highlights that the Proposed Development within this Borough is neither at risk of elevated groundwater flooding or associated with a property at direct risk of flooding. This is reiterated within the CoL's LFRMS Figure 7.

5.3.3. Figure 4e within LBC's SFRA, **Appendix B**, portrays a similar image to the above, showing that the Proposed Development's boundary does not lie within an area of increased susceptibility to elevated groundwater flooding. It does however show it to be within proximity of a reported EA groundwater flood incident.

5.3.4. Borehole BGS 1067061 recorded that groundwater was struck in the borehole at approximately -33mAOD, significantly below the depth of the tunnels. Across the extent of the tunnel network there may be localised pockets of perched groundwater at or above the level of the tunnels. However, the tunnels were observed to be dry during site visits (May and July 2023) and there were no reported incidents of groundwater seepage into the tunnels.

5.3.5. Based on the information available, the risk of groundwater flooding from inundation at the shaft Sites or groundwater seepage can be assessed as **Low.** However, given the restricted and inherent subterranean nature of the Proposed Development, it is recommended to mitigate this risk through appropriate waterproofing and the provision of underfloor drainage and pump systems to capture any residual seepage and discharge this to the public sewer network.

5.4. SURFACE WATER FLOODING

5.4.1. Surface water flooding occurs when intense rainfall or overland flow is unable to drain away by traditional means such as into drainage systems or infiltrating into the ground. This excess water could run off quickly off land and result in localised flooding.

5.4.2. The EA's surface water flood risk mapping shows the Site's footprint generally to comprise areas of Very Low risk of surface water flooding, with some isolated areas of Low to Medium risk. The EA's Likelihood of Flooding from Surface Water Map indicates the following classifications:

- Very low risk = less than a 0.1% (1 in 1000 year) chance of flooding in any given year.
- Low risk = between a 0.1% (1 in 1000 year) and a 1% (1 in 100 year) chance of flooding in any given year.
- Medium risk = between 1% (1 in 100 year) and a 3.3% (1 in 30 year) chance of flooding in any given year.
- High risk = Greater than 3.3% (1 in 30 year) chance of flooding in any given year

5.4.3. Based on the nature of the Proposed Development, surface water flooding has been assessed for the two shaft Sites at Fulwood Place and Furnival Street only as these present the only at-grade flood water ingress routes to the Proposed Development.

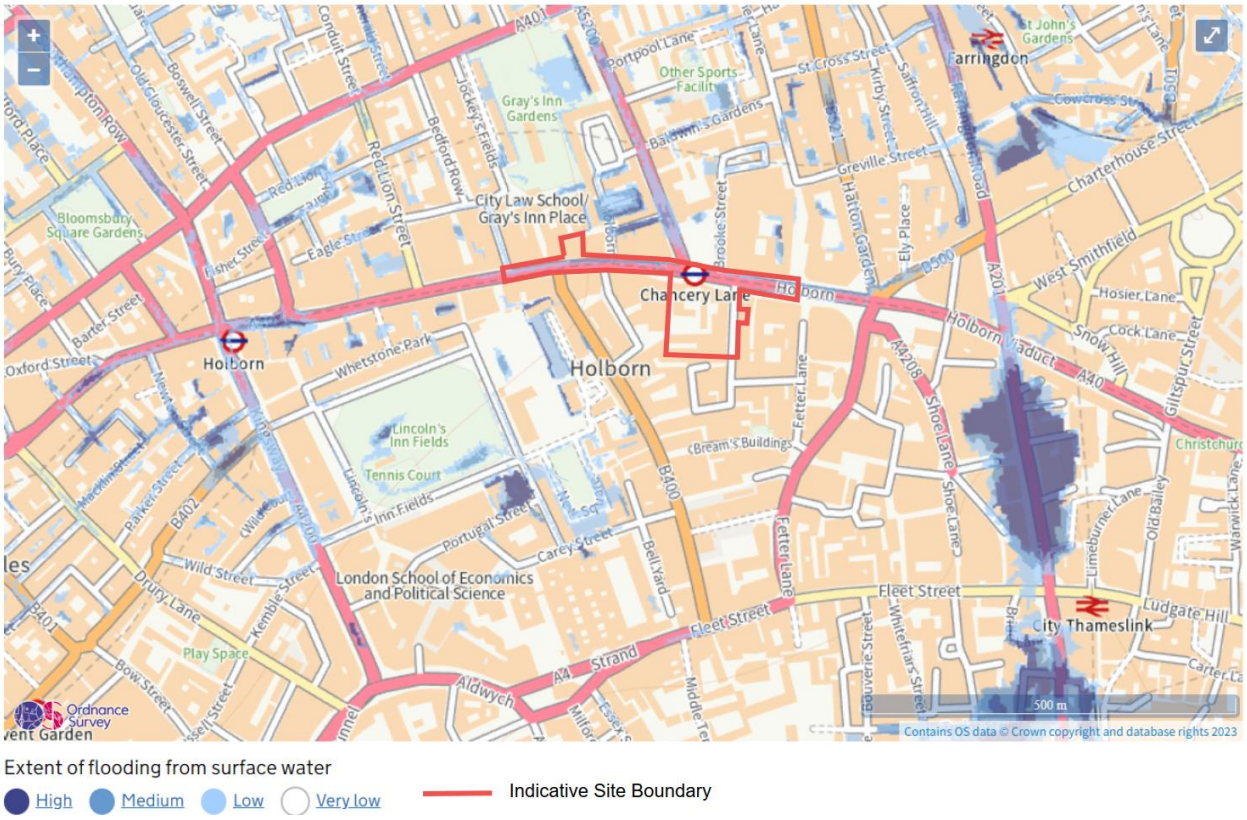


Figure 7 – Extract from EA mapping 'Surface Water Flood Risk' Frequency

5.4.4. Mapping of surface water flood extents within the CoL's SFRA highlights that the Site is not at risk of flooding from surface water up to the 3.3% AEP event alongside showing that it is outside of surface water flooding extents for the 1 in 100 year plus 40%CC storm event. This is also shown in CoL's LFRMS Figure 4.

5.4.5. LBC's SFRA provides more extensive surface water mapping, highlighting the risk of surface water flooding within all roads within the Borough. Figure 3i in the SFRA (extract below), shows there to be an isolated and localised area at low risk of surface water flooding (1% AEP) to the north of the Fulwood Place shaft Site. This correlates with basement light wells associated with Fairfax House to the north of the Site, and has no upstream catchment, therefore would pose very low risk to the Proposed Development. No areas at risk of surface water flooding are shown within the vicinity of the Furnival Street shaft Site. Figure 3vi of the SFRA shows limited hazard of flooding in the vicinity of the Proposed Development for the 1 in 1000 year flood event.

5.4.6. All proposed accesses at the Furnival Street and Fulwood Place shaft Sites sit a minimum of 100mm above proximate low points on the public highway network. Flood water ingress via these thresholds would require an extent of flooding of the public highway that would completely block access along the respective footways. Given the size of sewers that serve the public highways at both shaft Sites, and the high level of traffic that these routes receive, such a flood event is highly improbable.

Figure 8 - Extract from the LBC SFRA with the Fulwood Place and Furnival Street shaft sites shown in red

5.4.7. Therefore, the risk of surface water flooding at the Site has been assessed to be **Low.**

5.4.8. The proposed drainage strategy will detail how the Scheme design will aim to reduce the surface water flood risk further using various Sustainable Drainage Systems (SuDS). It is recommended that threshold drainage is provided at all thresholds to mitigate the residual risk of any flood waters entering the shaft Sites.

5.5. SEWER FLOODING

5.5.1. Sewer flooding is caused when a blockage occurs or by excess surface water entering the drainage network, exceeding available capacity. This generally occurs during periods of heavy rainfall when the drainage network becomes overwhelmed.

5.5.2. Given the size of the sewers that run along Fulwood Place and Furnival Street, and the limited upstream catchment they serve, capacity issues or blockage of these sewers resulting in significant flood events is highly unlikely. As discussed previously, proposed access thresholds at both shaft Sites sit above proximate low points in the public highway network, with these low points and wider areas of public highway served by the Fulwood Place and Furnival Street sewers. Therefore, in the unlikely event that sewer flooding occurs in the vicinity of the shaft Sites, flood waters would cut-off access along Furnival Street, Fulwood Place or High Holborn, before this flooding reached threshold levels. Given the location of these streets and the footfall they receive, such an event is highly improbable.

5.5.3. LBC's SFRA (**Appendix B**) shows no history of external or internal sewer flooding in vicinity of the Site from the proximate sewer network. In addition, the Thames Tideway Scheme (which has the purpose of intercepting overflows into the River Thames) has been developed so surcharging of sewers will occur less frequently.

5.5.4. CoL's PFRA notes that in the instance where extreme tidal events coincided with heavy rainfall within the River Fleet catchment, storm water would be unable to discharge via storm overflows and could therefore surcharge within the sewer network. However, it further explains *"such a risk is likely to be rare due to the requirement for a high tide and storm surge combined with heavy rainfall"* making such risk unlikely.

5.5.5. A review of the Site's topography and the surrounding areas shows ground levels at and surrounding the Site, and north of the River Thames, fall south and east towards the river. Therefore, any surcharging of the Fleet and Fleet Storm Relief sewers or flooding that could occur as a result would travel away from the Site and towards the river. Refer to Figure 9 below and **Appendix B** for a graphical illustration of this.

5.5.6. From the information made available WSP have assessed the risk of sewer flooding in the vicinity of the Site as **Low**.

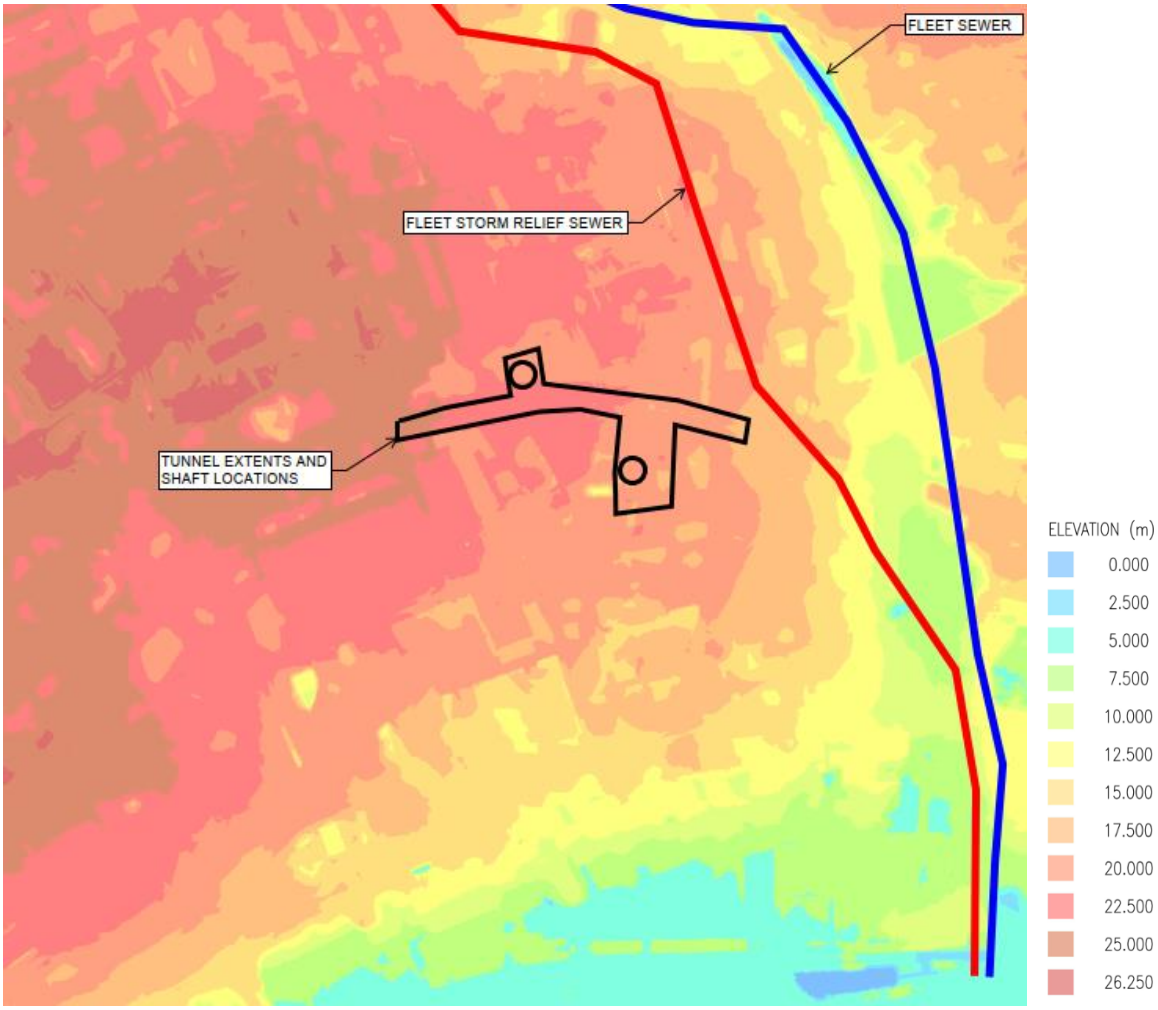


Figure 9 – Terrain map showing the Site in relation to the Fleet and Fleet Storm Relief Sewers

5.6. RESERVOIR AND ARTIFICIAL SOURCES OF FLOODING

5.6.1. Areas which lie within the maximum extent of flooding by an uncontrolled release of water from a reservoir are considered to be areas where lives could be threatened.

5.6.2. Based on the gov.uk online maps, seen in Figure 10, the Site has not been identified as within the extent of flooding from reservoirs. Based on the information available, the probability of flooding from reservoir and artificial watercourses at the Site is considered to be **Negligible.**

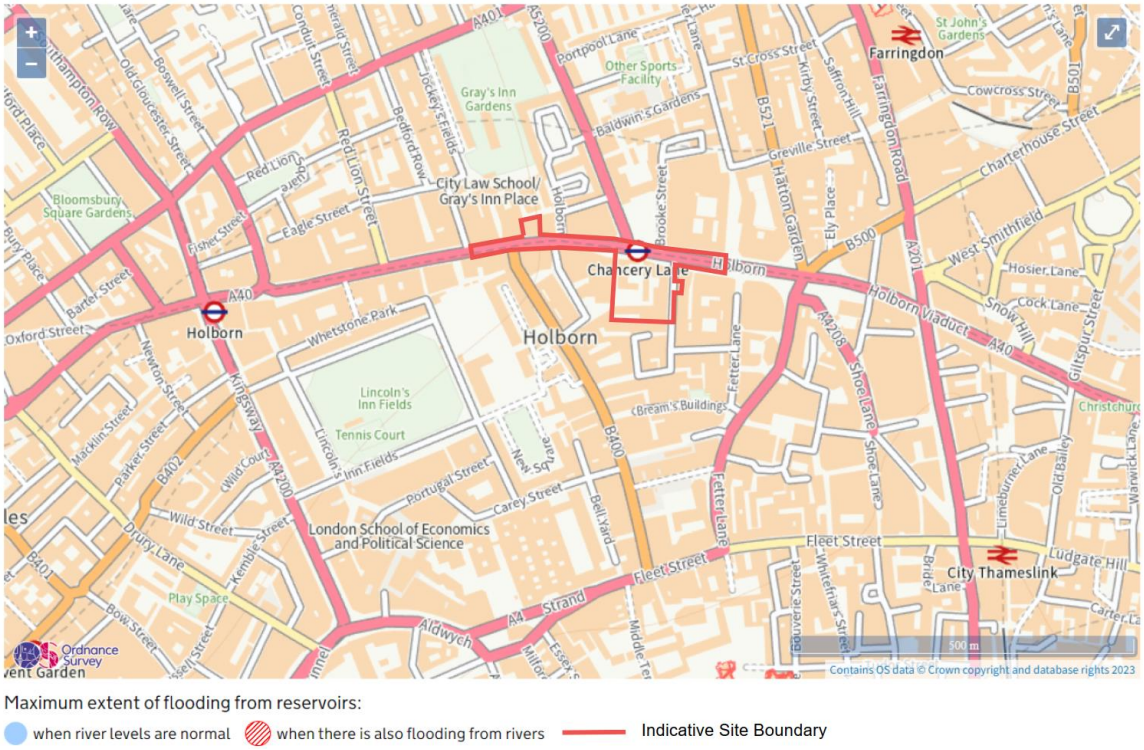


Figure 10 - Extract from EA mapping 'Flood risk from reservoirs'

6. CLIMATE CHANGE

6.1. BACKGROUND INFORMATION

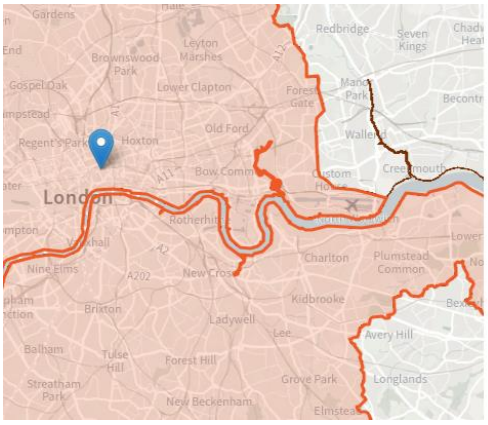
6.1.1. As explained in the Climate Change Adaptation Sub-Committee Progress Report 2014, increased flood risk is the greatest threat to the UK from climate change. Models of the climate system suggest floods of the type experienced in England and Wales in Autumn 2000, and between December 2013 and February 2014, have become more likely as a consequence of increased concentrations of greenhouse gases in the atmosphere.

6.1.2. More frequent short-duration, high intensity rainfall and more frequent periods of long-duration rainfall could be expected. Sea levels are also expected to continue to rise.

6.1.3. For peak rainfall the EA Guidance provides an upper end and central allowance depending on epoch; the guidance recommends assessing both the central and upper end allowances to understand the range of possible impacts.

6.1.4. On 10th May 2022 the peak rainfall allowances in 'Flood risk assessments: climate change allowances' were updated so they reflect the latest projections in UKCP Local (2.2km) and subsequent research 'FUTURE-DRAINAGE: Ensemble climate change rainfall estimates for sustainable drainage' (referred to as 'FUTURE-DRAINAGE herein). Peak rainfall allowances are provided for management catchments rather than a single set of national allowances for England.

6.1.5. Based on the EA's Climate Change Allowances 'Hydrology Data Explorer, the Site is located within the London Management Catchment. The rainfall allowance for the Site is provided in Figure 8.



1% annual exceedance rainfall event

Epoch

	Central allowance	Upper end allowance
2050s	20%	40%
2070s	25%	40%

*Use '2050s' for development with a lifetime up 2060 and use the 2070s epoch for development with a lifetime between 2061 and 2125.

This map contains information generated by Met Office Hadley Centre (2019): UKCP Local Projections on a 5km grid over the UK for 1980-2080. Centre for Environmental Data Analysis, 2022

Figure 11 **- Peak rainfall allowance for the London Management Catchment**

6.2. DEVELOPMENT LIFESPAN

6.2.1. A typical lifespan for the type of development proposed is 100 years.

6.2.2. Based on this, the contingency peak rainfall allowances for climate change that are potentially applicable to this Site are as set out in Table 2 of the EA's "Flood risk assessments: climate change allowances" advice are:

- Upper End – 40% increase in peak rainfall by 2070;
- Central – 25% increase in peak rainfall by 2070.

6.2.3. When undertaking the outline drainage strategy, the surface water attenuation calculations will be determined using the central and upper end estimates to prevent potential exceedance flows off-site.

6.3. IMPACT OF CLIMATE CHANGE ON THE DEVELOPMENT

6.3.1. Albeit it low, when conflated with other risk events (such as a sewer blockage), surface water runoff could, in theory represent a risk to the Site, especially when the effects of climate change are considered. The Surface Water Drainage Strategy produced as part of this study considers the potential impacts of climate change.

6.3.2. The Surface Water Drainage Strategy demonstrates that the surface water drainage provision for the Site will be designed to accommodate surface water run-off for all events up to and including the 100-year return period plus 40% climate change allowance.

7. FLOOD RISK MITIGATION MEASURES

7.1.1. As stated in Section 5.2, the Proposed Development is located within Flood Zone 1. Alongside this, Section 5 of this report has demonstrated that the Site is at low or negligible risk from all sources of flooding identified within the NPPF.

7.1.2. At both shaft Sites, existing building thresholds sit above external roads levels with pavements falling away from the thresholds to kerbed gutters along these roads. In the unlikely event of flooding in the vicinity of the shaft Sites, floodwaters will be conveyed along these gutters away from potential ingress routes to the Tunnels. In the highly unlikely event of floodwaters breaching building thresholds (i.e. through a blocked gutter or sewer), the volume of floodwater entering the buildings will be negligible relative to the size of the Tunnels and pose nominal risk to occupant safety.

7.1.3. Surface water has been deemed as having a low risk of flooding at the two shaft Sites. The ODS section of this report, Section 8, will reduce this risk further by implementing appropriate SuDS measures where deemed feasible. It will highlight how these strategies will reduce the risk along with modelling data to demonstrate why these particular features have been selected.

7.1.4. Based on the available information, groundwater flooding at the Site has been assessed as having a Low risk to the shaft Sites. However, given the restricted nature of the Proposed Development within an existing tunnel network, appropriate waterproofing measures should be deployed throughout to manage the risk of groundwater seepage with under floor drainage and pumping systems provided to remove any residual seepage.

7.1.5. While the overall likelihood of flooding at the Proposed Development is low to negligible, given the restricted and subterranean nature of the Site, to mitigate any residual risks of flooding it is recommended that:

- Any routes for surface water ingress to the Tunnels (i.e. via proposed building thresholds and the Tunnel shafts) are protected either by:
  - Comprehensive threshold drainage;
  - Finished floor levels that rise to a minimum of 50mm above adjacent street levels; or
  - External ground levels that fall away from proposed building thresholds at a minimum slope of 1 in 60 with thresholds set a minimum of 150mm above proximate low points on the public highway network.
- Where practicable, all electrical and life safety infrastructure is provided a minimum of 300mm above finished floor levels, or where this is not practicable, such equipment is designed to be flood resilient, or protected by an appropriate drainage system; and
- A Flood Evacuation Plan is prepared for the development and agreed with the CoL and LBC prior to occupation.

8. SURFACE WATER DRAINAGE STRATEGY

8.1. OVERVIEW

8.1.1. A Surface Water Drainage Strategy is essential for any new development to ensure that surface water runoff from the development is managed effectively limiting flood risk on and off-site and ensuring compliance with policies and best practice.

8.1.2. This section of the report discusses the principles of the proposed Surface Water Drainage Strategy with appropriate design calculations and drainage maintenance requirements provided thereafter. Given the tunnel network is underground therefore doesn't receive surface water, and given the limited extent of alterations to the existing building at the Fulwood Place shaft Site, the subject of this surface water drainage strategy is the Proposed Development at 38-41 Furnival Street.

Figure 12 - Plan & Section Views of Development Proposals at Furnival Street

8.1.3. It is proposed that the existing building at 38-39 Furnival Street will be demolished while the building at 40-41 Furnival Street redeveloped. Both buildings will in turn be converted into the principal visitor centre entrance for the below ground tunnel network, with 2 basement levels, retail at first and second floor levels and ancillary offices and plant at third and fourth.

8.1.4. All proposed drainage will be designed in accordance with local policies, local SuDS guidance, national standards and best practice where applicable. This Surface Water Drainage Strategy identifies the principles of drainage management at the Site and all agreements, permits and applications for connections to the public sewer network will be made post discharge of the Planning Conditions through engagement with CoL and Thames Water.

8.2. PROPOSED SURFACE WATER DISCHARGE METHOD

SUDS OPTION APPRAISAL

8.2.1. Gov.uk guidance relating to flood risk and coastal change in the planning process states that developments should aim to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable:

1. Capture and store water for re-use;
2. Into the ground (infiltration);
3. To a surface watercourse;
4. To a surface water sewer, highway drain, or another drainage system; and
5. To a combined sewer.

8.2.2. The Sustainable Drainage System (SuDS) hierarchy has been followed as practically as possible in applying the use of sustainable drainage techniques in the proposed drainage strategy. This has been set out and summarised in Table 8-1 below with justification provided where particular techniques are deemed not feasible.

THE DRAINAGE HIERARCHY & SUDS STRATEGY

Table 8-1 – SuDS Feasibility

Drainage Hierarchy	SuDS Feature	Feasibility	Potential Use in Development & Reasons
Rainwater use as a resource	Rainwater Harvesting	Yes	Rainwater harvesting for internal use should be utilised within the Proposed Development where space for attenuation tanks permits.
Rainwater infiltration to ground at or close to source	Soakaways	No	Due to the nature of the ground below the Proposed Development being London Clay, along with the proposals for basements within the Proposed Development, this discharge option is unfeasible..
Rainwater discharge direct to a watercourse (unless not appropriate)	/	No	There are no watercourses within direct vicinity of the Site and therefore this is an unfeasible option.
Rainwater Attenuation in green infrastructure features for gradual release	Blue / Green Roofs	Yes	Due to the Proposed Development having limited external space, blue and/or green roofs should be considered for the development at Furnival Street. This would allow for an attenuation system and gravity discharge to be utilised.

			Limited space available at roof level within the Proposed Development means that this is unlikely to be a viable solution to meet all attenuation requirements.
	Raingardens / Bioretention Systems	No	There are no external areas surrounding the Proposed Development where such features could be utilised and therefore this is an unfeasible solution.
	Ponds & Open water features	Yes	There are no external areas surrounding the Proposed Development where such features could be utilised and therefore this is an unfeasible solution.
	Permeable Paving	No	There are no pavements or at-grade external areas within the Proposed Development.
	Below Ground / Slab Storage	Yes	Attenuation tanks could be located below the basement slab, however pumping will be required to discharge to the TW sewer network.
Controlled rainwater discharge to a surface water sewer or drain	/	No	TW asset records show that there are no surface water sewers within the vicinity of the Site and therefore this is an unfeasible option.
Controlled rainwater discharge to a combined sewer	/	Yes	TW asset records show there are combined sewers within the vicinity of the Site and therefore this is a feasible discharge option.

BROWNFIELD RUNOFF

8.2.3. As previously mentioned, this is a brownfield Site with a catchment area of 0.039ha, all of which is impermeable. It is believed that the existing Site discharges unrestricted flows into the combined existing Thames Water sewer in Furnival Street. The existing brownfield discharge rates shown in Table 7-2 below have been calculated in line with the Wallingford Procedure's Rational Method using the following equation:

Q = 2.78 x Rainfall Intensity (mm/hour) x Area (ha)

GREENFIELD RUNOFF

8.2.4. Policy SI13 of the London Plan 2021 requires developments to aim to achieve greenfield runoff rates. Calculations for greenfield runoff rates for the Site were carried out using the HR Wallingford

Greenfield Runoff Rate Estimation Tool. Results are summarised in Table 8-2 below and in **Appendix D**. Due to the nature of the Proposed Development and the spatial constraints of the Site, the surface water drainage strategy proposes a maximum discharge from the development of 1.5 l/s to the combined sewer in Furnival Street, which is the lowest technically feasible discharge rate given the proposals to utilize a blue roof system with a gravity outfall, and the need to supplement this attenuation capacity with a below slab tank and pump system.

Table 8-2 - Brownfield and Greenfield Runoff Rates

Storm Event	Catchment Area (ha)	Rainfall Intensity (mm/hr)	Brownfield Runoff Rate (l/s)	Greenfield Runoff Rate (l/s)	Proposed Discharge Rate (l/s)
1:1 Year	0.039	17.06	1.85	0.27	1.5
1:30 Year		80.8	8.76	0.72	1.5
1:100 Year		105	11.38	1	1.5
1:100 Year +40%					1.5

PRE-DEVELOPMENT ENQUIRY

8.2.5. A pre-development enquiry Ref. DS6108664 was submitted to TW for the development to ensure that the local sewer network has provision to accommodate the proposed flows from the Proposed Development. WSP is currently awaiting a response. However, given the size of the sewer at Furnival Street and the proposed reduction in run-off rate from the Site, it is reasonable to assume that capacity is available.

8.3. SURFACE WATER MODELLING AND RESULTS

8.3.1. When undertaking the modelling for the surface water drainage strategy the following design parameters have been applied:

- FEH rainfall data has been used in the design calculations.
- Storage will be provided for a design storm of up to the 1 in 100-year plus 40% climate change event.
- The total impermeable area for the Proposed Development is 0.039ha, which has been taken as the plan area of new proposed building within the Site boundary. Due to the proposed building type and spatial Site constrains, the Site catchment areas have been split as shown in Table 8-3 below.

PROPOSED SURFACE WATER RUNOFF RATES

8.3.2. The proposed maximum discharge rate from the Proposed Development is 1.5 l/s, which is as close as technically feasible to greenfield run-off rates given the nature of the development and offers a significant betterment on existing pre-development run-off rates. Catchment areas have been split as summarised in Table 8-3, along with their associated proposed discharge rates.

Table 8-3 - Attenuation systems and associated catchment area

Catchment	Area m^2	Storage System	Proposed Max. Discharge l/s
Catchment area 1 - Terraced roof level 4	92	System 1 (Blue roof)	0.5 Gravity
Catchment area 2 – Roof level 5 (plant room)	180.5	System 2 (Basement tank)	1.0 Pumped
Catchment area 3 - Remaining impermeable areas	114.4		
Total	**386.9**	**2no. Attenuation systems**	**1.5**

Catchment area 1 - Terraced roof level 4

8.3.3. Rainwater landing on roof level 4 will be captured and directed to the blue roof system **(Storage System 1)** located beneath the terrace floor for storage. Flows will then be discharged at a restricted maximum rate of 0.5 l/s for the 1 in 100 plus 40%, to the ground floor drainage system before a gravity connection to the existing combined public sewer in Furnival Street via existing laterals.

Catchment area 2 - roof level 5 (plant room)

8.3.4. Rainwater landing on roof level 5 will be captured and directed via downpipes to the underground storage tank **(Storage system 2)** located below B3 slab. Flows will then be pumped up at a maximum pump rate of 1.0 l/s for the 1 in 100 plus 40%, to a break chamber on the ground floor, before a gravity discharge to the existing combined public sewer in Furnival Street via existing laterals.

Catchment area 3 – remaining impermeable areas

8.3.5. Rainwater from the remaining hard catchment areas will be captured and directed via a piped network to **Storage system 2** before being pumped up to a break chamber on the ground floor for a gravity discharge to the existing combined public sewer in Furnival Street.

MODELLING RESULTS: ATTENUATION REQUIREMENTS

8.3.6. Preliminary calculations for the above catchment areas have been undertaken using InfoDrainage hydraulic modelling software and Aco blue roof design software to understand attenuation requirements set against the design criteria above. Details of SuDS location, attenuation volume, and discharge routing have been shown on Outline Drainage Strategy plan TLT-WSP-XX-XX-SK-DR-00001 in **Appendix E** and also summarised in Table 8-4 below.

Table 8-4 - Proposed storage systems and capacities

Storage System	Storage Volume provided m^3
System 1 (Blue Roof)	4.9
System 2 (Basement Tank)	21
Total	25.90

8.3.7. Hydraulic modelling results for the two storage systems for the 1 in 2, 1 in 30 and 1 in 100 +40% storm events are summarised in Table 8-5 below. The 1 in 2 has been analysed instead of the 1 in 1 because FEH data will only allow the interrogation down to the 1 in 2 year storm event.

Table 8-5 - Summary of InfoDrainage modelling results

Storage System	Storm Event	Infodrainage flowrate output (l/s)
System 1 (Blue Roof)	1 in 2	0.5
	1 in 30	0.5
	1 in 100 + 40%	0.5
System 2 (Basement Tank)	1 in 2	1.0
	1 in 30	1.0
	1 in 100 + 40%	1.0

8.3.8. The results presented in Table 8-5 above show a 1.5 l/s maximum post-development discharge rate from the Proposed Development which does not exceed the pre-development scenario calculated brownfield rates. The design is therefore in compliance with the London Plan (2021) and NPPF (2023).

8.3.9. A CCTV drainage survey will be undertaken prior to detailed design stage to confirm the location and invert levels, as well assess the condition of all existing laterals serving the Site to determine suitability for reuse.

8.4. RAINWATER HARVESTING SYSYEM

8.4.1. Rainwater harvesting is suggested for the Proposed Development to supplement the mains water supply for the sprinkler system and for flushing purposes. The harvesting system will be connected to the to the basement storage tank. Full details of the rainwater harvesting system can be found in the MEP report.

8.5. WATER QUALITY CONTROL

8.5.1. Surface water runoff from the Proposed Development will all come from roof catchment areas, which are considered low risk pollution areas. Furthermore, the flows will be discharged into a combined

sewer network. Pollution control measures such as trapped gullies, running traps and catchpit chambers as well as internal flood prevention measures such as non-return valves will be used in line with best practise.

9. PROPOSED FOUL WATER DRAINAGE STRATEGY

9.1. OVERVIEW

9.1.1. Based on the number of staff and anticipated number of visitors, the estimated foul flow discharge rate for the Proposed Development is 4.5 l/s. The exact split of flows between the Furnival Street and Fulwood Place entrances will be determined at the next design stage. Flows from the Furnival Street end will be discharged to the existing combined sewer in Furnival Street via existing laterals serving the existing Site. Flows from the Fulwood Place end will be discharged to the existing combined sewer in Fulwood Place via existing laterals which currently serve the Site.

9.1.2. Given the depth of the tunnels, pump performance requirements may dictate the need to pump at higher peak discharge rates to overcome gravitational head. However, pump systems will be planned so that multiple pumps do not operate simultaneously to minimise total peak discharge rate. It is proposed that total peak pumped discharge rate will not exceed 6 l/s at each shaft Site.

9.2. FOUL FLOW DISCHARGE RATE AT FURNIVAL STREET

9.2.1. Foul water flows from the ground floor and above will be directed via a piped system and downpipes to a chamber on the ground floor within the building, before being discharged by gravity to the existing combined TW sewer in Furnival Street.

9.2.2. Foul flows from the basement and the Tunnels will be directed to designated pumping stations and pumped to a break chamber on the ground floor within the building before being discharged by gravity to the existing combined TW sewer in Furnival Street via existing laterals.

9.3. FOUL FLOW DISCHARGE RATE AT FULWOOD PLACE

9.3.1. There are no proposed new foul flow sources at ground floor and above at Fulwood Place. All additional foul flows will be from the basement areas and the Tunnels.

9.3.2. Flows from the basement areas and the Tunnels will be directed to pumping station and pumped up to a break chamber on the ground floor within the Site boundary, before being discharged by gravity to the existing combined sewer in Fulwood Place via existing laterals.

9.4. GENERAL

9.4.1. Pump design and specification will be undertaken during the following next design stages. Emergency storage capacities within the pumping stations in the event of pump failure will be agreed and confirmed during the following next design stages, however at this stage it is proposed to provide 24 hours emergency storage where practicable.

9.4.2. A CCTV drainage survey has been requested prior to detailed design stage to confirm the location and invert levels, and assess the condition of all existing laterals serving the Site to determine suitability for reuse.

9.4.3. Non-return valves will be installed on outfalls where practicable and necessary to mitigate risk of internal flooding and offer rodent protection.

10. DEVELOPMENT CONSTRAINTS

10.1. OVERVIEW

10.1.1. The nature of the Proposed Development requires a significant amount of MEP equipment to be located on roof level 5, preventing the area from being utilised for blue roof attenuation. During the following design stages, there may be an opportunity to locate some blue roofs on level 5 subject to coordination with the MEP team and agreement with the rest of the design team. This will reduce the below slab storage requirement and pumping demand from the Site.

10.1.2. There may also be opportunities to move the below slab storage to MEP plant rooms within level B1 as the project progresses to the following design stages. This will significantly reduce the pumping demands.

11. DRAINAGE MAINTENANCE AND MANAGEMENT STRATEGY

11.1. INTRODUCTION

11.1.1. The Drainage Maintenance and Management Strategy shown on Table 11-1 below has been prepared and builds on information provided within the SuDS Manual; it is expected that the maintenance for the entire Scheme will be under the management of specialist maintenance management company, in which a suitably qualified maintenance specialist will undertake the work for the entire Proposed Development.

11.2. DRAINAGE MAINTENANCE AND MANAGEMENT STRATEGY

Table 11-1 - Drainage Maintenance and Management Strategy

Drainage Feature	Regular Maintenance	Occasional Maintenance	Monitoring
Blue Roofs	Inspection chambers will be checked every 6 months for the accumulation of debris and silt and cleaned as necessary. Remove debris from the catchment surface where it may cause risk to performance (monthly).		Inspect every 6 months or after large storm.
Manholes / Inspection Chambers	Inspection chambers will be checked every 6 months for the accumulation of debris and silt and cleaned as necessary.	Clean as necessary. All manhole and inspection chamber covers and frames to be replaced as necessary.	Inspect every 6 months or after large storm.
Rainwater Harvesting Systems	Inspection of the tank for debris and sediment build-up. Cleaning of tank inlets and outlets, gutters, withdrawal devices and roof drain filters of silts and other debris.	Cleaning and/or replacement of any filters	Inspect every 3 months or after large storm.
Flow Control	Inspected every 3 months or as needed if problems occur		Inspect every 3 months

12. CONCLUSIONS

12.1.1. WSP UK Ltd have prepared this FRA and Outline Drainage Strategy (ODS) on behalf of London Tunnels PLC to support the Planning Application for the redevelopment of the Kingsway Exchange Tunnels ('the Site'), in Holborn, London.

12.1.2. Based on the information provided within this report, it is concluded that:

- Flood risk posed to the Proposed Development from all sources identified within the NPPF are considered Low to Negligible.
- Despite the Low to Negligible flood risk and Less Vulnerable proposed land-use classification, it is recommended that, due to the restrictive and inherent subterranean nature of the tunnels, and alongside other flood risk mitigation measures in line with best practise, a Flood Evacuation Plan is prepared as part of future design stages to help mitigate residual risks associated with any flood events in and around the Proposed Development.
- Published geology shows that the underlying geology is identified to be London Clay formation confirmed. As a result, the use of infiltration measures to discharge surface water off the Proposed Development were not considered in this assessment.
- The proposed drainage strategy arrangement will comprise of blue roof systems and harvesting, which are both considered SuDS solutions that will provide a significant benefit in terms of reducing direct runoff to the existing sewer network as well as aiding a sustainable water supply.
- Surface water runoff from the Proposed Development will be managed through two drainage storage systems, which have been sized to accommodate the 1 in 100-year storm rainfall event with a 40% allowance for climate change. The systems are located on different levels of the development as described in Section 7. The proposed strategy will restrict Site discharge to a maximum rate of 1.50 l/s, offering significant betterment on pre-development rates.
- Foul water flows from the ground floor and above at both Furnival Street and Fulwood Place will discharge by gravity to the existing nearby combined sewer network. Foul flows from below ground will be pumped up to ground floor and gravity discharge to the combined sewer network.
- Both surface and foul water drainage for the Proposed Development will connect to the existing Thames Water combined sewer networks via existing laterals within the Site application boundary.

12.1.3. It is concluded that, in terms of flood risk and drainage, the development is compliant with the criteria set out in local and national policy, including the London Plan (2021) and NPPF (2023).

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