LONDON

TUNNELS

The London Tunnels

27. Contaminated Land Preliminary Risk Assessment

PROJECT NO. 70087403
REF NO. TLT-WSP-XX-XX-AS-CV-00001

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The London Tunnels PLC

TLT (KINGSWAY EXCHANGE TUNNELS: FURNIVAL STREET AND FULWOOD PLACE)

Contaminated Land Preliminary Risk Assessment

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Contaminated Land Preliminary Risk Assessment

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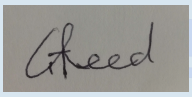
Signature	 Digitally signed by Gareth.Reed@wsp.com DN: cn=Gareth.Reed@wsp.com Date: 2023.11.30 13:51:36
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1 INTRODUCTION AND OBJECTIVES

1.1 TERMS OF REFERENCE

The London Tunnels PLC (the Client) commissioned WSP UK Limited (WSP) to undertake a Preliminary Risk Assessment (PRA) of potential contaminated land risks, associated liabilities and constraints for Fulwood Place, located at 31-33 High Holborn, London, WC1V 6AX, and 38, 39, 40 and 41 Furnival Street, London, EC4A 1JQ. The two sites are approximately 230m apart and will be assessed in separated sections within the report. Each site will be referred to as 'the Site' within its respective section.

These two Sites are part of the wider TLT scheme that includes the Tunnels and shafts forming a former deep shelter built in 1940 and later government telephone exchange. This assessment's scope is only for the two addresses listed above and as such, assessment of the Tunnels from a contaminated land perspective will not be included within this report.

The two Sites are addressed separately in the report. Fulwood Place is assessed in **Sections 2 to 6** and 38, 39, 40 and 41 Furnival Street in **Sections 7 to 11**. Conclusions and Recommendations for both Sites are present in **Section 12**.

The Site location and Site boundary plans are presented in **Appendix A**.

1.2 PROPOSED SCHEME

The Proposed Scheme comprises the redevelopment and refurbishment of the former Chancery Lane Deep Shelter and Kingsway Telephone Exchange Tunnels into a new cultural and education attraction. For the purposes of this report, only proposed works relevant to the above ground sections of the Proposed Scheme have been considered.

Fulwood Place - Refurbishment of the existing building and amendments to base of existing shaft. The current shaft has two smaller diameter shafts at its base. The understanding is that these will be removed to enable the extension to the larger diameter shaft which extends from ground level with a connecting tunnel formed at the base to link to the tunnel network at this level.

38-39 Furnival Street – Demolition of the existing building to enable construction of a new four storey building with a three-storey basement that will have a Foundation Floor Level (FFL) of 13.2m below ground level (bgl). It is assumed the basement will connect into the upper existing Tunnels, which will replace the existing shaft. It is expected that the shaft diameter will be increased below the new basement to the lower-level Tunnels along with modification to connecting tunnel at base to increase clear width/diameter.

40-41 Furnival Street - Demolition of the existing building to enable construction of a new building. It is understood there may be a new shaft or intrusive ground works from or beneath this building.

1.3 AIMS AND OBJECTIVES

The aim of the assessment is to support a planning application for the Proposed Scheme as described above.

The key objectives of this assessment are as follows:

- Develop a preliminary Conceptual Site Model (CSM) to identify potential contamination risks associated with the Proposed Scheme; and,
- Evaluate likely contaminated land exposure pathways and their potential significance to identified receptors to support the Proposed Scheme.

1.4 PROJECT SCOPE

To assist in meeting the aims and objectives as stated in **Section 1.3**, the scope of works for the PRA comprise:

- Completion of a walkover of the Sites;
- A review of publicly available regulatory information and available historical Ordnance Survey maps to assess the current and historical potentially contaminative uses of the Sites, and of land uses in the vicinity of the Sites;
- A review of publicly available information pertaining to the geology, hydrogeology and hydrology of the Sites and surrounding area to assess ground conditions and the presence of plausible sensitive environmental receptors. This will include a review of available borehole data, regulatory databases and mapping;
- Liaison with relevant authorities including the Environment Agency and local council (Environmental Health);
- Derivation of a preliminary conceptual site model (CSM) through the identification of plausible contaminant linkages in order to provide a preliminary qualitative ranked assessment of the likelihood of potential sources of land contamination posing a significant risk to the human health and the environment; and,
- Outline the environmental risks and / or opportunities, with respect to ground, groundwater and ground gas conditions, which may potentially arise as liabilities or constraints associated with the proposed future uses of the Sites.

1.5 LEGISLATIVE CONTEXT AND GUIDANCE

The assessment was undertaken in the legislative context of:

- Part 2A of The Environmental Protection Act (1990); and,
- The National Planning Policy Framework (NPPF) (2021).

The following good practice and statutory guidance was considered, and the assessment was undertaken in general accordance with:

- Environment Agency ‘Land Contamination: Risk Management Guidance’ (2023); and
- CIRIA C552 ‘Contaminated Land Risk Assessment. A Guide to Good Practice’ (2001).

1.6 SOURCES OF INFORMATION

The following relevant sources of information were used in the production of this report:

- Groundsure reports dated 30 May 2023 ref: GS-LL5-ZKO-P92-KXU and GS-98E-AWA-3ZN-3F9 (Furnival Street) and ref: GS-S7O-S7X-FY5-VRI and GS-YT7-EYB-HDX-4WV (Fulwood Place);

- British Geological Survey (BGS) Geological Map Sheet No. 256, North London, 1:50,000 Bedrock and Superficial Edition (2006);
- BGS Online Viewer (http://mapapps.bgs.ac.uk/geologyofbritain/home.html), accessed on 30 May 2023;
- Defra's Magic Map website (https://magic.defra.gov.uk/MagicMap.aspx), accessed on 30 May 2023;
- Department of Environment Industry Profiles;
- UK Government's Flood Risk Map website (https://flood-map-for-planning.service.gov.uk/), accessed on 30 May 2023;
- UK Radon Maps, (https://www.ukradon.org/information/ukmaps), accessed 30 May 2023;
- Zetica UXO website (https://zeticauxo.com/downloads-and-resources/risk-maps/), accessed 31 May 2023; and
- Zetica UXO Pre-Desk Study Assessment dated 09 June 2023.

1.7 UNDERSTANDING RISK

It is important to understand that the risks identified during a preliminary assessment, such as the one presented in this document, are perceived risks based on the information reviewed. A more detailed assessment of the actual risks can only be assessed following further intrusive investigations. The preliminary assessments presented herein are qualitative based on professional judgements following the review of available data and within the context of the existing/proposed use. Those risk categories presented (very low, low, low to moderate, moderate, high and very high) follow guidance presented in CIRIA Publication C552, Contaminated Land Risk Assessment – A Guide to Good Practice. CIRIA states that the risk levels should be based on an understanding of both the probability (likelihood) of a risk occurring and the magnitude of the potential consequence (severity) of a risk. CIRIA defines four levels of probability and four levels of severity with relation to contaminated land, as presented in **Appendix B**.

1.8 LIMITATIONS

This report is addressed to and may be relied on upon by The London Tunnels PLC and may not be relied upon or transferred to any other parties without the express written agreement of WSP.

This report should be read and used in full. No responsibility will be accepted where this report is used, with in its entirety or in part, by any other party. WSP cannot be held liable for third party information. Full details of the limitations are provided as **Appendix C.**

2 SUMMARY OF THE SITE AND SURROUNDING AREA

2.1 SITE DESCRIPTION AND CURRENT USE

Table 2-1 summarises the details obtained from a desk based review of the Fulwood Place site.

A Site walkover was undertaken on 27 July 2023 by two WSP representatives. The key observations from the walkover are summarised within **Table 2-1**. Site walkover photos are presented in **Appendix D**.

Table 2-1 – Summary of Site Details

DETAILS	COMMENT
Name and Address of Site	Fulwood Place, High Holborn, London, WC1V 6AX (Set at the ground level rear of Chancery Station House, 31-33 High Holborn, London, WC1V 6AX)
National Grid Reference	531000, 181643
Site Description and Current Use	The Site comprises a mixed use 6-7 storey commercial building. The ground floor is currently occupied by an accountancy firm, the floors above comprise office space and residential properties. Beneath the ground floor of the Site are located the disused shaft entrances of the old Chancery Lane Underground Station and the Chancery Lane Deep Shelter (subsequently called the Kingsway Telephone Exchange). The Site is located on High Holborn Street with the Central Underground Line, the former Chancery Lane Tube Station (closed approximately 1930s) and the later Chancery Lane Deep Shelter west entrance below.
Area and Ground Cover	Approximately 0.03 ha. The entire footprint of the Site comprises building cover. External areas adjacent to the Site comprise walkways surfaced with paving slabs.
Site Setting and Surrounding Area	The Site is set within the London Borough of Camden and the surrounding areas comprise mixed residential apartments and commercial office buildings.
Topography	Based on OS mapping, the topography of the Site was noted to be relatively flat and level.
Trees and Vegetation	During the walkover, there was no vegetation observed on or adjacent to the Site.

3 SITE HISTORY

3.1 ON-SITE

Historical maps were obtained as part of the Groundsure report (**Appendix E**) and were reviewed to identify potentially contaminative former land uses on-site.

The earliest available historical mapping from 1875 indicates the Site comprised of unlabelled buildings. Mapping from 1896 indicates that two of the buildings extending into the southern part of the Site were public houses. The Site remained in that configuration until the approximately 1916 when the Site is labelled as the Central Line's Chancery Lane Station. It is noted that the station was closed and disused in the 1930s but is not relabelled as such in the 1951 National Grid map. The Site has remained unchanged in its current configuration until the present day and the entrance to the Tunnels is still present beneath the building.

3.2 OFF-SITE

A review of the available mapping and satellite imagery has been undertaken for the Site. A summary of potential off-site sources of contamination, within 250m of the Site boundary, is presented within **Table 3-2**.

Table 3-2 – Summary of Pertinent History of the Surrounding Area

FEATURE	APPROX. DISTANCE AND DIRECTION	HISTORICAL MAP DATE/SCALE
Electrical Substation	45m east 180m east	1975 – 1994, County Series 1:2,500 1989 – 1994, County Series 1:2,500

4 ENVIRONMENTAL SETTING

4.1 GEOLOGY

The British Geological Survey (BGS) 'GeoIndex' online viewer indicates that the geology underling the Site predominantly comprises superficial deposits of Lynch Hill Gravel Member (Sand and Gravel) overlying London Clay Formation - Clay, Silt and Sand bedrock. The London Clay Formation is underlain at depth by the Lambeth Group, Thanet Formation and Chalk Group. Given the Site location and development history, man-made soils (Made Ground) are expected near the surface across the Site where the shafts and basements are absent. These soils are likely to exhibit a certain degree of heterogeneity. The nature of the material can be expected to vary substantially in both composition and thickness over short distances. It should be noted that the Site and surrounding area currently has underground infrastructure, therefore it is considered likely that the superficial deposits underlying the Site have been removed where underground infrastructure is present.

A publicly available BGS borehole log (ref: TQ38SW13) located approximately 16m south-east of the Site, logged to a depth of approximately 12m was reviewed and is presented in **Appendix F**. This log is summarised in **Table 4-1-1**.

Table 4-1 - Summary of Publicly Available Borehole Log

GEOLOGICAL UNIT / STRATUM	TOP OF UNIT (m bgl)	THICKNESS (m)	STRATA DESCRIPTION
Made Ground	0	0.6	Concrete Slab
Lynch Hill Gravel Member	0.6	0.8	Soft brown sandy silty clay with fine medium coarse gravel.
	1.4	3.5	Light brown fine medium coarse sand and fine medium, coarse gravel.
London Clay Formation	4.9	0.3	Stiff brown silty clay.
	5.2	7	Stiff blue grey fissured silty clay. Colour changes gradually from blue-grey to grey between 6 and 9m.

A publicly available BGS borehole log (ref: TQ38SW3150) located approximately 100m south-east of the Site, logged to a depth of approximately 54m was reviewed and is presented in **Appendix F**. This log is summarised in **Table 4-2**.

Table 4-2 - Summary of Publicly Available Borehole Log

GEOLOGICAL UNIT / STRATUM	TOP OF UNIT (m bgl)	THICKNESS (m)	STRATA DESCRIPTION
Basement below road level	0	3.6	

GEOLOGICAL UNIT / STRATUM	TOP OF UNIT (m bgl)	THICKNESS (m)	STRATA DESCRIPTION
River Gravel	3.6	4.5	Ballast
London Clay Formation	8.1	25.9	Stiff brown silty clay
Reading Beds	34	4.5	Coloured mottled clay
	38.5	2.1	Sand and water
	40.6	4.5	Coloured mottled sandy clay and pebbles
	46.1	0.6	Pebbles, sand and oyster shells
	46.7	1.2	Sand and small pebbles
Thanet Formation	47.9	6.8	Fine Thanet sands and water

4.2 GROUND STABILITY HAZARDS

Information on potential ground hazards assessed by the BGS, and included within the Groundsure report are summarised in **Table 4-3.**

Table 4-3 - Ground Stability Hazards on Site

FEATURE	HAZARD
Collapsible deposits	Very Low
Compressible deposits	Negligible
Ground dissolution of soluble rocks	Negligible
Landslides	Very Low
Running sands	Very Low
Shrinking or swelling clays	Moderate

4.3 HYDROGEOLOGY

The superficial Lynch Hill Gravel Member (Sand and Gravel) is classified as a Secondary A Aquifer. The London Clay Formation is classified as Unproductive strata. The Lambeth Group and Thanet Formation are classified as Secondary A Aquifers, and the Chalk Group is classified as a Principal Aquifer. The EA does not classify Made Ground deposits, however, there is the potential for groundwater to be present as localised pockets of perched water.

There are no recorded surface or groundwater abstractions within 250m of Site. However, historical mapping shows a pump labelled approximately 90m north-east of the Site in Gray's Inn Square. The depth and source of this pump are unknown, and it is no longer present on present day OS mapping.

The Site is not located within a Source Protection Zone (SPZ).

4.4 HYDROLOGY

The River Thames is located approximately 840m south of the Site boundary. The Fleet River (a lost river) is located approximately 550m east of the Site boundary.

4.5 PRELIMINARY HYDROGEOLOGICAL MODEL

The Lynch Hill Gravel Member, indicated to be present underlying the Site, is classified as a Secondary A Aquifer. Groundwater within the Lynch Hill Gravel Member aquifer is expected to flow south / south-east towards the River Thames. However, given the distance from the Site to the River Thames, it is considered unlikely that groundwater within the Lynch Hill Gravel Member underlying the Site will significantly impact the River Thames. It is also acknowledged that the presence of below ground structures underlying the Site, may have removed the superficial deposits and / or create localised variations in the flow of groundwater.

It is understood that the Tunnels are located approximately 30m below the existing street level and there is a shaft underlying the Site which connects to the Tunnels. Based on this, it is considered that the below ground infrastructure has breached the base London Clay Formation underlying the Site leading to localised hydraulic connectivity between groundwater within the Lynch Hill Gravel Member and the deeper aquifers of the Lambeth Group, Thanet Formation and the Chalk.

4.6 ENVIRONMENTALLY SENSITIVE SITES

The Site are not within a Nitrate Vulnerability Zone (NVZ).

The Site is also located within a Site of Special Scientific Interest (SSSI) Impact Risk Zone. However, this is considered unlikely to be pertinent in the context of contaminated land as the Impact Risk Zone only applies to applications of aviation, air pollution and combustion developments.

4.7 FLOODING

The UK Government's Flood Risk Map website indicates that the Fulwood Place Site is located in an area classified as Flood Zone 1 indicating a Low probability of flooding from rivers and the sea and from surface waters, where the annual risk of flooding is less than 0.1%.

4.8 RADON

The UK Health Security Agency (UKHSA) website shows that the Site is located within an area where less than 1% of properties are above the above the action level for radon gas. However, given that the Proposed Scheme includes the provision of occupied below ground spaces within basements, shafts and tunnels, consideration should be given to further monitoring and assessment in line with UKHSA guidance.

5 REGULATORY INFORMATION AND CONSULTATION

5.1 REGULATORY DATABASE

The Groundsure reports include information and data collected from several organisations including the Environment Agency (EA), the Local Authority, the British Geological Survey (BGS), Department for Environment, Food & Rural Affairs (Defra), Health & Safety Executive (HSE), and the National Radiological Protection Board (NRPB).

WSP considers the databases listed in **Table 5-1** to represent those of potential concern in relation of contamination.

The Groundsure report indicates that there are active contemporary trade directories located within 500m of the Site related to commercial and industrial businesses including a Civil Engineering Services directory located 50m south, Vehicle Hire and Rental directory located 61m east, a Rubber, Silicones and Plastics products directory located 61m southeast and a Mechanical Engineering Services directory located 64m southeast. However, it was determined using remote sensing and from a walkover of the surrounding areas that these directories are office spaces and are likely to contain no potentially contaminative activities or processes. Additionally, Groundsure lists several potential contaminative land-uses and records that are summarised in **Table 5-1**.

Table 5-1 Summary of Database Search

DESCRIPTOR	ON-SITE	0-250m	251-500m	DETAILS
Historical Tanks	0	0	6	Six unspecified tanks located at distance from the Site with closest being approximately 265m east and furthest at 435m south-east. Note that Groundsure indicate a tank present approximately 188m south-east of Site. This feature is not a tank and is labelled as a turntable on OS maps.
Licenced Waste Sites	0	0	1	Single recorded site is approximately 360m east of the Site.
Waste Exemptions	0	5	27	The majority of the records are dry cleaners' outlets and are outside the zone of influence of the Site.
Licensed industrial activities (Part A(1))	0	0	1	Closest is approximately 450m south-east and is a New Medium Combustion Plant.
Licensed Pollutant Release (Part A(2)/B)	0	1	13	Records comprise a mix of four metals related activities located approximately 415m, 435m, 455m and 460m north-east of the Site. Remaining ten being Dry Cleaners including closest at approximately 157m north-east.
Surface Ground Workings	0	1	0	Unspecified surface ground workings dated to 1898 associated with the Gray's Inn Gardens.

DESCRIPTOR	ON-SITE	0-250m	251-500m	DETAILS
Pollutant Release to Public Sewer	0	0	1	Single historical record located approximately 290m south-east of the Site from 2005 to 2018.
Underground Railways (London)	0	1	0	London Underground Central Line is aligned approximately 35m south of the Site running east – west.
Crossrail 1	0	0	2	Tunnel alignments for the Crossrail 1 project (Elizabeth Line) running east – west approximately 135m north at closest point.

5.2 LOCAL AUTHORITY

London Borough of Camden was contacted by email on 2 June 2023 with a request to provide environmentally pertinent information relating to Fulwood Place that may be in their records. A response was received on the 22 June 2023 which confirmed that the Site has not been determined as contaminated land under Part IIA of the EPA. No records of further information regarding the Site that has not already been highlight from other sources was provided. The full correspondence is recorded in **Appendix H**.

5.3 ENVIRONMENT AGENCY

The Environment Agency (EA) was contacted by email on 31 May 2023 for environmental information held within their databases relating to Fulwood Place. A response was received from the EA on the 22 June 2023 and returned that the EA had no records of any further pertinent information regarding the Site that has not already been collected and reported from the Groundsure Report. The full correspondence is recorded in **Appendix H**.

5.4 UNEXPLODED ORDNANCE

A preliminary pre-desk study assessment was undertaken by Zetica, to provide an indication of risk from unexploded ordnance (UXO) at the Site and is presented in **Appendix G**.

The assessment indicated that the Site is at a **High** risk (as defined by Zetica) of Unexploded Ordinance. Given this, further assessment of the risk, or employment of mitigation measures is likely to be required prior to intrusive works at the Site.

6 PRELIMINARY CONCEPTUAL MODEL

6.1 INTRODUCTION

The preliminary Conceptual Site Model (CSM) is based upon the environmental conditions of the Site as described in the previous Sections and was developed in the context of the Proposed Scheme.

The assessment follows a risk-based approach, with potential environmental risk assessed qualitatively using the 'source-pathway-receptor' contaminant linkage concept introduced in the guidance documents (principally the Environment Agencies LCRM guidance) on the practical implementation of the Environmental Protection Act 1990.

Environmental risk can be defined as the combination of the consequence of a harmful effect and the probability of its occurrence. The existence of a contaminant linkage is primarily dependent on-site usage and environmental conditions.

The environmental risk assessment has been carried out by identifying and evaluating the significance of the following:

- **Potential sources of contamination:** these include any actual or potentially contaminating materials and activities, located either on or in the vicinity of the Site;
- **Potential receptors of contamination:** these include future land users, activities or persons at the Site; and,
- **Potential pathways for contaminant migration:** these are the routes or mechanisms by which contaminants may migrate from the source to the receptor.

Separate preliminary Conceptual Site Models have been developed for Furnival Street and Fulwood Place.

6.2 POTENTIAL SOURCES OF CONTAMINATION

Table 6-1 provides a summary of the potential sources of contamination that may be present at the Site, as well as the likely nature of such sources.

Table 6-1 - Potential Sources of Contamination

POTENTIAL SOURCE	POTENTIAL CONTAMINANTS OF CONCERN	LIKELY / ANTICIPATED DISTRIBUTION
ON-SITE		
Made Ground	Full range of contaminants including metals, inorganics (e.g. cyanide), petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), ground gas (methane and carbon dioxide) and asbestos	Extensive Made Ground anticipated to be present across the Site associated with the historical redevelopment.
Historical use as personnel lift for the Tunnels.	Metals, oils (including fuels and minerals) and asbestos.	Potential contaminants of concern could be located across the entire Site at both a shallow and deep level below ground.

POTENTIAL SOURCE	POTENTIAL CONTAMINANTS OF CONCERN	LIKELY / ANTICIPATED DISTRIBUTION
	OFF-SITE	
Electrical Substations	Metals, metalloids, PCBs and mineral oils.	Approximately 61m east and 176m east
Pumping Station	Metals, metalloids, PCBs and mineral oils.	Approximately 88m north and 162m east

6.3 POTENTIAL RECEPTORS

In the context of the future proposed development, the following potential receptors were identified:

Human Health

- Future site users;
- Future construction and maintenance workers; and,
- Third party residential and commercial neighbours.

Controlled Waters

- Groundwater within the Lynch Hill Gravel Member (Secondary A Aquifer);
- Lambeth Group (Secondary A Aquifer)
- Thanet Formation (Secondary A Aquifer)
- Chalk Group (Principal Aquifer)

Other

- Underground services; and
- Underground tunnels and facilities.

No new areas of landscaping are proposed, therefore, risks to plant life will not be assessed further.

The River Thames has been discounted as a receptor due to its distance from the Site is unlikely to be significantly influenced by groundwater underlying the Site.

Fleet River has been discounted as a receptor due to its distance from the Site and the culverted and storm drain integrated nature of the rivers path to the River Thames. Therefore, the culverted River Fleet is considered unlikely to be in hydraulic continuity with groundwater underlying the Site.

6.4 Plausible Preliminary Contaminant Linkages

Table 6-2 provides an evaluation of the potential contaminant linkages that were considered to be plausible on the basis of the information currently available for the Site.

Table 6-2 - Plausible Contaminant Linkages

POTENTIAL CONTAMINANT SOURCES	RECEPTOR	PATHWAYS	COMMENTS
ON-SITE			
▪ **Made Ground** ▪ **Elevator equipment associated with historical use of the Site** ▪ **Old tunnel and shaft facilities**	**Human Health** ▪ Future site users ▪ Future maintenance workers ▪ Third party residential and commercial neighbours	▪ Dermal contact ▪ Ingestion of impacted soil particles on-site, and windblown to neighbouring properties. ▪ Inhalation of dust and asbestos fibres, and windblown to adjacent properties ▪ Migration of ground gas and volatile vapours into buildings.	Based on the historical development of the Site, Made Ground is considered likely to be present. The Proposed Scheme includes minor intrusive works proposed which are likely to require some breaking of ground or hardstanding across parts of the Site. The entirety of the Site is covered by hardstanding or building cover. Construction of the Proposed Scheme may require the occasional breaking of ground and excavation of Made Ground. It is therefore possible for Site construction workers to encounter asbestos or contaminated soils during works, therefore the risk to site workers is considered to be **Low to Moderate**. The same risks would be present for future maintenance workers who would be required to break ground. However, these risks should be managed with Health and Safety protocols during the works. Following scheme completion, it likely that any areas of exposed workings would be sealed and hardcovered. Future site users and third-party residential and commercial neighbours are therefore unlikely to come into contact with asbestos or contaminated materials or soils during construction and occupation, therefore the risk to site neighbours is considered to be **Low** but the risks during construction should be managed with Health and Safety protocols during the works.

POTENTIAL CONTAMINANT SOURCES	RECEPTOR	PATHWAYS	COMMENTS
			In addition, the existing and proposed site use is commercial with likely frequent human use. It is assumed that the building and basement has a modern construction with ventilation and adequate waterproofing and sealant, therefore the risk from migration of ground gas and volatile vapours into the building and basement is considered to be **Low**.
	Controlled Waters ▪ Secondary A Aquifer (within the Lynch Hill Gravel Member) ▪ Lambeth Group (Secondary A Aquifer) ▪ Thanet Formation (Secondary A Aquifer) ▪ Chalk Group (Principal Aquifer)	▪ Vertical and lateral leaching from impacted soil and lateral migration of impacted groundwater derived from on-Site Vertical and lateral migration via groundwater via exposed profiles from intrusive groundworks in proposed basement and piling works.	The hydrogeological model indicates that groundwater within underlying Made Ground and superficial Lynch Hill Gravel Member has the potential to be present, however may be interrupted or absent due to structures underlying the Site. The majority of the Site is covered by hardstanding and building cover which greatly reduces infiltration and therefore potential leaching of any contaminants into the Made Ground and further into Lynch Hill Gravel Member from surface contamination. Groundwater within the deeper aquifers within the Lambeth Group, Thanet Formation and Chalk Group is present at depth of greater than approximately 42m and is likely to be protected by the London Clay acting as an aquitard which is likely to have bottom depth of approximately 42m. However, where existing and proposed shafts exceed the depth of the bottom of the London Clay, a preferential pathway for the vertical migration of contaminants into the deeper aquifers. There is the potential for contaminants to impact on groundwater units through the existing and potential preferential pathway. However, it is noted that significantly contaminative land uses on the Site and within the surrounding area have not been identified. Therefore, the risk is considered to be **Low.**

POTENTIAL CONTAMINANT SOURCES	RECEPTOR	PATHWAYS	COMMENTS
	Infrastructure and Services ▪ Underground services ▪ Underground tunnels and facilities	▪ Direct contact with impacted soils and groundwater (chemical attack and degradation from aggressive contaminants)	There is the potential for contaminants to pose risks to water pipes and below ground structures. Soils with high sulphate or sulphide contents and petroleum hydrocarbons may exist and may present a risk to buried concrete. The Proposed Scheme includes minor groundworks likely to include a concrete lined basement, additionally the geological conditions present suggest that aggressive ground conditions may be present causing a risk to below ground structures and services. Therefore, the risk to underground structures and services is considered to be **Low to Moderate.**
OFF-SITE			
▪ **Made Ground** ▪ **Electrical Substations** ▪ **Pumping Station**	▪ **Human Health** ▪ Future site users ▪ Future maintenance workers	▪ Migration of ground gas ▪ Inhalation of dust and asbestos fibres windblown from neighbouring properties.	Ground gas generated from Made Ground surrounding the Site may migrate laterally within the subsurface and accumulate in enclosed spaces which may pose a risk of asphyxiation or explosion. It is considered likely that the below ground structures (basement and shafts) will be constructed with appropriate ventilation, therefore mitigating potential ground gas accumulation. Thus, the risk of ground gas migration is considered to be **Low**. The area surrounding the Site is predominantly covered with hardstanding, therefore, the risk from wind-blown dust impacting human health receptors on the Site is considered to be **Low**.
	Controlled Waters ▪ Secondary A Aquifer (within the Lynch Hill Gravel Member)	▪ Lateral migration of contaminants via impacted groundwater	The hydrogeological model indicates that groundwater may be present in the underlying Made Ground and superficial Lynch Hill Gravel Member. The London Clay underlying the Lynch Hill Gravel Member is likely to act as an aquitard which will prevent groundwater from migrating vertically. There is some potential for

POTENTIAL CONTAMINANT SOURCES	RECEPTOR	PATHWAYS	COMMENTS
	▪ Lambeth Group (Secondary A Aquifer) ▪ Thanet Formation (Secondary A Aquifer) ▪ Chalk Group (Principal Aquifer)		contaminants from off-site sources to migrate onto Site within groundwater. However, given the lack of contaminative surrounding land uses, the risk to groundwater from off-site sources is considered to be **Low**.
	Infrastructure and Services ▪ Underground services. ▪ Underground tunnels and facilities	▪ Lateral migration of contaminants via impacted groundwater	There is the potential for contaminants to pose risks to water pipes and below ground structures due to off-site Sources. However, significant off-site sources of contamination have not been identified within vicinity of the Site. Therefore, risk to underground services, facilities and structures from off-site sources is considered to be **Low**.

7 SUMMARY OF THE SITE AND SURROUNDING AREA

7.1 SITE DESCRIPTION AND CURRENT USE

Table 7-1 summarises the details obtained from a desk based review of the 38, 39, 40 and 41 Furnival Street site.

A Site walkover was undertaken on 27 July 2023 by two WSP representatives. The key observations from the walkover are summarised in **Table 7-1**. Site walkover photos are presented in **Appendix D**.

Table 7-1 – Summary of Site Details

DETAILS	COMMENT
Name and Address of Site	38, 39, 40 and 41 Furnival Street, London, EC4A 1AB
National Grid Reference	531217, 181535
Site Description and Current Use	The Site comprises a two storey brick building which houses a disused freight elevator and associated equipment for the operation of the elevator. The Site is currently not in use and has not been since the closure of the Tunnels. It is understood that the Tunnels are located approximately 60m below the existing street level.
Area and Ground Cover	Approximately 0.03 hectares (ha). The entire footprint of the Site comprises building cover. External areas adjacent to the Site, along 38, 39, 40 and 41 Furnival Street, comprise a walkway surfaced with paving slabs.
Site Setting and Surrounding Area	The Site is set within the City of London and the surrounding areas comprise almost entirely mixed residential apartments and commercial office buildings. It is set approximately 40m south of High Holborn Street, under which the Central Underground Line runs.
Topography	Based on OS mapping and the walkover, the topography of the Site was noted to be relatively flat and level.
Trees and Vegetation	During the walkover, there is no vegetation on, adjacent or directly nearby the Site.

8 SITE HISTORY

8.1 ON-SITE

Historical maps were obtained as part of the Groundsure report (**Appendix E**) and were reviewed to identify potentially contaminative former land uses on-site.

The earliest available historical mapping from 1875 indicates the Site comprised unlabelled buildings. The Site remained in that configuration until the circa 1940 when the current building was constructed on 39-38 Furnival Street. 40 Furnival Street remained unchanged during this period, but showed 41 Furnival Street to also be within the footprint of the building. 40 Furnival Street remained unchanged until the late 1980s when the existing office building was constructed. In 2003, 41 Furnival Street is no longer labelled within 40 Furnival Street's building footprint. 39-38 Furnival Street remained unchanged during this time. At the time of writing, the equipment and internal structures for the operation of the freight lift to the Tunnels below are still present inside 39-38 Furnival Street.

8.2 OFF-SITE

A review of the available mapping and satellite imagery has been undertaken for the Site. A summary of potential off-site sources of contamination, within 250m of the Site boundary, is presented within **Table 8-1**.

Table 8-1 – Summary of Pertinent History of the Surrounding Area

FEATURE	APPROX. DISTANCE AND DIRECTION	HISTORICAL MAP DATE/SCALE
Distillery	50m east	1875, Town Plan 1:1,056 1878, County Series 1:2,500 1896, Town Plan 1:1,056
Unspecified Station	220m north-west	1920, County Series 1:2,500
Electrical Substations	65m south-east 140m north 185m north-west 235m south 245m south-east	1971 – 1989, County Series 1:2,500 1989 – 1994, County Series 1:2,500 1975 – 1991, County Series 1:2,500 1989 – 1995, County Series 1:2,500 1971 – 1995, County Series 1:2,500
Unspecified Tanks	155m south 160m north 250m south	1995, County Series 1:2,500 1951 – 1957, County Series 1:2,500 1916, County Series 1:2,500
Tinfoil Manufactory	250m north	1878, County Series 1:2,500

9 ENVIRONMENTAL SETTING

9.1 GEOLOGY

The British Geological Survey (BGS) 'GeoIndex' online viewer indicates that the geology underling the Site comprises superficial deposits of Hackney Gravel Member (Sand and Gravel) overlying London Clay Formation - Clay, Silt and Sand bedrock. The London Clay Formation is underlain at depth by the Lambeth Group, Thanet Formation and Chalk Group. Given the Site location and development history, man-made soils (Made Ground) are expected near the surface across the Site. These soils are likely to exhibit a certain degree of heterogeneity. The nature of the material can be expected to vary substantially in both composition and thickness over short distances. It should be noted that the Site currently has underground infrastructure associated with a lift shaft, therefore it is considered that the superficial deposits may have been removed underlying the Site.

A publicly available BGS borehole log (ref: TQ38SW126) recorded approximately 48m northwest of the Site, logged to a depth of approximately 40m was reviewed and is presented in **Appendix F**. This log is summarised in **Table 9-1** below.

Table 9-1 – Summary of Publicly Available Borehole Log

GEOLOGICAL UNIT / STRATUM	TOP OF UNIT (m bgl)	THICKNESS (m)	STRATA DESCRIPTION
Made Ground	0.00	0.9	Concrete and Hardcore Fill
Hackney Gravel Member	0.9	1.5	Sandy Clay and Gravel
	2.4	2.9	Medium sand and gravel getting coarser with depth
	5.3	0.7	Firm brown sandy clay and gravel
London Clay Formation	6.1	16.5	Stiff grey-blue silty fissured clay with some sand content
	22.6	2.1	Stiff grey-blue sandy fissured clay
	24.7	1.8	Stiff grey-blue fissured clay
	26.5	1.8	Stiff grey-blue sandy fissured clay
	28.3	6.9	Stiff brown, grey and red mottled fissured clay
	35.2	1.8	Compact light grey fine sand
	37	0.9	Stiff dark grey fissured clay
	37.9	0.5	Firm grey, green and red mottled clay with traces of limestone
	38.4	0.6	Stiff brown, grey and red mottled fissured clay

A publicly available BGS borehole log (ref: TQ38SW2887) recorded approximately 49m southwest of the Site, was logged to a depth of approximately 198.1m from a starting depth of 36m below ground level (bgl) (records of upper 36m of logs are not available as not recorded) was reviewed and is presented in **Appendix F**. This log is summarised in **Table 9-2** below.

Table 9-2 – Summary of Publicly Available Borehole Log

GEOLOGICAL UNIT / STRATUM	TOP OF UNIT (m bgl)	THICKNESS (m)	STRATA DESCRIPTION
London Clay Formation	36	6	Mottle Clay
Woolwich and Reading Beds (Lambeth Group)	42	2.7	Grey Sand
	44.7	3	Mottle Clay
	47.7	0.9	Sandy Clay and Pebbles
	58.6	0.6	Green Sand and Pebbles
Thanet Formation	59.2	2.4	Green Sand and Pebbles and Shells
	61.6	9	Green Sand
	70.6	0.2	Green Coated Flints
Chalk Group	70.8	29.8	Chalk and Flints (dry)
	100.6	3	Chalk and Flints (previously water bearing now dry)
	103.6	94.5	Chalk and Flints

Based on the observed geology identified within nearby boreholes, it is anticipated that the Kingsway Tunnels are founded within the London Clay and Lambeth Group Formation (at approximately 30m bgl).

9.2 GROUND STABILITY HAZARDS

Information on potential ground hazards assessed by the BGS, and included within the Groundsure report are summarised in **Table 9-3**.

Table 9-3 - Ground Stability Hazards on Site (38, 39, 40 and 41 Furnival Street)

FEATURE	HAZARD
Collapsible deposits	Very Low
Compressible deposits	Negligible

FEATURE	HAZARD
Ground dissolution of soluble rocks	Negligible
Landslides	Very Low
Running sands	Very Low
Shrinking or swelling clays	Moderate

9.3 HYDROGEOLOGY

The superficial Hackney Gravel Member (Sand and Gravel) is classified by the Environment Agency (EA) as a Secondary A Aquifer and the London Clay Formation is classified as an Unproductive Aquifer. The Lambeth Group and Thanet Formation are classified as Secondary A Aquifers, and the Chalk Group is classified as a Principal Aquifer. The EA does not classify Made Ground deposits, however, there is the unlikely potential for groundwater to be present as localised pockets of perched water rather than a continuous waterbody.

There are no surface or groundwater abstractions within 250m of Site.

The Site is not located within a Source Protection Zone (SPZ).

9.4 HYDROLOGY

The River Thames is located approximately 740m from the south of the Site boundary.

The Fleet River (a lost river) is located approximately 350m east of the Site boundary.

9.5 HYDROGEOLOGICAL MODEL

The Hackney Gravel Member is indicated to be present across the entirety of the Site, is classified as a Secondary A Aquifer. Groundwater within the Hackney Gravel Member aquifer is expected to flow south / south-east towards the River Thames. However, given the distance from the Site to the River Thames, it is considered unlikely that groundwater within the Hackney Gravel Member underlying the Site will significantly impact the River Thames. There is the potential for groundwater within the Hackney Gravel Member to be interrupted by below ground structures on the Site.

It is understood that the Kingsway Tunnels are located approximately 30m below the existing street level and there is a shaft underlying the Site which connects to the Tunnels. Based on this, it is considered likely that the below ground infrastructure has breached the London Clay Formation underlying the Site leading to localised hydraulic connectivity between groundwater within the Hackney Gravel Member and the deeper aquifers of the Lambeth Group, Thanet Formation and the Chalk.

9.6 ENVIRONMENTALLY SENSITIVE SITES

The Site is not within a Nitrate Vulnerability Zone (NVZ).

The Site is also located within a Site of Special Scientific Interest (SSSI) Impact Risk Zone. However, this is considered unlikely to be pertinent in the context of contaminated land as the Impact Risk Zone only applies to applications of aviation, air pollution and combustion developments.

9.7 FLOODING

The UK Government's Flood Risk Map website indicates that the 38, 39, 40 and 41 Furnival Steet Site is located in an area classified as Flood Zone 1 indicating a Low probability of flooding from rivers and the sea and from surface waters, where the annual risk of flooding is less than 0.1%.

9.8 RADON

The UK Health Security Agency (UKHSA) website shows that the 38, 39, 40 and 41 Furnival Steet Site is located within an area where less than 1% of properties are above the above the action level for radon gas. However, given that the Proposed Scheme includes the provision of occupied below ground spaces within basements, shafts and tunnels, consideration should be given to further monitoring and assessment in line with UKHSA guidance.

10 REGULATORY INFORMATION AND CONSULTATION

10.1 REGULATORY DATABASE

The Groundsure reports include information and data collected from several organisations including the Environment Agency (EA), the Local Authority, the British Geological Survey (BGS), Department for Environment, Food & Rural Affairs (Defra), Health & Safety Executive (HSE), and the National Radiological Protection Board (NRPB).

WSP considers the databases listed in **Table 10-1** to represent those of potential concern in relation of contamination.

The Groundsure report indicates that there are active contemporary trade directories located within 500m of the Site related to commercial and industrial businesses including a Published Goods directory located 32m northeast, Special Purpose Machinery and Equipment directory located 32m northeast and a Water Pumping Station located 58m northwest. However, it was determined using remote sensing and from a walkover of the surrounding areas that these directories are office spaces and are likely to contain no potentially contaminative activities or processes. Additionally, Groundsure lists several potential contaminative land-uses and records that are summarised in **Table 10-1**.

Table 10-1 – Summary of Database Search

DESCRIPTOR	ON-SITE	0-250m	251-500m	DETAILS
Historical Tanks	0	3	5	Three records of unspecified tanks located in proximity to Site at approximately 155m south, 160m north and 250m south. Five unspecified tanks located at distance from the Site with closest being approximately 365m south-east and furthest at 450m north-east. It is noted that the Groundsure report indicates a tank present approximately 26m north-west of Site. This feature is not a tank and is labelled as a turntable on OS maps.
Licenced Waste Sites	0	1	0	Single recorded site is approximately 130m east of the Site.
Waste Exemptions	0	9	29	The majority of the records are dry cleaners' outlets and are outside the zone of influence of the Site.
Licensed Industrial Activities (Part A(1))	0	1	1	Closest is approximately 230m south-east and is a New Medium Combustion Plant, second record is for multiple records for a single site approximately 450m north-east and is a New Medium Combustion Plant and associated processes.
Pollutant Release to Public Sewer	0	1	0	Single historical record located approximately 80m south-east of the Site from 2005 to 2018.

DESCRIPTOR	ON-SITE	0-250m	251-500m	DETAILS
Underground Railways (London)	0	1	0	London Underground Central Line is aligned approximately 40m north of the Site running east – west.
Crossrail 1	0	1	0	Tunnel alignments for the Crossrail 1 project (Elizabeth Line) running east – west approximately 195m north at closest point.

10.2 LOCAL AUTHORITY

The City of London Council was contacted by email on 31 May 2023 with a request to provide environmentally pertinent information relating to 38, 39, 40 and 41 Furnival Street that may be in their records. A response was received from the City of London Environmental Health Officer on the 22 June 2023. The local authority confirmed that the Site has not been classified as contaminated land under Part 2A of the EPA and has not been identified for further review under the authorities contaminated land strategy. Further pertinent information regarding the Site that has not already been collected and reported from the Groundsure Report. The full correspondence is recorded in **Appendix H**.

10.3 ENVIRONMENT AGENCY

The Environment Agency (EA) was contacted by email on 31 May 2023 for environmental information held within their databases relating to 38, 39, 40 and 41 Furnival Street. A response was received from the EA on the 22 June 2023. The EA had no records of any further pertinent information regarding the Site that has not already been collected and reported from the Groundsure Report. The full correspondence is recorded in **Appendix H**.

10.4 UNEXPLODED ORDNANCE

A preliminary pre-desk study assessment was undertaken by Zetica, to provide an indication of risk from unexploded ordnance (UXO) at the Site and is presented in **Appendix G**.

The assessment indicated that the Site is at a High risk (as defined by Zetica) of Unexploded Ordinance. Based on this further assessment, or mitigation measures will be required prior to intrusive works.

11 PRELIMINARY CONCEPTUAL MODEL

11.1 INTRODUCTION

The preliminary Conceptual Site Model (CSM) is based upon the environmental conditions of the Site as described in the previous Sections and was developed in the context of the Proposed Scheme.

The assessment follows a risk-based approach, with potential environmental risk assessed qualitatively using the 'source-pathway-receptor' contaminant linkage concept introduced in the guidance documents (principally the Environment Agencies LCRM guidance) on the practical implementation of the Environmental Protection Act 1990.

Environmental risk can be defined as the combination of the consequence of a harmful effect and the probability of its occurrence. The existence of a contaminant linkage is primarily dependent on-site usage and environmental conditions.

The environmental risk assessment has been carried out by identifying and evaluating the significance of the following:

- Potential sources of contamination: these include any actual or potentially contaminating materials and activities, located either on or in the vicinity of the Site;
- Potential receptors of contamination: these include future land users, activities or persons at the Site; and,
- Potential pathways for contaminant migration: these are the routes or mechanisms by which contaminants may migrate from the source to the receptor.

Separate preliminary Conceptual Site Models have been developed for 38, 39, 40 and 41 Furnival Street and Fulwood Place.

11.2 POTENTIAL SOURCES OF CONTAMINATION

Table 11-1 provides a summary of the potential sources of contamination that may be present at the Site, as well as the likely nature of such sources.

Table 11-1 – Potential Sources of Contamination

POTENTIAL SOURCE	POTENTIAL CONTAMINANTS OF CONCERN	LIKELY / ANTICIPATED DISTRIBUTION
ON-SITE		
Made Ground	Full range of contaminants including metals, inorganics (e.g. cyanide), petroleum hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), ground gas (methane and carbon dioxide) and asbestos	Made Ground anticipated to be present across the Site associated with the development of the Site.
Historical use as freight lift for the Kingsway Tunnels.	Metals, oils (including fuels and minerals) and asbestos.	Potential contaminants of concern could be located across the entire Site.
OFF-SITE		

POTENTIAL SOURCE	POTENTIAL CONTAMINANTS OF CONCERN	LIKELY / ANTICIPATED DISTRIBUTION
Electrical Substations	Metals, metalloids, Polychlorinated Biphenyls (PCBs) and mineral oils.	Approximately 141m north and 187m northwest.
Pumping Station	Metals, metalloids, PCBs, hydrocarbon, PAH, fuels and mineral oils.	Approximately 58m northwest of the Site.
Distillery	Metals, metalloids, hydrocarbons, PAH, fuels and mineral oils, organic compounds, solvents and cleaning solutions.	50m east
Unspecified Tanks	Dependant on contents of tanks but could include hydrocarbon fuels, fuel oils and mineral oils.	155m south 160m north 250m south
Tinfoil Manufactory	Metals, metalloids, hydrocarbons, PAH, fuels and mineral oils, solvents and cleaning solutions.	250m north

11.3 POTENTIAL RECEPTORS

In the context of the future proposed development, the following potential receptors were identified:

Human Health

- Future site users;
- Future construction and maintenance workers; and,
- Third party neighbours.

Controlled Waters

- Groundwater within the Hackney Gravel Member (Secondary A Aquifer);
- Lambeth Group (Secondary A Aquifer)
- Thanet Formation (Secondary A Aquifer)
- Chalk Group (Principal Aquifer)

Buildings and Infrastruture

- Underground services; and
- Underground tunnels and facilities.

No new areas of landscaping are proposed, therefore, risks to plant life will not be assessed further.

The River Thames has been discounted as a receptor due to its distance from the Site is unlikely to be significantly influenced by groundwater underlying the Site.

Fleet River has been discounted as a receptor due to its distance from the Site and the culverted and storm drain integrated nature of the rivers path to the River Thames. Therefore, the culverted River Fleet is considered unlikely to be in hydraulic continuity with groundwater underlying the Site.

11.4 PLAUSIBLE PRELIMINARY CONTAMINANT LINKAGES

Table 11- 2 provides an evaluation of the potential contaminant linkages that were considered to be plausible on the basis of the information currently available for the Site.

Table 11-2 – Plausible Contaminant Linkages

POTENTIAL CONTAMINANT SOURCES	RECEPTOR	PATHWAYS	COMMENTS
ON-SITE			
▪ **Made Ground** ▪ **Elevator equipment associated with historical use of the Site** ▪ **Old tunnel and shaft facilities**	**Human Health** ▪ Future site users ▪ Future maintenance workers ▪ Third party neighbours	▪ Dermal contact ▪ Ingestion of impacted soil particles on-site, and windblown to neighbouring properties. ▪ Inhalation of dust and asbestos fibres, and windblown to adjacent properties ▪ Migration of ground gas and volatile vapours into buildings.	Based on the historical development of the Site, Made Ground is considered likely to be present. Construction of the Proposed Scheme will require the widespread breaking of ground and excavation of Made Ground and Superficial Deposits. Site construction workers are therefore likely to come into contact with asbestos or contaminated soils during works, therefore the risk to site workers is considered to be **Low to Moderate**. However, these risks should be managed with Health and Safety protocols during the works. Following Scheme completion, it likely that any areas of exposed workings would be sealed and hardcovered. Future site users and maintenance workers, and third-party neighbours are therefore unlikely to come into contact with asbestos or contaminated soils during works, therefore the risk to site workers is considered to be **Low**. Where existing and proposed shafts and basements are excavated on the 38, 39, 40 and 41 Furnival

POTENTIAL CONTAMINANT SOURCES	RECEPTOR	PATHWAYS	COMMENTS
			Street Footprint, it will incur the removal of all the Made Ground and Superficial Deposits. This will also remove any contaminated soils or groundwater within those strata and therefore the risk to human health is considered to be **Negligible** at these locations. In addition, the existing and proposed site use is commercial with likely frequent human use. It is assumed that the building and basement has a modern construction with ventilation and adequate waterproofing and sealant, therefore the risk from migration of ground gas and volatile vapours into the building and basement is considered to be **Low**.
	Controlled Waters ▪ Secondary A Aquifer (within the Hackney Gravel Member) ▪ Lambeth Group (Secondary A Aquifer) ▪ Thanet Formation (Secondary A Aquifer) ▪ Chalk Group (Principal Aquifer)	▪ Vertical and lateral leaching from impacted soil and lateral migration of impacted groundwater derived from on-Site Vertical and lateral migration via groundwater via exposed profiles from intrusive groundworks in proposed basement and piling works.	The hydrogeological model indicates that groundwater within underlying Made Ground and superficial Hackney Gravel Member has the potential to be present, however may be interrupted or absent due to structures underlying the Site. Groundwater within the deeper aquifers within the Lambeth Group, Thanet Formation and Chalk Group is present at depth of greater than approximately 42m and is considered to be protected by the London Clay acting as an aquitard. There is considered to be **Negligible** risk of contamination to the shallow aquifer within the Hackney Gravel Member. However, proposed shafts and basements within the footprint of 38, 39, 40 and 41 Furnival Street will incur the removal of all the Made Ground and Superficial Deposits. This will also remove any contaminated soils or groundwater within those strata and such will

POTENTIAL CONTAMINANT SOURCES	RECEPTOR	PATHWAYS	COMMENTS
			no longer present a risk to the underlying Aquifers. Therefore, the risk to aquifers below 38, 39, 40 and 41 Furnival Street is considered to be **Negligible**.
	Infrastructure and Services ▪ Underground services ▪ Underground tunnels and facilities	▪ Direct contact with impacted soils and groundwater (chemical attack and degradation from aggressive contaminants)	There is the potential for contaminants to pose risks to water pipes and below ground structures. Soils with high sulphate or sulphide contents and petroleum hydrocarbons may exist and may present a risk to buried concrete. The Proposed Scheme includes minor groundworks likely to include a concrete lined basement, additionally the geological conditions present suggest that aggressive ground conditions may be present causing a risk to below ground structures and services. Therefore, the risk to underground structures and services is considered to be **Low.**
OFF-SITE			
▪ **Made Ground** ▪ **Electrical Substations** ▪ **Pumping Station** ▪ **Distillery** ▪ **Tinfoil Manufactory** ▪ **Unspecified Tanks**	**Human Health** ▪ Future site users ▪ Future maintenance workers	▪ Migration of ground gas ▪ Inhalation of dust and asbestos fibres windblown from neighbouring properties.	Ground gas generated from Made Ground surrounding the Site may migrate laterally within the subsurface and accumulate in enclosed spaces which may pose a risk of asphyxiation or explosion. It is considered likely that the below ground structures (basement and shafts) will be constructed with appropriate ventilation, therefore mitigating potential ground gas accumulation. Thus, the risk of ground gas migration is considered to be **Low**.

POTENTIAL CONTAMINANT SOURCES	RECEPTOR	PATHWAYS	COMMENTS
			The area surrounding the Site is predominantly covered with hardstanding, therefore, the risk from wind-blown dust impacting human health receptors on the Site is considered to be **Low**.
	Controlled Waters ▪ Secondary A Aquifer (within the Hackney Gravel Member) ▪ Lambeth Group (Secondary A Aquifer) ▪ Thanet Formation (Secondary A Aquifer) ▪ Chalk Group (Principal Aquifer)	▪ Lateral migration of contaminants via impacted groundwater	The hydrogeological model indicates that groundwater may be present in the underlying Made Ground and superficial Hackney Gravel Member. The London Clay underlying the Hackney Gravel Member is likely to act as an aquitard which will prevent groundwater from migrating vertically. There is some potential for contaminants from off-site sources to migrate onto Site within groundwater. However, given the lack of contaminative surrounding land uses, the risk to groundwater from off-site sources is considered to be **Low**.
	Infrastructure and Services ▪ Underground services. ▪ Underground tunnels and facilities	▪ Lateral migration of contaminants via impacted groundwater	There is the potential for contaminants to pose risks to water pipes and below ground structures due to off-site sources. However, significant off-site sources of contamination have not been identified in the vicinity of the Site. Therefore, the risk to underground services, facilities and structures from off-site sources is considered to be **Low to Moderate**.

12 CONCLUSIONS AND RECOMMENDATIONS

12.1 CONCLUSIONS

This report includes reference to two Sites associated with the Kingsway Tunnels. The first Site is Fulwood Place which is located at the historical location of the Chancery Lane Central Line Underground Station building at 31-33 High Holborn Street. The second Site is Furnival Street which is located at 38, 39 and 40 Furnival Street. Both of the Sites are located within a mixed-use area, with residential and commercial uses in the surrounding area.

Historical mapping for Fulwood Place indicates the Site comprised of unlabelled buildings from 1985. The Site remained relatively unchanged until approximately 1916 when the Site is labelled as occupied by the Central Line's Chancery Lane Station. The Station appeared to be closed and disused in the 1930s. During the Second World War, the Chancery Lane Deep Shelter (subsequently called the Kingsway Telephone Exchange) was constructed with two shafts forming the west entrance beneath the site. These remain to the present.

The earliest available historical mapping for Furnival Steet from 1875 indicates the Site comprised unlabelled buildings. The Site remained in that configuration until the circa 1940 when the current building was constructed on 38-39 Furnival Street. 40 Furnival Street remained unchanged during this period, but showed 41 Furnival Street to also be within the footprint of the building. 40 Furnival Street remained unchanged until the late 1980s when the existing office building was constructed. In 2003, 41 Furnival Street is no longer labelled within 40 Furnival Street's building footprint. 39-38 Furnival Street remained unchanged during this time. At the time of writing, the equipment and internal structures for the operation of the freight lift to the Tunnels below are still present inside 39-38 Furnival Street.The Fulwood Place Site is underlain by superficial deposits comprising Lynch Hill Gravel Member and the Furnival Street Site is underlain by Hackney Gravel Member. The bedrock geology underlying the Site comprises the London Clay Formation. The Lynch Hill and Hackney Gravel Members are both classified as a Secondary A Aquifer. The London Clay Formation bedrock is classified as an unproductive Aquifer. The London Clay underlying both Sites is subsequently underlain by Lambeth Group (Secondary A Aquifer), Thanet Formation (Secondary A Aquifer) and Chalk Group (Principal Aquifer).

There are many records of any high explosive bombs that have previously fallen on the area surrounding the Site. Based on the available information, the risk from UXO is considered to be **High**. Further risk assessment and / or mitigation measures are considered to be required for ahead of intrusive works.

Based on the assessments undertaken, the following was identified for Fulwood Place:

- The risk to future Site users and third party neighbours from contamination is considered to be **Low**;
- The risk to construction and maintenance workers from contamination is considered to be **Low to Moderate**, however, these risks should be managed via health and safety protocols;
- The risk from ground gas risk has been assessed as being **Low**, based on the assumption that the buildings and below ground structures will be subject to appropriate ventilation and waterproofing;

- The risk to groundwater bodies underlying the Fulwood Place Site from contamination has been assessed as **Low**; and,
- The risk to underground structures and services is considered to be **Low to Moderate**.

Based on the assessments undertaken, the following was identified for Furnival Street:

- The risk to from contaminated land future Site users and third party neighbours is considered to be **Low**, however the risk is considered to be **Negligible** in the footprint of buildings 38 and 39 where the proposed basement will remove Made Ground and superficial deposits;
- The risk to construction and maintenance workers from contaminated land is considered to be **Low to Moderate**, however, these risks should be managed via health and safety protocols;
- The risk from ground gas risk has been assessed as being **Low**, based on the assumption that the buildings and below ground structures will be subject to appropriate ventilation and waterproofing;
- The risk to the shallow groundwater body underlying 40 and 41 Furnival Street has been assessed as **Low**, however the risk to the deeper aquifers below the London Clay Formation have been assessed as **Negligible**;
- The risk to groundwater bodies underlying the 38 and 39 Furnival Street have been assessed as **Negligible**; and,
- The risk to underground structures and services is considered to be **Low to Moderate**.

12.2 RECOMMENDATIONS

The following recommendations are made based on this Preliminary Risk Assessment:

- An intrusive investigation should be undertaken. The ground investigation should be compliant with current UK guidance e.g., BS10175 and include a Generic Quantitative Risk Assessment (GQRA) to allow the assessment of identified plausible contaminant linkages and if the remedial measures may be required. Geotechnical testing should also be undertaken to inform foundation design. It is recommended that the ground investigation is designed based on the following technical objectives:
  - Characterisation of the ground and groundwater conditions;
  - Soil and groundwater sampling for contamination and geotechnical testing;
  - Groundwater monitoring;
  - Provision of a GQRA to assess risks to human health and controlled waters; and
  - An assessment of potential foundation design and geotechnical constraints (if required).
- A piling risk assessment should be undertaken which assesses the risk to the aquifers underlying the Site from piling activities should a piled foundation solution be utilised as part of the proposed development;
- Consideration should be given to detailed UXO risk assessment and / or mitigation prior to intrusive works at the Site;
- Given that the Proposed Scheme includes the provision of occupied below ground spaces within basements, shafts and tunnels, consideration should be given to further radon monitoring and assessment in line with UKHSA guidance.

- Should development plans change or are altered, an update of the assessments undertaken within this report are likely to be required.