10.0 Ground Conditions and Contamination

10.1 Introduction

10.1.1 This Chapter reports the likely significant effects of the Proposed Development on the site and the surrounding area in terms of ground conditions and contamination matters. Where appropriate, it also identifies proposed mitigation measures to prevent, minimise or control likely negative effects arising from the Proposed Development and the subsequent anticipated residual effects.

10.1.2 The effects of the Proposed Development are considered over both the demolition & construction and operational phases.

10.1.3 The main ground condition and contamination issues covered in this Chapter include the following:

Demolition & Construction Phase

- Effect on human health from potential contaminants within the near surface soils.
- Risk of inhalation of liberated respirable fibres of asbestos from within the Made Ground soils.
- Risk to site preparation workers from ground gas (if present) while working in confined trenches or excavations.
- Damage to buildings or buried structures associated with potentially elevated sulphates in the ground causing concrete degradation.
- Damage to buildings or structures associated with potentially excessive volume change in the clay strata underlying the site; and
- Potential for Unexploded Ordnance (UXO) to be present on-site and to be disturbed during construction.

Operational Phase

- Effect on human health from potential contaminants within the near surface soils.
- Effect on human health from the inhalation of potential ground gas (if present) resulting from migration into indoor air and accumulation within small spaces; and
- Damage to buildings or buried structures associated with the potential accumulation of ground gas (if present).

10.1.4 This Chapter (and its associated figures and appendices) should be read together with the Introductory Chapters of this Environmental Statement (ES) (Chapters 1 – 5), as well as **Chapter 17: Cumulative Effects**. Potentially significant effects in terms of water resources and flood risk are addressed within **Chapter 9: Water Resources, Drainage and Flood Risk.**

10.1.5 This Chapter is accompanied by the following appendices:

- A Land Contamination Desk Study (LCDS) has been prepared for the site and this is included within **Appendix 10.1** and referred to where applicable within this Chapter.

- A Land Contamination Risk Assessment - Part 1 (LCRA – Part 1) has been prepared for the site and this is included within **Appendix 10.2** and is referenced where applicable within this Chapter.

Competence

10.1.6 This assessment has been undertaken by Kerry Murray of Pell Frischmann.

10.1.7 Kerry has over 16 years of experience in the contaminated land industry and holds a BSc (Hons) and is a chartered scientist (CSci). The Chapter was reviewed and authorised by Amy Boucher. Amy has over 20 years of experience in the contaminated land industry and holds a BSc (Hons) and is a chartered waste manager (MCIWM).

10.2 Legislation, Planning Policy and Guidance

10.2.1 The following national, regional and local planning policy and guidance is of relevance to the assessment of the effects of the Proposed Development in relation to Ground Conditions and Contamination.

10.2.2 The applicable legislative framework is summarised within **Table 10.1**~~Table 10.1~~. This table presents (i) a summary of the requirements of the legislation; and (ii) demonstrates how the Chapter complies with these requirements.

Table 10.1: Compliance with Legislative Framework

Legislation	Summary of Requirements	Chapter Compliance
Environment Act, 1995 [10.1] and Part IIA of the Environmental Protection Act, 1990 [10.2]	The provisions on the assessment of contaminated land are set out in Section 57, which inserts Part 2a into the Environmental Protection Act, 1990. The legislation supports a systematic approach to the identification and remediation of land affected by historical contamination. The approach of 'suitable for use' is set out, where remedial action is only required if there are unacceptable risks to human health and/or the environment, taking into account the use of the land and its environmental setting.	The baseline conditions Chapter (**Chapter 10.5**) provides the first step towards the 'suitable for use' principle by assessing if there are unacceptable risks or not associated with the site.
Contaminated Land (England) Regulations, 2006 (amended 2012) [10.3]	The regulations provide a risk assessment methodology in terms of 'significant contaminants' and 'significant contaminant linkages' within a source-pathway-receptor (S-P-R) conceptual model. Contaminated land is identified where: 1 Significant harm is being caused;	A preliminary Conceptual Site Model (CSM) (**Chapter 10.5**) was developed as part of the LCDS, outlining the source, pathways and receptors of the site, and potential contaminant linkages. Further qualitative assessment is required as part of the future ground investigation works.

	2 There is a possibility of significant harm caused; and/or 3 Pollution of Controlled Waters is being, or is likely to be, caused.	Any mitigation requirements that may be required as part of the redevelopment works are included within this document (**Chapter 10.8**), assuming the potential significant contaminant linkages exist on the site.
Control of Asbestos Regulations (CAR), 2012 [10.4]	The regulations prohibit the importation, supply and use of all forms of asbestos. If existing asbestos containing materials (ACMs) are in good condition, they may be left in place; their condition monitored and managed to ensure they are not disturbed.	The LCDS considers the likelihood of the presence of asbestos in soils on the site (**Chapter 10.5**).
Control of Substances Hazardous to Human Health (COSHH) Regulations, 2002 (amended 2004) [10.5]	Provides an assessment of the risk to health created by work involving substances hazardous to health.	Any mitigation requirements that may be required as part of the redevelopment works are included within this document (**Chapter 10.8**).
Construction (Design & Management) (CDM) Regulations, 2015 [10.6]	The regulations outline the duties that exist under the Health and Safety at Work Act, 1974 and the Management of Health and Safety at Work Regulations, 1999. This requires clients to ensure that the arrangements set out other duty holders are sufficient to safeguard the health and safety of those working or those affected by that work.	Any mitigation requirements that may be required as part of the redevelopment works are included within this document (**Chapter 10.8**).

Planning Policy Context

National

10.2.3 The following national level policy and guidance documents are of relevance to the Proposed Development:

National Planning Policy Framework (2021) [10.7]

10.2.4 Chapter 11, paragraph 120 states 'Planning policies should: … give substantial weight to the value of using suitable brownfield land within settlements for homes and other identified needs, and support appropriate opportunities to remediate despoiled, degraded, derelict, contaminated or unstable land'.

10.2.5 Chapter 15, paragraph 174 states 'Planning policies and decisions should contribute to and enhance the natural and local environment by … remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land'.

10.2.6 Chapter 15, paragraph 183 states 'Planning policies and decisions should ensure that a site is suitable for its proposed use … taking account any risks from contamination, … former activities and … any proposal for mitigation'. 'After remediation, the land should not be determined as contaminated land under Part IIA of the Environmental Protection Act 1990 [10.2]'. 'Adequate site investigation information, prepared by a competent person, is available to inform these assessments'.

10.2.7 Chapter 15, paragraph 184 states 'Where a site is affected by contamination … issues, responsibility for securing a safe development rests with the developer and/or landowner'.

Regional

10.2.8 The following regional level policy and guidance documents are of relevance to the Proposed Development:

The London Plan 2021 [10.8]

10.2.9 Policy SD1 Opportunity Areas states that 'the Mayor will provide support and leadership… and implementation of planning frameworks that… encourage the strategic remediation of contaminated land' and that 'Boroughs, through Development Plans and decisions, should take appropriate measures to deal with contamination that may exist'.

10.2.10 Policy E7 Industrial intensification, co-location and substitution states that 'appropriate design mitigation is provided in any residential element to ensure compliance … with particular consideration given to … potential contamination'.

Contaminated Land Process Note (2021) [10.9]

10.2.11 Provides guidance on dealing with contaminated and polluted sites, in regard to what counts as contaminated land and who is responsible for dealing with it. Steps for developers and local planning authorities are outlined, such as undertaking site inspection, Environmental Impact Assessments, etc.

Local

10.2.12 The following local level policy and guidance documents are of relevance to the Proposed Development:

Camden's 'Local Area Requirements for Planning Applications' [10.10]

10.2.13 Section 4, Contaminated Land Assessment states that 'A Contaminated Land Assessment should be carried out by a Geotechnical or Geoenvironmental Engineer ... The amount of information required should be sufficient to determine the existence or otherwise of the contamination, the nature of the contamination, risks it may pose, and whether these can be satisfactorily reduced to an acceptable level'.

London Borough of Camden Local Plan (2017) [10.11]

10.2.14 The local plan states that 'Proposals for the redevelopments of sites that are known to be contaminated, have the potential to be contaminated, or are located in close proximity to such sites should submit relevant assessments and take appropriate remedial action to the Council's satisfaction if required'.

Camden Planning Guidance - Amenity, 2021 [10.12]

10.2.1 Supplementary planning document to the Camden Local Plan [10.11]. Provides guidance on key amenity issues within the borough. 'Contaminated land assessments should be submitted for developments located on contaminated land or propose a use that has the potential to contaminate land'. 'Developers should contact the Council's Contaminated Land team for information regarding a site's contamination history and possible remedial measures'.

Guidance

10.2.2 The following guidance documents are of relevance to the Proposed Development:

Land Contamination Risk Management (LCRM), 2020 [10.13]

10.2.3 Sets out the process that should be followed for managing the risk from land contamination, including within regulatory and site management contexts. The process of LCRM should be used to:

1 Identify and assess if there is an unacceptable risk

2 Assess what remediation options are suitable to manage the risk

3 Plan and carry out remediation

4 Verify that remediation has worked

Assessing Risks Posed by the Hazardous Ground Gas to Buildings, 2007 [10.14]

10.2.4 Updated guidance on measurement of ground gases, good practice in investigation, the collection of relevant data and monitoring programmes in a risk-based approach to gas contaminated land. A step-wise approach to risk assessment is described

Guidance on Evaluation of Development Proposals on Sites where Methane and Carbon Dioxide are present, 2007 [10.15]

10.2.5 Guidance on best practice methods of dealing with sites where ground gases are present, techniques and suitability of ground gas measurements in order to characterise the ground gas regime on a given site and monitoring.

British Standard (BS) 8485:2015+A1:2019 - Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings, 2019 [10.16]

10.2.6 Describes how to characterise sites and prevent the entry of toxic, asphyxiating or explosive ground gases.

Health and Safety Executive (HSE) Safe work in confined spaces, 2014 [10.17]

10.2.7 The guidance expands the current understanding provided under the Confined Spaces Regulations 1997, providing a clear definition of a confined space, risk assessment guidance and the precautions in place for work to be carried out safely.

10.3 Consultation

10.3.1 As discussed in **Chapter 2: Approach to Assessment**, consideration has been given to the formal EIA Scoping Opinion provided by the London Borough of Camden Council (LBC) and consultees and any additional consultation that may have occurred during the design period of the Proposed Development.

10.3.2 The consultation feedback in regard to the Proposed Development is summarised within **Table 10.2**~~**Table 10.2**~~**Table 10.1**.

Table 10.2: Consultation Feedback

Consultee	Comment	Where is this addressed?
LBC Contaminated Land Team Paul Adams	Scoping opinion response. Broad agreement with the following considerations: • UXO supervision during intrusive site investigation works; • Prove / disprove the presence of the landfill; • Risk to controlled waters is low, however, there is a risk of perched water (lateral migration of contamination) and vapour intrusion risk. Prove depth of top of London Clay at regular intervals across the site; and • Supplementary intrusive site investigation likely required post demolition of buildings.	Any mitigation requirements that may be required as part of the redevelopment works are included within this document (**Chapter 10.8**). Future site investigation works are expected to take place on the site to address the presence of the potential landfill on the site.
Environment Agency (EA) George Lloyd	No comments on the application.	N/A

10.4 Assessment Methodology and Significance Criteria

10.4.1 The following section outlines the methodologies applied to identify and assess the potential impacts and likely effects to result from the Proposed Development.

Scope of the Assessment

10.4.2 An EIA Scoping Report was issued to LBC in April 2021 (**Appendix 2.1**). LBC's formal Scoping Opinion was issued in October 2021 (**Appendix 2.2**).

Likely Significant Effects

Demolition and Construction Phase

- Direct contact with the Made Ground onsite resulting in dermal contact, inhalation or ingestion of soil-based contaminants;
- Inhalation of liberated respirable fibres of asbestos from within the Made Ground soils, this risk is typically lower for clay-based soils during damp conditions but may worsen during long dry spells;
- If ground gas is present, then the risk to site preparation workers while working in confined trenches or excavations will need to be considered;
- Damage to buildings or buried structures associate with potentially elevated sulphates in the ground causing concrete degradation;
- Damage to buildings or structures associated with potentially excessive volume change in the clay strata underlying the site; and
- Potential for UXO to be present on-site and to be disturbed during construction

Operational Phase

- Effect on human health from potential contaminants within the near surface soils;
- Effect on human health from the inhalation of potential ground gas (if present) resulting from migration into indoor air and accumulation within small spaces; and
- Damage to buildings or buried structures associated with the potential accumulation of ground gas (if present).

Extent of The Study Area

10.4.3 The study area for the LCDS used a similar site boundary to the application boundary shown in **Chapter 1: Introduction.**.

10.4.4 The search radius for surrounding features and for historical mapping features was typically up to 100m from the site boundary. Consideration has been given to surface water features and controlled water receptors within 1km radius of the site.

Method of Baseline Collection

Desk Study

10.4.5 A desk study (LCDS) has previously been prepared for the site by Pell Frischmann to assess the environmental setting and historical land uses, and to obtain information about potential ground conditions and contamination issues at the site. This is included as **Appendix 10.1**.

10.4.6 Sources of information reviewed within the LCDS include:

- Historic and current Ordnance Survey maps;
- Historic and current aerial photographs (Google imagery and Envirocheck);
- British Geological Survey (BGS) maps and records;
- Environment Agency (EA) data;
- EA River Basin Management Plans;
- Commission specific geoenvironmental database search results (Envirocheck);
- Lost Rivers of London information; and

- Relevant internet-based data sources (e.g. MAGIC and Layers of London).

Site Visits and Surveys

10.4.7 A site walkover survey was undertaken as part of the desk study included in **Appendix 10.1**. The walkover survey was carried out on the 16th February 2021.

10.4.8 The aims of the walkover survey were to:

- Identify potentially contaminative land-uses onsite or adjacent to the site;
- To look for features of geoenvironmental significance;
- To observe current site conditions (including ground cover); and
- To consider likely access or restrictions for future site investigation equipment (if required).

Ground Investigation

10.4.9 Ground investigation works were undertaken in September 2021.

10.4.10 The aims of the ground investigation were to:

- Provide information about the nature and thickness of the upper soil profile (Made Ground and shallow London Clay) for geoenvironmental, earthworks and waste classification purposes.
- Provide information about the thickness and soil strength characteristics of the underlying bedrock (London Clay) for primary deep foundation design.
- Provide soil samples for laboratory testing (geotechnical and geoenvironmental testing).
- Provide both continuous and point ground gas monitoring of selected boreholes in a small area of the site.

10.4.11 The proposed scope of the ground investigation comprises:

- Drilling of 4 no. cable percussive boreholes;
- Drilling via dynamic sampling of 6 no. windowless sample boreholes;
- Excavation of 2 no. trial pits;
- Soil sampling for geochemical and geotechnical testing;
- In-situ testing (including standard penetration tests and photo ionisation detection);
- Selected installation and subsequent monitoring of gas and groundwater wells;
- Geochemical and geotechnical laboratory analysis of soil samples, and;
- Completion of a factual Ground Investigation Report.

Generic Quantitative Risk Assessment

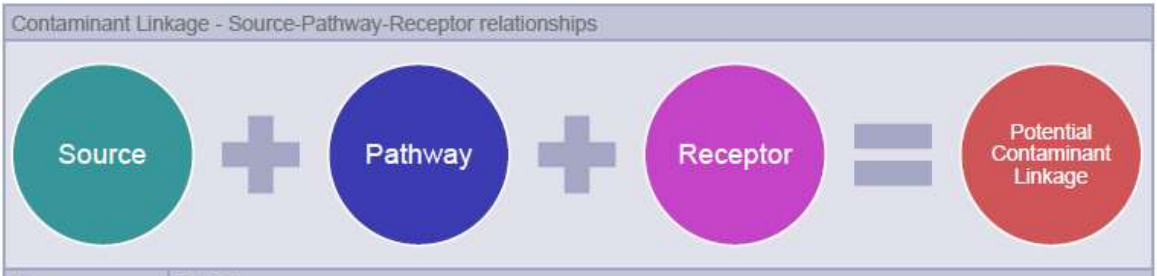
10.4.12 A generic quantitative risk assessment (GQRA) has been prepared for the site by Pell Frischmann based on the findings of the ground investigation. The GQRA has been completed to assess potential contaminants of concern, update the CSM and refine the risk ratings for each of the identified potential contaminant linkages and inform whether further information, Detailed Quantitative Risk Assessment (DQRA) or remediation may be required. This report is included as Appendix 10.2.

Method of Assessment

10.4.13 The main guidance applied in the impact assessment methodology are provided in **Chapter 10.2** and details of the approach are described in further detail in the following paragraphs.

10.4.14 In accordance with the LCRM [10.13] guidance, a preliminary CSM was developed as part of the preliminary risk assessment (PRA) within the LCDS. A CSM shows the possible relationships between contaminants, pathways and receptors based on the S-P-R approach, as shown in **Figure 10.1**~~**Figure 10.1**~~ below extracted from the LCDS. All three must be present for a land contamination risk (contaminant linkage) to exist. As part of the PRA, a potential risk rating was assigned for each potential contaminant linkage. The risk ratings have been updated within the GQRA to account for the data obtained from the ground investigation along with that previously presented in the LCDS and the qualitative assessment provided at that stage. The assessment has considered the product of the 'severity of the consequence' and the 'probability of the likelihood' in line with CIRIA 552.

Form



Term	Definition
Source	A contaminant that is in, on or under the land and has the potential to cause harm or pollution
Pathway	A route by which a receptor is or could be affected by a contaminant
Receptor	Something that could be adversely affected by a contaminant for example a person, controlled waters, an organism, an ecosystem or Part 2A receptors such as buildings, crops or animals.
Contaminant Linkages	The presence and relationship between contaminants, pathways and receptors.

Figure 10.1: Contaminant Linkage

10.4.15 In accordance with the Construction Industry Research and Information Association (CIRIA) publication C665 (2007) [10.14], the National House-Building Council (NHBC) publication (2007) [10.15] and the BS publication BS8485 (2019) [10.16], the potential ground gas regime has been assessed within the GQRA.

Significance Criteria

10.4.16 The assessment of the potential impacts and likely effects as a result of the Proposed Development has taken into account both the Demolition and Construction Phases and Operational phases. The significance level attributed to each effect has been assessed based on the magnitude of change due to the Proposed Development and the sensitivity of the affected receptor/receiving environmental to change, as well as several other factors that are outlined in more detail in **Chapter 2: Approach to Assessment**.

10.4.17 Magnitude of change and the sensitivity of the affected receptor/receiving environmental are both assessed on a scale of high, medium, low and negligible (as shown in **Chapter 2: Approach to Assessment**). The identified receptors and their sensitivities are summarised in Table 10.6~~Table 10.6~~~~Table 10.4~~. The magnitude of change (impact) on the identified receptors for the proposed development would be assessed using the criteria outlined in Table 10.3~~Table 10.3~~~~Table 10.3~~.

Table 10.3: Magnitude of Impact

Magnitude of Impact	Criteria	Human Health Receptors	Controlled Waters Receptors	Ecological Receptors
High	Results in loss of attribute and/ or quality and integrity of the attribute.	Acute risk to human health.	Surface waters and/or groundwater: Substantial acute pollution or long-term degradation of sensitive water resources (Principal Aquifer, groundwater source protection zone, surface waters of good or very good quality).	Significant change to the number of one or more species or ecosystems.
Medium	Results in effect on integrity of attribute, or loss of part of attribute.	Chronic risk to human health.	Surface water and/or groundwater: Pollution of non-sensitive water resources or small-scale pollution of sensitive water resources (Principal or Secondary Aquifers of water courses of fair quality or below).	Change to population densities of non-sensitive species.
Low	Results in some measure-able change in attributes quality or vulnerability	Slight reversible short- term effects to human health.	Surface waters and/or groundwater: Slight pollution of non-sensitive water resources.	Some change to population densities of non-sensitive species with no negative effects on the function of the ecosystem.
Negligible	Results in effect on attribute, but of insufficient magnitude to affect the use or integrity.	No measurable effects on humans.	Surface waters and/or groundwater: Insubstantial pollution to non-sensitive water resource.	No significant changes to population densities in the environment or in any ecosystem.

10.4.17~~10.4.18~~ The receptor sensitivity and impact magnitude are then combined within the significance matrix to define the significance of effect as per Table 10.4~~Table 10.4~~.

Table 10.4: Matrix for Determining the Significance of Effects for Ground Conditions Assessment

		Sensitivity of Receptor			
		High	Medium	Low	Negligible
Magnitude of Impact	High	Major	Moderate	Minor	Negligible
	Medium	Moderate	Minor	Minor	Negligible
	Low	Minor	Minor	Negligible	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

Effect Significance

10.4.18 10.4.19 The following terms have been used to define the significance of effects identified:

- **Major positive or negative effect** – where the Proposed Development would cause a large improvement (or deterioration) to the existing environment;
- **Moderate positive or negative effect** – where the Proposed Development would cause a noticeable improvement (or deterioration) to the existing environment;
- **Minor positive or negative effect** – where the Proposed Development would cause a small improvement (or deterioration) to the existing environment; and
- **Negligible** – no discernible improvement or deterioration to the existing environment as a result of the development will occur.

10.4.19 10.4.20 Effects which are deemed to be significant for the purpose of this assessment are those which are described as being moderate or major positive or negative.

10.4.20 10.4.21 A distinction will be made between direct and indirect; short and long-term; permanent and temporary; primary and secondary; cumulative; positive and negative effects. **Chapter 17: Cumulative Effects** provides a further assessment of the cumulative effects.

10.5 Baseline Conditions

10.5.1 This section outlines the existing baseline conditions of the site.

10.5.2 The baseline conditions have been established from the LCDS (**Appendix 10.1**) undertaken by Pell Frischmann along with the findings from the ground investigation discussed within the GQRA (**Appendix 10.2**). The PRA & GQRA findings have been included where appropriate.

10.5.3 Whilst controlled waters have been removed as a receptor from the scope assessment, reference to surface waters and groundwater have still been included in the following sections to support the decision.

Site Description and Current Land Use

10.5.4 The site lies between Finchley Road (east) and West End Lane (west), in the London Borough of Camden, and includes the O2 Centre at 255 Finchley Road, London, NW3 6LU; the National Grid Reference of the centre of the site is 525650, 184730. Elevation of the site is generally between 49m and 50m Above Ordnance Datum (AOD), rising to 56mAOD in the east. The site is irregular in shape at 5.7 hectares (Ha).

10.5.5 A site walkover survey was completed in February 2021 by Pell Frischmann. The site currently comprises commercial and industrial land-uses including from east to west: the O2 Centre, a car park, a Homebase store, car dealerships and a builders yard, and has remained relatively unchanged since the late 1990s. The key points noted from the site walkover are:

- The lower-storey of the O2 centre (Level 0) includes plant rooms for elevator motors, gas boilers, sprinkler tanks/ pumps and gas and electrical equipment. Plant rooms were generally bunded and waterproofed to contain leakages. An above ground diesel storage tank was also identified within a concrete bund;
- A sub-basement level (Level -1) beneath the west of the building includes plant rooms for the supermarket above containing ventilation and refrigeration equipment, bunded electrical equipment and a gas boiler room;
- Manhole covers resembling a series of interceptor chambers were observed along the western side of the existing car wash building;
- A cylindrical tank identified in the Homebase yard area was confirmed to be a water storage (sprinkler) tank. A plant room to the west of the building contained pumping equipment for the sprinkler system; and
- Access to the west and far west of the site was limited to external areas only. Above ground oil storage tanks (waste oil and motor oil) were identified in the external areas surrounding the vehicle repair garages in the west. Storage of metal drums of motor oil was also noted.

10.5.6 The site is bound by railway lines (Network Rail) to the north; Finchley Road, a rail bridge and a 5m retaining wall to the east; a London Underground line (Metropolitan and Jubilee) to the south; West End Road to the west; and residential buildings and the London Overground Thameslink (and associated bridge) to the northwest. Finchley Road and West Hampstead underground stations lie to the southeast and southwest of the site respectively.

10.5.7 The wider surrounding area predominately comprises a mixture of residential and commercial land-uses, with occasional industrial land-uses.

Historical Land Use

10.5.8 Earliest mapping (1870s) indicates that the site was occupied by agricultural land with railway sidings and a railway cutting present in the north and northeast respectively. A

small pond was located along the central southern boundary which was likely infilled by the 1890s.

10.5.9 Expansion of the railway infrastructure (including coal depots) continued between the early 1990s and the 1960s, and remained on site until the early 1990s, predominately towards the east and centre of the site.

10.5.10 A refuse transfer station was present in the 1960s towards the northeast of the site, which is shown to expand towards the centre of the site until the mid-1990s. Waste records indicate that the waste transfer station onsite was licenced to accept commercial waste and construction industry waste, inert waste and general non-putrescible waste until 1992. A possible landfill was also located in the location of the waste transfer building in 1994 mapping.

10.5.11 Warehouses, depots and works are shown to have occupied the centre west of the site from the early 1930s to the mid-1990s.

10.5.12 By the late-1990s, the site was redeveloped to the present-day layout with the former structures largely removed by the mid-1990s. No significant changes have occurred since the late 1990s.

10.5.13 Contemporary trade directory entries capture the car dealerships towards the western centre of the site and the Builders' Merchants in the west of the site, in addition to a historic printers and dry cleaners also in the west of the site.

Geology

10.5.14 Published geology indicates that no superficial deposits have been mapped onsite, with bedrock geology of London Clay (silty to very silty clay, clayey silty and sometimes silt with some layers of sandy clay). There are no mapped linear geological or artificial ground features onsite.

10.5.15 The ground investigation, encountered Made Ground across the site to a variable thickness of between 0.50m to 2.95m. A layer of reworked London Clay between 0.4m to 1.10m thick was also identified. The investigation confirmed the published records and identified that the Made Ground was underlain by London Clay formation in all locations to a proven depth of >60m.

10.5.16 A BGS borehole record located 75m to the north of the site indicates that London Clay is present from ground level to a depth of 73m (-20.57mAOD), underlain by 8m of Sand over Chalk of over 80m thick (proven to -124.66mAOD).

10.5.17 BGS ground stability data indicates that there is a moderate natural ground stability hazard onsite associated with shrinking or swelling clay (London Clay).

10.5.18 The site is located within a lower probability radon area where less than 1% of homes are at or above the road Action Level based on 1km squares; no radon protection measures are necessary in the construction of new buildings or extensions.

Hydrology

10.5.19 There are no rivers, streams or active surface water abstractions recorded onsite or within 1km.

10.5.20 The LCDS identified a former 'Lost River' of London likely to cross the eastern part of the site, flowing south, as a present-day sewer. Records of a second 'Lost River' in the west of the site are unclear and is likely located beyond the western boundary, historical records indicate that this former watercourse may no longer be connected and has not provided flow to downstream waterbodies since the early 19th Century.

Hydrogeology

10.5.21 The London Clay (bedrock) is designated as Unproductive Strata; these deposits have a low permeability with a negligible significance for water supply or river base flow.

10.5.22 The site is not located within a Source Protection Zone (SPZ). There are two active groundwater abstractions within 1km of the site, located 687m and 711m south of the site within 'Swiss Cottage Open Space'. The former is used to supply water for 'land and pond throughflow' and the latter is used for spray irrigation within a municipal area operated by London Borough of Camden.

10.5.23 The ground investigation did not encounter any significant groundwater during drilling. Return monitoring was carried out over four return visits following the site investigation works and recorded the presence a very limited thickness of perched groundwater within some installations (typically 3 of 5) installed across the Made Ground. Remaining locations were dry. The perched groundwater within Made Ground is considered to be isolated, laterally discontinuous and vertically confined by the London Clay. Notable groundwater flow in these deposits is not anticipated.

10.5.24 The ground investigation has confirmed that the is no viable linkage to controlled water receptors at the site. Either surface water or groundwater.

10.5.25 Flood risk is discussed in **Chapter 9: Water Resources, Drainage and Flood Risk**.

Ecology

10.5.26 No ecological system receptors have been identified onsite or within 1km of the site boundary.

10.5.27 No geological sites of scientific interest (SSSIs) have been identified onsite or within 1km.

London Underground and Rail

10.5.28 The Network Rail First Capital Connect route runs along the northern site boundary; the Jubilee and Metropolitan London Underground line runs along the southern site boundary and the London Overground line passes the site to the northwest, as noted in the historic map review.

10.5.29 Records of railway cuttings are recorded immediately offsite along existing railway alignments and two railway tunnels are also recorded 8m (Belsize Tunnel) and 46m east (Belsize New Tunnel). The nearest tunnel air shaft is recorded around 300m east.

Unexploded Ordnance (UXO)

10.5.30 The site and surrounding areas are classified as an area with a potential high bomb risk. Several bomb strikes occurred within the site boundary and in particular to the south of the site where extensive bomb damage is documented and visible in an aerial photograph from 1946.

10.5.31 A Preliminary Desk Study Assessment obtained from Zetica indicates that 358-high explosive bombs fell in the Metropolitan Borough of Hampstead during World War 2, including several bombs in close proximity to the site. The assessment recommends that 'a detailed desk study is commissioned to assess, and potentially zone, the UXO hazard level on the site'.

10.5.32 During the ground investigation, specialist UXO clearance was undertaken using a magnetometer within each of the exploratory locations to help mitigate risks to site personnel. No positive UXO indications were identified.

Ground Investigation

10.5.33 The September 2021 ground investigation was spatially confined by current site use and activity, so is not sufficient to cover the entire proposed development at this stage. Further phases of ground investigation will be undertaken once site clearance works are progressed at a later date.

10.5.34 Future supplementary phases of ground investigation are expected to be completed as part of the pre-development works. The proposed scope of works is provided in Chapter 10.4.13.

Conceptual Site Model (CSM)

10.5.35 The following CSM is based on the information provided from the LCDS & GQRA (**Appendix 10.1 & Appendix 10.2**).

10.5.36 Potential contaminant sources and potentially contaminative land-uses identified onsite and in proximity to the site are summarised in **Table 10.5~~Table 10.5~~Table 10.3** below.

Table 10.5~~53~~: Potential Sources

Onsite Sources	Offsite Sources
Made Ground (heavy metals, hydrocarbons and asbestos in soils) associated with the former land-uses and several phases of redevelopment and change on site.	Current and historic railway land and activities to the north, south and west. Note: given the underlying clay strata and in the absence of shallow aquifers to facilitate contaminant migration, the risk from off-site
Existing car park and car dealerships (leaks and spills).	

Historic railway land.	sources is likely to be low and therefore this report focuses on potential off-site sources closest to the site.
Historic waste transfer station and possible landfill record (potential source of ground gas) however, ground investigation has found no evidence of an on-site former landfill.	
Builders yard/merchants	
Historic dry cleaners and printers	
Small, infilled pond (late 1800s).	

10.5.37 Potential receptors identified with respect to the site and the Proposed Development and the level of sensitivity are summarised in Table 10.6~~Table 10.6~~~~Table 10.4~~ below.

Table 10.6~~64~~: Potential Receptors and Sensitivity

Receptor	Future Receptors	Temporary Receptor	Sensitivity	Justification
Human Health				
Site preparation, demolition and construction workers	n/a	Yes	High	Human health receptors have been classified as *High* sensitivity due to their close proximity of the works and the qualitative PRA undertaken to date. The exact conditions of the soils on the site are unknown. Future ground investigation works are expected to be completed.
People on neighbouring third party land	n/a	Yes	High	
Maintenance workers	Yes	n/a	High	
Future site users and residents	Yes	n/a	High	
Controlled Waters				
Surface water	None recorded within 1km			
Groundwater	No, the underlying London Clay is designated as unproductive strata and the underlying chalk too deep to be affected by the development. Piled foundations will terminate within the London Clay. The ground investigation and return groundwater monitoring visits did not encounter any significant groundwater. Where encountered perched groundwater within the Made Ground is considered to be isolated, laterally discontinuous and vertically confined by the London Clay.			
Other				
Buildings and structures (ground gas only)	Yes	Yes (UXO only)	Low	Buildings and structures in relation to ground gas has been classified as *Low* sensitivity due the limited thickness and granular nature of made ground on site. The site investigation did not identify any notable ground gas sources and ground gas monitoring confirmed low risk. The site is located in an area of low risk from Radon.

Ecological systems	None recorded within 1km

10.5.38 Potential pathways identified with respect to the site and the Proposed Development are:

- Ingestion, inhalation and dermal contact;
- Inhalation of liberated respirable fibres;
- Inhalation of indoor air;
- Inhalation of outdoor air within trenches/excavations;
- Migration and accumulation; and
- Migration through water supply pipes (depending on material type) into potable water.

10.5.39 The potential contaminant linkages and the associated risk rankings are summarised in the CSM within the GQRA. The GQRA assigned a moderate preliminary land contamination risk rating to the Proposed Development. The receptors within the preliminary CSM (end users and site preparation and construction workers) have been updated, where necessary, for the purposes of this assessment to reflect the Proposed Development.

10.5.40 The potential contaminant linkages are listed in **Table 10.7~~Table 10.7~~Table 10.5** below.

Table 10.7~~75~~: Potentially Active Contaminant Linkages

Source/s	Pathway/s	Receptor/s
Contaminants within Made Ground onsite	Ingestion, inhalation and dermal contact	Site preparation, demolition and construction workers
		Maintenance workers
		Future site users and residents
Asbestos containing soils (ACSs)	Inhalation of liberated respirable fibres	Site preparation, demolition and construction workers
		People on neighbouring third-party land
		Maintenance workers
		Future site users and residents
Ground gas associated with historic waste activities on site (localised parts of the site)	Inhalation of indoor air	Future site users and residents
	Inhalation of outdoor air within trenches/excavations	Site preparation, demolition and construction workers
	Migration and accumulation	Buildings and structures

Hydrocarbon contamination within Made Ground	Migration through water supply pipes (depending on material type) into potable water	Future site users and residents (following consumption of potable water)

10.6 Future Baseline

10.6.1 This section outlines the future baseline conditions of the site.

10.6.2 Should the site remain in its current use, the site is considered unlikely to present a notable risk to the identified receptors. This is due to the likely localised nature of contamination that may be present on the site as a result of current and historic uses and the site cover is predominately hardstanding. However, in order to confirm the potential risks to the receptors identified, future ground investigation works are expected to take place prior to redevelopment to confirm the presence or absence of soil or groundwater contamination at the site

10.7 Sensitive Receptors

10.7.1 The following are the sensitive receptors which will be considered in the following assessment:

- Site preparation, demolition and construction workers
- People on neighbouring third-party land
- Maintenance workers
- Future site users and residents
- Buildings and structures (ground gas only)

10.8 Assessment of Effects, Mitigation and Residual Effects

Demolition & Construction Phase

10.8.1 This section identifies and assesses the scale and nature of the main effects arising from the Proposed Development during the demolition and construction phase.

<u>Direct contact with the Made Ground onsite resulting in dermal contact, inhalation or ingestion of soil-based contaminants</u>

10.8.2 Potential sources of contamination have been recorded onsite and offsite, associated with the former railway infrastructure, coal depots, warehouses, waste transfer station and possible landfill. Based on the historic land use, there is a potential for contaminants to be located within soils on the site. Ground investigation works were carried out in September 2021, in order to identify any widespread contamination in shallow soils and visual or olfactory evidence of contamination in deeper soils across the site, as well as conducting ground gas and groundwater monitoring.

10.8.3 Where human health receptors are exposed to contaminants above threshold concentrations, there is the potential for both temporary and long-term health problems to arise; this is dependent on several factors including: type of contaminant, characteristics of receptor and duration of exposure.

10.8.4 The length of exposure from human health receptors will depend on the amount of time site workers spend on the site during the demolition and construction phase.

10.8.5 Potential contaminant linkages have been identified on the site (**Chapter 10.5**). Construction works are likely to expose site workers to potentially localised ground contamination, creating plausible contaminant linkages through dermal contact, inhalation or ingestion of soil-based contaminants. Dust during excavations or wind-blow dust from stockpiled materials could temporarily expose site workers to potentially contaminated dust. All contaminant linkages will be updated following the completion of ground investigation works.

10.8.6 The ground investigation reported a variable thickness of Made Ground onsite ranging between 0.70m and 2.95m bgl, with an average thickness of 1.87m. A single occurrence of faint hydrocarbon odour was identified in one location within the Made Ground. Evidence of only limited ground contamination was identified within the ground investigation and laboratory testing

10.8.7 Asbestos was identified in 7 of 29 soil samples identified as amosite within five samples and chrysotile in two samples. Only one sample identified asbestos above the detection (quantification) limit of 0.001% which found amosite asbestos as loose fibres in soil at 0.0032%.

10.8.8 The September 2021 site investigation was spatially confined by current site use, so is not considered sufficient to cover the entire proposed development.

10.8.9 The sensitivity of the human (site workers) receptor is high, and the magnitude of impact is considered to be Medium. Therefore, ~~T~~there is likely to be a direct, temporary and/or permanent, short-term to medium-term, **moderate negative** effect on site workers prior to the implementation of mitigation measures.

Mitigation

10.8.10 Dependent on the findings of further phases of ground investigation, mitigation for construction workers will be defined within the Construction Phase Plan following regulatory consultation (LBC, NHBC, EA, etc.).

10.8.11 Supplementary ground investigation will be required post demolition of the current site buildings and structures on site, following discussions with regulators (LBC, NHBC, EA, etc.).

10.8.12 All site preparation, demolition and construction workers will be made aware of the findings of the ground investigation works and the potential for residual contamination at the site. A Construction Management Plan (CMP) will incorporate the findings to ensure mitigation is completed to an appropriate level. Risk assessments will be prepared to ensure site workers and the general public are protected during the demolition and construction phase, identifying appropriate safe working practices.

10.8.13 Standard safe working practices that will be adhered to should include but are not limited to the following. All of the measures and good site practices will be included within the CMP.

- Use of appropriately qualified persons for the intended task;
- Use of Personal Protective Equipment (PPE);
- Provision of on-site washing facilities;
- Washing of hands at the end of every work period (including forearms, face etc. if they become dirty);
- No eating rule on-site and confining of smoking areas away from the work site, and only after decontamination;
- Reporting of any ill health; and
- The damping down of exposed surfaces during periods of dry/windy weather.

10.8.14 All works will be conducted in accordance with the COSHH Regulations [10.5] and CDM Regulations [10.6].

10.8.15 Consideration of a Material Management Plan (MMP) may be required for the movement of materials to, from and around the site to ensure that the material is not placed in locations that might represent a risk to human health.

10.8.16 Appropriate selection and implementation of water supply pipes to prevent any potential contamination impacting on the potable water supply pipes onsite, dependent on the findings of the ground investigation.

Residual Effect

10.8.17 The magnitude of impact following mitigation is considered to be negligible. Therefore, ~~T~~there is likely to be a direct, temporary and/or permanent, short-term to medium-term, **negligible** residual effect on site workers following the implementation of mitigation measures (Not Significant).

Inhalation of liberated respirable fibres of asbestos from within the Made Ground soils

10.8.18 It is considered likely that ACSs and ACMs are located onsite, based on the historic land uses on the site; former buildings onsite and residual asbestos may have been incorporated into the soil during previous redevelopments. The ban on asbestos in the United Kingdom was not fully completed until 1999 and asbestos may be present in the current building and structures onsite.

10.8.19 If asbestos is present, the potential risk to human health receptors (site workers and neighbouring users) would be dependent on the type, nature and quantity of asbestos. Where human health receptors are exposed to ACSs above threshold concentrations, there is the potential for temporary and long-term health problems to arise.

10.8.20 The ground investigation works screened all soil samples for asbestos within soils to allow for a quantitative risk assessment. Asbestos was detected within 7 out of 29 samples, of these samples six had concentrations of <0.001% of either amosite (brown) or chrysotile (white) asbestos. A single sample was reported to contain 0.0032% amosite (brown) asbestos. No visual evidence of potential ACMs was reported during the ground investigation works.

10.8.21 Potential contaminant linkages have been identified on the site (**Chapter 10.5**). Construction works are likely to expose site workers to respirable fibres of asbestos, creating plausible contaminant linkages through inhalation. Wind-blown dust from stockpiled materials could temporarily expose site workers and neighbouring land users to potentially ACSs dust. All contaminant linkages will be updated following the ground investigation works.

10.8.22 The magnitude of impact on site workers is considered to be medium. Therefore, ~~T~~there is likely to be a direct, temporary and/or permanent, short-term to medium-term, **moderate to major negative effect** on site workers prior to the implementation of mitigation measures.

10.8.23 The sensitivity of neighbouring land users is high, and the magnitude of impact is considered to range from low to medium before mitigation. Therefore, ~~T~~there is likely to be a direct, temporary and/or permanent, short-term to medium-term, **minor to moderate negative effect** on neighbouring land users prior to the implementation of mitigation measures.

Mitigation

10.8.24 Dependent on the findings of further ground investigation, any mitigation and remediation work required will be undertaken and validated (through a Remediation Strategy and Verification Report) prior to the demolition and construction phase, following discussions with regulators (LBC, NHBC, EA, etc.).

10.8.25 All site preparation, demolition and construction workers will be made aware of the findings of the future ground investigation works and the potential for residual contamination at the site. A CMP will incorporate the findings to ensure mitigation is completed to an appropriate level. Risk assessments will be prepared to ensure site workers and the general public are protection during the demolition and construction phase, identifying appropriate safe working practices.

10.8.26 Standard safe working practices that will be adhered to should include but are not limited to the following. All of the measures and good site practices will be included within the CMP.

- Use of appropriately qualified persons for the intended task;
- Use of PPE;
- Provision of on-site washing facilities;
- Washing of hands at the end of every work period (including forearms, face etc. if they become dirty);
- No eating rule on-site and confining of smoking areas away from the work site, and only after decontamination;
- Appropriate bunding and containments of stockpiles and use of covered lockable skips;
- Reporting of any ill health; and
- The damping down of exposed surfaces during periods of dry/windy weather.

10.8.27 All works will be conducted in accordance with the COSHH Regulations [10.5], CDM Regulations [10.6] and CAR Regulations [10.4].

Residual Effect

10.8.28 The magnitude of impact on site workers following the implementation of mitigation measures is negligible. Therefore, t~~T~~here is likely to be a direct, temporary and/or permanent, short-term to medium-term, **negligible** residual effect on site workers following the implementation of mitigation measures.

10.8.29 The magnitude of impact on neighbouring land users following the implementation of mitigation measures is negligible. Therefore, ~~T~~there is likely to be a direct, temporary and/or permanent, short-term to medium-term, **negligible** residual effect on neighbouring land users following the implementation of mitigation measures (Not Significant).

The risk from ground gas to site preparation workers while working in confined trenches or excavations

10.8.30 The underlying geology (London Clay) is generally not considered to represent a potential risk of ground gas generation. Radon is considered to represent a low risk to human health at the site.

10.8.31 BGS borehole records indicate a deeper stratum of Made Ground offsite, associated with the former railway infrastructure and redevelopment of residential housing to the south of the site. Only a limited thickness of Made Ground has been identified across the site, with the majority of this material comprising sub-base and likely construction materials for the existing development. A former waste transfer site operated for over 30 years (1960s to 1990s) and the record of a possible historic landfill is located within the car park area to the west of the O2 centre.

10.8.32 Ground investigation works have identified Made Ground on site to a depth of between 0.70 to 2.95m bgl (average depth 1.87m bgl). The ground investigation targeted the location of the possible landfill and footprint of the waste transfer station, however, the investigation did not identify the presence of any notably deleterious materials within the Made Ground and no evidence of the presence of a former landfill was identified.

10.8.33 Ground gas monitoring was conducted as part of the ground investigation works, followed by a GQRA for ground gas (Appendix 10.2). Negligible concentrations of methane were detected during the ground gas monitoring and limited carbon dioxide concentrations were recorded. The ground gas risk assessment suggests ground gas conditions indicative of BS8485 Characteristic Situation 1 (CS1) conditions, whereby no special gas protection measures are considered necessary.

10.8.34 While potential contaminant linkages have been identified on the site (**Chapter 10.5**). based on the findings of the ground investigation in respect to ground gas, construction works are unlikely to expose site workers to significant ground gas through the inhalation of outdoor air within trenches/excavations. Following the ground investigation works these linkages have been updated (Table 10.8~~Table 10.6~~).

10.8.35 The magnitude of impact on site workers is considered to be negligible. Therefore, ~~T~~there is likely to be a direct, temporary and/or permanent, short-term to medium-term**,**

negligible negative effect on site workers prior to the implementation of mitigation measures.

Mitigation

10.8.36 Additional ground gas monitoring is not required following the ground investigation works. No further action is proposed. The site is indicative of of BS8485 Characteristic Situation 1 (CS1) conditions, whereby no special gas protection measures are considered necessary.

10.8.37 All works will be conducted in line with the HSE guidance [10.17].

Residual Effect

10.8.38 There is likely to be a direct, temporary and/or permanent, short-term to medium-term, **negligible** residual effect on site workers prior to the implementation of mitigation measures (Not Significant).

Damage to buildings or buried structures associate with potentially elevated sulphates in the ground causing concrete degradation

10.8.39 Buried concrete structures may be susceptible to chemical attack, particularly from sulphates. Contamination may therefore compromise the structural integrity of underground structures.

10.8.40 Ground investigation works were undertaken, in September 2021 in order to confirm the ground conditions across the site. Ground investigation works confirmed that Made Ground is presence on site to a depth of between 0.70 to 2.95m bgl (average depth 1.87m bgl), over London Clay. Results of chemical testing indicated a Sulphate class: DS-2 and ACEC class: AC-1s for concrete foundations design.

10.8.41 The sensitivity of buildings and structures is low and the magnitude of impact is considered to be medium. Therefore, ~~T~~there is likely to be a direct, permanent, medium-term to long-term, ~~**moderate**~~ **minor** **negative effect** on buildings and structures prior to the implementation of mitigation measures.

Mitigation

10.8.42 Concrete for foundations appropriate for sulphate bearing soils (DS-2 AC-1) would be selected and designed as part of the construction phase.

10.8.43 All works will be conducted in accordance with the CDM Regulations [10.6].

Residual Effect

10.8.44 The magnitude of impact following the implementation of mitigation measures is negligible. Therefore, ~~T~~there is likely to be a direct, permanent, medium-term to long-term, **negligible** effect on buildings and structures following the implementation of mitigation measures (Not Significant).

Damage to buildings or structures associated with potentially excessive volume change in the clay strata underlying the site

10.8.45 Ground investigation works were undertaken in September 2021 to confirm the ground conditions across the site.

10.8.46 The geology underlying the site has been proven as predominantly granualar Made Ground to a depth of between 0.70 to 2.95m bgl (average depth 1.87m bgl), overlying, Re-worked London Clay between 0.4m-1.1m thick, over bedrock of London Clay (proven to a thickness of >57.10m). The base of London Clay was not proven during the ground investigation. Based on BGS borehole records in close proximity to the site, the thickness of London Clay is anticipated to be approximately 73m thick, underlain by strata of clay and sand at 22m thick, underlain by chalk at over 80m thick.

10.8.47 The magnitude of impact before mitigation is considered to be high. Therefore, ~~T~~there is likely to be a direct, permanent, medium-term to long-term, **moderate negative** effect on buildings and structures prior to the implementation of mitigation measures.

Mitigation

10.8.48 If required, appropriate pilling techniques would be selected and designed as part of the construction phase.

10.8.49 All works will be conducted in accordance with the CDM Regulations [10.6].

Residual Effect

10.8.50 The magnitude of impact following mitigation is considered to be low. Therefore, ~~T~~there is likely to be a direct, permanent, medium-term to long-term, **negligible** effect on buildings and structures following the implementation of mitigation measures (Not Significant).

Potential for UXO to be present on-site and to be disturbed during construction

10.8.51 As stated within the Baseline Conditions (**Chapter 10.5**), a preliminary desk study assessment provided within the LCDS indicates that 358-high explosive bombs fell in the Metropolitan Borough of Hampstead during WWII, including several bombs in close proximity to the site. Records document that extensive bomb damage occurred to the south of the site and several bombs strike occurred within the site boundary.

10.8.52 A detailed UXO desk study was recommended as part of the preliminary desk study assessment, however, the contractor selected direct risk mitigation through the use of a UXO clearance specialist to undertake a magnetometer probing survey within each of the exploratory holes as part of the ground investigation.

10.8.53 During the September 2021 ground investigation works, UXO supervision as well as the use of surface and down hole magnetometers, was carried out at each exploratory location. No positive UXO indications were identified as part of the works.

10.8.54 The impact on site workers before mitigation is considered to be high. Therefore. ~~T~~there is likely to be a direct, permanent, short-term **major negative** effect on site workers prior to the implementation of mitigation measures.

10.8.55 The impact on neighbouring land users before mitigation is considered to be high. Therefore, there is likely to be a direct, permanent, short-term **major negative** effect on neighbouring land users prior to the implementation of mitigation measures.

10.8.56 The magnitude of impact on buildings and structures is considered to be high. Therefore, there is likely to be a direct, permanent, short-term, **major negative** effect on buildings and structures prior to the implementation of mitigation measures.

Mitigation

10.8.57 Dependent on the findings any detailed desk-based UXO risk assessment, UXO supervision will be required during all future intrusive site investigation works, as well as the use of surface and down hole magnetometers.

Residual Effect

10.8.58 The impact on site workers following mitigation is considered to be negligible. Therefore, there is likely to be a direct, permanent, short-term **negligible** residual effect on site workers following the implementation of mitigation measures (Not Significant).

10.8.59 The impact on neighbouring land users following mitigation is considered to be negligible. Therefore, there is likely to be a direct, permanent, short-term **negligible** residual effect on neighbouring land users following the implementation of mitigation measures (Not Significant).

10.8.60 The impact on buildings and structures following mitigation is considered to be negligible. Therefore, ~~T~~there is likely to be a direct, permanent, short-term **negligible** residual effect on buildings and structures following the implementation of mitigation measures (Not Significant).

Operational Phase

10.8.61 This section identifies and assesses the scale and nature of the main effects arising from the Proposed Development during the operational phase.

Effect on human health from potential contaminants within the near surface soils

10.8.62 Should unexpected contamination be encountered during the construction phase, appropriate remediation measures will be implemented as part of the construction works.

10.8.63 If imported soils are required, soils will be validated for depth and chemical quality as part of the construction phase.

10.8.64 The September 2021 ground investigation works screened all soil samples for asbestos within soils and allows for a quantitative risk assessment to determine required remediation measures that will be implemented as part of the construction works, the

results of this are discussed within the GQRA (Appendix 10.2) and within Section 10.8.2010.8.18

10.8.65 The Proposed Development comprises a mixture of residential, commercial and public open space. In areas without hardstanding areas or buildings, there is likely to be the incorporation of soft-scaped areas. Future site users / residents and maintenance workers could be potentially exposed to contaminated Made Ground and soils through dermal contact, ingestion and inhalation of soils.

10.8.66 The impact on maintenance workers is considered to be negligible. Therefore, there is likely to be a direct, temporary and/or permanent, long-term, **negligible** effect on maintenance workers prior to the implementation of mitigation measures.

10.8.67 The impact on future users is considered to be negligible. Therefore, there is likely to be a direct, temporary and/or permanent, long-term, **negligible** effect on future site users prior to the implementation of mitigation measures.

Mitigation

10.8.68 No mitigation measures will be required as part of the operational phase, assuming that all the mitigation measures relating to potential exposure to contamination within near surface soils have been implemented during the demolition and construction phase.

Residual Effect

10.8.69 There is likely to be a direct, temporary and/or permanent, long-term, **negligible** effect on maintenance workers following the implementation of mitigation measures.

10.8.70 There is likely to be a direct, temporary and/or permanent, long-term, **negligible** effect on future site users following the implementation of mitigation measures (Not Significant).

Effect on human health from the inhalation of potential ground gas resulting from migration into indoor air and accumulation within small spaces

10.8.71 The underlying geology (London Clay) is generally not considered to represent a potential risk of ground gas generation. Radon is considered to represent a low risk to human health at the site.

10.8.72 The ground investigation did not identify the presence of notable organic or deleterious material within the limited thickness of Made Ground encountered across the site which was predominantly granular construction subbase in many locations.

10.8.73 The ground investigation targeted the area of a potential historic landfill record which was identified within the PRA within the car park west of the O2 Centre, however, the investigation did not encounter any evidence of landfilled material or waste deposits in these or any locations targeted by the works.

10.8.74 Ground gas monitoring was conducted as part of the ground investigation works, followed by a GQRA for ground gas (Appendix 10.2). Negligible concentrations of methane wrer detected during the ground gas monitoring and limited carbon dioxide

concentrations were recorded. The ground gas risk assessment suggests ground gas conditions indicative of BS8485 Characteristic Situation 1 (CS1) conditions, whereby no special gas protection measures are necessary.

10.8.75 The impact on maintenance workers is considered to be negligible. Therefore, there is likely to be a direct, temporary and/or permanent, medium-term to long-term, **negligible** negative effect on maintenance workers prior to the implementation of mitigation measures.

10.8.76 The impact on future users is considered to be negligible. Therefore, there is likely to be a direct, temporary and/or permanent, medium-term to long-term, **negligible** negative effect on future site users prior to the implementation of mitigation measures.

Mitigation

10.8.77 Additional ground gas monitoring is not required following the ground investigation works. No further action is proposed. The site is indicative of of BS8485 Characteristic Situation 1 (CS1) conditions, whereby no special gas protection measures are necessary.

10.8.78 Maintenance workers are assumed to adopt safe working principles when entering confined spaces and/or excavations, including but not limited to those listed below, in order to mitigate any potential residual risk of exposure to hazardous gases or depleted oxygen:

- appropriate PPE and RPE;
- monitoring equipment; and
- safe entry procedures.

Residual Effect

10.8.79 There is likely to be a direct, temporary and/or permanent, medium-term to long-term, **negligible** residual effect on maintenance workers following the implementation of mitigation measures.

10.8.80 There is likely to be a direct, temporary and/or permanent, medium-term to long-term, **negligible** residual effect on future site users following the implementation of mitigation measures (Not Significant).

Damage to buildings or buried structures associated with the potential accumulation of ground gas (if present)

10.8.81 The underlying geology (London Clay) is generally not considered to represent a potential risk of ground gas generation.

10.8.82 The ground investigation did not identify the presence of notable organic or deleterious material within the limited thickness of Made Ground encountered across the site which was predominantly granular construction subbase in many locations.

10.8.83 The ground investigation targeted the area of a potential historic landfill record which was identified within the PRA within the car park west of the O2 Centre, however, the investigation did not encounter any evidence of landfilled material or waste deposits in these, or any locations targeted by the works.

10.8.84 Ground gas monitoring was conducted as part of the ground investigation works, followed by a GQRA for ground gas (Appendix 10.2). Negligible concentrations of methane wrer detected during the ground gas monitoring and limited carbon dioxide concentrations were recorded. The ground gas risk assessment suggests ground gas conditions indicative of BS8485 Characteristic Situation 1 (CS1) conditions, whereby no special gas protection measures are necessary.

10.8.85 The impact on building and structures is considered to be negligible. There is likely to be a direct, temporary and/or permanent, medium-term to long-term, **negligible** negative effect on buildings and structures prior to the implementation of mitigation measures.

Mitigation

10.8.86 Additional ground gas monitoring is not required following the ground investigation works. No further action is proposed. The site is indicative of of BS8485 Characteristic Situation 1 (CS1) conditions, whereby no special gas protection measures are necessary.

Residual Effect

10.8.87 There is likely to be a direct, temporary and/or permanent, medium-term to long-term **negligible** residual effect on buildings and structures following the implementation of mitigation measures (Not Significant).

10.9 Limitation and Assumptions

10.9.1 The assessment of ground conditions is based on a review of desk-based information and the September 2021 ground investigation which was spatially confined as a result of current land uses.

10.9.2 The findings of further ground investigation and any supplementary works completed in the future as part of any planning conditions applied to the application will be completed in consultation with the regulators, undertaken in compliance with Health, Safety and Environmental good practice and incorporated into the CMP and foundation designs to ensure that an appropriate level of mitigation is provided. Risk assessments will be updated following receipt of relevant further information.

10.9.3 It is assumed that material moved around the site or imported onto site during the construction phase (e.g. to obtain required ground elevations) will have been subject to chemical testing (and will be geotechnically suitable) and will therefore not present a risk to human health or controlled waters.

10.10 Cumulative Effects

10.10.1 This section considers the likely cumulative effects that could arise from the Proposed Development when considered alongside other committed development schemes proximate to the site. It identifies whether effects from several developments which individually may be insignificant could, when considered together, cause significant cumulative effects requiring mitigation.

10.10.2 A number of committed developments have been identified following a review of LBC's planning portal and have been agreed with LBC (Figure 17.1). The assessment of cumulative effects on ground conditions and land contamination has been scoped out. This is on the basis that in the absence of shallow aquifers to facilitate contamination migration to neighbouring sites (or onto Site) and the lack of any migration pathways between the Made Ground and the deep aquifer within the chalk (which is too deep to be affected by the development as any piles will terminate within the London Clay), it is highly unlikely that any construction or operational effects will have a cumulative effect.

10.10.3 The assessment is based on the best available information and draws on the assessments included in the ES and Application Reports that accompany the development applications, where available.

10.11 Summary

10.11.1 The main effects relating to potential soil contamination result from the disruption to potential existing ground contamination during construction works and abnormal ground conditions associated with poor natural ground conditions.

10.11.2 Ground investigation works were undertaken in September 2021 in order to provide information about the ground conditions, soil samples for laboratory testing and ground gas monitoring data.

10.11.3 Supplementary ground investigation will be required post demolition of the current site buildings and structures on site, following discussions with regulators. Based on the findings of the GQRA (phase 1) it is likely that a Remediation Strategy will be required as part of the detailed design of the Proposed Development. The specific requirements for a Remediation Strategy would be dependent on the findings of further phases of ground investigation and GQRA that are likely to be completed in later stages of the site development.

10.11.4 Mitigation measures should be implemented in order to minimise or remove the risks identified within this ES. Mitigation measures are likely to include PPE for construction and maintenance workers and a watching brief during ground investigation.

10.11.5 If all mitigation measures are implemented then it is anticipated that overall, there is likely to be an effect on all receptors of a **negligible significance** (Not Significant).

10.11.6 **Table 10.8~~Table 10.8~~~~Table 10.6~~** contains a summary of the likely effects of the Proposed Development.

Table 10.~~8~~86: Summary of Effects

DESCRIPTION OF SIGNIFICANT EFFECTS	RECEPTOR	SIGNIFICANCE OF EFFECTS					SUMMARY OF MITIGATION / ENHANCEMENT MEASURES	SIGNIFICANCE OF RESIDUAL EFFECTS					RELEVANT POLICY/LEGISLATION
		MAJOR / MODERATE / MINOR / NEGLIGIBLE	POSITIVE / NEGATIVE	P / T	D / I	ST / MT / LT		MAJOR / MODERATE / MINOR / NEGLIGIBLE	POSITIVE / NEGATIVE	P / T	D / I	ST / MT / LT	
Demolition and Construction Phase													
Direct contact with the Made Ground onsite resulting in dermal contact, inhalation or ingestion of soil-based contaminants	Site preparation, demolition and construction workers	Moderate	Negative	T & P	D	ST-MT	Remediation Strategy / Verification Report (if required) CEMP and standard safe working practices MMP (if required)	Negligible	N/A	T & P	D	SM-MT	COSHH Regulations [10.5] CDM Regulations [10.6]
Inhalation of liberated respirable fibres of asbestos from within the Made Ground soils	Site preparation, demolition and construction workers	Moderate to Major	Negative	T & P	D	ST-MT	Remediation Strategy / Verification Report (if required) CEMP and standard safe working practices	Negligible	N/A	T & P	D	SM-MT	COSHH Regulations [10.5] CDM Regulations [10.6] CAR Regulations [10.4]
	People on neighbouring third party land	Minor to Moderate	Negative	T & P	D	ST-MT		Negligible	N/A	T & P	D	SM-MT	
The risk from ground gas (if present) to site preparation workers while working in confined trenches or excavations	Site preparation, demolition and construction workers	Negligible	Negative	T & P	D	ST-MT	Standard safe working practices including within confined spaces	Negligible	N/A	T & P	D	ST-MT	HSE Guidance [10.17].
Damage to buildings or buried structures associate with potentially elevated sulphates in the ground	Buildings and Structures	~~Moderate~~Minor	Negative	P	D	MT-LT	Appropriate design for foundations	Negligible	N/A	P	D	MT-LT	CDM Regulations [10.6]

DESCRIPTION OF SIGNIFICANT EFFECTS	RECEPTOR	SIGNIFICANCE OF EFFECTS					SUMMARY OF MITIGATION / ENHANCEMENT MEASURES	SIGNIFICANCE OF RESIDUAL EFFECTS					RELEVANT POLICY/LEGISLATION
		MAJOR / MODERATE / MINOR / NEGLIGIBLE	POSITIVE / NEGATIVE	P / T	D / I	ST / MT / LT		MAJOR / MODERATE / MINOR / NEGLIGIBLE	POSITIVE / NEGATIVE	P / T	D / I	ST / MT / LT	
causing concrete degradation													
Damage to buildings or structures associated with potentially excessive volume change in the clay strata underlying the site	Buildings and Structures	Moderate	Negative	P	D	MT-LT	Appropriate design for foundations Appropriate pilling techniques (if required)	Negligible	N/A	P	D	MT-LT	CDM Regulations [10.6]
Potential for UXO to be present on-site and to be disturbed during construction	Site preparation, demolition and construction workers	Major	Negative	P	D	ST	UXO supervision / watching brief (if required) Surface and down hole magnetometers (if required)	Negligible	N/A	P	D	ST	N/A
	People on neighbouring third party land	Major	Negative	P	D	ST		Negligible	N/A	P	D	ST	
	Buildings and Structures	Major	Negative	P	D	ST		Negligible	N/A	P	D	ST	
Operational Phase													
Effect on human health from potential contaminants within the near surface soils	Maintenance Workers	Negligible	N/A	T & P	D	LT	N/A (Implemented during the demolition and construction phase)	Negligible	N/A	T & P	D	LT	N/A
	Future Site Users and Residents	Negligible	N/A	T & P	D	LT		Negligible	N/A	T & P	D	LT	
Effect on human health from the inhalation of	Maintenance Workers	Negligible	Negative	T & P	D	MT-LT	Standard safe working practices including within confined spaces	Negligible	N/A	T & P	D	MT-LT	CIRIA C665 guidance [10.14] NHBC guidance [10.15]

DESCRIPTION OF SIGNIFICANT EFFECTS	RECEPTOR	SIGNIFICANCE OF EFFECTS					SUMMARY OF MITIGATION / ENHANCEMENT MEASURES	SIGNIFICANCE OF RESIDUAL EFFECTS					RELEVANT POLICY/LEGISLATION
		MAJOR / MODERATE / MINOR / NEGLIGIBLE	POSITIVE / NEGATIVE	P / T	D / I	ST / MT / LT		MAJOR / MODERATE / MINOR / NEGLIGIBLE	POSITIVE / NEGATIVE	P / T	D / I	ST / MT / LT	
potential ground gas (if present) resulting from migration into indoor air and accumulation within small spaces	Future Site Users and Residents	Negligible	Negative	T & P	D	MT-LT		Negligible	N/A	T & P	D	MT-LT	BS Code of Practice [10.16]
Damage to buildings or buried structures associated with the potential accumulation of ground gas (if present)	Buildings and Structures	Negligible	Negative	T & P	D	MT-LT	Not required	Negligible	N/A	T & P	D	MT-LT	CIRIA C665 guidance [10.14] NHBC guidance [10.15] BS Code of Practice [10.16]

10.12 References

Ref 10.1 Environment Agency (EA). (1995). *Environment Act, Section 57.*
Ref 10.2 *Environmental Protectional Act, Part IIA – Contaminated Land.* (1990).
Ref 10.3 *Contaminated Land (England) (Amendment) Regulations*. (2012).
Ref 10.4 *Control of Asbestos Regulations*. (2012).
Ref 10.5 *Control of Substances Hazardous to Human Health (Amendment) Regulations*. (2004).
Ref 10.6 Health and Safety Executive. (2005). *Construction (Design & Management) Regulations.*
Ref 10.7 Ministry of Housing, Communities and Local Government. (2021). *National Planning Policy Framework.*
Ref 10.8 Greater London Authority. (2021). *The London Plan - The Spatial Development Strategy for Greater London.*
Ref 10.9 Greater London Authority. (2021). *Contaminated Land Process Note – Good Practice Note – Dealing with Contaminated and Polluted Sites.*
Ref 10.10 London Borough of Camden (LBC). (2018). *Camden's Local Area Requirements for Planning Applications.*
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Ref 10.13 Environment Agency (EA). (2020). *Land Contamination Risk Management (LCRM).*
Ref 10.14 Construction Industry Research and Information Association (CIRIA). (2007). *Assessing risks posed by hazardous ground gases to buildings (C665).*
Ref 10.15 National House-Building Council (NHBC). (2007). *Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present.*
Ref 10.16 British Standard (BS). (2019). *8485:2015+A1:2019 - Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings.*
Ref 10.17 Health and Safety Executive (HSE). (2014). *Safe work in confined spaces - Confined Spaces Regulations 1997 Approved Code of Practice, Regulations and guidance.*