5 Geology, Soils and Contaminated Land

5.1 Introduction

5.1.1 This chapter reports the likely significant effects of the Proposed Development in terms of ground conditions and contamination in the context of the site and surrounding area. It considers the potential effects as a result of contamination risks due to the Proposed Development on the soil and groundwater at the site and surrounding area. It also assesses the potential subsequent effects on sensitive receptors such as future site users, construction works and controlled waters (groundwater and surface water).

5.1.2 This chapter and the supporting ground conditions and contamination preliminary risk assessment (ES Part 3, Appendix 3.A) have been prepared by WSP | Parsons Brinckerhoff.

5.2 Relevant Legislation

5.2.1 Land contamination is regulated under several regimes, including environmental protection, pollution prevention and control, waste management, planning and development control and health and safety legislation.

National

Environmental Protection Act 1990

5.2.2 Specific UK legislation on contaminated land is principally contained within Part IIA of the Environmental Protection Act (EPA) 1990 (Ref. 5-1). The legislation endorses the principle of ‘Polluter Pays’ and a ‘suitable for use’ approach to contaminated land, where remedial action is required only if there are significant risks to human health or Controlled Waters.

Contaminated Land (England) Regulations 2006, as amended

5.2.3 The 2006 Regulations (Ref. 5-2) extend Part IIA of the EPA to include land which has been affected by radioactivity.

5.2.4 The Contaminated Land (England) (Amendment) Regulations 2012 (Ref. 5-3) provides amendments to, and supersedes the original Regulations issued in 2000. The amendments largely reflect an update to the definition of Controlled Waters.

Water Resources Act 1991

5.2.5 The Water Resources Act 1991 (Ref. 5-4) seeks to protect the quality of groundwater and surface water, collectively defined as ‘Controlled Waters’. The Act is of relevance to soil contamination in those cases where the nature, extent and mobility of contamination present a risk of pollution of Controlled Waters. In such cases, the land owner is committing an offence if the pollution of Controlled Waters is not prevented once the site has been identified as being a source of contamination.
5.3 Relevant Planning Policy and Other Guidance


5.3.1 The primary reference to contaminated land within the National Planning Policy Framework (NPPF) (Ref. 5-5) is in Section 11, Paragraphs 109, 120, and 121, which are reproduced below:

- “109. The planning system should contribute to and enhance the natural and local environment by:
  o preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability; and
  o remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.”

- “120. To prevent unacceptable risks from pollution and land instability, planning policies and decisions should ensure that new development is appropriate for its location. The effects (including cumulative effects) of pollution on health, the natural environment or general amenity, and the potential sensitivity of the area or Proposed Development to adverse effects from pollution, should be taken into account. Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner.”

- “121 Planning policies and decisions should ensure that:
  - The site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation;
  - After remediation, as a minimum, land should not be capable of being determined as contaminated land under Part II A of the Environmental Protection Act 1990; and,
  - Adequate site investigation information, prepared by a competent person, is presented.
  - In doing so, local planning authorities should focus on whether the development itself is an acceptable use of the land and the impact of the use, rather than the control of processes or emissions themselves where these are subject to approval under pollution control regimes. Local planning authorities should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities.”


5.3.2 The Contaminated Land Statutory Guidance (Ref. 5-6) describes a risk assessment methodology in terms of ‘significant pollutants’ and ‘significant pollutant linkages’ within a source-pathway-receptor conceptual model. The model comprises:

The principal pollutant hazards (sources) associated with a site:

- The principal receptor(s) at risk from the identified hazards (for example, people, environmental assets, surface water and / or groundwater); and
- The existence, or absence, of plausible pathways which may exist between the identified hazards and receptor(s).
5.3.3 For land to be determined as ‘contaminated’ in a regulatory sense, and therefore requiring remediation (or a change to less sensitive use), all three elements (source-pathway-receptor) of a significant pollutant linkage must be present. The legislation places a responsibility on the Local Planning Authority to determine whether the land in its area is contaminated by consideration of whether:

- Significant harm is being caused to Human Health or Controlled Waters;
- There is a possibility of significant harm being caused. And, in regard of radioactivity:
  - Harm is being caused; or
  - There is a significant possibility of such harm being caused.

Planning Practice Guidance

5.3.4 On 6th March 2014, the Department for Communities and Local Government (DCLG) launched the Planning Practice Guidance web-based resource (Ref. 5-7). The Planning Practice Guidance does not contain any specific policies on ground conditions and contamination, however it contains a chapter (ID.33) which provides guiding principles on how the planning process can manage land affected by contamination.


5.3.5 Environment Agency and Department for Environment, Food and Rural Affairs (Defra) guidance; Model Procedures for the Management of Land Contamination: Contaminated Land Report 11 (CLR11) (2004) (Ref. 5-8) advocates the use of a conceptual risk assessment model. The basis of this approach comprises three elements, namely a source, a pathway and a receptor. Without all three of these there can be no contamination risk. Therefore, the presence of measurable concentrations of contaminants within the ground and subsurface environment does not automatically imply that a contamination problem exists, since the contamination must be defined in terms of pollutant linkages and unacceptable risk of harm. The nature and importance of both pathways and receptors, which are relevant to a particular site, will vary according to the intended use of the site, its characteristics and its surroundings. The potential for harm to occur requires three conditions to be satisfied:

- The presence of substances (potential contaminants/pollutants) that may cause harm (the ‘Source’ of pollution);
- The presence of a receptor which may be harmed, (e.g. the water environment or humans, buildings, fauna and flora) (the ‘Receptor’); and
- The existence of a linkage between the source and the receptor (the ‘Pathway’).

5.3.6 CLR11 has been followed to provide a technical framework to assist in the understanding of how contamination issues that may arise on the site could be managed.


5.3.7 The Environment Agency’s approach to the management of groundwater is outlined in Groundwater Protection: Principles and Practice (2012) (Ref. 5-9). This document contains the conceptual method for risk-based decision making and developing policy statements in areas such as the control of groundwater abstraction and diffuse pollution of groundwater. The Policy is presented as a framework within which decisions should be made and sets out the
Environment Agency’s broad approach to existing risks and new developments. The Policy is underpinned by published groundwater vulnerability maps and groundwater Source Protection Zones (SPZ).

5.3.8 The protection of key groundwater resources and, in particular, those used for public drinking water supply, is accomplished by the establishment of SPZ. The SPZ provide an indication of the potential risk of pollution, based on the local soil and geological conditions and the depth of the water table. Generally the closer a polluting activity or release is to a groundwater source, the greater the risk. Three zones (an inner, outer and total catchment) are usually defined. These zones are used to control the activities and discharges in the area to protect the aquifer.

Guiding Principles for Land Contamination (2010)

5.3.9 The Environment Agency’s approach to best practise of management of contaminated land is outlined in GPLC1 – Guiding Principles for Land Contamination (2010) (Ref. 5-10). This document provides generic guidance for problem holders (whom the responsibility for contaminated land lies) and their expert advisors and consultants. The document outlines; 1) the roles and responsibilities of contaminated land; 2) good practise to promote compliance with regulatory requirements; and 3) supporting guidance and documents for contaminated land management.

Regional (Greater London)

5.3.10 Key policies of the London Plan: Spatial Development Strategy for Greater London (2011) (the London Plan) (Ref. 5-11) relating to contaminated land are set out in Policy 5.21 Contaminated Land. This policy states that such land affected by contamination should be recycled into new uses, reducing the risk to the environment and may require measures to prevent contamination being activated or spread when building takes place.

5.3.11 The policy is set out as follows: *Policy 5.21 Contaminated Land*

- Strategic
  - A The Mayor supports the remediation of contaminated sites and will work with strategic partners to ensure that the development of brownfield land does not result in significant harm to human health or the environment, and to bring contaminated land to beneficial use.

- Planning decisions
  - B Appropriate measures should be taken to ensure that development on previously contaminated land does not activate or spread contamination.

  - Local Development Framework (LDF) preparation

  - C LDFs should encourage the remediation of contaminated sites and set out policy to deal with contamination."

5.3.12 On 11th October 2013 the Mayor published Revised Early Minor Alterations to the London Plan (REMA) (Ref. 5-12). From this date, the REMA are operative as formal alterations to the London Plan and form part of the development plan for Greater London. The REMA adds the following wording to Policy 5.21:
“Where potentially contaminating activities are proposed, development should include appropriate measures to mitigate any harmful effects”.

5.3.13 On 15th January 2014, the Mayor published Draft Further Alterations to the London Plan (FALP) (Ref. 5-13) for a twelve week period of public consultation. The FALP was published on 10th March 2015. The FALP also do not alter Policy 5.21.

Local (London Borough of Hammersmith and Fulham)

5.3.14 The London Borough of Hammersmith Core Strategy October 2011 (Ref. 5-14) considers the management of contaminated land within Policy CC4 – protecting and enhancing environmental quality, which states:

- “The council will support measures to protect and enhance the environmental quality of the borough including harmful emissions to land, air and water and the remediation of contaminated land. It will work with partner organisations to help deliver this. In particular, measures will be taken to (among others):
  - manage the development of land to minimise the potential harm of contaminated sites and where appropriate, ensure that mitigation measures are put in place”

5.3.15 Paragraphs 8.106 and 8.107 state:

- “(8.106) The presence of contamination on a site can affect or restrict the beneficial use of land, though development can present an opportunity to deal with it. Contamination can create risks to human health, property and the wider environment. The council has developed and implemented a Contaminated Land Strategy in which over 20% of the borough has been identified as potentially contaminated land and consequently risk assessed.

- (8.107) Where necessary, remediation works will be required to ensure the development can be safely built and occupied without posing any unacceptable risks to human health or the environment.”

London Borough of Hammersmith and Fulham Development Management Local Plan (DMLP)

5.3.16 The DMLP July 2013 (Ref. 5-15) sets out the development management policies to be used by the council in helping to determine individual planning applications and must be read alongside the Core Strategy. With regards to contaminated land the following Policy - DM H7 Contaminated land is applicable:

- “When development is proposed on or near a site that is known to be, or there is good reason to believe may be, contaminated, or where a sensitive use is proposed, an applicant should carry out a site assessment and submit a report of the findings in order to establish the nature and extent of the contamination. Development will not be permitted unless practicable and effective measures are to be taken to treat, contain or control any contamination so as not to:
  - expose the occupiers of the development and neighbouring land uses including, in the case of housing, the users of gardens to unacceptable risk;
  - threaten the structural integrity of any building built, or to be built, on or adjoining the site;
5.3.17 The council consider that in built up areas such as Hammersmith and Fulham where there has been a history of heavy industry, land contamination is known to exist. Therefore it is important that any land that is known or suspected of being contaminated, or where a sensitive use is proposed, is dealt with before the development takes place.

5.3.18 It is considered that any potential risks associated with contaminated land should be identified and assessed at the planning pre-application stage. Some sites may be contaminated as a result of being in the vicinity of a contaminated site. The risk of this contamination depends on ground conditions and the type of contamination. Where necessary, developers will be required to carry out remediation works and to satisfy the council that their development can be safely built and occupied without posing any unacceptable risks to human health or the environment.

5.3.19 The council state that developers must ensure that their remediation works are sustainable and result from a robust site investigation and risk assessment and that remediation is conducted in-situ when possible to reduce the amount of waste produced which requires transport, and recycle soils and aggregates when possible to avoid the need for disposal, hence minimising the pollution of the wider environment. Any investigation or treatment of the contamination must be agreed with the council before it is implemented.

London Borough Hammersmith and Fulham - Planning Guidance Supplementary Planning Document (SPD)

5.3.20 The Planning Guidance SPD, July 2013 (Ref. 5-16), provides a description of potentially contaminated land in the borough and provides a list of policies that the council will apply when considering development proposals on or near such land or where a sensitive use is proposed. The policies are based on the NPPF 2012 and the council’s Core Strategy and DMLP as outlined above.

5.3.21 Of particular relevance to contaminated land, SPD Amenity Policy 5: Key Contamination Considerations states

- Developers, applicants or their agents should carry out the following key actions to ensure that delays and further expense are avoided:
  - Appoint a competent person to undertake any necessary assessment or remediation;
  - Liaise with the council’s specialist officer dealing with contamination as early in the process as possible;
  - Ensure that land potentially affected by contamination is addressed in a phased approach seeking agreement with the council at each phase;
  - Ensure that key stages in development are timed and planned with consideration of the assessment of contamination;
  - Ensure that key elements of design upon which contamination may be a factor are carefully considered;

- Any application will be assessed in relation to the suitability of the proposed use for the conditions on that site. Any permission for development will require that the measures to assess and abate any risks to human health or the wider environment agreed with the authority must be completed as the first step in the carrying out of the development.
- Ensure that the conveyance of ground materials on and off site are in line with guidance and legislation and that the relevant paperwork is collated.

- Ensure that any changes to development details are considered in the development's conceptual site model.

- All of the guidance and requirements outlined in the Technical Details and Submission Details sections should be followed.”

_Hammersmith and Fulham Council - Draft Local Plan, Regulation 18 Consultation_

5.3.22 This Draft Local Plan, January 2015 (Ref. 5-17), has been produced in connection with the council’s decision to prepare and adopt a new Hammersmith and Fulham Local Plan, in accordance with Regulation 18 of the Town and Country Planning (Local Planning (England)) Regulations 2012.

5.3.23 Policy CC8 within the Draft Local Plan relates to contaminated land and is identical to Policy DM H7 within the DMLP, with the exception of the ‘Alternative Options – Policy CC8 (Contaminated Land) that states:

- “Development should not be permitted unless action is taken to address any contamination on the site so as not to expose future users to any risk.”

5.4 Scope of Assessment

Consultation

5.4.1 An EIA Scoping Report was submitted to London Borough of Hammersmith and Fulham (LBHF) dated 31st July 2015, see ES Part 3, Appendix 1.A. The EIA Scoping Report detailed the approach to Ground Conditions, Hydrogeology and Contamination and stated that a Preliminary Risk Assessment (PRA) was being undertaken in order to assess whether land contamination may be present at the site. An EIA Scoping Opinion was received from LBHF on 14 September 2015.

5.4.2 The assessment included within this Chapter is in accordance with the EIA Scoping Report and Scoping Opinion and considers potential environmental risks associated with the site in regards to current activities and in the context of the Proposed Development, including potential receptors that could be impacted by the redevelopment.

5.4.3 Following on from the assessment, mitigation measures are considered that will enable the Proposed Development to progress with minimal impact to human health and controlled waters, which are considered under the NPPF and Environment Agency’s Guiding Principles for Land Contamination.

5.4.4 The LBHF, London Fire Brigade and the Environment Agency were consulted to identify any potential sources of contamination at the site.

Preliminary Risk Assessment

5.4.5 The scope of works for the assessment comprised a Phase 1 Environmental Desk Study, also known as a Preliminary Risk Assessment (PRA) which contains the following elements:
- Assessment of the ‘sensitivity’ of the site location as determined by factors such as hydrogeology, proximity of watercourses, neighbouring land use, ecologically sensitive uses (Landmark Information Group April 2015) and geology (British Geological Survey, Borehole Log Records & Geological Map Sheet No. 270 (South London);

- Enquiries with relevant environmental regulatory bodies such as the LBHF and Environment Agency as to whether records on remediation, enforcement notices or reported pollution incidents are held for the site;

- Review of existing reports and utilisation of the information contained therein;

- Assessment of the potential for contaminated soil and/or groundwater associated with historical and current land uses (sources);

- Assessment of potential migration pathways within the saturated and unsaturated zones beneath the site (pathways);

- Assessment of the potential effects of contaminated land, on groundwater, end users, and other sensitive receptors (receivers); and

- A site reconnaissance survey will be undertaken for the purpose of identifying current site features, types of land use and potential sources of contamination.

5.4.6 The PRA is included ES Part 3, Appendix 3.

Geology, Soils and Contaminated Land Chapter

5.4.7 From the desk study a Conceptual Site Model (CSM) of ground conditions and contamination has been formulated for the site and source-pathway-receptor linkages described for the construction and operational phases.

5.4.8 An assessment has been made of each source-pathway-receptor linkage, taking into account the anticipated form and level of the Proposed Development.

5.4.9 The assessment determines, qualitatively, the likely significance of effects on a scale of Major/Moderate/Minor/Negligible, either positive or negative in accordance with current industry good practice including the provisions adapted from CLR11.

5.4.10 Mitigation measures that will reduce or remove likely significant effects have been determined based upon recommendations from the PRA and a baseline site investigation to mitigate adverse effects, and may include:

- Unexploded ordnance survey prior to ground works;

- Building design modifications (e.g. gas membrane) to mitigate against potential ground gas and volatile vapours; and,

- Safe handling, remediation and disposal of any contaminated soils during the construction phase.
5.5 **Assessment Methodology**

**Assessment Guidance and Methods**

5.5.1 Contaminated land legislation and guidance focuses on the site-specific assessment of likely contaminant linkages based on a source-pathway-receptor model as described in CLR11. Potential contaminant sources, pathways and receptors are described later in this chapter. There is no specific methodology or guidance for the assessment of effects on ground conditions for the purposes of Environmental Impact Assessment (EIA) and significance criteria have been developed based on the sensitivity of the receptor (receptor and elements of the pathway) and potential magnitude for change (typically the source and elements of the pathway).

5.5.2 The significance level attributed to each effect has been assessed based on the magnitude of change due to the Proposed Development and the sensitivity/value of the affected receptor / receiving environment to change. The magnitude of change and the sensitivity of the affected receptor / receiving environment are both assessed on a scale of high, medium, low and negligible (very low).

**Defining Receptors and their Sensitivity and Value**

5.5.3 Potential receptors for contamination include:

- Human Health: Future Site Users, Construction and Maintenance Workers;
- Controlled Waters: Surface Water and Groundwater; and
- Built Structures and Services.

5.5.4 The sensitivities have been assigned based on professional judgement and experience, as well as reference to guidance. The importance of a feature is assessed on attributes such as: quality; scale; rarity and substitutability. Factors which may affect the sensitivity of the potential receptor include:

- Age, weight, sex, duration on-site, distance from the site (human receptors);
- Distance from the site, resource potential (Controlled Waters receptors); and
- Value and sensitivity of species and habitats.

5.5.5 The significance is assessed by classifying both the importance and sensitivity of these receptors and the magnitude of any impact. Elements considered when assessing the magnitude of the effect are mostly the quantity of the contamination, and the hazard it presents to people or the environment, but also include whether the effect is indirect or direct, temporary or permanent, frequent or infrequent and whether the effect will ensue for a short, medium or long time.

5.5.6 The quality of the resource is important in assessing impacts, and is closely linked to the magnitude of effects. For example, the existing surface water quality of a receiving water body may be excellent and therefore a small deterioration in quality (low magnitude) could still represent a significant effect. A similar situation may occur for groundwater quality at abstraction wells with a potable use, where a small deterioration in quality (low magnitude) could represent a significant effect.
5.5.7 The table below (Table 5.1) illustrates the matrix used in identifying the potential overall significance of effects on ground conditions and contamination.

<table>
<thead>
<tr>
<th>Magnitude of Change</th>
<th>Sensitivity of receptor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>High</td>
<td>Major</td>
</tr>
<tr>
<td>Medium</td>
<td>Major</td>
</tr>
<tr>
<td>Low</td>
<td>Moderate</td>
</tr>
<tr>
<td>Negligible</td>
<td>Negligible</td>
</tr>
</tbody>
</table>

5.5.8 Table 5.2 below provides examples of how the significance of effects on ground conditions and contamination has been derived.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Adverse</td>
<td>High risk site classification – acute or severe chronic effects to human health and/or animal/plant populations predicted.</td>
</tr>
<tr>
<td>(Significant)</td>
<td>A significant effect on a potable groundwater or surface water resource of regional importance e.g. Principal Aquifer, public water reservoir or inner protection zone of a public supply borehole.</td>
</tr>
<tr>
<td></td>
<td>Effect on an outer groundwater source protection zone. Temporary alteration to the regional hydrological or hydrogeological regime or permanent alteration to the local regime.</td>
</tr>
<tr>
<td>Moderate Adverse</td>
<td>Medium risk site classification and proven (or likely significant) pollutant linkages with human health and / or animal/plant populations, with harm from long-term exposure.</td>
</tr>
<tr>
<td>(Significant)</td>
<td>Effect on an outer groundwater source protection zone. Temporary alteration to the regional hydrological or hydrogeological regime or permanent alteration to the local regime.</td>
</tr>
<tr>
<td>Minor Adverse</td>
<td>Medium risk site classification and potential pollutant linkages with human health and / or animal / plant populations identified. Reversible, localised reduction in the quality of groundwater or surface water resources used for commercial or industrial abstractions, Secondary Aquifer.</td>
</tr>
<tr>
<td>Negligible</td>
<td>Low risk site classification – No appreciable effect on human, animal or plant health, potable</td>
</tr>
</tbody>
</table>
Table 5.2: Description of Significance

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>groundwater or surface water resources.</td>
<td></td>
</tr>
<tr>
<td>Minor Beneficial</td>
<td>Risks to human, animal or plant health are reduced to acceptable levels. Local scale improvement to the quality of groundwater or surface water resources used for commercial or industrial abstraction.</td>
</tr>
<tr>
<td>Moderate Beneficial (Significant)</td>
<td>Significant reduction in risks to human, animal or plant health, to acceptable levels. Significant local improvement to the quality of potable groundwater or surface water resources. Significant improvement to the quality of groundwater or surface water resources used for public water supply.</td>
</tr>
<tr>
<td>Major Beneficial (Significant)</td>
<td>Major reduction in risks to human, animal or plant health. Significant regional scale improvement to the quality of potable groundwater or surface water resources.</td>
</tr>
</tbody>
</table>

Summary of Consultation

5.5.9 Table 5.3 provides a summary of the consultation activities undertaken in support of the preparation of this Chapter. Correspondence is included within the PRA in ES Part 3, Appendix 3.

Table 5.3: Summary of Consultation Undertaken to Date

<table>
<thead>
<tr>
<th>Body / Organisation</th>
<th>Individual/s at Body / Organisation</th>
<th>Meeting Dates and Other forms of Consultation</th>
<th>Summary of Outcome of Discussions</th>
</tr>
</thead>
<tbody>
<tr>
<td>London Borough of Hammersmith and Fulham</td>
<td>Contaminated Land Officer</td>
<td>Request for pertinent information submitted 04/08/2015.</td>
<td>Response received 18/08/2015. The site has not been designated as Contaminated Land under Part IIA of the EPA.</td>
</tr>
<tr>
<td>London Fire Brigade</td>
<td>Petroleum Group lead</td>
<td>Request for pertinent information submitted 04/08/2015.</td>
<td>Response received 12/08/2015. No records of fuel tanks being present at the site.</td>
</tr>
<tr>
<td>Environment Agency</td>
<td>Customers and</td>
<td>Request for pertinent information submitted</td>
<td>Response received</td>
</tr>
</tbody>
</table>
Table 5.3: Summary of Consultation Undertaken to Date

<table>
<thead>
<tr>
<th>Body / Organisation</th>
<th>Individual/s at Body / Organisation</th>
<th>Meeting Dates and Other forms of Consultation</th>
<th>Summary of Outcome of Discussions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engagement Officer</td>
<td></td>
<td>04/08/2015</td>
<td>19/08/2015</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>The site is considered not to be an identifiable contamination risk with regards to groundwater. The EA does not hold records of contaminated land issues associated with the site.</td>
</tr>
</tbody>
</table>

5.6 Existing and Future Baseline

Information sources

5.6.1 Data for the Chapter has been drawn from a wide range of sources including:

- WSP | Parsons Brinckerhoff Ground Conditions and Contamination Preliminary Risk Assessment (PRA), August 2015 (included as ES Part 3, Appendix 3);
- Review of previous available ground conditions reports;
- Landmark Envirocheck report 66983846_1_1 (April 2015);
- Consultation with LBHF Contaminated Land Officer;
- Historical Maps;
- Regulatory databases and consultation; and,
- Site walkover.

Existing Baseline

Geology and Hydrogeology

5.6.2 The British Geological Survey (BGS) Map No. 270 South London (1998) (Solid and Drift) (1:50,000 Series) indicate that the underlying geology is likely to be as presented in Table 5.4 below and also provides the EA’s aquifer designations for each of the geological units.
Table 5.4: Underlying Geology

<table>
<thead>
<tr>
<th>Geological Unit/Stratum</th>
<th>Description</th>
<th>Estimated depth to base of stratum (m bgl)</th>
<th>Aquifer Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kempton Park Gravel Formation</td>
<td>Sand and Gravel</td>
<td>~ 8m</td>
<td>Secondary (A)</td>
</tr>
<tr>
<td>London Clay Formation (part of the Thames Group)</td>
<td>Clay and mudstone</td>
<td>~ 30m</td>
<td>Unproductive/ confining</td>
</tr>
<tr>
<td>Lambeth Group</td>
<td>Shallow marine sand, fluvial and estuarine mud and sand</td>
<td>~ 30m</td>
<td>Secondary (A)</td>
</tr>
<tr>
<td>Upper Chalk Formation</td>
<td>Chalk with banded flint nodules</td>
<td>&gt;150m</td>
<td>Principal</td>
</tr>
</tbody>
</table>

5.6.3 There are no licensed groundwater abstraction points within a 500m radius of the site. The nearest groundwater abstraction point is located approximately 520m south east of the site, operated by Mitie Energy Limited at the Chelsea Academy, with water utilised for heat pumps.

Hydrology

5.6.4 The nearest surface water body is an unnamed pond located approximately 150m east of the site. The nearest significant surface water body is the River Thames, located approximately 700m to the south east of the site. There are no surface water abstraction points within 500m of the site.

Current Site Use and Description

5.6.5 A site walkover was carried out on 19th May 2015 by a WSP | Parsons Brinckerhoff Engineer. The site comprises the main football stadium structure which occupies the majority of the site area. The main stadium structure includes four stands surrounding the football pitch with concourse areas within the stands. Built on to the main structure are office blocks and a club shop on the western most section of the South Stand, residential units in the south west of the structure, and a hotel (The Copthorne) with adjoining ground level restaurants in the south eastern corner of the Stadium. A separate building is located to the north of the stadium and includes Chelsea FC offices, the Chelsea Museum and a leisure centre. A second hotel (The Millennium) is also located in a separate building in the south eastern corner of the site. This hotel is connected to an underground basement car park which extends underneath the south eastern corner of the site.

5.6.6 Plant rooms are located in each of the four stands, both hotels and within the leisure centre which include diesel powered back-up generators, hydraulic tanks (associated with passenger lifts) and air conditioning units. An electrical substation is located in the east stand of the stadium. During the site visit in May 2015, plant was observed to be located on sealed hardstanding with generally no apparent evidence of staining or impact. Minor chemical staining was noted within the plant room of the leisure centre although this is considered not to provide a potential source of contamination given that it is internal within the building and is situated on concrete of good condition.
Surrounding Land Uses

5.6.7 A summary of the surrounding land uses is outlined in Table 5.5.

Table 5.5: Surrounding Land Uses

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>London Underground railway (above ground) beyond which are commercial and residential properties.</td>
</tr>
<tr>
<td>South</td>
<td>Commercial and residential properties.</td>
</tr>
<tr>
<td>West</td>
<td>Commercial and residential properties.</td>
</tr>
<tr>
<td>East</td>
<td>Overground railway, beyond which is Brompton Park and cemetery.</td>
</tr>
</tbody>
</table>

On-site Historical Land Uses

5.6.8 Historical mapping is included within the PRA in ES Part 3, Appendix 3.

5.6.9 A detailed account of the history of the site is provided in Chapter 8: Archaeology and Cultural Heritage. According to the earliest available historical map (1869-1874), the site was largely undeveloped with trees and fields and an agricultural appearance. A number of buildings were located at the southwest portion of the site and appeared to be utilised for housing. A railway line was also located on-site along the eastern boundary, orientated southeast-northwest. By 1896, the site had been developed and was annotated as ‘Stamford Bridge Athletic Ground’ comprising tennis courts, pavilions and an oval playing field. A railway identified on historical mapping as ‘Fulham Extension Line’ had been constructed within the western portion of the site. By 1916 the site remained as ‘Stamford Bridge Athletic Ground’ and a stadium structure had been constructed on the site with a pavilion area and raised embankments surrounding the oval playing field. Historical photographs of the site indicated that the levels of the site had been significantly altered and the terraces appeared to be on raised ground (potentially Made Ground or fill).

5.6.10 By the 1950s the Stadium had increased in size and the pavilion had been converted into a ‘Stand’, a racing track was present and large areas surrounding the oval playing field had been developed as raised terraces. A small electricity sub-station was present in the south east corner of the site. Between the 1960s and 2013, historical maps and aerial photography indicate that various terraces and stands were redeveloped, but the overall layout and configuration of the site remained largely unaltered.

Offsite Historical Land Uses

5.6.11 The earliest available historical mapping (1869 – 1874), indicates that the site was surrounded by predominantly undeveloped agricultural land (north of site) or low density residential properties (south of site). A cemetery was present immediately northeast of the site, labelled ‘Brompton Cemetery’. The 1896 map indicated a hospital for ‘infectious diseases’, approximately 100 m north of the site. A ‘tank’ was also present, approximately 150m northwest of the site associated with the ‘London Road Car Company Depot’. 
5.6.12 By 1951, the ‘London Road Car Company Depot’ was labelled ‘Motor Repair Works’. Further developments in the local area included a ‘laundry’ located approximately 150m west of the site, a ‘printing works’ and ‘warehouse’ located approximately 80m southwest of the site. By 1970, the site-wide land use remained generally unchanged. Minor alterations included two ‘electrical substations’, located approximately 130m northwest and 80m south of the site.

5.6.13 The general land use of the area surrounding the site remained the same until the last available mapping and photography (2015), with some minor changes and alterations with regards to redevelopment and regeneration.

Potential Sources of Contamination

5.6.14 There is no evidence in the information obtained to date that there is contamination present on the site, however, until a detailed ground investigation is undertaken the potential for some contamination to be present cannot be ruled out. The following potential sources of contamination on and off site have therefore been identified, based upon historical land uses, and these are presented in Table 5.6 below.

<table>
<thead>
<tr>
<th>Potential Source</th>
<th>Potential Contaminants of Concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Made Ground at the site, particularly associated with fill material of raised embankment within historic terraces</td>
<td>Metals, petroleum hydrocarbons, poly aromatic hydrocarbons (PAHs), benzene, toluene, ethyl benzene, and xylene (BTEX) and asbestos.</td>
</tr>
<tr>
<td>Historic and current use of site as football stadium with associated plant rooms containing generators, oil tanks, chemicals and an electrical substation</td>
<td>Metals, petroleum hydrocarbons, PAHs, volatile organic compounds (VOCs), BTEX, polychlorinated biphenyls (PCBs) and asbestos.</td>
</tr>
<tr>
<td>Historic and current railways within the site</td>
<td>Metals, hydrocarbons, BTEX and pesticides.</td>
</tr>
<tr>
<td>Industrial land uses in immediate area</td>
<td>Metals, petroleum hydrocarbons, PAHs, VOCs, BTEX, PCBs, solvents and asbestos.</td>
</tr>
<tr>
<td>Cemetery</td>
<td>Chlorides, sulphate, ammonia, nitrate, sodium, potassium, magnesium and bacteria (such as faecal streptococci, clostridium, and Pseudomonas aeruginosa).</td>
</tr>
</tbody>
</table>

Future Baseline

5.6.15 Should no development take place and site conditions remain as they are, no significant change to the current baseline would be predicted. Any potentially polluting activities that are currently occurring would be likely to continue (if present), however the identified contamination sources are historical, off-site or inactive, so on-site contamination is unlikely to
significantly increase/worsen. However, assuming no remediation takes place it is possible that any existing sources of contamination (if present) could allow for the concentration and accumulation of contaminants, which will increase the potential effect to sensitive receptors. It should be noted that no significant contaminative activities were observed to be present at the site during the site walkover in April 2015.

**Potential Receptors**

5.6.16 Potential receptors have been determined from the PRA and baseline information above, and are summarised below. They have been given a sensitivity (presented in brackets) based on the paragraph above. For the purposes of the assessment, potential receptors are assessed separately for the construction and operational phases.

- **Human Health**
  - Future site users and maintenance workers (High Sensitivity);
  - Construction workers (Medium Sensitivity – due to short term exposure) and personal protective equipment (PPE);
  - Off-site receptors (residents) during construction works (Medium Sensitivity – due to distance from site); and
  - Potable water supply (Medium Sensitivity).

- **Controlled Waters**
  - Groundwater of the Kempton Park Gravels (Secondary (A) Aquifer) (Medium Sensitivity);
  - Groundwater of Lambeth Group (Secondary (A) Aquifer) and Upper Chalk (Principal Aquifer) (High Sensitivity); and
  - Surface water of the River Thames and nearby pond (Medium Sensitivity).

- **Ecological receptors**
  - Ecological receptors in surface water or terrestrial ecosystems could be affected by the migration of contaminants from soil or groundwater during the Proposed Development (Low Sensitivity).

- **Buildings**
  - Buried concrete and services could undergo chemical attack (Medium Sensitivity); and
  - Building structures from ground gas build up (High Sensitivity).

5.6.17 Overall, the site is considered to be of moderate environmental sensitivity in view of the surrounding and adjacent residential properties, nearby surface water features, and the underlying groundwater beneath the site, which is classified as a Secondary A Aquifer.
5.7 Potential Effects and Embedded Mitigation

5.7.1 Potentially significant effects have been determined from the PRA and baseline information above, which are also considered to be plausible contaminant linkages, and are summarised below:

Construction Phase Effects

- Increase in contaminated dust generated by on-site activities on existing on-site receptors and nearby properties, which could contain elevated concentrations of contaminants;
  - Construction workers and off site receptors may be exposed to any contaminants that are present in the Made Ground, or that are present in the natural or made ground after migrating from contaminant sources, during any earthworks or site clearance.
- Increase in infiltration due to removal of hardstanding during construction phase;
  - Removal of surface cover (buildings and hardstanding) has the potential to increase the rate of infiltration of rainfall and therefore leaching of contaminants from shallow soils (if present) into the underlying groundwater.
- Increase mobilisation and disturbance of contaminants in Made Ground;
  - There is potential for exposure to asbestos or other contaminants during any earthworks or site clearance, if such contaminants were present in the Made Ground. Construction workers could be affected by inhalation of dusts, gases and vapours, dermal contact with soil and groundwater; or ingestion of soil and dust.
- Potential to expose/activate unexploded ordnance; and
- Potential for construction techniques to create preferential pathways and so affect the deeper groundwater below the London Clay (i.e. Lambeth Group and Chalk aquifers).
  - Piling techniques carried out during the construction phase have the potential to generate preferential pathways from areas of contamination in the shallow soils of the Secondary (A) aquifer of the Lambeth Group Formation and the Principal aquifer of the Upper Chalk.

Operational Phase Effects

- Future site users could be exposed to potentially contaminated soil and groundwater;
- Future site users could be exposed to the inhalation of ground gas and volatile vapours;
- The potable water supply could be affected by contaminants present in soil and groundwater;
- Contaminated soil could impact Controlled Waters (i.e. aquifers present below and off-site);
- Chemicals in soil and groundwater could attack buried concrete; and
- Ground gas could migrate into building structures.
5.7.2 These potential effects, as well as some standard aspects of mitigation, are considered further below.

**Construction Phase Embedded Mitigation**

5.7.3 It is considered that the following standard good practices shall be adhered to during the demolition of existing buildings and structures and the subsequent construction of the Proposed Development. These measures will form part of a standard construction management plan, which will be produced for the Proposed Development and shall comprise:

- Standard PPE to be worn by site workers to include gloves, safety glasses, and if necessary disposable overalls. Standard hygiene measures to be taken by site workers (e.g. hand washing and only eating in designated areas);

- The presence of contaminants and the associated risks will be explained to site workers before they begin work in tool box talks and during the site induction;

- Fuel storage on-site to be carried out under best practice i.e. integrally bunded containers. Plant refuelling and maintenance to be carried out in designated areas using best practice techniques and any spills to be controlled with a spill kit:

- Dust suppression measures (e.g. damping down) will be implemented as necessary to minimise the potential for dust generation that could contain contamination, including asbestos fibres; and

- Wheel washing of site vehicles will be carried out in order to minimise the potential for dust generation and ‘track out’ onto public roads that could then be ingested and inhaled by local residents.

5.7.4 The above measures are typical of a development in accordance with the ‘Considerate Contractor Scheme’, which will minimise exposure risks for the duration of the construction.

5.7.5 A desk based unexploded ordnance (UXO) threat assessment will be carried out to identify areas of potential risk from UXO and provide recommendations for safe below ground works that shall be adhered to. If site workers expose UXO during ground investigation, excavation or piling activities, and the device was activated it could cause fatalities, or other major health effects. However, the probability of such an incident occurring are considered to be minimal given the historical development of the site and lack of evidence to support the presence of UXO.

5.7.6 It has been assumed that excavated material from the site will be appropriately classified and disposed to licenced facilities under the Environmental Protection (Duty of Care) Regulations 1991 (Ref. 5-18).

**Construction Phase Effects on Groundwater**

5.7.7 Removal of surface cover (buildings and hardstanding) has the potential to increase the rate of infiltration of rainfall and therefore leaching of contaminants from shallow soils (if present) into the underlying groundwater. It is however considered that measures will be put in place to control the volume of standing water that builds up on site as this could impact the development, and the need for dewatering elsewhere within the site will be able to incorporate standing surface water. The ground will only be exposed for the short periods of time during the development which will limit the volume of water that could migrate into the underlying geology and mobilise residual contaminants. Overall, the risk associated with exposed ground and the impact on the underlying groundwater is considered to be negligible.
5.7.8 Piling techniques carried out during the construction phase have the potential to generate preferential pathways from areas of contamination in the shallow soils of the Secondary (A) aquifer of the Lambeth Group Formation and the Principal aquifer of the Upper Chalk.

5.7.9 Therefore, there is likely to be a direct, permanent, effect on groundwater of minor adverse significance prior to the implementation of mitigation measures.

5.7.10 It is noted that consultation with the EA has not identified the site as a significant identifiable contaminative source, although a Piling Risk Assessment may be required to consider risks to the deeper underlying groundwater due to the Proposed Development. Such a requirement is anticipated to form a planning condition, and as such will be addressed within this process.

Operational Phase Embedded Mitigation

5.7.11 To supplement the desk based information gathered as part of this assessment, a ground investigation will be carried out prior to the commencement of the Development works (at a time that suits the programme and current site activities) to confirm the findings of the PRA and identify and assess in more detail potential contaminant linkages. The ground investigation will consider in more detail the risk from exposure to soils, groundwater and ground gas. If the ground investigation were to identify plausible contaminant linkages, a Remediation Strategy will be produced for the site, to specify protective measures for the operational phase of the Proposed Development.

5.7.12 A verification report would be completed for any remedial works that are required, in accordance with best practice guidance demonstrating that the plausible pollutant linkages are no longer credible and have been disrupted.

5.7.13 It has been assumed that imported materials and reused materials will be suitable for use in the Proposed Development and subject to the required chemical analysis.

5.7.14 It has been assumed that interceptors will be installed within the surface water drainage network where surface water is received from roads, delivery bays or car parking areas to prevent ingress of petroleum hydrocarbons from vehicles using roadways and car parks into the underlying groundwater.

Operational Phase Effect on Potable Water Supply

5.7.15 The potable water supply on-site could be affected by direct contact with contaminants, or by contaminants migrating into plastic water supply pipes. Some contaminants have the ability to migrate through plastic pipes, and others to degrade plastics. Changes in surface cover may increase the amount of contaminants that can come into contact with the pipes by increasing infiltration of rainwater through the removal of hardstanding.

5.7.16 The sensitivity of potable water supply is medium and the magnitude of change, prior to mitigation, is medium. Therefore, there could be a direct, temporary, short-term effect on potable water supply of minor adverse significance prior to the implementation of mitigation measures. It is considered however that the implementation of remedial works could reduce this risk to negligible. The risk to potable water supply could be reduced further through use of protective pipes (e.g. foil cored barrier pipes).

Operational Phase Effect on Building Structures

5.7.17 Below ground structures (basements, services, piles) could come into contact with contaminated soil and groundwater which may attack buried concrete.
5.7.18 Ground gas could migrate into enclosed spaces and cause an explosive or asphyxiatory hazard.

5.7.19 The sensitivity of building structures is medium to high and the magnitude of change, prior to mitigation, is medium. Therefore, there could be a direct, temporary effect on building structures supply of minor adverse significance prior to the implementation of mitigation measures.

5.8 Committed Mitigation

Construction Phase Mitigation

5.8.1 All construction works will be carried out in accordance with best practice and the Health and Safety at Work Act 1974 (Ref. 5-19), which provides guidance to minimise risks to site operatives, adjacent land users and the environment. If risk is considered to be unacceptable then appropriate mitigation measures and PPE will be incorporated during the construction phase, or if possible, the identified risks will be engineered or designed out of the Proposed Development. Specific measures will be determined following completion of the ground investigation has been undertaken prior to development commencing.

5.8.2 The principal contractor will be responsible for monitoring dust, noise, vibration and other environmental parameters that could impact on human health and the wider area, and will be responsible for minimising these impacts in accordance with the Construction Environmental Management Plan, that will be approved by the Local Authority and subsequently adhered to during the detailed design phase. An outline CEMP is provided in ES Part 3, Appendix 2.B.

Mitigation for Construction Workers

5.8.3 Magnetometer surveys would be carried out in areas at high risk of UXO (which will be identified in a desk based UXO threat assessment) which will detect the presence of ferric objects below ground. Construction workers will be given a toolbox talk covering the identification of UXO and the procedures required in the event of locating a suspicious object.

Mitigation for Offsite Receptors

5.8.4 As detailed above, an assessment of contamination risk would be undertaken prior to any site works taking place to ensure all the contamination risks associated with the site are fully understood and the appropriate mitigation measures are put in place. If necessary further remediation of affected areas would be completed prior to site works.

5.8.5 Construction would be carried out using current Institute of Air Quality Management (IAQM) best practice, as necessary, to prevent the generation of dust. Measures are likely to include damping down of stockpiles and wheel washing of site vehicles. Such measures are typical for urban redevelopment projects and undertaken as standard practice by professional and competent contractors in accordance with the ‘Considerate Contractor’ scheme.

Mitigation for Effect on Groundwater

5.8.6 The ground investigation will identify areas of contamination in shallow soils which will be appropriately remediated prior to the construction phase.

5.8.7 A Piling Risk Assessment will be undertaken prior to the development works. Recommendations to protect the deeper aquifers would be incorporated into the construction method statement.
Operational Phase Mitigation

Mitigation for Future Site Users

5.8.8 The implementation of remedial works, if required, during the development of the site will reduce risks to future site users to negligible.

5.8.9 The presence of buildings, basements and hardstanding across the majority of the site will limit the potential for direct dermal contact, ingestion or inhalation of contaminated soil by future users.

Mitigation for Maintenance Staff

5.8.10 The implementation of remedial works, if required, during the development of the site will reduce risks to future risks users to negligible. If necessary, clean service corridors would be specified to break the contaminant linkage between maintenance workers and contaminated materials that could be encountered during future below ground works.

Mitigation for Groundwater

5.8.11 If the ground investigation were to identify areas of contamination and the Proposed Development were to pose an increased risk to the underlying groundwater, remedial works would be undertaken as part of the construction phase.

5.8.12 The Proposed Development will be largely covered by buildings or hardstanding, which will limit rainfall infiltration and subsequent vertical leaching of contamination into the deeper groundwater, with the exception of the pitch which will remain in the same location/orientation, and as such there will be no increase in infiltration than that which currently occupies the site.

Mitigation for Potable Water Supply

5.8.13 If the contaminants capable of attacking or migrating through plastic supply pipes were encountered, the guidance detailed in UK Water Industry Research (UKWIR): Risk Assessment for Water Pipes in Land Potentially Affected by Contamination. Contaminated Land Assessment Guidance (2014) (Ref. 5-20) would be followed during the redevelopment of the site and consultation with the water supply company to confirm appropriate water supply pipes. It may also be necessary to backfill service and utility trenches with clean imported material, which will also have the benefit of mitigating potential risks to future maintenance workers. This is standard practice for brownfield redevelopment works.

Mitigation for Building Structures

5.8.14 The ground investigation would identify the presence of chemicals capable of attacking buried concrete (e.g. sulphate) and if this were the case the concrete would be specified to be resistant to attack using BRE Special Digest 2005: Concrete in Aggressive Ground (Ref. 5-21).

5.8.15 The ground investigation will consider the potential for risks from ground gas. If necessary a Remediation Strategy will be produced for the site, and remedial works will be appropriately validated on completion, which could include the installation of gas membranes. The use of chemical aggressive concrete is not uncommon within urban redevelopment projects although this would need to be fully considered by the development contractor.
5.9 Residual Effects

Construction Phase

Construction Workers

5.9.1 The sensitivity of construction workers is medium and the magnitude of change, following mitigation, is negligible. Therefore, there is a direct, temporary, but negligible effect on construction workers (not significant) following the implementation of mitigation measures.

Offsite Receptors

5.9.2 The sensitivity of off-site receptors (residents) is medium and the magnitude of change, following mitigation is negligible. Therefore, there is a direct, temporary, negligible effect on offsite receptors (not significant) following the implementation of mitigation measures.

Groundwater

5.9.3 The sensitivity of the aquifers below the site is medium to high and the magnitude of change, following mitigation, is negligible. Therefore, there is direct, temporary negligible effect on groundwater at the site (not significant), of negligible significance following the implementation of mitigation measures.

Operational Phase

Future Site Users

5.9.4 The sensitivity of future users is high and the magnitude of change, following mitigation, is negligible. Therefore, there is a direct, permanent, negligible effect on future site users of (not significant) following the implementation of mitigation measures.

Maintenance Staff

5.9.5 The sensitivity of maintenance staff is medium and the magnitude of change, following mitigation, is negligible. Therefore, there is a direct, permanent, negligible effect on maintenance workers (not significant) following the implementation of mitigation measures.

Groundwater

5.9.6 The sensitivity of the aquifers below the site is medium to high and the magnitude of change, following mitigation, is negligible. Therefore, there is a direct, permanent, negligible effect on groundwater (not significant) following the implementation of mitigation measures.

Surface Water

5.9.7 The sensitivity of the surface waters (the River Thames and nearby pond) is medium and the magnitude of change, following mitigation, is negligible. Therefore, there is a direct, permanent, negligible effect on surface waters (not significant) following the implementation of mitigation measures.
Potable Water Supply

5.9.8 The sensitivity of potable water is medium and the magnitude of change, following mitigation, is negligible. Therefore, there is a direct, permanent, negligible effect on potable water (not significant) following the implementation of mitigation measures.

Building Structures

5.9.9 The sensitivity of building structures is medium to high and the magnitude of change, following mitigation, is negligible. Therefore, there is a direct, permanent, negligible effect on building structures (not significance) following the implementation of mitigation measures.

Buried concrete and services

5.9.10 The sensitivity of buried concrete and services is medium and the magnitude of change, following mitigation, is negligible. Therefore, there is a direct, permanent, negligible effect on buried concrete and services (not significance) following the implementation of mitigation measures.

5.9.11 A summary of residual effects is presented in Table 5.7.

5.10 Assumptions and Limitations

5.10.1 The work undertaken to provide the basis of this Chapter comprised a study of available documented information from a variety of sources and consultation with relevant authorities and other interested parties.

5.10.2 It should be noted that any risks identified in this Chapter are perceived risks based on the information reviewed; actual risks can only be identified and addressed following physical intrusive investigation of the site.

5.11 Conclusions

5.11.1 The site is considered to be of moderate environmental sensitivity due to the surrounding and adjacent residential properties, nearby surface water features, and the underlying groundwater beneath the site, which is classified as a Secondary A Aquifer.

5.11.2 The main potential effects relate to the potential for soil and groundwater contamination beneath the site. This risk will be confirmed through a ground investigation, which will be undertaken prior to construction in order to identify any contaminants present across the site, and in particular in the areas of concern identified in the PRA. Intrusive ground investigation is also recommended for geotechnical design purposes. This will include groundwater gas monitoring and sampling to determine the groundwater level and contamination status of the Secondary A Aquifer beneath the site.

5.11.3 The results of the ground investigation will be used to identify any remedial requirements for the development, with suitable remediation strategies identified if required. The remedial options will involve the removal of the identified source, through on-site treatment or off-site disposal, or the interruption of pollutant pathways by breaking the linkage between the source and the associated receptor. Details of remedial activities cannot be provided until the ground investigation has been completed, however, all risks associated with contaminated land can and will be suitably managed to allow for the safe and timely redevelopment of the site.

5.11.4 Following implementation of appropriate mitigation, and remedial techniques (if required) all potential effects on ground conditions would be negligible and not significant.
5.12 References

Ref. 5-3 HM Government (2012), Contaminated Land (England) Regulations (Amendment).
Ref. 5-5 HM Government (2012), National Planning Policy Framework.
Ref. 5-7 Department of Communities and Local Government (2014), Planning Practice Guidance.
Ref. 5-10 Environment Agency (2010) GPLC1 Guiding Principles for Land Contamination.
Ref. 5-12 Greater London Authority (2013), Revised Early Minor Alterations to the London Plan.
Ref. 5-15 London Borough of Hammersmith and Fulham (2013), Development Management Local Plan (DMLP).
Ref. 5-17 Hammersmith and Fulham Council (2015), Draft Local Plan Regulation 18 Consultation.
Ref. 5-20 UK Water Industry Research, (2012), Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites, 10/WM/03/21.
Ref. 5-21 Building Research Establishment (BRE) (2006), Special Digest 2005: Concrete in Aggressive Ground.
### Table 5.7: Summary of Residual Effects

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Baseline Value/Sensitivity</th>
<th>Sources and type of effect</th>
<th>Mitigation</th>
<th>Magnitude of Effect</th>
<th>Significance of Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Future site users</td>
<td>High sensitivity</td>
<td>Future site users could be exposed to potentially contaminated soil and groundwater</td>
<td>A ground investigation will be undertaken prior to any site works taking place to ensure all the contamination risks associated with the site are fully understood and the appropriate mitigation measures can be put in place. If necessary remediation of affected areas will be completed.</td>
<td>Magnitude of change following mitigation is negligible. Likely to be a local, direct, permanent effect on future site users.</td>
<td>Negligible</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Future site users could be exposed to the inhalation of ground gas and volatile vapours during the operational phase</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintenance workers</td>
<td>High sensitivity</td>
<td>Future site users could be exposed to potentially contaminated soil and groundwater and inhalation of ground gas and volatile vapours during the operational phase</td>
<td>A ground investigation should be undertaken prior to any site works taking place to ensure all the contamination risks associated with the site are fully understood and the appropriate mitigation measures can be put in place during future maintenance works. If necessary remediation of affected areas will be completed.</td>
<td>Magnitude of change following mitigation is negligible. Likely to be a local, direct, permanent effect on maintenance workers.</td>
<td>Negligible</td>
</tr>
<tr>
<td>Construction workers</td>
<td>Medium Sensitivity</td>
<td>Increase in dust generated by on-site activities on existing off-site receptors and nearby properties</td>
<td>Water can be sprayed onto material being worked to damp down any potentially contaminated dust and prevent it from becoming airborne. Also wheel washing of site vehicles.</td>
<td>Magnitude of change following mitigation is negligible. Likely to be a local, direct, temporary effect on construction workers.</td>
<td>Negligible</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Potential to expose/activate unexploded ordnance</td>
<td>Magnetometer surveys can be carried out in areas at high risk of UXO (which will be identified in a desk based UXO threat assessment) which will detect the presence of ferric objects below ground.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Exposure to potentially contaminated soil and groundwater</td>
<td>Construction workers should be required to wear PPE such as gloves and face masks (where appropriate) to prevent dermal contact and inhalation or ingestion.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receptor</td>
<td>Baseline Value/Sensitivity</td>
<td>Sources and type of effect</td>
<td>Mitigation</td>
<td>Magnitude of Effect</td>
<td>Significance of Effect</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>---------------------------</td>
<td>-------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>Off-site receptors during construction</td>
<td>Medium Sensitivity</td>
<td>Increase in dust generated by on-site activities on existing on-site receptors and nearby properties</td>
<td>Water can be sprayed onto material being worked to damp down any potentially contaminated dust and prevent it from becoming airborne. Also wheel washing of site vehicles to prevent dust and soils leaving the site and potentially impacting on adjacent site users.</td>
<td>Magnitude of change following mitigation is negligible. Likely to be a local, direct, temporary effect on offsite receptors during construction.</td>
<td>Negligible</td>
</tr>
<tr>
<td>Potable water supply</td>
<td>Medium Sensitivity</td>
<td>The potable water supply could be affected by contaminants present in soil and groundwater during the operational phase</td>
<td>Implementation of guidance detailed in UK Water Industry Research (UKWIR): Risk Assessment for Water Pipes in Land Potentially Affected by Contamination if contamination is identified from site investigation and the use of appropriately protective pipes. It may also be necessary to backfill trenches with clean imported material.</td>
<td>Magnitude of change following mitigation is negligible. Likely to be a local, direct, permanent effect on potable water supply during the operational phase.</td>
<td>Negligible</td>
</tr>
<tr>
<td>Secondary A Aquifer of Kempton Park Gravels</td>
<td>Medium Sensitivity</td>
<td>Increase in infiltration and leaching of potential contaminants due to removal of hardstanding during construction phase</td>
<td>A ground investigation will identify areas of contamination, which will be remediated as required. The Proposed Development will be largely covered by buildings or hardstanding, which will limit rainfall infiltration and subsequent vertical leaching of contamination.</td>
<td>Magnitude of change following mitigation is negligible. Likely to be a local, direct, temporary effect on groundwater during construction.</td>
<td>Negligible</td>
</tr>
<tr>
<td>Deeper Aquifers of Lambeth Group and Upper Chalk</td>
<td>High Sensitivity</td>
<td>Creation of pathway for migration of contamination from Superficial Deposits to Deeper Aquifers</td>
<td>A Piling Risk Assessment should be carried out prior to the works and recommendations protective to the deeper aquifers should be carried out prior to the works and recommendations protective to the deeper aquifers should be</td>
<td>Magnitude of change following mitigation is negligible. Likely to be a district scale direct, temporary, effect on groundwater during construction.</td>
<td>Negligible</td>
</tr>
</tbody>
</table>
Table 5.7: Summary of Residual Effects

<table>
<thead>
<tr>
<th>Receptor</th>
<th>Baseline Value/Sensitivity</th>
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<th>Magnitude of Effect</th>
<th>Significance of Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deeper aquifers</td>
<td></td>
<td>incorporated into the construction method statement.</td>
<td>the construction of piled foundations.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surface Water of River Thames and nearby pond</td>
<td>Medium Sensitivity</td>
<td>Migration of contaminated groundwater to surface waters during construction</td>
<td>A ground investigation will identify areas of contamination, which if considered to be significant will be remediated as appropriate. The Proposed Development will be largely covered by buildings or hardstanding, which will limit rainfall infiltration and subsequent leaching of contamination and horizontal migration.</td>
<td>Magnitude of change following mitigation is negligible. Likely to be a district scale direct, permanent, effect on surface waters.</td>
<td>Negligible</td>
</tr>
<tr>
<td>Buried concrete and services</td>
<td>Medium Sensitivity</td>
<td>Chemicals in soil and groundwater could attack buried concrete and services</td>
<td>The ground investigation will identify chemicals capable of attacking buried concrete (e.g. sulphate). Concrete will be specified to be resistant to attack using BRE Special Digest 2005: Concrete in Aggressive Ground.</td>
<td>Magnitude of change following mitigation is negligible. Likely to be a local, direct, medium to long term effect on building structures.</td>
<td>Negligible</td>
</tr>
<tr>
<td>Building structures</td>
<td>High Sensitivity</td>
<td>Ground gas could migrate into building structures</td>
<td>The ground investigation will consider the risk from ground gas. If necessary a Remediation Strategy will be produced for the site, and remedial works will be appropriately implemented and validated, which could include the installation of gas membranes.</td>
<td>Magnitude of change following mitigation is negligible. Likely to be a local, direct, medium to long term effect on building structures.</td>
<td>Negligible</td>
</tr>
</tbody>
</table>