

Contents – Geology, Hydrology and Ground Conditions

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1. Introduction

1.1 This section reviews the ground and contaminated land issues associated with construction and operation of the development. The government's good practice guide for EIA¹ states that the following potential environmental effects should be considered:

- i. physical effects of the development – for example changes in topography, soil compaction, soil erosion, ground stability etc
- ii. effects on geology as a valuable resource – for example mineral resource sterilisation, loss or damage to regionally important geological sites, geological Special Site of Scientific Interest (SSSIs) etc
- iii. effects on soils as a valuable resource – e.g. loss or damage to soils with good agricultural quality
- iv. effects associated with ground contamination that may already exist on site – for example introducing/changing pathways and receptors
- v. effects associated with the potential for polluting substances used (during construction/operation) to cause new ground contamination issues on site – for example introducing/changing the source of contamination
- vi. effects associated with re-use of soils and waste soils – re-use of site-sourced materials on or off site, disposal of site-sourced materials off-site, importation of materials to the site etc

1.2 The environmental aspects of relevance to the proposed development are related to:

- Physical impacts of the development (i) on geology, hydrology and contamination;
- Agricultural value of the soils (iii) will be discussed but is not required to be assessed;

¹ Department for Communities and Local Government, 2006. Environmental Impact Assessment. A Guide to Good Practice and Procedures. A consultation paper. London: DCLG.

- Potential for the introduction or alteration of pathways and receptors (iv) with respect to ground contamination;
- Potential for the introduction of new sources of contamination (v); and,
- Potential for the generation of waste soils and potential re-use in absence of a “Waste” ES Chapter (vi).

1.3 No sensitive geological receptors or potential geological resources (including coal) have been identified within 250m of the site and therefore item (ii) above does not require consideration of assessment.

1.4 Construction workers have been excluded from the assessment on the basis that future construction works will be undertaken in accordance with legislative requirements, statutory and regulatory guidance and industry best practice, e.g. safe systems of work (SSoW), risk assessments and method statements (RAMS) and provision of appropriate personal protective equipment (PPE). Visitor access will be restricted during the works and no trespassers will be able to access the construction area.

1.5 This chapter is supported by the following report, which is included in Appendix 4:

- Geo-environmental Desk Study, Land West of Yarnton, WSP, September 2021 (70048642-R01 Rev4).

1.6 This chapter should be read in conjunction with the overall introduction to the ES Chapters 2-5.

1.7 Table 1 demonstrates that the author and reviewer of this chapter both have sufficient experience to ensure completeness and quality of this Land Contamination Chapter.

Table 1 - Summary of Expertise and Professional Qualifications

Name	Grade & Company	Expertise and Professional Qualifications
Becca Fagan	Consultant (Specialist Consultants), WSP	<ul style="list-style-type: none"> • Fellow of the Geological Society • Msci Environmental Geology
		<p>Experienced in the preparation of desk studies and preliminary / generic qualitative risk assessments. Previous experience of ES preparation and support.</p> <ul style="list-style-type: none"> • Windmill Golf Course, Coventry (Desk Study/ ES Chapter)

		<ul style="list-style-type: none"> • Disstington Garden Village (ES Chapter Review) • Regency House (Desk Study) • Clive Works (Desk Study) • HS2 Phase 1 – Curzon Street Wharf (Desk Study / GQRA) • Rolls-Royce Hucknall Outline Planning Application (ES Chapter)
Catriona Woods	Associate (Specialist Consultants), WSP	<ul style="list-style-type: none"> • Chartered Scientist (Institution of Environmental Sciences) • PhD Environmental Mineralogy • MSc Earth & Environmental Science • BSc (Hons) Geology
		<p>Technical lead for preparation of Land Quality scoping reports and ES chapters, and supporting PIER / desk study reports / interpretative reports for numerous infrastructure schemes, including:</p> <ul style="list-style-type: none"> • HS2 Phase 1 Rural North (AP4 & AP5) • West Anglia Mainline Electrification (WAML) Scheme • Midland Mainline Electrification (MMLE) • Kettering – Corby Capacity Increase (K2C) • Barking Riverside Extension • West Anglia Mainline (WAML) • Sizewell C Environmental Statement & DCO application supporting documents

2. Policy Context

NATIONAL PLANNING POLICY FRAMEWORK

- 2.1 The National Planning Policy Framework (2021) considers potential impacts in relation to contaminated land, specifically:
- 2.2 Paragraph 174. Planning policies and decisions should contribute to and enhance the natural and local environment by:
- e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and,*
 - f) remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.*
- 2.3 Paragraph 183. Planning policies and decisions should ensure that:
- a) a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation);*
 - b) after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and,*
 - c) adequate site investigation information, prepared by a competent person, is available to inform these assessments.*
- 2.4 Paragraph 184. Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner.

PLANNING PRACTICE GUIDANCE

2.5 The following sections of the Planning Practice Guidance are considered relevant to this assessment:

- Land affected by contamination² – provides guiding principles on how the planning process can deal with land affected by contamination. The guidance outlines the interaction of planning with other regimes, such as Part 2A of the Environmental Protection Act (see below), Building Regulations and the Environmental Permitting Regulations, in order to deal adequately with contamination which may limit or preclude development whilst protecting human health, property and the wider environment;
- Land Stability³ – sets out the roles of the regulators and processes to deal with potential stability risks associated with proposed developments;
- Natural Environment⁴ – including guidance on the ecological value placed on brownfield land, and why it is important to consider pollution in soils; and
- Water supply, wastewater and water quality⁵ - outlines why water supply, wastewater and water quality are an important consideration during development.

LEGISLATIVE CONTEXT

2.6 Part 2A of the Environmental Protection Act 1990 (as amended) establishes a legal framework for dealing with land contamination in the UK and provides a means of dealing with unacceptable risks posed by land contamination to human health and the environment. Government objectives with respect to land contamination policy and the Part 2A regime are set out in the Department for Environment Food and Rural Affairs (Defra) Contaminated Land Statutory Guidance (2012) as:

- to identify and remove unacceptable risks to human health and the environment;
- to seek to ensure that contaminated land is made suitable for its current use; and

² <https://www.gov.uk/guidance/land-affected-by-contamination>

³ <https://www.gov.uk/guidance/land-stability>

⁴ <https://www.gov.uk/guidance/natural-environment>

⁵ <https://www.gov.uk/guidance/water-supply-wastewater-and-water-quality>

- to ensure that the burdens faced by individuals, companies and society as a whole are proportionate, manageable and compatible with the principles of sustainable development.

2.7 These three objectives underlie the 'suitable for use' approach to the assessment and remediation of 'land contamination'. This approach recognises that the risks presented by any given level of land contamination will vary greatly according to the use of the land and a wide range of other factors, such as the sensitivity of the underlying geology and the receptors which may be affected. The 'suitable for use' approach consists of three elements:

- Ensuring that land is suitable for its current use;
- Ensuring that land is made suitable for any new use; and
- Limiting requirements for remediation to the work necessary to prevent unacceptable risks to human health or the environment in relation to the current use or future use of the land.

2.8 The following secondary legislation has also been considered during the preparation of this Chapter:

- Control of Substances Hazardous to Health Regulations (2002) (as amended) provide an assessment of the risk to health created by work involving substances hazardous to health;
- The Water Framework Directive) (2000) (2000/60/EC) establish a framework for protecting the water environment;
 - The Water Environment (Water Framework Directive) England and Wales Regulations 2017
- Dangerous Substances Directive (Amendment) (2006) controls the amount of dangerous substances that are discharged into inland, coastal and territorial waters;
- Environmental Damage (Prevention and Remediation) Regulations (2015) aim to prevent serious environmental effects or ensure that remediation is carried out. The duty to prevent or remediate falls on operators of activities. The Regulations specifically define three types of environmental damage: biodiversity damage - to

European Union protected species and habitats, and Sites of Special Scientific Interest; water damage; and land damage;

- The Environmental Permitting (England and Wales) Regulations (2016) replace those parts of the Water Resources Act that relate to the regulation of discharges to controlled waters. Under the Regulations, groundwater activities relate to inputs of pollutants to groundwater. The Regulations also replace the Groundwater Regulations, 2009 which in turn replaced the Groundwater Regulations, 1998. The Regulations also transpose the Groundwater Directive 1980, the Water Framework Directive and Groundwater Daughter Directive 2006 into UK law;
- Control of Asbestos Regulations (2012) prohibit s the importation, supply and use of all forms of asbestos. If existing asbestos containing materials are in good condition, they may be left in place; their condition monitored and managed to ensure they are not disturbed. The Control of Asbestos Regulations also include the 'duty to manage asbestos' in non-domestic premises;
- Contaminated Land (England) Regulations (2006) provide a definition of what constitutes 'contaminated land' and set out the responsibilities of the Local Authority and the Environment Agency in the identification and management of contaminated land; and
- Construction (Design & Management) (CDM) Regulations (2015) require clients to use their influence to ensure that the arrangements made by other duty holders are sufficient to safeguard the health and safety of those working or those affected by that work.
 - Building work is subject to Building Control under the Building Regulations 2010. Under these regulations there is a requirement that "precautions shall be taken to avoid danger to health and safety caused by substances found on or in the ground covered by the building". It is noted that if contaminative substances in the ground have the potential to attack building materials, it may lead to a breach of these Regulations which relate to structural safety.
 - Water Industry Act 1991 (and subsequent 1999 additions) which set out the main duties and powers of water and sewerage utility companies.

GUIDANCE

2.9 The following guidance documents have been referred to during the preparation of this Chapter:

- Health and Safety Executive (HSE) (1991) Guidance Note HS(G)66, Protection of Workers and the General Public during the development of Contaminated Land;
- Construction Industry Research and Information Association (CIRIA) C532 (2001) Control of Pollution from Construction Sites;
- Environment Agency (2020) Land Contamination Risk Management⁶ (LCRM)
- CIRIA 665 (2007), Assessing Risks Posed by Hazardous Gases to Buildings;
- Environment Agency and NHBC (2008) Guidance for the safe development of housing on land affected by contamination, Environment Agency R&D Publication 66;
- British Standards (BS) 10175 (2011+A2:2017) Investigation of Potentially Contaminated Sites – Code of Practice;
- HSE (2012), Control of Asbestos Regulations;
- Department for Environment, Food and Rural Affairs (DEFRA), Contaminated Land Statutory Guidance April 2012;
- Environment Agency (2012) Groundwater Protection: Policy and Practice (GP3);
- British Standards Institute (BSI) BS 5930 (2015) The Code of Practice for Site Investigations;
- BSI, BS 8576 (2013) Guidance on Investigations for Ground Gas – Permanent Gases and Volatile Organic Compounds;
- CIRIA C735 (2014) – Good practice on the testing and verification of protection systems for buildings against hazardous ground gases; and

⁶ <https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm>

- BSI, BS 8485 (2015) Code of Practice for the Characterisation and Remediation from Ground Gas in Affected Developments.

2.10 In addition to those stated above the following Local Authority documents have been reviewed:

- Oxfordshire Strategic Housing Market Assessment (SHMA), GL Hearn Ltd, March 2014.
- Adopted Cherwell Local Plan (2011-2031), Adopted 07 September 2020 (the Local Plan)⁷.

2.11 Pertinent details from the Local Plan comprise:

- Paragraph 1.21 referencing B.95 of the previous local plan "...The urban capacity of Oxford is as yet unconfirmed. Cherwell District Council will continue to work jointly and proactively with the Oxfordshire local authorities and through the Oxfordshire Growth Board to assess all reasonable spatial options, including the release of brownfield land, the potential for a new settlement and a full strategic review of the boundaries of the Oxford Green Belt..."

⁷ Adopted Cherwell Local Plan (2011-2031), Adopted 07 September 2020 (the Local Plan) .

3. Assessment Methodology

CONSULTATION

3.1 As part of the Geo-environmental Desk Study prepared by WSP, the Environmental Health Team at Cherwell District Council were contacted. The council's response, dated 02 November 2018, indicates that the council hold no historical reports for the site, nor has the site or surrounding land been identified as potentially contaminated land under Environment Agency Part 2A.

SCOPE OF THE ASSESSMENT

3.2 This Chapter primarily assesses the effects of the Proposed Development on the potential for contamination to be introduced to the environment or mobilised as a result of the construction and operation.

3.3 For its preparation WSP were provided with the following documents and references:

- Geo-environmental Desk Study, Land West of Yarnton, WSP, September 2021 (70048642-R01 Rev4).
- PR9 Development Brief, Alan Baxter, August 2020 (site masterplan).

3.4 The study area for the contamination assessment encompasses the Site and a buffer of 250m surrounding the site. This is based on the potential sources of contamination and sensitive environmental receptors and is also the recommended buffer in the NHBC guidance R&D 66.

3.5 The following elements of the Proposed Development (PR9) are considered relevant to the assessment of the effects on land affected by contamination:

- Earthworks – as part of the construction and preparation of the Proposed Development there will be an element of soil excavation and ground preparation and temporary storage of chemicals/waste;
- Land Uses – hardstanding, areas of soft landscaping and gardens where contaminated soils may be present at/or near the surface;
- Construction – placing below-ground structures / services; and,

- Construction of residential dwellings / business park properties and creation of enclosed spaces.

3.6 Furthermore, a preliminary site investigation will be required to be undertaken to obtain information on the nature and extent of potential contamination at the site. This will consider the potential contaminated land risks associated with soil, controlled water or ground gas issues.

CONTAMINATED LAND ASSESSMENT

3.7 The process of contaminated land risk assessment is defined in LCRM as follows:

- hazard identification – establishing contaminant sources
- hazard assessment – establishing pathways and receptors, identifying pollutant linkages
- risk estimation – predicting the likelihood of harm/pollution occurring (probability assessment) and the degree of harm/pollution (consequence assessment)
- risk evaluation – deciding whether the risk is significant and/or unacceptable

3.8 The hazard identification and assessment stage concludes with development of the Conceptual Site Model (CSM). This is the description of the pollutant linkages formed (or potentially formed) when a source of contamination is linked to a receptor via a pathway of exposure/migration.

3.9 When there are no relevant data on the levels of land contamination at a site, as is the case with this Proposed Development, a qualitative contaminated land risk assessment is undertaken. The contaminated land risk assessment will be undertaken using a 'matrix approach' to account for the probability and consequence associated with the pollutant linkages.

3.10 Risk evaluation is the process of deciding whether a risk is acceptable or not and entails the application of evaluation criteria. These evaluation criteria are set in relation to a level of harm or pollution to the specific receptor. They may be

absolute standards or recommended limit values e.g., a health criteria value for the intake of a substance.

3.11 Where there is no site data and a purely qualitative risk assessment is undertaken, the evaluation criteria are based on value judgements as to whether the contaminated land risks are acceptable or not. For quantitative risk assessments based on some site specific data, there are various threshold levels that determine the level of significance of the contaminated land risks, e.g. generic assessment criteria below which the risk is considered to be acceptable and site specific assessment criteria above which the risk is unacceptable.

3.12 Definitions of probability and consequence are given in the following guidance.

- NHBC and EA R&D66⁸ - providing general guidance on the development and application of the consequence and probability “*matrix approach*” to contaminated land risk assessment, and broad definitions of consequence.
- LCRM – recognising the tiered approach to risk assessment and the use of generic and site specific assessment criteria through the application of preliminary and quantitative risk assessment.
- EA technical advice on pollution of controlled waters⁹ - providing the Agency’s policy and definitions on significant pollution of controlled waters.
- Environmental Protection Act 1990: Part 2A¹⁰ providing the definition of contaminated land and “significant harm”.

3.13 These sources of guidance have been used to develop definitions of probability that will be used for the impact assessment as given in Table 1, and consequence in Table 2, presented in Appendix 2.

8 National House-Building Council & Environment Agency, 2008. Guidance on the Safe Development of Housing on Land Affected by Contamination. London: NHBC and Environment Agency (R&D66).

9 Environment Agency, 2002. Technical Advice to Third Parties on Pollution of Controlled Waters for Part IIA of the EPA1990. Version 2. Bristol: Environment Agency.

10 DEFRA Contaminated Land Statutory Guidance, April 2012

3.14 The potentially significant effects that have been identified for inclusion in the assessment are as follows.

Construction Phase

- Disturbance of contaminated ground during construction resulting in mobilisation of contaminants and dust impacting human health;
- Disturbance of the ground causing both physical (siltation/ sedimentation) and chemical (contamination) runoff impacting surrounding surface water courses;
- Hazardous ground gas and/or vapour accumulation within confined spaces posing risks to human health;
- Introducing polluting substances to the Site via leaks and spills to ground associated with vehicles and chemical / waste storage areas; and,
- Potential for ground instability impacting construction workers.

Operational Phase

- Potential exposure of future site occupants to contaminants; and,
- Potential risk of hazardous ground gas and/ or vapour ingress into future properties and associated effects on the health of future site users and third parties.

3.15 The following aspects have been scoped out of the assessment based on the findings of the preliminary risk assessment (Appendix 1) .

- No effects on statutory and non-statutory sites of geological or scientific importance (SSSI) as no sites have been identified on site or within 250m.
- No effects from coal mining as the site is not within a Coal Authority designated mining area;
- No effects on ecological receptors; potential effects due to the Proposed Development are covered in the Ecology Chapter within this ES (Chapter 8); and,

4. Baseline Description

- 4.1 The study area comprises the site (as defined in Introduction, Chapter 2) and land within 250m of the red line boundary. The contaminated land baseline has been evaluated utilising the Geo-environmental Desk Study, Land West of Yarrnton, WSP, September 2021 (70048642-R01 Rev4) and references therein.

GEOLOGY, HYDROGEOLOGY AND HYDROLOGY

- 4.2 In the absence of site-specific ground investigation British Geological Survey (BGS) online mapping has been used to identify the underlying ground conditions. BGS mapping indicates the site to be underlain by Oxford Clay and West Walton Formation (undifferentiated) across the site). Superficial deposits are only recorded at discrete locations comprising Summertown-Radley Sand and Gravel Member in the extreme north and south of the site and the Hanborough Gravel Member in the west of the site.
- 4.3 Bedrock on site is designated as unproductive strata by the Environment Agency (EA). Superficial deposits, where present, are classified as Secondary A Aquifers by the EA. No groundwater abstractions or source protection zones were noted within 1km of the site.
- 4.4 Surface water features identified within the study area include unnamed streams and issues (on site) and Rowel Brook (250m to the east). None of the identified surface water features have had their water quality classified by the EA. At the time of site walkover (October 2018) no streams and issues were observed on site, potentially due to abnormally dry weather.
- 4.5 Provisional Agricultural Land Classification (ALC) for the site, designated by Natural England is Grade 3. ALC uses this grading system to compare the quality of agricultural land and its potential uses based on climate, site and soil characteristics. Grade 3 indicates good to moderate quality agricultural land.

POTENTIAL FOR EXISTING CONTAMINATION

- 4.6 In order to identify potential historical sources of contamination which may be present, a number of historical OS maps were reviewed as part of the Geo-environmental Desk Study.
- 4.7 Historical mapping indicates that the site has remained as undeveloped land since the earliest mapping, with roads / tracks in approximately the same configuration as was observed during the site walkover. Some gravel pits were noted within 250m in 1906 but were not shown by 1981.
- 4.8 Potential for existing contamination on site is considered to be sourced from use of the site as agricultural land (accidental spillages, use of herbicides and pesticides etc) and potential for localised Made Ground (associated with unmapped gravel pits or constructed access tracks). Potential offsite sources identified were considered too far from the site to represent a risk.

POTENTIAL EFFECTS

- 4.9 Construction and operation processes for developments have the potential to give rise to contamination of the ground through, for example, the following:
- causing new ground contamination due to the failure to adequately control the storage, transfer and use of polluting substances, for example spills of oils/fuels used for construction vehicles and equipment, spillages of chemicals used for treatment of water in the power station plant
 - introducing new pathways such that existing ground contamination becomes connected to a receptor where there was no connection before, for example as can happen when drilling or piling through contaminated land.
- 4.10 Human health receptors with potential to be affected by contaminated land include construction workers, maintenance workers and future site users. Construction workers are excluded from this assessment on the basis that any potential impacts will be mitigated by the implementation of industry best practice and following appropriate Health and Safety legal requirements during construction.

4.11 Controlled water receptors include groundwater within Superficial deposits (Secondary A Aquifers), on site surface water features and Rowel Brook.

4.12 Based on the available Desk Study information, a Preliminary Conceptual Site Model (PCSM) has been prepared with respect to the Proposed Development and is presented in Table 2, below.

Table 2 - Preliminary Conceptual Site Model

Source	Pathway	Receptor
Agricultural Use (Potential contaminants likely include Pesticides, herbicides, localised Total Petroleum Hydrocarbons (TPH), and Polycyclic Aromatic Hydrocarbons (PAH))	Direct contact with impacted soils	Future site users
	Ingestion/ inhalation of impacted soils and soil-derived dust	
	Migration into groundwater following disturbance during development of the site	Groundwater within superficial aquifers
		Groundwater-fed surface water features
Migration into surface water following disturbance during development of the site	Surface water quality on-site and off-site	
Localised Made Ground (Potential contaminants likely to include Asbestos, metals, TPH and PAH)	Direct contact with impacted soils	Future site users
	Ingestion/ inhalation of impacted soils / fibres	
	Migrating into groundwater following disturbance during development of the site	Groundwater within superficial aquifers
		Groundwater fed surface water features
Migration into surface water following disturbance during development of the site	Surface water quality on-site and off-site	

5. Contaminated Land Impact Assessment

5.1 The approach to the impact assessment will entail undertaking contaminated land risk assessments for each of the following.

- Baseline Contaminated Land Risk Assessment (PCSM) as outlined in Section 4 above.
- Construction Phase Contaminated Land Risk Assessment compares the PCSM to the CSM and risk assessment for the construction phase, addressing the potential for new sources of contamination to be introduced to the site and the change in pathways and receptors

5.2 Operational Phase Contaminated Land Risk Assessment compares the PCSM to the CSM for the developed site, reflecting the final site conditions including the status of contamination sources and the changes in the receptors

5.3 The assessment of likely significant effects as a result of the Proposed Development has taken into account both the construction 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 environment to change, as well as a number of other factors that are outlined in more detail in this ES. Magnitude of change and the sensitivity of the affected receptor / receiving environment are both assessed on a scale of high, medium, low and negligible.

5.4 Example receptor sensitivity and magnitude of impact scenarios based on professional experience are provided within Table 3 and Table 4 respectively.

Table 3 - Sensitivity Descriptor Definitions

Sensitivity	Description
High	Areas containing geological, hydrological or habitat features considered to be of national or international interest, for example SSSIs. Highly permeable superficial deposits allowing free transport of

	<p>contaminants to groundwater and surrounding surface waters.</p> <p>Site located within a groundwater Source Protection Zone (SPZ) 1 or 2.</p> <p>Area to be occupied by residential properties.</p>
Medium	<p>Areas containing features of designated regional importance, for example Regionally Important Geological and Geomorphological Sites (RIGS), considered worthy of protection for their educational, research, historical or aesthetic importance.</p> <p>Site Located within a groundwater SPZ Zone 3.</p> <p>Moderately permeable superficial deposits allowing some limited transport of contaminants to groundwater and surrounding surface waters.</p> <p>Area to be occupied by residential flats (or similar) or public open space</p>
Low	<p>Geological features not currently protected and not considered worthy of protection.</p> <p>Low permeability superficial deposits likely to inhibit the transport of contaminants.</p> <p>Site not located within a groundwater SPZ.</p> <p>Site to be occupied by commercial properties or hardstanding</p>

Table 4 - Magnitude Descriptor Definitions

Magnitude	Description
Major	<p>Significant (greater than 50%), or total loss of a site of recognised geological importance,</p> <p>Significant contamination identified, in excess of relevant thresholds for protection of Controlled Waters.</p> <p>Significant impact upon human health.</p>
Moderate	<p>Partial loss (between approximately 10% to 50%) of a site of recognised geological importance.</p> <p>Localised or marginal contamination or potential but not proven contamination.</p> <p>Moderate impact on human health.</p>

Magnitude	Description
Minor	<p>Minimal effect (a loss of up to 10%) on a site of recognised geological importance.</p> <p>No significant contamination identified or could reasonably be expected based on the PRA.</p> <p>Minor/insignificant impact upon human health.</p>
Negligible	<p>Very slight change from baseline conditions. Change hardly discernible, e.g. short-term compaction from machinery movements.</p> <p>No contamination above relevant thresholds identified or could reasonably be expected based on the PRA.</p>

5.5 The impact assessment includes the mitigation measures that will be included to address the potential environmental effects. This CSM comparison approach allows the changes in contaminated land status during construction and during operation of the site to be identified as either positive, neutral or negative effects and consideration of whether they are major, moderate or minor. Table 5 presents an explanation of these significant criteria.

Table 5 -Significance criteria

Significance Criteria	Definition
Major adverse effect	<p>For example, land that has a very low contamination risk in the baseline becomes a high or very high risk.</p> <p>Land that does not meet the statutory definition of Contaminated Land in the existing baseline becomes capable of being determined under Part 2A.</p>
Moderate adverse effect	<p>For example, land that has a low contamination risk in the baseline becomes a moderate or high risk.</p> <p>Land that does not meet the statutory definition of Contaminated Land in the existing baseline becomes capable of being determined under Part 2A.</p>
Minor adverse effect	<p>For example, land that has a low contamination risk in the baseline becomes a moderate/low risk.</p>
Neutral effect	<p>No change in the risks presented by contamination.</p>
Minor beneficial effect	<p>For example, land that has a moderate/low contamination risk in the baseline becomes a low risk.</p>
Moderate beneficial	<p>For example, land that has a high contamination risk in the</p>

effect	baseline becomes a moderate/low or low risk. Land that meets the statutory definition of Contaminated Land in the existing baseline is no longer capable of being determined under Part 2A.
Major beneficial effect	For example, land that has a very high contamination risk in the baseline becomes a low or very low risk. Land that meets the statutory definition of Contaminated Land in the existing baseline is no longer capable of being determined under Part 2A.

5.6 Conceptual site models for all three stages considered within the ES Chapter are presented in Appendix 3.

CONSTRUCTION ASSESSMENT

5.7 The following have been assumed as measures of embedded mitigation during the construction phase of the Proposed Development.

- The construction works of the Proposed Development will be undertaken in accordance with industry best-practice and regulatory requirements. A Construction Environmental Management Plan (CEMP) will be in place to manage environmental risks. The CEMP will include as a minimum, measures regarding waste management, dust & air pollution, pollution prevention controls, ecological mitigation (if required) and noise pollution.
- If necessary, 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 appropriate chemical testing (and will be geotechnically suitable) and will therefore not present a risk to controlled waters (e.g. via leaching of potential contaminants) or human receptors. Material movements will be undertaken in accordance with the Contaminated Land: Applications in Real Environments (CL:AIRE) Development Industry Code of Practice under a complaint Materials Management Plan.
- Development-specific, intrusive ground investigation will be undertaken to target potential sources of contamination and reduce uncertainty. Subsequent remediation will be undertaken, if required.
- A temporary drainage strategy will be implemented during the construction phase as part of the design solution.

- Good management of stockpiles in accordance with EA Pollution Prevention Guideline: working at construction and demolition sites (PPG6) to reduce infiltration.

5.8 A summary of construction effects taking into account embedded mitigation is presented in Table 6, below.

Table 6 - Summary of Assessed Construction Effects with Mitigation

Source	Baseline			Impact Assessment				
	Receptor	Pathway	Value / Sensitivity	Baseline level of risk	Construction risk	Embedded Mitigation	Effect	Significance of effect
<p>Agricultural Use</p> <p>Potential contaminants likely include Pesticides, herbicides, localised Total Petroleum Hydrocarbons (TPH), and Polycyclic Aromatic Hydrocarbons (PAH)</p> <p>Localised Made Ground</p> <p>Potential contaminants likely to include Asbestos, metals, TPH and PAH</p>	Human Health: Future Site Users	Dermal contact with impacted soils or ingestion of contaminants in soil, soil-derived dust and water. Inhalation of contaminants in soil, soil-derived dust and vapours	High	Receptor not present in Baseline	Receptor not present during Construction	The construction works of the Development will be undertaken in accordance with industry best-practice and regulatory requirements. Principal contractor will provide a method statement in compliance with the CoCP manage dust and the risk of pollution. Remediation / removal of existing contamination.	With embedded mitigation no residual effects anticipated	Neutral (no effect)
	Human Health: Occupants of residential and commercial properties in the surrounding area	Dermal contact with, inhalation and ingestion of contaminants in soil-derived dust which may have migrated off-site.	High	Very low risk	Very low risk			
	Controlled Waters: Groundwater within superficial deposits (Superficial A Aquifers)	Leaching of contaminants in soil to groundwater in underlying aquifers.	Medium	Low risk	Low risk	Good management of stockpiles in accordance with EA Pollution Prevention Guideline: working at construction and demolition sites (PPG6) to reduce infiltration. Remediation / removal of existing contamination.	With embedded mitigation no residual effects anticipated	Neutral (no effect)
		Migration of contaminated water through preferential pathways such as underground services, pipes and granular material to groundwater in underlying aquifers.	Medium	Low risk	Low risk			
	Controlled Waters: On-site surface water features	Lateral migration of contaminated groundwater with discharge to surface watercourses as base flow.	Low	Very low risk	Very low risk	Preparation of a CEMP, including temporary site drainage plan to prevent overland flow and run-off. Piling risk assessment, if required	With embedded mitigation no residual effects anticipated	Neutral (no effect)
		Discharge of contaminants entrained in surface water run-off followed by overland flow and discharge.	Low	Very low risk	Very low risk			
	Controlled Waters: Rowel Brook (offsite)	Lateral migration of contaminated groundwater with discharge to surface watercourses as base flow.	Low	Very low risk	Very low risk			
	Property/ Services Future structures and services on site.	Direct contact of contaminants in soil and/or groundwater	High	Very low risk	Very low risk	Appropriate assessment and design of services resistant to chemical attack Intrusive investigation to include ground gas monitoring and mitigation measures incorporated into design of buildings and services if required. Remediation / removal of existing contamination	With mitigation in place, the risk to these receptors would be minimised any adverse effects would be temporary, localised and minor in nature.	Neutral (no effect)
		Migration of ground gas along strata and preferential pathways such as service routes or differentially permeable strata.	High	Very low risk	Very low risk			

OPERATIONAL ASSESSMENT

5.9 The following have been assumed as embedded mitigation measures within the detailed design of the Proposed Development.

- No site-specific ground gas data has yet been obtained for the site. Should mitigation measures be required, these will be installed within buildings where appropriate during the construction. Recommended ground gas protective measures will be agreed with the regulators prior to installation.
- Imported soils, if required as part of the earthworks balance or remediation strategy, will be validated in accordance with a remediation strategy for depth and chemical quality as part of the construction phase, mitigating any associated risk prior to the operational phase.
- No additional mitigation measures will be necessary during the operational phase following implementation of the construction phase measures (including completion of ground investigation and / or remediation).
- Sustainable Urban Drainage Systems (SUDS) to be utilised throughout the development and prevent washing of potential contaminants into controlled waters. This is further covered in the Water Resources Chapter (Chapter 11).

5.10 A summary of operational effects taking into account embedded mitigation is presented in Table 7 below.

Table 7 -Summary of Assessed Operational Effects with Mitigation

Source	Baseline			Baseline level of risk	Operational risk	Impact Assessment		
	Receptor	Pathway	Value / Sensitivity			Embedded Mitigation	Effect	Significance of effect
Agricultural Use	Human Health: Future Site Users	Dermal contact with impacted soils or ingestion of contaminants in soil, soil-derived dust and water. Inhalation of contaminants in soil, soil-derived dust and vapours	High	Receptor not present in Baseline	Very low risk	Completion of ground investigation and / or remediation suitable for residential end -use development.	With embedded mitigation no residual effects anticipated	Neutral (no effect)
	Human Health: Occupants of residential and commercial properties in the surrounding area	Dermal contact with, inhalation and ingestion of contaminants in soil-derived dust which may have migrated off-site.	High	Very low risk	Very low risk	Use of ground gas membranes (if found to be required). Imported material to meet suitable for use criteria.		
Potential contaminants likely include Pesticides, herbicides, localised Total Petroleum Hydrocarbons (TPH), and Polycyclic Aromatic Hydrocarbons (PAH)	Controlled Waters: Groundwater within superficial deposits (Superficial A Aquifers)	Leaching of contaminants in soil to groundwater in underlying aquifers.	Medium	Low risk	Very low risk	Completion of ground investigation and / or remediation suitable for residential end -use development.	With embedded mitigation no residual effects anticipated; a minor beneficial effect may be achieved through remediation of contamination (if found to be present)	Neutral to Minor Beneficial effect
		Migration of contaminated water through preferential pathways such as underground services, pipes and granular material to groundwater in underlying aquifers.	Medium	Low risk	Very low risk			
Localised Made Ground	Controlled Waters: On-site surface water features	Lateral migration of contaminated groundwater with discharge to surface watercourses as base flow.	Low	Very low risk	Very low risk	Imported material to meet suitable for use criteria.	With embedded mitigation no residual effects anticipated; a minor beneficial effect may be achieved through remediation of contamination (if found to be present)	Neutral to Minor Beneficial effect
		Discharge of contaminants entrained in surface water run-off followed by overland flow and discharge.	Low	Very low risk	Very low risk	Presence of site drainage and SUDS (as discussed in the Water Resources chapter)		
	Controlled Waters: Rowel Brook (offsite)	Lateral migration of contaminated groundwater with discharge to surface watercourses as base flow.	Low	Very low risk	Very low risk			
Potential contaminants likely to include Asbestos, metals, TPH and PAH	Property/ Services Future structures and services on site.	Direct contact of contaminants in soil and/or groundwater	High	Very low risk	Very low risk	Use of ground gas membranes (if found to be required).	With mitigation in place, the risk to these receptors would be minimised any adverse effects would be temporary, localised and minor in nature.	Neutral (no effect)
		Migration of ground gas along strata and preferential pathways such as service routes or differentially permeable strata.	High	Very low risk	Very low risk	Suitable concrete classification to be used for foundations (as assessed by ground investigation data).		

RESIDUAL EFFECTS

- 5.11 Following the correct implementation of identified mitigation measures there are no residual effects anticipated at either construction or operational phase.

CUMULATIVE EFFECTS

- 5.12 Mitigation measures outlines will minimise the potential for contamination. It is assumed that developers and appointed contractors for other committed developments will also follow current best practice guidance and, although no committed developments have been identified as part of this ES chapter, it is considered unlikely that in combination effects would exist in relation to any surrounding committed development.

6. Conclusion

- 6.1 The baseline data for this chapter is based on the Geo-environmental Desk Study prepared in January 2019. A ground investigation will be required to be completed as per the recommendations of the desk study to refine the conceptual site model and allow for identification and design of appropriate risk mitigation measures. It is anticipated that the requirement for a GI will be confirmed through the planning process.
- 6.2 The site currently comprises open agricultural land and limited potential sources of contamination were identified within the PCSM.
- 6.3 Mitigation measures for the potential effects identified are generally inherent to the Proposed Development and will be incorporated into the detailed design, RAMS and CEMP required for the Construction Phase. Should unacceptable contamination sources be identified in ground investigation or during construction / earthworks mitigation measures will include the implementation of a remedial scheme in accordance with a site-specific remediation strategy.
- 6.4 Following implementation of embedded mitigation measures into the detailed design of the Proposed Development, it is considered unlikely that there will be any residual significant effects.
- 6.5 The impact assessment is presented in Table 6 and Table 7 and supports the identification of no adverse residual effects.