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12.0 GEOLOGY, HYDROGEOLOGY AND LAND CONTAMINATION

12.1 Introduction

12.1.1 This chapter of the Environmental Statement (ES) identifies and addresses the potential impacts and effects of the construction, operation (including maintenance) and decommissioning of the Proposed Development on ground conditions and land quality. It should be read with reference to the description of the Proposed Development in Chapter 4.

12.1.2 The assessment has been prepared in accordance with the methodology described in Section 12.3 and is based on the information obtained following the completion of the Phase 1 Geo-environmental and Geotechnical Desk Study report (provided in Appendix 12A in ES Volume III (Document Ref 6.4)) and a ground investigation undertaken in 2019 (reports provided in Appendices 12B and 12C in ES Volume III (Document Ref 6.4)).

12.2 Legislation and Planning Policy Context

12.2.1 The European Union (EU) Directives and United Kingdom (UK) Acts considered the key legislative drivers for the geology, hydrogeology and land contamination assessment, including risks to human health and the environment from ground conditions, are summarised in the following paragraphs.

The Building Act 1984 and The Building Regulations &c. (Amendment) Regulations 2015

12.2.2 The Building Act 1984 and in particular the associated Building Regulations &c. (Amendment) Regulations 2015 are key when considering structural and design aspects of a development in terms of the geotechnical properties of the ground. The Building Act 1984 requires that buildings are constructed so that ground movement caused by swelling, shrinkage, freezing, landslip or subsidence of the sub-soils will not impair the stability of any part of the building.

The Environmental Protection Act 1990 (EPA) Part 2A - the Contaminated Land Regime

12.2.3 Current legislation relating to contaminated land in the UK is contained within Part 2A of the EPA, which was inserted by Section 57 of the Environment Act 1995 and by Section 86 of the Water Act 2003 (see below), and implemented by the Contaminated Land (England) Regulations 2006 [S.I. 2006/1380] (amended 2012 [S.I. 2012/263]). Under Part 2A, sites are identified as 'contaminated land' if they are (i) causing harm; (ii) if there is a significant possibility of significant harm; or (iii) if the site is causing, or could cause, pollution of controlled waters (i.e. both surface and groundwater).

The Water Resources Act 1991

12.2.4 The Water Resources Act 1991 provides statutory protection for controlled waters (i.e. streams, rivers, canals, marine environment and groundwater) and makes it an offence to discharge to controlled waters without the permission or consent of the regulators of these areas.

The Water Act 2003

12.2.5 The Water Act 2003 introduced a revision to the wording of the EPA, which requires that if a site is causing or could cause significant pollution of controlled waters, it may be determined as contaminated land. Once a site is determined to be contaminated land then remediation is required to render significant pollutant linkages insignificant (i.e. the source-pathway-receptor relationships that are associated with significant harm to human health and/ or significant pollution of controlled waters), subject to a test of reasonableness.

Other Legislation

12.2.6 Other legislation of relevance to this Chapter includes:

- Anti-Pollution Works Regulations 1999;
- Environmental Damage (Prevention and Remediation) (England) (Amendment) Regulations 2017;
- The Contaminated Land (England) (Amendment) Regulations 2012;
- The Control of Asbestos Regulations (2012);
- Environmental Permitting (England and Wales) Amendment (No 2) Regulations 2018;
- Hazardous Waste (England and Wales) (Amendment) Regulations 2016;
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017;
- The Waste Enforcement (England and Wales) Regulations 2018;
- The Water Framework Directive (2000/60/EC);
- The Groundwater Directive (2006/118/EC);
- The Environmental Quality Standards (EQS) Directive (2008/105/EC); and
- The Environmental Liability Directive (2004/35/EC).

Guidance on Assessment of Contaminated Land

12.2.7 Contaminated land, as defined in Part 2A of the EPA, is assessed through the identification and assessment of pollutant linkages (contaminant-pathway-receptor relationships). Implicit in EPA 1990: Part 2A Contaminated Land Statutory Guidance (Department for Environment, Food and Rural Affairs (Defra), 2012) is the application of risk assessment to assess whether potential pollutant linkages may be significant.

12.2.8 The risk-based methodology adopted in this report is based upon the Environment Agency's Model Procedures for the Management of Land Contamination (CLR11) (Environment Agency, 2004) together with the supporting guidance referenced within CLR11 and the revised guidance from the Environment Agency 'Land Contamination: Risk Management' (2019) (https://www.gov.uk/guidance/land-contamination-how-to-manage-the-risks). The methodology relies on the development of a site specific Conceptual Site Model (CSM) consisting of three components:

- a source of contamination: for example due to historical site operations;
- a pathway: a route by which receptors can become exposed to contaminants (examples include vapour inhalation, soil ingestion and groundwater migration); and
- a receptor: a target that may be exposed to contaminants via the identified pathways (examples include human occupiers/ users of the site, surface water, groundwater, property or ecosystems).

12.2.9 For a potential risk to either environmental and/ or human health receptors to exist, a plausible pollutant linkage involving each of these components must exist. If one of the components is absent then a pollutant linkage, and thereby potentially unacceptable risk, is also unlikely to exist. Where all three components are or may be present, a potentially complete pollutant linkage can be considered to exist. This does not automatically imply the presence of unacceptable risk but further investigation of the potential pollutant linkages is required.

Planning Policy Context – National Policy Statements

12.2.10 The Overarching National Policy Statement (NPS) for Energy (EN-1) Section 4.10 (Pollution control and other environmental regulatory regimes) (Department for Energy and Climate Change, 2011a) details that issues relating to discharges or emissions from a proposed project which may affect air quality, land quality and the marine environment, or which include noise and vibration may be subject to separate regulation under the pollution control framework or other consenting and licensing regimes. Before consenting any potentially polluting developments it should be confirmed that:

- the relevant pollution control authority is satisfied that potential releases can be adequately regulated under the pollution control framework; and
- the effects of existing sources of pollution in and around the site are not such that the cumulative effects of pollution when the proposed development is added would make that development unacceptable, particularly in relation to statutory environmental quality limits.

12.2.11 Section 5.3 of NPS EN-1 (Biodiversity and geological conservation) states that:

"where the development is subject to EIA the applicant should ensure that the ES clearly sets out any effects on internationally, nationally and locally designated sites of ecological or geological conservation importance, on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity"

12.2.12 Section 5.15 of NPS EN-1 (Water Quality and resources) states that:

"where the project is likely to have effects on the water environment, the applicant should undertake an assessment of the existing status of, and impacts of the proposed project on, water quality, water resources and physical characteristics of the water environment as part of the ES or equivalent. The ES should in particular describe:

- the existing quality of waters affected by the proposed project and the impacts of the proposed project on water quality, noting any relevant existing discharges, proposed new discharges and proposed changes to discharges;
- existing water resources affected by the proposed project and the impacts of the proposed project on water resources, noting any relevant existing abstraction rates, proposed new abstraction rates and proposed changes to abstraction rates (including any impact on or use of mains supplies and reference to Catchment Abstraction Management Strategies);
- existing physical characteristics of the water environment (including quantity and dynamics of flow) affected by the proposed project and any impact of physical modifications to these characteristics; and
- any impacts of the proposed project on water bodies or protected areas under the Water Framework Directive and source protection zones (SPZs) around potable groundwater abstractions."

12.2.13 The National Policy Statement for Renewable Energy Infrastructure EN-3 provides the primary basis for decisions on applications for nationally significant renewable energy infrastructure including energy from biomass and/ or waste facilities (>50 megawatts (MW)).

12.2.14 Other planning policy of relevance to the geology, hydrogeology and land contamination assessment is provided in Tables 12.1 and 12.2.

Table 12.1: The National Planning Policy Framework (Ministry for Housing, Communities and Local Government, 2019)

POLICY REFERENCE	SUMMARY
Paragraph 117	Planning policies and decisions should promote an effective use of land in meeting the need for homes and other uses, while safeguarding and improving the environment and ensuring safe and healthy living conditions. Strategic policies should set out a clear strategy for accommodating objectively assessed needs, in a way that makes as much use as possible of previously-developed or 'brownfield' land.
Paragraph 118 c)	Planning policies and decisions should give substantial weight to the value of using suitable brownfield land within settlements for homes and other identified needs, and support appropriate opportunities to remediate despoiled, degraded, derelict, contaminated or unstable land.
Paragraph 170 a)	Planning policies and decisions should contribute to and enhance the natural and

POLICY REFERENCE	SUMMARY
	local environment by: …. protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan).
Paragraph 170 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 improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans.
Paragraph 170 f)	…by…remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.
Paragraph 171	Plans should: distinguish between the hierarchy of international, national and locally designated sites; allocate land with the least environmental or amenity value, where consistent with other policies in this Framework…...
Paragraph 178 a)	Planning policies and decisions should ensure that: …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)
Paragraph 178 b)	Planning policies and decisions should also ensure that:… 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
Paragraph 178 c)	Planning policies and decisions should also ensure that… adequate site investigation information, prepared by a competent person, is presented.

POLICY REFERENCE	SUMMARY
Paragraph 179	Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner.
Paragraph 180	Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development.
Paragraph 183	The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions 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.

Table 12.2: North East Lincolnshire Local Plan (North East Lincolnshire Council, 2018)

POLICY REFERENCE	SUMMARY
Policy 5 Paragraph 1	**Development Boundaries** Development Boundaries are identified on the Policies Map. All development proposals located within or outside of the defined boundaries will be considered with regard to suitability and sustainability, having regard to: • the quality of agricultural land; • measures to address any contamination of the site; and • impact on areas of heritage, landscape, biodiversity and geodiversity value, including open land that contributes to settlement character.

POLICY REFERENCE	SUMMARY
Policy 31 Paragraph 3	**Renewable and Low Carbon Infrastructure** Proposals for renewable and low carbon energy generating systems will be supported where any significant adverse impacts are satisfactorily minimised and the residual harm is outweighed by the public benefits of the proposal. Developments and their associated infrastructure will be assessed on their merits and subject to the following impact considerations, taking account of individual and cumulative effect: • biodiversity, geodiversity and nature conservation, with regard given to the findings of the site and project specific HRA and potential impacts on SPA birds where appropriate; • the land, including land stability, contamination, soils resources and loss of agricultural land.

12.3 Assessment Methodology and Significance Criteria

Baseline Conditions and Sensitive Receptors

12.3.1 This assessment of impacts to and from the existing ground conditions as a result of the Proposed Development has been undertaken using importance and significance criteria that have been developed and successfully applied to other Environmental Impact Assessments (EIAs). The methodology considers the potential presence of land and groundwater contamination as well as sites of geological/ geomorphological significance such as geological conservation features or mineral resources. Geotechnical constraints (e.g. differential settlement, subsidence and the potential for ground gas accumulation) are also discussed within this chapter with the Proposed Development infrastructure identified as a receptor.

12.3.2 Information obtained from the following sources mentioned in Section 12.4 below have been used to establish the baseline conditions. The CSM presented in the Phase 1 Geo-environmental and Geotechnical Desk Study Report within Appendix 12A in ES Volume III (Document Ref. 6.4), is integrated into the assessment of baseline conditions. All supporting information is consistent with the risk-based framework adopted in the Environment Agency guidance Land Contamination: Risk Management (2019) online at https://www.gov.uk/guidance/land-contamination-how-to-manage-the-risks and guidance document Model Procedures for the Management of Land Contamination - CLR11 (Environment Agency, 2004). Guidance within British Standard (BS) 10175: 2011+A2:2017 Investigation of Potentially Contaminated

Sites – Code of Practice (British Standards Institute (BSI), 2017) has also been followed.

12.3.3 A ground investigation has also been undertaken and findings are summarised within this chapter.

12.3.4 The geology, hydrogeology and land contamination assessment initially entailed defining the importance/ sensitivity of identified receptors which takes into consideration the following:

- surrounding land uses, based on mapping, site visits and existing planning designations;
- proposed end-use, based on the nature of the Proposed Development;
- soil resource losses as associated with the Proposed Development;
- construction activities that are necessary for the Proposed Development;
- details of geological and/ or nature conservation importance; and
- geology, hydrogeology and hydrology of the Site and the Study Area (which is defined in Section 12.4).

12.3.5 Potential sources of contamination associated with the Site are identified considering the current and previous land use from study of existing reports, current and historic maps, photographs, local history sources, environmental database information and a Site inspection.

12.3.6 Where a significant contamination source has been identified and the sensitivity of receptors considered, then the potential effects can be determined by consideration of the pathways through which the source or hazard may affect the receptors. The magnitude of impact and the significance of effect is then determined taking due account of strength of pathway between a source and a receptor.

Assessment of Significance of Effects

12.3.7 This section describes the framework of the assessment in identifying the magnitude of impact, sensitivity of receptor, and classification of effect. The impact assessment methodology applied takes account of technical guidance that has been produced in the UK for the assessment of ground conditions and water resources by the government - the Environment Agency document Model Procedures for the Management of Land Contamination - CLR11 (Environment Agency, 2004), Contaminated land: Applications in Real Environments (CL:AIRE, 2010); and BS 10175: 2011 Investigation of Potentially Contaminated Sites – Code of Practice (BSI, 2011).

12.3.8 The effects are assessed in terms of the sensitivity or importance of a receptor or feature, and the magnitude of change or scale of impact due to the Proposed Development.

12.3.9 The sensitivity of a receptor reflects the quality of the receptor and its ability to absorb an impact without perceptible change. Sensitivity is defined in Table 12.3. The importance of potentially affected geological/ geomorphological features and

the sensitivity of receptors that may be affected by land contamination impacts, have been assessed on this basis.

Table 12.3: Importance/ sensitivity criteria of geology, hydrogeology and land contamination resources/ receptors

SENSITIVITY/ VALUE OF RECEPTOR	RECEPTORS SUSCEPTIBLE TO LAND CONTAMINATION AND GROUND HAZARD IMPACTS	SOIL GEOLOGICAL AND HYDROGEOLOGICAL RESOURCES
High	Future site users (residential development). Residential areas or schools within 50 m of construction works. Water features deemed to be of high value. Ecological features deemed to be of high value. Allotments, arable farmland, livestock or market gardens on or adjacent to the site.	Principal Aquifer, Internationally and nationally designated sites. Regionally important sites with limited potential for substitution. High quality agricultural soils (Grade 1 and 2) or soils of high nature conservation or landscape importance. Presence of significant mineral reserves and within a Mineral Consultation Area. Soil/ materials disposal required following earthworks resulting in a significant increase in demand on waste management infrastructure.
Medium	Future site users (commercial development). Residential areas or schools within 50 to 250 m of construction works. Commercial areas within 50 m of construction works. Water features deemed to be of medium value. Ecological features deemed to be of medium value.	Secondary A and B Aquifers. Secondary A Aquifer providing source of water for agricultural or industrial use with limited connectivity with surface water features. Regionally important sites with potential for substitution. Locally designated sites with limited potential for substitution. Good quality agricultural soils (Grade 3a) or soils of medium conservation or landscape importance.

SENSITIVITY/ VALUE OF RECEPTOR	RECEPTORS SUSCEPTIBLE TO LAND CONTAMINATION AND GROUND HAZARD IMPACTS	SOIL GEOLOGICAL AND HYDROGEOLOGICAL RESOURCES
	The built environment including buildings and infrastructure.	Site within a Mineral Consultation Area. Soils/ materials disposal required following earthworks resulting in a moderate increase in demand on waste management infrastructure.
Low	Future site users (car park, highways and railway related development). Residential areas >250 m from construction works. Commercial areas within 50 to 250 m of construction works. Water features deemed to be of low value. Ecological features deemed to be of low value.	Secondary B Aquifers. Secondary B Aquifer providing source of water for agricultural or industrial use with limited connectivity with surface water features. Undesignated sites of some local earth heritage interest. Moderate or poor quality agricultural soils (Grade 3b or 4) or soils of low nature conservation or landscape importance. Limited potential for mineral reserves and site not within a Mineral Consultation Area. Soil/ materials disposal required following earthworks resulting in a minor increase in demand on waste management infrastructure.
Very Low	Attribute has a negligible quality or rarity on a local scale. Other sensitive receptors susceptible to soil or groundwater contamination.	Unproductive groundwater strata. No mineral extraction potential. No geological or geomorphological features of interest.

SENSITIVITY/ VALUE OF RECEPTOR	RECEPTORS SUSCEPTIBLE TO LAND CONTAMINATION AND GROUND HAZARD IMPACTS	SOIL GEOLOGICAL AND HYDROGEOLOGICAL RESOURCES
		No developed land uses other than transport infrastructure within 250 m. Surface water feature deemed to be of negligible quality/ value.

Magnitude of Impacts

12.3.10 The magnitude of a potential impact considers the scale of the predicted change to the baseline condition taking into account its duration (i.e. the magnitude may be moderated by the impacts being temporary rather than permanent, short term rather than long term). Definitions for impact magnitude are described in Table 12.4. It is generally unlikely that impacts on geology, hydrogeology and land contamination due to new developments would be beneficial, so the examples of magnitude all relate to negative/ adverse impacts.

Table 12.4: Impact magnitude criteria (geology, hydrogeology and land contamination)

MAGNITUDE	DESCRIPTION	EXAMPLES
High	Total loss or major alteration to key features of the baseline conditions such that post development character/ composition of baseline condition will be fundamentally changed.	Pollution of potable sources of water abstraction. Loss of, or extensive change to, an aquifer or groundwater supported designated wetland. Loss of, or extensive change to, nationally important geological/ geomorphological features.
Medium	Loss or alteration to one or more key features of the baseline conditions such that post development character/ composition of baseline condition will be materially changed.	Partial loss or change to an aquifer. Partial loss of the integrity of groundwater supported designated wetlands. Permanent loss of regionally important geological features or substantial changes to nationally important

MAGNITUDE	DESCRIPTION	EXAMPLES
		geological/ geomorphological features.
Low	Results in some measurable change in attributes quality or vulnerability compared to baseline conditions. Changes arising from the alteration will be detectable but not material; the underlying character/ composition of baseline condition will be similar to the pre-development situation.	Measurable effect on aquifer but of limited size or proportion, which does not lead to a reduction in the aquifer status. Minor effects on groundwater supported wetlands. Minor changes to regionally important geological/ geomorphological features or small changes to nationally important geological/ geomorphological features.
Very Low	Very little change from baseline conditions. Change is barely distinguishable, approximating to a 'no change' situation.	No measurable effect upon groundwater, or geology/ geomorphology.

Assessment of Significance of Effects

12.3.11 The classification and significance of a potential effect is derived from both the sensitivity of the feature and the magnitude of the impact, and can be then determined using the matrix presented in the Table 12.5. Effects can be beneficial, adverse or neutral and their significance major, moderate, minor or negligible.

Table 12.5: Classification of effects

MAGNITUDE OF IMPACT	SENSITIVITY OF RECEPTOR			
	High	**Medium**	**Low**	**Very Low**
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Negligible
Low	Moderate	Minor	Negligible	Negligible
Very Low	Minor	Negligible	Negligible	Negligible

12.3.12 The EIA Regulations require the likely significant effects to be identified. Any effect predicted to be minor or negligible is considered to be not significant. Effects assessed as moderate or major are considered to be significant.

12.3.13 The classification of effect is further explained in Table 12.6.

Table 12.6: Explanation of significance classifications

CLASSIFICATION	GENERAL DESCRIPTION	SIGNIFICANT?
Major (adverse or beneficial)	A large and/ or detrimental change to a valuable/ sensitive receptor; likely or apparent exceeding of accepted (often legal) threshold or a major departure from national targets. A large and beneficial change, resulting in improvements to baseline conditions whereby previously poor conditions are replaced by compliance with accepted (often legal) thresholds or a major contribution is made to national targets. These are effects which may represent key factors in the decision making process. Potentially associated with sites and features of national importance or likely to be important considerations at a regional or district scale. Major effects may relate to impacts on resources or features which are rare and cannot be relocated, or if lost, cannot be replaced.	Yes
Moderate (adverse or beneficial)	A medium scale change which, although not beyond an accepted (often legal) threshold, is still considered to be generally unacceptable, unless balanced out by other significant positive benefits of the development. Likely to relate to departure from relevant planning policy, rather than legal compliance. A positive moderate effect is a medium scale change that is significant in that the baseline conditions are improved to the extent that guideline targets are contributed to. These effects, if adverse, are likely to be important at a local or district scale and on their own could have a material influence on decision making.	Yes

CLASSIFICATION	GENERAL DESCRIPTION	SIGNIFICANT?
Minor (adverse or beneficial)	A small change that, whilst adverse, does not exceed accepted thresholds, legal or guideline standards. Unlikely to be a departure from planning policy. A small positive change, but not one that is likely to be a key factor in the overall balance of issues. These effects may be raised as local issues but are typically unlikely to be critical in the decision making process.	No
Negligible (adverse or beneficial)	A very small change that is so small and unimportant that it is considered acceptable to disregard. Effects which are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error, these effects are unlikely to influence decision making, irrespective of other effects.	No

Assessment Scenarios and Parameters

12.3.14 As described in Chapter 4: The Proposed Development and Chapter 5: Construction Programme and Management, three possible construction programme scenarios have been identified. The assessment of impacts presented in this chapter is relevant to all three scenarios. None of the scenarios presents a worst case over another in terms of the potential for likely significant effectseffects on Geology, Hydrogeologygeology, hydrogeology and Land land contamination as the impacts for all three scenariosscenarios are likely to be the same.

12.3.15 However the maximum development parameters (the Rochdale Envelope) as set out in Chapter 4: The Proposed Development have been adopted to ensure a robust, worst case assessment in relationrelation to the size and scale of the PropsedProposed Development.

Consultation

12.3.16 The EIA Scoping Opinion received from the Planning Inspectorate on 2nd October 2019 (see Appendix 1B in ES Volume III, Document Ref 6.4) confirmed that an assessment of impacts on ground conditions (including ground waters and contamination) during construction, operation (including maintenance) and decommissioning should form part of the EIA. The consultation response by NELC to PINS explained that the EIA Scoping Report captured the relevant information requested by NELC in the scoping opinion in respect of the Consented Development and that NELC have no further comments.

12.3.17 Table 12.7 below summarises the comments within the EIA Scoping Opinion that are relevant to this Chapter.

Table 12.7: Summary of EIA Scoping Opinion comments relevant to geology, hydrogeology and land contamination

COMMENT	WHERE ADDRESSED
Planning Inspectorate EIA Scoping Opinion	
Definition of the study area: The report should explain how the study area has been defined, how this relates to the zone of influence of the Proposed Development and why it is sufficient to address the extent of the impacts associated with the Proposed Development.	Refer to Section 12.4
Assessment of Land Contamination: It is noted that the assessment of potential impacts would follow the relevant statutory guidance and the Contaminated Land Report 11: Model Procedures for the Management of Land Contamination. The Applicant is advised to agree the approach to assessing land contamination with the EA.	Refer to Section 12.3 and Appendix 12A
Mitigation Measures: Any mitigation relied upon for the purposes of the assessment should be explained in detail within the ES. The likely efficacy of the mitigation proposed should be explained with reference to residual effects. The ES should also address how any mitigation proposed is secured, with reference to specific DCO requirements or other legally binding agreements. A minimum specification of actions should be proposed in reference to any plans or strategies on drainage, or traffic management, which will give confidence about the nature and implementation of the measures. Technical chapters of the ES will include a section on mitigation and enhancement measures. NPS EN-1 requires thedecision maker to consider the mitigation measures proposed and to determine if additional measures are required. A distinction should be drawn within the ES between measures to mitigate the significant effects of the Proposed Development and those that are provided for	Refer to Section 12.5 and 12.7

COMMENT	WHERE ADDRESSED
any other purpose e.g. compensation or environmental enhancement.	
Environment Agency response on EIA Scoping	
The Environment Agency stated "the scope of work for the assessment of risks associated with land contamination does not change as a result of the revised proposals for the site – compared to those associated with the Consented Development. I can confirm that the applicant's proposal to review and update the desk-based (Phase 1) assessment, where required, is appropriate."	Refer to Appendix 12A
The EA recommend that the Applicant should: • follow the risk management framework provided in CLR11, Model Procedures for the Management of Land Contamination, when dealing with land affected by contamination; • refer to the Environment Agency Guiding principles for land contamination for the type of information that we required in order to assess risks to controlled waters from the site. The Local Authority can advise on risk to other receptors, such as human health; • consider using the National Quality Mark Scheme for Land Contamination Management which involves the use of competent persons to ensure that land contamination risks are appropriately managed; • refer to the contaminated land pages on GOV.UK for more information.	Refer to Section 12.3

12.3.18 Comments have been received from The Environment Agency (EA), dated 6th December 2019, regarding consultation on the Geology, Hydrogeology and Ground Conditions chapter of the Preliminary Environmental Information (PEI) Report. The EA comments are based on their assessment of the PEI Report and findings of the Phase 1 desk study (Appendix 12A in ES Volume III (Document Ref. 6.4)), as the ground investigation data was not available at the time of the PEI Report.

12.3.19 On the basis of Made Ground being present within the Main Development Area and shallow groundwater within the underlying superficial deposits, the EA consider there to be a potential risk of contamination which could be mobilised during construction to pollute controlled waters. The EA indicates that the adjacent drainage channels around the Site could potentially be a receptor for potential contamination within the underlying shallow groundwater. The EA

consider risk to the principal aquifer as low due to the overlying low permeable deposits at the Site. Following on from the Phase 1 report the EA will require further detailed information before the Proposed Development is built.

12.3.20 In addition the EA have requested that they review additional assessments of groundwater monitoring and risk assessment following the ground investigation and a piling risk assessment which was included as a mitigation measure in the PEI Report and remains as mitigation in this ES.

12.3.21 A meeting with the EA was held on 18th February 2020, during which the it was agreed that the findings of the ground investigation would be submitted with the DCO application and no further queries were raised.

Summary of Key Changes to Chapter 12 since Publication of the Preliminary Environmental Information (PEI) Report

12.3.1 The PEI Report was published for statutory consultation in December 2019, allowing consultees the opportunity to provide informed comment on the Proposed Development, the assessment process and preliminary findings through a consultation process prior to the finalisation of this ES.

12.3.2 The key changes since the PEI Report was published are summarised in Table 12.8 below.

Table 12.8: Summary of Key Changes to Chapter 12 since Publication of the PEI Report

SUMMARY OF CHANGE SINCE PEI REPORT	REASON FOR CHANGE	SUMMARY OF CHANGE TO CHAPTER TEXT IN ES
Update to include findings of the Ground Investigation Factual and Interpretive Reports. These are presented as Appendices 12B and 12C respectively (ES Volume III, Document Ref. 6.4).	Additional information available to inform the assessment as result of the ground investigation undertaken between 12 August and 12 September 2019.	Additional baseline information described at paragraphs 12.4.31 to 12.4.42, summarising the ground conditions encountered, and Conceptual Site Model set out at paragraphs 12.6.2 to 12.6.5 updated based on the ground investigation findings. No change to assessment conclusions.

12.4 Baseline Conditions

12.4.1 Baseline conditions are set out in the Phase I Geo-environmental and Geotechnical Desk Study Report presented as Appendix 12A in ES Volume III (Document Ref. 6.4).

Study Area

12.4.2 The Study Area for the geology, hydrogeology and land contamination assessment is the boundary of the Site and up to 500 m from the Site boundary. Where necessary, the assessment of impacts will be extended outside the Study Area to include important off-Site features within the vicinity of the Site.

12.4.3 A 500 m Study Area is considered appropriate for the above topics and aligns with established industry practice for defining study areas for the geology, hydrogeology and land contamination topic in EIA.

12.4.4 Whilst the review of baseline conditions focuses on the geological and hydrogeological setting, it also considers the wider environment in terms of identifying potential receptors that could be impacted upon by any existing or resulting soil and/ or groundwater contamination. There is therefore some reference made to hydrological and ecological features in this chapter. These are also discussed in more detail within Chapter 14: Water Resources, Flood Risk and Drainage and Chapter 10: Ecology and Nature Conservation.

Geology

12.4.5 The Proposed Development is not situated within any identified areas of Artificial Ground. However, the uneven surfaces of the Main Development Area and the presence of a mound noted during the Site walkover indicate the presence of Made Ground. The underlying geology comprises superficial deposits of Tidal Flat (Clay and Silt) normally a consolidated soft silty clay, with layers of sand, gravel and peat. The Tidal Flat deposits are underlain by Glacial Deposits of Devensian age. The bedrock geology underlying the Tidal Flats is the Flamborough Chalk Formation, described by the British Geological Survey (BGS) Lexicon (BGS 'GeoIndex Onshore' website accessed 25/09/2019) as being "*White, well-bedded, flint-free chalk with common marl seams (typically about one per metre). Common stylolitic surfaces and pyrite nodules*."

12.4.6 No geological faults have been identified at the Site either on BGS 1:50,000 or 1:10,560 scale maps.

12.4.7 There are four BGS boreholes within 250 m of the Main Development Area; TA21SW119, TA21SW347, TA21SW346 and TA21SW345. In borehole TA21SW119, Made Ground was identified between ground level and 0.30 m below ground level (bgl). In borehole TA21SW119, from approximately 0.30 m bgl to 7.48 m bgl, the geology was described as mudflat intertidal channel comprising of layers of clayey silt and sandy silts. Underlying the mudflat intertidal channel to 9.00 m bgl (base of borehole) was low salt marsh which comprised of silty clay with peat, wood fragments, pebbly sandy silt with chalk pebbles. No groundwater strike was recorded. The three remaining boreholes recorded alluvium from ground level at depths of between 6.60 m and 9.30 m bgl. Underlying the alluvium glacial deposits was described comprising of layers of clay and sand to depths of 23.00 m bgl overlying the Flamborough Chalk. Groundwater was encountered in these three boreholes between depths of 9.70 m bgl and 11.40 m bgl.

12.4.8 The Site is not within an area affected by coal mining and there are no BGS Recorded Mineral Sites within the Study Area.

Hydrogeology

12.4.9 The superficial deposits within the Site are classified by the Environment Agency as an Unproductive Aquifer. The bedrock geology is designated as a Principal Aquifer, i.e. exhibiting high permeability and/or provides a high level of water storage. Principal Aquifers may support water supply and/or river base flow on a strategic scale.

12.4.10 The Site is not located within a Groundwater Source Protection Zone and there are no groundwater abstractions within the Study Area.

Hydrology

12.4.11 To the east of the Site is the Humber Estuary. 'High Water Tide' mark is noted on the Ordnance Survey (OS) maps as approximately 175 m from the eastern boundary of the Main Development Area.

12.4.12 There is a system of drainage channels around the majority of the perimeter of the Site. The Oldfleet Drain is located approximately 140 m south of the Site boundary (at its closest point) and it connects to the Mawbridge Drain approximately 1 km south of the Site.

12.4.13 A large pond lies off-Site approximately 250 m south of the Site to the south of the Oldfleet Drain.

12.4.14 The Environment Agency Catchment Data Explorer (https://environment.data.gov.uk/ catchment-planning/ accessed online on 25/09/2019) indicates the north-eastern area of the Site is within the 'North Beck Drain' catchment area and the south-western area is within the 'Mawbridge Drain' catchment area. The chemical qualities of both catchments are classified as 'Good' in the 2016 classification, indicating the Water Framework Directive (WFD) objective has been met. The ecological qualities of both catchments are designated as 'Moderate' in the 2016 classification, with an objective of 'Good' classification set for 2027.

12.4.15 The Environment Agency's flood map for planning (accessed https://flood-map-for-planning.service.gov.uk/ online on 25/09/2019) indicates that the Site is within Flood Zone 3. These are areas assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year. The flood zone does not take into account the presence of flood defences in the area.

12.4.16 Water quality and flood risk as discussed further in Chapter 14: Water Resources, Flood Risk and Drainage.

Designated and Non-Designated Geology Sites

12.4.17 There are no geologically designated sites identified within the Study Area.

Site History

12.4.18 Historical mapping from 1887 until 1999 depicts the Site and the Study Area as agricultural fields with drainage channels, with the Humber Estuary lying to the east of the Site.

12.4.19 During the late 1990s the South Humber Bank Power Station (SHBPS) was built within the Site, to the west of the Main Development Area, with an attenuation lagoon (pond) in the south of the Main Development Area. By 2006 a pond is depicted on the historical mapping situated in the north-eastern corner of the Main Development Area. The attenuation lagoon and pond have recently been infilled in preparation for the construction of the Consented Development.

12.4.20 From 1965 until the 1980s the most significant changes were the development of works buildings on the south-eastern boundary of the Site with further development on the north-east corner of the Site boundary, appearing in 1968 and by 1978 further works had been developed on the outskirts of the north-eastern and eastern Site boundaries.

12.4.21 In 2006 an underground pipeline is depicted on the historical mapping, 270 m north from the eastern boundary of the Site which extends from the headland towards the sea.

Potentially Contaminative Land Uses

12.4.22 The SHBPS, which lies directly to the west of the Main Development Area, is considered as a potentially contaminative land use due to its use as an energy generation facility which will have included some storage of fuel and chemicals for use in the maintenance and operation of the facility.

12.4.23 No landfill sites or waste management facilities are listed within the Study Area, with the exception of one Permitted Waste Management Facility, which is located 337 m north of the Site – the NEWLINCS waste management facility, for which a Permit was issued in May 2012.

12.4.24 Just outside the Study Area there are:

- seven Licensed Waste Management Facilities located between 500 m and 1 km of the Site;
- one BGS Recorded Landfill Site located 825 m south-east of the Site; and
- four Historic Landfills listed between 500 m to 1 km south-east of the Site (Stallingborough Landfill located c. 750 m to the north-west and Landfills No2, No3 and No4 at Greatcoates Works located c. 800 m to the south-east of the Site).

Contemporary Trade Uses

12.4.25 Two active Contemporary Trade Uses are listed on Site: a waste disposal service and a power transmission service.

12.4.26 There are a further two entries within 250 m of the Site; one classified as a rubber and plastic products manufacturer, which is active, and the other a chemicals and allied products manufacturer which is listed as inactive.

12.4.27 Just outside the Study Area between 500 m and 1 km, there are two Contemporary Land Uses entries which are both active; one classified as a Recycling Centre and the other as a Gas Supplier.

Previous Ground Investigations

12.4.28 In 2006, Centrica commissioned a Site Protection and Monitoring Program for SHBPS, which included a ground investigation and installation of monitoring wells in the western part of the Site and a monitoring programme.

12.4.29 The intrusive ground investigation recorded variable thicknesses of Made Ground overlying superficial alluvial clay deposits comprising very soft or soft black to grey brown or dark grey clay with a slight organic reducing odour. The alluvial clay was observed as becoming very sandy at 4.0 m bgl along with groundwater seepages. During the ground investigation groundwater was encountered across the monitoring well network with resting groundwater levels ranged from 0.219 mbct to 1.549 mbct (metres below monitoring well casing top). It is assumed that the monitoring well casing top is at 0.3m above ground level. The ground investigation report inferred that groundwater flowed towards the south-east.

12.4.30 Analysis of the soils undertaken during the investigation indicated the presence of localised, trace concentrations of heavy fractions (C21 – C25) aromatic and aliphatic Total Petroleum Hydrocarbons (TPH) and Polycyclic Aromatic Hydrocarbons (PAH) at shallow depths. Groundwater chemical analysis results recorded TPH concentrations below the method detection limit and aqueous PAH concentrations of 0.129 µg/l and 0.29 µg/l. The ground investigation report noted that the groundwater pH and chloride concentrations suggested alkaline freshwater conditions beneath the Site, with no evidence of saline intrusion from the Humber Estuary.

12.4.31 In July 2019, Socotec UK Limited were commissioned by EP UK Investments Ltd (EPUKI) to carry out a ground investigation within the Main Development Area for the Consented Development.

12.4.32 The intrusive ground investigation reported that the geology across the Main Development Area was broadly uniform consisting of Made Ground underlain by tidal flat deposits, and glacial till and a chalk bedrock.

12.4.33 The Made Ground was encountered from ground level to 3.05 m bgl. At some locations Made Ground was absent. The Made Ground consisted of reworked natural deposits with some man made gravel e.g. concrete, brick and tile.

12.4.34 The tidal flat deposits were encountered at varying depths below the made ground and comprised predominantly clay or silts with organic layers and occasional silty fine sand bands.

12.4.35 Underlying the tidal flat deposits was glacial till. The top of the glacial till was encountered between 8.15m and 13.60m bgl and comprised sandy gravelly clay and silty sand.

12.4.36 The bedrock underlying the glacial till was chalk and was encountered between 20.7m and 22.50m bgl. The chalk was recovered as a sandy gravel with occasional cobbles or gravel in a silt matrix. The base of the chalk was not proven during the ground investigation.

12.4.37 The Interpretive report prepared by Socotec UK Ltd included a CSM, identifying potential contaminant sources, exposure pathways and receptors. The source of potential contamination was identified as localised Made Ground. Localised

Made Ground identified in the CSM by Socotec is the same source of potential contamination identified in the CSM of the desk study report prepared by AECOM (see Appendix 12A in ES Volume III).

12.4.38 Potential exposure pathways to construction site workers and future site users was identified as being via soil ingestion, dermal contact, and/ or inhalation of soil dust/ vapour. In addition, potential leaching of contaminants from Made Ground would be a pathway which could affect building foundations, structures and underground services.

12.4.39 In accordance with Defra/ Environment Agency Land contamination: risk management guidance CLR11 (Environment Agency, 2004), a Generic Quantitative Risk Assessment (GQRA) was carried out by comparing the recorded soil contaminant concentrations against conservative Generic Assessment Criteria (GAC). The GAC were derived using the Environment Agency Contaminated Land Exposure Assessment (CLEA) model for industrial/ commercial developments, which is relevant to the Proposed Development.

12.4.40 The conclusion of the assessment was that risk to human health was unlikely. None of the determinands analysed exceeded GAC.

12.4.41 Risks to Controlled Waters were also considered to be unlikely. This was due to the recorded concentrations of potential contaminants in soil being very low compared to GACs and no visual or olfactory evidence of contamination was observed during the ground investigation. The nearest controlled water receptor was the Humber Estuary at approximately 175 m east of the Site and the presence of a low permeability clay and silt material between the Made Ground and the underlying chalk aquifer.

12.4.42 Three rounds of ground gas monitoring were undertaken between September and November 2019. Ground gas readings from September and October were recorded, but during the November visit groundwater levels were above the level of the gas taps and therefore no readings were able to be taken. The interpretive report (Appendix 12C in ES Volume III) concludes that due to high groundwater levels the majority of the gas monitoring data was discounted. However peak readings of carbon dioxide and oxygen were noted. WS09 and WS10 recorded carbon dioxide at 21.3%/vol and 21.6%/vol respectively and oxygen at 0.1%/vol for both locations. The detailed design will take this into account.

12.5 Development Design and Impact Avoidance

12.5.1 This section considers how potential environmental impacts have or will be avoided, prevented, reduced or offset through design and/ or management of the Proposed Development with respect to ground conditions and contamination.

12.5.2 As noted above a ground investigation has been undertaken to more accurately quantify potential hazards and a risk assessment carried out to define potential remediation objectives to narrow the degree of uncertainty in the risk rankings. The ground investigation comprised the following:

- investigation of the nature and extent of the Made Ground across the Main Development Area;

- investigation of the nature of the underlying natural strata, where present, including determination of in-situ soil properties; the natural bearing resistance of the overburden subsoil, porewater pressure, shear wave velocity, dynamic shear module and Poisson ratios;
- investigation of depths to rockhead;
- obtain soil and groundwater samples for chemical testing and geotechnical testing;
- install gas and groundwater monitoring wells and monitoring of ground gas concentrations and groundwater levels; and
- undertake a range of suitable soil, leachate and groundwater chemicals, including Building Research Establishment (BRE) sulphate tests.

12.5.3 A Construction Environmental Management Plan (CEMP) will be prepared and implemented by the selected construction contractor. This CEMP will include a range of measures associated with mitigating potential impacts associated with land contamination as detailed below. Such measures accord with legal compliance and best practice guidance when working with or around contaminated materials. An Outline CEMP is presented within Appendix 5A in ES Volume III (Document Ref. 6.4).

12.5.4 The interpretive report (Appendix 12C in ES Volume III) concluded that the level of potential contamination, in general, was low across the Main Development Area, based on the chemical analysis suite used. The interpretive report also stated that the expected construction of hardstanding to be installed at the Main Development Area would further reduce potential exposure and therefore any risk to likely receptors. Therefore, on the basis of the current investigation and risk assessment, no specific remedial measures were deemed necessary, by Socotec, to mitigate potential contamination risks to future site end users.

12.5.5 A Materials Management Plan (MMP) will be prepared as part of the CEMP. The MMP will detail the procedures and measures that will be taken to classify, track, store, dispose of and possibly re-use all excavated materials that are expected to be encountered during the construction of the Proposed Development.

12.5.6 The disposal of soil waste, contaminated or otherwise to landfill sites will be mitigated by minimisation of the overall quantities of waste generated during construction and by ensuring that excavated material consigned to landfill cannot, as an alternative, be put to use either on Site or on other sites (see Chapter 16: Waste Management).

12.5.7 The Flamborough Chalk formation is known to contain pyritic minerals. The appropriate design sulphate concrete classification to prevent chemical attack on concrete has been addressed in the ground investigation report (Appendix 12C, ES Volume III, Document Ref. 6.4) and will be used to inform the detailed design of the Proposed Development.

Construction Phase

Impacts on Soil Resources

12.5.8 The potential impacts on soil resources will be managed by minimising trafficking over topsoil materials and undertaking soil stripping during appropriate weather conditions, such that the soils are not wet. Once stripped the soils will be stored in soil bunds to an agreed height so that the materials own weight does not damage the structure of the soil. The topsoil will be reused in areas of landscaping within the Site or off-Site if it cannot be re-used on Site.

Impacts on Human Receptors

12.5.9 The potential impacts specific to construction workers during construction of the Proposed Development will be managed by adherence to the working practices in accordance with Construction Industry Research and Information Association (CIRIA) C741 Environmental Good Practice on Site 4th Edition (CIRIA, 2015), including:

- measures to minimise dust generation;
- provision of personal protective equipment (PPE), such as gloves, barrier cream, overalls etc. to minimise direct contact with soils;
- provision of adequate hygiene facilities and clean welfare facilities for all construction site workers;
- monitoring of confined spaces for potential ground gas accumulations, restricting access to confined spaces i.e. by suitably trained personnel, and use of specialist PPE, where necessary; and
- preparation and adoption of a Site and task specific health and safety plan.

Impact on Controlled Waters

12.5.10 To manage the potential impact on controlled waters, groundwater monitoring wells have been installed in targeted response zones. Groundwater level monitoring and chemical testing has been undertaken to determine the presence of any contaminants in groundwater.

12.5.11 The management measures implemented through the CEMP will minimise the risk of any contaminated surface water runoff from the Site during the site preparation, earthworks and construction phase so that it does not have a detrimental effect on the receiving watercourse and the underlying aquifers. The surface water runoff will be controlled using appropriate drainage measures and segregating uncontaminated surface water from any potentially polluted waters, as well as impermeable surfacing to minimise infiltration into the ground where necessary. This will minimise the likelihood for potential contaminants to migrate to controlled waters.

12.5.12 If dewatering of the Site is required during the construction phase of the Proposed Development a permit from the Environment Agency to discharge to surface water or a consent to discharge to foul sewer will need to be obtained, and arrangements will need to be made to store any waters collected during dewatering to determine whether contamination is present before deciding on

where to discharge the waters. Dewatering of an excavation may be undertaken without a permit subject to complying with conditions set out in the Environment Agency Regulatory Position Statement 'Temporary dewatering from excavations to surface water' (2018).

12.5.13 A piled foundation is proposed for the Proposed Development. Therefore, a piling risk assessment will be undertaken in accordance with Environment Agency guidance. This will be used to establish the means of mitigating any risks of causing new pollutant linkages and/ or worsening existing ones with respect to risks to controlled waters at the construction stage of the Proposed Development.

12.5.14 The prevention of pollution of surface water and/ or groundwater will comply with the requirements set out by the Environment Agency within guidelines published at www.gov.uk/guidance/pollution-prevention-for-businesses.

Impact on Development Infrastructure

12.5.15 Materials used in infrastructure will be designed and specified taking due account of the aggressive ground conditions identified in the 2019 ground investigation (see Appendices 12B and 12C in ES Volume III, Document Ref. 6.4). The assessment methodology set out in BRE Special Digest 1 (2005) has been adopted to determine the appropriate concrete classification in relation to the protection of buried concrete against sulphate attack.

12.5.16 The Interpretive Ground Investigation Report (Appendix 12C in ES Volume III, Document Ref. 6.4) identifies the following Design Sulphate Class and ACEC Class by strata as follows:

- Made Ground – DS-1 AC-1;
- tidal flat deposits – DS-5 AC-5;
- glacial till – DS-3 AC-3; and
- chalk – DS-2 AC-2.

12.5.17 The design specification may include the import of engineered fill to improve the bearing capacity of the soil.

Operation Phase

Impact on Maintenance Workers

12.5.18 For maintenance workers during the operation phase, any maintenance works will be carried out in accordance with CIRIA (2015) C741 Environmental Good Practice on Site 4th Edition. Maintenance workers will be provided with appropriate PPE such as gloves and overalls to minimise direct contact with soils. Entry into excavations or confined spaces will comply with confined space legislation and assessed prior to entry. Should the detailed design of the Proposed Development incorporate any confined spaces such as ducts, manholes and inspection chambers, a gas monitoring programme and gas risk assessment will be undertaken in accordance with good practice guidance.

Impact on Off Site Receptors and Future Site Users

12.5.19 The risk to future Site users from direct contact with the underlying soils is considered very low. The Proposed Development will maintain an area of

hardstanding across the majority of the Main Development Area, which will break the potential contaminant linkage and therefore reduce the likelihood of contact further.

12.5.20 The risk to future Site users from direct contact with contaminated leachate or groundwater is considered low. It is considered the probability that future Site users will come into contact with contaminated leachate or groundwater at the site is unlikely due to the majority of the area being covered by hardstanding.

Impact on Controlled Waters

12.5.21 The Proposed Development will include activities that are likely to generate contaminants that could pose risks to controlled waters if not managed. In addition there is potential for environmental risks associated with spillages due to road accidents or faulty vehicles. To manage potential impacts on controlled waters during the operational stage of the Proposed Development, suitable drainage systems will be employed during construction and maintained during operation to prevent infiltration of surface water or potential contaminants into the ground during the operation phase. The operator of the Proposed Development will comply with the requirements of any permits and/ or will handle and store materials such as chemicals and fuels as recommended by the manufacturer.

Impact on Development Infrastructure

12.5.22 In order to mitigate potential risks to sub-surface concrete structures from aggressive ground conditions associated with the presence of sulphate, the following options will be considered on a case by case basis:

- the specification of materials to be used for the construction of the Proposed Development will be specific to the ground conditions into which they will be placed;
- the modification of concrete mix to resist sulphate attack;
- bitumen coating of sub-surface structures; and
- additional sacrificial thickness of sub-surface concrete.

12.5.23 The ground investigation will determine the suitable founding material which will be required across the Main Development Area. Any residual risks relating to soft ground will be addressed during the detailed design stage, taking into account the ground investigation results. The specification design will be determined using data from the recent ground investigation and chemical analysis of soil samples analysing the BRE Sulphate suite.

Decommissioning Phase (including demolition)

Impacts on Soil Resources

12.5.24 During the decommissioning phase of the Proposed Development the potential impacts on soil resources will be managed by minimising trafficking over topsoil.

Impacts on Human Receptors

12.5.25 The potential impacts specific to demolition workers during the decommissioning phase of the Proposed Development will be mitigated by adherence to the working practices in accordance with CIRIA (2015) C741 Environmental Good

Practice on Site 4th Edition (or the equivalent good practice guidance available at the time of decommissioning), including:

- measures to minimise dust generation;
- provision of PPE such as gloves, barrier cream, overalls etc. to minimise direct contact with soils;
- provision of adequate hygiene facilities and clean welfare facilities for all demolition workers;
- monitoring of confined spaces for potential ground gas accumulations, restricting access to confined spaces i.e. by suitably trained personnel, and use of specialist PPE, where necessary; and
- preparation and adoption of a site and task specific health and safety plan.

Impact on Controlled Waters

12.5.26 Mitigation measures similar to those employed for the construction phase of the Proposed Development will be implemented to minimise the risk of any contaminated surface water runoff from the Site during the decommissioning phase so that it does not have a detrimental effect on the receiving watercourse and the underlying aquifers. The surface water runoff will be controlled using appropriate drainage measures and segregating uncontaminated surface water from any process effluent streams, as well as impermeable surfacing to minimise infiltration into the ground. This will minimise the potential for potential contaminants to migrate to controlled waters.

12.5.27 If dewatering of the Site is required during the decommissioning phase of the Proposed Development this may be tankered offsite or a permit from the Environment Agency to discharge to surface water will need to be obtained, and arrangements will need to be made to store any waters collected during dewatering to determine whether contamination is present before deciding on where to discharge the waters. Dewatering of an excavation may be undertaken without a permit subject to complying with conditions set out in the Environment Agency Regulatory Position Statement 'Temporary dewatering from excavations to surface water' (2018).

12.6 Likely Impacts and Effects

12.6.1 The impacts and effects of the Proposed Development are described below.

Conceptual Site Model (CSM)

12.6.2 The CSM defines the plausible contaminant source, pathway and receptor linkages, which is integral to defining the baseline conditions. The CSM presents potential sources of contamination, potential receptors and potential sources of contamination migration pathways that have been identified for the Proposed Development.

12.6.3 The topography, geology, hydrogeology and hydrology of the Site are the main factors that influence the way in which potential contaminants in the soil or groundwater can be transported on or off Site, and the ways in which contamination can affect different receptors. Potential receptors are first

summarised in this section, and where applicable references are made to the other relevant chapters within the ES. Potential sources and pathways linking any sources to the defined receptors are then identified.

Table 12.9: Sources of potential contamination for the Main Development Area (including a 250 m buffer)

POTENTIAL SOURCE	POTENTIAL PATHWAY	POTENTIAL RECEPTOR
Diffuse metal, inorganic and organic contamination within the Made Ground at the Site and from off Site sources.	Ingestion of contaminated soil Inhalation/ ingestion of soil derived dust Inhalation of organic vapours. Direct contact with soils/ dusts	Future Site users Construction/ maintenance workers Development infrastructure Flora and fauna Off Site receptors
Asbestos containing materials (ACM) within the Made Ground (if present, although it is noted that none was identified by the ground investigation)	Inhalation of soil derived dust Direct contact with soils/ dusts	Future Site users Construction/ maintenance workers Off Site receptors
Generated leachate from Made Ground and spills/ leaks into natural ground	Leaching into groundwater and migration to surface watercourses Plant uptake	Surface watercourses Perched groundwater Off Site flora and fauna
Contaminants in groundwater (e.g. from on or off Site spills and leaks)	Migration and diffusion	Middle Drain and Oldfleet Drain Shallow groundwater (in Principal Aquifer)
Ground gases	Migration and diffusion via permeable strata	Future Site users Construction/ maintenance workers Flora and fauna Development infrastructure Off Site receptors

12.6.4 The assessment considers the potential impacts upon identified receptors prior to design and impact avoidance measures (initial classification). The residual effects when the embedded mitigation and good practice guidance as outlined in Section 12.5 are included are described in Section 12.9.

12.6.5 The following assessment is based on the methodology set out in Section 12.3. The assessment considers the impacts of the construction, operation (including maintenance) and decommissioning of the Proposed Development on identified receptors.

Construction Phase

Table 12.10: Summary of impacts and effects during construction phase (in the absence of development design and impact avoidance measures)

SOURCE	DESCRIPTION OF RESOURCE/ RECEPTOR AND IMPACT	SENSITIVITY/ IMPORTANCE OF RESOURCE/ RECEPTOR	MAGNITUDE OF IMPACT	INITIAL CLASSIFICATION OF EFFECT
Soil resource	Topsoil: loss/ deterioration of soil resource	Medium	Low	Minor adverse (not significant)
Made Ground and soil derived leachate	Construction workers: exposure to contaminants, dust and vapours	High	Very low	Minor adverse (not significant)
	Controlled waters (surface water): reduction in groundwater/ surface water quality due to uncontrolled release of pollutants	High	Low	Moderate adverse (significant)
	Controlled waters (groundwater): migration of contaminated water through preferential pathways (such as piling) to groundwater in underlying aquifer.	High	Low	Moderate adverse (significant)
	Development infrastructure: chemical attack on buried structures such as concrete; permeation of water pipes by contaminants.	Medium	Medium	Moderate adverse (significant)
	Off Site receptors: exposure to contaminants, dust and vapours.	Medium	Low	Minor adverse (not significant)
	Flora and fauna: migration of contaminants to ecological receptors	Medium	Medium	Moderate adverse (significant)

SOURCE	DESCRIPTION OF RESOURCE/ RECEPTOR AND IMPACT	SENSITIVITY/ IMPORTANCE OF RESOURCE/ RECEPTOR	MAGNITUDE OF IMPACT	INITIAL CLASSIFICATION OF EFFECT
Ground water	Controlled waters (surface water): migration to surface watercourses	High	Low	Moderate adverse (significant)
	Controlled waters: lateral migration through aquifer	High	Low	Moderate adverse (significant)
	Off Site receptors: migration of groundwater vapours	Medium	Low	Minor adverse (not significant)
Ground gas	Construction workers: accumulation of ground gas in confined spaces – asphyxiation and explosion risks	High	Medium	Majoradverse (significant)
	Development infrastructure: explosion risk	Medium	Low	Minor adverse (not significant)
	Off Site receptors: ground gas migration caused by ground disturbance during construction works	Medium	Low	Minor adverse (not significant)
Ground instability	Development infrastructure (e.g. settlement):	Medium	Low	Minor adverse (not significant)

Impacts on Soil Resources

12.6.6 During construction of the Proposed Development topsoil will be stripped and stored on Site. On completion of construction, stored topsoil will be re-used where possible in on Site landscaping. Any excess topsoil may need to be removed from Site for re-use elsewhere but it is expected that it will be retained and reused beneficially on Site.

12.6.7 The sensitivity of the soil on the Site is considered to be medium and the magnitude of the impact is considered to be low. The effect to soil resources is therefore considered to be minor adverse (not significant).

Impacts on Construction Workers

12.6.8 During the construction phase of the Proposed Development, the construction workers are potentially at risk of short term exposure to potential contaminants in Made Ground via dermal, inhalation and ingestion pathways. Asbestos could be encountered during the construction phase although none has been identified in previous ground investigations. Chemical testing of soils undertaken in the previous investigations (see Section 12.4 Baseline Conditions (Previous Ground Investigation)) indicated the presence of localised, trace concentrations of heavy fractions (C_{21} – C_{25}) aromatic and aliphatic TPH and PAH.

12.6.9 During the construction phase of the Proposed Development, the use of heavy equipment and activities such as excavation, backfilling and compaction may disturb the soil and mobilise potentially contaminated materials and asbestos containing materials if found to be present.

12.6.10 In addition construction workers may be exposed to ground gases when working in confined spaces from on-Site sources (e.g. Made Ground material) or via migration from off-Site sources.

12.6.11 The sensitivity of construction workers has been classed as high but as the magnitude of the impact is generally very low the effect on construction workers during the construction phase of the Proposed Development is considered to be minor adverse (not significant). Workers in confined spaces are at risk of asphyxiation and explosion due to accumulations of ground gas (if present). For workers in confined spaces the construction effect is major adverse (significant) without mitigation if ground gases are present.

Impacts on Controlled Waters

12.6.12 The groundwater underlying the Site is considered to be of high sensitivity. The superficial Tidal Flat Deposits are designated by the Environment Agency as an Unproductive Aquifer with the Flamborough Chalk designated as a Principal Aquifer. The Tidal Flat Deposits may provide some protection to the underlying Principal Aquifer, limiting migration of contaminants from the surface.

12.6.13 No groundwater abstractions have been identified within the Study Area and the Site is not located within a Groundwater Source Protection Zone.

12.6.14 Due to shallow groundwater depths recorded during the previous ground investigation in 2006, dewatering of excavations for the Proposed Development may be required during the construction phase. Storage and disposal of the water will comply with current regulations. The pre-construction ground

investigation in 2019 recorded groundwater levels at ground level to 3.62 m bgl. Two locations BH01 and BH02 within the chalk were noted as artesian. The shallow water levels indicate that dewatering will be required..

12.6.15 The main surface water features which may be impacted by the Proposed Development are:

- the Humber Estuary approximately 175 m east of the Proposed Development;
- drainage ditches around the majority of the perimeter of the Site;
- a new attenuation pond which will be constructed within the Main Development Area and a new ecological mitigation pond which will be constructed to the west of the SHBPS.

12.6.16 The sensitivity of surface water resources is classed as high and the magnitude is low. The sensitivity of groundwater resources is classed as high and the magnitude low. Therefore the effects on controlled waters during the construction phase of the Proposed Development are considered to be moderate adverse (significant) in relation to surface waters and groundwater, in the absence of mitigation measures.

Impacts on Development Infrastructure

12.6.17 Development and building infrastructure can be impacted upon by the ground conditions. Where adequate mitigation is not incorporated during the design and construction of a development, impacts could be realised during the operational phase.

12.6.18 The specification of materials to be used during construction of the Proposed Development are specific to the ground conditions into which they will be placed. For example, in the case of the Proposed Development, the results of the recent ground investigation suggest that there is potential for aggressive ground conditions to be present, which can cause damage to concrete. The ground gas monitoring recorded peak readings of carbon dioxide (21.6%/vol) and low levels of oxygen (0.1%/vol) which could present a risk of asphyxiation or explosion if allowed to accumulate in confined spaces without adequate mitigation. As such, appropriate mitigation will be incorporated during construction of the Proposed Development

12.6.19 The sensitivity of development infrastructure to the likely impacts has been classed as medium, with the magnitude being classed as low to medium. The effect on development infrastructure during the construction phase of the Proposed Development is considered to be minor adverse (not significant) to moderate adverse (significant), in the absence of mitigation measures.

Impacts on Off Site Receptors

12.6.20 The main off-Site human receptors are considered to be commercial/ industrial workers in the Study Area.

12.6.21 Workers and visitors to these areas are at risk from wind-blown dust and subsequent inhalation or direct contact with dusts of vapour generated by the construction activities associated with the Proposed Development.

12.6.22 The sensitivity of the receptors is medium and the magnitude of impact is low, and in the absence of mitigation measures, the effect on off Site receptors is considered to be minor adverse (not significant).

Impacts on Flora and Fauna

12.6.23 In the absence of mitigation, there is potential for impacts on flora and fauna in or adjacent to the Site due to uptake/ ingestion of water from the ground that is contaminated by spills/ leaks on Site or migration of contaminants from Made Ground. The sensitivity of receptors is low and the magnitude of impact is low, so the effect is considered to be negligible adverse (not significant) without mitigation.

Operation Phase

Table 12.11: Summary of impacts and effects during the operation phase (in the absence of development design and impact avoidance measures)

SOURCE	DESCRIPTION OF RESOURCE/ RECEPTOR AND IMPACT	SENSITIVITY/ IMPORTANCE OF RESOURCE/ RECEPTOR	MAGNITUDE OF IMPACT	INITIALCLASSIFICATION OF EFFECT
Made Ground and soil derived leachate	Future Site users (workers and visitors): exposure to contaminants, dust and vapours	Medium	Low	Minor adverse (not significant)
	Maintenance workers: exposure to contaminants, dust and vapours	High	Very low	Minor adverse (not significant)
	Controlled waters (surface water): reduction in groundwater/ surface water quality due to uncontrolled release of pollutants	High	Low	Moderate adverse (significant)
	Controlled waters (groundwater): migration of contaminated water through preferential pathways (such as piled foundations) to groundwater in underlying aquifer.	High	Low	Moderate adverse (significant)
	Development infrastructure: chemical attack on buried structures such as concrete; permeation of water pipes by contaminants	Low	Medium	Minoradverse (not significant)
	Off Site receptors: exposure to contaminants, dust and vapours	Medium	Very low	Negligible adverse (not significant)

SOURCE	DESCRIPTION OF RESOURCE/ RECEPTOR AND IMPACT	SENSITIVITY/ IMPORTANCE OF RESOURCE/ RECEPTOR	MAGNITUDE OF IMPACT	INITIALCLASSIFICATION OF EFFECT
	Flora and fauna: migration of contaminants to other ecological receptors	Low	Low	Negligible adverse (not significant)
Ground-water	Controlled waters (surface water): migration to surface watercourses	High	Low	Moderate adverse (significant)
	Controlled waters: lateral migration through aquifer	High	Low	Moderate adverse (significant)
	Off Site receptors: migration of groundwater vapours	Medium	Very low	Negligible adverse (not significant)
Ground gas	Future Site users (Site workers and visitors): Accumulations of ground gas in confined spaces	Medium	Very low	Negligible adverse (not significant)
	Development infrastructure: explosion risk	Low	Low	Negligible adverse (not significant)
	Off Site receptors: migration of ground gas	Medium	Very low	Negligible adverse (not significant)
Ground instability	Development infrastructure (e.g. settlement)	Medium	Medium	Moderate adverse (significant)

Impacts on Future Site Users

12.6.24 It is considered that there is the potential for ground contamination to occur during operation of the Proposed Development (due to leaks or spillages for example) and for ground gas to accumulate in confined spaces that could pose risk to future Site users during the operational phase.

12.6.25 The Main Development Area is proposed to be largely covered in one or more buildings and hardstanding, but areas of top-soiled landscaped land would be present around the margins of the Site.

12.6.26 Potentially hazardous materials (including those which represent a risk to controlled waters) will be stored in compliance with the requirements of any permits and/ or will handle and store such materials as recommended by the manufacturer.

12.6.27 Therefore, based on the proposed use of the Main Development Area the sensitivity of future Site users is classed as medium and the impacts are considered to have a low magnitude. The overall effect on future Site users during the operational phase of the Proposed Development is considered to be minor adverse (not significant) in relation to soil or groundwater contamination and ground gas.

Impacts on Future Maintenance Workers

12.6.28 Maintenance workers could be more directly exposed to soil or groundwater contaminants than future Site users (during excavation works for example). However, it is expected that the duration of exposure would be very short and that appropriate protective equipment and safe working procedures would be used.

12.6.29 Consequently the effect on maintenance workers during the operational phase of the Proposed Development is considered to be minor adverse (not significant).

Impacts on Controlled Waters

12.6.30 The Proposed Development will include activities during the operational phase that could generate contaminants that could pose risk to surface water (the Humber Estuary, drainage channels within the Site, and the proposed attenuation lagoon) and/ or groundwater. The Main Development Area will be largely covered in hardstanding with other areas of top-soiled landscaping which will reduce infiltration potential. In addition, the operator of the Proposed Development will comply with the requirements of any permits and/ or will handle and store materials such as chemicals and fuels as recommended by the manufacturer. However, there could be potential for environmental risks associated with spillages due to road accidents or faulty vehicles.

12.6.31 The sensitivity of controlled waters during the operational phase of the Proposed Development has been classed as high for surface water and groundwater. The magnitude of the impacts to controlled waters is classed as low. Therefore the effect on controlled waters during the operational phase of the Proposed Development is considered to be moderate adverse (significant) in relation to soil and groundwater contamination, in the absence of mitigation measures.

Impacts on Development Infrastructure

12.6.32 Materials such as concrete, metals and plastic will be employed during the construction of the Proposed Development. These materials could be used underground or above ground level. Development/ building infrastructure can be impacted where materials have been incorrectly specified at the design/ construction stage. Buried concrete could be exposed to chemical attack especially from acidity associated with the presence of sulphate and this could compromise the structural integrity of the underground structures.

12.6.33 The sensitivity of the development infrastructure is considered low to medium. The magnitude of impact prior to the implementation of the mitigation measures is considered to be medium to low.

12.6.34 Therefore, the effect on development infrastructure during the operational phase of the Proposed Development is considered to be minor adverse (not significant) in relation to soil or groundwater contamination, negligible adverse (not significant) in relation to ground gas, and moderate adverse (significant) in relation to ground instability in the absence of mitigation measures.

Impacts on Off Site Receptors

12.6.35 The Proposed Development could potentially include activities during the operational phase that are likely to impact off Site receptors, for example fuel/ chemical spillages that could run off and infiltrate into the ground and surface water.

12.6.36 The sensitivity of the off Site receptors is considered to be medium. The magnitude of impact prior to the implementation of the mitigation measures is considered to be very low. Therefore the effect on off Site receptors during the operational phase of the Proposed Development is considered to be negligible adverse (not significant) for commercial/ industrial workers and visitors to the Proposed Development in relation to migration of soil or groundwater contamination.

Impacts on Flora and Fauna

12.6.37 The Proposed Development includes areas of landscaping around the margins of the Site. Whilst Site operations are not anticipated to be undertaken in the areas of landscaping, spillages could potentially occur and runoff into the areas of soft landscaping or to surrounding habitats and infiltrate into the ground.

12.6.38 The sensitivity of the flora and fauna is considered to be low. The magnitude of impact prior to the implementation of the mitigation measures is considered to be low. Therefore the effect on flora and fauna during the operational phase of the Proposed Development is considered to be negligible adverse (not significant) in relation to soil contamination.

Decommissioning Phase

Table 12.12: Summary of impacts and effects during the decommissioning phase (in the absence of development design and impact avoidance measures)

SOURCE	DESCRIPTION OF RESOURCE/ RECEPTOR AND IMPACT	SENSITIVITY/ IMPORTANCE OF RESOURCE/ RECEPTOR	MAGNI-TUDE OF IMPACT	INITIAL CLASSIFI-CATION OF EFFECT
Made Ground and soil derived leachate	Demolition workers: exposure to contaminants, dust and vapours	High	Very low	Minor adverse (not significant)
	Controlled waters (surface water): reduction in groundwater/ surface water quality due to uncontrolled release of pollutants	High	Low	Moderate adverse (significant)
	Controlled waters (ground-water): migration of contaminated water through preferential pathways to groundwater in underlying aquifer	High	Very low	Minor adverse (not significant)
	Off Site receptors: exposure to contaminants, dust and vapours	Medium	Low	Minor adverse (not significant)
	Controlled waters (surface water): migration to surface watercourses	High	Low	Moderate adverse (significant)
Ground-water	Controlled waters: lateral migration through aquifer	High	Low	Moderate adverse (significant)
	Off Site receptors: migration of groundwater vapours	Medium	Low	Minor adverse (not significant)

SOURCE	DESCRIPTION OF RESOURCE/ RECEPTOR AND IMPACT	SENSITIVITY/ IMPORTANCE OF RESOURCE/ RECEPTOR	MAGNI-TUDE OF IMPACT	INITIAL CLASSIFI-CATION OF EFFECT
Ground gas	Off Site receptors: ground gas migration caused by ground disturbance during decommissioning works	Medium	Low	Minor adverse (not significant)

Impacts on Demolition Workers

12.6.39 During the decommissioning phase of the Proposed Development, the demolition workers are potentially at risk of short term acute exposure to potential contaminants in Made Ground via dermal, inhalation and ingestion pathways.

12.6.40 During the decommissioning phase of the Proposed Development, the use of heavy equipment and activities such as excavation, backfilling and compaction may disturb the soil and mobilise potentially contaminated materials if found to be present.

12.6.41 In addition demolition workers may be exposed to ground gases when decommissioning in confined spaces, from on Site sources (e.g. Made Ground material).

12.6.42 Whilst the sensitivity of construction workers has been classed as high, the magnitude of the impact is likely to be very low as mandatory PPE will be worn. Therefore, the effect on construction workers during the decommissioning phase of the Proposed Development is considered to be minor adverse (not significant).

Impacts on Controlled Waters

12.6.43 The groundwater underlying the Site is considered to be of high sensitivity. The superficial Tidal Flat Deposits are designated by the Environment Agency as an Unproductive Aquifer with the Flamborough Chalk designated as a Principal Aquifer. The Tidal Flat Deposits may provide some protection to the underlying Principal Aquifer, limiting migration of contaminants from the surface.

12.6.44 Should any dewatering of excavations for the Proposed Development be required during the decommissioning phase, storage and disposal of the water will comply with applicable regulations at that time.

12.6.45 The main surface water features which may be impacted by decommissioning of the Proposed Development are:

- the Humber Estuary approximately 175 m east of the Main Development area;
- drainage channels around the majority of the perimeter of the Site;
- the two surface water bodies within the Main Development Area (the new attenuation pond constructed within the Main Development Area and the new

ecological mitigation pond constructed to the west of the South Humber Bank Power Station).

12.6.46 The sensitivity of surface water resources is classed as high and the magnitude is low. The sensitivity of groundwater resources is classed as high and the magnitude very low to low. Therefore, in the absence of mitigation, during the decommissioning phase of the Proposed Development, the effects on controlled waters are considered to be moderate adverse (significant) in relation to surface waters and minor adverse (not significant) to moderate adverse (significant) in relation to groundwater.

Impacts on Off Site Receptors

12.6.47 The main off Site human receptors are considered to be commercial/ industrial workers in the Study Area.

12.6.48 Workers and visitors to these areas are at risk from wind-blown dust and subsequent inhalation or direct contact with dusts of vapour generated by the decommissioning activities.

12.6.49 The sensitivity of the receptors is medium and the magnitude of impact is low. Therefore, the effect on off Site receptors is considered to be minor adverse (not significant).

Comparison of Proposed Development and Consented Development

12.6.50 The impacts and effects of the Proposed Development compared to the impacts and effects of the Consented Development are described below.

Construction

12.6.51 The potential for impacts during the construction phase of the Proposed Development which include the discovery of contaminated groundwater and soils during groundworks, contamination risks to soils and groundwater from leaks and spills, airborne contamination (dusts) and risks from presence of ground gases are the same as for the Consented Development. No additional impacts over and above those already identified for the Consented Development have been identified for the Proposed Development.

12.6.52 This is because the Main Development Area boundary, the type of construction activities, and the nature and locations of receptors will be the same for the Consented Development and Proposed Development.

12.6.53 As such, the construction of the Proposed Development is predicted to have no impact compared to the construction of the Consented Development.

Operation

12.6.54 The is no difference between the methods or scale of operation of the Consented Development and the Proposed Development in terms of the risks of contamination, so no additional impacts have been identified associated with the operation of the Proposed Development compared the operation of the Consented Development. These include for example leaks, spills and contamination from storage of chemicals, fuels and wastes on site affecting future Site users and groundwater, and the presence of gases, vapours and groundwater in the ground potentially affecting future Site users and buildings.

12.6.55 The same appropriate management methods will be applied for both the Consented Development and the Proposed Development e.g. housekeeping and preventative maintenance practices, such as appropriate storage of potentially contaminating liquid, as required by the Environmental Permit.

12.6.56 As such, the operation of the Proposed Development is predicted to have no additional impact compared to the operation of the Consented Development.

Decommissioning

12.6.57 The nature and scale of decommissioning activities required for the Proposed Development would be the same as those required for the Consented Development, so the decommissioning of the Proposed Development is predicted to have no impact compared to the decommissioning of the Consented Development.

12.7 Mitigation and Enhancement Measures

12.7.1 Mitigation measures for geology, hydrogeology and land contamination required for the Proposed Development are described in Section 12.5 Development Design and Impact Avoidance. Residual effects after these measures are adopted are set out in Section 12.9.

12.8 Limitations or Difficulties

12.8.1 This chapter relies on the information contained in previous desk study (AECOM, 2018), the Site Protection and Monitoring Programme (SPMP) for South Humber Bank Power Station (RSK, 2007), the Site Protection and Monitoring Programme Review for South Humber Bank Power Station (Ford Consulting Group, 2011) and the results of the pre-construction ground investigation for the Main Development Area (Socotec, 2019 – see Appendices 12B and 12C in ES Volume III, Document Ref. 6.4).

12.8.2 The pre-construction ground investigation reports provide the results of groundwater level monitoring, but the final results of groundwater sampling were not available at the time of writing, so worst case assumptions have been made to ensure the assessment is robust.

12.9 Residual Effects and Conclusions

12.9.1 Tables 12.13, 12.14 and 12.15 provide a summary of residual effects for the construction, operational and decommissioning phases of the Proposed Development following the implementation of the design and impact avoidance measures set out in Section 12.5. No likely significant residual effects are anticipated as a result of the Proposed Development.

Table 12.13: Summary of residual effects during construction phase following adoption of mitigation/ impact avoidance measures

SOURCE	DESCRIPTION OF RESOURCE/ RECEPTOR AND IMPACT	SENSITIVITY/ IMPORTANCE OF RESOURCE/ RECEPTOR	MAGNITUDE OF IMPACT	INITIAL CLASSIFIC-ATION OF EFFECT	IMPACT AVOIDANCE MEASURES	RESIDUAL EFFECTS
Soil resource	Topsoil: loss/ deterioration of soil resource	Medium	Low	Minor adverse (not significant)	See Section 12.5	Minor adverse (not significant)
Made Ground and soil derived leachate	Construction workers: exposure to contaminants, dust and vapours	High	Very low	Minor adverse (not significant)	See Section 12.5	Negligible adverse (not significant)
	Controlled waters (surface water): reduction in groundwater/ surface water quality due to uncontrolled release of pollutants	High	Low	Moderate adverse (significant)	See Section 12.5	Negligible adverse (not significant)
	Controlled waters (groundwater): migration of contaminated water through preferential pathways (such as piling) to groundwater in underlying aquifer.	High	Low	Moderate adverse (significant)	See Section 12.5	Minor adverse (not significant)

SOURCE	DESCRIPTION OF RESOURCE/ RECEPTOR AND IMPACT	SENSITIVITY/ IMPORTANCE OF RESOURCE/ RECEPTOR	MAGNITUDE OF IMPACT	INITIAL CLASSIFIC-ATION OF EFFECT	IMPACT AVOIDANCE MEASURES	RESIDUAL EFFECTS
	Development infrastructure: chemical attack on buried structures such as concrete; permeation of water pipes by contaminants.	Medium	Medium	Moderate adverse (significant)	See Section 12.5	Minor adverse (not significant)
	Off Site receptors: exposure to contaminants, dust and vapours.	Medium	Low	Minor adverse (not significant)	See Section 12.5	Negligible adverse (not significant)
	Flora and fauna: migration of contaminants to ecological receptors	Medium	Medium	Moderate adverse (significant)	See Section 12.5	Negligible adverse (not significant)
Groundwater	Controlled waters (surface water): migration to surface watercourses	High	Low	Moderate adverse (significant)	See Section 12.5	Negligible adverse (not significant)
	Controlled waters: lateral migration through aquifer	High	Low	Moderate adverse (significant)	See Section 12.5	Minor adverse (not significant)

SOURCE	DESCRIPTION OF RESOURCE/ RECEPTOR AND IMPACT	SENSITIVITY/ IMPORTANCE OF RESOURCE/ RECEPTOR	MAGNITUDE OF IMPACT	INITIAL CLASSIFIC-ATION OF EFFECT	IMPACT AVOIDANCE MEASURES	RESIDUAL EFFECTS
	Off Site receptors: migration of groundwater vapours	Medium	Low	Minor adverse (not significant)	See Section 12.5	Negligible adverse (not significant)
Ground gas	Construction workers: accumulation of ground gas in confined spaces – asphyxiation and explosion risks	High	Medium	Major adverse (significant)	See Section 12.5	Negligible adverse (not significant)
	Development infrastructure: explosion risk	Medium	Low	Minor adverse (not significant)	See Section 12.5	Negligible adverse (not significant)
	Off Site receptors: ground gas migration caused by ground disturbance during construction works	Medium	Low	Minor adverse (not significant)	See Section 12.5	Negligible adverse (not significant)
Ground instability	Development infrastructure (e.g. settlement):	Medium	Low	Minor adverse (not significant)	See Section 12.5	Negligible adverse (not significant)

Table 12.14: Summary of residual effects during the operational phase following adoption of mitigation/ impact avoidance measures

SOURCE	DESCRIPTION OF RESOURCE / RECEPTOR AND IMPACT	SENSITIVITY/ IMPORTANCE OF RESOURCE/ RECEPTOR	MAGNITUDE OF IMPACT	INITIAL CLASSIFIC-ATION OF EFFECT	IMPACT AVOIDANCE MEASURES	RESIDUAL EFFECTS
Made Ground and soil derived leachate	Future Site users (workers and visitors): exposure to contaminants, dust and vapours	Medium	Low	Minor adverse (not significant)	See Section 12.5	Negligible adverse (not significant)
	Maintenance workers: exposure to contaminants, dust and vapours	High	Very low	Minor adverse (not significant)	See Section 12.5	Negligible adverse (not significant)
	Controlled waters (surface water): reduction in surface water quality due to uncontrolled release of pollutants	High	Low	Moderate adverse (significant)	See Section 12.5	Negligible adverse (not significant)
	Controlled waters (groundwater): migration of contaminated water through preferential pathways (such as piled foundations) to	High	Low	Moderate adverse (significant)	See Section 12.5	Minor adverse (not significant)

SOURCE	DESCRIPTION OF RESOURCE / RECEPTOR AND IMPACT	SENSITIVITY/ IMPORTANCE OF RESOURCE/ RECEPTOR	MAGNITUDE OF IMPACT	INITIAL CLASSIFIC-ATION OF EFFECT	IMPACT AVOIDANCE MEASURES	RESIDUAL EFFECTS
	groundwater in underlying aquifer.					
	Development infrastructure: chemical attack on buried structures such as concrete; permeation of water pipes by contaminants	Low	Medium	Minor adverse (not significant)	See Section 12.5	Negligible adverse (not significant)
	Off Site receptors: exposure to contaminants, dust and vapours	Medium	Very low	Negligible adverse (not significant)	See Section 12.5	Negligible adverse (not significant)
	Flora and fauna: migration of contaminants to other ecological receptors	Low	Low	Negligible adverse (not significant)	See Section 12.5	Negligible adverse (not significant)
Groundwater	Controlled waters (surface water): migration to surface watercourses	High	Low	Moderate adverse (significant)	See Section 12.5	Negligible adverse (not significant)
	Controlled waters: lateral migration through aquifer	High	Low	Moderate adverse (significant)	See Section 12.5	Minor adverse (not significant)

SOURCE	DESCRIPTION OF RESOURCE / RECEPTOR AND IMPACT	SENSITIVITY/ IMPORTANCE OF RESOURCE/ RECEPTOR	MAGNITUDE OF IMPACT	INITIAL CLASSIFIC-ATION OF EFFECT	IMPACT AVOIDANCE MEASURES	RESIDUAL EFFECTS
	Off Site receptors: migration of groundwater vapours	Medium	Very low	Negligible adverse (not significant)	See Section 12.5	Negligible adverse (not significant)
Ground gas	Future Site users (Site workers and visitors): accumulations of ground gas in confined spaces	Medium	Very low	Negligible adverse (not significant)	See Section 12.5	Negligible adverse (not significant)
	Development infrastructure: explosion risk	Low	Low	Negligible adverse (not significant)	See Section 12.5	Negligible adverse (not significant)
	Off Site receptors: migration of ground gas	Medium	Very low	Negligible adverse (not significant)	See Section 12.5	Negligible adverse (not significant)
Ground instability	Development infrastructure (e.g. settlement):	Medium	Medium	Moderate adverse (significant)	See Section 12.5	Negligible adverse (not significant)

Table 12.15: Summary of impacts and effects during the decommissioning phase following adoption of mitigation/ impact avoidance measures

SOURCE	DESCRIPTION OF RESOURCE / RECEPTOR AND IMPACT	SENSITVITY / IMPORTANCE OF RESOURCE RECEPTOR	MAGNITUDE OF IMPACT	INITIAL CLASSIFIC-ATION OF EFFECT	IMPACT AVOIDANCE MEASURES	RESIDUAL EFFECTS
Made Ground and soil derived leachate	Demolition workers: exposure to contaminants, dust and vapours	High	Very low	Minor adverse (not significant)	See Section 12.5	Negligible adverse (not significant)
	Controlled waters (surface water): reduction in ground water / surface water quality due to uncontrolled release of pollutants	High	Low	Moderate adverse (significant)	See Section 12.5	Negligible adverse (not significant)
	Controlled waters (groundwater): migration of contaminated water through preferential pathways to groundwater in underlying aquifer.	High	Very low	Minor adverse (not significant)	See Section 12.5	Negligible adverse (not significant)
	Off Site receptors: exposure to contaminants, dust and vapours.	Medium	Low	Minor adverse (not significant)	See Section 12.5	Negligible adverse (not significant)
	Controlled waters (surface water): migration to surface watercourses	High	Low	Moderate adverse (significant)	See Section 12.5	Negligible adverse (not significant)

SOURCE	DESCRIPTION OF RESOURCE / RECEPTOR AND IMPACT	SENSITVITY / IMPORTANCE OF RESOURCE RECEPTOR	MAGNITUDE OF IMPACT	INITIAL CLASSIFIC-ATION OF EFFECT	IMPACT AVOIDANCE MEASURES	RESIDUAL EFFECTS
Groundwater	Controlled waters: lateral migration through aquifer	High	Low	Moderate adverse (significant)	See Section 12.5	Negligible adverse (not significant)
	Off Site receptors: migration of groundwater vapours	Medium	Low	Minor adverse (not significant)	See Section 12.5	Negligible adverse (not significant)
Ground gas	Off Site receptors: ground gas migration caused by ground disturbance during de-commissioning works	Medium	Low	Minor adverse (not significant)	See Section 12.5	Negligible adverse (not significant)

12.10 References

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