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TABLES

13.0 GEOLOGY, HYDROGEOLOGY AND LAND CONTAMINATION

13.1 Introduction

13.1.1 This chapter of the Preliminary Environmental Information (PEI) Report addresses the potential effects of the construction, operation (including maintenance) and decommissioning of the Proposed Development on geology, hydrogeology and land contamination (considering effects to and from any existing contamination and also any potential to cause contamination). The assessment considers:

- the present-day and future baseline geological and hydrogeological conditions during construction and at opening;
- the likely nature and existing sources of contamination which may be present at the Proposed Development Site;
- the effects of construction and operation of the Proposed Development on geology, geo-environmental ground conditions and groundwater; and
- the potential effects of the eventual decommissioning of the Proposed Development.

13.1.2 This chapter is supported by **Appendix 13A:** Phase 1 Desk Based Assessment (PEI Report Volume II). It should be noted that given the considerable overlap between disciplines, some of the potential impacts and effects relating to hydrogeology are also addressed within **Chapter 12**: Water Resources and Flood Risk (PEI Report Volume I).

13.2 Legislation, Planning Policy and Guidance

13.2.1 This section outlines the planning policy of relevance to geology, hydrogeology and contaminated land. An overview of all relevant planning policy is provided in **Chapter 7:** Legislative Context and Planning Policy Framework, which also sets out the primacy of National Policy Statements (NPS) in decision-making on nationally significant infrastructure projects (NSIPs), such as the Proposed Development.

Legislation

13.2.2 The following key legislation (UK Acts/ Regulations) are of direct relevance to the assessment of effects of the Proposed Development on geo-environmental ground conditions:

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

13.2.3 Current legislation relating to contaminated land in the UK is contained within Part 2A of The Environmental Protection Act (EPA), which was inserted by s57 of the Environment Act 1995 and by s86 of the Water Act 2003 and elaborated upon within 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: causing significant harm, if there is a significant possibility of significant harm, or if a

site is causing, or could cause, significant pollution of controlled waters (i.e. both surface and groundwater).

The Water Act 2003

13.2.4 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 may be 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.

The Water Resources Act 1991

13.2.5 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 Building Act 1984 and the Building Regulations & c (Amendment) Regulations 2016

13.2.6 The Building Act 1984 and in particular the associated Building Regulations & c (Amendment) Regulations 2016 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. Notably, the Building Regulations & c (Amendment) Regulations 2016 also control ground gas mitigation which is a particularly pertinent consideration when considering land contamination.

Other relevant legislation

13.2.7 Other legislation (EU Directives, followed by UK Acts then Regulations) of reference to this topic, and not already outlined above, includes:

- The Water Framework Directive (2000/60/EC);
- The Groundwater Directive (2006/118/EC);
- The Environmental Quality Standards (EQS) Directive (2008/105/EC);
- The Environmental Liability Directive (2004/35/EC);
- The Environment Act 1995;
- The Town and Country Planning Act 1990;
- Environmental Permitting (England and Wales) Regulations 2016;
- Hazardous Waste (England and Wales) (Amendment) Regulations 2016;
- Contaminated Land (England) (Amendment) Regulations 2012;

- Environmental Damage (Prevention and Remediation) (England) Regulations 2015; and
- Anti-Pollution Works Regulations 1999.

Planning policy

13.2.8 The following planning policy and guidance documents are of direct relevance to the assessment of effects of the Proposed Development on geo-environmental ground conditions.

Overarching National Policy Statements for Energy (EN-1)

13.2.9 The primary basis for deciding whether or not to grant a Development Consent Order (DCO) is the National Policy Statement (NPS) for Energy (EN-1) (DECC, 2011a) which, at Part 5, sets out policies to guide how DCO applications will be decided and how the impacts of energy infrastructure should be considered.

Overarching National Policy Statement for Fossil Fuel Generating Infrastructure (EN-2)

13.2.10 NPS EN-2 (DECC, 2011b) on Fossil Fuel Electricity Generating Infrastructure (EN-2) states that where a project is likely to have *'effects on water quality or resources, the applicant for development consent should undertake an assessment which should particularly demonstrate that appropriate measures will be put in place to avoid or minimise adverse impacts of abstraction and discharge of cooling water. The applicant for development consent should demonstrate measures to minimise adverse impacts on water quality and resources'.* (paragraph 2.10.2)

13.2.11 Table 13.1 identifies the policies in NPS EN-1 and NPS EN-2 relevant to geology, hydrogeology and contaminated land, and where in this PEI chapter, information is provided to address the policies.

Table 13.1: Relevant NPS EN-1 policies for geology, hydrogeology and contaminated land assessment

Relevant NPS paragraph reference	Requirement of the NPS	Where in the PEI Chapter is information provided to address this policy
NPS EN-1		
5.3.3	Where the development is subject to Environmental Impact Assessment (EIA) the applicant should ensure that the Environmental Statement (ES) clearly sets out any effects on internationally, nationally and locally designated sites of … geological conservation importance...	13.4 – 'Local Geological Sites/ Regionally Important Geological Sites'

Relevant NPS paragraph reference	Requirement of the NPS	Where in the PEI Chapter is information provided to address this policy
5.3.4	The applicant should show how the project has taken advantage of opportunities to conserve and enhance … geological conservation interests.	13.4 – 'Local Geological Sites/ Regionally Important Geological Sites'
5.10.8	For developments on previously developed land, applicants should ensure that they have considered the risk posed by land contamination.	Notably 13.4 and 13.6 – 'Land contamination'
5.15.2	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.	Notably 13.4 and 13.6 and will be assessed further as a receptor to contamination in the ES chapter. See also **Chapter 12**: Water Resources and Flood Risk of this PEI Report
5.15.3	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); and • any impacts of the proposed project on water bodies or protected areas under the Water Framework Directive and source protection zones (SPZ) around potable groundwater abstractions.	Notably 13.4 and 13.6 and will be assessed further as a receptor to contamination in the ES chapter. See also **Chapter 12**: Water Resources and Flood Risk (PEI Report Volume I)

Relevant NPS paragraph reference	Requirement of the NPS	Where in the PEI Chapter is information provided to address this policy
NPS EN-2		
2.10.2	Effects on water quality or resources, the applicant for development consent should undertake an assessment which should particularly demonstrate that appropriate measures will be put in place to avoid or minimise adverse impacts of abstraction and discharge of cooling water. The applicant for development consent should demonstrate measures to minimise adverse impacts on water quality and resources.	See **Chapter 12**: Water Resources and Flood Risk (PEI Report Volume I)

National Planning Policy Framework

13.2.12 The latest version of the National Planning Policy Framework (NPPF) was adopted in February 2019 (Ministry of Housing, Communities and Local Government, 2019a). The policies contained within the NPPF are expanded upon and supported by the 'Planning Practice Guidance' (Ministry of Housing, Communities and Local Government, 2019b).

13.2.13 The NPPF sets out the Government's planning policies for England and how these are to be applied. It is a material consideration in planning decisions. The section of the NPPF that is of particular relevance relevant to the scope of the geology, hydrogeology and contaminated land chapter is Section 15 – Conserving and enhancing the natural environment. Table 13.2 identifies the NPPF policies relevant to geology, hydrogeology and contaminated land. However, parts of other sections may also be of relevance.

Table 13.2: Relevant NPPF policies for geology, hydrogeology and contaminated land assessment

Relevant NPPF paragraph reference	Requirement of the NPPF
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.

Relevant NPPF paragraph reference	Requirement of the NPPF
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.
170 a)	Planning policies and decisions should contribute to and enhance the natural and 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).
170 e)	Planning policies and decisions should contribute to and enhance the natural and local environment by: • preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans.
170 f)	Planning policies and decisions should contribute to and enhance the natural and local environment by: • remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.
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.
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).
178 b)	Planning policies and decisions should ensure that: after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part 2A of the Environmental Protection Act 1990.
178 c)	Planning policies and decisions should ensure that: adequate site investigation information, prepared by a competent person, is available to inform these assessments.

Relevant NPPF paragraph reference	Requirement of the NPPF
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.
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, 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.
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.

Local planning policy

13.2.14 Other relevant policies and guidance have been considered as part of the geology, hydrogeology and land contamination chapter where these have informed the identification of receptors and resources and their sensitivity; the potential for significant environmental effects; and required mitigation. These policies include:

- North Lincolnshire Core Strategy (North Lincolnshire Council, 2011a) - adopted June 2011 (Chapter 11, Environment and Resources); and
- Saved Policies of North Lincolnshire Local Plan (Local Development Frameworks Government Office for Yorkshire and The Humber, 2007) - adopted May 2003, saved September 2007 (C1 - Special Protection Areas, Special Areas of Conservation and Ramsar Sites, LC2 - Sites of Special Scientific Interest and National Nature Reserves, DS7 - Contaminated Land, DS13 - Groundwater Protection and Land Drainage and DS15 - Water Resources).

13.2.15 North Lincolnshire Council is preparing a new Local Plan to 2036. Once agreed (formally adopted), it will replace the current North Lincolnshire Local Plan and the Core Strategy. The Council undertook their Regulation 18 ‘Preferred Options’ between February and March 2020.

Guidance/ best practice

13.2.16 The following includes a non-exhaustive list of additional guidance considered pertinent and applicable to the geology, hydrogeology and land contamination topic:

- BS 10175 (2011 +A2 2017), Investigation of Potentially Contaminated Sites - Code of Practice;
- BS 8576 (2013), Guidance on investigations for ground gas. Permanent gases and Volatile Organic Compounds (VOCs);
- BS 8485 (2019), Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings;
- CIRIA C665, assessing risks posed by hazardous ground gases to buildings, 2007;
- CIRIA C552 Contaminated Land Risk Assessment: A Guide to Good Practice, 2001;
- CIRIA C692 3rd Edition 'Environmental Good Practice on Site' 2010;
- Environment Agency's recently published revised online guidance for the management of land contamination 'Land contamination: risk management (LCRM)'; and
- Guidance for the Safe Development of Housing on Land Affected by Contamination, R&D Publication 66, 2008.

13.3 Assessment Methodology

Consultation

13.3.1 The consultation undertaken with statutory consultees to inform this chapter, including a summary of comments raised *via* the formal scoping opinion (**Appendix 1B** of PEI Report Volume II) is summarised in Table 13.3.

Table 13.3: Consultation summary table

Consultee approached	Date, method and nature of consultation	Summary of response
Natural England	Query (via email) sent on 22 July requesting information on: • Designated Local Geological Sites (LGS)/ Regionally Important Geological Sites (RIGS); or contacts for Local Geology Groups (LGG) – up to 250m from the Proposed Development Site.	Email received on 31 July advising that Natural England does not hold the required information.
Greater Lincolnshire Nature Partnership	Query (via email) sent on 22 July requesting information on: • Designated LGS/ RIGS; or contacts for LGG – up to 250m from the Proposed Development Site.	Email received on 22 July indicating that no such sites were identified.

Consultee approached	Date, method and nature of consultation	Summary of response
North Lincolnshire Council – Ecology	Query (via email) sent on 5 August requesting information on: • Designated LGS/ RIGS; or contacts for LGG – up to 250m from the Proposed Development Site.	Email received on 5 August advising a search through Greater Lincolnshire Nature Partnership (see above).
North Lincolnshire Council – Environmental Protection	Query (via email) sent on 5 August requesting information on: • Landfills – up to 250m from the Proposed Development Site; • Ground investigation reports – up to 50m from the Proposed Development Site; and • Potential or known contaminated land/ known or potential Part 2A sites – up to 250m from the Proposed Development Site.	No response received yet.
North Lincolnshire Council – Spatial Planning	Query (via email) sent on 5 August requesting information on: • Mineral Safeguarding Areas (MSA)/ Mineral Consultation Areas (MCA)/ designated or safeguarded sites – up to 250m from the Proposed Development Site; and • Mining/ quarrying – up to 250m from the Proposed Development Site.	Email received on 5 August indicating that no such constraints were identified.
North Lincolnshire Council	Query (via email) sent on 20 July requesting information on: • Private Water Supplies and whether they are a surface or groundwater source – 1km from the Proposed Development Site.	No response received yet.
Environment Agency	Query (via email) sent on 5 August requesting information on: • Landfills – up to 250m from the Proposed Development Site; • Ground investigation reports – up to 50m from the Proposed Development Site; • Potential or known contaminated land/ known or potential Part 2A sites – up to 250m from the Proposed Development Site;	Email received on 19th August confirming that no licensed landfills are located within 250m of the Proposed Development Site and that eight historical landfills are located within 250m of the Proposed Development Site, additional

Consultee approached	Date, method and nature of consultation	Summary of response
	• Designated LGS/ RIGS; or contacts for LGG – up to 250m from the Proposed Development Site; • MSA/ MCA/ designated or safeguarded sites – up to 250m from the Proposed Development Site; and • Mining/ quarrying – up to 250m from the Proposed Development Site.	information has been included in Table 13.11. No other constraints were identified.
Environment Agency	Query (via email) sent on 20 July requesting information on: • Active abstraction licences (groundwater and surface water) including location (NGR), user, and purpose – 1km from the Proposed Development Site; • Active water activity permits (i.e. formerly discharge consents) including location (NGR) and effluent type – 1km from the Proposed Development Site; • Any Category 3 or worse water pollution incidents within the past 5 years as recorded on NIRS (including location (NGR), pollution source, category and affected water body) – 1km from the Proposed Development Site; • Aquifer status and groundwater levels – 1km from the Proposed Development Site; and • Comments on any issues of concern regarding water resources, both surface and groundwater, in the study area – 1km from the Proposed Development Site.	Email received on 18th August 2020. This information has been included where relevant, throughout this PEI chapter.

Assessment methods

Geology and hydrogeology

13.3.2 Geological and hydrogeological conditions at the Proposed Development Site are summarised in **Section 13.4** and will be assessed in the ES, where applicable, as potential receptors to land contamination.

13.3.3 The resource value of groundwater is addressed within **Chapter 12**: Water Resources and Flood Risk (PEI Report Volume I).

Land contamination

13.3.4 For this PEI chapter, areas of potential contamination have been identified within the study area of the Proposed Development Site.

13.3.5 In line with the Environment Agency's LCRM, the assessment of land contamination will take the form of a tiered, risk-based approach, as summarised below:

- Tier 1: qualitative risk assessment based on a desk top study of available information to identify potential sources of contamination, receptors to contamination and potential pathways between them. The identified sources, pathways and receptors are presented in the form of a Conceptual Site Model (CSM) showing the potential contaminant linkages (PCL);
- Tier 2: If PCL are identified, this means there is a theoretical risk to receptors from contamination and intrusive investigation should be used to provide data to inform a generic quantitative risk assessment (GQRA). The GQRA involves comparison of site-specific, laboratory analytical data against appropriate generic assessment criteria (GAC) for human health and/ or controlled waters which represent minimal or tolerable risk; and
- Tier 3: detailed quantitative risk assessment to identify whether contamination identified above minimal or tolerable risk levels represents an unacceptable risk and therefore requires remediation.

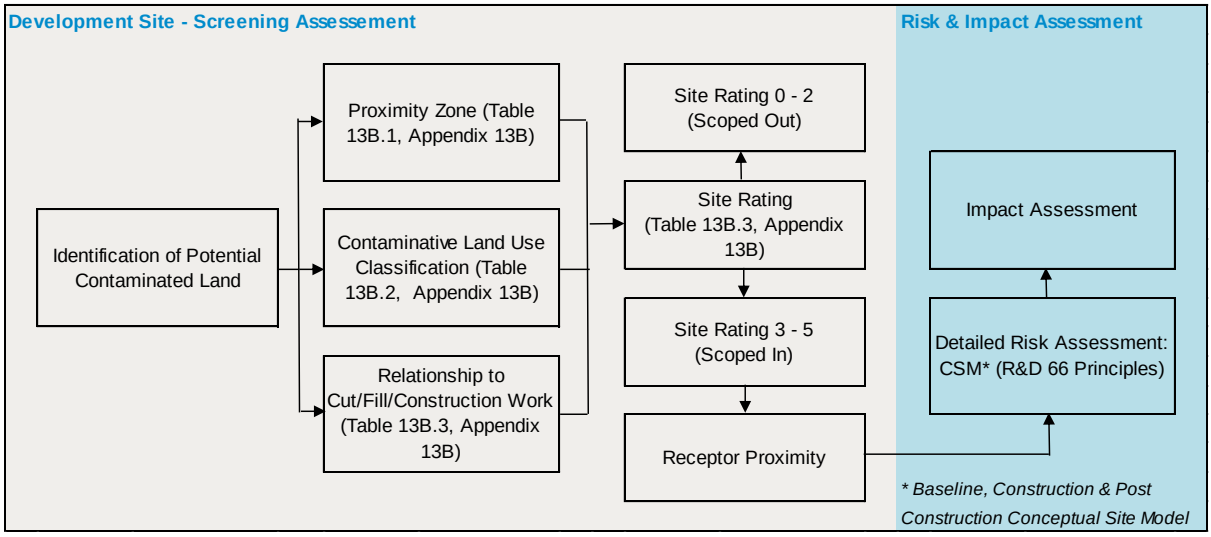
Screening assessment (undertaken as part of Tier 1)

13.3.6 A qualitative assessment of the risks posed by land contamination within the study area has been undertaken as part of this PEI chapter by first assigning a 'site rating' to each identified historical or current area of potential land contamination identified in the baseline review. The site rating has been determined using the tables provided in **Appendix 13B** (PEI Report Volume II). The site rating is based partly on the relationship between the identified area of potential land contamination and its proximity to the Proposed Development Site (**Appendix 13B**, Table 13B.1, PEI Report Volume II) together with the proposed cut/ fill of the Proposed Development design at its closest point (**Appendix 13B,** Table 13B.3, PEI Report Volume II). The site rating also considers the nature of the current and/ or historical land use, as certain land uses typically result in a greater potential for contamination of the ground to have occurred (**Appendix 13B**, Table 13B.2, PEI Report Volume II). The lower the site rating then the lower the perceived level of risk.

13.3.7 Professional judgement has been applied in reviewing the generated site ratings. Generally, site ratings of two or less are considered not to pose a significant risk and will not be considered for further assessment. Site ratings of three or more will be considered for further risk and impact assessment as described below. The further risk and impact assessment will be undertaken as part of the ES chapter for Geology, Hydrogeology and Land Contamination, following submission of this PEI Report.

13.3.8 A flow chart summarising the screening, risk and impact assessment steps is presented in **Figure 13.1**.

Figure 13.1: Land contamination assessment flow chart



Risk and impact assessment

13.3.9 The approach to assessing the potential impacts of the Proposed Development will be undertaken in the ES by comparing the risk levels at baseline with the CSM and the risk levels for the construction and post-construction stages respectively, to determine any change in risk at each stage.

13.3.10 Potential risks will be determined and assessed based on the likelihood (or probability) and consequence using the principles given in the Section 6.3 of CIRIA C552, 2001. This provides guidance on development and application of the consequence and probability matrix to risk assessment and broad definitions of consequence. The risk matrix is presented in Table 13.4.

Table 13.4: Estimation level of risk

Probability	Consequence			
	Severe	Medium	Mild	Minor
High likelihood	Very high risk	High risk	Moderate risk	Low risk
Likely	High risk	Moderate risk	Moderate/low risk	Low risk
Low likelihood	Moderate risk	Moderate/low risk	Low risk	Very low risk
Unlikely	Moderate/low risk	Low risk	Very low risk	Very low risk

13.3.11 The significance of the effects of land contamination has been assessed by comparing the difference in risk for each contaminant linkage at baseline to those at construction and at post construction stages. Where there is shown to be a decrease in contamination risk the Proposed Development is assessed as having a beneficial effect on the environment in the long term.

13.3.12 The definitions of the significance criteria used are presented in Table 13.5 below. This provides details of how increases and decreases in the contamination risks identified are related to the significance criteria adopted. Potential effects that are determined as being moderate or major are classed as 'significant' effects. Where an effect has been anticipated to be neutral or minor, these effects are classed as 'not significant'. Predicted effects of minor or neutral/ negligible significance are acceptable and do not require further consideration. It is only predicted effects of moderate or high that require a more detailed assessment. A full assessment of the potential impacts of the Proposed Development will be undertaken in the ES (see Section 13.3.9). However, as part of this PEI chapter, some anticipated effects have been predicted; these are covered in Section 13.6.

Table 13.5: Significance criteria

Significance Criteria	Definition
Major adverse effect	An increase in contamination risk of 4 or 5 risk levels in the risk matrix, e.g. from land that has a very low contamination risk in the baseline becomes a high or very high risk.
Moderate adverse effect	An increase in contamination risk of 2 or 3 risk levels in the risk matrix, e.g. land that has a low contamination risk in the baseline becomes a moderate or high risk.
Minor adverse effect	An increase in contamination risk of 1 risk level in the risk matrix, e.g. land that has a low contamination risk in the baseline becomes a moderate/low risk.
Neutral effect	No change in contaminated land risks.
Minor beneficial effect	A reduction in contamination risk of 1 risk level in the risk matrix, e.g. land that has a moderate/low contamination risk in the baseline becomes a low risk.
Moderate beneficial effect	A reduction in contamination risk of 2 or 3 risk levels in the risk matrix, e.g. land that has a high contamination risk in the baseline becomes a moderate/low or low risk.
Major beneficial effect	A reduction in contamination risk of 4 or 5 risk levels in the risk matrix, e.g. land that has a very high contamination risk in the baseline becomes a low or very low risk.

Study area

13.3.13 For the purposes of determining the local baseline conditions with respect to geology and land contamination, a study area that extends 250m from the boundary of the

Proposed Development Site[1] is adopted (see **Figure 13.1, PEI Report Volume III**). This is extended for hydrogeology to 1km from the boundary of the Proposed Development Site. This is appropriate to assess the local geological and hydrogeological setting and any influence that potential land contamination might have on the Proposed Development or local receptors. However, the baseline conditions in terms of soil chemical quality, where available, will be based on information directly within the Proposed Development Site only.

Data sources

13.3.14 This PEI Report chapter draws on information from a combination of the following sources:

- historical mapping included as part of a professional Envirocheck Report provided by the Landmark Information Group (April 2020) (see **Appendix 13A**: Phase 1 Desk Based Assessment (**Annex B**) (PEI Report Volume II));
- Envirocheck (in GIS data format – April 2020);
- British Geological Survey (BGS) Geological Mapping and Memoirs;
- Environment Agency website;
- BGS website;
- Cranfield Soil and AgriFood Institute (CSAI) Soilscapes website;
- stakeholder consultation; and
- Department for Environment Food and Rural Affairs (DEFRA) Multi Agency Geographic Information for the Countryside (MAGIC) website.

Use of Rochdale Envelope

13.3.15 Each of the operational modes of the Proposed Development (baseload mode or dispatchable mode) may produce slightly different impacts in terms of height and massing of structures, emissions to air, discharges to water and generation of waste. This PEI Report and the ES undertaken to support the application for development consent will assess the worst-case for each environmental effect utilising the Rochdale Envelope approach (outlined in PINS Advice Note 9: Using the Rochdale Envelope (Planning Inspectorate, 2018)) to define an overall consenting envelope that encompasses the worst-case emissions and maximum extent of the physical infrastructure and considering the different potential modes of operation.

[1] It should be noted that for the purposes of defining the Proposed Development Site and the associated study area, the proposed access road from the A18 and the potential laydown options in adjacent agricultural fields have not been included at this stage, as they are subject to ongoing feasibility assessment. These areas will be included as part of the ES and additional Envirocheck data and historical Ordnance Survey mapping will be sourced for these areas, if included at that stage.

13.4 Baseline Conditions

13.4.1 This section presents the baseline conditions for geology and soils. It also considers potential receptors that could be impacted upon by any existing or resulting ground contamination. There is therefore reference made to surface water, groundwater and ecological features in this section which are discussed in more detail in **Chapter 11:** Biodiversity and Nature Conservation and **Chapter 12**: Water Resources and Flood Risk (PEI Report Volume I).

Soils classification

13.4.2 Information obtained from CSAI (2020) describes the soils on the Proposed Development Site to be loamy and clayey soils of coastal flats with naturally high groundwater (Soilscape identification description number 21). Land within this soil type is described as generally draining to local groundwater and mostly drained. Shallow groundwater and marginal ditches to most fields mean that the water resource is vulnerable to pollution from nutrients, pesticides and wastes that may be applied to the land.

Geology

13.4.3 The BGS Geoindex website and published 1:50,000 scale geological maps of the area (Sheet 88, Doncaster and Sheet 79, Goole) have been reviewed, alongside selected historical BGS borehole records available from the Proposed PCC Site and historical ground investigations (summarised in **Appendix 13A:** Phase 1 Desk Based Assessment (Annex B) (PEI Report Volume II)). These records indicate that the Proposed Development Site is underlain by the geological succession summarised in Table 13.6.

Table 13.6: Geological succession from published mapping and on-site BGS logs

Geological stratum	Location	Anticipated thickness	Description
Made Ground	Although not mapped at the site, Made Ground is expected across the Proposed Development Site given the historical site use.	Up to 2m	Artificial deposits on the natural ground's surface.
Warp (artificially induced Alluvium)	Across the majority of the Proposed Development Site and the study area.	12 – 17m	Clay and silt
Cohesive Alluvium	Eastern extent of the Proposed Development Site and study area.		Normally soft to firm consolidated, compressible silty clay, but can contain layers of silt, sand, peat and basal gravel.

Geological stratum	Location	Anticipated thickness	Description
Granular Alluvium	Beneath the Cohesive Alluvium.		Sands, silts and clays, with occasional peat layers (peat layers recorded between 0.45m and 1.6m thickness). Sands sometimes described as '*blown sands*'[1].
Mercia Mudstone Group (bedrock)	Across the Proposed Development Site and study area, beneath the superficial deposits.	Up to 200m	Dominantly red, less commonly green-grey, mudstones and subordinate siltstones with thick halite-bearing units in some basinal areas. Thin beds of gypsum/ anhydrite widespread; sandstones are also present.

[1] *Blown sand; defined by BGS as sand that has been transported by wind, or sand consisting predominantly of wind-borne particles*

Soil chemistry

13.4.4 The BGS Soil Chemistry datasets detail the topsoil concentrations of five potentially harmful elements (PHE): arsenic (As), cadmium (Cd), copper (Cu), nickel (Ni) and lead (Pb). Elevated concentrations of these PHE can exist because of natural geological conditions or possible anthropogenic sources. The estimated soil chemistry levels attributed to the Proposed Development Site are set out in Table 13.7.

Table 13.7: Estimated soil chemistry

Potentially Harmful Element	Estimated geometric mean concentration range within the Proposed Development Site boundary (mg/kg)
Arsenic	14.1 – 18.9
Cadmium	South-western area of the site – 0.49 – 0.85 Remainder of the site – <0.33
Copper	15.4 – 35.0
Lead	47.1 – 242
Nickel	23.5 – 31.9

Hydrogeology

Aquifer classification

13.4.5 The Environment Agency's Groundwater Protection Policy (Environment Agency, 2018) adopts aquifer designations that are consistent with the Water Framework Directive (Water Framework Directive 2000/60/EC).

13.4.6 The superficial geology (Alluvium/ Warp) is classified as a Secondary A aquifer. These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. Based on the Water Framework Directive this groundwater body currently is at "Poor Overall Status" (quality) due to the "Chemical Dependent Surface Water Body Status" parameter. Further details are provided in **Chapter 12**: Water Resources and Flood Risk (PEI Report Volume I) (Section 12.4.10).

13.4.7 The bedrock geology (Mercia Mudstone Formation) is classified as a Secondary B aquifer. These are predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers. Based on the Water Framework Directive this groundwater body currently is at "Good Overall Status" (quality). Further details are provided in **Chapter 12**: Water Resources and Flood Risk (PEI Report Volume I) (Section 12.4.10).

Groundwater vulnerability

13.4.8 The Environment Agency's simplified Groundwater Vulnerability Map (Environment Agency, 2017) shows that the Proposed Development Site is located in an area where the groundwater vulnerability to pollution is classified as medium-high. These are high priority groundwater resources that have limited natural protection. These areas are likely to be characterised by generally high leaching soils. This results in a medium-high overall pollution risk to groundwater from surface activities. Activities in these areas may require additional measures over and above good practice to ensure they do not cause groundwater pollution.

Groundwater Source Protection Zones

13.4.9 The Proposed Development Site does not lie within a SPZ. There are no SPZ within 1km of the Proposed Development Site.

Groundwater abstractions

13.4.10 According to the Envirocheck Report (see **Appendix 13A:** Phase 1 Desk Based Assessment (Annex B) (PEI Report Volume II), there is one licenced groundwater abstraction recorded within the Proposed Development Site and none within the extended 1km study area for groundwater abstractions. This abstraction point is indicated to be within the footprint of the existing Keadby Power Station (National Grid Reference 482619, 411656). It has multiple variations to the licence, with the most recent licensed to '*Siemens Public Limited Company*' (Md/028/0083/040). The abstraction is listed as being for '*industrial/commercial/public services/dewatering*'.

13.4.11 Engagement is ongoing with relevant stakeholders, principally the Environment Agency and local authority to obtain records of any further private abstractions within a 1km radius of the Proposed Development Site; this is discussed further in **Chapter 12:** Water Resources and Flood Risk (PEI Report Volume I). A contemporaneous review of private abstractions will be provided in the ES.

Groundwater levels

13.4.12 Groundwater levels within the historical borehole records reviewed indicate generally shallow groundwater levels within the superficial geology of between 0.9m - 3.0m below ground level (bgl). Occasionally, deeper groundwater strikes were recorded between 5.4m - 6.9m bgl. There is insufficient information to conclude at this stage whether these levels are representative of true groundwater levels across the wider area. The Environment Agency do not hold any groundwater level monitoring data within a 1km radius from the Proposed Development Site boundary.

Hydrology

Surface watercourses and drainage

13.4.13 There are numerous surface water features located within the Proposed Development Site and wider study area. These are detailed, along with river quality information (where available) in Table 13.8.

Table 13.8: Surface water features

Surface water feature name	Location	River Quality Information
Various unnamed drains	Located on-site and within the study area; various directions.	Not available.
River Trent (tidal river) (Humber Upper)	Overlaps slightly onto the eastern spurs of the Proposed Development Site; north-south direction.	Reach: A631 Gainsborough To Keadby River Quality C Flow greater than 80 cumecs Year: 2000
Paupers Drain (includes Warping Drain and Eastoft Moors Drain)[2] / Eastoft Moors (Warping) Drain (inland river)[3]	Overlaps slightly onto the north-eastern spur of the Proposed Development Site; west-east direction.	Reach: Track Bridge to Confluence of River Trent River Quality D Flow less than 0.31 cumecs Year: 2000

[2] Source, Water Framework Directive (WFD)
[3] Source, Envirocheck data

Surface water feature name	Location	River Quality Information
Sewer Drain (drain)	Overlaps slightly onto the north-eastern spur of the Proposed Development Site; west-east direction.	Not available.
North Soak Drain (inland river)	Overlaps slightly onto the southern boundary of the Proposed Development Site; west-east direction.	Reach: Medge Hall To Confluence of South Soak Drain River Quality E Flow less than 0.31 cumecs Year: 2000
Sheffield and South Yorkshire Navigation/ Stainforth and Keadby Canal (canal)	Overlaps slightly onto the southern boundary of the Proposed Development Site; west-east direction.	Reach: Thorne Lock to Trent River Quality C Flow greater than 80 cumecs Year: 2000 Reach: River Don Navigation to Thorne Lock River Quality Chemistry General Quality Assessment (GQA) Grade A - Very Good Year: 2009 Reach: Thorne Lock to Trent River Quality Chemistry GQA Grade A - Very Good Year: 2009
South Soak Drain (inland river)	Crossed by the Construction and Operational Access Route at its closest point; west-east direction.	Reach: Moors Bridge to Confluence of Three Rivers River Quality D Flow less than 0.31 cumecs Year: 2000

Surface water feature name	Location	River Quality Information
Torne/Three Rivers (includes South Engine Drain and Folly Drain)[4] / Three Rivers (inland river)[5]	100m south of the Waterborne Transport Off-loading Area at its closest point; south-west to north-east direction	Reach: Pilfrey Bridge to Keadby Pumping Station River Quality C Flow less than 1.25 cumecs Year: 2000 Reach: Pilfrey Bridge to Keadby Pumping Station River Quality Chemistry GQA Grade D - Fair Year: 2009

13.4.14 Further information on the quality and status of relevant watercourses can be found in **Chapter 12**: Water Resources and Flood Risk (PEI Report Volume I) and **Appendix 12B**: Water Framework Directive Screening Assessment (PEI Report Volume II).

Surface water abstractions

13.4.15 Eight surface water abstractions have been identified within 250m of the Proposed Development site. These are listed in Table 13.9.

Table 13.9: Environment Agency licensed surface water abstractions

National Grid Reference	Approximate distance	Licence number and operator*	Use
483540, 411640	On the Proposed Development Site, located on the eastern extent of the eastern spur	03/28/85/0007 Keadby Generation Ltd Includes two variations of the licence.	Production of energy: boiler feed; and Non-evaporative cooling
481780, 412230	23m north-west	03/28/84/0008 Mr W Foster-Thornton	General agriculture: spray irrigation - direct
482790, 411490	10m east of the Canal Water Abstraction Option	03/28/83/0171 Canal and River Trust/ British Waterways	Production of energy: boiler feed

[4] Source, WFD
[5] Source, Envirocheck data

National Grid Reference	Approximate distance	Licence number and operator*	Use
482790, 411490	10m east of the Canal Water Abstraction Option	Md/028/0083/014 Canal and River Trust	Mechanical non-electrical; evaporative cooling
481800, 411400	160m south of the Construction and Operational Access Route	03/28/83/0094 J A Chapman Farms	General agriculture: spray irrigation - direct
483700, 411795	190m east	03/28/85/0006/1 Holly Hall Farms Ltd	Spray irrigation
483700, 411795	190m east	03/28/85/0010 T F Belton Limited	General agriculture: spray irrigation - direct
483171, 412204	230m north	Md/028/0084/005 RJ & AE Godfrey	General agriculture: spray irrigation - direct

**Permit end dates for these abstractions are specified as 'not supplied', and therefore all are assumed to be active abstractions.*

Nitrate vulnerable zones

13.4.16 The Proposed Development Site and the study area are located within a nitrate vulnerable zone – surface water. Designations of nitrate vulnerable zones occur where land drains contribute to nitrate concentrations found in polluted water. Polluted waters include:

- surface waters that contain at least 50 mg/l of nitrate;
- surface waters that are likely to contain at least 50 mg/l of nitrate if no action is taken; and
- waters which are eutrophic, or are likely to become eutrophic, if no action is taken.

Drinking Water Protected Areas

13.4.17 The Proposed Development Site and the study area are not located within a Drinking Water Protected Area (surface water).

Mining and mineral resources

13.4.18 The adopted 2003 Local North Lincolnshire Plan does not refer to any MSA or MCA in the study area. The 2003 Local North Lincolnshire Plan is due to be replaced by the North Lincolnshire Local Plan which will run to 2037. This is currently at Preferred Options Consultation stage. Furthermore, local authority consultation carried out confirms no MSA or MCA at, or in the study area of the Proposed Development Site. Therefore, these features are scoped out of the assessment.

13.4.19 Based on available data and local authority consultation carried out there are no records of aggregate/ mineral quarrying or mining, non-coal mining or coal mining at or in the study area of the Proposed Development Site. Therefore, these features are scoped out of the assessment.

Local Geological Sites/ Regionally Important Geological Sites

13.4.20 Based on available data and consultation carried out with the local authority, Greater Lincolnshire Nature Partnership and Natural England, there are no records of LGS or RIGS at or in the study area of the Proposed Development Site. Therefore, these features are scoped out of the assessment.

Land contamination

Regulated processes and pollution incidents

13.4.21 Information on regulated processes and pollution incidents has been collated from Environment Agency and Local Authority datasets within the Landmark Information Group GIS data presented in **Appendix 13A**: Phase 1 Desk Based Assessment (Section 5) (PEI Report Volume II). Recorded pollution incidents can indicate a potential for land contamination, whilst regulated processes provide a good indicator as to the nature of the processes undertaken at a site, which whilst regulated may nonetheless have, over time, resulted in the potential for some residual land contamination. Key information is summarised as follows:

- Integrated Pollution Controls – 12 no. located within the Proposed Development Site. All named under 'Keadby Generation Limited' and concern combustion processes within the Fuel & Power Industry;
- Integrated Pollution Prevention and Control – 13 no. located within the Proposed Development Site. For 'Keadby Generation Limited' or 'National Grid Gas plc' and concern combustion; any fuel greater or equal to 50Mw and gasification, liquefaction and refining; odorising natural gas/LPG;
- Local Authority Pollution Prevention and Controls – 1 no. located within the Proposed Development Site (for odourising natural gas and liquified petroleum gas) and 3 no. located within the study area (all for coal, coke and coal product processes);
- Planning Hazardous Substances Consents – 1 no. located within the study area. This is located 55m west of the Additional Abnormal Indivisible Load Route and it concerns ammonium nitrate-based fertilisers which conforms to the Fertilisers Regulations 1991(a) and composite fertilisers containing phosphate and/or potash. However, its status is indicated to have been withdrawn;
- there are no Registered Radioactive Substances or records of COMAH (Control of Major Accidents Hazards) sites or licenses listed on the Proposed Development Site or in the study area;
- there is one recorded pollution incident to controlled waters (Category 3) listed for the Proposed Development Site. This is indicated to have been at the eastern extent of the proposed Water Connection Corridor and concerned raw sewage in

filter pipes which impacted an abstraction. The receiving water was identified as a saline estuary (River Trent) and the incident occurred in 1999;

- there are a further four Category 3 pollution incidents to controlled waters within the study area. The closest of these was 10m north of the proposed Waterborne Transport Off-Loading Area and concerned oil pollutants to an unknown receiving water in 1996. Of the remaining three incidents, these are either older than 30 years or in excess of 100m from the Proposed Development Site; and
- in response to the submitted data request, the Environment Agency have stated that there have been no Category 3 or above pollution incidents in the area of interest within the last 5 years.

Proposed Development Site and surrounding area history

13.4.22 Historical mapping has been reviewed to evaluate the potential for past activities, both on and adjacent to the Proposed Development Site, to have impacted upon the site's environmental and land quality. A detailed appraisal is presented in **Appendix 13A**: Phase 1 Desk Based Assessment (PEI Report Volume II) and an overall summary provided here.

13.4.23 Earliest available mapping (circa 1885 – 1886) indicates that at this time the Proposed Development Site was largely undeveloped comprising predominantly open fields, with Keadby Common at the centre with properties limited to the eastern-most spur of the Proposed Development Site. A railway passed just over the southern boundary near to Keadby Junction. By 1967 – 1969 a power station was developed in the central/ eastern area with railway sidings in the south-west which led to, and terminated, at the power station. An area of marshland is also shown in the south-west along with a small refuse heap. By 1978 – 1982, approximately seven mixed circular and rectangular tanks are shown to occupy the land directly south of the main power station building. Keadby Common Farm was also indicated as present.

13.4.24 Mapping indicates that the power station was disused by 1991 – 1994 and by this time Keadby Common Farm was also no longer shown.

13.4.25 From 1995 onwards, the disused power station became an electric generation station and a change in site layout had occurred. A set of small tanks and a single tank were indicated on mapping located to the west; with five tanks parallel to the south, and an additional set of tanks located east of the electric generation station. Further west from the electric generation station, towards the centre of the Proposed Development Site, a further three large tanks were shown. The refuse heap and area of marshland to the south-west of the Proposed Development Site were by this time indicated to be absent.

13.4.26 Within the wider study area historical features of note include a railway line parallel and adjacent to the south of the Proposed PCC Site, areas of marshland to the south extending up to 50m away from the boundary, and also to the south a gasometer that was approximately 60m away.

13.4.27 Around 1966 – 1969, 220m west of the Proposed Development Site, a large slag heap with two sludge beds and a pond were indicated. A drain was also present adjacent

to the slag heap and pond, which appears to be connected to one of the sludge beds and the Proposed Development Site, passing through the centre. An additional drain is also present north of the slag heap that passes past the northern boundary of the Proposed Development Site, with a drain adjacent to the south of the slag heap which runs onto the Proposed Development Site.

13.4.28 To the east, adjacent to the Proposed Development Site, a coal wharf was present on mapping (1966 – 1969) on the banks of the River Trent, with a loading bay on train tracks further inland approximately 30m from the Proposed Development Site. Further south and to the east is a depot approximately 120m south, along with a set of tanks present approximately 220m from the Proposed Development Site. A pond is also present which by 1994 appears to have been infilled.

13.4.29 Historical maps from 1995 show the slag heap to the west of the Proposed Development Site as a disused spoil heap. The two sludge beds, pond and drains associated with this area are no longer apparent and are assumed to have been infilled.

Potential land contamination sources

13.4.30 Data obtained from the Environment Agency and the local authority that is contained in the Envirocheck data, along with historical Ordnance Survey mapping (see **Appendix 13A:** Phase 1 Desk Based Assessment (Annex B) (PEI Report Volume II)), aerial mapping and site walkover records, have been reviewed to identify current and historical potential contaminative land uses. A summary of the key areas of potentially contaminated land identified within the study area is presented in Table 13.10.

Table 13.10: Summary of potential sources of contamination within the study area

Potential sources within Proposed Development Site	Potential sources within the study area (0 to 250m from the Proposed Development Site)
Heavy industrial sites including: • Keadby Power Station (formerly coal-fired, currently gas-fired), including tanks and former rail sidings. Located in the central/ eastern area of the Proposed Development Site; and • Historic tank (eastern extent of the Proposed Development Site).	Heavy industrial sites including: • Historic tank. 220m south of the proposed Waterborne Transport Off-Loading Area.
Light industrial sites including: • Pumping stations; and • Current PD Ports Marina and wharf, including current warehouse and former gasometer in the eastern extent of the Proposed Development Site (within Proposed Development Site and study area).	Light industrial sites including: • Depot. 80m from the proposed Waterborne Transport Off-Loading Area; • Former S L Cleaning Services; commercial cleaning services. 200m north and south-east of the proposed Water Connection Corridors; and

Potential sources within Proposed Development Site	Potential sources within the study area (0 to 250m from the Proposed Development Site)
	• Pumping stations.
Former landfills including; • Historical landfill site; Keadby Power Landfill located in the central part of the Proposed Development Site; • Historical landfill site; Keadby Central Electricity Generating Board located adjacent to the southern boundary of the Proposed Development Site; • Licensed waste management facility and historical landfill site: Keadby Power Station landfill located adjacent to the southern boundary of the Proposed Development Site; • Registered landfill site and historical landfill site; Transtore Industries/ Former Keadby Power Station landfill located in the west of the Proposed Development Site and extends beyond to the west. • BGS recorded landfill site and historical landfill site; Keadby Power Station landfill located in the northern area of the Proposed Development Site and extends beyond the Proposed Development Site boundary to the west.	Former landfills including; • Historical landfill site; Keadby Power Station landfill located to the west of the Pulverised Fuel Ash (PFA) Settlement Lagoon and 15m west of the Proposed Development Site at its closest point. • Historical landfill site; PFA Settlement Lagoon, Keadby Power Station, located to the east of the Keadby Power Station landfill and 25m west of the Proposed Development Site at its closest point. • Licensed waste management facility and historical landfill site: John Brown Engineering landfill located adjacent to the southern boundary of the Proposed Development Site;
Former agricultural land.	Current and former agricultural land.
Current and former railways; located in the south and south-western areas of the Proposed Development Site.	Current and former railways; located adjacent to the southern boundary.
Peat.	Marshland, peat.

Potential pathways

13.4.31 The following potential pathways have been identified which outline the mechanism through which any potential land contamination could impact upon a receptor:

- direct contact/ ingestion of contaminants within Made Ground/ soils, together with soil derived dust and groundwater;
- inhalation of organic vapours from Made Ground/ soils, soil derived dust, and groundwater;

- leaching of soluble contaminants and migration of mobile contaminants into shallow groundwater;
- vertical groundwater flow through Made Ground and superficial deposits to underlying bedrock aquifer;
- lateral groundwater flow and direct run-off to surface waters;
- vertical migration of ground gases to indoor and outdoor air and migration of ground gases into enclosed spaces (inhalation/ asphyxiation/ explosion);
- inhalation of asbestos fibres;
- direct contact of buried concrete with contaminated soils (i.e. hydrocarbons) and aggressive ground conditions (pH and sulphate)/ direct contact of services and supply pipes with contaminated soils; and
- indirect pathway: Migration of hazardous gases/vapours via permeable strata into enclosed spaces and service/utility trenches.

Identified receptors

13.4.32 Potential receptors associated with the Proposed Development Site are as follows:

- current on-site human health users including;
  - commercial users (workers at Keadby 1 Power Station)
  - public open space users (Keadby Common users)
  - residential users (on the eastern-most spur only)
- future on-site human health users including;
  - commercial users (workers at Keadby 2 and the Proposed Development);
- current and future off-site human health users including;
  - commercial and public open space users (surrounding)
  - residential users (Keadby village, adjacent to the east)
- groundwater including;
  - superficial geology (Alluvium/ Warp) which is classified as a Secondary A aquifer
  - groundwater abstraction located on-site (not potable)
  - bedrock geology (Mercia Mudstone Formation) which is classified as a Secondary B aquifer.
- surface water located on-site and off-site including;
  - watercourses: various unnamed drains, River Trent, Eastoft Moors (Warping) Drain, Sewer Drain, North Soak Drain, Sheffield and South Yorkshire Navigation/ Stainforth and Keadby Canal, South Soak Drain, Three Rivers
  - surface water abstractions located on-site and off-site (not potable)
- building and infrastructure located on-site and off-site: infrastructure at risk from ignition of gas in confined space, below ground infrastructure at risk from aggressive ground conditions; and
- ecological sites including;

- Ramsar Site, SSSI and SAC – Humber Estuary
- Non-statutory designated ecological sites: Local Wildlife Sites (LWS) – Keadby Warping Drain, Stainforth and Keadby Canal Corridor, Keadby Boundary Drain, Keadby Wetland, South Soak Drain, Keadby, Keadby Wet Grassland, Three Rivers.

13.5 Development Design and Impact Avoidance

13.5.1 Measures that have been integrated into the Proposed Development in order to avoid or reduce adverse environmental effects are described in the following section. The assessment of impacts and effects will take account of these measures already being in place.

13.5.2 As part of the Proposed Development any on-site contamination that poses a plausible risk to any of the receptors will need to be mitigated or remediated such that potential risks to identified receptors are minimised to a standard suitable for the proposed end use of the site. In implementing any such measures, it will be necessary to prevent potential pollution of the environment occurring, either through disturbance of land contamination or through the introduction of potential contaminative materials during construction.

Ground Investigation

13.5.3 Ground investigation will be undertaken before construction to inform the development of the preliminary and detailed design. The ground investigation will validate the assumptions made in the initial Conceptual Site Model and Preliminary Risk Assessment (**Appendix 13A:** Phase 1 Desk-based Assessment (PEI Report Volume II) and provide site-specific data upon which to base a land contamination risk assessment. The ground investigation will be designed to target the potentially contaminative sources identified, including the historical landfilling activities identified on the Proposed Development Site. Where risks are deemed to be significant, detailed remediation strategies will be developed accordingly, pursuant to the process set out by the planning authorities.

Construction

Legislation and Regulation

13.5.4 A Construction Environmental Management Plan (CEMP) will be developed that will contain measures to ensure compliance with relevant standards and legislation. The CEMP will set out the environmental mitigation requirements and also the project level expectations on how the Proposed Development will be constructed. Measures contained within the CEMP would be designed to limit the potential for dispersal and accidental releases of potential contaminants, soil derived dusts and uncontrolled run-off to occur during construction. For example, the CEMP will set out how material is to be excavated, segregated and stockpiled to minimise the potential for run-off, soil quality degradation and wind dispersal of dusts. The CEMP will also establish procedures for dealing with unexpected soil or groundwater contamination that may be encountered. A framework CEMP which will accompany the ES and the DCO

Application. The submission, approval and implementation of the final CEMP will be secured by a requirement of the Development Consent Order (DCO).

Soil and groundwater pollution control mitigation

13.5.5 It is assumed that all structures at the Proposed Development Site will require piling. There will be a requirement to avoid creating flow paths between potentially contaminated soils and/ or groundwater in the underlying superficial deposits which are classified as Secondary A aquifers and the bedrock which is classified as a Secondary B aquifer. Piling options will be fully defined on conclusion of scheme specific ground investigation at detailed design stage with final layout for the Proposed Development.

13.5.6 Potential impacts specific to construction workers during site preparation and construction would be mitigated by the following measures and through working in accordance with CIRIA C692, 2010:

- 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 construction site workers;
- monitoring of confined spaces for potential ground gas accumulations, restricting access to confined spaces, i.e. to suitably trained personnel only, and use of specialist Personal Protective Equipment (PPE), where necessary; and
- preparation and adoption of a site and task specific health and safety plan as is required under Health and Safety legislation.

13.5.7 A Pollution Response Plan will be in place prior to the commencement of construction works. The plan will outline key pollution mitigation measures to be adopted including a Control of Substances Hazardous to Health (COSHH)/ fuel inventory and key contacts to be notified in the event of a significant pollution incident, which may subsequently lead to the contamination of controlled waters or soils. All bulk fuel and COSHH items will be stored in accordance with the relevant Environment Agency Pollution Prevention Guidance notes (withdrawn but widely considered good practice) and storage regulations. Tanks and dispensing pumps will be locked when not in use to prevent unauthorised access.

13.5.8 Any hazardous materials will be stored in designated locations with specific measures to prevent leakage and the release of their contents. This will include a requirement to position storage areas at least 10m away from surface water features/ drains (and take into consideration the positions of any groundwater abstraction wells), on an impermeable base with an impermeable bund that has no outflow and is of adequate capacity to contain at least 110% of the contents. Valves and trigger guns will be protected from vandalism and kept locked when not in use.

13.5.9 Only well-maintained plant will be used during construction to minimise the potential for accidental pollution from leaking machinery or damaged equipment. Static

machinery and plant are expected to be stored in hardstanding areas when not in use and, where necessary, to make use of drip trays beneath oil tanks/ engines/ gearboxes/ hydraulics. Spill response kits containing equipment that is appropriate to the types and quantities of materials being used and stored during construction will be maintained on Project Area for the duration of the works.

13.5.10 The CEMP will set out procedures for dealing with unexpected soil or groundwater contamination that may be encountered. This would typically require affected works to stop to enable appropriate people to be notified, and further characterisation and risk assessment to be undertaken, before remediation or mitigation proposals are agreed with all required stakeholders.

13.5.11 Specific mitigation measures may be required in the form of treating/ remediating any contamination encountered during construction (e.g. any contamination that may be associated with any potentially contaminative sites identified as part of the assessment, notably the landfills and areas of potentially infilled land). This will be confirmed based on information gathered through ground investigation.

13.5.12 Any remediation works, or the removal of contaminated soils or waters associated with the construction of the Proposed Development would be expected to result in the enhancement of the local environment.

Excavated materials management

13.5.13 Prior to construction, a strategy will be prepared as part of the design development, which will set out how the earthworks stage of the construction phase will be undertaken. Where necessary the strategy will consider what excavated materials can be reused or are required for the various components of the Proposed Development, and what materials are surplus and require either disposal or onward management to ensure appropriate re-use.

13.5.14 To minimise the effects on soil resources during any earthworks, including materials management following foundation construction in relation to the Proposed Development, high standards of soil handling and management will be employed with a view to minimising where possible the double handling of soils and the extent to which exposed soils will be left vulnerable to erosional processes.

13.5.15 The re-use of excavated materials during construction will be governed by either a Materials Management Plan developed in accordance with CL:AIRE (2007), an environmental permit or a relevant exemption. The CL:AIRE Code of Practice is a voluntary framework for excavated materials management and re-use. Following this framework results in a level of information being generated that is sufficient to demonstrate to any regulator that excavated material has been re-used appropriately and is suitable for its intended use. It demonstrates that waste material has not been used in the development. The Materials Management Plan details the procedures and measures that will be taken to classify, track, store, reuse and dispose of all excavated materials that will be encountered during the development works.

13.5.16 The disposal of soil waste, contaminated or otherwise, to landfill sites would be best 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 the Proposed Development or on other sites.

13.5.17 Where there is a requirement to dispose of surplus excavated materials off site as waste, the material will be characterised to determine firstly whether it is Hazardous or Non-Hazardous waste in accordance with the Environment Agency's Technical Guidance WM3 and then once this is established, the appropriate disposal facility will be determined through Waste Acceptance Criteria (WAC) analysis, as required.

Operation

13.5.18 Operational materials, including chemicals, fuels and oils (acetylene, lubricating oils, distillate fuels, or other fuels), will be stored at the Proposed Development Site. In common with other modern infrastructure development, secondary containment appropriate to the level of risk will be included in the installed design.

13.5.19 The design of the Proposed Development includes measures that would contain and control any releases of contaminants to ground and surface and foul drainage network. Drainage control for the Proposed Development is considered further in **Chapter 12**: Water Resources and Flood Risk.

Decommissioning

13.5.20 The Proposed Development is expected to operate for at least 25 years. At the end of its operating life, the most likely scenario is that the Proposed Development would be shut down and all above ground structures removed. The Proposed Development Site would then be suitably remediated as required to facilitate re-use.

13.5.21 A Decommissioning Plan (including Decommissioning Environmental Management Plan (DEMP)) would be produced and agreed with the Environment Agency as part of the Environmental Permitting and site surrender process. The DEMP would consider in detail all potential environmental risks on the Proposed Development Site and contain guidance on how risks can be removed or mitigated.

13.6 Likely Impacts and Effects

Land contamination

13.6.1 **Figure 13.2** (PEI Report Volume III) illustrates the identified historical and current areas of potential contamination within the DCO boundary and 250m study area. In accordance with the screening methodology presented in Section 13.3, a risk score has been assigned to each of these areas and this is presented in **Appendix 13C**, **Table 13C.1** (PEI Report Volume II), and is also visually represented on **Figure 13.2** (PEI Report Volume III). For the purposes of this PEI chapter, it has been assumed at this stage that excavation (cut) may occur anywhere within the Proposed Development Site boundary – this will be refined as the design develops. Those with a risk score of three and above will be considered for further impact assessment in the ES chapter, those with a risk score of two or below are not considered to pose a significant risk within the context of Proposed Development construction or operation and have therefore been scoped out.

13.6.2 Table 13.11 presents a summary of the potential areas of contamination with baseline risk scores of 3 to 5.

Table 13.11: Potential areas of contamination (baseline risk scores 3 to 5)

Site ID	Site name	Proximity zone[1]	Land use class[2]	Relationship to cut/ fill/ construction work	Baseline risk score[3]
S1	Keadby Power Station (formerly coal fired, current gas fired). Keadby Power Landfill (deposited waste included inert and industrial waste) also within S1 area, along with numerous tanks and former railway (southern-most boundary) and former farms (west and north)	Zone 1	Class 3	Cut	5
S2	Historic Landfill and BGS Recorded Landfill Site - Keadby Power Station. Deposited waste included inert and industrial waste	Zone 1	Class 3	Cut	5
S3	Historic Landfill and Licensed Waste Management Facility - John Brown Engineering Landfill. Deposited waste included inert and industrial waste, and liquid sludge	Zone 2	Class 3	Cut	4
S4	Historic Landfill and Licensed Waste Management Facility - Keadby Power Station. Deposited waste included inert, commercial and household waste	Zone 1	Class 3	Cut	5

Site ID	Site name	Proximity zone[1]	Land use class[2]	Relationship to cut/ fill/ construction work	Baseline risk score[3]
S5	Historic Landfill - Keadby Central Electricity Generating Board. Deposited waste included inert, industrial, commercial and household waste, ash (from Keadby power station after lagoon settlement), construction, colliery tailings, refractories (from Keadby power station), asbestos	Zone 1	Class 3	Cut	5
S6	Historic Landfill - Former Keadby Power Station and Registered Landfill - Transtore Industries. Deposited waste included industrial, commercial, household and special waste	Zone 1	Class 3	Cut	5
S7	Historic Landfill Site - PFA Settlement Lagoon	Zone 2	Class 3	Cut	4
S8	Historic Landfill Site - Keadby Power Station	Zone 3	Class 3	Cut	3
S9	Current railway	Zone 2	Class 2	Cut	3
S10	Former railway	Zone 1	Class 2	Cut	4
S11	Former railway sidings and conveyor system	Zone 1	Class 2	Cut	4
S12	Current PD Ports Marina and wharf including current warehouse and former railway and gasometer	Zone 1	Class 2	Cut	4

Site ID	Site name	Proximity zone[1]	Land use class[2]	Relationship to cut/ fill/ construction work	Baseline risk score[3]
S14	Current pumping station	Zone 1	Class 1	Cut	3
S18	Current pumping station	Zone 1	Class 1	Cut	3
S19	Former tanks	Zone 1	Class 3	Cut	5
S22	Former tanks	Zone 3	Class 3	Cut	3

[1] *Proximity zone definition is included within* ***Table 13B.1, Appendix 13B***

[2] *Land use class types are defined within* ***Table 13B.2, Appendix 13B***

[3] *Baseline risk scoring method is defined within* ***Table 13B.3, Appendix 13B***

Construction impacts

13.6.3 In the locations of the identified potentially contaminative land uses, and in the event of ground disturbance occurring, there is the potential for construction to affect human, controlled waters, building and infrastructure, and ecological receptors, and for the ground conditions to impact upon the design of the Proposed Development.

13.6.4 Potential impacts include but are not limited to:

- mobilising existing contamination in soil and groundwater as a result of ground disturbance and potential de-watering during construction;
- increasing the potential for contaminants in unsaturated soils to leach to groundwater in open excavations during construction;
- increasing the potential for contaminated surface run-off to migrate to surface water and groundwater receptors as a result of leaching from uncovered stockpiles;
- introducing new sources of contamination, such as fuels and oils used in construction plant;
- creating preferential pathways for the migration of soil contamination and gases, for example, along new below ground service routes, service ducts and as a result of potential de-watering; and
- introducing new human health receptors such as site staff during and post construction.

13.6.5 Construction activities can also result in physical damage to soil, including soil compaction as a result of heavy construction vehicle movements or the exacerbation of soil erosion through handling and storage of soils.

13.6.6 It is anticipated (in the absence of a full risk and impact assessment, as detailed in **Section 13.3**), that there may still be some temporary minor adverse effects during the construction period from ground disturbance. These temporary minor adverse

impacts at the construction stage are unlikely to be regarded as significant as the development of a CEMP will mitigate impact.

13.6.7 It is anticipated that if any remediation is carried out on potentially contaminated sites identified within the Proposed Development Site boundary, there will, in most instances, be overall beneficial effects, which may be considered to be significant (this will be determined through more detailed assessment as part of the ES). If required, (subject to ground investigation at the Proposed Development Site), site-specific permanent remediation measures, which will focus on source removal, pathway breakage or receptor protection, will be developed during the detailed design stage. These measures will reduce risks to human health, controlled waters and property from contamination, gas and vapours in the ground (the principal risks in this area), to an acceptable level.

Operation impacts

13.6.8 During the operational stage of the Proposed Development, conditions may have altered from the baseline as a result of, but not limited to:

- introducing commercial users (workers at the Proposed Development), and development infrastructure as new receptors;
- contamination which has been encountered having been removed, remediated or mitigated;
- additional drainage and discharge routes and the potential for polluted surface water run-off and drainage to be directed towards groundwater and surface water receptors with the new drainage system acting as a more efficient pollutant pathway;
- the potential for impacts arising from pollutants e.g. fuel spillages (acetylene, lubricating oils, distillate fuels, or other fuels), to pass directly into the underlying ground/ aquifers, bypassing the drainage system; and
- reduction in soil erosion through additional hardstanding, improved drainage design and improvement in surface water runoff quality from on-site surface water attenuation features required which would be incorporated into the layout of the Proposed Development.

13.6.9 It is anticipated that there will be no significant effects during the operation of the Proposed Development as maintenance and operation of the Proposed Development will be in accordance with environmental legislation and good practice.

Decommissioning

13.6.10 During the decommissioning of the Proposed Development, conditions may alter from the baseline as a result of, but not limited to:

- mobilising existing contamination in soil and groundwater as a result of ground disturbance during decommissioning;
- increasing the potential for contaminants in unsaturated soils to leach to groundwater in open excavations during decommissioning;

- increasing the potential for contaminated surface run-off to migrate to surface water and groundwater receptors as a result of leaching from uncovered stockpiles; and
- introducing new sources of contamination, such as fuels and oils used in decommissioning plant.

13.6.11 It is anticipated (in the absence of a full risk and impact assessment, as detailed in Section 13.3), that there may still be some temporary minor adverse effects during the decommissioning period from ground disturbance. These temporary minor adverse impacts at the construction stage are unlikely to be regarded as significant as the development of DEMP will mitigate the potential risks.

13.7 Mitigation and Enhancement Measures

13.7.1 As discussed in Section 13.5, the CEMP, which will be prepared prior to the commencement of construction activities, will set out the expectations with regards to how preliminary and main works will be delivered and specific requirements associated with the geology, hydrogeology and land contamination topic.

13.7.2 A Decommissioning Plan (including DEMP) would be produced for the decommissioning stage. This would consider in detail all potential environmental risks on the Proposed Development Site and contain guidance on how risks can be removed or mitigated.

13.7.3 No additional mitigation, compensation and enhancement measures are considered to be required during the construction, operation or decommissioning phase.

13.8 Monitoring

13.8.1 As detailed in Section 13.5, ground investigation will be undertaken before construction to inform the development of the preliminary and detailed design. Depending on information gathered through this ground investigation, monitoring of groundwater and surface water may be recommended before construction commences, during construction works and post-construction.

13.9 Limitations

13.9.1 It should be noted that for the purposes of defining the Proposed Development Site and study area, the existing access road into the site from the A18 and the potential construction laydown options south of the Stainforth and Keadby Canal have not been included at this stage, given that these areas are subject to ongoing feasibility studies. These areas will be assessed as part of the ES, if included in the final layout proposed.

13.9.2 The current assessment has been based on the collation and evaluation of readily available documentation provided to date by the Environment Agency, BGS, Envirocheck historical mapping, Envirocheck site sensitivity data, and other data sources made available. Additional Envirocheck data and historical Ordnance Survey mapping has not been obtained to date for areas, particularly for the proposed A18 access road area, that are currently under review. Further information will be obtained

as the Proposed Development progresses and any such detail will be assessed in the ES.

13.9.3 Any borehole data from BGS sources are included on the basis that: 'The British Geological Survey accept no responsibility for omissions or misinterpretation of the data from their Data Bank as this may be old or obtained from non-BGS sources and may not represent current interpretation'.

13.9.4 This chapter should be read in light of the legislation, statutory requirements and/ or industry good practice applicable at the time of the works being undertaken. Any subsequent changes in this legislation, guidance or design may necessitate the findings to be reassessed in the light of these circumstances.

13.10 Residual Effects and Conclusions

13.10.1 A review of the baseline conditions within the study area has identified a number of potential contamination sources. In the locations of the identified potentially contaminative land uses, there is the potential for construction to affect human, controlled waters, ecological and building and infrastructure receptors and for the ground conditions to impact on the design of the Proposed Development. A summary of the key effects identified based on the studies completed to date is provided below.

Land contamination

13.10.2 For land contamination, construction effects have the potential to be adverse in the short term in respect of mobilising existing contamination. However, post-construction there is the potential for a beneficial effect to be realised if land contamination is identified and has required remediation to be undertaken.

13.10.3 The potential exists to encounter contaminated soils during the construction phase of the Proposed Development, notably in the areas of former landfills, associated with the Keadby Power Station (formerly coal-fired, currently gas-fired) and near the former and current railways and PD Ports Marina and wharf (eastern extent). It is assumed that all structures at the Proposed Development Site will require piling (given information resulting from Keadby 2 Power Station development). Direct/ indirect potential adverse impacts on groundwater quality within the Secondary A aquifer could occur as a result of mobilisation of existing contaminants during construction. There will be a requirement to avoid creating flow paths between potentially contaminated soils and/or groundwater in the underlying aquifer.

13.10.4 In addition, there is potential for contamination associated with off-site sources such as the off-site former landfills, railways and pumping stations. Some potential exists for cross-boundary migration of contamination to the construction area through ground gas and groundwater flow in the Secondary A aquifer. Localised excavations near surface water courses that overlap onto the Proposed Development Site may result in the mobilisation of contaminants in groundwater and migration to the surface waters.

13.10.5 Construction activities could create dust, which combined with ground preparation and earthworks, soil handing and vehicle movements could disturb or spread existing contaminated soils which may result in potential adverse effects. This could result in

harm to the human health of neighbouring residents, workers in, and visitors to, commercial properties, and members of the public accessing areas of open space and community facilities.

13.10.6 Hazardous materials will be introduced and stored on-site during construction, in the form of diesel fuel, oils, chemicals and solvents, as well as construction materials such as cement and bentonite. Improper handling and use of hazardous materials has the potential to introduce contaminants into underlying soils and groundwater which may in turn result in impacts to surface water courses through groundwater migration or uncontrolled run off with the water quality potentially reduced as a consequence. Leakages/ spillages from materials and fuel storage areas or from the incorrect disposal of waste or surplus material, could also impact on the underlying ground and hydrogeological conditions which would affect the groundwater resource potential.

13.10.7 There has been some ground investigation within the Proposed Development Site boundary. This is summarised in Section 7 of **Appendix 13A:** Phase 1 Desk Based Assessment (PEI Report Volume II). Further ground investigation and assessment will be undertaken to identify the potential for chemically unacceptable soils or groundwater to be encountered during the construction phase.

13.10.8 Appropriate mitigation measures to limit or potentially remove the effects described above have been outlined, and these will be refined in the next stage of the EIA assessment.

13.10.9 Anticipated significance of the effects during the construction, operation and decommissioning phases has been provided in Section 13.6; however, these will be formally assessed in the ES using the guidance set out in **Section 13.3**. This will ensure the final mitigation measures set out in the ES are sufficient so that all identified effects to receptors are minimised as far as practicable within the constraints of the Proposed Development and in accordance with all applicable legislation.

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