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# 10. Geology, Hydrogeology and Contaminated Land

## 10.1 Introduction

- 10.1.1 This chapter of the Environmental Statement (ES) assesses the potential for significant effects of the Proposed Development on geology, soils and contaminated land arising from construction, operation (including maintenance) and decommissioning of the project. Consideration has been given to geology, superficial soils and bedrock, geological and hydrogeological designations, soils and agricultural land classification, contamination and minerals.
- 10.1.2 This chapter describes the impacts and effects that are anticipated, and outlines proposed design and other measures to mitigate these potential effects.
- 10.1.3 Baseline information has been established through desk-based assessment. A preliminary sources study report (PSSR) has been prepared and is included as Appendix 10A: Preliminary Sources Study Report (ES Volume III, Document Ref. 6.4). In addition the chapter is accompanied by Appendix 10B: Conceptual Site Model (CSM) and Appendix 10C: Contaminated Land Environmental Preliminary Risk Assessment (PRA) and Appendix 10D: Geotechnical Risk Register (ES Volume III, Document Ref. 6.4).
- 10.1.4 This Chapter is accompanied by Figures 10-1 to 10-25 (ES Volume II, Document Ref. 6.3).
- 10.1.5 At the time of writing no scheme specific ground investigation (GI) has been undertaken. This is scheduled to be undertaken in Q2/Q3 2021. The GI will verify the baseline conditions within the PCC Site area and CO<sub>2</sub> Export Corridor and relevant assumptions obtained from the desk-based assessment presented in Appendix 10A: PSSR (ES Volume III, Document Ref. 6.4) and will be used to inform the early design development.

## 10.2 Legislation and Planning Policy Context

- 10.2.1 The 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 listed in Table 10-1.

**Table 10-1: Relevant UK Legislation**

### Legislation

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Anti-Pollution Works Regulations 1999

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

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The Water Resources Act 1991

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The Water Act 2003

## Legislation

Environmental Damage (Prevention and Remediation) (England) (Amendment) Regulations 2017
The Contaminated Land (England) (Amendment) Regulations 2012
The Control of Asbestos Regulations (2012)
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
Control of Pollution Act 1974, as amended
Control of Pollution (Oil Storage) (England) Regulations 2001 (UK Gov, 2001);
The Control of Substances Hazardous to Health (COSHH) Regulations 2002, as amended
Environmental Protection Act 1990, as amended
Pollution Prevention and Control Act 1999
The Environment Act 1995, as amended
The Land Drainage Act 1991, as amended
The Environmental Permitting (England and Wales) Amendment (No. 2) Regulations 2018

10.2.2 The key piece of UK Legislation which specifically impacts the assessment of geology, hydrogeology and contaminated land is presented in Table 10-2.

**Table 10-2: Relevant UK Legislation (geology, hydrogeology and contaminated land)**

Scale	Legislation	Summary
UK	Environmental Protection Act 1990	<ul style="list-style-type: none"> <li>Contaminated land is defined as: "any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that:               <ul style="list-style-type: none"> <li>significant harm is being caused or there is significant possibility of such harm being caused; or</li> <li>significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused."</li> </ul> </li> </ul>

10.2.3 The key pieces of UK Legislation relating to water resource management are presented in Table 10-3.

**Table 10-3: Relevant UK Legislation (water resource management)**

Scale	Legislation	Summary
UK	The Water Resources Act 1991	<ul style="list-style-type: none"> <li>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</li> </ul>

## Scale Legislation

## Summary

Scale Legislation	Summary
UK The Water Act 2003	<p>permission or consent of the regulators of these areas.</p> <ul style="list-style-type: none"> <li>The Water Act 2003 introduced a revision to the wording of the Environmental Protection Act 1991, 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.</li> </ul>

## Guidance on the Assessment of Contaminated Land

10.2.4 This chapter has been prepared in accordance with the following:

- Design Manual for Roads and Bridges (DMRB), Highways England (HE) CD622 - Managing Geotechnical Risk (Highways Agency, 2020);
- Land Contamination: Risk Management (Environment Agency, 2020);
- BS10175:2011 + A2:2017 (British Standards Institution, 2017); and
- Environment Agency's (EA) guiding principles for land contamination in assessing risks to controlled waters, GPLC1 (Environment Agency, 2010).

## Planning Policy

10.2.5 Relevant planning policies which ensure that new developments do not present unacceptable risks of pollution or harm to soils, geological resources and surface and groundwaters are presented in Table 10-4.

**Table 10-4: Relevant National, Regional and Local Planning Policy**

Scale Planning Policy	Summary
UK Overarching National Policy Statement (NPS) for Energy (EN-1) (Department for Energy and Climate Change, 2011)	<p>Section 4.10 (Pollution control and other environmental regulatory regimes) (Department for Energy and Climate Change, 2011) 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:</p>

## Scale Planning Policy

## Summary

		<p>-the relevant pollution control authority is satisfied that potential releases can be adequately regulated under the pollution control framework; and</p> <p>-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.</p> <p>Other relevant Sections include</p> <ul style="list-style-type: none"> <li>-Section 5.3 Biodiversity and geological conservation</li> <li>- Section 5.15 Water Quality and resources</li> </ul>
UK	National Planning Policy Framework (NPPF) (2019) (Ministry of Housing, Communities & Local Government, 2019)	Presents issues regarding conserving and enhancing the natural environment. Planning Policy relevant to this chapter are provided in paragraph 170, 178 and 179 of this NPPF document.
Local	Stockton-on-Tees Borough Council Local Plan – Adopted January 2019 (STBC, 2019)	<p>Sets out the Council’s policies and proposals to guide planning decisions</p> <p>Establishes the framework for the sustainable growth and development of the Borough up to 2032</p> <p>Policies relevant to this chapter are presented in Figure 10-21</p>
	Redcar & Cleveland Local Plan Adopted May 2018 (RCBC, 2018)	<p>Sets out the vision and overall development strategy for the Council’s area and how it will be achieved for the period until 2032</p> <p>Policies relevant to this chapter are presented in Figure 10-22</p>
	Tees Valley Joint Minerals and Waste Development Plan Documents, Policies and Sites DPD, Adopted September 2011 (Stockton-on-Tees Borough Council et al, 2011a)	<p>Issues relating to minerals and waste development</p> <p>Identifies specific sites for minerals and waste development and sets out policies which will be used to assess minerals and waste planning applications.</p> <p>There are no locally-specific issues pertinent to minerals and waste developments in the Tees Valley which have been identified during the plan making processes which are significant enough to warrant specific policies.</p>
	Tees Valley Joint Minerals and Waste Development Plan Documents, Core Strategy DPD, Adopted September 2011 (Stockton-on-Tees Borough Council et al, 2011b)	<p>Addresses the long-term spatial vision and the strategic policies needed to achieve the key objectives for minerals and waste developments in the Tees Valley. Key aspects of the Core Strategy relevant to this assessment include:</p> <p><b>Policy MWC1: Minerals Strategy</b> - The sustainable use of minerals resources in the Tees Valley will be delivered through:</p> <p>Where appropriate, identifying sources of alternatives to primary mineral resources, including secondary and recycled minerals, and encouraging the development of facilities to process alternative materials either at the point of production or other suitable locations;</p>

## Scale Planning Policy

## Summary

Identifying minerals resources underlying the Tees Valley and protecting them from unnecessary sterilisation by built development;

In taking forward minerals development in the plan area, and particularly along the river corridor and the Tees Estuary, proposals will need to demonstrate that there will be no adverse impact on the integrity of the Teesmouth and Cleveland Coast Special Protection Area and Ramsar site, and other European sites, either alone or in combination with other plans and programmes. Any proposed mitigation measures must meet the requirements of the Habitat Regulations. All minerals developments must be compatible with their setting and not result in unacceptable impacts on public amenity, environmental, historic or cultural assets from their design, operations, management and restoration.

**Policy MWC4: Safeguarding of Minerals Resources from Sterilisation** - Within the minerals safeguarding areas, non-minerals development will only be permitted in the following circumstances:

If there is evidence that the mineral resource occurs at depth and could therefore be extracted in an alternative way, thus avoiding sterilisation;

If there is evidence that the resource has been sufficiently depleted by previous extraction;

If the mineral will be extracted prior to development and this will not significantly adversely affect the timing and viability of the non-minerals development; or

If the need for the non-mineral development can be demonstrated to outweigh the need for the mineral resource.

### Associated Drawings

Safeguarded Plan Deep Resources Policy MW4 Drawing 27333-r04, May 2010;

Safeguarded Plan – Shallow Resources Policies MWC4, MWC5, MWC11. Drawing 27333-r05, May 2010.; and

Marine Dredged Sand and Gravel Safeguarded Wharves Policy MWC1, Drawing 27333-r12, May 2010.

Stockton-on-Tees Borough  
Council Local Development  
Framework Proposal Map  
Addendum

To be read in conjunction with the Tees Valley Minerals  
and Waste Core Strategy DPD

## Consultation

- 10.2.6 Consultation for the Proposed Development has been ongoing and commenced at the EIA Scoping Stage with the preparation of the EIA Scoping Opinion Report which was submitted in February 2019 and Scoping Opinion

was received from the Planning Inspectorate in April 2019. (Appendix 1A in ES Volume III, Document Ref. 6.4).

- 10.2.7 The Applicant also undertook a formal Section 42 and Section 47 consultation, which commenced at the same time as the publication of the Preliminary Environmental Information (PEI) Report in early July 2020 and ended in September 2020. The issues that have been raised through consultation, and how these have been considered and addressed within the design evolution of the Proposed Development and the EIA are set out where relevant within each of the topic chapters in the ES and where relevant in Chapter 6: Alternatives and Design Evolution (ES Volume I, Document Ref. 6.2).
- 10.2.8 Table 10-5 provides a summary of how comments raised by stakeholders to date in relation to the Geology, Hydrogeology and Contaminated Land have been considered and actioned where appropriate.

**Table 10-5: Consultation Summary Table**

Consultee	Relevant Aspect (as per Table 10-6)/ topic	Summary of comments	Summary of response/how comments have been addressed
Secretary of State EIA Scoping Opinion	Source Protection Zones (SPZs), Drinking Water Protected Areas/Safeguard Zones and Licensed groundwater abstractions	<p>The Scoping Report states that there are no SPZs, Drinking Water Protected Areas/Safeguard Zones and licensed groundwater abstractions 'near' or 'in the vicinity of' the SSI site.</p> <p>The ES should avoid the use of imprecise terms such as 'near' or 'in the vicinity of' and should confirm the absence.</p> <p>The study area has not yet been defined. If these receptors are identified within the study area (which should include all components of the Proposed Development), any likely significant effects should be assessed within the ES.</p>	Accepted
Secretary of State EIA Scoping Opinion	Historic contamination	<p>The Applicant states that the current operator of the SSI site intends to address any historic contamination prior to commencement of the Proposed Development. Whilst this is noted, unless there are assurances that this would take place, the Applicant should assess a worst case scenario whereby existing contamination is not remediated. Any necessary remediation measures should be identified and associated impacts assessed within the ES.</p>	<p>In order to ensure a robust assessment of the likely significant environmental effects of the Proposed Development, the EIA is being undertaken adopting the principles of the 'Rochdale Envelope' approach where appropriate.</p>

Consultee	Relevant Aspect (as per Table 10-6)/ topic	Summary of comments	Summary of response/how comments have been addressed
Secretary of State EIA Scoping Opinion	Desk based assessment	The assessment in the ES should follow the risk management framework provided in Land Contamination: Risk Management (2019), when dealing with land affected by contamination. The ES should also refer to the Environment Agency's (EA) guiding principles for land contamination in assessing risks to controlled waters.	Refer to Section 10.4: Baseline Conditions and Appendix 10A: PSSR (ES Volume III, Document Ref. 6.4)
Secretary of State EIA Scoping Opinion	Baseline – connection corridors	No details have been provided in the Scoping Report regarding the baseline conditions under the River Tees. Should works be required within/under the river, the Inspectorate would expect the ES to include a detailed baseline description and a robust assessment of the likely significant effects from the river crossing.	See Table 10-15 for assessment of Effects. Key activities to assess baseline conditions would include: 1. Desk Study to look hydrological and geological conditions with respect to ground/water contamination and engineering considerations. 2. Site investigation on land and over water on the Tees. 3. Tunnel impact assessment/Risk Assessment.
Secretary of State EIA Scoping Opinion	Baseline – connection corridors	Should the River Tees be crossed by tunnelling methodology, information should be provided on the storage and disposal of spoil from these works.	All earthworks operations will need to be undertaken in accordance with BS6031:2009 'Code of Practice for Earthworks' (British Standards Institute, 2009) and HE guidelines including DMRB Series 600 'Earthworks' (Highways England, 2009). Information on the storage and disposal of soil will be included in the Tunnel impact assessment/Risk Assessment.



Consultee	Relevant Aspect (as per Table 10-6)/ topic	Summary of comments	Summary of response/how comments have been addressed
Secretary of State EIA Scoping Opinion	Construction methodologies - connections	Should overhead pylons be constructed, the ES should detail the location, depth and number of piled foundations.  If piling or trenching takes place around areas of contaminated land, the ES should assess the likely effects and, if necessary, provide mitigation measures that would be required to protect sensitive receptors e.g. groundwater.	No overhead pylons are to be constructed. See Section 10.6. In order to ensure a robust assessment of the likely significant environmental effects of the Proposed Development, the EIA is being undertaken adopting the principles of the 'Rochdale Envelope' approach where appropriate. The need for piling will be assessed in the Foundation Options Report.
Secretary of State EIA Scoping Opinion	Reinstatement	The ES should detail how the Applicant would ensure successful reinstatement of land that is temporarily affected during the construction phase.	See Section 10.7.
Environment Agency (S42 Response to the PEI Report)	Remediation	A remedial options appraisal and remediation strategy would be required (at an appropriate time).	This requirement is noted and has been included in Section 10.5. Remedial works will be undertaken by the landowner to a specification agreed with the Applicants.
Environment Agency (S42 Response to the PEI Report)	Baseline	Section 10.1.3 refers to a desk-based assessment which is stated to have been appended to the PEI Report as Appendix 10A: Preliminary Sources Study Report. This does not appear to have been appended and therefore we have been unable to review it. We would welcome the opportunity to review this report. In the absence of the Preliminary Sources Study Report we have been unable to provide comment on Appendix 10b Contaminated Land Conceptual Site Model and Appendix 10c (Environmental Risk Assessment)	The PSSR (see Appendix 10A, ES Volume III, Document Ref. 6.4) Contaminated Land Conceptual Site Model (see Appendix 10B, ES Volume III, Document Ref. 6.4) and Environmental Risk Assessment (see Appendix 10C, ES Volume III, Document Ref. 6.4) are all included with the ES.

Consultee	Relevant Aspect (as per Table 10-6)/ topic	Summary of comments	Summary of response/how comments have been addressed
Environment Agency (S42 Response to the PEI Report)	Baseline-Ground Investigation	Section 10.1.5 states that a scheme specific ground investigation has not been undertaken. We would welcome consultation on the scope and extent of the ground investigation, particularly with respect to investigation of land quality and risk assessment of controlled waters.	The GI is programmed to commence in Q2 2021.
Environment Agency (S42 Response to the PEI Report)	Remediation	Section 10.1.7 refers to remedial works that may be required. We would highlight that the potential requirement for soil remediation along with active groundwater remediation and long-term monitoring should not be discounted. We would welcome the inclusion of this information within the DCO.	Options for remedial works are still under consideration by the landowner and the Applicants but may include soil and groundwater remediation with long-term monitoring.
Environment Agency (S42 Response to the PEI Report)	Legislation and Policy	With respect to section 10.2 (Legislation and Planning Policy Context) it is noted that the Contaminated Land Regulations and UK Legislation implementing the WFD have not been included. Reference to WFD should be included.	This has now been included within Section 10.2.
Environment Agency (S42 Response to the PEI Report)	Baseline - Geology	The EA identified that the Sherwood Sandstone may be present at shallow depth below rockhead beneath the Mercia Mudstone Group.	The Receptor Sensitivity of the Sherwood Sandstone has been updated to reflect this information provided by the EA.
Environment Agency (S42 Response to the PEI Report)	Baseline - Geology	The EA noted discrepancy between the details in 10.4.30 and Table 10.15.	This information has been reviewed and updated where required within the Chapter.
Environment Agency (S42 Response to the PEI Report)	Baseline - Geology	The EA recommended that the Sherwood Sandstone should be classified as having Very High Sensitivity.	The Receptor Sensitivity of the Sherwood Sandstone has been updated to reflect this information provided by the EA.

Consultee	Relevant Aspect (as per Table 10-6)/ topic	Summary of comments	Summary of response/how comments have been addressed
Environment Agency (S42 Response to the PEI Report)	Baseline - Geology	<p>It is not clear in Table 10.16 why some of the superficial deposits and superficial groundwater aquifers have not been considered during the operation.</p> <p>Additionally, it is not clear why superficial groundwater aquifers have not been considered during decommissioning phase.</p> <p>Additionally, in the absence of site specific ground investigation and confirmed development plans, we consider it difficult to accurately assign magnitude of impact and an appropriate level of residual risk. Based upon our previous comments with respect to resource value, consideration should be given to the recategorization of the magnitude of impact and residual risk.</p>	Table 10-15 has been updated where required.
Environment Agency (S42 Response to the PEI Report)	Groundwater	The EA outlined in their consultation response the importance of the Sherwood Sandstone as a Principal Aquifer, requirements for abstraction licences, and general information on Groundwater Protection.	All of this has been noted. This chapter provides and assessment of the likely impacts on groundwater as a result of the Proposed Development.
Environment Agency (S42 Response to the PEI Report)	Land Contamination	The EA outlined that their remit in relation to contaminated land is only insofar as it related to issues relating to controlled waters and provide links to guidance in relations to land contamination and management of risk in relation to this.	This is noted. All the guidance referred to by the EA has been used to inform the assessment provided in this Chapter.
Redcar and Cleveland Borough Council (S42 Repose to PEI Report)	Land Contamination	<p>The Contaminated Land Officer provided commentary on what has been included in the PSSR and assessment.</p> <p>In addition, clarification was requested on the following</p> <p><i>Will the recommended GI include sampling of the boundary of the footprint of the proposed development to assess if there will be any on/off site migration of contamination (for the purpose of the baseline environmental permit and characterisation of the site); and will it be dealt with to ensure the footprint is not or does not become impacted during operation both on and off site through migration of contaminants?</i></p>	The GI will cover the PCC Site and the CO <sub>2</sub> Export Corridor. The PCC Site forms only part of the former Redcar Steelworks and the investigation will allow assessment of contaminant migration outside this area of the site.

Consultee	Relevant Aspect (as per Table 10-6)/ topic	Summary of comments	Summary of response/how comments have been addressed
Redcar and Cleveland Borough Council (S42 Repose to PEI Report)	Land Contamination	Chapter 10 Geology indicates from historical investigations the site is contaminated and further site investigation is necessary to fully characterise and remediate the Site. There is therefore great potential that during the remedial and the demolition/construction phase to generate contaminated dusts including asbestos across the Site and it is important that this is included within the Final CEMP to protect both onsite workers, offsite workers and beach users from being impacted from dust.	Asbestos has been considered in this Chapter and management measures required to reduce the risk associated with Asbestos will be included in the Final CEMP.

## 10.3 Assessment Methodology and Significance Criteria

- 10.3.1 This assessment considers the following resources:
- Geology: artificial ground, superficial deposits and bedrock;
  - Minerals;
  - Aquifer designations;
  - Soils and agricultural land classification; and
  - Contamination of soils and groundwater.
- 10.3.2 A detailed assessment of potential Source-Pathway-Receptor linkages and a risk assessment used to develop the CSM is provided in the PSSR included as Appendix 10A (ES Volume III, Document Ref. 6.4) with summary tables provided in Appendix 10B.
- 10.3.3 Assessment of receptor value (sensitivity) for Geology, Soils and Contamination follows the procedure described in Table 3.11 of the HE DMRB Sustainability & Environmental Appraisal, LA 109 Geology and Soils (Highways England, 2019a).
- 10.3.4 Assessment of receptor value (importance) for groundwater resources follows the procedure described in Table 3.70 of the HE DMRB Sustainability & Environmental Appraisal LA 113, Road drainage and the water environment (Highways England, 2019b).
- 10.3.5 The value (sensitivity or importance) of a resource ranges from Very High to Negligible (or Low for groundwater) and is dependent on the assessment area or features of importance and conservation value. The criteria for determining the value of a resource and typical examples for geology, soils, contamination and groundwater are given in Table 10-6.
- 10.3.6 Resources are assessed against potential Impacts, Effects and Mitigation Measures in Section 10.6: Likely Impacts and Effects.

**Table 10-6: Estimating Value (sensitivity) of Resources**

Receptor Value (sensitivity) Importance	Criteria	Aspect	Typical Examples
<b>Very High</b>	Very rare and of international importance with no potential for replacement. Geology meeting international designation citation criteria which is not designated as such.	Geology	UNESCO World Heritage Sites, UNESCO, Global Geoparks, SSSI and Geological Conservation Review sites where citations indicate features of international importance.
	Soils directly supporting an EU designated site.	Soils	Special Area of Conservation (SAC) Special Protection Area (SPA), Ramsar, Agricultural Land Classification (ALC) Grade 1 & 2
	Human health: very high sensitivity land use.	Contamination	Residential or allotments.
	Nationally significant attribute of high importance.	Groundwater	Principal aquifer providing a regionally important resource and/or supporting a site protected under EC and UK legislation Ecology and Nature Conservation. Groundwater locally supports Groundwater Dependent Terrestrial Ecosystem (GWDTE) or Source Protection Zones (SPZ) 1.
<b>High</b>	Rare and of national importance with little potential for replacement. Geology meeting national designation citation criteria which is not designated as such.	Geology	Geological SSSI, National Nature Reserves (NNR)
	Soils directly supporting a UK designated site	Soils	SSSI ALC Grade 3a
	Human Health: high sensitivity land use.	Contamination	Public Open Space.
	Locally significant attribute of high importance	Groundwater	Principal aquifer providing locally important resource or supporting a river ecosystem. Groundwater supports a GWDTE or SP22.
<b>Medium</b>	Of regional importance with limited potential for replacement. Geology meeting regional designation criteria which is not designated as such.	Geology	Regionally Important Geological Sites.
	Soils supporting non-statutory designated sites.	Soils	Local Nature Reserves (LNR), Local Geological Sites (LGS), Sites of

Receptor Value (sensitivity) Importance	Criteria	Aspect	Typical Examples
			Nature Conservation Importance (SNCI). ALC Grade 3b
	Human Health: medium sensitivity land use.	Contamination	Commercial or Industrial.
	Of moderate quality and rarity	Groundwater	Aquifer providing water for agricultural or industrial use with limited connection to surface water. SPZ3.
<b>Low</b>	Of local importance / interest with potential for replacement.	Geology	Non designated geological exposures, former quarries / mining sites.
	Soils supporting non-designated notable or priority habitats.	Soils	ALC Grade 4 & 5
	Low sensitivity land use.	Contamination	Highways and rail
	Lower quality	Groundwater	Unproductive strata
<b>Negligible</b>	No geological exposures, little / no local interest.	Geology	e.g. significant depth of made Ground
	Soils: previously developed land formerly in 'hard uses' with little potential to return to agriculture.	Soils	Industrial Land / soils not present
	Human health: undeveloped surplus land I no sensitive land use proposed.	Contamination	e.g. extensive areas of existing hardstanding
	Negligible is <u>not applicable</u> to Groundwater under Table 3.7 of LA 113	Groundwater	N/A

Source: DMRB Table 3.11 LA 109 and DMRB Table 3.70 LA 113

- 10.3.7 The assessment of magnitude of impact for geology, soils and contamination follows the procedure described in Table 3.12 of DMRB Sustainability & Environmental Appraisal, LA 109 Geology and Soils (Highways England, 2019a).
- 10.3.8 The assessment of the magnitude of impact for groundwater resources follows the procedure described in Table 3.71 of DMRB Sustainability & Environmental Appraisal LA 113 (Highways England, 2019b), Road drainage and the water environment.
- 10.3.9 The magnitude of impact on a resource ranges from Major to No Change (geology, soils and contaminated land) with additional Magnitude descriptions of Minor beneficial, Moderate Beneficial and Major Beneficial prescribed to groundwater resources. The criteria for determining the magnitude of impact on a resource are given in Table 10-7. The significance (effect) of a potential effect on a resource is dependent on its assigned value and the magnitude of impact and is broadly categorised according to the matrix included as Table 10-7.

**Table 10-7: Estimating the Magnitude of Impact on a Resource**

Magnitude	Criteria	Aspect	Typical Description
<b>Major</b>	Results in loss of resource / designation or quality of the resource	Geology	Loss of geological feature / designation and/or quality and integrity, severe damage to key characteristics, features or elements.
		Soils	Soil: physical removal or permanent sealing of soil resource or agricultural land.
		Contamination	Contamination heavily restricts future use of land.
	Human health: significant contamination identified Contamination levels significantly exceed background levels and relevant screening criteria (e.g. category 4 screening levels) SP1010 (CL:AIRE, 2014) with potential for significant harm to human health.		
<b>Major Adverse</b>	Results in loss of attribute and/or quality and integrity of the attribute.	Groundwater	Loss of, or extensive change to, an aquifer. Loss of regionally important water supply. Calculated risk of pollution from spillages $\geq 2\%$ annually (Spillage Assessment). Potential high risk of pollution to groundwater from routine runoff - risk score $>250$ (Groundwater quality and runoff assessment). Loss of, or extensive change to GWDTE or baseflow contribution to protected surface water bodies. Reduction in water body WFD classification. Loss or significant damage to major structures through subsidence or similar effects.
<b>Moderate</b>	Results in partial loss of resource / designation or quality of the resource	Geology	Partial loss of geological feature / designation, potentially adversely affecting the integrity; partial loss of/damage to key characteristics, features or elements.
		Soils	Permanent loss / reduction of one or more soil function(s) and restriction to current or approved future use e.g. through degradation, compaction, erosion of soil resource.

Magnitude	Criteria	Aspect	Typical Description
	Human health: contaminant concentrations exceed background levels and are in line with limits of relevant screening criteria (e.g. category 4 screening levels) SP1010 (CL:AIRE, 2014). Significant contamination can be present.	Contamination	Control / remediation measures are required to reduce risks to human health / make land suitable for intended use.
<b>Moderate Adverse</b>	Results in effect on integrity of attribute, or loss of part of attribute	Groundwater	<p>Partial loss or change to an aquifer.</p> <p>Degradation of regionally important public water supply or loss of significant commercial/ industrial/ agricultural supplies.</p> <p>Potential medium risk of pollution to groundwater from routine runoff - risk score 150-250.</p> <p>Calculated risk of pollution from spillages <math>\geq 1\%</math> annually and <math>&lt; 2\%</math> annually.</p> <p>Partial loss of the integrity of GWDTE.</p> <p>Contribution to reduction in water body WFD classification.</p> <p>Damage to major structures through subsidence or similar effects or loss of minor structures.</p>
<b>Minor</b>	Results in minor measurable change in resource / designation	Geology	Minor measurable change in geological feature / designation attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements.
		Soils	Temporary loss / reduction of one or more soil function(s) and restriction to current or approved future use (e.g. through degradation, compaction, erosion of soil resource).
	Human health: contaminant concentrations are below relevant screening criteria (e.g. category 4 screening levels) SP1010 (CL:AIRE, 2014). Significant contamination is unlikely with a low risk to human health.	Contamination	Best practice measures can be required to minimise risks to human health.
<b>Minor Adverse</b>	Results in some measurable change in attributes, quality or vulnerability.	Groundwater	Potential low risk of pollution to groundwater from routine runoff - risk score $< 150$ .



Magnitude	Criteria	Aspect	Typical Description
			Calculated risk of pollution from spillages $\geq 0.5\%$ annually and $< 1\%$ annually. Minor effects on an aquifer, GWDTEs, abstractions and structures.
<b>Negligible</b>	Results in effect on attribute, but of insufficient magnitude to affect the use or integrity.	Geology	Very minor loss or detrimental alteration to one or more characteristics, features or elements of geological feature / designation. Overall integrity of resource not affected
		Soils	No discernible loss / reduction of soil function(s) that restrict current or approved future use.
	Human health: contaminant concentrations substantially below levels outlined in relevant screening criteria.	Contamination	No requirement for control measures to reduce risks to human health / make land suitable for intended use.
	Results in effect on attribute, but of insufficient magnitude to affect the use or integrity.	Groundwater	No measurable impact upon an aquifer and / or groundwater receptors and risk of pollution from spillages $< 0.5\%$ .
<b>Minor Beneficial</b>	Results in some beneficial effect on attribute or a reduced risk of negative effect occurring.	Groundwater (only)	Reduction of groundwater hazards to existing structures. Reductions in waterlogging and groundwater flooding.
<b>Moderate Beneficial</b>	Results in moderate improvement of attribute quality.	Groundwater (only)	Contribution to improvement in water body WFD classification. Improvement in water body catchment abstraction management Strategy (CAMS) (or equivalent) classification. Support to significant improvements in damaged GWDTE.
<b>Major Beneficial</b>	Results in major improvement of attribute quality.	Groundwater (only)	Removal of existing polluting discharge to an aquifer or removing the likelihood of polluting discharges occurring. Recharge of an aquifer. Improvement in water body WFD classification
<b>No Change</b>	No temporary or permanent loss in resource or designation.	Geology	No temporary or permanent loss / disturbance of characteristics features or elements.
		Soils	No loss / reduction of soil function(s) that restrict current or approved future use.

Magnitude	Criteria	Aspect	Typical Description
	Human health: reported contaminant concentrations below background levels.	Contamination	No intervention required.
<b>No Change</b>	No loss or alteration of characteristics, features or elements.	Groundwater	No observable impact in either direction.

Source: DMRB Table 3.12 LA 109 and DMRB Table 3.71 LA 113

10.3.10 Once the Value (Significance) of each Aspect (Resource) and the Magnitude of the potential Impact upon it are established, the Significance (Effect) matrix included in Table 3.8.1 DMRB Sustainability & Environmental Appraisal, LA 104 Environment Assessment and monitoring (Highways England, 2019c) is used to determine the Significance (Effect) of the potential impact as reported in Table 3.7. These have been reproduced and presented as Tables 10-8 and 10-9, respectively.

**Table 10-8: Significance (Effect) Matrix**

Receptor Value	Magnitude of Impact (degree of change)				
	No change	Negligible	Minor	Moderate	Major
<b>Very High</b>	Neutral	Slight	<b>Moderate or large</b>	<b>Large or very large</b>	<b>Very large</b>
<b>High</b>	Neutral	Slight	Slight or moderate	<b>Moderate or large</b>	<b>Large or very large</b>
<b>Medium</b>	Neutral	Neutral or slight	Slight	<b>Moderate</b>	<b>Moderate or large</b>
<b>Low</b>	Neutral	Neutral or slight	Neutral or slight	Slight	Slight or moderate
<b>Negligible</b>	Neutral	Neutral	Neutral or slight	Neutral or slight	Slight

Source: DMRB Table 3.8.1 LA 104

**Table 10-9: Significance Categories (Effects) and Typical Descriptions**

Significance Category	Typical Description
Very large	Effects at this level are material in the decision-making process.
Large	Effects at this level are likely to be material in the decision-making process.
Moderate	Effects at this level can be considered to be material decision-making factors.
Slight	Effects at this level are not material in the decision-making process.
Neutral	No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

Source: DMRB Table 3.7 LA 104.

- 10.3.11 The methodology described above has been used to assess the significance for stages including:
- Construction;
  - Operation;
  - Decommissioning; and
  - Cumulative effects.
- 10.3.12 Where possible, each effect has been classified both before and after mitigation measures have been applied. Effects after mitigation are referred to as 'residual effects'.

## 10.4 Baseline Conditions

- 10.4.1 A full description of baseline conditions is provided in the PSSR in Appendix 10A (ES Volume III, Document Ref. 6.4), which contains a detailed Desk Based assessment of Geological and Hydrogeological Conditions across the Site. It includes a CSM, a PRA and an initial assessment of risk to human health and controlled waters. Baseline conditions for each element of the Proposed Development are summarised in the following sections of this chapter for the purposes of assessment of potential impacts, effects and mitigation measures.
- 10.4.2 The PRS provided in the PSSR is in accordance with Phase 1 of the Land Contamination Risk Management guiding principles (Environment Agency, 2020). Environmental impacts to controlled waters are provided on the assumption that confirmatory laboratory testing is carried out as part of future GI works to allow further Generic Quantitative Risk Assessment (GQRA) and Detailed Quantitative Risk Assessment (DQRA) to refine the conceptual model and baseline assumptions, in accordance with the Phase 2 works recommended in the Land Contamination Risk Management guiding principles (Environment Agency, 2020).
- 10.4.3 At the time of writing this Chapter of the ES, scheme specific GI, laboratory testing and contamination assessment was not available. Baseline assessment will need to be reviewed in light of the findings of future GI works undertaken as part of further scheme development, design and construction.
- 10.4.4 Baseline conditions for the proposed development are separated into key scheme elements, as detailed here.
- PCC Site;
  - CO2 Export Pipeline;
  - Water Connection Corridor;
  - CO2 Gathering Network and Natural Gas Connection Corridor; and
  - Electrical Connection Corridor.

### Statutory and Non-Statutory Designated Sites

- 10.4.5 Sensitive land uses identified from the Envirocheck Report within the Site are summarised in Tables 10-10 and are shown on Figure 10-14 (ES Volume II, Document Ref. 6.3).

**Table 10-10: Sensitive Land Use**

Site / Relevant Feature	Description
<b>PCC Site</b>	No areas of Sensitive Land Use are located within the PCC Site.
<b>CO<sub>2</sub> Export Pipeline</b>	
Teesside and Cleveland Coast Ramsar Site (below majority of the Site, approximately 25 ha, approximately 2% of overall Ramsar site area).	Teesmouth And Cleveland Coast Reference: <b>UK11068</b> Total Area (m <sup>2</sup> ): 12537569.88
Teesside and Cleveland Coast Site of Special Scientific Interest (SSSI) (below majority of the Site, approximately 38 ha, 1.3% of overall SSSI area).	Teesmouth And Cleveland Coast Reference: <b>1000263</b> Total Area (m <sup>2</sup> ): 29770346.88
Teesside and Cleveland Coast Special Protection Area (SPA) (as Ramsar site above)	Teesmouth And Cleveland Coast Reference: <b>UK9006061</b> Total Area (m <sup>2</sup> ): 12515083.54
<b>Water Connection Corridor</b>	
Ramsar Site (below majority of the Site, approximately 56 ha, approximately 4.5% of overall Ramsar site area)	Teesmouth And Cleveland Coast Reference: <b>UK11068</b> Total Area (m <sup>2</sup> ): 12537569.88
SPA (as Ramsar above))	Teesmouth And Cleveland Coast Reference: <b>1000263</b> Total Area (m <sup>2</sup> ): 29770346.88
SSSI (below majority of the development site, approximately 65 ha, approximately 2% of overall SSSI site area)	Teesmouth And Cleveland Coast Reference: <b>UK9006061</b> Total Area (m <sup>2</sup> ): 12515083.54
<b>CO<sub>2</sub> Gathering Network and Natural Gas Connection Corridors</b>	
Ramsar Site (infringes below south boundary of the Site only, approximately 1.3 ha, <0.5% of Ramsar site area)	Teesmouth And Cleveland Coast Reference: <b>UK11068</b> Total Area (m <sup>2</sup> ): 12537569.88
SSSI (infringes below south boundary of the Site only, approximately 24 ha, <0.1% of SSSI)	Teesmouth And Cleveland Coast Reference: <b>1000263</b> Total Area (m <sup>2</sup> ): 29770346.88
SSSI (below majority of the Site, approximately 15 ha of SSSI site area)	Seal Sands Reference: <b>1000141</b> Total Area (m <sup>2</sup> ): 210585.36
<b>Electrical Connections Corridor</b>	No areas of Sensitive Land Use are located within the Electrical Connections Corridor.

## Soils – Agricultural Land Classification

- 10.4.6 Information is provided on Defra’s interactive MAGiC online map (n.d) for Agricultural Land Classification (ALC) in the form of Provisional ALC and Post 1988 ALC maps. The Provisional ALC data covers the entire study area, whereas the Post 1988 ALC data shows a localised area in greater detail. Sheet 1 of Figure 10-24 (ES Volume II, Document Ref. 6.3) presents the Site wide Provisional ALC data, and Sheet 2 of Figure 10-24 ( ES Volume II, Document Ref. 6.3) illustrates the Post 1988 ALC data. A summary of the information regarding the agricultural land classification at each key asset of the proposed development is presented in Table 10-11.

**Table 10-11: Agricultural Land Classifications**

Asset	Classification
PCC Site	Underlain by urban and non-agricultural soils giving the soils a Low resource value.
CO <sub>2</sub> Export Pipeline	Coatham Dunes and Sands; classified as non-agricultural soils. These soils are deemed to have a Low resource value.
Water Connection Corridor	Underlain by urban and non-agricultural soils giving the soils a Low resource value.
CO <sub>2</sub> Gathering Network and Natural Gas Connection Corridors	Underlying soils classified primarily as urban soils with recorded areas of non-agricultural, Grade 5 and Grade 4 soils. The urban and non-agricultural soils are categorised with a Low resource value. The Grade 4 and 5 soils fall within a Low resource value.
Electrical Connection Corridor	Classified as urban soils with an area of non-agricultural soils, located south of the PCC Site. The urban and non-agricultural soils are deemed to have a Low resource value.

## Geology

- 10.4.7 The geology beneath the Site is shown on British Geological Survey (BGS) 1:50,000 Sheet 33 Stockton (1987) and Sheet 34 Guisborough (1998). It is also shown on extracts of the BGS 1:50,000 Digital Geological Map of Great Britain that was obtained as part of the Envirocheck Report included within the PSSR, Appendix 10A (ES Volume III, Document Ref. 6.4).
- 10.4.8 BGS 1:50,000 scale mapping reproduced from the BGS digital data is shown on Figures 10-1: Artificial Geology, 10-2: Superficial Geology and 10-3: Bedrock Geology (all ES Volume II, Document Ref. 6.3).
- 10.4.9 A detailed description of the geology of the Site is provided in section 4.2 of the PSSR. Typical depth ranges of the strata proved from available BGS boreholes is included in the PSSR. A summary of this information is provided in Table 10-12.

**Table 10-12: Geology**

No.	Site	Artificial Ground	Superficial Geology	Bedrock Geology
1	<b>PCC Site</b>	Present below the Site	Blown Sand - Sand Tidal Flat Deposits – Sand and Silt Glacio-Lacustrine Deposits Glacial Till	Redcar Mudstone Formation - Mudstone Penarth Group - Mudstone Mercia Mudstone Group - Mudstone Sherwood Sandstone Group
2	<b>CO<sub>2</sub> Export Pipeline</b>	None present.	Beach and Tidal Flat Deposits (Undifferentiated) - Sand Blown Sand - Sand Tidal Flat Deposits – Sand and Silt Glacio-Lacustrine Deposits Glacial Till	Redcar Mudstone Formation - Mudstone
3	<b>Water Connection Corridor</b>	Present below the south of the Site	Beach and Tidal Flat Deposits (Undifferentiated) - Sand Blown Sand – Sand Tidal Flat Deposits – Sand and Silt Tidal Flat Deposits – Sand, Silt and Clay Glacio-Lacustrine Deposits Glacial Till	Redcar Mudstone Formation - Mudstone
4	<b>CO<sub>2</sub> Gathering Network and Natural Gas Connection Corridors</b>	Present either side of the River Tees (including reclaimed areas of Seal Sands, Bran Sands and Saltholme Marsh)	Glaciolacustrine Deposits – Clay and Silt Blown Sand - Sand Tidal Flat Deposits – Sand and Silt Tidal Flat Deposits – Sand, Silt and Clay Peat	Redcar Mudstone Formation - Mudstone Penarth Group - Mudstone Mercia Mudstone Group - Mudstone Sherwood Sandstone Group - Sandstone
5	<b>Electrical Connection Corridor</b>	Present below the south-east of the Site	Glaciolacustrine Deposits, Devensian – Clay and Silt Blown Sand - Sand Tidal Flat Deposits – Sand and Silt Tidal Flat Deposits – Sand, Silt and Clay	Redcar Mudstone Formation - Mudstone

Notes: Based on GIS data layers of 1:50,000 Digital Geological Map of Great Britain reproduced from the Envirocheck Report. The table uses the summary geological descriptions provided in the BGS GIS data layers; and the superficial geology refers to that present at the top of the natural soil succession. The table identifies surface soils and rocks at rock head; soil and rock layers not exposed are not listed. Glacial soils may underlie Blown Sand or Tidal Flat Deposits and not be recorded in the table.

## Geological Features and Minerals

- 10.4.10 There are no recorded Regionally Important Geological Sites (RIGS) or Locally important Geological Sites within the proposed development boundary.
- 10.4.11 RIGS within Redcar and Cleveland outside of the Site include:
- Coatham Rocks – outside of the Site boundary, approximately 0.7 km south east.
  - Redcar Rocks (also a Site of Special Scientific Interest) – outside of the Site boundary, approximately 2.1 km south east.
- 10.4.12 There are no recorded RIGS within Stockton-on-Tees.
- 10.4.13 The Tees Valley has a long history of mineral extraction, the specialist nature of which supported the development of the chemical and steel making industries on the Tees. However, the range of current primary mineral extraction is limited to crushed rock, sand and gravel with some brine extraction at Seal Sands and small-scale clay extraction at Cowpen Bewley. The Tees Valley has relatively few remaining minerals operations.
- 10.4.14 In taking forward minerals development in the plan area, and particularly along the river corridor and the Tees Estuary, any proposals will need to demonstrate that there will be no adverse impact on the integrity of the Teesmouth and Cleveland Coast SPA and Ramsar site.
- 10.4.15 There is one brinefield for the production of salt currently active in the Study Area which is near Seal Sands in Stockton-on-Tees. Two further brinefields in the Seal Sands area have existing planning permissions and two brinefield cavities at Wilton in Redcar and Cleveland have existing permission for extraction under an 'Instrument of Consent'. The Wilton cavities are presently used for gas storage rather than extraction. Information from the BGS indicates brine extraction has limited viability itself, but it is acknowledged that there may be future interest to create storage caverns for gas and other fluids.
- 10.4.16 Permission was granted in 2009 for the extraction of natural gas at Kirkleatham from a Permian limestone reservoir. Permission also exists for the extraction of anhydrite from a deep mine at Billingham (Stockton-on-Tees) although the mine has not been worked since 1971.
- 10.4.17 Ten dormant minerals sites were identified in the Tees Valley, one of which has had new conditions approved for minerals extraction (the anhydrite mine at Billingham). Of the remaining nine, it is now considered that seven of these sites are highly unlikely to ever resume extraction due to recent development, designations or proposed allocations for other uses. Land at the remaining sites at Low Middlesfield Farm and Eaglescliffe Brickworks (Stockton-on-Tees) may require new planning permissions to be approved before they could be reopened.
- 10.4.18 The sterilisation of minerals occurs when other non-minerals developments take place on, or close to, mineral deposits and render them incapable of being extracted. Minerals Planning Statement 1 (DCLG, 2006) states that minerals safeguarding areas should be identified in DPDs to avoid such

sterilisation. Sand and gravel, limestone, potash, salt, gypsum / anhydrite and coal are widespread across the Tees Valley. Whilst the extraction of these resources may not be currently viable for reasons of price, geology, quality and previous extractive work, this situation may change and they may be required at some point in the future. The spatial extent of these deep and shallow resources (excluding certain areas of constraint) are identified as safeguarding areas on the plans in Appendix A and the appropriate areas will be shown on each of the individual planning authority's adopted proposals maps.

- 10.4.19 Appendix C of the Tees Valley Joint Minerals and Waste Development Plan Documents, Core Strategy DPD (Stockton-on-Tees Borough Council, 2011b) indicates Safeguarded Minerals (deep) extending below the whole of the Site (including service corridors) include salt and gypsum (Drawing 27333-r04-May 2010). Safeguarded marine dredged sand and gravel (shallow resources) are present locally at Tees Dock which may extend below the footprint of the CO<sub>2</sub> Gathering Network and Natural Gas Connection Corridors. Tees Dock is also identified as a Safeguarded Wharf (Drawing 27333-r12, May 2010).

### Hydrogeology

- 10.4.20 Figure 10-17 and Figure 10-18 (ES Volume II, Document Ref. 6.3) present the designated superficial and bedrock aquifers below the Site, respectively.
- 10.4.21 The definitions provided by the EA to describe the characteristics of different aquifer designations are provided in Appendix 10A: PSSR Report (ES Volume III, Document Ref. 6.4).
- 10.4.22 Hydrogeological classifications for each area of the Proposed Development are summarised in Table 10-13.
- 10.4.23 There are no Groundwater Dependent Terrestrial Ecosystems (GWDTE) or Source Protection Zones (SPZ 1 to 3) which are likely to be affected by activities within the Site.



**Table 10-13: Hydrogeology**

Relevant Feature	Aquifer Designation	Strata
<b>PCC Site</b>		
Superficial Aquifer Designation	Secondary Aquifer – A	Blown Sand and Tidal Flat Deposits (sand and silt)
	Unproductive Strata	Glacio-lacustrine deposits Till (Diamicton)
Bedrock Aquifer Designation	Principal Aquifer	Sherwood Sandstone Group- Sandstone
	Secondary Aquifer – B	Mercia Mudstone Group and Penarth Group - Mudstone
	Secondary Aquifer – Undifferentiated	Redcar Mudstone Formation - Mudstone
Groundwater Vulnerability	High Vulnerability	
Productivity	Productive	
Source Protection Zones	None (Magic Defra)	
<b>CO<sub>2</sub> Export Pipeline</b>		
Superficial Aquifer Designation	Secondary Aquifer – A	Blown Sand and Tidal Flat Deposits (sand and silt)
	Unproductive Strata	Glacio-lacustrine deposits Till (Diamicton)
Bedrock Aquifer Designation	Principal Aquifer	Sherwood Sandstone Group- Sandstone
	Secondary Aquifer – Undifferentiated	Redcar Mudstone Formation – Mudstone
	Secondary Aquifer - B	Mercia Mudstone Group – Mudstone and Penarth Group - Mudstone
Groundwater Vulnerability	High Vulnerability	
Productivity	Productive	
Source Protection Zones	None (Magic Defra)	
<b>Water Connection Corridor</b>		
Superficial Aquifer Designation	Secondary Aquifer – A	Blown Sand and Tidal Flat Deposits (sand and silt)
	Unproductive Strata	Glacio-lacustrine deposits Till (Diamicton)
Bedrock Aquifer Designation	Principal Aquifer	Sherwood Sandstone Group- Sandstone
	Secondary Aquifer – Undifferentiated	Redcar Mudstone Formation – Mudstone
	Secondary Aquifer - B	Mercia Mudstone Group – Mudstone and Penarth Group – Mudstone

Relevant Feature	Aquifer Designation	Strata
Groundwater Vulnerability	High Vulnerability	
Productive Strata	Productive	
Source Protection Zones	None (Magic Defra)	
<b>CO<sub>2</sub> Gathering Network and Natural Gas Connection Corridors</b>		
Superficial Aquifer Designation	Secondary Aquifer – A Unproductive Strata	Blown Sand and Tidal Flat Deposits (sand and silt) Till (Diamicton) Glaciolacustrine Deposits (clay and silt) and peat
Bedrock Aquifer Designation	Principal Aquifer Secondary Aquifer – Undifferentiated Secondary Aquifer - B	Sherwood Sandstone Group- Sandstone Penarth Group – Mudstone and Redcar Mudstone Formation - Mudstone Mercia Mudstone Group – Mudstone and Penarth Group - Mudstone
Groundwater Vulnerability	High Vulnerability	
Productive Strata	Productive	
Source Protection Zones	None (Magic Defra)	
<b>Electrical Connection Corridor</b>		
Superficial Aquifer Designation	Secondary Aquifer – A Secondary Aquifer – Undifferentiated Unproductive Strata	Glaciofluvial Deposits (sand and gravel), Blown Sand, Tidal Flat Deposits (sand and silt) and Glaciolacustrine Deposits (sand) Till (Diamicton) Glaciolacustrine Deposits (clay and silt)
Bedrock Aquifer Designation	Principal Aquifer Secondary Aquifer – Undifferentiated Secondary Aquifer - B	Sherwood Sandstone Group- Sandstone Redcar Mudstone Formation – Mudstone and Penarth Group - Mudstone Penarth Group – Mudstone and Mercia Mudstone Group - Mudstone
Groundwater Vulnerability	High Vulnerability	
Productive Strata	Productive	
Source Protection Zones	None (Magic Defra)	

## Historical Development

- 10.4.24 The Site has been subject to extensive industrial development since before the date of earliest Ordnance Survey map (1854) with potential contaminative uses present to the current day.
- 10.4.25 The historical development of the Site is discussed in detail in Appendix 10A: PSSR Report (ES Volume III, Document Ref. 6.4). Contaminative uses include iron and steel works, coking works, railways, tar macadam / slag works, brine works, cement manufacture, anhydrite mining, landfill and chemical works with associated buildings, plants, production facilities, pavements, services and waste storage and transfer areas.
- 10.4.26 Historical land uses are provided on the following Figures ( ES Volume II, Document Ref. 6.3).
- Figure 10-5: Quarrying and Landfill
  - Figure 10-6: Waste Management
  - Figure 10-7: Infilled Land - Non-Water
  - Figure 10-8: Infilled Land – Water
  - Figure 10-9: Hazardous
  - Figure 10-10: Contaminated Land – Point – Envirocheck Data
  - Figure 10-11: Contaminated Land – Line – Envirocheck Data
  - Figure 10-12: Contaminated Land – Polygon – Envirocheck Data
  - Figure 10-13: Historic Tanks
  - Figure 10-15: Discharge
  - Figure 10-23: Historical Features (Sheets 1 to 3) – from review of O.S. Mapping
- 10.4.27 A CSM has been prepared and is presented in Appendix 10B (ES Volume III, Document Ref. 6.4) which has been prepared using a Source-Pathway-Receptor model to identify potential pathways by which sources of contamination may impact on receptor.

## Environmental Risk Assessment

- 10.4.28 Based upon the CSM presented in Appendix 10B (ES Volume III, Document Ref. 6.4), an evaluation of the risks posed by the identified potential pollutant linkages at the Site has been prepared and is presented in Appendix 10C (ES Volume III, Document Ref. 6.4).

## Geotechnical Engineering Assessment and Risk Register

- 10.4.29 A Preliminary Engineering Assessment and Geotechnical Risk Register is described in detail within Appendix 10A ES Volume III, Document Ref. 6.4) and is presented in Appendix 10D (ES Volume III, Document Ref. 6.4).
- 10.4.30 The Geotechnical and Engineering risks identified have been reviewed in the Assessment of Potential Impacts and Effects and Mitigation and Enhancement Measures described in Sections 10.6 and 10.7 respectively.

## Summary of Resource Value

10.4.31 This assessment considers the following resources:

- Geology: artificial ground, superficial deposits and bedrock;
- Minerals;
- Hydrogeological aquifer designations;
- Soils and agricultural land classification; and
- Contamination to soils and groundwater.

10.4.32 The results of this assessment are summarised in Table 10-15 with assessment of Impacts, Effects and identified Mitigation Measures are presented in Section 10.6.

## 10.5 Development Design and Impact Avoidance

10.5.1 Measures that have been integrated into the Proposed Development in order to avoid or reduce adverse environmental effects will be described. Such measures may include refinement of the design and layout of the Proposed Development to avoid impacts on sensitive receptors, implementation of Environmental Management Plans (EMP), and adherence to relevant legislation, guidance and best practice. The assessment of impacts and effects has been undertaken on the basis of these measures being implemented (i.e. they are 'embedded mitigation').

10.5.2 Specific measures include building and foundation design, institutional controls for the prevention of contamination associated with operations at the PCC through an Environmental Permit. The use of existing pipeline infrastructure where possible, running along existing pipe racking and using existing culverts and overbridges, to minimise impacts upon ground and groundwater.

10.5.3 In addition, this chapter references the requirement for adherence to the following:

- A Construction Environmental Management Plan (CEMP) in order to mitigate the Magnitude and Significance of potential effects during construction.
- Defra's waste hierarchy guidance in PB530 which gives top priority to preventing waste in the first place. When waste is created, it gives priority to preparing it for re-use, then recycling, then recovery, and last of all disposal (e.g. landfill). The following plans shall be required:
  - A Site Waste Management Plan (SWMP),
  - A Materials Management Plan (MMP);
  - A Hazardous materials management plan including Asbestos; and
  - A Remedial Options Appraisal and Remediation Strategy to set out the measures that will need to be taken to prevent, minimise, remedy or mitigate the effects of any unacceptable risks identified for the Site.

10.5.4 Further detail on mitigation and enhancement measures is presented in Section 10.7.

## 10.6 Likely Impacts and Effects

10.6.1 Prior to development the site will need to be cleared and any remedial works required undertaken by Teesworks as the site owner (with the agreement of the Applicants). The development of a geotechnical remediation strategy will be included in a Foundations Options Study to be developed after the GI has been completed (i.e. later in 2021). For the purposes of this chapter, the remedial works that may be required are assumed to include:

- UXO clearance;
- removal of hotspots of contamination;
- removal of some underground structures;
- backfilling and compaction of voids;
- use of cover systems;
- soil remediation; and
- active groundwater remediation and long-term monitoring.

10.6.2 The Proposed Development may require supporting infrastructure that may impact the geology, hydrogeology and contaminated land within the region of the works. This may include foundation construction (e.g. piles and shallow footings), earthworks and excavations (e.g. foundations and service conduits).

10.6.3 A GI is to be carried out as part of future phases of ground conditions assessment and design. The GI will be specified in accordance with the UK Specification for Ground Investigation (Site Investigation Steering Group, 2012) and carried out in accordance with BS EN 1997-2:2007 (British Standards Institution, 2014).

10.6.4 Further assessment of any existing contamination will be risk-based and will develop upon the initial CSM presented in Appendix 10B (ES Volume III, Document Ref. 6.4). This will also involve further assessment of the contamination sources, receptors and plausible pollutant linkages at the Site, in accordance with government guidance, Contaminated Land Statutory Guidance (Defra, 2012) and the UK framework for the assessment of risk arising from contaminated land. The assessment will take into account principles adopted by the EA in Land Contamination: Risk Management (2020). The significance of impacts will take into account the principles of assessment identified in CIRIA Report C552, (CIRIA, 2011) and EA's guiding principles for land contamination in assessing risks to controlled waters (Environment Agency, 2010).

10.6.5 The majority of the impacts relating to geology, hydrogeology and contaminated land that are expected to arise as a result of the development are anticipated to occur during the remediation and construction stage.

**Table 10-14: Resource Value (Sensitivity)**

Aspect / Criteria	Resource / Receptor	Location / Site	Resource Value / Sensitivity	Justification
<b>Geology – See Figure 10-3 – Bedrock Geology</b>				
<b>Geology Bedrock</b>	Sherwood Sandstone Group - Sandstone	PCC Site CO <sub>2</sub> Export Pipeline Water Connection Corridor CO <sub>2</sub> Gathering Network and Natural Gas Connection Corridors Electrical Connection Corridor	Medium	The Sherwood Sandstone is not a designated RIGS.
<b>Geology Bedrock</b>	Mercia Mudstone Group - Mudstone	PCC Site Water Connection Corridor CO <sub>2</sub> Gathering Network and Natural Gas Connection Corridors Electrical Connection Corridor	Low	The Mercia Mudstone is a non-designated geological exposure.
<b>Geology Bedrock</b>	Penarth Group - Mudstone	PCC Site Water Connection Corridor CO <sub>2</sub> Gathering Network and Natural Gas Connection Corridors Electrical Connection Corridor	Low	The Penarth Group is a non-designated geological exposure.
<b>Geology Bedrock</b>	Redcar Mudstone Formation - Mudstone	PCC Site CO <sub>2</sub> Export Pipeline Water Connection Corridor CO <sub>2</sub> Gathering Network and Natural Gas Connection Corridors Electrical Connection Corridor	Low	The Redcar Mudstone is a non-designated geological exposure.
<b>Geology / Minerals</b>	Concealed Permian Formations - Salt and Gypsum	PCC Site CO <sub>2</sub> Export Pipeline Water Connection Corridor	Medium	There is one brinefield reported in the Tees Value Minerals Core Strategy to be active near Seal Sands (Stockton-on-Tees), although the BGS have suggested this ceased operation in 2002. Two further

Aspect / Criteria	Resource / Receptor	Location / Site	Resource Value / Sensitivity	Justification
		CO <sub>2</sub> Gathering Network and Natural Gas Connection Corridors Electrical Connection Corridor		brinefields in the Seal Sands area have existing planning permissions and two brinefield cavities at Wilton (Redcar and Cleveland) have existing permission for extraction under an 'Instrument of Consent'. Permission also exists for the extraction of anhydrite from a deep mine at Billingham (Stockton-on-Tees) although the mine has not been worked since 1971.
<b>Minerals</b>	Shallow Resources Marine Dredged Sand and Gravel	CO <sub>2</sub> Gathering Network and Natural Gas Connection Corridors (Local to Teesport)	Medium	Safeguarded under the Tees Valley Joint Minerals and Waste Development Minerals and Waste Core Strategy DPD.
<b>Soils – See Figure 10-24 – Agricultural Land Value</b>				
<b>Soils</b>	Agricultural Land Value (measured using the ALC)	PCC Site CO <sub>2</sub> Export Pipeline Water Connection Corridor CO <sub>2</sub> Gathering Network and Natural Gas Connection Corridors Electrical Connection Corridor	Low	Soils are recorded as Grade 4 or 5 and are Non-Agricultural / Urban.
<b>Soils (Topsoil)</b>	Best and Most Versatile Agricultural Land	Not Applicable	N/A	Outside of designated area.
<b>Soils – See Figure 10-1 – Artificial Geology and Figure 10-2 – Superficial Geology</b>				
<b>Soils</b>	Blown Sand and Beach and Tidal Flat Deposits (Undifferentiated - sand)	CO <sub>2</sub> Export Pipeline Water Connection Corridor	High	Soils in sensitive environmental designations of Special Protection Area (SPA), Ramsar and Site of Special Scientific Interest (SSSI) – Teesmouth and Cleveland Coast.

Aspect / Criteria	Resource / Receptor	Location / Site	Resource Value / Sensitivity	Justification
<b>Soils</b>	Tidal Flat Deposits - Sand and Silt	CO <sub>2</sub> Gathering Network and Natural Gas Connection Corridors	Low	Soils supporting non-designated notable or priority habitats. The majority of the Tidal Flat Deposits are exposed south west of the coastline and along the margins of the River Tees. Inland these soils are already overlain by Artificial Ground / Made Ground.
	Tidal Flat Deposits – Sand, Silt and Clay	Electrical Connection Corridor Water Connection Corridor		
<b>Soils</b>	Glaciolacustrine Deposits, Clay and Silt. Glaciofluvial Deposits, Sand and Gravel. Glacial Till, Devensian – Diamicton	Electrical Connection Corridor	Low	Soils supporting non-designated notable or priority habitats.
<b>Groundwater – See Figure 10-17 – Bedrock Aquifer</b>				
<b>Groundwater Contamination</b> (Bedrock)	<b>Principal Aquifer</b> Sherwood Sandstone Group - Sandstone	PCC Site CO <sub>2</sub> Export Pipeline Water Connection Corridor CO <sub>2</sub> Gathering Network and Natural Gas Connection Corridor Electrical Connection Corridors	Very High	Area is outside of any designated Source Protection Zone. Principal Aquifer.  High Vulnerability in the extreme west of the CO <sub>2</sub> Gathering Network as outcrops at surface.  Low Vulnerability over the remainder of the site – because overlain by a thick cover of low permeability superficial deposits, or to the east at subcrop it is overlain by low permeability mudrocks of the Mercia Mudstone Group and / or Penarth Group and / or Redcar Mudstone Formation.



Aspect / Criteria	Resource / Receptor	Location / Site	Resource Value / Sensitivity	Justification
<b>Groundwater Contamination</b> (Bedrock)	<b>Secondary Aquifer – B</b> Penarth Group - Mudstone	PCC Site Water Connection Corridor CO <sub>2</sub> Gathering Network and Natural Gas Connection Corridors Electrical Connection Corridor	Medium	Area is outside of any designated Source Protection Zone. Secondary Aquifer – B  Low Vulnerability over the remainder of the site – because overlain by low permeability superficial deposits (Tidal Flat clays and Diamicton).
<b>Groundwater Contamination</b> (Bedrock)	<b>Secondary Aquifer – B</b> Redcar Mudstone Formation - Mudstone	PCC Site CO <sub>2</sub> Export Pipeline Water Connection Corridor CO <sub>2</sub> Gathering Network and Natural Gas Connection Corridors Electrical Connection Corridor	Medium	Area is outside of any designated Source Protection Zone. Secondary Aquifer – B  Low Vulnerability over the remainder of the site – because overlain by low permeability superficial deposits (Tidal Flat clays and Diamicton).
<b>Groundwater – See Figure 10-18 – Superficial Aquifer</b>				
<b>Groundwater Contamination</b> (Superficial)	<b>Secondary Aquifer - A</b> Blown Sand and Beach and Tidal Flat Deposits (Undifferentiated - sand)	CO <sub>2</sub> Export Pipeline Water Connection Corridor	High	Area is outside of any designated Source Protection Zone. Secondary Aquifer – A  High vulnerability for permeable layers with associated risk of lateral migration (although impermeable layers will limit downward migration of contamination).
<b>Groundwater Contamination</b> (Superficial)	<b>Secondary Aquifer- Undifferentiated</b> Tidal Flat Deposits – Sand and Silt Tidal Flat Deposits – Sand, Silt and Clay	CO <sub>2</sub> Gathering Network and Natural Gas Connection Corridors Electrical Connection Corridor Water Connection Corridor	High	Area is outside of any designated Source Protection Zone. Secondary Aquifer - A  High vulnerability

Aspect / Criteria	Resource / Receptor	Location / Site	Resource Value / Sensitivity	Justification
<b>Groundwater Contamination (Superficial)</b>	<b>Unproductive Strata</b> Glaciolacustrine Deposits, Clay and Silt. Glaciofluvial Deposits, Sand and Gravel. Glacial Till, Devensian – Diamicton	Electrical Connection Corridor	Low	Area is outside of any designated Source Protection Zone. Unproductive Strata
<b>Contamination (Soils)</b>	<b>See Figure 10-10 – Contaminated Land Point, Figure 10-11 - Contaminated Land Line, Figure 10-12 - Contaminated Land Polygon and Figure 10-13 – Tanks</b> (GIS Information provided by Envirocheck – for further details refer to Appendix 10A (ES Volume III, Document Ref. 6.4). <b>See Figure 10-23 (Sheets 1 to 3)</b> – Potential contaminative land used identified from review of historical OS mapping – for further details refer to Appendix 10A).			
<b>Contamination (Soils)</b>	Blown Sand and Beach and Tidal Flat Deposits (Undifferentiated - sand)	CO <sub>2</sub> Export Pipeline Water Connection Corridor	High	Public Open Space.
<b>Contamination (Soils)</b>	Tidal Flats Sand and Silt Tidal Flats – Sand, Silt and Clay	CO <sub>2</sub> Gathering Network and Natural Gas Connection Corridors Electrical Connection Corridor Water Connection Corridor	Low	Extensive existing Highways, Rail and Industrial Land Use. The majority of the Tidal Flat Deposits are exposed south west of the coastline or along the margins of the River Tees. Inland these soils are already overlain by Artificial Ground / Made Ground.
<b>Contamination (Soils)</b>	Glaciolacustrine Deposits, Clay and Silt. Glaciofluvial Deposits, Sand and Gravel. Glacial Till, Devensian – Diamicton	Electrical Connection Corridor	Low	Extensive existing Highways, Rail and Industrial Land use.

## Construction Impacts and Effects

10.6.6 The construction phase of the proposed development could involve activities that may impact upon the geology, hydrogeology and contaminated land at the Site. The construction methodology will be reviewed and considered in relation to potential impacts to ground and groundwater.

10.6.7 Activities that may result in potential impacts to ground and groundwater at the Site (without mitigation) include the following:

- Remedial works, including disturbance and / or removal of the ground and groundwater which could potentially remove, relocate or mobilise potential existing contaminants (e.g. during foundation construction, earthworks and excavations);
- Creation of new Source-Pathway-Receptor linkages (e.g. pile foundation construction through existing Made Ground into underlying natural soils or bedrock, pile foundation construction or excavation through an existing aquiclude (impermeable fine / cohesive soils) into an aquifer (comprised of coarse or sandy soils);
- The mobilisation of existing contaminants via the exposure of soils / increases in rainwater infiltration through changes in ground cover / in excavations or bulk earthworks;
- Changes to the hydrogeological regime (e.g. dewatering activities) may impact groundwater;
- Surface water quantity and quality changes, and potential effects on surface water supplies, surface water run-off and drainage quantity and quality could result due to activities relating to bulk earthworks;
- Activities relating to foundation construction, earthworks and excavations and associated transportation activities have the potential to expose construction workers to potentially contaminated dust;
- On site construction traffic, through compaction of the existing soils, could increase the speed of surface water run-off and increase the potential for erosion and transportation of sediment.
- Potential temporary impacts may result from the accidental leak of fuels and oils from vehicular plant or from stored liquids. Other temporary impacts may also result from the use of materials and substances with polluting potential (e.g. concrete, fuel, oils and soil) which have the potential to be mobilised to ground or controlled waters.

10.6.8 Remediation and construction phase effects (inclusive of mitigation) are summarised in Table 10-15 and includes the following:

### Potential Soil Resource and Agricultural Land Quality

10.6.9 The proposed site for the PCC and the connections corridors are already largely covered in made ground or in industrial land use. Soils are recorded as Grade 4 or 5 and are Non-Agricultural / Urban therefore the construction impact from any loss is considered negligible.

## Geology

- 10.6.10 There are no bedrock exposures or outcrops present within the Site boundary and potential impacts on the underlying geology are primarily related to the potential risk of creating new Source-Pathway-Receptor linkages.

## Mineral Resources

- 10.6.11 The proposed development will not sterilise local mineral resources (salt and gypsum). Mineral resources present are at a depth below the Site and are already primarily covered by existing industrial development. The proposed development does not preclude the potential future extraction of these minerals. Therefore, it is considered that the risk to mineral resources considered is negligible.

## Hydrogeology - Changes to Hydrogeological Regime

- 10.6.12 Excavations and foundations have the potential to disrupt shallow groundwater. Temporary groundwater controls such as dewatering or physical cut-offs may be required to prevent the excavations filling with water, which would be likely to result in the lowering of groundwater levels in the immediate area of the excavation. Existing service ducts and tunnels can also provide preferential flow pathways for groundwater. Dewatering of excavations could result in an adverse risk to groundwater and could also draw contaminated groundwater on site, should any be present.

## Controlled Waters - Contamination

- 10.6.13 Potential effects to groundwater quality could arise from contamination of the Principal and Secondary 'A' Aquifers via the following routes:
- Disturbance and / or removal of the ground and groundwater which could potentially remove, relocate or mobilise potential contaminants; e.g. during foundation construction, earthworks and excavations.
  - Pollution of groundwater (and surface water) could result from concrete, fuel, oil and hydrocarbon spillages. The risk of pollution is greater near to excavations where higher permeability strata are exposed, i.e. close to the River Tees within the Tidal Flat Deposits or across the proposed CO2 Export Pipeline within the Blown Sands.
  - Creation of new potential contaminant linkages, e.g. pile foundation construction through existing made ground into underlying natural soils or bedrock or pile foundation construction / excavation through an existing aquiclude (impermeable fine / cohesive soils) into an aquifer (comprised of coarse or sandy soils).
  - Creation of new potential contaminant linkages or mobilisation of existing contaminants may result from exposure of soils / increases in rainwater infiltration through changes in ground cover / in excavations or bulk earthworks.
  - Changes to the hydrogeological regime and potential mobilisation of contamination into groundwater during construction (and decommissioning) and potential effects on groundwater aquifers, e.g. from dewatering activity required as part of construction.

- Surface water quantity and quality changes during construction (and decommissioning) and potential effects on surface water supplies, surface water run-off and drainage quantity and quality, e.g. during bulk earthworks.

### Operational Impacts and Effects

- 10.6.14 The operational impacts of the proposed development with regards to geology, hydrogeology and contaminated land are associated with the permanent site infrastructure which includes plant and buildings, roadways, service corridors and areas of hardstanding.
- 10.6.15 The potential impacts (without mitigation) that could arise during the operational phase of the proposed development are outlined here and summarised in Table 10-15:
- Permanent soil loss (until the Site is decommissioned) where permanent infrastructure is installed. However, the loss is likely to be negligible given the low quality of the existing soils and the widespread existing industrial development across the former Redcar Steelworks site;
  - Impacts to soil quality, groundwater and watercourses could potentially occur during operation as a result of accidental spills from the handling or leakage of fuels, lubricants, stored chemicals and process liquids; and
  - Receptors may change from the assumed baseline conditions and may include site occupants, commercial users and visitors.

### Decommissioning Impacts and Effects

- 10.6.16 The Power and Capture site will have a design life of 25 years. The Compressor Station, CO<sub>2</sub> Gathering Network and CO<sub>2</sub> Export Pipeline will have a longer design life of up to 40 years.
- 10.6.17 At the end of the operating life of the Low-Carbon Electricity Generating Station it is expected that all above-ground equipment will be decommissioned and removed from the Site.
- 10.6.18 Prevention of contamination is a specific requirement of the Environmental Permit for the operation of the Proposed Development. Therefore, it will be designed so that it will not create any new areas of ground contamination or pathways to receptors as a result of construction or operation.
- 10.6.19 A Decommissioning Plan (including a Decommissioning Environmental Management Plan (DEMP)) will be produced and agreed with the EA as part of the Environmental Permitting and site surrender process. The Decommissioning Environmental Management Plan will consider in detail all potential environmental risks on the Site and contain guidance on how risks can be removed or mitigated. This will include details of how surface water drainage should be managed at the PCC Site during decommissioning and demolition.
- 10.6.20 Decommissioning activities will be conducted in accordance with the appropriate guidance and legislation at the time of the Proposed Development's closure. It is anticipated that a large proportion of the materials resulting from the demolition will be recycled and a record will be

kept in order to demonstrate that the maximum level of recycling and reuse has been achieved.

- 10.6.21 Upon completion of the decommissioning programme, including any remediation works that might be required, the Environment Agency will be invited to witness a post-decommissioning inspection by site staff. All records from the decommissioning process will be made available for inspection by the Environment Agency and other relevant statutory bodies, in accordance with the Environmental Permit requirements.
- 10.6.22 Decommissioning is therefore unlikely to result in impacts exceeding moderate significance on the geology, soils, hydrogeology and contaminated land across site provided that good demolition practice is undertaken.

### **In-Combination Climate Change Impact Assessment**

- 10.6.23 There is inherent uncertainty in climate change projections.
- 10.6.24 There is often uncertainty in the relationship between changes in climate hazards and the respective response in terms of asset performance.
- 10.6.25 The evidence relating to climate change impacts for some categories of assets and infrastructure is limited, e.g. the exact relationship between climate change and groundwater levels and the potential effects on the scheme. In these cases, the assessment has been informed by professional judgement.
- 10.6.26 Design measures to aid in the reduction of carbon include the following:
- Ensuring an approximate earthworks balance on the scheme to minimise import of soils;
  - Ensuring any excess Topsoil will be re-used on site within any landscaping areas; and
  - Designing on-site remedial measures that allow re-use of soils and reduce the requirement for disposal of soils to landfill.
- 10.6.27 Opportunities have been identified in relation to materials used to further lower carbon which may be assessed as the design develops:
- The reduction of material (structures and earthworks) generally through design efficiencies, for example reducing the size of structural elements or cement replacement in concrete (e.g. with pulverised fuel ash or Ground Granulated Blast-furnace Slag); and
  - The replacement of typical materials in pavement construction with lower carbon alternatives, for example recycled plastic, concrete or glass, or the use of cold-rolled products where suitable.

## **10.7 Limitations or Difficulties**

- 10.7.1 Scheme specific GI information is not yet available for the proposed development.
- 10.7.2 Prior to the detailed design of the development, a GI will be undertaken to assess whether there is any localised contamination on site and determine the impacts this may have on site users and the environment. The findings

will feed into the detailed design process and Final CEMP for the proposed development so that appropriate mitigation measures can be taken.

- 10.7.3 If any contamination is found which has not been previously identified, an appropriate risk assessment will be prepared by the landowner with the agreement of the Applicants. Any actions resulting from the risk assessment will be agreed with the local planning authorities along with any remedial measures in consultation with the EA if required. Any remedial works will be undertaken by the landowner with the agreement of the Applicants prior to site handover.

## 10.8 Mitigation and Enhancement Measures

- 10.8.1 Where the Effect is determined to be Moderate or higher mitigation measures are required. Mitigation measures are summarised in the next section and presented in Table 10-15 with residual effects set out in Section 10.8.

### Construction Mitigation

- 10.8.2 Construction phase mitigation measures in relation to the geological and hydrogeological environment are summarised here:

- Prior to the design and construction of the project, a GI will be undertaken to assess the degree to which the Site is contaminated and identify the potential impacts this may have to site users and the environment. The findings will feed into the detailed design process and a Final CEMP prepared and implemented in order to mitigate the effect of the proposed development during construction so that appropriate measures are taken;
- Best practice will be adopted during construction to prevent or reduce as far as reasonably practicable spillage risk and spillage effects by adhering to the Final CEMP. The Final CEMP shall address the management of concrete batching, concrete usage and accidental spillage relating to foundation and building construction;
- The need for piling works for construction of the PCC will be assessed in the Foundation and Remediation Options Study. Piling works would be planned in accordance with best practice guidance 'Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention, EA National Groundwater & Contaminated Land Centre Report NC/99/73. Piling operations would be subject to a Foundation Works risk assessment and prevention of contamination of bedrock would be covered by measures detailed in Piling Method statements. Piled foundations will be designed to not allow migration of contamination into the Sherwood Sandstone Principal Aquifer. Where contaminated soils and elevated groundwater levels are proved by GI and piling is required, consideration is to be given to construction of cased bored piled foundations to remove potential pathway between Made Ground and underlying bedrock. All Piling Activities will be carried out under an appropriate Piling Risk Assessment including groundwater monitoring to ensure risk is managed. If piling is required, low noise piling techniques will be adopted where possible;

- A SWMP and MMP will be implemented to provide suitable controls to facilitate the re-use of materials such as soils and crushed concrete;
- An Asbestos Management Plan will be prepared and implemented. Particular emphasis is placed on this with regards to the development of the PCC;
- If during the course of the development any contamination is found which has not been previously identified, an appropriate risk assessment will be prepared. Any actions resulting from the risk assessment will be agreed with the Local Planning Authorities / Natural England along with any remedial measures. Contamination assessment will be in accordance with the CIRIA C552 - Contamination Land Risk Assessment, A Guide to Good Practice and the Land Contamination Risk Management guidance (Environment Agency, 2020). These remedial measures will be adopted as part of the scheme;
- Where required, there will be ongoing communication with the EA to ensure that construction activities are timed to minimise to the extent reasonably practicable any potential effects on Controlled Waters;
- At the time of writing this report, information on proposed levels and hence requirements for cut and fill activities were not known. It is considered likely that the scheme development will actively work towards achieving an earthworks balance. The suitability of excavated materials for re-use will be assessed as part of the proposed GI works. All earthworks operations will need to be undertaken in accordance with BS6031:2009 (British Standards Institution, 2009) and Highways England guidelines including DMRB Series 600 'Earthworks' (Highways England, 2009);
- Land disturbance will be reduced as far as is reasonably practicable and disturbed areas outside the footprint of the proposed development will be revegetated as soon as possible after construction. Soil excavation will be undertaken with consideration given to the prevailing ground and weather conditions when programming the execution of the works to reduce the potential for mobilisation of exposed soil and / or sediment. Although not anticipated to be widely present, if encountered, topsoil and subsoil will be kept separately during excavation;
- Stockpiled excavation material will be kept to a minimum as far as is reasonably practicable and stored away from watercourses to prevent surface water entering or leaving the stockpile area;
- All areas of stockpiled material may be reseeded or otherwise covered temporarily until restoration activities commence. All areas of unused and exposed soil following reinstatement of the proposed development will be reseeded or otherwise covered as soon as possible. Erosion protection matting may also be used to reduce as far as is reasonably practicable sediment being entrained by water flow or becoming entrained by the wind if allowed to dry out;
- Temporary construction compound areas will be located away from all significant surface water bodies where possible. If the buffer zone has to



be reduced, impermeable liners and bunds will need to be used to prevent materials entering watercourses; and

- Washing out of vehicles or equipment will only take place in controlled areas. Suitable areas will be identified within the Final CEMP and consultation with the EA will take place before construction commences.

10.8.3 Fuels, Oils and Chemicals will be required during construction. Measures to reduce the potential effect from these during construction will include the following:

- The preparation of a map that highlights all potential contamination sources as part of the Final CEMP, SWMP, MMP and AMP;
- The preparation of an inventory of all chemicals, fuels and oils which will be kept up to date and be available on site. Spill contingency plans will be created for each of the items on the inventory. These will be supported by warning notices and appropriate spillage containment equipment and materials at key locations;
- Chemicals, fuels and oils will be stored in secure and designated storage areas in accordance with the appropriate regulatory requirements, including the Control of Pollution (Oil Storage) (England) Regulations 2001 (UK Gov, 2001) and Control of Substance Hazardous to Health (COSHH) Regulations 2002 (UK Gov, 2002). Storage areas will need to be located on hardstanding areas to prevent the possible infiltration of contaminants into soils;
- Re-fuelling of plant will take place in appropriate areas to be agreed in the Final CEMP, i.e. ones that have an impervious base and are bunded or provided with interceptor drains. Spill kits will be kept with all vehicles on site and all bowzers are to be double skinned or have a bund. Vehicles and equipment will not be left unattended during re-fuelling. In order to prevent materials leaking from static plant, such as pumps and generators, static plant will be placed on drip trays wherever practicable;
- All pumps, generators and similarly fuelled equipment will be placed on drip trays or in a bunded area and no vehicles or equipment will be allowed to enter any watercourses at any stage. Refuelling areas will be positioned a minimum of 50 m away from any watercourse or drain. All vehicles, generators and similarly fuelled equipment will be maintained to a high standard to reduce as far as is reasonably practicable potential pollution incidents;
- All valves, hoses and associated re-fuelling equipment will be regularly inspected to ensure that they are still in a suitable condition. This equipment will be protected from vandalism and unauthorised interference and will be turned off and securely locked when not in use;
- All storage of drums containing hazardous material will be located within the temporary construction compound. Any spillages or leaks will be dealt with promptly and all waste disposed of in an appropriate manner. All tanks, drums and other containers will be clearly marked as to their contents. Before any tank is removed or perforated, all contents and residues will be emptied by a competent operator for safe disposal;

- All bunds will have a capacity of at least 110% of the storage volume and will be covered where practical to prevent the collection of rainwater; and
- Any staff involved in fuel handling will be given appropriate training, and site-specific procedures will be developed for all staff. Workers will be made aware of their statutory responsibility under Section 85 of the Water Resources Act 1991 (UK Gov, 1991) not to 'cause or knowingly permit' water pollution. In addition, they will be made aware of their statutory responsibility under Regulations 38(1) and 12(1) of the Environment Permitting Regulations 2010 (UK Gov, 2010) not to 'cause or knowingly permit' a water discharge activity or groundwater activity without an environmental permit.

### Operational Mitigation

10.8.4 Mitigation measures relating to the operational risks identified previously in this report include:

- The PCC Site will be operated under an Environmental Permit regulated by the Environment Agency;
- The implementation of standard industry practices will be adopted to mitigate potential impacts from accidental spills or leaks;
- The storage and handling of processed chemicals will be undertaken in properly surfaced and bunded areas;
- Implementation of rapid spill response planning and training;
- The preparation and implementation of a groundwater quality monitoring plan; and
- The preparation and implementation of a land quality monitoring plan.

### Decommissioning Mitigation

10.8.5 The decommissioning phase is anticipated to involve the removal of all above surface structures and service corridors including buried services, followed by reinstatement of ground to a condition suitable for future re-use. Potential effects during the decommissioning phase will be broadly similar to those during the construction phase described above and additionally include, potential changes to receptors and the need to address impacts and effects from production of bulk wastes from demolition of buildings and hardstanding to be recycled for re-use.

## 10.9 Cumulative Effects

10.9.1 A cumulative impact may arise where the construction, operation or decommissioning of other planned projects or developments interact with those impacts associated with the Proposed Development to result in a greater significance of effect on environmental receptors.

10.9.2 Other developments considered in this cumulative assessment are described in Chapter 24: Cumulative and Combined Effects (ES Volume I, Document Ref. 6.2) and illustrated on Figure 24-2 and Figure 24-3 (ES Volume II, Document Ref. 6.3). The cumulative developments, alongside the Proposed

Development, would not result in effects that are greater than those reported in this ES.

- 10.9.3 Potential cumulative developments included in the refined short list (see Table 24-5, Chapter 24, ES Volume I, Document Ref. 6.2) which are within the 500 m zone of influence of the construction works associated with the development on the PCC Site and the Natural Gas Connection Corridor, CO<sub>2</sub> Gathering Network Corridor, Electrical Connection Corridor and Water Connection Corridors are:
- Teesworks Developments:
    - 66. Demolition and site clearance
    - 85. The Foundry;
    - 86. Long Acres; and
    - 87. Steel House
  - 77. Redcar Energy Centre
  - York Potash Developments:
    - 2. Wharf/Jetty Facilities; and
    - 27. Conveyor.
- 10.9.4 As evidenced by Condition 3 in Planning Permission R/2020/0411/FFM for the Redcar Energy Centre, this development, along with the Teesworks Developments, will not commence until the following have been carried out to the satisfaction of the Local Planning Authority:
- Site characterisation comprising an investigation and risk assessment, including inter alia assessment risks to human health, property (existing or proposed), groundwater and surface water and ecological systems;
  - Submission and approval of a detailed remediation scheme to bring the sites to a condition suitable for intended use by removing unacceptable risks to human health, buildings and other property and the natural and historic environment; and
  - Implementation of the approved remediation scheme prior to the commencement of development.
- 10.9.5 The scale of the Teesworks developments means that foundation works are unlikely to require piling. It is assumed that piling risk associated with the construction of the Redcar Energy Centre would be managed in accordance with a Code of Construction Practice as set out in the Environmental Statement for that development. It is assumed that this will contain a piling risk assessment.
- 10.9.6 The NZT development and the York Potash developments will be carried out in accordance with the requirement of their respective DCOs and as such will mitigate any risks associated with land contamination.
- 10.9.7 As such, risks associated with land contamination will be managed so that significant cumulative effects on human health or environmental receptors do not occur.

## 10.10 Residual Effects and Conclusion

10.10.1 Residual permanent effects are provided in Table 10-15. The majority of the effects (inclusive of mitigation) are shown to be Neutral/Slight (adverse).

**Table 10-15: Magnitude of Impact and Residual Effects**

Development Stage	Aspect / Resource	Resource Value / Sensitivity (Table 10-14)	Impact	Magnitude of Impact inclusive of embedded mitigation	Mitigation measure	Residual effect	Nature of effect(s)
Note: Lt = long term, Mt = medium term, St = short term, P = permanent, T = temporary							
Construction	<b>Geology</b> Sherwood Sandstone	<b>Very High</b>	Foundations	Negligible	GI is required to confirm Baseline Assumptions.  Piled foundations will be designed to not allow not allow migration of contamination into the Sherwood Sandstone Principal Aquifer	Slight (Adverse)	P
Construction	<b>Geology</b> Redcar Mudstone Formation - Mudstone Penarth Group - Mudstone Mercia Mudstone Group - Mudstone	Low	Use of trenchless technologies through mudstones to form crossing below the River Tees. Spoil generated from construction.	Minor	GI is required to confirm Baseline Assumptions.  All earthworks operations will need to be undertaken in accordance with BS6031:2009 'Code of Practice for Earthworks' and HE guidelines including DMRB Series 600 'Earthworks'.  Scheme will actively work towards achieving an earthworks balance.	Neutral or Slight (Adverse)	T
Construction	<b>Minerals - Deep Resources</b> Salt and Gypsum	<b>Medium</b>	Sterilisation of minerals. Non-minerals developments take place on, or close to, mineral deposits and render them incapable of being extracted. Development to take place across an area defined in the Tees Valley Joint Minerals and	Minor	Minerals are at depth and are already primarily covered by existing development.  The proposed development does not preclude the future extraction of these minerals	Slight (Adverse)	P

Development Stage	Aspect / Resource	Resource Value / Sensitivity (Table 10-14)	Impact	Magnitude of Impact inclusive of embedded mitigation	Mitigation measure	Residual effect	Nature of effect(s)
			Waste Development Plan Core Strategy as protected to allow for future Gypsum and Salt extraction.				
Construction	<b>Minerals - Shallow Resources</b> Marine Dredged Sand and Gravel	<b>Medium</b>	Safeguarded under the Tees Valley Joint Minerals and Waste Development Minerals and Waste Core Strategy DPD.	Minor	Use trenchless technologies in Diamicton or bedrock	Slight (Adverse)	T
Construction	<b>Soils</b> Agricultural Land Classification	<b>Low</b>	Excavation Removal	Minor	Soils to be stockpiled and re-used within landscaping areas.	Slight (Adverse)	P
Construction	<b>Soils</b> (General)	<b>Medium</b>	Spoil resulting from excavations and earthworks.	Minor	GI is required to confirm Baseline Assumptions.  All earthworks operations will need to be undertaken in accordance with BS6031:2009 'Code of Practice for Earthworks' and HE guidelines including DMRB Series 600 'Earthworks'. Scheme will actively work towards achieving an earthworks balance.	Slight (Adverse)	T
Construction	<b>Groundwater – (Bedrock Contamination)</b> Principal Aquifer Sherwood Sandstone Group - Sandstone	<b>Very High</b>	Changes to Hydrogeological Regime. Mobilisation of contaminants during construction.	Negligible	GI and groundwater level and quality to confirm Baseline assumptions.  The need for piling works for construction of the PCC will be assessed in the Foundation and Remediation Options Study. Piling	Slight (Adverse)	P/T

Development Stage	Aspect / Resource	Resource Value / Sensitivity (Table 10-14)	Impact	Magnitude of Impact inclusive of embedded mitigation	Mitigation measure	Residual effect	Nature of effect(s)
					<p>works would be planned in accordance with best practice guidance '<i>Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention, EA National Groundwater &amp; Contaminated Land Centre Report NC/99/73</i>. Piling operations would be subject to foundation works risk assessment and prevention of contamination of bedrock would be covered by measures detailed in piling method statements. Piled foundations will be designed to not allow migration of contamination into the Sherwood Sandstone Principal Aquifer. Where contaminated soils and elevated groundwater levels are proved by GI and piling is required, consideration to be given construction of cased rotary bored piled foundations to remove potential pathway between Made Ground and underlying bedrock. All Piling Activities will be carried out under an appropriate Piling Risk Assessment including groundwater monitoring to ensure risk is managed.</p>		

Development Stage	Aspect / Resource	Resource Value / Sensitivity (Table 10-14)	Impact	Magnitude of Impact inclusive of embedded mitigation	Mitigation measure	Residual effect	Nature of effect(s)
Construction	<b>Groundwater (Bedrock Contamination)</b> Secondary Aquifer – B Mercia Mudstone Group – Mudstone Penarth Group - Mudstone	<b>Medium</b>	Changes to Hydrogeological Regime. Mobilisation of contaminants if piling through potentially contaminated superficial soils into underlying bedrock aquifer.	Minor	<p>GI and groundwater level and quality to confirm Baseline assumptions.</p> <p>The need for piling works for construction of the PCC will be assessed in the Foundation Options Study informed by the results of the Ground Investigation and controlled waters risk assessment.</p> <p>Piling works would be planned in accordance with best practice guidance '<i>Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention, EA National Groundwater &amp; Contaminated Land Centre Report NC/99/73</i>'. Piling operations would be subject to foundation works risk assessment and prevention of contamination of bedrock would be covered by measures detailed in piling method statements. Piled foundations will be designed to not allow migration of contamination into the Sherwood Sandstone Principal Aquifer.</p> <p>Where contaminated soils and elevated groundwater levels are proved by GI and piling is required, consideration to be given</p>	Slight (Adverse)	P



Development Stage	Aspect / Resource	Resource Value / Sensitivity (Table 10-14)	Impact	Magnitude of Impact inclusive of embedded mitigation	Mitigation measure	Residual effect	Nature of effect(s)
					<p>construction of cased rotary bored piled foundations to remove potential pathway between Made Ground and underlying bedrock. All Piling Activities will be carried out under an appropriate Piling Risk Assessment including groundwater monitoring to ensure risk is managed.</p>		
Construction	<p><b>Groundwater (Bedrock Contamination)</b></p>	<p><b>Medium</b></p>	<p>Impact as above.</p>	<p>Minor (Adverse)</p>	<p>GI and groundwater level and quality to confirm Baseline assumptions.</p>	<p>Slight (Adverse)</p>	<p>P</p>

Development Stage	Aspect / Resource	Resource Value / Sensitivity (Table 10-14)	Impact	Magnitude of Impact inclusive of embedded mitigation	Mitigation measure	Residual effect	Nature of effect(s)
	Secondary Aquifer – B Penarth Group - Mudstone				Pile mitigation measures as above.		
Construction	<b>Groundwater – (Bedrock Contamination)</b> Secondary Aquifer – Undifferentiated Redcar Mudstone Formation - Mudstone	<b>Medium</b>	Impact as above.	Minor (Adverse)	GI and groundwater level and quality to confirm Baseline assumptions.  Pile mitigation measures as above.	Slight (Adverse)	P
Construction	<b>Groundwater – (Soil Contamination) Secondary Aquifer - A</b> Blown Sand and Beach and Tidal Flat Deposits (Undifferentiated)	<b>High</b>	Potential mobilisation of existing contaminants during construction. New contaminant pathways or mobilisation of existing contaminants may result from exposure of soils / increases in rainwater infiltration through changes in ground cover / in excavations.	Minor (Adverse)	Development of and adherence to the Final CEMP. Groundwater monitoring during construction.	Slight (Adverse)	T
Construction	<b>Groundwater – (Soil Contamination) Secondary Aquifer-Undifferentiated</b> Tidal Flat Deposits – Sand and Silt	<b>High</b>	Potential mobilisation of existing contaminants during construction. New contaminant pathways or mobilisation of existing contaminants may result from exposure of soils / increases in rainwater infiltration through	Minor (Adverse)	Development of and adherence to the Final CEMP. Groundwater monitoring during construction.	Slight (Adverse)	T

Development Stage	Aspect / Resource	Resource Value / Sensitivity (Table 10-14)	Impact	Magnitude of Impact inclusive of embedded mitigation	Mitigation measure	Residual effect	Nature of effect(s)
	Tidal Flat Deposits – Sand, Silt and Clay		changes in ground cover / in excavations.				
Construction	<b>Contamination (Soils)</b> Tidal Flat Deposits - Sand and Silt Tidal Flat Deposits – Sand, Silt and Clay  <b>Contamination (Soils)</b> Glaciolacustrine Deposits, Clay and Silt. Glaciofluvial Deposits, Sand and Gravel. Glacial Till, Devensian – Diamicton	<b>High</b>	Potential contaminant pathways within PCC Site are reduced or removed by construction of remedial works including clean cover or capping layer as well as through construction of new structures, hardstanding, pavements over existing contaminated soils. Infiltration and pathways are reduced.	Minor (beneficial)	Note DMRB LM 104, Sustainability & Environment Appraisal, does not include for a Magnitude category 'Beneficial' category.  However, any remedial works by the site owner, such as placement of clean cover, soil treatment, soil stabilisation, removal of localised 'hotspots' of identified contamination would provide improvement to the existing condition.  GI and soils testing is required to quantify potential contamination and confirm Baseline Assumptions and will be undertaken by the landowner prior to hand-over of the site to the Applicants.	Neutral or slight (Beneficial)	P
Construction	<b>Contamination (Soils)</b> Tidal Flat Deposits - Sand and Silt Tidal Flat Deposits – Sand, Silt and Clay	<b>High</b>	Potential contaminant pathways to controlled waters during pipeline construction work in CO2 Gathering Network.  Impacts on soil quality arising from accidental spills resulting	Minor (beneficial)	Development and implementation of the Final CEMP including pollution control and avoidance measures.	Neutral or slight (Beneficial)	P

Development Stage	Aspect / Resource	Resource Value / Sensitivity (Table 10-14)	Impact	Magnitude of Impact inclusive of embedded mitigation	Mitigation measure	Residual effect	Nature of effect(s)
	<b>Contamination (Soils)</b> Glaciolacustrine Deposits, Clay and Silt. Glaciofluvial Deposits, Sand and Gravel. Glacial Till, Devensian – Diamicton		from handling or leakage of fuels, lubricants or chemicals.				
Operation	<b>Contamination (Soils)</b> (Blown Sand and Beach and Tidal Flat Deposits (both types))	<b>High</b>	Impacts on soil quality could potentially occur during operation caused by accidental spills resulting from handling or leakage of fuels, lubricants, stored chemicals and processed liquids.	Minor	Storage and handling of processed chemicals to be undertaken in properly surfaced and bunded areas.  All bunded area will provide 110% of stored volume and constructed with impermeable materials.  Rapid spill response planning and training and the implementation of SWMP, MMP and AMP.	Slight (Adverse)	P
Operation	<b>Groundwater – (Bedrock Contamination)</b> Principal Aquifer / Secondary A / B Aquifer	<b>Medium - Very High</b>	Impacts on groundwater and watercourses could potentially occur during operation caused by accidental spills resulting from handling or leakage of fuels,	Negligible	Storage and handling of processed chemicals to be undertaken in properly surfaced and bunded areas.	Slight (Adverse)	P

Development Stage	Aspect / Resource	Resource Value / Sensitivity (Table 10-14)	Impact	Magnitude of Impact inclusive of embedded mitigation	Mitigation measure	Residual effect	Nature of effect(s)
			lubricants, stored chemicals and processed liquids		All bunded area will provide 110% of stored volume and constructed with impermeable materials.  Rapid spill response planning and training and the implementation of SWMP, MMP.		
Decommissioning	<b>Contamination (Soils)</b>	<b>Medium</b>	<b>Excavation of materials / soil removal</b> Demolition workers exposed to historic and current potentially contaminated soil sources on Site	Minor	Implementation of DEMP, SWMP, MMP and AMP.	Slight (Adverse)	T
Decommissioning	<b>Contamination (Soils)</b>	<b>Medium</b>	<b>Accidental spills.</b> Impacts on soil quality could potentially occur during decommissioning caused by accidental spills resulting from handling or leakage of fuels, lubricants, stored chemicals and processed liquids.	Minor	Implementation of DEMP, SWMP, MMP and AMP.	Slight (Adverse)	T
Decommissioning	<b>Groundwater – (Bedrock Contamination)</b> Principal Aquifer / Secondary - B Aquifer	<b>Medium - Very High</b>	Impacts on groundwater could potentially occur during decommissioning caused by removal of pile caps, accidental spills resulting from handling or leakage of fuels, lubricants, stored chemicals and processed liquids	Negligible	Implementation of DEMP, SWMP, MMP and AMP.	Slight (Adverse)	T

Development Stage	Aspect / Resource	Resource Value / Sensitivity (Table 10-14)	Impact	Magnitude of Impact inclusive of embedded mitigation	Mitigation measure	Residual effect	Nature of effect(s)
Decommissioning	<b>Groundwater - (Superficial Contamination)</b> Secondary Aquifer - A / Secondary Aquifer - Undifferentiated	<b>High</b>	Impacts on groundwater and watercourses could potentially occur during decommissioning caused by removal of pile caps, accidental spills resulting from handling or leakage of fuels, lubricants, stored chemicals and processed liquids	Minor	Implementation of DEMP, SWMP, MMP and AMP.	Slight (Adverse)	T
Decommissioning	<b>Soils (General)</b>	<b>Medium</b>	Export, excavation, stockpiling, redistribution and / or removal of Made Ground	Minor	All earthworks operations will need to be undertaken in accordance with BS6031:2009 'Code of Practice for Earthworks' and HE guidelines including DMRB Series 600 'Earthworks'.	Slight (Adverse)	T

## 10.11 References

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