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10. Geology, Hydrogeology and Contaminated Land

10.1 Introduction

- 10.1.1 This chapter assesses the potential for significant effects of the Proposed Development on geology, soils and contaminated land arising from construction, operation 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 help mitigate these potential effects. This chapter references the requirement for development and adherence to the following:
- A Construction Environmental Management Plan (CEMP) in order to mitigate the Magnitude and Significance of potential effects during construction.
 - In order to follow 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); and
 - A Hazardous materials management plan including Asbestos.
- 10.1.3 Baseline information has been established through desk based assessment. A preliminary sources study report (PSSR) has been prepared and is appended to this report as Appendix 10A: Preliminary Sources Study Report (PEI Report, Volume III). This was prepared in accordance with the following:
- Design Manual for Roads and Bridges (DMRB), Highways England (HE) Design Note HD 22/08 Managing Geotechnical Risk (Highways Agency, 2008);
 - Land Contamination: Risk Management (Environment Agency, 2019);
 - Model Procedures for the Management of Contaminated Land CLR11 (Environment Agency, 2004);
 - 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).

- 10.1.4 Figures 10-1 to 10-25 which accompany this assessment can be found in PEI Report, Volume II.
- 10.1.5 It is noted that that no scheme specific ground investigation (GI) has been undertaken. A GI will be required to verify the baseline conditions and assumptions obtained from the desk based assessment included in the PSSR (Appendix 10A: PEI Report, Volume III).
- 10.1.6 It is considered the results of any GI will be used to aid further phases of design and layout for the proposed development, and therefore a degree of flexibility in the layout of structures, foundations, pavements and service corridors is recommended.
- 10.1.7 Prior to development the site will need to be cleared and remedial works undertaken. The development of a geotechnical remediation strategy will be included in a Foundations and Remediations Options Study which will be prepared in advance of the DCO application and will be summarised in the ES. For the purposes of this PEI Report, the remedial works that may be required include:
- UXO clearance;
 - removal of hotspots of contamination;
 - removal of some underground structures;
 - backfilling and compaction of voids; and
 - use of cover system(s).
- 10.1.8 The Preliminary Risk Assessment (PRA) provided in the PSSR is in accordance with Phase 1 of the guiding principles provided in GPLC1 (Environment Agency, 2010). 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 Phase 2 works recommended in GPLC1 (Environment Agency, 2010).
- 10.1.9 Similarly, a GI and groundwater level monitoring will be required to inform the further phases of development design and construction methods. Construction methods will need to be considered to ensure that they do not create a significant new pathway, for groundwater flow and transport to underlying aquifers or the River Tees. Construction methods will also need to be considered to minimise the risk of mobilisation of any existing contaminants, for example through exposure of soils/ increases in rainwater infiltration through changes in ground cover/ in excavations.

10.2 Legislation and Planning Policy Context

- 10.2.1 EU and UK legislation relevant to the geological and hydrogeological environment is listed in Table 10-1.

Table 10-1: Relevant EU and UK Legislation

Scale	Legislation
EU	Dangerous Substances Directive, 2006/11/EC
	Environmental Liability Directive, 2004/35/EC
	Water Framework Directive 2000/60/EC
	Groundwater Daughter Directive 2006/118/EC
UK	Anti-Pollution Works Regulations 1999
	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) Regulations 2010

EU Legislation

10.2.2 The key pieces of EU Legislation which may impact geology, hydrogeology and contaminated land are presented in Table 10-2.

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

Scale	Legislation	Summary
EU	The Environmental Liability Directive (2004/35/EC)	Regards prevention and remedying of environmental damage Establishes a framework based on the “polluter pays” principle to prevent and remedy environmental damage

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

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

Scale	Legislation	Summary
EU	Water Framework Directive 2000/60/EC	<p>Framework for the community action in the field of water policy</p> <p>Main objective is for all groundwater, surface water and coastal water bodies to achieve 'good' status by 2015</p> <p>Includes broader ecological objectives as well as aims to prevent deterioration of all water bodies</p> <p>Must be considered in any scheme that has the potential to have an impact on any part of the water environment</p>
	Groundwater Daughter Directive 2006/118/EC	<p>Classifies groundwater bodies, establishes pollutant threshold values, and identifies trends and starting points for their reversal</p>

UK Legislation

10.2.4 The key pieces of UK Legislation which may impact geology, hydrogeology and contaminated land are presented in Table 10-4.

Table 10-4: Relevant UK Legislation (geology, hydrogeology and contaminated land)

Scale	Legislation	Summary
UK	Environmental Protection Act 1990	<p>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:</p> <p>significant harm is being caused or there is significant possibility of such harm being caused; or</p> <p>significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused."</p>

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 10-5.

Table 10-5: Relevant National, Regional and Local Planning Policy

Scale	Planning Policy	Summary
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>Policy MWC1: Minerals Strategy - 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> <p>Identifying minerals resources underlying the Tees Valley and protecting them from unnecessary sterilisation by built development;</p> <p>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.</p> <p>Policy MWC4: Safeguarding of Minerals Resources from Sterilisation - Within the minerals safeguarding areas, non-minerals development will only be permitted in the following circumstances:</p>

Scale Planning Policy

Summary

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 PINS has been consulted along with other statutory consultees and non-statutory consultees through the iterative EIA and design process. Further consultation with Local Authorities and relevant stakeholders may be required as the EIA is progressed. The Scoping Opinion received from the Secretary of State (SoS) for Geology and Hydrogeological aspects has identified the aspects presented in Table 10-6 as being necessary to be included within the ES prepared to support the DCO application and which are therefore assessed within this PEI Report.

Table 10-6: Scoping Opinion – Geology and Hydrogeology

Aspect	Scoping Opinion	Comment
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
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>
Desk based assessment	<p>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 EA's guiding principles for land contamination in assessing risks to controlled waters.</p>	<p>Refer to Section 10.4 and PSSR included as Appendix 10A: Preliminary Sources Study Report.</p>
Baseline – connection corridors	<p>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.</p>	<p>See Table 10-15 for assessment of Effects</p>
Baseline – connection corridors	<p>Should the River Tees be crossed by tunnelling methodology, information should be provided on the storage and disposal of spoil from these works.</p>	<p>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).</p>

Aspect	Scoping Opinion	Comment
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.	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 and Remediation Options Report.
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.

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 Conceptual Site Model (CSM) is provided in the PSSR included as Appendix 10A: Preliminary Sources Study Report (PEI Report, Volume III) 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 10-7.

10.3.6 Resources assessed to have a Value (sensitivity) of **Medium or Higher** are assessed against potential Impacts, Effects and Mitigation Measures in Section 10.6 (Table 10-15) and 10.7 to 10.9 (Table 10-16).

Table 10-7: Estimating Value (sensitivity) of Resources

Receptor Value (sensitivity) Importance	Criteria	Aspect	Typical Examples
Very High	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.
High	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 SPZ2.
Medium	Of regional importance with limited potential for replacement. Geology meeting regional designation citation criteria which is not designated as such.	Geology	Regionally Important Geological Sites.

Receptor Value (sensitivity) Importance	Criteria	Aspect	Typical Examples
	Soils supporting non-statutory designated sites.	Soils	Local Nature Reserves (LNR), Local Geological Sites (LGS), Sites of 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.
Low	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
Negligible	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 10-8. 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 10-9.

Table 10-8: Estimating the Magnitude of Impact on a Resource

Magnitude	Criteria	Aspect	Typical Description
Major	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.
	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.	Contamination	Contamination heavily restricts future use of land;
Major Adverse	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.
Moderate	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)

Magnitude	Criteria	Aspect	Typical Description
			and restriction to current or approved future use e.g. through degradation, compaction, erosion of soil resource.
	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.
Moderate Adverse	Results in effect on integrity of attribute, or loss of part of attribute	Groundwater	Partial loss or change to an aquifer. Degradation of regionally important public water supply or loss of significant commercial/ industrial/ agricultural supplies. Potential medium risk of pollution to groundwater from routine runoff - risk score 150-250. Calculated risk of pollution from spillages $\geq 1\%$ annually and $< 2\%$ annually. Partial loss of the integrity of GWDTE. Contribution to reduction in water body WFD classification. Damage to major structures through subsidence or similar effects or loss of minor structures.
Minor	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.

Magnitude	Criteria	Aspect	Typical Description
Minor Adverse	Results in some measurable change in attributes, quality or vulnerability.	Groundwater	Potential low risk of pollution to groundwater from routine runoff - risk score <150. Calculated risk of pollution from spillages $\geq 0.5\%$ annually and <1% annually. Minor effects on an aquifer, GWDTEs, abstractions and structures.
Negligible	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.
Negligible	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%.
Minor beneficial	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.
Moderate beneficial	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.
Major beneficial	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
No Change	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

Magnitude	Criteria	Aspect	Typical Description
			approved future use.
	Human health: reported contaminant concentrations below background levels.	Contamination	No intervention required.
No Change	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 10-9 and 10-10, respectively.

Table 10-9: Significance (Effect) Matrix

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

Source: DMRB Table 3.8.1 LA 104

Table 10-10: 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 Appendix 10A, 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 scheme are summarised in the following sections of this chapter for the purposes of assessment of potential impacts, effects and mitigation measures.

10.4.2 At the time of writing this report, 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.

10.4.3 Baseline conditions for the proposed development are separated into key scheme elements, as detailed here.

- PCC;
- CO₂ Export Pipeline;
- Water Connection Corridors;
- CO₂ Gathering Network and Natural Gas Connection Corridor (includes crossing beneath the River Tees using trenchless technologies); and
- Electrical Connection Corridor.

Statutory and Non-Statutory Designated Sites

10.4.4 Sensitive land uses identified from the Envirocheck Report within the Site are summarised in Table 10-11 and are shown on Figure 10-14.

Table 10-11: Sensitive Land Use

Site / Relevant Feature	Description
PCC	No areas of Sensitive Land Use are located within the PCC.
CO₂ Export Pipeline	
Ramsar Site (below majority of the Site, approximately 25 ha, approximately 2% of overall Ramsar site area).	Teesmouth And Cleveland Coast Reference: UK11068 Total Area (m ²): 12537569.88
SSSI (below majority of the Site, approximately 38 ha, 1.3% of overall SSSI area).	Teesmouth And Cleveland Coast Reference: 1000263 Total Area (m ²): 29770346.88
SPA (as Ramsar site above)	Teesmouth And Cleveland Coast Reference: UK9006061 Total Area (m ²): 12515083.54
Water Connection Corridors	
Ramsar Site (below majority of the Site, approximately 56 ha, approximately 4.5% of overall Ramsar site area)	Teesmouth And Cleveland Coast Reference: UK11068 Total Area (m ²): 12537569.88
SPA (as Ramsar above))	Teesmouth And Cleveland Coast Reference: 1000263 Total Area (m ²): 29770346.88
SSSI (below majority of the development site, approximately 65 ha, approximately 2% of overall SSSI site area)	Teesmouth And Cleveland Coast Reference: UK9006061 Total Area (m ²): 12515083.54
CO₂ Gathering Network and Natural Gas Connection Corridors	
National Nature Reserve (infringes below south boundary of the Site only)	Teesmouth Reference: 1006937 Total Area (m ²): 3625243.52
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: UK11068 Total Area (m ²): 12537569.88
SSSI (infringes below south boundary of the Site only, approximately 24 ha, <0.1% of SSSI)	Teesmouth And Cleveland Coast Reference: 1000263 Total Area (m ²): 29770346.88
SSSI (below majority of the Site, approximately 15 ha of SSSI site area)	Seal Sands Reference: 1000141 Total Area (m ²): 210585.36
Electrical Connections Corridor	
SSSI (east of site area, as SSSI below CO ₂ Connectivity and Natural Gas Connection Corridor above, area below Electrical corridor <0.5%)	Teesmouth And Cleveland Coast Reference: 1000263 Total Area (m ²): 29770346.88

Soils – Agricultural Land Classification

10.4.5 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. Figure 10-24 (Sheet 1) presents the Site wide Provisional ALC data, and Figure 10-24 (Sheet 2) illustrates the Post 1988 ALC data (both PEI Report, Volume II). A summary of the information regarding the agricultural land classification at each key asset of the proposed development is presented in Table 10-12.

Table 10-12: Agricultural Land Classifications

Asset	Classification
PCC	Underlain by urban and non-agricultural soils giving the soils a Low resource value.
CO ₂ Export Pipeline	Coatham Dunes and Sands; classified as non-agricultural soils. These soils are deemed to have a Low resource value.
Water Connections Corridor	Underlain by urban and non-agricultural soils giving the soils a Low resource value.
CO ₂ Gathering Network and Natural Gas Connection Corridors	Classified primarily of urban soils with recorded areas of non-agricultural, Grade 5 and Grade 4 soils. The Provisional ALC map indicates a minor section of the western corridor to be classified as Grade 3 (assumed 3a) 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. The Grade 3, assumed Grade 3a, is given a High resource value.
Electrical Connection Corridor	Classified as urban soils with an area of non-agricultural soils, located south of the PCC. A section of the eastern boundary, situated between Dormanstown and Wilton International and north of Kirkleatham, is classified as Grade 2 soils. The Post 1988 ALC map classifies the soils in this area as a combination of Grade 2, Grade 3a, Grade 3b and other. The urban, non-agricultural and other soils are deemed to have a Low resource value. The Grade 2, 3a, 3b soils are categorised as Medium to Very High resource values.

Geology

10.4.6 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 (PEI Report, Volume III).

10.4.7 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 (PEI Report, Volume II).

10.4.8 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 as Table 6 of the PSSR. A summary of this information is provided in Table 10-13.

Table 10-13: Geology

No.	Site	Artificial Ground	Superficial Geology	Bedrock Geology
1	PCC	Present below the Site	Blown Sand - Sand Tidal Flat Deposits – Sand and Silt	Redcar Mudstone Formation - Mudstone Penarth Group - Mudstone Mercia Mudstone Group - Mudstone
2	CO₂ Export Pipeline	Present below the south and centre of the Site	Beach and Tidal Flat Deposits (Undifferentiated) - Sand Blown Sand - Sand Tidal Flat Deposits – Sand and Silt	Redcar Mudstone Formation - Mudstone Penarth Group - Mudstone Mercia Mudstone Group - Mudstone
3	Water Connections Corridors	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	Redcar Mudstone Formation - Mudstone Penarth Group - Mudstone Mercia Mudstone Group - Mudstone
4	CO₂ Gathering Network and Natural Gas Connection Corridors	Present either side of the River Tees (including reclaimed areas of Seal Sands, Bran Sands and Saltholme Marsh)	Till, Devensian - Diamicton 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	Electrical Connection Corridor	Present below the south-east of the Site	Till, Devensian - Diamicton Glaciofluvial Deposits, Devensian – Sand and Gravel Glaciolacustrine Deposits, Devensian – Clay and Silt Glaciolacustrine Deposits, Devensian – Sand 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

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

- 10.4.9 There are no recorded Regionally Important Geological Sites (RIGS) or Locally important Geological Sites within the proposed development boundary.
- 10.4.10 RIGS within Redcar and Cleveland outside of the Site of the Site include:
- Coatham Rocks – outside of the Site boundary, approximately 2.0 km south east.
 - Redcar Rocks (also a Site of Special Scientific Interest) – outside of the Site boundary, approximately 2.5 km south east.
- 10.4.11 There are no recorded RIGS within Stockton-on-Tees.
- 10.4.12 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 and 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.
- 10.4.13 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.
- 10.4.14 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.
- 10.4.15 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.
- 10.4.16 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.
- 10.4.17 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 Policy Statement 1 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.

- 10.4.18 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 CO₂ Gathering Network and Natural Gas Connection Corridors. Tees Dock is also identified as a Safeguarded Wharf, Drawing 27333-r12, May 2010.

Hydrogeology

- 10.4.19 Figure 10-17 and Figure 10-18 present the designated superficial and bedrock aquifers below the Site, respectively.
- 10.4.20 The definitions provided by the EA to describe the characteristics of different aquifer designations are provided in section 4.7 of Appendix 10A: Preliminary Sources Study Report (PEI Report, Volume III).
- 10.4.21 Hydrogeological classifications for each area of the proposed development are summarised in Table 10-14.
- 10.4.22 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.

Historical Development

- 10.4.23 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.
- 10.4.24 The historical development of the Site is discussed in detail in Appendix 10A (PEI Volume III). 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.

Table 10-14: Hydrogeology

Relevant Feature	Aquifer Designation	Strata
PCC		
Superficial Aquifer Designation	Secondary Aquifer - A	Blown Sand and Tidal Flat Deposits (sand and silt)
Groundwater Vulnerability	High Vulnerability	
Productivity	Productive	
Source Protection Zones	None (Magic Defra)	
Bedrock Aquifer Designation	Secondary Aquifer – Undifferentiated	Redcar Mudstone Formation - Mudstone
Groundwater Vulnerability	High Vulnerability	
Productivity	Productive	
Bedrock Aquifer Designation	Secondary Aquifer – B	Mercia Mudstone Group – Mudstone and Penarth Group - Mudstone
Groundwater Vulnerability		
Productivity		
Source Protection Zones	None (Magic Defra)	
CO₂ Export Pipeline		
Superficial Aquifer Designation	Secondary Aquifer - A	Blown Sand and Tidal Flat Deposits (sand and silt)
Bedrock Aquifer Designation	Secondary Aquifer – Undifferentiated Secondary Aquifer - B	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)	
Water Connections Corridors		
Superficial Aquifer Designation	Secondary Aquifer – A Secondary Aquifer – Undifferentiated	Blown Sand and Tidal Flat Deposits (sand and silt) Till (Diamicton)
Bedrock Aquifer Designation	Secondary Aquifer – Undifferentiated Secondary Aquifer - B	Redcar Mudstone Formation – Mudstone Mercia Mudstone Group – Mudstone and Penarth Group – Mudstone
Groundwater Vulnerability	High Vulnerability	
Productive Strata	Productive	

Relevant Feature	Aquifer Designation	Strata
Source Protection Zones	None (Magic Defra)	
CO₂ Gathering Network and Natural Gas Connection Corridors		
Superficial Aquifer Designation	Secondary Aquifer – A	Blown Sand and Tidal Flat Deposits (sand and silt) Till (Diamicton)
	Secondary Aquifer – Undifferentiated	Glaciolacustrine Deposits (clay and silt) and peat
	Unproductive Strata	
Bedrock Aquifer Designation	Principal Aquifer	Sherwood Sandstone Group- Sandstone
	Secondary Aquifer – Undifferentiated	Penarth Group – Mudstone and Redcar Mudstone Formation - Mudstone
	Secondary Aquifer - B	Mercia Mudstone Group – Mudstone and Penarth Group - Mudstone
Groundwater Vulnerability	Low to High Vulnerability	
Productive Strata	Productive	
Source Protection Zones	None (Magic Defra)	
Electrical Connection Corridor		
Superficial Aquifer Designation	Secondary Aquifer – A	Glaciofluvial Deposits (sand and gravel), Blown Sand, Tidal Flat Deposits (sand and silt) and Glaciolacustrine Deposits (sand)
	Secondary Aquifer – Undifferentiated	Tidal Flat Deposits (sand, silt and clay), Till (Diamicton)
	Unproductive Strata	Glaciolacustrine Deposits (clay and silt)
Bedrock Aquifer Designation	Secondary Aquifer – Undifferentiated	Redcar Mudstone Formation – Mudstone and Penarth Group - Mudstone
	Secondary Aquifer - B	Penarth Group – Mudstone and Mercia Mudstone Group - Mudstone
Groundwater Vulnerability	Superficial: Low to High Vulnerability Bedrock: Low to Medium Vulnerability	
Productive Strata	Productive	
Source Protection Zones	None (Magic Defra)	

10.4.25 Historical land uses are provided on the following Figures (all PEI Report, Volume II).

- 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

10.4.26 A Conceptual Site Model has been prepared and is presented in Appendix 10B (PEI Report, Volume III) 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

10.4.27 Based upon the CSM produced for the Site (Appendix 10B, PEI Report, Volume III), an evaluation of the risks posed by the identified potential pollutant linkages at the Site has been prepared and is presented in Appendix 10C (PEI Report, Volume III).

Geotechnical Risk Register

10.4.28 A Preliminary Engineering Assessment and Geotechnical Risk Register is described in detail within Appendix 10A (PEI Report, Volume III) and is presented in Appendix 10D (PEI Report, Volume III).

10.4.29 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.

Summary of Resource Value

10.4.30 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.

10.4.31 The results of this assessment are summarised in Table 10-15. Resources assessed to have a Value (sensitivity) of **Medium** or higher are assessed against potential Impacts, Effects and Mitigation Measures are presented in Section 10.6.

10.5 Development Design and Impact Avoidance

10.5.1 Significant impacts can be reduced through the design described in Chapter 4: Proposed Development (PEI Report, Volume I). 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.

10.6 Potential Impacts and Effects (Significance)

10.6.1 The Proposed Development and service corridor connections 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. piled supports, strip and pad footings), earthworks and excavations (foundations, service conduits and a section of open cut through nationally protected dune habitat below and north of the CO₂ Export Pipeline).

10.6.2 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).

10.6.3 Further assessment of any existing contamination will be risk-based and will develop upon the initial CSM that is produced. This will also involve further assessment of the contamination sources, receptors and plausible pollutant linkages at the Site, in accordance with government guidance 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 (2019). 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).

10.6.4 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 works.

Table 10-15: Resource Value (Sensitivity)

Aspect / Criteria	Resource / Receptor	Location / Site	Resource Value / Sensitivity	Justification
Geology – See Figure 10-3 – Bedrock Geology				
Geology Bedrock	Sherwood Sandstone Group - Sandstone	CO ₂ Gathering Network and Natural Gas Connection Corridors (in the section of the route between Billingham and Saltholme)	Medium	The Sherwood Sandstone is not a designated RIGS, geological unit, however considered medium due to aquifer designation described below.
Geology Bedrock	Mercia Mudstone Group - Mudstone	PCC CO ₂ Export Pipeline Water Connections Corridors CO ₂ Gathering Network and Natural Gas Connection Corridors Electrical Connection Corridor	Low	The Mercia Mudstone is a non-designated geological exposure.
Geology Bedrock	Penarth Group - Mudstone	PCC CO ₂ Export Pipeline Water Connections Corridors CO ₂ Gathering Network and Natural Gas Connection Corridors Electrical Connection Corridor	Low	The Penarth Group is a non-designated geological exposure.
Geology Bedrock	Redcar Mudstone Formation - Mudstone	PCC CO ₂ Export Pipeline Water Connections Corridors CO ₂ Gathering Network and Natural Gas Connection Corridors Electrical Connection Corridor	Low	The Redcar Mudstone is a non-designated geological exposure.

Aspect / Criteria	Resource / Receptor	Location / Site	Resource Value / Sensitivity	Justification
Geology / Minerals	Concealed Permian Formations - Salt and Gypsum	PCC CO ₂ Export Pipeline Water Connections Corridors CO ₂ Gathering Network and Natural Gas Connection Corridors Electrical 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 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.
Minerals	Shallow Resources Marine Dredged Sand and Gravel	CO ₂ 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.
Soils – See Figure 10-24 – Agricultural Land Value				
Soils (ALC)	Agricultural Land Value (measured using the ALC)	PCC CO ₂ Export Pipeline Water Connections Corridors CO ₂ Gathering Network and Natural Gas Connection Corridors	Low	Soils are predominantly recorded as Grade 4 or 5 and are Non-Agricultural / Urban.
Soils (ALC)	Agricultural Land Value (measured using the ALC)	Electrical Connection Corridor	High / Medium	Localised area of Grade 3a and 3b ALC.
Soils (Topsoil)	Best and Most Versatile Agricultural Land	Not Applicable	N/A	Outside of designated area.

Aspect / Criteria	Resource / Receptor	Location / Site	Resource Value / Sensitivity	Justification
Soils – See Figure 10-1 – Artificial Geology and Figure 10-2 – Superficial Geology				
Soils	Blown Sand and Beach and Tidal Flat Deposits (Undifferentiated - sand)	PCC CO ₂ Export Pipeline Water Connections Corridors	High	Soils in sensitive environmental designations of Special Protection Area (SPA), Ramsar and Site of Special Scientific Interest (SSSI) – Teesmouth and Cleveland Coast.
Soils	Tidal Flat Deposits - Sand and Silt Tidal Flat Deposits – Sand, Silt and Clay	CO ₂ Gathering Network and Natural Gas Connection Corridors Electrical Connection Corridor Water Connections 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.
Soils	Glaciolacustrine Deposits, Clay and Silt. Glaciolacustrine Deposits, Sand. Glaciofluvial Deposits, Sand and Gravel. Glacial Till, Devensian – Diamicton	Electrical Connection Corridor	Low	Soils supporting non-designated notable or priority habitats.
Groundwater – See Figure 10-17 – Bedrock Aquifer				
Groundwater Contamination (Bedrock)	Principal Aquifer Sherwood Sandstone Group - Sandstone	CO ₂ Gathering Network and Natural Gas Connection Corridor (in the area between Billingham and Salholme)	High	Area is outside of any designated Source Protection Zone. Principal Aquifer. Low Vulnerability – because at subcrop it is overlain by a thick cover of low permeability superficial deposits, to the east of its subcrop it is overlain by low permeability mudrocks of the Mercia Mudstone Group

Aspect / Criteria	Resource / Receptor	Location / Site	Resource Value / Sensitivity	Justification
				and / or Penarth Group and / or Redcar Mudstone Formation.
Groundwater Contamination (Bedrock)	Secondary Aquifer – B Penarth Group - Mudstone	PCC CO ₂ Export Pipeline Water Connections Corridors CO ₂ Gathering Network and Natural Gas Connection Corridors Electrical Connection Corridor	Medium	Area is outside of any designated Source Protection Zone. Secondary Aquifer - B
Groundwater Contamination (Bedrock)	Secondary Aquifer – B Redcar Mudstone Formation - Mudstone	PCC CO ₂ Export Pipeline Water Connections Corridors CO ₂ Gathering Network and Natural Gas Connection Corridors Electrical Connection Corridor	Medium	Area is outside of any designated Source Protection Zone. Secondary Aquifer - B
Groundwater – See Figure 10-18 – Superficial Aquifer				
Groundwater Contamination (Superficial)	Secondary Aquifer - A Blown Sand and Beach and Tidal Flat Deposits (Undifferentiated - sand)	PCC CO ₂ Export Pipeline Water Connections Corridors	Medium	Area is outside of any designated Source Protection Zone. Secondary Aquifer – A
Groundwater Contamination (Superficial)	Secondary Aquifer-Undifferentiated Tidal Flat Deposits – Sand and Silt Tidal Flat Deposits – Sand, Silt and Clay	CO ₂ Gathering Network and Natural Gas Connection Corridors Electrical Connection Corridor Water Connections Corridors	Medium	Area is outside of any designated Source Protection Zone. Secondary Aquifer - A
Groundwater Contamination (Superficial)	Unproductive Strata Glaciolacustrine Deposits, Clay and Silt.	Electrical Connection Corridor	Low	Area is outside of any designated Source Protection Zone. Unproductive Strata

Aspect / Criteria	Resource / Receptor	Location / Site	Resource Value / Sensitivity	Justification
	Glaciofluvial Deposits, Sand and Gravel. Glacial Till, Devensian – Diamicton			
Contamination (Soils)	See Figure 10-10 – Contaminated Land Point, Figure 10-11 - Contaminated Land Line, Figure 10-12 - Contaminated Land Polygon and Figure 10-13 – Tanks (GIS Information provided by Envirocheck – for further details refer to Appendix 10A (PEI Report, Volume III). See Figure 10-23 (Sheets 1 to 3) – Potential contaminative land used identified from review of historical OS mapping – for further details refer to Appendix 10A).			
Contamination (Soils)	Blown Sand and Beach and Tidal Flat Deposits (Undifferentiated - sand)	PCC CO ₂ Export Pipeline Water Connections Corridors	High	Public Open Space.
Contamination (Soils)	Tidal Flats Sand and Silt Tidal Flats – Sand, Silt and Clay	CO ₂ Gathering Network and Natural Gas Connection Corridors Electrical Connection Corridor Water Connections Corridors	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.
Contamination (Soils)	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

- 10.6.5 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.
- 10.6.6 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.
- 10.6.7 Remediation and construction phase effects (inclusive of mitigation) are summarised in Table 10-16 and includes the following:

Potential Soil Resource and Agricultural Land Quality

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



10.6.9 The exception to this is a localised area of Grade 3a and 3b soils in the eastern extent of the proposed Electrical Connection Corridor, where potential impact is Minor with residual effects considered to be Slight (Adverse).

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 could potentially have an adverse effect upon mineral resources as a result of the potential sterilisation of local mineral resources (salt and gypsum) for the lifetime of the proposed development. However, mineral resources present are at 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. Service trenches 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 the groundwater could arise from contamination of the Secondary 'A' Aquifers.

10.6.14 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.

10.6.15 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.

10.6.16 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 or excavation through an existing aquiclude (impermeable fine / cohesive soils) into an aquifer (comprised of coarse or sandy soils).

10.6.17 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.

10.6.18 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.

10.6.19 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

10.6.20 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.

10.6.21 The potential impacts (without mitigation) that could arise during the operational phase of the proposed development are outlined here and summarised in Table 10-16:

- 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 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

10.6.22 The Power and Capture site will have a design life of 25 years. The Compressor Station, CO₂ Gathering Network and CO₂ Export Pipeline will have a longer design life of up to 40 years.

10.6.23 At the end of its operating life, it is expected that all above-ground equipment associated with the Proposed Development will be decommissioned and removed from the Site.

10.6.24 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.

10.6.25 A Decommissioning Plan (including a Decommissioning Environmental Management Plan) 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 on the PCC during decommissioning and demolition.

- 10.6.26 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.
- 10.6.27 Upon completion of the decommissioning programme, including any remediation works that might be required, the EA will be invited to witness a post-decommissioning inspection by site staff.
- 10.6.28 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

- 10.6.29 There is inherent uncertainty in climate change projections.
- 10.6.30 There is often uncertainty in the relationship between changes in climate hazards and the respective response in terms of asset performance.
- 10.6.31 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.
- 10.6.32 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 or Grade 3a and 3b Soils (as found in the eastern extent of the Electricity Connection Corridor) will be re-used on site within any landscaping areas; and
 - Designing site remedial measures that allow re-use of soils and reduce the requirement for disposal of soils to landfill.
- 10.6.33 In future design changes, a number of 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 Mitigation and Enhancement Measures

10.7.1 Where the Effect (Significance) is determined to be Moderate or higher mitigation measures are required. Mitigation measures are summarised in the next section and presented in Table 10-16 with residual effects set out in Section 10.8.

Construction Mitigation

10.7.2 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 CEMP prepared and implemented in order to mitigate the effect of potential impacts or 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 CEMP. The CEMP shall address the management of concrete batching, concrete usage and accidental spillage relating to foundation and building construction;
- Should the GI and Foundations and Remediation Options Study prove the need for piling or soil mixing to take place, the construction methodology will be assessed to reduce as far as reasonably practicable the risk of development of preferential pathways (e.g. groundwater flow) between the Made Ground present and the underlying Secondary 'A' or 'B' bedrock Aquifers. 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 AMP 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 Model Procedures for the Management of Contaminated Land, CLR11 (Environment Agency, 2004). 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 HE (HE) 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 CEMP and consultation with the EA will take place before construction commences.

10.7.3 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 CEMP, SWMP, MMP and AMP;
- The preparation of an inventory of all chemicals, fuels and oils 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 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 bowsers 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

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

- The 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; and
- The preparation of a groundwater quality monitoring plan.

Decommissioning Mitigation

10.7.5 The decommissioning phase is anticipated to involve the removal of all above surface structures, 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 receptor 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.

10.8 Residual Effects or Conclusions

- 10.8.1 Residual permanent Effects are provided in Table 10-16. The majority of the Effects (inclusive of embedded mitigation) are shown to be Neutral, Slight (adverse) or Slight/Moderate (adverse).
- 10.8.2 Although it is intended to maximise the replacement of disturbed sand and allow post-construction reinstatement of dune habitat/s, the results of the following mitigation measures are required before this can be further rationalised:
- GI and groundwater level monitoring;
 - Hydrological assessment;
 - Baseline ecological assessment; and
 - Development of an Ecological Risk Assessment and Mitigation Strategy and implementation in Construction.

Table 10-16: Magnitude of Impact and Residual Effects

Development Stage	Aspect / Resource	Resource Value (Table 10-15)	Impact	Magnitude of Impact inclusive of embedded mitigation	Mitigation measure	Residual effect	Nature of effect(s)
Construction	Geology Sherwood Sandstone Group - Sandstone Mercia Mudstone Group – Mudstone Penarth Group - Mudstone	Medium Low Low	Foundations	Minor	GI is required to confirm Baseline Assumptions.	Slight (Adverse)	P
Construction	Geology Redcar Mudstone Formation - Mudstone Penarth Group - Mudstone Mercia Mudstone Group - Mudstone	Low	Directional Drilling 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' (Ref. 19) and HE guidelines including DMRB Series 600 'Earthworks' (Ref. 20). Scheme will actively work towards achieving an earthworks balance.	Neutral or Slight (Adverse)	T

Development Stage	Aspect / Resource	Resource Value (Table 10-15)	Impact	Magnitude of Impact inclusive of embedded mitigation	Mitigation measure	Residual effect	Nature of effect(s)
Construction	Minerals - Deep Resources Salt and Gypsum	Medium	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 Waste Development Plan Core Strategy as protected to allow for future Gypsum and Salt extraction.	Minor	Minerals are at depth and are already primarily covered by existing development. The proposed development does not <u>preclude</u> the future extraction of these minerals	Slight (Adverse)	P
Construction	Minerals - Shallow Resources Marine Dredged Sand and Gravel	Medium	Safeguarded under the Tees Valley Joint Minerals and Waste Development Minerals and Waste Core Strategy DPD.	Minor	Utilise existing above or below ground service conduits where possible.	Slight (Adverse)	T
Construction	Soils Agricultural Land Classification	Medium / High	Excavation Removal	Minor	Soils to be stockpiled and re-used within landscaping areas.	Slight (Adverse)	P

Development Stage	Aspect / Resource	Resource Value (Table 10-15)	Impact	Magnitude of Impact inclusive of embedded mitigation	Mitigation measure	Residual effect	Nature of effect(s)
Construction	Soils Blown Sand and Beach and Tidal Flat deposits (Undifferentiated) (locally present adjacent to the North Sea coastline). Protected as part of the Teesmouth and Cleveland Coast SSSI, SPA and Ramsar sites.	High	Excavation of sand and damage to dune habit during construction of CO ₂ Export Pipeline in Designated Site (SSSI, SPA, Ramsar)	Minor	GI is required to confirm Baseline Assumptions. Habitat Regulations Assessment Baseline ecological assessment, Development of Ecological Risk Assessment and Mitigation Strategy and implementation in Construction. Maximise replacement of disturbed sand and post-construction reinstatement of dune habitat learning from experience of successful Breagh Pipeline route reinstatement.	Slight (Adverse)	T
Construction	Soils (General)	Medium	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' (Ref. 19) and HE guidelines including DMRB Series 600 'Earthworks' (Ref. 20). Scheme will actively work towards achieving an earthworks balance.	Slight (Adverse)	T

Development Stage	Aspect / Resource	Resource Value (Table 10-15)	Impact	Magnitude of Impact inclusive of embedded mitigation	Mitigation measure	Residual effect	Nature of effect(s)
Construction	Groundwater – (Bedrock Contamination) Principal Aquifer Sherwood Sandstone Group - Sandstone	High	Changes to Hydrogeological Regime. Mobilisation of contaminants during construction.	Minor Adverse	GI and groundwater level and quality to confirm Baseline assumptions. Construction of piled foundations or deep excavations resulting in disturbance of the Sherwood Sandstone are not anticipated over the length of the CO ₂ Gathering Network or Natural Gas Collection Corridors.	Slight (Adverse)	P/T

Construction	Groundwater (Bedrock Contamination) Secondary Aquifer – B Mercia Mudstone Group – Mudstone Penarth Group - Mudstone	Medium	Changes to Hydrogeological Regime. Mobilisation of contaminants if piling through potentially contaminated superficial soils into underlying bedrock aquifer.	Minor	GI and groundwater level and quality to confirm Baseline assumptions. The need for piling works will be assessed in the Foundation and Remediation Options Study. Any piling works required 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 & Contaminated Land Centre Report NC/99/73.</i> ' Any piling operations required would be subject to foundation works risk assessment and any potential to cause pollution to the aquifer would be covered by measures to be detailed in piling method statements. 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 aquifer.	Slight (Adverse)	P
Construction	Groundwater (Bedrock Contamination)	Medium	Impact as above.	Minor (Adverse)	GI and groundwater level and quality to confirm Baseline assumptions.	Slight (Adverse)	P

Development Stage	Aspect / Resource	Resource Value (Table 10-15)	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	Groundwater – (Bedrock Contamination) Secondary Aquifer – Undifferentiated Redcar Mudstone Formation - Mudstone	Medium	Impact as above.	Minor (Adverse)	GI and groundwater level and quality to confirm Baseline assumptions. Pile mitigation measures as above.	Slight (Adverse)	P
Construction	Groundwater – (Soil Contamination) Secondary Aquifer - A Blown Sand and Beach and Tidal Flat Deposits (Undifferentiated)	Medium	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 and adherence to CEMP. Remedial measures likely to comprise clean cover layer / capping. (Resultant effect maybe beneficial – see below).	Slight (Adverse)	T

Development Stage	Aspect / Resource	Resource Value (Table 10-15)	Impact	Magnitude of Impact inclusive of embedded mitigation	Mitigation measure	Residual effect	Nature of effect(s)
Construction	Groundwater – (Soil Contamination) Secondary Aquifer-Undifferentiated Tidal Flat Deposits – Sand and Silt Tidal Flat Deposits – Sand, Silt and Clay	Medium	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 and adherence to CEMP. Remedial measures likely to comprise clean cover layer / capping. (Resultant effect maybe beneficial – see below).	Slight (Adverse)	T
Construction	Contamination (Soils) Blown Sand and Beach and Tidal Flat Deposits (Undifferentiated)	High	New cut and cover construction results in contamination of soils within Designated Site (SSSI, SPA, Ramsar) during construction of CO ₂ Export Pipeline.	Moderate (adverse)	GI is required to confirm Baseline Assumptions. Habitat Regulations Assessment Baseline ecological assessment, Development of Ecological Risk Assessment and Mitigation Strategy and implementation in Construction. Maximise replacement of disturbed sand and post-construction reinstatement of dune habitat learning from experience of successful Breagh Pipeline route reinstatement.	Slight (Adverse)	T

Development Stage	Aspect / Resource	Resource Value (Table 10-15)	Impact	Magnitude of Impact inclusive of embedded mitigation	Mitigation measure	Residual effect	Nature of effect(s)
Construction	<p>Contamination (Soils) Tidal Flat Deposits - Sand and Silt Tidal Flat Deposits – Sand, Silt and Clay</p> <p>Contamination (Soils) Glaciolacustrine Deposits, Clay and Silt. Glaciofluvial Deposits, Sand and Gravel. Glacial Till, Devensian – Diamicton</p>	Low	<p>Potential contaminant pathways 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.</p> <p>Infiltration and pathways are reduced.</p>	Minor (beneficial)	<p>Note DMRB LM 104, Sustainability & Environment Appraisal, does not include for a Magnitude category ‘Beneficial’ category.</p> <p>However, any remedial works such as placement of clean cover, soil treatment, soil stabilisation, removal of localised ‘hotspots’ of identified contamination would provide improvement to the existing condition.</p> <p>GI and soils testing is required to quantify potential contamination and confirm Baseline Assumptions</p>	Neutral or slight (Beneficial)	P

Development Stage	Aspect / Resource	Resource Value (Table 10-15)	Impact	Magnitude of Impact inclusive of embedded mitigation	Mitigation measure	Residual effect	Nature of effect(s)
Operation	Contamination (Soils) (Blown Sand and Beach and Tidal Flat Deposits (both types))	High	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 CEMP, SWMP, MMP and AMP.	Slight (Adverse)	P
Operation	Groundwater – (Bedrock Contamination) Principal Aquifer / Secondary A / B Aquifer	Medium / High	Impacts on groundwater and watercourses 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 CEMP, SWMP, MMP.	Slight (Adverse)	P

Development Stage	Aspect / Resource	Resource Value (Table 10-15)	Impact	Magnitude of Impact inclusive of embedded mitigation	Mitigation measure	Residual effect	Nature of effect(s)
Decommissioning	Contamination (Soils)	Medium	Excavation of materials / soil removal Demolition workers exposed to historic and current potentially contaminated soil sources on Site	Minor	Implementation of CEMP, SWMP, MMP and AMP.	Slight (Adverse)	T
Decommissioning	Contamination (Soils)	Medium	Accidental spills. 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 CEMP, SWMP, MMP and AMP.	Slight or (Adverse)	T
Decommissioning	Groundwater – (Bedrock Contamination) Principal Aquifer / Secondary A / B Aquifer	Medium / High	Impacts on groundwater and watercourses 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 CEMP, SWMP, MMP and AMP.	Slight (Adverse)	T
Decommissioning	Soils (General)	Medium	Export, excavation, stockpiling, redistribution and / or removal of the Made Ground	Minor	All earthworks operations will need to be undertaken in accordance with BS6031:2009 'Code of Practice for Earthworks' (Ref. 19) and HE guidelines including DMRB Series 600 'Earthworks' (Ref. 20).	Slight (Adverse)	T

Note: Lt = long term, Mt = medium term, St = short term, P = permanent, T = temporary

10.9 Limitations or Difficulties

- 10.9.1 Scheme specific GI information is not yet available for the proposed development.
- 10.9.2 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 CEMP for the proposed development so that appropriate measures are taken.
- 10.9.3 If, during 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 along with any remedial measures in consultation with the EA if required.

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