

Viking CCS Pipeline

**Environmental  
Statement Volume II -  
Chapter 9: Geology and  
Hydrogeology**

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# 9 Geology and Hydrogeology

## 9.1 Introduction

9.1.1 This chapter of the Environment Statement (ES) presents the assessment of the likely significant effects of the Viking CCS Pipeline (the Proposed Development) on geology and hydrogeology during construction, operation and decommissioning. The chapter details the methodology followed for the assessment, summarises the regulatory and policy framework related to geology and hydrogeology and describes the geological setting in the area surrounding the Proposed Development.

9.1.2 Geology and hydrogeology are interrelated with other environmental effects and so this chapter should be read in conjunction with:

- *Chapter 10: Agriculture and Soils; and*
- *Chapter 11: Water Environment.*

9.1.3 This chapter is supported by Figures 9-1 to 9-11 which are included in this Chapter, as well as higher resolution versions of the same figures presented within *ES Volume III (Application Document Ref. 6.3)*. Additional information is also contained in the following appendices (*ES Volume IV, Application Document 6.4*):

- *Appendix 9.1: Geology Summary Tables;*
- *Appendix 9.2: The Coal Authority - Coal Mining Report;*
- *Appendix 9.3: Hydrogeological Risk Assessment; and*
- *Appendix 9.4: Conceptual Site Model.*

## 9.2 Legislation, Policy and Guidance

### Introduction

9.2.1 The Legislation, Policy and Guidance section of this chapter provides an overview of the relevant legislation, planning policy and technical guidance relevant to the geology and hydrogeology assessment.

### Legislation

9.2.2 The following pieces of legislation apply specifically to the geology and hydrogeology assessment:

- The Water Framework Directive (2000/60/EC) (Ref 9-1);
- The Groundwater Directive (2006/118/EC) (Ref 9-2);
- Classification Labelling & Packaging (CLP) Regulation (2008/1272/EC) (Ref 9-3), replacing The Dangerous Substances Directive (67/548/EEC) in 2016 (Ref 9-4);
- The Priority Substances Directive (2008/105/EC) (Ref 9-5);
- Environmental Protection Act 1990 (Ref 9-6);
- The Environment Act 1995 (Ref 9-7);
- The Contaminated Land (England) Regulations 2006 (Ref 9-8);
- Groundwater (England and Wales) Regulations 2009 (Ref 9-9);

- Environmental Damage (Prevention and Remediation) (England) Regulations 2015 (Ref 9-10);
- The Water Act 2003 (Ref 9-11);
- The Water Resources Act 1991 (Ref 9-12);
- The Land Drainage Act 1991 (Ref 9-13);
- The Environmental Permitting (England and Wales) Regulations 2016 (Ref 9-14);
- The Water Environment (Water Framework Directive) Regulations 2017 (Ref 9-15); and
- Water Resources (Control of Pollution) (Silage, Slurry and Agricultural Fuel Oil) (England) Regulations 2010 (Ref 9-16).

### National Planning Policy

9.2.3 Quotations from the National Planning Policy relevant to geology and hydrogeology are detailed in **Table 9-1**. An overview of how relevant national planning policy has been complied with is provided within the *Planning Statement (Application Document 7.1)*.

**Table 9-1: National Planning Policy Relevant to Geology and Hydrogeology**

Policy Reference	Policy Context
<b>National Policy Statements</b>	
National Planning Policy Framework (2023) (Ref 9-17)	
Paragraph 174	<p><i>‘Planning policies and decisions should contribute to and enhance the natural and local environment by:</i></p> <p><i>a) protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils (in a manner commensurate with their statutory status or identified quality in the development plan);</i></p> <p><i>e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and</i></p> <p><i>f) remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.’</i></p>

Policy Reference	Policy Context
Paragraph 179	<p><i>‘To protect and enhance biodiversity and geodiversity, plans should:</i></p> <ul style="list-style-type: none"> <li><i>a) Identify, map and safeguard components of local wildlife-rich habitats and wider ecological networks, including the hierarchy of international, national and locally designated sites of importance for biodiversity<sup>61</sup>; wildlife corridors and stepping stones that connect them; and areas identified by national and local partnerships for habitat management, enhancement, restoration or creation<sup>62</sup>; and</i></li> <li><i>b) promote the conservation, restoration and enhancement of priority habitats, ecological networks and the protection and recovery of priority species; and identify and pursue opportunities for securing measurable net gains for biodiversity.’</i></li> </ul>
Paragraph 180	<p><i>‘When determining planning applications, local planning authorities should apply the following principles:</i></p> <ul style="list-style-type: none"> <li><i>a) if significant harm to biodiversity resulting from a development cannot be avoided (through locating on an alternative site with less harmful impacts), adequately mitigated, or, as a last resort, compensated for, then planning permission should be refused;</i></li> <li><i>b) development on land within or outside a Site of Special Scientific Interest, and which is likely to have an adverse effect on it (either individually or in combination with other developments), should not normally be permitted. The only exception is where the benefits of the development in the location proposed clearly outweigh both its likely impact on the features of the site that make it of special scientific interest, and any broader impacts on the national network of Sites of Special Scientific Interest;</i></li> <li><i>c) development resulting in the loss or deterioration of irreplaceable habitats (such as ancient woodland and ancient or veteran trees) should be refused, unless there are wholly exceptional reasons<sup>63</sup> and a suitable compensation strategy exists; and</i></li> <li><i>d) development whose primary objective is to conserve or enhance biodiversity should be supported; while opportunities to improve biodiversity in and around developments should be integrated as part of their design, especially where this can secure measurable net gains for biodiversity or enhance public access to nature where this is appropriate.</i></li> </ul>
Paragraph 181	<p><i>‘The following should be given the same protection as habitats sites:</i></p> <ul style="list-style-type: none"> <li><i>a) potential Special Protection Areas and possible Special Areas of Conservation;</i></li> <li><i>b) listed or proposed Ramsar sites; and</i></li> <li><i>c) sites identified, or required, as compensatory measures for adverse effects on habitats sites, potential Special Protection Areas, possible Special Areas of Conservation, and listed or proposed Ramsar sites’.</i></li> </ul>

Policy Reference	Policy Context
Paragraph 182	<i>'The presumption in favour of sustainable development does not apply where the plan or project is likely to have a significant effect on a habitats site (either alone or in combination with other plans or projects), unless an appropriate assessment has concluded that the plan or project will not adversely affect the integrity of the habitats site'.</i>
Paragraph 183	<i>'Planning policies and decisions should ensure that: a) a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation); b) after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and c) adequate site investigation information, prepared by a competent person, is available to inform these assessments'.</i>
Paragraph 184	<i>'Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner'.</i>
Paragraph 185	<i>'Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should: a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life<sup>65</sup>; b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation'.</i>
Paragraph 188	<i>'The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities'.</i>

Policy Reference	Policy Context
Overarching National Policy Statement for Energy (EN-1) (2011) (Ref 9-18)	
Paragraph 5.15.1	<i>‘Infrastructure development can have adverse effects on the water environment, including groundwater, inland surface water, transitional waters and coastal waters. During the construction, operation and decommissioning phases, it can lead to increased demand for water, involve discharges to water and cause adverse ecological effects resulting from physical modifications to the water environment. There may also be an increased risk of spills and leaks of pollutants to the water environment. These effects could lead to adverse impacts on health or on protected species and habitats (see Section 4.3 and Section 4.18) and could, in particular, result in surface waters, groundwaters or protected areas failing to meet environmental objectives established under the Water Framework Directive.’</i>
Paragraph 5.15.3	<i>‘Where the project is likely to have effects on the water environment, the applicant should undertake an assessment of the existing status of, and impacts of the proposed project on, water quality, water resources and physical characteristics of the water environment as part of the ES or equivalent. (See Section 4.2).’</i>
Draft Overarching National Policy Statement for Energy (EN-1) (2023) Ref 9-19).	
Paragraph 5.4.12	<i>‘Sites of regional and local biodiversity and geological interest, which include Regionally Important Geological Sites, Local Nature Reserves and Local Wildlife Sites, are areas of substantive nature conservation value and make an important contribution to ecological networks and nature’s recovery. They can also provide wider benefits including public access (where agreed), climate mitigation and helping to tackle air pollution’.</i>
Paragraph 5.4.17	<i>‘Where the development is subject to EIA the applicant should ensure that the ES clearly sets out any effects on internationally, nationally, and locally designated sites of ecological or geological conservation importance (including those outside England), on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity, including irreplaceable habitats’.</i>
Paragraph 5.4.38	<i>‘To further minimise any adverse impacts on geodiversity, where appropriate applicants are encouraged to produce and implement a Geodiversity Management Strategy to preserve and enhance access to geological interest features, as part of relevant development proposals’.</i>
Paragraph 5.16.2	<i>‘During the construction, operation, and decommissioning phases, development can lead to increased demand for water, involve discharges to water and cause adverse ecological effects resulting from physical modifications to the water environment. There may also be an increased risk of spills and leaks of pollutants to the water environment. These effects could lead to adverse impacts on health or on protected species and habitats (see Section 4.2) and could result in surface waters, groundwaters or protected areas failing to meet environmental objectives established under the Water Environment (Water</i>



Policy Reference	Policy Context
	<i>Framework Directive) (England and Wales) Regulations 2017 and the Marine Strategy Regulations 2010.'</i>
Paragraph 5.16.5	<i>'Where possible, applicants are encouraged to manage surface water during construction by treating surface water runoff from exposed topsoil prior to discharging and to limit the discharge of suspended solids e.g. from car parks or other areas of hard standing, during operation'.</i>
Paragraph 5.16.6	<i>'Applicants are encouraged to consider protective measures to control the risk of pollution to groundwater beyond those outlined in River Basin Management Plans and Groundwater Protection Zones - this could include, for example, the use of protective barriers'.</i>
National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) (2011) (Ref 9-20)	
Paragraph 1.8.2	<i>'Pipelines which meet the Planning Act threshold at 1.8.1 (iv) could be carrying different types of gas, fuel or chemicals. This NPS only covers those nationally significant infrastructure pipelines which transport natural gas or oil. However, information in this NPS may be useful in identifying impacts to be considered in applications for pipelines intended to transport other substances.'</i>
Paragraph 2.19.8	<i>'When designing the route of new pipelines applicants should research relevant constraints including proximity of existing and planned residential properties, schools and hospitals, railway crossings, major road crossings, below surface usage and proximity to environmentally sensitive areas, main river and watercourse crossing.'</i>
Paragraph 2.19.10	<i>'When choosing a pipeline route, applicants should seek to avoid or minimise adverse effects from usage below the surface. Where it is not considered practicable to select a route that avoids below surface usage, applicants should demonstrate in the ES that mitigating measures will be put in place to avoid adverse effects both on other below ground works and on the pipeline.'</i>
Paragraph 2.22.2	<i>'Constructing pipelines creates corridors of surface clearance and excavation that can potentially affect watercourses, aquifers, water abstraction and discharge points, areas prone to flooding and ecological receptors. Pipeline impacts could include inadequate or excessive drainage, interference with groundwater flow pathways, mobilisation of contaminants already in the ground, the introduction of new pollutants, flooding, disturbance to water ecology, pollution due to silt from construction and disturbance to species and their habitats. Impacts during construction should be avoided as far as possible through route selection or mitigated if unavoidable and ground should be reinstated after construction.'</i>
Paragraph 2.22.3	<i>'Where the project is likely to have effects on water resources or water quality, for example impacts on groundwater recharge or on existing surface water or groundwater abstraction points, or on associated ecological receptors, the applicant should provide an assessment of the impacts in line with Section 5.15 of EN-1 as part of the ES. 2.22.4 Where the project is likely to give rise to effects on water quality, for example through siltation or spillages,</i>

Policy Reference	Policy Context
	<i>discharges from maintenance activities or the discharge of disposals such as wastewater or solvents, the applicant should provide an assessment of the impacts.'</i>
Paragraph 2.23.1	<i>'New pipelines will be installed in a variety of geological conditions. It will be important for applicants to understand the soil types and the nature of the underlying strata. Underground cavities and unstable ground conditions may present particular risks to pipeline projects. Impacts could include sterilisation of mineral resources or loss of soil quality'.</i>
Paragraph 2.23.2	<i>'Applicants should assess the stability of the ground conditions associated with the pipeline route and incorporate the findings of that assessment in the ES (see Section 4.2 of EN-1) as appropriate. Desktop studies, which include known geology and previous borehole data, can form the basis of the applicant's assessment. The applicant may find it necessary to sink new boreholes along the preferred route to better understand the ground conditions present. The assessment should cover the options considered for installing the pipeline and weigh up the impacts of the means of installation. Where the applicant proposes to use horizontal directional drilling (HDD) as the means of installing a pipeline under a National or European Site and mitigating the impacts, the assessment should cover whether the geological conditions are suitable for HDD'.</i>
Paragraph 2.23.3	<i>'When considering any application where the pipeline goes under a designated area of geological or geomorphological interest, the applicant should submit details of alternative routes, which either bypass the designated area or reduce the length of pipeline through the designated area to the minimum possible, and the reasons why they were discounted'.</i>
Paragraph 2.23.4	<i>'Applicants should consult with the relevant statutory consultees at an early stage'.</i>
Paragraph 2.23.7	<i>'Mitigation measures to minimise any adverse effects on soil and geology should include measures to ensure that residual impacts on the surface are minor, for example some differential vegetation growth. Mitigation measures should include appropriate treatment of soil (and in particular topsoil) during site construction and other infrastructure activity (and appropriate soil storage and reinstatement in line with the principles and practices outlined in the Code of Practice for the Sustainable Management of Soils on Construction Sites. The IPC should consider what appropriate conditions should be attached to any consent'.</i>
Paragraph 2.23.8	<i>'Where HDD is proposed, the applicant should provide an alternative plan for installing the pipeline in the event that HDD fails. Such alternative means could include open cut, micro-tunnelling and tunnelling'.</i>

Policy Reference	Policy Context
	Draft National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) (2023) (Ref 9-21).
Paragraphs 2.221 and 2.22.2	<p><i>'Where it is not considered practicable to select a route that avoids below surface usage, applicants must demonstrate in the ES that mitigating measures will be put in place to avoid adverse effects both on other below ground works and on the pipeline. 2.22.2 Mitigating measures may include:</i></p> <ul style="list-style-type: none"> <li>• <i>protection or diversion of underground services;</i></li> <li>• <i>gas detection near landfill sites;</i></li> <li>• <i>HDD techniques; and</i></li> <li>• <i>Rerouting'.</i></li> </ul>
Paragraph 2.21.42	New pipelines will be installed in a variety of geological conditions. It will be important for applicants to understand the soil types and the nature of the underlying strata.
Paragraph 2.21.44	Applicants must assess the stability of the ground conditions associated with the pipeline route and incorporate the findings of that assessment in the ES (see Section 4.2 of EN-1) as appropriate.
Paragraph 2.21.46	The applicant may find it necessary to sink new boreholes along the preferred route to better understand the ground conditions present.



## Local Planning Policies

9.2.4 Local Planning Policies relevant to geology and hydrogeology are detailed in **Table 9-2**. An overview of how relevant local planning policy has been complied with is provided within the *Planning Statement (Application Document 7.1)*.

**Table 9-2: Local Planning Policies Relevant to Geology and Hydrogeology**

Policy Reference	Policy Context
North Lincolnshire Council Local Plan (2011 Ref 9-22)	The North Lincolnshire Local Development Framework, Core Strategy is a framework which sets out planning policies for North Lincolnshire and identifies how land will be used. The relevant policies to this chapter include: <ul style="list-style-type: none"> <li>• Policy CS17: Biodiversity; and</li> <li>• Policy CS21: Minerals.</li> </ul>
North East Lincolnshire Council Plan (2018) Ref 9-23	The North East Lincolnshire Council Plan is focused on how the council will be helping to create jobs, build new homes and how they will protect and enhance those features of our Borough which are special. The relevant policies to this chapter include: <ul style="list-style-type: none"> <li>• Policy 34: Water Management; and</li> <li>• Policy 41: Biodiversity and Geodiversity.</li> </ul>
East Lindsey Local Plan (2018) Ref 9-24	The local plan sets out its strategic priorities for its area, and policies for growth and development across the District. The relevant policies to this chapter include: <ul style="list-style-type: none"> <li>• Strategic Policy 10 (SP10) – Design; and</li> <li>• Strategic Policy 24 (SP24) – Biodiversity and Geodiversity.</li> </ul>
Central Lincolnshire Council Plan (2023) Ref 9-25	The Central Lincolnshire Council Plan includes the City of Lincoln Council, North Kesteven Council and West Lindsey District Council. The plan prepares plans and policies which help create places that are sustainable and attractive to live in within the area. The relevant policies to this chapter include: <ul style="list-style-type: none"> <li>• Policy S56: Development on Land Affected by Contamination;</li> <li>• Policy S60: Protecting Biodiversity and Geodiversity.</li> </ul>

## Guidance

9.2.5 The geology and hydrogeology assessment has been carried out in accordance with the following:

- Planning Practice Guidance for the Natural Environment (PPGNE) 2019 (Ref 9-26);
- Department for the Environment, Food and Rural Affairs (DEFRA): Construction Code of Practice for the Sustainable Use of Soil on Development Sites (2009) (Ref 9-27);
- Environment Agency (2021) Guidance for Pollution Prevention: Vehicle Washing and Cleaning GPP 13 (Ref 9-28);
- Environment Agency (2020) Land Contamination Risk Management (LCRM) (Ref 9-29);
- Highways England (2019) Design Manual for Roads and Bridges (DMRB), LA 109: Geology and Soils (Ref 9-30);

- Highways England (2020) Design Manual for Roads and Bridges (DMRB), LA 113 Road drainage and the Water Environment (Ref 9-31);
- British Standard (2015) BS 5930:2015 Code of Practice for Ground Investigations (A1:2020) (Ref 9-32);
- British Standard (2011) BS10175:2011 A2: 2017 Investigation of potentially contaminated sites – code of practice (Ref 9-33); and
- Environment Agency (2018) The Environment Agency’s approach to groundwater protection (Ref 9-34).

## 9.3 Scope of Assessment and Consultation

### Scoping Report and Scoping Opinion

- 9.3.1 A scoping exercise was undertaken in early 2022 to establish the content of the geological and hydrogeological assessment and the approach and methods to be followed. A Scoping Report was submitted to the Planning Inspectorate in March 2022, a copy of which is included in *ES Volume IV: Appendix 5.1 (Application Document 6.4.5.1)*. Following receipt of the Scoping Opinion (*ES Volume IV: Appendix 5.2 (Application Document 6.4.5.2)*), some additional requirements have been identified by the Planning Inspectorate which have been taken account of as part of the ongoing geology and hydrogeology assessment.
- 9.3.2 A summary of stakeholder engagement specific to geology and hydrogeology (including through the scoping process) have been provided in **Table 9-3**.

### Feedback on Preliminary Environmental Information Report (PEIR)

- 9.3.3 A summary of the relevant PEIR feedback and responses relating to geology and hydrogeology has been provided in **Table 9-4**.

**Table 9-3: Geology and Hydrogeology Scoping Opinion**

Stakeholder	Summary of Scoping Opinion	Response
The Planning Inspectorate	<p><u>Water Framework Directive (WFD) groundwater bodies</u> ES chapter to consider two WFD groundwater bodies identified within DCO Site Boundary (also referred to as Draft Order Limits in some DCO documents) and the impacts to surface water features and the implications for the requirements of the WFD.</p>	<p>These have been considered within the ES, including in Chapter 11: Water Environment.</p>
	<p><u>Location of Brownfield Sites</u> It is not clear what definition is used to define Brownfield sites. In the case that this specifically refers to sites designated under part II(a) of the Environmental Protection Act 1990, the Inspectorate considers that the potential exists for non-designated brownfield sites, or other areas subject to contamination of land or controlled waters, to exist within the study area. The ES should consider the potential effects to and from all possible sources of contamination identified within the baseline data.</p>	<p>This Chapter considers the potential effects from all possible sources of contamination identified within the baseline data and not just sites designated under part II(a) of the Environmental Protection Act 1990.</p>
	<p><u>Construction Phase Effect</u> The Inspectorate considers that overlap exists for these matters with other environmental aspect assessments, namely Agriculture and Soils, Water Environment, and Major Accidents and Disasters. The ES should explain the matters to be addressed in each of these chapters and clearly set out where these matters interact.</p>	<p>This comment has been taken on board and the scope of each chapter is clearly outlined, and where matters interact, cross-referencing to other chapters is included.</p>
	<p><u>Effects on Foundations and Main Pipeline and Construction</u> The ES should assess any likely significant effects from physical damage to the pipeline from aggressive ground conditions (or other sources such as accidental damage from other parties during future works) and set out any proposed mitigation where required.</p>	<p>No aggressive ground conditions which could affect buried concrete during construction, the pipeline or structure foundations have currently been identified. This will be assessed further once the findings of the ground investigation are available.</p>
	<p><u>Decommissioning Effects</u> The proposed Decommissioning strategy was not established when</p>	<p>This chapter has assessed the likely significant effects which may occur during the</p>

Stakeholder	Summary of Scoping Opinion	Response
	<p>the Scoping Report was prepared. Regardless, the ES should assess all possible likely significant effects during the decommissioning phase.</p>	<p>decommissioning phase.</p>
	<p><u>Assessment of Radiation</u> The Inspectorate accepts that, based on the nature of the Proposed Development, significant effects from radiation emissions are unlikely and agrees that this can be scoped out of the ES.</p>	<p>As agreed, this has been scoped out of the assessment.</p>
	<p><u>Potential Effects</u> ES chapter to consider an assessment of the likely significant effects of artesian groundwater conditions and the presence of unique groundwater features (e.g., blow wells, chalk streams, and springs).</p>	<p>This has been included as part of this chapter.</p>
<p>Anglian Water</p>	<p><u>Mitigation relating to abstractions</u> Several Source Protection Zones (SPZ) have been identified within the DCO Site Boundary. Anglian Water requests that where investigation work identify risks through surface water and groundwater to water sources including abstractions that we are included in design and mitigation discussions with the Environment Agency.</p>	<p>A preliminary hydrogeological risk assessment has been undertaken with the risk ratings for SPZ 1 and 2s being classified as ‘low’. Appropriate mitigation measures are identified and included where necessary. This will be reviewed further based on the findings of future geotechnical ground investigation work (date to be confirmed) and both Anglian Water and the EA will be consulted, as well as private landowners with private water abstractions where applicable. The requirement for a geotechnical ground investigation will be included as a commitment within the Draft CEMP (<i>ES Volume IV: Appendix 3.1 (Application Document 6.4.3.1)</i>).</p>
<p>East Lindsey District Council</p>	<p><u>Aquifers and private borehole water supplies</u> ES to consider location and potential impact on the District’s aquifers and private borehole water supplies.</p>	<p>Information was received on 28<sup>th</sup> June 2023 and has been included in this chapter.</p>

Stakeholder	Summary of Scoping Opinion	Response
Lincolnshire County Council	<p><u>Information from LCC – Minerals &amp; Waste</u> ES to consider the Minerals &amp; Waste Plan from the county council.</p>	<p>This has been included within this ES, specifically within <i>ES Volume II: Chapter 18: Materials and Waste (Application Document Ref 6.2.18)</i>.</p>
Mablethorpe & Sutton Town Council	<p><u>Geological Disposal Facility (GDF)</u> ES to consider the impact of any future proposed geological disposal facility at the same location be factored into route/scheme within Cumulative Effects.</p>	<p>At the current time, no plans or planning application have been submitted for a Geological Disposal Facility at Theddlethorpe, and thus it is not possible to undertake a detailed assessment. Further information is provided in <i>ES Volume IV: Appendix 20.1 (Application Document Ref 6.4.20.1)</i>.</p>
North Lincolnshire Council	<p><u>Phase 1 Report</u> In relation to land contamination a Phase 1 report in respect of land contamination should be provided with any future application and depending on the findings, a Phase 2 report may also be required.</p>	<p>The information usually provided within a Phase 1 Report is included within this ES Chapter. If required, a Phase 2 Report will be undertaken as part of the detailed design work. A conceptual Site Model and Risk Assessment is included in <i>ES Volume IV: Appendix 9-4 (Application Document 6.4.9.4)</i>.</p>
Environment Agency	<p><u>Receptors or factors which need to be scoped in for consideration within Chapter 9 or 11 include:</u></p> <ul style="list-style-type: none"> <li>• Groundwater resources – specifically licensed and deregulated supplies, data held by the Environment Agency, and private (unlicensed) water supplies registered with the local authorities. There is minimal reference to these and ensuring the development works do not interrupt any licenced water abstraction in the area is essential - they are key receptors; several private supplies appear to lie along the route itself.</li> <li>• <u>Artesian conditions – there is the potential for artesian groundwater flow if bedrock is penetrated; this should be considered as a potential risk.</u></li> <li>• <u>Unique groundwater features in the area – blow wells, chalk streams, springs.</u></li> </ul>	<p>This ES has considered both licensed and private water supplies. A data request was submitted to the EA and the four relevant local authorities with North East Lincolnshire Council, East Lindsey District Council and West Lindsey District Council identifying private water supplies potentially within the vicinity of the Proposed Development. North Lincolnshire Council did not hold any records of private water supplies within 2km of the Proposed Development.</p> <p>This ES chapter has considered the potential for artesian conditions and unique groundwater features in the area on the Project. Additionally, they are discussed further in the Preliminary</p>

Stakeholder	Summary of Scoping Opinion	Response
	<ul style="list-style-type: none"> <li>• <u>Groundwater quality – identifying the baseline conditions and specific protection measures.</u></li> </ul>	Hydrogeological Risk Assessment ( <i>ES Volume IV: Appendix 9.3, Application Document 6.4.9.3</i> ).
Environment Agency	<p><u>Errors in Hydrogeological Classifications</u> A number of Hydrogeological classifications contain several errors which need to be corrected.</p>	Hydrogeological details have been updated within the ES, relating to drinking water safeguarding zones, source protection zones and nitrate vulnerable zones.
	<p><u>Protection Designations</u> Although protection designations have been identified, there is no discussion as to how these will be used to target mitigation measures; we presume this will become more evident in the full EIA.</p>	This ES has considered targeted mitigation measures in relation to identified protection designations.
	<p><u>Dewatering Scheme</u> More detailed hydrogeological risk assessments are to be undertaken for trenchless crossings or where dewatering is required. A dewatering scheme will be developed prior to construction in consultation with the Environment Agency. We welcome the confirmation that we will be consulted on all hydrogeological risk assessments, as suggested, particularly for trenchless crossings; every care should be taken to avoid reaching the underlying principal chalk aquifer bedrock to mitigate against potential impacts and issues with water resources, for example artesian flow.</p>	The ES considers hydrogeological risk assessments for trenchless crossings or where dewatering may be required that fall within SPZ 1 and SPZ 2. The EA will be consulted prior to the commencement of construction as part of developing dewatering scheme. Information relating to the need to try and avoid reaching the underlying principal chalk aquifer bedrock has been shared with the design team and has been considered as part of the Proposed Developments design.
	<p><u>Guidance</u> There is no reference to the ‘Environment Agency’s approach to groundwater protection’ or relevant Groundwater Protection Position Statements, in particular section C.</p>	The ES (and this chapter) has considered and made reference to the ‘Environment Agency’s approach to groundwater protection’ or relevant Groundwater Protection Position Statements, in particular section C.
	<p><u>Guidance</u> Little reference is made to our Land Contamination: Technical Guidance. We recommend that this guidance is followed. Reference should also be made to British Standards BS 5930:1999 A2:2010</p>	The ES (and this chapter) has considered and made reference to the following documents: The EA’s Land Contamination: Technical Guidance; British Standards BS 5930:1999 A2:2010 code of practice for site investigations; and BS10175:2011

Stakeholder	Summary of Scoping Opinion	Response
	code of practice for site investigations and BS10175:2011 A1: 2013 Investigation of potentially contaminated sites – code of practice.	A1: 2013 Investigation of potentially contaminated sites – code of practice.
	<u>Consultation</u> EA to be consulted prior to any remedial strategy being put in place.	Confirmation that the EA will be consulted prior to any remedial strategy being put in place.
	<u>Contaminated Sites</u> Several potentially contaminated sites have been identified, and there is the potential for heterogeneity in ground conditions. As such we would suggest that if, during development, contamination not previously identified is found to be present at the site then no further development (unless otherwise agreed in writing with the local planning authority) shall be carried out until the developer has submitted a remediation strategy detailing how this unsuspected contamination shall be dealt with.	In relation to contamination which has not previously been identified, within this ES recommendation has been made for an inspection and discovery strategy as part of the proposed mitigation measures.



**Table 9-4: Geology and Hydrogeology Feedback on PEIR**

Stakeholder	Date	Summary of PEIR Feedback	Response
The Coal Authority	17 November 2022 via Email  Response received 30 November 2022	<u>Coal Mining</u> Confirmation that whilst parts of the site (Section 5: Manby Middlegate to Theddlethorpe) marginally lies within the coalfield area, the area falls within the Development Low Risk Area only. It is noted that the existing offshore pipeline lies within this specific area. In light of the above, the Environmental Impact Assessment will not need to consider coal mine workings as part of the proposal or for the determining authority to consult us.	Confirmation that this ES does not consider coal mine workings in any further detail than the PEIR did, and that no further correspondence with the Coal Authority is required as part of the ES.
Environment Agency	17 November 2022 via Email  Response received 22 December 2022	<u>Consultation</u> Table 9-1 – we note the inclusion of the groundwater considerations listed within the scope of the EIA, and the corrections to hydrogeological features in Tables 9-10 and 11-9. We also welcome the intention to consult the Environment Agency regarding further hydrogeological and remediation assessments and on the proposed contamination inspection and discovery strategy.	A preliminary hydrogeological risk assessment has been undertaken for the site ( <i>ES Volume IV: Appendix 9.3, (Application Document 6.4.9.3)</i> ). Upon the completion of the ground investigation at the Proposed Development, the EA will be consulted in relation to whether a more detailed assessment is required. Additionally, if required, the proposed approach for the contamination inspection and discovery strategy will be outlined and agreed with the EA.
		<u>Sensitivity Classifications</u> Table 9-3 – we would query the applicability of sensitivity criteria in terms of the hydrogeological examples used. All Source Protection Zones (SPZs) delineate catchments for regionally important public water supplies, but different travel times; any SPZ, 1, 2 or 3 should be considered at least medium-high risk. SPZ 3 does not equate to agricultural / industrial sources, but by definition is delineated as the total	SPZ sensitivity has been amended to align with EA's comments and queried wording removed.



Stakeholder	Date	Summary of PEIR Feedback	Response
		<p>catchment around potable or public water supplies. We suggest SPZ 3 should be considered medium sensitivity as a minimum and SPZ 1 and 2 should be considered high sensitivity. Also, we suggest removing wording around the potential for replacement of geology in the criteria; this isn't likely under any circumstance.</p>	
		<p>Table 9-13 – we disagree with the assessment of the potential duration of impacts to hydrogeology (principal and secondary aquifers, SPZs and abstractions) as being short-term in relation to pollution incidents and contamination. We can provide several case studies demonstrating the largescale impacts (geographically, temporally and financially) of relatively small pollution incidents, which are extremely difficult to remediate when groundwater has been affected. This should be revised to reflect the potential duration of any pollution impact and highlight the recognition of the risk to be mitigated.</p>	<p>The ES has considered the duration of potential effects within the magnitude rating and the overall assessment has been adjusted to consider hydrogeological receptors as higher risk than previously identified in the PEIR based on feedback from the EA.</p>
		<p><u>Remediation</u> 9.8.2 – there is a recognised need to remediate potential contamination at both Option 1 for the Theddlethorpe Facility and the Immingham Facility, and an assumption has been made that this remediation will be complete before works begin. Can clarification be provided as to who will be responsible for ensuring this remediation is completed prior to development? Appropriate remediation, verification, reporting and approval will need to be completed and factored into the Proposed Development programme. We recommend that developers should:</p> <ol style="list-style-type: none"> <li>1. Follow the risk management framework provided in 'Land contamination: risk management' when dealing with land affected by contamination.</li> <li>2. Refer to our Guiding principles for land contamination for the type of information that we require in order to assess risks to controlled waters from the site – the local authority can advise on risks to other receptors, such as human health.</li> <li>3. Consider using the National Quality Mark Scheme for Land Contamination Management which involves the use of competent persons to ensure that land contamination risks are appropriately managed.</li> <li>4. Refer to the contaminated land pages on gov.uk for more information.</li> </ol>	<p>The land is set to be remediated by the current site landowners prior to the construction of the Proposed Development. This will form a condition of the lease agreement.</p>

## Additional Consultation

9.3.4 A summary of stakeholder engagement specific to geology and hydrogeology has been provided in **Table 9-5**.

**Table 9-5: Geology and Hydrogeology Additional Consultation**

Stakeholder	Date of meeting / communication	Summary of discussions
Environment Agency	23 November 2022 via Call	Discussed methodology to be followed in the PEIR and ES and discussed a data gap in relation to no abstraction data being provided north of Alvingham in the PEIR. EA agreed to provide rest of abstraction data set to cover the remainder of the Draft Order Limits for Proposed Development.  <i>Dataset provided by the EA.</i>
Environment Agency	15 February 2023 via Email  Response Received 1 March 2023	A request for environmental information relating to water abstractions.  <i>Data provided.</i>
Anglian Water	26 January 2023	Discussed the outline findings from the PEIR and about the geology in the vicinity of an Anglian Water abstraction located adjacent to the Proposed Development.  <i>Anglian Water provided information relating to the geology within this area.</i>
Environment Agency	15 February 2023 via Email  Response Received 16 February 2023	A request for environmental information relating to the hydraulic head levels and water quality within the Lincolnshire Chalk Aquifer.  <i>Data provided however the majority of sampling points are located approximately 2km from the DCO Site Boundary.</i>
Landowner – Private Water Abstractions	28 March 2023 via Email  Questionnaire via Email/Letter	A request for environmental information relating to two potential private water abstractions on the landowners' property was issued via a questionnaire.  The landowner is not aware of any private water abstraction on their property therefore it can likely be assumed that this abstraction is no longer in use.

Stakeholder	Date of meeting / communication	Summary of discussions
Environment Agency	22 June 2023 via email	<p>Email update outlining the approach taken for the preliminary hydrogeological risk assessment (ES Volume IV: Appendix 9.3 (<i>Application Document 6.9.3.4</i>)).</p> <p><i>Acknowledgement of update received, including advice to consider position statements A4, A5 and B3 in 'The Environment Agency's approach to groundwater protection' guidance which have been considered as part of this chapter.</i></p> <p><i>Advice to also consider the requirement for abstraction licensing and timescales required to obtain the relevant approvals for potential dewatering activities.</i></p>
East Lindsey District Council	28 June 2023 via Email	A follow-up request for private abstraction information, which was received as a GIS shapefile on 28 June 2023.

## Scope of Assessment

9.3.5 This section of the ES details what aspects have been scoped in and scoped out of the assessment based on consultation with stakeholders.

### *Aspects scoped into the assessment*

9.3.6 The scope of this assessment covers the construction, operation and decommissioning phases of the Proposed Development and includes:

- Risks to Human Health;
- Risks to Geology (superficial and bedrock geologies); and
- Risks to Hydrogeology (aquifers, SPZ, WFD groundwater bodies, de-regulated water supplies, artesian conditions, and groundwater resource losses).

### *Aspects scoped out of the assessment*

9.3.7 The following has been scoped out of the assessment:

- Radiation;
- Hydrology (This is covered in *Chapter 11: Water Environment* of this ES); and
- Agriculture and Soils (This is covered in *Chapter 10: Agriculture and Soils* of this ES).

## 9.4 Assessment Methodology

### Overview

9.4.1 The baseline and potential effects have been established through the desk study and the Proposed Development description (*Chapter 3: Description of the Proposed Development*). Utilising this information and consultation with statutory consultees undertaken to date, a combination of qualitative and quantitative risk assessment has been undertaken to assess the potential effects of the existing ground conditions on the Proposed Development, and the potential effects of the Proposed Development on the Geology and Hydrogeology.

9.4.2 In relation to ground contamination, the risk assessment has been based on the source-pathway-receptor methodology outlined in Land Contamination Risk Management (LCRM) (Ref 9-35) and promoted by Department of Environment, Food and Rural Affairs (DEFRA) and the EA. For there to be an identifiable risk, not only must there be contaminants present on the site (source) there must also be a receptor and a viable pathway which allows the source to impact on the receptor.

9.4.3 The general assessment methodology used for the ES is summarised in *Chapter 5: EIA Methodology*. However, the assessment of the significance of the potential effects on geology and hydrogeology has been based on guidance in the Design Manual for Roads and Bridges (DMRB) LA 109 Geology and Soils (geology) (Ref 9-36) and LA 113 Road Drainage and the Water Environment (groundwater) (Ref 9-37). There is no specific guidance in relation to CO<sub>2</sub> transportation schemes for assessing geology and hydrogeology. Therefore, DMRB LA 109 has been used as it is considered to be the most appropriate methodology for the geology and hydrology assessment of the Proposed Development because it is designed for assessing effects on linear schemes (including 'point' features), albeit road schemes. It is also a well-established and tested methodology, familiar to the statutory consultees.

### Receptor Sensitivity

9.4.4 The sensitivity of the receptor reflects the quality of receptor and its ability to absorb an effect without perceptible change. Sensitivity is defined in **Table 9-6**.

**Table 9-6: Criteria to Determine the Sensitivity of Receptors**

Sensitivity / Value	Description	Typical Examples*
<b>High</b>	<p><u>Geology</u> Very rare and of international importance</p> <p><u>Human Health</u> Residential or allotments</p> <p><u>Hydrogeology</u> Nationally significant attribute of high importance.</p>	<p><u>Geology</u></p> <ul style="list-style-type: none"> <li>• UNESCO World Heritage Sites;</li> <li>• SSSIs of international importance; or</li> <li>• Global Geoparks.</li> </ul> <p><u>Contamination</u> <i>Human Health:</i></p> <ul style="list-style-type: none"> <li>• Very high sensitivity land use (e.g., residential).</li> </ul> <p><i>Hydrogeology (Groundwater):</i></p> <ul style="list-style-type: none"> <li>• Principal aquifer providing a regionally important resource and/ or supporting site protected under European and UK habitat legislation;</li> <li>• SPZ 1, 2; or</li> <li>• Groundwater locally supports Groundwater Dependent Terrestrial Ecosystem (GWDTE).</li> </ul>
<b>Medium</b>	<p><u>Geology</u> Rare and of national importance</p> <p><u>Human Health</u></p>	<p><u>Geology</u></p> <ul style="list-style-type: none"> <li>• SSSIs; or National Nature Reserves.</li> </ul> <p><u>Contamination</u> <i>Human Health:</i></p> <ul style="list-style-type: none"> <li>• High sensitivity land use (e.g., public open space).</li> </ul>

Sensitivity / Value	Description	Typical Examples*
	Public Open Space  <u>Hydrogeology</u> Locally significant attribute of high importance.	<i>Hydrogeology (Groundwater):</i> <ul style="list-style-type: none"> <li>Principal aquifer providing a locally important resource or supporting a river ecosystem;</li> <li>SPZ 3;</li> <li>Groundwater supports GWDTE.</li> </ul>
<b>Low</b>	<u>Geology</u> Of regional importance  <u>Human Health</u> Commercial and/or industrial).  <u>Hydrogeology</u> Of moderate quality and rarity.	<u>Geology</u> <ul style="list-style-type: none"> <li>RIGS.</li> </ul> <u>Contamination</u> <i>Human Health:</i> <ul style="list-style-type: none"> <li>Medium sensitivity land use (e.g., commercial and/or industrial).</li> </ul> <i>Hydrogeology (Groundwater):</i> <ul style="list-style-type: none"> <li>Aquifer providing water for agricultural or industrial use with limited connection to surface water.</li> </ul>
<b>Very Low</b>	<u>Geology</u> Of local importance or little/ no local interest.  <u>Human Health</u> Highways and rail  <u>Hydrogeology</u> Lower quality.	<u>Geology</u> <ul style="list-style-type: none"> <li>Non-designated geological exposures, former quarries / mining sites.</li> <li>No geological exposures.</li> </ul> <u>Contamination</u> <i>Human Health:</i> <ul style="list-style-type: none"> <li>Low sensitivity land use (e.g., highways and rail);</li> <li>No sensitive land use proposed.</li> </ul> <i>Hydrogeology (Groundwater):</i> <ul style="list-style-type: none"> <li>Unproductive strata.</li> </ul>

## Magnitude

9.4.5 The magnitude of a potential impact considers the scale of the predicted change to the baseline condition taking into account its duration (i.e., the magnitude may be moderated by the effects being temporary rather than permanent, short term rather than long term). Definitions for impact magnitude are described in **Table 9-7**. It is unlikely that any effects on geology and soils will be beneficial, so the examples of magnitude all relate to adverse effects.

**Table 9-7: Criteria to Determine the Magnitude of Impact**

Magnitude	Criteria	Typical Examples
<b>High</b>	<u>Geology</u> Loss of feature/ designation and/ or quality and integrity,	<u>Geology</u> Destruction of features at a protected site; i.e., SSSIs of international importance; or Global Geoparks.

Magnitude	Criteria	Typical Examples
	<p>severe damage to key characteristics.</p> <p><u>Human Health</u> Significant contamination identified</p> <p><u>Hydrogeology</u> Loss of attribute and/or quality and integrity of the attribute.</p>	<p><u>Contamination</u> <i>Human health:</i></p> <ul style="list-style-type: none"> <li>Contaminant concentrations significantly exceed background levels and relevant screening criteria;</li> <li>Small-scale pollution incident that leads to long-term impacts due to difficulties remediating the groundwater;</li> <li>Potential for significant harm to human health; or Contamination heavily restricts future use of land.</li> </ul> <p><i>Hydrogeology (Groundwater):</i></p> <ul style="list-style-type: none"> <li>Loss of, or extensive change to, an aquifer;</li> <li>Loss of regionally important water supply;</li> <li>Loss of, or extensive change to GWDTE or baseflow contribution to protected surface water bodies;</li> <li>Reduction in water body WFD classification.</li> </ul> <p><i>Infrastructure:</i></p> <ul style="list-style-type: none"> <li>Loss or significant damage to major structures through subsidence or similar effects.</li> </ul>
<p><b>Medium</b></p>	<p><u>Geology</u> Partial loss of feature / designation, potentially adversely affecting integrity; partial loss of/damage to key characteristics, features or elements.</p> <p><u>Human Health</u> Significant contamination identified</p>	<p><u>Geology</u></p> <ul style="list-style-type: none"> <li>Partial loss of features at a protected site; i.e., SSSIs; National Nature Reserves.</li> </ul> <p><u>Contamination</u> <i>Human Health:</i></p> <ul style="list-style-type: none"> <li>Contaminant concentrations exceed background levels and are in line with limits of relevant screening criteria;</li> <li>Significant contamination can be present.</li> </ul>

Magnitude	Criteria	Typical Examples
	<p><u>Hydrogeology</u> Results in effect on integrity of attribute, or loss of part of attribute.</p>	<p><i>Hydrogeology (Groundwater):</i></p> <ul style="list-style-type: none"> <li>• Partial loss or change to an aquifer; Degradation of regionally important public water supply or loss of significant commercial/ industrial/ agricultural supplies;</li> <li>• Partial loss of the integrity of GWDTE;</li> <li>• Contribution to reduction in water body WFD classification.</li> </ul> <p><i>Infrastructure:</i></p> <ul style="list-style-type: none"> <li>• Damage to major structures through subsidence or similar effects or loss of minor structures.</li> </ul>
<p><b>Low</b></p>	<p><u>Geology</u> 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.</p> <p><u>Human Health</u> Contamination identified but not significant.</p> <p><u>Hydrogeology</u> Results in some measurable change in attributes, quality or vulnerability.</p>	<p><u>Geology</u></p> <ul style="list-style-type: none"> <li>• Minor measurable change of features at Geological sites; i.e., RIGS.</li> </ul> <p><u>Contamination</u> <i>Human Health:</i></p> <ul style="list-style-type: none"> <li>• Contaminant concentrations are below relevant screening criteria;</li> <li>• Significant contamination is unlikely with a low risk to human health.</li> <li>• Groundwater: Minor effects on an aquifer, GWDTEs, abstractions.</li> </ul> <p><i>Infrastructure:</i></p> <ul style="list-style-type: none"> <li>• Minor effects on structures.</li> </ul>
<p><b>Very Low</b></p>	<p><u>Geology</u> Very minor loss or detrimental alteration to one or more characteristics, features or elements of geological feature / designation. Overall</p>	<p><u>Geology</u></p> <ul style="list-style-type: none"> <li>• Very minor change of features at sites of local importance, i.e., non-designated geological sites.</li> </ul> <p><u>Contamination</u> <i>Human Health:</i></p>



Magnitude	Criteria	Typical Examples
	integrity of resource not affected.  <u>Human Health</u> No measurable impact on human health receptors  <u>Hydrogeology</u> Results in effect on attribute, but of insufficient magnitude to affect the use or integrity.	<ul style="list-style-type: none"> <li>Contaminant concentrations substantially below relevant screening criteria.</li> </ul> <i>Hydrogeology (Groundwater):</i> <ul style="list-style-type: none"> <li>No measurable impact upon an aquifer and/or groundwater receptors.</li> </ul>

### Significance Criteria

9.4.6 The significance of environmental effect is typically a function of the sensitivity of a receptor and the magnitude of an impact. Effects can be beneficial, adverse or negligible and their significance Major, Moderate, Minor or Negligible. Significance Categories are presented in **Table 9-8**.

**Table 9-8: Table of Significance Categories**

		Magnitude of Change			
		Very Low	Low	Medium	High
Sensitivity of Receptor	High	Negligible/ Minor	Moderate	Major	Major
	Medium	Negligible	Minor	Moderate	Major
	Low	Negligible	Negligible	Minor	Moderate
	Very Low	Negligible	Negligible	Negligible	Negligible/ Minor

9.4.7 Any effect predicted to be Negligible, or Minor are considered to be 'Not Significant'. Effects assessed as Moderate, or Major are considered to be 'Significant'.

### Assumptions and Limitations

9.4.8 To ensure transparency within the EIA process, the following limitations and assumptions have been identified:

- The assessment will rely on available data, and reasonable endeavours will be made to ensure that the data is accurate and up to date, however the accuracy of third-party information cannot be confirmed;
- Assessments will be limited by availability of design information, specifically in relation to below ground structures (i.e., depth of piles/foundations, pipe/ tunnel invert levels);
- It is recognised that ground contamination may be present at one of the options for the proposed Theddlethorpe Facility at the former TGT, but it is assumed that by the time of construction, this area within the DCO Site Boundary will have been fully remediated, with mitigation in place to avoid disturbing remedial works. The land is set to be remediated by the current site landowners prior to the construction of the Proposed Development. This will form a condition of the lease agreement.



- If remedial works are required at the proposed Immingham Facility, it is assumed remediation will have occurred prior to construction of the Proposed Development as part of other works the current site landowner is undertaking (This will form a condition of the lease agreement). and
- A geotechnical and geo-environmental ground investigation will be undertaken to inform the detailed design of the Proposed Development. This is a commitment which is captured within the Draft CEMP included in *ES Volume IV: Appendix 3.1 (Application Document 6.4.3.1)*.

## 9.5 Baseline Conditions and Study Area

### Study Area

- 9.5.1 The Study Area for the ES of the geology and hydrogeology assessment is 250m either side of the DCO Site Boundary. Interactions between the Proposed Development and receptors or sources of contamination beyond 250m would generally not occur as a result of ground conditions present in and around the Proposed Development, as a viable pathway between source and receptor is unlikely to be present over this distance.
- 9.5.2 The receptors and sources of contamination have been identified within the DCO Site Boundary. Where relevant for specific subtopics, the Study Area extends to 500m either side of the DCO Site Boundary for groundwater SPZs and up to 2km for groundwater abstractions.

### Sensitive receptors

- 9.5.3 The sensitive receptors relevant to this assessment include the following:

#### *Human Health*

- Construction Workers;
- Site Users;

#### *Geology*

- Superficial Deposits;
- Bedrock Geology;

#### *Hydrogeology*

- Aquifers (Principal, Secondary A, B and undifferentiated);
- Source Protection Zones (1, 2 & 3);
- Regulated and unregulated abstractions;

#### *Hydrology*

- Surface Water Features; and

#### *Development Infrastructure*

- Above Ground Installations (AGIs) and Pipelines.

### Desk Study

- 9.5.4 Baseline conditions of the Study Area were established during a desk study assessment using the following sources:
- Google Maps and Aerial Imagery (Ref 9-38);
  - Groundsure Report (Ref 9-39);

- MAGIC.gov.uk (DEFRA) (Ref 9-40);
- British Geology Survey (BGS) Online Viewer (Geo-Index) (Ref 9-41);
- Zetica UXO Risk Maps (Ref 9-42);
- The Coal Authority (Ref 9-43); and
- UKradon (UK Health Security Agency) (Ref 9-44).

### Site Visits and Surveys

9.5.5 Geology and hydrogeology surveys were undertaken on the 22 and 23 January 2023. The surveys primarily focussed on the Immingham Facility and Theddlethorpe Facility with a number of other visits to other areas of interest along the pipeline route. The areas identified for site surveys are listed below:

- Immingham Facility (Publicly accessible areas only);
- Source Protection Zone 1;
- Old Chalk Pits;
- Private Water Supplies (Hawerby Lodge and Hall);
- Anglian Water Treatment Works (Publicly accessible areas only);
- Theddlethorpe Facility (Option 1 only); and
- Mablethorpe Beach.

9.5.6 With the exception of the Private Water Supply locations and the Anglian Water Treatment Works, where there were access constraints, a site reconnaissance was successfully undertaken at the locations mentioned above, and a series of photographs taken.

9.5.7 The site reconnaissance did not identify any potential sources of contamination or any features of interest, therefore, a photolog has not been included.

### Baseline Conditions

9.5.8 Due to the length of the Proposed Development, the pipeline route has been split along the route based on key road intersections to aid in providing descriptions of the existing baseline. The five sections as stated within *Chapter 3: Description of the Proposed Development* can be defined as the following:

- Section 1 – Rosper Road, Immingham to A180;
- Section 2 – A180 to A46;
- Section 3 – A46 to Pear Tree Lane;
- Section 4 – Pear Tree Lane to B1200 (Manby Middlegate); and
- Section 5 – B1200 (Manby Middlegate) to Theddlethorpe Reception Facility and down to MLWS.

9.5.9 It is worth noting that there are two pipeline route options being considered for the Immingham Facility which are relevant when considering the existing conditions. These are:

- Option 1 coming in from the tie-in at the Immingham Facility then running south parallel to Manby Road before crossing south of the Immingham Calor Cylinder Distribution site heading towards Former Immingham Golf Course; and

- Option 2 being via Phillips 66 through the Humber Refinery Site, more details can be found in *Chapter 3: Description of the Proposed Development*.

9.5.10 There are two options being considered for the location of the Theddlethorpe Facility:

- Option 1 at the former Theddlethorpe Gas Terminal (TGT); and
- Option 2 to the west of the former TGT site.

9.5.11 The following sub-sections provide a summary of the existing ground conditions within the Study Area, based on the sources of information identified in Section 9.5.4.

### Geology

9.5.12 Published geological maps and the GIS data sourced from the BGS (Ref 9-45 to Ref 9-51) indicate that the Proposed Development is underlain by the geological succession summarised below in **Table 9-9**. Geological mapping for the Proposed Development is shown as **Figure 9-1** and **Figure 9-2**.

**Table 9-9: Summary of Geology from BGS 1:50,000 mapping and Groundsure Data**

Section	Stratum Type	Description
<b>Section 1</b>	Made Ground	An area of Artificial Ground is shown within the DCO Site Boundary. Although Made Ground / Artificial Ground is only formally mapped along the east of Section 1 (around Immingham Docks), it is anticipated that most of this section will be underlain by Made Ground due to historical and current industrial use, including the VPI Immingham and P66 sites.
	Superficial	The majority of this Section is indicated to be underlain by Till, Devensian deposits which comprise Diamicton. In addition, there are also localised areas of Tidal Flat deposits, comprising of Clay and Silt along the north of the DCO Site Boundary (and along the north and east of the Immingham Facility) and Alluvium comprising of Clay, Silt, Sand and Gravel immediately north of the A180 at Section Break 1.
	Bedrock	The whole Section is underlain by Chalk of the Burnham Chalk Formation.
<b>Section 2</b>	Made Ground	No Artificial Ground is shown within the DCO Site Boundary, however, there is a small area of Artificial Ground within the wider Study Area, located east of Riby.
	Superficial	The majority of this Section is underlain by Till, Devensian deposits. However, there are localised areas of Alluvium, Lacustrine Deposits (Sand, Silt and Clay), Glaciofluvial Sheet Deposits (Sand & Gravel) and Glaciofluvial deposits (Sand & Gravel), particularly around Aylesby and Laceby. There are also several small areas towards the south of this Section where there are no superficial deposits.
	Bedrock	The majority of the Section is underlain by chalk of the Burnham Chalk Formation with the exception of a thin band of Welton Chalk Formation immediately east of Laceby.

Section	Stratum Type	Description
<b>Section 3</b>	Made Ground	No Artificial Ground is shown within the DCO Site Boundary, however, there is a small area of Artificial Ground within the wider Study Area, located southwest of North Thoresby.
	Superficial	The majority of this Section is underlain by Till, Devensian deposits. However, there are localised areas of Alluvium between Barnoldby le Beck and Brigsley, Lacustrine Deposits (Sand, Silt and Clay) particularly north west of Ashby cum Fenby, and Glaciofluvial deposits (Sand & Gravel) particularly southeast of Irby Upon Humber.
	Bedrock	The majority of the Section is underlain by chalk of the Welton Chalk Formation with the exception of the DCO Site Boundary between the A46 and Welbeck Hill and to the southwest of Brigsley where the geology comprises of Burnham Chalk Formation.
<b>Section 4</b>	Made Ground	No Artificial Ground is shown within the DCO Site Boundary.
	Superficial	The majority of this Section is underlain by Till, Devensian deposits. However, there are localised areas of Alluvium, Lacustrine Deposits (Sand, Silt and Clay) and Glaciofluvial deposits (Sand & Gravel). There are also sections of Tidal Flat deposits between North Cockerington and the B1200.
	Bedrock	The majority of the Section is underlain by chalk of the Welton Chalk Formation with the exception of an area comprising chalk of the Ferriby Chalk Formation within the middle of this Section.
<b>Section 5</b>	Made Ground	No Artificial Ground is shown within the DCO Site Boundary.
	Superficial	The majority of this Section is underlain with Tidal Flat deposits. There is a small area of Till at the northern most point of the Section, and near Great Carlton, and then a band of Blown Sand (Sand), Storm Beach Deposits (Sand) and Beach and Tidal Flat Deposits (Clay, Silt and Sand) at the end of the Section along the coast.
	Bedrock	The first half of this section is underlain by chalk of the Welton Chalk Formation until Great Carlton where the DCO Site Boundary extend to the east and bedrock changes to chalk of the Burnham Chalk Formation.
<p><i>Source: 1:50,000 Scale BGS Map Sheets 80, 81, 90, 103 and 104 - References Ref 9-39, Ref 9-41, Ref 9-45 to Ref 9-51</i></p>		

### **Previous Ground Investigation**

9.5.13 A review of publicly available data and the Groundsure data has identified several sensitive land uses, the majority of which are at the end of Section 5 where the DCO Site Boundary extend to Mean Low Water Springs (MLWS). Further information can be seen in **Table 9-13**. BGS Geo-Index online viewer (Ref 9-45) provides records for ground investigation data from

many boreholes drilled within the Study Area and surrounding area. The number of boreholes within each section of the route is detailed in **Table 9-10**. The strata encountered in these exploratory locations generally correlate with information obtained from BGS mapping data. Strata encountered are summarised below in **Table 9-11**.

9.5.14 **Figure 9-3** shows the locations of the BGS boreholes within the Study Area and further data is tabulated in *ES Volume IV: Appendix 9.1 (Application Document 6.4.9.1)*.

**Table 9-10: Summary of BGS Geo-Index Boreholes**

Section	BGS Boreholes
<b>Section 1</b>	24 No. existing boreholes within the Study Area.
<b>Section 2</b>	27 No. existing boreholes within the Study Area.
<b>Section 3</b>	34 No. existing boreholes within the Study Area.
<b>Section 4</b>	16 No. existing boreholes within the Study Area.
<b>Section 5</b>	55 No. existing boreholes within the Study Area.

**Table 9-11: Summary of BGS Geo-Index Borehole Geology**

Stratum Type	Description
<b>Artificial / Made Ground</b>	Within Section 1 Made Ground deposits are shown to generally comprise stiff to firm, yellow / grey silty CLAY with evidence of anthropogenic materials. The origin for the described material is assumed to be re-worked Glacial Till.
<b>Superficial</b>	Tidal Flat Deposits: Soft to very soft dark grey silty organic CLAY. Glacial Till: Firm to stiff slightly fissured grey brown slightly gravelly CLAY. Alluvium: Soft to firm sandy gravelly CLAY with localised silt. Lacustrine Deposits: Soft to firm laminated slightly sandy silty CLAY. Glaciofluvial Deposits: Medium dense orange brown slightly silty fine to medium SAND.
<b>Bedrock</b>	Welton Chalk Formation: Hard white thickly bedded CHALK with common flint nodules. Burnham Chalk Formation: White thinly bedded CHALK with common discontinuous flint bands and sporadic marl seams.

### **Ground Stability**

9.5.15 Ground stability records which highlight the risk of ground stability hazards across the DCO Site Boundary (Ref 9-39) are detailed below within **Table 9-12** and presented on **Figure 9-4**.

**Table 9-12: Summary of Ground Stability**

Section	Hazard Potential	Class and Description
<b>Section 1</b>	Collapsible Ground Stability	A - Deposits with potential to collapse when loaded and saturated are believed not to be present.

Section	Hazard Potential	Class and Description
		B - Deposits with potential to collapse when loaded and saturated are unlikely to be present.
	Compressible Ground Stability	A - Compressible strata are not thought to occur. D - Compressibility and uneven settlement hazards are probably present. Land use should consider specifically the compressibility and variability of the site.
	Ground Dissolution Stability	A – Soluble rocks are either not thought to be present within the ground, or not prone to dissolution. Dissolution features are unlikely to be present.
	Landslide Ground Stability	B - Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered. C - Slope instability problems may be present or anticipated. Site investigation should consider specifically the slope stability of the site.
	Running Sand Ground Stability	B – Running sand conditions are unlikely. No identified constraints on land use due to running conditions unless water table rises rapidly. C – Running sand conditions may be present. Constraints may apply to land uses involving excavation or the addition or removal of water. D – Running sand conditions are probably present. Constraints may apply to land uses involving excavation or the addition or removal of water.
	Shrinking or Swelling Clay Ground Stability	B – Ground conditions predominantly low plasticity. C – Ground conditions predominantly medium plasticity.
<b>Section 2</b>	Collapsible Ground Stability	A – Deposits with potential to collapse when loaded and saturated are believed not to be present. B – Deposits with potential to collapse when loaded and saturated are unlikely to be present.
	Compressible Ground Stability	A – Compressible strata are not thought to occur. D – Compressibility and uneven settlement hazards are probably present. Land use should consider specifically the compressibility and variability of the site.
	Ground Dissolution Stability	A - Soluble rocks are either not thought to be present within the ground, or not prone to dissolution. Dissolution features are unlikely to be present. B - Soluble rocks are present within the ground. Few dissolution features are likely to be present. Potential for



Section	Hazard Potential	Class and Description
		difficult ground conditions or localised subsidence are at a level where they need not be considered.
	Landslide Ground Stability	<p>B – Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered.</p> <p>C – Slope instability problems may be present or anticipated. Site investigation should consider specifically the slope stability of the site.</p>
	Running Sand Ground Stability	<p>A – Running sand conditions are not thought to occur whatever the position of the water table. No identified constraints on lands use due to running conditions.</p> <p>B – Running sand conditions are unlikely. No identified constraints on land use due to running conditions unless water table rises rapidly.</p> <p>C – Running sand conditions may be present. Constraints may apply to land uses involving excavation or the addition or removal of water.</p>
	Shrinking or Swelling Clay Ground Stability	<p>A – Ground conditions predominantly non-plastic.</p> <p>B – Ground conditions predominantly low plasticity.</p> <p>C – Ground conditions predominantly medium plasticity.</p>
<b>Section 3</b>	Collapsible Ground Stability	<p>A – Deposits with potential to collapse when loaded and saturated are believed not to be present.</p> <p>B – Deposits with potential to collapse when loaded and saturated are unlikely to be present.</p>
	Compressible Ground Stability	<p>A – Compressible strata are not thought to occur.</p> <p>B – Compressibility and uneven settlement problems are not likely to be significant on the site for most land uses.</p> <p>D – Compressibility and uneven settlement hazards are probably present. Land use should consider specifically the compressibility and variability of the site.</p>
	Ground Dissolution Stability	<p>A - Soluble rocks are either not thought to be present within the ground, or not prone to dissolution. Dissolution features are unlikely to be present.</p> <p>B - Soluble rocks are present within the ground. Few dissolution features are likely to be present. Potential for difficult ground conditions or localised subsidence are at a level where they need not be considered.</p>
	Landslide Ground Stability	B – Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered.

Section	Hazard Potential	Class and Description
		C – Slope instability problems may be present or anticipated. Site investigation should consider specifically the slope stability of the site.
	Running Sand Ground Stability	<p>A – Running sand conditions are not thought to occur whatever the position of the water table. No identified constraints on lands use due to running conditions.</p> <p>B – Running sand conditions are unlikely. No identified constraints on land use due to running conditions unless water table rises rapidly.</p> <p>C – Running sand conditions may be present. Constraints may apply to land uses involving excavation or the addition or removal of water.</p>
	Shrinking or Swelling Clay Ground Stability	<p>A – Ground conditions predominantly non-plastic.</p> <p>B – Ground conditions predominantly low plasticity.</p> <p>C – Ground conditions predominantly medium plasticity.</p>
<b>Section 4</b>	Collapsible Ground Stability	<p>A – Deposits with potential to collapse when loaded and saturated are believed not to be present.</p> <p>B – Deposits with potential to collapse when loaded and saturated are unlikely to be present.</p>
	Compressible Ground Stability	<p>A – Compressible strata are not thought to occur.</p> <p>D – Compressibility and uneven settlement hazards are probably present. Land use should consider specifically the compressibility and variability of the site.</p>
	Ground Dissolution Stability	<p>A - Soluble rocks are either not thought to be present within the ground, or not prone to dissolution. Dissolution features are unlikely to be present.</p>
	Landslide Ground Stability	<p>B – Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered.</p>
	Running Sand Ground Stability	<p>B – Running sand conditions are unlikely. No identified constraints on land use due to running conditions unless water table rises rapidly.</p> <p>C – Running sand conditions may be present. Constraints may apply to land uses involving excavation or the addition or removal of water.</p> <p>D – Running sand conditions are probably present. Constraints may apply to land uses involving excavation or the addition or removal of water.</p>



Section	Hazard Potential	Class and Description
	Shrinking or Swelling Clay Ground Stability	<p>A – Ground conditions predominantly non-plastic.</p> <p>B – Ground conditions predominantly low plasticity.</p> <p>C – Ground conditions predominantly medium plasticity.</p>
<b>Section 5</b>	Collapsible Ground Stability	<p>A – Deposits with potential to collapse when loaded and saturated are believed not to be present.</p> <p>B – Deposits with potential to collapse when loaded and saturated are unlikely to be present.</p>
	Compressible Ground Stability	<p>A – Compressible strata are not thought to occur.</p> <p>D – Compressibility and uneven settlement hazards are probably present. Land use should consider specifically the compressibility and variability of the site.</p>
	Ground Dissolution Stability	<p>A - Soluble rocks are either not thought to be present within the ground, or not prone to dissolution. Dissolution features are unlikely to be present.</p>
	Landslide Ground Stability	<p>B – Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered.</p> <p>C – Slope instability problems may be present or anticipated. Site investigation should consider specifically the slope stability of the site.</p>
	Running Sand Ground Stability	<p>B – Running sand conditions are unlikely. No identified constraints on land use due to running conditions unless water table rises rapidly.</p> <p>C – Running sand conditions may be present. Constraints may apply to land uses involving excavation or the addition or removal of water.</p> <p>D – Running sand conditions are probably present. Constraints may apply to land uses involving excavation or the addition or removal of water.</p>
	Shrinking or Swelling Clay Ground Stability	<p>A – Ground conditions predominantly non-plastic.</p> <p>B – Ground conditions predominantly low plasticity.</p> <p>C – Ground conditions predominantly medium plasticity.</p>



LEGEND

- DCO Site Boundary
- Route Section Break

Superficial Geology 50k (BGS)

- Alluvium - Clay, Silt, Sand and Gravel
- Beach and Tidal Flat Deposits (Undifferentiated) - Clay, Silt, and Sand
- Blown Sand - Sand
- Glaciofluvial Deposits, Devensian - Sand and Gravel
- Glaciofluvial Sheet Deposits, Devensian - Sand and Gravel
- Lacustrine Deposits - Sand, Silt, and Clay
- Storm Beach Deposits - Sand
- Tidal Flat Deposits - Clay and Silt
- Till, Devensian - Diamicton

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FIGURE TITLE

**Figure 9-1**

**Superficial Geology**

ISSUE PURPOSE

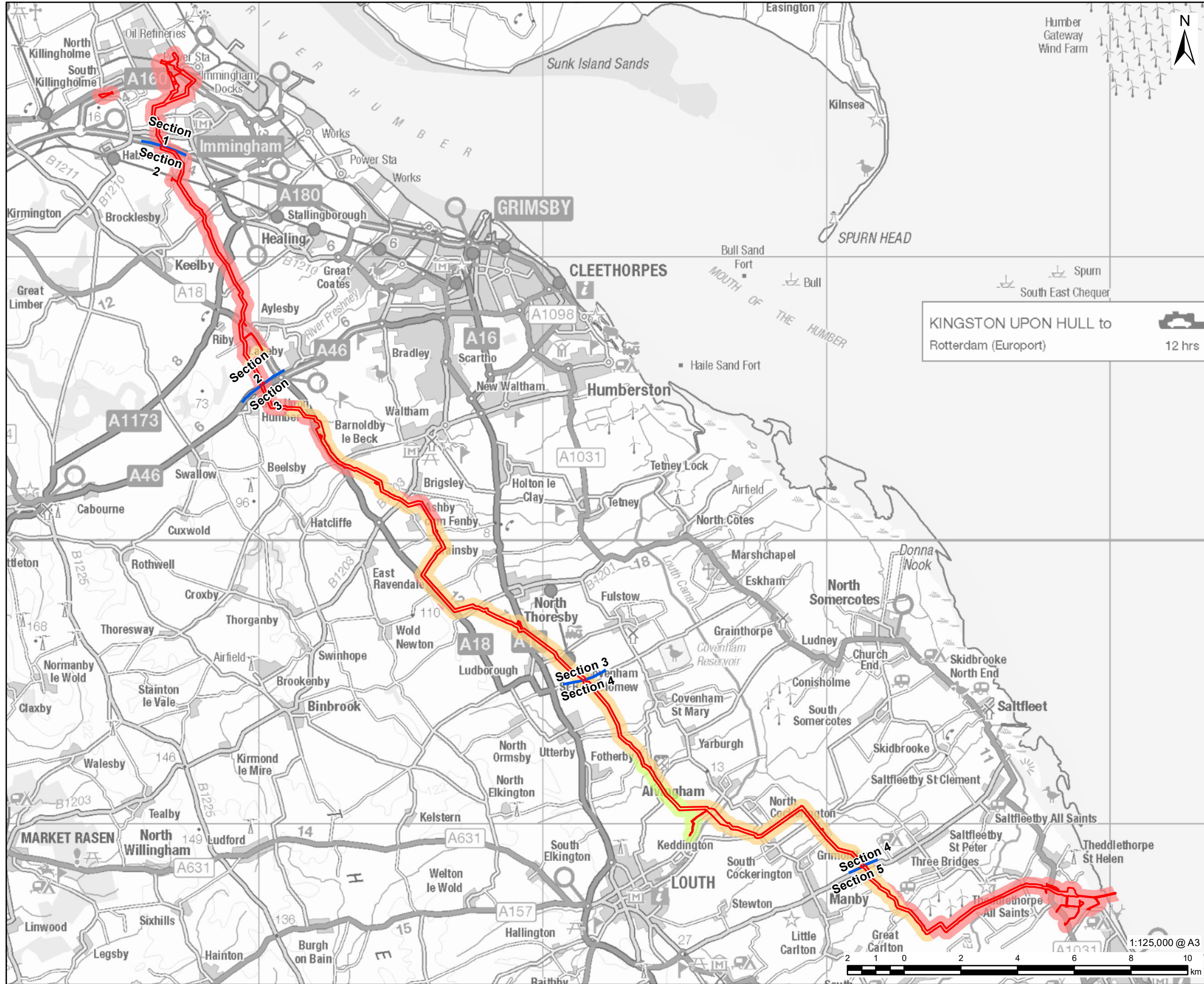
ENVIRONMENTAL STATEMENT

PROJECT NUMBER / REFERENCE

60668955 / VCCS\_230927\_ES\_9-1

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**VikingCCS**

**AECOM**

PROJECT

**Viking CCS Pipeline**

LEGEND

- DCO Site Boundary
- Route Section Break

Bedrock Geology 50k (BGS)

- Burnham Chalk Formation - Chalk
- Ferriby Chalk Formation - Chalk
- Welton Chalk Formation - Chalk

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FIGURE TITLE

**Figure 9-2**

**Bedrock Geology**

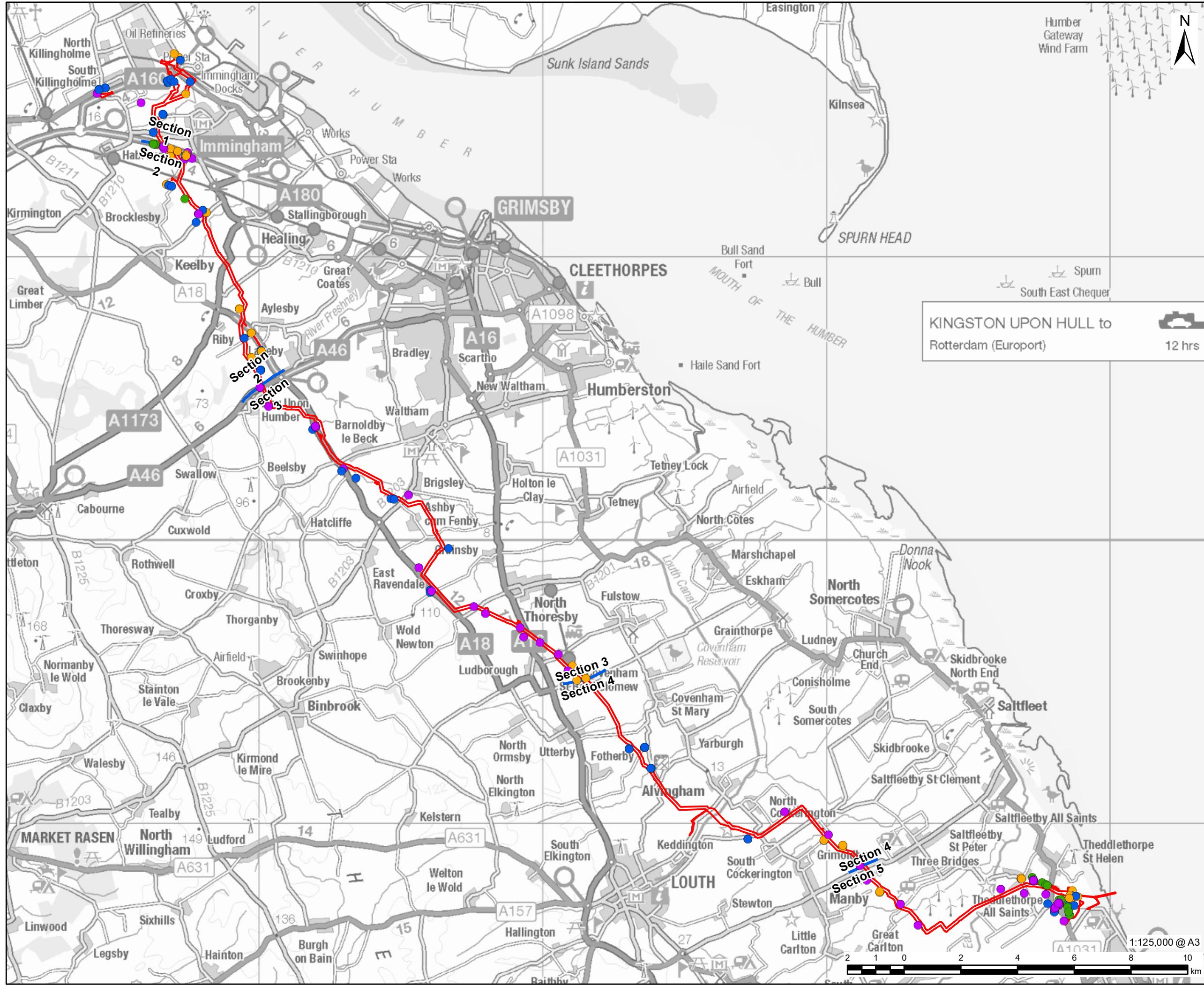
ISSUE PURPOSE

ENVIRONMENTAL STATEMENT

PROJECT NUMBER / REFERENCE

60668955 / VCCS\_230927\_ES\_9-2





LEGEND

- DCO Site Boundary
- Route Section Break

British Geological Survey (BGS) Borehole

- Confidential
- Less than 10m
- 10m - 30m
- Greater than 30m

KINGSTON UPON HULL to Rotterdam (Europort) 12 hrs

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FIGURE TITLE

**Figure 9-3**  
**British Geological Survey Boreholes**

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- DCO Site Boundary
- Route Section Break
- Collapsible Deposits**
- Deposits with potential to collapse when loaded and saturated are believed not to be present.
- Deposits with potential to collapse when loaded and saturated are unlikely to be present.

KINGSTON UPON HULL to Rotterdam (Europort)  
12 hrs

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FIGURE TITLE

**Figure 9-4 (1 of 6)**  
**Ground Stability - Collapsible Deposits**

ISSUE PURPOSE

ENVIRONMENTAL STATEMENT

PROJECT NUMBER / REFERENCE

60668955 / VCCS\_231018\_ES\_9-4





**LEGEND**

- DCO Site Boundary
- Route Section Break

**Compressible Deposits**

- Compressible strata are not thought to occur.
- Compressibility and uneven settlement problems are not likely to be significant on the site for most land uses.
- Compressibility and uneven settlement hazards are probably present. Land use should consider specifically the compressibility and variability of the site.

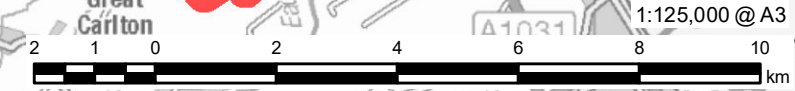
KINGSTON UPON HULL to Rotterdam (Europort)  
 12 hrs

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**FIGURE TITLE**  
 Figure 9-4 (2 of 6)  
 Ground Stability - Compressible Deposits

**ISSUE PURPOSE**  
 ENVIRONMENTAL STATEMENT  
 PROJECT NUMBER / REFERENCE  
 60668955 / VCCS\_231018\_ES\_9-4

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- DCO Site Boundary
- Route Section Break
- Ground Dissolution of Soluble Rocks
  - Soluble rocks are either not thought to be present within the ground, or not prone to dissolution. Dissolution features are unlikely to be present.
  - Soluble rocks are present within the ground. Few dissolution features are likely to be present.
  - Potential for difficult ground conditions or localised subsidence are at a level where they need not be considered.

KINGSTON UPON HULL to Rotterdam (Europort)

12 hrs

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FIGURE TITLE

**Figure 9-4 (3 of 6)**

**Ground Stability - Ground Dissolution of Soluble Rocks**

ISSUE PURPOSE

ENVIRONMENTAL STATEMENT

PROJECT NUMBER / REFERENCE

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LEGEND

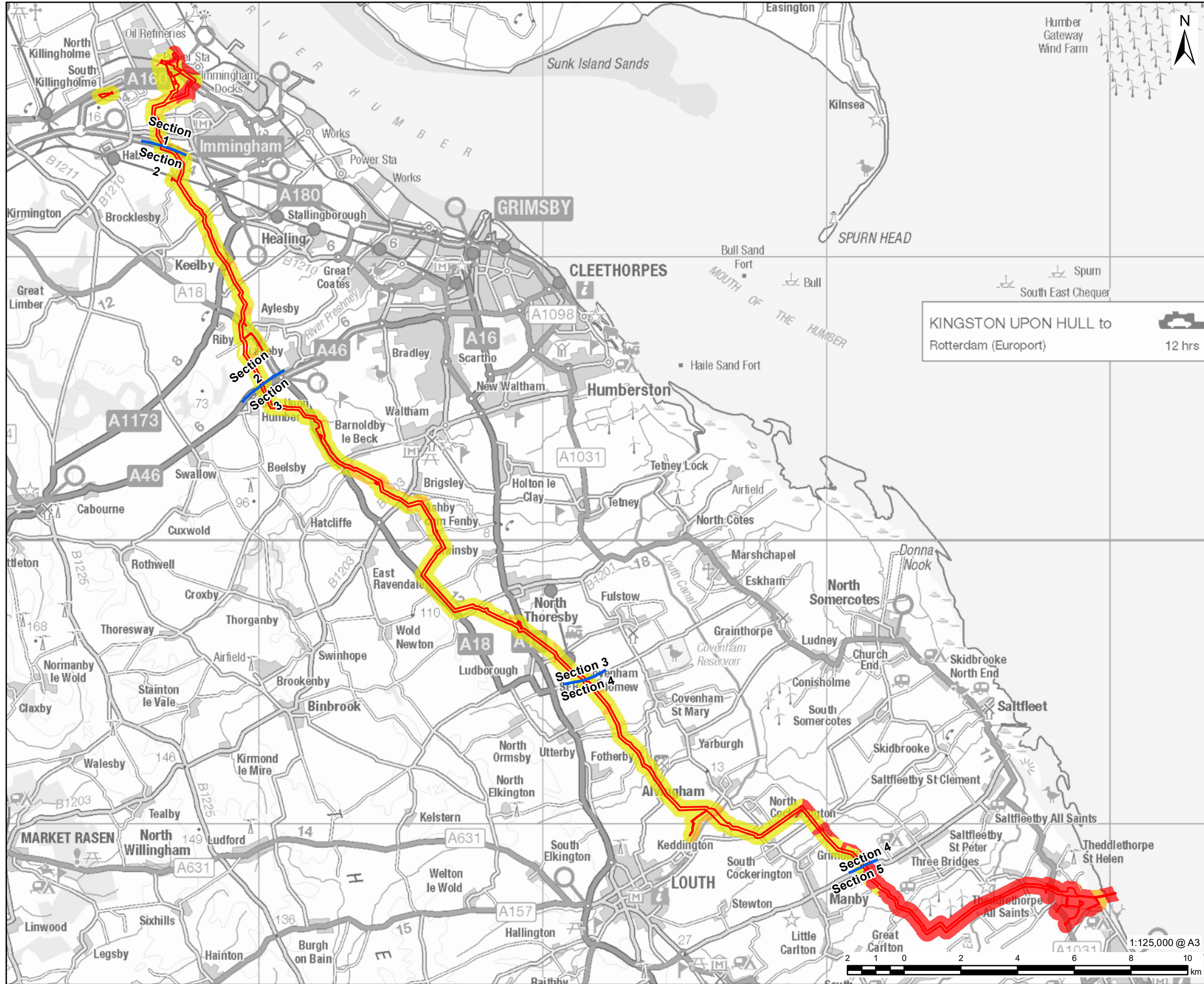
- DCO Site Boundary
  - Route Section Break
- Landslides
- Slope instability problems are not thought to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered.
  - Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered.
  - Slope instability problems may be present or anticipated. Site investigation should consider specifically the slope stability of the site.
  - Slope instability problems are probably present or have occurred in the past. Land use should consider specifically the stability of the site.

KINGSTON UPON HULL to Rotterdam (Europort)  
 12 hrs

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FIGURE TITLE  
**Figure 9-4 (4 of 6)  
 Ground Stability - Landslides**





**LEGEND**

- DCO Site Boundary
- Route Section Break

**Running Sand**

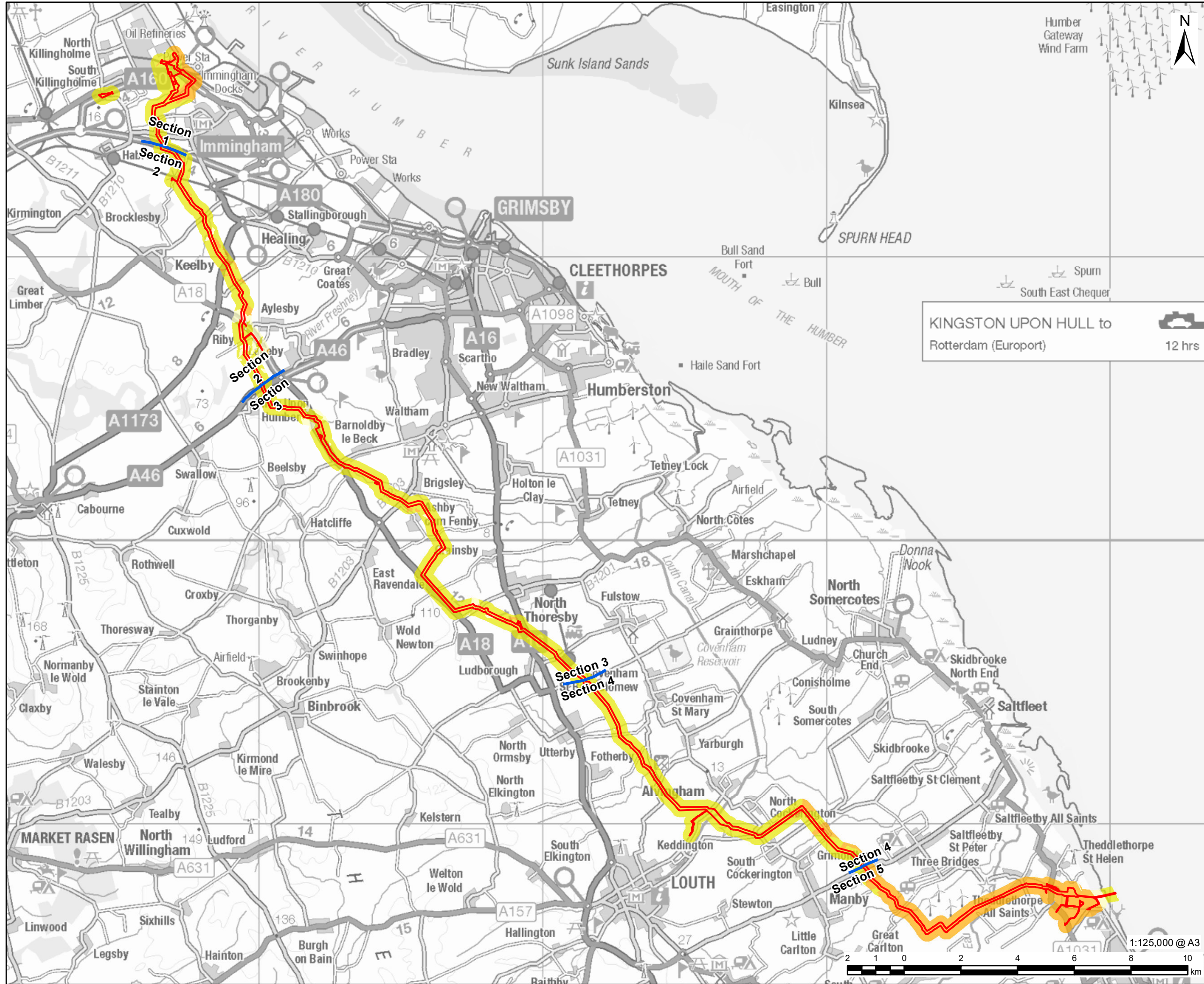
- Running sand conditions are not thought to occur whatever the position of the water table. No identified constraints on lands use due to running conditions.
- Running sand conditions are unlikely. No identified constraints on land use due to running conditions unless water table rises rapidly.
- Running sand conditions may be present. Constraints may apply to land uses involving excavation or the addition or removal of water.
- Running sand conditions are probably present. Constraints may apply to land uses involving excavation or the addition or removal of water.

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**FIGURE TITLE**  
 Figure 9-4 (5 of 6)  
 Ground Stability - Running Sand

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**LEGEND**

- DCO Site Boundary
- Route Section Break
- Shrink Swell Clays
- Ground conditions predominantly non-plastic.
- Ground conditions predominantly low plasticity.
- Ground conditions predominantly medium plasticity.

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**FIGURE TITLE**  
 Figure 9-4 (6 of 6)  
 Ground Stability - Shrink Swell Clays

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### **Geological Sites of Special Scientific Interest and Regionally Important Geological Sites**

9.5.16 A review of currently available information on MAGIC.gov.uk and relevant searches with local councils did not identify any geological Sites of Special Scientific Interest (SSSI), Regionally Important Geological Sites (RIGS) or Local Geological Sites within the DCO Site Boundary.

### **Sensitive Land Uses**

9.5.17 A review of publicly available data and the Groundsure data has identified several sensitive land designations, the majority of which are at the end of Section 5 where the DCO Site Boundary extend to Mean Low Water Springs (MLWS). Further information can be seen in **Table 9-13**.

**Table 9-13: Sensitive Land Designations**

<b>Section of DCO Site Boundary and wider Study Area</b>	<b>Sensitive Land Designations</b>
Section 1	None.
Section 2	None.
Section 3	Lincolnshire Wolds: <ul style="list-style-type: none"> <li>• Area of Outstanding Natural Beauty (AONB).</li> </ul>
Section 4	None.
Section 5	Greater Wash: <ul style="list-style-type: none"> <li>• Special Protection Area (SPA).</li> </ul> Saltfleetby Dunes – Theddlethorpe: <ul style="list-style-type: none"> <li>• Site of Specific Scientific Interest (SSSI);</li> <li>• Special Area Conservation (SAC);</li> <li>• SPA; and</li> <li>• National Nature Reserve (NNR).</li> </ul> Humber Estuary: <ul style="list-style-type: none"> <li>• RAMSAR site.</li> </ul>

### **Coal Mining and Shallow Mining**

9.5.18 The Coal Authority online interactive map (Ref 9-43) and the Groundsure data (Ref 9-39) indicates that the DCO Site Boundary are not within a Coal Mining Reporting Area or Development High Risk Area. The Coal Authority also confirmed this in their Scoping Opinion response. However, there is a Coal Mining Reporting Area immediately bordering the site along the east coast which is within the Study Area. Therefore, a Consultants Coal Mining Report (*ES Volume IV: Appendix 9.2 (Application Document 6.4.9.2)*) was obtained from the Coal Authority, though this identified no issues.

### **Mineral Sites and Designations**

9.5.19 The effects of the Proposed Development on waste and materials are preliminarily assessed in *Chapter 18: Materials and Waste*.

9.5.20 Review of publicly available records indicates that the DCO Site Boundary are governed by three mineral planning authorities.



- 9.5.21 North Lincolnshire Council are the authority for the most northerly section of the DCO Site Boundary within Section 1. No records of mineral safeguarding areas or active extraction sites present within 500m of the DCO Site Boundary have been identified within this area.
- 9.5.22 North East Lincolnshire Council are the mineral planning authority for Section 2 to Section 3 of the DCO Site Boundary. Reference to the NELC Local Plan 2013-2032 indicates there are several mineral safeguarding areas for Sands and Gravels within the DCO Site Boundary, predominantly between Riby and Grainsby. There are no records showing active extraction sites with 500m of the DCO Site Boundary.
- 9.5.23 Lincolnshire County Council is the authority for the remainder of the DCO Site Boundary (where East Lindsey and West Lindsey District Councils are part of the Lincolnshire County Council Mineral Planning Authority). The Lincolnshire Minerals and Waste Local Plan (2016) (Ref 9-52) does not indicate there are any active extraction sites or mineral safeguarding areas within 500m of the DCO Site Boundary.

*Hydrogeology - Aquifer Classifications*

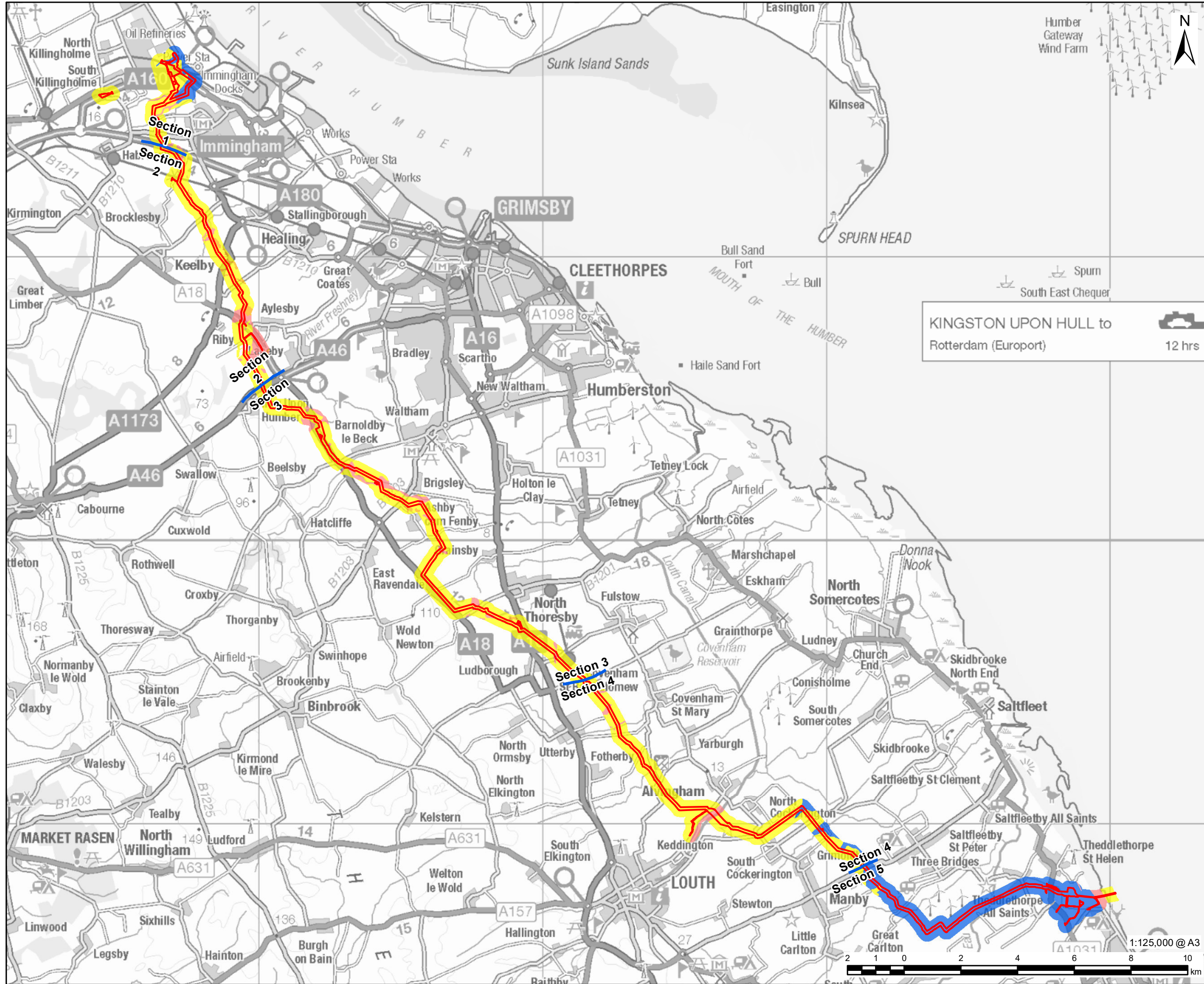
- 9.5.24 Aquifer classification maps on Defra’s ‘MAGIC’ mapping portal and from the Groundsure report (Ref 9-39 and Ref 9-40) indicate the following aquifer classifications are present within the DCO Site Boundary (**Table 9-14** and **Figure 9-5** and **Figure 9-6**).

**Table 9-14: Summary of Aquifer Classifications**

Stratum Type	Stratum	Aquifer Classification	Definition (Environment Agency)	Section within DCO Site Boundary
<b>Superficial</b>	Tidal Flat Deposits	Unproductive	Unproductive strata are largely unable to provide usable water supplies and are unlikely to have surface water and wetland ecosystems dependent on them.	Sections 1, 4 and 5
	Glacial Till	Secondary (Undifferentiated)	Secondary undifferentiated are aquifers where it is not possible to apply either a Secondary A or B definition because of the variable characteristics of the unit type. These have only a minor value.	All sections
	Beach and Tidal Flat Deposits	Secondary (Undifferentiated)		Section 5
	Glaciofluvial Deposits	Secondary A	Secondary A aquifers comprise permeable layers that can support local water supplies and may form an important source of base flow to rivers.	Sections 2, 3 and 4
	Glaciofluvial Sheet Deposits	Secondary A		Section 2
	Alluvium	Secondary A		Sections 1, 2, 3 and 4



<b>Stratum Type</b>	<b>Stratum</b>	<b>Aquifer Classification</b>	<b>Definition (Environment Agency)</b>	<b>Section within DCO Site Boundary</b>
	Blown Sand	Secondary A		Section 5
	Storm Beach Deposits	Secondary A		Section 5
	Lacustrine Deposits	Secondary B	Secondary B aquifers are predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers	Sections 2, 3 and 4
<b>Bedrock</b>	Welton Chalk Formation	Principal	Principal aquifers provide significant quantities of drinking water, and water for business needs. They may also support rivers, lakes and wetlands.	Sections 2, 3, 4 and 5
	Burnham Chalk Formation			Sections 1, 2, 3, 4 and 5
	Ferriby Chalk Formation			Section 4



**VikingCCS**

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PROJECT  
**Viking CCS Pipeline**

LEGEND

- DCO Site Boundary
- Route Section Break

Superficial Aquifer Deposits (BGS)

- Secondary Superficial Aquifer - Undifferentiated
- Secondary A Superficial Aquifer
- Secondary B Superficial Aquifer
- Unproductive Superficial Aquifer

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FIGURE TITLE  
**Figure 9-5  
 Superficial Hydrogeology**

ISSUE PURPOSE  
 ENVIRONMENTAL STATEMENT

PROJECT NUMBER / REFERENCE  
 60668955 / VCCS\_231018\_ES\_9-5

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PROJECT  
**Viking CCS Pipeline**

LEGEND

- DCO Site Boundary
- Route Section Break

Bedrock Aquifer Classification (BGS)

- Principal Bedrock Aquifer

KINGSTON UPON HULL to Rotterdam (Europort)  
12 hrs

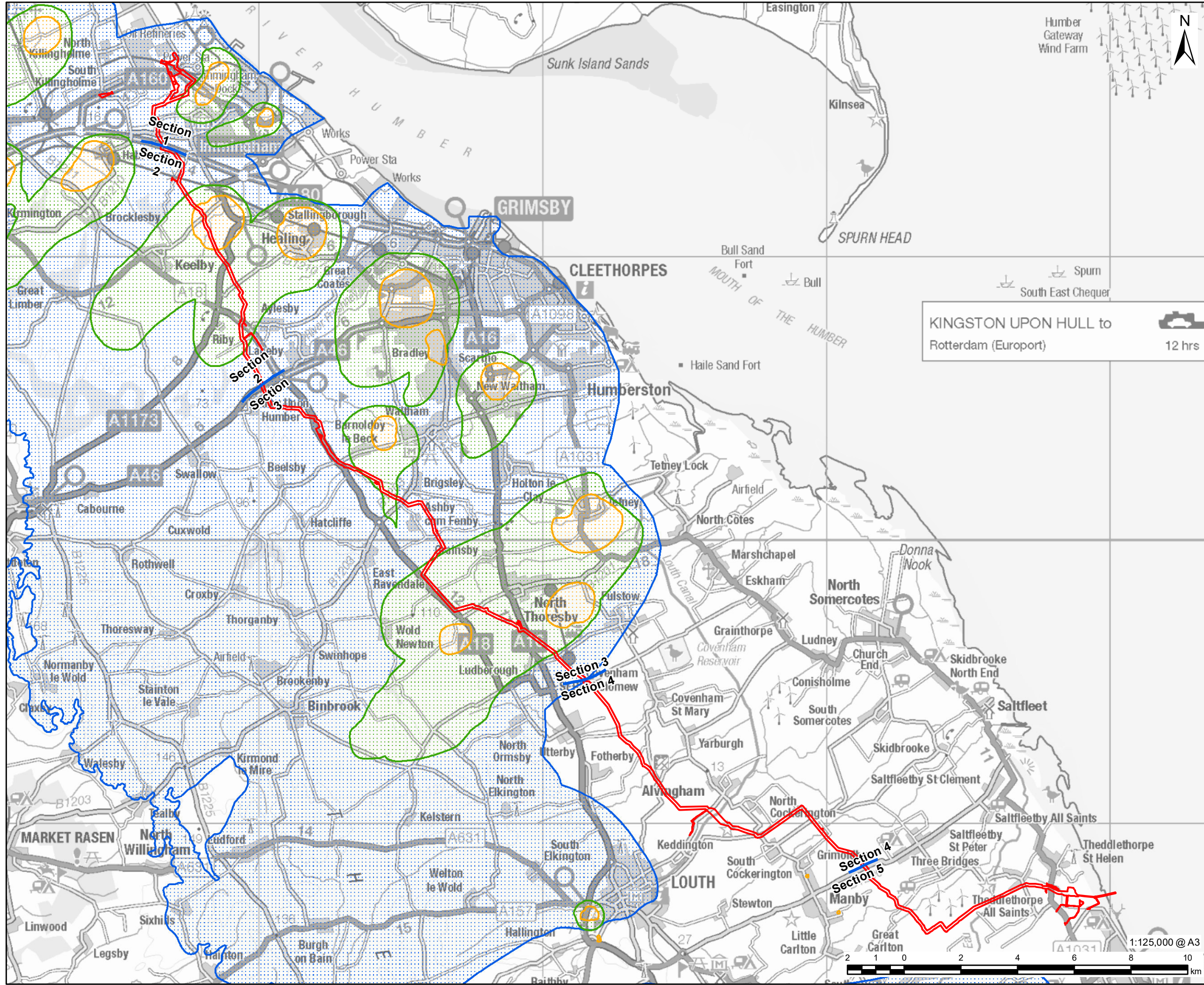
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FIGURE TITLE  
**Figure 9-6  
Bedrock Hydrogeology**

ISSUE PURPOSE  
ENVIRONMENTAL STATEMENT  
PROJECT NUMBER / REFERENCE  
60668955 / VCCS\_231018\_ES\_9-6

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LEGEND

- DCO Site Boundary
- Route Section Break
- Source Protection Zone (EA)
- Zone 1 - Inner Protection Zone
- Zone 2 - Outer Protection Zone
- Zone 3 - Total Catchment

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FIGURE TITLE

**Figure 9-7**

**Source Protection Zones**

ISSUE PURPOSE

ENVIRONMENTAL STATEMENT

PROJECT NUMBER / REFERENCE

60668955 / VCCS\_231018\_ES\_9-7

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### Water Framework Directive Groundwater Bodies

9.5.25 The following two Water Framework Directive (WFD) groundwater bodies have been identified within the DCO Site Boundary:

- North Lincolnshire Chalk Unit (Poor Quality); and
- South Lincolnshire Chalk Unit (Poor Quality).

### Other Hydrogeological Classifications and Features

9.5.26 The following additional hydrogeological classifications and features have been identified and are summarised in **Table 9-15** below. **Figure 9-7** shows the SPZ within the Study Area.

**Table 9-15: Other Hydrogeological Classifications**

Section of DCO Site Boundary	Description of other Hydrogeological Classifications and Features
<p><b>Section 1</b></p>	<p><b>Source Protection Zones</b> This section of the DCO Site Boundary contains two Source Protection Zones:</p> <ul style="list-style-type: none"> <li>• Zone 3 – Total Catchment, present between Immingham Docks and Section Break 1.</li> <li>• Within the wider Study Area, this section includes an additional two Source Protection Zones:</li> <li>• Zone 2 – Outer Protection Zone, present from Immingham Docks to Immingham town.</li> </ul> <p><b>Drinking Water Safeguard Zones</b> <u>Groundwater</u> Within this section of the DCO Site Boundary there are two Drinking Water Safeguard Zones (Ground Water):</p> <ul style="list-style-type: none"> <li>• GWSGZ0286 – Present west of DCO Site Boundary (and 1 separate parcel within the DCO Site Boundary but separated from the main pipeline, where it is understood materials may be stored for the Proposed Development) around South Killingholme;</li> <li>• GWSGZ0281 – Present west of DCO Site Boundary and north of A180.</li> </ul> <p><u>Surface Water</u> None within this section.</p> <p><b>Nitrate Vulnerable Zones 2021 to 2024 (pre appeals)</b> This section is within several Nitrate Vulnerable Zones as detailed below: <u>Groundwater</u></p> <ul style="list-style-type: none"> <li>• Groundwater G80 – Lincolnshire Chalk NVZ</li> </ul> <p><u>Surface Water</u></p> <ul style="list-style-type: none"> <li>• Surface Water S359 – North Beck Drain NVZ</li> <li>• Surface Water S361 – Skitter Beck / East Halton Beck NVZ</li> </ul>
<p><b>Section 2</b></p>	<p><b>Source Protection Zones</b> This section of the DCO Site Boundary and Study Area contains three Source Protection Zones:</p>

Section of DCO Site Boundary	Description of other Hydrogeological Classifications and Features
	<ul style="list-style-type: none"> <li>• Zone 1 – Inner Protection Zone, present around Little London. The DCO Site Boundary pass directly through the Inner Protection Zone;</li> <li>• Zone 2 – Outer Protection Zone, present around Roxton and between Keelby and Aylesby; and</li> <li>• Zone 3 – Total Catchment, present around Section Break 1 and between Laceby and Section Break 2.</li> </ul> <p><b><i>Drinking Water Safeguard Zones</i></b></p> <p><u>Groundwater</u></p> <p>This section of the DCO Site Boundary contains two Drinking Water Safeguard Zone (Ground Water):</p> <ul style="list-style-type: none"> <li>• GWSGZ0284 – Present within DCO Site Boundary and to the east and west between Brocklesby and Keelby;</li> <li>• GWSGZ0283 – Present within DCO Site Boundary and to the east and west between Keelby and Laceby.</li> </ul> <p><u>Surface Water</u></p> <p>None within this section.</p> <p><b><i>Nitrate Vulnerable Zones 2021 to 2024 (pre appeals)</i></b></p> <p>This section is within several Nitrate Vulnerable Zones as detailed below:</p> <p><u>Groundwater</u></p> <ul style="list-style-type: none"> <li>• Groundwater G80 – Lincolnshire Chalk NVZ;</li> </ul> <p><u>Surface Water</u></p> <ul style="list-style-type: none"> <li>• Surface Water S359 – North Beck Drain NVZ; and</li> <li>• Surface Water S357 - Laceby Beck / River Freshney Catchment (to N Sea) NVZ.</li> </ul>
<b>Section 3</b>	<p><b><i>Source Protection Zones</i></b></p> <p>This section of the DCO Site Boundary contains two Source Protection Zones:</p> <ul style="list-style-type: none"> <li>• Zone 2 – Outer Protection Zone, present between Barnoldby le Beck and Brigsley and a separate Outer Protection Zone between Grainsby and Ludborough (understood to be protective of public water supply abstractions at Tetney (~4.7km east) and Fulstow (~2.1km east)); and</li> <li>• Zone 3 – Total Catchment Protection Zone, present between Section Break 2 and Barnoldby le Beck, Brigsely and Grainsby and then Ludborough and Section Break 3.</li> </ul> <p><b><i>Drinking Water Safeguard Zones</i></b></p> <p><u>Groundwater</u></p> <p>Within this section of the DCO Site Boundary there are four Drinking Water Safeguard Zones (Ground Water):</p> <ul style="list-style-type: none"> <li>• GWSGZ0015 - Present within DCO Site Boundary and to the east and west between Laceby and Barnoldby le Beck;</li> <li>• GWSGZ0282 – Present within DCO Site Boundary and to the east and west between Barnoldby le Beck and Ashby cum Fenby;</li> </ul>



Section of DCO Site Boundary	Description of other Hydrogeological Classifications and Features
	<ul style="list-style-type: none"> <li>• GWSGZ0285 - Present within DCO Site Boundary and to the east and west between Grainsby to North Thoresby</li> <li>• GWSGZ0288 – Present within DCO Site Boundary and to the east and west between Brigsley to Grainsby</li> </ul> <p><u>Surface Water</u></p> <ul style="list-style-type: none"> <li>• SWSGZ1001 – Present from Barnoldby le Beck into next section.</li> </ul> <p><b>Nitrate Vulnerable Zones 2021 to 2024 (pre appeals)</b> This section is within several Nitrate Vulnerable Zone as detailed below:</p> <p><u>Groundwater</u></p> <ul style="list-style-type: none"> <li>• Groundwater G80 – Lincolnshire Chalk NVZ;</li> </ul> <p><u>Surface Water</u></p> <ul style="list-style-type: none"> <li>• Surface Water S357 - Laceby Beck / River Freshney Catchment (to N Sea) NVZ;</li> <li>• Surface Water S354 - Waithe Beck lower catchment (to Tetney Lock) NVZ; and</li> <li>• Surface Water S353 - Louth Canal NVZ.</li> </ul>
<b>Section 4</b>	<p><b>Source Protection Zones</b> This section of the DCO Site Boundary contains one Source Protection Zone:</p> <ul style="list-style-type: none"> <li>• Zone 3 – Total Catchment Protection Zone, present surrounding Covenham St Bartholomew, which is understood to be protective of several public water supply abstractions within the area.</li> </ul> <p><b>Drinking Water Safeguard Zones</b></p> <p><u>Groundwater</u> None within this section.</p> <p><u>Surface Water</u></p> <ul style="list-style-type: none"> <li>• SWSGZ1001 Present between Covenham St Bartholomew and Keddington.</li> </ul> <p><b>Nitrate Vulnerable Zones 2021 to 2024 (pre appeals)</b> This section is within several Nitrate Vulnerable Zones as detailed below:</p> <p><u>Groundwater</u> None within this section.</p> <p><u>Surface Water</u></p> <ul style="list-style-type: none"> <li>• Surface Water S353 - Louth Canal NVZ; and</li> <li>• Surface Water S366 - South Dike and Grayfleet Drain NVZ.</li> </ul>
<b>Section 5</b>	<p><b>Source Protection Zones</b> This section of the DCO Site Boundary does not contain any Source Protection Zones.</p> <p><b>Drinking Water Safeguard Zones</b></p> <p><u>Groundwater</u> None within this section.</p> <p><u>Surface Water</u></p> <ul style="list-style-type: none"> <li>• SWSGZ1002 – Present between Manby and Theddlethorpe St Helen.</li> </ul>

Section of DCO Site Boundary	Description of other Hydrogeological Classifications and Features
	<p><b><i>Nitrate Vulnerable Zones 2021 to 2024 (pre appeals)</i></b>                      This section is within several Nitrate Vulnerable Zones as detailed below:</p> <p><u>Groundwater</u>                      None within this section.</p> <p><u>Surface Water</u></p> <ul style="list-style-type: none"> <li>• Surface Water S363 – Woldgrift Drain NVZ; and</li> <li>• Surface Water S365 - Great Eau (downstream of South Thoresby) NVZ.</li> </ul>

### ***Abstraction Data from Environment Agency and Local Councils***

9.5.27 Abstraction data obtained from the EA indicates that there are 32 No. groundwater abstractions, 15 No. surface water abstractions and 1 No. tidal water abstractions within 2km of the DCO Site Boundary. Additionally, North East Lincolnshire Council has provided information on an additional 19 No. private water abstractions within 2km of the DCO Site Boundary within their district. East Lindsey District Council also provided the details of private water abstractions within their district, with 52 No. private water abstractions within 2km of the DCO Site Boundary. West Lindsey District Council provided the details for one private water supply within 2km of the Proposed Development, located in Keelby and not considered further in the assessment due to the distance from the Proposed Development. Further details can be seen in **Figure 9-8** and in Tables 9-6, 9-7 and 9-8 in *ES Volume IV: Appendix 9.1* (Application Document 6.4.9.1). No abstractions fall within the DCO Site Boundary.

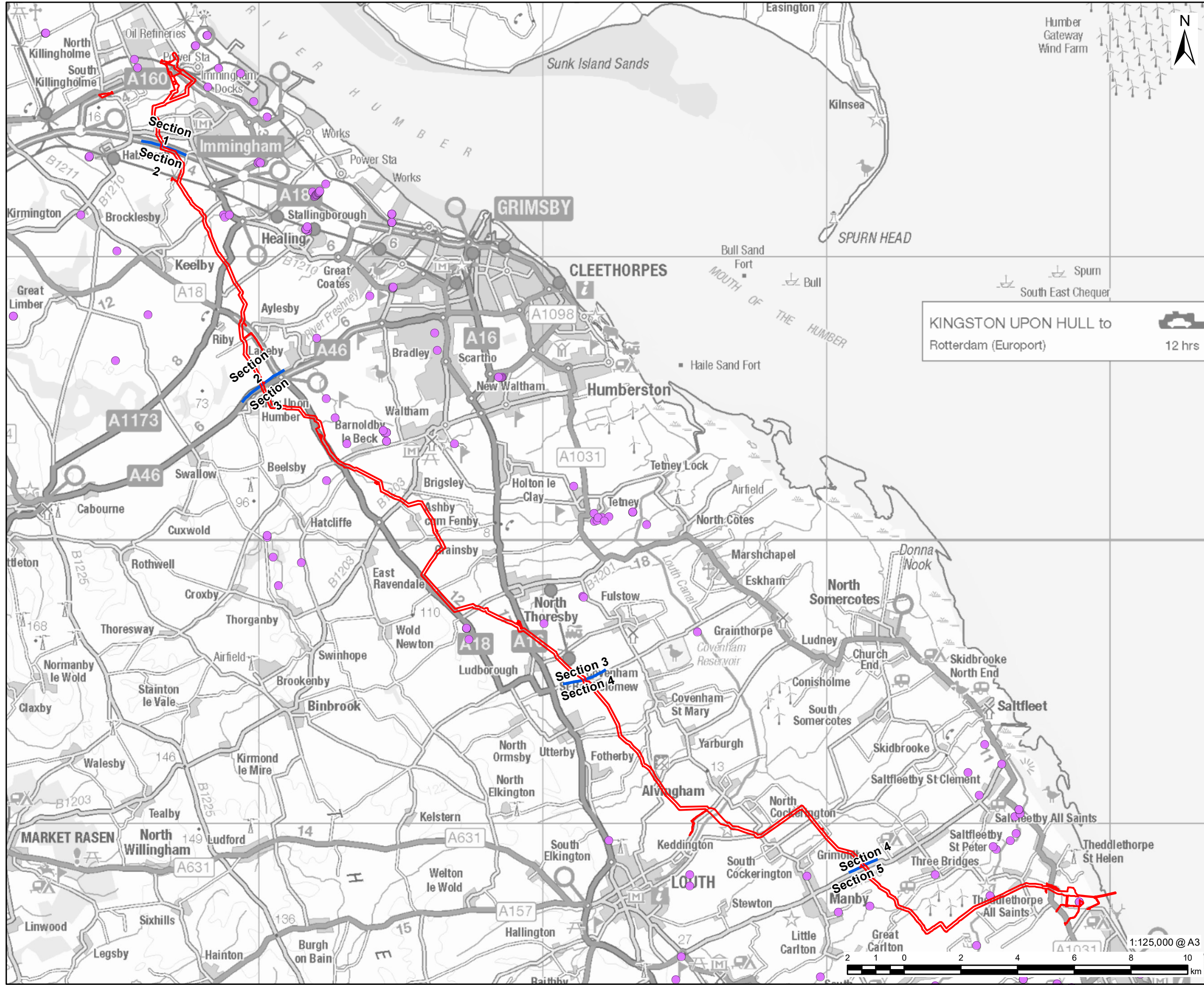
### ***Current Potentially Contaminative Land Uses***

9.5.28 A review of the current potentially contaminative land uses within the DCO Site Boundary and wider Study Area, suggests that contaminative land uses are likely to be generally confined to industrial land such as the VPI Immingham and P66 sites and other industrial land associated with the nearby Immingham Docks in the north of the DCO Site Boundary and the former TGT site in the south of the DCO Site Boundary. There is the potential to encounter contamination within the agricultural areas within the DCO Site Boundary.

9.5.29 Other current potentially contaminative land uses have been identified and are shown on **Figure 9-9**. Further details are provided in *ES Volume IV: Appendix 9.1* (Application Document 6.4.9.1). These include the following:

- Waste Storage, Processing and Disposal (Sewage Works & Outfalls);
- Farming (Poultry Houses, Silo, Livestock);
- Fuel Distributors & Suppliers (associated with Immingham Docks / Industrial Area and past activities at the former TGT site);
- Gas Valve Compound (associated with Immingham Docks / Industrial Area);
- Engineering and Maintenance Services;
- Tanks (Generic) (associated with Immingham Docks / Industrial Area and Theddlethorpe Gas Terminal);
- Energy Production (Solar Panels & Wind Turbines); and
- Electrical Features (Sub Stations).





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PROJECT

**Viking CCS Pipeline**

LEGEND

- DCO Site Boundary
- Route Section Break
- Licensed Water Abstraction (EA)

KINGSTON UPON HULL to Rotterdam (Europort)  
12 hrs

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FIGURE TITLE

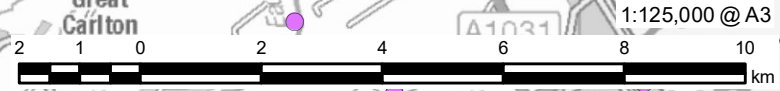
**Figure 9-8**  
**Abstraction Data from the Environment Agency**

ISSUE PURPOSE

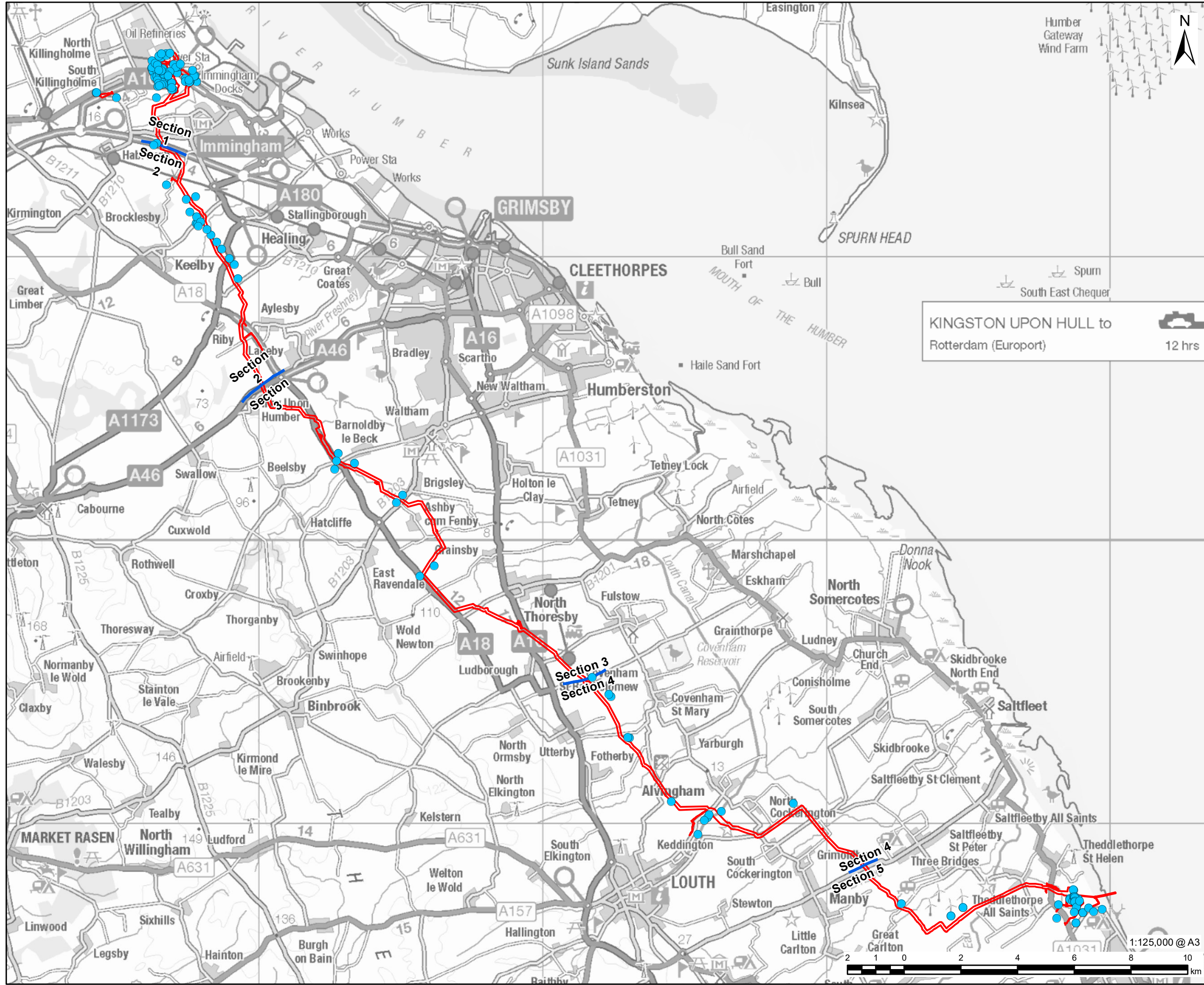
ENVIRONMENTAL STATEMENT

PROJECT NUMBER / REFERENCE

60668955 / VCCS\_231018\_ES\_9-8







**VikingCCS**

**AECOM**

PROJECT

**Viking CCS Pipeline**

LEGEND

- DCO Site Boundary
- Route Section Break
- Current Industrial Land Use (OS)

KINGSTON UPON HULL to Rotterdam (Europort) 12 hrs

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FIGURE TITLE

**Figure 9-9  
 Current Potentially Contaminative  
 Land Uses**

ISSUE PURPOSE

ENVIRONMENTAL STATEMENT

PROJECT NUMBER / REFERENCE

60668955 / VCCS\_231018\_ES\_9-9

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### Historical Potentially Contaminative Land Uses

9.5.30 A review of the data currently available through historical mapping and the Groundsure Report (Ref 9-39) indicates that throughout the DCO Site Boundary and wider Study Area, numerous localised potentially contaminative historical land uses have been identified.

9.5.31 Historical land uses have been identified and further details can be seen on **Figure 9-10** in addition to *ES Volume IV: Appendix 9.1 (Application Document 6.4.9.1)*. These include the following:

- Historical Energy Features (Sub Stations and Liquid Gas Depot (Immingham Docks / Industrial Area) and a Gas Terminal (Theddlethorpe Gas Terminal));
- Historical Garages;
- Docks (Immingham Docks);
- Mills (Unspecified);
- Tanks (Unspecified) (associated with Immingham Docks / Industrial Area and Theddlethorpe Gas Terminal);
- Railway (Tracks, Sidings & Cuttings) (associated with Immingham Docks / Industrial Area and Theddlethorpe Gas Terminal);
- Former Pits (Gravel, Chalk, Unspecified); and
- Disused Airfield.

### Current and Historical Landfills

9.5.32 The effects of the Proposed Development on materials waste are covered in *Chapter 18: Materials and Waste*. Where this overlaps with the geology and hydrogeology preliminary assessment, is detailed below as both current and historical landfills act as a contaminated land use and have therefore also been included in this preliminary assessment.

9.5.33 Recorded current and historical landfills from the Groundsure data (Ref 9-39) identified within the Study Area are summarised below in **Table 9-16**. Locations of landfills are shown in **Figure 9-11**.

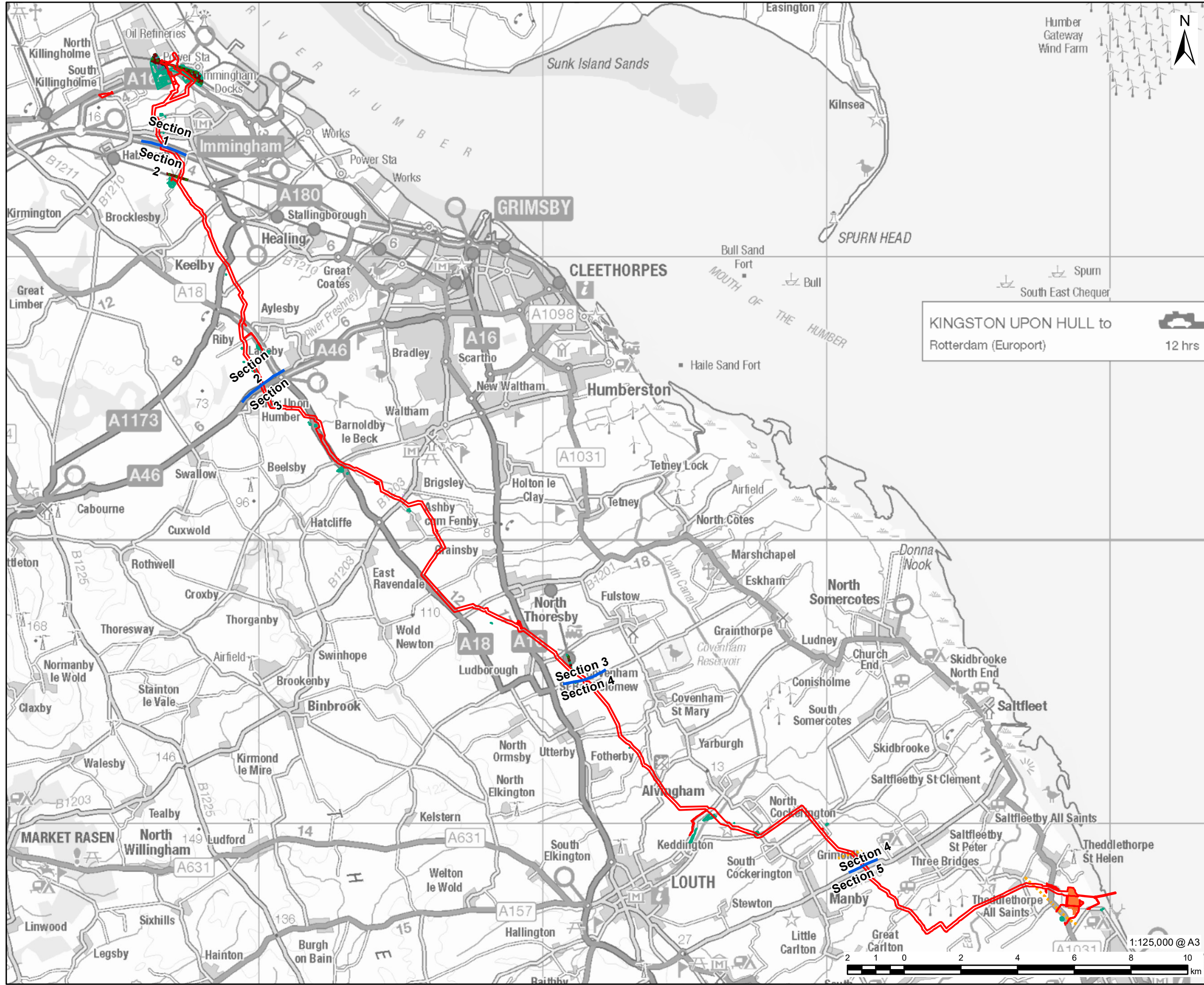
**Table 9-16: Summary of Current and Historical Landfills**

Section of the DCO Site Boundary	Landfill Type	Description
Section 1	EA Historical Landfill	Site name: Lindsey Oil Refinery Site reference EAHLD01515 Location: Approximately 500m North of the DCO Site Boundary
		Site name: Conoco Site reference: 55/19/0148, 1480, 2000/5295 Location: Located within the DCO Site Boundary
		Site name: Conoco Site reference: 55/19/0148, 1480, 2000/5296 Location: Located within the DCO Site Boundary



Section of the DCO Site Boundary	Landfill Type	Description
		Site name: Mill Lane Site reference: 55/17/0026, 55/17/0029 Location: Approximately 250m East of the DCO Site Boundary
	EA Licensed Waste Site	Site Name: Phillips 66 Ltd Site Reference: EA/EPR/YP3995NG/V003 Location: Within DCO Site Boundary Description: Biological Treatment Facility
	EA Permitted Waste Sites Authorised Landfill	There are no active landfill sites that have been identified within the Study Area.
<b>Section 2</b>	EA Historical Landfill	Site name: Aylesby Site reference: 2000/0294 Location: Immediately East of the DCO Site Boundary
	EA Permitted Waste Sites Authorised Landfill	There are no active landfill sites that have been identified within the Study Area.
<b>Section 3</b>	EA Historical Landfill	Site name: Barton Street Site reference: 55/19/0635,55/20/0113 Site location: Approximately 115m West of the DCO Site Boundary
	EA Permitted Waste Sites Authorised Landfill	There are no active landfill sites that have been identified within the Study Area.
<b>Section 4</b>	EA Historical Landfill	There are no historical landfill sites that have been identified within the Study Area.
	EA Permitted Waste Sites Authorised Landfill	There are no active landfill sites that have been identified within the Study Area.
<b>Section 5</b>	EA Historical Landfill	There are no historical landfill sites that have been identified within the Study Area.
	EA Permitted Waste Sites	There are no active landfill sites that have been identified within the Study Area.





**LEGEND**

- DCO Site Boundary
- Route Section Break
- Railway OSM
- Railway Track
- Historical Railway
- Historical Railway Feature LD
- Historical Railway Feature HD
- Historical Tank
- Historical Petrol Station
- Historical Industrial Land Use
- Historical Garage
- Historical Energy Feature

KINGSTON UPON HULL to  
Rotterdam (Europort)  
12 hrs

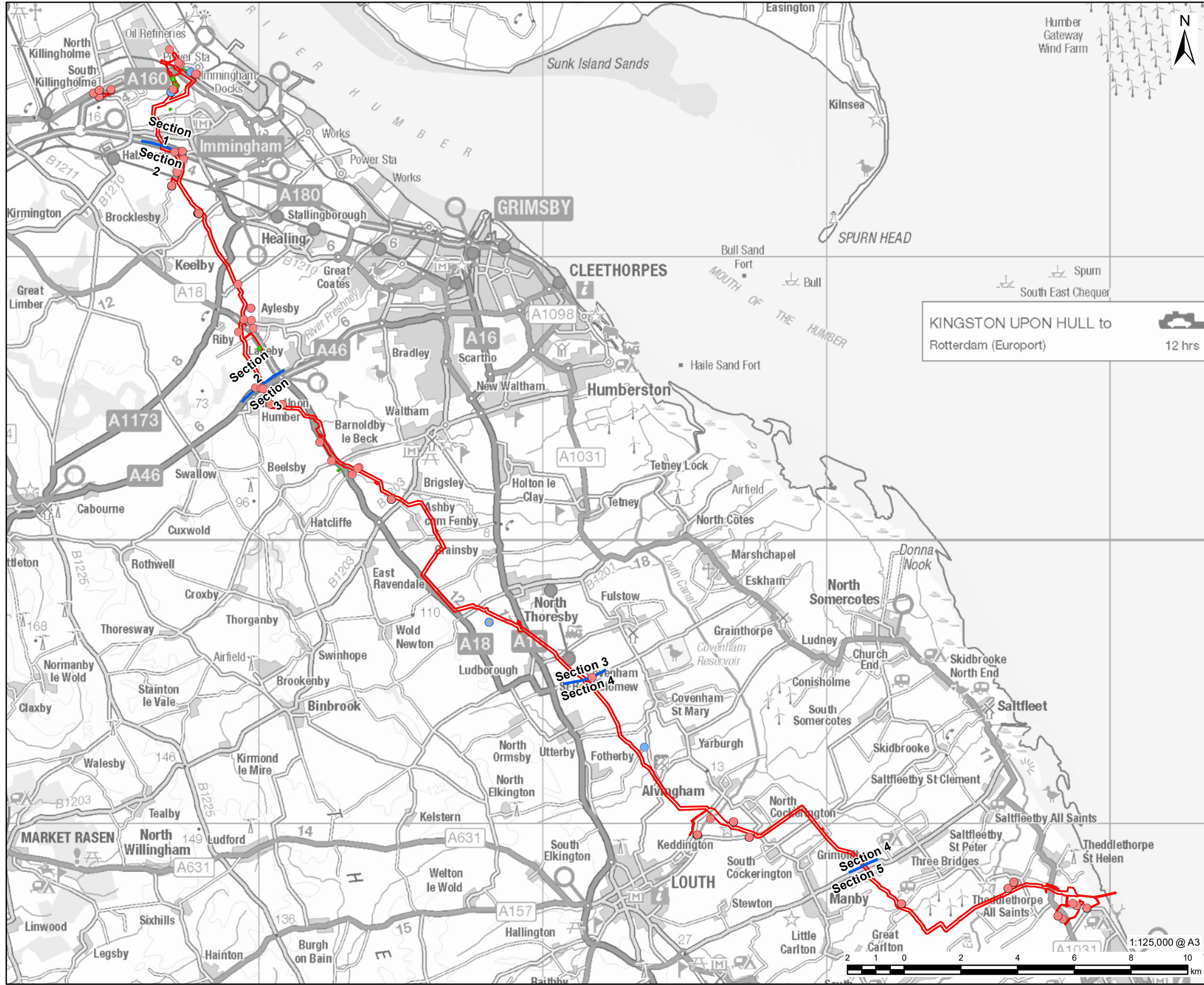
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**FIGURE TITLE**  
**Figure 9-10**  
**Historic Potentially Contaminative Land Uses**

**ISSUE PURPOSE**  
ENVIRONMENTAL STATEMENT  
**PROJECT NUMBER / REFERENCE**  
60668955 / VCCS\_231018\_ES\_9-10

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LEGEND

	DCO Site Boundary
	Route Section Break
	Licensed Waste Site (EA)
	Waste Exemption (EA)
	Historical Waste Site
	Historical Landfill

KINGSTON UPON HULL to Rotterdam (Europort)

12 hrs

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FIGURE TITLE

**Figure 9-11**

**Current and Historic Landfills**

ISSUE PURPOSE

ENVIRONMENTAL STATEMENT

PROJECT NUMBER / REFERENCE

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### Ground Gas

- 9.5.34 Ground gas including methane and carbon dioxide may be present associated with the natural strata and Made Ground deposits, where present, throughout the DCO Site Boundary. Ground gas may also be associated with recorded landfills, as well as unregistered infilled land (e.g., backfilled sand and chalk pits).
- 9.5.35 There is one chalk pit listed as within the DCO Site Boundary, this is located in Section 2 approximately 450m north of the Section 3 break according to the historical mapping. There are an additional four chalk pits (70m W, 75m W, 200m W and 60m W) and two gravel and sand pits (40 W and 230m W) and within the wider Study Area.

### Unexploded Ordnance Potential

- 9.5.36 Online Zetica Unexploded Ordnance (UXO) risk mapping shows “Low Risk” (15 bombs per 1,000 acres or less) for most of the Study Area (Sections 2 to 5). The Study Area between Immingham Docks and Grimsby (Section 1) records an UXO “Moderate Risk” (15 to 49 bombs per 1,000 acres). An assessment has been commissioned from Zetica of the DCO Site Boundary in review of the UXO risk, the findings are discussed in *ES Volume II Chapter 19: Major Accidents and Disasters* (Application Document 6.2.19) of this ES.

### Information from Statutory Authorities

- 9.5.37 Information determined to be relevant in relation to potentially contaminative activities has been summarised below in **Table 9-17**. Further information and details can be seen in **Figure 9-12** and tabulated in *ES Volume IV: Appendix 9.1 (Application Document 6.4.9.1)*. The majority of the entries are concentrated around Industrial land/Immingham Docks in Section 1 and the former TGT in Section 5. There are several other entries scattered along the length of the DCO Site Boundary.

**Table 9-17: Statutory Authority Information**

Section of the DCO Site Boundary	Summary of Statutory Information	Details
Section 1	4 No. COMAH sites (2 No. Historical, 2 No. Current)	Historical COMAH: Conoco Manufacturing Ltd and Humberside Sea Land Services Ltd.  Current COMAH: Phillips 66 Limited and Associated British Ports. (Immingham Docks)
	4 No. Hazardous Substance Storage (HSS) (1 No. Historical, 3 No. Current)	Historical HSS: Hazardous Substances Consent to store 3050 tonnes of petroleum gas oil (VPI Immingham LLP).  Current HSS: No details (VPI Immingham LLP); Ammonium Nitrate based fertilizer. Max quantity present during established period – 35,000 tonnes. Established quantity - 52,500 tonnes (Humberside Sea and Land Services Ltd; and



Section of the DCO Site Boundary	Summary of Statutory Information	Details
		Hazardous Substances Consent to increase the amount of LPG cylinder storage from 25 tonnes to 44 tonnes (Calor Gas Ltd). (Immingham Docks)
	19. No Licensed Discharges to Controlled Waters (16 No. Historical, 3 No. Current)	Licensed discharges to water include: Trade Discharges Drainage; Sewage – Final Treated Effluent – Not Water – Site Company; and Miscellaneous – Surface Water.
	12 No. Licensed Industrial Activities Part A1 (1. No. Effective, 11 No. Superseded)	Licensed Industrial Activities: 6 No. VPI Immingham LLP – Combustion; 5 No. Immingham CHP LLP – Combustion; 20 No. Phillips 66 Ltd – Crude Oil, Liquefaction, Gasification, Inorganic Chemicals, Oil Refining. (Immingham Docks)
	7 No. Licensed Pollutant Release Part A2 B (3 No. Active, 4 No. Historical)	Licensed Pollutant Releases: PD Port Services Limited – Coal and Coke; Gradebrook Filling Stations Ltd – Unloading of petrol into storage; and Phillips 66 Limited – Coal and Coke. (Immingham Docks)
	1 No. List 1 Dangerous Substances (Not Active)	List 1 Dangerous Substances: Mercury; and Cadmium. (Immingham Docks)
	1 No. List 2 Dangerous Substances (Active)	List 2 Dangerous Substances: Arsenic; Chromium; Copper; Lead; Nickel; and Zinc. (Immingham Docks)
	5 No. Pollution Incident	Pollutant Type: 2 No. Diesel – Category 3 (Minor) Land; 1 No. Smoke – Category 4 (No Impact) Air; 1 No. Crude Oil – Category 3 (Minor) Land, Category 2 (Significant) Water; and 1 No. Construction Waste – Category 3 (Minor) Land.

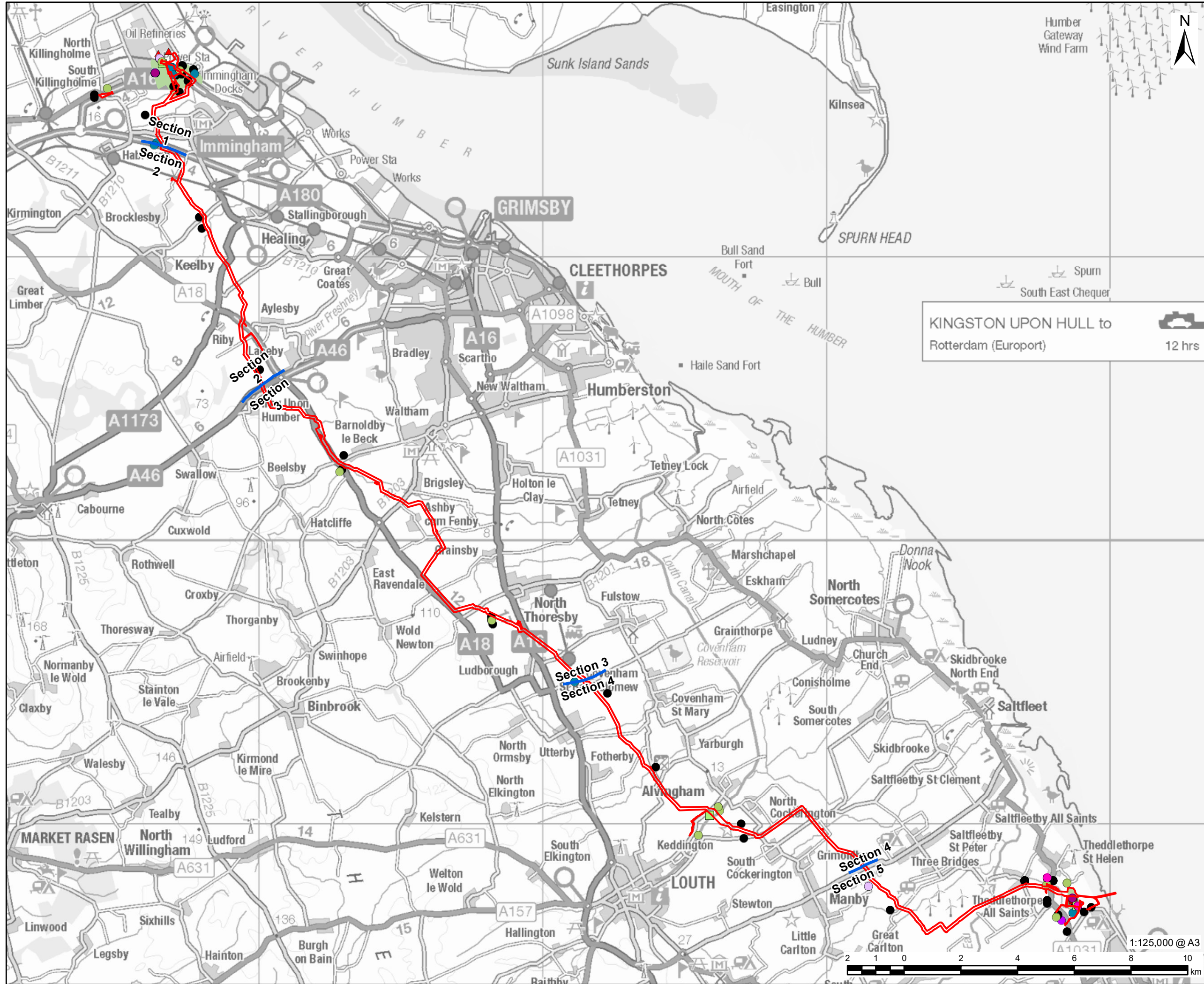
Section of the DCO Site Boundary	Summary of Statutory Information	Details
	39 No. Pollution Inventory Substances	Type: 30 No. Phillips 66 Limited – Refineries and Fuel; and 9 No. VPI Immingham LLP – Power, Combustion. (Immingham Docks)
	2 No. Pollution Inventory Waste Transfer	Type: VPI Immingham LLP – Combustion; and Phillips 66 Limited – Combustion. (Immingham Docks)
<b>Section 2</b>	3 No. Licensed Discharges to Controlled Waters (2 No. Historical, 1 No. Current)	Licensed discharges to water include: Trade Discharges – Site Drainage; Sewage – Final Treated Effluent – Not Water Company; and Miscellaneous – Surface Water.
	1 No. Licensed Pollutant Release Part A2 B (1 No. Active)	Licensed Pollutant Releases: Gradebrook Filling Stations Ltd – Unloading of petrol into storage.
<b>Section 3</b>	6 No. Licensed Discharges to Controlled Waters (6 No. Historical)	Licensed discharges to water include: Trade Discharges – Site Drainage; Sewage – Process Effluent – Not Water Company; and Miscellaneous – Surface Water.
	2 No. Pollution Incident	Pollutant Type: Process Effluent – Category 3 (Minor) Land; and Inert Materials and Wastes – Category 4 (No Impact).
<b>Section 4</b>	10 No. Licensed Discharges to Controlled Waters (8 No. Historical, 2 No. Current)	Licensed discharges to water include: Trade Discharges – Site Drainage; Sewage – Final Treated Effluent – Not Water Company; and Miscellaneous – Surface Water.
	1 No. Licensed Pollutant Release Part A2 B (1 No. Historical)	Licensed Pollutant Releases: Royal Crushing & Earthmoving – Other Mineral Resources.
	16 No. List 2 Dangerous Substances (6 No. Active, 10 No. Not Active)	List 2 Dangerous Substances: Chromium; Copper;



Section of the DCO Site Boundary	Summary of Statutory Information	Details
	4 No. Pollution Incidents	<p>Lead; pH; and Zinc.</p> <p>Pollutant Type: 1 No. Household Waste – Category 3 (Minor) Air and Land; 1 No. Vegetable Cuttings – Category 3 (Minor) Air and Land; 1 No. Unidentified – Category 4 (No Impact); and 1 No. Vegetable Cuttings and Household Waste – Category 3 (Minor) Air and Land.</p>
<b>Section 5</b>	1 No. COMAH site (Historical)	Historical COMAH: Conoco Phillips Petroleum Company U.K. Limited. (Theddlethorpe Gas Terminal)
	2 No. Hazardous Substance Storage (1 No. Historical, 1 No. Current)	<p>Current HSS: For the process and storage of flammable substances- Conoco Philips Petroleum Company Ltd. (Theddlethorpe Gas Terminal) Deemed consent for the receipt and handling of high-pressure natural gas (Natural Gas Terminal).</p> <p>Historical HSS: Application to increase the amount of stored hazardous materials -Conoco Philips Petroleum Company Ltd. (Theddlethorpe Gas Terminal)</p>
	8 No. Historical Licensed Activities	Historical Licensed Activities: Conoco Phillips Petroleum Company U.K. Limited - Gasification and Associated Processes. (Theddlethorpe Gas Terminal)
	18 No. Licensed Discharges to Controlled Waters (17 No. Historical)	Licensed discharges to water include: Unspecified, Sewage – Final Treated Effluent – Not Water Company and Agricultural – Fish Farming.
	15 No. Licensed Industrial Activities Part A1 (4. No. Effective, 11 No. Superseded)	Licensed Industrial Activities: 2 No. Chrysaor Production Limited – Combustion and Gasification; 11 No. Conoco Phillips UK LTD – Combustion and Gasification; and 2 No. Annyalla Chicks UK Ltd – Associated Process and Intensive. (Theddlethorpe Gas Terminal)

Section of the DCO Site Boundary	Summary of Statutory Information	Details
	1 No. Licensed Pollutant Release Part A2 B (1 No. Historical)	Licensed Pollutant Releases: British Gas – Gas Processes. (Theddlethorpe Gas Terminal)
	1 No. List 1 Dangerous Substances (Not Active)	List 1 Dangerous Substances: Mercury; and Cadmium. (Theddlethorpe Gas Terminal)
	1 No. List 2 Dangerous Substances (Active)	List 2 Dangerous Substances: Arsenic; Chromium; Copper; Iron; Lead; and Zinc. (Theddlethorpe Gas Terminal)
	3 No. Pollution Incidents	Pollutant Type: 1 No. Unidentified – Category 3 (Minor) Water; and 2 No. Oils and Fuel – Category 3 (Minor) Water.
	1 No. Pollution Inventory Radioactive	Conoco Phillips UK Ltd: Total Alpha, Total BETA/Gamma. (Theddlethorpe Gas Terminal)
	1 No. Pollution Inventory Substance	Type: Chrysaor Production UK Ltd – Refineries and Fuel – Combustion. (Theddlethorpe Gas Terminal)
	1 No. Pollution Inventory Waste Transfer	Type: Chrysaor Production UK Ltd – Refineries and Fuel – Combustion. (Theddlethorpe Gas Terminal)
	2 No. Radioactive Substance Authorisations	Type: 2 No. Conoco Phillips UK Ltd - Disposal of Radioactive Waste (was Rsa60 Section 6) Superseded /Revoked. (Theddlethorpe Gas Terminal)





LEGEND

- DCO Site Boundary
- Route Section Break
- ▲ Hazardous Substance Storage (HSE)
- Historical Licensed Industrial Activity (EA)
- Licensed Discharge to Controlled Waters (EA)
- Licensed Industrial Activity Part A1 (EA)
- Licensed Pollution Release Part A2 (EA)
- List 1 Dangerous Substance (EA)
- List 2 Dangerous Substance (EA)
- Pollution Incident (EA)
- Pollution Inventory Radioactive (EA)
- Pollution Inventory Substance (EA)
- Pollution Inventory Waste Transfer (EA)
- Radioactive Substance Authorisation (EA)
- Control of Major Accident Hazards (COMAH) Site (HSE)

NOTES:

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FIGURE TITLE

**Figure 9-12**  
Information from Statutory Authorities

ISSUE PURPOSE

ENVIRONMENTAL STATEMENT

PROJECT NUMBER / REFERENCE

60668955 / VCCS\_231018\_ES\_9-12

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### **Contaminated Land Risk Assessment**

- 9.5.38 A qualitative risk assessment for contaminated land has been undertaken for the construction and operational phase of the Proposed Development. The risk assessment is based on the assumption that standard best practices would be implemented during the works, and has been used to identify where additional mitigation measures would be required.
- 9.5.39 The contaminated land risk assessment for the Proposed Development has been provided in *ES Volume IV: Appendix 9.4 (Application Document 6.4.9.4)*.
- 9.5.40 The potential risk for the Proposed Development ranges between 'Moderate / Low' to 'Moderate'. Where risks have been identified that may result in potentially significant environmental effects these have been brought forward into the effect assessment.

### **Future Baseline**

- 9.5.41 The Proposed Development is situated within predominantly agricultural land, however, at the start and end of the pipeline route it overlaps with existing and / or historical industrial sites (Immingham Facility and Theddlethorpe Facility).
- 9.5.42 At the time of writing, there are several potentially significant nearby schemes and/or infrastructure changes that could impact on the Proposed Development.
- 9.5.43 There are two Development Consent Orders (DCO) granted within the DCO Site Boundary around the Immingham Facility area. These relate to VPI Immingham Open Cycle Gas Turbine (OCGT) for the construction of a new gas-fired power station and Hornsea Project Four Offshore Wind Farm (Generation Stations). The DCO Site Boundary and the cable corridor associated with the Hornsea Four Offshore Wind Farm transect just south of Immingham in Section 1 and 2 of the pipeline route.
- 9.5.44 Although there is the potential for the baseline presented in this chapter to change overtime; it is considered that the data presented provides a good representation of land use and geological and hydrogeological conditions at this stage of the Proposed Development; and thus the baseline presented provides a realistic platform upon which to base any impact assessment work.

## **9.6 Development Design and Embedded Mitigation**

- 9.6.1 EIA is an iterative process which informs the development of the project design. Where the outputs of the preliminary assessment identify likely significant effects, changes to the design can be made or mitigation measures can be built-in to the proposal to reduce these effects.
- 9.6.2 This type of mitigation is defined as embedded mitigation, as mitigation measures which have been identified and adopted as part of the evolution of the project design ("embedded" into the project design).
- 9.6.3 The design of the Proposed Development has been further developed to reflect the findings of ongoing environmental studies, comments raised during the statutory consultation and ongoing engagement with stakeholders. As the design has developed, embedded mitigation measures have been refined as part of an iterative process.
- 9.6.4 Those embedded mitigations relevant to geology and hydrogeology include design changes and route amendments to avoid potential sensitive receptors, important geological features or resources and sources of contamination.
- 9.6.5 In relation to Geology and Hydrogeology, one route amendment was made through the design process, the DCO Site Boundary was moved east in the central area between

Section 3 and 4, to avoid the source of a chalk stream, Wellbeck Spring to avoid adversely impacting the surface water body supplied by a groundwater source.

- 9.6.6 No further route amendments were required based on the baseline conditions not identifying any areas of contamination beyond the areas agreed to be remediated and no RIGS.

Route amendments which were made during the evolution of the design of the Proposed Development and are outlined in *ES Volume II, Chapter 2: Design Evolution and Alternatives (Application Document 6.2.2)*.

## 9.7 Potential Impacts and Assessment of Effects

### Introduction

- 9.7.1 This section presents an assessment of how the Proposed Development could result in impacts to geology and hydrogeology receptors during the construction and operational stages, as well as how the existing geology and hydrogeology could impact upon the Proposed Development.
- 9.7.2 Potential receptors in the context of the geology and hydrogeology assessment are considered to be geology (superficial and bedrock geology), hydrogeology (Aquifers, SPZs and groundwater abstractions), human health (construction workers and site users) and development infrastructure (above ground infrastructures and pipelines).
- 9.7.3 The geology underlying the Proposed Development is classified as having 'low' sensitivity. There are no RIGS or local geological sites reported within the DCO Boundary; however, the chalk bedrock is considered to be of regional importance due to the unique identified features such as chalk streams and blow wells. The potential impact on the geology underlying the Proposed Development is classified as having a 'low' to 'medium' magnitude as there is the potential for partial loss and/or damage to protected sites and contamination if mitigation measures are not implemented. The magnitude classification also reflects the conclusions of the contaminated land risk assessment.
- 9.7.4 Groundwater within the bedrock underlying the majority of the Proposed Development is classified as a Principal Aquifer (Bedrock). The Proposed Development passes through SPZ 1, SPZ 2 and SPZ 3 designations. Although the WFD classification is 'poor', groundwater vulnerability is classified as 'medium' to 'high'. Secondary undifferentiated and unproductive aquifers (within the superficial deposits) along with SPZ 3 are classified as 'medium' and principal, secondary A and B aquifers (within some of the superficial deposits and all mapped bedrock) along with SPZ 1 and 2 and associated abstractions being classified as 'high'. A preliminary hydrogeological risk assessment (HyRA) has been undertaken for the works passing through the SPZ 1 (surrounding Little London) and SPZ 2 (North of Immingham, between Keelby and Aylesby, between Barnoldby le Beck and Brigsley and between Grainsby and Ludborough) designations, this is set out in *ES Volume IV: Appendix 9.3 (Application Document 6.4.9.3)*. The magnitude for the hydrogeology receptors is classified as 'low' to 'medium' as there is the potential for partial loss or change to the aquifers and potentially degradation of regionally important public water supply if mitigation measures are not implemented. The magnitude classification also reflects the conclusions of the contaminated land risk assessment.
- 9.7.5 Additionally, following Position Statement B3 in 'The Environment Agency's approach to groundwater protection', private groundwater abstractions identified by North East Lincolnshire Council and East Lindsey District Council and used for human consumption or food production purposes within 50m of the DCO Site Boundary have been classified as a SPZ 1. This applies to 1 No. abstraction approximately 43m north of the DCO Site Boundary in the East Lindsey District Council boundary, which is a single domestic supply from an unknown source (and therefore assumed to be an active groundwater abstraction used for

human consumption as a worst-case scenario). The sensitivity of this receptor has been classified as 'high' and is assessed in the HyRA.

- 9.7.6 Two private water abstractions used for domestic purposes within the North East Lincolnshire Council district boundary and within 50m of the DCO Site Boundary are considered unlikely to be active based on contact with the relevant landowners and, therefore, have not been further assessed. Whilst other private groundwater abstractions are present within 250m of the DCO Site Boundary (and therefore could have a default SPZ 2 classification based on Position Statement B3), they have not been assessed in the HyRA as the abstracted volumes are considered to be minimal (up to 1m<sup>3</sup> / day within 210m of the DCO Site Boundary and 1.4m<sup>3</sup> / day approximately 245m from the DCO Site Boundary).
- 9.7.7 The sensitivity rating for human health (construction workers and site users) for the Proposed Development has been classified as 'low' for the Project. This is due to the end-use scenario for the Project being Commercial/Industrial. The magnitude rating for Human Health receptors has been classified as 'low' to 'medium' as although the majority of the DCO Boundary is undeveloped agricultural land, there is still the potential for contamination to be present. The magnitude classification also reflects the conclusions of the contaminated land risk assessment.
- 9.7.8 The sensitivity rating for above ground infrastructure for the Proposed Development has been classified as 'medium' for the Project. There is minimal AGIs associated with the Proposed Development. The magnitude rating for infrastructure has been classified as 'low' rating as there are limited AGIs related to the Project with the exception of the block valve stations and the reception facilities. These structures are not thought to be susceptible to significant damage from geology and hydrogeology. The magnitude classification also reflects the conclusions of the contaminated land risk assessment.
- 9.7.9 Pathways by which the identified geological and hydrogeological receptors have the potential to be impacted by the Proposed Development during the construction and operational phases include direct release of substances to ground (e.g. fuel spills), creation of pathways to deeper groundwater as a result of groundworks (e.g. foundations/piling), adverse effects on groundwater quality or quantity due to construction activities (e.g. dewatering of excavations) and reduction in soil quality (e.g. due to heavy trafficking or handling).
- 9.7.10 Localised sources of potential contamination, including railways and historical landfills that have been identified along the DCO Site Boundary, result in the potential for contaminated soil and/or groundwater to be present. However, along the majority of the route, few potentially significant sources of ground contamination have been identified with the exception of the industrial land located relating to Immingham Docks and the former Theddlethorpe Gas Terminal. During construction, workers could be exposed to potentially contaminated soil and/or groundwater, if present. During the operational phase, no viable human health receptors are likely to be present, with the exception of workers during occasional maintenance activities. The sensitivity with respect to human health has been assessed to be low.

## Assessment of Potential Impacts and Effects: Construction Phase

### General Overview

- 9.7.11 The construction phase will comprise the use of construction equipment, construction of temporary haul roads and site compounds, excavation of the pipeline route, placement and backfilling of the pipeline route.
- 9.7.12 Pathways by which the identified geological and hydrogeological receptors have the potential to be impacted by the Proposed Development during the construction phase include:



- Chemical spillages and leaks from plant and machinery, and from chemicals and other contaminants stored on site causing pollution of ground or groundwater;
- Changes in subsoil structure and reduction of subsoil quality due to compaction or erosion during storage;
- Compaction of subsoil due to construction vehicle movements degrading soil quality and causing potential water logging;
- Changes in subsoil/rock structure that could affect ground stability (collapsible deposits, compressible deposits, ground dissolution, landslides, running sands and shrink well clays);
- Requirement for dewatering, which may reduce flow to groundwater supported sites and unique features such as blow wells, abstractions (regulated and non-regulated) and surface water bodies and change soil hydrology locally;
- Requirement for dewatering, reducing quality or levels of groundwater supporting sites protected under European and UK habitat legislation, such as a RAMSAR Site, a SSSI or SPZ 1;
- Disturbance of potentially contaminated soils, sediments and waters posing a risk to construction workers, groundwater, and geology;
- Importation of contaminated aggregates posing a potential risk to human health and underlying geology and groundwater;
- Trenchless techniques whereby excavations/ drilling creates the potential for groundwater losses, should artesian flow be encountered during construction excavations affecting sensitive groundwater receptors (e.g., Principal Aquifers or regulated and non-regulated abstractions) or sensitive surface water receptors or unique groundwater features such as blow wells, chalk streams and springs; and
- Requirement to remove excess potentially contaminated soils from pipeline route posing a potential risk to human health and the environment.

9.7.13 **Table 9-18** presents an overview of the potential effects pre-mitigation which could occur as a result of the occurrence of the different impacts during the construction phase.

9.7.14 Significance of effects categorised as 'Negligible' or 'Minor' are considered 'Not Significant'. Significance categorised as 'Moderate' or 'Major' are considered potentially 'Significant'. Those effects considered potentially 'Significant' are considered in the context of proposed mitigation measures and re-assessed in Section 9.9.

9.7.15 The sensitivity and magnitude of the potential impacts have been assigned the relevant rating according to Table 9-6 and Table 9-7 where appropriate examples have been listed.

9.7.16 In relation to ground stability, the ratings are drawn from published policy and/or good practice guidance and based on professional judgements within AECOM and have been successfully used on other assessments.

**Table 9-18: Assessment of Potential Effect: Construction Phase**

Potential Impact	Description	Receptor	Assessment of Potential Effects		
			Magnitude	Sensitivity	Significance
Chemical spillages and leaks from plant and machinery, and from chemicals and other contaminants stored on site causing pollution of ground or groundwater.	<p>Potential for plant to leak or spill oil and/ or fuel. Leaks and spillages could occur in any area of the working width and construction compounds in which plant is operated or stored, including refuelling. Additionally, the potential exists for spills and drips to occur associated with stored fuels and chemicals brought onto the site to facilitate construction. There is potential that such spillages could enter the underlying uncontaminated strata and contaminate shallow groundwater, as well as presenting a risk to human health.</p> <p>No construction compounds or storage of fuels proposed to be within the SPZ 1 or 2 (including the default SPZ 1 around the private groundwater abstraction in Section 5), where possible. Smaller laydown areas to be include welfare and parking currently proposed within these areas, refuelling to be undertaken in designated areas only.</p>	Human Health: Construction Workers/Site Users	Low	Low	<b>Negligible (Not Significant)</b>
		Geology: Superficial deposits and Bedrock	Low	Low	<b>Negligible (Not Significant)</b>
		Hydrogeology: Aquifers (Principal, Secondary A & B Aquifers), Source Protection Zones (SPZ 1 and 2) and Regulated and unregulated abstractions	Low	High	<b>Moderate Adverse (Significant)</b>
		Hydrogeology: Aquifers (Undifferentiated and Unproductive), Source Protection Zone 3	Low	Medium	<b>Minor Adverse (Not Significant)</b>
Changes in subsoil structure and reduction of subsoil quality due to compaction or erosion during storage.	During the excavation and temporary storage of soils, minor changes to soil characteristics, such as soil hydrology and soil structure, could occur due to handling and storage of topsoil and subsoil in inappropriate conditions. Soils stored in bunds are also susceptible to erosion from run-off during heavy rainfall or wind erosion during dry periods. The reduction in the quality of	Geology: Superficial deposits	Low	Low	<b>Negligible (Not Significant)</b>

Potential Impact	Description	Receptor	Assessment of Potential Effects		
			Magnitude	Sensitivity	Significance
	the soils could lead to the loss or alteration to one or more key important features.				
Compaction of subsoil due to construction vehicle movements degrading soil quality and causing potential water logging.	The tracking of heavy plant across the site during construction could compact the ground surface causing degradation of soil quality. In addition, compaction could lead to a decrease in infiltration and, therefore, potential water logging and increase of surface water runoff, and a reduction of local groundwater levels.	Geology: Superficial deposits	Low	Low	<b>Negligible (Not Significant)</b>
		Hydrogeology: Aquifers (Principal, Secondary A & B Aquifers), Source Protection Zones (SPZ 1 and 2) and Regulated and unregulated abstractions	Low	High	<b>Moderate Adverse (Significant)</b>
		Hydrogeology: Aquifers (Undifferentiated and Unproductive), Source Protection Zone 3	Low	Medium	<b>Minor Adverse (Not Significant)</b>
Changes in subsoil/rock structure that could affect ground stability (collapsible deposits, compressible deposits, ground dissolution, landslides, running sands and shrink well clays)	Excavation of the ground, dewatering (if required), laying of track matting, access roads and construction compounds along with heavy plant movements during construction may affect the ground stability conditions.	Geology: Superficial deposits and Bedrock	Medium	Medium	<b>Moderate Adverse (Significant)</b>



Potential Impact	Description	Receptor	Assessment of Potential Effects		
			Magnitude	Sensitivity	Significance
Requirement for dewatering, which may reduce flow to groundwater supported sites, abstractions (regulated and non-regulated) and surface water bodies and change soil hydrology locally.	<p>During construction, there may be a requirement to excavate below the water table (e.g., in HDD locations and foundations for the reception facilities at Immingham and Theddlethorpe). If this is the case, dewatering may be required. Groundwater would likely be extracted from sumps within the excavation and discharged to surrounding ground.</p> <p>Groundwater levels could be locally affected. A reduction in groundwater levels may lead to reduced baseflow to watercourses and to groundwater abstraction points. In addition, the quality of surrounding soils may be affected through a reduction of soil water changing the soil structure.</p> <p>Through the design process the DCO Site Boundary was moved east in the central area between Section 3 and 4, to avoid the source of a chalk stream, Wellbeck Spring to avoid adversely impacting the surface water body.</p>	Hydrogeology: Aquifers (Principal, Secondary A & B Aquifers), Source Protection Zones (SPZ 1 and 2) and Regulated and unregulated abstractions	Low	High	<b>Moderate Adverse (Significant)</b>
		Hydrogeology: Aquifers (Undifferentiated and Unproductive), Source Protection Zone 3	Low	Medium	<b>Minor Adverse (Not Significant)</b>

Potential Impact	Description	Receptor	Assessment of Potential Effects		
			Magnitude	Sensitivity	Significance
Requirement for dewatering, reducing quality or levels of groundwater supporting sites protected under European and UK habitat legislation, such as a RAMSAR Site or a SSSI.	<p>During construction, there may be a requirement to excavate below the water table (e.g., in HDD locations, foundations for the reception facilities at Immingham and Theddlethorpe). If this is the case, dewatering may be required. Groundwater would likely be extracted from sumps within the excavation and discharged to surrounding ground. This would be subject to confirmation of water quality and in agreement with the Environment Agency.</p> <p>Groundwater levels could be locally affected, and a reduction in levels and quality could affect designated sites supported by the groundwater. Through the design process the DCO Site Boundary was moved east in the central area between Section 3 and 4, to avoid the source of a chalk stream, Wellbeck Spring to avoid adversely impacting the surface water body. Additionally, based on information gathered from the hydrogeological risk assessment, it is advised not to drill any deeper than 10m bgl within the SPZ 1 where chalk is anticipated to come in at ~15m bgl to allow for sufficient thickness of glacial till to protect the chalk.</p>	Hydrogeology: Aquifers (Principal, Secondary A & B Aquifers), Source Protection Zones (SPZ 1 and 2) and Regulated and unregulated abstractions	Low	High	<b>Moderate Adverse (Significant)</b>
		Hydrogeology: Aquifers (Undifferentiated and Unproductive), Source Protection Zone 3	Low	Medium	<b>Minor Adverse (Not Significant)</b>

Potential Impact	Description	Receptor	Assessment of Potential Effects		
			Magnitude	Sensitivity	Significance
Disturbance of potentially contaminated soils, sediments and waters posing a risk to construction workers, groundwater, and geology.	<p>Most of the land comprises farmland. A number of historical railway lines transect the DCO Site Boundary. Infilled ground (pits, former railway cuttings, canals etc.) may be present. There has been heavy industrial activity known to have occurred at Immingham and Theddlethorpe in the past. The land at both facilities is set to be remediated by the current site landowners prior to the construction of the Proposed Development. This will form a condition of the lease agreement.</p> <p>The potential presence of contaminated soils encountered during construction could lead to adverse impacts associated with contaminated soils:</p> <ul style="list-style-type: none"> <li>• Vehicles tracking over potentially contaminated soils have the potential to spread contamination and carry it off-site;</li> <li>• Construction workers may be exposed during the excavation of material to potentially harmful contaminants and ground gases;</li> </ul>	Human Health: Construction Workers/Site Users	Medium	Low	<b>Minor Adverse (Not Significant)</b>
		Geology: Superficial deposits and Bedrock	Medium	Low	<b>Minor Adverse (Not Significant)</b>
		Hydrogeology: Aquifers (Principal, Secondary A & B Aquifers), Source Protection Zones (SPZ 1 and 2) and Regulated and unregulated abstractions	Medium	High	<b>Major (Significant)</b>



Potential Impact	Description	Receptor	Assessment of Potential Effects		
			Magnitude	Sensitivity	Significance
	<ul style="list-style-type: none"> <li>Disturbance of soils may alter the chemical conditions within the site soils resulting in mobilisation of potential contaminants;</li> <li>The surfaces of contaminated material may be exposed in excavations, which could cause dissolution and/ or mobilisation of contaminants by percolating rainwater; and</li> <li>Arisings from the excavation of soil could potentially result in the stockpiling of contaminated soils on the site and reuse on-site. The exposed soils could lead to increased migration of potential contaminants both on-site and off the site through dust generation and to underlying soils and Controlled Waters through leaching and surface water runoff.</li> </ul>	Hydrogeology: Aquifers (Undifferentiated and Unproductive), Source Protection Zone 3	Medium	Medium	<b>Moderate Adverse (Significant)</b>
Importation of contaminated aggregates posing a potential risk to human health and underlying geology and groundwater	Without controls in place, imported construction materials, to create building platforms, access tracks and other working areas, could be contaminated and present a potential a risk to construction workers underlying uncontaminated strata and groundwater.	Human Health: Construction Workers/Site Users	Medium	Low	<b>Minor Adverse (Not Significant)</b>
		Geology: Superficial deposits and Bedrock	Medium	Low	<b>Minor Adverse (Not Significant)</b>
		Hydrogeology: Aquifers (Principal, Secondary A & B Aquifers), Source Protection Zones (SPZ 1 and 2) and	Medium	High	<b>Major Adverse (Significant)</b>

Potential Impact	Description	Receptor	Assessment of Potential Effects		
			Magnitude	Sensitivity	Significance
		Regulated and unregulated abstractions			
		Hydrogeology: Aquifers (Undifferentiated and Unproductive), Source Protection Zone 3	Medium	Medium	<b>Moderate Adverse (Significant)</b>
Trenchless techniques whereby excavations/ drilling creates a pathway for drilling fluids or other fluids used during construction to reach sensitive groundwater receptors (e.g., Principal Aquifers or abstractions (regulated and non-regulated)) or sensitive surface water receptors, or unique	There is expected to be a substantial thickness superficial deposits (~15m) which would typically reduce the potential for vertical migration between shallow groundwater and the bedrock (Principal) aquifer. However, the superficial aquifer is itself classified as a Secondary A Aquifer. If penetrated by piling (or other construction activities), there is the potential for preferential pathways for vertical migration to be created between Made Ground/ contaminated shallow groundwater/ drilling fluids to deeper uncontaminated strata and groundwater. However, in the absence of ground investigation data, the potential for significant contamination to be present cannot be ruled out, so is currently assessed on a worst case. It should be noted however that a ground investigation will be undertaken to confirm the ground conditions and potential contamination prior to construction along with the requirement for mitigation and / or remediation.	Geology: Superficial deposits and Bedrock	Medium	Low	<b>Minor Adverse (Not Significant)</b>
		Hydrogeology: Aquifers (Principal, Secondary A & B Aquifers), Source Protection Zones (SPZ 1 and 2) and Regulated and unregulated abstractions	Medium	High	<b>Major Adverse (Significant)</b>

Potential Impact	Description	Receptor	Assessment of Potential Effects		
			Magnitude	Sensitivity	Significance
groundwater features such as blow wells, chalk streams and springs.	Through the design process the DCO Site Boundary was moved east in the central area of between Section 3 and 4 to avoid the source of a chalk stream, Wellbeck Spring to avoid adversely impacting the surface water body. Additionally, based on information gathered from the hydrogeological risk assessment, it is advised not to drill any deeper than 10m bgl within the SPZ 1 where chalk is anticipated to come in at ~15m bgl to allow for sufficient thickness of glacial till to protect the chalk.	Hydrogeology: Aquifers (Undifferentiated and Unproductive), Source Protection Zone 3	Medium	Medium	<b>Moderate Adverse (Significant)</b>
Re-use of Potentially contaminated soils from pipeline route posing a potential risk to human health and the environment.	Although the majority of arisings are unlikely to be contaminated based on the land uses identified, there is still the potential for contaminated spoil to be generated from pipeline route excavations. Where material is suitable this may be re-used within the Proposed Development. Contaminated materials would not be re-used without treatment otherwise it is likely they would require removal from the site along with surplus materials if generated.	Human Health: Construction Workers/Site Users	Medium	Low	<b>Minor Adverse (Not Significant)</b>
		Geology: Superficial deposits and Bedrock	Medium	Low	<b>Minor Adverse (Not Significant)</b>
		Hydrogeology: Aquifers (Principal, Secondary A & B Aquifers), Source Protection Zones (SPZ 1 and 2) and Regulated and unregulated abstractions	Medium	High	<b>Major Adverse (Significant)</b>
		Hydrogeology: Aquifers (Undifferentiated and Unproductive), Source Protection Zone 3	Medium	Medium	<b>Moderate Adverse (Significant)</b>



## Assessment of Potential Impacts and Effects: Operational Phase

- 9.7.17 The operational phase will comprise the operation and maintenance of the pipeline, the Immingham Facility, Theddlethorpe Facility and the Block Valve Stations associated with the Proposed Development.
- 9.7.18 Pathways by which the identified geological and hydrogeological receptors have the potential to be impacted by the Proposed Development during the operational phase include:
- The foundations of structures and pipelines may provide a preferential pathway for contaminants to migrate to non-contaminated soils, geology and groundwater; and
  - The potential for aggressive ground contaminants posing a risk to the pipeline.
- 9.7.19 Identified impacts during the operational phase are described in **Table 9-19**, along with an assessment of the potential significance of the impact on the identified receptors, assuming no mitigation measures (other than mitigation by design).
- 9.7.20 Significance of effects categorised as 'Negligible' or 'Minor' are considered 'Not Significant'. Significance categorised as 'Moderate' or 'Major' are considered potentially 'Significant'. Those effects considered potentially 'Significant' are considered in the context of proposed mitigation measures and re-assessed in Section 9.9.
- 9.7.21 The sensitivity and magnitude ratings have been classified based on **Table 9-6** and **Table 9-7**.

**Table 9-19: Assessment of Potential Impacts: Operational Phase**

Potential Impact	Description	Receptor	Assessment of Potential Effects		
			Magnitude	Sensitivity	Significance
The foundations of structures and pipelines may provide a preferential pathway for contaminants to migrate to non-contaminated geology, and groundwater.	There is the potential for foundations associated with the reception facilities and block valve stations, particularly if piled foundations, creating a potential preferential pathway for contaminants to migrate into groundwater.	Geology: Superficial deposits and Bedrock	Low	Low	<b>Negligible (Not Significant)</b>
		Hydrogeology: Aquifers (Principal, Secondary A & B Aquifers), Source Protection Zones (SPZ 1 and 2) and Regulated and unregulated abstractions	Low	High	<b>Moderate Adverse (Significant)</b>
		Hydrogeology: Aquifers (Undifferentiated and Unproductive), Source Protection Zone 3	Low	Medium	<b>Minor Adverse (Not Significant)</b>
The potential for aggressive ground contaminants posing a risk to the pipeline.	There is the potential for aggressive ground conditions to pose a risk to the pipeline and buried concrete.	Development Infrastructure: AGIs and Pipelines	Low	Medium	<b>Minor Adverse (Not Significant)</b>

## Assessment of Potential Impacts and Effects: Decommissioning Phase

9.7.22 The scale and nature of activities undertaken during decommissioning phase would be similar to those described previously for construction phase, and they would be temporary during the period of decommissioning activities on site. The decommissioning strategy is currently designed to leave the pipeline in-situ and only to remove the above ground facilities. Following the removal of the structures and the reinstatement of the land there would be no further potential effects on geological and hydrogeological receptors. The potential effects from decommissioning should therefore be regarded as, at worst, the same as construction. Refer to **Table 9-18** for a summary of the potential impacts and effects.

## 9.8 Additional Mitigation and Enhancement Measures

### Additional Mitigation and Enhancement – Construction Phase

- 9.8.1 The Draft CEMP (*ES Volume IV: Appendix 3.1 (Application Document 6.4.3.1)*) sets out the additional mitigation measures identified in this assessment of likely significant effects. These are contained within the Mitigation Register of the CEMP. This section summarises the types of mitigation measures that will be considered to mitigate against the effects on geology and hydrogeology where required. Each entry in the Mitigation Register has an alpha-numerical reference e.g., “E1” to provide a cross reference to the secured commitment. These measures will be adopted during the relevant phase, either pre-construction (e.g., appropriate ground investigation or production of an inspection and discovery strategy, etc), or during the construction phase (e.g., maintaining a watching brief during construction works).
- 9.8.2 A schedule of the environmental commitments is presented in Table 3 of the Draft CEMP, contained within *ES Volume IV: Appendix 3.1 (Application Document 6.4.3.1)*.
- 9.8.3 Enhancements are measures that are considered to be over and above any measures to avoid, reduce or remediate adverse impacts of the Proposed Development.
- 9.8.4 The relevant mitigation measures to geology and hydrogeology are presented below with the associated reference number:

#### Ground Contamination

- **E1:** An appropriate intrusive ground investigation of selected areas of the DCO Site Boundary will be undertaken in accordance with all relevant guidance and legislation including BS 10175:2011, Environment Agency/DEFRA Land Contamination Risk Management (LCRM) series of reports.

The ground investigation will be undertaken to achieve the following objectives:

- Determine the ground conditions to allow design of foundations and structures;
- Assess the nature, extent and magnitude of soil and groundwater contamination present;
- Assessment of artesian groundwater conditions and identification of where unique groundwater features could occur within the DCO Site Boundary;
- Assess the risks (if any) from potential contaminants to human health and Controlled Waters; and
- Assess the ground gas regime.

If areas of the DCO Site Boundary are shown to pose a risk, if feasible, infrastructure would be moved to a different location. However, if it is not possible to move the infrastructure in contact with the ground, remedial measures would be implemented.



- **E2:** A remediation strategy comprising an inspection and discovery strategy will be devised and discussed with the regulatory authorities (including relevant local authorities and the Environment Agency) if required, prior to any remedial works. Contaminated material that is considered to pose a risk would be remediated in line with the strategy or disposed of appropriately.
- **E3:** A more detailed hydrogeological assessment will be undertaken at Front End Engineering Design (FEED), where trenchless techniques or dewatering is required in high sensitivity groundwater environments. Where dewatering is required, a dewatering scheme will be developed prior to construction (in consultation with the Environment Agency, appropriate public water abstraction companies and private landowners (where applicable in Section 5)) to demonstrate that there is an effective strategy to manage water arising from the operations and, where required, sufficient proposals to treat the water prior to controlled discharge. Any such assessment will consider the effects of any draw down or impacts on nearby abstractions or resources.
- **E4:** Produce an environmental emergency response plan which will detail such measures as making appropriate equipment (e.g., spill kits, absorption mats) easily accessible on-site and training personnel in using them. The plan should include clear protocols and communication channels to ensure that any spillages are dealt with immediately and adequately. This will prevent large areas of soil / geology potentially becoming contaminated and in turn protect surface water quality.
- **E5:** Prepare a SWMP following the protocols within the Contaminated Land Application in the Real Environment (CL:AIRE) Definition of Waste: Development Industry Code of Practice to ensure that excavated materials are re-used appropriately, sustainably and remain outside the waste hierarchy.
- **F1:** Prepare a detailed Soil Management Plan following the guidance in the Defra (2009) Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (or updated version thereof) and other relevant documents such as The Institute of Quarrying's Good Practice Guide for Handling Soils in Mineral Workings. This plan will be based upon the Outline Soil Management Plan presented within *ES Volume IV: Appendix 10.1, (Application Document 6.4.10.1)*.
- **E6:** Pre-entry meetings will be held with landowners / occupiers during which any requirements for temporary fencing, accesses, monitoring of water supplies and reinstatement will be discussed.
- **E7:** A watching brief will be maintained during construction works to confirm the absence of potential sources of contamination such as Made Ground, visual or olfactory evidence of hydrocarbons etc. If identified, these areas of potentially contaminated ground and/or water will be sampled and undergo appropriate sampling and laboratory analysis.
- **E8:** Subsequently a dynamic risk assessment will be undertaken in accordance with the Environment Agency report Land Contamination Risk Management (LCRM) to identify if these areas of potential contaminants pose a risk to construction workers or site operators and Controlled Waters. If areas of the site are shown to pose a risk, remedial measures required will be implemented. A discovery and disposal strategy will be devised and agreed with the regulatory authorities prior to construction works to outline this process to allow the dealing of risks in a timely manner.

9.8.5 Mitigation measures to prevent the creation of contaminant linkages would be required; these include the following commitments within the Draft CEMP:

- **E16:** Risk assessments in accordance with the Health and Safety at Work Act to restrict exposure to potentially harmful substances to a safe level for construction workers. Construction Design and Management practices will be applied;
- **J2:** Develop a Dust Management Plan (DMP), which includes measures to control other emissions. This will form part of the Final CEMP;
- **J20:** Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use;
- **J22:** Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport;
- **E9:** Should contaminated material that poses a risk be identified, it will be treated and/or disposed of appropriately;
- **E10:** Undertake proportionate UXO assessment including, but not limited to, areas with a 'moderate' identified risk from UXO;
- **E11:** Within the construction compounds specific areas will be designated for the storage of chemicals, waste oils and fuel and refuelling activities and will be placed on secondary containment e.g., double walled tanks or bunded areas with a capacity of 110% of the maximum stored volume. Refuelling on the pipeline spread will be undertaken using plant nappies and be at least 30 m away from watercourses and vehicles and plant will not be left unattended during refuelling;
- **E12:** Designated fuel transfer areas are to be established and used for the transfer of fuel or other potentially contaminating liquids. Drip trays are to be provided;
- **E13:** All persons engaged in site construction works will be made aware of any potential contaminated material. To prevent risks from exposure to any contaminants the appropriate Personal Protective Equipment and Respiratory Protective Equipment will be made available;
- **E14:** A repeat baseline survey to be undertaken once the construction is complete and the temporary construction compounds reinstated to demonstrate the area has been returned to its previous state;
- **E15:** On completion of the works there will be reinstatement of all land in agreement with landowners;
- **E16:** Risk assessments in accordance with the Health and Safety at Work Act to restrict exposure to potentially harmful substances to a safe level for construction workers. Construction Design and Management practices will be applied;
- **E17:** Where, if required, piled foundations are used, they will be designed in accordance with the EA guidance document 'Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention' (Ref 9-53);
- **E18:** Any material imported to site, such as for supporting foundations, will be natural quarried stone or, if recycled, the material will undergo chemical testing. The suite of contaminants and site use criteria will be agreed with regulatory authorities, in order to demonstrate that the material is suitable for use on site and does not pose a risk to construction workers or the environment;
- **E21:** Storage and Handling: Oil/ diesel storage (including fixed tanks, IBCs, mobile bowsers and generators) will be placed be at least 10m from any watercourse and 50 m from any borehole/ well. Spill kits and drip trays will be provided for all equipment with

liquid storage. Drip trays will be checked and emptied daily and will retain at least 10% of the volume being handled. Daily inspections will be undertaken of plant using hydraulic oils. Storage containers will be correctly labelled. Storage areas will be kept secure to prevent acts of vandalism which may result in leaks/ spills. There would be no storage of chemicals within a SPZ 1 or 2, including the default SPZ 1 around the private groundwater abstractions identified in Section 5;

- **E22:** Unless where essential (e.g., for safety at road crossings), vehicle washing will not take place within the SPZ 2. Where vehicle washing does take place, this will be undertaken in designated areas in which the arising effluent can be captured and managed appropriately; and
- **E23:** A Water Management Plan (WMP) will be in place to mitigate potential impacts to identified receptors by ensuring surface water runoff quality and quantity is managed effectively. This includes intercepting surface run-off from the works areas by filters and 'header' drains running along the edge of the temporary haul roads, which will lead to attenuation ponds prior to being discharged to appropriate surface watercourses (subject to agreement from the relevant IDB).

### Groundwater – Dewatering

9.8.6 As per the EA's Approach to Groundwater Protection (Ref 9-34), *'Where a new infrastructure development presents a significant risk to groundwater, the Environment Agency may require a programme of groundwater monitoring to be designed, agreed, installed and undertaken to give early warning of any developing groundwater pollution and/or interference to groundwater flow. This programme may include off-site locations if necessary to identify pollution and to allow monitoring in the event that the site becomes inaccessible. Where appropriate, the Environment Agency will use its powers to require this at existing sites.'* Therefore, the following commitments are included in the Draft CEMP:

- **E3:** A more detailed hydrogeological assessment will be undertaken at FEED stage, where trenchless techniques or dewatering is required in high sensitivity groundwater environments. Where dewatering is required, a dewatering scheme will be developed prior to construction (in consultation with the Environment Agency, appropriate public water abstraction companies and private landowners (where applicable in Section 5)) to demonstrate that there is an effective strategy to manage water arising from the operations and, where required, sufficient proposals to treat the water prior to controlled discharge. Any such assessment will consider the effects of any draw down or impacts on nearby abstractions or resources; and
- **E19:** During ground investigation surveys, ground water levels will be recorded and piezometers installed in boreholes at certain locations to allow groundwater levels to be monitored. This is to record the level changes throughout the year to inform design. From these groundwater profiles will be derived and along with excavation methods and other hydrogeological conditions, the requirements for de-watering will be identified.

### Private Water Supplies

9.8.7 Where available from the relevant local authorities, details of private water supplies have been presented as part of the ES chapter assessment. However, until all information is received, the following commitment is included in the Draft CEMP:

- **E20:** During the detailed design phase of the Proposed Development, investigations will be completed to identify all private water supplies that may be affected by the Proposed Development. Where identified and deemed necessary (particularly where localised SPZ 1 classification may be applicable around an abstraction), questionnaires will be conducted to obtain further information. Following this, a risk assessment will be



conducted to assess whether these water supplies could be affected by construction activities. Selected private water supplies will then be monitored before, during and after construction, with water quality testing completed where required, to protect the affected private water supply.

### **Geology**

- 9.8.8 As shown in **Table 9-18** and **Table 9-19**, all potential impacts were assessed as not significant with respect to geology. Therefore, no additional mitigation is proposed with respect to geology.

### **Groundwater**

- 9.8.9 Ground investigation surveys will be undertaken to inform the design of the Proposed Development. During surveys, groundwater levels will be monitored to allow groundwater profiles to be derived. From this, along with excavation methods and other hydrogeological conditions, the requirements for de-watering will be identified.
- 9.8.10 If required, a detailed dewatering scheme will be developed prior to construction to manage the water arising from dewatering operations and treat the water prior to controlled discharge. This may include the construction of raised lagoons for the storage of water and to allow the settlement of any sediment prior to discharge. Consideration will be given to the potential effects of dewatering on adjacent water features and groundwater abstraction points, both from drawdown during dewatering and subsequent discharge, and mitigation applied, such as use of cessation rings around HDD launch pits etc.
- 9.8.11 In addition, a detailed HyRA will be undertaken where the Proposed Development passes through SPZ 1 and SPZ 2 designations, including SPZ designations around private abstractions where applicable. The HyRA will consider potential effects on the groundwater regime (levels, flow regime and supply to abstractions) as well as potential pollution risk from the construction activities. This will expand upon the preliminary HyRA presented in *Volume IV: Appendix 9.3 (Application Document 6.4.9.3)* and will be informed by the results of the ground investigation and final Contractor design. Mitigation measures will be implemented to reduce the potential risk to acceptable levels.
- 9.8.12 Mitigation measures included within the preliminary HyRA include aquifer protection during drilling using a bentonite seal if it is required to drill into the chalk aquifer as this is good practice. If drilling into the chalk Principal Aquifer is required, the EA would also be consulted to ensure appropriate mitigation measures (e.g., aquifer protection during drilling as described above) are in place prior to the works commencing and to ensure no delays. This will be reviewed and updated based on the ground investigation data within the detailed HyRA.
- 9.8.13 Mitigation measures associated with the potential contamination of groundwater during construction are discussed below.

### **Ground Contamination – Additional mitigation based on Ground Investigation**

- 9.8.14 The majority of the potential effects are associated with an assumed worst case relating to potential soil and groundwater contamination for the Proposed Development, which have been derived by qualitative assessment based on available desk-based baseline data. In order to accurately mitigate the potential contaminants, the actual nature, extent and magnitude of any significant potential contamination will be assessed through ground investigation.
- 9.8.15 In addition to the mitigation by design measures, including those in the Draft CEMP (*ES Volume IV: Appendix 3.1 Table 3, Section E (Application Document 6.4.3.1)*) additional project specific measures may be required where the ground investigation indicates

significant potential for contamination exists. The scope of the additional mitigation measures is dependent on the findings of the ground investigation, but may include:

- **E24:** Ground Gas Risk Assessment: Should ground gas investigations and the GGRA determine that the site is at risk from of a hazardous ground gas regime then there may be a requirement for ground gas protection measures for any manned buildings, such as the Immingham Facility. The requirement for ground gas protection measures will be assessed in line with British Standard 8485:2015+A1:2019 - Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings (Ref 9-47);
- **E17:** Piling Risk Assessment: Where piled foundations are proposed (i.e. the Immingham and Theddlethorpe Facilities and Block Valve Stations), they will be designed in accordance with the EA guidance document 'Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention' (Ref 9-53) which includes preventing piles acting as preferential pathways for vertical migration of contaminants to groundwater;
- **E25:** Generic Quantitative Risk Assessment: A Generic Quantitative Risk Assessment (GQRA) will be undertaken in line with LCRM guidance (Ref 9-29) to identify potential risks to identified human health and groundwater receptors from soil, soil vapour and groundwater contamination. Although the CEMP assumes a GQRA will be undertaken in line with LCRM, this is particularly pertinent at the proposed Immingham and Theddlethorpe Facilities where permanent above-ground, potentially manned buildings will be present. A contamination inspection and discovery strategy will be devised and agreed with the regulatory authorities prior to any remedial works, if required. The determination of the risks through ground investigation and risk assessment, and the potential remediation of areas may result in the reduction of the significance, or even removal, of some of the potential effects identified;
- **E26:** Additional assessment may also be required in relation to handling of potentially contaminated spoil, for example at HDD launch pits. Depending on the findings of such an assessment, this may include additional measures to reduce the potential risk to construction workers and groundwater (e.g., segregation of materials, validation testing and additional personal protective equipment), over and above the standard 'best practice' measures included in the Draft CEMP for the rest of the Proposed Development. If areas of the proposed redevelopment are shown to pose a risk, remedial measures will be implemented. If handling of contaminated soils is required, risk assessments will be in place in accordance with the Health and Safety at Work Act to restrict exposure to potentially harmful substances to a safe level for construction workers;
- **E27:** Where sand and gravel lenses are identified, with lesser thicknesses of Glacial Till, additional mitigation measures may be required for deeper excavation for the HDD crossings to prevent contamination of the underlying chalk Principal Aquifer. Clean drilling will be undertaken if visual or olfactory evidence of contamination is identified, using a bentonite seal to seal off the contamination if this contamination cannot be treated;
- **E28:** Based on local geological features previously identified in the Immingham area and close to the coastline, such as blow wells, there is a possibility that groundwater will be artesian in the chalk. The drilling depth of HDD will be minimised wherever possible to avoid the possibility of entering the chalk Principal aquifer. However, if drilling into the chalk Principal Aquifer is required due to engineering or technical reasons, the EA would be consulted to ensure appropriate mitigation measures (e.g., clean drilling as described above) are in place prior to the works commencing and to ensure no delays. Ground

investigation data, including geological, hydrogeological and contamination data, will be obtained prior to commencement of construction and appropriate measures required as a result of the findings of the ground investigation and associated risk assessments will be incorporated into the final CEMP; and

- **E33:** Where ground instability risks have been identified in sections 1 and 5, (generally mapped Tidal Flat Deposits) and are proven by ground investigation, in-situ ground improvement measures combined with dewatering may be required.

### **Human Health – Site Users**

9.8.16 The Site Users during the construction phase will include construction workers and visitors. The following mitigation may need to be undertaken to ensure the safety of construction workers for the duration of the construction phase, this should be managed in addition to the mitigation by design measures and including those in the Draft CEMP (*ES Volume IV: Appendix 3.1 Table 3, Section E (Application Document 6.4.3.1)*) as detailed below:

- **E25:** Potential impact on human health from contaminated soils - A Generic Quantitative Risk Assessment (GQRA) will be undertaken in line with LCRM guidance to identify potential risks to identified human health and groundwater receptors from soil, soil vapour and groundwater contamination. Although the CEMP assumes a GQRA will be undertaken in line with LCRM, this is particularly pertinent at the Reception Facilities where permanent above-ground, potentially manned buildings will be present. A contamination inspection and discovery strategy will be devised and agreed with the regulatory authorities prior to any remedial works, if required. The determination of the risks through ground investigation and risk assessment, and the potential remediation of areas may result in the reduction of the significance, or even removal, of some of the potential effects identified.

### **Enhancement Measures**

9.8.17 No enhancement measures are required above the additional mitigation detailed above during construction phase.

### **Additional Mitigation and Enhancement – Operational Phase**

9.8.18 The potential impacts and assigned significance associated with the operational phase (as described in Section 9.7) are an assumed worst-case scenario based on the baseline data and assuming no mitigation measures are in place, other than mitigation by design.

9.8.19 Where possible, measures will be put in place during the construction phase through the CEMP which will mitigate against the identified potential operational impacts, largely based on the findings of any ground investigation and risk assessments carried out. Potential impacts during the operational phase for which mitigation may be required would already have been implemented at construction phase.

### **Enhancement Measures**

9.8.20 No enhancement measures are required above the additional mitigation detailed above during operational phase.

### **Additional Mitigation and Enhancement – Decommissioning Phase**

9.8.21 There is no additional mitigation or enhancement proposed with respect to geology and hydrogeology. It is assumed that the pipeline line will remain in-situ and only the above ground infrastructure would be removed. Therefore, additional mitigation will be the same as for construction phase. Refer to construction phase above for more details.



### **Enhancement Measures**

9.8.22 No enhancement measures are required above the additional mitigation detailed above during decommissioning phase.

## **9.9 Residual Effects**

9.9.1 The potentially significant impacts identified in Section 9.7 (**Table 9-18** (construction phase) and **Table 9-19** (operational phase)) have been reviewed in light of the additional mitigation measures detailed in Section 9.8.

9.9.2 Implementation of the additional mitigation measures will reduce the magnitude of the potential effects, for example:

- Development of detailed dewatering schemes, based on ground investigation data, to reduce impact on groundwater levels/flow, manage the water arising from dewatering operations and treat the water prior to controlled discharge;
- Appropriate pile design, in accordance with relevant guidance, to prevent the creation of vertical pathways, both during construction and long-term;
- Clean drilling will be undertaken if visual or olfactory evidence of contamination is identified, using a bentonite seal to seal off the contamination; and
- Additionally, due to the possibility that groundwater will be artesian in the chalk, if drilling into the chalk Principal Aquifer is required, the EA would be consulted to ensure appropriate mitigation measures (e.g., clean drilling as described above) are in place prior to the works commencing and to ensure no delays.

9.9.3 The following sections outline the assessment of residual effects, taking into account the outlined mitigation, for the construction and operational of the Proposed Development.

### **Assessment of Residual Effects: Construction Phase**

9.9.4 The additional mitigation measures during the construction phase, as outlined in Section 9.8, will reduce the magnitude of the potential impacts identified in Section 9.7.11 by:

- Ensuring no significant effect on identified groundwater or surface water receptors (including SPZs and groundwater-fed watercourses) by undertaking detailed dewatering design and hydrogeological risk assessment prior to commencement of construction; and
- Depending on the findings of ground investigations and GQRA, undertaking GGRA, piling risk assessment (PRA) and/ or additional detailed risk assessment to ensure remediation or adequate mitigation measures in relation to ground contamination (if encountered).

9.9.5 An assessment of residual effects for the construction phase of the Proposed Development, after implementation of additional mitigation measures, is presented in **Table 9-20. No significant residual effects have been identified.**

### **Assessment of Residual Effects: Operational Phase**

9.9.6 As described in Section 9.8, many of the potential impacts during the operational phase identified in Section 9.7.18 will be addressed via additional mitigation measures implemented during the construction phase. Depending on the findings of ground investigations and risk assessments prior to construction, this may include:

- Removal of contaminants source or breaking of contaminant linkages (should the GQRA indicate that contaminants in soil, soil vapour and/ or groundwater are present at

concentrations which may present a risk to identified human health or groundwater receptors);

- Installation of ground gas protection measures in manned buildings (should ground gas investigations / GGRA determine that the site is at risk of a hazardous ground gas regime).

9.9.7 An assessment of residual effects for the operational phase of the Proposed Development, after implementation of mitigation measures. Refer to **Table 9-18** for detailed descriptions of each potential impact. **No significant residual effects have been identified.**

### **Assessment of Residual Effects: Decommissioning Phase**

9.9.8 There is no additional mitigation or enhancement proposed with respect to geology and hydrogeology. It is assumed that the pipeline line will remain in-situ and only the above ground infrastructure will be removed. Therefore, the assessment of residual effects will be the same as for construction phase. Refer to **Table 9-20**.

**Table 9-20: Summary of Construction Phase Residual Effects**

Potential Impact	Receptor	Sensitivity	Assessment of Potential Effects		Mitigation Measure(s)	Assessment of Residual Effects	
			Magnitude	Significance		Magnitude	Significance
<b>Chemical spillages and leaks from plant and machinery, and from chemicals and other contaminants stored on site causing pollution of ground or groundwater.</b>	Human Health: Construction Workers/Site Users	Low	Low	Negligible (Not Significant)	Mitigation measures are included in the Draft CEMP, including training, pollution prevention measures, responsible storage and handling and spill response measures etc., which would reduce the likelihood of, and the likely magnitude of the effect of, any spill/leak.	Very Low	<b>Negligible (Not Significant)</b>
	Geology: Superficial deposits and Bedrock	Low	Low	Negligible (Not Significant)	Mitigation measures are included in the Draft CEMP, including training, pollution prevention measures, responsible storage and handling and spill response measures etc., which would reduce the likelihood of, and the likely magnitude of the effect of, any spill/leak.	Very Low	<b>Negligible (Not Significant)</b>
	Hydrogeology: Aquifers (Principal, Secondary A & B Aquifers), Source Protection Zones (SPZ 1 and 2) and Regulated and unregulated abstractions	High	Low	Moderate (Significant)	Mitigation measures are included in the Draft CEMP, including training, pollution prevention measures, responsible storage and handling and spill response measures etc., which would reduce the likelihood of, and the likely magnitude of the effect of, any spill/leak.  A preliminary hydrogeological risk assessment (HyRA) has been undertaken where the Proposed Development passes through SPZ 1 and SPZ 2 designations, including assessment of potential pollution risk from the construction activities. Based on the HyRA specific mitigation measures will be implemented to reduce the potential risk to acceptable levels. These have been outlined within <i>ES Volume IV: Appendix 9.3 (Application Document Ref. 6.4.9.3)</i> and include consulting the EA for appropriate mitigation measures for if it is required to drill into the chalk Principal Aquifer, this would occur prior to works commencing.	Very Low	<b>Minor Adverse (Not Significant)</b>
	Hydrogeology: Aquifers (Undifferentiated and Unproductive), Source Protection Zone 3	Medium	Low	Minor (Not Significant)	Mitigation measures are included in the Draft CEMP, including training, pollution prevention measures, responsible storage and handling and spill response measures etc., which would reduce the likelihood of, and the likely magnitude of the effect of, any spill/leak.	Very Low	<b>Negligible (Not Significant)</b>
<b>Changes in subsoil structure and reduction of subsoil quality due to compaction or erosion during storage.</b>	Geology: Superficial deposits	Low	Low	Negligible (Not Significant)	Mitigation measures are included in the Draft CEMP, including only handling soil in suitable conditions, maximum height of temporary storage bunds / stockpiles and use of appropriate machinery etc., which would reduce the likely magnitude of the effect. In addition, soil will be handled in accordance with a detailed Soil Management Plan.	Low	<b>Negligible (Not Significant)</b>
<b>Compaction of subsoil due to construction vehicle movements degrading soil quality and causing potential water logging.</b>	Geology: Superficial deposits	Low	Low	Negligible (Not Significant)	Mitigation measures are included in the Draft CEMP, including use of protective mats for temporary haul roads etc., which would reduce the likely magnitude of the effect. In addition, soil will be handled in accordance with a detailed Soil Management Plan.	Low	<b>Negligible (Not Significant)</b>
	Hydrogeology: Aquifers (Principal, Secondary A & B Aquifers), Source Protection Zones (SPZ 1 and 2) and	High	Low	Moderate (Significant)	Mitigation measures are included in the Draft CEMP, including use of protective mats for temporary haul roads etc., which would reduce the likely magnitude of the effect.	Very Low	<b>Minor Adverse (Not Significant)</b>



Potential Impact	Receptor	Sensitivity	Assessment of Potential Effects		Mitigation Measure(s)	Assessment of Residual Effects	
			Magnitude	Significance		Magnitude	Significance
	Regulated and unregulated abstractions						
	Hydrogeology: Aquifers (Undifferentiated and Unproductive), Source Protection Zone 3	Medium	Low	Minor (Not Significant)	Mitigation measures are included in the Draft CEMP, including use of protective mats for temporary haul roads etc., which would reduce the likely magnitude of the effect.	Very Low	<b>Negligible (Not Significant)</b>
<b>Changes in subsoil/rock structure that could affect ground stability (collapsible deposits, compressible deposits, ground dissolution, landslides, running sands and shrink well clays)</b>	Geology: Superficial deposits and Bedrock	Medium	Medium	Moderate (Significant)	<p>Mitigation measures are included in the Draft CEMP, including the use of appropriate track matting/materials for access roads, which would reduce the likely magnitude of the effect.</p> <p>Detailed ground investigations including geotechnical testing would be completed prior to development commencing and appropriate remediation designed and implemented as required. This can be secured by planning condition.</p>	Very Low	<b>Negligible (Not Significant)</b>
<b>Requirement for dewatering, which may reduce flow to groundwater supported sites, abstractions (regulated and non-regulated) and surface water bodies and change soil hydrology locally.</b>	Hydrogeology: Aquifers (Principal, Secondary A & B Aquifers), Source Protection Zones (SPZ 1 and 2) and Regulated and unregulated abstractions	High	Low	Moderate (Significant)	<p>Mitigation measures are included in the Draft CEMP, including monitoring of groundwater levels to assess groundwater profiles to inform dewatering requirements.</p> <p>Where required, a detailed dewatering scheme will be developed prior to construction to manage the water arising from dewatering operations and treat the water prior to controlled discharge. Consideration will be given to the potential effects of dewatering on adjacent water features and groundwater abstraction points, both from drawdown during dewatering and subsequent discharge, and mitigation applied, such as use of cessation rings around HDD launch pits, etc.</p> <p>In addition, a HyRA will be undertaken where the Proposed Development passes through SPZ 1 and SPZ 2 designations, including assessment of potential pollution risk from the construction activities.</p> <p>Also, based on local geological features previously identified in the Immingham area and close to the coastline, such as blow wells, there is a possibility that groundwater will be artesian in the chalk. Additional mitigation measures have been included in Preliminary HyRA ES Volume IV: Appendix 9.3 (<i>Application Document 6.4.9.3</i>) and Draft CEMP (<i>ES Volume IV: Appendix 3.1 (Application Document Ref. 6.4.3.1)</i>). These include consulting the EA for appropriate mitigation measures for if it is required to drill into the chalk Principal Aquifer, this would occur prior to works commencing.</p>	Very Low	<b>Minor Adverse (Not Significant)</b>

Potential Impact	Receptor	Sensitivity	Assessment of Potential Effects		Mitigation Measure(s)	Assessment of Residual Effects	
			Magnitude	Significance		Magnitude	Significance
	Hydrogeology: Aquifers (Undifferentiated and Unproductive), Source Protection Zone 3	Medium	Low	Minor (Not Significant)	Mitigation measures are included in the Draft CEMP, including monitoring of groundwater levels to assess groundwater profiles to inform dewatering requirements.	Very Low	<b>Negligible (Not Significant)</b>
<b>Requirement for dewatering, reducing quality or levels of groundwater supporting sites protected under European and UK habitat legislation, such as a RAMSAR Site or a SSSI.</b>	Hydrogeology: Aquifers (Principal, Secondary A & B Aquifers), Source Protection Zones (SPZ 1 and 2) and Regulated and unregulated abstractions	High	Low	Moderate (Significant)	<p>Mitigation measures are included in the Draft CEMP, including monitoring of groundwater levels to assess groundwater profiles to inform dewatering requirements.</p> <p>Where required, a detailed dewatering scheme will be developed prior to construction to manage the water arising from dewatering operations and treat the water prior to controlled discharge. Consideration will be given to the potential effects of dewatering on adjacent water features and groundwater abstraction points, both from drawdown during dewatering and subsequent discharge, and mitigation applied, such as use of cessation rings around HDD launch pits etc.</p> <p>In addition, a HyRA will be undertaken where the Proposed Development passes through SPZ 1 and SPZ 2 designations, including assessment of potential pollution risk from the construction activities. Mitigation measures will be implemented to reduce the potential risk to acceptable levels.</p> <p>Also, based on local geological features previously identified in the Immingham area and close to the coastline, such as blow wells, there is a possibility that groundwater will be artesian in the chalk. Additional mitigation measures have been included in Preliminary HyRA ES Volume IV: Appendix 9.3 and Draft CEMP (<i>ES Volume IV: Appendix 3.1 (Application Document Ref. 6.4.3.1)</i>). These have been outlined within <i>ES Volume IV: Appendix 9.3 (Application Document 6.4.9.3)</i> and include consulting the EA for appropriate mitigation measures for if it is required to drill into the chalk Principal Aquifer, this would occur prior to works commencing.</p>	Very Low	<b>Minor Adverse (Not Significant)</b>
	Hydrogeology: Aquifers (Undifferentiated and Unproductive), Source Protection Zone 3	Medium	Low	Minor (Not Significant)	Mitigation measures are included in the Draft CEMP, including monitoring of groundwater levels to assess groundwater profiles to inform dewatering requirements.	Very Low	<b>Negligible (Not Significant)</b>
<b>Disturbance of potentially contaminated soils, sediments and waters posing a risk to construction workers,</b>	Human Health: Construction Workers/Site Users	Low	Medium	Minor (Not Significant)	<p>Mitigation measures are included in the Draft CEMP, including investigation and risk assessment in line with LCRM guidance (Ref 9-29), employing CDM practices, undertaking risk assessments, dust suppression and design in accordance with relevant guidance etc., which would reduce the likely magnitude of the effect of any disturbance of contaminated soils, sediments or waters.</p> <p>The outcome of the ground investigation and risk assessment will be used to inform whether additional measures could be required to reduce the potential risk to construction workers (e.g., segregation of materials, validation testing and additional personal protective equipment), over and</p>	Low	<b>Negligible (Not Significant)</b>

Potential Impact	Receptor	Sensitivity	Assessment of Potential Effects		Mitigation Measure(s)	Assessment of Residual Effects	
			Magnitude	Significance		Magnitude	Significance
<b>groundwater, and geology.</b>					above the standard 'best practice' measures included in the Draft CEMP for the rest of the Proposed Development.		
	Geology: Superficial deposits and Bedrock	Low	Medium	Minor (Not Significant)	Mitigation measures are included in the Draft CEMP, including employing CDM practices, undertaking risk assessments design in accordance with relevant guidance etc., which would reduce the likely magnitude of the effect of any disturbance of contaminated soils, sediments or waters.	Very Low	<b>Negligible (Not Significant)</b>
	Hydrogeology: Aquifers (Principal, Secondary A & B Aquifers), Source Protection Zones (SPZ 1 and 2) and Regulated and unregulated abstractions	High	Medium	Major (Significant)	Mitigation measures are included in the Draft CEMP, including employing CDM practices, undertaking risk assessments and design in accordance with relevant guidance etc., which would reduce the likely magnitude of the effect of any disturbance of contaminated soils, sediments or waters. Depending on the outcome of the ground investigation and preliminary risk assessment, additional assessment may be required in relation to handling of potentially significant volumes of potentially contaminated spoil. Depending on the findings of such an assessment, this may also entail the preparation of an Inspection and Discovery Strategy including additional measures to reduce the potential risk to groundwater (e.g., segregation of materials, validation testing), over and above the standard 'best practice' measures included in the CEMP for the rest of the Proposed Development. If areas of the proposed redevelopment are shown to pose a risk, any remedial measures required will be implemented. The contractor will be required to produce a Materials Management Plan before the commencement of works as part of the CEMP submitted for approval to the local planning authority under the DCO.	Very Low	<b>Minor Adverse (Not Significant)</b>
	Hydrogeology: Aquifers (Undifferentiated and Unproductive), Source Protection Zone 3	Medium	Medium	Moderate Adverse (Significant))	Mitigation measures are included in the Draft CEMP, including employing CDM practices, undertaking risk assessments and design in accordance with relevant guidance etc., which would reduce the likely magnitude of the effect of any disturbance of contaminated soils, sediments or waters.	Very Low	<b>Negligible (Not Significant)</b>
<b>Importation of contaminated aggregates posing a potential risk to human health and underlying geology and groundwater.</b>	Human Health: Construction Workers/Site Users	Low	Medium	Minor (Not Significant)	Mitigation measures are included in the Draft CEMP, including chemical testing to confirm suitability of imported material, which would reduce the likely magnitude of the effect.	Low	<b>Negligible (Not Significant)</b>
	Geology: Superficial deposits and Bedrock	Low	Medium	Minor (Not Significant)		Very Low	<b>Negligible (Not Significant)</b>
	Hydrogeology: Aquifers (Principal, Secondary A & B Aquifers), Source Protection Zones (SPZ 1 and 2) and Regulated and unregulated abstractions	High	Medium	Major (Significant)		Very Low	<b>Minor Adverse (Not Significant)</b>
	Hydrogeology: Aquifers (Undifferentiated and	Medium	Medium	Moderate (Significant)		Very Low	<b>Negligible (Not Significant)</b>



Potential Impact	Receptor	Sensitivity	Assessment of Potential Effects		Mitigation Measure(s)	Assessment of Residual Effects	
			Magnitude	Significance		Magnitude	Significance
	Unproductive), Source Protection Zone 3						
<b>Trenchless techniques whereby excavations/ drilling creates a pathway for drilling fluids or other fluids used during construction to reach sensitive groundwater receptors (e.g., Principal Aquifers or abstractions (regulated and non-regulated)) or sensitive surface water receptors, or unique groundwater features such as blow wells, chalk streams and springs.</b>	Geology: Superficial deposits and Bedrock	Low	Medium	Minor (Not Significant)	Mitigation measures are included in the Draft CEMP, including employing CDM practices, undertaking risk assessments and design in accordance with relevant guidance etc., which would reduce the likely magnitude of the effect of any disturbance of contaminated soils, sediments or waters.	Very Low	<b>Negligible (Not Significant)</b>
	Hydrogeology: Aquifers (Principal, Secondary A & B Aquifers), Source Protection Zones (SPZ 1 and 2) and Regulated and unregulated abstractions	High	Medium	Major (Significant)	Mitigation measures are included in the Draft CEMP, including monitoring of groundwater levels to assess groundwater profiles to inform dewatering requirements.  In addition, a HyRA will be undertaken where the Proposed Development passes through SPZ 1 and SPZ 2 designations, including assessment of potential pollution risk from the construction activities. Mitigation measures will be implemented to reduce the potential risk to acceptable levels. Where sand and gravel lenses are identified, with lesser thicknesses of Glacial Till, additional mitigation measures may be required for deeper excavation for the HDD crossing, to prevent contamination of the underlying chalk Principal Aquifer. Clean drilling will be undertaken if visual or olfactory evidence of contamination is identified, using a bentonite seal to seal off the contamination. Also, based on local geological features previously identified in the Immingham area and close to the coastline, such as blow wells, there is a possibility that groundwater will be artesian in the chalk. If drilling into the chalk Principal Aquifer is required, the EA would be consulted to ensure appropriate mitigation measures (e.g., clean drilling as described above) are in place prior to the works commencing and to ensure no delays	Very Low	<b>Minor Adverse (Not Significant)</b>
	Hydrogeology: Aquifers (Undifferentiated and Unproductive), Source Protection Zone 3	Medium	Medium	Moderate (Significant)	Mitigation measures are included in the Draft CEMP, including monitoring of groundwater levels to assess groundwater profiles to inform dewatering requirements.	Very Low	<b>Negligible (Not Significant)</b>
<b>Requirement to remove spoil from excess potentially contaminated soils from pipeline route posing a potential risk to human health and the environment.</b>	Human Health: Construction Workers/Site Users	Low	Medium	Minor (Not Significant)	Mitigation measures are included in the Draft CEMP, including investigation and risk assessment in line with LCRM guidance (Ref 9-29), employment of CDM practices, risk assessments and dust suppression measures, which would reduce the likely magnitude of the effect of handling of potentially contaminated spoil.  Depending on the findings of ground investigation and preliminary risk assessment, additional assessment may also be required in relation to handling of potentially significant volumes of potentially contaminated spoil. Depending on the findings of such an assessment, this may also entail the preparation of Materials Management Plan, including additional measures to reduce the potential risk to construction workers (e.g., segregation of materials, validation testing and additional personal protective equipment), over and above the standard 'best practice' measures included in the Draft	Low	<b>Negligible (Not Significant)</b>

Potential Impact	Receptor	Sensitivity	Assessment of Potential Effects		Mitigation Measure(s)	Assessment of Residual Effects	
			Magnitude	Significance		Magnitude	Significance
					CEMP for the rest of the Proposed Development. If handling of contaminated soils is required, risk assessments will be in place in accordance with the Health and Safety at Work Act to restrict exposure to potentially harmful substances.		
	Geology: Superficial deposits and Bedrock	Low	Medium	Minor Negligible (Not Significant)	Mitigation measures are included in the Draft CEMP, including employment of CDM practices, risk assessments and dust suppression measures, which would reduce the likely magnitude of the effects from potentially contaminated spoil.	Very Low	<b>Negligible (Not Significant)</b>
	Hydrogeology: Aquifers (Principal, Secondary A & B Aquifers), Source Protection Zones (SPZ 1 and 2) and Regulated and unregulated abstractions	High	Medium	Major (Significant)	Mitigation measures are included in the Draft CEMP, including investigation and risk assessment in line with LCRM guidance (Ref 9-29), employment of CDM practices, risk assessments and dust suppression measures, which would reduce the likely magnitude of the effect on groundwater by handling of potentially contaminated spoil. Depending on the outcome of the ground investigation and preliminary risk assessment, additional assessment may also be required in relation to handling of potentially significant volumes of potentially contaminated spoil. Depending on the findings of such an assessment, this may also entail the preparation of Materials Management Plan, including additional measures to reduce the potential risk to groundwater (e.g., segregation of materials, validation testing), over and above the standard 'best practice' measures included in the Draft CEMP for the rest of the Proposed Development. If areas of the proposed redevelopment are shown to pose a risk, any remedial measures required will be implemented.	Very Low	<b>Minor Adverse (Not Significant)</b>
	Hydrogeology: Aquifers (Undifferentiated and Unproductive), Source Protection Zone 3	Medium	Medium	Moderate (Significant)	Mitigation measures are included in the Draft CEMP, including investigation and risk assessment in line with LCRM guidance (Ref 9-29), employment of CDM practices, risk assessments and dust suppression measures, which would reduce the likely magnitude of the effect on groundwater by handling of potentially contaminated spoil.	Very Low	<b>Negligible (Not Significant)</b>

9.9.9 Refer to **Table 9-18** for detailed descriptions of each potential impact.

**Table 9-21: Summary of Operational Phase Residual Effects**

Potential Impact	Receptor	Sensitivity	Assessment of Effect Significance		Mitigation Measure(s)	Assessment of Residual Effects	
			Magnitude	Significance		Magnitude	Significance
<b>The foundations of structures and pipelines may provide a preferential pathway for contaminants to migrate to non-contaminated geology, and groundwater.</b>	Geology: Superficial deposits and Bedrock	Low	Very Low	Negligible (Not Significant)	Mitigation measures are included in the Draft CEMP, including adherence to specific guidance for piling on land affected by contamination, which would reduce the likely magnitude of the effect. Depending on the findings of ground investigations and risk assessment prior to construction, additional assessment may be required, such as a PRA and design of piles in accordance with EA guidance document 'Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention' (Ref 9-29) to prevent piles acting as preferential pathways for vertical migration of contaminants (should the ground investigation indicate that piling is required for either the reception facilities or block valve stations). Additionally, Clean drilling will be undertaken if visual or olfactory evidence of contamination is identified, using a bentonite seal to seal off the contamination.	Very Low	<b>Negligible (Not Significant)</b>
	Hydrogeology: Aquifers (Principal, Secondary A & B Aquifers), Source Protection Zones (SPZ 1 and 2) and Regulated and unregulated abstractions	High	Low	Moderate (Significant)	Mitigation measures are included in the Draft CEMP, including adherence to specific guidance for piling on land affected by contamination, which would reduce the likely magnitude of the effect. Depending on the findings of ground investigations and risk assessment prior to construction, additional assessment may be required, such as a PRA and design of piles in accordance with EA guidance document 'Piling and Penetrative Ground Improvement Methods on Land Affected by Contamination: Guidance on Pollution Prevention' (Ref 9-29) to prevent piles acting as preferential pathways for vertical migration of contaminants (should the ground investigation indicate that piling is required for either the reception facilities or block valve stations).	Very Low	<b>Minor Adverse (Not Significant)</b>
	Hydrogeology: Aquifers (Undifferentiated and Unproductive), Source Protection Zone 3	Medium	Low	Minor (Not Significant)	Mitigation measures are included in the Draft CEMP, including adherence to specific guidance for piling on land affected by contamination, which would reduce the likely magnitude of the effect.	Very Low	<b>Negligible (Not Significant)</b>
<b>The potential for aggressive ground contaminants posing a risk to the pipeline.</b>	Development Infrastructure: AGIs and Pipelines	Medium	Low	Minor (Not Significant)	Mitigation measures are included in the Draft CEMP, including suitable chemical testing of any imported material, which would reduce the likely magnitude of the effect.	Low	<b>Minor Adverse (Not Significant)</b>

9.9.10 Refer to **Table 9-19** for detailed descriptions of each potential impact.



## 9.10 Cumulative Effects

- 9.10.1 This section reports the findings of an assessment of potential intra-project and inter-project cumulative effects associated with the Proposed Development with a focus on how these effects may impact upon geology and hydrogeology.
- 9.10.2 Intra-project cumulative effects from the Proposed Development may arise where several different types of effect resulting from the Proposed Development have the potential to affect a single receptor. Intra-project effects are taken into consideration during the construction phase and operational phase.
- 9.10.3 Inter-project cumulative effects have the potential to arise where two or more developments are proposed within close enough proximity that lead to effects on the same receptor.
- 9.10.4 The methodology for this assessment can be found in *Chapter 20: Cumulative Effects*. The Zone of Influence adopted for assessment of the effects to geology and hydrogeology is 250m from the DCO Site Boundary on the basis that interaction between the Proposed Development and receptors or sources of contamination beyond 250m generally would not occur as a result of the ground conditions present in and around the Proposed Development. A viable pathway between source and receptor is less likely to be present over greater distances. However, it is noted that effects on high sensitivity groundwater environments (i.e., mapped SPZ 1 and 2 areas within the chalk bedrock) may extend beyond 250m.

### Assessment of Intra-Project Effects

#### Assessment of effects related to the Proposed Development

- 9.10.5 There is the potential for Intra-Project effects relating to *Chapter 11: Water Environment*. There are local geological features within the area that are in connectivity with surface water features, such as chalk streams and blow wells. The route of the Proposed Development was amended and moved east to avoid an identified chalk stream, Wellbeck Spring to reduce potential intra-project effects. Additionally, based on publicly available mapping at the time of writing, no known blow wells fall within the DCO Site Boundary (Ref 9-55). Intra-project effects are not thought to be significant as effects on hydrogeological and hydrological receptors will be mitigated via measures outlined in the CEMP.
- 9.10.6 At present, no potential Intra-Project effects relating to *Chapter 10: Agriculture and Soils*, *Chapter 18: Materials and Waste* and *Chapter 19: Major Accidents and Disasters* have been identified.

#### Assessment of effects related to the wider Viking CCS Project

- 9.10.7 As outlined in *Chapter 1: Introduction*, the Proposed Development forms one element of the wider Viking CCS Project, along with the offshore repurposing and extension of the LOGGS pipeline and construction of a new not permanently attended installation (NPAI). Due to distances of separation between each element of the wider Project, intra-project cumulative effects to individual receptors will not occur, for example no property or ecological site would experience effects from both onshore pipeline and offshore developments.

### Assessment of Inter-Project Effects

- 9.10.1 Overall cumulative effects for the Proposed Development are considered within *Chapter 20: Cumulative Effects Assessment*. Several proposed/committed developments included on the shortlist extend within 250m of the DCO Site Boundary (particularly around Immingham in Section 1 of the Draft Order Limits), comprising the following:
- Grimsby Solar Farm;
  - CHI Investments – The Willows;

- ABP – Land Adjacent to the West Entrance, Port of Immingham;
- VPI Immingham – VPI Immingham Pilot Carbon Capture Plant;
- Orsted Gigastack Limited and Phillips 66 Limited – Gigastack Project;
- Humber Zero Project – Phillips-66 Carbon Capture Plant;
- Humber Zero Project – VPI Immingham LLP Carbon Capture Plant;
- ABP – Immingham Onshore Wind;
- VEV Services Limited – Vitol (VPI Immingham);
- New gas-fired power station; and
- The Wider Viking CCS Project (offshore elements).

9.10.2 The developments are likely to require excavation, which could have a potential impact on geology and hydrogeology. However, no significant inter-project cumulative effects have been identified in terms of the Proposed Development and other proposed/committed developments within its immediate area.

9.10.3 Effects from the Proposed Development would be limited to within the confines of the working width, and off-site developments are not considered likely to lead to effects on geology, groundwater quality or human health within the Proposed Development, as any such development would be constructed and operated in accordance with relevant legislation and current good practice. There is some limited potential for groundwater to be affected by off-site activities through dewatering during construction creating short term reduction of groundwater levels, which could combine with similar effects from the Proposed Development. However, due to the short-term minor effects identified for the Proposed Development and the nature of the off-site developments, it is considered unlikely that effects on shared receptors would be significant. At detailed design stage, the likelihood of the construction phase of the Proposed Development and the identified off-site developments occurring at the same time will need to be considered as part of the hydrogeological assessment where dewatering is required in high sensitivity groundwater environments, to assess the cumulative effects of dewatering. This should be in consultation with the Environment Agency, appropriate public water abstraction companies and private landowners (where applicable as indicated Section 5).

## 9.11 Summary of Assessment

9.11.1 This chapter has assessed the potential effects of the Proposed Development on the geology and hydrogeology within the study area. The potential for effects of ground and groundwater contamination materials on human health has also been considered.

9.11.2 The assessment has shown that the geology underlying the Proposed Development comprises predominantly Glacial Till between Section 1 and Section 4 and Tidal Flat Deposits in Section 5, with localised pockets of Alluvium, Beach Deposits, Lacustrine Deposits, Glaciofluvial Deposits, Glaciofluvial Sheet Deposits. Storm Beach Deposits and Blown Sand. Bedrock underlying the superficial deposits consists of predominantly Burnham Chalk Formation for Sections 1 and 5, Welton Chalk Formation for Sections 2, 3 and 5, with a small section of Ferriby Chalk Formation in the centre of Section 3. Although not mapped, areas of Made Ground are likely to be present associated with developed land, including in the vicinity of Immingham Docks and the former Theddlethorpe Gas Terminal and various current and historical railways.

9.11.3 In relation to hydrogeology, the superficial deposits are classified as Unproductive Strata or Secondary Aquifers. The chalk is classified as a Principal Aquifer. Groundwater vulnerability

is generally classified as medium to high. The route intersects several Source Protection Zones (SPZ) which include a SPZ 2 North of Immingham, a SPZ 1 surrounding Little London and another SPZ 2 situated around Roxton and between Keelby and Aylesby, between Barnoldby le Beck and Brigsley and between Grainsby and Ludborough.

- 9.11.4 Sites of potentially contaminative current and/or historical land uses have been identified within the study area including railways and nearby industrial development associated with Immingham Docks and the former Theddlethorpe Gas Terminal. However, the majority of land within the planning application boundary is used for agriculture which is likely to have low potential for contamination.
- 9.11.5 The identified potential impacts which may occur during the construction phase are primarily associated with spillages and leaks of fuel/oil associated with plant/machinery, disturbance of contaminated soils and potential degradation of soil quality during handling and movement of soil or tracking of heavy plant, as well as the potential for dewatering to locally affect groundwater levels. In addition, there may be the potential for creation of pathways between shallow soils, drilling fluids and/or contaminated groundwater (if present) and deeper (uncontaminated) strata and groundwater, depending on the construction techniques employed. However, all of these effects can be controlled through good practice and standard mitigation measures outlined in the Draft CEMP (*ES Volume IV: Appendix 3.1 (Application Document 6.4.3.1)*) and the residual effects are considered to be **Negligible to Minor Adverse (Not significant)**.
- 9.11.6 During the operational phase, identified potential impacts are limited to effects resulting from potential land contamination on site users and groundwater receptors. Mitigation of the potential impacts will be put in place at construction phase which would also aid in the reduction of operational effects. Required mitigation will be confirmed by means of risk assessments based on ground investigation data (when available) and may include removal of contaminant sources and installation of gas protection measures on the buildings (i.e., the reception facilities). As such, the significance of residual effects has been assessed as being **Negligible to Minor Adverse (Not Significant)**.
- 9.11.7 Overall, the mitigation required to address the potential impacts is standard practice. As a result, the assessment of effects of the Proposed Development in relation to geology and hydrogeology is predicted to be of **Negligible (Not Significant)** significance with respect to geology, human health and infrastructure, and **Minor Adverse (Not Significant)** significance with respect to groundwater.



## 9.12 References

**Ref 9-1** European Parliament and of the Council (2000) The Water Framework Directive (2000/60/EC). Available at <https://www.legislation.gov.uk/eudr/2000/60/contents> (Accessed: May 2023).

**Ref 9-2** European Parliament and of the Council (2006) The Groundwater Directive (2006/118/EC). Available at: <https://www.legislation.gov.uk/eudr/2006/118> (Accessed: May 2023).

**Ref 9-3** European Parliament and of the Council (2008) Classification Labelling & Packaging of Substances and Mixtures (CLP) Regulation (2008/1272/EC). Available at: <https://www.legislation.gov.uk/eur/2008/1272/contents> (Accessed: 9 March 2023).

**Ref 9-4** European Parliament and of the Council (2016) The Dangerous Substances Directive (67/548/EEC). Available at: <https://www.legislation.gov.uk/eudr/1967/548/adopted> (Accessed: May 2023).

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**Ref 9-6** Parliament of the United Kingdom (1990) Environmental Protection Act. Available at: <https://www.legislation.gov.uk/ukpga/1990/43/contents> (Accessed: May 2023).

**Ref 9-7** Parliament of the United Kingdom (1995) The Environment Act

**Ref 9-8** The Contaminated Land (England) Regulations (2006) SI 1380. Available at: <https://www.legislation.gov.uk/uksi/2006/1380/contents/made> (Accessed: May 2023).

**Ref 9-9** Groundwater (England and Wales) Regulations (2009) SI 2902. Available at: The Groundwater (England and Wales) Regulations 2009 (legislation.gov.uk) (Accessed: May 2023).

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**Ref 9-11** The Water Act (2003). Available at: <https://www.legislation.gov.uk/ukpga/2003/37/contents> (Accessed: May 2023).

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**Ref 9-13** The Land Drainage Act (1991) (as amended). Available at: <https://www.legislation.gov.uk/ukpga/1991/59/contents> (Accessed: May 2023).

**Ref 9-14** The Environmental Permitting (England and Wales) Regulations (2016) SI 1154. Available at: <https://www.legislation.gov.uk/uksi/2016/1154/contents/made> (Accessed: May 2023).

**Ref 9-15** The Water Environment (Water Framework Directive) Regulations (2017) SI 407. Available at: <https://www.legislation.gov.uk/uksi/2017/407/contents/made> (Accessed: May 2023).

**Ref 9-16** Department for Environment, Food and Rural Affairs (2018) Water Resources (Control of Pollution) (Silage, Slurry and Agricultural Fuel Oil) (England) Regulations 2010

(as amended). Available at: <https://www.legislation.gov.uk/ukxi/2010/639/contents/made> (Accessed: May 2023).

**Ref 9-17** Ministry of Housing Communities and Local Government (2023) National Planning Policy Framework. Available at: [National Planning Policy Framework \(publishing.service.gov.uk\)](https://publishing.service.gov.uk) (Accessed: 12/09/2023).

**Ref 9-18** Department of Energy and Climate Change (2011) Overarching National Policy Statement for Energy (EN-1). Available at: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/47854/1938-overarching-nps-for-energy-en1.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/47854/1938-overarching-nps-for-energy-en1.pdf) (Accessed: May 2023).

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