

Humber Carbon Capture Pipeline

Preliminary Environmental Information Report – Volume 4 – Appendices (Part 1)

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Appendix 3.1 – Further Information Regarding the Humber Low Carbon Pipelines Project

Introduction

This Appendix provides further detail to the information provided in Volume 2 - Chapter 3 – Consideration of Alternatives regarding the separate, and since withdrawn, Humber Low Carbon Pipelines previously proposed by National Grid Ventures (NGV).

Design development to HLCP's non-statutory consultation

Stage 1 – Initial Constraints Analysis

An initial 'Environmental Constraints Study' (Ref 3.1.1) was undertaken and published in December 2019 by NGV.

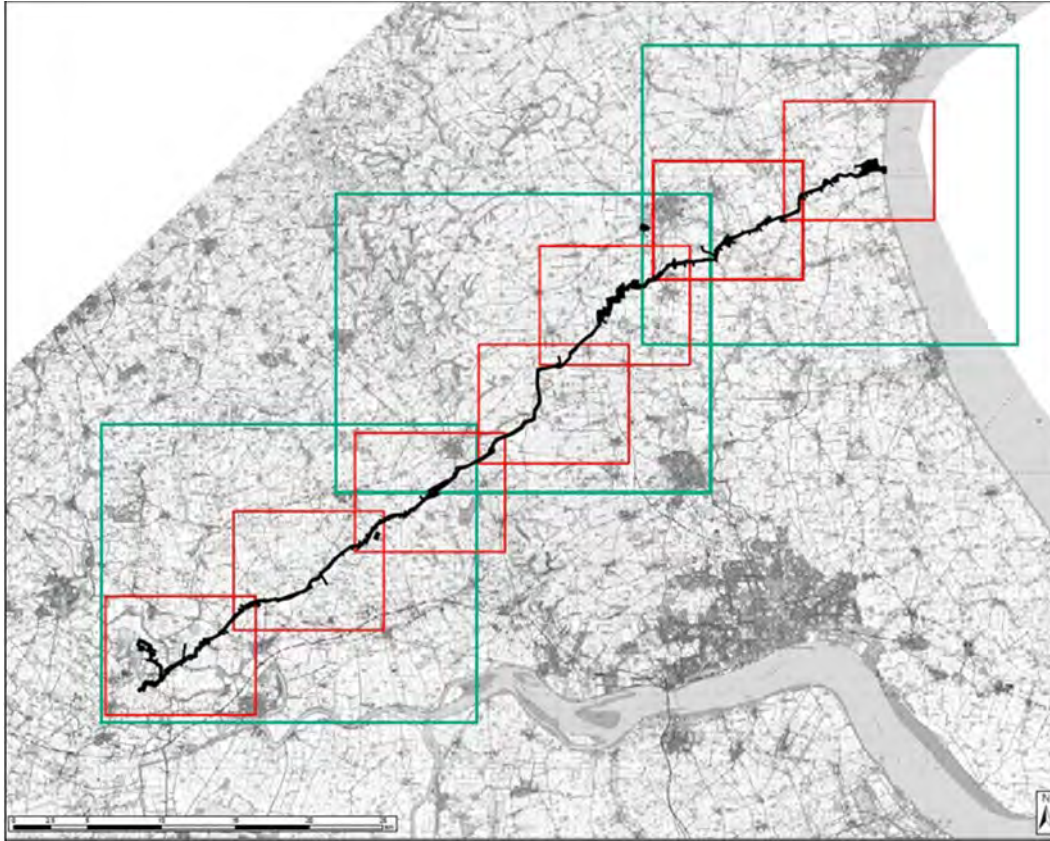
The aim of the study was to provide baseline environmental information for NGV to be considered in subsequent pipeline routing studies. The study collected publicly available datasets for environmental features within the following broad categories:

- Water resources – such as flood zones and main rivers.
- Geology, Hydrogeology and Ground Conditions – such as landfill sites, Source Protection Zones and Local Geological Sites.
- Land Use and Agriculture – such as agricultural land classification, planning applications and relevant local plan allocations.
- Ecology and Nature Conservation – such as local, national and international designated sites for nature conservation and ancient woodland.
- Archaeology and Cultural Heritage – such as Scheduled Monuments and Listed Buildings.
- Landscape and Visual – such as landscape character areas and Areas of Outstanding Natural Beauty.
- Socio economics and Tourism – such as Public Rights of Way and National Cycle Network.

The study was desk based and considered two broad Study Areas:

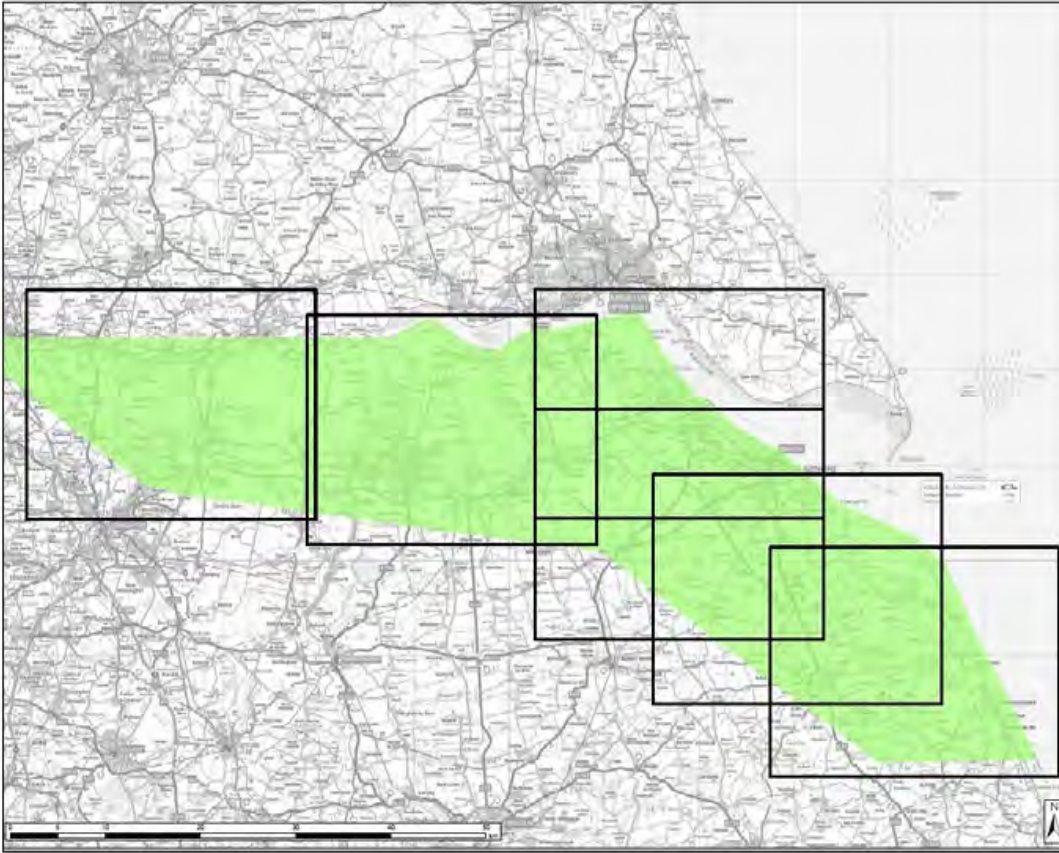
- Study Area 1 - a route initially identified for the Yorkshire and Humber Carbon Capture and Storage (YHCCS) Cross Country Pipeline, which was subject to a previous Development Consent Order (DCO) application submitted in June 2014. This DCO application was subsequently refused in 2017 following withdrawal of Government

funding. Study Area 1 was studied principally to identify any changes to the constraints that were considered as part of the previous application.



Insert A3-1-1 – Extract from the December 2019 NGV Environmental Constraints Study showing Study Area 1

- Study Area 2 - this area covered an area to the south of the River Humber and extended down the coast to just south of Theddlethorpe. Study Area 2 included the settlements of Scunthorpe, Barton-upon Humber, Grimsby, Cleethorpes, Louth, and Market Rasen. This Study Area did not relate to a previous application and was therefore substantially larger than Study Area 1.



Insert A3-1-2 – Extract from the December 2019 NGV Environmental Constraints Study showing Study Area 2

A summary of the findings of the Environmental Constraints Study are as follows:

- Study Area 1 – The study found that the majority of information on environmental constraints that were reported within YHCCS application remained applicable, with little or no changes. However, the report found that there were some significant changes to Source Protection Zones, changes to statutory designated sites of nature conservation (including the introduction of the Greater Wash Special Protection Area (SPA) and the Flamborough Head and Bempton Cliffs SPA) and several non-statutory designated sites and several notable planning applications which would change land use.
- Study Area 2 – identified a wide range of constraints. In brief, the study found:
 - All grades of agricultural land and historic and authorised landfills are present.
 - There are multiple Main Rivers, Source Protection Zones and Flood Risk Areas present and field drains are plentiful.
 - There are numerous statutory and non-statutory designated sites for nature conservation, including the following features which have multiple designations up to

international level; River Humber, Thorne Moor and Hafield Moor. There are also areas of Ancient and semi-natural woodland.

- There are numerous Scheduled Monument and Listed Buildings present, as well as two Registered Park and Gardens.
- The Lincolnshire Wolds Area of Natural Beauty (AONB) is present
- The South Humber Industrial Investment Plan (a 15year programme of investment to support major South Humber ports) and the Lincolnshire Lakes Area Action Plan (planning policy framework to deliver the Lincolnshire Lakes development) is also present, along with several Nationally Significant Infrastructure Project applications, including the North Killingholme Power Project, South Humber Bank Energy Centre and Little Crow Solar Park.

Overall, the study identified numerous key environmental constraints that were considered in subsequent design stages.

Stage 2 – Pipeline Route Corridor Constraints Study

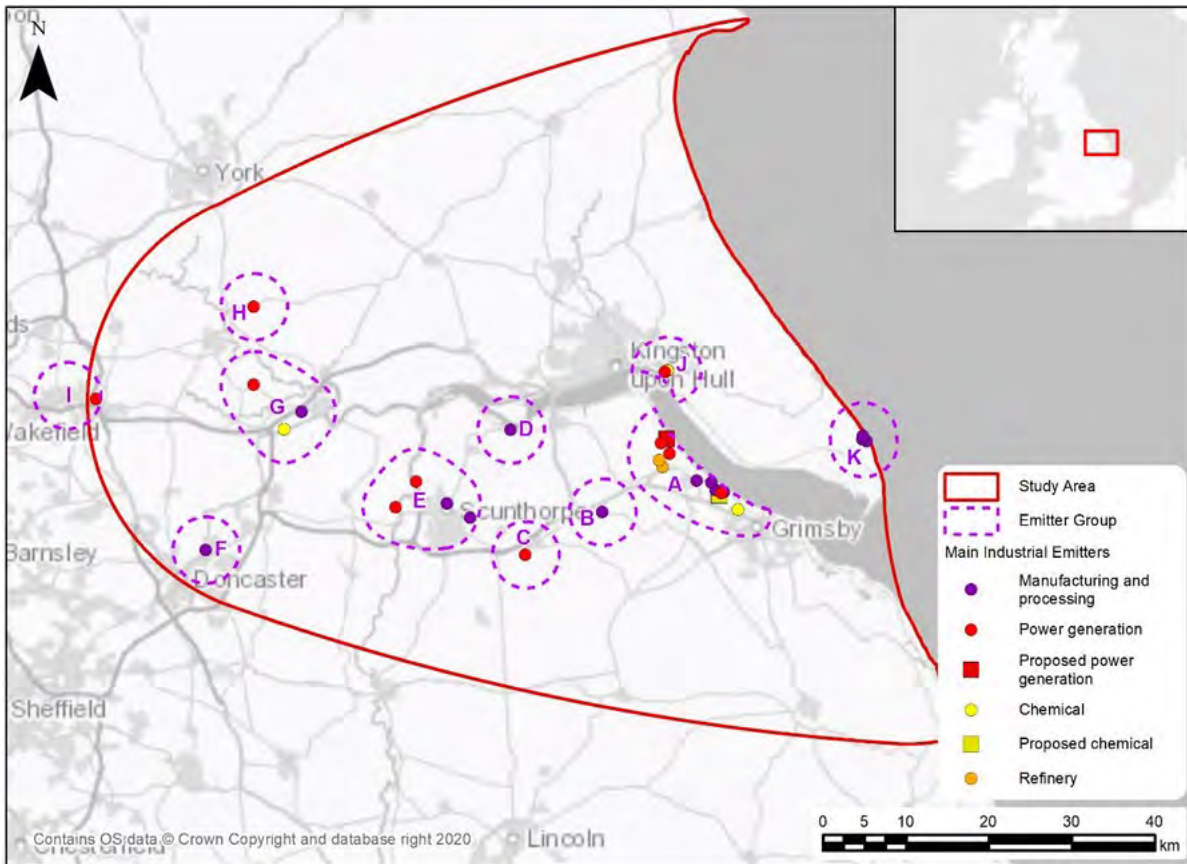
In April 2021, NGV undertook the second stage of the design development and reported the findings in a the ‘Humber Cluster Proposed Carbon Dioxide Transportation Pipeline System – Pipeline Route Corridor and Above Ground Infrastructure (AGI) Siting Constraints Study’ (Ref 3.1.2).

The Stage 2 work built upon the findings of Stage 1 to identify 1km wide route corridor options that linked potential carbon capture projects in the region to potential landfall points for onward transportation to the offshore CO₂ store. The report was centred around identifying suitable pipeline route corridors that considered the constraints identified at Stage 1 with the following criteria for AGIs:

- Potential sites to locate a Pump Facility close to the landfall options; these sites would need to be approximately 10ha in size and 5km was identified as a suitable distance to a possible site from the coast.
- Sites for an AGI close to Salt End, of up to 1.5ha in size.
- Sites for an AGI close to Killingholme power station, again of up to 1.5ha in size.
- Sites of approximately 5ha in size for locating an AGI in the Drax area.
- Sites of approximately 5ha in size for an AGI close to a crossing point of the River Ouse at Saltmarshes / Reedness.

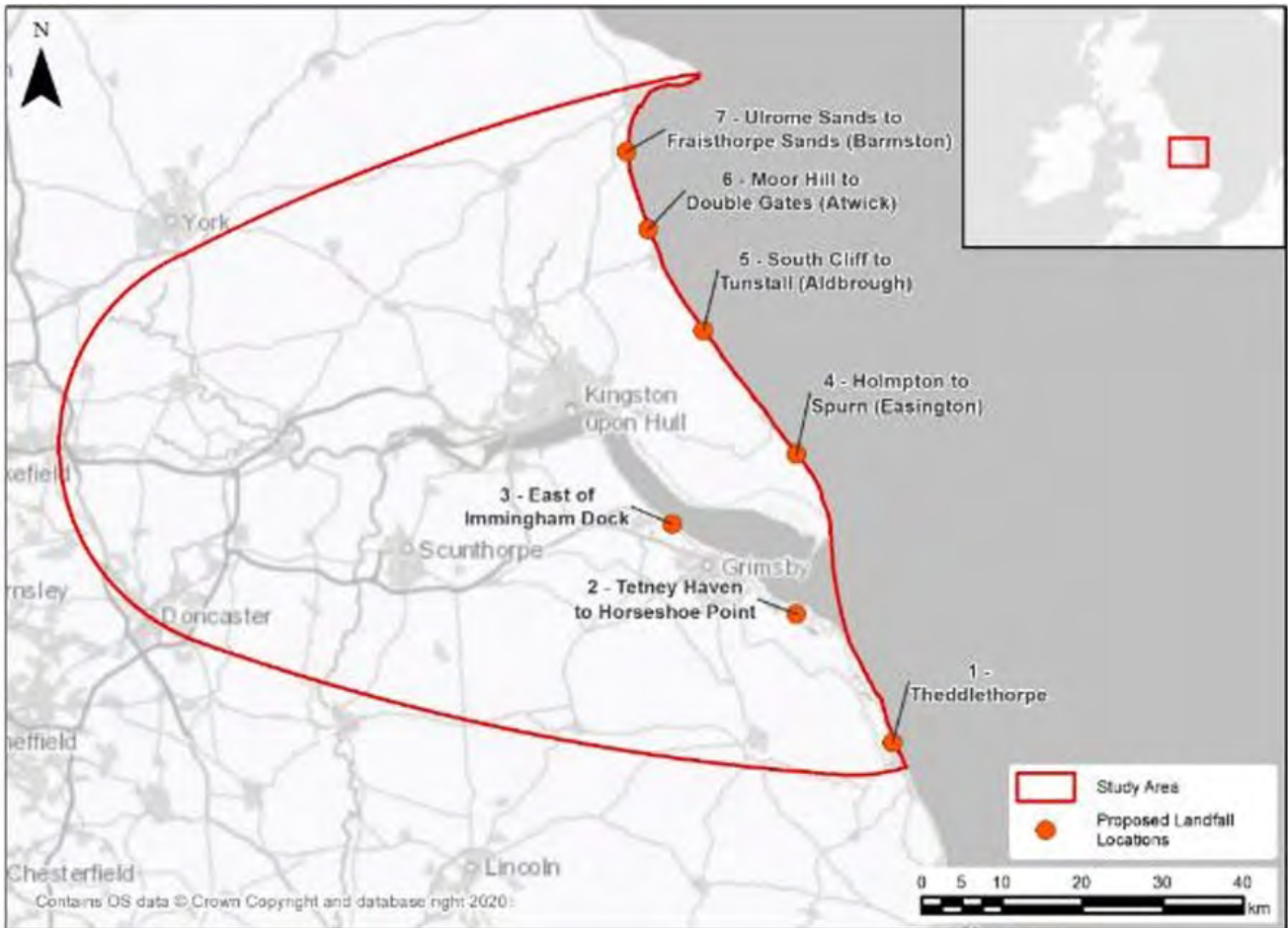
The Stage 2 study also used desk-based data sources for environmental constraints, and identified potential carbon capture projects in the region. Details of 30 potential key industrial and power sector projects were identified that may want to connect to the proposed Carbon Capture, Use and Storage (CCUS) transportation infrastructure. To

rationalise the identification of route corridors, emitters were grouped, and connections were identified between the groups, rather than linking each potential carbon capture project back to a possible landfall, as shown in Insert A-3-1-3.



Insert A3-1-3 – Stage 2 Study Area and the location of identified carbon capture projects, including rationalised grouping

Seven potential landfall locations were identified, as shown in Insert A3-1-4.



Insert A3-1-4 – Potential landfall locations identified at the NGV HLCP project Stage 2

The objectives of the identifying the preferred landfall locations were:

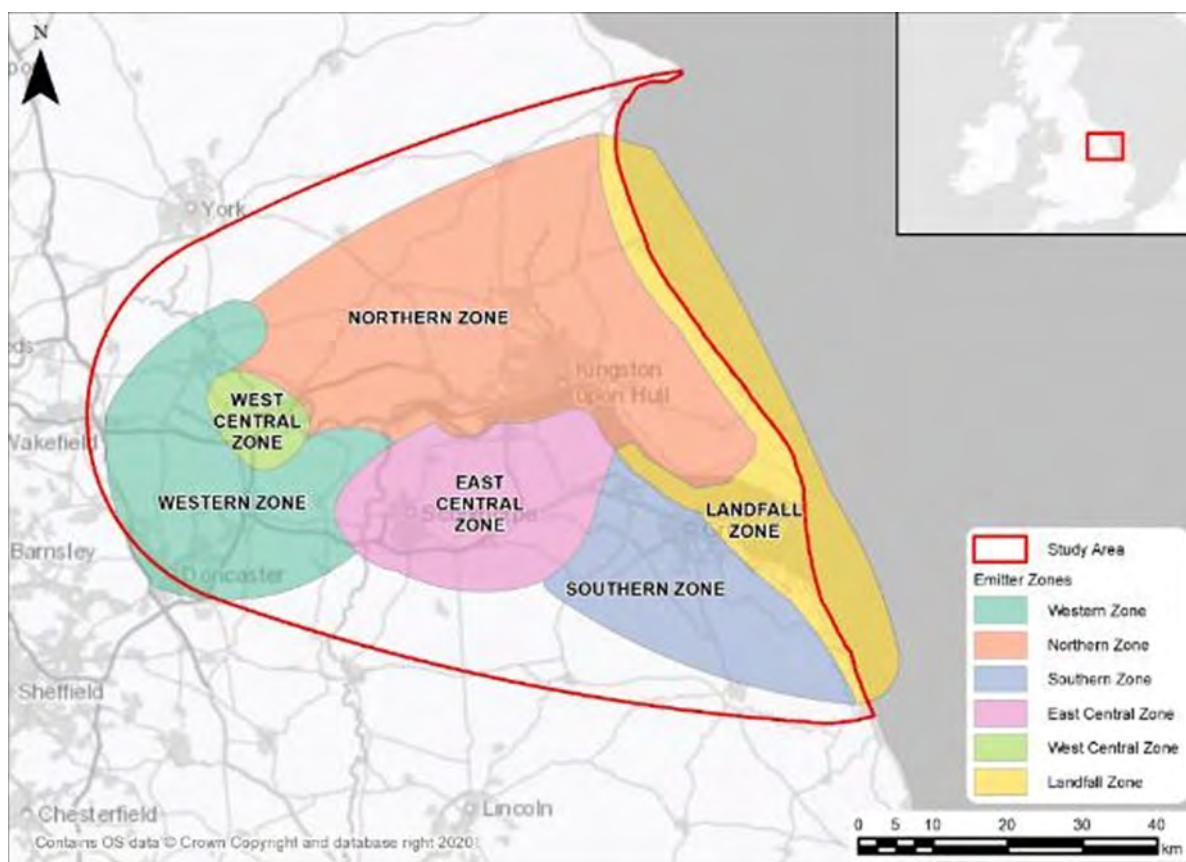
- Considering the physical, environmental and socio-economic constraints and their relative influence on the pipeline routeing between the offshore carbon dioxide store and the Yorkshire, Humber and Lincolnshire coasts.
- Maximising execution predictability, in terms of cost and schedule.
- Ensuring contestability, in terms of minimising environmental, social and landowner risks.

Route corridor options were identified by working backwards from an initial list of seven identified landfall locations towards the carbon capture project groups, which inherently also informed the refinement of the potential landfall locations.

A variety of route corridor options were developed to connect the carbon capture projects, primarily clustered south and east of the Humber, including key locations like Keadby power station, British Steel, and Drax power station.

The study used a zoning approach, which grouped areas that have similar characteristics or features, as follows and illustrated in Insert A3-1-5:

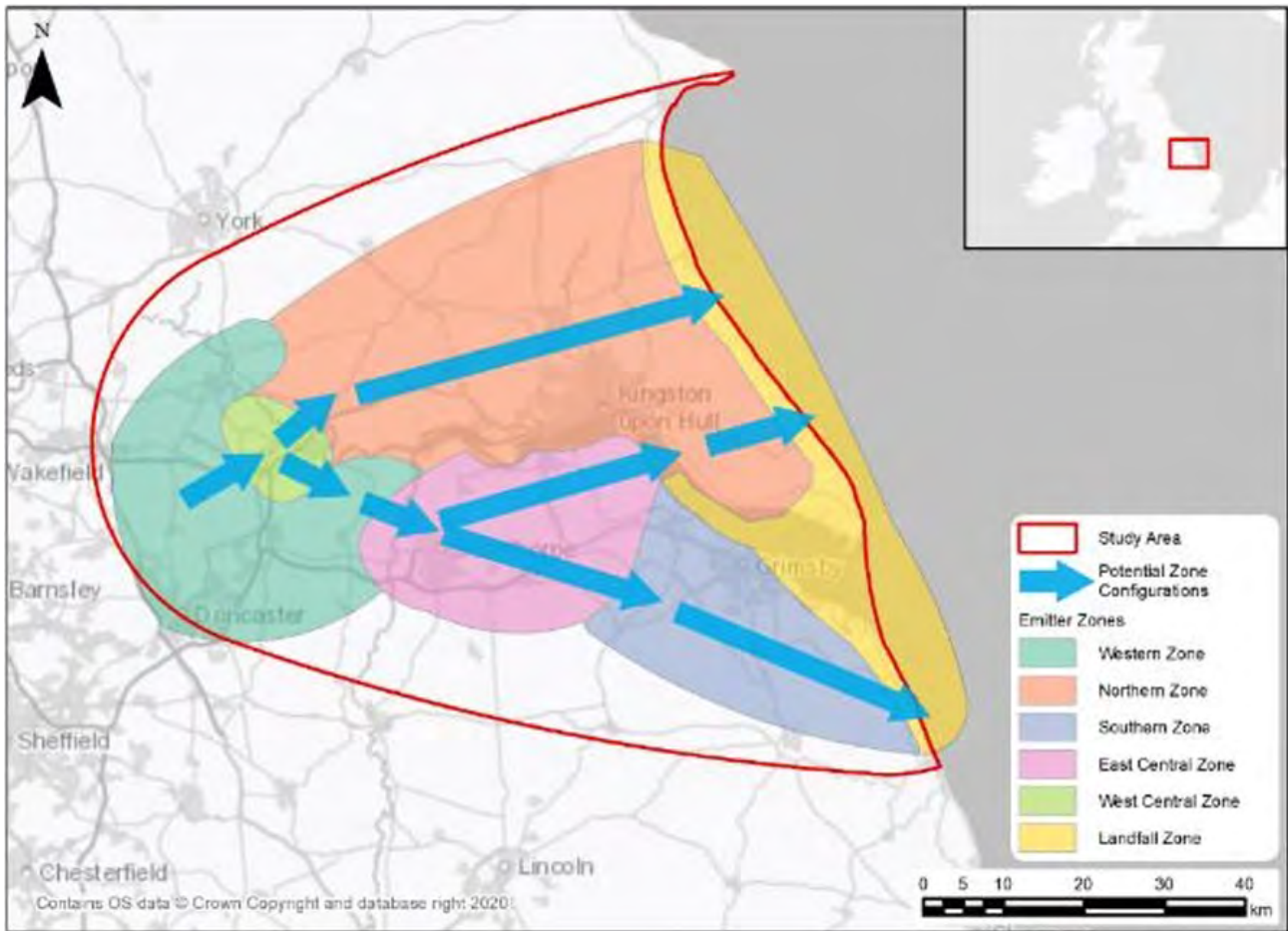
- West-central zone
- East-central zone
- Northern zone
- Southern zone
- Western zone
- Landfall zone



Insert A3-1-5 – Routeing zones used in the NGV HLCP Stage 2 report

These zones allowed for a structured approach to the analysis of potential constraints as each zone was considered in turn. Constraints were identified for each zone, and route corridor options already identified were routed to avoid key environmental constraints wherever possible.

The study then used the zones to consider different configurations for potential direct end-to-end solutions, which resulted at a high level in the arrangement shown in Insert A3-1-6



Insert A3-1-6 – Potential zone configurations for considering direct route options in the NGV HLCP Stage 2 report

From the zoned approach outlined above, route corridor options were identified to allow a single, or group of, carbon capture projects to be connected to any of the potential landfall locations. Potential constraints were identified from a desktop exercise, following on from the Stage 1 study, within the following broad categories:

- Biological environment – such as statutory and non-statutory designated sites for nature conservation.
- Physical environment - such as Main Rivers, flood zones and historic landfill sites.
- Settlement and population – such as key towns in the zone.
- Landscape – such as AONBs.
- Historic Environment – such as Scheduled Monuments and Listed Buildings
- Tourism and Recreation – such as Public Rights of Way, Country Parks and National Cycle Networks.

- Land use and Planning – such as agricultural land classifications, land allocations within the relevant Local Planning Authority’s Local Development Plan.
- Infrastructure – such as the presence of existing motorways, railways, pipelines and overhead lines.

This resulted in the identification of the potential corridors shown in Insert A3-1-7 below:



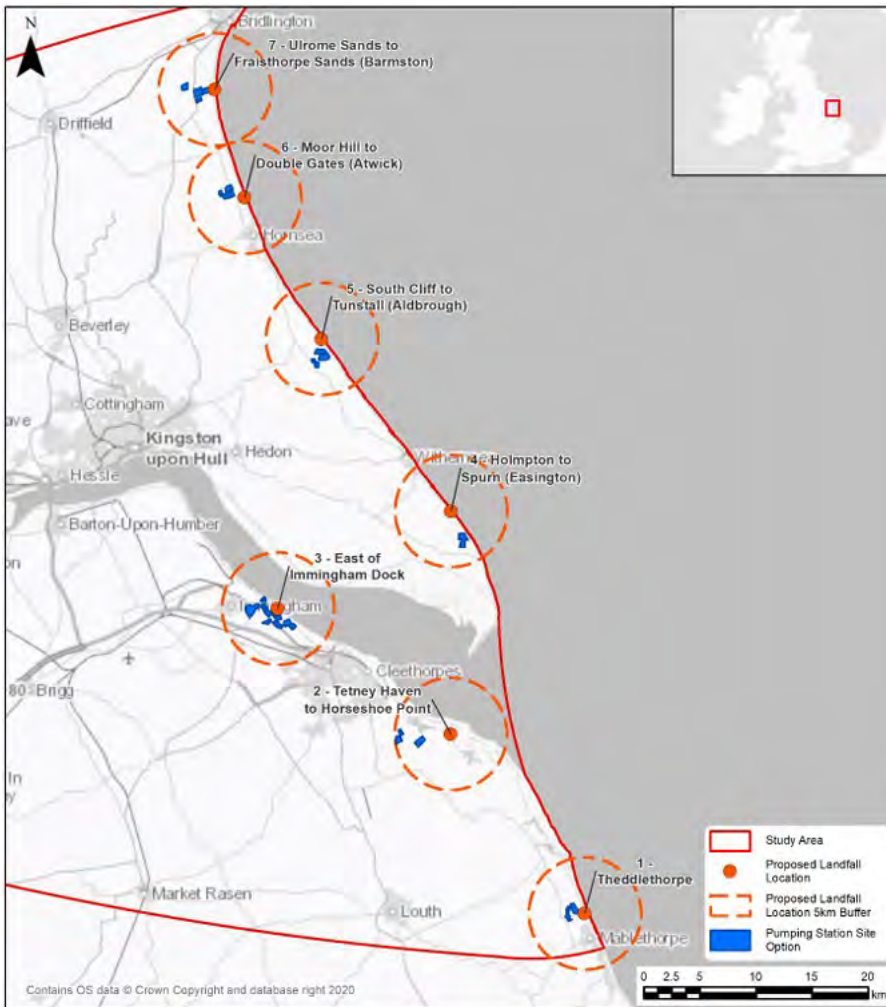
Insert A3-1-7 – Potential route corridors identified in the NGV HLCP Stage 2 report

Potential locations for a Pump Facility at each of the landfall locations were also presented in the report, along with the constraints (following the same broad criteria as those used for the route options, described above) relevant to each location.

The criteria used to identify potential Pump Facility sites was:

- Options need to be identified for each of the seven potential landfall sites.
- Within 5km of an identified landfall option.
- Need to be able to accommodate a Pump Facility of approximately 10ha.

An overview of the identified potential locations is shown in Insert A3-1-8:



Insert A3-1-8 – Overview of the potential Pump Facility locations for each landfall option, as identified in the NGV HLCP Stage 2 report

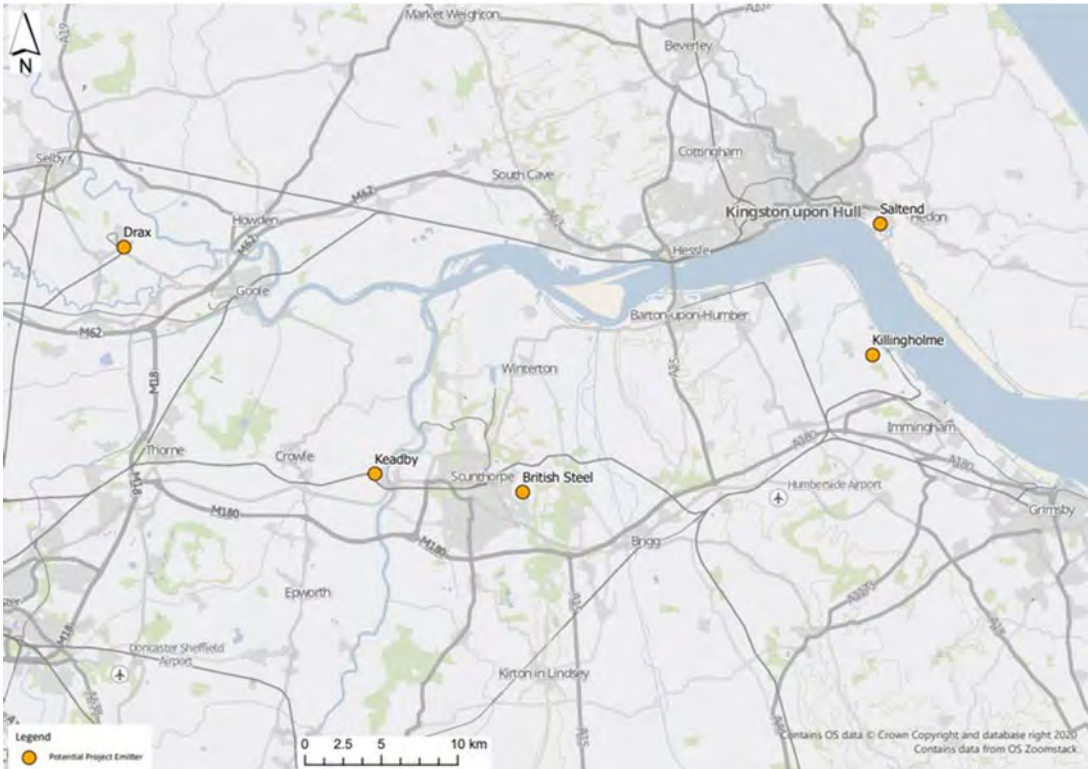
Overall, the Stage 2 report identified that after considering environmental and social constraints, there are a substantial number of potential pipeline route and Pump Facility location options.

Stage 3 – Humber Low Carbon Pipelines Route Corridor Report

Following Stage 1 and 2, a third study was undertaken and reported in NGV’s Humber Low Carbon Pipelines – Route Corridor Report (Ref 3.1.3).

To allow the design development work to continue prior to the outcome of the DESNZ process for CCUS deployment, the Stage 3 study was based on the following assumed emitter projects (as shown in Insert A3-1-9) from Zero Carbon Humber and the Industry Strategy Challenge Fund within a 50km radius.

- Drax
- Keadby
- Scunthorpe (British Steel)
- Killingholme
- Salt End



Insert A3-1-9 – Emitters considered in the NGV Stage 3 report

A review was also undertaken of the seven options of landfall locations identified at Stage 2 to assess their practicality given the refined project definition (i.e. focussing on the five emitter locations described above).

As such, the following landfall options (as described above and illustrated in Insert A3-1-10) were discounted due to the availability of viable, shorter alternatives:

- Landfall Zone 1 – Theddlethorpe
- Landfall Zone 2 – Tetney Haven to Horseshoe Point
- Landfall Zone 7 – Ulrome Sands to Fraisthorpe Sands (Barmston)

Landfall Zone 7, while offering a way to avoid the Greater Wash SPA and the Holderness Inshore MCZ, is about 11km longer than the Atwick options and already serves as the

landfall location for the Dogger Bank and Hornsea Four Offshore Wind Farm cables. Therefore, it was not considered further.

The three landfall zones south of the River Humber (Landfall zones 1, 2 and 3 – would require much longer offshore pipelines (ranging from approximately 120km to 145km) and would cross a much larger number of existing and proposed pipeline and cable routes (12 - 13 existing and two proposed). There is also a greater navigation density, greater potential for overlap with wind farm areas and slightly more interaction with nature conservation designations than for landfall zones north of the River Humber. As a result, Landfall Zone 3: East of Immingham Dock was also discounted.

Following the review of landfall options at, three landfall zones were taken forward for further consideration, as follows:

- Landfall Zone 4: Holmpton to Spurs (Easington).
- Landfall Zone 5: South Cliff to Tunstall (Aldbrough).
- Landfall Zone 6: Moor Hill to Double Gates (Atwick).

The Stage 3 report was structured across two packages:

- Package 1 – Main route corridor options i.e. routes providing connections between the potential emitters.
- Package 2 – Landfall route corridors i.e. routes from the three shortlisted landfall options to a connection with the main route corridors (set out in Package 1).

Package 1 – Main route corridor options

At the commencement of the study, it was considered that there were two principal ways to connect the potential emitters to the north and to the south of the River Humber (Insert A3-1-10):

- Configuration A (to the south of the River Humber) was the shortest most direct route. A route that would run between the emitter locations, crossing the River Humber via a new pipeline crossing and then continue from Salt End to a landfall location.
- Configuration B (to the north of the River Humber), a route that would run between Drax to Killingholme to the south of the Humber. As an alternative to a potential tunnel crossing of the River Humber, a crossing of the Ouse would be undertaken to the east of Goole and additional pipeline infrastructure north of the Humber would connect to Salt End and then to a landfall location.



Insert A3-1-10 – Main route corridor options – Configuration A and Configuration B

The main route corridor options appraisal was undertaken in two parts. In the first part, for Configuration A, two route corridor options were initially taken forward (options A1 and A2) and for Configuration B, four route corridor options were taken forward (B1, B2, B3 and B4).

All options were appraised against the following criteria to allow a clear comparison of the potential key constraints:

- Biodiversity
- Landscape and Visual
- Historic Environment
- Water Environment
- Soils and Geology
- Settlement and Population
- Tourism and Recreation
- Traffic and Access

- Land Use
- Planning
- Technical (Engineering)
- Cost
- Lands




Following this appraisal, it was determined that the two options (options A1 and A2) making up Configuration A were to be taken forward to the second appraisal round.

Configuration A options (A1 and A2) were preferred for several of the environment / socio-economic sub-topics including Landscape and Visual, Historic Environment, Water Environment, Soils and Geology, Settlement and Population, Tourism and Recreation, Traffic and Access, and Land Use. Additionally with regards to the feasibility of construction, the River Humber Gas Pipeline Replacement Project has been constructed close to the proposed crossing of the River Humber for Configuration A using a bored tunnel approach. A DCO was granted for the River Humber Gas Pipeline Replacement Project in 2016, supported by a Habitat Regulation Assessment (HRA) that concluded there would not be an adverse effect on integrity of the Humber Estuary SPA and Ramsar as a result of the project alone and in combination with other plans and projects. This demonstrates that a crossing beneath the River Humber at this location is technically and environmentally feasible.

Configuration B options were discounted based on environmental, constructability, cost, programme and lands considerations. Configuration B options were between (approximately) 49 km – 53 km longer than the Configuration A options. Therefore, Configuration B options had the potential to result in environmental effects on a greater number of receptors over a larger area, as they would interact with a larger number of environmental receptors. For example, they would interact with a much larger number of ecological receptors including watercourses and priority habitats. Configuration B also involves two rather than one crossing of the ecological designations, once under the River Ouse and once under the River Trent. In addition, from a land use perspective, the longer route also introduces more land interests and crossings of land parcels.

In the second part of the appraisal of the main route corridor options, a review of the initial two Configuration A routes was undertaken to avoid pinch points and impacts on sensitive receptors. This led to Configuration A being developed into three different updated options (A3, A4 and A5). An overview of the appraisal of these options is provided in Table 1 below.

Table A3-1-1 – Appraisal of Main Route Corridor Options

Aspect	Option A3	Option A4	Option A5
Location	 <p>A map showing the proposed route for Option A3 in blue. The route starts near the River Trent, crosses it north of Garthorpe via HDD, and then heads south, crossing the River Humber north of Killingholme Power Station and south of Salt End Chemicals Park. The map includes a north arrow and a scale bar from 0 to 10 km.</p>	 <p>A map showing the proposed route for Option A4 in orange. The route crosses the River Trent north of Amcotts via HDD and the River Humber north of Killingholme Power Station and south of Salt End Chemicals Park. The map includes a north arrow and a scale bar from 0 to 10 km.</p>	 <p>A map showing the proposed route for Option A5 in brown. The route crosses the River Trent south of West Butterwick via HDD and the estuary north of Killingholme power station and south of Salt End Chemicals Park. The map includes a north arrow and a scale bar from 0 to 10 km.</p>
Length	<p>Approximately 82 km. The option crosses the River Trent north of Garthorpe via Horizontal Directional Drilling (HDD) and the estuary would be crossed via a bored tunnel immediately north of Killingholme Power Station and south of the Salt End Chemicals Park.</p>	<p>Approximately 79 km. The option crosses the River Trent north of Amcotts via HDD and the River Humber would be crossed via a bored tunnel immediately north of Killingholme Power Station and south of the Salt End Chemicals Park.</p>	<p>Approximately 85 km. The Option crosses the River Trent south of West Butterwick via HDD and the estuary would be crossed via a bored tunnel immediately north of Killingholme power station and south of the Salt End Chemicals Park.</p>
Key Environmental Constraints	<ul style="list-style-type: none"> • Passes through Humber Estuary Site of Specific Scientific Interest (SSSI) / SAC / Ramsar. • Spring Wood and Far Wood Ancient Woodland are partially 	<ul style="list-style-type: none"> • Passes through Humber Estuary SSSI / SAC / Ramsar. • Drax Augustinian Priory Scheduled Monument is within the route 	<ul style="list-style-type: none"> • Passes through Humber Estuary SSSI / SAC / Ramsar. • Drax Augustinian Priory Scheduled Monument is within the route

Aspect	Option A3	Option A4	Option A5
	<p>within and adjacent to the route corridor section east of British Steel.</p> <ul style="list-style-type: none"> • The corridor section intersects some areas of Priority Habitat • Drax Augustinian Priory Scheduled Monument is within the route corridor immediately north of Drax power station. • Heavy Anti-aircraft gunsite Scheduled Monument is within the route corridor south of Winteringham. • There are extensive areas of Flood Zone 2 and Flood Zone 3 within the route corridor (approximately 40%) due to extensive areas of low-lying flood plains surrounding the various rivers that feed into the River Humber. Flood zones and the crossing of 13 watercourses would be unavoidable (including six main river crossings). 	<p>corridor immediately north of Drax power station.</p> <ul style="list-style-type: none"> • There are extensive areas of Flood Zone 2 and Flood Zone 3 within the route corridor (approximately two thirds of the route) due to extensive areas of low-lying flood plains surrounding the various rivers that feed into the River Humber. Flood zones and the crossing of multiple watercourses would be unavoidable (including six main river crossings). • Several priority habitats are within this option: deciduous woodland (numerous locations throughout route), intertidal substrate foreshore, coastal saltmarsh, mudflats (River Trent Crossing) and lowland heathland (east of British Steel). • Capital costs were considered taking into account the length of the corridor (82 km) and the major watercourse crossings (HDD under 	<p>corridor immediately north of Drax power station.</p> <ul style="list-style-type: none"> • There are extensive areas of Flood Zone 2 and Flood Zone 3 within the route corridor (60%) due to extensive areas of low-lying flood plains surrounding the various rivers that feed into the River Humber. • Flood zones and the crossing of 18 watercourses would be unavoidable (including 14 main river crossings). • Capital costs were considered taking into account the length of the corridor (85km) and the major watercourse crossings (HDD under the River Trent and bored tunnel under the River Humber). On that basis, it was estimated that the costs for Options A3, A4 and A5 would be comparable.

Aspect	Option A3	Option A4	Option A5
	<ul style="list-style-type: none"> Capital costs were considered taking into account the length of the corridor (82 km) and the major watercourse crossings (HDD under the River Trent and bored tunnel under the River Humber). On that basis, it was estimated that the costs for Options A3, A4 and A5 would be comparable. 	<p>the River Trent and bored tunnel under the River Humber). On that basis, it was estimated that the costs for Options A3, A4 and A5 would be comparable.</p>	
<ul style="list-style-type: none"> All three options largely avoid interactions with the key receptor groups of each environmental sub-topic or the alignment of the pipelines could be adjusted through careful routing to avoid interactions or substantially minimise the environmental effects. All the options would include a bored tunnel crossing under the River Humber and an HDD crossing under the River Trent which have the potential to impact the internationally designated sites (SSSI / SAC / SPA / Ramsar). Following this analysis, it was concluded that all three Configuration A Options (A3, A4 and A5) should be taken forward to Non Statutory Consultation based on the overall balance of environmental, socio-economic, technical and costs considerations. 			

Package 2 – Landfall route corridors

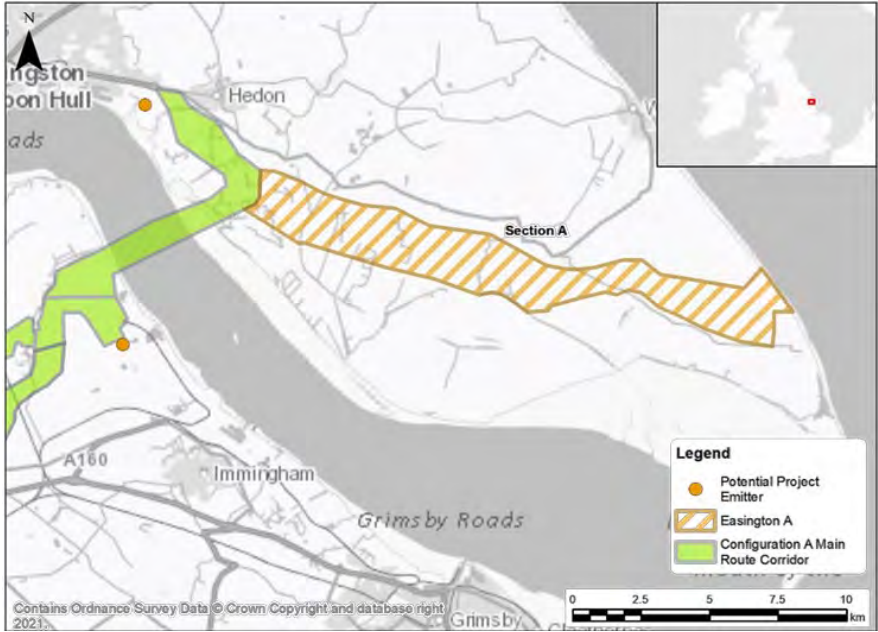
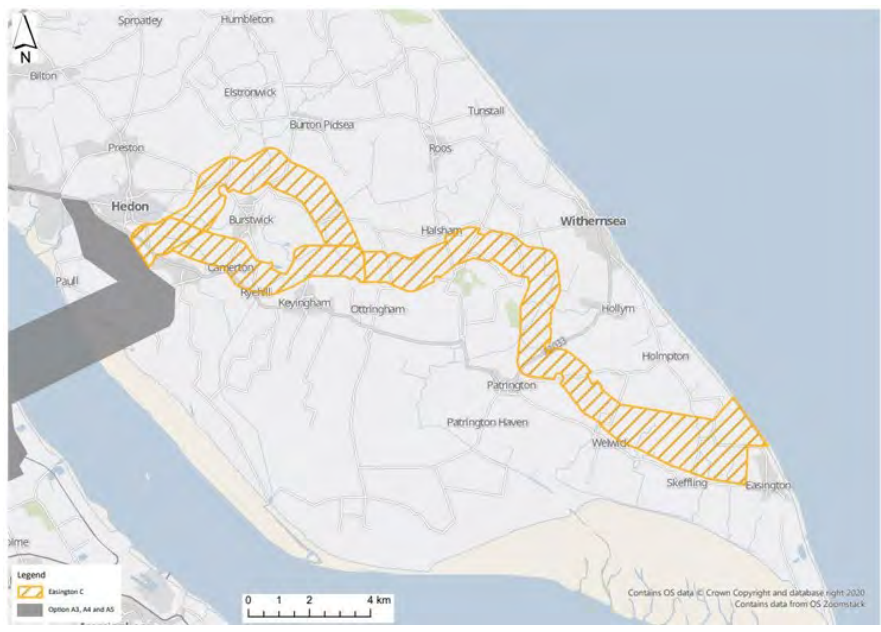
Package 2 involved identifying possible landfall route corridors connecting to three landfall options (Easington, Aldbrough and Atwick) from both Configuration A and B.

A total of 11 options were considered, however five of the options were discounted on the basis that they connected to configuration B of package was, which was discounted as explained above. Therefore, the following six locations were progressed to the appraisal stage:

- Easington A
- Easington C
- Aldbrough A
- Aldbrough B
- Atwick A
- Atwick B

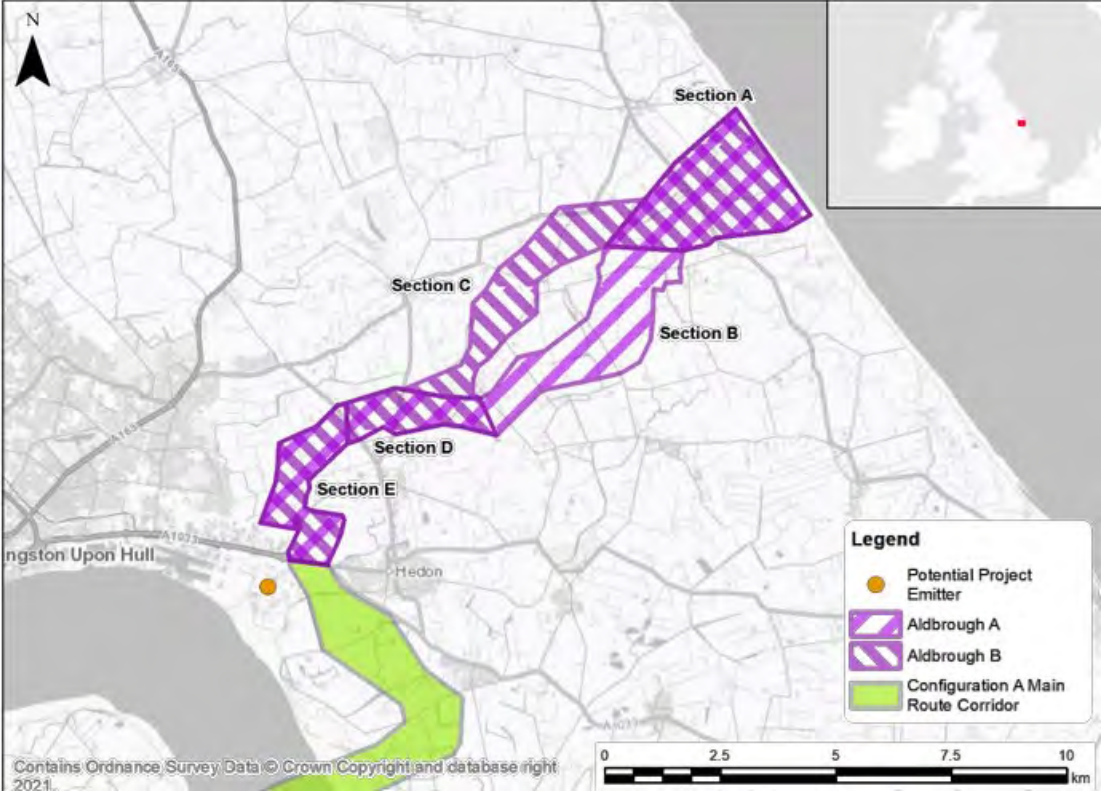
A summary of the appraisal for each option is outlined in Table 2 below.

Table A3-1-2 – Summary of the options appraisal for the shortlisted Package B - Easington options

Aspect	Easington A	Easington C
Location	 <p>The map shows the Easington A route corridor (orange hatched area) extending from the coast near Hedon and Immingham towards the east. A green area represents the Configuration A Main Route Corridor. Two orange dots indicate Potential Project Emitters. The map includes labels for 'Kingston on Hull', 'Hedon', 'Immingham', 'Grimsby Roads', and 'Section A'. A legend identifies the symbols for Potential Project Emitter, Easington A, and Configuration A Main Route Corridor. A scale bar shows 0 to 10 km.</p>	 <p>The map shows the Easington C route corridor (orange hatched area) extending from Hedon in the west towards Easington in the east. The route follows the coast and inland through various villages. Labels include 'Sproatley', 'Humbleton', 'Elsthorwick', 'Burton Pidsea', 'Tunstall', 'Preston', 'Hedon', 'Burstwick', 'Keyingham', 'Oxtingham', 'Withernsea', 'Hollym', 'Holmpton', 'Pattingham', 'Pattingham Haven', 'Welmor', 'Skeffling', and 'Easington'. A legend identifies the symbols for Easington C and Option A3, A4 and A5. A scale bar shows 0 to 4 km.</p>
Length	Approximately 20km	Approximately 20km
Key Environmental Constraints	<ul style="list-style-type: none"> • Humber Estuary SAC / SPA / Ramsar / SSSI / RSPB IBA runs parallel to the south. • Dimlington Cliff SSSI is across the entirety of the route corridor's foreshore area north of Easington. 	<ul style="list-style-type: none"> • Humber Estuary SAC / SPA / Ramsar / SSSI / RSPB IBA runs parallel to the south. • Dimlington Cliff SSSI is across the entirety of the route corridor's foreshore area north of Easington. • A cluster of scheduled monuments south of and at the western extent of the route corridor

Aspect	Easington A	Easington C
	<ul style="list-style-type: none"> • Enholmes Plantation Local Wildlife Site (LWS) is a woodland at the centre of the route corridor southeast of Patrington. • Out Newton – Skeffling LWS runs in a north to south direction at the centre of the route corridor and along the route of the Punda Drain. • A cluster of scheduled monuments south of and at the western extent of the route corridor • There is a cluster of listed buildings in the centre of Easington including the Grade I listed Church of All Saints. • The route corridor is within the Humber Estuary National Character Area and the Holderness National Character Area. The coastal region is subject to coastal erosion. • There are extensive areas of Flood Zone 2 and Flood Zone 3 within the route corridor (particularly the western extent, west of Patrington) • Most of the route corridor consists of Grade 2 (very good quality) Agricultural Land, with the remainder Grade 3 (good to moderate quality) Agricultural Land. A PRow runs through the corridor. 	<ul style="list-style-type: none"> • There is a cluster of listed buildings in the centre of Easington • The route corridor is within the Humber Estuary National Character Area and the Holderness National Character Area. The coastal region is subject to coastal erosion. • There are extensive areas of Flood Zone 2 and Flood Zone 3 within the route corridor • Most of the route corridor consists of Grade 2 (very good quality) Agricultural Land, with the remainder Grade 3 (good to moderate quality) Agricultural Land.

Table A3-1-3 – Summary of the options appraisal for the shortlisted Package 2 - Aldbrough options

Aspect	Aldbrough A and Aldbrough B
Location	 <p>The map shows the proposed pipeline route through the Aldbrough area, divided into five sections: Section A, B, C, D, and E. Section A is at the top right, followed by B, C, D, and E moving south-west. A green area at the bottom represents the Configuration A Main Route Corridor. A yellow dot indicates a Potential Project Emitter. The map includes a north arrow, an inset map of the UK, a scale bar (0-10 km), and a legend. The legend defines: Potential Project Emitter (yellow dot), Aldbrough A (diagonal purple lines), Aldbrough B (diagonal purple lines), and Configuration A Main Route Corridor (green). Text on the map includes 'Kingston Upon Hull', 'Hedon', and 'Contains Ordnance Survey Data © Crown Copyright and database right 2024'.</p>
Length	Approximately 16km

Aspect	Aldbrough A and Aldbrough B
Key Environmental Constraints	<ul style="list-style-type: none"> • The western extent of the route corridor close to Salt End is approximately 1.5km from the Humber Estuary SAC / SPA / Ramsar / SSSI / RSPB IBA. • The foreshore and the wider offshore environment are designated as the Greater Wash SPA and the Holderness Inshore MCZ which both stretch along the entirety of the Holderness coast. • Bail Wood Ancient Woodland and LWS is at the centre of the route corridor, immediately east of Garton Road. • Hedon Medieval Town Scheduled Monument is approximately 500m east of the route corridor close to Salt End Chemicals Park and North Park Farm Scheduled Monument is approximately 600m south of the route corridor south of Lelley. The Two Moated Sites and Associated Features 520m North of Grimston Garth Scheduled Monument is to the southeast of the corridor. • There are several listed buildings in the vicinity of the corridor. • Sproatley Grange historic landfill site is approximately 500m north of the route corridor as it passes east of Lelley. • There are extensive areas of Flood Zone 2 and Flood Zone 3 within the route corridor. • Most of the route corridor consists of Grade 2 (very good quality) Agricultural Land, with the remainder Grade 3 (good to moderate quality) Agricultural Land.

Table A3-1-4 – Summary of the options appraisal for the shortlisted Package 2 - Atwick options

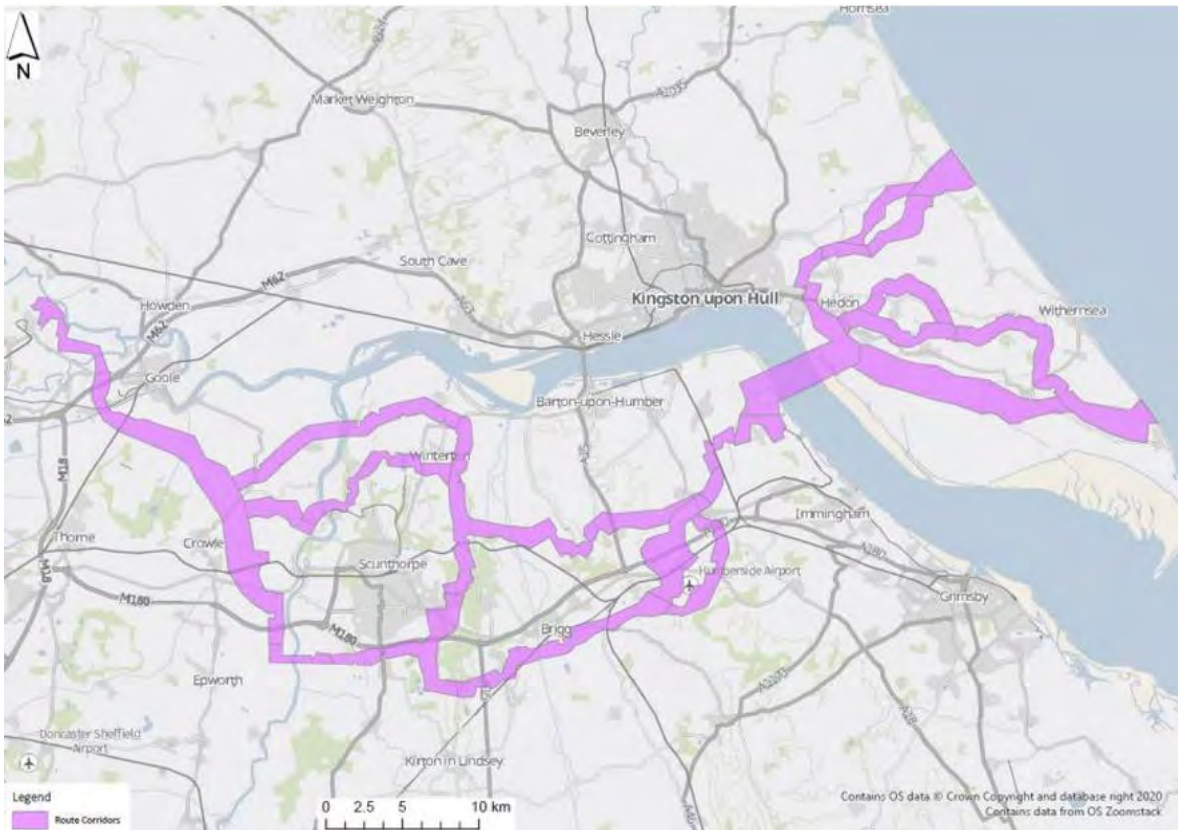
Aspect	Atwick A and Atwick B
Location	<p>The map displays the proposed route for the Atwick options, divided into five sections (A, B, C, D, E) highlighted with blue hatching. The route starts near the coast at Hornsea and extends southwards through Beverley, Cottingham, and Kingston upon Hull, ending near Hedon. A green hatched area indicates the Configuration A Main Route Corridor. A yellow circle marks a Potential Project Emitter near Hedon. The map includes major roads (A1079, A1035, A165, A164, A1033, A1165, A63), towns (Beverley, Cottingham, Kingston upon Hull, Hedon, South Cave, Hesse), and the Humber estuary. A legend, scale bar (0-10 km), and north arrow are also present.</p>

Aspect	Atwick A and Atwick B
Length	Approximately 33km
Key Environmental Constraints	<ul style="list-style-type: none"> • The southern extent of the route corridor close to Salt End is approximately 1.5km from the Humber Estuary SAC / SPA / Ramsar / SSSI / RSPB IBA. • The Hornsea Mere RSPB SPA, SSSI and RSPB IBA and Low Wood Ancient Woodland (within the boundary of Hornsea Mere) are approximately 500m south of the route corridor at Hornsea; the Leven Canal SSSI is approximately 1.7km north of the route corridor between Riston Grange and Leven. Noddle Hill LNR is approximately 200m south of the route corridor between Bransholme and Swine. • Hornsea Disused Railway Line is a linear LWS that spreads across most of the route corridor (Section E) south of Swine. • The route corridor is immediately adjacent to Siggleshorne – Goxhill LWS, Crofting Ponds LWS, Low Wood, Wassand LWS, and Wassand Hall LWS and passes through the northern extent of Rise – Huddlecross LWS. • Hedon Medieval Town Scheduled Monument is approximately 500m east of the route corridor close to Salt End Chemicals Park. The route corridor also passes close to a further four Scheduled Monuments. • There is a small cluster of Grade II listed buildings and the Village Cross Scheduled Monument in the village of Atwick. • There are extensive areas of Flood Zone 2 and Flood Zone 3 within the route corridor. • The route corridor consists of Grade 3 (good to moderate quality) Agricultural Land and Grade 2 (very good quality) Agricultural Land. • Several A roads are intersected by the route corridor.

The outcome of the appraisal of the shortlisted Package 2 options was as follows:

- All Atwick options were discounted on the basis of distance, cost and proximity to receptors once Configuration A had been selected.
- On balance, from an environment and socio-economic perspective, there are few differentiators between Easington A and the Aldbrough options.
 - Easington A is slightly preferred for the sub-topics of: Landscape and Visual due to there being slightly less interaction with receptors than the Aldbrough options; Historic Environment due to the proximity of designated heritage assets and the greater potential for impacts on the settings of those heritage assets for the Aldborough options; Traffic and Access as it has slightly better access; and Planning as it was considered interactions with planned developments could be avoided through careful routeing.
 - Aldbrough is slightly preferred for the sub-topics of: Biodiversity due to their shorter length and general potential for reduced effects whilst the Easington options were less preferable due to their closer proximity to the River Humber; Soils and Geology due to the potential for interaction with Geological Conservation Review (GCR) sites at the Easington landfall and shorter length of the Aldbrough options; and Settlement, Tourism and Recreation due to fewer residential properties, holiday parks, caravan sites and self-catering facilities in the vicinity.
- The remaining sub-topics of Water Environment and Land Use were unable to identify any notable differentiators and therefore this leads to a slight preference for the Aldbrough options due to their shorter length.

The Stage 3 (Package 1 and Package 2) appraisal concluded with the route corridor options that were taken forward to NGV's Non-Statutory Consultation in 2021 which are shown in Insert A3-1-11.



Insert A3-1-11 – Route corridor options, NGV’s Non-Statutory Consultation, 2021

Selection of the HLCP Preferred Route Corridor

Following the HLCP Non-Statutory Consultation between September and October 2021, the feedback that was received was reviewed alongside further studies to consider environmental, socio-economic, technical and planning constraints.

The process and outcome of the review were published in the Humber Low Carbon Pipelines project – Stage 1 Non-Statutory Consultation Feedback Report in March 2022 (Ref 3.1.4).

Following the format that was presented in the HLCP Non-Statutory Consultation material, the feedback was analysed by dividing the route options across three sections, as shown in Insert A3-1-12.



Insert A3-1-12 – HLCP Non-Statutory Consultation route corridors

The preferred route corridor was identified by selecting the preferred route corridor option within each section. A summary of the reasons for the selection are as follows:

Section A

Comments were received concerning corridor option A2 which highlighted the proximity of the site to the River Humber and the potential for greater environmental impact. This began to indicate the potential selection of a corridor route to the south of Scunthorpe, utilising route corridor option A4. Network Rail also highlighted that corridor option A2 would involve fewer railway crossings than other options.

Corridor option A3 was not preferred for further consideration due to the potential for any route within this corridor to be closer to populated areas and potential constraints. Whilst a route within this corridor may be technically feasible, it was considered that a less constrained route corridor should be taken forward as a preferred option.

A number of comments were received that raised potential deliverability issues in relation to route corridor option A5, connecting to British Steel from the north and providing an onward connection from options A2 or A3.

On balance, it was considered that route corridor sections A1 and A4 be identified as the preferred option in this section as it would be likely to have a reduced potential for direct impacts on environmentally designated sites.

Whilst all options in this section would involve crossing the River Trent, it is considered that the crossing point in option A4 is preferred from an engineering perspective and would also take place outside the SSSI, SAC and Ramsar Site environmental designations.

Section B

Following the consideration of the corridor options within Section A leading to a preference for options A1 and A4, it is considered appropriate to take forward corridor options B2 or B3 as the preferred option in this section to provide an onward connection from Section A4.

The selection of corridor options B2 or B3 was also supported by feedback that indicated that it had the potential to facilitate connections to additional sites and emitters in the future.

Linked to the identification of potential deliverability issues associated with corridor option A5, feedback was received that supported the selection of corridor options B2 or B3. National Grid Ventures concurs with this and considers the selection of a route corridor to the south of Scunthorpe, utilising corridor options A4 and B2 to be the most appropriate option to take forward for future development.

As highlighted through the response from Network Rail, it is acknowledged that corridor option B2 would involve more railway crossings than other options within this section. National Grid Ventures would however continue to engage with Network Rail as the project develops to minimise disturbance to their operations throughout the construction of the project.

Following the end of the consultation period, the project team continued to engage with stakeholders in order to identify a preferred route option in the vicinity of Humberside Airport. Two options were included in the non-statutory consultation and no specific consultation feedback was received which indicated a preference in this location. Following discussions with Singleton Birch Quarry and Humberside Airport, it was considered preferable to take forward a corridor to the east of the airport. A corridor in this location would avoid potential interaction with quarry expansion plans, whilst maintaining the flexibility to allow for connections to additional emitters in the future.

Section C

The feedback received throughout the non-statutory consultation period did not indicate an overriding preference for any corridor option in Section C.

NGV worked closely with project partners, including the project team working on the offshore element of the carbon dioxide pipeline system, to enable the selection of a preferred corridor and associated landfall site. The differentiators favouring Easington were:

- Easington has the greatest execution certainty in terms of cost, schedule and constructability.
- Easington is an existing industrial complex with multiple landfalls of incoming pipelines. The Tolmount pipeline is an excellent precedent for the Northern Endurance Partnership (NEP) offshore pipeline giving more confidence (and precedent) to what would be a complex scope regardless of location.
- Easington has a reduced environmental impact on the Holderness Inshore Marine Conservation Zone.

The differentiators favouring Aldbrough were:

- Albrough has a marginally lower overall cost.
- Aldbrough requires less land acquisition and has a slightly reduced offshore environmental effect across a number of constraints due to its shorter pipeline length.

As a result, Easington was selected as the preferred landfall location.

Following the selection of the preferred landfall location, consideration was given to a preferred route corridor between Salt End and Easington. Whilst it is the more direct route, route corridor option C6 contains multiple National Transmission System high pressure gas pipelines within large sections of the corridor. It was therefore considered that the construction of additional dual pipelines within this corridor could be technically more challenging than other options and was therefore not considered to be preferred. Route corridor option C6 also runs in closer proximity to the River Humber designated site than alternative corridors in this section.

Due to the potential for routing constraints to the south of Winestead which could make pipeline routing challenging in that area, corridor option C5 was not considered preferable to take forward for future development.

On the basis of Easington being selected as the preferred landfall option and the potential routing challenges associated with corridor options C5 and C6, route corridor option C4 has been selected as the preferred option in Section C.

The resulting preferred route corridor to be taken forward initially to HLCP's EIA Scoping Report and onward to HLCP's Statutory Consultation is shown in Insert A3-1-13 below.



Insert A3-1-13 – The HLCP Preferred Route Corridor following Non-Statutory Consultation

Review of the HLCP design

HLCP Statutory Consultation change control and the decision to route north of Scunthorpe

As mentioned in Chapter 3 – Design Evolution and Consideration of Alternatives, the feedback that was received from the HLCP Statutory Consultation was reviewed and relevant comments were taken forward to a collaborative ‘change control’ process.

A total of 381 change control items were evaluated via workshops attended by representatives from environmental, lands and engineering teams to identify options. A series of desktop environmental (and, where data was available, lands) feasibility reports were then produced to evaluate and inform the proposed solution.

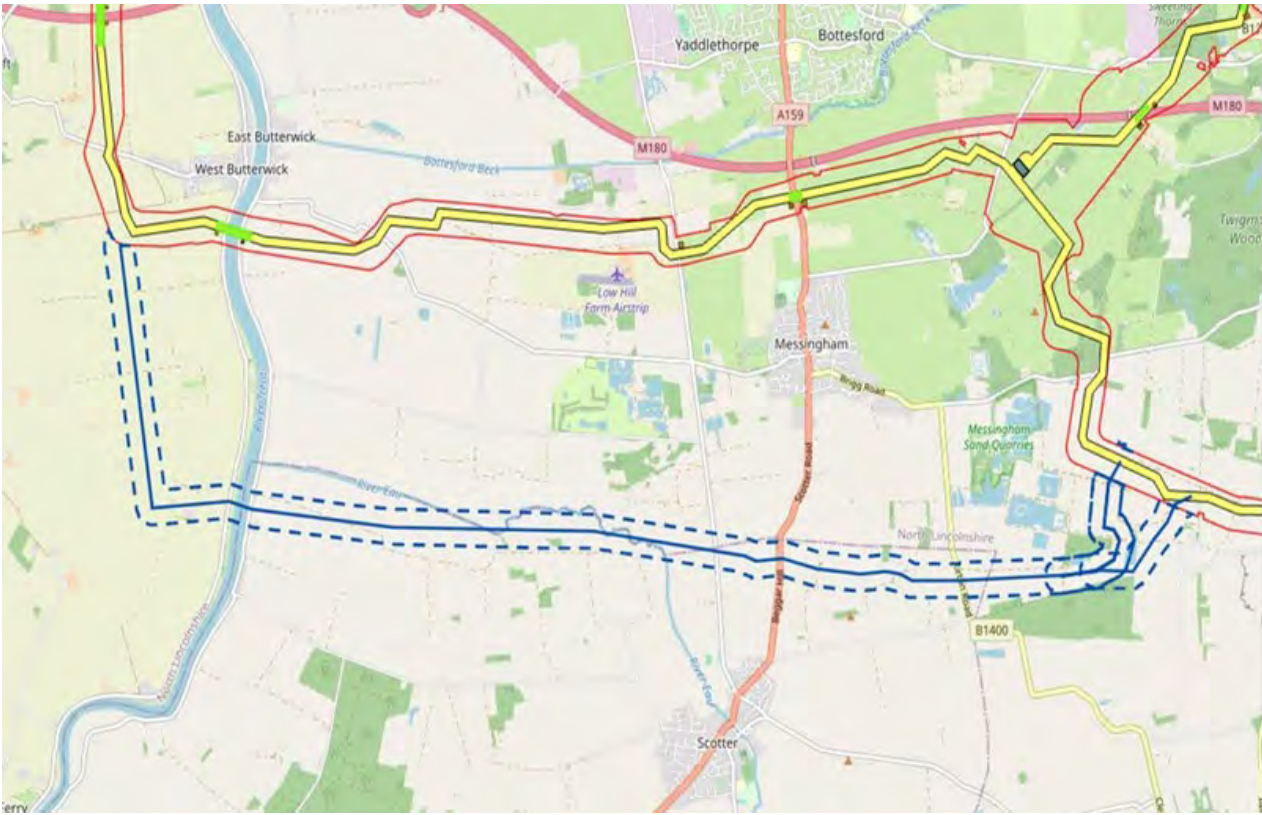
The feedback that has been taken forward and informed the Project design is discussed in the respective sections below.


The carbon capture projects the Project would connect to are set out in Volume 2 - Chapter 2 – Project Description and Section 3.1 above. The key difference in this regard is

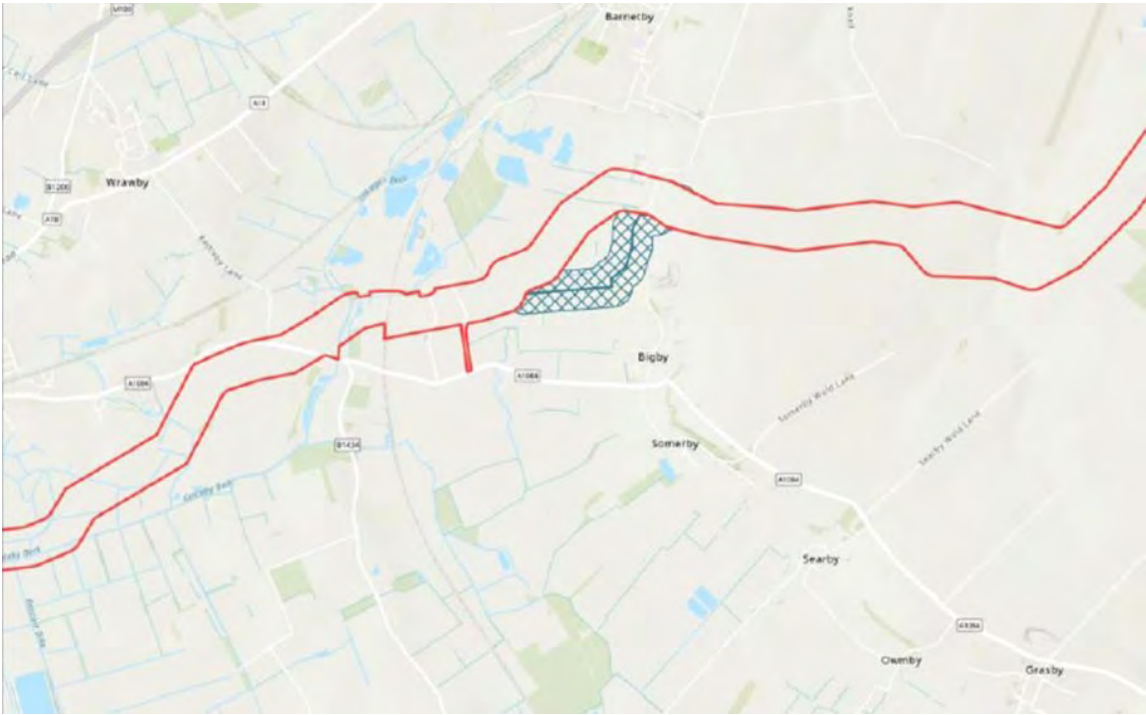
that the Project does not seek to provide a connection to British Steel, as this is not one of the projects shortlisted by DESNZ. Therefore, removing the need to route the pipeline to this area presented the possibility of exploring a shorter route between the Keadby and Killingholme area that passes north of Scunthorpe.

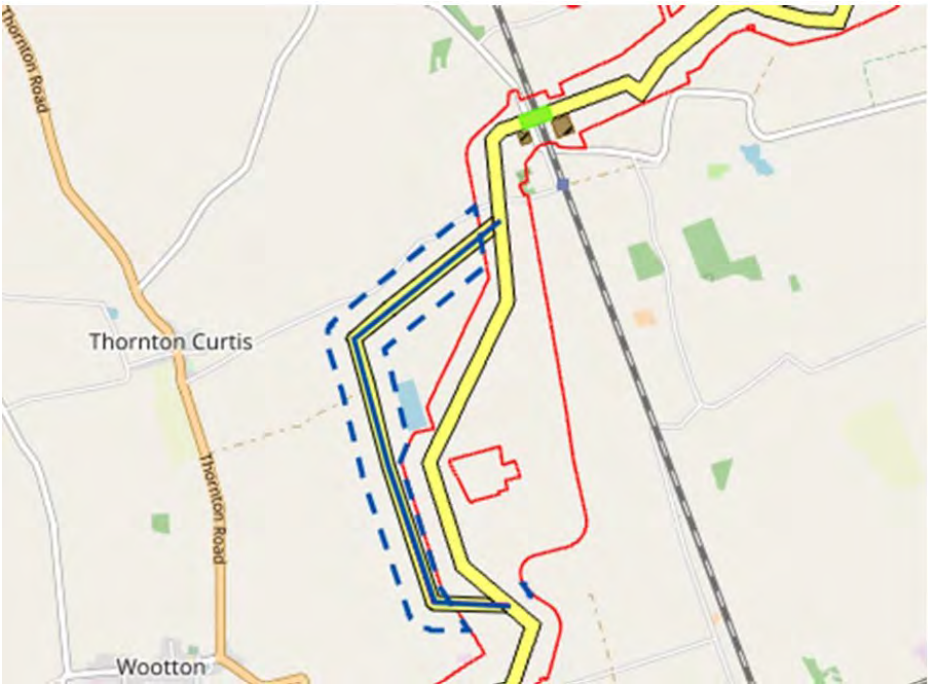
Key change controls from the HLCP Statutory Consultation relating to the section of the route that passes to the south of Scunthorpe were reviewed, to help inform the decision on whether to route to the north of Scunthorpe. The key change controls, along with the reasonable alternatives that were considered, are described below.

Table A3-1-5 – Key change controls from the HLCP Statutory Consultation relating to the route south of Scunthorpe

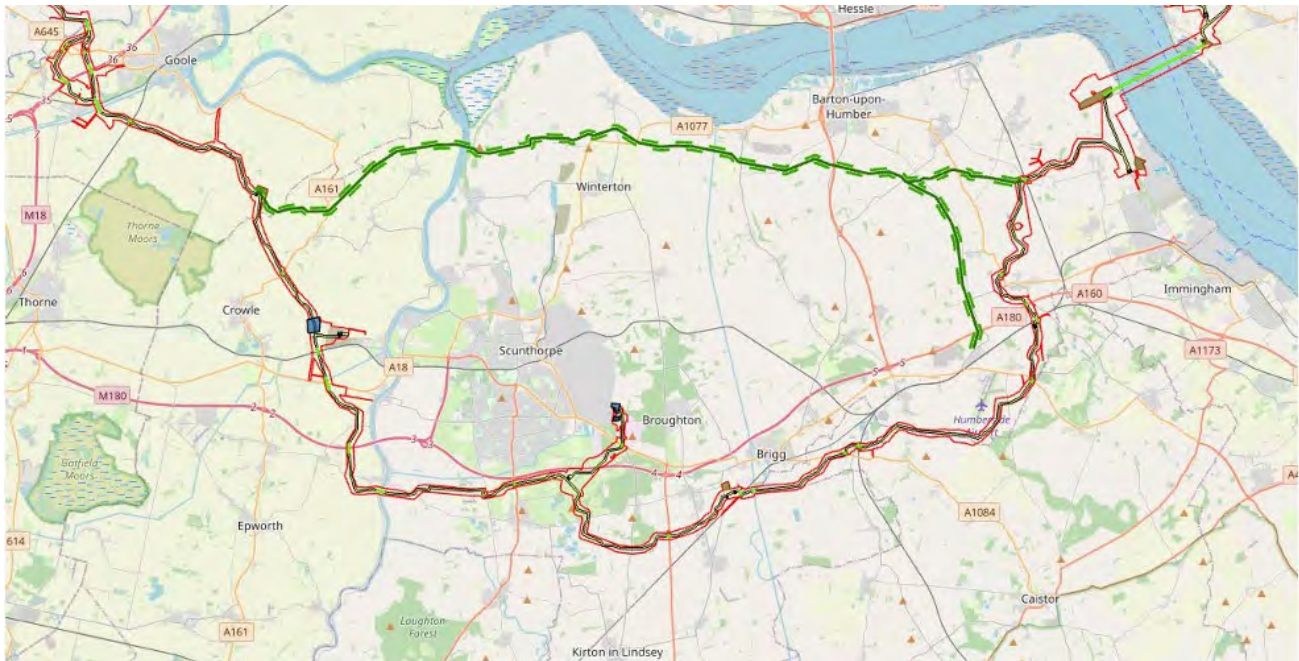
HLCP Statutory Consultation south of Scunthorpe change control	Alternative considered	Description of the alternative considered
<p>Interaction with multiple constraints north of Messingham, including allocated sites for minerals by North Lincolnshire, a historic landfill, proximity to several SSSIs and comments raised by several residents regarding concerns of disturbance during construction.</p>	 <p>The map displays a geographical area south of Scunthorpe, including locations like East Butterwick, West Butterwick, Messingham, and Scotter. A blue dashed line represents the proposed alternative route, which is shorter and more direct than the existing routes (yellow and red lines). The alternative route avoids several constraints, including allocated mineral sites, a historic landfill, and proximity to SSSIs, which are indicated by various colored areas and labels on the map. Key roads like the M180, A159, and B1400 are also shown.</p>	<p>With consideration that a pipeline spur to British Steel is no longer required, an alternative route (shown in blue) was proposed. This alternative route provided a shorter, more direct route that avoided the constraints crossed by the HLCP route. At the eastern extent of the alternative route, two options were considered due to the potential interaction with a</p>

HLCP Statutory Consultation south of Scunthorpe change control	Alternative considered	Description of the alternative considered
		planning application in the area.
<p>Interaction with a planning allocation and an allocated site for mineral resources at an operational quarry near Kettleby.</p>	<p><u>Brigg to Bigby South alternative</u></p> 	<p>Two alternative routes were identified.</p> <p>The Brigg to Bigby South alternative routed the pipeline further away from the Kettleby Quarry by passing the village of Bigby to the south. However, this option presented engineering and technical complexities due to topography and the proximity of residential properties</p>

HLCP Statutory Consultation south of Scunthorpe change control	Alternative considered	Description of the alternative considered
	<p><u>Bigby North alternative</u></p> 	<p>The Bigby North alternative, although routing closer to the Kettleby quarry than the Brigg to Bigby South alternative, still avoided the planning application and mineral allocated site. It also avoided the topographical and engineering challenges presented by the other alternative and was therefore preferred.</p>

HLCP Statutory Consultation south of Scunthorpe change control	Alternative considered	Description of the alternative considered
<p>Request from a landowner to avoid land used for livestock farming, an agricultural reservoir and a potential future solar development.</p>	 <p>The map displays a proposed route (yellow line) that curves through agricultural fields. It starts near Thornton Road, passes south of Thornton Curtis, and then curves eastward, avoiding a farm holding (indicated by a red outline), an agricultural reservoir (blue area), and a potential future solar development (dashed blue area). The route ends near Wootton. Other roads shown include Thornton Road and a road running north-south through the center of the map.</p>	<p>A route was identified to the west of the farm holding which passed through agricultural fields with no clear constraints identified from a desktop review.</p>

As part of the Applicant's due diligence work and review of the HLCP route, a route option north of Scunthorpe was also identified. The northern option for Scunthorpe considered the similar route corridor options identified by the HLCP project, such as option A3 mentioned earlier. This was adapted to align with the differing aims of the Project, specifically removing the connection to British Steel and adding a connection to the Croxton area. An overview of the initially identified north of Scunthorpe route option compared to the HLCP Statutory Consultation south of Scunthorpe route (discounting the change control alternatives, discussed above) is illustrated in Insert A3-1-14.



Insert A3-1-14 – Overview of the HLCP South of Scunthorpe route and the Project's initial north of Scunthorpe route option (shown in green)

An environmental appraisal was undertaken on the initial north of Scunthorpe route option to identify potential constraints and understand their level of risk for the Project to obtain consent, supporting the decision on whether the Project would progress with exploring the north of Scunthorpe route option.

The appraisal used desk-based environmental data and relevant survey information obtained from the HLCP project (where relevant and available). Professional judgement was used to assign a risk category to each environmental topic.

The only 'High Risk' identified was for ecology, primarily due to the proximity of the route to the statutory international and national ecologically designated sites associated with the crossing location of the River Trent and the proximity of the River Humber. Further ecological constraints identified include non-statutory designated sites such as the proximity of New River Ancholme Local Wildlife Site west of South Ferriby and the presence of numerous areas of sensitive habitats including semi-improved grassland, riparian habitat, and small pockets of woodland. Other environmental topics were considered to be of Medium or Low risk.

In addition, separate engineering studies were also undertaken on the north of Scunthorpe route option to inform the decision, including:

- Service and utility searches
- Desktop geotechnical / geohazard assessment
- Desktop constructability assessment
- Quantitative Risk Assessment
- A site vantage point survey

The outcome of the studies decided that the north of Scunthorpe route was selected as the option to be progressed, for the following reasons:

- Avoids some known environmental and planning constraints, such as interacting with known planning applications and allocations, such as those associated with minerals discussed above, as well as fewer main river crossings.
- Provides improvements in operational safety, with regards to the route passing in proximity to fewer densely populated areas or sensitive locations (as defined by the relevant standard PD8010).
- Requires two fewer AGIs.
- Requires a route that is approximately 10km shorter, providing cost and construction programme benefits.

The north of Scunthorpe route option would introduce a crossing of the River Trent at a location that is designated as a SAC, SSSI, Ramsar. However, via engagement with Natural England, the design has chosen a crossing location that is considered to be of lower sensitivity to birds, given the presence of Blacktoft Sands and Alborough Flats RSPB reserves to the north. Furthermore, mitigation such as the trenchless crossing method for the River Trent (as discussed in Volume 2 - Chapter 2 – Project Description) would mitigate impacts. Natural England's feedback also commented on the north of Scunthorpe's proximity to River Humber and the potential impacts upon birds and habitats that are functionally linked to the Humber Estuary SPA. Bird surveys are being undertaken to understand the potential impacts and engagement will continue with Natural England upon the results, and the findings will inform the design and any proposed mitigation measures.

Therefore, upon balance with the benefits noted above, the north of Scunthorpe route option was selected.

Process Safety

The safety of the population residing, living, and working in proximity to the pipeline is at the core of the HCCP pipeline routeing. To aid the routeing exercise, a detailed QRA was undertaken in line with industry standards and updated at each major revision of the route to guarantee the safety of the route and achieve a continual risk reduction during pipeline route development. The results for the current routeing profile were in the broadly acceptable range, with recommendations to further reduce the likelihood of release with additional safeguards being added to the route, such as slabbing in areas of the pipeline

with a higher identified release frequency. These will be adopted by the project as it develops.

In the extremely unlikely event of loss of containment of carbon dioxide due a failure of the pipeline, the pipeline routeing has avoided all centres of population and individual dwellings wherever practicable. This is demonstrated that during the course of the Qualitative Risk Assessment (QRA), the calculated risk meets and exceeds regulatory requirements. This design principle was applied based on current population and workplace data, as well as planning applications and an appreciation of where populations could grow during the lifetime of the pipeline.

In addition, all requirements of Land Use Planning (LUP) were followed to ensure that the HSE would provide a “Does Not Advise Against” (“DNAA”) response to Planning Authorities (PA).

References

- Ref 3.1.1 AECOM (2019) Proposed Humber Carbon Capture Usage and Storage Project, Environment Constraints Study, National Grid Ventures, CC-AEC-RP-ENV-000002.
- Ref 3.1.2 AECOM (2021) Humber Cluster Proposed Carbon Dioxide Transportation Pipeline System, Pipeline Route Corridor and AGI Siting Constraints Study National Grid Ventures.
- Ref 3.1.3 Arcadis (2021) Humber Low Carbon Pipelines, Route Corridor Report, National Grid.
- Ref 3.1.4 Wood (2022) Humber Low Carbon Pipelines, Stage 1 Non-Statutory Consultation Feedback Report, National Grid.

Appendix 4.1 – Construction Environmental Management Plan (CEMP)

Introduction

This draft Construction Environmental Management Plan (CEMP) sets out how site-specific measures and construction methodologies will help to avoid and reduce potential environmental impacts during construction of the Project. Northern Endurance Partnership (NEP) (or contractors working on their behalf) will be responsible for implementing the measures outlined within this draft CEMP.

At this stage the focus of the draft document is on the expected guidance and control measures pertinent to the site. Additional detail including points of contact, roles and responsibilities, incident reporting etc that will form the detailed CEMP will be developed by the Contractor(s).

Scope of Work and Project Description

Background

Carbon Capture and Storage (CCS) is a process which removes carbon dioxide emissions from industrial processes and power generation and transports them to secure storage areas, where carbon dioxide is permanently stored.

Several industrial sites in the Humber region are developing plans to capture their carbon emissions and it is anticipated that other carbon capture projects are likely to come forward in the near future.

The Humber Carbon Capture Pipeline (HCCP) is an essential part of CCS in the Humber region and would provide the required onshore captured carbon dioxide transportation infrastructure. Carbon dioxide will then be permanently stored underground in offshore stores held by NEP. These include Endurance (CS001) and expansion stores (CS006, CS007 and CS025). At this point, the Project would interface with an offshore pipeline that would deliver the continuation of the carbon dioxide transportation pipeline to secure subsea storage.

Proposed Works

The objective of the Project is to deliver a new onshore pipeline network and associated infrastructure to transport captured carbon dioxide from industrial and power generation facilities in the Humber region to the coast north of Easington.

Consents and Licences

A schedule of the currently known consents and licences required for the Project has been prepared, refer to Table A4-1-1 below. The relevant commitments and conditions on

consents and licenses will be transferred to the control and guidance register to ensure they are delivered, and their implementation is monitored.

Table A4-1-1 – Summary of consents and licences required

Consents / licence	Consenting Body	Statutory Timescales
Flood Risk Activity Permit	Environment Agency	2 months
Ordinary Watercourse Consent	Lead Local Flood Authority (LLFA)	2 months
Abstraction Licence	Environment Agency	Full licence – within 4 months Temporary licence (if abstracting over less than 28 days) 28-56 days
European Protected Species (EPS) Mitigation Licence for bats (if required)	Natural England	30 working days
EPS Mitigation Licence for Water Vole (if required)	Natural England	30 working days
EPS Mitigation Licence for Otter (if required)	Natural England	30 working days
EPS Mitigation Licence for Badger (if required)	Natural England	30 working days
Public Path Orders	County Councils	No statutory period for issue, public consultation statutory 28 days

A record will be kept of all the consultations with statutory and non-statutory organisations and all correspondence (sent and received) with meeting notes copied to NEP. An index of the correspondence is required to be kept for ease of access on a consultation schedule. The schedule may also make a record of all communications with third parties, including telephone conversations and site visits.

Team Roles and Responsibilities

Environmental Management Systems

NEP will implement management processes and briefings so that the works are carried out in accordance with current legislation and guidance.

The policy statement will be displayed on the site notices boards, publicised to all site staff and operatives, and made available to interested parties upon request.

Responsibilities

The Main Works Contractor(s) will undertake the construction works in accordance with any planning conditions and associated documents including the draft CEMP. The relevant aspects of this draft CEMP will be notified to the workforce at commencement of works to highlight the relevant commitments and responsibilities to those undertaking the work.

Roles and responsibilities for the Project are presented in Table A4-1-2. These roles may be delivered by multiple people across the Project, who are designated with that specific responsibility.

Table A4-1-2 – Roles and Responsibilities

Role	Organisation	Responsibilities
Environmental Manager	Main Works Contractor(s)	The Environmental Manager will be responsible for the maintenance of all environmental plans and registers, including monitoring that the environmental measures and mitigations are implemented. They will be the main point of contact for all environmental matters on the Project. They will oversee ecological pre-construction surveys. They will also develop good working relationships with external stakeholders such as the Environment Agency.
Site Waste Manager	Main Works Contractor(s)	The Site Waste Manager will be responsible for day-to-day waste management and maintaining site waste registers / documentation. They will maintain the central register of all waste consignment notes together with schedules of carriers and disposal locations and waste datasheets to provide efficient tracking of waste management as part of record keeping for internal and external auditing purposes.
Environmental Clerk of Works (EnvCoW)	Main Works Contractor(s) / NEP	The EnvCoW will monitor that the works proceed in accordance with relevant environmental requirements and adhere to the required mitigation measures. The EnvCoW will be supported by appropriate technical specialist advisors depending on the location and potential impacts.
Ecological Clerk of Works (ECoW)	Main Works Contractor(s) / NEP	A suitably qualified ECoW will supervise works such as vegetation clearance. The ECoW will ensure that the works proceed in accordance with relevant ecological requirements and adhere to the required mitigation measures.
Permits and Consents Manager	Main Works Contractor(s)	The Permits and Consents Manager will work with the Environmental Manager to draft and submit permits and consents on behalf of the Project, track progress, provide updates and communicate approvals.

Role	Organisation	Responsibilities
Works Supervisor	Main Works Contractor(s)	The Works Supervisor will be responsible for delivering the site works in accordance with the requirements and implementing good environmental practices required by the Environmental Manager. They will be responsible for managing operatives, plant and their areas of work in accordance with the principles of good environmental practice.
Technical specialist advisors	Main Works Contractor(s) / NEP	These will have the relevant experience to supervise the relevant aspects of the works, which may include a land contamination specialist, and a soil specialist as required depending on the nature of works.

Information Training and Awareness

All staff and operatives working on the Project will undergo training to increase their awareness of environmental issues as applicable to their role on the Project. Suitable site-specific induction training and on-going programmes of environmental training will, as minimum, include:

- Importance and relevance of the detailed CEMP.
- Roles and responsibilities in relation to compliance with consents and designations, permits and operating procedures.
- Location of sensitive receptors and areas of high environmental value.
- Familiarisation with site environmental procedures.
- Hazard and risk management to ensure personnel understand the potential impacts and proposed mitigation measures.
- Community complaints management procedure.

Regular environmental toolbox talks will be provided by the Main Works Contractor(s) for all staff. These will give targeted information about site-specific issues or activities taking place at that time, as appropriate (e.g. nesting birds in early March to August (inclusive)). Toolbox talks specific to the site will be developed and included in the detailed CEMP.

Community Engagement and Public Information

During construction, a programme of effective and sustained communication is to be incorporated into the detailed CEMP. The Main Works Contractor will notify stakeholders, occupiers of nearby or affected properties, businesses and adjacent or affected parish councils a minimum of two weeks in advance of planned construction works that may affect them. Information included in the notifications will include, as appropriate:

- The location of the planned works.
- The activities to be carried out.
- The duration of the planned works and the periods within which works will be undertaken (i.e., whether during normal working hours, during the evening or overnight).
- The anticipated impacts of the planned works.
- The measures to be implemented in line with the detailed CEMP to mitigate the impact of the planned works.
- Enquires and complaints procedure.

Environmental Control Measures

General Arrangements

Copies of the following documents will be available upon request:

- Planning approval.
- The detailed CEMP.

- Any licences / consents / permits required.
- The Construction Traffic Management Plan (CTMP).
- Soil Management Plan.
- Site Waste Management Plan.
- Materials Management Plan.
- Flood Risk Action Plan.
- Pollution Control Plan.
- Landscape and Ecology Management Plan (LEMP).
- The pollution spillage response plans and all site emergency procedures.
- Staff training records.

To reduce the likelihood of either an environmental incident or nuisance occurring measures have been collated and can be found in Appendix 4.2: Draft Register of Environmental Actions and Commitments.

Construction Methodology

Construction Programme

A construction programme and phasing plan will be included in the detailed CEMP.

Proposed Construction Schedule

The indicative construction and commissioning stage will consist of the following:

- Pre-commencement works.
- Site establishment and enabling works.
- Main Construction Activities/
- Reinstatement.
- Demobilisation.

Working Hours

The sequencing of construction works would aim to be undertaken in the most efficient manner, taking account of technical, environmental, landowner and stakeholder factors wherever reasonable and practicable. Not all locations throughout the route of the Project would be subject to construction works at once. The exact construction programme at each specific location along the route would be developed by the construction contractor during detailed design and engagement with stakeholders would be undertaken where necessary.

The Applicant has been considering what preliminary works could be undertaken to facilitate the construction works programme. These works will be discussed with stakeholders at the appropriate time where practicable.

Twenty-four-hour working would be required to align with critical work activities such as tunnelling, boring, other trenchless crossings, testing or works associated with offshore interfaces. Throughout the EIA process each environmental discipline will assess the likely significant effects of 24-hour working.

Consents, Licences and Permits

Any licences or consents required during construction will be listed in the detailed CEMP.

Construction Plant

Precise details of the nature, quantity and delivery of plant and machinery are unknown at this stage but will be defined in the detailed CEMP.

Construction Site Layout

As far as reasonably practicable and appropriate, the site layout and appearance will be designed using the following principles:

- Screening of the compound, where necessary and practical, to supplement where the compound is already screened by existing features.
- Providing measures for site security.
- Any proposed security cameras will be sited and directed so that they do not intrude into occupied residential properties.
- Storage sites, fixed plant and machinery equipment and temporary offices will be located to limit environmental impacts, as far as reasonably practicable, and having due regard to neighbouring accommodation, as far as allowed by the constraints of the site.
- Site lighting will be located and directed so as not to intrude on to sensitive receptors or constitute a road hazard.
- Site facilities will be powered from mains electrical sources, where practicable.

Prior to Project starting construction, the Main Works Contractor(s) will allow for:

- The parking of vehicles of Site operatives and visitors.
- Loading and unloading of plant and materials.
- Storage of plant and materials used in constructing the Project.
- The erection and maintenance of security hoarding including decorative displays and facilities for public viewing, where appropriate. Wheel washing facilities where required.
- Measures to control the emission of dust and dirt during construction.
- A scheme for recycling / disposing of waste resulting from demolition and construction works.

Compound Offices / Welfare

Construction will require the establishment of a construction compound to accept material deliveries, provide storage for materials, tools, plant and equipment, provide office and

welfare facilities for workers and a base for vehicle recovery. The detailed CEMP will include a plan of the proposed construction compound layout.

Storage of Materials

Secure, hard-standing space will be designated alongside loading and unloading areas for the initial storage of plant and materials. Where required, additional localised storage areas will be introduced, in line with the phasing of the development, to reduce the movement of plant and materials around the site.

All hazardous substances (including liquids and solids) will be stored within secure, impermeable, bunded areas where applicable, protected from the rain, to remove the risk of migration to groundwater or a nearby watercourse. The measures proposed will reduce the risk of contaminants and suspended solids to migrating to surface and groundwater and protect water quality and the ecosystems that the water resources support.

Construction Routes, Access Points and Temporary Access Routes

Details of the construction routes, access points and temporary access routes are set out within the CTMP.

Vegetation Clearance

Details of vegetation clearance will be included in the detailed CEMP. Refer to Appendix 5.1 Outline Soil Management Plan for all Agriculture and Soils commitments.

Efficient Water Consumption during construction

The main uses of water on the Project will be:

- General water consumption: This includes drinking water for workers, handwashing and washing facilities and flushing of toilets. Water consumption will be reduced by having variable flush toilets, cut-off taps, and efficient washing machines where provided.
- Dust suppression: Non-potable water will be used as a preference to suppress dust generated during the work, particularly during dry spells.
- Cleaning of roads and working areas: Non-potable tanker water will be used to clean roads and working areas. Similarly for dust suppression reuse of water will be sought.
- Pre-commissioning and hydrostatic testing: The pipelines would be internally cleaned, gauged, flooded and hydrostatically tested to prove their integrity in accordance with the relevant specifications.
- Trenchless crossings: Drilling fluid is typically a mixture of fresh water and bentonite clay in powder form, mixed on the surface and pumped into the drill string using a high-pressure drilling fluid pump.
- Water holding lagoons.
- Vegetation reinstatement.

The construction compound may be connected to mains water supply and use suitable treatment measures such as biodigesters for wastewater or for this to be taken away by tankers.

The construction compound will be provided with good practice measures for water conservation, for example the use of water-efficient taps within welfare facilities, waterless toilet facilities, assessment of whether water can be reused, and regular checks to hoses for water leaks.

Efficient Energy Use During Construction

Vehicles will be correctly maintained and operated in accordance with manufacturer's recommendations and in a responsible manner. All plant and vehicles will be required to switch off their engines when not in use and when it is safe to do so.

Temporary site units will be energy efficient, for example having the following features, where practicable:

- Double glazed windows.
- Insulated walls.
- Energy efficient lighting, with motion sensors.
- Energy monitoring and smart switching.

It is anticipated that the construction compound will be connected to a mains electricity supply where possible. The Main Works Contractor(s) would seek to source electricity from green energy suppliers. Local compounds and isolated work fronts will use hybrid generators with battery units where appropriate. Generators will be appropriately sized to optimise running efficiency.

Non-hybrid fleet vehicles are presently being phased out and consideration will be given to electrical vehicles where available and practicable. Charging points will be provided for site vehicles at the construction compound if applicable.

Implementation

Implementing the detailed CEMP

Robust procedures will be put in place to inform and supervise all those working on the Project including its Main Works Contractor(s), to make sure the control measures set out in the detailed CEMP (to be developed by the Main Works Contractor(s)) are adopted when undertaking the construction of the Project. The main responsibility for implementing these control measures will fall to the Main Works Contractor(s), with NEP retaining accountability.

The Main Works Contractor(s) will brief all operatives on the specific details within the detailed CEMP prior to the commencement of works. The briefings will be delivered by a

suitably trained member of the team such as a Site supervisor, Construction Manager, Environmental Manager or EnvCoW.

Site Checks and Reporting

Regular site checks will be carried out to monitor compliance with the detailed CEMP. The programme of site inspections will be controlled by the Environmental Manager and implemented by the EnvCoW. The overarching inspections are summarised in Table A4-1-3. Immediate action including, if necessary “stop works”, will be taken should any incidents or non-conformance with the detailed CEMP be found during inspection.

Site checks and inspections will include checks against compliance with good practice measures and other commitments made by the Project. The programme of site inspections will be controlled by the Environmental Manager and implemented by the EnvCoW, who will draw on appropriate suitably experienced specialists for specific tasks.

Table A4-1-3 – Summary of overarching inspections

Inspection Type	Purpose	Who	Frequency
General site Inspections			
Environmental Inspections	<p>To monitor compliance with Project commitments and the environmental standards.</p> <p>To record adherence to good practice measures and raise actions where concerns are identified.</p> <p>To check mitigation measures for sensitive features are in place.</p>	Environmental Manager EnvCoW	Weekly
Audits (External / Internal)	Formal audit process for internal Management System.	Internal or External Auditor Environmental Manager	Annual
Site Checks	To ensure that working practices are carried out in accordance with approved methods, standards and good practice measures.	Work Supervisor	Daily visual check in working area

The results of inspections will be recorded in an Environmental Log. Findings will be disseminated to the wider construction team as appropriate and additional procedures put in place if required.

Non-Compliance Procedure

The EnvCoW will be responsible for undertaking site audits to check compliance with the detailed CEMP and method statements. All incidents associated with the construction of the Project, including environmental incidents and non-conformance with the detailed CEMP, will be reported and investigated as defined within the detailed CEMP. Further detail will be included in the detailed CEMP to be developed by the Main Works Contractor(s).

Complaints Procedure

To be included in the detailed CEMP.

Appendix 4.2 – Register of Environmental Actions and Commitments (REAC)

Introduction

This draft Register of Environmental Actions and Commitments (REAC) contained in Table A4-2-1 below describes the environmental actions and commitments that have been identified during the preliminary stage and reported within the PEIR chapters (Volume 2) in order to mitigate the potential environmental effects of the Project.

The draft REAC contains measures that will be implemented during design, construction, operation and decommissioning of the Project. It will enable the Applicant to communicate environmental actions and commitments to designers, contractors, operators and users of the Project.

In this context, good practice means standard approaches and actions commonly used on infrastructure development projects to avoid or reduce environmental impacts, typically applicable across the whole Project. Essential mitigation means any additional Project-specific measures needed to avoid, reduce or offset potential impacts that could otherwise result in effects considered significant in the context of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (EIA Regulations).

As measures are refined and / or updated as the Project progresses, this draft REAC will be updated and submitted alongside the Environmental Statement (ES), where further refinement of the Project will be assessed and the measures proposed within this draft REAC adapted to encapsulate the proposed mitigation measures within the ES.

Table A4-2-1 – Preliminary Register of Environmental Actions and Commitments

Reference Number	Commitment / Mitigation Measure	Project phase	Description	Relevant Topic / Aspect	Securing Mechanism	Responsible Organisation
Design						
REAC1	Design Approach Document	Design / Construction	Design Approach Document (DAD) will be produced, setting out all procedures to be implemented during construction of the Project.	Various	DCO Application	Design team to produce / Main Works Contractor(s) to implement
ECO19 SEC5 TT1 CP2	Design Life	Design	Pipeline to be adequately buried below the predicted cliff line and seabed profile throughout its design life (25 years).	Various	DCO Application	Design team
ECO13	Avoiding Most Sensitive Important Ecological Features (IEFs)	Design	The locations of AGIs and the Pump Facility have already been selected to avoid the most sensitive IEFs, while the positioning of other permanent infrastructure will be refined, where feasible, through detailed design and consultation with ecological specialists to further minimise impacts on IEFs.	Ecology and Biodiversity	DCO Application	Design Team
GEO4	Hydrogeologically Sensitive Areas	Design	Routeing of pipeline to avoid Hydrogeologically sensitive areas such within a SPZ1 of a public water supply well.	Ground Conditions and Hydrogeology	DCO Application	Design Team
GEO5	Shallow Groundwater Flow Pathways	Design	Avoid disrupting shallow groundwater flow pathways with extensive underground infrastructure, which could create a barrier effect and potentially lead to groundwater flooding.	Ground Conditions and Hydrogeology	DCO Application	Design Team
GEO6	Avoid Mixing Waters Between Aquifers	Design	Avoid mixing waters between multiple aquifers, such as in deep open excavations, which could cause contamination of groundwater by mobilising shallow contamination.	Ground Conditions and Hydrogeology	DCO Application	Design Team
CH3	Sensitive Heritage Receptors	Design	Routeing and siting for the Project will be sensitive. The Project will avoid and reduce, as far as practicable, effects on identified heritage receptors.	Cultural Heritage	DCO Application	Design team
CH4	Landscape Planting	Design	Above Ground Installations and the Pump Facility WILL have an associated landscape planting scheme to integrate the facility into the surrounding landscape, if a requirement is determined based on the assessment. This would be in order to reduce potential visual impacts to the setting of heritage assets during the operation phase.	Cultural Heritage	DCO Application	Design team
LV1	Siting and Layout	Design	AGIs and Pump Facility are positioned to respond to the surrounding landscape character and to better integrate with their setting.	Landscape	DCO Application	Design team
LV2	Materials and colours	Design	Finishes will be specified to reduce visual contrast and help the AGIs and Pump Facility sit more comfortably within their landscape setting.	Landscape	DCO Application	Design team

Reference Number	Commitment / Mitigation Measure	Project phase	Description	Relevant Topic / Aspect	Securing Mechanism	Responsible Organisation
LV3	Integrated with Surrounding Landscape	Design	Any proposed earthworks will be shaped to ensure they are well integrated with the surrounding landscape and avoid an overly engineered appearance.	Landscape	DCO Application	Design team
LV4	Soft Landscape Planting	Design	The AGIs have been designed with a surrounding buffer area that will be used for soft landscape planting. This is likely to include native tree and shrub species, which will help to visually soften the appearance of the industrial structures and assist in integrating the AGIs into the surrounding landscape.	Landscape	DCO Application	Design team
HH1	Public Right of Way (PRoW) Management Plan	Design / Construction	Development of and adherence to a PRoW Management Plan to minimise impact.	Human Health and Wellbeing	DCO Application	Design team to produce / Main Works Contractor(s) to implement
CP12	Coastal Erosion	Design	Pipeline route optimisation in the nearshore will be conducted where reasonably practicable to minimise impacts on potential features of conservation interest.	Coastal Processes	DCO Application	Design team
CP1	Cliff Retreat	Design	Pump Facility will be set back at an appropriate distance from the cliff such that there is no risk in the context of cliff retreat over the lifetime of the Project.	Coastal Processes	DCO Application	Design team
Construction						
REAC2	Landscape Environmental Management Plan (LEMP)	Construction	LEMP will be produced and implemented.	Landscape	DCO Application	Main Works Contractor(s)
REAC3	Construction Phase Plan	Construction	Management of the construction stage of the Project through the implementation of the Construction Phase Plan (required under the Construction Design and Management (CDM) Regulations 2015).	Major Accidents and Disasters	DCO Application	Main Works Contractor(s)
REAC4	Soil Management Plan (SMP)	Construction	Soil management measures will be set out in a SMP as part of the Construction Environmental Management Plan (CEMP).	Agriculture and Soils	DCO Application	Main Works Contractor(s)
REAC5 HH3	Construction Transport Management Plan (CTMP)	Construction	CTMP would be implemented by Main Works Contractor to ensure that all traffic associated with the Project's construction works operate in a safe and compliant manner.	Various	DCO	Main Works Contractor(s)
GEO14 CH2 TT3 HYD19 CP8	CEMP	Construction	A CEMP will be produced, setting out all procedures to be implemented during construction of the Project. The CEMP will set out a series of measures, based on best practice guidance from a range of environmental disciplines to control the environmental effects of the construction of the Project.	Various	DCO Requirement	Main Works Contractor(s)
GEO12 SEC7 TT4	Cofferdam and Other Associated Infrastructure If Present	Construction	The cofferdam, if used, and other associated infrastructure will be present for as short a time as reasonably practicable during construction.	Various	DCO Application	Main Works Contractor(s)

Reference Number	Commitment / Mitigation Measure	Project phase	Description	Relevant Topic / Aspect	Securing Mechanism	Responsible Organisation
CP10						
GG5 MW1	Site Waste Management Plan (SWMP)	Construction	SWMP will be produced.	Various	DCO Application	Main Works Contractor(s)
GEO8 CP4	Piling	Construction	Where practicable, vibratory piling to be used over impact piling for the installation of the cofferdam if used.	Various	DCO Application	Main Works Contractor(s)
GEO11 HYD18 CP7	Best Practice Guidance	Construction	Construction, operations, decommissioning and design of the pipeline will be in accordance with best practice guidance.	Various	DCO Application	Main Works Contractor(s)
AQ1	Stakeholder Communication Plan	Construction	Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.	Air Quality	DCO Application	Main Works Contractor(s)
AQ2	Air Quality and Dust Issues	Construction	Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager / engineer or the site manager.	Air Quality	DCO Application	Main Works Contractor(s)
AQ3	Contact Information	Construction	Display the head or regional office contact information.	Air Quality	DCO Application	Main Works Contractor(s)
AQ4	Dust Management Plan (DMP)	Construction	Develop and implement a DMP, which may include measures to control other emissions, approved by the Local Authority.	Air Quality	DCO Application	Main Works Contractor(s)
AQ5	Dust and Air Quality Complaints	Construction	Record all dust and air quality complaints (as required), identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.	Air Quality	DCO Application	Main Works Contractor(s)
AQ6	Complaints log	Construction	Make the complaints log available to the local authority when asked.	Air Quality	DCO Application	Main Works Contractor(s)
AQ7	Exceptional Incidents	Construction	Record any exceptional incidents that cause dust and / or air emissions, either on- or off-site, and the action taken to resolve the situation in the log book.	Air Quality	DCO Application	Main Works Contractor(s)
AQ8	Meetings	Construction	Hold regular liaison meetings with other high risk construction sites within 250m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport / deliveries which might be using the same strategic road network routes.	Air Quality	DCO Application	Main Works Contractor(s)
AQ9	Site Inspections	Construction	Undertake on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the Local Authority when asked. This should include regular dust soiling checks of surfaces such as street	Air Quality	DCO Application	Main Works Contractor(s)

Reference Number	Commitment / Mitigation Measure	Project phase	Description	Relevant Topic / Aspect	Securing Mechanism	Responsible Organisation
			furniture, cars and window sills within 100m of site boundary, with cleaning to be provided if necessary.			
AQ10	DMP Compliance Inspections	Construction	Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked.	Air Quality	DCO Application	Main Works Contractor(s)
AQ11	Increased Inspections	Construction	Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.	Air Quality	DCO Application	Main Works Contractor(s)
AQ12	LPA Monitoring	Construction	If required, agree dust deposition, dust flux, or real-time PM10 continuous monitoring locations with the Local Authority. Where possible, commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences. Further guidance is provided by IAQM on monitoring during demolition, earthworks and construction.	Air Quality	DCO Application	Main Works Contractor(s)
AQ13	Site Layout	Construction	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.	Air Quality	DCO Application	Main Works Contractor(s)
AQ14	Soil Screens or Barriers	Construction	Where required by Risk Assessment Method Statement (RAMS), erect solid screens or barriers around dusty activities or the site boundary so that are at least as high as any stockpiles on site.	Air Quality	DCO Application	Main Works Contractor(s)
AQ15	Enclose Site	Construction	Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period and where risk to the receptors is present.	Air Quality	DCO Application	Main Works Contractor(s)
AQ16	Runoff	Construction	Avoid site runoff of water or mud.	Air Quality	DCO Application	Main Works Contractor(s)
AQ17	Fencing, Barriers and Scaffolding	Construction	Regularly maintain site fencing, barriers and scaffolding.	Air Quality	DCO Application	Main Works Contractor(s)
AQ18	Materials	Construction	Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site, cover as described below.	Air Quality	DCO Application	Main Works Contractor(s)
AQ19	Stockpiles	Construction	Cover, seed or fence stockpiles to prevent wind whipping.	Air Quality	DCO Application	Main Works Contractor(s)
AQ20	No Idling Vehicles	Construction	Ensure all vehicles switch off engines when stationary - no idling vehicles.	Air Quality	DCO Application	Main Works Contractor(s)
AQ21	Avoid Diesel and petrol powered	Construction	Avoid the use of diesel or petrol powered plant equipment, and use mains electricity or battery powered equipment where practicable.	Air Quality	DCO Application	Main Works Contractor(s)

Reference Number	Commitment / Mitigation Measure	Project phase	Description	Relevant Topic / Aspect	Securing Mechanism	Responsible Organisation
AQ22	Maximum-speed-limit	Construction	Impose and signpost a maximum-speed-limit, as defined by the RAMS, on surfaced and unsurfaced haul roads and work areas (if long haul routes are required, these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the Local Authority, where appropriate).	Air Quality	DCO Application	Main Works Contractor(s)
AQ23	Construction Logistics Plan	Construction	Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.	Air Quality	DCO Application	Main Works Contractor(s)
AQ24	Travel Plan	Construction	Implement a Travel Plan that supports and encourages sustainable travel (e.g. public transport, cycling, walking, and car-sharing).	Air Quality	DCO Application	Main Works Contractor(s)
AQ25	Dust Suppression Techniques	Construction	Where practicable, only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.	Air Quality	DCO Application	Main Works Contractor(s)
AQ26	Adequate Water Supply	Construction	Where required ensure an adequate water supply on the site for effective dust / particulate matter suppression / mitigation, using non-potable water where possible and appropriate.	Air Quality	DCO Application	Main Works Contractor(s)
AQ27	Enclosed Chutes, Conveyors and Covered Skips	Construction	Where practicable, use enclosed chutes and conveyors and covered skips.	Air Quality	DCO Application	Main Works Contractor(s)
AQ28	Minimise Drop Heights	Construction	Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.	Air Quality	DCO Application	Main Works Contractor(s)
AQ29	Spillages	Construction	Ensure equipment is readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.	Air Quality	DCO Application	Main Works Contractor(s)
AQ30	Avoid Bonfires and Waste Burning	Construction	Avoid bonfires and burning of waste materials.	Air Quality	DCO Application	Main Works Contractor(s)
AQ31	Biological Debris	Construction	Bag and remove any biological debris or damp down such material before demolition.	Air Quality	DCO Application	Main Works Contractor(s)
AQ32	Re-vegetate Earthworks	Construction	Re-vegetate earthworks and exposed areas / soil stockpiles to stabilise surfaces as soon as practicable.	Air Quality	DCO Application	Main Works Contractor(s)
AQ33	Hessian, Mulches or Tackifiers	Construction	Use Hessian, mulches or tackifiers (chemical adhesive to increase the stickiness of a surface) where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.	Air Quality	DCO Application	Main Works Contractor(s)

Reference Number	Commitment / Mitigation Measure	Project phase	Description	Relevant Topic / Aspect	Securing Mechanism	Responsible Organisation
AQ34	Temporary Construction Areas	Construction	For temporary construction areas, the AGIs and the Pump Facility, only remove the cover in small areas during work and not all at once.	Air Quality	DCO Application	Main Works Contractor(s)
AQ35	Scabbling	Construction	Avoid scabbling (roughening of concrete surfaces) if possible.	Air Quality	DCO Application	Main Works Contractor(s)
AQ36	Bunded Areas	Construction	Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.	Air Quality	DCO Application	Main Works Contractor(s)
AQ37	Bulk Cement and Other Fine Powder Materials	Construction	Ensure bulk cement and other fine powder materials are delivered in enclosed tankers or sealed bags and stored in silos with suitable emission control systems to prevent escape of material and overflowing during delivery or with other dust control measures.	Air Quality	DCO Application	Main Works Contractor(s)
AQ38	Fine Powder Materials	Construction	For smaller supplies of fine powder materials ensure bags are sealed after use and stored appropriately to prevent dust.	Air Quality	DCO Application	Main Works Contractor(s)
AQ39	Water-assisted Dust Sweeper(s)	Construction	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.	Air Quality	DCO Application	Main Works Contractor(s)
AQ40	Avoid Dry Sweeping	Construction	Avoid dry sweeping of large areas.	Air Quality	DCO Application	Main Works Contractor(s)
AQ41	Aggregate Transportation	Construction	Ensure aggregate transportation vehicles entering and leaving sites are covered to prevent escape of materials during transport.	Air Quality	DCO Application	Main Works Contractor(s)
AQ42	Haul Routes	Construction	Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	Air Quality	DCO Application	Main Works Contractor(s)
AQ43	Haul Roads	Construction	Record all inspections of haul routes and any subsequent action in a site log book.	Air Quality	DCO Application	Main Works Contractor(s)
AQ44	Haul Roads	Construction	Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.	Air Quality	DCO Application	Main Works Contractor(s)
AQ45	Wheel Washing	Construction	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	Air Quality	DCO Application	Main Works Contractor(s)
AQ46	Wheel Washing	Construction	Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.	Air Quality	DCO Application	Main Works Contractor(s)

Reference Number	Commitment / Mitigation Measure	Project phase	Description	Relevant Topic / Aspect	Securing Mechanism	Responsible Organisation
AQ47	Access Gates	Construction	Access gates to be located at least 10 m from receptors where possible.	Air Quality	DCO Application	Main Works Contractor(s)
AQ48	Non-Road Mobile Machinery (NRMM)	Construction	Ensure all off-road vehicles comply with the requirements of the European NRMM standards, where applicable. Use stage 4 NRMM as a minimum and stage 5 where practicable.	Air Quality	DCO Application	Main Works Contractor(s)
ECO1	Trenchless Crossings	Construction	<p>As per Volume 2 - Chapter 10: Ground Conditions and Hydrogeology, trenchless crossings will be employed at the following watercourses:</p> <ul style="list-style-type: none"> • River Ouse • River Aire • Aire and Calder Navigation • Dutch River • River Trent • Halton Drain • New River Ancholme • East Halton Beck • River Humber • Winestead Drain <p>It is currently understood that trenchless crossings would also be employed to avoid direct impacts on the following IEF's: Humber Estuary</p> <p>Corridor, Holderness Coast, Hedon-Winestead Disused Railway Line LWS, Winterton Beck, West Drain, Weir Dike / East Drain, Paull Holme Strays LWS, coastal saltmarsh, mudflats and lowland fens; and some of the following habitats: lowland calcareous grassland, deciduous woodland, hedgerows (including Important hedgerows), unnamed ditches / drains and roadside verges.</p> <p>Following review of survey data, in response to consultation and as design develops, the use of trenchless crossings may be adopted at additional IEFs.</p>	Ecology and Biodiversity	DCO Application	Main Works Contractor(s)
ECO2	Wet Grassland Areas	Construction	Route alignment to minimise impact. Avoidance of construction within designated wet grassland area. Micro-siting to avoid surface hydrology features.	Ecology and Biodiversity	DCO Application	Main Works Contractor(s)
ECO3	Mosaic Habitat	Construction	Avoidance of open mosaic habitat where feasible. Habitat change monitoring and pre-construction surveys if impacted.	Ecology and Biodiversity	DCO Application	Main Works Contractor(s)
ECO4	Special Protection Areas (SPAs)	Construction	Avoidance of known high-use SPA supporting habitat. Timing of works to avoid peak use by non-breeding waterbirds.	Ecology and Biodiversity	DCO Application	Main Works Contractor(s)

Reference Number	Commitment / Mitigation Measure	Project phase	Description	Relevant Topic / Aspect	Securing Mechanism	Responsible Organisation
ECO5	Construction Exclusion Zones (CEZ)	Construction	CEZ will be established prior to construction to define working areas and protect retained habitats. A minimum buffer of 10 m (where practicable) would be retained around Important Ecological Features (IEFs) to reduce any potential direct or indirect impacts on the species and habitats associated with them and the CEZ may need to be extended beyond 10 m for certain IEFs, such as woodlands and trees, for example for root protection zones. The location of CEZs will be informed by a pre-construction / pre-decommissioning ecological walkover (to identify any changes to the baseline) and a tree survey (to British Standard BS 5837:2012)	Ecology and Biodiversity	DCO Application	Main Works Contractor(s)
ECO6	Pollution Control Plan	Construction	A Pollution Control Plan will be implemented during construction, including best practice drainage and pollution prevention measures in accordance with Construction Industry Research and Information Association (CIRIA) guidance. Any in-channel works will be carried out under an approved method statement and undertaken sensitively to minimise ecological impact.	Ecology and Biodiversity	DCO Application	Main Works Contractor(s)
ECO7	Aquatic and Semi-Aquatic Species	Construction	A method statement will be developed to ensure flumes used during open-cut crossings allow continued passage of aquatic and semi-aquatic species (e.g. otter, water vole, fish), including dry access routes where practicable. In-channel works may be supported by cofferdams, and fish rescue operations (under Environment Agency licence) will be undertaken using stop nets and electric fishing, with rescued fish released downstream. Open-cut activities will be kept to the minimum practicable duration.	Ecology and Biodiversity	DCO Application	Main Works Contractor(s)
ECO8	Retention	Construction	Retention where possible. Compensatory planting using native species where partial removal is unavoidable.	Ecology and Biodiversity	DCO Application	Main Works Contractor(s)
ECO9	Construction Footprint	Construction	Where avoidance is not possible, minimise construction footprint by crossing features perpendicular to their alignment, using existing gaps in vegetation, and avoiding mature trees and meanders or widened sections. Removal limited to minimum length required. Reinstatement to include species-rich planting with native species appropriate to local landscape character. Controls to be set out in the Biodiversity Management Strategy.	Ecology and Biodiversity	DCO Application	Main Works Contractor(s)
ECO10	Mature Trees and Tree Preservation Order (TPO)	Construction	Micro-siting to avoid woodland blocks, individual mature trees and TPOs, supported by arboricultural input. Where avoidance is not possible, impacts will be minimised and compensatory planting provided. Controls to be set out in the Biodiversity Management Strategy. Where potential ancient or veteran trees are identified,	Ecology and Biodiversity	DCO Application	Main Works Contractor(s)

Reference Number	Commitment / Mitigation Measure	Project phase	Description	Relevant Topic / Aspect	Securing Mechanism	Responsible Organisation
			<p>further arboricultural verification will inform appropriate protection measures.</p> <p>Where tree surgery to the crown or roots is necessary, this would be undertaken in accordance with BS 3998:2010; however, the Project, and specific construction tasks, would aim to retain as many trees as possible.</p>			
ECO11	Biosecurity Measures	Construction	Biosecurity measures to prevent the spread of Invasive non-native species (INNS) and toolbox talks were relevant.	Ecology and Biodiversity	DCO Application	Main Works Contractor(s)
ECO 12	Sediment and Pollution Control Measures	Construction	<p>Sediment and pollution control measures (e.g. silt fencing, cut-off ditches, fuel spill kits) to be implemented near watercourses and retained vegetation.</p> <p>Lighting, noise and dust emissions to be minimised near sensitive receptors. Lighting will be directional and switched off when not in use to avoid spill onto habitats.</p>	Ecology and Biodiversity	DCO Application	Main Works Contractor(s)
ECO14	Natural England Licence	Construction	<p>If required, where adverse effects cannot be ruled out, the Project will only proceed under a Natural England licence, secured prior to works affecting the protected species (under advice from ECoW / licensed ecologist).</p> <p>Where impacts on IEFs / protected species cannot be avoided, precautionary working methods will be adopted, including phased vegetation clearance and timing restrictions.</p> <p>Precautionary working methods would include, but not be limited to:</p> <ul style="list-style-type: none"> • Avoidance of habitat disturbance / destruction where feasible. Avoidance of ground disturbance of wetland priority habitats in wintering bird season (Oct–Mar). • Vegetation clearance will be scheduled outside the bird breeding season where possible. Where clearance during the breeding season is unavoidable, affected vegetation will be checked by an Ecological Clerk of Works (ECoW) within 48 hours of works. Exclusion zones would be implemented where active nests are found and adhered to until an ecologist confirms the nest is no longer in use. • Excavations will either be closed overnight or be battered, ramped or secured with barriers to prevent wildlife entrapment. • An ECoW will supervise works in sensitive areas, ensure implementation of mitigation measures, and provide toolbox talks to site personnel. 	Ecology and Biodiversity	DCO Application	Main Works Contractor(s)
ECO15	Great Crested Newt (GCN)	Construction	Mitigation for Great Crested Newt (GCN) will be delivered through the District Level Licensing (DLL) scheme, approved by Natural	Ecology and Biodiversity	DCO Application	Main Works Contractor(s)

Reference Number	Commitment / Mitigation Measure	Project phase	Description	Relevant Topic / Aspect	Securing Mechanism	Responsible Organisation
			England. Implementation of the DLL will be undertaken in accordance with the scheme's requirements / under the direction of Natural England.			
ECO15	Baseline Condition or Enhanced Ecological Value	Construction	All temporary works areas will be reinstated to at least baseline condition or enhanced to improve ecological value (e.g. hedgerow species diversity). Accordingly, sections of hedgerow scheduled for removal during construction would be reinstated and, where appropriate, would be improved from their baseline condition e.g. defunct or species-poor hedgerows would be replanted so as to achieve species-rich and continuous hedgerows, once re-established.	Ecology and Biodiversity	DCO Application	Main Works Contractor(s)
ECO17	Biodiversity Net Gain (BNG)	Construction	BNG will be delivered in accordance with the emerging policy context and forthcoming Government guidance for Nationally Significant Infrastructure Projects (NSIPs).	Ecology and Biodiversity	DCO Application	Main Works Contractor(s)
ECO18	IEFs	Construction	Pipeline to be installed using trenchless methods, where practicable, where these IEFs could be impacted. If practicable, vibratory piling to be used over impact piling for the installation of the cofferdam at the Easington landfall if required.	Ecology and Biodiversity	DCO Application	Main Works Contractor(s)
ECO19	Trenchless Methods	Construction	Pipeline to be installed using largely trenchless methods where these IEFs could be impacted. Pipeline to be adequately buried below the predicted cliff line at the landfall and below the seabed profile throughout its design life (25 years).	Ecology and Biodiversity	DCO Application	Main Works Contractor(s)
ECO20	Cofferdam and Other Associated Infrastructure If Present	Construction	The cofferdam, if selected as the cliff crossing methodology, and other associated infrastructure will be present for as short a time as reasonably practicable during construction. Pipeline route optimisation in the nearshore will be conducted where reasonably practicable to minimise impacts on IEFs. Following pipeline installation, it will be buried using excavated material and the beach will be reinstated to pre-construction condition.	Ecology and Biodiversity	DCO Application	Main Works Contractor(s)
CL1	Pipe Trenches	Construction	Pipe trenches should be exposed for the minimum length of time where possible to reduce risks associated with water accumulation. Where necessary, outfall drains should be reconnected across the trench as part of the backfill operation.	Climate Resilience	DCO Application	Main Works Contractor(s)

Reference Number	Commitment / Mitigation Measure	Project phase	Description	Relevant Topic / Aspect	Securing Mechanism	Responsible Organisation
CL2	Post-construction Drainage	Construction	Additional post-construction drainage should be installed where necessary to ensure that any existing drainage infrastructure impacted by the construction process remains operational.	Climate Resilience	DCO Application	Main Works Contractor(s)
CL3	Landscaping Design	Construction	Landscaping designs should consider using drought-resistant vegetation to reduce die-back and improve soil stability, decreasing the risk of slope instability arising from variable precipitation rates.	Climate Resilience	DCO Application	Main Works Contractor(s)
CL4	Material Durability	Construction	Material durability should be considered within the design to ensure that the pipeline and associated AGIs are able to withstand future climatic changes and their associated impacts.	Climate Resilience	DCO Application	Main Works Contractor(s)
CL5	Adverse Climate Conditions	Construction	Construction activities should not be undertaken during adverse climate conditions and, where possible, work should be limited during high-risk periods.	Climate Resilience	DCO Application	Main Works Contractor(s)
CL6	Anti-Corrosion Coatings	Construction	Where defined by design, anti-corrosion coatings (e.g. Fusion Bonded Epoxy) should be used to prevent corrosion and other impacts associated with climate impacts.	Climate Resilience	DCO Application	Main Works Contractor(s)
GG2	Sustainable Resource Management	Construction	Sustainable resource management: <ul style="list-style-type: none"> Selecting low carbon materials where applicable and practicable. Prioritise materials with recycled content. Design out waste, following the waste hierarchy and using modular construction where possible. 	Greenhouse Gases	DCO Application	Main Works Contractor(s)
GG3	Local Materials	Construction	Where possible, source materials locally, prioritising local suppliers.	Greenhouse Gases	DCO Application	Main Works Contractor(s)
GG4	Sustainable Construction Methods	Construction	Where applicable, use sustainable construction methods, including energy efficient plant, sustainable fuel alternatives and minimise machine idling.	Greenhouse Gases	DCO Application	Main Works Contractor(s)
GG6	Sustainable Resource Management	Construction	Sustainable resource management (including designing out waste) in the context of the Waste Hierarchy, which promotes prevention, reuse, recycling and recovery of waste before considering disposal.	Greenhouse Gases	DCO Application	Main Works Contractor(s)
GG7	Proximity Principle	Construction	The Proximity Principle, where waste is ideally managed as close to the source of generation as is practicable.	Greenhouse Gases	DCO Application	Main Works Contractor(s)
GEO1	Contaminated Sites	Construction	Site Investigation of potentially contaminated sites, with a subsequent risk assessment of the findings determining if remedial measures are required in areas of the Project. If required site specific remediation strategy prepared and implemented prior to installation of pipe.	Ground Conditions and hydrogeology	DCO Application	Main Works Contractor(s)

Reference Number	Commitment / Mitigation Measure	Project phase	Description	Relevant Topic / Aspect	Securing Mechanism	Responsible Organisation
GEO2	Geologically, Hydrogeological or Ecologically Sensitive Areas	Construction	Adoption of appropriate investigation and construction methodologies when working in geologically, hydrogeological or ecologically sensitive areas (Site of Special Scientific Interests (SSSI), Ramsar site), if avoidance using route design is not possible.	Ground Conditions and hydrogeology	DCO Application	Main Works Contractor(s)
GEO3	Pollution Control Measures	Construction	Adoption of appropriate pollution control measures when undertaking ground investigation and construction works to reduce the risks to identified receptors. No storage of chemicals or fuels within a SPZ1.	Ground Conditions and hydrogeology	DCO Application	Main Works Contractor(s)
GEO7	Trenchless Methods	Construction	Pipeline to be installed beneath Dimlington Cliffs utilising trenchless methods to reduce the impact on the SSSI.	Ground Conditions and hydrogeology	DCO Application	Main Works Contractor(s)
GEO9	Pipeline Installation	Construction	Following pipeline installation, it will be buried using excavated material and the beach will be reinstated to pre-construction condition.	Ground Conditions and hydrogeology	DCO Application	Main Works Contractor(s)
GEO10	Temporary Access Track	Construction	Material excavated for construction of the temporary access track through Dimlington Road will be stored, and subsequently reinstated following completion of Project construction	Ground Conditions and hydrogeology	DCO Application	Main Works Contractor(s)
GEO13	Pipeline Route Optimisation	Construction	Pipeline route optimisation in the nearshore will be conducted where reasonably practicable to minimise impacts on potential features of conservation interest.	Ground Conditions and hydrogeology	DCO Application	Main Works Contractor(s)
GEO16	Imported Material	Construction	If imported material is needed or excavated material is re-used during the construction / backfilling of the pipeline, the material used is suitable for use and meets appropriate criteria with regards to contaminant levels.	Ground Conditions and hydrogeology	DCO Application	Main Works Contractor(s)
CH1	Heritage Assets	Construction	Trenchless crossing via Horizontal Directional Drill (HDD) or similar of major infrastructure would avoid direct physical impact to those identified as heritage assets, within the draft Order Limits.	Cultural Heritage	DCO Application	Main Works Contractor(s)
LV5	Reinstatement of Hedgerows	Construction	Reinstatement of any hedgerows removed to facilitate construction of the pipeline.	Landscape and Visual	DCO Application	Main Works Contractor(s)
NV1	Static and Semi-Static Plant	Construction	Where practicable, temporary enclosures should be used to screen all static or semi-static plant from noise sensitive receptor locations.	Noise and Vibration	DCO Application	Main Works Contractor(s)
NV2	Minimising Drop Heights of Materials	Construction	Drop heights of materials should be minimised, i.e. lorry with lifting boom or dumper carefully depositing materials.	Noise and Vibration	DCO Application	Main Works Contractor(s)
NV3	Importance of Noise Mitigation Briefings	Construction	Operators of moving plant to be briefed on a regular basis with an emphasis on the importance of noise mitigation and avoiding movements over irregular surfaces (which tends to create more noise / vibration emissions).	Noise and Vibration	DCO Application	Main Works Contractor(s)

Reference Number	Commitment / Mitigation Measure	Project phase	Description	Relevant Topic / Aspect	Securing Mechanism	Responsible Organisation
NV4	Minimise Shouting or Raised Voices	Construction	At all times, workers' shouting or raised voices to be kept to a minimum.	Noise and Vibration	DCO Application	Main Works Contractor(s)
NV5	Noise Limit and Noise Marking Requirements	Construction	All plant and equipment should comply with the noise limit and noise marking requirements.	Noise and Vibration	DCO Application	Main Works Contractor(s)
NV6	Equipment and Noise Control Measures	Construction	All plant, equipment and noise control measures applied to plant and equipment should be maintained in good and efficient working order and operated such that noise and vibration emissions are minimised as far as reasonably practicable. Any plant, equipment or items fitted with noise control equipment found to be defective will not be operated until repaired.	Noise and Vibration	DCO Application	Main Works Contractor(s)
NV7	Plant and Equipment Maintenance	Construction	All plant and equipment should be maintained so they are kept in good running order which ensures optimum performance.	Noise and Vibration	DCO Application	Main Works Contractor(s)
NV8	Machines in Intermittent use	Construction	Machines in intermittent use should be shut down or throttled down to a minimum during periods between works.	Noise and Vibration	DCO Application	Main Works Contractor(s)
NV9	Location and Orientation of Semi-static Equipment	Construction	As far as is reasonably practicable, the location and orientation of semi-static equipment should be chosen to minimise the noise impact on sensitive receptors.	Noise and Vibration	DCO Application	Main Works Contractor(s)
NV10	Specific Inductions and Briefings	Construction	All personnel on site should undergo site specific inductions and briefings. Where relevant, specific noise and vibration control measures should be incorporated into the contractor's method statements.	Noise and Vibration	DCO Application	Main Works Contractor(s)
NV11	Reversing Plant	Construction	Where safe to do so, noise from reversing alarms will be controlled and limited as far as possible through the use of a banksman or other means.	Noise and Vibration	DCO Application	Main Works Contractor(s)
SEC1	Acting Considerably in Relation to Local Residents	Construction	Ensuring contractors act considerably in relation to local residents.	Socio-economics, Tourism and Recreation	DCO Application	Main Works Contractor(s)
SEC2	Fencing, Signage and Safety Precautions	Construction	Appropriate fencing, signage and safety precautions.	Socio-economics, Tourism and Recreation	DCO Application	Main Works Contractor(s)
SEC3	Construction Compounds	Construction	Construction compounds would be located to avoid or minimise environmental and community impacts, provide the best access for personnel and deliveries in relation to major structures and worksites, and meet other construction requirements for the Project.	Socio-economics, Tourism and Recreation	DCO Application	Main Works Contractor(s)
SEC4	Public Right of Way (PRoW) or Cycle Routes	Construction	Where PRoW or cycle routes may be disrupted by construction of the Project, temporary diversions will be put in place together with	Socio-economics, Tourism and Recreation	DCO Application	Main Works Contractor(s)

Reference Number	Commitment / Mitigation Measure	Project phase	Description	Relevant Topic / Aspect	Securing Mechanism	Responsible Organisation
			appropriate signage as necessary. If this is not possible, discussions will occur with stakeholders to agree the most appropriate approach.			
SEC5	Easington Cliff Line and Seabed Profile	Construction	Pipeline to be adequately buried below the predicted Easington cliff line and seabed profile throughout its design life (25 years).	Socio-economics, Tourism and Recreation	DCO Application	Main Works Contractor(s)
SEC6	Easington Beach Reinstatement.	Construction	Following pipeline installation, Easington beach will be reinstated to pre-construction condition.	Socio-economics, Tourism and Recreation	DCO Application	Main Works Contractor(s)
HH2	Code of Construction Practice	Construction	Adherence to the REAC to minimise construction effects.	Human Health and Wellbeing	DCO Application	Main Works Contractor(s)
HH4	Physical Health	Construction	Any additional measures as laid out in other technical chapters to incorporate best practice measures and limit any potential introduction of additional noise, vibration, air pollution, water pollution or disruption of contaminated land that could affect physical health.	Human Health and Wellbeing	DCO Application	Main Works Contractor(s)
HH5	Mental Health	Construction	Any additional measures as laid out in other technical chapters to incorporate best practice measures and limit any potential introduction of additional noise, vibration, landscape and visual effects, changes to the historic environment, road user stress, or any other aspect that could affect mental health.	Human Health and Wellbeing	DCO Application	Main Works Contractor(s)
TT2	Haul Road	Construction	Where practical the delivery of materials along the construction haul road will be prioritised in order to minimise traffic impact on identified sensitive receptors.	Traffic and Transport	DCO Application	Main Works Contractor(s)
TT5	Notifications to Inform Other Sea Users	Construction	Relevant notifications to inform other sea users of installation works (i.e., Notice to Mariners, Kingfisher Bulletin).	Traffic and Transport	DCO Application	Main Works Contractor(s)
TT6	Vessel Management Plan (VMP).	Construction	VMP to be developed as relevant.	Traffic and Transport	DCO Application	Main Works Contractor(s)
TT7	Compliance	Construction	Compliance with Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGS).	Traffic and Transport	DCO Application	Main Works Contractor(s)
MW2	Materials Management Plan (MMP)	Construction	MMP (if required) will be produced in accordance with the CL:AIRE Definition of Waste: Code of Practice (DoWCoP).	Materials and Waste	DCO Application	Main Works Contractor(s)
HYD1	Environment Agency Floodline and Flood Risk Action Plan	Construction	Where possible, AGIs and the Pump Facility will be located outside areas of flood risk. Where this has not been practicable. It is proposed that the Main Works Contractor (and others) would sign up to the Environment Agency's Floodline service whilst works within the floodplain are being undertaken. A Flood Risk Action Plan would be established containing appropriate evacuation procedures to be followed upon receipt of a flood warning. Further information on the	Hydrology and Land Drainage	DCO Application	Main Works Contractor(s)

Reference Number	Commitment / Mitigation Measure	Project phase	Description	Relevant Topic / Aspect	Securing Mechanism	Responsible Organisation
			Action Plan would be included in the CEMP, an outline of which would be submitted with the ES.			
HYD2	Flood Defence Infrastructure	Construction	Where pipelines would be routed under flood defence infrastructure monitoring of the structures is proposed at key locations (as agreed with the Environment Agency) to establish a pre-construction baseline and during construction and ensure no changes in their level and structural integrity. Engagement with the Environment Agency is also ongoing with reference to potential conflicts between the construction works and planned flood risk management projects and capital works in the vicinity of the draft Order. Once finalised, the exact location of the proposed pipelines and construction areas would be provided to the Environment Agency, with intended timings, to ensure that the schemes could co-exist.	Hydrology and Land Drainage	DCO Application	Main Works Contractor(s)
HYD3	Sequential Test and Incorporate Flood Resilience	Construction	Where construction activities take place in Flood Zone 3, construction compounds and other working areas will be laid out in accordance with the Sequential Test and incorporate flood resilience measures where necessary, for example incorporating raised bunds to prevent floodwater ingress into Horizontal Directional Drilling (HDD) pits. Storage of construction equipment and materials will be done in such a way as to avoid forming barriers to floodplain flows. Material storage areas will be located outside of the fluvial floodplain where practicable.	Hydrology and Land Drainage	DCO Application	Main Works Contractor(s)
HYD4	Additional Mitigation of Flood Risk	Construction	Where additional mitigation of flood risk may be required, such as where drive pits for trenchless crossings are located in the floodplain (Flood Zone 3), suitable protection would be provided. Specific measures (such as raised earth bunds for example) would be determined as an outcome of the Flood Risk Assessment (FRA) that would be prepared in support of the ES and recorded within the Register of Commitments.	Hydrology and Land Drainage	DCO Application	Main Works Contractor(s)
HYD5	Surface Water Flood Zones	Construction	Where construction activities take place within surface water flood zones, prior to works commencing appropriate site drainage will be put in place to reduce the risk of standing water and avoid substantial delays to the construction programme.	Hydrology and Land Drainage	DCO Application	Main Works Contractor(s)
HYD6	Flood Mitigation / Drainage	Construction	Where construction haul roads pass within or cross floodplains, the haul road design will include for flood mitigation / drainage to allow for the flow of water within the floodplain. The design of the haul roads themselves will include for some resilience to flooding, for	Hydrology and Land Drainage	DCO Application	Main Works Contractor(s)

Reference Number	Commitment / Mitigation Measure	Project phase	Description	Relevant Topic / Aspect	Securing Mechanism	Responsible Organisation
			example, incorporating suitable geo-textiles to stabilise the road surfacing, as well as allowing water to flow within the floodplain. Suitable materials will be used to surface the haul roads. In some cases, bespoke construction methodologies may be used based on site constraints and ground conditions.			
HYD7	Open Cut Crossing of Rivers	Construction	Where open cut crossings of rivers are proposed, reinstatement works would be carried out to mitigate potential impacts on the conveyance, flow and hydromorphology of the watercourses, as well as mitigating detrimental impacts on the habitats they support. A pre-construction survey would be undertaken to map the profile of the existing bed, banks and channel gradient to inform the reinstatement works. The survey would also identify the location of any in-channel features such as riffles and pools although it is noted that for the majority of watercourses crossed by open cut techniques morphological diversity is likely to be low.	Hydrology and Land Drainage	DCO Application	Main Works Contractor(s)
HYD8	Riverbed Materials	Construction	Once the pipelines are installed, the bank, channel profile and gradient would be reinstated to existing or enhanced conditions. The riverbed material would be replaced within the channel and opportunities to encourage flow regime diversity would be considered. Further detail on ecological mitigation and enhancement is included in Volume 2 - Chapter 7: Ecology and Biodiversity. A geomorphologist would review the method statement for the open cut watercourse crossings, which would be included in the detailed CEMP, and would also confirm that the channels have been suitably reinstated.	Hydrology and Land Drainage	DCO Application	Main Works Contractor(s)
HYD9	Trenchless Techniques	Construction	Where practicable, canals crossed by the proposed pipeline would be crossed using trenchless techniques.	Hydrology and Land Drainage	DCO Application	Main Works Contractor(s)
HYD10	Existing Land Drainage	Construction	The location and condition of existing land drainage infrastructure would be established during pre-construction surveys and a record would be compiled. Where necessary, and subject to agreement with the landowner / occupier, new field drains would be installed to: <ul style="list-style-type: none"> • Enable the landowner / occupier's current drainage system to continue working throughout the period of pipeline construction. • Help prevent damage to the soil structure. • Aid recovery from construction activity. • Ensure the site work areas are kept as dry as practically possible. A specialist drainage contractor may be employed to carry out the work. Records of the land drainage locations would be produced.			

Reference Number	Commitment / Mitigation Measure	Project phase	Description	Relevant Topic / Aspect	Securing Mechanism	Responsible Organisation
HYD11	Riverbank and In-channel Vegetation Retention	Construction	Riverbank and in-channel vegetation will be retained where not directly affected by installation works. Natural substrate will be provided through box culverts at temporary watercourse crossings.	Hydrology and Land Drainage	DCO Application	Main Works Contractor(s)
HYD12	Sustainable Drainage (SuDS)	Construction	Surface water drainage features, based on SuDS techniques, will be installed at the AGI and Pumping Station sites during construction. Access roads and haul roads will also have suitable drainage provisions. Drainage features would provide attenuation and treatment of runoff.	Hydrology and Land Drainage	DCO Application	Main Works Contractor(s)
HYD13	Fuels, Oils and Chemicals	Construction	Fuels, oils and chemicals will be stored responsibly, away from sensitive water receptors. Where practicable, they will be stored >15m from watercourses, ponds, and groundwater dependent terrestrial ecosystems, such as fens, springs and / or flushes. Where it is not practicable to maintain a >15m distance, additional measures will be identified. All refuelling, oiling, and greasing of construction plant and equipment will take place above drip trays and away from drains as far as is reasonably practicable. Vehicles and plant will not be left unattended during refuelling.	Hydrology and Land Drainage	DCO Application	Main Works Contractor(s)
HYD14	Wash Down of Vehicles and Equipment	Construction	Wash down of vehicles and equipment will take place in designated areas within construction compounds. Wash water will be prevented from passing untreated into watercourses and groundwater. Appropriate measures will include use of sediment traps.	Hydrology and Land Drainage	DCO Application	Main Works Contractor(s)
HYD15	Run-off	Construction	Run-off across the site will be controlled through a variety of methods including header drains, buffer zones around watercourses, on-site ditches, silt traps and bunding. There will be no intentional discharge of site runoff to ditches, watercourses, drains or sewers without appropriate treatment and agreement of the appropriate authority (except in the case of an emergency).	Hydrology and Land Drainage	DCO Application	Main Works Contractor(s)
CP3	Dimlington Cliffs Trenchless Methods	Construction	Pipeline to be installed beneath Dimlington Cliffs utilising trenchless methods.	Coastal Processes	DCO Application	Main Works Contractor(s)
CP5	Pre-construction Condition	Construction	Following pipeline installation, it will be buried using excavated material and the beach will be reinstated to pre-construction condition.	Coastal Processes	DCO Application	Main Works Contractor(s)
CP6	Temporary Access Track	Construction	Material excavated for construction of the temporary access track through Dimlington Road will be stored, and subsequently reinstated following completion of Project construction.	Coastal Processes	DCO Application	Main Works Contractor(s)
CP11	Beach Sediments	Construction	Any significant accumulation of beach sediments due to physical presence of the cofferdam will be mechanically removed to ensure nature sediment transport processes continue.	Coastal Processes	DCO Application	Main Works Contractor(s)

Reference Number	Commitment / Mitigation Measure	Project phase	Description	Relevant Topic / Aspect	Securing Mechanism	Responsible Organisation
Operation						
REAC6	Operational Environmental Management Plan	Operation	An Operational Environmental Management Plan (OEMP) will be produced, setting out all procedures to be implemented during Operation of the Project.	Various	DCO Requirement	Operator
CL7	Maintenance	Operation	The pipeline and associated AGIs will be regularly maintained to ensure maximum operational efficiency and proactively monitor and repair faults. Pipelines will be internally inspected periodically in addition to regular maintenance activities to check for corrosion and any other potential damage arising from climate-related hazards.	Climate Resilience	DCO Application	Operator
CL8	Maintenance	Operation	increasing rates of material deterioration should be considered in maintenance regimes.	Climate Resilience	DCO Application	Operator
CL9	Automatic Leak Monitoring Systems	Operation	Implement automatic leak monitoring systems to ensure that any compromises to the pipeline that may arise as a result of climate-related impacts are repaired swiftly by specialist maintenance staff.	Climate Resilience	DCO Application	Operator
CL10	Emergency Response Plans	Operation	Emergency response plans should be developed and regularly tested to ensure that staff are equipped to address any pipeline damages that may arise from climate hazards swiftly and effectively.	Climate Resilience	DCO Application	Operator
HYD16	AGIs in Floodplains	Operation	Where AGIs are located in floodplains, the footprint of the AGIs would be very small compared to the expansive nature of the floodplains they would be located within. Flood risk impacts on vulnerable components such as AGIs would be mitigated using a flood resilient design.	Hydrology and Land Drainage	DCO Application	Operator
HY17	SuDS	Operation	Surface water drainage from permanent above ground infrastructure would be managed using SuDS in accordance with policy and guidance requirements of the relevant Lead Local Flood Authorities. The drainage systems will be designed to accommodate runoff from the 1 in 100 year storm, inclusive of the recommended 40% allowance for climate change.	Hydrology and Land Drainage	DCO Application	Operator
CP13	Maintenance	Operation	Regular maintenance checks.	Coastal Processes	DCO Application	Operator
Decommissioning						
GEO15 SEC8 TT8 HYD20	Outline Decommissioning Environmental Management Plan (ODEMP)	Decommissioning	Production of an ODEMP to identify and mitigate the potential impacts of decommissioning Activities.	Various	DCO Requirement	Decommissioning Contractor(s)

Reference Number	Commitment / Mitigation Measure	Project phase	Description	Relevant Topic / Aspect	Securing Mechanism	Responsible Organisation
CP9						
HH6	PRoW	Decommissioning	Disruption to or severance of PRoW will be avoided as far as possible. Where necessary, suitable diversions would be agreed with relevant local authority access officer.	Human Health and Wellbeing	DCO Requirement	Decommissioning Contractor(s)

Appendix 5.1 – Outline Soil Management Plan

Introduction

Background

This Outline Soil Management Plan (SMP) forms part of the Preliminary Environmental Information Report (PEIR) Chapter 5: Agriculture and Soils and the draft Construction Environmental Management Plan (CEMP) (Volume 4, Appendix 4.1: Construction Environmental Management Plan).

This Outline SMP provides further details on the construction mitigation measures stated in Volume 2 - Chapter 5: Agriculture and Soils.

The Outline SMP aims to protect agricultural land and soil resources and health, restore the disturbed agricultural land and soils to previous quality and functionality and use site-won soils sustainably.

Scope

This Outline SMP sets out the strategy, approach, methodology and guidance of soil mitigation, and the key requirements for developing a Detailed SMP, to be created pre-construction, for soil handling during the construction phase in accordance with national policies and industry guidance in relation to soil resources and health.

This Outline SMP covers the following aspects:

- Pre-construction planning.
- Roles and responsibility.
- Soil resources baseline.
- Soil Management, including:
 - General soil protection measures.
 - Soil Training.
 - Site preparation and vegetation clearance.
 - Soil stripping.
 - Soil stockpiles.
 - Soil stockpile maintenance.
 - Soil reinstatement.
 - Soil Aftercare.
 - Monitoring.
 - Report of findings.
 - Failures of Acceptability Criteria and Corrective Actions.
 - Implementation of the Detailed SMP.

Legislation, Policy and Guidance

The Agricultural Land (Removal of Surface Soil) Act (1953) (Ref 1.1) states ‘Removal of surface soil without planning permission to be an offence against this Act.’

Paragraphs 5.11.13 - 5.11.15 of Overarching National Policy Statement for Energy (EN-1) (Department for Energy Security & Net Zero (DESNZ), 2024) (Ref 1.2) state:

- ‘Applicants should also identify any effects and seek to minimise impacts on soil health and protect and improve soil quality taking into account any mitigation measures proposed.’
- ‘Applicants are encouraged to develop and implement a Soil Management Plan which could help minimise potential land contamination. The sustainable reuse of soils needs to be carefully considered in line with good practice guidance where large quantities of soils are surplus to requirements or are affected by contamination.’
- ‘Developments should contribute to and enhance the natural and local environment by preventing new and existing developments 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.’

In accordance with the legislation and the National Policy EN-1, this Outline SMP has been produced in line with the following guidance:

- Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (Department for Environment, Food and Rural Affairs (Defra), 2009) (Ref 1.3).
- Good Practice Guide for Handling Soils in Mineral Workings (Institute of Quarrying, 2021) (Ref 1.4).
- BS 3882 Specification for topsoil (British Standards Institution, 2015 (Ref 1.5).
- BS 8601 Specification for subsoil and requirements for use (British Standards Institution, 2013) (Ref 1.6).
- Soil Professional Competence Standards No. 1 (Foundation skills in field soil investigation, description, and interpretation) from the British Society of Soil Science (BSSS) (BSSS, 2018) (Ref 1.7).
- Soil Professional Competence Standards No. 4 (Soil science in soil handling and restoration) from the British Society of Soil Science (BSSS, 2018) (Ref 1.8).
- Planning and aftercare advice for reclaiming land to agricultural use (Natural England, 2022) (Ref 1.9).

Preconstruction Planning

It is the Main Works Contractor(s) responsibility to manage soil responsibly during the construction phase.

Prior to construction, a review of all relevant DCO documents will be conducted to identify any gaps in the soil baseline data and any soil mitigation commitments.

If there are soil baseline data gaps, a soil survey will be undertaken by a suitably qualified and experienced soil scientist or practitioner to fill the soil data gap.

A Detailed SMP will be produced preconstruction to provide sufficient detail on each section included in this Outline SMP to ensure that the exact nature of works and the mitigation measures are clearly set out for the effective sustainable management and re-use of soils.

Roles and Responsibilities

The implementation of the soil management measures will require, as a minimum, the following roles and responsibilities:

- Site Environmental Manager.
- Soil Scientist.
- Site Agent.

The effective implementation of the soil management measures will be the responsibility of the Site Environmental Manager(s) of the Main Works Contractor(s). This individual will be supported by a Soil Scientist in assessing soils, soil conditions and soil handling operations to ensure the measures outlined within this Outline SMP can be implemented, supervised, and monitored effectively.

The Soil Scientist appointed by the Main Works Contractor(s) will provide any training required and will undertake monitoring visits and audits. The Soil Scientist will be a qualified soil scientist with the necessary training, qualifications, and experience, having achieved the Soil Professional Competence Standards No. 1 (Foundation skills in field soil investigation, description, and interpretation) as set out by the British Society of Soil Science (Ref 1.7); and No. 4 (Soil science in soil handling and restoration) (Ref 1.8) (Annex A).

Further details of the responsibilities of these roles are set out in Sections 3.2 - 3.5 below.

Site Environmental Manager

The Site Environmental Manager will be responsible for:

- Preconstruction planning.
- Adherence to access / haul route alignments and compliance with no off-route access throughout the works.
- Effective vegetation and foreign matter clearance prior to soil stripping commencing.
- Confirmation that topsoil and subsoil resources have been correctly identified, and soil plasticity tests are undertaken and recorded ahead of soil stripping.
- Effective separation of soil types and layers during stripping and stockpiling, where data related to the volume and type of topsoil and subsoil excavated, transported and stockpiled is recorded.

- Effective stockpile construction where locations and conditions are recorded, and monthly inspections of stockpile condition, and
- Effective backfilling of each layer in the correct sequence.

The Site Environmental Manager will be responsible for reporting on all soil stripping and stockpiling activities through recording the following:

- Confirmation of effective vegetation clearance and the removal of arisings.
- Confirmation that topsoil and subsoil resources have been correctly identified.
- Records of soil plasticity test results.
- Data relating to the volume and type of topsoil and subsoil excavated, transported and stockpiled.
- Stockpile location and condition with reference to finalised site and landscaping plans, and
- Thickness of each layer replaced where soil reinstatement is required, with reference to finalised site and landscaping plans.

The Site Environmental Manager may delegate these activities to individuals with sufficient training and expertise where required. The Site Environmental Manager and anyone with delegated responsibility will undertake training provided by the appointed Soil Scientist.

Soil Scientist

The appointed Soil Scientist will be responsible for the provision of expert and technical soils advice throughout the earthworks and the subsequent site restoration activities. The role includes the following:

- Liaison with the Site Environmental Manager and any other personnel / organisations as relevant to works affecting soils.
- Train key site staff in identification of topsoil and subsoil resources which are suitable for re-use so that accurate segregation of topsoil and subsoil resources can be achieved.
- Provide training on the assessment of soil plasticity status based on the field technique provided in Annex B and provide advice on the appropriate locations for the use of any soil stabilisation methodology to ensure it would not result in a detrimental change to the soil characteristics or the reinstatement of the land to its required post-construction use.
- Monitoring and auditing of all soil handling activities identified in this SMP.

Site Agent

The Site Agent will be responsible for effectively implementing soil handling activities in accordance with the Detailed SMP and following instruction from Site Environmental Manager and Soil Scientist.

Roles and Responsibilities Checklist

Table A5-1-1 summarises the split of responsibilities across the Soil Scientist and Environmental Manager roles.

Table A5-1-1 – Roles and Responsibilities Matrix

Main Activity	Sub-activities	Frequency	Responsible	Qualifications
Training	Presentation of key aspects of soil management.	Once, at start of site preparation works.	Soil Scientist	An individual with the necessary “Foundation Skills,” having achieved the soil professional competence standards set out by the British Society of Soil Science (Ref 1.7).
	Identification of topsoil and subsoil resources.	Once, at start of site preparation works.		
	Soil plasticity assessment.	Once, at start of site preparation works.		
	Toolbox talks.	To be agreed with the Environmental Manager.		
Inspections and monitoring	Adherence to access / haul route alignments and compliance with no off-route access, including determining appropriate locations for the use of soil stabilisation if this approach is proposed.	Continuous until soil stripping complete.	Site Environmental Manager (can be delegated to individuals with sufficient training and expertise where required).	In-house training provided by qualified soils scientist (with monitoring by the Soil Scientist to check works).
	Vegetation and foreign matter clearance	Ahead of soil stripping		
	Soil plasticity	Ahead of soil stripping for each stripping unit. Additional checks required if rainfall results in works having to be stopped prior to soil stripping recommencing within that stripping unit		
	Appropriate separation of soil layers as required (topsoil, upper subsoil, lower subsoil) and accurate documentation of depths stripped, and volumes transported from each stripping unit.	Continuous until soil stripping complete.		
	Appropriate segregation of soil materials in stockpiles by stripping unit, layer and plasticity, and accurate documentation of material source and stockpile location.	Continuous until soil stockpiling complete.		
	Stockpile construction	Continuous until soil stockpiling complete, and stockpiles prepared for storage period.		
	Inspection of soil storage stockpiles	Monthly.		
	Assessment of soil condition (including plasticity) within stockpiles prior to re-use	Prior to re-use from each stockpile.		
	Inspection of soil reconditioning windrows (where required)	Continuous until soil reconditioning complete		
	Inspections of restored soil profiles	Continuous until soil placement complete. Checks should be undertaken as each layer is placed.		
Reporting	Condition reports detailing works undertaken and replaced soil conditions (in relation to target)	On completion of soil replacement activities for each asset	Soil Scientist	An individual with the necessary “Foundation Skills,” having achieved the soil professional competence standards set out by the British Society of Soil Science (Ref 1.7).

Main Activity	Sub-activities	Frequency	Responsible	Qualifications
Monitoring	All the above activities will be monitored.	Weekly checks of soil handling operations (either combined with site visit or through review of reporting documentation).	Soil Scientist	
Auditing	All above activities will be audited	Monthly audits will be undertaken of activities which have taken place in the preceding month. Annual audits of all activities will be undertaken.	Soil Scientist	

Soil Resources Baseline

A soil resources baseline will be established based on soil data from the soil and Agricultural Land Classification (ALC) surveys that have been carried out in 2025. The Detailed SMP will incorporate:

- Soil types (including soil textures and the main soil types present onsite).
- Soil depths of topsoil and subsoil.
- Soil depth map.
- Potential site-won soil volume.
- Soil balance.

The soil baseline information along with other soil mitigation measures will guide soil handling activities.

Soil Management

General Soil Protection Measures

Soils will be handled when they are in a reasonably dry and friable state, or on the assumption they have passed the tests for soil plasticity assessment.

Work will be programmed, and plant and other site vehicles will be managed so that they do not traffic across in situ topsoil.

All areas which will not be stripped will be clearly demarcated with appropriate signage and fencing. Other potential constraints, such as relating to landowner boundaries, flood zones or archaeologically / ecologically sensitive features will also be clearly demarcated and specific toolbox talks delivered in relation to any additional requirements.

Machinery and its operation shall comply with the Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (Ref 1.3) and the Good Practice Guide for Handling Soils in Mineral Workings (Ref 1.4). The exact plant to be used will be defined by the appointed contractor and the relevant information included in the Detailed SMP.

Soil Training

The Soil Scientist will provide training on identifying topsoil, subsoil, soil type, and soil plasticity assessment to relevant personnel involved in soil handling and management activities.

The Soil Scientist will conduct site-specific toolbox talks which have been developed with the Site Environmental Manager.

Toolbox talks must include at least the following topics:

- Key aspects of the Detailed SMP.

- Identification of topsoil and subsoil resources (to ensure accurate soil stripping and prevention of topsoil / subsoil mixing).
- Stockpile creation.
- Assessment of soil plasticity using the techniques set out in Annex B, and
- Soil reinstatement approach (where required).

Site Preparation and Vegetation Clearance

Prior to soil stripping activities commencing any existing vegetation will be cleared in line with the measures in the CEMP, with arisings removed, to ensure the soil is free from significant quantities of green vegetative material or other materials which would make the soils unsuitable for their intended re-use.

All vegetation clearance works will be undertaken ensuring that soils are not damaged through the creation of ruts or mixing of topsoil and subsoil resources.

The clearance operation should ensure the vegetation is removed to ground level and all arisings (including chipped wood material) are removed. Vegetation clearance will be undertaken by best practicable methods; however, blading off vegetation using a bulldozer will not be permitted.

If invasive non-native species (INNS) are identified, they should be handled in specific control procedures as defined in the CEMP. If soils are contaminated by INNS, soils need to be treated appropriately.

Soil Stripping

Before any soil stripping activities take place, the proposed works and phasing will be detailed by the Main Works Contractor(s) in the Contractor pre-start information pack (to include method statements, drawings, specifications etc.) and issued to the Applicant for acceptance. The Contractor pre-start information pack will provide timescales and sequencing of soil stripping the proposed haul routes.

The earthworks will be phased to ensure that the topsoil is stripped in each part of the site ahead of subsoil materials, and that all soils are stripped from a designated area prior to bulk excavation and earthwork activities within that area.

To ensure that the correct soil depths are stripped (to avoid the mixing of topsoil and subsoil resources) all personnel involved in the works will attend a toolbox talk to gain general awareness on the identification of topsoil and subsoil resources. Specific instructions regarding soil depths to be stripped will be provided during daily briefing.

All stripped soils will be logged, tracked and labelled.

All stripped soils will be free from significant quantities of foreign matter or other materials which would make the soils unsuitable for their intended re-use.

Immediately prior to stripping, the soil shall be tested for plasticity using the methodology presented in Annex B.

Soil will be stripped using a hydraulic excavator or tracked dozer, where practicable, following the methodology set out in Annex C to minimise the risk of compaction of either topsoil or subsoil materials.

Prior to soil stripping commencing, a toolbox talk will be provided by a Soil Scientist (or suitably briefed delegate) in conjunction with the construction lead, to set out how topsoil and subsoil resources will be stripped and stockpiled separately. This will ensure that any differences between the topsoil / subsoil boundary is understood.

Dump trucks will be used to transport the soils to the landscape bund or stockpile locations.

Soil Stockpiles

Stockpile Formation

Locations of stockpiles will be determined in collaboration with the technical team, site team, Environmental Manager and / or Soil Scientist when pre-construction information is available. Soil stockpiles will be located in appropriate locations to avoid increased flood risk, watercourses and topographic depressions, and close to end use location as close as possible.

Stockpile will be designed to reduce the potential for damage to the physical condition and erosion and facilitate the shedding of water.

Soils will be stockpiled within the height as determined in the Detailed SMP. Defra (Ref 1.3) and Natural England (Ref 1.9) suggest that topsoil stockpiles should be no higher than 3-4 m and subsoil no higher than 5 m. The precise size and height of the stockpile should be determined by the technical team, Environmental Manager and / or Soil Scientist taking into account the amount of space available, the nature and composition of the soil, the prevailing weather conditions at the time of stripping and planning conditions associated with the works, in line with the Outline SMP.

Stripped topsoil and subsoil resources will be stored separately in stockpiles. Different types of topsoil and subsoil to be stockpiled separately and clearly labelled.

Soil Stockpile Maintenance

Soil stockpiles will be managed and monitored throughout their lifetime so that they can be maintained in relation to stability and integrity. Measures to manage stockpiles are as follows:

- Soil stockpiles will be covered with material adequate to prevent erosion by wind or rainwater runoff and covers shall be maintained in good condition.

- Soil stockpiles will be seeded with a native grassland seed mix to maintain slope stability and to prevent erosion or dust generation if they will be used in place for longer than six months.
- All stockpiles will be clearly labelled.
- Weed growth will be managed.

Stockpile Reconditioning

Soils will be reconditioned to restore a structured, uncompacted and well-aerated soil profile.

Prior to restoration activities taking place, soil resources may have been stored in stockpiles for extended periods and in some exceptional cases, soils may have been handled and stockpiled in a plastic state. To confirm suitability of stockpiled soils for restoration, they should be visually inspected, and assessments carried out before their reinstatement (see Section 1.10 - Monitoring). If any soil is found to be plastic or display excessive anaerobic conditions the materials should be reconditioned as detailed below. It will be the responsibility of the Soil Scientist to assess soil in each stockpile and to recommend and record appropriate pre-treatment prior to soil placement, should it be required.

Soils which are plastic in consistency shall be reconditioned using the methodology presented in Annex E. Where possible, soils stripped when plastic will be reconditioned before being stockpiled if time, weather conditions and available space allow.

Soil Reinstatement

The works required to effectively reinstate a soil profile suitable for the proposed end use and ensure the required soil structure is present and that there is no compaction, will depend on what soil layers have been stripped and the extent of the trafficking over the exposed surface that has occurred.

The sequence required to reinstate the soil profile will be detailed by the technical team, Site Environmental Manager and/or Soil Scientist and will be briefed to all personnel involved in the work.

Subsoil and topsoil re-use will aim to achieve the following:

- Creation of the required combination of topsoil and/or subsoil to create a soil profile with the characteristics required for the proposed end use or re-create the soil profile in line with pre-existing soils where restoration to previous land use and land quality (including ALC grade) is required.
- Ensure, through careful handling and placement of soils, no compaction within the restored soil profiles that may limit vegetation establishment and growth or restrict water infiltration etc.

The approach for the checks required and the methodology to be used to reinstate the land at the end of the construction phase will depend on the thickness of soils stripped and the results of compaction testing etc. The approaches set out will be in line with published guidance and will ensure the following:

- Deep ripping of the overburden where required prior to the placement of subsoil
- The soil profile created will be checked by the Soil Scientist to ensure it is suitable for the proposed end use as stated in Table A5-1-1 Roles and responsibilities matrix.

Where soils stripped for the construction of temporary haul roads and compounds are to be reinstated, any stone and/or membrane must be fully removed prior to soil reinstatement.

Where soils stripped during the construction phase will not be reinstated and cannot be re-used on site, they will be removed off-site. Prior to any removal off-site, the quantity and characteristics of available soil materials will be assessed.

The soil profiles being reinstated will be designed to maximise re-use (ensuring placing more soil does not have any detrimental effects). For example, it will be assessed whether a thicker topsoil layer can be placed. The final soil profile requirements will be detailed within the final landscape plans. A soil re-use summary report, produced by the Soil Scientist with supporting information from the Environmental Manager and technical team, will demonstrate how off-site disposal has been minimised.

During the placement of soil resources in their final location the methods outlined above will be followed. This will include, but not be limited to, the implementation of an access and egress plan for vehicles and plant to prevent unnecessary trafficking of restored areas, use of appropriate scale plant, avoidance of double handling and avoidance of mixing topsoil and subsoil where these materials are required for the restoration of agricultural land. Soil replacement will be undertaken in accordance with the methodology set out in Annex F.

Aftercare

It takes some time for restored soils to be settled after reinstatement. Checking and monitoring will be conducted to ensure the restored soils regain their previous condition by the end of aftercare period.

There will be a requirement for an aftercare period up to 5 years as required by Natural England (Ref 1.9) where soils are being reinstated to ensure they are returned to their previous condition, or the condition required for their end-use.

An Aftercare Management Plan will be produced by the Main Works Contractor(s) which will detail the aftercare period, monitoring frequency and interventions which may be required depending on issues highlighted by the monitoring.

Monitoring

To ensure that the quality of the soils is not detrimentally affected during the soil stripping, stockpiling and re-use / restoration works, monitoring by the Soil Scientist will be undertaken as detailed in Table A5-1-2 – Monitoring requirements and responsibilities.

The movement and storage of soils will be logged, tracked and labelled, in line with the requirements.

Responsibility for some repeated tasks, as indicated in the table below, can be delegated to a suitable experienced and trained person following the initial monitoring. Training would be provided by the Soil Scientist.

Table A5-1-2 – Monitoring Requirements and Responsibilities

Monitoring Requirement	Responsible
1 Effective clearance of vegetation and arisings from the soil surface – once, prior to soil stripping commencing	Soil Scientist (can be delegated)
2 Soil plasticity state – prior to soil stripping commencing with additional tests following rainfall events	Soil Scientist (can be delegated)
3 Topsoil stripping – correct identification of base of topsoil and minimisation of subsoil incorporation throughout the soil stripping operations	Soil Scientist (can be delegated)
4 Subsoil stripping (if required) – correct identification of base of subsoil and minimisation of overburden incorporation throughout the soil stripping operations	Soil Scientist (can be delegated)
5 Stockpile construction to ensure no mixing of topsoil and subsoil – throughout the stockpile construction period	Soil Scientist (can be delegated)
6 Stockpile condition – checks to record signs of vehicle tracking, erosion and weed growth, and set out remedial measures should issues be identified	Soil Scientist (can be delegated)
7 General monitoring of soil handling operations	Soil Scientist
8 Reinstated soil profiles – check to confirm profile and soil condition is suitable for the proposed end use	Soil Scientist

A record of monitoring visits will be created to include those listed in Table 1-3- Items for Monitoring Records.

Table A5-1-3 – Items for Monitoring Records

No	Information to be Recorded
1	Confirm successful treatment of vegetation
2	Confirmation of soil type (topsoil or subsoil)
3	Soil depth stripped
4	Soil plasticity (determined as 'plastic' or 'non-plastic')
5	Date(s) stripped, weather conditions during stripping, equipment / plant used for stripping
6	Stockpile location. Designate each stockpile or stockpile portion as 'plastic' or 'non-plastic'
7	Record any stockpile non-compliance from stockpile inspections. Detail, date, and stockpile location code (refer to Stockpile Inspection Checklist and Stockpile Plan)
8	Reinstated soil profiles characteristics and condition
9	Sign off for each stage

Reporting of Findings

The findings of all examinations and assessments will be recorded and held by the Main Works Contractor(s) for record keeping and to enable actioning of any necessary corrective actions.

Failures of Acceptability Criteria and Corrective Actions

The findings of all examinations and assessments will be recorded and held by the Main Works Contractor(s) for record keeping and to enable actioning of any necessary corrective actions.

Soil Management during Operation & Decommissioning Phase

During operation phase, there will be minimal maintenance work with minimal disturbance to soils and land. Good soil handling practice will be followed throughout the duration of the operation in line with the Soil Management Plan tailored for operation phase, should soil handling be required. The Soil Management Plan for operation phase should be produced by the appointed subcontractor prior to the commencement of soil work.

During the decommissioning phase, it is anticipated that the pipeline would be left in situ in order to avoid further disturbance to the soils and the land, the disturbance to agricultural land and soils would be minimal except minimal decommissioning work. Good soil handling practice will be followed throughout the duration of the decommissioning phase

in line with the Soil Management Plan tailored for decommissioning phase. The Soil Management Plan for decommissioning phase should be produced by the appointed subcontractor prior to the commencement of soil work.

Implementation of the Detailed SMP

Implementing the Detailed SMP

The Applicant will put in place robust procedures to inform and supervise all those working on the Project including its Main Works Contractor(s), to make sure the control measures set out in the Outline SMP (subsequently in the Detailed SMP, which will be developed by the Main Works Contractor(s)) are adopted when undertaking the construction of the Project. The main responsibility for implementing these control measures will fall to the Main Works Contractor(s).

The Main Works Contractor(s) will brief all operatives on the specific details within the Detailed SMP prior to the commencement of works. The briefings will be delivered by a suitably trained member of the team such as the Site Environmental Manager or Works Supervisor.

Non-Compliance Procedure

The Site Environmental Manager will be responsible for undertaking site audits to check compliance with the Detailed SMP and method statements. All incidents associated with the construction of the Project, including environmental incidents and non-conformance with the Detailed SMP, will be reported and investigated.

References

- Ref 1.1 Agricultural Land (Removal of Surface soil) Act (1953) Available at: Agricultural Land (Removal of Surface Soil) Act 1953.
- Ref 1.2 Department for Energy Security & Net Zero (DESNZ) (2024) Overarching National Policy Statement for Energy (EN-1) Available at: <https://www.gov.uk/government/publications/overarching-national-policy-statement-for-energy-en-1>.
- Ref 1.3 Department for Environment, Food and Rural Affairs (Defra) (2009) Construction Code of Practice for the Sustainable Use of Soils on Construction Sites.
- Ref 1.4 Institute of Quarrying (2021) Good Practice Guide for Handling Soils.
- Ref 1.5 British Standards Institution (2015) BS 3882:2015 Specification for topsoil. London: British Standards Institution.
- Ref 1.6 British Standards Institution (2013) BS 8601:2013 Specification for subsoil and requirements for use. London: British Standards Institution.

- Ref 1.7 British Society of Soil Science (2018) Foundation skills in field soil investigation, description and interpretation Available at: <https://soils.org.uk/wp-content/uploads/2021/02/WWS-1-Foundation-Skills.pdf>.
- Ref 1.8 British Society of Soil Science (2018) Soil science in soil handling and restoration Available at: <https://soils.org.uk/wp-content/uploads/2021/02/WWS-4-Soil-Handling-and-Restoration.pdf>.
- Ref 1.9 Natural England (2022) Planning and aftercare advice for reclaiming land to agricultural use - GOV.UK.

Annex A – British Society of Soil Science Competency Standards

DOCUMENT 1

Foundation skills in field soil investigation, description and interpretation



Background

The investigation of soils in the field, their consistent description according to a recognised scheme, and the interpretation of soil profiles, properties and conditions are generic foundation skills for professional scientists and engineers employed on tasks that relate to the use and/or management of land. This document identifies the minimum qualifications, skills and knowledge which the British Society of Soil Science (BSSS) considers to be required of scientists and engineers conducting field soil investigations.

Qualifications

Professional soil scientists with competence in these foundation skills are likely to have graduated in a relevant science subject. They will also have a number of years of relevant, regular field soil-based experience and will have, or be adequately qualified for, membership of a relevant professional body such as the BSSS.

Minimum competencies

Skills:

- 1 The ability to dig and/or auger a soil, or to instruct others to do this, so as to **expose a soil profile** to a relevant depth and to then accurately **identify the sequence of horizons** that comprise the soil profile (natural or manmade) using standard reference documents such as The Soil Survey Field Handbook¹
- 2 The **design and development of a soil investigation strategy** that is appropriate to the site or landscape to be investigated, and will generate representative soil information at an appropriate scale. This should be based upon the objectives and context of the study, and an understanding of the likely patterns of soil variability
- 3 The ability to **read and interpret maps/spatial data** of topography, geology, soil and aerial photography in relation to the interpretation of soil conditions; where and when appropriate, conversance with the use of GIS, GPS and mobile technology

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Foundation skills in field soil investigation, description and interpretation

- 4 The application of a relevant scheme of **field soil description** (such as Soil Survey Field Handbook) and the production and recording of accurate, consistent descriptions of soil profiles or materials. This should normally include the ability to describe soil colour (e.g. using a Munsell soil colour chart²) including mottling, soil texture, the properties of the soil surface, soil structure, consistence and porosity
- 5 The consistent **hand texturing** of particle size distribution in the fine earth, and the description of stones by their frequency, size, shape and rock type
- 6 The ability to **interpret soil horizons, features and materials** and whole profile descriptions to develop an understanding of the soil environment and its variability within a landscape
- 7 The ability and understanding required to **sample a soil or the soils of a site** for one or more relevant determinands representative of the soil or site and relevant to the objectives of the study. This may involve the collection of aggregated topsoil samples or horizon bag or tin samples
- 8 The ability and knowledge required to interpret the results of any soil chemical, physical or microbial analysis
- 9 The ability to **interpret the relationships between soil and landscape, land use and climate**
- 10 The ability to **produce accurate and understandable verbal and written reports** of the soil conditions (text and map information as appropriate) at or across the investigation site, with an interpretation of these in a way that is relevant to the context of the investigation (this is amplified by other BSSS PCSS documents in this series)

1 Hodgson, J M (1997) Soil Survey Field Handbook, Soil Survey Technical Monograph No 5, Silsoe

2 Munsell Soil Colour Book, Munsell Colour (2009)

Knowledge:

- 1 An understanding of **soil development processes** and of the influence of relief, geology, climate, vegetation and soil organisms on soil development
- 2 A basic knowledge of world and European soils and their taxonomy, and a more detailed knowledge of soil development and taxonomy within the United Kingdom
- 3 An understanding of the potential for **soil heterogeneity** in space and time, and of the factors that cause and influence variability
- 4 Knowledge of **soil horizon notation** and, where appropriate, of a relevant scheme for soil classification including the identification of diagnostic horizons, features and materials
- 5 Knowledge of **local soils and land use history affecting the soils** and of the range of soils developed across the UK and Europe, and of information sources for more detailed information
- 6 Knowledge of **natural soil properties and conditions** that is sufficient to set soil conditions at an investigation site within the context of natural variability
- 7 Knowledge and application of relevant **Health and Safety, Environmental and Biosecurity regulations**, including any animal or plant health restrictions in force and all relevant safe working practices
- 8 Knowledge of the **potential impacts of human activity and of land management** on soil properties and processes
- 9 Particular specialist knowledge of soil and crop nutrition, soil hydrology, and of the influence of soil on plant and animal ecology may be required in particular circumstances and these are detailed in related PCSS competency documents

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Soil science in soil handling and restoration



Background

Large amounts of soil are disturbed during the development of land for urban, industrial/retail and transport uses, for installation of energy networks and for the quarrying of aggregates and minerals. In addition, previously excavated soils are re-instated after mineral working and in the restoration of previously despoiled land to green after-use and to create parks, gardens and landscaped areas within the built environment. Professional soil science has an important role to play in ensuring a successful outcome. Professional competence in managing the restoration of land after soil disturbance builds upon foundation skills in field soil investigation, description and interpretation (BSSS PCSS Document 1). The competencies outlined in BSSS PCSS Documents 6 (Soil science in the establishment, management and/or conservation of natural habitats and ecosystems) and 8 (Soil science in landscape design and construction) will also be relevant depending on the intended after-use of a site.

Qualifications

Professional soil scientists and engineers with competence in soil handling and land restoration will have graduated in a relevant science subject. They will also have a second degree and/or a number

of years relevant field experience and will have or be adequately qualified for full membership of a relevant professional body such as the British Society of Soil Science (BSSS).

Minimum competencies

Skills and knowledge:

These are described under a number of sub-headings that relate to different tasks. A professionally-competent scientist or engineer should have the skills and knowledge identified under the **General heading** and **all other headings that are relevant** to the tasks required. Professional soil scientists and engineers working in this sector should be familiar with the Defra Construction Code of Practice for the Sustainable use of Soils on Construction Sites (Defra 2009).

General

- 1 The ability to investigate, sample, describe and interpret soils in the field in a consistent manner and to professional standards (BSSS PCSS Document 1)
- 2 The ability and knowledge required to interpret the results of any soil chemical, physical or microbiological analyses

Soil science in soil handling and restoration



- 3 Knowledge of relevant European and national regulations and policies, including national and local land use planning policy and guidance, and soil protection policy
- 4 A working knowledge of the industry being advised, whether quarrying, development, infrastructure installation or landscaping
- 5 The ability to effectively communicate soil information in a simple and relevant form to developers, planners, landscape architects and earthmoving contractors with clear statements as to the reliability and certainty of the results
- 6 The ability to write accurate reports and/or method statements, written in clear terms, that communicate the relevant information to site planners, site managers, site personnel and eventual users of restored land
- 7 An awareness of the importance of systems of quality assurance and control in all aspects of professional work

The characterisation of soil resources

- 1 The know-how to select appropriate survey and sampling densities to characterise *in situ* and stockpiled soil resources to required levels of certainty
- 2 Understanding of Health and Safety requirements on site and the ability to compile a risk assessment when requested
- 3 Familiarity with the use and limitations of GPS for determining sampling locations on site
- 4 Proficiency in fieldwork practices and procedures such as soil texturing, soil description and the delineation of soil resource units (see BSSS PCSS Document 1)

The provision of advice on soil handling

- 1 A knowledge of the machines used for handling soils, their capabilities and limitations
- 2 An awareness of methods of soil handling that minimise physical damage to soils and guidance¹ that describes such methods, including management of stockpiled soil
- 3 An understanding of soil hydrology and physical and engineering properties such as plastic limit, and their relevance to soil handling

- 4 The ability to calculate volumes of *in situ* soil layers to be moved as well as soil stored in stockpiles
- 5 A knowledge and understanding of waste management and/or contaminated land regulations that might restrict the export of soil materials off-site or their management within site
- 6 Familiarity with British Standards relevant to characterising soil materials already on site or being imported to site²
- 7 The ability to prepare a Soil Management Strategy/Soil Resource Plan³ and simple method statements for site personnel

The restoration of land

- 1 The ability to characterise existing substrates on site and make best use of them, including chemical or physical amelioration where necessary
- 2 Knowledge and experience of the uses of manufactured soils and the use of organic materials for soil creation where natural soils are in short supply
- 3 Understanding of the specific soil chemical and physical conditions (including the principles of soil engineering) necessary for various restored after uses and landforms, such as woodland, Best and Most Versatile agricultural land, wet meadow, species-rich grassland, commercial landscaping, etc.

The aftercare and assessment of restored land

- 1 The ability to prepare and/or interpret aftercare plans (for those restored land uses where one is required)⁴
- 2 The ability to assess soil physical quality and make any recommendations for amelioration to create a 'fit-for-purpose' soil profile⁵
- 3 The ability to take representative soil samples for chemical analysis and to interpret the results to make recommendations for the use of fertilisers⁶, lime or other chemical ameliorants⁷

1 for example the MAFF (2000) Good Practice Guide for Handling Soils

2 e.g. BS3882:2007 Specification for Topsoil and Requirements for Use

3 Defra (2009) Construction Code of Practice for the Sustainable Use of Soils on Construction Sites

4 Might necessitate a FACTS qualification where the use is agricultural; see BSSS PCSS Document 10 Soil science in crop and livestock production

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Annex B – Field Assessment of Soil Plasticity

This Annex presents the method for assessing the plasticity (consistency) of soils in the field. This method is to be used to assess soil plasticity at all pertinent stages of the earthworks programme including:

- In situ before/during soil stripping.
- Storage stockpiles (non-plastic soils only).
- Reconditioning windrows.
- During soil re-spreading and decompaction/cultivation operations.

The procedure is outlined as:

- Walkover/visual examination.
- Soil sampling.
- Sample assessment.

Walkover/ Visual Examination

The assessor shall first walk over or along the area / field or stockpile / windrow to be assessed in order to identify any apparent significant variability (e.g., evidence of poaching incidents of surface water ponding, saturated soils, or distribution of moisture loving plant species such as rushes (*Juncus*)) and to identify suitable locations for sampling.

In addition to any areas identified from the walkover, any locations likely to display varying plasticity to the majority (low-lying spots, the base of stockpiles / windrows etc) shall be accounted for when sampling.

Site observations relating soil moisture content and soil plasticity and the distribution of any significant variability shall be recorded.

Soil Sampling

For undisturbed areas, the topsoil and upper subsoil shall be sampled at several locations using an Edelman soil auger. Separate samples from each soil layer shall be taken from their full depth.

For stockpiles and windrows, the soil shall be sampled at representative locations using an Edelman soil auger at a range of depths depending on the stockpile size. Where deemed necessary by the site Soil Scientist, samples from greater depths shall be obtained using a suitably sized mechanical excavator.

For each layer, approximately a double handful of soil shall be collected and mixed up in a suitable container.

A minimum of five locations shall be sampled and assessed per field or stockpile / windrow.

Sample Assessment

The test sample (small handful) shall be taken from the collected sample and prepared for assessment by removing stones and vegetation including all roots greater than 1 mm. Any significant quantity of very fine roots (<1 mm) shall be removed.

The test sample shall be kneaded to break down any structure and ensure the mass is all at the same moisture content and assessed in accordance with the tables below.

Sample Assessment for Dry and Friable Soils

Examination	Assessment
If the soil sample is wet, films of water are visible on the surfaces of grains and aggregates and/or when a soil sample is squeezed in the hand, and it readily deforms into a cohesive 'ball.'	Handling not recommended – if handled, stockpiled material to be recorded as plastic
Peds (structures) break up/crumble readily when squeezed in the hand rather than forming into a ball.	Handling ok
If the sample is moist, there is a slight dampness when squeezed between the fingers, but it does not significantly change colour (darken) on further wetting.	No handling by dozers but may be handled by tracked excavators if consistency test is passed
If the sample is dry and brittle it will look dry and change colour (darken) if water is added.	Handling ok if consistency test is passed

Consistency Test

Attempt to mould a soil sample into a ball by hand:

First Consistency Test for Dry and Friable Soils

Examination	Assessment
Impossible because the soil is too hard (dry)	Handling ok
Impossible because the soil is too loose (dry)	Handling ok

Examination	Assessment
Impossible because the soil is too loose (wet)	Handling not recommended – if handled, stockpiled material to be recorded as plastic
Possible	Go to table below

Attempt to roll the ball into a thread of 3 mm diameter on a flat non-adhesive surface using light pressure from the flat of the hand:

Second Consistency Test for Dry and Friable Soils

Examination	Assessment
Impossible; the soil crumbles or disintegrates	Handling ok
Possible	Handling not recommended – if handled, stockpiled material to be recorded as plastic

Annex C – Soil Stripping Methodology

This Annex sets out the approach to be followed for soil stripping.

Existing Vegetation

Woodlands / hedges shall be pre-treated before soil stripping, in two stages:

- Each tree shall be felled and removed from site, including all branches / brash.
- Tree stumps and associated large roots (>20 mm diameter) shall be lifted using a suitable excavator.

All woody materials (tree trunks, stumps, branches and brash, etc), including wood chippings, shall be removed from the area being stripped and will be managed in accordance with the Site Waste Management Plan. Excessive amounts of woody material will not be incorporated with the stripped soils. The only exception would be where deadwood forms a component of the surface features; in such circumstances a proportion of existing dead wood will be salvaged and used to recreate this habitat.

Any temporary stockpiles of woody materials shall be constructed with a small 'core' to minimise the risk of spontaneous combustion and monitored as appropriate.

Other vegetation will be cleared using an appropriate method. All arisings will be removed prior to soil stripping commencing to ensure significant quantities of green materials are not incorporated with the stripped topsoil as this can lead to the development of anaerobic conditions within the stockpiled soil.

Access Routes

Access to each area / compartment to be stripped shall be created by stripping the topsoil (and some subsoil) and aggregate (e.g. stone) placed on top of the subsoil. The intention is that the receiving dump truck for the rest of the area/compartment shall run on the aggregate layer to prevent damage to the topsoil or subsoil.

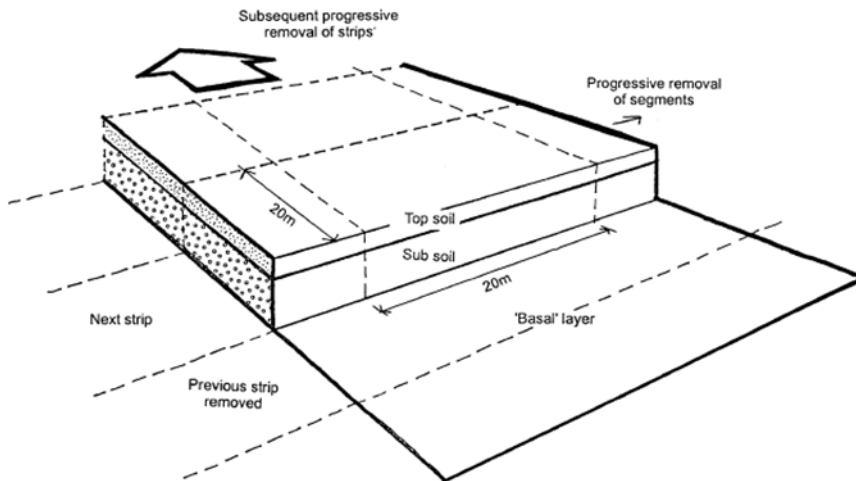
Access shall be created wide enough to permit access for the dump trucks which shall transport the stripped soils to the storage area.

Topsoil Stripping

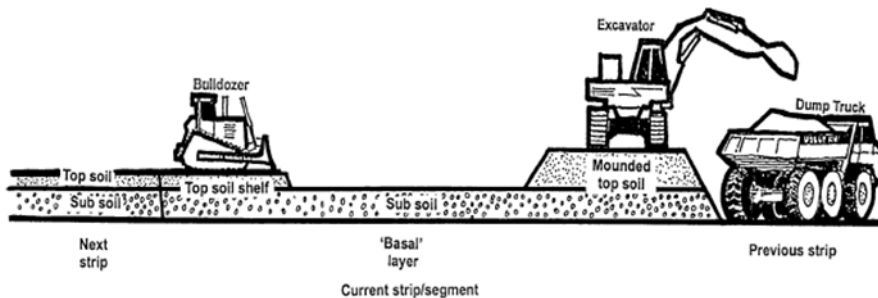
In advance of stripping, the topsoil shall be cleared of all foreign matter or waste materials e.g. building rubble and fill materials.

All topsoil shall be stripped using hydraulic excavators and tracked dozers and transported using dump trucks, unless being stockpiled to one side of the construction area in accordance with the Good Practice Guide for Handling Soils in Mineral Workings (Ref 1.4) as shown in the figures below.

The tracked dozer shall run on the surface of the subsoil and push up the topsoil in a single pass into a temporary row at the end of its run. Using a hydraulic excavator, the stripped topsoil shall be loaded onto a dump truck for transportation to the designated stockpile location.



Soil stripping with bulldozers and dump trucks: the bed and segment system



Soil stripping with bulldozers and dump trucks: Topsoil

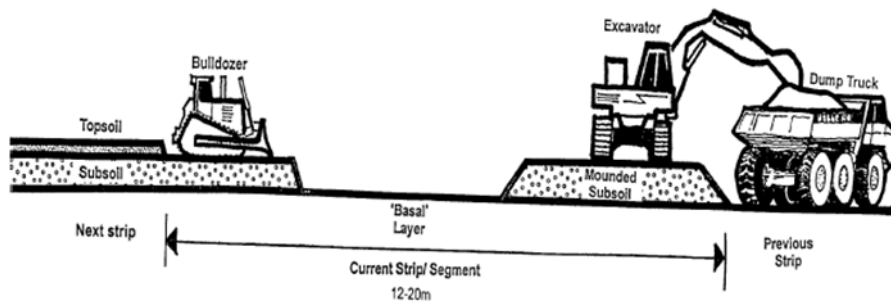
The depth of strip shall be as set out in the Soil Stripping Plan. The aim of the topsoil strip is to enable the majority of the topsoil to be recovered without the inclusion of significant quantities of underlying subsoil. Some variation in topsoil depths is expected and therefore some discretion shall be made by the machine operator (based on soil colour and/or firmness) during the topsoil strip to maximise topsoil recovery without compromising the quality of the soil resource.

Once loaded, the dump truck shall transport the topsoil along the pre-designated access route to the desired stockpile location.

These operations shall be closely monitored to ensure that the correct soil type is recovered without the inclusion of other soils or wastes. Cross contamination with subsoil could significantly degrade the quality of the topsoil.

Subsoil Stripping

Subsoil shall be stripped (where required) using hydraulic excavators and tracked dozers and transported using dump trucks.



Soil stripping with bulldozers and dump trucks: Subsoil

The tracked dozer shall run on the surface of the basal layer and push up the subsoil in a single pass into a temporary row at the end of its run. Using a hydraulic excavator fitted with a toothed bucket, the stripped subsoil shall be loaded onto a dump truck for transportation.

Once loaded, the dump truck shall transport the subsoil along the pre-designated access route to the desired stockpile location.

These operations shall be closely monitored to ensure that the correct soil type is recovered without the inclusion of other soils or wastes. Cross contamination with deeper subsoil / parent material could significantly degrade the quality of the subsoil.

Annex D – Soil Stockpiling Methodology

Introduction

This Annex sets out the approach for the storage (stockpiling) of soils.

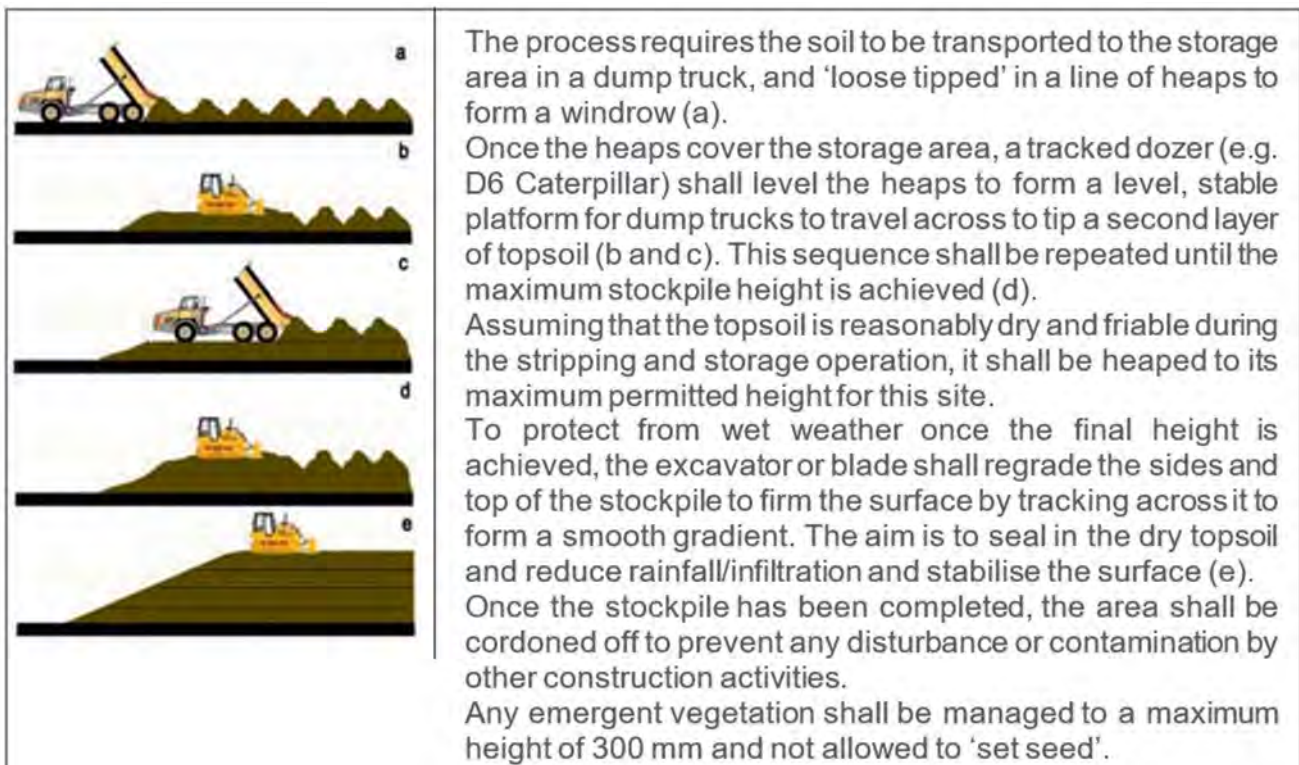
Stockpiling will ensure that topsoil and subsoil resources are stored separately. Where required, soil resources with differing characteristics are also stockpiled separately.

Stockpile locations will be identified in advance and clearly shown on relevant plans such that they do not interfere with other site operations, minimising the risk of stockpiled soil resources becoming contaminated, tracked over, etc.

The area(s) designated for soil storage shall be cleared of vegetation and stripped, where required ahead of stockpile construction. Topsoil will be stored on top of in situ topsoil, with a marker layer of straw placed first to ensure, at the time of soil recovery, it is clear where the base of the stockpiled material lies. Subsoil will only be stored on subsoil (i.e. in an area where topsoil has been stripped).

Stockpiling Method

The approach illustrated in Figure 1-4 Stockpiling Method below will be used to stockpile non-plastic soils. Ideally, plastic soils will be reconditioned as shown in Annex E prior to final stockpile creation.



Stockpiling Method

Annex E – Soil Reconditioning Methodology

Introduction

This Annex presents the approach to be used for reconditioning plastic soils. This Outline SMP requires all soils to be handled when non-plastic but should this not happen or plastic soils be identified in stockpiles prior to re-use, reconditioning will be required.

Reconditioning will be undertaken in area(s) of the site where it will not interfere with other site operations to minimise the risk of soils that are being reconditioned becoming contaminated, tracked over etc.

The area(s) designated for soil reconditioning shall be cleared of vegetation. Soil materials will only be windrowed on compatible soil types / layers. Where possible, reconditioning at the re-use location will reduce the amount of handling required.

Soil Reconditioning Method

The approach illustrated in the graphic below shall be applied through placing the plastic soils into windrows and allowing the soil to dry over a period of several weeks (assuming suitable weather conditions). The reconditioned soil can then be used to reinstate areas or be re-stockpiled in a non-plastic state, as shown in Figure 1-5 – Conditioning prior to stockpiling below.

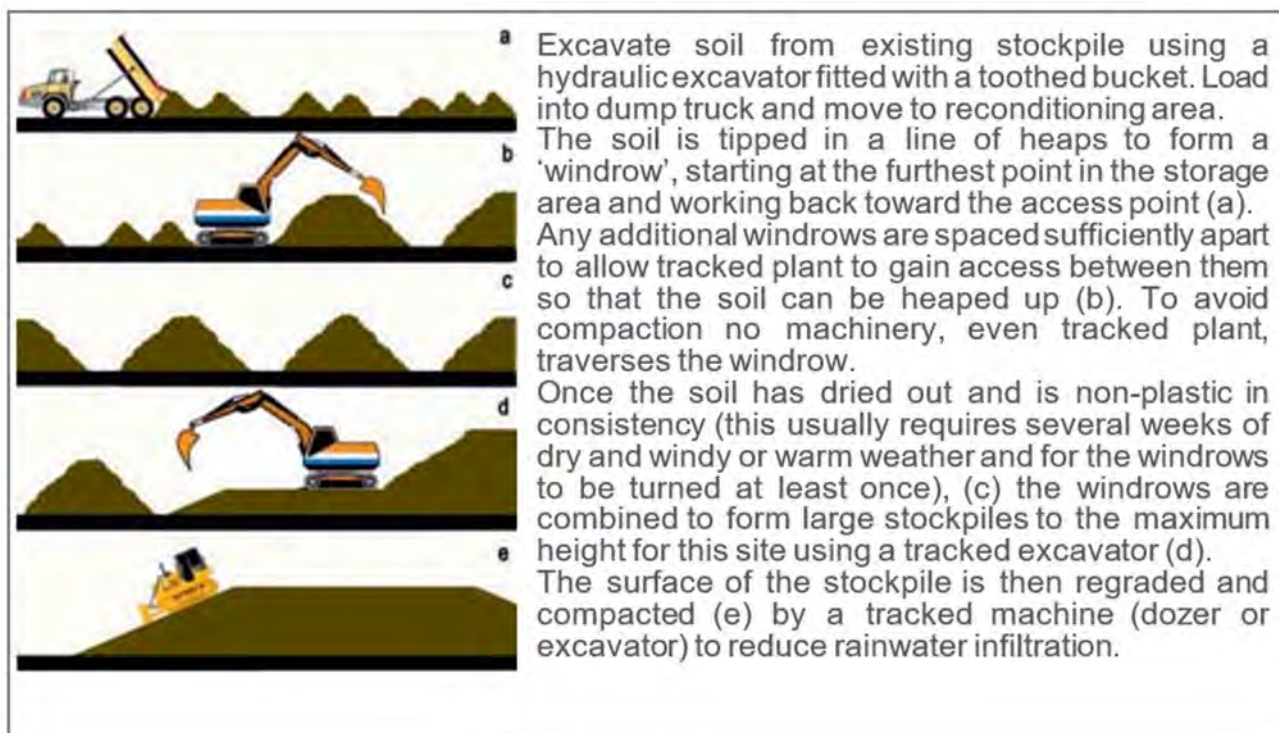


Figure 1-5 – Conditioning prior to stockpiling

Annex F – Soil Placement Methodology

This Annex presents the methods for the placement of the soils. It comprises the following:

- Soil handling considerations.
- Placement and treatment of overburden.
- Subsoil and topsoil placement and spreading.
- Cultivations and monitoring.

Soil Handling Considerations

To avoid further physical degradation during all phases of soil placement and handling (e.g. re-spreading/placement, overburden ripping/subsoiling and topsoil cultivation), these operations will be carried out when soil is non-plastic in consistency. As such, soil handling will be stopped during and after heavy rainfall and not continue until the soil is again non-plastic in consistency.

Monitoring of the soil placement will be undertaken to ensure the placed soil is not structurally damaged and so any required remedial measures can be implemented as the works progress.

Placement and Treatment of Overburden

The finished surface, prior to the placement of subsoil and topsoil materials, will be loosened through the use of appropriate plant, such as a heavy duty subsoiler/ripper fixed to a tracked dozer. If access is limited, a single rigid tine fitted to a hydraulic excavator will be used to undertake this operation.

The depth of ripping of the overburden will be to 0.4 m, with tine spacing at a maximum of 1 m centres. Any oversized rocks (greater than 0.2 m diameter) that are uplifted to the soil surface during ripping will be picked and removed for use as infill elsewhere.

To ensure effective drainage, ripping shall include a straight run across the width of the area being reinstated at an angle of approximately 45° to any slope followed by a subsequent oblique pass. If assessed as necessary by the Soil Scientist, a third pass shall be run at an angle of 90° to the first pass to ensure that there are no remaining blocks of unbroken compacted soil.

As the areas being reinstated are generally narrow linear corridors, ripping will be undertaken to ensure tie-in with adjacent, non-worked land parcels such that the ripping does not result in subsequent drainage issues on those land parcels.

Subsoil and Topsoil Placement

A sequential approach to subsoil and topsoil placement will be undertaken as outlined below:

Subsoil Placement

- Using hydraulic excavator fitted with toothed bucket (to avoid smearing) remove subsoil from stockpiles.
- Transport with dump truck to the appropriate re-use location.
- Tip subsoil in a line of heaps at the edge of the ripped/subsoiled area to avoid re-compaction of the overburden.
- Spread the subsoil using either a tracked dozer or tracked excavator.
- Subsoil depths to be checked by Soil Scientist to ensure correct subsoil depth is achieved across the reinstatement area.

Topsoil Spreading

Once satisfactory subsoil placement has been achieved, topsoil shall be removed from stockpiles and spread following the same procedures for subsoil above, ensuring that placed and loosened subsoil and overburden is not tracked over.

Topsoil depths to be checked by Soil Scientist to ensure correct topsoil depth is achieved.

Cultivations and Monitoring

Once the soil profile has been formed, final cultivation will be undertaken. Cultivation will only be undertaken when the soils are dry and friable to the full depth of working to avoid the risk of smearing the soil.

An appropriate tracked machine or tractor fitted with a wing-tine subsoiler will be used for loosening the subsoil (subsoiling). For inaccessible areas, a suitable tracked excavator, fitted with a single rigid tine (ripper tooth) will be used. Loosening will be undertaken to a minimum depth of 0.6 m below surface level at maximum 0.6 m centres.

To ensure good drainage, subsoiling will include a straight run across the width of the reinstatement area at an angle of approximately 45° to any slope followed by a subsequent oblique pass. If assessed as necessary by the Soil Scientist, a third pass shall be run at an angle of 90° to the first pass to ensure that there are no remaining blocks of unbroken compacted soil.

After subsoiling, the Soil Scientist shall assess the subsoil layer to check the effectiveness of the operation. If compaction is still recorded, the above process will be repeated until this is removed.

Once subsoiling has been undertaken successfully, the topsoil will then be cultivated (with repeat cultivations as required) to its full depth using appropriate tillage equipment (e.g. chisel plough, power harrow or set of discs) to produce a suitable tilth. This operation will also help to re-aerate the topsoil after storage (if applicable).

Where access is limited, the topsoil may be cultivated using a landscape rake attachment fitted to a suitable hydraulic excavator.

Any undesirable material brought to the surface during this exercise shall be removed by picking or raking. For example, stones, fill materials and coarse vegetation larger than 50 mm in any dimension.

After topsoil cultivation, the Soil Scientist shall assess the topsoil horizon to check the effectiveness of the operation and to confirm the condition of the topsoil is suitable for the intended end use.

Appendix 6.1 – Construction Dust Assessment

To determine appropriate mitigation measures, a dust risk assessment has been carried out in accordance with the methodology outlined in the IAQM construction dust guidance (IAQM, 2024).

Step 1

Step 1 screens the requirement for a more detailed assessment. Should human receptors be identified within 250 m of the site boundary or up to 50 m from the construction vehicle routes then the assessment proceeds to Step 2. Additionally, should ecological receptors be identified within 50 m of the site boundary or up to 50 m from the construction vehicle routes then the assessment proceeds to Step 2.

Step 2

Step 2 assesses the risk of potential dust impacts. A site is allocated a risk category based on two factors:

- The scale and nature of the works, which determines the potential dust emission magnitude as: small, medium, or large (Step 2A).
- The sensitivity of the area to dust impacts, which can be defined as low, medium, or high sensitivity (Step 2B).

The two factors are combined in Step 2C to determine the risk of dust impacts without mitigation applied.

Step 2A defines the potential magnitude of dust emission through the construction phase. The relevant criteria are summarised in Table A6-1-1.

Table A6-1-1 – Construction Dust Magnitude of Emissions

Magnitude	Activity	Criteria
Large	Demolition	Total building volume greater than 75,000 m ³ Potentially dusty construction material (e.g. concrete) On-site crushing and screening Demolition activities greater than 12 m above ground level
	Earthworks	Total site area greater than 110,000 m ² Potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size) More than 10 heavy earth moving vehicles active at any one time Formation of bunds greater than 6 m in height
	Construction	Total building volume greater than 75,000 m ³ On site concrete batching Sandblasting
	Trackout	More than 50 Heavy Duty Vehicle (HDV) outward trips per day Potentially dusty surface material (e.g. high clay content) Unpaved road length greater than 100 m
Medium	Demolition	Total building volume 12,000 m ³ to 75,000 m ³ Potentially dusty construction material Demolition activities 6 m to 12 m above ground level
	Earthworks	Total site area 18,000 m ² to 110,000 m ² Moderately dusty soil type (e.g. silt) 5 to 10 heavy earth moving vehicles active at any one time Formation of bunds 3 m to 6 m in height

Magnitude	Activity	Criteria
	Construction	Total building volume 12,000 m ³ to 75,000 m ³ Potentially dusty construction material (e.g. concrete) On site concrete batching
	Trackout	20 to 50 HDV outward trips per day Moderately dusty surface material (e.g. high clay content) Unpaved road length 50 m to 100 m
Small	Demolition	Total building volume under 12,000 m ³ Construction material with low potential for dust release (e.g. metal cladding or timber) Demolition activities less than 6 m above ground level Demolition during wetter months
	Earthworks	Total site area less than 18,000 m ² Soil type with large grain size (e.g. sand) Less than 5 heavy earth moving vehicles active at any one time Formation of bunds less than 3 m in height
	Construction	Total building volume less than 12,000 m ³ Construction material with low potential for dust release (e.g. metal cladding or timber)
	Trackout	Less than 20 HDV outward trips per day Surface material with low potential for dust release Unpaved road length less than 50 m

Step 2B defines the sensitivity of the area around the site to potential dust impacts. The influencing factors are shown in Table A6-1-2.

Table A6-1-2 – Examples of Factors defining Sensitivity of an Area

Receptor Sensitivity	Examples	
	Human Receptors	Ecological Receptors
High	<p>Users expect high levels of amenity.</p> <p>High aesthetic or value property.</p> <p>People expected to be present continuously for extended periods of time.</p> <p>Locations where members of the public are exposed over a time period relevant to the air quality objective for PM₁₀ e.g. residential properties, hospitals, schools and residential care homes.</p>	<p>Internationally or nationally designated site e.g. Special Area of Conservation, and the designated features may be affected by dust soiling.</p> <p>Locations where there is a community of a particular dust sensitive species such as vascular species included in the Red Data List for Great Britain.</p>
Medium	<p>Users would expect to enjoy a reasonable level of amenity.</p> <p>Aesthetics or value of their property could be diminished by soiling.</p> <p>People or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land e.g. parks and places of work.</p>	<p>Nationally designated site e.g. Sites of Special Scientific Interest (SSSIs) with dust sensitive features.</p> <p>Locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown.</p>
Low	<p>Enjoyment of amenity would not reasonably be expected.</p> <p>Property would not be expected to be diminished in appearance.</p> <p>Transient exposure, where people would only be expected to be present for limited periods. e.g. public footpaths, playing fields, shopping streets, playing fields, farmland, footpaths, short term car park and roads.</p>	<p>Locally designated site e.g. Local Nature Reserve (LNR) where the features may be affected by dust deposition.</p>

The guidance also provides the following factors to consider when determining the sensitivity of an area to potential dust impacts:

- Any history of dust generating activities in the area.
- The likelihood of concurrent dust generating activity on nearby sites.
- Any pre-existing screening between the source and receptors.
- Any conclusions drawn from analysing local meteorological data which accurately represent the area.
- The season during which works will take place.
- Any conclusions drawn from local topography.
- Duration of the potential impact, as a receptor may become more sensitive over time.
- Any known specific receptor sensitivities which go beyond the classifications given in the document.

These factors were considered when undertaking the assessment.

The criteria for determining the sensitivity of the area to dust soiling effects on people and property is summarised in Table A6-1-3.

Table A6-1-3 – Sensitivity of the area to dust soiling effects on people and property

Receptor Sensitivity	Number of Receptors	Distance from the Source (m)			
		Less than 20	Less than 50	Less than 100	Less than 250
High	More than 100	High	High	Medium	Low
	10 - 100	High	Medium	Low	Low
	1 - 10	Medium	Low	Low	Low
Medium	More than 1	Medium	Low	Low	Low
Low	More than 1	Low	Low	Low	Low

Table A6-1-4 outlines the criteria for determining the sensitivity of the area to human health impacts.

Table A6-1-4 – Sensitivity of the Area to Human Health Impacts

Receptor Sensitivity	Annual Mean PM ₁₀ Concentration	Number of Receptors	Distance from the Source (m)			
			Less than 20	Less than 50	Less than 100	Less than 250
High		More than 100	High	High	High	Medium

Receptor Sensitivity	Annual Mean PM ₁₀ Concentration	Number of Receptors	Distance from the Source (m)			
			Less than 20	Less than 50	Less than 100	Less than 250
	Greater than 32µg/m ³	10 - 100	High	High	Medium	Low
		1 - 10	High	Medium	Low	Low
	28-32µg/m ³	More than 100	High	High	Medium	Low
		10 - 100	High	Medium	Low	Low
		1 - 10	High	Medium	Low	Low
	24-28µg/m ³	More than 100	High	Medium	Low	Low
		10 - 100	High	Medium	Low	Low
		1 - 10	Medium	Low	Low	Low
	Less than 24µg/m ³	More than 100	Medium	Low	Low	Low
		10 - 100	Low	Low	Low	Low
		1 - 10	Low	Low	Low	Low
	Medium	Greater than 32µg/m ³	More than 10	High	Medium	Low
1 - 10			Medium	Low	Low	Low
28-32µg/m ³		More than 10	Medium	Low	Low	Low
		1 - 10	Low	Low	Low	Low
24-28µg/m ³		More than 10	Low	Low	Low	Low
		1 - 10	Low	Low	Low	Low
Less than 24µg/m ³		More than 10	Low	Low	Low	Low
		1 - 10	Low	Low	Low	Low
Low	-	More than 1	Low	Low	Low	Low

Table A6-1-5 outlines the criteria for determining the sensitivity of the area to ecological impacts.

Table A6-1-56 - Sensitivity of the Area to Ecological Impacts

Receptor Sensitivity	Distance from the Source	
	Less than 20 m	Less than 50 m
High	High	Medium
Medium	Medium	Low
Low	Low	Low

Step 2C combines the dust emission magnitude with the sensitivity of the area to determine the risk of unmitigated impacts.

Table A6-1-6 outlines the risk category from demolition activities.

Table A6-1-6 - Dust Risk Category from Demolition Activities

Receptor Sensitivity	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Table A6-1-7 outlines the risk category from earthworks and construction activities.

Table A6-1-7 Dust Risk Category from Construction and Earthwork Activities

Receptor Sensitivity	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table A6-1-8 outlines the risk category from trackout activities.

Table A6-1-8 – Dust Risk Category from Trackout Activities

Receptor Sensitivity	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk

Receptor Sensitivity	Dust Emission Magnitude		
	Large	Medium	Small
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Step 3

Step 3 requires the identification of site-specific mitigation measures within the guidance to reduce potential dust impacts based upon the relevant risk categories identified in Step 2. For sites with negligible risk, mitigation measures beyond those required by legislation are not required. However, additional controls may be applied as part of good practice.

Step 4

Once the risk of dust impacts has been determined and the appropriate mitigation measures identified, the final step is to determine the significance of any residual impacts. For almost all construction activity, the aim should be to control effects using effective mitigation. Experience shows that this is normally possible, hence the residual effect will normally be not significant.

Preliminary Construction Dust Assessment

Step 1

Undertaking of construction activities such as demolition, excavation, ground works, cutting, construction and storage of materials has the potential to result in fugitive dust emissions throughout the construction phase.

A desk study has identified human receptors (i.e. residential properties) within 250m of the draft Order Limits. Construction vehicle routes have not yet been confirmed for this PEIR stage assessment, although preliminary routes are undergoing consultation. There are also a number of ecological sites that have been identified within 250m of the draft Order Limits (in the absence of finalised construction vehicle routes). Therefore, a detailed dust risk assessment has been undertaken for both human and ecological receptors up to 250 m from the draft Order Limits.

Step 2

Demolition

There are no notable demolition activities anticipated for the construction phase of the Project other than the removal of temporary construction compounds. The total building volume to be demolished is assumed to be less than 12,000 m³. The height of demolition activities is assumed to be less than 6m above ground level. As such the potential dust emission magnitude for demolition is considered to be small.

Earthworks

The total site area is greater than 110,000 m². Details of soil type, bunds and the number of heavy earth moving vehicles are currently unconfirmed. However, given the scale of the Project, the potential dust emission magnitude for earthworks is considered to be large.

Construction

Above Ground Installations (AGIs) and a Pump Facility will be constructed as part of the Project, along with temporary construction compounds. The total building volume is assumed to be less than 12,000 m³. Construction materials are likely to include concrete however it is not confirmed if on site concrete batching is required. As such the potential dust emission magnitude for construction is considered to be medium at this stage.

Trackout

The maximum number of outward HDV movements per day is unconfirmed at this stage and the length of unpaved access tracks for construction HDVs is currently unknown. As such the magnitude of potential dust emissions from trackout is considered to be large as a worst case.

The dust emission magnitude for each dust generating activity for the Project is summarised in Table A6-1-9 below.

Table A6-1-9 – Dust Emission Magnitude Summary

Activity	Dust emission magnitude
Demolition	Small
Earthworks	Large
Construction	Medium
Trackout	Large

Step 2B

Receptors sensitive to potential dust impacts during demolition, earthworks, trackout and construction activities were approximated from a desktop study of the area up to 250m

from the draft Order Limits. These are summarised in Table A6-1-10. It has been assumed at PEIR stage that all ecological sites within 250m of the draft Order Limits are sensitive to dust. This will be reviewed at ES stage upon receipt of the final construction vehicle routes to determine the final study area for dust impacts on ecological sites.

Table A6-1-10 – Demolition, Earthworks Trackout and Construction Dust Sensitive Receptors

Distance from Site (m)	Approximate Number of Human Receptors	Approximate Number of Ecological Receptors
Less than 20	10 - 100	1-10
Less than 50	10 - 100	1-10
Less than 100	>100	1-10
Less than 250	>100	1-10

In accordance with the IAQM Construction Dust guidance (IAQM, 2024) the highest level of sensitivity should be recorded from the criteria outlined in the guidance.

The IAQM Construction Dust guidance (IAQM, 2024) defines residential properties as being high sensitivity receptors to dust soiling impacts and therefore the sensitivity of the surrounding area for dust soiling impacts has been determined based on the number of high sensitivity receptors and the distance of the receptor from the source. It has been assumed at PEIR stage that all ecological sites within 250m of the draft Order Limits are high sensitivity receptors. This will be reviewed at ES stage.

To determine the sensitivity of the receiving environment for human health effects the maximum Defra PM₁₀ background concentration for 2029 (Year 1) across the draft Order Limits was obtained from the Defra website (Defra, 2025). This was identified as 15.8µg/m³. Therefore, in accordance with the IAQM Construction Dust guidance (IAQM, 2024) health impacts should be determined based on the criteria within the less than 24 µg/m³ category (refer to Table A6-1-4).

The sensitivity of the receiving environment to specific dust impacts is summarised in Table A6-1-11.

Table A6-1-11 – Summary of the Sensitivity of the Area

Potential Impact	Sensitivity of the surrounding area			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	High	High	High	High

Human Health	Low	Low	Low	Low
Ecological Sites	High	High	High	High

Step 2C

The risk of effects in the absence of environmental measures was then defined based upon the interaction between the magnitude of emission and the highest level of area sensitivity (determined in Steps 2A and 2B, respectively) for each dust generating activity. The risk of dust effects was determined, as presented in Table 1 A6-1-12.

Table A6-1-12 – Summary of the Risk of Dust Effects

Potential Impact	Risk			
	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Medium Risk	High Risk	Medium Risk	High Risk
Human Health	Negligible	Low Risk	Low Risk	Low Risk
Ecological	Medium Risk	High Risk	Medium Risk	High Risk

As indicated in Table A6-1-12, the potential risk for dust soiling and ecological impacts is high for earthworks and trackout activities and medium for demolition and construction activities. The potential risk of health impacts is low risk for earthworks, construction and trackout activities and negligible for demolition activities. The assessment has indicated that the risk of dust effects is high as a worst-case.

Step 3

The IAQM Construction Dust guidance (IAQM, 2024) provides potential mitigation measures to reduce impacts as a result of fugitive dust emissions during the construction phase of the Project. These have been adapted for the Project based on the risk of dust effects (Table A6-1-12) and are summarised in Table A6-1-3.

Table A6-1-13 – Proposed Dust Mitigation Measures based on the IAQM Guidance

Mitigation Measure	Measures H=Highly Recommended D=Desirable
Communications	
Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.	H
Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.	H
Display the head or regional office contact information.	H
Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the Local Authority.	H
Site Management	
Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.	H
Make the complaints log available to the local authority when asked.	H
Record any exceptional incidents that cause dust and/or air emissions, either on- or off-site, and the action taken to resolve the situation in the log book.	H
Hold regular liaison meetings with other high risk construction sites within 250m of the site boundary, to ensure plans are co-ordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/deliveries which might be using the same strategic road network routes.	H

Mitigation Measure	Measures H=Highly Recommended D=Desirable
Monitoring	
Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the Local Authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100m of site boundary, with cleaning to be provided if necessary.	H
Carry out regular site inspections to monitor compliance with the DMP, record inspection results, and make an inspection log available to the local authority when asked.	H
Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.	H
Agree dust deposition, dust flux, or real-time PM ₁₀ continuous monitoring locations with the Local Authority. Where possible, commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences. Further guidance is provided by IAQM on monitoring during demolition, earthworks and construction.	H
Preparing and maintaining the site.	
Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.	H
Erect solid screens or barriers around dusty activities or the site boundary so that are at least as high as any stockpiles on site.	H

Mitigation Measure	Measures H=Highly Recommended D=Desirable
Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.	H
Avoid site runoff of water or mud.	H
Keep site fencing, barriers and scaffolding clean using wet methods.	H
Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site, cover as described below.	H
Cover, seed or fence stockpiles to prevent wind whipping.	H
Operating vehicle/machinery and sustainable travel.	
Ensure all vehicles switch off engines when stationary - no idling vehicles.	H
Avoid the use of diesel- or petrol-powered generators and use mains electricity or battery powered equipment where practicable.	H
Impose and signpost a maximum-speed-limit of 10mph on surfaced and unsurfaced haul roads and work areas (if long haul routes are required, these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the Local Authority, where appropriate).	H
Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.	H
Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing).	H

Mitigation Measure	Measures H=Highly Recommended D=Desirable
Operations	
Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.	H
Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.	H
Use enclosed chutes and conveyors and covered skips.	H
Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.	H
Ensure equipment is readily available on site to clean any dry spillages and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.	H
Waste Management	
Avoid bonfires and burning of waste materials.	H
Demolition	
Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).	N/A
Ensure effective water suppression is used during demolition operations. Hand-held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition, high volume	H

Mitigation Measure	Measures H=Highly Recommended D=Desirable
water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground.	
Avoid explosive blasting, using appropriate manual or mechanical alternatives.	H
Bag and remove any biological debris or damp down such material before demolition.	H
Earthworks	
Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.	H
Use Hessian, mulches or tackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.	H
Only remove the cover in small areas during work and not all at once.	H
Construction	
Avoid scabbling (roughening of concrete surfaces) if possible.	D
Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.	H
Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.	D
For smaller supplies of fine powder materials ensure bags are sealed after use and stored appropriately to prevent dust.	D

Mitigation Measure	Measures H=Highly Recommended D=Desirable
Trackout	
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.	H
Avoid dry sweeping of large areas.	H
Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	H
Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	H
Record all inspections of haul routes and any subsequent action in a site log book.	H
Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.	H
Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	H
Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.	H
Access gates to be located at least 10 m from receptors where possible.	H

These mitigation measures will be secured as relevant in the Construction Environmental Management Plan (CEMP).

Appendix 6.2 – Local Authority Air Quality Monitoring Data

Local authority monitoring data is reported in each local authority’s Annual Status Report and the available data is summarised below in Tables A6-2-1 to A6-2-4. For East Riding of Yorkshire Council, North East Lincolnshire Council, North Lincolnshire Council and North Yorkshire Council the most recent year of monitoring data available at the time of this assessment was 2023. For Kingston upon Hull City Council the most recent year of monitoring data available was for 2022.

Table A6-2-1 – Local Authority NO₂ Diffusion Tube Data

Site ID	Local Authority	Site Type	X	Y	Annual average NO ₂ concentration (µg/m ³)	
					2022	2023
S1	East Riding of Yorkshire	Suburban	503426	425868	14.9	15.8
S2	East Riding of Yorkshire	Roadside	470833	451312	21.2	20.1
S3	East Riding of Yorkshire	Kerbside	487620	441789	18.6	19.7
S4	East Riding of Yorkshire	Roadside	470804	447111	11.0	9.4
S5	East Riding of Yorkshire	Kerbside	473573	424055	24.4	23.9
S6	East Riding of Yorkshire	Kerbside	524097	438567	13.4	13.4
S7	East Riding of Yorkshire	Roadside	519064	450816	12.6	11.1
S8	East Riding of Yorkshire	Roadside	503064	439001	20.9	21.3
S9	East Riding of Yorkshire	Roadside	503086	439020	22.5	21.4
S10	East Riding of Yorkshire	Kerbside	503013	438913	20.0	19.6

Site ID	Local Authority	Site Type	X	Y	Annual average NO ₂ concentration (µg/m ³)	
					2022	2023
S11	East Riding of Yorkshire	Kerbside	480061	449146	21.8	20.4
S12	East Riding of Yorkshire	Roadside	516804	454970	10.1	9.3
S13	East Riding of Yorkshire	Roadside	505498	428881	17.0	15.2
S14	East Riding of Yorkshire	Roadside	518102	468387	-	20.4
S15	East Riding of Yorkshire	Roadside	502269	457754	21.5	18.9
S16	East Riding of Yorkshire	Roadside	503302	427403	25.2	22.3
S17	East Riding of Yorkshire	Roadside	495261	426908	15.8	15.9
S18	East Riding of Yorkshire	Roadside	501827	429826	10.3	10.3
S19	East Riding of Yorkshire	Roadside	494244	449418	27.8	26.6
S20	East Riding of Yorkshire	Roadside	502581	425599	-	19.5
S21	East Riding of Yorkshire	Roadside	474900	427902	26.4	24.2
S22	East Riding of Yorkshire	Roadside	504100	433232	22.0	20.2
S23	East Riding of Yorkshire	Roadside	515781	429027	23.5	22.9
S24	East Riding of Yorkshire	Roadside	496997	426490	33.1	32.9
S25	East Riding of Yorkshire	Roadside	502309	457081	21.4	22.7

Site ID	Local Authority	Site Type	X	Y	Annual average NO ₂ concentration (µg/m ³)	
					2022	2023
S26	East Riding of Yorkshire	Roadside	504637	440017	22.1	21.5
S27	East Riding of Yorkshire	Roadside	497943	426316	23.3	22.4
S28	East Riding of Yorkshire	Roadside	504697	439882	26.6	22.8
S29	East Riding of Yorkshire	Roadside	495626	427060	33.4	32.4
S30	East Riding of Yorkshire	Roadside	468844	421735	18.1	16.1
S31	East Riding of Yorkshire	Kerbside	472612	425584	15.1	14.7
S32	East Riding of Yorkshire	Roadside	472721	425422	10.6	9.3
S33	East Riding of Yorkshire	Roadside	503754	439572	20.1	19.2
S34	East Riding of Yorkshire	Roadside	476054	425330	10.2	9.8
S35	East Riding of Yorkshire	Roadside	492328	431214	-	15.0
S36	East Riding of Yorkshire	Roadside	495723	426954	25.3	23.7
S37	East Riding of Yorkshire	Roadside	518784	430418	-	22.9
S38	East Riding of Yorkshire	Kerbside	518701	430577	-	-
S39	East Riding of Yorkshire	Roadside	474766	422543	15.3	13.0
S40	East Riding of Yorkshire	Roadside	496006	427313	13.4	12.3

Site ID	Local Authority	Site Type	X	Y	Annual average NO ₂ concentration (µg/m ³)	
					2022	2023
S41	East Riding of Yorkshire	Roadside	505234	426460	14.7	13.1
S42	East Riding of Yorkshire	Kerbside	494543	449616	24.6	22.7
S43	East Riding of Yorkshire	Roadside	494675	449632	20.0	19.4
S44	East Riding of Yorkshire	Roadside	496872	426518	16.8	14.9
S45	East Riding of Yorkshire	Roadside	496771	426527	27.3	22.4
S46	East Riding of Yorkshire	Roadside	492244	431032	23.6	21.7
S47	East Riding of Yorkshire	Roadside	519971	447581	30.3	29.0
S48	East Riding of Yorkshire	Roadside	494733	428221	12.6	10.6
S49	East Riding of Yorkshire	Roadside	495732	426997	31.9	23.2
S50	East Riding of Yorkshire	Roadside	501315	445463	9.9	9.9
S51	East Riding of Yorkshire	Roadside	497423	426118	16.3	14.0
S52	East Riding of Yorkshire	Roadside	494770	428016	15.7	14.1
S53	East Riding of Yorkshire	Roadside	492243	431116	20.4	19.2
S54	East Riding of Yorkshire	Roadside	498492	426550	22.3	20.1
S55	East Riding of Yorkshire	Roadside	476124	424942	11.8	12.4

Site ID	Local Authority	Site Type	X	Y	Annual average NO ₂ concentration (µg/m ³)	
					2022	2023
S56	East Riding of Yorkshire	Roadside	506332	456175	-	13.1
S57	East Riding of Yorkshire	Roadside	520021	447520	21.5	20.8
S58	East Riding of Yorkshire	Roadside	496860	425815	22.8	20.6
S59	East Riding of Yorkshire	Roadside	497222	426412	27.0	23.9
S60	East Riding of Yorkshire	Roadside	471539	455708	17.9	18.3
S61	East Riding of Yorkshire	Roadside	502951	428700	16.1	14.2
S62	East Riding of Yorkshire	Roadside	522589	444098	-	11.1
S63	East Riding of Yorkshire	Roadside	494158	426490	14.3	13.5
S64	East Riding of Yorkshire	Roadside	464192	422112	30.4	28.4
S65	East Riding of Yorkshire	Roadside	498622	426191	-	14.8
S66	East Riding of Yorkshire	Roadside	464163	422151	28.2	22.7
S67	East Riding of Yorkshire	Roadside	516824	429457	16.7	17.0
S68	East Riding of Yorkshire	Kerbside	516957	428795	20.1	19.9
S69	East Riding of Yorkshire	Roadside	498623	426192	-	14.8
S70	East Riding of Yorkshire	Roadside	504063	439233	17.5	17.1

Site ID	Local Authority	Site Type	X	Y	Annual average NO ₂ concentration (µg/m ³)	
					2022	2023
S71	East Riding of Yorkshire	Roadside	504489	439562	14.7	12.7
S72	East Riding of Yorkshire	Roadside	508853	442647	-	20.8
NEL S1	North East Lincolnshire Council	Roadside	527095	409367	28.1	29.0
NEL S2	North East Lincolnshire Council	Kerbside	526185	409136	-	17.3
NEL S3	North East Lincolnshire Council	Kerbside	525461	408347	-	14.1
NEL S4	North East Lincolnshire Council	Kerbside	526482	407708	-	23.8
NEL S5	North East Lincolnshire Council	Kerbside	526504	406678	-	21.0
NEL S6	North East Lincolnshire Council	Kerbside	526427	404055	-	14.7
NEL S7	North East Lincolnshire Council	Roadside	527716	404516	19.8	16.8
NEL S8	North East Lincolnshire Council	Roadside	527748	404396	15.1	12.3
NEL S9	North East Lincolnshire Council	Kerbside	530760	408378	-	17.3

Site ID	Local Authority	Site Type	X	Y	Annual average NO ₂ concentration (µg/m ³)	
					2022	2023
NEL S10	North East Lincolnshire Council	Kerbside	530288	408898	-	19.6
NEL S11	North East Lincolnshire Council	Roadside	529532	406835	21.0	16.8
NEL S12	North East Lincolnshire Council	Roadside	528891	408078	19.8	16.6
NEL S13/S14/S15	North East Lincolnshire Council	Roadside	527540	408080	21.9	18.6
NEL S16	North East Lincolnshire Council	Roadside	523284	409883	16.6	12.2
NEL S17	North East Lincolnshire Council	Kerbside	518108	414533	28.1	14.6
NEL S18/S19/S20	North East Lincolnshire Council	Urban Background	518277	415116	-	9.6
NEL S21	North East Lincolnshire Council	Roadside	519193	415279	21.7	19.4
NEL S22	North East Lincolnshire Council	Roadside	526077	410124	23.8	23.9
NEL S23	North East Lincolnshire Council	Kerbside	527182	410092	28.0	23.0

Site ID	Local Authority	Site Type	X	Y	Annual average NO ₂ concentration (µg/m ³)	
					2022	2023
NEL S24/S25/S26	North East Lincolnshire Council	Roadside	527761	410425	36.7	33.0
NEL S27	North East Lincolnshire Council	Kerbside	527754	410445	31.5	25.4
NEL S28	North East Lincolnshire Council	Kerbside	527789	410438	31.3	23.9
NEL S29	North East Lincolnshire Council	Kerbside	527693	410413	27.2	24.3
NEL S30	North East Lincolnshire Council	Roadside	528725	410102	28.1	24.2
NEL S31	North East Lincolnshire Council	Roadside	527627	409563	-	18.6
NEL S32	North East Lincolnshire Council	Kerbside	527403	408666	25.9	20.9
NEL S33	North East Lincolnshire Council	Kerbside	527183	409647	23.9	20.3
NEL S34	North East Lincolnshire Council	Roadside	527181	409513	26.7	24.4
NEL S35	North East Lincolnshire Council	Other	527288	409223	-	11.6

Site ID	Local Authority	Site Type	X	Y	Annual average NO ₂ concentration (µg/m ³)	
					2022	2023
1	North Lincolnshire Council	Urban Background	489099	411723	28.4	25.0
2	North Lincolnshire Council	Roadside	487239	411259	24.3	23.5
3	North Lincolnshire Council	Roadside	486699	411110	19.8	16.5
4	North Lincolnshire Council	Roadside	486928	411156	20.7	18.6
5	North Lincolnshire Council	Urban Background	489190	411285	24.0	21.6
6	North Lincolnshire Council	Urban Background	489209	411118	22.7	21.7
7	North Lincolnshire Council	Roadside	489172	409926	22.9	21.5
8	North Lincolnshire Council	Roadside	489112	409463	25.3	22.7
9	North Lincolnshire Council	Roadside	491628	408658	19.1	18.0
10	North Lincolnshire Council	Roadside	491901	408626	30.2	36.7

Site ID	Local Authority	Site Type	X	Y	Annual average NO ₂ concentration (µg/m ³)	
					2022	2023
11	North Lincolnshire Council	Roadside	491859	408645	19.6	19.1
12	North Lincolnshire Council	Suburban	499975	407421	19.6	17.0
13	North Lincolnshire Council	Roadside	514573	415901	16.8	14.2
14	North Lincolnshire Council	Roadside	514782	415971	27.1	24.1
15	North Lincolnshire Council	Urban Background	515452	416107	16.7	15.0
16	North Lincolnshire Council	Roadside	515279	416085	23.8	20.8
17	North Lincolnshire Council	Suburban	503025	421942	22.3	18.5
18, 19, 20	North Lincolnshire Council	Industrial	490316	410837	13.4	11.8
21	North Lincolnshire Council	Roadside	490080	411258	20.2	19.7
22	North Lincolnshire Council	Roadside	514141	417483	24.4	21.4

Site ID	Local Authority	Site Type	X	Y	Annual average NO ₂ concentration (µg/m ³)	
					2022	2023
23	North Lincolnshire Council	Roadside	488645	412891	24.3	14.6
24	North Lincolnshire Council	Roadside	487203	408372	15.9	14.3
3N	North Yorkshire Council	Urban Background	460855	432820	11.8	11.0
4N	North Yorkshire Council	Roadside	461096	432191	18.7	17.7
9N	North Yorkshire Council	Urban Background	460899	430935	10.9	9.7
S1	North Yorkshire Council	Roadside	461638	432345	26.8	26.4
S2	North Yorkshire Council	Roadside	461689	432422	24.9	24.0
S3a, S3b, S3c	North Yorkshire Council	Roadside	461670	432408	30.6	30.8
S4	North Yorkshire Council	Roadside	461681	432407	37.1	36.8
S5a, S5b, S5c	North Yorkshire Council	Roadside	461659	432405	30.1	32.8
S6	North Yorkshire Council	Roadside	461635	432372	22.7	22.5
S7a, S7b, S7c	North Yorkshire Council	Roadside	461688	432434	39.1	39.8
S8	North Yorkshire Council	Roadside	461697	432424	23.5	22.3
S10	North Yorkshire Council	Roadside	461317	432356	23.7	23.4

Site ID	Local Authority	Site Type	X	Y	Annual average NO ₂ concentration (µg/m ³)	
					2022	2023
S11	North Yorkshire Council	Roadside	461507	432319	27.1	24.3
S18	North Yorkshire Council	Roadside	461517	432582	23.5	21.4
S19	North Yorkshire Council	Roadside	461526	432584	26.5	25.4
S22	North Yorkshire Council	Roadside	461733	432411	19.8	-
S23	North Yorkshire Council	Roadside	461821	432376	15.9	16.7
S24	North Yorkshire Council	Roadside	461788	432379	20.2	19.5
S25	North Yorkshire Council	Roadside	461762	432408	20.6	20.2
S26	North Yorkshire Council	Roadside	461648	432384	27.2	27.6
S27	North Yorkshire Council	Roadside	461120	432303	28.1	26.1
S28	North Yorkshire Council	Roadside	461062	432475	16.6	15.3
S29	North Yorkshire Council	Roadside	461041	432539	20.1	18.4
S30	North Yorkshire Council	Roadside	461806	432546	18.4	18.7
S31	North Yorkshire Council	Roadside	461852	432594	17.6	17.9
S32	North Yorkshire Council	Roadside	461871	432643	13.8	13.7
S33	North Yorkshire Council	Roadside	461935	432672	14.3	13.6

Site ID	Local Authority	Site Type	X	Y	Annual average NO ₂ concentration (µg/m ³)	
					2022	2023
S34	North Yorkshire Council	Roadside	461938	432710	20.8	20.0
S35	North Yorkshire Council	Roadside	461617	432148	-	19.6
1	Kingston Upon Hull City Council	Roadside	510721	428732	18.5	-
2	Kingston Upon Hull City Council	Roadside	508140	427802	27.3	-
3	Kingston Upon Hull City Council	Kerbside	507972	427770	27.1	-
4	Kingston Upon Hull City Council	Kerbside	506018	428892	20.2	-
5	Kingston Upon Hull City Council	Kerbside	505914	429362	21.7	-
6	Kingston Upon Hull City Council	Kerbside	507331	428719	28.5	-
7	Kingston Upon Hull City Council	Kerbside	507345	428738	30.7	-
8	Kingston Upon Hull City Council	Kerbside	508149	428670	31.9	-
9	Kingston Upon Hull City Council	Kerbside	508413	428659	24.2	-

Site ID	Local Authority	Site Type	X	Y	Annual average NO ₂ concentration (µg/m ³)	
					2022	2023
10	Kingston Upon Hull City Council	Kerbside	508905	428502	16.4	-
11	Kingston Upon Hull City Council	Roadside	508489	427986	24.0	-
12	Kingston Upon Hull City Council	Roadside	508921	428659	23.8	-
13	Kingston Upon Hull City Council	Roadside	509727	428473	26.2	-
14	Kingston Upon Hull City Council	Kerbside	509917	428437	26.0	-
15	Kingston Upon Hull City Council	Urban Centre	509913	428446	31.9	-
16, 17, 18	Kingston Upon Hull City Council	Kerbside	510039	428687	26.7	-
19	Kingston Upon Hull City Council	Urban Background	509482	429322	18.7	-
20	Kingston Upon Hull City Council	Kerbside	509465	429281	25.0	-
21	Kingston Upon Hull City Council	Kerbside	509125	429228	30.7	-

Site ID	Local Authority	Site Type	X	Y	Annual average NO ₂ concentration (µg/m ³)	
					2022	2023
22	Kingston Upon Hull City Council	Kerbside	509273	428811	33.3	-
23	Kingston Upon Hull City Council	Roadside	509299	428797	26.8	-
24	Kingston Upon Hull City Council	Roadside	509186	428904	33.0	-
25	Kingston Upon Hull City Council	Kerbside	509198	429022	30.6	-
26	Kingston Upon Hull City Council	Kerbside	509134	429115	29.3	-
27	Kingston Upon Hull City Council	Kerbside	509202	428944	38.6	-
28	Kingston Upon Hull City Council	Kerbside	509102	429228	29.9	-
29	Kingston Upon Hull City Council	Kerbside	509004	429312	35.1	-
30	Kingston Upon Hull City Council	Kerbside	508865	429378	27.0	-
31	Kingston Upon Hull City Council	Kerbside	508819	429372	26.5	-

Site ID	Local Authority	Site Type	X	Y	Annual average NO ₂ concentration (µg/m ³)	
					2022	2023
32	Kingston Upon Hull City Council	Kerbside	508241	429602	31.7	-
33	Kingston Upon Hull City Council	Roadside	508780	428925	24.4	-
34	Kingston Upon Hull City Council	Kerbside	508233	429887	27.5	-
35	Kingston Upon Hull City Council	Kerbside	508327	429572	33.6	-
36	Kingston Upon Hull City Council	Kerbside	508201	429800	38.1	-
37	Kingston Upon Hull City Council	Kerbside	508537	429492	23.3	-
38	Kingston Upon Hull City Council	Kerbside	508258	429939	29.4	-
39	Kingston Upon Hull City Council	Roadside	508276	430730	18.5	-
40	Kingston Upon Hull City Council	Roadside	506590	430671	21.0	-
41	Kingston Upon Hull City Council	Kerbside	507876	432075	14.9	-

Site ID	Local Authority	Site Type	X	Y	Annual average NO ₂ concentration (µg/m ³)	
					2022	2023
42	Kingston Upon Hull City Council	Roadside	508299	432952	23.7	-
43	Kingston Upon Hull City Council	Kerbside	506972	433172	11.4	-
44	Kingston Upon Hull City Council	Roadside	508698	434348	19.7	-
45	Kingston Upon Hull City Council	Roadside	511529	433117	25.7	-
46	Kingston Upon Hull City Council	Kerbside	512678	432075	14.0	-
47	Kingston Upon Hull City Council	Kerbside	511793	430508	25.7	-
48	Kingston Upon Hull City Council	Kerbside	513877	430355	23.9	-
49	Kingston Upon Hull City Council	Kerbside	514113	429329	27.8	-
50	Kingston Upon Hull City Council	Roadside	514129	429321	35.8	-
51	Kingston Upon Hull City Council	Roadside	514387	429162	31.4	-

Site ID	Local Authority	Site Type	X	Y	Annual average NO ₂ concentration (µg/m ³)	
					2022	2023
52	Kingston Upon Hull City Council	Roadside	514195	432166	31.9	-
53	Kingston Upon Hull City Council	Kerbside	511024	430853	20.3	-
54	Kingston Upon Hull City Council	Kerbside	510317	431730	33.6	-
55	Kingston Upon Hull City Council	Kerbside	510320	431650	32.2	-
56	Kingston Upon Hull City Council	Kerbside	510380	431236	30.9	-
57	Kingston Upon Hull City Council	Kerbside	509941	431405	23.0	-
58	Kingston Upon Hull City Council	Other	508603	431582	29.8	-
59	Kingston Upon Hull City Council	Kerbside	508520	431875	27.8	-
60	Kingston Upon Hull City Council	Kerbside	508741	431050	30.2	-
61	Kingston Upon Hull City Council	Kerbside	508918	430568	28.4	-

Site ID	Local Authority	Site Type	X	Y	Annual average NO ₂ concentration (µg/m ³)	
					2022	2023
62	Kingston Upon Hull City Council	Kerbside	510364	430215	26.5	-
63	Kingston Upon Hull City Council	Kerbside	508929	430340	26.3	-
64, 65, 66	Kingston Upon Hull City Council	Kerbside	509155	429125	30.3	-
67	Kingston Upon Hull City Council	Industrial	513309	429319	22.9	-

Table A6-2-2 – Local Authority NO₂ Automatic Monitoring Data

Site ID	Local Authority	Site Type	X	Y	Annual average NO ₂ concentration (µg/m ³)	
					2022	2023
AURN Immingham Woodlands Avenue	North East Lincolnshire Council	Urban background	518277	415116	11.7	10.4
Cleethorpe Road	North East Lincolnshire Council	Roadside	527767	410414	29.6	26.4
Peaks Parkway	North East Lincolnshire Council	Roadside	527540	408080	26.3	20.6
CM1	North Lincolnshire Council	Industrial	490320	410831	13	12

Site ID	Local Authority	Site Type	X	Y	Annual average NO ₂ concentration (µg/m ³)	
					2022	2023
CM3	North Lincolnshire Council	Industrial	49294 5	41193 1	13	11
CM6	North Lincolnshire Council	Other	51488 0	41613 3	14	13
CM1	Kingston Upon Hull City Council	Industrial	51330 9	42931 9	23	-
CM2	Kingston Upon Hull City Council	Urban background	50948 2	42932 2	18	-
CM3	Kingston Upon Hull City Council	Roadside	51179 4	43051 1	22	-

Table A6-2-3 – Local Authority PM₁₀ Automatic Monitoring Data

Site ID	LA	Site Type	X	Y	Annual average PM ₁₀ concentration (µg/m ³)	
					2022	2023
AURN Immingham Woodlands Avenue	North East Lincolnshire Council	Urban background	51827 7	41511 6	12.7	11.9
CM1	North Lincolnshire Council	Industrial	49032 0	41083 1	19	17
CM2	North Lincolnshire Council	Urban background	49066 3	40978 9	22	19
CM3	North Lincolnshire Council	Industrial	49294 5	41193 1	30	27
CM4	North Lincolnshire Council	Industrial	49134 3	40878 2	20	16

Site ID	LA	Site Type	X	Y	Annual average PM ₁₀ concentration (µg/m ³)	
					2022	2023
CM5	North Lincolnshire Council	Industrial	490224	411301	22	19
CM6	North Lincolnshire Council	Other	514880	416133	18	17
CM2	Kingston Upon Hull City Council	Urban background	509482	429322	15	-
CM3	Kingston Upon Hull City Council	Roadside	511794	430511	19	-

Table A6-2-4 – Local Authority PM_{2.5} Automatic Monitoring Data

Site ID	LA	Site Type	X	Y	Annual average PM _{2.5} concentration (µg/m ³)	
					2022	2023
AURN Immingham Woodlands Avenue	North East Lincolnshire Council	Urban background	518277	415116	7.6	7.0
CM2	North Lincolnshire Council	Urban background	490663	409789	8	5
CM3	North Lincolnshire Council	Industrial	492945	411931	13	11

Appendix 7.1 – Ecological Appraisal

Introduction

This report is Appendix 7.1 of the Preliminary Environmental Information Report (PEIR) and has been prepared in support of Chapter 7: Ecology and Biodiversity for the Humber Carbon Capture Pipeline project (i.e. 'the Project', the boundary for which is hereafter referred to as the 'draft Order Limits'). Chapter 2 of the PEIR (Project Description) provides greater details of the Project and the draft Order Limits.

This report provides an Ecological Appraisal comprising a desk study and an Extended UK Habitat Classification survey to establish the ecological baseline of and key ecological constraints associated with the Project. The Ecological Appraisal aims to establish:

- The current baseline regarding habitat types and their quality, importance and distribution within the study area.
- The likely ecological constraints to the Project, including the presence of designated sites and the presence, potential presence or likely absence of protected, notable and invasive non-native species (INNS) within the survey area, and
- Which Important Ecological Features are carried forward for assessment within the PEIR.

Methodology

Overview

This Ecological Appraisal has been prepared in accordance with the assessment and report guidance produced by the Chartered Institute of Ecology and Environmental Management (Ref 7.1.2 and Ref 7.1.2) and includes a desk-based study, a site survey, assessment and evaluation. It describes an assessment of the Important Ecological Features (IEFs) present, or potentially present, within the zone(s) of influence in relation to the proposed works and uses the results of a UK Habitat Classification survey to map the habitats and vegetation present.

The 'zone of influence' (Zol) refers to the area within which potential IEFs, whether on-site or off-site, could be impacted by the Project and its associated activities. The extent of the Zol varies depending on the potential IEFs involved and their sensitivity to environmental changes.

Desk Study

A desk study was undertaken to develop an understanding of the baseline conditions and highlight key ecological constraints that may be impacted by the Project. The study area for the desk study comprised the draft Order Limits plus the following buffers, referred to as the Zol:

- 2 km for statutory designated sites, extended to 5 km for internationally designated sites with qualifying features for bats and wintering / passage birds.
- 2 km for non-statutory designated sites.
- 2 km for priority habitats (including ancient woodland) and protected and notable species and,
- 50 m for Tree Preservation Orders (TPOs) and ancient / veteran / notable trees.

Table A-7-1-1 summarises the various sources of information utilised for the desk study and the information obtained.

Table A7-1-1 – Sources of Information

Source	Information Obtained	Date received / accessed
APEM aerial imagery (Ref 7.1.3)	Digital surface model (DSM) tiles, digital terrain model (DTM) tiles, Ortho-mosaic tiles and tree crown mapping were provided for the draft Order Limits. Imagery at a resolution of 3 cm Ground Sampling Distance was captured using fixed-wing aircraft.	September 2024
Google Earth (Ref 7.1.4)	Review of freely available aerial photography to allow habitats within the study area to be assessed in a wider (landscape-scale) context; assessment and identification of potential ephemeral ecological features that may not be evident on the ground during the field survey (e.g. ephemeral ponds); identification of potential wildlife corridors or barriers to animal movements (e.g. road networks, built development and major watercourses); and a review of changes to habitats over time so that an assessment of reliability / longevity can be made.	August 2025
Multi-agency geographic information for the countryside (MAGIC) (Ref 7.1.5)	<p>The location of statutory designated sites for nature conservation, Priority Habitats, Ancient Woodland, granted EPS Licence applications, great crested newt (<i>Triturus cristatus</i>; GCN) survey licence returns, 2017-2019 GCN pond survey results, the Living England Habitat Map, Open Mosaic Habitat, and the National Habitat Network Maps.</p> <p>As some ecological features are not always apparent on aerial photographs, relevant Ordnance Survey mapping was studied to identify ponds, issues and/or drains.</p>	August 2025

Source	Information Obtained	Date received / accessed
Local Record Centres	The location of non-statutory designated sites for nature conservation and records of protected, notable and INNS species within 2 km of the draft Order Limits were obtained from Lincolnshire Environmental Records Centre (LERC) (Ref 7.1.6) and North & East Yorkshire Ecological Data Centre (NEYEDC) (Ref 7.1.7). NB: any records older than 20 years were omitted from the results unless specified for that species / species group.	November 2024 (LERC) and October 2024 (NEYDC)
DEFRA Ecology & Fish Data Explorer (Ref 7.1.8)	The Environment Agency's fish and ecology open data was searched for records within 2 km of the draft Order Limits. NB: any records older than 20 years were omitted from the results unless specified for that species / species group.	August 2025
Institute of Estuarine and Coastal Studies (Ref 7.1.9)	Data presented by the University of Hull at the Humber Nature Forum Meeting in 2015 were reviewed to obtain additional sea and river lamprey records within the Humber Estuary.	August 2025
British Trust for Ornithology (BTO) (Ref 7.1.10)	Wetland Bird Survey (WeBS) data from all WeBS Core Sites within 5km of the draft Order Limits. Data provided was from the most recent 5 years from the date ordered (January 2020 onwards).	February 2025
National Infrastructure Planning and Local Planning Portals (Ref 7.1.11)	The National Infrastructure Planning website and local planning portals for North Lincolnshire Council, East Riding of Yorkshire Council, North East Lincolnshire Council, West Lindsey District Council and North Yorkshire County Council were searched for any relevant ecological survey information relating to any existing semi-natural habitats within the draft Order Limits, dated within the last 20 years. Results relating to the following were reviewed:	August 2025

Source	Information Obtained	Date received / accessed
	<ul style="list-style-type: none"> • The Keadby 3 Low Carbon Gas Power Station Project (Planning Inspectorate Ref: EN010114); • Humber International Enterprise Park (Planning Reference: 18/04071/STPLFE); • Yorkshire Energy Park (Planning Reference: 17/01673/STOUTE) • Able Marine Energy Park (TR030001 and TR030006) • Able Logistics Park (PA/2015/1264) • North Killingholme Power Project (EN010038) 	
National Water Vole Database and Mapping Project (Ref 7.1.12)	Location of water vole (<i>Arvicola amphibius</i>) and American mink (<i>Neovison vison</i>) records (2009 – 2018) and information on trends in water vole populations at a regional and national level.	August 2025
Local Councils	Locations of trees with TPOs and conservation areas were requested from North Lincolnshire Council (Ref 7.1.13), East Riding of Yorkshire Council, West Lindsey District Council and North Yorkshire County Council and North East Lincolnshire District Council. .	August 2025
Woodland Trust (Ref 7.1.14)	Locations of ancient, veteran and notable trees.	August 2025

Extended UK Habitat Classification Habitat Survey

A UKHab survey was carried out between March and August 2025, under appropriate weather conditions and by suitably experienced ecologists. Habitats were classified following the UKHab classification system (Ref 7.1.15). The survey area included all land within the draft Order Limits and a minimum 50m buffer zone.

The survey was used to provide information on the habitats within the survey area and identify actual or potential presence of legally protected and / or otherwise notable species / habitats. Dominant flora was noted, and target notes were included, highlighting the presence of any INNS, habitats suitable to support protected flora / fauna and areas where further surveys are recommended.

The UKHab baseline plan is provided in Volume 3 – Figure 7.4.

Assumptions and Limitations

Ecological surveys are limited by factors which affect the presence of plants and animals such as the time of year, migration patterns and behaviour. Therefore, the absence of evidence of any particular species should not be taken as conclusive proof that the species is not present or that it will not be present in the future. Absence of species records from the desk study data may also be due to under-recording of some taxa (e.g. invertebrates) and / or biases of data collection e.g. in areas where surveys have taken place to inform other development projects, or where long-term monitoring is taking place.

Private residential and industrial land has not been surveyed in detail as it is assumed these areas will be excluded from the development project. Similarly, land access to the entire draft Order Limits has not yet been granted (see Figure 7.4 in Volume 3 for the area currently not accessible). Where possible, these areas were assessed using binoculars and aerial imagery to complete the UKHabs habitat mapping and assessment of suitability for protected or notable species. For hedgerows where access and high-resolution imagery from APEM was not available, mapped presence of hedgerows was less certain, and those added to the map based on aerial imagery alone were assumed to be species-rich. Access to these areas continues to be sought, and it is the intention that all areas within the draft Order Limits will be subject to full field survey in advance of submission of the ES.

Any grid references provided within this report are approximate and are to be used as a guide only.

Results

Statutory Designated Nature Conservation Sites

The following section sets out details relating to all statutory designated sites within the Zol of the Project. Further information on statutory designated sites specifically relevant to the intertidal and nearshore environment at the Easington Landfall is provided in Appendix 7.3: Intertidal and Marine Technical Appendix.

Humber Estuary Corridor

The draft Order Limits extend across a section of the Humber Estuary, a large, macro-tidal coastal plain estuary, created by the meeting of the Ouse and Trent rivers. The estuary is designated as a SAC, SPA and Ramsar site, which share a boundary within the draft Order Limits. Within the Zol, these designations also include marine components and parts are underpinned by the Humber Estuary SSSI (which is also crossed by the draft Order Limits) and the North Killingholme Haven Pits SSSI (which is situated within the draft Order Limits). The reasons for each designation are presented in Table A7-1-2.

Table A7-1-2 – Site Designation Associated with the Humber Estuary

Designated site	Brief Description
Humber Estuary SAC	Designated primarily for its extensive estuarine and intertidal mudflats habitats. The site supports a wide range of other qualifying Annex I habitats, including subtidal sandbanks, intertidal mudflats and sandflats, coastal lagoons (a priority feature), pioneer saltmarsh with <i>Salicornia</i> species, Atlantic salt meadows, and a variety of coastal dune systems such as embryonic dunes, shifting “white” dunes, fixed “grey” dunes (a priority feature), and dunes with sea buckthorn <i>Hippophae rhamnoides</i> . The estuary also provides important habitat for several Annex II species, with populations of sea lamprey <i>Petromyzon marinus</i> , river lamprey <i>Lampetra fluviatilis</i> , and grey seal <i>Halichoerus grypus</i> contributing to the site’s overall conservation importance.
Humber Estuary SPA	Designated because it supports breeding populations of bittern <i>Botaurus stellaris</i> , marsh harrier <i>Circus aeruginosus</i> , avocet <i>Recurvirostra avosetta</i> , little tern <i>Sternula albifrons</i> and Mediterranean gull <i>Larus melanocephalus</i> , as well as internationally important passage and wintering populations including golden plover <i>Pluvialis apricaria</i> , bar-tailed godwit <i>Limosa lapponica</i> and ringed plover <i>Charadrius hiaticula</i> . The estuary also supports large numbers of wintering waterfowl, regularly exceeding 20,000 individuals, with key species including shelduck <i>Tadorna tadorna</i> , teal <i>Anas crecca</i> , pintail <i>Anas acuta</i> , oystercatcher <i>Haematopus ostralegus</i> , knot <i>Calidris canutus</i> , dunlin <i>Calidris alpina</i> , black-tailed godwit <i>Limosa limosa</i> and redshank <i>Tringa totanus</i> . These populations reflect the estuary’s critical role as a breeding, passage and overwintering site for migratory birds.
Humber Estuary Ramsar site	Designated for its extensive estuarine habitats, including intertidal mudflats and sandflats, saltmarsh and coastal lagoons, which together represent an internationally important wetland system. The site supports a breeding colony of grey seal and a nationally important breeding population of natterjack toad <i>Epidalea calamita</i> . It is internationally important for non-breeding waterfowl assemblages, regularly supporting numbers well in excess of 20,000 individuals, and also for migratory populations during spring and autumn passage, including species such as knot, dunlin and redshank. The estuary additionally supports nationally important populations of several breeding bird species, and functions as a key migratory route for river lamprey and sea lamprey.

Designated site	Brief Description
Humber Estuary SSSI	<p>Characterised by its macro-tidal regime and extensive habitats, including intertidal and subtidal mudflats, sandflats, saltmarsh and reedbeds. The site supports nationally important breeding bird populations associated with lowland open waters and their margins, and at least 22 species of wintering waterfowl in nationally important numbers. Passage waterfowl also use the estuary extensively, with key species including knot, dunlin and redshank. The estuary is also of importance for migratory fish, notably river lamprey and sea lamprey, and supports a breeding colony of grey seal. In addition, the Humber Estuary SSSI is notable for its botanical diversity, with at least ten nationally scarce vascular plant species characteristic of coastal and wetland habitats, and for its invertebrate assemblages of high conservation value.</p>
North Killingholme Haven Pits SSSI	<p>A series of large saline lagoons formed in former clay extraction pits, together with associated reedbeds, grassland and scrub. The lagoons provide important roosting and feeding grounds for waterfowl, supporting significant numbers of species such as shelduck, teal, mallard <i>Anas platyrhynchos</i>, wigeon <i>Mareca penelope</i>, lapwing <i>Vanellus vanellus</i> and curlew <i>Numenius arquata</i>. The site is also notable for its invertebrate interest, including several scarce species characteristic of saline lagoon habitats, such as the polychaete worm <i>Alkmaria romijni</i>.</p>

Impact Risk Zones (IRZ) associated with the Humber Estuary SSSI and North Killingholme Haven Pits SSSI extend over the draft Order Limits. At this distance threshold, pipelines and underground cables are listed as development types that could have a harmful effect on the SSSI (and thus the SAC, SPA or Ramsar sites they underpin).

The Humber Estuary Corridor, defined within the draft Order Limits on both the north and south banks by the flood defence embankment, includes seven Local Wildlife Sites (LWS) located within the Zol. These non-statutory designated sites - Asselby Island LWS, Alkborough Flats LWS, Dawson City Claypits LWT, East Marsh LWS, Halton Marsh Clay Pits LWS, Killingholme Haven Pits LWT and Paull Holme Strays LWS - are of ornithological interest and provide supporting habitat for species associated with the Humber Estuary SPA. As such, they are considered as Functionally Linked Land (FLL) for assessment and are considered part of the broader Humber Estuary Corridor IEF, which also includes the Humber Estuary SPA, SAC, Ramsar site, and associated SSSIs.

Holderness Coast

The draft Order Limits extend to the Holderness Coast, reaching seaward to Mean Low Water Spring (MLWS). This section of coastline, overlapped by the draft Order Limits, includes areas designated as the Greater Wash SPA (marine) and the Holderness Inshore Marine Conservation Zone (MCZ). The reasons for each designation are presented in Table A7-1-3.

Table A7-1-3 – Site Designations Associated with the Holderness Coast

Designated site	Reason for designation
SPA (marine)	Designated for regularly supporting bird populations of national importance over winter, on passage and during the breeding season.
MCZ	The seabed in this site comprises a mosaic of habitats that support a diverse range of algae, sponges and other encrusting fauna. The site also supports fish species such as European eel <i>Anguilla anguilla</i> , dab <i>Limanda limanda</i> and wrasse (<i>Labrus sp.</i>) as well as commercially significant crustaceans such as edible and velvet swimming crabs <i>Cancer pagurus</i> and <i>Necora puber</i> and lobster <i>Homarus gammarus</i> . The sandy beaches of intertidal and muddy sand and the strandline of seaweed and other debris provide important habitat for a range of fauna including bivalves, common cockle <i>Cerastoderma edule</i> and sea snails.

Dimlington Cliff SSSI is also situated in this area; however, the SSSI is designated for geological features only and thus the site has not been carried forward for assessment

within the Chapter 7: Ecology and Biodiversity chapter of the PEIR and it is not mentioned further in this report. Note that the Site is considered as part of the Ground Conditions and Hydrogeology chapter (Volume 2: Chapter 10: Ground Conditions and Hydrogeology).

River Derwent

The River Derwent is situated approximately 480 m upstream of, and outside, the draft Order Limits. However, it lies within the Zol. Sections of the River and its riparian habitats are designated a SSSI, SAC, SPA, Ramsar site and National Nature Reserve (NNR). The reasons for each designation are presented in Table A7-1-4

Table A7-1-4 – Site designations associated with the River Derwent

Designated site	Reason for designation	Approximate distance from draft Order Limits
River Derwent SSSI	Supports diverse communities of aquatic flora and fauna, including an exceptionally rich assemblage of invertebrates. Eleven species of dragonfly have been recorded, including the banded agrion <i>Agrion splendens</i> at its most north-easterly site in the country. The river is also noted for its diversity of fish species, an excellent breeding bird community and otter.	480 m north
River Derwent SAC	Designated for the presence of estuaries, mudflats and sandflats. Other habitats and species present include coastal lagoons, sea lamprey, river lamprey, allis shad <i>Alosa alosa</i> , twaite shad <i>A. fallax</i> and harbour seal.	480 m north
Lower Derwent Valley SPA	The SPA is of international importance for wintering waterfowl including teal, wigeon <i>A. penelope</i> , shoveler <i>A. clypeata</i> , pochard <i>Aythya ferina</i> , whimbrel and ruff and supports nationally important wintering populations of Bewick's swan <i>Cygnus columbianus bewickii</i> and golden plover. The SPA also supports large numbers of ruff <i>Philomachus pugnax</i> during spring migration and shoveler during the breeding season.	3.8 km north
Lower Derwent Valley Ramsar site	Traditionally managed species-rich alluvial flood meadow, wetland invertebrates (including 16 species of dragonfly and damselfly, 15 British Red Data Book wetland invertebrates and the only known site in Great Britain for a leafhopper <i>Cicadula ornata</i>), nationally important numbers of passage ruff and whimbrel <i>Numenius phaeopus</i> in the spring and wintering waterfowl assemblages of international importance. Wigeon and teal also occur in populations of international importance over winter.	3.8 km north
Lower Derwent Valley NNR	A series of flood meadows, pastures and woodlands. The reserve supports assemblages of rare plant species and outstanding populations of breeding and wintering birds, including whooper swan <i>Cygnus cygnus</i> , pochard <i>Aythya ferina</i> , lapwing, curlew and golden plover.	4.3 km north

IRZ associated with the River Derwent SSSI extend over the draft Order Limits. At this distance threshold, pipelines and underground cables are listed as development types that could have a harmful effect on the SSSI (and thus the SAC, SPA or Ramsar sites it underpins).

Humberhead Peatlands

Sections of the Humberhead Peatlands are designated a SAC, SPA, SSSI and NNR. The reasons for each designation are presented in Table A7-1-5.

Table A7-1-5 – Site designations associated with the Humberhead Peatlands

Designated site	Reason for designation	Approximate distance from draft Order Limits
Thorne Moor SAC	The presence of degraded raised bogs still capable of natural regeneration.	800 m south
Thorne and Hatfield Moors SPA	The SPA is used regularly by nationally important numbers of breeding nightjar <i>Caprimulgus europaeus</i> and also supports hen harrier <i>Circus cyaneus</i> , merlin <i>Falco columbarius</i> , short-eared owl <i>Asio flammeus</i> , hobby <i>Falco subbuteo</i> and nightingale <i>Luscinia megarhynchos</i> .	800 m south
Thorne, Crowle and Goole Moors SSSI	The SSSI forms the largest extent of lowland raised mire in England. The extensive series of canals linking the wet peat cuttings contain a wide range of plant species. The moors are highly regarded for their invertebrate fauna, especially insects, including several nationally rare species associated with peat bog and fen habitats such as the bog bush cricket <i>Metrioptera brachiptera</i> . There is also a strong population of large heath butterfly <i>Coenonympha tullia</i> . This site is important for wintering birds and breeding bird populations, including nightjar, nightingale and woodcock <i>Scolopax rusticola</i> which are associated with dry scrub and heathland, wet heath and fen habitats.	800 m south
Humberhead Peatlands NNR	The largest area of raised bog wilderness in lowland Britain. More than 5000 species of plants and animals have been recorded on the reserve of which more than 4000 are insects. There are also sizeable populations of adder <i>Vipera berus</i> and water vole. More than 200 bird species have been recorded, including woodlark <i>Lullula arborea</i> , oystercatcher, lapwing, ringed plover, great crested grebe <i>Podiceps cristatus</i> , marsh harrier, whooper swan, pink-footed geese <i>Anser brachyrhynchus</i> , hen harrier and short-eared owl.	900 m south

Due to their upstream location and separation distance from the draft Order Limits, no perceivable impact pathways have been identified for Thorne Moor SAC, Thorne, Crowle and Goole Moors SSSI or Humberhead Peatlands NNR. Accordingly, these sites have not been carried forward for assessment within the PEIR. This approach is consistent with the EIA Scoping Opinion issued by the Planning Inspectorate (PINS) and is referenced in Chapter 7: Ecology and Biodiversity of the PEIR in Table 7.4.

In relation to Thorne and Hatfield Moors SPA, Natural England previously raised the potential for foraging nightjar within the draft Order Limits. However, radio-tracking data from the LIFE+ Project conducted between 2015 and 2018 (Ref 7.1.19) indicate that nightjar foraging activity is highly localised and typically associated with specific habitat types. The research showed that the extensive arable monoculture surrounding the SPA, particularly to the north, provides poor-quality foraging habitat and was infrequently used by tracked individuals. In contrast, preferred foraging areas were linked to structurally diverse habitats such as woodland edges and rough grassland mosaics (for example, an old colliery site at Thorne Moor).

While nightjar foraging patterns are known to shift in response to landscape changes (particularly following woodland clearance, which increases edge habitat and promotes use of early-successional areas), the habitats within the draft Order Limits up to 3 km from the SPA boundary are predominantly characterised by large open arable fields with minimal hedgerow or scrub structure and no woodland. These habitats are considered unsuitable for supporting nightjar foraging activity. On this basis, and supported by both field observations and habitat analysis, Thorne and Hatfield Moors SPA has not been carried forward for detailed assessment within the PEIR.

A preliminary Habitats Regulations Assessment (HRA) Screening Report is being made available as part of the PEIR to enable consultees, including Natural England, to review the approach and preliminary conclusions prior to DCO submission. This report includes a more detailed justification for scoping out Hatfield Moors SPA.

Other SSSIs for Nature Conservation

In addition to those listed above, there are five SSSIs outside of the draft Order Limits but within the Zol. The reasons for each designation are presented in Table A7-1-6.

Table A7-1-6 – Other SSSIs within the Zol

Designated site	Reason for designation	Approximate distance from draft Order Limits
Eskamhorn Meadows SSSI	Five floristically diverse fields supporting unimproved neutral grassland. Of particular note is the occurrence of meadow thistle <i>Cirsium dissectum</i> which is uncommon in the lowlands of Yorkshire. Small numbers of curlew and lapwing breed in the meadows.	Adjacent east and west
Eastoft Meadow SSSI	A herb-rich hay meadow. Of particular note is the occurrence of Green-winged Orchid <i>Orchis morio</i> , Burnt-tip Orchid <i>O. ustulata</i> and Adder's-tongue fern <i>Ophioglossum vulgatum</i> .	290 m west
Crowle Borrow Pits SSSI	Comprises a variety of habitats including alder carr, scrub, open water and fen containing the nationally rare marsh fern <i>Thelypteris thelypteroides</i> .	1.3 km west
Hatfield Chase Ditches SSSI	A large area of former marsh and wetland containing a rich assemblage of aquatic and emergent plants, including ivy-leaved duckweed <i>Lemna trisulca</i> and various-leaved pondweed <i>Potamogeton gramineus</i> . Four reed beetles have been recorded including two nationally scarce species - <i>Donacia clavipes</i> and <i>D. simplex</i> . The ditches also support a population of water vole.	1.5 km west
The Lagoons SSSI	The SSSI comprises a variety of coastal habitats, including saline lagoons and pools (the only example of this nationally rare habitat in North Humberside). The lagoons support nationally scarce flora and invertebrates characteristic of coastal saline water habitats. The SSSI supports a variety of migratory and wintering birds and is noted for supporting breeding ringed plover and over 1% of the British breeding population of little tern <i>Sternula albifrons</i> .	1.8 km south-east

Kirmington Pits SSSI, South Ferriby Chalk Pit SSSI and Kelsey Hill Gravel Pits SSSI were also identified within the study area; however, these are all designated for geology and accordingly are not mentioned further within this report.

Due to their upstream location and separation distance from the draft Order Limits, no perceivable impact pathways have been identified for Crowle Borrow Pits SSSI or Hatfield Chase Ditches SSSI. Accordingly, these sites have not been carried forward for assessment within the PEIR. This approach is consistent with the EIA Scoping Opinion issued by PINS and is referenced in Chapter 7 of the PEIR, in Table 7.4.

Other National and Local Nature Reserves

No other National Nature Reserves (NNRs), in addition to the sites listed above, were identified within the Zol. However, one Local Nature Reserve (LNR) was identified: Sugar Mills Ponds, a former brickworks and sugar refinery situated approximately 230m from the draft Order Limits, adjacent to the Aire and Calder Navigation Canal. The site comprises two small lakes and supports notable species, including water vole (*Arvicola amphibius*), grass snake (*Natrix helvetica*), and approximately 70 resident bird species, such as great crested grebe, kingfisher (*Alcedo atthis*), and barn owl (*Tyto alba*).

Due to its upstream location, physical separation from the draft Order Limits by the M62 / M8, the Aire and Calder Navigation Canal, and the Dutch River, and the overall distance from proposed works, no perceivable impact pathways have been identified for this LNR. Accordingly, the site has not been carried forward for assessment within the PEIR.

Non-Statutory Designated Nature Conservation Sites

Details of all other non-statutory designated sites (i.e. those not already mentioned above as part of larger IEFs) within draft Order Limits or outside the draft Order Limits but potentially hydrologically connected are listed in Table A7-1-7 and shown in Volume 3 - Figure 7.2.

Table A7-1-7 Non-statutory Designated Sites within the Zol but not part of IEFs

Location	Designated Site
Sites within the draft Order Limits	Keadby Warping Drain LWS, New River Ancholme LWS, Ancholme Fields LWS, Hedon - Winestead Disused Railway Line LWS, Burkinshaw's Covert LWS, Chase Hill Wood LWS, Hodgson's Fields LWS, Whiting Mill Bottom Road Verges LWS, East Drain, South Ferriby LWS, Thornton Curtis Chalk Pit Road Verge LWS, Barton Road, Wootton Hall LWS, Keadby Boundary Drain LWS, Paupers' Drain LWS, Stainforth and Keadby Canal Corridor LWS and Hatfield Waste Drain LWS.
Sites outside the draft Order	Oak Hill LWS, Mayflower Wood Meadow LWS, Keadby Wet Grassland LWS, Keadby Wetland LWS, Three Rivers LWS, Folly Drain North

Location	Designated Site
Limits but potentially hydrologically connected	LWS, River Torne LWS, North Engine Drain, Belton LWS, South Engine Drain, Belton LWS, Gunness Common LWS, Abbot's Lodge Grassland LWS, South Cloister Covert LWS, Hollym Carrs LWS, Weldon's Plantation LWS, Enholmes Plantations Historic LWS, Fort Paull Humber Grassland Candidate LWS, Brockholes SINC, Newland Ings, Newland SINC, Out Newton – Skeffling LWS, Thealby Gullet LWS, Patrington Haven Drain Candidate LWS, Goxhill Marsh South LWS, South Soak Drain, Keadby LWS, Leggott's Quarry LWS and Manor House Farm Field LWS.

Due to their upstream location and / or separation distance from the draft Order Limits, no perceivable impact pathways have been identified for the following sites: Meadow Area 4 LWS, Goxhill Meadows LWS, Alder Wood LWS, Bonby Road Verge LWS, Sandhills Quarry LWS, Burton upon Stather Brick Pit LWS, Burton Wood LWS, Normanby Park LWS, Rosper Road Pool LWS, Homestead Park Pond LWS, Scrub Lane East Field LWS, East View Meadow LWS, Crowle Moor LWS, Carlton Park Pond SINC, Southfield Reservoir Candidate LWS and Frodingham – Winestead LWS. Accordingly, these sites have not been carried forward for assessment within the PEIR. This approach is consistent with the EIA Scoping Opinion issued by PINS and is referenced in Chapter 7 of the PEIR in Table 7.4.

Due to their upstream location and separation distance from the draft Order Limits, it is also proposed that the following sites have no perceivable impact pathways and should therefore not be carried forward for assessment within the PEIR: A15 / A1077 Road Verges LWS, Alder Carr Wood LWS, Bagmoor Gullet LWS, Beacon Hill Road Verge LWS, Burnham Lodge Quarry LWS, Burnham Road LWS, Deepdale LWS, Deepdale Quarry Road Verges LWS, Derrythorpe LWS, Melton Ross Quarry LWS, Melton Ross Road Verges LWS, New Barnetby Road Verges LWS, Race Lane Verges LWS, South Ferriby Chalk Springs LWS, South Ferriby Churchyard LWS, Sykes Lane Meadows LWS, Warping Drain, Wold Road LWS and Wootton Grange LWS.

Other Notable Sites

Keadby Ash Tip

Keadby Ash Tip is a former industrial ash disposal site located near Keadby, and partially within the draft Order Limits. Since decommissioning in the 1990s, the area has undergone a process of natural regeneration (though based on aerial photography, sections of Keadby Ash Tip within the draft Order Limits were utilised for agriculture in the early 2000s) and now supports a diverse mosaic of semi-natural habitats, including open mosaic habitat on previously developed land (OMH), alongside semi-improved neutral

grassland, unimproved acid grassland, dense scrub, broadleaved semi-natural woodland, and bryophyte-rich communities. Several orchid species have been recorded, indicating high botanical value. This structural and floristic diversity supports a wide range of faunal species, including invertebrates and foraging bats, and contributes significantly to local ecological networks (Ref 7.1.20).

Due to its habitat complexity, species interest, and presence of priority habitat, Keadby Ash Tip is considered to be of high ecological value and carried forward for assessment within the PEIR as an IEF.

Newton Garth

Newton Garth is located to the northeast of Paull and partially overlapped by the draft Order Limits. The site was established to support impact avoidance measures for the Humber International Enterprise Park (HIEP), also known as Hedon Haven. The site was originally developed around 2015 (but most recent habitat creation and enhancement works concluded in September 2022) in response to HRA requirements for HIEP. Its purpose was to enable a conclusion of no likely significant effect on the Humber Estuary SPA by providing suitable foraging and roosting habitat for key SPA bird species.

The mitigation area comprises converted arable land, now managed as wet grassland and the inclusion of wader scrapes designed to retain surface water. The habitats are managed to support overwintering birds associated with the Humber Estuary SPA and are known to support curlew, golden plover and lapwing (Ref 7.1.21). The site is carried forward for assessment within the PEIR as an IEF.

Thorn Marsh Farm

Thorn Marsh Farm is identified as a future ecological mitigation site associated with Yorkshire Energy Park (YEP). Although not yet required, the site is proposed to be converted from arable land to marshy grazed grassland, intended to support Humber Estuary SPA FLL mitigation (Ref 7.1.22).

This habitat creation is essential to enable the full delivery of Phase 2 of the YEP. Timescales for delivery are currently unknown, but a substantial lead-in period will be necessary to allow for the successful conversion of the land and establishment of ecologically functional marshy grassland.

The site is currently managed as agricultural land, and as such, it is not carried forward for assessment within the PEIR as an IEF. However, due to its potential future value as FLL for the Humber Estuary SPA, this site is noted within the future baselines section of the PEIR (Volume 2, Chapter 7: Ecology and Biodiversity).

Halton Marshes

Halton Marshes is a managed wet grassland area established c.2017 as part of a series of mitigation and compensation schemes for development projects affecting the Humber

Estuary SPA. The site forms part of a strategically managed network of SPA mitigation land that functions as overcompensation for the Able Marine Energy Park, and with additional mitigation roles for the Able Logistics Park and the North Killingholme Power Project. The site is targeted to support species including black-tailed godwit, curlew, golden plover, lapwing, and redshank. Its ongoing management is designed to support the ecological integrity of the Humber Estuary SPA by maintaining suitable foraging and roosting conditions for target bird populations (Ref 7.1.23).

The site is situated adjacent to the draft Order Limits and is hereafter considered as part of the Humber Estuary Corridor IEF.

Old Little Humber Farm

Old Little Humber Farm was a proposed 38.5 ha compensation site, partially overlapped by the draft Order Limits to the southeast of Paull Holme. The site was intended to form part of the ecological mitigation strategy for the Able Marine Energy Park to support foraging and roosting habitat for estuarine SPA bird species. However, the status of this site remains highly uncertain. In its Written Representation, Natural England raised significant concerns about the deliverability and ecological suitability of the site, and no publicly available evidence could be found to confirm that habitat creation will be implemented (Ref 7.1.24). This site is not carried forward for assessment within the PEIR as an IEF.

Priority Habitats

According to the Priority Habitat Inventory and data received from the local record centres (Ref 7.1.6, 7.1.7), recognised areas of Priority Habitat that were identified within the Zol are shown in Table A7-1-8. Habitats marked with an asterisk indicate those that were also identified within the draft Order Limits.

Table A7-1-8 – Priority Habitats Within the Zol

Priority Habitat Type	Total Area within the Zol	Priority Habitat Type	Total Area within the Zol
Deciduous woodland	906.94	Mudflats*	897.20
Coastal and floodplain grazing marsh	709.29	Coastal saltmarsh	286.43
No main habitat but additional habitats present	167.67	Lowland raised bog	138.13
Good quality semi-improved grassland*	123.34	Lowland fens	66.38

Priority Habitat Type	Total Area within the Zol	Priority Habitat Type	Total Area within the Zol
Reedbeds*	59.05	Deciduous woodland, Lowland raised bog*	52.32
Reedbeds, Coastal saltmarsh*	51.22	Maritime cliff and slope*	24.72
Saline lagoons	21.12	Lowland meadows	19.25
Lowland calcareous grassland*	18.39	Traditional orchard*	16.64
Lowland dry acid grassland*	7.57	Coastal sand dunes	1.22
Lowland fens, Reedbeds*	0.71	Ponds	0.19
Coastal and floodplain grazing marsh, Coastal saltmarsh*	0.13	Coastal saltmarsh, Saline lagoons*	0.05

The draft Order Limits contain 192 parcels of recognised areas of Priority Habitat, totalling 290.71 ha. These habitats are detailed in Table A7-1-9 and shown Volume 3 – Figure 7.3 - Priority Habitats, Ancient Woodland and Arboricultural Features.

Table A7-1-9 – Priority habitats located within the draft Order Limits

Habitat type	No. of parcels	Total area (ha)
Coastal and floodplain grazing marsh	34	94.44
Mudflats	16	85.73
Coastal saltmarsh	22	32.90
Deciduous woodland	54	25.81
No main habitat but additional habitats present	34	19.41
Saline lagoons	12	17.26
Good quality semi-improved grassland	8	7.12
Maritime cliff and slope	2	4.59
Lowland calcareous grassland	1	1.87
Lowland fens	4	1.14

Habitat type	No. of parcels	Total area (ha)
Reedbeds, Coastal saltmarsh	2	0.38
Lowland dry acid grassland	1	0.04
Traditional orchard	1	0.02
Reedbeds	1	0.01
Total	192	290.72

The most ecologically significant areas of priority habitat within the draft Order Limits are identified within the IEFs listed above. However, small parcels of priority habitat, shown in Table A7-1-9, are situated within the draft Order Limits (but outside the above IEFs).

Ancient Woodland

5 parcels of Ancient Woodland were identified within the Zol, the details of which are shown in Table A7-1-10 and Volume 3 - Figure 7.3: Priority Habitats, Ancient Woodland and Arboricultural Features.

Table A7-1-10 – Ancient Woodland within the Zol

Location	Further Details	Distance from draft Order Limits
Alder Carr Wood LWS	1 parcel of ancient & semi-natural woodland	610 m south
Alder Wood	3 parcels of ancient & semi-natural woodland	680 m south
Burton Wood	1 parcel of ancient replanted woodland	1.12 km south

No parcels of Ancient Woodland were identified within the draft Order Limits.

Due to their separation from the draft Order Limits, a lack of hydrological connectivity and that indirect effects (e.g. pollution from dust / machinery emissions during construction and decommissioning) are unlikely to be significant at the distances listed, no perceivable impact pathways to these locations have been identified. Accordingly, these sites have not been carried forward for assessment within the PEIR. This approach is consistent with the EIA Scoping Opinion issued by PINS and is referenced in Chapter 7: Ecology and Biodiversity, Table 7.4.

Arboricultural Features

The details for all TPOs identified within 50m of the draft Order Limits are provided in Table A7-1-11. Their location is shown in Volume 3 - Figure 7.3.

Table A7-1-11 – TPOs located within 50m of the draft Order Limits

Location	TPO area or point	Information obtained
Railway Embankment, Long Drax	1 x linear area and 3 x points	Species include oak (<i>Quercus spp.</i>), Sycamore (<i>Acer pseudoplatanus</i>), Ash (<i>Fraxinus excelsior</i>), Hawthorn (<i>Crataegus monogyna</i>) and willow (<i>Salix spp.</i>).
Sweeting Thorns LWS	1 x area	Woodlands consisting mainly of Oak, Silver Birch (<i>Betula pendula</i>) and Sycamore.
North of Main Road, Thorngumbald	1 x linear area	Various species.
Winestead Drain	1 x linear area	20 Beech (<i>Fagus sylvatica</i>), 2 oak, 1 Sycamore.
Winestead	2 x linear area	8 Elm (<i>Ulmus spp.</i>), 4 Maple (<i>Acer spp.</i>), 18 Oak, and various other species.
Winestead, West of Winestead Lane	1 x linear area	1 Ash, 2 Beech, 4 Elm, 9 Oak, 1 Sycamore.
Winestead, East of Winestead Ings Lane	1 x linear area	Various species
Winestead, South of Winestead Lane	1 x linear area	Various species (Ash, Beech, Cedar (<i>Cedrus libani</i>), Sweet Chestnut (<i>Castanea sativa</i>), Elm, Oak, Poplar (<i>Populus spp.</i>) and Sycamore)
Elsham 1972	6 x linear areas	Mixed hardwoods consisting mainly of Beech and Ash, Hawthorn and Ash, larch (<i>Larix spp.</i>), Ash and Sycamore, a mixture of different trees, and 29 Beech and 4 Oak
Westcote Farm, Barrow Upon Humber 1966	4 x linear areas	Groups consisting of: 1 Ash, 2 Beech, 7 Elm and 7 Sycamore; 2 Ash, 8 Beech, 17 Elm, 2 Oak and 18 Sycamore; 1 Ash, 25 Beech, 13 Elm, 2 Oak and 15 Sycamore; and Ash, Beech, Elm and Sycamore
CPRS Route Corridor Section A5	1 x linear area	Various species

The Woodland Trust Ancient Tree Inventory (Ref 7.1.25, Ref 7.1.17) identified no veteran trees within the draft Order Limits.

While existing veteran tree records indicate that no confirmed veteran trees are present within the draft Order Limits, several potential veteran trees were identified during the UKHab survey. These features will be further assessed, and the results will be presented in the ES.

Extended UK Habitat Classification Survey

The following section describes habitats associated with the draft Order Limits. Further detail on habitats specific to the intertidal and nearshore environment is provided in Appendix 7.3: Intertidal and Marine. The UKHabs habitat map is presented in Volume 3 – Figure 4.

Area Habitats

The survey area contained mainly cropland habitat, making up approximately 84% of the total survey area. The majority of arable fields were intensively managed and had narrow, species-poor margins.

All area habitat types identified within the draft Order Limits, and their percentage of the total survey area, are detailed in Table A7-1-12.

Table A7-1-12 – Summary of Area Habitats within the draft Order Limits

Habitat Type	Total Area (Ha)	%	Habitat Type	Total Area (Ha)	%
Cereal crops	4694	69	Wet woodland	4	<1
Non-cereal crops	491	7	Hawthorn scrub	3	<1
Temporary grass and clover leys	377	6	Purple moor grass and rush pastures	3	<1
Modified grassland	309	5	Maritime cliff and slopes	2	<1
Bare ground	153	2	Artificial saltmarshes and saline reedbeds	1	<1
Developed land; sealed surface	138	1	Artificial unvegetated, unsealed surface	1	<1
Other neutral grassland	99	1	Floodplain wetland mosaic and Coastal and Floodplain Grazing Marsh	1	<1
Saltmarshes and saline reedbeds	94	1	Other coniferous woodland	1	<1
Winter stubble	89	1	Tall forbs	1	<1

Habitat Type	Total Area (Ha)	%	Habitat Type	Total Area (Ha)	%
Littoral mud	65	<1	Willow scrub	1	<1
Other woodland; broadleaved	48	<1	Allotments	<1	<1
Mixed scrub	36	<1	Arable field margins cultivated annually	<1	<1
Open mosaic habitats on previously developed land	35	<1	Arable field margins game bird mix	<1	<1
Arable field margins pollen and nectar	21	<1	Artificial hard structures	<1	<1
Ponds (non-priority habitat)	19	<1	Blackthorn scrub	<1	<1
Reedbeds	15	<1	Felled woodland	<1	<1
Lowland heathland	14	<1	Inland rock outcrop and scree habitats	<1	<1
Other woodland; mixed	13	<1	Littoral mixed sediments	<1	<1
Littoral muddy sand	12	<1	Low energy littoral rock	<1	<1
Littoral sand	12	<1	Lowland dry acid grassland	<1	<1
Arable field margins tussocky	11	<1	Lowland mixed deciduous woodland	<1	<1
Tall herb communities	9	<1	Ponds (priority habitat)	<1	<1
Ruderal / Ephemeral	6	<1	Traditional orchards	<1	<1
Bramble scrub	5	<1	Vegetated garden	<1	<1
Built linear features	5				

Much of the arable landscape within the survey area was bisected by hedgerows, ditches and / or drains.

Hedgerows

Approximately 182 km of hedgerows are present within the draft Order Limits, of which 31.7 km were species-rich native hedgerows. Further detail on hedgerow categorisation within the survey area is shown in Table A7-1.13 below.

Table A7-1-13 – Summary of Hedgerows within the draft Order Limits

Hedgerow Type	Number Surveyed	Total Length (km)	%
Native hedgerow	355	66.73	37

Hedgerow Type	Number Surveyed	Total Length (km)	%
Native hedgerow - associated with bank or ditch	172	35.92	20
Native hedgerow with trees	117	23.70	13
Native hedgerow with trees - associated with bank or ditch	89	18.02	10
Species-rich native hedgerow with trees	68	13.14	7
Species-rich native hedgerow	52	9.56	5
Species-rich native hedgerow with trees - associated with bank or ditch	19	5.47	3
Line of trees	33	4.13	2
Species-rich native hedgerow - associated with bank or ditch	13	3.53	2
Line of trees - associated with bank or ditch	8	1.27	<1
Non-native and ornamental hedgerow	7	0.56	<1
Ecologically valuable line of trees	1	0.11	<1

Watercourses

There were 244 km of watercourses within the draft Order Limits, of which 94% were ditches. Further detail on watercourse categorisation within the survey area is shown in Table A7-1-14 below.

Table A7-1-14 – Summary of Watercourses within the draft Order Limits

Watercourse Type	Number Surveyed	Total Length (km)	%
Ditches	627	229.94	94
Other rivers and streams	9	6.99	3
Priority habitat	7	6.33	3
Canals	1	0.98	<1

Flora

The desk study returned records of 14 notable / protected species of plant. Two of these are protected under Schedule 8 of the Wildlife and Countryside Act 1981 (as amended); namely Bluebell (*Hyacinthoides non-scripta*) and Greater Yellow-Rattle (*Rhinanthus angustifolius*); however, neither were located within the draft Order Limits. Typically, these

protected / notable flora were associated with the recognised areas of priority habitat and / or the above mentioned IEFs.

The closest record of Bluebell was recorded 60 m away from the draft Order Limits within Paull Holme Copse (a deleted LWS). Further records were returned within Hedon - Winestead Disused Railway Line LWS, White Hall Plantation (a deleted LWS) and Weldon's Plantation LWS.

Greater Yellow-Rattle was only recorded within Thorne, Crowle and Goole Moors SSSI. This site is a constituent of the Humberhead Peatlands IEF and as such, Greater Yellow-Rattle will be covered as part of this IEF.

The remaining 12 species were S41 species and included Divided Sedge (*Carex divisa*) and Burnt Orchid (*Neotinea ustulata*). Several species of orchid have been recorded within Keadby Ash Tip IEF, and Grass Vetchling (*Lathyrus nissolia*), which is listed as 'rare' within North Lincolnshire (i.e. occurring in only 1-3 of the 1114 tetrads (2 km x 2 km squares) within the county) (Ref 7.1.26) was recorded along a field boundary in East Halton.

Most notable and protected plant records are associated with recognised areas of Priority Habitat or semi-natural vegetation already identified as IEFs in this report. However, isolated records of certain species, such as Grass Vetchling along field boundaries, occur outside these IEFs and within habitats potentially affected by the Project. Accordingly, potential impacts to notable flora will be assessed both within the context of relevant IEFs and, where necessary, at a wider project scale for species occurring outside these designated areas.

Invasive Non-Native Species

The desk study returned records of 14 INNS, as listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended), distributed throughout the study area. These included terrestrial plants such as Japanese Knotweed (*Reynoutria japonica*), Giant Hogweed (*Heracleum mantegazzianum*) and Rhododendron (*Rhododendron ponticum*) and aquatic plants including New Zealand Pigmyweed (*Crassula helmsii*) and Nuttall's Waterweed (*Elodea nuttallii*).

During the extended UKHabs field survey, INNS were noted in 18 locations distributed throughout the draft Order Limits:

- Indian Balsam (*Impatiens glandulifera*) recorded at 12 locations;
- Japanese Knotweed recorded at two locations;
- Rhododendron (*Rhododendron ponticum*) recorded at two locations;
- Japanese Rose (*Rosa rugosa*) recorded at one location; and
- Giant Hogweed (*Heracleum mantegazzianum*) recorded at one location.

In addition to the terrestrial and freshwater INNS listed above, a number of marine and estuarine INNS have the potential to occur within the Humber Estuary and adjacent

coastal waters (e.g. slipper limpet *Crepidula fornicata*, Chinese mitten crab *Eriocheir sinensis*, Darwin's barnacle *Austrominius modestus*, killer shrimp *Dikerogammarus villosus*, zebra mussel *Dreissena polymorpha*, wakame *Undaria pinnatifida*, leathery sea squirt *Styela clava*, and oyster drill *Ocenebra erinaceus*). Further detail on these species is provided in Appendix 7.3: Intertidal and Marine Technical Appendix, which addresses the intertidal and nearshore environment.

While INNS are not considered an IEF in their own right, their presence within the draft Order Limits represents a potential ecological constraint. Accordingly, INNS will be addressed within the PEIR through the development of appropriate mitigation and management measures to prevent their spread during construction and operation.

Invertebrates

The desk study returned records of 62 notable or protected invertebrate species (terrestrial and aquatic) within the Zol.

Of these, seven terrestrial invertebrate species with accurate (six-figure or better) grid references were recorded within the draft Order Limits, with additional low-resolution records located in overlapping grid squares. These included crucifix ground beetle (*Panagaeus cruxmajor*), necklace ground beetle (*Carabus monilis*), small heath (*Coenonympha pamphilus*), five-banded weevil-wasp (*Cerceris quinquefasciata*), cinnabar (*Tyria jacobaeae*), shaded broad-bar (*Scotopteryx chenopodiata*) and sea aster mining bee (*Colletes halophilus*). Multiple records of white-letter hairstreak (*Satyrium w-album*) were also identified outside the draft Order Limits, the closest being within Alkborough Flats LWS, approximately 20 m away.

Ten aquatic invertebrate species with accurate grid references were recorded within the draft Order Limits, again with further low-resolution records within overlapping grid squares. These comprised *Enochrus bicolor*, *Helophorus strigifrons*, *Helochares punctatus*, *Agabus uliginosus*, *Phytobius leucogaster*, *Enochrus quadripunctatus*, *Agabus conspersus*, *Haliphus apicalis*, *Helophorus nanus* and mud pond snail (*Omphiscola glabra*).

Records of both terrestrial and aquatic invertebrates were well distributed across the draft Order Limits, with particularly high densities within the following existing IEFs: the Humber Estuary Corridor, Humberhead Peatlands, Paupers' Drain LWS, Rosper Road Pools LWS, and the watercourses around Keadby including Stainforth and Keadby Canal Corridor LWS, Folly Drain North LWS, River Torne LWS and Keadby Wetland LWS.

Records outside the draft Order Limits included multiple associated with Drax Power Station and its surrounding land and included small heath and the beetles *Enochrus quadripunctatus*, *Haliphus apicalis*, *Notaris scirpi* and *Agabus uliginosus*. However, the closest of these was situated approximately 460 m from the draft Order Limits.

The Project and its Zol are considered to be outside the current natural range of the white-clawed crayfish (*Austropotamobius pallipes*). Consultation with the Environment Agency (EA) identified a single anomalous record from South Soak Drain, located approximately 1.6 km west of the draft Order Limits. Subsequent EA surveys have been unable to confirm this record. The species is therefore currently assumed to be likely absent and not carried forward to assessment within the PEIR; however, any changes to this baseline will be reviewed and assessed throughout the Project's lifetime.

Although notable and protected invertebrate species are recorded widely across the draft Order Limits, the majority of high-resolution records and highest densities are closely associated with discrete areas of semi-natural vegetation and habitat mosaics already identified as IEFs in this report. These habitats typically provide the structural complexity, floral diversity, and microhabitat variety required to support these species, in contrast to the intensively managed arable land that dominates much of the survey area. As such, the conservation importance of invertebrates is intrinsically linked to these IEFs, and potential impacts to this species group will be addressed through the assessment of those IEFs. No additional invertebrate receptors have therefore been scoped in separately for further assessment.

Fish

Table A7-1-15 provides a summary of the fish species identified within the Zol during the desk study. Further detail on species relevant to the intertidal and nearshore environment, based on a wider 15 km search area, is provided in Appendix 7.3: Intertidal and Marine Technical Appendix.

Table A7-1-15 – Summary of fish records within the Zol

Species	Distribution
Allis shad (<i>Alosa alosa</i>)	Restricted to the Humber Estuary.
Twaite shad (<i>Alosa fallax</i>)	Restricted to the Humber Estuary.
European eel	Widely distributed throughout several waterbodies / catchments crossed by the Project, including the Humber Estuary, River Aire, Dutch River, River Trent, River Ancholme and East Halton Beck. Due to the wide distribution of known records and because the species can inhabit most waterbodies, European eel is considered likely to occur (at varying degrees of likelihood) within the majority of watercourses within the study area.
Spined loach (<i>Cobitis taenia</i>)	Restricted distribution within the River Trent, River Ancholme and River Ouse.
Bullhead (<i>Cottus gobio</i>)	Recorded in the River Derwent at its confluence with the River Ouse. There are also records within the River Eau, which is a tributary of the River Trent, the Dutch River, Aire and Calder Navigation and within the River Trent itself (but only within the upper reaches of this river). Although not numerous, Bullhead are also recorded in the River Ancholme and other tributaries of the Humber.
River lamprey	Recorded in the Humber Estuary, River Derwent, River Trent and River Ancholme at its confluence with the Humber Estuary. The River Ouse catchment supports one of the most important river lamprey populations in the UK (Ref 7.1.27). River lamprey is likely to occur within these rivers and accessible tributaries.
Smelt (<i>Osmerus eperlanus</i>)	Recorded in the Humber Estuary and lower reaches of the River Ouse and River Trent (Ref 7.1.8, Ref 7.1.27). This species has been considered likely to occur within the Humber Estuary and lower freshwater / brackish reaches of connected watercourses.
Sea lamprey	Recorded within the River Ouse and Humber Estuary, although in low numbers (Ref 7.1.9, Ref 7.1.8). Named as a qualifying feature of the River Derwent SAC, but not a primary reason for site selection due to low numbers.

Species	Distribution
Atlantic salmon (<i>Salmo salar</i>)	Recorded within the River Ouse, River Trent and the Humber Estuary (Ref 7.1.8).
Brown / sea trout (<i>Salmo trutta</i>)	Recorded within the Dutch River, River Ouse, River Trent and the Humber Estuary (Ref 7.1.8).
Other commercially important species	Plaice (<i>Pleuronectes platessa</i>), common sole (<i>Solea solea</i>), whiting (<i>Merlangius merlangus</i>), Atlantic cod (<i>Gadus morhua</i>), herring (<i>Clupea harengus</i>) and dab are mainly restricted to the Humber Estuary (Ref 7.1.8, Ref 7.1.27). Plaice, which can survive quite a low salinity content of water, has also been recorded within East Halton Beck (Skitter Beck) and the lower reaches of the River Ouse (Ref 7.1.6, Ref 7.1.8). Herring has been recorded in the River Trent and River Ouse at their confluence with the Humber Estuary (Ref 7.1.8) but this species is unlikely to occur further upstream within these rivers due to the reduced salinity.

The majority of notable and protected fish records fall within existing IEFs where suitable habitats and ecological functions are concentrated (namely the Humber Estuary Corridor, River Derwent and New River Ancholme LWS). However, certain species, most notably European eel, are more widely distributed across the watercourses intersecting the draft Order Limits and are considered likely to occur in multiple catchments beyond these IEFs. As such, potential impacts to fish will be assessed both through the evaluation of relevant IEFs and, where applicable, at a wider project scale for species with broader distributions.

Amphibians

The desk study returned 424 records of GCN within the ZoI, alongside numerous records of common toad (*Bufo bufo*), common frog (*Rana temporaria*), palmate newt (*Lissotriton helveticus*) and smooth newt (*Lissotriton vulgaris*). With the exception of palmate newt, all species were recorded within the draft Order Limits.

Several granted EPS licence applications for GCN were identified in proximity to the draft Order Limits:

- Within the draft Order Limits at East Halton: licence ref. 2014-1559-EPS-MIT (1-3), implemented 2014–2020 (licensable activities not detailed in available records).
- Within the draft Order Limits at North Killingholme: licence ref. 2016-26829-EPS-MIT-2, implemented 2017–2019, permitting damage / destruction of resting places.
- Adjacent, north of the draft Order Limits at Paull: licence ref. EPSM2009-1243, implemented in 2010, permitting destruction of resting places.
- Adjacent, east of the draft Order Limits at South Killingholme: licence ref. 2020-49777-EPS-MIT, valid 2020–2031, permitting damage / destruction of resting places.

Numerous waterbodies occur within the draft Order Limits; however, some sections lack such features, including between Goole Fields and West Halton, South Ferriby and Barrow upon Humber, and Thorngumbald and Patrington. While much of the draft Order Limits comprises intensively farmed arable land that is sub-optimal for amphibians, there are multiple patches and corridors of semi-natural habitat which provide breeding and resting opportunities for amphibian species including GCN.

To offset potential impacts to GCN, it is intended that a licence will be sought through the Natural England District Level Licensing (DLL) scheme (Ref 7.1.28). Under DLL, risk zones are defined as:

- Red zones – GCN populations of regional, national, or international importance. No red zones occur within the draft Order Limits.
- Amber zones – GCN populations with suitable habitats and dispersal routes. Sections of the draft Order Limits fall within amber zones.
- Green zones – areas with lower GCN occurrence and fewer suitable habitats. The majority of the draft Order Limits within the DLL coverage falls within green zones.

Small sections of the draft Order Limits extend into North Yorkshire and North East Lincolnshire, which are not currently covered by DLL. Given their proximity to DLL-covered areas, a hybrid licensing approach, applying the same principles as DLL, is anticipated to be acceptable to Natural England. It is proposed that this approach will be progressed via the Discretionary Advice Service and detailed within the Environmental Statement.

Insert A7-1-1 highlights the GCN risk zone areas associated with the draft Order Limits and the two sections that are not currently covered by DLL.



Insert A7-1-1 – GCN risk zones associated with the draft Order Limits

Natterjack toad is a designating feature of the Humber Estuary Ramsar site, which lies within the draft Order Limits. However, no records of this species were returned from the desk study, and the nearest known colony is approximately 30 km south of the draft Order Limits, within the dune slacks at Saltfleetby–Theddlethorpe. This species is therefore not taken forward for assessment within the PEIR. Notwithstanding this, amphibians (including GCN) will be assessed within the PEIR, both through consideration of relevant IEFs and, where applicable, at a wider project scale.

Reptiles

A summary of the reptile records identified during the desk study and field observations is provided in Table A7-1-16

Table A7-1-16 – Summary of reptile records within the Zol

Species	Distribution
Slow worm (<i>Anguis fragilis</i>)	Appears largely absent across the study area, with presence reported only at Hedon Aerodrome (desk study record), situated north of and potentially segregated from the draft Order Limits by the A1033. Due to their fossorial nature, slow worms are typically under-recorded, but

Species	Distribution
	if present, are likely to be restricted to extensive areas of semi-natural habitat and railway corridors.
Grass snake (<i>Natrix helvetica</i>)	<p>Appears to be the most widespread and abundant reptile species in the study area, though still with a patchy distribution. Multiple records exist around Drax, Thorne, Crowle and Goole Moors SSSI, and Keadby. In addition to the SSSI, the species is noted on the citations for Sugar Mill Ponds LNR and Three Rivers LWS.</p> <p>During non-target field surveys across 2025, the species was also recorded within the draft Order Limits as follows:</p> <ul style="list-style-type: none"> • An adult was observed in a ditch adjacent to Paull Holme Strays. • An adult was observed on the bank of a ditch (approximate grid reference SE 82083 20118). • Two dead grass snakes were recorded during on Chapel Lane, Keadby (approximate grid references SE 83110 11896 and SE 83207 11889).
Adder (<i>Vipera berus</i>)	Appears restricted to Thorne, Crowle and Goole Moors SSSI and surrounding areas. One record (2002) occurred outside the SSSI, associated with the Oak Hill, Dutch River and Aire & Calder Canal corridor, suggesting potential presence here.
Common lizard (<i>Zootoca vivipara</i>)	Distribution appears patchy, with multiple records from Thorne, Crowle and Goole Moors SSSI, but few records outside this site. Large expanses of the draft Order Limits are devoid of records; however, reptiles are typically under-recorded and the species may be more widespread in low numbers.

Absence of reptiles from suitable habitats has also been reported in surveys by Drax Power Limited (Ref 7.1.29), Able UK Ltd and ERM (Ref 7.1.30) and AECOM (Ref 7.1.31), indicating a patchy distribution and localised absence in parts of the study area.

Large-scale presence or high reptile populations are considered unlikely due to the predominantly structurally poor arable habitats within the draft Order Limits. Nevertheless, grass snake and common lizard may occur widely in suitable habitats, with adder and slow worm potentially present in more restricted areas. Reptiles are therefore assumed present in all suitable habitats.

Reptile surveys are ongoing, with survey and assessment methodology detailed in Appendix 7.2. Potential impacts to reptiles will be assessed within the PEIR both through relevant IEFs and, where appropriate, at a wider project scale.

Birds

The desk study returned records of 176 bird species within the Zol. These included 67 species protected under Schedule 1 of the Wildlife and Countryside Act 1981 (as amended), including species of high conservation concern such as barn owl, hen harrier and bittern. The desk study also identified 56 red-listed species (including cuckoo *Cuculus canorus* and corn bunting *Emberiza calandra*) and 78 amber-listed species (including song thrush *Turdus philomelos*, nightjar and avocet).

Numerous species that form part of the qualifying wintering bird assemblage of the Humber Estuary SPA and Ramsar site were also recorded, including high numbers of golden plover, lapwing, dunlin, teal, wigeon and curlew. Large areas of the draft Order Limits are therefore known to support passage and wintering birds associated with the Humber Estuary Corridor IEF, while farmland and semi-natural habitats within the Zol also provide opportunities for breeding farmland birds and others such as barn owl. Nightjar are discussed above, in relation to Thorne and Hatfield Moors SPA.

Targeted surveys for passage, wintering and breeding birds have been undertaken, and data analysis is ongoing. The methodologies for these surveys are detailed in Appendix 7.2. In addition, a preliminary HRA Screening Report is being made available as part of the PEIR, and this includes an overview of the bird surveys undertaken. Potential impacts to birds will be assessed within the PEIR both through relevant IEFs and, where appropriate, at a wider project scale.

At the Easington Landfall, intertidal surveys (2022 and 2025) recorded the presence of sand martin (*Riparia riparia*) nesting in cliff burrows, as well as oystercatcher and several gull species. Further detail on these survey results is provided in Appendix 7.3: Intertidal and Marine Technical Appendix.

Badgers

The desk study returned 754 records of badger (*Meles meles*) within the study area, including 612 records of badger setts. These were widely distributed throughout the search area and included multiple setts within the draft Order Limits.

Badger presence within the draft Order Limits was also confirmed during field surveys, with 93 badger setts recorded within the survey area.

Habitats within the survey area are generally suitable for badger activity and sett creation, particularly hedgerows, scrub, dry ditches, woodland and adjacent arable land. Given this habitat suitability and the rural nature of the Project, badgers are considered to be widespread throughout the draft Order Limits.

Targeted field surveys for badgers are ongoing, and the survey and assessment methodologies are detailed in Appendix 7.2. This species is carried forward for assessment within the PEIR.

Bats

The desk study returned records of 10 bat species within the Zol, including common pipistrelle (*Pipistrellus pipistrellus*), soprano pipistrelle (*P. pygmaeus*), Nathusius's pipistrelle (*P. nathusii*), Brandt's bat (*Myotis brandtii*), brown long-eared bat (*Plecotus auritus*), Daubenton's bat (*M. daubentonii*), Leisler's bat (*Nyctalus leisleri*), Natterer's bat (*M. nattereri*), noctule (*N. noctula*) and whiskered bat (*M. mystacinus*). Records were widely distributed across the study area, with particularly high concentrations around Barlow, Winterton and South Killingholme.

Roosts

The desk study also identified 175 bat roosts within the Zol. These comprised roosts from seven species, including common pipistrelle, soprano pipistrelle, noctule, Natterer's bat, whiskered bat, brown long-eared bat and Daubenton's bat. Some roost records were potentially located within the draft Order Limits; however, all were returned at a 1 km square grid resolution, and precise locations are therefore uncertain.

Activity

In addition, 821 bat activity records were returned (field observations, feeding areas, monitoring and emergence surveys). These records included the species listed above for roost, as well as Nathusius's pipistrelle, Brandt's bat and Leisler's bat. Activity records were widely distributed across the Zol.

Although the desk study indicates a diverse assemblage of bats in the wider Zol, the species most frequently recorded within the draft Order Limits were common and widespread species.

Field surveys identified several features within the draft Order Limits with potential to support roosting, foraging and commuting bats. Targeted bat activity and roost surveys are ongoing, and the survey and assessment methodologies are detailed in Appendix 7.2. Given the number of records, habitat suitability and potential for impacts, bats are carried forward for assessment within the PEIR.

Otters

The River Derwent SAC citation lists otter as an Annex II species present as a qualifying feature, though not a primary reason for site selection. The River Derwent lies approximately 480 m north of the draft Order Limits, and several watercourses crossed by the Project are hydrologically connected to this site.

Desk study records confirm the presence of otter across the study area, with clusters reported around Drax, the River Ouse, the Dutch River and Aire and Calder Navigation, the Stainforth and Keadby Canal, North Soak Drain, South Soak Drain, Three Rivers and South Engine Drain, the River Trent, Scawby Old Ancholme and Soak, the New River Ancholme, the Humber Estuary and Hedon Haven. No granted EPS licences for otter were identified during the desk study.

Targeted otter surveys are ongoing, and the survey and assessment methodologies are detailed in Appendix 7.2. Given the widespread distribution of records, suitable habitat availability and potential for project impacts, otter is carried forward for assessment within the PEIR.

Water voles

The desk study returned 1,376 records of water vole (*Arvicola amphibius*) within the search area. Water voles are widespread throughout the draft Order Limits, with known 'hot spots' between Eastoft and Keadby and around the Humber Estuary at Immingham and Paull.

Data from The Wildlife Trusts' National Water Vole Database & Mapping Project (Ref 7.1.12) indicate that American mink (*Neovison vison*) - a key predator of water voles - are also widespread across the area, with a relative absence around East Halton. The desk study also returned mink records from several locations, including the River Ancholme and near Three Rivers LWS.

Targeted water vole surveys are ongoing, and the survey and assessment methodologies are detailed in Appendix 7.2. Given the number and distribution of records and the availability of suitable habitat, the species is carried forward for assessment within the PEIR.

Other Notable Mammals

The desk study highlighted that brown hare (*Lepus europaeus*) and hedgehog (*Erinaceus europaeus*) were widespread across the draft Order Limits. Brown hare were also

recorded within the draft Order Limits on five separate occasions during the Extended UKHabs habitat survey (detailed records for other notable mammals will be presented within a dedicated technical appendix as part of the Environmental Statement).

The data search returned seven harvest mouse (*Micromys minutus*) records, one of which was within Three Rivers LWS in Keadby, and the remainder were located adjacent to Burkinshaw's Covert LWS in Killingholme.

On the basis of desk study records and field observations, these species are considered likely to be present within suitable habitats across the draft Order Limits and are therefore carried forward for assessment within the PEIR.

The draft Order Limits lie outside the natural range of dormouse (*Muscardinus avellanarius*), and there is no publicly available information indicating nearby release sites. Absence is therefore assumed, and dormouse has not been carried forward for assessment within the PEIR.

The desk study returned no records of polecat (*Mustela putorius*) or pine marten (*Martes martes*) within the Zol, and no statutory or non-statutory site citations in the study area note either species. Likely absence is therefore assumed, and polecat and pine marten are not carried forward for assessment within the PEIR.

Breeding grey seal is a qualifying / designated feature of the Humber Estuary Ramsar site / SAC / SSSI, and harbour seal is present within the Humber Estuary SAC (noted as a non-significant presence). These designated sites lie within the draft Order Limits. One desk-study record of grey seal was returned (River Humber, south of Hull); no harbour seal records were returned. The nearest known grey seal breeding colony is at Donna Nook, approximately 20 km south of the draft Order Limits. Given the presence of marine mammals associated with designated features, marine mammals are carried forward for assessment within the PEIR (via the Humber Estuary Corridor and Holderness Coast IEFs). Further detail on marine mammal records and potential overlap with the intertidal and nearshore environment at the Easington Landfall (including grey seal, harbour seal and others) is provided in Appendix 7.3: Intertidal and Marine Technical Appendix.

Table A7-1-16 identifies the IEFs that have been scoped in for further assessment within the PEIR. IEF's have been grouped by geographical importance in accordance with CIEEM guidelines (Ref 7.1.32).

Table A7-1-16 – IEFs Scoped in for Further Assessment within the PEIR

Importance	IEF
Up to International	<ul style="list-style-type: none"> Humber Estuary Corridor – containing Humber Estuary SAC, SPA, Ramsar site, SSSI, North Killingholme Haven Pits SSSI, Asselby Island LWS, Alkborough Flats LWS, Dawson City Claypits LWS, East Marsh

Importance	IEF
	<p>LWS, Halton Marsh Clay Pits LWS, Killingholme Haven Pits LWS, Paull Holme Strays LWS and Halton Marshes</p> <ul style="list-style-type: none"> • Holderness Coast - containing Greater Wash SPA (marine) and Holderness Inshore MCZ • River Derwent Corridor – containing River Derwent SAC and SSSI, and Lower Derwent Valley SPA, Ramsar site and NNR.
Up to National	<ul style="list-style-type: none"> • Eskamhorn Meadows SSSI • Eastoft Meadow SSSI • The Lagoons SSSI • Keadby Ash Tip • Newton Garth
Up to Regional	<ul style="list-style-type: none"> • Invertebrates • Fish • Amphibians • Bats • Otter • Marine mammals
Up to County	<ul style="list-style-type: none"> • Non-statutory sites within the draft Order Limits: Keadby Warping Drain LWS, New River Ancholme LWS, Ancholme Fields LWS, Hedon - Winestead Disused Railway Line LWS, Burkinshaw's Covert LWS, Chase Hill Wood LWS, Hodgson's Fields LWS, Whiting Mill Bottom Road Verges LWS, East Drain, South Ferriby LWS, Thornton Curtis Chalk Pit Road Verge LWS, Barton Road, Wootton Hall LWS, Keadby Boundary Drain LWS, Paupers' Drain LWS, Stainforth and Keadby Canal Corridor LWS and Hatfield Waste Drain LWS • Non-statutory sites outside the draft Order Limits but potentially hydrologically connected: Oak Hill LWS, Mayflower Wood Meadow LWS, Keadby Wet Grassland LWS, Keadby Wetland LWS, Three Rivers LWS, Folly Drain North LWS, River Torne LWS, North Engine Drain, Belton LWS, South Engine Drain, Belton LWS, Gunness Common LWS, Abbot's Lodge Grassland LWS, South Cloister Covert LWS, Hollym Carrs LWS, Weldon's Plantation LWS, Enholmes Plantations Historic LWS, Fort Paull Humber Grassland Candidate LWS, Brockholes SINC, Newland Ings, Newland SINC, Out Newton – Skeffling LWS, Thealby Gullet LWS, Patrington Haven Drain Candidate LWS, Goxhill Marsh South LWS, South Soak Drain, Keadby LWS, Leggott's Quarry LWS and Manor House Farm Field LWS • Priority Habitats situated outside existing IEFs

Importance	IEF
	<ul style="list-style-type: none"> • Notable plants and INNS • Reptiles • Birds • Water vole
Up to Local	<ul style="list-style-type: none"> • Arboricultural features (TPOs and veteran trees) • Badgers • Other notable mammals

Table A7-1-17 identifies the ecological features that have been scoped out of further assessment within the PEIR.

Table A7-1-17 – Ecological Features Scoped Out of Further Assessment

Ecological Features	Reason for Scoping Out
<p>Humberhead Peatlands – Thorne Moor SAC, Thorne and Hatfield Moors SPA, Thorne, Crowle and Goole Moors SSSI, Humberhead Peatlands NNR</p>	<p>Due to their upstream location and separation distance (> 800 m) from the draft Order Limits, no perceivable impact pathways have been identified for Thorne Moor SAC, Thorne, Crowle and Goole Moors SSSI or Humberhead Peatlands NNR.</p> <p>Habitats within the draft Order Limits are considered unsuitable for supporting nightjar foraging activity.</p>
<p>Crowle Borrow Pits SSSI and Hatfield Chase Ditches SSSI</p>	<p>Due to their upstream location and separation distance (> 1.3 km) from the draft Order Limits, no perceivable impact pathways have been identified.</p>
<p>Meadow Area 4 LWS, Goxhill Meadows LWS, Alder Wood LWS, Bonby Road Verge LWS, Sandhills Quarry LWS, Burton upon Stather Brick Pit LWS, Burton Wood LWS, Normanby Park LWS, Rosper Road Pool LWS, Homestead Park Pond LWS, Scrub Lane East Field LWS, East View Meadow LWS, Crowle Moor LWS, Carlton Park Pond SINC, Southfield Reservoir Candidate LWS, Frodingham – Winestead LWS, A15 / A1077 Road Verges LWS, Alder Carr Wood LWS, Bagmoor Gullet LWS, Beacon Hill Road Verge LWS, Burnham Lodge Quarry LWS, Burnham Road LWS, Deepdale LWS, Deepdale Quarry Road Verges LWS, Derrythorpe LWS, Melton Ross Quarry LWS, Melton Ross Road Verges LWS, New Barnetby Road Verges LWS, Race Lane Verges LWS, South Ferriby Chalk Springs LWS, South Ferriby Churchyard LWS, Sykes Lane Meadows LWS, Warping Drain, Wold Road LWS and Wootton Grange LWS.</p>	<p>Due to their upstream location and separation distance from the draft Order Limits, no perceivable impact pathways have been identified.</p>

Ecological Features	Reason for Scoping Out
Thorn Marsh Farm	The site is identified as a future ecological mitigation site; however, this mitigation is not yet required, and the site is currently managed as agricultural land.
Old Little Humber Farm	This site was a proposed bird compensation site; however, no publicly available evidence could be found to confirm that habitat creation will be implemented.
Ancient woodland	Due to their upstream location and separation distance from the draft Order Limits, no perceivable impact pathways have been identified.
Dormouse, polecat and pine marten	Absent locally.

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Appendix 7.2 – Survey Methodology

Background and Introduction

Background

Project Context

This report is Appendix 7.2 of the Preliminary Environmental Information Report (PEIR) and has been prepared in support of the Humber Carbon Pipelines project (i.e. ‘the Project’). The boundary for the Project is hereafter referred to as the ‘draft Order Limits’ which are defined in Section 2.3 of Chapter 2 (Project Description) of the PEIR). This document outlines the proposed methodologies for the ecological surveys that have or will be conducted as part of the Project. It is intended to provide stakeholders with a clear understanding of the approaches to ecological surveys that will be completed prior to the commencement of the Project.

Survey Status

Some ecological assessments have already been undertaken, and a number of baseline surveys have commenced within the draft Order Limits. These initial surveys provided early data to inform the PEIR and identify key ecological constraints. However, other surveys are still planned and will be completed in advance of the Environmental Statement (ES). Where surveys are ongoing or planned, these may extend to the final Order Limits, which will be confirmed and refined for submission in the ES.

Legislative Framework

The Project is defined as a Nationally Significant Infrastructure Project (NSIP) as set out in the Planning Act 2008, Section 14 (1)(g) and Section 21 (Ref 7.2.1). As such, to construct and operate the Project, a Development Consent Order (DCO) application will be made.

Purpose of this Appendix

A suite of environmental studies will be required to support the DCO application, and this report details the framework for undertaking ecological survey and assessment for the range of ecological features (habitats, species, and ecosystems, including ecosystem function and processes) associated with the Project. It provides a standard for methodologies and sets out the proposed survey programme.

The survey methodology and programme aim to be robust and proportionate. It will facilitate Ecological Impact Assessment (EclA), and the production of the Biodiversity Enhancement Strategy (BES), as well as a Construction Environmental Management Plan (CEMP).

Streamlined Approach

The Project will encourage a symbiotic relationship between design and survey / assessment, whereby survey / assessment information will influence design (in line with the mitigation hierarchy) and effective design will aim to minimise impacts, driving proportionate survey and reporting. Further to this, apart from permanent land take for areas associated with the above ground installations (AGI), habitat reinstatement will ensure most impacts are temporary. For habitats identified as important ecological features (IEFs), reinstatement will be to a condition of ecological value equal to or above the baseline.

Ecological features can be important for various reasons and require specific assessment within EclA (Ref 7.2.2). The assessment methodology can be found in Section 7.4 of Chapter 7 (Ecology and Biodiversity) of the PEIR. The Ecological Appraisal (Appendix 7.1) sets out the IEFs of relevance for this Project; however, IEFs will be reassessed during production of the ES as a greater understanding of IEFs associated with the Project is achieved through survey / assessment and consultation with stakeholders and strategic partners.

It is proposed that the above approach will reduce the need for some ecological survey / assessment or delay the need for this information until pre-construction (i.e. post DCO consent), allowing adherence to legislative and welfare requirements whilst ensuring that there is sufficient time to apply for any Natural England (NE) derogation licences required and undertake mitigation. It is also envisaged that this approach will streamline the EclA, allowing it to focus on constraints that are important, and help drive a “better, faster, greener, fairer and more resilient” NSIP planning process (in line with the government NSIP Reform Action Plan (Ref 7.2.3) with regards to Ecology and Biodiversity.

Concept

The need for ecological survey and assessment is primarily driven by EclA – a process of identifying, quantifying, and evaluating the potential effects of development-related or other proposed actions on habitats, species and ecosystems and identifying mitigation requirements (Ref 7.2.2).

Application of the principles outlined in this document to the detailed design of ecological mitigation and compensation aims to ensure that adverse effects identified during EclA are addressed.

To ensure that all potential significant effects of the Project will be identified, where baseline information comprises solely desk-based assessment or limited site-based survey data, a precautionary approach of assuming a 'reasonable worst-case' valuation is to be adopted for some IEFs. This approach will assign precautionary values to both known and potential IEFs based on the currently available information.

As part of the DCO, EclA will be applied during the production of the ecological component of the ES and for Habitats Regulations Assessment (HRA). Ecological survey and assessment will also be required pre-, during- and post-construction to:

- Ensure that the Project accords with DCO requirements, relevant planning policy and legislation;
- Inform NE derogation licences; and.
- Demonstrate success of the BES and any biodiversity enhancement management plans.

The draft survey and assessment programme is set out for each relevant ecological feature in the sections below. Following CIEEM guidelines (Ref 7.2.2), the programme has been developed to be streamlined and proportionate, yet robust enough to support the consent application, thus minimising the collection of irrelevant / abortive information and the need for repeat surveys. Nevertheless, in the first instance, survey and / or assessment will be presumed to be required where:

- An IEF is confirmed, or it is thought there is a reasonable likelihood that an IEF may be present; and,
- Significant effects on the ecological integrity or conservation status of an IEF may arise from construction, operation or decommissioning of the Project.

A full range of ecological features have been considered in preparing this document. Several were discounted on the basis that they are unlikely to occur on site (for example, due to geographical absence or unsuitable habitat; see Ecological Appraisal (Appendix 7.1)). Only those features considered relevant to the Project are identified below.

The survey methodology is designed to inform planning and ensure that Project impacts do not result in significant adverse effects on the conservation status of IEFs and biodiversity in general. The draft Order Limits will be refined as the pipeline route, AGI locations, and construction details are finalised.

Qualifications, Experience and Licencing

Where required, surveys will be led by surveyors holding appropriate survey licences. For example, where a survey / inspection has the potential to elicit disturbance to a European Protected Species (EPS), the lead surveyor will hold or be accredited under the appropriate Natural England survey licence. All other surveys will be led by surveyors who meet the competency criteria for species-specific survey published by CIEEM (Ref 7.2.4) and are approved under Arcadis' technical competency framework.

Biosecurity

All field surveyors will take reasonable measures to ensure compliance with species-specific best practice guidelines for preventing the spread of disease and of invasive species of flora and fauna.

This is especially applicable to working in water. Current best practice biosecurity measures (Ref 7.2.4) will be implemented, with disinfection of footwear and equipment between surveys, where they are used on more than one watercourse or water body.

Ecological Appraisal and Desk Study

Introduction

The Ecological Appraisal prepared for the Project is provided in Appendix 7.1. It incorporates both a desk study and an Extended UK Habitat Classification (UKHab) survey to establish the ecological baseline and identify key ecological constraints associated with the Project. The appraisal sets out the IEFs and potential constraints within the draft Order Limits and the wider Zone of Influence (Zoi).

The desk study, reported in the Ecological Appraisal, collated existing ecological information from a comprehensive range of sources to cover all IEFs relevant to the Project. It also informed survey design and effort. The desk study is an ongoing process, with information reviewed and updated as new data becomes available. A summary of results is provided in Appendix 7.1, with the full outputs to be presented in the ES.

Together, the desk study and UKHab survey results provide the baseline against which ecological effects are assessed in Chapter 7: Ecology and Biodiversity of the PEIR. The desk study has also informed the scope and design of the survey programme described in this report for the various IEFs.

Methodology

The detailed methodology, assessment and results of both the UKHab survey and desk study are set out in the Ecological Appraisal (Appendix 7.1). A summary of the desk study approach is provided below for context. The desk study comprised:

- A review of statutory and non-statutory designated sites within defined buffers of the draft Order Limits (2–5 km, depending on feature type).
- Collation of records for protected, notable and invasive non-native species from Local Environmental Record Centres and national datasets (e.g. MAGIC, NBN Atlas, BTO WeBS).
- Review of aerial imagery, Ordnance Survey mapping, planning portals and previous ecological assessments to identify habitats and potential ecological constraints.
- Consideration of wider ecological networks, habitat connectivity, and potential Functionally Linked Land associated with designated sites.

This information has been used to identify IEFs, guide survey effort, and provide context for interpreting field survey results.

Hedgerow Survey

Introduction

The Project extends through a predominantly agricultural landscape, and hedgerows are widespread throughout the draft Order Limits, forming field boundaries. As a result, impacts on hedgerows are unavoidable. However, given the largely temporary nature of construction impacts, any adverse effects on hedgerows are expected to be minor and reversible.

The EclA approach for hedgerows is to ensure that the Project delivers an overall increase in the extent and quality of hedgerow habitat and maintains connectivity across the wider landscape. This will be achieved by:

- Minimising permanent impacts (limited to AGIs and the Pump Facility) to hedgerows.
- Reinstating temporarily affected habitats to a condition equal to or better than baseline.
- Enhancing ecological networks in line with the Project's BES.

Screening for Survey and Defining the Survey Area

The Hedgerows Regulations 1997 (Ref 7.2.5) serve to protect hedgerows which are assessed as being 'Important' (according to certain criteria) from being removed (uprooted or destroyed), in whole or in part. The focus of hedgerow surveys is therefore to identify Important hedgerows across the entire draft Order Limits.

Methodology

A UKHab survey was carried out between March and August 2025, under appropriate weather conditions and by suitably experienced ecologists. During this survey, all hedgerow habitats were mapped, classified, and an assessment of hedgerow habitat condition was undertaken following the UKHab classification system (Ref 7.2.6).

Alongside the UKHabs survey, a hedgerow survey following guidance set out in the Hedgerow Survey Handbook (Ref 7.2.7) was undertaken on all species-rich hedgerows. Each hedgerow was surveyed for attributes identified in the Hedgerows Regulations 1997 (Ref 7.2.5). This data was used to determine the "importance" of the hedgerows according to the Hedgerows Regulations 1997.

Each species-rich hedgerow was sampled in a maximum of three 30 m sections. Information recorded for each hedgerow included:

- Height and width of hedgerow (metres).
- Species composition.
- 'Associated features' (According to sub-paragraph 4, Section 7 of Part II of Schedule 1 of the Hedgerows Regulations 1997).
- Any association with a Public Right of Way (PRoW).

The Hedgerows Regulations 1997 apply to any hedgerow which is at least 20 m in length, or if less than 20 m in length, meets another hedgerow at each end. Hedgerows are considered 'Important' under Wildlife and Landscape criteria of the Hedgerows Regulations 1997 if they are at least 30 years old and meet at least one of the following criteria:

- Contains species listed in Schedule 1 (Part 1 only), Schedule 5, or Schedule 8 of the Wildlife and Countryside Act 1981 (as amended) or Red Data Book species.
- The hedgerow is adjacent to a PRow (excluding adopted highways but including roads used as a public path) and contains at least four woody species and least two Associated Features (as detailed below).
- Contains at least six woody species.
- Contains at least five woody species and has associated with it at least three 'associated features'.
- Contains at least five woody species including one of the following: black poplar tree (*Populus nigra*); large-leaved lime (*Tilia platyphyllos*), small-leaved lime (*Tilia cordata*) and wild service tree (*Sorbus torminalis*).
- Contains at least four woody species and has associated with it at least four 'associated features'; or
- There is presence / recorded presence of particular animal and plant species (as detailed in Criteria 6 sub-paragraphs (1)-(4) of the Hedgerow Regulations 1997 (Ref 7.2.5).

'Associated features' include:

- A bank / wall or ditch for at least half the length.
- Gaps of less than 10% of the total hedgerow length.
- At least one standard tree per 50 m.
- At least three ground flora woodland species as defined in Schedule 2 of the Regulations within 1 m of the hedgerow.
- Connections scoring four or more points (1 point = connection with a hedgerow; 2 points = connection with broadleaved woodland or a pond).
- A parallel hedge within 15 m.

The survey area included all land within the draft Order Limits and a minimum 50m buffer zone.

Biodiversity Net Gain

Introduction

Biodiversity Net Gain (BNG) is an approach to development that aims to leave the natural environment in a measurably better state than before. While the statutory requirement for NSIPs to deliver BNG under the Environment Act 2021 has not yet come into force, it is anticipated that a minimum 10% uplift in biodiversity value will be required from May 2026.

The Project is taking a proactive approach, recognising the emerging policy framework and incorporating opportunities to achieve BNG alongside the mitigation hierarchy.

Methodology

A preliminary BNG assessment has been undertaken for the Project to support early design development. However, due to the absence of confirmed secondary legislation, guidance, or a bespoke NSIP metric, this assessment is not presented as part of the PEIR. At this stage, it is being used primarily as an internal design tool to help identify areas of ecological value to be avoided by construction and to highlight opportunities for ecological enhancement. The assessment therefore serves an interim, precautionary role, rather than fulfilling its intended statutory purpose of demonstrating measurable net gain. Once NSIP-specific requirements are confirmed, the assessment will be updated, refined, and reported in full within the ES.

Further detail on the policy context for BNG, and how it has been considered alongside the mitigation hierarchy, is provided in Chapter 7: Ecology and Biodiversity of the PEIR.

Invertebrates

Introduction

The Project extends through a predominantly agricultural landscape, comprising intensively managed arable land and grazed pasture of generally low structural diversity. As a result, large populations of protected invertebrates and / or notable invertebrate assemblages are likely to be confined to distinct habitats identified during the Ecological Appraisal, which the Project will seek to avoid. Given the largely temporary nature of construction impacts, any adverse effects on these habitats are expected to be minor and reversible.

The EclA approach for invertebrates is to ensure that the Project delivers an overall increase in the extent and quality of suitable habitat and maintains connectivity across the wider landscape. This will be achieved by:

- Minimising permanent impacts (limited to AGIs and the Pump Facility) on habitats of ecological value.
- Reinstating temporarily affected habitats to a condition equal to or better than baseline.
- Enhancing ecological networks in line with the Project's BES.

On this basis, the requirement for targeted invertebrate surveys is expected to be minimal.

Screening for Survey and Defining the Survey Area

Desk Study

A desk study was undertaken to identify habitats within the draft Order Limits with potential to support invertebrates, and to collate existing records on species presence,

assemblage and distribution (see Section Hedgerows). The desk study results are summarised in the Ecological Appraisal (Appendix 7.1), with full outputs to be presented in the ES.

Survey and Assessment

There are several reasons for undertaking invertebrate surveys (Ref 7.2.8) particularly in the following areas:

- Where the presence of legally protected invertebrates has been identified.
- Within or adjacent to a statutory or non-statutory designated site where invertebrates are a notable feature.
- Within land that has been identified as particularly botanically diverse and / or sensitive, or a habitat type restricted in the UK / Region.
- Where there is a perceived and proportionate risk of invertebrate presence.

For watercourses, Environment Agency data (Ref 7.2.9) will be reviewed to identify locations where an assemblage of aquatic macro-invertebrate's indicative of good water quality¹ occurs within the same catchment as the Project.

Where invertebrate surveys are required, the survey boundary will incorporate an appropriate, habitat- and species-specific Zol. The scope and results of such surveys will be reported within an Invertebrate Technical Appendix to the ES.

Methodology

Many invertebrate taxa remain poorly understood in terms of their ecology and distribution. Although species records can add to distributional knowledge, they do not always provide a reliable measure of site value, particularly where baseline data are limited. A single record of a poorly known taxon does not necessarily confer ecological significance without appropriate contextual information. To address this, surveys will focus on habitat-based assessments using the recommended taxa for each habitat type (Ref 7.2.8). The aim is to evaluate the conservation value of habitats for invertebrates rather than to catalogue all individual species. Where survey is required, a two-stage approach will be applied:

- Stage 1 – habitat-based classification of invertebrate assemblages and / or suitability assessments for key species.
- Stage 2 – targeted species surveys to identify assemblage types, species richness, and the presence, distribution and abundance of notable species.

Where detailed surveys (terrestrial or aquatic) are considered necessary, appropriate methods (including survey timing and effort) will be selected based on habitat and target taxa, following guidance published by Drake *et al.* (Ref 7.2.8). Methods may include

¹ Evidenced by a Biological Monitoring Working Party score of 71 or more (**Error! Reference source not found.**8) occurring on a regular basis within the last 5-10 years.

sweep-netting, pitfall trapping, suction sampling, and hand searches for terrestrial habitats, and pond-netting for aquatic habitats.

Survey Programme and Effort

The survey programme and effort will be set out in the Invertebrate Technical Appendix, which will also provide justification for whether surveys are required. Where surveys are deemed necessary, they will be tailored to the target species or assemblages and the context of local habitats and scheduled within the appropriate survey season prior to site enabling and establishment works.

Fish

Introduction

The proposed survey methodology, detailed below, was produced following consultation with the Environment Agency (EA) via email on 25 July 2025, and further detail is provided in Table 7-8 of Chapter 7 (Ecology and Biodiversity) of the PEIR.

Screening for Survey and Defining the Survey Area

Desk Study

A desk study was undertaken to identify habitats within the draft Order Limits with potential to support fish, and to collate existing records on species presence, assemblage and distribution (see Section Hedgerow Survey). The desk study results are summarised in the Ecological Appraisal (Appendix 7.1), with full outputs to be presented in the ES.

Habitat Suitability Assessment and Site Evaluation

Habitat suitability within each watercourse will be appraised during a field survey. This will allow the exclusion of any watercourses that are discounted based on professional judgement (i.e. small channel size and / or isolated). The appraisal will include an assessment of watercourses upstream and downstream of the Order Limits and classify each as good, moderate and poor-quality based on the characteristics listed below:

- **Good:** The watercourse displays varying flow types including riffles, pools, runs and glides. Substrate diversity is complex and there is good cover to provide refuge for juvenile and adult fish (both in-stream and in marginal vegetation). Abundance of substrate suitable for spawning. No evidence of pollution or other habitat degradation.
- **Moderate:** The watercourse displays a number of flow types. Limited substrate diversity. Sparse cover for both juvenile and adult fish. Low in-stream and marginal vegetation diversity. Limited substrate present for spawning. No evidence of pollution; other habitat degradation (e.g. poaching) may be present. Potential barriers to migration present (where applicable to species concerned).

Poor: Watercourse with minimal variation. Minimal substrate diversity. No bankside / marginal cover. In-stream and marginal vegetation (where present) typically limited to a

single dominating species. No substrate available for spawning. The watercourse may receive diffuse, land-based pollution (run-off) and exhibit a high degree of other degradation such as poaching, regular cleaning / management and/or be dry for some of the year. Barriers to migration (e.g. debris / man-made dams) present (where applicable to species concerned).

The habitat assessment will also note which species each watercourse is potentially suitable for, and this will be combined with the results of the desk study, habitat requirements for each species and professional judgement to rank the likelihood of presence as follows:

- **Negligible:** While presence cannot be absolutely discounted, habitats are of poor quality for fish species and / or assemblages. There may be no desk study records and the connecting watercourses are considered unlikely to support wider populations. The Project may also be outside or peripheral to the known natural range of fish species.
- **Low:** Habitats are of poor to good quality for fish species and / or assemblages. There are few or no desk study records but presence cannot be discounted based on national distribution. Connecting watercourses are of poor / moderate quality. Barriers to migration or evidence of recent disturbance are present.
- **Medium:** Habitats are of moderate to good quality for fish species and / or assemblages. Desk study records reveal local occurrence, or the area is within the species' national distribution and with connectivity to moderate / good quality habitat. Factors limiting the likelihood of occurrence may be present (e.g. barriers to migration, and / or evidence of recent disturbance).
- **High:** Habitats are of moderate to good quality for fish species and / or assemblages. Desk study provides evidence of historic presence (greater than 2 years old, but see 'confirmed presence' below) or local occurrence. The area is within / peripheral to a national or regional stronghold and / or is well-connected to good quality habitat.
- **Confirmed Presence** – Presence confirmed by recent records (within the last 2 years) and / or long-standing presence data sets.

The habitat suitability assessment will be supported by photographs of each watercourse, taken during the field survey, and reported within a Fish Technical Appendix accompanying the ES.

Methodology

The requirement for fish surveys will be determined following a review of desk study and habitat suitability assessment data. Where surveys are required, they will be tailored to the target species or assemblages. The survey scope and methodology will be agreed with the EA on a location-by-location basis to assess the potential for significant impacts on fish.

Survey Programme and Effort

The timing for fish surveys will be agreed in consultation with local Environment Agency teams. The survey programme and effort will be set out in the Fish Technical Appendix.

Where surveys are deemed necessary, they will be scheduled within the appropriate survey season prior to site enabling and establishment works.

Where required, surveys are generally recommended to be undertaken from June to September, depending on target species (Ref 7.2.10). Where present, specific surveys may be required during spawning periods for salmonids (mid-November to the end of January) and Bullhead *Cottus gobio* (February to June).

Reptiles

Introduction

The Project extends through a predominantly agricultural landscape, comprising intensively managed arable land and grazed pasture of generally low structural diversity. As a result, large populations of reptiles are likely to be confined to distinct habitats identified during the Ecological Appraisal, which the Project will seek to avoid. Nonetheless, suitable habitat patches are present which may support grass snake *Natrix helvetica* and common lizard *Zootoca vivipara*, and potentially adder *Vipera berus* and slow worm *Anguis fragilis* in more localised areas.

Targeted reptile surveys commenced in spring 2025 and will be completed by September 2025. The complete results of the desk study exercise (site assessment and evaluation), together with the findings of the ongoing field surveys, will be reported within a Reptile Technical Appendix accompanying the ES. This will ensure that the ecological baseline is up to date at the time of submission and that robust and proportionate mitigation measures can be developed.

Screening for Survey and Defining the Survey Area

Desk Study

A desk study was undertaken to identify habitats within the draft Order Limits with potential to support reptiles, and to collate existing records on species presence, assemblage and distribution (see Section 3). The desk study results are summarised in the Ecological Appraisal (Appendix 7.1), with full outputs to be presented in the ES.

Habitat Suitability Assessment and Site Evaluation

Aerial imagery (Ref 7.2.11) was reviewed in conjunction with the desk study results to identify and map areas / sites known and / or potentially suitable to qualify as Key Reptile Sites (see Section 7.2.26) within or adjacent to the draft Order Limits. Habitat suitability within each area was appraised during the Extended UKHabs Survey (see Ecological Appraisal Appendix 7.1) for details based on the following characters (Ref 7.2.12, Ref 7.2.13 and Ref 7.2.14):

- Location in relation to species range
- Vegetation structure
- Insolation (sun exposure)
- Aspect
- Topography
- Surface geology
- Connectivity to nearby good quality habitat
- Prey suitability / abundance
- Refuge opportunity
- Hibernation habitat potential
- Disturbance; and
- Egg-laying site potential (grass snake only).

Each study area was then graded for reptile suitability as follows:

- **Poor** – habitat which is unfavourable for reptiles based on the majority of the habitat assessment characters listed above or is limited in size and highly isolated from other areas of suitable habitat.
- **Good** – habitat which is favourable or sub-optimal for many of the habitat assessment characters listed above; or is sub-optimal for some of the characters and has good connectivity with areas of more suitable habitat.
- **Exceptional** – habitat which is favourable for reptiles based on the majority of habitat assessment characters listed above.

Grading also noted which species the study area was considered potentially suitable for, and this was combined with the results of the desk study and professional judgement to rank the likelihood of presence:

- **Negligible** – while presence cannot be absolutely discounted, habitats are very limited in size or of poor quality for reptile species and / or assemblages. There may be no desk study records, and the surrounding habitats are considered unlikely to support wider populations. The Project may also be outside or peripheral to the known natural range of reptile species.
- **Low** – habitats are of poor to good quality for reptiles. There are few or no desk study records but presence cannot be discounted based on national distribution, the nature of surrounding habitats, habitat fragmentation or recent disturbance etc.
- **Medium** – habitats are of good quality and desk study records reveal local occurrence, or the area is within the national distribution and with suitable surrounding habitat. Factors limiting the likelihood of occurrence may include small habitat area, habitat isolation, and / or disturbance.
- **High** – habitats are of exceptional quality for reptiles. Desk study provides evidence of historic presence (greater than 2 years old but see ‘confirmed presence’ below) or local

occurrence. The area is within / peripheral to a national or regional stronghold and / or has good quality surrounding habitat and good connectivity.

- **Confirmed Presence** – presence confirmed from survey undertaken in support of this Project or by recent records (within the last 2 years) and / or long-standing presence data sets.

Accordingly, an isolated area of exceptional quality habitat could be considered to have a negligible likelihood of reptile presence, and an area of poor-quality habitat could have a high likelihood of reptile presence, if situated adjacent to better quality habitat with confirmed presence.

Key Reptile Sites

Froglife (Ref 7.2.12) defines criteria for ‘Key Reptile Sites’, whereby survey results can be used to obtain an objective evaluation of the importance of the reptile interest within a given area. To qualify as a Key Reptile Site, the site must meet one of the criteria illustrated within Insert A7-2-1.

- (1) supports three or more reptile species
- (2) supports two snake species
- (3) supports an exceptional population of one species (see table)
- (4) supports an assemblage of species scoring at least 4 (see table)
- (5) does not satisfy 1-5 but which is of particular regional importance due to local rarity (e.g. in the East Midlands of England, adders are very rare so even "low" populations should be designated as Key Sites)

	Low population <i>Score 1</i>	Good population <i>Score 2</i>	Exceptional population <i>Score 3</i>
Adder	<5	5 - 10	>10
Grass snake	<5	5 - 10	>10
Common lizard	<5	5 - 20	>20
Slow-worm	<5	5 - 20	>20

Figures in the table refer to maximum number of adults seen by observation and/or under tins (placed at a density of up to 10 per hectare), by one person in one day.

Insert A7-2-1 – Criteria for Key Reptile Sites, taken from Froglife (Ref 7.2.12)

Habitat suitability assessments and site evaluations were first used to identify areas / sites with the potential to qualify as Key Reptile Sites. Those areas considered likely to meet the criteria were then subject to presence / likely absence surveys, except where:

- The Project design already guarantees that the area / site can be fully safeguarded during construction activities; or
- The area / site is subject to access constraints (e.g. health and safety issues such as busy roadside verges).

Study Areas

Six study areas were identified on the basis of desk study records and habitat suitability assessments. For the purposes of this report, the term study area refers to the wider parcel of land assessed for its potential to support reptiles. Within each study area, a survey area was defined where field surveys (deployment of refugia and checks) are being undertaken. In some cases, the survey area represents only a portion of the wider study area due to factors such as access, health and safety constraints, or the location of habitats most suitable for reptiles.

Barlow Hagg

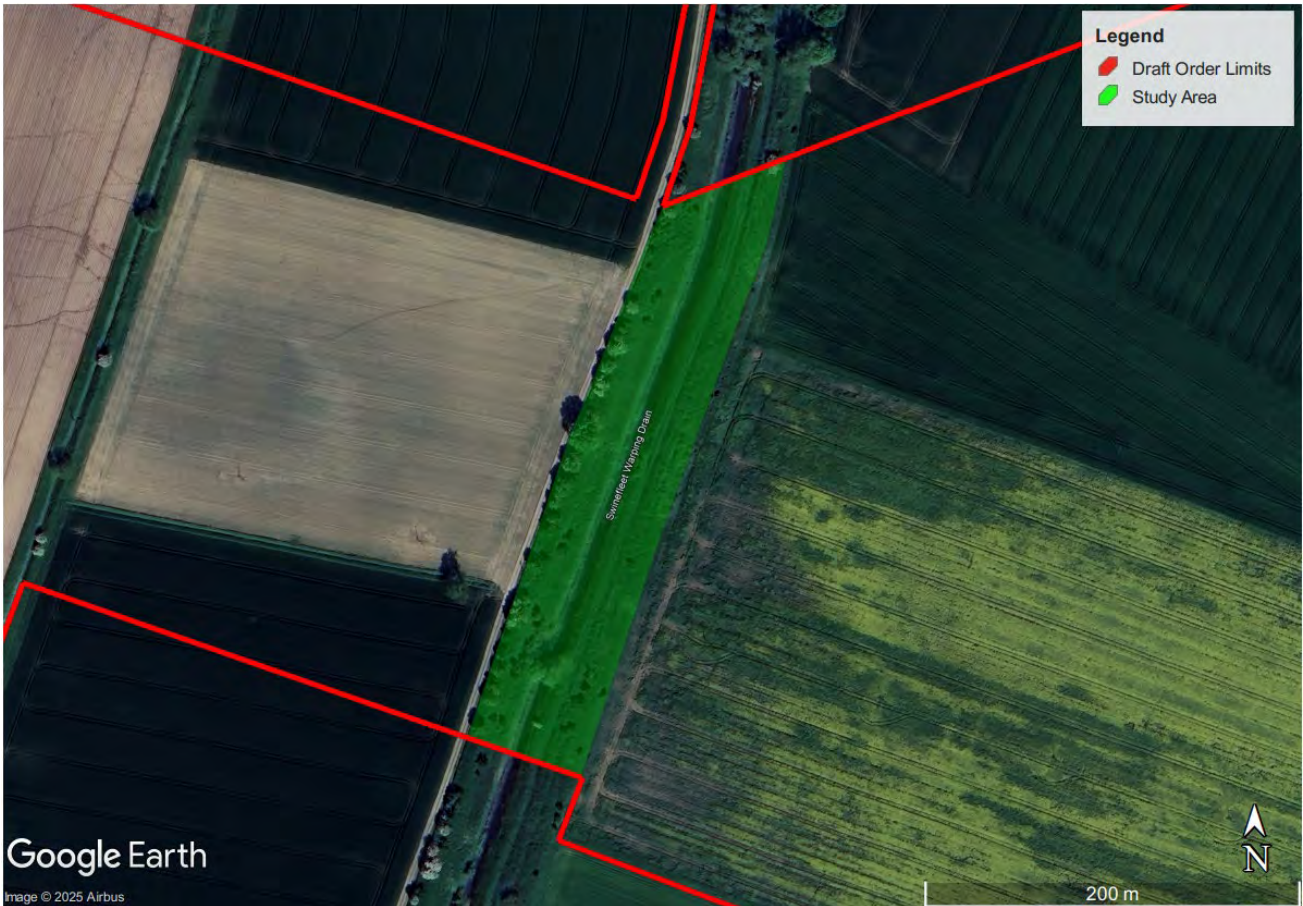
Barlow Hagg is located to the north of Drax Power Station (central National Grid Reference (NGR): SE 66365 28147) and comprises a mosaic of ditches, rough grassland, scrub, and woodland. The study area forms part of a wider expanse of semi-natural vegetation, with multiple records of grass snake from 2011 recorded to the north within the same habitat network. The approximate extent of the Barlow Hagg study area is illustrated on Insert A7-2-2.



Insert A7-2-2 – Barlow Hagg Study Area

Swinefleet Warping Drain

Swinefleet Warping Drain is an artificial waterway in East Riding of Yorkshire, constructed to transport silt from the River Ouse to Thorne, Crowle, and Goole Moors. The study area (see Insert A7-2-3) is located at Goole Fields (central NGR: SE 76532 19727) and comprises rank grassland and scrub forming the riparian corridor in this location. Although reptile records (adder, grass snake and common lizard) exist along the wider Drain, all are more than 2 km from the study area.



Insert A7-2-3 – Swinefleet Warping Drain study area

Keadby Warping Drain

Keadby Warping Drain is situated to the north of Keadby Power Station (central NGR: SE 81503 12674) and forms part of the engineered drainage network connecting inland channels to the River Trent. The study area (see Insert A7-2-4) comprises riparian grassland and marginal habitats along the Drain. Historical records of grass snake are connected with this watercourse, although all are located more than 400 m from the study area.



Insert A7-2-415 – Keadby Warping Drain study area

Keadby Ash Tip

Keadby Ash Tip is situated to the west of Keadby Power Station (central NGR: SE 81629 12068) and forms part of a large area of restored land created through the deposition of pulverised fuel ash. The study area (see Insert A7-2-5) comprises a section of this former ash tip that supports a mosaic of habitats (including Open Mosaic on Previously Developed Land) and contains historical records of grass snake dating from 2016.



Insert A7-2-5 – Keadby Ash Tip Study Area

Semi-natural area off East Halton Road

This study area (see Insert 7-2-6) comprises part of a larger block of semi-natural vegetation situated off East Halton Road in North Killingholme (central NGR: TA 13986 17850). Historical aerial imagery indicates that management of the land ceased around 2009, since which time it has developed into a mosaic of grassland and scrub. There are few local reptile records, although records of grass snake and common lizard occur within 2 km of the study area.



Insert A7-2-6 – Semi-natural area off East Halton Road Study Area

Semi-natural area off Ulceby Railway

This study area (see Insert A7-2-7) comprises a former agricultural field and part of the railway sidings associated with Ulceby Railway in North Killingholme (central NGR: TA 15092 16867). Historical aerial imagery suggests that grazing on the field ceased around 2015, since which time it has developed into a mosaic of grassland and scrub that complements the longer-established railway sidings to the north. No reptile records were identified within 2 km of the study area.



Insert A7-2-7 – Semi-natural area off Ulceby Railway Study Area

Assumptions and Limitations

While extensive effort has been made to identify all areas with potential to qualify as Key Reptile Sites, no assessment conducted without full survey data can provide a complete characterisation of the natural environment. Desk study records are not exhaustive and are biased towards areas with public access or where surveys have previously been undertaken to support development projects. As a result, some areas within or adjacent to the draft Order Limits that support reptiles may not have been identified through data searches. To address this limitation, the desk study analysis placed strong emphasis on habitat suitability, and the ES will apply a precautionary, “reasonable worst-case” approach for the purposes of impact assessment.

It is recognised that habitat suitability assessments can only indicate the likelihood of reptile presence. The assessments undertaken to date have been based on habitat quality, known species distributions in the local area, and direct evidence recorded during surveys. They do not represent a definitive account of reptile populations and are only valid at the time of assessment. A preliminary desk study has been completed, and where appropriate, additional surveys are ongoing. Results from these surveys, together with an

updated desk study, will be reported within the ES. This will ensure that the ecological baseline is up to date and that appropriate mitigation measures can be identified.

A lack of desk study or survey records does not necessarily indicate absence.

Accordingly, the ES will assess both confirmed records and the potential of habitats within the draft Order Limits to support reptiles, ensuring that the risk of impacts to these species is appropriately considered.

Methodology

Reptile presence / likely absence surveys have commenced across the six study areas in accordance with the below methodology, which draws heavily upon published guidance from the Herpetofauna Groups of Britain and Ireland (Ref 7.2.15), Froglife (Ref 7.2.12 and Ref 7.2.13) and Natural England (Ref 7.2.16). Within each study area, artificial refugia (corrugated onduline, minimum 0.5 m x 0.75 m) were deployed across suitable habitats. Refugia were placed at a density of at least 100 / ha in non-linear habitats and at a minimum frequency of one every 10 m in narrow linear habitats (e.g. hedgerows, ditches, watercourses). The refugia were laid on 9 April 2025 and were left to settle for over 14 days prior to the first survey visit.

Seven visits will be undertaken during the 2025 survey season: April (visit 1), May (visit 2), June (visits 3 and 4) and September (visits 5–7). Surveys were scheduled to ensure a minimum of two days between visits, and at least 30 days between the first and last visit. Each visit was undertaken in suitable weather conditions (air temperature 10–20 °C, still to moderate winds, no or very light rain). Visual searches were carried out using binoculars where appropriate, together with checks of the ground between refugia and careful inspection beneath each refugia. For every observation, the surveyor records refugia number / location, species, number of individuals, life stage (adult, subadult, juvenile), and, where possible, sex.

All surveys are scheduled within the recognised optimum survey months (April–June and September) and are being undertaken under suitable weather conditions. As such, no additional visits beyond the planned programme are anticipated, unless considered necessary by the surveyor to ensure a robust assessment.

Population size class assessments within each study area will be determined from the peak adult count for each species across all visits, standardised by survey area (hectares). Population densities will then be compared against criteria published by Herpetofauna Groups of Britain and Ireland (Ref 7.2.15) and Froglife (Ref 7.2.12) to determine whether any survey area qualifies as a “Key Reptile Site”.

Ornithological Surveys

Introduction

The Project will cross beneath the Humber Estuary, which is designated as a Special Protection Area (SPA), Special Area of Conservation (SAC) and Ramsar site. The Greater Wash SPA also lies along the east of the draft Order Limits at the Holderness coast. In addition, Thorne & Hatfield Moors SPA is located approximately 800 m south of the draft Order Limits, and the Lower Derwent Valley SPA and Ramsar site is approximately 3.8 km to the north.

Potential impacts on wintering, passage and breeding birds will be assessed through the HRA (in relation to European designated sites) and through the ES (for all other receptors), informed by targeted bird surveys that have been undertaken in 2021/22 and 2024/25. The survey methodology was agreed in consultation with Natural England and has been applied to establish a robust baseline of how bird communities utilise the draft Order Limits. Data analysis is ongoing and the full results will be reported in the ES.

Screening for Survey and Defining the Survey Area

Desk Study

A desk study was undertaken to identify habitats within the draft Order Limits with potential to support birds, and to collate existing records on species presence, assemblage and distribution (see Section 3). The desk study results are summarised in the Ecological Appraisal (Appendix 7.1), with full outputs to be presented in the ES.

Wintering and Passage Bird Surveys

The wintering and passage bird surveys aimed to establish:

- The baseline of passage and wintering bird communities utilising the study area;
- A list of bird species encountered and an estimate of the numbers of each bird species utilising the study and surrounding areas;
- A comparison of results with desktop data to identify any significant species status changes within the context of the Project.

During the preparation of the wintering and passage bird survey methodology, consultation with Natural England was undertaken through the Discretionary Advice Service (DAS) and survey guidance was provided via email on 28 June 2024. A follow-up meeting was held on 9 August 2024 where the proposed Project methodology was presented and agreed upon; this survey method is outlined below.

As suggested by Natural England, Annex C: Passage and wintering bird surveys for functionally linked land associated with the Humber Estuary and / or Lower Derwent Valley designated sites (Ref 7.2.17) was reviewed and incorporated into the assessment.

This document details the requirements for surveying areas of land that are potentially functionally linked to the Humber Estuary and Lower Derwent Valley SPA and Ramsar sites.

The methodology aims to screen and discount areas from survey where it is likely that the habitats support only low numbers of common birds whose conservation status would not be significantly affected by the Project. As proposed by Natural England, a study area was established which was defined as the area that meets the following criteria:

- Within the draft Order Limits.
- Within a 4 km Impact Risk Zone (IRZ) of the Humber estuary SPA / Ramsar site.
- Suitable habitat for wintering SPA / Ramsar site birds (i.e. open agricultural land).

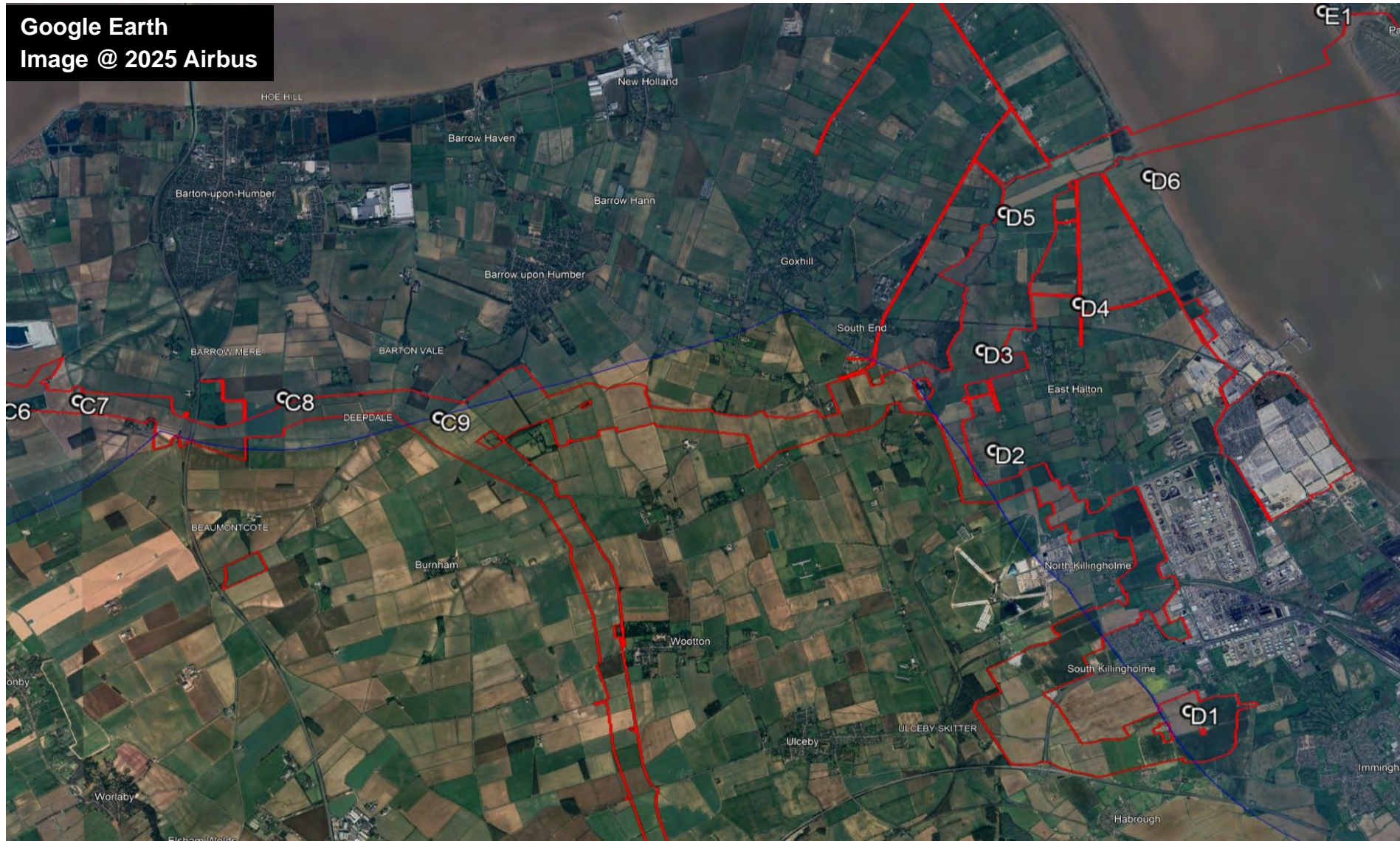
The following Inserts show all VP locations (white icons) and the 4 km IRZ of the SPA / Ramsar site (blue shading) in relation to the draft Order Limits (red line).



Insert A7-2-8 – Vantage Point Survey Locations from Drax to Garthorpe



Insert A7-2-9 – Vantage Point Survey Locations from Garthorpe to South Ferriby



Insert A7-2-10 Vantage Point survey locations from South Ferriby to Goxhill and South Killingholme



Insert A7-2-11 – Vantage Point Survey Locations from Goxhill to Keyingham



Insert A7-2-12 – Vantage Point Survey Locations from Keyingham to Easington

Breeding Bird Surveys

It is anticipated that the range of habitats within the land required for the construction of the Project will provide suitable habitat to support nesting birds, particularly those associated with farmland habitat.

The general approach to EclA for breeding birds is to ensure that the Project results in an increase in area of better-quality habitat (patch quality) than that affected by the Project and ensure that these habitats are well connected to the wider landscape. This will be achieved by avoiding permanent impacts (from AGIs) to habitats of perceived value, reinstating habitats affected in areas of temporary habitat loss to equal or better condition than existing and improving the quality and availability of ecological networks across the Project.

Breeding bird surveys were completed in 2025, focusing on suitable habitat within the draft Order Limits. The survey areas were defined as those that met either of the following criteria:

- Sites of known importance for breeding birds - Desk study information (see Section 3) was used to identify sites of known or perceived (based on association with 'known' sites) importance for breeding birds where there is the potential for adverse effects as a result of the Project. Such sites include statutory and non-statutory designated sites noted for the presence of breeding birds.
- Other areas identified as being of potential importance for breeding birds - Sites of potential importance for breeding birds (i.e. areas which are considered to have potential to support notable species; or which may support notable assemblages of common birds) where there is the potential for adverse effects as a result of the Project, based on a review of:
 - Aerial photography and Ordnance Survey mapping; and
 - Results of wintering and passage bird surveys conducted during 2021/2022 and 2024/2025.

The insert's below show all breeding bird survey transects (green line) in relation to the draft Order Limits (red line).



Insert A7-2-13 – Breeding Bird Survey Transects

Methodology

Wintering and Passage Bird Surveys

Vantage Point (VP) survey methodology has been adapted from Scottish Natural Heritage (SNH) guidance (Ref 7.2.18). This guidance pertains to the assessment of the effects of wind farms on birds; however, for this Project, it is being used to support the previous survey results and focus on bird movements between the Humber Estuary and River Trent crossing locations, the Project boundary and surrounding terrestrial habitats. It is acknowledged that SNH guidance (developed to collate data on bird flight behaviour for windfarm collision risk) outlines 36 hours of monitoring per season, with more regular surveying through the passage period when bird turnover is high. This level of survey effort was not considered proportionate for this Project which has a much lower collision risk. Following Natural England Guidance, wintering and passage bird VP surveys have been completed at the following frequency:

- Autumn Passage – two surveys per month between August and October 2024 inclusive.
- Winter - two surveys per month between October 2024 and March 2025 inclusive.
- Spring Passage – two surveys per month between March and Mid-May 2025 inclusive.

The survey included a total of 41 VP positions (see section 8.2), which were surveyed for 3 hours per visit. The VP locations were selected from an assessment of aerial imagery and further assessed for suitability during the surveys to ensure full coverage. To ensure surveys covered a mixture of tide states, one of the two monthly surveys at each VP extended from 1.5 hours before high tide to 1.5 hours after high tide.

During the VP surveys, fields were scanned using binoculars and scopes (where necessary). Surveyors recorded species, sex, number, behaviour, location and flight direction of the target species birds. All bird data was electronically mapped using the Fieldmaps app.

Breeding Bird Surveys

Breeding bird surveys followed the guidelines published by the Bird Survey & Assessment Steering Group (Ref 7.2.19) and included six survey visits (spaced at least one week apart) during the breeding season. The six visits were undertaken between late March and June 2025 (visits were undertaken taken in late March, early and late April, mid-May, and early and late June).

Nine breeding bird transects were surveyed within the draft Order Limits - see section 8.2 for breeding bird survey locations.

Surveys were undertaken during suitable weather with no more than a strong breeze (6 on the Beaufort Scale). The guidance permits surveys during dawn mist but surveys during dense fog were avoided. Surveys commenced no later than half an hour after sunrise and ended no later than mid-morning (11am).

During the transects, fields were scanned using binoculars and scopes (where necessary). Surveyors recorded species, sex, number, behaviour, location and flight direction. All bird data was electronically mapped using the Fieldmaps app.

Breeding Bird Status Classification

Breeding bird activity was categorised using BTO criteria (Ref 7.2.20) as detailed in Table A7-2-1 below.

Table A7-2-1 – Breeding Bird Activity Category Criteria

Category	Description
Confirmed breeder	Observations that confirm a species is breeding on or near to the site: occupied nest(s), nest containing eggs or young, recently fledged young, used nest or eggshells (recent), distraction-display / injury feigning, adults entering or leaving nest-site in circumstances indicating occupied nest and / or adult carrying food or faecal sac.
Probable breeder	Observations of behaviour suggesting that a species is probably part of a breeding pair observed in suitable nesting habitat in breeding season, permanent territory(s) presumed through registration of consistent territorial behaviour (for example song), courtship / display, visiting probable nest sites, agitated behaviour from adults and / or nest building.
Possible breeder	Species observed or heard singing in the breeding season within suitable breeding habitat.
Non-breeding	Species only recorded flying over the area, displaying wintering / passage behaviour, suspected to be still on migration or a summer non-breeder.

Assumptions and Limitations

Ornithological data for sensitive species of importance (e.g. Schedule 1 listed species, Annex 1 species) are typically provided in low-resolution (1 to 10km square Grid References) and with minimal detail by Local Record Centres to protect potential breeding / roosting sites from (for example) disturbance / damage, limiting their value. This is not considered a limitation since extensive desk study data from a range of additional sources alongside field survey data provided sufficient detail for the sensitive species of importance. Therefore, this limitation is not considered to have a significant impact.

Access permission was not granted for vantage point surveys at locations A3 and A4 until December 2024. The lack of topographical variation in the landscape meant that surveyors were able to survey some areas within the domain of A3 and A4 while

surveying adjacent vantage points (A2 and A5) until access was granted. However, survey information between August and November 2024 is limited in these areas.

Badger

Introduction

Presence of badgers *Meles meles* within the draft Order Limits has been confirmed through an initial walkover survey undertaken in 2025 and from incidental records during other ecological surveys. Given the suitability of habitats and the largely rural setting, badgers are considered widespread across the Project area. Potential impacts relate primarily to the loss of setts within land required for construction and the risk of disturbance to setts located close to the construction footprint.

As the works are largely temporary in nature, severance or fragmentation of territories is not considered a significant risk. The complete results of badger surveys, including forthcoming sett classification surveys to be completed in winter 2025/26, will be presented within a confidential technical appendix to the ES. This will ensure the ecological baseline is up to date and that robust, proportionate mitigation measures can be developed. Release of the confidential report will be restricted to the Planning Inspectorate and suitably qualified professionals on request, in line with the Protection of Badgers Act 1992 (Ref 7.2.21).

Screening for Survey and Defining the Survey Area

Desk Study

A desk study was undertaken to identify habitats within the draft Order Limits with potential to support badger, and to collate existing records on species presence and distribution (see Section Hedgerows). The desk study results are summarised in the Ecological Appraisal (Appendix 7.1), with full outputs to be presented in the ES.

Field Survey

The entire draft Order Limits, plus a 30 m buffer where accessible, was screened in for badger survey. This precautionary approach recognises the widespread suitability of habitats across the Project area and the potential for setts to occur both within and adjacent to the construction footprint. An initial walkover survey was completed in 2025. A detailed sett classification survey will be undertaken during winter 2025/26, when vegetation is less dense and sett entrances can be more readily identified.

Methodology

The initial walkover survey was undertaken in 2025, following best practice guidance (Ref 7.2.22) and standard badger survey methods. Surveyors carried out a systematic search of accessible areas within the draft Order Limits and recorded field signs including:

- Setts;
- Badger hair;
- Mammal / badger pathways;
- Foraging signs;
- Latrines;
- Footprints;
- Bedding material; and
- Evidence of rabbit *Oryctolagus cuniculus* and fox *Vulpes vulpes*.

All observations were digitally mapped to provide accurate referencing and context for further surveys.

Detailed sett classification surveys will be undertaken in winter 2025/26, when dense vegetation is less likely to obscure sett entrances. These surveys will categorise setts as 'main', 'annex', 'subsidiary' or 'outlier', and as 'active', 'partially active' or 'disused', in line with Ref 7.2.22. For each sett, the number and orientation of entrances, evidence of recent activity, and associated field signs will be recorded.

Survey Programme and Effort

The initial walkover survey was completed in 2025, covering the draft Order Limits and a 30 m buffer where accessible. This confirmed the presence of badgers and provided baseline information on potential areas of activity.

Detailed sett classification surveys will be undertaken in winter 2025/26, when vegetation is less dense and sett entrances can be more readily identified. These surveys will be timed to coincide with periods of good visibility on the ground and minimal vegetation cover, in line with best practice guidance (Ref 7.2.22).

All badger survey results, including the completed walkover and forthcoming sett classification surveys, will be presented within a confidential Badger Technical Appendix to the ES. Where required, the results will also be used to inform draft derogation licences to be submitted to Natural England.

Bats (Roosts)

Introduction

Potential impacts on roosting bats from construction activities are expected to be minor, as the draft Order Limits have been designed to avoid woodland where possible and the removal of standard trees and structures will be minimised. Species diversity within and close to the draft Order Limits is relatively low and restricted to common and widespread species such as common pipistrelle *Pipistrellus pipistrellus*, soprano pipistrelle *P. pygmaeus*, Nathusius' pipistrelle *P. nathusii*, brown long-eared bat *Plecotus auritus*, and species within the *Myotis* and *Nyctalus* groups.

A Preliminary Roost Assessment (PRA) and Ground Level Tree Assessment (GLTA) were completed in 2025, identifying trees and structures with potential roost features (PRFs). Tree climbing / aerial inspections and emergence surveys are scheduled for 2026, in line with Bat Conservation Trust guidance (Ref 7.2.23).

The complete results of all bat roost surveys will be presented in a confidential Bat Technical Appendix to the ES, ensuring that the ecological baseline is up to date and that appropriate mitigation measures can be developed.

Screening for Survey and Defining the Survey Area

Desk Study

A desk study was undertaken to identify habitats within the draft Order Limits with potential to support bats, and to collate existing records on species presence, assemblage and distribution (see Section 3). The desk study results are summarised in the Ecological Appraisal (Appendix 7.1), with full outputs to be presented in the ES. Records indicate that bat species diversity in the local area is relatively low and dominated by common and widespread species, although individual trees and structures may provide roosting opportunities.

Survey Area

A survey was undertaken during 2025 to identify trees, woodland blocks and structures with potential roost features (PRFs) within the draft Order Limits. Those with PRFs that cannot be avoided by the Project have been carried forward for further survey effort (aerial inspections and / or emergence / re-entry surveys) to determine presence / absence and inform mitigation requirements.

Methodology

Preliminary Roost Assessment/Ground Level Tree Assessment

Preliminary Roost Assessments (PRAs) and Ground Level Tree Assessments (GLTAs) were completed in 2025 across trees, woodland blocks and structures with potential roost features (PRFs) within the draft Order Limits. Where PRFs were present, these features were visually assessed to determine suitability for roosting bats, following Bat Conservation Trust good practice guidelines (Ref 7.2.23). Trees / structures were then classified as outlined in Table A7-2-2 and Table A7-2-3.

Table A7-2-2 – Suitability Description of Roosting Habitat within Trees

Suitability	Description of Roosting Habitat
None	Trees with no PRFs.
FAR	Further assessment required to establish if PRFs are present in the tree (e.g. some features cannot be seen from the ground and require closer inspection, or restricted access limits a thorough assessment).
PRF-I	PRF is only suitable for individual bats or very small numbers of bats either due to size or lack of suitable surrounding habitats.
PRF-M	PRF is suitable for multiple bats and may therefore be used by a maternity colony.

Trees assessed as PRF-M will be subject to further inspection (see “Tree Climbing / Aerial Inspection” below). Trees classified as FAR will be subject to further survey effort to ascertain the presence or absence of PRFs. Trees classified as PRF-I will be soft-felled / pruned under a precautionary working method statement (PWMS) during site enabling works with no further surveys required.

Table A7-2-3 – Suitability Description of Roosting Habitat within Structures

Suitability	Description of Roosting Habitat
None	No habitat features likely to be used by any roosting bats at any time of the year (i.e. a complete absence of crevices / suitable shelter at all ground / underground levels).
Negligible	No obvious habitat features likely to be used by roosting bats; however, a small element of uncertainty remains as bats can use small and apparently unsuitable features on occasion.
Low	A structure with one or more potential roost sites that could be used by individual bats opportunistically. However, these potential roost sites do not provide enough space shelter, protection, appropriate conditions and / or suitable surrounding habitat to be used on a regular basis or by larger numbers of bats (i.e., unlikely to be used for maternity or hibernation).
Moderate	A structure with one or more potential roosting sites that could be used by bats due to their size, shelter, protection, conditions and surrounding habitat but are unlikely to support a roost of high conservation status such as maternity or hibernation roost.
High	A structure with one or more potential roosting sites that are obviously suitable for use by larger numbers of bats on a more regular basis and

Suitability	Description of Roosting Habitat
	potentially for longer periods of time due to their size, shelter, protection conditions and surrounding habitat.

Structures assessed as low / moderate / high suitability will be subject to further survey (see “Emergence Surveys” below). Structures classified as negligible / no suitability require no further survey effort.

All trees / structures with potential to support roosting bats were recorded on GPS to provide accurate referencing and trees were tagged using a numbered tree tag to facilitate future identification on the ground.

Tree Climbing/Aerial Inspections

Trees assessed as PRF-M will be inspected using an endoscope and high-powered torch across 3 visits between May and September, with at least two visits between May and August. Where a ladder cannot be used to inspect PRFs at height, trees will be climbed by a licenced bat ecologist with tree climbing qualifications.

Trees affected by the Project that are down-graded to PRF-I or not suitable following inspection will be soft-felled / pruned under a precautionary working method statement (PWMS) during site enabling works with no further surveys required.

Where trees cannot be inspected at height due to safety or other constraints, emergence surveys (see below) will be undertaken.

Emergence Surveys

Emergence survey requirements:

- Trees with PRF-M that cannot be inspected aerially, and structures of high suitability: three dusk emergence surveys, at least 14 days apart, with two surveys between May and August.
- Moderate suitability structures: two surveys, at least 14 days apart, with one survey between May and August.
- Low suitability structures: one survey between May and August.

All surveys will be dusk emergence surveys, carried out from 15 minutes before sunset until two hours after sunset, in suitable weather conditions. Echolocation detectors and Night Vision Aids (NVAs) will be used to record and support identification, with all data analysed using appropriate software to confirm species and inform mitigation.

Survey Programme and Effort

PRA and GLTA were completed March – September 2025 across the draft Order Limits.

Tree climbing / aerial inspections and emergence surveys are scheduled for the bat active period of May–September 2026. Where trees or structures are identified as offering potential hibernation roosts, surveys will also be undertaken during the hibernation period.

All survey results, including those already completed and those scheduled, will be reported in a Bat Technical Appendix to the ES. The outcomes will be used to inform licensing requirements and proportionate mitigation.

Bats (Activity)

Introduction

Species diversity within and close to the draft Order Limits is low and largely restricted to common and widespread species (see Section 10.1). The Project extends through a predominantly agricultural landscape, comprising intensively managed arable land and grazed pasture of generally low structural diversity, all of which are suboptimal for bats. Linear habitat features that can provide commuting routes, such as tree lines, hedgerows and vegetated ditches, are infrequent within the draft Order Limits.

Bat activity surveys are ongoing, with results to be combined with desk study and habitat assessment findings. The complete results will be reported in a Bat Technical Appendix to the ES, ensuring that the ecological baseline is up to date at submission and that robust, proportionate mitigation measures can be developed.

Screening for Survey and Defining the Survey Area

Desk Study

A desk study was undertaken to identify habitats within the draft Order Limits with potential to support bats, and to collate existing records on species presence, assemblage and distribution (see Section 3). The desk study results are summarised in the Ecological Appraisal (Appendix 7.1), with full outputs to be presented in the ES.

Survey

The entire draft Order Limits was screened for habitats and features with potential to support commuting and foraging bats. This process drew on the desk study results and habitat suitability assessments to identify areas of higher potential value. Six survey areas were identified as having high suitability for commuting and / or foraging bats. Within these areas, field surveys are being undertaken to record bat activity and assess the presence, distribution and relative use of available habitats. These surveys are ongoing, and the results will be reported within the Bat Technical Appendix to the ES.

The approach to identifying and targeting survey locations was developed in accordance with the Bat Conservation Trust (BCT) good practice guidelines (Ref 7.2.23) which promote a proportionate, evidence-based and risk-led approach, focusing survey effort on features most likely to support roosting, commuting or foraging bats. The scope of surveys

was discussed and agreed with Natural England through the Discretionary Advice Service (see Chapter 7: Ecology and Biodiversity).

The strategy behind the choice of these six distinct locations was as follows:

- Habitats within and adjacent to the draft Order Limits were assessed for their suitability to support roosting, commuting and foraging bats using aerial imagery and results from the desk study;
- Linear habitat features across the draft Order Limits, and those linking to habitats outside the boundary, were assessed for their potential to support commuting bats; and
- A red–amber–green (RAG) rating system was applied to each potential commuting feature to indicate its likely importance for bats and whether it could be affected by the Project.

The detailed justification for survey design, including the assessment process, supporting evidence and RAG maps used to identify areas of high suitability, will be presented in full within the Bat Technical Appendix to the ES.

Study Areas

The six identified locations with High suitability to support commuting and / or foraging bats are shown below.

Disused Hull, Barnsley and West Riding Junction Railway

The disused Hull, Barnsley and West Riding Junction Railway lies to the east of Drax Power Station (central NGR: SE 6799 2781). It comprises a fragmented strip of woodland and scrub that provides connectivity between suitable bat foraging features in the wider landscape. To the south, these include Woodcock Wood and a large pond off Wren Hall Lane, while to the north, the corridor links to the River Ouse and a series of woodland blocks near Barmby on the Marsh.



Insert A7-2-14 – Static 1 – Disused Hull, Barnsley and West Riding Junction Railway

A645 Soft Estate

The woodland and scrub soft estate along the A645 (central NGR: SE 6804 2516) cuts through the draft Order Limits, forming an extensive linear corridor that provides connectivity between bat foraging habitats in the wider landscape. It intersects with another corridor associated with Seg Lane, which runs perpendicular to it, and to the west, it links with the large pond at Brockholes.



Insert A7-2-15 – Static 2 – A645 Soft Estate

Swinefleet Warping Drain

Swinefleet Warping Drain (central NGR: SE 76532 19727) is an artificial waterway that connects the River Ouse to Thorne, Crowle, and Goole Moors. The section that extends through the draft Order Limits comprises rank grassland and scrub forming the riparian corridor in this location.



Insert A7-2-16 – Static 3 – Swinefleet Warping Drain

Disused Barton and Immingham Light Railway

The disused Barton and Immingham Light Railway lies to the northwest of East Halton (central NGR: TA 1220 9859). It forms an extensive linear corridor across the area, linking Skitter Beck and a series of plantation woodlands to the west with North Killingholme Haven Pits and the Humber Estuary to the east.

Google Earth
Image @ 2025 Airbus



Insert A7-2-17 – Static 4 – East Halton

West Lands Plantation

West Lands Plantation is a linear block of mature plantation woodland extending through the draft Order Limits to the southeast of Ottringham (central NGR: TA 2787 2306). Even Dike runs beneath the woodland, and the survey location lies at its junction with Halfmoon Plantation, which in turn connects eastwards towards Winstead Drain.



Insert A7-2-18 – Static 5 – West Lands Plantation

Keadby Ash Tip

Keadby Ash Tip is situated to the west of Keadby Power Station (central NGR: SE 81629 12068) and forms part of a large area of restored land created through the deposition of pulverised fuel ash. The study area (see Insert A7-2-19) comprises a section of this former ash tip that supports a mosaic of habitats (including Open Mosaic on Previously Developed Land).



Insert A7-2-19 – Static 6 – Keadby Ash Tip

Methodology

Six locations were identified as highly suitable for commuting / foraging bats. Given the scale of the Project, Natural England agreed to a landscape-scale approach, applying survey methods proportionate to Low suitability sites (as per Ref 7.2.23) at these locations.

Song Meter SM4 bat detectors were deployed to collect five nights of data in each season (spring: April–May; summer: June–August; autumn: September–October). To ensure data were collected in appropriate weather conditions, forecasts were checked prior to deployment, and detectors were left in place for a minimum of two weeks at a time.

Survey Programme and Effort

Bat activity surveys are being conducted 3 times in the bat 'active period' of May–September, covering the periods of spring, summer and autumn. Survey results will be reported in a Bat Technical Appendix to the ES.

Otter

Introduction

Adverse effects on otter *Lutra lutra* from construction activities could occur near to watercourses where underground (holts) or above-ground (couches) resting sites may be located, or along watercourses that otter use as corridors.

The draft Order Limits extends across multiple watercourses of various size and desk study information suggests that otter are widespread throughout the local area (occurring on several watercourses bisected by the draft Order Limits). For the purposes of EclA, otter are assumed to be present on all suitable watercourses.

Construction activities will seek to avoid impacts to watercourses and time works to avoid disturbance to resting sites whilst occupied. Nevertheless, temporary impacts to habitats utilised by otter are anticipated during construction.

Screening for Survey and Defining the Survey Area

Given the presence of suitable habitat and the likelihood of otter using watercourses across the Project area, all watercourses within the draft Order Limits, together with a 200 m buffer where accessible, were screened in for survey. This precautionary approach ensures that both aquatic corridors and adjacent terrestrial habitats are assessed for potential commuting routes and resting places.

Methodology

All watercourses within the draft Order Limits, and a 200 m buffer where access was possible, were surveyed between April and September 2025. Surveys followed best practice guidance (Ref 7.2.24, Ref 7.2.25 and Ref 7.2.26) and CIEEM competencies for undertaking otter surveys (Ref 7.2.27).

Surveys focused on identifying holts and resting places that could be affected during construction. Each watercourse was walked and assessed for:

- Proximity to the land required for construction of the Project.
- Presence of significant barriers to dispersal and movement through the territory.
- Habitats present and suitability for use by otter (including terrestrial habitats).
- Adjoining land use.
- Level of disturbance.
- Features of watercourse / water body (estimated depth, level of flow, width of channel).
- Connectivity with other areas of suitable or sub-optimal habitat.
- Pollution.

Aquatic / Riparian Habitats

Watercourse and waterbody banks with potential to support otter and potentially affected by the Project were surveyed for evidence within a 200 m buffer of construction areas

(where access allowed). Riparian habitats such as reedbeds were also included. Signs searched for included footprints, spraints, anal jelly, feeding remains, slides, resting sites and breeding holts. Evidence of water vole *Arvicola amphibius* and American mink *Neovison vison* was also recorded. Results will be reported in the ES.

Terrestrial Habitats

Woodland, scrub and derelict man-made features within 200 m of construction areas (or 100 m of a watercourse or waterbody with potential to support otter) were surveyed for potential breeding (natal) holts. A holt was classified as active where any of the following signs were present:

- Spraints or footprint within tunnel or immediate ground outside.
- Scratch marks and / or body rubbing against tunnel wall.
- Otter hair within tunnel or immediate ground outside.
- Well-worn path to and from the holt entrance.

Where resting sites or breeding holts were identified, their locations were recorded using GPS. Appropriate buffer zones to avoid disturbance will be defined and reported in the ES (where appropriate). Buffer zones are expected to be 30 m for an active resting site and, depending on works and topography, 100–200 m for an active breeding holt.

In the unlikely event that any otter resting places are unavoidable, mitigation measures, including temporary loss under a derogation licence from Natural England, will be set out in the ES.

Survey Programme and Effort

All surveys were completed between April and September 2025. Surveys were scheduled to avoid periods of heavy rainfall or high water levels, when field signs could be obscured or lost.

Water Vole

Introduction

Based on desk study information, water voles are known to be widespread throughout the draft Order Limits with particular (known) 'hot spots' to the west and south-west of Scunthorpe and around the Humber at Goxhill and Paull.

The Project extends through a largely rural landscape, crossing multiple watercourses and ditches of varying size. While construction activities will seek to avoid direct impacts to watercourses, temporary disturbance to sections of field drains / ditches is anticipated. As a result, temporary and minor impacts to water voles and their burrows may occur during construction, with survey results (to be reported in the ES) providing the basis for defining any necessary mitigation.

Screening for Survey and Defining the Survey Area

Given the presence of suitable habitat and the likelihood of water vole using watercourses across the Project area, all watercourses within the draft Order Limits, together with a 200 m buffer where accessible, were screened in for survey.

Methodology

Water vole surveys were undertaken in accordance with the Water Vole Mitigation Handbook (Ref 7.2.28), using a modified landscape-scale approach agreed with Natural England, focusing on presence / absence. An initial site visit was carried out between mid-April and the end of June 2025. Where water voles were confirmed present, or habitats were clearly unsuitable, no further visits were required. Where absence was recorded in suitable habitat, a second visit was undertaken between July and September 2025.

Each watercourse was walked (in-channel where possible) to collect evidence of water vole presence, including latrines, burrows, runs, footprints, feeding remains / stashes, droppings and direct sightings. Additional habitat information was also recorded, including flow direction, bank substrate, disturbance, vegetation type / structure and adjoining land use.

Survey results will be reported in the ES and used to inform any derogation licence applications to Natural England (if required), with associated method statements setting out measures to minimise construction impacts and enhance the conservation status of water vole locally.

Survey Programme and Effort

All water vole surveys were completed between April and September 2025. Initial visits were undertaken between mid-April and June, with follow-up visits between July and September where required. Surveys were scheduled to avoid periods of heavy rainfall or high water levels, when field signs could have been obscured or lost.

Survey Summary and Programme

A summary of the proposed survey and assessment programme is provided within Table A7-2-4. Survey results will be presented within topic-specific technical appendices as part of the ES (NB: for sensitive species, a confidential report will be produced). If required, survey results for certain species will also be presented within draft derogation licences.

Table A7-2-4 – Survey and Assessment Summary

Topic	Survey Status (including survey completion date)
Biodiversity Net Gain	N/A.

Topic	Survey Status (including survey completion date)
UKHabs	Completed for draft Order Limits (August 2025).
Hedgerow Surveys	Completed for draft Order Limits (August 2025).
Invertebrates	If / where required, to be scheduled for the appropriate survey season prior to ES submission.
Fish	If / where required, to be scheduled for the appropriate survey season prior to phased construction activities.
Reptiles	Completed for target areas (September 2025).
Great crested newts	N/A – DLL approach is to be taken forward.
Birds	Passage, wintering and breeding bird surveys completed for target areas (August 2024 to June 2025).
Badger	The survey is ongoing and will be completed over winter 2025/26. Sett classification survey to take place prior to site enabling and establishment works.
Bats	GLTA / PRF surveys completed for draft Order Limits (September 2025). Activity surveys are ongoing and will be completed by October 2025. Roosts surveys (i.e. climbed inspections and / or dusk emergence surveys) are scheduled from winter 2025/26 to summer 2026.
Water Vole	Completed for draft Order Limits (September 2025).
Otter	Completed for draft Order Limits (September 2025).

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Appendix 7.3 – Intertidal and Marine Technical Appendix

Introduction

Scope of the Document

This Technical Appendix specifically presents baseline information relevant to the marine and intertidal environment of the Project, which encompasses all aspects that fall within Mean High-Water Springs (MHWS) and Mean Low Water Springs (MLWS), alongside the expected Zone of Influence (ZOI) of Project-related impacts. This includes the Easington Landfall, and the River Humber and tidal River Trent crossings. There is emphasis on the intertidal and marine environment at the Easington Landfall due to the potential for greater Project interaction here in comparison to the rivers, as the rivers will be crossed using trenchless techniques. A sampling intertidal survey was therefore only undertaken at Easington; the preliminary results of which are contained within this Appendix.

The baseline environment above MHWS is contained within Appendix 7.1: Ecological Appraisal and should be read alongside this appendix and Chapter 7: Ecology and Biodiversity. A high-level overview of receptors which interact with both the marine and terrestrial environment is further provided in the noted sections.

This Technical Appendix aims to:

- Present desk study findings and preliminary results from Phase 1 and Phase 2 intertidal surveys undertaken at Easington Landfall.
- Present the baseline information in relation the intertidal and marine environment in support of the Ecological Impact Assessment (EclA) (please refer to Chapter 7: Ecology and Biodiversity).
- Identify requirements for any further survey or assessment needed at the landfall to inform the Environmental Statement (ES).

A desk-based study was undertaken to inform the baseline of the marine and intertidal environment at the Easington Landfall, River Humber and River Trent crossings, with the best available information at the time of writing. This Appendix further summarises the results of a desk-based study and preliminary Phase 1 and Phase 2 intertidal surveys at Easington Landfall, with reference to earlier 2022 survey work, which supplements the baseline. This Appendix should also be read in conjunction with Chapter 7: Ecology and Biodiversity and Chapter 20: Coastal Processes, which provide wider ecological and physical process context for the Project.

Mitigation Hierarchy

The Mitigation Hierarchy is a sequential process that has been adopted throughout the Project evolution to avoid, mitigate and compensate negative ecological impacts and effects. A concise list of both embedded and additional mitigation measures has been presented within Chapter 7: Ecology and Biodiversity.

Legislation

A full summary of international, national and local legislation is presented alongside relevant policies and guidance within Chapter 7: Ecology and Biodiversity.

Methodology

Overview

This Section outlines the methodology used to establish the intertidal and nearshore marine baseline in relation to the Project in support of the ecology impact assessment presented within Chapter 7: Ecology and Biodiversity.

Desk Study

A desk-based study was undertaken to characterise the intertidal and nearshore marine environment of relevance to the Project, in support of Chapter 7: Ecology and Biodiversity. The baseline is informed from publicly available data and survey results from the Phase 1 and Phase 2 intertidal habitat surveys undertaken in April 2025 (including reference to previous surveys undertaken in 2022) at Easington. The survey results aim to supplement the baseline at Easington, due to significant Project interaction at this location. Surveys were not undertaken around the River Humber and River Trent locations due to the limited Project interaction with the rivers. The desk-based study was conducted using the best available information at the time of writing with consideration of the Project and its draft Order Limits.

A 5 km buffer has been considered for the marine and intertidal environment. A wider 15 km buffer (see Figure A7.3.1) was also considered with regard to intertidal and marine receptors due to the influence of coastal process on sediment supply and mobile nature of relevant species (please see Chapter 20: Coastal Processes and Chapter 7: Ecology and Biodiversity).

A list of relevant sources used to inform this Technical Appendix are contained within the reference list. In addition, the following was considered:

- Multi-Agency Geographic Information for the Countryside (MAGIC).
- Joint Nature Conservation Committee (JNCC) Mapper.

Phase 1 and Phase 2 Intertidal Habitat Survey

The Easington Landfall intertidal survey was undertaken between 27 and 30 April 2025. The methodology used followed a similar approach to that undertaken at the landfall in June 2022 such that consistent approaches to the survey programmes would allow comparison of the results.

An initial Phase 1 walkover survey was conducted to coincide with spring low tide on 28 April 2025 (1.03 m above Chart Datum (CD) at 12:40 BST). This allowed for maximum exposure of the intertidal area whilst physical observations were noted down. All target notes and field photographs were georeferenced and recorded using data tablets installed with the ArcGIS Field Notes application such that data could be easily uploaded to the projects GIS.

Phase 2 sediment sampling was undertaken on 29 April 2025, also timed to coincide with low water (0.95 m above CD 13:25 BST).

A full outline of sample analysis and results will be presented in the ES and contained with an accompanying survey report.

Phase 1 Walkover

The Phase 1 survey identified any predominant biotopes within a 500 m wide corridor (250 m either side of the centreline transect at the Easington Landfall). The methods used for Phase 1 intertidal surveys were in accordance with considered good practice for intertidal walkover surveys e.g., Handbook for Marine Intertidal Phase 1 Survey and Mapping (Wyn et al., 2006) (Ref 7.3.1).

Visual observations were noted down where relevant alongside georeferenced photographs taken of any notifying features.

Additional notes were taken on the predominant habitat at the sample stations on each of the transects.

Biotope descriptions contained within this Report are according to those presented in The Marine Habitat Classification for Britain and Ireland Version 22.04 (JNCC, 2022) (Ref 7.3.2), with the information on the shallower biotopes taken from the Version 04.05 manual (The Marine Habitat Classification for Britain and Ireland. Version 04.05 (Joint Nature Conservation Committee (JNCC), 2004) (Ref 7.3.3)).

Phase 2 Sampling

Sampling protocols adhered to standard methodologies that were considered through prior consultation with a number of statutory consultees prior to mobilising to the field.

A total of 5 transects were sampled within the 500 m corridor. Three stations were sampled per transect at upper, middle and lower shore height levels with the upper most stations sampled at the strandline close to the most recent high-water mark and the lower shore stations sampled as close to low-water as possible. The 5 transects were sampled perpendicular to the shoreline, with a total of 15 stations sampled in total.

The central transect was located on the anticipated route of the pipeline landfall. Two transects were located north and south of this centreline; transects either side of the centreline were spaced approximately 50 m from the transect, the two far transects approximately 100 m from the former transects. Stations were located using a hand-held GPS unit.

At each station two 0.5 litre samples were collected for Particle Size Analysis (PSA) and Total Organic Carbon (TOC), heavy and trace metals. These were collected using a disposable plastic scoop. A 120 ml sample was also taken using a Teflon coated metal scoop (collected in a glass jar) for the analysis of hydrocarbons intertidal sediment at each sampled station. Single replicates for the above analyses were collected at each station from the surface sediments.

Three replicate samples for the analysis of sediment infauna were also collected at each station using a hand-held corer of diameter of approximately 10 cm to a depth of approximately 15 cm. These samples were subsequently sieved on site over a 500 µm mesh and then preserved in 4 -10% buffered formal saline solution.

All samples were dispatched for laboratory analysis on 30 April 2025 under appropriate storage and transit conditions and chain of custody.

Analysis

Physio-chemical

The single replicate samples taken at each station from surface sediments were analysed for PSA, TOC and a range of contaminants (heavy metals, Polyaromatic Hydrocarbons (PAH), hydrocarbons, etc.) at the Cefas approved SOCOTEC UK Limited Laboratory.

Sediments were classified for grain size analysis according to Folk based on their relative content of gravel (>2 mm), sand (>63 µm and 2 mm), and mud (<63 µm). They have further been classified according to Ward (Insert 2-1).

TOC was analysed by acid digestion, combustion at 1600°C and Infrared Spectroscopy (IR) analysis for wet sediment.

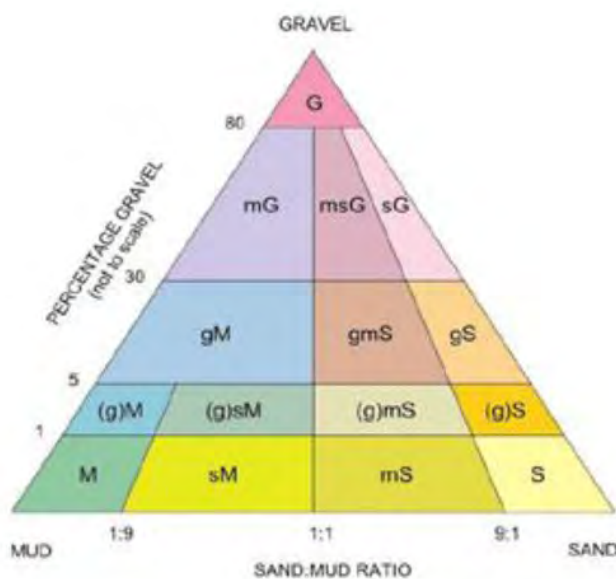
Analysis of trace and heavy metals was carried out on samples that were oven dried at less than 35°C. Determination of aluminium, barium, iron and lithium were analysed in marine sediments by High Frequency (HF) / Boric and two-stage microwave digestion followed by Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) analysis. The presence of the following were analysed by HF / bullet. Boric and two-stage

microwave digestion followed by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) analysis:

- Arsenic.
- Cadmium.
- Chromium.
- Copper.
- Lead.
- Nickel.
- Tin.
- Vanadium.
- Zinc.

Mercury analysis was conducted via nitric acid / peroxide extraction followed by ICP-MS analysis.

PAH analysis was carried out by solvent extraction and clean up followed by Gas Chromatography-Mass Spectrometry (GC-MS) analysis, on wet sediment. Whilst Total Petroleum Hydrocarbons (TPH) analysis was carried out on wet sediment, by solvent extraction and clean up followed by Gas Chromatography Flame Ionization Detector (GC-FID) analysis.



Insert A7-3-1 – Folk Classification of Sediments

Infauna

The three replicate benthic samples from each station were taken for infaunal analysis at Hebog Environmental Ltd (a participant in the NE Atlantic Marine Biological Analytical

Quality Control (NMBAQC) quality assurance scheme). Due to the overall paucity of species (both abundance and diversity) only relatively basic metrics could be applied to the data. Biotopes were defined as European Nature Information System (EUNIS) Level 4, barren or amphipod dominated mobile sandy shores (EUNIS Habitat Classification Revised 2004 (Davies et al., 2004) (Ref 7.3.4)).

Results

This section presents the desk-based results conducted for the intertidal and marine discipline whereby features overlap with Project aspects that fall below MHWS and are deemed of relevance to the Project and its perceived ZOI. As noted, emphasis on Easington Landfall has been contained within this Appendix, due to the greater interaction with the Project at this location and the connection to the offshore pipeline.

Designated Sites

Statutory Designated Sites

Table A7-3-1 provides a summary of statutory designated sites that overlap with, or are directly connected to, the Project.

Please note only features of relevance to the intertidal and marine environment have been noted here.

Table A7-3-1 – Statutory Designated Sites of Relevance to the Project and Intertidal and Marine Environment

Designated site	Reason for designation *indicates primary reason for site selection (where relevant)	Approx. distance from draft Order Limits (m)
Humber Estuary Ramsar	<p>Ramsar criterion 1:</p> <ul style="list-style-type: none"> Near natural estuary with the following component habitats, dune systems, humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarsh and coastal brackish / saline lagoons. <p>Ramsar criterion 3:</p> <ul style="list-style-type: none"> Breeding colony of grey seals (<i>Halichoerus grypus</i>). <p>Ramsar criterion 5:</p> <ul style="list-style-type: none"> Assemblages of international importance, 153,934 waterfowl, non-breeding season. <p>Ramsar criterion 6:</p> <ul style="list-style-type: none"> Species / populations at levels of international importance. <p>Ramsar criterion 8:</p> <ul style="list-style-type: none"> Migration route for both river (<i>Lampetra fluviatilis</i>) and sea lamprey (<i>Petromyzon marinus</i>). 	0
Humber Estuary Special Area of Conservation (SAC)	<p>Estuaries*</p> <p>Mudflats and sandflats not covered by seawater at low tide*</p> <p>Sandbanks which are slightly covered by sea water all the time</p> <p>Coastal lagoons</p> <p>Salicornia and other annuals colonising mud and sand</p> <p>Atlantic salt meadows (<i>Glauco-Puccinellietalia maritimae</i>)</p> <p>Embryonic shifting dunes</p>	0

Designated site	Reason for designation *indicates primary reason for site selection (where relevant)	Approx. distance from draft Order Limits (m)
	Shifting dunes along the shoreline with <i>Ammophila arenaria</i> (white dunes) Fixed coastal dunes with herbaceous vegetation (grey dunes) Dunes with <i>Hippopha rhamnoides</i> Sea lamprey River lamprey Grey seal	
Humber Estuary Special Protection Area (SPA) (including marine components)	Waterbird assemblage: <ul style="list-style-type: none"> • Great bittern (<i>Botaurus stellaris</i>) breeding and non-breeding. • Common shelduck (<i>Tadorna tadorna</i>), non-breeding. • Eurasian marsh harrier (<i>Circus aeruginosus</i>), breeding. • Hen harrier (<i>Circus cyaneus</i>), non-breeding. • Pied avocet (<i>Recurvirostra avosetta</i>), breeding and non-breeding. • European golden plover (<i>Pluvialis apricaria</i>), non-breeding. • Red knot (<i>Calidris canutus</i>), non-breeding. • Dunlin (<i>Calidris alpina</i>), non-breeding. • Ruff (<i>Philomachus pugnax</i>), non-breeding. • Black-tailed godwit (<i>Limosa limosa</i>), non-breeding. • Common redshank (<i>Tringa totanus</i>), non-breeding. • Little tern (<i>Sternula albifrons</i>), breeding. 	0
Greater Wash SPA (marine)	Red-throated diver (<i>Gavia stellata</i>), non-breeding Common scoter (<i>Melanitta nigra</i>), non-breeding	0

Designated site	Reason for designation *indicates primary reason for site selection (where relevant)	Approx. distance from draft Order Limits (m)
	Little gull (<i>Hydrocoloeus minutus</i>), non-breeding Sandwich tern (<i>Thalasseus sandvicensis</i>), breeding Common tern (<i>Sterna hirundo</i>), breeding Little tern, breeding	
Humber Estuary Site of Special Scientific Interest (SSSI)	Coastal plain estuary and associated intertidal habitats and species.	0
Holderness Inshore Marine Conservation Zone (MCZ)	Intertidal sand and muddy sand Moderate energy circalittoral rock High energy circalittoral rock Subtidal coarse sediment Subtidal mixed sediments Subtidal sand Subtidal mud Spurn head (subtidal)	0
Dimlington Cliffs SSSI	Rapidly eroding cliffs, Quaternary stratigraphy of east England	0

Additional sites that may need to be considered due to potential connectivity with more mobile species includes (please note this list is non-exhaustive):

- Southern North Sea SAC, designated for harbour porpoise (*Phocoena phocoena*).
- River Derwent SAC, designated for river and sea lamprey.
- Flamborough Head and Filey Coast SPA, designated for breeding seabird features.
- Moray Firth SAC, designated for bottlenose dolphin (*Tursiops truncatus*).

In addition, a preliminary HRA Screening Report is being made available as part of the PEIR and further sites may be considered as part of this process.

Habitats

The shoreline of the Project at the Easington Landfall is predominately formed of littoral sand; habitats and species are characteristic of a wave exposed coastline. Littoral sand may be comprised of muddy sand or sandy sediment, with shells and stones dispersed at the surface. This sediment type additionally provides a key intertidal habitat of the Holderness Inshore MCZ, that overlaps with the Project.

The estuarine environment of the Humber and tidal River Trent is characterised by mud and sandflat expanses supporting a range of marine and freshwater species.

Preliminary Phase 1 and 2 Survey Results

Phase 1 Observations

The intertidal zone of the Project is bordered by cliffs that are subject to significant erosion, this was noted in the 2022 landfall survey and also the survey undertaken April 2025; the cliffs are noted to be heavily eroding, specifically within the Dimlington Cliffs SSSI. There was a marked difference in the extent of cliff retreat between the 2022 and 2025 survey, with noticeable areas whereby erosion had markedly increased over the time period.

There was further evidence of recent cliff falls on the beach from the cliff (Insert A7-3-2), in addition to the survey personnel witnessing cliff falls during the 2025 survey. This is most likely as a result of the most recent spring high tide



Insert A7-3-2 – Cliff Deposit and Evidence of Cliff Retreat on Shoreline at Easington

Insert A7-3-3 further highlights the extent of cliff retreat from above the cliff itself.



Insert A7-3-3 – Evidence of Cliff retreat due to Erosion from above the Cliff at Easington

Rippled sand dominated the lower shore areas of the beach (Insert A7-3-4), with coarser sediments located toward the upper shore and strandline areas. In the mid / upper shore coarser pebbles and boulders were interspersed with cliff deposits (Insert A7-634). A clay platform was located at mid / lower shore (Insert A7-3-6).



Insert A7-3-4– Rippled Sand from Mid / Lower Shoreline at Easington



Insert A7-3-5 – Pebbles / Boulders Interspersed with Cliff Deposits and Beach Profile Changing from Upper to Mid Shore at Easington



Insert A7-3-6 – Clay Platform in Mid / Lower Shore at Easington

Though exposures of clay were recorded (Insert A7-3-5), suggesting the presence of communities on soft circalittoral rock (A4.23), characteristic of moderately wave-exposed shores and dominated by the piddock (*Pholas dactylus*), no piddock burrows were uncovered in either surveys.

There was limited documented anthropogenic activity along the shoreline aside from discarded litter and commercial fishing gear. However, the southern extent of the survey area noted the presence of boulder sea defence structures alongside groynes in several places along the shoreline forming the hard engineering defences for Easington Gas Terminal (Insert A7-3-6).



Insert A7-3-7 – Sea Defence and Groyne Structures toward the Southern Extend of the Survey Area at Easington

2022 Physio-chemical results

A summary of PSA data from the 2022 survey is outlined here. It is acknowledged that samples were taken from varying areas in comparison to the 2025 survey due to a slight change to the north between 2022 and 2025 of the proposed pipeline alignment, however they are included here as they are still to be considered representative. A full outline of physio-chemical results for the 2025 survey will be presented to inform the ES to draw out any comparisons and conclusions.

It concluded that relatively consistent sediment types across the survey area at the time. Sand was the predominant sediment type, found at all shore heights. Very little silt was recorded; and each sampling station was noting as having either sand, gravelly sand or slightly gravelly sand.

Medium sand dominated the upper shore, with 100% sand at the two most northerly locations. The two southern areas also had high sand content; the most southern position had 99% sand and the central transect had 97.4% sand.

The mid shoreline was dominated by sandy gravel or gravelly sand, possessing a higher gravel content compared to the lower and upper shoreline.

At the lower shore, southern and central transects had fine and medium sand, becoming coarse sand toward the north and very coarse sand at the northern most sampling point. Sandy gravel was also noted at this most northern point.

In conclusion for the 2022 survey, upper shore areas were largely sand with mid shore areas illustrating an increase in gravel composition: most notably in the most northern section of the survey area at the time. At the lower shore gravel content also increased toward the north of the survey area. The results of the PSA analysis confirm the view of an open aspect and relatively wave and tide dominated sandy shoreline.

TOC were analysed by % by weight of surface sediments. Values ranged from 0.08% in the upper shore of the northern most sampling point, to 0.25% on the lower shore, also of the northern most transect. The upper shore has lower TOC levels than the mid and lower shore which highlights the greater proportion of finer sediments at these locations.

The TOC analysis was consistent with what is expected for a moderate to high energy exposed sandy beach.

A full outline of the physio-chemical results of the 2025 survey will be presented in the ES, alongside comparisons with the 2022 dataset drawn.

Offshore NEP survey

An offshore survey undertaken by Gardline Surveys in 2022 for the offshore Northern Endurance Partnership (NEP) Project, recorded low resemblances of rocky and Sabellaria spinulosa reefs in the nearshore waters in the vicinity to the Project. Specifically, low resemblance rocky reefs were documented within the Holderness Inshore MCZ, where faunal communities on deep moderate energy circalittoral rock (A4.27) was noted. Subtidal mixed sediment (A5.4) and subtidal sand (A5.2) habitats have also been recorded along the coastline of the MCZ and overlap with the Project (NEP Integrated Site Survey - 2021 Environmental Survey Habitat Assessment (Gardline, 2022) (Ref 7.3.5)).

Crossings

At the tidal River Trent and Humber crossing areas, habitats primarily constitute estuarine environments with sand and mudflats that become exposed at low tide. At the mouth of the Humber specifically, habitats predominantly comprise of infralittoral sandy mud (A5.33), infralittoral fine sand/muddy sand (A5.23/A5.24) and circalittoral fine sand/muddy sand (A5.25/A5.26). Further upstream the Humber near the approaches of the crossing deep circalittoral mud/sand (A5.37/A5.27) may also be found (EUSeaMap 2023 Broad-Scale Predictive Habitat Map for Europe (EMODnet, 2025) (Ref 7.3.6)). In the tidal River Trent, mud and sandflats are also found in the vicinity of the crossings; such habitats support a wide range of species.

These habitat types are noted further within Appendix 7.1: Ecological Appraisal and Chapter 7: Ecology and Biodiversity where they are of relevance to the terrestrial environment.

Species

2022 Intertidal Infaunal Analysis

Faunal analysis during the 2022 Easington Landfall intertidal survey concluded sparse records; however, those taxa recorded were characteristic of typical mobile sandy habitats. Common species included, the polychaetes *Nephtys cirrosa* and *Scolelepis squamata* and the isopod *Eurydice pulchra*.

Nephtys cirrosa was present at the lower shore stations in the survey area at the time; *Scolelepis squamata* was found at only the middle shore stations on the northern transect; Nemertea were only present at the middle shore station on the southern transect, while *Lumbrineridae* were only present at the lower shore station on the southern transect.

In all sampled stations, faunal abundance was recorded as low; the lower shore stations on the centre transect had greatest infaunal abundance. More than half of the samples recorded no fauna, particularly concentrated on the upper and mid shore, suggesting low diversity in much of the mid and upper shore locations.

The above presents a brief outline of the infaunal results from 2022. A full description of the infaunal analysis will be presented in the ES for both the 2022 and 2025 surveys and comparisons will be drawn between them.

Crossings

Infaunal species in the Humber and tidal River Trent are expected to be dominated by a range of invertebrate infauna constituting polychaetes, tube building amphipods and bivalves. Notably robust fauna will occur in more exposed habitat types (i.e., infralittoral habitats, A5.23). In certain habitat types (e.g., A5.37 and A5.27) echinoderms and sea pens may also occur.

Fish species

The Project lies within the North Eastern Inshore Fisheries Conservation Authority (NE IFCA). The following commercial species are expected to be present at any given time, although it should be noted that this list is non exhaustive (Transitional and coastal water fish surveys (Environment Agency (EA), 2025) (Ref 7.3.7)):

- Atlantic herring (*Clupea harengus*).
- European plaice (*Pleuronectes platessa*).
- Dab (*Limanda limanda*).
- Lesser sand eel (*Ammodytes tobianus*).
- Atlantic cod (*Gadus morhua*).
- Lemon sole (*Microstomus kitt*).
- Flounder (*Ammodytes tobianus*).
- Whiting (*Merlangius merlangus*).

- Haddock (*Melanogrammus aeglefinus*).
- Turbot (*Scophthalmus maximus*).
- Sole (*Solea solea*)
- Brill (*Scophthalmus rhombus*)
- Sprat (*Sprattus sprattus*).
- Anglerfish (*Lophius piscatorius*).
- Blue whiting (*Micromesistius poutassou*).
- Mackerel (*Scomber scombrus*).
- European lobster (*Homarus gammarus*).
- Norway lobster (*Nephrops norvegicus*).
- Velvet crab (*Necora puber*).
- Brown shrimp (*Crangon crangon*).
- Scallop species (e.g., king scallop (*Pecten maximus*) and queen scallop (*Aequipecten opercularis*)).
- Whelk species (e.g., *Buccinidae* spp.).
- Periwinkle species (e.g., *Littorinidae* spp.).
- Cockle species (e.g., *Cardiidae* spp.).
- Mussel species (e.g., *Mytilus* spp.).
- Squid species (e.g., *Decapodiformes* spp.).

Specifically, crabs, lobsters, and scallops are among the most common landings in International Council for the Exploration of the Sea (ICES) Rectangles of relevance to the Project (see Chapter 14: Socioeconomics, Recreation and Tourism), alongside species such as European plaice, turbot, sole and brill (UK sea fisheries annual statistics report 2023 (Marine Management Organisation (MMO), 2024) (Ref 7.3.8)).

Additionally, the Humber is a documented migration route for river and sea lamprey owing to the designated of several statutory designated sites. Species such as allis shad (*Alosa alosa*), twaite shad (*Alosa fallax*) and European eel (*Anguilla anguilla*) may also be recorded in relation to the Project. Atlantic salmon (*Salmo salar*) and sea trout (*Salmo trutta*) may also overlap with the Project due to their presence in the River Trent and Ouse. Further detail on freshwater and migratory species is presented in Appendix 7.1: Ecological Appraisal.

Bird species

Extensive sand and mud flats in proximity to the Project offer extensive habitats to a diverse bird assemblage comprising both seabird and shorebird species. A number of these species are associated with designated sites of relevance to the Project (Table 3-1).

The intertidal surveys undertaken for the Project at Easington Landfall (2022 and 2025) further noted the presence of sand martins (*Riparia riparia*) nesting in burrows near the top of the cliff close to the Easington Landfall. Oystercatchers (*Haematopus ostralegus*)

and gull species (e.g., little gull, great black-backed gull (*Larus marinus*), common gull (*Larus canus*) and herring gull (*Larus argentatus*), were also recorded.

Further detail on breeding and non-breeding species is presented in Appendix 7.1: Ecological Appraisal.

Marine Mammals

Although the location of the Project suggests there is limited potential for significant overlap with marine mammal populations, they are considered due to the potential for underwater noise impacts and disturbance from vessels and construction works.

Grey seal and harbour seal (*Phoca vitulina*) may overlap with the Project. Donna Nook, which is approximately 20 km south of the Easington Landfall, supports a breeding colony of grey seals, and is the largest grey seal haul out on the eastern coast of the UK, where August counts increased from approximately 3500 to 6000 individuals (2022 to 2023). Harbour seal may also be present at the Donna Nook site, albeit in lower densities (Scientific Advice on Matters Related to the Management of Seal Population: 2022 (Special Committee on Seals (SCOS), 2024) (Ref 7.3.9Ref 7.3.9)). It is estimated there may be up to three harbour seals per 25km² and up to 75 grey seals per 25km² in the vicinity of the landfall of the Project (Habitat-based predictions of at-sea distribution for grey and harbour seals in the British Isles) (Carter et al., 2020) (Ref 7.3.10)).

Harbour porpoise are common in the offshore area of the North Sea, there have further been isolated records of presence within the Humber (Hull Live (Hull Daily Mail, 2023) (Ref 7.3.11)). In addition, it is important to note that the Project overlaps with the Moray Firth to Humber Estuary Important Marine Mammal Area (IMMA). This Area is noted for the following species (Moray Firth to Humber Estuary IMMA (Marine Mammal Protected Areas Task Force, 2025) (Ref 7.3.12)):

- Bottlenose dolphin.
- Grey seal.
- Harbour seal.
- Minke whale (*Balaenoptera acutorostrata*).

Of the marine mammal species noted, harbour porpoise is the species most likely to occur in proximity to the Project. It is appreciated it is unlikely for offshore species (i.e., minke whale) to overlap with the Project due to limited pathways for interaction. Though there has been marked increased in bottlenose dolphin populations off the eastern coast of England (Bottlenose dolphins in North-east England (Evans and Bertulli, 2021) (Ref 7.3.13)).

Easington Landfall overlaps with the Small Cetaceans in Atlantic Waters and the North Sea (SCANS) Block NS-C (Estimates of cetacean abundance in European Atlantic waters in summer 2022 from the SCANS-IV aerial and shipboard surveys (Gilles et al., 2023) (Ref 7.3.14)), whilst the Project as a whole overlaps with the North Sea Management Unit

for harbour porpoise and Greater North Sea Management Unit for bottlenose dolphin (Review of Management Units boundaries for cetaceans in UK waters (2023) (Inter-Agency Marine Mammal Working Group (IAMMWG), 2023) (Ref 7.3.15)).

Invasive Non-native Species

Based on the desk study, the following species have potential presence in the intertidal and marine environment:

- Slipper limpet (*Crepidula fornicata*).
- Chinese mitten crab (*Eriocheir sinensis*).
- Darwin's barnacle (*Austrominius modestus*).
- Killer shrimp (*Dikerogammarus villosus*).
- Zebra mussel (*Dreissena polymorpha*).
- Oyster drill (*Ocenebra erinaceus*).
- Wakame (*Undaria pinnatifida*).
- Leathery sea squirt (*Styela clava*).

Terrestrial and freshwater invasive non-native species recorded within the wider Project area are detailed separately in Appendix 7.1: Ecological Appraisal.

Discussion

Habitats

The preliminary observations noted from the 2022 and 2025 surveys suggest the presence of LS.LSa.MoSa (Barren or amphipod-dominated mobile sand shores) and/or LS.LCS.Sh (Shingle (pebble) and gravel shores) at the Easington Landfall, which also corresponds with the biotopes expected along much of the Holderness coast. There is also potentially the LS.LSa.St.Tal (Talitrids on the upper shore and strandline) biotope present. These biotope classifications will be further refined based on the 2025 infaunal analysis, which will be included in the ES.

No biotopes of conservation importance were recorded within the Easington Landfall survey corridor during the initial intertidal walkover, nor were any epibenthic or infaunal species of conservation importance noted in the vicinity of the Easington Landfall.

Physio-chemical analysis of samples taken at the Easington Landfall in 2022 were characteristic of a relatively exposed, sandy beach which is subject to a degree of moderate to high energy hydrodynamic conditions.

Metal concentrations in sediments at the Easington landfall were deemed low in comparison to reference levels used. In general, concentrations of metals were similar, or lower than metal concentrations encountered at other referenced locations around the UK coast, particularly when compared to those observed in the North Sea. Elevations of

metals in the northern most transect were likely attributed to the increased levels of cliff erosion noted here.

At Easington Landfall, habitats within the intertidal zone may be subject to temporary disturbance during pipeline installation activities. The extent and nature of any changes will be assessed within the ES, once detailed construction methods are confirmed. Habitats and benthic communities in the immediate pipeline footprint will be lost, with a degree of indirect impacts associated with smothering and sediment resuspension impacting neighbouring habitats and associated species. No rock placement is expected due to the sufficient burial of the pipeline.

At the Humber and tidal River Trent crossings there is deemed to be limited potential for interaction with the Project due to the nature of the proposed installation activities.

Species

Species expected to overlap with the Project in any given capacity are characteristic of shorelines on the eastern coast of the UK and North Sea. It is appreciated there is limited interface with the marine environment beyond MLWS due to Project scope, however species may yet be impacted by further reaching impacts associated with pipeline installation (i.e., underwater noise and vessel disturbance, suspended sediments etc).

Noise sensitive species may be impacted via the installation of the temporary cofferdam (at the landfall), installation of the pipeline and vessel presence, however such interactions are likely to be temporary in nature. The potential for construction-related effects will be assessed. Diving bird species may also be impacted; however, birds are expected to be more heavily impacted through habitat fragmentation in the intertidal and the physical presence of AGI locations (i.e., artificial light impacts and disturbance). This is considered further within Chapter 7: Ecology and Biodiversity and Appendix 7.1: Ecological Appraisal.

Underwater noise impacts will be appropriately and comprehensively assessed and reported in the ES. at the two estuary crossing locations (lower Humber and Tidal River Trent). At the Easington Landfall reference will be made to the underwater noise modelling undertaken for the Project as part of the Offshore Environmental Statement (Northern Endurance Partnership Development (OPRED, 2023) (Ref 7.3.16)) in order to inform mitigation requirements.

Conclusion

This Technical Appendix presents the initial desk-based review for the marine and intertidal environment in relation to the Project. It further outlines preliminary survey results for the Easington Landfall completed in 2022 and 2025.

This review provides an early baseline to inform the EclA reported in Chapter 7: Ecology and Biodiversity. The marine and intertidal baseline in relation to the Project will be developed further at ES using the best available data at the time of writing. The ES will

further provide the full results of the 2025 surveys, including laboratory analyses (e.g., infaunal identification and enumeration) and comparative assessments against the 2022 surveys and other relevant datasets.

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Appendix 11.1 – Cultural Heritage Assessment Methodology

Introduction

This document outlines the scope and methodology for the cultural heritage assessment for the Humber Carbon Capture Pipeline (HCCP) (hereafter referred to as the ‘Project’) Development Consent Order (DCO) application. The term ‘cultural heritage’ is taken to mean the study of archaeology, earthworks, historic landscape character and the historic built environment.

This note has been prepared for review by the consultees outlined below, with the aim of opening discussions to agree the scope and methodology for the cultural heritage assessment of the Project:

- Historic England.
- North Yorkshire Council.
- North Lincolnshire Council.
- East Riding of Yorkshire Council.
- North East Lincolnshire Council.

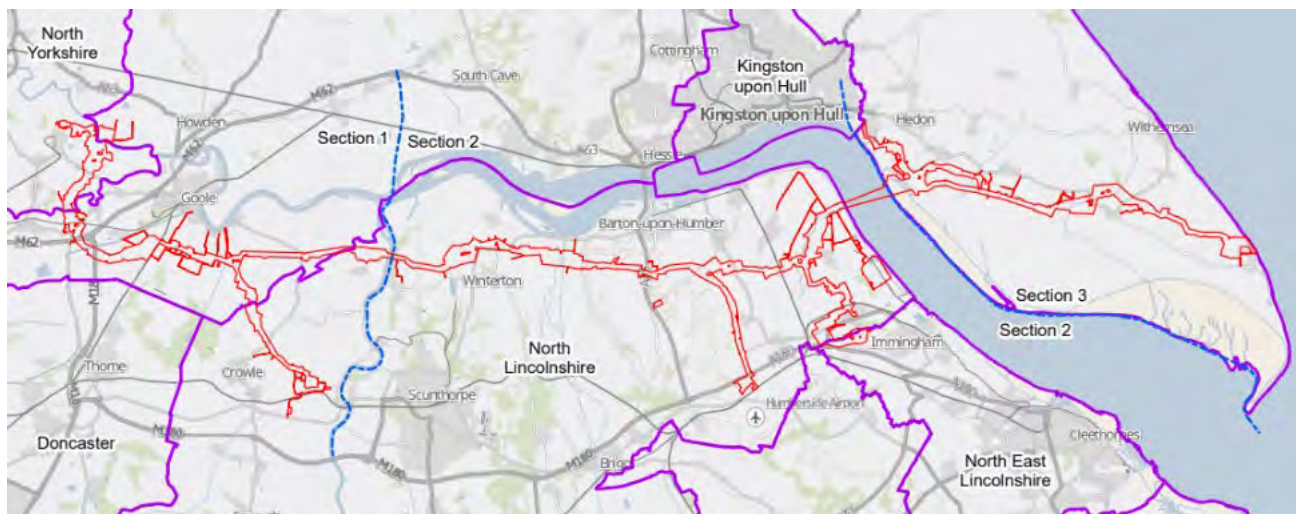
This document is based on the Project design, available at the time of writing and as ‘frozen’ for the Project’s statutory consultation and is the starting point for technical assessment. The methodology has been devised to remain appropriate for later stages of detailed design and refinement.

The methodology document has been shared following receipt of the Project’s Scoping Opinion and considers feedback from the Scoping Opinion.

Project Background

HCCP comprises a proposed underground, onshore pipeline (with associated above ground facilities required for operation and maintenance) (the Project) that aims to transport carbon dioxide produced by industrial projects and power generating facilities in the Humber region to secure offshore storage under the North Sea. The pipeline is proposed to be undergrounded between Drax area in North Yorkshire and a landfall location north of Easington in the East Riding of Yorkshire. There will be a number of Above Ground Installations (AGIs) along the route containing operation and maintenance equipment, these will be located at regular intervals at every 16-18km. A Pump Facility will also be required near Easington for the onward transportation of carbon dioxide through the marine environment. The AGIs will vary in size depending on the specific function they serve.

At Easington the Project interfaces with a separate, offshore pipeline leading to an offshore storage area, both of which area out of the scope of this assessment and subject to separate consents. Where the pipeline is required to cross complex features a ‘trenchless’ method will be used. This will include the crossing of the River Humber which will be crossed by either tunnelling or Horizontal Directional Drill (HDD).



Insert – A11-1-1 – Indicative draft Order Limits for the pipeline, September 2025 (Source: HCCP’s Preliminary Environmental Impact Report (PEIR), Volume 3: Figure 1.1 – HCCP Project Location)

Approach to Assessment

Introduction

The following section sets out the proposed approach to the assessment of Cultural Heritage for the Project. This includes the approach to consultation and stakeholder engagement.

Consultation and Stakeholder Engagement

Current ongoing tasks include design refinement, assessment and development of fieldwork strategies. To aid in consultation during this period it is intended to create a Heritage Working Group (HWG). The HWG will be formed of statutory consultees, members of the Arcadis Heritage and Project teams, and representatives of the Applicant.

The purpose of the HWG is to allow for a more informal flow of information outside of the formal application stages, in order to allow for a well-informed and transparent decision-making process. Feedback from consultees during the course of HWG sessions can therefore also be fed directly in to working documents. This document forms the first stage in that process, to go agree a broad methodology for the cultural heritage assessment for the Project.

It is envisaged that the HWG will meet on a semi-regular basis. Whilst key meetings are likely to require all consultees. It is envisaged that many will be location or topic specific e.g. when talking about impacts within a specific county or when only dealing with archaeology rather than the historic built environment.

Where applicable, and feasible, documents to be discussed will be informally shared well in advance of meetings, to allow consultees to review and provide meaningful feedback with meetings.

Scope of Assessment

The proposed approach to scoping elements of the cultural heritage assessment is outlined in Table A11-1-1.

Table A11-1-1 – Scoping of Cultural Heritage Assessment

Matter	Project stage	Scoped in	Scoped out	Justification	Agreed with
Physical impacts to terrestrial archaeology and paleoenvironmental deposits	Construction	✓		There is known archaeology present within the Draft Order Limits and the potential for additional previously unrecorded buried archaeology and earthworks from all periods. The assessment will assess the significance of effect of both physical impacts to archaeology and deposits as well as the physical impacts that may occur through permanent changes to hydrology	Agreed at Scoping
Physical impacts to terrestrial archaeology and paleoenvironmental deposits	Operation		✓	Any physical impacts to terrestrial archaeology and palaeoenvironmental deposits will occur during the construction phase only.	Agreed at Scoping; see Scoping Opinion, ID 3.7.1.
Historic landscape character	Construction and Operation	✓		No significant effects to historic landscapes are anticipated, as much of the landscape will be returned to baseline conditions following construction. However, due to the potential for the loss of elements of the historic landscape (hedgerows, field boundaries, areas of ridge and furrow) the matter will be scoped in at this stage.	Agreed at Scoping.
Intertidal and marine archaeology at the River Humber	Construction and Operation		✓	The Project will include a trenchless crossing of the River Humber. The locations of the entry and exit points of the trenchless crossing will be a sufficient distance from the banks of the River Humber to avoid impact to the riverbanks and archaeology that may be present at low or high tide. It is assumed that the entry and exit points will be no closer to the riverbanks than those for the River Humber Gas Pipeline Replacement Project (PINS ref: EN060004) which scoped out impacts to this matter. The Project anticipates works under the River Humber will be at a depth of greater than 10m from the river bed; with the River Humber Gas Pipeline Replacement Project working at a depth of 6m. Therefore, it is proposed to scope out assessment of impacts to intertidal and marine archaeology in this location.	Agreed at Scoping; see Scoping Opinion ID 3.7.2.
Inter-tidal archaeology at Easington	Construction and operation	✓		Assessment of potential impact up to Mean Low Water Springs (MLWS) mark at Easington will be made.	Agreed at Scoping.
Marine archaeology at Easington	Construction and Operation		✓	Consent is only sought to the MLWS mark, near Easington, with any associated works beyond this point in the marine environment assessed and consented via the NEP offshore application.	Scoping opinion ID 3.7.3 seeks justification in the Environmental Statement as to why no significant effects are likely to occur.
Physical impacts to the historic built environment	Construction and Operation		✓	The Project has sought to exclude built structures from the Draft Order Limits and therefore there will be no physical impact to the historic built environment. Should impacts be unavoidable, this will be scoped back in.	Scoping Opinion ID 3.7.4 confirms acceptance of approach, welcoming the flexibility to scope back in the assessment should the design change.
All assets – impacts through changes in the setting of assets,	Construction and Operation	✓		Impacts that would arise due to changes in the setting of an asset that affect their value will be assessed. This will be for those assets within 500m of the	Agreed at Scoping.

Matter	Project stage	Scoped in	Scoped out	Justification	Agreed with
where that setting contributes to their value				Draft Order Limits with the potential for that Study Area to be extended around AGIs and the Pump Facility based on the results of a ZTV.	
All assets	Decommissioning		✓	Decommissioning is unlikely to result in significant effects to the cultural heritage resource. There will be no further physical impacts beyond those experienced during construction and any impacts that arise during the decommissioning of AGIs and Pump Facility will be temporary during the process of returning the site to pre-commencement/baseline conditions.	Agreed as per Scoping Opinion ID 3.7.5.

The scope of assessment, outlined above in Table A11-1-1, has been reflected in the PEIR and will be carried through into subsequent documents of the DCO process, including, the baseline study and ES.

Approach to Historic Environment Baseline

This section will discuss the approach to determining the Study Area and gathering information to inform the Historic Environment Baseline. The baseline will be captured in a standalone document, referred to as the 'baseline study', and will be appended to the ES.

This section of the document will also give an overview of the methodology to determine the historic environment's character and extent, and the significance of the historic environment. This will include any contribution made to the significance of an asset by its setting.

The baseline study will be written based on a thematic landscape approach to identify relationships between assets, which will contribute to their significance, and consider the overall evolution of the landscape narrative within the Project's draft Order Limits and Study Area footprint.

As a result of this information, scoping of heritage assets for impact assessment will be undertaken, depending on whether they are within the proposed draft Order Limits or if the setting of the asset extends to the proposed draft Order Limits and the land within the draft Order Limits makes a positive contribution to the significance of the asset. This is intended to capture any heritage assets that may experience a physical impact resulting from construction of the Project. Assets which may experience an impact due to a change to their setting that affects their significance during construction, or operation would also be captured.

The wider discussion in the baseline study will ensure that the context of the heritage assets assessed in the ES is fully understood.

The baseline study document will adhere to the Chartered Institute for Archaeologists (CIFA) standard and guidance for historic environment desk-based assessment (Ref 1), with the exception that assessment of the impact of the Project and any proposed mitigation will be contained in the ES chapter.

The baseline study will consider only terrestrial archaeology, the historic built environment and historic landscape character as set out in the EIA Scoping Report and Scoping Opinion and outlined in Table 1 of this document.

Study Area

The Project will establish a Study Area, buffered 500m from the latest draft Order Limits. The Study Area will be used to identify both designated and non-designated heritage assets. Due to the linear nature and length of the Project, it is believed that using a 500m

buffer, will provide adequate information to understand the archaeological potential of the Project, while also characterising and contextualising the historic environment within the Project's wider environs. Baseline data is being collected based on the current draft Order Limits, although this is expected to be refined in the ES, therefore collating more data for use in the assessment than is proportionate for the final assessment.

Due to the largely underground nature of the Project, it is considered that this is also sufficient to understand potential impacts on the setting of heritage assets, for the majority of the Project. Any changes to setting during the construction of the pipeline element, will be temporary and reversible.

The Study Area will be extended at the location of the AGIs in order to account for the increased likelihood of impacts through changes in the setting of assets, due to the above ground infrastructure. The assessment will utilise the landscape Zone of Theoretical Visibility (ZTV) in the AGI locations for the scoping in of additional designated assets beyond the 500m Study Area in these locations. Those additional assets within the ZTV will have their setting assessed in the baseline report to scope for potential impact. Only those whose setting is assessed to extend to the Project will be assessed in the ES chapter.

In order to sense check this approach, a rapid appraisal of the nearest Grade I and Grade II* listed assets beyond the 500m Study Area was undertaken. The majority of the assets were churches, with a setting unlikely to extend to the Project. The remainder were halls or high-status homes, that were either well screened from the Project by mature designed landscaping, did not have principal views toward the Project and/or their setting did not contribute to their significance.

Data Gathering

Data will be drawn from a range of sources and managed through a Project specific GIS system.

These reference sources will include:

- Historic Environment Record (HER) data for known archaeological sites, monuments, find spots and events.
- Archaeological reports (grey literature) on archaeological interventions within the draft Order Limits and AGI locations.
- Published archaeological journals and monographs, local history books and pamphlets, including local history websites as appropriate.
- Historic maps, including Ordnance Survey (OS), estate maps, enclosure maps, tithe maps and military plans, all available scales of OS maps will be utilised.
- Available aerial photographs, particularly the Project commissioned Unmanned Aerial Vehicle (UAV) drone aerial survey (see section 3.5 for more information).
- LiDAR data (see section 3.5 for more information).

- Historic Landscape Character information provided by the respective HERs, alongside appropriate regional Historic Landscape Character (HLC) statements/studies.
- Data sets of designations from Historic England's National Heritage List for England.
- Conservation area appraisals where these are publicly available on Local Planning Authority (LPA) websites.
- The results of a targeted walkover survey and setting assessment.

The results of the above resources will be used to supplement the existing baseline datasets. Any new assets identified will be added to the baseline document and recognised as a project specific identified asset.

Data Presentation

Known heritage assets identified from the sources listed above will be referenced using a consistent, Project specific identification number in the baseline study and ES. The preferred identification number (HER number/List Entry Number) from the organisations from which the datasets were received will be provided in a gazetteer accompanying the baseline study for cross reference. Descriptions of the heritage assets will be reproduced in the appended gazetteer to the baseline study.

The report discussion will be based on geographical route areas, which will aid discussion and mark areas of relevant interest for heritage officers responsible for the stewardship of specific areas of the Project. Embedded within the route discussion will be additional headings that will look to identify groupings of assets to help with the contextualisation of the individual assets, contributing to an understanding of their significance; whilst building an overall narrative of the historic development of the landscape.

Asset groupings and individual heritage asset data sets will be illustrated on accompanying figures to the baseline study. The figures will support the presentation of discussion thematically.

Aerial Imagery for Assessment and the Scoping of Walkover

The first use of the aerial imagery will include the identification of potential heritage assets through an assessment of cropmarks and identification of earthwork features.

The aerial imagery has been provided to the team as a model, akin to a form of photogrammetry recording of the landscape. The models can therefore be used alongside other data sets to further understand asset's relationships within the landscape and aid the consideration of archaeological potential.

Areas of archaeological interest and identified heritage assets will be mapped in GIS, against their location on the model and incorporated into the wider Project GIS data set and gazetteer to contribute to assessment. Identified areas of archaeological interest will be further assessed during walkover survey, discussed below.

LiDAR

During the flight for aerial imagery, a Digital Terrain Model (DTM) and Digital Surface Model (DSM) of the flight corridors were also collected. Both the DTM and DSM have been processed in GIS to create hill shade models for the identification of archaeological features.

The DTM and DSM models are available at 25cm resolution. Each DTM and DSM have been processed into several hill shades with variation in either the Azimuth (Angle) and or the Altitude (Height). Processing of different hill shades is to allow for the best opportunity to identify archaeological features, which may show up in certain hill shade processes.

The LiDAR data will be assessed to identify features of potential archaeological interest, as either new heritage assets for the baseline or to supplement knowledge of existing heritage assets catalogued in the respective HERs.

Scoping of Walkover

It is intended to use the aerial imagery data to analyse where a walkover will provide value to the baseline understanding of the Project. The aerial imagery is also useful as an indicator of the current ground conditions within the draft Order Limits.

Walkover of areas under crop or deep plough has limitations for identifying archaeological features within heavily cultivated fields. While it is acknowledged that artefacts brought to the surface from ploughing have the potential to provide evidence for the location of archaeological sites, the purpose of the walkover survey is to ground truth site conditions, and not to conduct a systematic fieldwalking exercise.

As a result, the walkover will be targeted with areas scoped in or out for site visits, to aid a proportionate approach to assessment. Scoping of the targeted walkover will focus on areas of perceived limited modern disturbance and areas not 'neglected' which may have resulted in overgrown vegetation. The scoping of areas to visit will be data led and only where ground truthing of the conditions of heritage assets will be possible.

Areas scoped out of the walkover:

- Areas of existing infrastructure, industrial complexes, private gardens, or areas of hardstanding where only observations of modern disturbance would be available on site and the character of the area has been altered. It is anticipated these areas of infrastructure will be avoided by the Project.
- Areas of dense woodland or thick scrubland where identification of any potential earthworks will be difficult. It is anticipated these areas will be avoided by the Project.
- Fields which have been subject to previous archaeological investigations, such as geophysics and or excavation. A walkover survey would not be able to supplement information on heritage assets supplied by intrusive fieldwork.
- Areas removed from the Project, following refinement of design, which are not yet surveyed.

Areas scoped in to the walkover:

- Fields with monument records to ground truth the condition of the asset.
- Fields within the draft Order Limits in close proximity to a designated heritage asset for the purpose of supporting the setting assessment.
- Fields where potential assets or activity of interest have been identified through LiDAR or the aerial imagery.
- Grassland which have been identified through the aerial survey and considered to hold a greater potential to identify any standing earthworks due to an assumed limited disturbance from agricultural activity.

Where a field does not meet any of the above criteria, the field is scoped out for the walkover. The draft Order Limits is principally ploughed fields, and it is acknowledged that there are limitations in identifying features of archaeological interest within ploughed fields due to modern agricultural practices. It is estimated that approximately 50% of the proposed draft Order Limits will be visited, but the exact area will be determined through the analysis of the aerial imagery.

The final data set of assets identified and ground-truthed through the walkover, will be incorporated in the main baseline and gazetteer, discussed in section 3.6.

Walkover Methodology

The walkover will involve visiting scoped in areas, to assess the presence of any visible areas of past human activity. Whilst a scan of areas for surface finds will be conducted, the walkover will not be a systematic survey of field walking in transects.

The analysed data used to scope areas into assessment will be available to surveyors in the field, including the original aerial imagery. Surveyors will have use of a digital tablet that will have a GIS app installed, where up to date baseline data will be available and the latest Project information also displayed to consider all elements of the assessment together.

The GIS will allow surveyors to make accurate digitised records of observations, as well as taking geo-referenced photos for later use in the office. The information recorded using the GIS platform on the digital tablet can be easily pulled from the platform and integrated into the main GIS data set for use in the remaining assessment and presentation.

Any observations of perceived archaeological interest by surveyors, in addition to the already known assets from other sources, will be added to the Project gazetteer and reported in the baseline study. The detail of observations from the walkover will be an annex to the baseline study, with appropriate, proportionate supplementary information to the main narrative included in the main body of the baseline study.

Settings Assessment

In tandem with the site walkover, a settings assessment will also be undertaken. Recording of observations for the settings assessment, including a photographic record, will be undertaken using the same GIS application outlined in Section 3.6.

The contribution that setting makes to significance will be determined with reference to Historic England's guidance. The assessment of setting will utilise the 'five-step' approach given in part 2 of the good practice advice (GPA3) note (Ref 2).

Assessment will consider the setting of both the historic built environment and buried archaeology. This assessment will be principally carried out on site, whilst experiencing the setting, and reported on in the baseline study, where appropriate. Setting assessment of buried archaeology will be limited to where it is demonstratable that a setting exists and makes a contribution to the asset's value.

Assets will be grouped where appropriate and assessed collectively. For example, asset categories such as gates, gateposts and walls, where they have a distinct connection with other assets e.g. churches and halls will be assessed as a group with the churches/halls they are associated with. Where assets share the same setting e.g. a group of listed buildings within a conservation area noted as the historic core of a village, they will also be assessed as a whole, where this is proportionate and appropriate.

An initial rapid appraisal will be undertaken to identify areas where it is thought that there is limited potential for impacts through changes in the setting of assets. This may be due to, for example, local topography or the presence of intervening development and vegetation, which will be supported by the ZTV for areas around AGIs. This theory will be ground-truthed during site visits and where supported by site observations, assets will be immediately scoped out of further assessment and their significance not considered in more detail.

The assessment of curtilage will not be a standard consideration alongside setting, and therefore not applied across the Project Study Area. Design principles to avoid physical impacts to listed buildings and built structures generally are anticipated to result in the avoidance of any land immediately surrounding buildings. Therefore, very few (if any at all) cases where curtilage becomes a relevant factor of assessment is anticipated.

Assigning Value to Heritage Assets

Based on the understanding of heritage assets, including their group context within the landscape, an assessment of value will be provided within the baseline study.

Value will be provided for individual assets, not groups, but the value will account for the contribution the asset makes to the group and vice versa for the contextualisation of the asset in relation to others.

The value (heritage significance) of an asset will be derived from its ability to illustrate one or more of the heritage interests as outlined in National Planning Policy Framework (NPPF), which are artistic, architectural, historical and archaeological.

Use of these interests will also meet emerging recent guidance for cultural heritage impact assessment, which advocates for:

- A separate description stage that should ensure that the analysis of cultural significance, which follows, actually articulates the key cultural heritage values that are recognised in the asset and is not simply a description of all of the components of the asset (Ref 3).
- As discussed in section 3.7, the contribution of setting to the significance of a heritage asset will also be considered in as part of the assessment of value within the baseline study.
- Accounting for the significance of a heritage asset through their ability to demonstrate one or more heritage interests, the contribution of setting, and professional judgement, the following criteria will be used for assigning value:

Table A11-1-2 – Heritage Value Assessment Criteria

Value	Criteria for HCCP
Very High	World Heritage Sites (including nominated sites) inscribed for their cultural heritage importance. Assets that can contribute significantly to acknowledged international research objectives. Assets of acknowledged international importance.
High	Scheduled Monuments (including proposed sites) Grade I and II* Listed Buildings Grade I and II* Registered Parks and Gardens Registered Battlefields Protected Wrecks Conservation Areas containing buildings of predominantly high value. Non-designated assets of the quality and importance to be designated. Assets that can contribute significantly to acknowledged national research objectives.
Medium	Grade II listed buildings Grade II Registered Parks and Gardens Conservation Areas containing buildings of predominantly medium value. Assets that contribute to regional research objectives and/or have exceptional quality in their fabric or historical associations.
Low	Locally listed buildings, or those of equivalent quality in their fabric or historical associations.

Value	Criteria for HCCP
	Assets of local importance. Assets compromised by poor preservation and/or poor survival of contextual associations. Assets of limited value, but with potential to contribute to local research objectives.
Negligible	Assets with very little or no surviving archaeological/historical interest Buildings of no architectural or historical note; buildings of an intrusive character
Unknown	The importance of the resource has not been ascertained/is inaccessible

The value of the heritage asset, assigned in the baseline study, will be carried into the environmental statement for discussion of impact and proportionate mitigatory measures, discussed further in Sections 4 and 5 of this document.

Archaeological Potential

The baseline study will also present an understanding of the likelihood for hitherto undiscovered archaeological remains to be present within the draft Order Limits. The assessment of archaeological potential will identify the likelihood of the presence of unidentified archaeological remains based on an analysis of the available data sets, previous archaeological findings within the Study Area and professional judgement.

This will be supplemented with mapping of activity to geological and topographical landscape features / zones. Historic and modern impacts that might potentially have degraded the archaeological resource will be examined to assist in this process. Discussion of archaeological potential will require a holistic approach from baseline assessment to predicting patterns of past activity.

This section will include a narrative about the nature of the archaeological resource along the route by location and period. This will be essential in aiding the understanding of the nature of human activity since the prehistoric period, the evolving nature of settlement and exploitation of the landscape, the way in which past communities have harnessed local resources and consequently the way in which surviving archaeological remains reflect these activities.

In this document archaeological potential is classified as:

- High for areas where there is a strong likelihood of finding archaeological remains of a given period or type.
- Medium for areas where there is a likelihood of finding archaeological remains of a given period or type.

- Low for areas where there is little likelihood of finding archaeological remains of a given period or type.

It is intended that as part of a staged approach to assessment the baseline study, particularly the archaeological potential section, will be used to discuss potential further assessment work. The scoping of further works would be led by a series of research questions to tailor a proportionate and targeted approach to the gaps in our understanding, following the baseline study. Therefore, any results from such further assessment will be captured in an update of the ES baseline and or the mitigation strategy, dependent on the programme of this work.

Specialist Technical Input

Inter-tidal Archaeological Assessment

The Project has procured a specialist archaeological contractor to study the baseline for inter-tidal archaeology at the Easington landfall location only. The scope of the assessment will be the study of the archaeological character and potential for the area between Mean High-Water Springs (MHWS) and MLWS, at landfall.

A desk-based assessment (DBA) for the inter-tidal location at Easington was completed in July 2022 (Coracle Archaeology). This document remains valid for its assessment of the baseline at the time with little change expected. However, an addendum will be produced to inform the DCO application, to consider potential changes in baseline since July 2022 and allow weighing up of impact from potential changes in design assumptions.

The baseline assessment for inter-tidal archaeology of the Holderness Coast will form an appendix of the ES. Impact, as appropriate, to the intertidal archaeology baseline of the Holderness Coast will be assessed within the Cultural Heritage Chapter of the ES, alongside assessment of impact to terrestrial archaeology.

Geoarchaeology Assessment

The Project has commissioned a specialist geoarchaeological desk-based assessment as a technical appendix to the cultural heritage ES chapter. The geoarchaeology assessment will include a deposit model, to provide preliminary data on the nature and depth of the sediment sequences along the route. The characterisation of the deposit sequences will support the baseline understanding of the historic environment, particularly the assessment of potential for archaeological and paleoenvironmental remains and help inform the design of future investigation and mitigation strategies.

In order to compile the deposit model, the heritage assessment is seeking to utilise the opportunity to monitor the Project's engineering led Ground Investigations (GI). This may be supplemented by geoarchaeological boreholes where appropriate.

A geoarchaeology Written Scheme of Investigation (WSI) will be shared with consultees prior to undertaking the survey, but the work will be undertaken by a specialist with proven experience in the technique, and to guidance outlined by Historic England (2015, 2020) (Ref 4 and 5).

Geophysical Survey

The Project has procured Headland Archaeology to conduct Geophysical Survey along targeted sections of the route and provide the associated reporting. The survey will be used to inform areas for further intrusive investigation and mitigation.

It is considered that magnetometer survey will be the most cost-effective and suitable method for survey based on the current knowledge of the draft Order Limits. There are no current plans to supplement this with other remote sensing surveys. It is likely that a cart system will be employed for the majority of the survey, but that this may be supplemented by hand survey where necessary.

The purpose of the survey is to identify the presence or absence of magnetically anomalous features within the Project route; and where present to define their extent (where possible) and nature. The results will be used to inform both ongoing design works, where avoidance may still be feasible, and further non-intrusive or intrusive investigations.

Areas for survey will be selected using the data collated in the baseline study and supplemented by information gathered during the targeted walkover surveys. It is intended that the geophysical survey will be undertaken within a 180m buffer of the proposed pipeline route, rather than the entire draft Order Limits for the Project. As the pipeline is anticipated to have a 40m wide working easement, this will allow for deviation in design whilst still capturing sufficient information to inform further investigation.

The survey will specifically exclude the following areas:

- Those areas which have already had geophysical survey and/or trial trench evaluation.
- Areas of made ground or hardstanding.
- Woodland.
- Any areas that are too small, where opportunity for data collection would be limited and results would provide no meaningful interpretation.

It is likely that a staged programme of survey will be required in order to account for limitations in land access, seasonal conditions (in particular waterlogging of fields) and the presence of crops across much of the route.

An appropriate and experienced contractor will provide a specific methodology/WSI for approval prior to undertaking the fieldwork.

Reporting of the previous survey completed by Magnitude Surveys in 2023 and 2024 will be undertaken and submitted as an appendix to the ES chapter. Due to design changes,

much of the survey data is no longer relevant to the current design of the Project. Data located outside the latest Project design will be reported on as part of an appendix to the main report, to aid the reader with what remains relevant to the ES.

Trial Trench Evaluation

Based on the results of the geophysical and geoarchaeological survey and the information gathered during walkovers and the assessment of aerial prospection results, a scheme of archaeological evaluation will be developed. The evaluation will be used to determine, record and report on the nature, extent, preservation and significance of archaeological remains across the Project route.

Trenches will be located in order to target features noted during the geophysics, those located during walkover and to test the presence of assets noted in the HER data. 'Blank areas' of the geophysical survey will also be trenched in order to test the efficacy of the data. Whilst it is acknowledged that different local authority areas may have specific expectations in terms of trenching percentages and methodologies, the project will be looking to adopt a single working methodology across the Project route in order to create a data bias.

Whilst the percentages of trenching will be discussed within the Heritage Working Group, it is intended to base the trenching on a general principle of 3% coverage, with a potential contingency. Contingency will only be used in consultation with the local authority where it will demonstrably add to our understanding of significance or where it is considered that it will negate the requirement for further investigation or mitigation.

Trenching will not be undertaken on any areas of the route that may not end up in the final design submitted at DCO, to prevent abortive work that would otherwise harm the archaeological resource.

It should be noted that any programme of intrusive archaeological evaluation will require consideration of ecological and other requirements, that are likely to outweigh the justification for trench location.

Given land access constraints it is unlikely that the full extent of the route will be subject to evaluation prior to the application for consent. However, it is considered feasible that enough of the Project will have been evaluated that the consultees will be able to make an informed decision on the likely impacts of the Project, and that the work undertaken will be sufficient to inform an outline heritage mitigation strategy that will be submitted prior to or during the examination process. It is understood that archaeological mitigation will form part of the Construction Environment Management Plan (CEMP) submitted with the DCO.

On the basis that evaluation may be ongoing during the examination process, interim reports will be shared with the consultees in order that decision making can be made based on the most up to date information. However, it should be noted that all evaluation

work will meet the standards and guidance as outlined by ClfA and will therefore be reported on and archived fully to satisfy those standards.

A ClfA Registered Organisation will be sub-contracted for the archaeological evaluation. They will compile a WSI for the works based on a provided scope.

At the time of writing, the Project is seeking to procure services for trial trenching.

Approach to Impact Assessment

In establishing impact, the Overarching National Policy Statement for Energy (EN-1) (Ref 6) has the following discussion:

Paragraph 5.9.11 states ‘Where a site on which development is proposed includes, or the available evidence suggests it has the potential to include, heritage assets with an archaeological interest, the applicant should carry out appropriate desk-based assessment and, where such desk-based research is insufficient to properly assess the interest, a field evaluation. Where proposed development will affect the setting of a heritage asset, representative visualisations may be necessary to explain the impact’.

Paragraph 5.9.24 states ‘In considering the impact of a proposed development on any heritage assets, the Secretary of State should consider the particular nature of the significance of the heritage assets and the value that they hold for this and future generations. This understanding should be used to avoid or minimise conflict between their conservation and any aspects of the proposal’.

Paragraph 5.9.30 states ‘Substantial harm to or loss of designated assets of the highest significance, including Scheduled Monuments; registered battlefields; grade I and II* listed buildings; grade I and II* registered parks and gardens; and World Heritage Sites, should be wholly exceptional’.

The Project acknowledges the 2021 draft version of EN-1. However, as this document is currently a draft, use of the adopted 2011 version will remain the principal approach until superseded by an approved update.

There is no consistent methodology adopted for cultural heritage for assessing impacts on historic environment assets as part of an EIA, particularly for energy proposals. However, the International Council on Monuments and Sites (ICOMOS) have published guidance on Heritage Impact Assessments for Cultural World Heritage Properties (Ref 7).

There is also recent guidance from CIFA, Institute of Historic Building Conservation (IHBC) and Institute of Environmental Management and Assessment (IEMA), through the July 2021 document ‘Principles of Cultural Heritage Impact in the UK’. The guidance notes that:

The magnitude of the impact on cultural significance needs to be assessed. A distinction needs to be drawn as to whether the change will result in only a ‘small’ impact on, say just one component of cultural significance or whether the change would have a greater

impact on the totality of cultural significance. The terms 'large' 'medium' or 'small' are acceptable or any other simple scale that offers a form of gradation easily articulated in a written report (Ref 3).

A simple graded scale of effects should be defined and applied. However, decisions regarding the acceptability of the proposal will often require the effect to also be articulated within the parameters of the relevant legislative or policy tests that use their own specific language and terminology. For instance, in Environmental Impact Assessment, an impact can result in a significant or non-significant effect (Ref 3).

Where there is any potential for an impact to a heritage asset resulting from the Project, these assets will be assessed in full in the ES. This assessment will utilise the assessment of value assigned to heritage assets in the baseline study and will assign a magnitude of impact in line with the most up to date design information for the Project.

Potential impacts to heritage assets could arise from construction activity, including creation and use of access routes and traffic management, site compounds and working/storage areas, and the operational presence of AGIs. In addition, the potential impact of other environmental mitigation, such as ecological habitat creation or landscape planting, will be assessed for any impact to heritage assets.

Accounting for the above discussion, the following terminology for describing the magnitude of impact, is presented in Table A11-1-3.

Table A11-1-3 – Criteria for quantifying the magnitude of impact to heritage assets

Magnitude of Impact (term)	Criteria of impact
High	Change to most or all key archaeological materials, such that the resource is totally altered Comprehensive changes to setting of archaeology or the historic built environment Change to key historic building elements, such that the resource is totally altered
Medium	Changes to many key archaeological materials, such that the resource is clearly modified Considerable changes to setting that affect the character of the asset Change to many key historic building elements, such that the resource is significantly modified Changes to the setting of an historic building, such that it is significantly modified
Low	Changes to key archaeological materials, such that the asset is slightly altered Slight changes to setting Change to key historic building elements, such that the asset is slightly different Change to setting of an historic building, such that it is noticeably changed
Negligible	Very minor changes to archaeological materials, or setting Slight changes to historic building elements or setting that hardly affect it
No change	No change

Following an assessment of the magnitude of impact, mitigation measures may be proposed (discussed further in section 5).

The significance of effect is expressed as a result of the value of the heritage asset and the magnitude of impact it would experience as a result of the Project. The significance will be expressed as major, moderate, minor, negligible or neutral and can be adverse or beneficial. The matrix for reporting of significance of effect is outlined in Table 4, adapted from 'Heritage Impact Assessments for Cultural World Heritage Properties' (Ref 7).

Table A11-1-14 – Significance of effects matrix

		Value of Heritage Asset				
		Very High	High	Medium	Low	Negligible
Magnitude of impact	High	Major	Major	Major to moderate	Moderate to Minor	Minor
	Medium	Major to Moderate	Major to Moderate	Moderate	Minor	Negligible
	Low	Major to Moderate	Moderate to Minor	Minor	Negligible	Negligible
	Negligible	Minor	Minor	Negligible	Negligible	Neutral
	No Change	Neutral	Neutral	Neutral	Neutral	Neutral

The matrix will be used as a check to ensure that judgements on value, magnitude of impact and significance of effect are balanced, but in all cases professional judgement will be used and the value and impact judgements will be revisited if the significance of effect is unreasonable.

For the purpose of this assessment, a significant effect is a moderate or major effect. These significances of effect will be the primary focus of the main ES chapter.

Mitigation

Proposed mitigation measures will be proportionate to the level of impact and the value of the heritage asset. The need for a proportionate approach is outlined in the 2021 CIFA / IEMA / IHBC document which states:

The process should be proportionate to the importance of the cultural heritage assets being assessed. It should recognise the scale of the proposal and the potential magnitude of the impact (Ref 3).

An outline draft heritage mitigation strategy will accompany the ES chapter where an understanding of required mitigation measures will be located. It is intended that the

outline heritage mitigation strategy will remain a live document throughout the examination phase of the DCO application, to capture any changes in baseline understanding, impact and therefore required mitigation following delivery of any fieldwork results post DCO submission.

Additional heritage input will also be made to central Project documents such as the CEMP to ensure appropriate mitigation measures are secured in the DCO for both archaeology and the built historic environment, where appropriate.

References

- Ref 1: CIFA (2014). Standard and guidance for historic environment desk-based assessment. Reading: The Chartered Institute for Archaeologists.
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- Ref 3: CIFA; IEMA; IHBC (2021). Principles of Cultural Heritage Impact Assessment in the UK. Lincoln: IEMA.
- Ref 4: Historic England (2015) Geoarchaeology: Using an earth sciences approach to understand the archaeological record
- Ref 5: Historic England (2020) DEposit modelling and archaeology: Guidance for mapping buried deposits
- Ref 6: Department of Energy and Climate Change (2011). Overarching National Policy Statement for Energy (EN-1). London: Her Majesty's Government (UK).
- Ref 7: ICOMOS (2011). Guidance on Heritage Impact Assessments for Cultural World Heritage Properties. Paris, France: International Council on Monuments and Sites.

Appendix 11.2 – Geoarchaeology DBA

Humber Carbon Capture Pipeline

East Riding of Yorkshire, North
Lincolnshire and North Yorkshire

Geoarchaeological Desk Based Assessment

October 2025

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Humber Carbon Capture Pipeline, East Riding of Yorkshire, North Lincolnshire and North Yorkshire

Geoarchaeological Desk Based Assessment

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Glossary of Terms and Acronyms

AD	Abbreviation of Anno Domini
ADS	Abbreviation of Archaeological Data Service
AGI	Abbreviation of Above Ground Installation
Alluvium	Typically, fine-grained sediments deposited by flowing floodwater
BC	Abbreviation of Before Christ
BGS	Abbreviation of British Geological Survey
BP	Abbreviation of Before Present
cal BP/BC	Abbreviation for calibrated years Before Present/Before Christ (used in radiocarbon dating)
Carr	An environment of wet fen woodland or scrub typically dominated by alder and/or willow.
CCUS	Abbreviation of Carbon Capture, Usage and Storage
Chronostratigraphy	The application of time to sequences of rock layers to understand their ages
Colluvium	Sedimentary material deposited at the base of slopes by erosive processes
DEM	Abbreviation of Digital Elevation Model
Diamicton	Unsorted or poorly sorted deposits, typically of glacial origin (including till and boulder clay) but which have also been affected by additional processes such as solifluction or debris flow
EA	Abbreviation of Environment Agency
ECC	Abbreviation of East Coast Cluster
Ecotonal	Pertaining to a transitional area bridging two or more distinct ecological zones/environments
Esker	A long ridge of sands and gravels deposited by meltwater channels within/stemming from a retreating glacier or ice sheet.
Eutrophic wetland	A wetland environment that has become highly enriched with nutrients, primarily nitrogen and phosphorus
Fen carr	A type of wet woodland characteristic of lowland wetland fringes, typically dominated by willow, birch and alder
Fluvial	Of or relating to rivers and other watercourses
GDBA	Abbreviation of Geoarchaeological Desk-Based Assessment
Geoarchaeology	The application of earth science principles and techniques to the understanding of the archaeological record
Geomorphology	The study of the physical features (ie, topography) of the Earth's surface and their relation to geological processes

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GI	Abbreviation of Geotechnical/Ground Investigations
Glacio-eustatic	Sea level change resulting from changes in the volume of terrestrial glacial ice
Glacigenic	Sediments laid down within or under glacier ice or deposited by an ice sheet
Glacio-isostatic	The reactionary movement of land masses following the removal of glacial ice burden
HCCP	Abbreviation of Humber Carbon Capture Pipeline
HE	Abbreviation of Historic England
Interstadial	A period of slightly warmer climate during a glacial period, associated with reduced ice volumes and the retreat of glaciers
Ka	Abbreviation of thousand years ago
Kettle hole	A depression or hole formed by melting blocks of dead ice within a glacial outwash plain
Lacustrine	Of or pertaining to lakes
LCA	Abbreviation of Landscape Character Area, referring to geographically distinct areas or regions defined by their topography, vegetation, land use, history and cultural associations
LGM	Abbreviation of Last Glacial Maximum
LiDAR	Abbreviation of Light Detection And Ranging
Littoral	Relating to, or situated on, the shore of a sea or lake
Ma	Abbreviation of million years ago
Marine regression	A period of rising sea levels in which previously dry land is inundated by seawater and perimarine environments (eg saltmarsh) are driven further inland
Marine transgression	A period of falling sea levels in which previously inundated areas are exposed and develop into dryland and/or perimarine terrestrial environments
mbgl	Abbreviation of metres below ground level
MIS	Abbreviation of Marine Isotope Stage
m OD	Abbreviation of metres above Ordnance Datum (aka current average sea level)
Moraine	A mass of rocks and other sediment deposited by a glacier, typically along its frontal terminus
NEP	Abbreviation of Northern Endurance Partnership
NGR	Abbreviation of National Grid Reference

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NSIP	Abbreviation of Nationally Significant Infrastructure Project
OA	Abbreviation Oxford Archaeology
OS	Abbreviation of Ordnance Survey
OSL	Abbreviation of Optically Stimulated Luminescence
Palaeochannel	A former river or stream channel which no longer forms part of an active fluvial system, often being buried beneath later sediments
Palaeoenvironment	Environmental conditions at a given period in the past
Palaeotopography	Surface relief at a given period in the past
Paludification	The conversion of forested or other dryland environments to peatlands due to rising water levels and attendant vegetation change
Palustrine	Of or pertaining to freshwater wetlands dominated by vegetation (ie swamps, marshes, bogs, etc)
Periglacial	Environments situated on the peripheries of glaciated regions
Perimarine	Of or pertaining to terrestrial areas near a marine interface, often experiencing partial and/or periodic inundation, eg saltmarshes
Proglacial	Areas or landforms situated in front of a glacier or ice sheet
Radiometric dating	Scientific techniques used to date materials by measuring the rate of decay of specific radioactive isotopes, most commonly carbon
Roddon	The dry, raised bed of a former watercourse
RSL	Abbreviation of Relative Sea Level
Solifluction	A geomorphic process whereby water saturated sediments are slowly transported downslope through gravity
SSSI	Abbreviation of Site of Special Scientific Interest
Stadial	period of cold climate during a glacial period, associated with ice accumulation and the advance of glaciers
Taphonomy	The study of states and processes of preservation, in archaeology often relating to the preservation of organic matter (including archaeological artifacts)
Till	Unsorted and unstratified debris transported and deposited by a glacier or ice sheet, typically without subsequent fluvial reworking
Warp	Artificially induced alluvium, often used to raise ground levels and improve agricultural land in floodplain areas
WSI	Abbreviation of Written Scheme of Investigation

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SUMMARY

Oxford Archaeology (OA) was commissioned by Arcadis (UK) Ltd, on behalf of the Northern Endurance Partnership (NEP), to undertake a geoarchaeological desk-based assessment (GDBA) of the proposed route of the Humber Carbon Capture Pipeline (HCCP; henceforth, 'the Project') located across parts of Yorkshire and Lincolnshire. The Project is a Nationally Significant Infrastructure Project (NSIP) as set out in the *Planning Act 2008*, comprising the construction of a single underground carbon dioxide pipeline to facilitate carbon capture, usage and storage (CCUS), together with associated above ground installations (AGIs).

This assessment provides a baseline high-level review that broadly characterises the topography, bedrock geology, and associated superficial sediment sequences likely to be encountered across the Project through a review of regional models of landscape evolution, LiDAR data, geological mapping and historical borehole data. Overall, the assessment aims to provide an initial qualitative evaluation of geoarchaeological potential prior to more detailed deposit modelling underwritten by a future programme of purposive geoarchaeological investigations. This modelling is intended to inform further archaeological strategies throughout the course of the Project. The information provided by this report should be considered in conjunction with a separate archaeological desk-based assessment being produced by Arcadis.

The Project stretches for c. 110km from Easington in eastern Holderness, across the Humber Estuary, parts of the Lincolnshire Wolds, the Ancholme Valley, Lincoln Edge, the lower Trent Valley, and the Humberhead Levels to Drax Power Station in the lower Vale of York. The entire Humberside area once formed part of the continental landmass of Doggerland and only became separated from the European mainland following the postglacial inundation of the North Sea. Sea level changes throughout the Pleistocene and Holocene have greatly impacted the sediment packages all along the coastline and up the Humber Estuary, and the Project is hence discussed from east to west (ie, from the coast, inland) throughout this report to reflect this overarching history of landscape evolution.

The broader region is well known for its rich wetland and floodplain archaeology, with evidence of fish traps, log boats, rafts, historical mills, and bridges all previously being recovered from peatlands and postglacial sand and gravel deposits sealed beneath thick blankets of later alluvium and warp. The Project also crosses several large, low-lying river valleys, which historically provided access to both riverine and surrounding wetland resources and have previously produced evidence of both ritual and settlement activity throughout their catchments.

The geoarchaeological assessment has shown that there is scope across the Project for the potential preservation of both pre-Devensian and Devensian (Palaeolithic) deposits, as well as postglacial and Holocene (Mesolithic to postmedieval) archaeological and palaeoenvironmental remains.

Previous historical borehole data are available across the Project but are generally sparsely distributed and of limited utility. Where sufficient historic data is available to support future deposit modelling, this is indicated throughout the text and tabulated in Appendix A. Accordingly, any further deposit modelling will have to rely on data obtained from Project-specific ground interventions, either that derived from geotechnical works and/or through purposive geoarchaeological interventions.

ACKNOWLEDGEMENTS

Oxford Archaeology would like to thank Arcadis for commissioning this project. The project was managed for Oxford Archaeology by Elizabeth Stafford (Head of Geoarchaeology) and Steve Rowland (Senior Project Manager), and the report prepared by David Kay (Geoarchaeologist), partly utilising materials drawn together for an earlier version of the GDBA authored by Mairead Rutherford. The figures were prepared by Caroline Souday and Anne Stewardson.

1 INTRODUCTION

1.1 Project details

- 1.1.1 Oxford Archaeology (OA) was commissioned by Arcadis UK Ltd ('the client'), on behalf of the Northern Endurance Partnership (NEP), to undertake a high-level geoarchaeological desk-based assessment (GDBA) of the proposed onshore route of the Humber Carbon Capture Pipeline (HCCP; henceforth 'the Project'). The Project comprises an underground pipeline (with associated above ground facilities required for operation and maintenance) that aims to transport carbon dioxide produced by industrial projects and power generating facilities in the Humber region to secure offshore storage under the North Sea. The Project forms part of the East Coast Cluster (ECC) and is crucial to achieving net zero targets in the Humber, the UK's most carbon-intensive industrial region.
- 1.1.2 The proposed Project route extends for c. 110km from its coastal landfall at Easington in the East Riding of Yorkshire to its terminus at Drax Power Station in North Yorkshire (Figure 1). For the operation of the wider Project this overarching route has been divided into three contiguous sections: Section 1 – Drax to the River Trent; Section 2 – River Trent to the Humber; Section 3 – Humber to Easington (though for the purposes of this GDBA the route is discussed in smaller sections from east to west, cf Section 1.2.3).
- 1.1.3 The Project crosses a landscape that is both archaeologically rich and topographically diverse, straddling several river valleys and fluvial confluences, as well as the geologically and historically significant Humber Estuary itself. This GDBA is the first element of a multi-stage approach to characterise the deposits traversed by the Project, especially those that might seal previously unidentified archaeological and/or palaeoenvironmental remains. As such, this GDBA presents an initial qualitative review of the available data and provides a preliminary framework for understanding the presence of burial environments across the route that have the potential to preserve archaeological and/or palaeoenvironmental remains at multiple spatial and chronological scales.
- 1.1.4 Particular focus will be paid to deposits associated with existing and former river courses, floodplain valleys, lakes and meres, where Pleistocene and Holocene deposits typically exhibit a higher potential for preservation. These initial lithostratigraphic data will be based largely on previously published data for the Humber Estuary, existing BGS (British Geological Survey) borehole records and an assessment of the superficial geological deposits mapped by the BGS across the Project.
- 1.1.5 The geoarchaeological potential will be assessed across the Project based on the assessment of this data, with areas of poor data coverage also highlighted. Following completion of this geoarchaeological assessment, a phase of proportionate and targeted fieldwork may be appropriate, potentially combined with geotechnical ground investigations. Data resulting from
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interventions during this phase would be used to build a project specific deposit model, to investigate specific deposit sequences within landscape areas of higher geoarchaeological potential in greater detail.

1.2 Location and regional topography

1.2.1 The Project comprises the c. 110km route (the 'draft Order Limits') of a single pipeline extending west from its coastal landfall at Easington on the Holderness coast of the East Riding of Yorkshire to Drax Power Station in North Yorkshire, crossing the tidal Humber Estuary and Lower Trent Valley *en route* (Figure 1).

1.2.2 At a regional scale, this landscape comprises a horizontal transect across the catchment of the tidal Humber Estuary. The Estuary itself outfalls into the North Sea between the Lincolnshire Marshes to the south and the long spit of Spurn Head to the north (Figure 2); and extends westward to the 3km wide Humber Gap where the river passes between the scarps of the Yorkshire and Lincolnshire Wolds. West of the Humber Gap, the river is formed from the various confluences of the Rivers Ouse, Derwent, Aire, Don, Trent and Foulness, with the Humber itself commencing at Trent Falls between Goole and Hull. The southern Vale of York and Humberhead Levels then mark a broad extent of low-lying former wetlands (now mostly artificially drained) across the western head of this wider catchment (Figure 2).

1.2.3 The scale of the Project means that it crosses a variety of more localised landscapes exhibiting their own distinct geomorphological characteristics within this wider region. Accordingly, geoarchaeological discussion of the Project throughout this GDBA is divided into seven 'Landscape Character Areas' (LCAs; Figure 3). As postglacial sea level changes have significantly impacted sediment packages all along the coastline and up the Humber Estuary, the Project and its constituent LCAs are discussed from east to west (ie. from the coast, inland) throughout this report to reflect this overarching history of landscape evolution.

1.2.4 The seven LCAs crossed by the Project comprise:

- Holderness
- Humber Estuary
- Lincolnshire Wolds
- Ancholme Valley
- Lincoln Edge
- Trent Valley
- Humberhead Levels

1.2.5 However, as these areas are of varying size, and several are extremely large, the Project-specific data displayed in Figures 10-12 has been split into a series of equally sized overlapping sections, also arranged from east to west (Figure

4, insets a-j), such that the full extent of the draft Order Limits can be viewed at the same scale in continuous sequence. Reference to the appropriate figures when discussing individual LCAs are made throughout the text.

1.3 Localised topography

- 1.3.1 **Holderness:** Holderness is a coastal lowland of the East Riding of Yorkshire. To the north and west lie the Yorkshire Wolds and Hull Valley, to the south is the Humber Estuary, and to the east is the North Sea (Figures 2-3). The Project passes westwards through this LCA from Easington on the coast towards Winestead (crossing the small valley of the now-canalised Winestead Drain in the process), before heading west onto the lower-lying fringes of the Humber Estuary. The topography of the central and eastern part of Holderness is generally low and gently undulating (c. 10-20m OD), whereas in southern Holderness the landscape generally lies below c. 10m OD (Tweddle, 2000). Localised wetland areas have formed around small meres in the east. The relatively higher ground in the east forms the main watershed which drains inland via a network of natural streams modified as artificial channels, of which the Winestead Drain is a notable example (Van de Noort and Ellis, 1995).
- 1.3.2 **Humber Estuary:** the Project route runs across the northern fringes of the Humber Estuary before crossing the river to the southeast of Kingston-upon-Hull and north of Immingham. The 'Humber Gap' through which the estuary passes essentially separates the Yorkshire Wolds to the north from the Lincolnshire Wolds to the south (Figures 2-3). The Humber Gap initially formed as a result of geological faulting (Gaunt *et al*, 1992), which created an area of structural weakness that was later exploited by the eastward flow of the various rivers which converge to form the Humber itself (Frederick *et al*, 2001). The area is a flat, low-lying, estuarine environment, though most of the former saltmarsh and associated mudflats have since been reclaimed for agricultural or industrial purposes.
- 1.3.3 **Lincolnshire Wolds:** the Lincolnshire Wolds are composed of Cretaceous Chalk bedrock and form a distinctive band of high ground that comprises a contiguous geological unit with the Yorkshire Wolds to the immediate north (Figure 2). The Project route climbs onto this higher ground from the fringes of the Humber Estuary along the course of the East Halton Beck before turning east towards the Ancholme Valley, with southern spurs extending to the oil refineries around Killingholme and towards Humberside Airport (Figure 3). The Wolds themselves gradually rise in elevation from east to west in accordance with the tilted chalk bedrock, reaching 87m OD at their highest point within the draft Order Limits.
- 1.3.4 **Ancholme Valley:** the eastern boundary of the Ancholme Valley is defined by the scarp slope of the higher ground of the Lincolnshire Wolds, while to the west the ground rises more gradually up the side of the Lincoln Edge (see below). The Project crosses the Valley near its c. 3.5km wide mouth where the River Ancholme flows into the Humber (Figures 2-3). The River Ancholme
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itself was artificially diverted and straightened in the seventeenth century, so that it now joins the Humber in a straight line, resulting in an Old River Ancholme and a New River Ancholme (Van de Noort and Ellis, 1998).

1.3.5 **Lincoln Edge:** the Lincoln Edge is a north-south linear band of high ground composed of a series of interbedded Jurassic rocks, which at its northern extent where it is crossed by the draft Order Limits comprises twin escarpments sloping from east to west and reaching heights of 45 and 63m OD respectively. The narrow fault separating these escarpments is followed by the course of the Winterton Beck as it flows north to the Humber (Figures 2-3).

1.3.6 **Trent Valley:** the Project crosses the lower Trent Valley just south of its confluence with the Humber at Trent Falls, with a southern spur of the draft Order Limits also entering the western side of the Valley c. 7km to the south to reach Keadby Power Station (Figures 2-3). The floodplain of the lower reaches of the Trent is broad, flat and dominated by fine-grained sedimentation, with the river channel showing considerable lateral stability (Baker, 2007). To reduce the risk of flooding and improve agricultural productivity, the height of the ground across the surrounding floodplains has been raised in recent historic periods through a process known as warping. At high tide, sediment-laden estuarine waters would be directed onto embanked areas close to the estuary via a system of sluices and channels, permitting warp deposits (artificial alluvium) to settle out of the pooled water prior to its release (Ellis, 1990).

1.3.7 **Humberhead Levels:** the Humberhead Levels describe a low-lying basin surrounding the western head of the Humber Estuary (Figure 2). These flat, silt-dominated lowlands were originally formed from the basin of the former Pleistocene Lake Humber (see further discussion in Section 3.2). Rising ground formed by ridges of Permian rocks (the eastern Pennine foothills) lie to the west, with the southern extent of the Levels coinciding with a low ridge of Triassic rocks, including those forming the Isle of Axholme, beyond which lies the Trent Valley. To the north, the low gradient merges with the slightly more undulating terrain of the southern Vale of York (Gaunt, 1994; Gaunt *et al*, 2006; Van de Noort and Ellis, 1999). The Project terminates along this transition with the southern Vale of York at Drax Power Station, after having first crossed the Levels south of the River Ouse before turning north along the western edge of the basin to cross the Aire and Calder Navigation and the canalised River Don, the River Aire and the Ouse itself (Figures 2-3). As for the adjacent Trent Valley, much of these former low-lying wetland areas have been artificially raised through warping to reduce flooding and subsequently drained to create more productive agricultural land.

1.4 Regional geological background

1.4.1 The bedrock strata dip eastwards such that progressively younger strata are present further east, and progressively older rocks range westward (BGS 2025). The bedrock across Holderness and the Lincolnshire Wolds principally

comprises chalk limestone of various stratigraphic units, including the Flamborough Chalk Formation, Burnham Chalk Formation and Ferriby Formation. Further west, from the Ancholme Valley across the Lincoln Edge, bedrock comprises rocks of Jurassic age, including the Kimmeridge Clay Formation, Oxford Clay Formation and Whitby Mudstone Formation. The Trent Valley and Humberhead Levels are then underlain by Triassic rocks, comprising the Mercia Mudstone Group to the east and the older Sherwood Sandstone Group to the west.

- 1.4.2 Superficial deposits mapped by the BGS (2025) across the Project predominantly consist of thick deposits of tidal flats and/or freshwater alluvium associated with major river valleys such as the Humber, Ancholme, Trent, Aire and Ouse, with significant areas of warp blanketing the lower Trent Valley and adjoining Humberhead Levels. The far western end of the draft Order Limits also skirts localised areas of marginally higher ground fringing the Humberhead Levels/southern Vale of York which are composed of the Late Glacial deposits of the Brighton Sand Formation and Hemingbrough Glaciolacustrine Formation. The relative higher ground of Holderness, the Lincolnshire Wolds and Lincoln Edge are generally overlain by glacial till/diamicton and head deposits and localised pockets of periglacial gravels and blown sands.
- 1.4.3 These data are presented in greater detail for each LCA throughout Section 4.

1.5 Archaeological background

- 1.5.1 A detailed Archaeological Desk-Based Assessment for the Project route is currently under preparation, (Arcadis, forthcoming). As such, this section presents only a brief synopsis to contextualise the geoarchaeological assessment that follows.
- 1.5.2 Humans dispersed into Upper Palaeolithic Britain in the wake of the deglaciation that followed the Last Glacial Maximum (LGM) of c. 15-26 cal BP, though there is disparate evidence for activity during earlier interglacial periods. Evidence of this dispersal includes finds from outside the Project route but in the same general region, including two hand-axes of Lower or Middle Palaeolithic age from Lee Moor, Stanley, West Yorkshire (PRN3813; WYAAS, 2016), whilst the limestone caves of Creswell Crags in north Nottinghamshire contain Britain's only known Upper Palaeolithic cave art. Kirmington Pits Site of Special Scientific Interest (SSSI) in North Lincolnshire lies immediately adjacent to the draft Order Limits (see further discussion in Section 4.4.3) and is one of the few sites in Britain where Palaeolithic remains are believed to have been found beneath glacial deposits, in this case being determined to represent elements of a Clactonian assemblage dating to the Lower Palaeolithic in the early part of the Hoxnian Interglacial, c. 424-374k years BP (Burchell, 1931; 1935; Bridgland and Thomas, 1999). However, White (1999) has argued that it is plausible that some (if not most) of these finds are not true artefacts, but rather the products of abrasion/collision in a high-energy depositional environment.

- 1.5.3 Lake edges would have been attractive site for occupation throughout early prehistory, so there is potential for the littoral deposits of proglacial Lake Humber (which occupied the western half of the Project, cf Figure 5) to contain Late Upper Palaeolithic archaeological material, both reworked and *in situ*. Indeed, Palaeolithic remains, including a flint artefact, have previously been found on Lindholme ‘island’, a morainic ridge of sands and gravels formed by the terminal Late Devensian moraine within Lake Humber that now lies within the peatland of Hatfield Moors some 13km south of the Project (Bateman and Buckland, 2001; Pettitt, 2018).
- 1.5.4 The current interglacial period, aka the Holocene, began approximately 11,700 BP and encompasses many camps and settlement sites from the early Mesolithic onwards. The site of Star Carr on the shores of glacial Lake Flixton in the Vale of Pickering comprises a hugely significant early Mesolithic archaeological site within the surrounding region, located approximately 61km north of the Project. In Holderness, also to the north of the Project, evidence of occupation is derived from the Mesolithic lakeside platform of Round Hill, as well as the Bronze Age settlement at Barmston Drain which was located on the sediments of a Late Glacial mere (Fletcher and Van de Noort, 2007). Many important finds have been reported from throughout the Humber basin, in particular the discovery of prehistoric boats at North Ferriby (Van de Noort and Ellis, 1998) and the Brigg raft from the Ancholme Valley, dated to the Bronze Age/Iron Age transition (McGrail, 1990). From the Humberhead Levels to the southwest of the Project, a Bronze Age trackway has been reported from Thorne Moors, and a Neolithic trackway at Lindholme within Hatfield Moors (Chapman and Gearey, 2013).
- 1.5.5 The past several decades have seen a considerable amount of archaeological work associated with infrastructure projects undertaken throughout Holderness and North Lincolnshire (for example Abramson, 1996; Burgess and Daniel, 2018; Evans, 2016; Glover *et al*, 2016; Humber Field Archaeology, 2006; Malone and Williams 2010; NAA, 2000; OA, 2012; 2022; Savage, 2013), as well as the Humber Wetlands Survey run from the University of Hull in the 1990s (Van de Noort, 2004). These projects have revealed a wealth of sites encompassing activity from the Mesolithic right through to the post-medieval period. Sites of Iron Age and Roman date are particularly well represented and include evidence for both agriculture and salt making. An Iron Age settlement at Ulceby, immediately adjacent to the Project corridor within the northern Lincolnshire Wolds, is particularly noteworthy, as the artefacts found there included a metalwork hoard containing horse bridal fittings, gold torcs, and a bracelet, as well as large numbers of Iron Age coins dating to the first century BC (Farley, 2012).
- 1.5.6 The peatlands to the south and west of the Project route have also proved rich in archaeological finds. For instance, a wooden ‘corduroy’ trackway and platform were uncovered at Lindholme within Hatfield Moors, and were found to have been built in a single phase towards the end of the Neolithic period, around 2730-2450 cal BC (Chapman and Gearey, 2013). The trackway
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and platform were constructed from pine and birch, probably sourced from locally growing woodland, and were associated with a sizeable lithics assemblage. Three bog bodies have been recovered from Hatfield Moors in the vicinity of Hatfield Chase. A date in the late third or fourth century AD has been suggested for one, whilst another was described as a male dressed in 'Saxon' clothes (Chapman and Gearey, 2013; Turner and Scaife, 1995). A detailed account of the palaeoenvironmental history of this site and the surrounding peatlands is presented in Chapman and Gearey (2013).

2 AIMS AND METHODOLOGY

2.1 Research context

2.1.1 A firm basis for research on many archaeological projects is provided by the Regional Research Frameworks initiative devised by Historic England and the Association of Local Government Officers. The Project traverses two regions under this scheme and, whilst the framework for North/Eastern Yorkshire is currently still being compiled, the East Midlands Historic Environment Research Framework (EMHERF; Research Frameworks, 2022; see also Cooper, 2006) is available online. It encompasses numerous themes relating to this Project, with broad relevance to both the East Midlands (specifically North Lincolnshire) as well as the immediately adjacent areas of North and Eastern Yorkshire. The following themes comprise those of most immediate pertinence to the present Project:

- Pleistocene and Holocene climatic change (as evidenced, for example, by palaeochannel deposits).
- Changes in sea level, the configuration of sea and land, the drainage network and the spatial extent of wetlands.
- The impact of (and relationship with) human activity upon soil development and geomorphic processes (notably alluviation, colluviation and aeolian deposition).
- Exploitation and settlement of diverse ecological zones (including study of the pivotal highland-lowland contrast).
- The role of rivers as movement corridors.

2.1.2 Furthermore, the EMHERF also follows Howard's (2020) assertion that the development of models that place sedimentary deposits within a securely dated chronostratigraphic framework is a prerequisite for any archaeological project, especially those seeking to understand long-term trajectories of landscape evolution.

2.1.3 Finally, the EMHERF includes a series of more specific aims for research into the prehistoric period which are of particular relevance given the wider archaeological context of this Project. These include the following questions:

- How can we enhance the Historic Environment record dataset for the study of the Palaeolithic Period?
- How can we enhance our understanding of the environmental background to Mesolithic activity?
- How can we characterise the regional and local evidence for Mesolithic activity?
- How can we investigate the topographic locations of Mesolithic activity foci?
- How can we investigate the transition from the Mesolithic to the Neolithic?
- How can we target sites with late Mesolithic and early Neolithic stratigraphy and well-preserved organic remains to provide a chronological framework and understand exploitation of different landscape zones?
- How can we investigate landscape contexts of rural settlements.

2.2 Aims

2.2.1 This GDBA is one of the first elements of an iterative, multi-stage process and, as such, has four basic aims:

- To identify areas (eg, wetland ecotonal zones) considered to have high potential to preserve archaeological and/or palaeoenvironmental remains stratified within sediment sequences based on palaeotopography and to consider associated environments of deposition and taphonomy.
- To provide baseline data which may contextualise a future first-stage deposit model. This model will be based on Ground Investigation (GI) data and will contribute to a more detailed understanding, both locally and more regionally, of selected sediment sequences and geomorphological features and their geoarchaeological potential.
- Beyond predicting the potential location of buried geoarchaeological assets during initial evaluation, this GDBA is intended to provide the baseline data that will be used to develop an integrated archaeological and palaeoenvironmental landscape model for the duration of the Project. This model will be subsequently enhanced through a staged programme of geo/archaeological works, culminating in a detailed understanding of cultural and natural landscape relationships throughout the draft Order Limits.
- In the longer term, to contribute to a better understanding of the value of geoarchaeological work in the regional planning process.

2.3 Methodology

- 2.3.1 Within the parameters of this GDBA, the above aims are addressed through the following specific tasks:
- a. The review of published geoarchaeological and significant palaeoenvironmental data relevant to the Project.
 - b. The provision of mapped bedrock and superficial geological data relevant to the Project, and the characterisation of the sediments encompassed therein.
 - c. The examination of topographical and LiDAR data to identify features such as palaeochannels and gravel islands.
 - d. The assessment of publicly available BGS borehole/trial pit interventions that could be used to construct a geoarchaeological deposit model. This initial qualitative assessment will identify whether there are any high- to medium-priority zones where existing data are of sufficient density and quality to be incorporated within a more detailed sub-surface deposit model alongside that acquired through forthcoming Project GI works.
 - e. The identification of any geoarchaeologically significant zones or deposits that may hold potential for the recovery of archaeological and/or palaeoenvironmental remains and should therefore be prioritised during future GI watching briefs.
 - f. The identification of areas of uncertainty that lack lithostratigraphic data (either through BGS mapping and/or borehole data) and LiDAR data, and to make recommendations for future purposive works that could result in greater data coverage to better develop a more comprehensive Project-specific deposit model.
- 2.3.2 These tasks were carried out by a specialist geoarchaeologist in accordance with The Chartered Institute for Archaeologists' Code of Conduct (CifA, 2022), as well as Historic England guidance for deposit modelling (Historic England, 2020) and general geoarchaeological work (Historic England, 2015).
- 2.3.3 The process of geoarchaeological assessment is itself largely founded on gauging the potential for the preservation of archaeological and/or palaeoenvironmental remains within sub-surface deposits. Such preservation is likely to be highest where archaeological remains and associated land surfaces may lie buried beneath depths of sediment, particularly ecotonal areas adjacent to wetlands, on promontories and/or at the confluence of watercourses. The specific formation processes associated with different deposits is also considered, especially for sediments of generally high preservation potential such as peat. These issues are considered within this report for each individual LCA throughout Section 4, and a more synthetic discussion presented in Section 5.
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- 2.3.4 In order to conduct this specialist assessment, this report has drawn on a number of open-access data sources, including Ordnance Survey (OS), British Geological Survey (BGS) mapping, and Environment Agency (EA) Light Detection and Ranging Digital Terrain Model (LiDAR 1m DTM) data, along with relevant published and grey literature reports. A detailed Archaeological Desk-Based Assessment for the Project route is also currently under preparation (Arcadis, forthcoming), which should be read in tandem with this GDBA when assessing the overall archaeological potential of the Project area.
- 2.3.5 In terms of previously published literature, the work of the Humber Wetlands Group from the 1990s, in particular the volumes on Holderness, the Humberhead Levels, the Ancholme and Trent Valleys, and the Vale of York (Van de Noort and Ellis 1995; 1997; 1998; 1999), provides substantial quantities of geoarchaeological and palaeoenvironmental context for this Project. The Holocene evolution of the Humber Estuary has also formed the subject of both the NERC (Natural Environmental Research Council) funded Land-Ocean Evolution Perspective Study (LOEPS; Shennan *et al*, 2000a; 2000b) and Land-Ocean Interaction Study (LOIS; Metcalfe *et al*, 2000). Both projects interpreted data from preexisting borehole records, as well as from additional cores taken across both the inner and outer Humber Estuary by teams from the Universities of Durham and Hull. Composite lithological data derived from BGS borehole records along the lower Trent Valley are also available through the publications of the Trent GeoArchaeology Group (Challis, 2002). In the lower Vale of York, Kirby (1999) likewise used a database of over 100 borehole records to reconstruct the floodplain depositional environments of the lower Aire Valley.
- 2.3.6 There are a variety of historic BGS boreholes mapped across and around the Project route. However, their distribution is generally sparse and much of the data are denoted as confidential and the attendant records are thus not publicly available, whilst those from before the c. 1980s are typically of low quality in terms of the information that was logged. All BGS boreholes (both confidential and publicly available) located within 2km of the draft Order Limits are mapped across Figures 10-11, with those specifically mentioned in the text labelled on the corresponding figures. Those boreholes within a 500m buffer of the draft Order Limits that have been assessed to be of potential lithostratigraphic value for the production of a future deposit model are listed in Appendix A.
- 2.3.7 More localised geoarchaeological data are also available from previous developer-led infrastructure investigations that have been undertaken within the vicinity of the Project, especially its eastern end. Examples in Holderness include the Easington to Paull Pipeline (OA, 2012; 2021), Easington to Salt End Scheme (Burgess and Daniel, 2018), the Tunstall to Salt End Scheme (Evans, 2016) and AOC's investigations for the Dogger Bank Offshore Windfarm (AOC, 2024). Of those, only the latter, well to the north of the current Project, incorporated a specific GDBA and deposit model. Borehole samples were also recovered as part of the mitigation programme for the Feeder 9 Replacement
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Pipeline Tunnel at both Paull (OA, 2021; 2022) and Goxhill in North Lincolnshire (OA, 2016; 2022). Data are also available for borehole transects that cross the Project route southeast of Goxhill at East Halton Skitter (NAA, 2000) and beyond the draft Order Limits to the west of Scunthorpe at both Keadby (Headland Archaeology, 2013; 2018; SSE Thermal, 2021; Timpany, 2012; Trent and Peak Archaeology, 2021; York Archaeological Trust, 2022) and the proposed North Lincolnshire Green Energy Park (AOC, 2021).

2.3.8 Detailed 3D modelling of geological and superficial deposits is available for the Holderness area but limited in extent, as it stops south of Hornsea (Burke *et al*, 2015). Limited data are available from the BGS Selby 3D superficial deposits modelling (Burke *et al*, 2017), the south-eastern part of which is adjacent to the western extremity of the Project. The glacial evolution of the Vale of York is mapped by Ford *et al* (2004).

2.3.9 Before considering the specific geoarchaeological potential of the Project and the LCAs it crosses, Section 3 below provides some greater context for the landscape history of the region, especially its Pleistocene geomorphological character and the development of the proglacial Lake Humber.

3 CHRONOSTRATIGRAPHIC AND GEOARCHAEOLOGICAL FRAMEWORK

3.1 Quaternary chronostratigraphy and glaciations

- 3.1.1 The Pleistocene glacial history of the UK is complex, with the advance and retreat of several ice sheets occurring throughout the period as the climate oscillated between colder (glacial) and warmer (interglacial) stages. Comparatively warmer episodes occurring within glacial stages are then known as 'interstadials', and the intervening prevalence of severe cold conditions as 'stadials'. The last major glaciation across the UK is known as the Devensian, though the cycling of warmer and colder conditions within the stage varies at a regional scale. Table 1 below presents the generalised framework of this chronostratigraphic sequence, alongside the main archaeological periods recognised within the UK.
- 3.1.2 During the colder Pleistocene periods, sea levels were lower than today, and the Humber area was located on the western margins of 'Doggerland,' an area of low-lying dry land linking eastern England to what is now continental Europe (Bicket and Tizzard, 2015). For the greater Humber region, the most significant ice advance was that of the Late Devensian glacial, during which the Humber wetlands were covered by the North Sea ice lobe that extended down the North Sea Basin as far as north Norfolk, depositing till and glaciofluvial sands and gravels across the region (cf Figure 5). Following the final retreat of the ice at the end of the Devensian, there was rapid incision of the regional river valleys down to contemporary sea levels, creating steep-sided valleys now infilled with Holocene sediments (Van de Noort, 2004).
- 3.1.3 Glacial deposits associated with the Dimlington stadial icesheet (MIS 2) remained east of the Lincolnshire Wolds (Figure 5). However, the possibility of earlier Devensian ice (in MIS 4) across this part of the Lincolnshire Wolds also contributes to the complex and less well understood glacial stratigraphy of this area (Howard, 2022; Straw, 2019). Sedimentary deposits reflect erosion and deposition in a varied succession of environments during the much milder climatic conditions that followed in the post-glacial Holocene. Fluvial deposits occur in almost all valleys or river courses and are still forming to this day. These include a wide range of fluvial and alluvial deposits, including clays, silts, sands, and gravels. Peat deposits have also accumulated since the start of the Holocene and may occur both in local topographic lows in floodplain and estuarine environments, and as broader expanses of blanket bog over areas of higher ground.

Humber Carbon Capture Pipeline, East Riding of Yorkshire, North Lincolnshire and North Yorkshire

Table 1: Generalised correlation of Mid-/Late Pleistocene and Holocene chronostratigraphy within the UK

Geological Epoch	Archaeological Period	Chronostratigraphy			
		Geological Stage		Age (years BP)	Marine Isotope Stage (MIS)
Holocene	Roman to post-Medieval	Flandrian Interglacial	V - Sub-Atlantic	2k-present	1
	Later Neolithic to Iron Age		IV - Sub-Boreal	5-2k	
	Mesolithic to Early Neolithic		III - Atlantic	7-5k	
			II - Boreal	9-7k	
			I - Pre-Boreal	11.7-9k	
Late Pleistocene	Upper Palaeolithic	Late Devensian Glaciation	Loch Lomond Stadial (Younger Dryas)	12.9-11.7k	2-5d
			Windermere Interstadial	14.7-12.9k	
			Dimlington Stadial (Last Glacial Maximum)	26-14.7k	
	Later Middle Palaeolithic	Middle Devensian Glaciation	Cold period	39-26k	
			Upton Warren Interstadial	43-39k	
			Cold period	60-43k	
		Early Devensian Glaciation	Cold period	72-60k	
			Brimpton Interstadial	86-72k	
			Cold period	92-86k	
			Chelford Interstadial	108-92k	
	Cold period	115-108k			
	Ipswichian Interglacial	130-115k	5e		
	Middle Pleistocene	Early Middle Palaeolithic	Wolstonian 'Complex'	374-130k	
Hoxnian Interglacial			424-374k	11	
Anglian Glaciation			478-424k	12	
Lower Palaeolithic		Cromerian 'Complex'	800-478k	13-19	

3.2 Proglacial Lake Humber

- 3.2.1 Mapping the advances and retreats of the British and Irish ice sheets has revealed that significant ice dams formed at key places in the landscape during the Last Glacial Maximum (LGM, aka the Dimlington stadial). These dams in turn impounded large volumes of glacial meltwater and resulted in the development of a series of proglacial lakes across the lowlands of eastern England. Most pertinently for this Project, the damming of the Humber Gap by the North Sea ice lobe resulting in the creation of Lake Humber (Figure 5; Bateman *et al*, 2015; 2018; Buckland *et al*, 2019). The ice sheet overlying the Vale of York then expanded briefly from c. 18.7 +/- 0.63ka, moving across Lake Humber into South Yorkshire and North Lincolnshire, before later retreating and leaving the Escrick and York moraines in its wake (Figure 9; Bateman *et al*, 2015).
- 3.2.2 Excavations at Finningley, near Ferrybridge (West Yorkshire), revealed lacustrine sediments of the former Lake Humber which were dated by optically stimulated luminescence (OSL) techniques to c. 14,650 BC, with evidence that the lake had silted up by c. 9150 BC (ie, by the early Holocene; Buckland *et al*, 2019). The pattern of drainage across the former lake is complex, but it is thought to have persisted at its maximum extent until at least until c 14,500 BP (Fairburn and Bateman, 2016). Proglacial Lake Humber would have been a highly significant feature in the late Pleistocene regional landscape, and even after its drainage in the early Holocene would have remained as an extensive network of wetland areas providing a wide range of resources for both wildlife and early prehistoric communities.
- 3.2.3 Following the retreat of the ice sheets and the infilling of Lake Humber, braided drainage channels formed across the floor of the former lake, with levées of sand and silt building up along its margins. Wind erosion resulted in the deposition of aeolian sands (coversands), with the development of extensive dune systems occurring across the southern and eastern portions of the Vale of York. Much of this geomorphological activity is dated to the period of climatic deterioration associated with the Loch Lomond stadial (Van de Noort and Ellis, 1999).
- 3.2.4 At this time, sea levels were significantly lower than at present, though as they began to rise in following periods so increasing quantities of alluvium were deposited along the length of the region's river channels, including material deposited from tidal estuarine environments in perimarine environments (Van de Noort and Ellis, 1999). Riverine locations, both coastal and inland, represent prime areas for exploitation by prehistoric peoples due to their rich and varied resources, as well as key sites for the preservation of high-resolution palaeoenvironmental archives suitable for landscape reconstruction as well as radiometric dating.

3.3 Regional sea level change

- 3.3.1 The LOIS and LOEPS research projects (cf Section 2.3.5) produced palaeogeographical reconstruction maps of the Humber Estuary throughout
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- the Holocene, from the early Mesolithic to the Bronze Age (Metcalf *et al*, 2000; Shennan *et al*, 2000a; 2000b). Shennan *et al* (2000a) utilised sea level index points, based on lithological and palaeoenvironmental data, to suggest that during by the early Mesolithic the coastline across north-east England was only a little to the east of its present position.
- 3.3.2 Accordingly, at around 10,000 cal BP the North Sea coastline comprised a western embayment extending south to the latitude of Flamborough Head, with the ancient Holderness coastline modelled at 10m+ above current mean sea level (Metcalf *et al*, 2000; Shennan *et al*, 2000a). By 9000 cal BP, the western embayment had extended further south to a position just off that now occupied by Spurn Point. Its eastern extent produced a shallow estuary to the south of the (now offshore) Dogger Bank, with the area around the Humber Estuary itself modelled to be around 10m above current mean sea level.
- 3.3.3 By 8000 cal BP, the North Sea was connected to the English Channel via a narrow strait, and modelling suggests that by 7500 cal BP all the estuaries of the contemporary east coast were subject to tidal influence. Dogger Bank was then completely submerged by 6000 cal BP as sea levels continued to gradually rise (Metcalf *et al*, 2000; Shennan *et al*, 2000a). The loss of Doggerland would have caused the westward movement of people from the low-lying areas of the former continental shelves (Coles, 1998), with major consequences for the early prehistory of both the East Riding of Yorkshire and North Lincolnshire.
- 3.3.4 More detailed palaeo-reconstruction data specific to the Humber Estuary (Figure 6; Metcalf *et al*, 2000; Shennan *et al*, 2000a), show that estuarine conditions existed in a relatively narrow channel within the outer estuary by c. 8000 cal BP, with sea levels about 17m below the present mean. Palaeoenvironmental reconstructions based on pollen, diatom, and radiocarbon data from freshwater peats provide evidence for extensive eutrophic wetlands within the estuary, with a mosaic of hazel-oak fen wood, sedge fens, open standing water, and some evidence for possible, short-lived marine incursions. From about c 7000 cal BP, deposit sequences in the outer estuary record the transgression of intertidal environments across previously eutrophic wetlands, with the limit of intertidal sediments roughly at the River Ancholme's contemporary confluence with the main Humber channel (Metcalf *et al*, 2000). This transgression continued into the inner Humber Estuary after c 6000 cal BP and had considerable impacts on its hydrology, with impeded freshwater drainage causing ponding, waterlogging, and paludification (the conversion of forest to peatland). Reconstructed palaeogeographic maps show the general areas influenced by this main incursion but do not track the tidal reaches of individual rivers (Metcalf *et al*, 2000).
- 3.3.5 Sea levels continued to rise until the early to middle Iron Age, followed by a phase of marine regression during the late Iron Age and Roman Period, allowing settlement to expand into areas previously too wet to support
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permanent habitation (Long *et al*, 1998). Many sites were then abandoned as a result of renewed sea level rise during the early fourth century AD, though some settlement continued across patches of relatively higher ground into the early medieval period (Fleming and Royall, 2019). Low-lying areas adjacent to the Humber and the lower reaches of its tributaries persisted as wetlands until the medieval period due to their susceptibility to inundation by estuarine and/or riverine flooding, as well generally high water tables. From then on, widespread changes occurred due to artificial drainage, land reclamation, and associated land-use changes, including the build-up of warp deposits across much of the Humberhead Levels (Metcalf *et al*, 2000).

3.4 Development of the Humber Wetlands

3.4.1 A broad phased geoarchaeological model of the landscape evolution of the region impacted by the Project south of the Humber (excluding Holderness) is based on previous research by Van de Noort and Ellis (1997; 1998; 1999), as well as earlier work by Gaunt (1975; 1981; 1987; 1994; Gaunt *et al*, 1971) and Dinnin (1997a). Six key stages of geoarchaeological activity have been identified, which in chronological order comprise:

1. Lake Humber phase;
2. Braided river phase;
3. Blown sand phase;
4. Channel incision phase;
5. Channel aggradation phase;
6. Aggradation of river floodplains.

3.4.2 The evolution and drainage of proglacial Lake Humber has been outlined in Section 3.2 above. As Lake Humber drained, the resulting deposits of lacustrine clays, silts, and sands formed the '25 foot Drift', aka the Hemingbrough Glaciolacustrine Formation (BGS, 2025). This large expanse of loose, unconsolidated sediments forms most of the floodplain of the southern part of the Vale of York (Burke *et al*, 2017).

3.4.3 Between the end of proglacial Lake Humber and the early Holocene, sand ridges (or levées) developed across the emergent lake plain through the action of braided river channels (Gaunt, 1994; Van de Noort and Ellis, 1998; 1999). The distribution of these deposits reflects the meandering water courses, with individual levées subject to periodic reworking, and the aeolian removal of fine, unconsolidated sediments resulting in the localised development of blown sand and dune formations (Gaunt, 1987). Thermoluminescence dating of these aeolian sands suggests that such reworking principally occurred from around 12,480+/-1130 years BP until 10,040+/-790 years BP and continued into the early Holocene in the area around Scunthorpe in North Lincolnshire, with renewed dune formation occurring during the late Iron Age, Roman and early medieval periods

- (Buckland, 1982; Van de Noort and Ellis, 1998). These blown sand deposits are represented across the Project by the Sutton Sand Formation.
- 3.4.4 A phase of channel incision followed the development of these braided channel and levée formations and may have overlapped in part with preceding periods of aeolian reworking (Van de Noort and Ellis, 1998). This phase of incision is generally considered to have been relatively brief, beginning in the late Devensian and continuing until an equilibrium was reached between river base and sea levels during the early Holocene. Continued sea level rise towards present-day OD then resulted in the accrual of fining up sequences within river channels. This aggradation would have been influenced by both impeded freshwater runoff and estuarine incursions (Van de Noort and Ellis, 1998).
- 3.4.5 A high-energy fluvial system then developed within the lower reaches of the Trent during the early and middle Holocene, incorporating much of the drainage of the Humberhead Levels (Van de Noort and Ellis, 1998; Bateman *et al*, 2001). The capture and abandonment of active river channels may have led to the development of backswamp areas throughout this period, in which alluvium and peat deposits could have accumulated in shifting patterns across the area. One such example is the palaeochannel of the Trent at Bole Ings, south of Gainsborough, Lincolnshire (Dinnin, 1997b; Dinnin and Brayshay, 1999). Stratified sequences of alluvium deposited in this manner are particularly important as they have the potential to incorporate accumulations of waterlogged organic-rich sediments that may preserve both cultural and environmental remains. Peat and organic deposits, when found within these sedimentary packages, could further facilitate the precise dating of specific pre-Holocene and Holocene palaeochannel sequences.
- 3.4.6 A combination of impeded runoff, overbank flooding, and paludification hereafter led to the development of extensive, time transgressive, floodplain peats throughout the later prehistoric and early historic periods. Accordingly, both floodplain mire peats and blanket deposits of fine-grained minerogenic alluvium, with more localised peat development occurring in marginal dune locations, would have characterised the Trent floodplain from the mid-Holocene onwards (Van de Noort and Ellis, 1998). Accelerated erosion and alluviation then occurred across the Humber wetlands during the later Iron Age to Roman periods (Van de Noort and Ellis, 1999) and continued until the introduction of widespread artificial drainage from perhaps as early as the Roman period, with more in/extensive warping taking place from the postmedieval period onwards (Van de Noort and Ellis, 1998).

4 RESULTS

4.1 Introduction and presentation of results

4.1.1 The results of the GIS data analysis and literature review for each LCA within the Project is presented below in geographical sequence, beginning in the east at Holderness. Individual figures are cited within the main text as appropriate.

4.2 Holderness

Overview mapping

4.2.1 The bedrock geology across this section of the Project is Late Cretaceous chalk limestone of the Flamborough Formation (Figure 10a). This is overlain by superficial deposits of Pleistocene and Holocene age (Figure 11a), primarily Devensian glacial till with small, isolated pockets of glaciofluvial sands and gravels and lacustrine sands, silts and clays, the latter likely indicative of small meres formed within glacial kettle holes which have since infilled and dried out. The coastal frontage at Easington then consists of beach and tidal flat deposits composed of a mix of clays, silts and sands, whilst the valley of the Winestead Drain is largely filled with fine grained alluvial deposits associated with the former free-ranging watercourse prior to its more recent canalisation.

4.2.2 LiDAR imagery (Figure 12a) reveals a slightly hummocky but otherwise fairly level landscape, of which the only significant topographic feature is the valley of the Winestead Brook. The flat, even surface of the base of this valley, together with the lack of any prominent palaeochannel structures evident on the LiDAR, suggests that significant siltation through active warping may mask fluvial features buried beneath the modern land surface.

Geomorphology and landscape modelling

4.2.3 The hummocky terrain of Holderness as a whole is interpreted as an ice-marginal series of sand and gravel outwash fans, deposited sequentially at the margin of the receding North Sea ice lobe at the end of the Dimlington stadial (Evans *et al*, 2001). BGS mapping of the Holderness region has produced a 3D model of these superficial deposits (Burke *et al*, 2015). However, the study does not include the coastal area south of Hornsea and thus excludes the area traversed by this Project. That said, these data do illustrate thick accumulations of Holocene deposits across Holderness, most pertinently tidal flat deposits along the Humber Estuary and alluvium along various river courses. Pleistocene features include a palaeo-shoreline that runs north from Hessele on the Humber Estuary, curving eastwards to the coast at Sewerby. This feature has been attributed to the Ipswichian period (an interglacial period dated to the early part of the Late Pleistocene, approximately 115-230ka).

- 4.2.4 An extensive buried cliff in the chalk bedrock also runs west of Hull towards Bridlington and is exposed at Sewerby. Although outside the Project route, this palaeo-cliff provides evidence that the pre-Devensian landscape comprised a marine erosion surface or ‘wave-cut platform’ in the underlying bedrock and indicates the location of the shoreline during a period when the inferred relative sea level was approximately 2m above present OD (Catt, 2007). This feature is also incised by several deep channels that are likely to have formed during major sea level lowering at the onset of the last (or previous) glaciations. It thus pre-dates the near-surface glacial deposits in the area and could represent depositional sites within which late Pleistocene and early Holocene sediments then accumulated (Burke *et al*, 2015). As part of a wider complex of coastal landforms, a similar channel near Immingham in North Lincolnshire area reached depths of 80m below present-day OD (Berridge and Pattison, 1994).
- 4.2.5 The well-known Quaternary cliff site at Dimlington, originally situated near to Easington but now lost to coastal erosion, is the type site for the Late Pleistocene stadial (LGM) cold phase, dated to approximately 15-26ka during the Devensian glaciation. The cliff geology comprises a series of till deposits, with the Basement Till overlain by organic Dimlington Silts and two further late Devensian till strata (Skipsea and Withernsea). Radiocarbon dating of the organic remains within the Dimlington Silts have rendered a maximum age of 18.2-18.5ka for the advance of the North Sea lobe of the British Ice Sheet during the Late Devensian, which deposited the named tills (Evans *et al*, 2001).
- 4.2.6 Complex glacial features evident across the Holderness area record abrupt transitions between glaciolacustrine (glacial lake), glaciofluvial (glacial rivers) and subglacial (till) environments (Burke *et al*, 2015). River valleys across the coastal plain typically follow channels that were probably cut through the glacial deposits by meltwater from the flowing ice sheet margins.
- 4.2.7 Of relevance to the current study are the archaeological investigations carried out along the route of an underground electricity cable in southern Holderness between Easington and Salt End (Burgess and Daniel, 2018). These investigations showed that former settlement patterns at the eastern and western ends of the Project were greatly influenced by local topography, with almost all sites situated on areas of relative high ground, predominantly on hills or ridges above the 5m contour. The data have been interpreted to suggest that the distribution of sites corresponds with the changing location of the Humber shoreline, possibly defining the fringes of habitable land since the later Iron Age.
- 4.2.8 Although there are various BGS boreholes located within 500m of the draft Order Limits across Holderness (Figures 10-11a), very few of are of use in assessing the sub-surface strata due to their age and lack of recorded detail.

Palaeoenvironmental and vegetational succession

- 4.2.9 Insect and plant macrofossil evidence from the immediately pre-Late Devensian ice advance deposits at Dimlington indicate the presence of a cold tundra-like landscape (Penny *et al*, 1969; Tweddle, 2001). The earliest part of the Late Glacial has here been dated as spanning from 13,045 +/-270 BP (Birm-317) until 11,200 +/-220 BP (Birm-406; Beckett, 1975). Pollen records from across Holderness, particularly from The Bog at Roos (Beckett, 1975; 1981), Gransmoor (Walker *et al*, 1993) and Skipsea Withow Mere (Hunt *et al*, 1984), provide a comparatively well-characterised Late Glacial vegetational and environmental history to match these dates.
- 4.2.10 Pollen from four small, infilled kettle holes also provide palaeoenvironmental data for the early Mesolithic to early Neolithic periods (Tweddle, 2000; 2001). This vegetational history includes the recognition of increases in hazel and alder, the expansion of elm and oak, and a date for the elm decline at Gransmoor, northern Holderness, of 4038-3772 cal BC (5099±50 BP; SR-229; Beckett 1975). Pollen data from The Bog at Roos, closer to the draft Order Limits, suggest that a mixed oak/hazel/elm woodland dominated the catchment during the early Mesolithic between 8605-8012 cal BC (9101±85 BP; AA-33290) and 6470-6238 cal BC (7525±65BP; AA-32292). The data showed little evidence for disturbance to the canopy during this period, with low microcharcoal counts evidencing little anthropogenic interference in the local landscape (Tweddle, 2000).
- 4.2.11 Although some palaeoenvironmental data are available for the mid/late Holocene across Holderness, precise dating of that evidence is generally lacking. The impacts of people on the landscape became clearer and more widespread through the later Holocene, with woodland clearance attributed to increased activity in the area, especially in the Bronze Age, with sustained land-use throughout the Iron Age inferred from pollen sequences recovered from The Bog at Roos (Tweddle, 2001).
- 4.2.12 Sedimentary archives and pollen records from sites located along the Easington to Paull pipeline route through southern Holderness all suggest a coastal floodplain environment during the late Iron Age/Roman period. This environment would have been subject to freshwater conditions but was also probably influenced by relative proximity to marine inputs (OA North 2012; 2021). Periodic flooding may have led to the creation of some shallow, freshwater ponds on a semi-permanent basis. The Holderness landscape thus contained many localised wetland areas prior to the introduction of artificial drainage in the early modern period (Fletcher and Van de Noort, 2007).
- 4.2.13 Additional, though highly localised, palaeoenvironmental archives could be contained within organic (including peat) lacustrine deposits formed within kettle holes, of which several are dotted across the Project route, primarily to the east of the Winestead Drain (cf Figure 11a). However, such deposits are also likely to have suffered the degrading effects of dewatering due to their small size and their later infill within intensively farmed agricultural land.

4.3 Humber Estuary

Overview mapping

4.3.1 East of the Humber River, the Project is again underlain by chalk of the Flamborough Formation. West of the Humber crossing, the route is underlain by slightly older chalk limestone of the Burnham Formation, formed in the Late Cretaceous (Figures 10b-d). Superficial deposits are mapped by the BGS as being predominantly fine grained (clays and silts) tidal flat deposits, with more heterogenous beach/tidal flat deposits fronting the main channel of the Humber itself (Figures 11b-d). On the western side of the Humber crossing, these tidal flats interface with freshwater-derived alluvium at the outfall of the Halton Beck, where interdigitated freshwater and estuarine sediments have the potential to have accrued in comparatively deep sequences. On the eastern side of the crossing, small pockets of Devensian till and Kelsey Hill gravels are located on the fringes of the higher ground to the north.

4.3.2 LiDAR images (Figures 12b-d) closely correspond with the above distribution of superficial geology, in that flat mudflats are evident along the fringes of the Humber, rising slightly but remaining low and flat to the transition with Holderness to the north. Very faint traces of former palaeochannels are evident in places, particularly near the outfall of the now-canalised Winestead Drain, but in general artificial drainage and/or warping seems to have additionally levelled the modern land surface, potentially cloaking traces of earlier heterogeneity. There are likewise no obvious palaeochannel structures visible near the outfall of the East Halton Beck, though this does not rule out their presence at greater depths. Lastly, the till/Kelsey Hill deposits across the northern part of the zone are again evident as small 'islands' of relatively higher ground, whose fringes comprise ecotonal zones with the potential to preserve archaeological/palaeoenvironmental remains beneath the alluvial overburden.

Geomorphology and landscape modelling

4.3.3 Data from two small developer-led studies, at Goxhill (on the southern bank of the Humber) and Paull (on the northern bank, outside but adjacent to the draft Order Limits), provide geoarchaeological data ranging from the early Mesolithic to Neolithic periods (OA, 2021). Peat deposits dated from the early Mesolithic through to the late Neolithic reflect sea level changes that ultimately resulted in the submergence of the prehistoric woodland landscape of the Humber Estuary and the creation of the present-day coastline. The earliest Mesolithic date from Paull was 7569-7482 cal BC (8434±25 BP; SUERC-76296) to 6776-6642 cal BC (7866±23 BP; SUERC-76291).

4.3.4 The area crossed by the Project between Holderness and the Humber crossing is also important in that the build-up of tidal flat deposits throughout the Holocene may conceal more deeply buried topographic features such as small fluvial valleys and/or lacustrine deposits with the potential to preserve palaeoenvironmental remains. Artificial warping and the associated build-up of the present-day ground surface is also likely to have further buried such

environments, though in many cases warp is difficult to separate from the underlying natural alluvial deposits (Burke *et al*, 2015).

- 4.3.5 Associated with glacial outwash and esker deposits located along the edge of the Dimlington stadial ice sheet (Eyles *et al*, 1994; Thomson and Evans, 2001), the isolated outcrops of Kelsey Hill Gravels may also incorporate (reworked) Palaeolithic remains, including faunal assemblages (Huddart and Glasser, 2007; Whittaker, 2001). The relative high ground of the outcropping Kelsey Hill Gravels are also notable for their attractiveness for exploitation by past communities given their access to multiple resource zones. Archaeological and/or palaeoenvironmental remains located along these ecotones may thus be buried beneath later accruals of alluvium and/or warp. A survey of Neolithic sites by Van de Noort (2004) has identified precisely this pattern of distribution, with numerous sites occurring on the southern valley edge of the Winestead Drain, along the fringe of the higher tills to the west of its outfall into the tidal flats of the Humber Estuary, and around the gravel 'islands' located between Thorngumbold and Paull (Van de Noort, 2004, fig. 21).
- 4.3.6 A line of BGS boreholes from 1968 crossing the Humber itself to the immediate north of the draft Order Limits (see labelled boreholes on Figures 10c and 11c) suggests that riverbed sediments of sands, silts and clays descend to a depth up to c. 16mbgl within the course of the modern channel. These boreholes, together with the local geomorphology and surface topography, suggest that the course of the river has changed very little in this location since its first incision in the Pleistocene. A north-south transect of BGS boreholes on the western shore of the Humber at Paull could also prove useful for future deposit modelling in conjunction with data derived from more recent purposive geoarchaeological works in that location (see above; Figures 10c and 11c).

Paleoenvironmental and vegetational succession

- 4.3.7 Limited palaeoenvironmental data spanning the early Mesolithic to early Neolithic periods are available from deep boreholes undertaken by developer-funded projects at sites at Paull and Goxhill (see above; OA, 2016; 2021; 2022). Rackham *et al* (2011) also reported pollen evidence of rising sea levels in the later Neolithic (2670-2900 cal BC/4200±40 BP; Beta-255935), with localised flooding of either fresh or brackish water impacting the northern margins of the Humber Estuary.
- 4.3.8 To the north of the draft Order Limits at Kingston upon Hull, peats that formed during the late Mesolithic (6076-5639 cal BC/6970±100 BP; IGS-C14/99) at between 9.15m OD and -11.58m OD were likewise overlain by an estuarine transgressive episode after c. 6000-5000 BC (6890±100 BP; IGS-C14/100; Van de Noort and Ellis, 2000). This transgression progressed up-estuary over time throughout this period, with intercalated peats indicative of a finely balanced oscillation between intertidal and freshwater sedimentary inputs. The probable maximum extent of these intertidal deposits occurred c. 1500-1000 cal BC (c. 3000 BP), and numerous sites throughout the Humber Estuary

record the removal of intertidal sedimentation after this date (Metcalfé *et al*, 2000).

- 4.3.9 Sea levels then regressed in the Humber Estuary during the Iron Age (Long *et al*, 1998). Closer to Paull, Rackham *et al* (2011) found that halophyte (salt tolerant) elements of the pollen and plant macrofossil assemblages continued right through to the late Iron Age, with evidence of freshwater marsh elements appearing in the later Roman and the start of the early Medieval periods. A major increase in wetland fen communities is then recorded throughout the middle of the Early Medieval Period (Rackham *et al*, 2011).

4.4 Lincolnshire Wolds

Overview mapping

- 4.4.1 The northernmost range of the Lincolnshire Wolds crossed by the Project is underlain by bedrock of the Burnham and Welton Chalk Formations, both Cretaceous in age (Figure 10d-f). Progressively older strata of the Ferriby and Hunstanton Chalk Formations, followed by Kimmeridge Clay and Ampthill Clay, then outcrop on the westward facing scarp of the Wolds as they drop down into the Ancholme Valley. The lower, eastward facing slopes of the Wolds are then overlain predominantly by glacial till deposits of Devensian age (Figures 11d-f). More localised deposits of glaciofluvial sands and gravels, as well as Holocene alluvium and peats occur within the small valley of the East Halton Beck as it flows across the draft Order Limits towards its confluence with the Humber at East Halton Skitter. Further localised instances of both Pleistocene head deposits and Holocene alluvium (as well as a small area of periglacially reworked 'clay with flints' near Kingsforth Farm) also occur along the courses of the many, much smaller drainage channels which drain down to the northeast from the crest of the Wolds, whilst the western facing scarp is itself blanketed by a north-south aligned strip of aeolian reworked coversands associated with the Brighton Sand Formation. Finally, the 500m buffer around the terminus of the southern spur of the Project that extends towards Humberside Airport also encompasses small pockets of relict interglacial beach and glaciolacustrine deposits, though these do not occur within the draft Order Limits themselves.
- 4.4.2 Visual analysis of the LiDAR data for this LCA directly corroborates the above geological mapping, with the East Halton Beck marking a discrete small valley running across the lower slopes of the Wolds to the Humber Estuary in the north, whilst a number of much smaller and less deeply incised channels also run down the western slope of the Wolds themselves. The western scarp then marks a sharp drop-off into Ancholme Valley. Again, no palaeochannel features are evident within the valley of the East Halton Beck, though this does not preclude their preservation at greater depths. However, given the small size of both the valley and the watercourse itself, any such features are likely to be relatively limited in extent. The exception may lie within the area of

peat mapped by the BGS where the draft Order Limits turn eastward up the slope of the Wolds immediately north of College Bridge.

Geomorphology and landscape modelling

- 4.4.3 The southern spur of the Project extending towards Humberside Airport terminates to the immediate west of Kirmington Pits SSSI (NGR TA103116), designated for its geological interest and comprising a thick sequence of glacial, estuarine, and freshwater sediments infilling a fossil valley cut into the underlying chalk (Bridgland and Thomas, 1999). The estuarine and freshwater sediments are attributed to interglacial conditions and include flint-rich gravels that have yielded putative Palaeolithic artefacts, as well as a thin peat deposit from which pollen has been successfully extracted (Bridgland and Thomas, 1999; Bridgland *et al.*, 2014). Straw (2018) has argued that the gravels are of Ipswichian age and represent beach sediments deposited at the head of the deep Immingham Channel. Similar interglacial beach deposits are mapped by the BGS within the 500m of the Project corridor to the west, though not within the draft Order Limits themselves. Nevertheless, some potential remains for the presence of similar deposits within this area that have not been priorly mapped by the BGS.
- 4.4.4 On the south side of East Halton Beck, near the northeastern edge of the LCA, lithological data from three transects of 44 boreholes identified a sequence of Holocene sediments from a large intertidal channel (NAA, 2000). Rising sea levels during the early Bronze Age were here seen to have resulted in the development of tidal mudflats, with pollen and diatom data suggestive of saltmarsh vegetation alongside the development of reed swamps and the accumulation of peat deposits. Glacial till deposits may have represented higher ground (islands) within/fringing this wetland setting, providing a potential focus for archaeological activity. The interface between the Lincolnshire Wolds and Humber Estuary LCAs is thus likely to hold significant potential for the presence of both archaeological and palaeoenvironmental remains, especially within the vicinity of the East Halton Beck.
- 4.4.5 Although several BGS boreholes are mapped in this area (Figures 10-11d), none are of sufficient quality for use in any future deposit modelling, either of this or other target zones within the LCA.

Palaeoenvironmental and vegetational succession

- 4.4.6 The palynology of the pre-Devensian (interglacial) history of this area is limited to a thin peat band sandwiched within estuarine silts at Kirmington Pits SSSI (see above). This pollen record was interpreted as indicative of predominantly reed swamp and saltmarsh vegetal communities. Woodland containing abundant oak, pine and alder, with lower frequencies of spruce, holly, elm and hazel-type, was also inferred to exist close by. On comparison with other sites across the UK, these characteristics are suggestive of a possible Hoxnian interglacial date for the overall sequence (Watts, 1959). Further work by Gale and Hoare (2007) suggested that these organic deposits separated tills assigned to the Anglian (early Middle Pleistocene) and late
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Devensian (Late Pleistocene) glaciations. Palaeoenvironmental reconstructions for the Lincolnshire Wolds in general is very limited for both the Late Glacial and Holocene due to a continued dearth of high-quality pollen data (Tweddle, 2001).

4.5 Ancholme Valley

Overview mapping

- 4.5.1 The bedrock geology across the Ancholme Valley comprises softer Jurassic rocks situated between the harder-wearing outcrops of the Lincolnshire Wolds and Lincoln Edge. These rocks are arranged in north-south beds and tilted up to the west, such that they progress from younger to older with westward progression. In sequence these comprise the Amphill Clay, West Walton Mudstone, Oxford Clay, Kellaways Sand, Kellaways Clay, Cornbrash Limestone, Rutland/Blisworth Limestone and Clay Formations, and Thorncroft Sand Member (Figure 10f). Across the base of the Valley these are overlain by Holocene freshwater alluvial sediments associated with the Ancholme River, with Pleistocene coversands of the Brighton Formation skirting the higher ground to the east and glacial till/glaciofluvial sand and gravel deposits that to the west (Figure 11f). Estuarine tidal flat deposits are also mapped to the immediate north along the edge of the Humber, which in reality may interdigitate with the freshwater alluvium mapped within the draft Order Limits themselves.
- 4.5.2 LiDAR imagery again mirrors the geological mapping, with the flat valley bottom meeting the steep scarp of the Lincolnshire Wolds to the east and the gentler backslope of the Lincoln Edge to the west (Figure 12f). An area of slightly raised ground to the south indicates an outcrop of till, though this lies outside of the Project itself. Within the immediate Project area, faint sinuous patterns across the valley floor indicate the presence of complex palaeochannel features, the majority slightly raised relative to the modern land surface due to the deflation of surrounding sediments and thus forming very low relief roddons. This is most evident to the immediate south of the draft Order Limits, where the c. 400m wide former tidal channel of the lower River Ancholme is visible as it meanders close to the eastern side of the valley towards its confluence with the Humber near what is now South Ferraby Cement Plant. This channel was largely abandoned and infilled when the canalised New River Ancholme was constructed in the mid-seventeenth century, with the sluice at South Ferraby restricting tidal influence from the Humber (Boyes and Russell, 1977). The surrounding land was successfully drained at around the same time, though the dendritic creek beds visible on the LiDAR plot evidence the former presence of an extensive tidal mudflat/saltmarsh environment blanketing the base of the valley across the Project route.

Geomorphology and landscape modelling

- 4.5.3 The early Holocene Ancholme Valley would have been characterised by a single channel and a flat valley floor. Fine sands overlying lacustrine clays across this valley floor probably originated from the fluvial reworking of aeolian sands, themselves of probable late Devensian age. The low-lying floodplain became increasingly characterised by tidally influenced saltmarsh and reed swamp wetlands throughout the Holocene, with shallow streams and tidal creeks following meandering courses to confluences with either the Ancholme itself or the Humber to the immediate north. Artificial drainage of this landscape began in earnest in the thirteenth century AD, with major works (including the canalisation of the New River Ancholme) being undertaken from the mid-seventeenth century onwards (Van de Noort and Ellis, 1998).
- 4.5.4 The shallower gradient and reduced discharge of the Ancholme Valley would have resulted in a lower energy environment than that of the Trent to the west (see Section 4.7 below). In this part of the Project, sea level rises throughout the early to mid-Holocene would have positively impacted floodplain aggradation, with sediment accumulation resulting from the incursion of brackish water entering the Ancholme from the Humber Estuary (Van de Noort and Ellis, 1998).
- 4.5.5 Although a north-south transect of BGS boreholes does cross the Ancholme Valley within the draft Order Limits (Figures 10-11f), they are unfortunately of insufficient quality to further elucidate the underlying sediments in this location. However, a broadly east-west aligned transect of 28 boreholes (with AGS data available) across the southern bank of the Humber Estuary to the immediate north of the draft Order Limits records the presence of estuarine sediments up to 25m deep, with organic strata being particularly evident around the mouth of the Ancholme River itself (Figures 10-11f).

Palaeoenvironmental and vegetational succession

- 4.5.6 Marine diatoms in basal sand deposits from within a deep palaeochannel at Brigg, some 11km south of the Project route, suggest that the Ancholme initially developed as a tidal inlet of the Humber during the Late Glacial or very early Holocene, (Van de Noort and Ellis, 1998). The earliest dates for the onset of mire development in the Ancholme Valley are late Mesolithic, with peat development confined to low-lying areas adjacent to the incised palaeo-Ancholme. Much of the valley floor was covered in woody fen carr by the end of the Neolithic, with mire expansion continuing during the Bronze Age and reaching its maximum extent at the late Bronze Age/iron Age transition. Evidence of small-scale clearance at Brigg during the early Bronze Age has also been inferred from pollen archives dated to 2580-2330 cal BC (3940+/-45 BP; OxA-7091; Van de Noort and Ellis, 1998).
- 4.5.7 There is further evidence of a marine transgression and flooding event during the middle Bronze Age, which resulted in increased saltmarsh and coastal reed swamp development along the main river channel, whilst fen carr
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woodland hugged the valley edges (Van de Noort and Ellis, 1998). The increasingly waterlogged conditions were conducive to the preservation of organic artefacts, including a trackway and several wooden boats near Brigg (Van de Noort and Ellis, 1998). These include 'the Brigg Raft', which was recovered from within a grey clay deposit that separated two peat layers and was dated to the Bronze Age/Iron Age transition (McGrail, 1990). Though located c. 11km south of the draft Order Limits, the cluster of Mesolithic through to Bronze Age flint scatters on the drier valley edges in the environs of Brigg (cf Van de Noort, 2004, fig. 24) clearly demonstrate the importance of such ecotonal zones for prehistoric populations. The valley edges crossed by the Project route near the Ancholme's outfall hold similar potential, but to date have not been subject to similarly focussed archaeological investigation.

4.6 Lincoln Edge

Overview Mapping

- 4.6.1 As for the Lincolnshire Wolds (see Section 4.5.1), the bedrock underlying the Lincoln Edge comprise layered strata tilted upwards to the west, such that more westward rock units are progressively older, though all were formed in the Jurassic. In sequence from east to west, these rocks comprise the Thorncroft Sand Member, Hibaldstow Limestone, interbedded Kirton Cementstone and Scawby Limestone Beds, Grantham Formation, Whitby Mudstone Formation, Marlstone Rock Formation, interbedded Charlmouth Mudstone Formation and Pecten Ironstone, Frodingham Ironstone Member, and Scunthorpe Mudstone Formation (Figures 10f-g). Triassic mudstones of the Mercia and Penarth Groups also outcrop on the far westward-facing scarp of the Edge. Superficial deposits of glacial till and glaciofluvial sands and gravels then cap the lower eastern slopes of the Edge (Figures 11f-g), whilst the small north-south aligned valley of the Winterton Beck is flanked by deposits of head to its south and remnants silts and clays of the Hemingbrough Glaciolacustrine Formation to its north. The valley base is itself largely infilled by Holocene alluvium and some localised peat, whilst alluvium also fills much smaller channels running down the sloping back of the Edge to both its east and west. As for the Lincolnshire Wolds, pockets of blown sand deposits are also present across the inclined slopes, though are predominantly concentrated along the highest ridgelines.
- 4.6.2 Once more, LiDAR imagery corroborates the data from BGS geological mapping. It makes especially clear the presence of the major fault line that separates the eastern and western edges, which has been further eroded and accentuated by the passage of the Winterton Beck, whose outfall into the Humber Estuary lies just to the north of the draft Order Limits (Figures 12-f-g). Though the northern part of this small valley evidences no palaeochannels or similar features, the mapping of peat deposits by the BGS in this area suggests that at least some potential for palaeoenvironmental recovery where it crosses the Project route.

Geomorphology and landscape modelling

- 4.6.3 No notable previous investigations of the northern Lincoln Edge have been noted within reasonable proximity of the current Project. That said, analysis of the BGS superficial geological mapping and EA LiDAR data discussed above would suggest that where geoarchaeological potential does exist, it is likely to be located within the narrow valley of the Winterton Beck. Given the spatially constrained nature of this valley, it is however unlikely to contain deep sedimentary archives, and any it does (such as the BGS mapped peat) are liable to encompass palaeoenvironmental remains that pertain to a highly localised catchment. Slightly greater geoarchaeological potential may also lie along the transition with the Ancholme Valley LCA to the immediate east where estuarine deposits and/or freshwater alluvium blankets the lower slopes of the Edge itself.
- 4.6.4 Despite a plethora of BGS boreholes located in close proximity to the Winterton Beck and atop the scarp to its immediate east (cf Figures 10-11f-g), none are of sufficient quality to further inform the character of the subsurface sedimentary archive in this area.

Palaeoenvironmental and vegetational succession

- 4.6.5 Again, no previous investigations have been noted that are of contextual relevance to this area of the Project route across the northernmost Lincoln Edge, though the mapping of peat deposits within the base of the Winterton Beck valley by the BGS suggests there is potential for such archives to exist in this location.

4.7 Trent Valley

Overview mapping

- 4.7.1 Where the draft Order Limits cross the Trent Valley LCA they are underlain almost entirely by Triassic mudstones of the Mercia Group, with a thin band of slightly younger mudstones belonging to the Penarth Group outcropping along the basal scarp of the Lincoln Edge to the east (Figures 10g-i). Superficial geological strata are similar mapped as being dominated by either natural Holocene alluvium or artificial warp deposits, with isolated patches of blown sands (including aeolian reworked deposits associated with the Brighton and Sutton Sand Formations, cf Ford *et al*, 2008) and periglacial head deposits located along the valley margins (Figures 11g-i).
- 4.7.2 LiDAR imagery reveals a flat, low-lying landscape displaying the faint streaky 'feathering' indicative of artificial warping across much of the area crossed by the Project route, both to the north near the Trent's confluence with the Humber and to the south around Keadby (Figures 12g-i). This pattern somewhat belies the clear distinction made on the BGS mapping between natural alluvium and artificial warp, particularly as the two forms of water-lain deposit can be particularly difficult to distinguish in the field (cf Burke *et al*, 2015).

4.7.3 Even with the build-up of warp across the LCA, large roddon palaeochannel structures are evident across the centre of the area, crossing the Valley from north of the Isle of Axholme in the southwest towards Trent Falls in the northeast. This palaeochannel complex centres on the former course of the Old River Don before its diversion northward along Turnbridgedike in 1626 by Dutch engineer Cornelius Vermudyen (Skempton, 2002). Early medieval villages such as Eastoft and Luddington thus used to be riverside settlements, quite unlike their present situation in the modern landscape. Fieldwalking surveys and small excavations conducted by the Humber Wetlands Group in the 1990s also identified a cluster of Roman settlement near the confluence of the Old River Don and River Trent at Adlingfleet (Van de Noort, 2004, 118). The shadows of smaller, more dendritic palaeochannels north of Keadby and extending across the Project route south of the Ouse/Humber estuary are also indicative of the widespread tidal saltmarsh/mudflat environments which characterised this whole area prior to the onset of sustained drainage efforts in the late medieval and early modern periods.

Geomorphology and landscape modelling

4.7.4 Though the upper and middle reaches of the Trent Valley have been the subject of much concerted research over the years (eg, Howard, 2004; 2005; Howard *et al*, 2008; 2011), the lower reaches of the floodplain have far received less attention. Previous palaeochannel mapping of the lower Trent (ie, north of Gainsborough) has revealed very few surface-visible palaeochannels, largely as a consequence of thick deposits of alluvium and/or warp masking the sub-surface topography (Baker, 2007). Nevertheless, the Trent Valley GeoArchaeology project was able to establish the broad character of the deposits across the lower Trent, distinguishable as units of sand and gravel, peat, and clay/silt alluvium (Figure 7; Challis, 2002). Alluvial deposits throughout this area are typified by vertical accretion and stratified sequences of fine-grained sands, silts, clays, and peat. Though derived from relatively simplistic data, the Project was still able to model a generalised profile crossing the lower Valley (Figures 7 and 8). Challis (2002) also identified the presence of localised peat deposits associated with depressions in the underlying sand and gravel surface which may be indicative of older palaeochannels of the modern Trent no longer visible from the ground surface due to the accrual of more recent overburden from alluvial deposition and/or warping.

4.7.5 More recent deposit modelling has also been developed for the Keadby Power Station 2 and Wind Farm site, located immediately east of the modern Trent at the terminus of the southern spur of the draft Order Limits (Timpany, 2012; Trent and Peak Archaeology, 2021; SSE Thermal, 2021). This modelling has identified mudstone bedrock at variable depths between -9.5 to -17m OD. Alluvial deposits of sand and clay up to 15m thick then overlay this undulating bedrock. Bands of distinctly peaty alluvium were also recorded within the uppermost layers of this sequence, at approximately 0.55 to -1.55m OD, with the thickest deposits located close to the eastern bank of the River Trent itself.

- 4.7.6 Investigations of the more deeply buried peat (-3.88m to -4.20m OD, recovered via borehole coring) at Keadby Wind Farm resulted in an early Holocene date for this horizon (Headland Archaeology, 2013). Pollen from the recovered peat recorded the spread of juniper and dwarf birch throughout the local environment, suggestive of prevailing cold conditions during the end of the Late Glacial and the very early Holocene periods (Headland Archaeology, 2013; SSE Thermal, 2021). A second, undated peat horizon was also recorded at between -3.12m and -3.52m OD. Analysis of two other cores allowed for an upper peat unit which appeared to occur consistently across the site, to be dated to the between the late Neolithic and Iron Age dates, with a thin lens of further peat development occurring near the top of the sequence remaining undated (Headland Archaeology, 2013; SSE Thermal, 2021).
- 4.7.7 Data from these geoaerchaeological studies have been used to identify a palaeochannel of the Trent running northeast to southwest beneath the footprint of Keadby 1 Power Station (Le Quesne, 2015) and it is likely that the area between this palaeochannel and the modern Trent may have formed a sandy island, or eyot (SSE Thermal, 2021). A more recent geoaerchaeological hand auger survey (Keadby 3 Low Carbon Gas Power Station; Trent and Peak Archaeology, 2021) found that sand deposits (likely to belong to the Sutton Sand Formation) contained isolated pockets of deeper organic accumulations within hollows in the underlying sand surface. These organic deposits have been interpreted as remnants of an encroaching floodplain which may have developed across the site after the Iron Age. The resultant deposit model was also used to suggest that pre-Iron Age land surfaces may be preserved beneath these organic and later warp deposits, and that the sands themselves might also mask earlier remains (Trent and Peak Archaeology, 2021). More consistent peat development was believed to have occurred during the late Neolithic, with associated potential for the presence of a buried pre-Neolithic land surface to exist beneath this horizon. Further radiocarbon dating and palaeoenvironmental assessment of these deposits remains in progress (York Archaeological Trust, 2022).
- 4.7.8 Further up the Valley near Gainsborough (c. 22km south of the draft Order Limits), a similar palaeochannel sequence at Bole Ings was also found to contain an important sedimentological and palaeoenvironmental archives (Dinnin and Brayshay, 1999). In this case, boreholes indicated a maximum depth of c. 9m of Holocene alluvium, including peaty deposits, spanning the early Mesolithic through to the Bronze Age. The potential for such archives thus seems to be prevalent throughout the lower Trent.
- 4.7.9 The appearance of the lower Trent floodplain during the Bronze and Iron Ages has been described by Knight and Howard (2004) as consisting of a rich, low-lying wetland with multiple channels flowing through it. Continued clearance of woodland from both the floodplain and surrounding gravel terraces as well as adjacent upland areas during the later Iron Age and Roman periods would have resulted in the development of an even more
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open landscape over time. This open landscape would in turn have been prone to soil erosion and sedimentary redeposition through both colluvial and alluvial processes. There was thus an increase in the sediment load of regional river systems (including the Trent and Ancholme), and thick deposits of fine-grained alluvium were deposited across the floodplain throughout the latter part of the Roman period (Tweddle, 2001). Moreover, whilst the main channel of the Trent would have remained active during this time, minor streams and abandoned channels fringed by reed swamp would have steadily infilled through low-energy siltation. These processes were further impacted by a marine transgression starting around 800-500 cal BC and continued into the Roman period. Terrestrialisation, possibly linked to falling sea levels or lower amplitude tidal regimes, was then renewed during the first to fourth centuries AD (Van de Noort and Ellis, 1998).

- 4.7.10 Attempts at flood alleviation from around 1485 AD to the present day have resulted in a network of drainage channels extending across the lower Trent Valley and the loss of the natural wetland environment. Channel re-direction (including that of the Old River Don, cf Section 4.7.2) and the build-up of blankets of artificial alluvium (warp) have since further distorted the present-day land surface relative to its geomorphological origins, and in many cases cloaked the underlying palaeosurface under significant depths of recent sedimentation.
- 4.7.11 In addition to the project specific borehole/auger interventions cited above, data is also available from 16 BGS boreholes across the southern spur of the Project located within the Trent Valley (see Figures 10-11h) which are of high enough quality that they could be of utility in future deposit modelling efforts.

Palaeoenvironmental and vegetational succession

- 4.7.12 The pollen and plant remains from a peat deposit at Messingham (Carrott *et al*, 1997), located c. 10km southeast of the draft Order Limits on the eastern side of the Trent Valley, correlate with previous studies of beetle remains preserved beneath coversands (Buckland, 1982) that describe cold climate sedge-dominated fen conditions typical of the Late Glacial period. Radiocarbon analysis of peats which underlay 3m of coversands at Messingham produced a date of 10,280 \pm 120 BP (Birm-349; Buckland and Dolby, 1973). There is also a possible association between a Late Upper Palaeolithic end scraper and macroscopic willow (*Salix*) charcoal at this site (Buckland, 1984; Tweddle, 2001). This find suggests that there may be some (albeit relatively low) potential for Upper Palaeolithic archaeology and/or associated paleoenvironmental remains across the lower Trent Valley in general.
- 4.7.13 The most detailed palaeoenvironmental work from the lower Trent has been conducted some 22km south of the Project at Bole Ings near Gainsborough (cf Section 4.7.7 above). Investigations of a palaeochannel of the Trent here recovered environmental data spanning the Mesolithic through to the early Iron Age (Dinnin and Brayshay, 1999). These data were

interpreted as suggestive of alder-dominated, low-energy floodplain/backswamp environments, with wetland margins extending along the riverbank and around gravel islands/ridges on the floodplain, the latter also supporting pine and mixed deciduous woodland. Habitat disturbance throughout the early Holocene was explicitly linked to hydrological changes (for example, waterlogging), possibly in response to rising sea levels and floodplain aggradation (Dinnin and Brayshay, 1999).

- 4.7.14 The mid-Holocene (Mesolithic to Neolithic transition) Elm Decline was also identified in the pollen record at Bole Ings. A later, Bronze Age decline in lime dated to 2140-1740 cal BC (3579±70 BP; BETA-75271) and associated with a peak in microcharcoal particles was then interpreted to signify anthropogenic forest disturbance beyond the floodplain, but with no evidence for major disturbance of the dense alder carr occupying the floodplain itself. Increased disturbance of land beyond the floodplain for the purposes of both arable and pastoral agriculture was then dated to 1120-540 cal BC (2690±100 BP; BETA-75270) and has been interpreted as evidence of increased exploitation of drier, relatively higher ground such as the Valley-edge gravel terraces during the early Iron Age (Dinnin and Brayshay, 1999).

4.8 Humberhead Levels

Overview mapping

- 4.8.1 The bedrock geology across the Humberhead Levels portion of the Project transitions from Triassic rocks of the Mercia Mudstone Group to those of the Sherwood Sandstone Group just south of Goole (Figures 10i-j). As for the Trent Valley, superficial strata are predominantly composed of Holocene alluvium and/or modern warp. The fringes of the slightly higher ground towards the far western extent of the Project also traverse more localised areas of silty clay belonging to the Hemingborough Glaciolacustrine Formation (the remnant lakebed of proglacial Lake Humber), sandier/gravellier patches of lacustrine beach deposits, and both potentially *in situ* (ie, fluvially deposited) and aeolian reworked sands of the Brighton Sand Formation (Figures 11i-j). The latter also contains the potential to include thin clay beds/laminae and/or peaty horizons across the Project area (Ford *et al*, 2004; 2008).
- 4.8.2 Again, as per the lower Trent Valley, LiDAR imagery is indicative of a flat, low-lying landscape characterised by the 'feathered' silt fans indicative of artificial warping (Figures 12i-j). In many cases this is likely interdigitated with, or at least partly overlying, deposits of more 'natural' alluvium. Traces of smaller palaeochannels/creeks are evident across this section of the Project, though generally not a scale to suggest the near-surface preservation of former tidal flat or saltmarsh topographies, though such formations do likely exist at greater depth. Conversely, a few larger palaeochannels are evident, such as that which extends northwest from the fringes of the Trent Valley to a confluence with the Ouse southwest of Swinefleet (cf Figure 12i). Although no contemporary channels mirror this former watercourse, its fossilised

- headwaters likely mark the former western watershed of the Trent in this location.
- 4.8.3 A large former meander of the now-canalised River Went/River Don is also visible across land immediately south of the draft Order Limits where they turn north towards Drax Power Station (cf Figure 12j), whilst the southern branch of the Old River Don is again evident as a meandering raised roddon feature within the far southeastern portion of the Humberhead Levels LCA near its juncture with the Trent Valley. The northerly branch of the Don once flowed north to meet the River Aire at Turnbridge near East Cowick, prior to its diversion into the canalised River Don (aka the Dutch River) by Vermudyen in the early seventeenth century. Its earlier course is itself believed to have been at least partly modified as a navigation channel during the Roman period (Skempton, 2002; Van de Noort, 2004).
- 4.8.4 The floodplain of the River Aire appears to have subject to less intensive warping/general reclamation through the modern period, such that a fine network of dendritic palaeo-creeks can still be made out along its course, with a few larger former channels incising down to meet it from the relatively higher ground to the northwest. Such patterns are also (faintly) evident along the northern bank of the River Ouse where it crosses the Project to the north and are again indicative of former estuarine environments under tidal influence.
- 4.8.5 Otherwise, the visualisation of the EA LiDAR DTM aptly highlights the spatial distribution of relative topographical highs underlain by deposits associated with the Hemingborough Glaciolacustrine and/or Brighton Sand Formations that extend across the westernmost portions of the draft Order Limits. As noted above, some of these deposits, notably the Brighton Sand Formation, have the potential to seal organic sediments and palaeoenvironmental archives within their sequences. Such areas of higher ground on the edges of rich, low-lying wetlands and river courses are also highly likely to have been exploited by past populations throughout both prehistoric and historic periods. The higher ground of the northernmost tip of the Isle of Axholme bordering the Trent Valley is likely to have fulfilled a similar role for human communities throughout the past.

Geomorphology and landscape modelling

- 4.8.6 The Humberhead Levels (incorporating the southernmost extent of the Vale of York) are drained by several large rivers, particularly the Aire and Ouse, that occupied similar courses to those of today during the early Holocene (Gaunt, 1987; Van de Noort and Ellis, 1999). Two borehole/augur transects were undertaken by the Humber Wetlands Survey across the Ouse at Airmyn (c. 3.6km east of the draft Order Limits) and Aire at Carlton (c. 1.7km to the west). The results of the Airmyn transect suggested that fluvial sands underlay the sequence at c. 9mbgl, deposited as reworked levée and floodplain sediments as the river system was first initiated across the emergent floor of Lake Humber between c. 11,000+/-200 BP (N-810) and 10,469+/-60 BP (SRR-870;

- Van de Noort and Ellis, 1999; cf Gaunt *et al*, 1971; Gaunt and Tooley, 1974; Jones and Gaunt, 1976; Gaunt, 1994). Channel aggradation may then have occurred as early as 7500-6300 cal BC (8500-7500 BP), though material from the base of the floodplain at Airmyn itself suggested a later date of 5330-4900 cal BC (6200+/-80 BP; GU-5761). The lateral spread of peat was determined to have occurred from the mid-/later Mesolithic through to the early Bronze Age, likely coinciding with a cessation of channel incision and the upper range of local wetland development (Van de Noort and Ellis, 1999).
- 4.8.7 Conversely, the lithostratigraphic sequence of the Carlton transect has been interpreted as representing the long-term persistence of low-energy fen carr environments coupled with sporadic phases of alluvial inundation (ie, flooding). However, the central part of the floodplain at Carlton Marsh showed evidence of having been more regularly reworked by high-energy fluvial activity throughout the Holocene, limiting the potential for the recovery of archaeological and palaeoenvironmental data in that location. The earliest date for organic sedimentation at this location is estimated at c. 5000-4000 BC in the later Mesolithic (Van de Noort and Ellis, 1999).
- 4.8.8 Kirby (2001) similarly utilised a database of over 100 borehole records to reconstruct the floodplain depositional environments of the lower Aire valley to the south and west of the Project. A clayey wood peat was here found to overlie the buried pre-Holocene surface, grading upwards into clays of estuarine origin. These data reflect the interplay between wetland and estuarine environments controlled, in part, by the fluctuating sea levels that were prevalent throughout the early to mid-Holocene.
- 4.8.9 The peatlands of Thorne and Hatfield Moors (located approximately 2 and 12km south of the draft Order Limits respectively) are remnants of the once extensive range of raised mires and wetlands that formed c 6,000 years ago and blanketed the Humberhead Levels (Bateman *et al*, 2001). These mires formed on the laminated clays and silts that infilled the proglacial Lake Humber during the Late Devensian. On Hatfield Moor, windblown sands overlie these basal deposits (Gaunt, 1994). The two Moors are separated by the riverbed of a previous branch of the River Don (Gaunt, 1975; Bateman *et al*, 2001), parts of which are now entrained as the Stainforth and Keadby Canal.
- 4.8.10 Lindholme Island, forms an area of dryland in the centre of Hatfield Moor, comprising one of several discontinuous deposits of sand and gravel stretching southeast from near Selby to the southern part of the Isle of Axholme, crossing the western fringes of the Project in the process. These sands and gravels were deposited as ice marginal morainic sediment during the high-level phase of Lake Humber (Bateman *et al*, 2001), and throughout their extent are likely to have been utilised by past populations as drier 'safe havens' adjacent to the lower lying wetlands that were rich in resources but far less suitable for sustained settlement.
- 4.8.11 In addition to the project specific borehole/augur interventions cited above, data is also available from clusters of BGS boreholes located where the Project
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route crosses the River Don/Aire and Calder Navigation, in the vicinity of the M62 crossing, and as an irregular transect (plus others in the vicinity) between Drax Power Station and the eastern bank of the River Ouse (cf Figures 10-11i-j).

Palaeoenvironmental and vegetational succession

- 4.8.12 An early palaeoenvironmental record for the landscape evolution of the upper Humberhead Levels/lower Vale of York was recovered from very near the Project route at Rawcliffe, just west of Goole by Gaunt (1974). Here, boreholes returned evidence of organic sediment dating bearing pollen indicative of the Ipswichian Interglacial of 230-115ka. The deposits were interbedded with clays, sands, and gravels and rested directly on the Sherwood Sandstone bedrock. They were in turn overlain by lacustrine deposits of Late Devensian age. Both freshwater and saltmarsh habitats were inferred from the recovered pollen sequence, together with evidence of estuarine tidal conditions as a result of sea level rise during the early part of the Interglacial.
- 4.8.13 Pollen and diatom data have similarly been used to reconstruct the early Holocene environments of the lower Aire Valley, through which it has been suggested that the inception of peat development due to increased waterlogging led to the spread of fen carr wetland vegetation throughout the valley bottom (Kirby, 2001). This was followed by the encroachment of estuarine conditions into the upper reaches of the Ouse/Humber fluvial system, resulting in the creation of large tidal lagoons, such as at Goole where a brackish lagoon persisted throughout the early to middle Mesolithic (Kirby, 2001).
- 4.8.14 Alder dominated fen carr had expanded throughout the Humberhead Levels by the middle Mesolithic (Long *et al*, 1998; Metcalfe *et al*, 2000), whilst diatom data have indicated a return of estuarine conditions within the lower Aire valley during the mid- to late Holocene. These conditions involved the deposition of estuarine alluvium and the expansion of tidal creek networks which eroded parts of the surrounding floodplain peats (Kirby, 2000). During the Bronze Age/Iron Age transition, peat was again deposited as sea levels once again fell.

5 GEOARCHAEOLOGICAL POTENTIAL

5.1 Introduction

- 5.1.1 This section integrates the data presented above throughout Section 4 to consider the geoarchaeological potential across the Project. That potential is expressed in terms of:
- i. The possible presence of archaeological remains that may lie sealed by, or within, different sedimentary facies.
 - ii. Areas with good stratigraphic sequences that could contribute to a deposit model (either in the case of existing project-specific or BGS-derived data, or where GI or purposive works could be undertaken).
- 5.1.2 The data is first considered at a general level within the broader context of the overarching Project (Section 5.2; Table 2), then more specifically for each of the seven LCAs traversed by the draft Order Limits (Section 5.3).

5.2 General potential of the sedimentary facies

- 5.2.1 This section considers and summarises the broad potential for encountering archaeological remains within the various environments and sedimentological sequences that are present across the Project. The sedimentary facies are summarised below in Table 2, with a more detailed commentary regarding facies of higher geoarchaeological potential following thereafter.

Table 2: Summary of facies types and inferred geoarchaeological potential

Sediment Unit	Environment of Deposition	Archaeological Potential
Topsoil	Modern agricultural ploughsoil and/or artificial made ground.	Could contain redeposited pottery or lithic material brought to the surface through ploughing and sub-surface disturbance.
Warp	Modern alluviation for soil improvement and ground level build-up. Low energy.	Has the potential to seal in-situ historic and prehistoric archaeological remains and palaeoenvironmental sequences.
Colluvium	Potential modern and ancient soil movement associated with agriculture and vegetation clearance (hillwash/ploughwash). Soil creep, slope/sheet wash, rill and gully erosion. Low to moderate energy.	Potential to contain re-deposited pottery and lithic material from historic and prehistoric activities on higher ground/slopes, and to seal land surfaces and archaeological remains across footslopes.

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Tidal flat deposits	Holocene sedimentation of sands, silts and clays in coastal and/or estuarine settings. Mudflats, sandflats, saltmarsh and tidal creeks. Moderate to high energy.	Has the potential to seal in-situ historic and prehistoric archaeological remains and palaeoenvironmental sequences in waterlogged conditions. May preserve evidence of former saltmarsh and creek systems, as well as earlier freshwater environments at depth. May form focus of seasonal activities (timber trackways and fish traps, salt making, etc).
Alluvium/Fluvial deposits	Holocene alluviation associated with overbank flooding and migrating river/stream channels, backwater areas. Low to high energy.	Has the potential to seal in-situ historic and prehistoric archaeological remains and palaeoenvironmental sequences in waterlogged conditions, including former dryland areas. Reworking and erosion may also be associated with coarse grained channel facies (sands and gravels). Timber structures may be preserved, particularly at the margins of channels or marginal ecotonal zones adjacent to buried islands or at floodplain edges.
Peat/Organic Alluvium	Periods of stabilisation or channel migration that result in encroachment of vegetation. Low energy.	In-situ prehistoric potential in waterlogged conditions, including palaeoenvironmental sequences and organic artefacts, including timber structures.
Head	Head deposits may occur on lower slopes and the base of valleys as a result of mass wastage, solifluction and/or sheet wash. Generally composed of poorly sorted sands and gravels, often the	Some Palaeolithic or early prehistoric potential. May seal land surfaces where reworked as colluvium in later periods. Gravelly facies may contain reworked artefacts from higher upslope.

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	product of reworked glacial and fluvioglacial sediments.	
Pleistocene/early Holocene fluvial and aeolian deposits	Fluvial (riverine) sand, silt, and clay deposits, frequently reworked and redeposited as aeolian coversands. Fluvial deposits may incorporate more organic/peaty beds. Named deposits, eg, Sutton Sand Formation, Brighton Sand Formation.	Some Palaeolithic and/or early prehistoric potential. May seal older land surfaces and/or incorporate organic horizons. Potential for later prehistoric/historic activity where deposits form areas of relative higher ground.
Pleistocene glaciofluvial deposits/river terrace deposits	Undifferentiated Pleistocene sands and gravels. Named deposits, eg, Kelsey Hill Gravels.	Some Palaeolithic potential, predominantly for reworked artefacts.
Pleistocene glaciolacustrine sediments	Sands, silts and clays associated with infilling of proglacial Lake Humber. Named deposits, eg, Hemingbrough Formation (aka the 25 foot Drift).	Some Palaeolithic potential, including <i>in situ</i> stratified artefacts at marginal locations, ecotonal zones.
Pleistocene till	Deposits of sands and gravels deposited by glaciers.	None. Very rarely may mask underlying Palaeolithic archaeology.
Pleistocene interglacial beach deposits	Sands and gravels representing pre-Devensian shoreline deposits. May include estuarine deposits which may incorporate organic rich sediments.	Palaeolithic potential. Artefact and ecofact assemblages are most likely to have been reworked but may be <i>in situ</i> in some cases.
Bedrock	Geological strata. Predominantly mudstones of Early Jurassic-Late Triassic age in the west, with Middle and Upper Jurassic clays and limestones further east, followed by chalk limestones of Cretaceous age in the far east.	None.

Pleistocene deposits

- 5.2.2 These deposits cover a range of sediments, including potentially earlier Pleistocene estuarine and beach deposits in some cases, as at Kirmington (Lincolnshire Wolds LCA) where BGS mapping places such deposits within 1km of the draft Order Limits (cf Section 4.4.3). Named units such as the Kelsey Hill Gravels are then recorded across the fringes of the Humber Estuary as upstanding ridges (eskers) or 'islands' bordered by Holocene tidal flat deposits. Lower sea levels prevalent throughout the Late Glacial and early Holocene meant that this area forming part of a much larger low-lying plain extending all the way to the continental mainland (ie, Doggerland; Tweddle, 2001). It is therefore possible that these deposits could contain evidence of Palaeolithic activity. Indeed, bones of animals such as horse, deer, mammoth and bison have all previously been recovered from the Kelsey Hill Gravels from the area around Keyingham, to the immediate north of the draft Order Limits as they cross the eastern flats of the Humber Estuary (Whittaker, 2001). Deposits such as glacial till, glaciofluvial sands and gravels, and head may also mask or seal underlying deposits that could contain Palaeolithic archaeological and/or palaeoenvironmental remains.
- 5.2.3 The silting up and draining of proglacial Lake Humber throughout the late Pleistocene/earliest Holocene led to accumulations of glaciolacustrine sediments (particularly those of the Hemingbrough Formation) across the western end of the Project. These deposits are predominantly composed of laminated clays, silts, and sands, are largely unconsolidated, and together underlie much of the floodplain extending across the southern Vale of York and north/western Humberhead Levels. Along the Trent Valley, the development of a fast-moving braided channel system resulted in the formation of the Trent Valley terrace sequence and associated gravel islands. These gravel islands likely played a key role in the development of early human settlement, providing a focus for activity on drier land within the otherwise low-lying and often swampy river valleys. Where the Project crosses the Trent and Ancholme Valleys and runs on into the Humberhead Levels these early sequences are likely to be covered in thick deposits of alluvium and later warp. Elsewhere throughout the draft Order Limits, undifferentiated Pleistocene sands and gravels are mapped as glaciofluvial deposits.
- 5.2.4 Fluvial and/or aeolian sand deposits, including those of the Sutton and Brighton Sand Formations are mapped by the BGS across the western half of the Project route (Figures 11f-j). Dating of these units is generally imprecise, primarily due to the frequent re-activation of these sediments as windblown coversands in a process that began during the early Holocene and continues to this day (Bateman and Buckland, 2001). The bands of coversands mapped along the westward-facing scarps of the Lincolnshire Wolds and Lincoln Edge are particularly likely to have been reworked and redeposited in this manner, while those present across the Humberhead Levels to the west are liable to incorporate more *in situ* material. In either case, it is likely that any archaeological remains contained within these deposits may be reworked, or

else deposited in later periods in places where sand accumulation had formed low, comparatively drier rises within the surrounding wetlands. Even where reworked, Palaeolithic artefacts in particular would remain significant given their general paucity within the region. Where *in situ*, deposits of the Brighton Sand Formation also have the potential to incorporate beds of more clayey and/or peaty sediment, whilst aeolian reworked coversands could seal underlying land surfaces and/or palaeoenvironmental sequences.

Holocene alluvial and peat deposits

- 5.2.5 As the sea levels began to rise throughout the early Holocene, thick swathes of alluvium were deposited across the floodplain of the Humber and its various tributaries. Extensive areas of alluvium are mapped by the BGS across the Project, particularly throughout the Ancholme and Trent Valleys and across the Humberhead Levels. Alluvial sediments deposited under explicitly estuarine conditions (ie, tidal flat deposits) are also mapped throughout the Humber Estuary and across the lowermost reaches of the Rivers Trent and Ouse. Such deposits have the potential to seal both *in situ* historic and prehistoric archaeological remains/palaeoenvironmental archives in waterlogged conditions, especially across areas of former dry land that were buried as the ecotonal zone shifted further upslope with increased sedimentation. That said, reworking and erosion may also be associated with coarser grained fluvial facies such as channel sands and gravels.
- 5.2.6 Timber structures have a particularly elevated potential for preservation where modern drainage/dewatering has been relatively limited, especially at key points in the landscape such as channel margins, confluences and ecotonal zones adjacent to buried islands or at floodplain edges. Peat deposits are likely to be present as intercalated deposits within larger alluvial sequences and may be present in substantial thicknesses in places where subsequent fluvial activity has not eroded earlier phases of wetland sedimentation. Whilst small pockets of peat are mapped at surface level across parts of the Project route these are more likely to be degraded from modern exposure and dewatering, with far greater geoarchaeological potential associated with peat deposits buried at greater depths.

Holocene colluvial deposits

- 5.2.7 Colluvial deposits composed of Holocene slope deposits associated with de-vegetation and agricultural practices (eg, ploughing) have the potential to bury earlier deposits and potential land surfaces that could be associated with worked lithics, as well as sealing wetland sequences (eg, valley margin peats). Though not explicitly mapped by the BGS, such deposits are likely to occur across the footslopes of any of the areas of higher ground evident across the Project, especially within the Holderness, Lincolnshire Wolds and Lincoln Edge LCAs.

Recent warp

- 5.2.8 The main areas of extensive warp deposition as mapped by the BGS occur across the Trent Valley and Humberhead Levels, though it also likely to be present across the Humber Estuary and the lower reaches of the Winestead Drain in Holderness. These deposits of artificial alluvium can easily mask the topographic presence of any natural landforms they cover, including former land surfaces of archaeological or palaeoenvironmental potential (eg, palaeochannels, gravel islands, etc). Gauging the depth of these deposits can be particularly difficult, even when using borehole records, due to the strong sedimentological similarities between silts derived from intentional warping and natural alluviation.

5.3 Specific areas of potential within Landscape Character Areas

Holderness

- 5.3.1 The southern tip of Holderness crossed by the Project route is of generally low geoarchaeological potential, with the notable exception of the small valley of the now-canalised Winestead Drain and its outfall into the tidal flats fringing the Humber Estuary. Alluvial sediments across the base of this valley may blanket and preserve both organic archaeological remains and localised palaeoenvironmental archives, including those associated with the natural course of the tidally influenced channel prior to its canalisation and the installation of sluice gates across its outlet near Patrington Haven in the eighteenth and nineteenth centuries (cf Allison, 1976; Sheppard, 1966). The ecotonal zones along the lower flanks of the valley sides are also likely to have been areas attractive to both historic and prehistoric human activity. The valley itself may also have formed a preferred routeway for travelling between the lower ground along the estuary and the comparatively higher ground of Holderness, especially in earlier prehistory when that higher ground extended significantly further east than it does today.
- 5.3.2 Precedent for such areas preserving waterlogged prehistoric remains is provided from further north in Holderness by sites such as West Furze, where a trackway spanning the Neolithic to Bronze Age was uncovered, the Mesolithic lakeside platform of Round Hill, and Barmston Drain, where a Bronze Age settlement was located on the sediments of a former Late Glacial mere (Fletcher and Van de Noort, 2007).

Humber Estuary

- 5.3.3 As the draft Order Limits pass westward towards the Humber, they cross a wide area of reclaimed tidal flat deposits to the south of the A1033. These deposits have the potential to incorporate deeply stratified palaeoenvironmental sedimentary archives related to the fluctuation of freshwater and estuarine environmental conditions alongside the main river channel since the late Pleistocene/earliest Holocene, including proxy signals of the encroaching coastline as Doggerland was gradually lost to the North Sea. Previous geoarchaeological investigations at Paull, to the immediate
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north of the Humber crossing on its eastern bank, and Goxhill, on its western bank, have previously identified significant peat development in these locations throughout the Mesolithic and Neolithic periods in particular (cf Section 4.3.3). The data from both projects could be included within any future location-specific deposit modelling (cf Appendix A).

- 5.3.4 The fringes of the higher ground of Holderness to the immediate north of the draft Order Limits are also at least partly comprised of glaciofluvial deposits of the Kelsey Hill Gravels, several 'islands' of which occur within the draft Order Limits on the eastern side of the Humber crossing. As noted in Section 4.3.5, these gravel deposits have some potential to include Palaeolithic artefacts as well as palaeoenvironmental remains (such as animal bones) in themselves. Perhaps more significantly, as localised areas of higher ground situated within the surrounding wetland, they are highly likely to have formed foci for both prehistoric and historic activity concentrated along this ecotonal zone. Work by the Humber Wetlands Survey in the 1990s has already identified several sites of Neolithic date situated across these gravels between Thorngumbald and Paull (Van de Noort, 2004, fig. 21). Older (ie, Mesolithic) sites have the potential to lie more deeply buried around these outcrops as later estuarine sedimentation gradually enveloped their lower slopes. Similarly, the tidal flat and alluvial deposits blanketing the lower slopes of the glacial tills edging the western bank of the Humber also have the potential to seal waterlogged prehistoric archaeology and/or palaeoenvironmental remains, especially around the outfall of the East Halton Beck to the immediate northeast of Goxhill.

Lincolnshire Wolds

- 5.3.5 The area of the Lincolnshire Wolds crossed by the draft Order Limits is of generally low geoarchaeological potential, with the localised exception of the small valley formed by the East Halton Beck across the northeastern part of the LCA. As with other small streams/rivers, this valley contains alluvial deposits with the potential to seal more deeply buried organic sediments, as is suggested by the pockets of BGS surface-mapped peat at the juncture of the main Project route and the southern spur towards Humberside Airport. Previous geoarchaeological works near the northeastern outfall of this channel have identified significant peat deposits dated to the early Bronze Age (cf Section 4.4.4). As with other ecotonal zones, the surrounding slopes of till, head and glaciofluvial sands/gravels are also likely to have been foci of activity for past communities, whilst more recent colluviation may also bury older archaeological remains/sequences on the lowermost slopes. The valley itself is also likely to have formed a preferred routeway for travelling between this lower ground and the higher ground of the Wolds.
- 5.3.6 The lower slopes of the Wolds themselves, both to the east bordering the Humber Estuary and to the west bordering the Ancholme Valley, are also likely to have comprised attractive ecotonal zones throughout the past. The deposits of the Brighton Sand Formation mapped across the westward facing slopes on the edge of the Ancholme Valley are also highly likely to
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mask earlier surfaces/deposits, as these sands are most likely windblown in origin rather than comprising *in situ* fluvial sediments. Monitoring of future GI works and/or purposive investigations should be able to resolve how thick these coversands are and whether they do indeed seal underlying deposits of geoarchaeological interest.

- 5.3.7 The SSSI of Kirmington Pits near the terminus of the southern spur of the draft Order Limits is well known for its important pre-Devensian interglacial channel and beach deposits and possible Palaeolithic artefacts (cf Section 4.4.3). Whilst lying outside of the draft Order Limits themselves, BGS mapping does show other interglacial beach deposits in the vicinity, including within the 500m buffer (cf Figure 11e), and so the potential for similar deposits within the Project route in this location cannot be discounted. If encountered within the draft Order Limits, the analysis of such deposits could address several strategic objectives of the East Midlands Research Agenda, in particular how the regional Historic Environment Record dataset for the study of the Palaeolithic could be enhanced.

Ancholme Valley

- 5.3.8 The Project route near the mouth of the Ancholme Valley is likely to cross complex sedimentary sequences that extend to substantial depths (ie, $\geq 20\text{m}$), composed of interdigitated freshwater and estuarine/tidal deposits related to the confluence of the Ancholme and Humber rivers. LiDAR imagery clearly shows that prior to modern canalisation and drainage the Ancholme was a much larger watercourse than it is today and cut through an extensive area of saltmarsh/tidal mudflats infilling the valley bottom (cf Section 4.5.2). Although the influence of strong tidal conditions in later periods is likely to have flushed out and/or reworked much of the earlier sediments in this confluence area, there remains the potential for preserved organic facies, including peat, at greater depths which could contain significant palaeoenvironmental archives related to early prehistory. The former banks of the natural river channel and its larger contributory creeks may also have formed focuses for shoreside activity, whilst waterlogged channel sediments have the potential to preserve woody artefacts/structures such as boats and jetties, as exemplified by the 'Brigg raft' and other such finds encountered further south within the valley (cf Section 4.5.7).
- 5.3.9 The lower slopes of the valley, to both west and east, are also likely to have been exploited throughout the past as dryland ecotonal areas adjacent to the wetlands of the valley bottom, as found to be the case further south by the Humber Wetlands Survey (Section 4.5.7; cf Van de Noort, 2004, fig. 24). This situation is particularly likely for the area crossed by the draft Order Limits as LiDAR mapping shows that areas of moderately higher ground within the valley bottom (formed by outcropping bedrock to the east and a ridge of till in the west) would have formed a large embayment within the Project area where the Ancholme flowed into the Humber (Figures 10, 11 and 12f). These surrounding areas of higher ground would have formed ideal places from which to access and exploit the estuary itself. As noted above (Section 5.3.6),
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coversand deposits on the eastern flank of the valley may seal underlying palaeo-surfaces, a function that may also be performed by unmapped colluvial deposits on either side of the valley. Sites/artefact scatters located on the lowermost slopes may also have been buried under alluvial sedimentation as the valley floor itself aggraded over time.

Lincoln Edge

- 5.3.10 There is generally low geoarchaeological potential across the Lincoln Edge LCA as traversed by the draft Order Limits. The most obvious exception is, as for Holderness and the Lincolnshire Wolds, the ecotonal lower footslopes to both the east and west where palaeo-surfaces and associated archaeological remains could be buried beneath localised colluvium, including reworked head deposits, or aggrading alluvium from the floodplains below. The blown sand deposits mapped across the western edge of the escarpment are perhaps less likely than those in other locations along the Project route to seal significant depths of underlying deposits given their position 'perched' atop the high ground flanking the eastern side of the Trent Valley, though confirmation of this hypothesis should be sought through either purposive in-field investigation and/or the monitoring of GI works.
- 5.3.11 The small valley of the Winterton Beck also holds some geoarchaeological potential, both in terms of sites/and or isolated finds that may lie sealed beneath localised alluvium, and the potential for the recovery of palaeoenvironmental data from the peat deposits mapped across the northern edge of the draft Order Limits by the BGS (cf Figure 11g). As for other similar small valleys along the Project route, the Winterton Beck may also have been used throughout the past as a preferred routeway extending up from the edges of the Humber Estuary to the north onto the ridge of the Lincoln Edge and on between the Ancholme and Trent Valleys to the south.

Trent Valley

- 5.3.12 The Project route crosses two parts of the Trent Valley – across its full width near its northern confluence with the Ouse/Humber, and along its western side near Keadby a few kilometres to the south. Both areas are characterised by extensive alluvium and warp deposits, both of which almost certainly cap deeply stratified former channel and wetland sedimentary sequences, as well as potentially cloaking buried topographic features such as sand/gravel islands and the ridges of former river terraces that could have been exploited by past communities. Determining the potential thickness of these deposits and the nature of what lies beneath them should form a key aim of any future deposit modelling based off project-specific GI and/or purposive geoarchaeological works.
- 5.3.13 Previous geoarchaeological investigations in and around Keadby Wind Farm (at the terminus of the southern spur of the draft Order Limits) ascertained these deep alluvial deposits to be up to 17m thick, and in this location to incorporate extensive early to mid-Holocene peat horizons within their upper 5m (cf Sections 4.7.5-4.7.7). These investigations both prove the case for the
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potential presence of deposits of high palaeoenvironmental potential (including extensive former peatlands) throughout this section of the draft Order Limits and provide useful data that could be incorporated within a project-specific deposit model alongside that derived from Project GI and purposive geoarchaeological boreholes.

- 5.3.14 The presence of sub-surface waterlogged peat horizons also raises the potential for the preservation of organic archaeological remains, including timber structures and other artefacts, throughout the LCA. Such remains are perhaps most likely to occur within/alongside buried palaeochannel features (as well as that of the modern-day Trent itself) as these would have formed important routeways in the past, both for the exploitation of local resources and for travelling across the wider region. The largest and most obvious of these former channels is that of the Old River Don, along which the early medieval villages of contemporary Eastoft, Luddington, Garthorpe and Adlingfleet exemplify its previous importance within the local landscape.
- 5.3.15 The draft Order Limits cross this major palaeochannel in two key locations. The first is that of the old confluence of the Don with the Trent near Adlingfleet, itself located just south of the Trent's outfall into the Humber Estuary. This is likely to have formed a focus for activity within both historic and prehistoric periods, as has already been suggested by the presence of Roman settlement in this location (Section 4.7.3; cf Van de Noort, 2004, 118). To the south, the draft Order Limits then cross the former Don just north of the very northernmost tip of the Isle of Axholme, itself composed of outcropping Mercia mudstone in this location. The proximity of this higher, drier land and the access provided into both the Trent Valley and Don Valley/Humberhead Levels suggests that this too is likely to have formed a key focus for human activity throughout the past. As for other similar locations across the Project route, any archaeological sites situated on the lowermost slopes of the adjacent high ground are also likely to have been sealed beneath later phases of alluvial aggradation, both natural and as the result of artificial warping.

Humberhead Levels

- 5.3.16 As for the Trent Valley, extensive deposits of alluvium and warp across the Humberhead Levels cap deeply stratified former wetland (including peatland) sequences, and also have the potential to blanket raised levees, riverbanks and sand/gravel 'islands' that may have formed foci of past human activity. These latter landforms are particularly likely to be present across the western parts of the LCA where the BGS have mapped deposits belonging to the Hemingbrough Glaciolacustrine and Brighton Sand Formations. Both these Formations also include some potential, primarily for palaeoenvironmental recovery, where they remain *in situ* (ie, have not been reworked by later aeolian activity) and incorporate lenses of more clayey and/or peaty horizons associated with the fringes of the former proglacial Lake Humber during the later Pleistocene and earliest Holocene. They also have some potential for the recovery of (predominantly reworked) early prehistoric artefacts.

- 5.3.17 In addition to the former (now drained) wetlands infilling the former lake basin, several large river systems cross the Project route throughout the LCA, in particular the (previous course of the) Don, Aire and Ouse. Previous geoarchaeological investigations by the Humber Wetlands Survey of the Aire and Ouse floodplains to either side of the draft Order Limits (at Carlton and Airmyn respectively) have shown that the subsurface sedimentary sequences in these locations extend to at least 9mbgl and record extensive fluvial activity bracketing phases of lower energy backswamp development, as well as signatures related to the gradual but punctuated increase of estuarine influence as sea levels rose throughout the early to mid-Holocene (cf Sections 4.8.6-4.8.7; Van de Noort and Ellis, 1999). Data from these surveys could also be usefully incorporated within any future Project-specific deposit modelling of this area, whilst they also highlight the potential for the presence similar sequences across other areas of active floodplain crossed by the current Project.
- 5.3.18 As noted for the Trent Valley, peat horizons and other waterlogged subsurface deposits adjacent to contemporary rivers and/or within older palaeochannels also have the potential to preserve organic archaeological remains and structures such as boats and trackways. This is true for areas adjacent to the present-day courses of the Aire and Ouse, as well as that of both the western and eastern branches of the Old River Don. The eastern branch of the Don is discussed in Sections 5.3.14-5.3.15 above, as the location where the palaeochannel roddon is crossed by the draft Order Limits lies right on the boundary of the Trent Valley and Humberhead Levels LCAs. The northern palaeochannel branch and its former confluence with the Aire near East Cowick are likewise areas of high geoarchaeological potential, both for deeply stratified waterlogged sediments containing valuable palaeoenvironmental archives, and as sites of potential archaeological activity. The latter factor is particularly raised given the close proximity to the former confluence of a ridge of raised ground formed by outcropping Sherwood sandstone and glaciolacustrine beach deposits to the immediate west, as well as the higher ground to the north of the Aire Valley which is also cut by several smaller palaeochannels (Figures 10, 11 and 12j).
- 5.3.19 A further large palaeochannel crossing the draft Order Limits is evident on the LiDAR plot to the east, flowing into the Ouse approximately 1km southwest of Swinefleet (Figure 12i). Several other such channels could be buried deeper within the blanketing alluvium/warp, in addition to areas of higher ground such as banks and levees. The evaluation of the potential depth of the uppermost masking deposits should thus form a major focus of any future assessment of project specific GI and/or purposive geoarchaeological works.

6 CONCLUSIONS

6.1 Key points

6.1.1 The Project traverses a considerable transect across a landscape that is both diverse and complex in its geomorphology, sediment history, and geoarchaeological potential. The findings of this GDBA have been discussed in considerable detail throughout the previous sections, and are summarised below:

- Mapping of superficial deposits by the BGS has recorded swathes of both freshwater alluvial and tidal sediments across large parts of the Project, representing (in part) low-energy environments depositing organic silts and clays, and sometimes peat. This suggests considerable geoarchaeological potential with regards to former wetland margins and vegetated palaeoenvironments. Alluvial zones may also preserve relict palaeochannel systems and encompass ecotonal zones which may have acted as a focus for activity in the past, eg, for hunting, fishing, transport, etc. The waterlogged nature of such sediments further increases the potential for the preservation of organic remains, which may include timber structures as well as palaeoenvironmental archives suitable for landscape reconstruction.
- Naturally occurring alluvial/tidal flat deposits are in many places across the Project, though particularly the Trent Valley and Humberhead Levels LCAs, either overprinted by and/or interdigitated with more recent artificial warp, which similarly has the potential to mask many sub-surface topographic features and/or archaeological sites. Distinguishing between natural alluvium and artificial warp can be particularly difficult, though a key focus of the future assessment of GI and/or purposive geoarchaeological boreholes should be to see if this is possible, and if so then to ascertain how thick warp deposits may be across the Project route.
- Humans are often drawn to watercourses, springs and wetland-edge environments (ie, ecotonal zones). Mapping of floodplain channels and other topographic features, especially with LiDAR data, has demonstrated that several such features of likely archaeological importance can be identified across the Project. During this qualitative GDBA, several potential palaeochannels have been identified either within or immediately adjacent to the draft Order Limits, eg, both the western and eastern branches of the Old River Don crossing the Humberhead Levels and lower Trent Valley. Alluvial and fluvial deposits associated with such environments also have the potential to seal buried land surfaces associated with well-preserved archaeological features, structures or *in situ* artefact assemblages.
- River terrace deposits, although not specifically mapped as such by the BGS, may also be present across the Project though masked by later phases of alluviation and/or artificial warping, particularly where the

Project crosses the Rivers, Ancholme, Trent, Don, Aire and Ouse. Such deposits, as well as now-buried outcrops of bedrock and/or superficial Pleistocene deposits, may have formed subtle topographic highs in the past that would have been attractive to prehistoric people as sites from which to exploit the resources of the surrounding wetlands. Such areas may also have formed key communication routes across the surrounding landscape. Smaller valleys extending from lower lying to higher areas similarly hold high potential for past activity in terms of enabling access to different resource zones. These are exemplified within the Project by the valleys of the Winestead Drain in Holderness and the East Halton Beck in the Lincolnshire Wolds.

- Sites within the lower reaches of the various river valley systems crossed by the Project are complex because both fluvial and estuarine processes may have influenced phases of deposition and erosion. This is true both for larger river systems, like the Ancholme and Trent, and smaller channels, such as the Winestead Drain or the East Halton Beck that drain the higher ground immediately adjacent to the Humber Estuary. Even sedimentary archives at considerable depth are likely to be complex given the introduction of scouring tidal forces in later periods as sea levels rose and the coastline moved westward throughout the early to mid-Holocene. Likewise, areas adjacent to former ice sheets (eg, the lower Vale of York within the Humberhead Levels LCA) may also display complicated stratigraphy due to the cyclic surging and waning of the ice, resulting in multiple periods of deposition that are often difficult to separate, correlate and date. It is therefore of critical importance that a robust chronological framework is established for the Pleistocene and Holocene deposits across the Project to enable any reliable deposit modelling.
- A large geographical area traversed by the Project, particularly the Humberhead Levels and Trent Valley LCAs, represents part of the modelled extent of the former proglacial Lake Humber (cf Figure 5). There is therefore some potential for the survival of early prehistoric remains at, or near, possible former lake edge/wetland environments within the Project area, though they are in most cases likely to be either partially reworked and/or buried beneath thick deposits of later alluvium. Where glacio-lacustrine and glacio-fluvial deposits such as those associated with the Hemingbrough and Brighton Sand Formations remain *in situ*, there is also the potential for stratified organic (including peaty) horizons to contain palaeoenvironmental archives relating to the late Pleistocene/earliest Holocene.
- Small pockets of BGS-mapped lacustrine deposits across the Holderness LCA could encompass accumulations of organic sediment, for example within small meres formed in kettle holes. These deposits have some potential to contain palaeoenvironmental data, though of a highly localised nature and of potentially degraded status given modern drainage and agricultural land use practices.

- Deposits of sands and gravels (including periglacial head and Holocene colluvium) could also mask underlying archaeological remains across the Project, especially across the footslopes of areas of higher ground or within small valleys located therein. Though outside the draft Order Limits, the important interglacial beach deposits at Kirmington Pits SSSI also raise the (admittedly fairly constrained) possibility that other, as yet unmapped, pre-Devensian organic sequences are also present across the southern part of the Lincolnshire Wolds LCA.
- BGS borehole data across the Project are largely historical and of limited use in the construction of future deposit models. Such records often lack altitudinal data and have been sited to focus on bedrock geology rather than superficial deposits, or else the scanned record sheets are themselves of poor quality. In many cases, the spread of boreholes is too far apart to produce a meaningful deposit model representative of the subsurface deposits in a given location. There are, however, several areas (mentioned throughout the text and tabulated in Appendix A) where BGS borehole coverage is reasonable and would provide sufficient data to supplement new data acquired from future GI and/or purposive geoarchaeological investigations. Similarly, data from previous developer-funded geoarchaeological projects could provide supplementary data to accentuate more detailed deposit modelling across the Project (see Appendix A).

6.2 Summary of potential

- 6.2.1 The geoarchaeological and palaeoenvironmental potential of the depositional facies traversed by the Project is summarised in Table 3 below. This is further differentiated into zones of high-, medium-, or low potential, based on the extent and nature of the deposits found within each LCA traversed by the draft Order Limits. It should be noted that this potential is often specific to discrete regions of these LCAs (eg, palaeochannels, valley systems, ecotonal zones, etc), rather than the area in its entirety.
- 6.2.2 Deposits of geoarchaeological potential reflect sediment accumulations that could be considered for further in-field evaluation, either as a part of a GI watching brief or through purposive interventions, as well as potential mitigation works later in the Project timeline. Specific deposits may form priority targets due to their intrinsic character, including their potential to act as foci for past human activity, as well as their potential to mask/seal underlying deposits and/or archaeological remains of more direct interest. Deposits of palaeoenvironmental potential are those which are more likely to specifically contain organic sediments that may hold valuable data for establishing chronological and vegetational histories. The distinction between high-, medium-, and low potential is based on the extent and nature of the deposits found within each LCA, and thus effectively represents the 'average' potential for the area as a whole.

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Table 3: Summary of geoarchaeological/palaeoenvironmental potential

Landscape Character Area (LCA) traversed by draft Order Limits	Depositional facies	Potential					
		Geoarchaeological			Palaeoenvironmental		
		High	Med	Low	High	Med	Low
Holderness	Till			x			x
Holderness	Glaciofluvial Sheet Deposits			x			x
Holderness	Lacustrine Deposits			x		x	
Holderness	Alluvium		x		x		
Holderness	Tidal Flat Deposits		x		x		
Humber Estuary	Till			x			x
Humber Estuary	Kelsey Hill Gravels	x					x
Humber Estuary	Alluvium		x		x		
Humber Estuary	Tidal Flat Deposits		x		x		
Lincolnshire Wolds	Bedrock			x			x
Lincolnshire Wolds	Till			x			x
Lincolnshire Wolds	Head, Clay with Flints, and Glaciofluvial Sheet Deposits			x			x
Lincolnshire Wolds	Brighton Sand Formation		x				x
Lincolnshire Wolds	Interglacial Beach/Lacustrine Deposits		x			x	
Lincolnshire Wolds	Alluvium		x		x		
Lincolnshire Wolds	Peat		x		x		
Ancholme Valley	Bedrock			x			x
Ancholme Valley	Till			x			x
Ancholme Valley	Glaciofluvial Sheet Deposits		x				x
Ancholme Valley	Brighton Sand Formation		x				x
Ancholme Valley	Alluvium	x			x		
Lincoln Edge	Bedrock			x			x
Lincoln Edge	Till			x			x

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Lincoln Edge	Head and Glaciofluvial Sheet Deposits			x			x
Lincoln Edge	Hemingbrough Glaciolacustrine Formation			x			x
Lincoln Edge	Blown Sand			x			x
Lincoln Edge	Alluvium		x			x	
Lincoln Edge	Peat		x			x	
Trent Valley	Head		x				x
Trent Valley	Blown Sand		x				x
Trent Valley	Sutton Sand Formation		x				x
Trent Valley	Tidal Flat Deposits		x		x		
Trent Valley	Alluvium	x			x		
Trent Valley	Warp	x					x
Humberhead Levels	Glaciolacustrine Beach Deposits		x				x
Humberhead Levels	Hemingbrough Glaciolacustrine Formation		x			x	
Humberhead Levels	Brighton Sand Formation		x			x	
Humberhead Levels	Tidal Flat Deposits		x		x		
Humberhead Levels	Alluvium	x			x		
Humberhead Levels	Warp	x					x

6.3 Considerations for further work

- 6.3.1 Further geoarchaeological investigation of the various deposits and landforms present throughout the Project would necessarily follow a multi-staged scheme of works, with each stage informing the scope of the next. Within that context, this final section provides an overview of a limited scope of early-stage work that could be undertaken to test the findings of this GDBA and to provide suitable baseline data for more detailed deposit modelling at key locations throughout the draft Order Limits.
- 6.3.2 A geoarchaeological watching brief on any Project GI works would provide direct observations of the sediment sequences and offer the opportunity to record any evidence of buried land surfaces and associated cultural activity. These data, combined with the better-quality BGS records listed in Appendix A, could form the basis for a first-stage deposit model specific to different

'interest areas' across the Project. Opportunistic sampling may also provide material for range-finding radiocarbon dating and initial palaeoenvironmental assessment, although detailed assessment is typically only carried out through targeted purposive investigations (see below). For geoarchaeological modelling purposes, high-priority targets for any GI monitoring should include waterlogged alluvial/wetland zones (including tidal flats and expanses of peat/lacustrine deposits) and valley areas which may include Holocene colluvium and/or coversand deposits. Ecotonal edge environments may also contain shallower sequences where the impact of construction works may be greater. These areas should be targeted for the direct observation of GI works to allow for the identification of stratified archaeological horizons, if present, in addition to deeper sequences where directional drilling is planned for crossing points (eg, roads and watercourses). Lower priority areas for geoarchaeological purposes would include areas where the Project crosses glacial deposits (eg, glacial till), or where the BGS maps near-surface bedrock without superficial covering deposits across areas of higher ground.

- 6.3.3 It is unlikely that data from Project GI interventions alone would provide a sufficient density of subsurface data to fully address questions of geoarchaeological potential. Targeted purposive borehole surveys (to fill gaps in any proposed GI arrays) in areas considered to be of higher potential (ie, through sediment sequences including alluvial/tidal, peaty, colluvial and aeolian deposits), would thus provide additional stratigraphic data to aid the development of Project-specific deposit models, as well as material for palaeoenvironmental assessment and radiocarbon dating. An initial phase of purposive geoarchaeological boreholes would also prove of benefit in assessing the character of near-surface sediments for the purposes of guiding the scope of any archaeological evaluation trenching, especially in areas where recent warp is presumed to mask older deposits.
- 6.3.4 Multiple phases of geoarchaeological boreholes could also be considered, comprising an initial phase of evaluative works (as outlined above) followed by further targeted interventions to address specific questions and/or knowledge gaps that arise during the progression of wider programmes of investigation and mitigation. The quantity and placement of these latter interventions would depend on the availability of other data sources suitable for subsurface deposit modelling and be undertaken following the careful consideration of their potential value and effectiveness to meet specific Project aims (Historic England, 2015; 2020).

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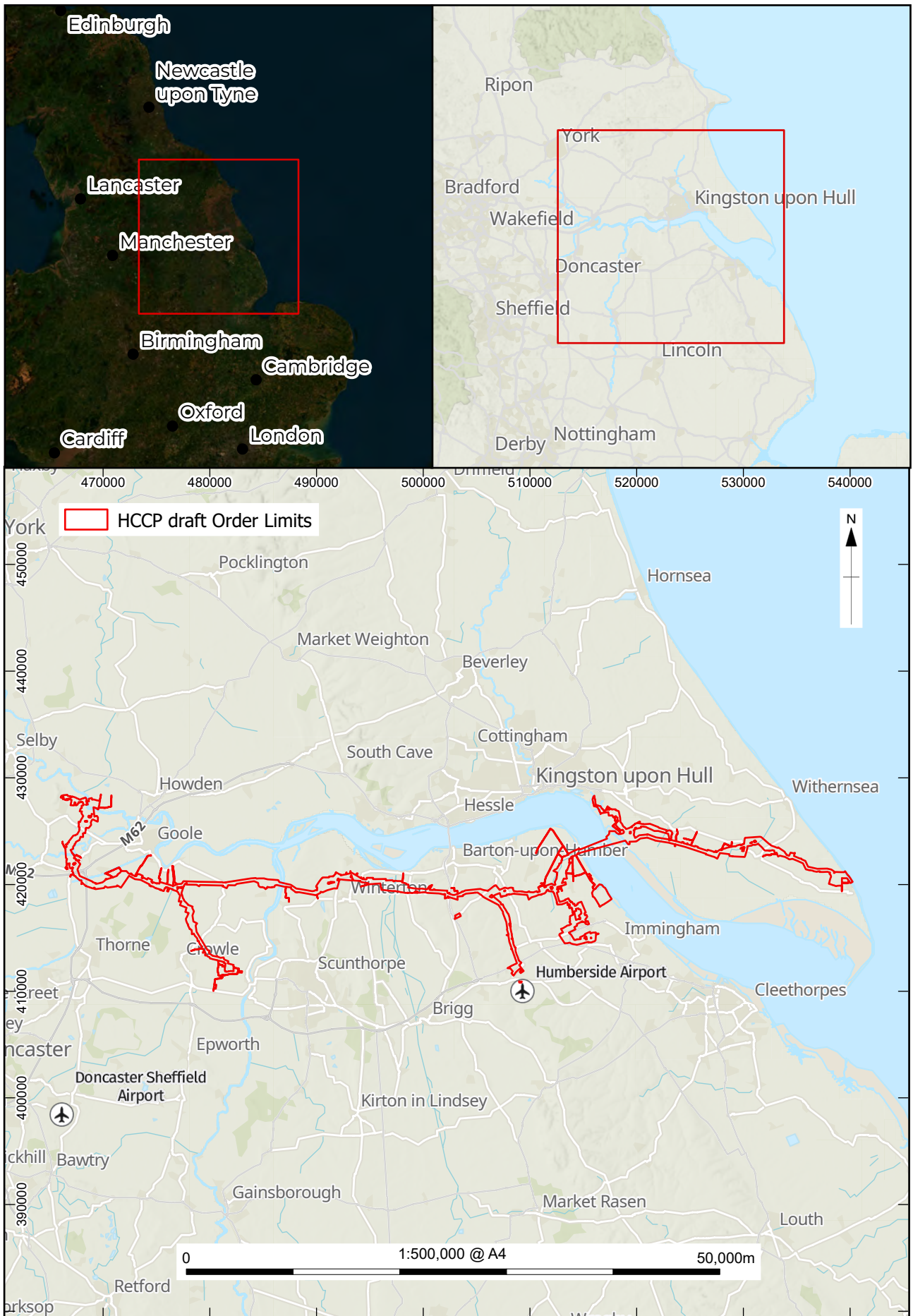
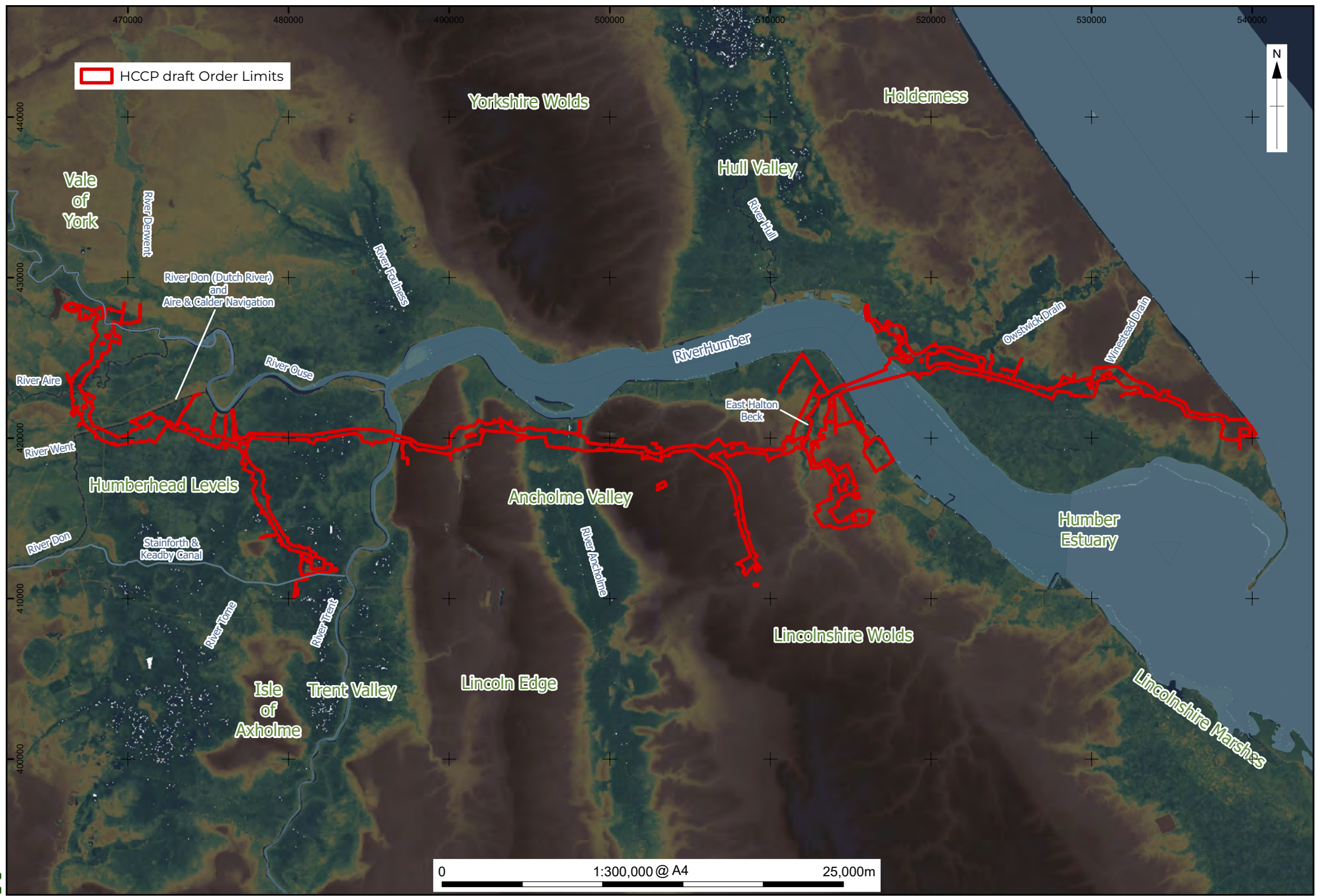


Figure 1: Location map

World Imagery: Earthstar Geographics
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GB Topographic: Contains OS data © Crown Copyright and database right 2025
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Ordnance Survey Terrain 50DTM
World Hillshade: Esri, CGIAR, USGS

Figure 2: Regional topography

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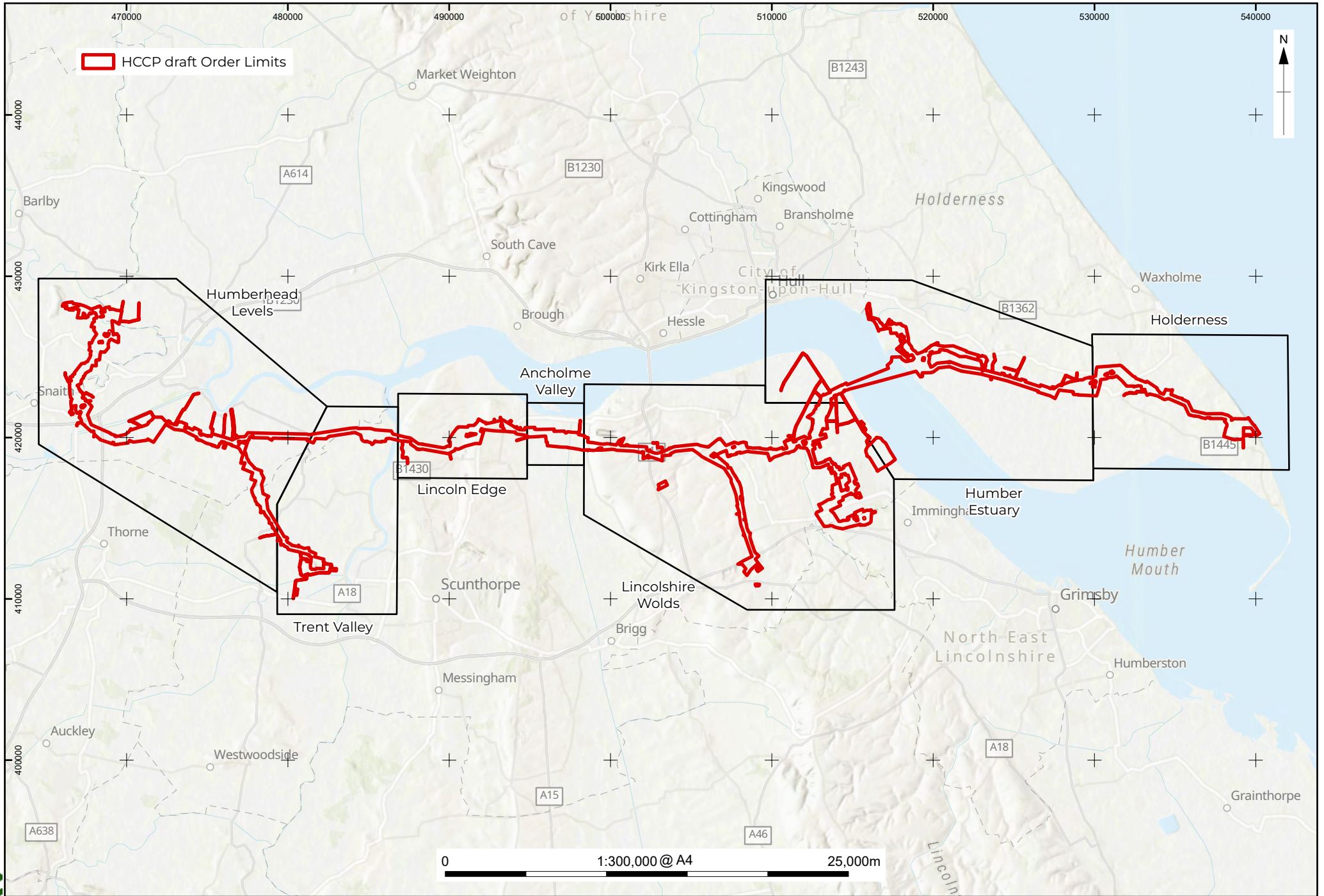


Figure 3: Division of Draft Order Limits into landscape character areas

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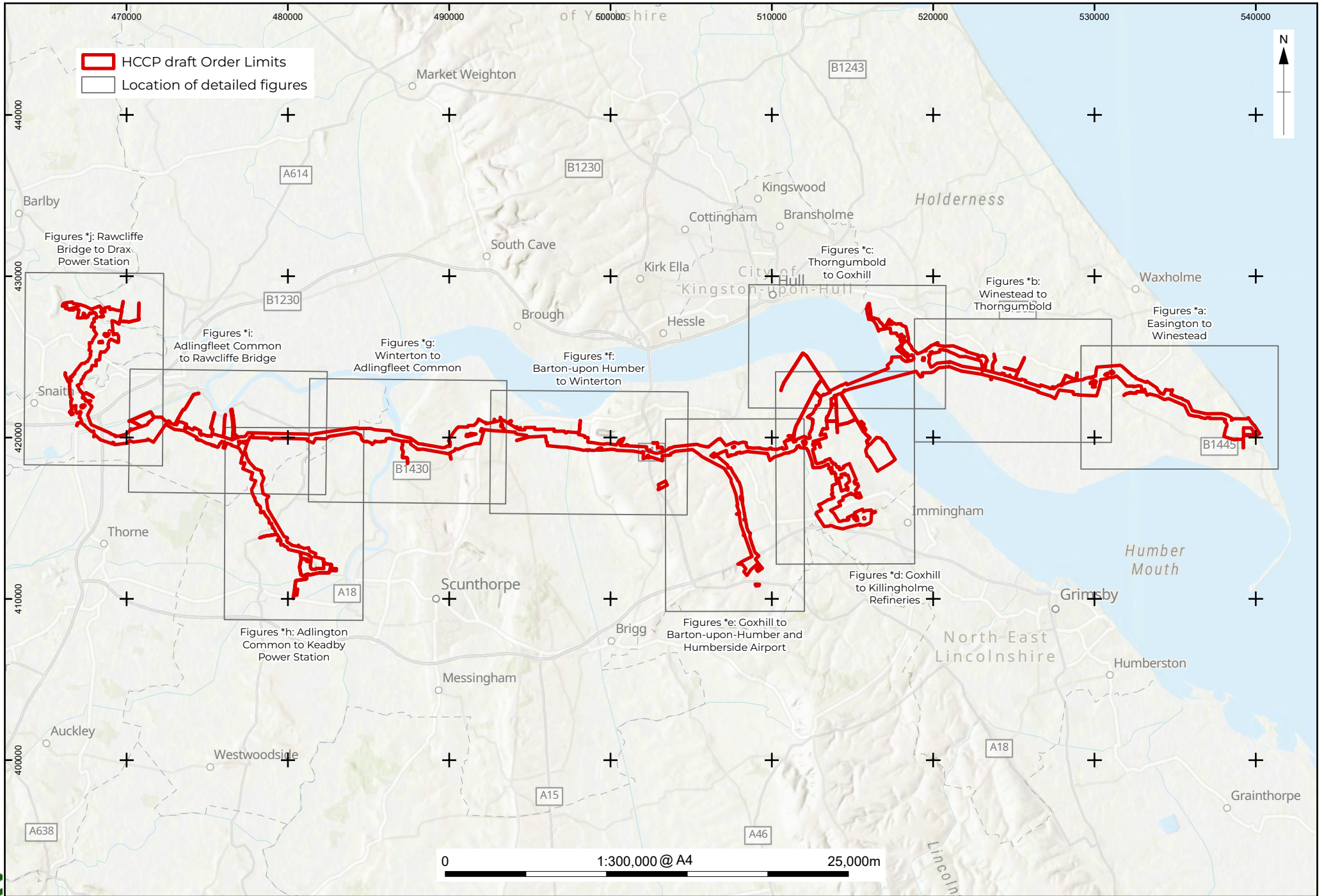
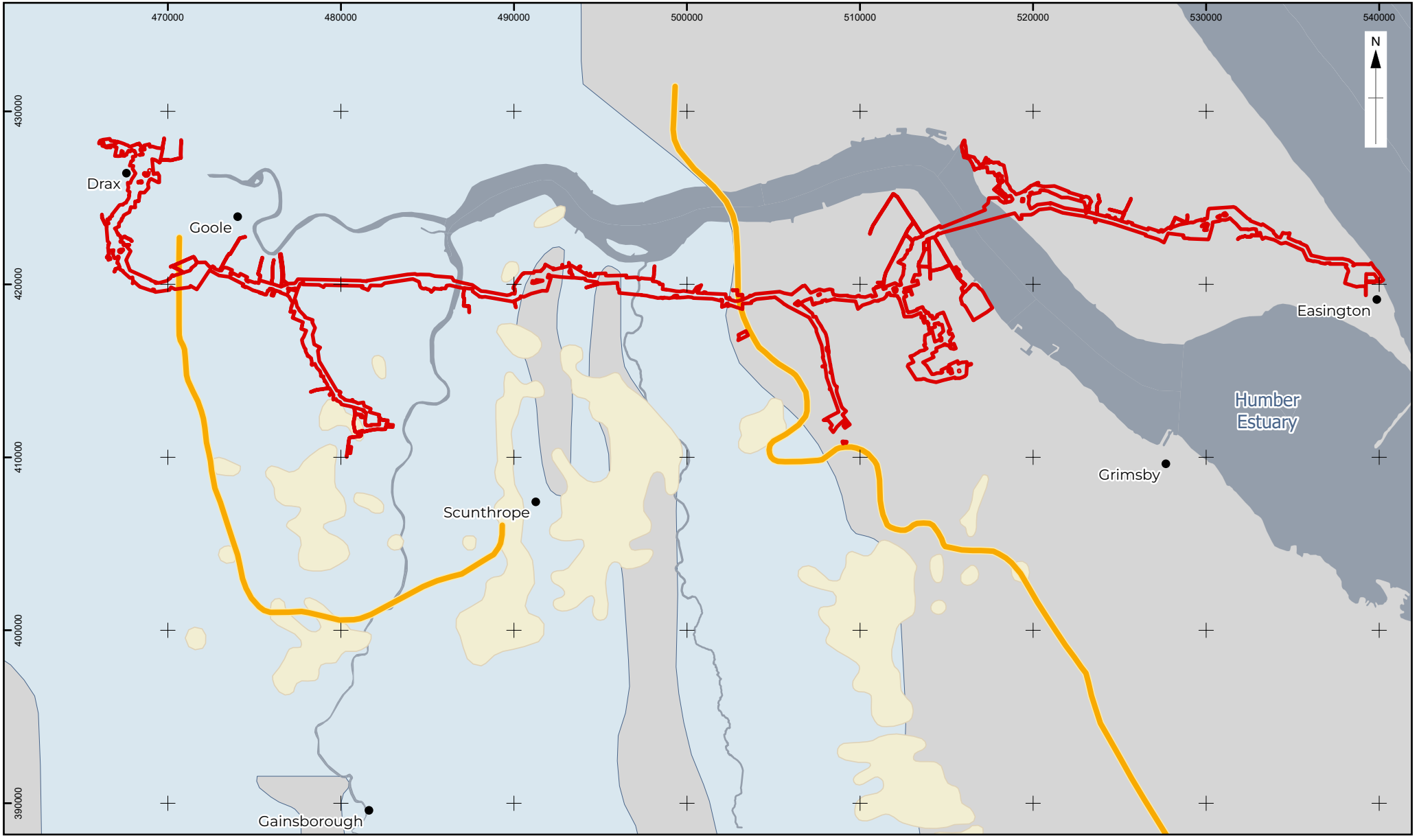


Figure 4: Location of detailed figures

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Ordnance Survey Terrain 50DTM

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- HCCP draft Order Limits
- Cover sand
- Lake Humber
- Ice margin

Figure 5: Extent of proglacial Lake Humber and Devensian ice margins (redrawn after Bateman et al, 2015; Buckland et al, 2019)

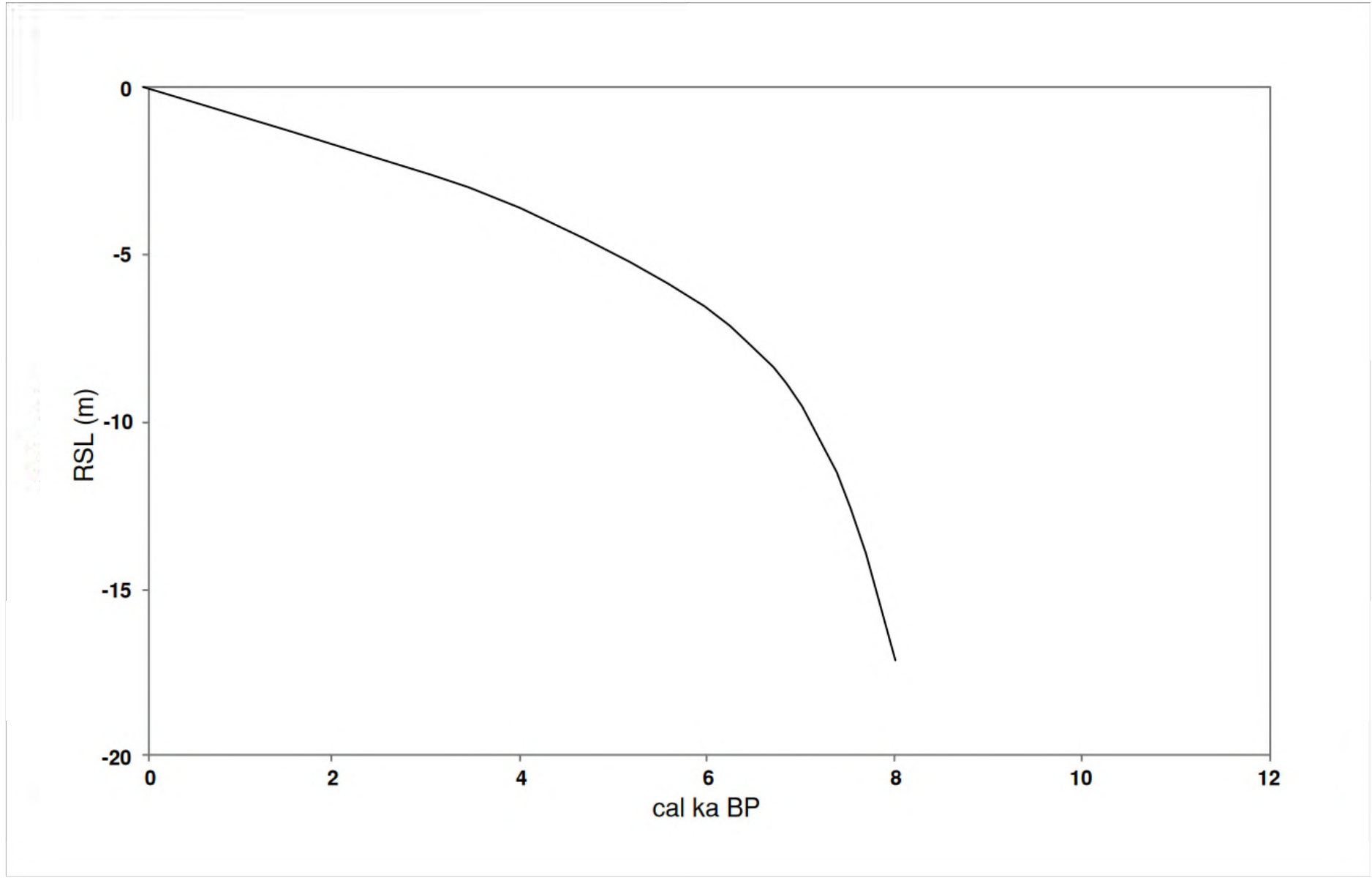


Figure 6: Humber Estuary relative sea-level curve (redrawn after Shennan et al, 2000a).
N.B. index point errors are not shown but are available in the original publication

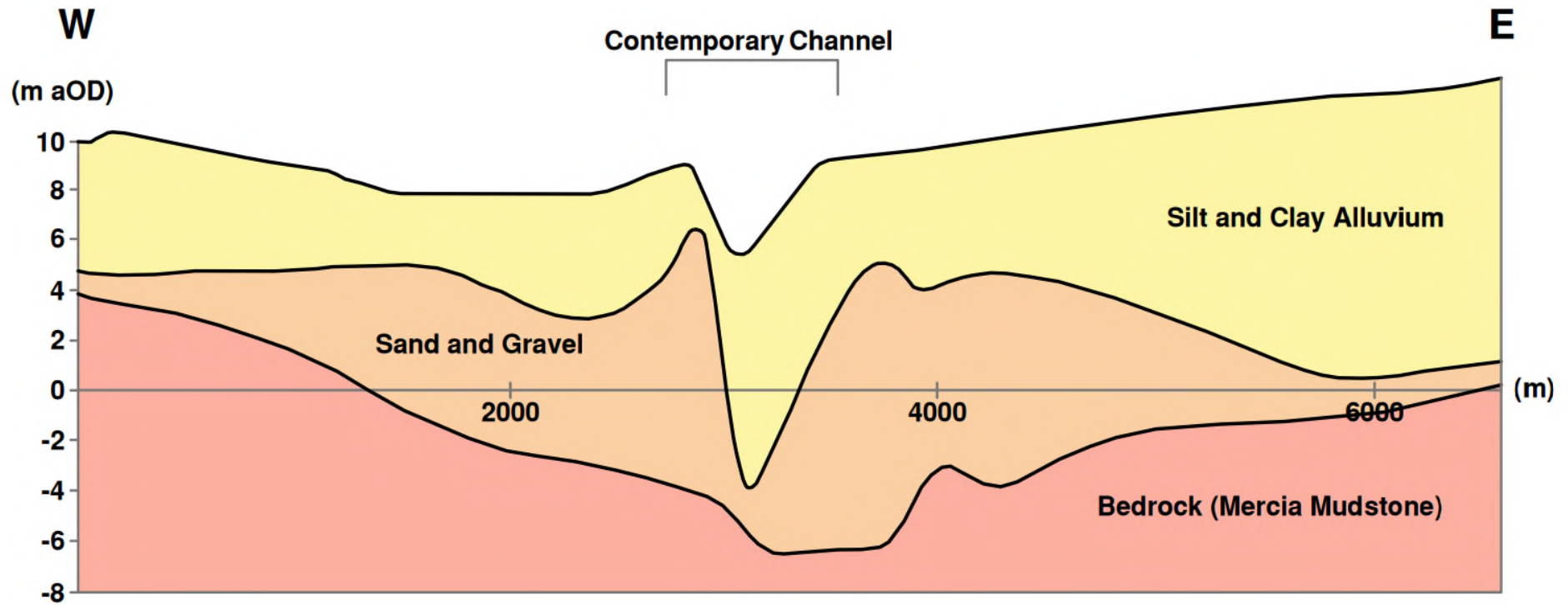


Figure 7: Cross-section profile through the alluvial sediments of the Lower Trent Valley, modelled from sub-surface DEM data (redrawn after Challis, 2000)

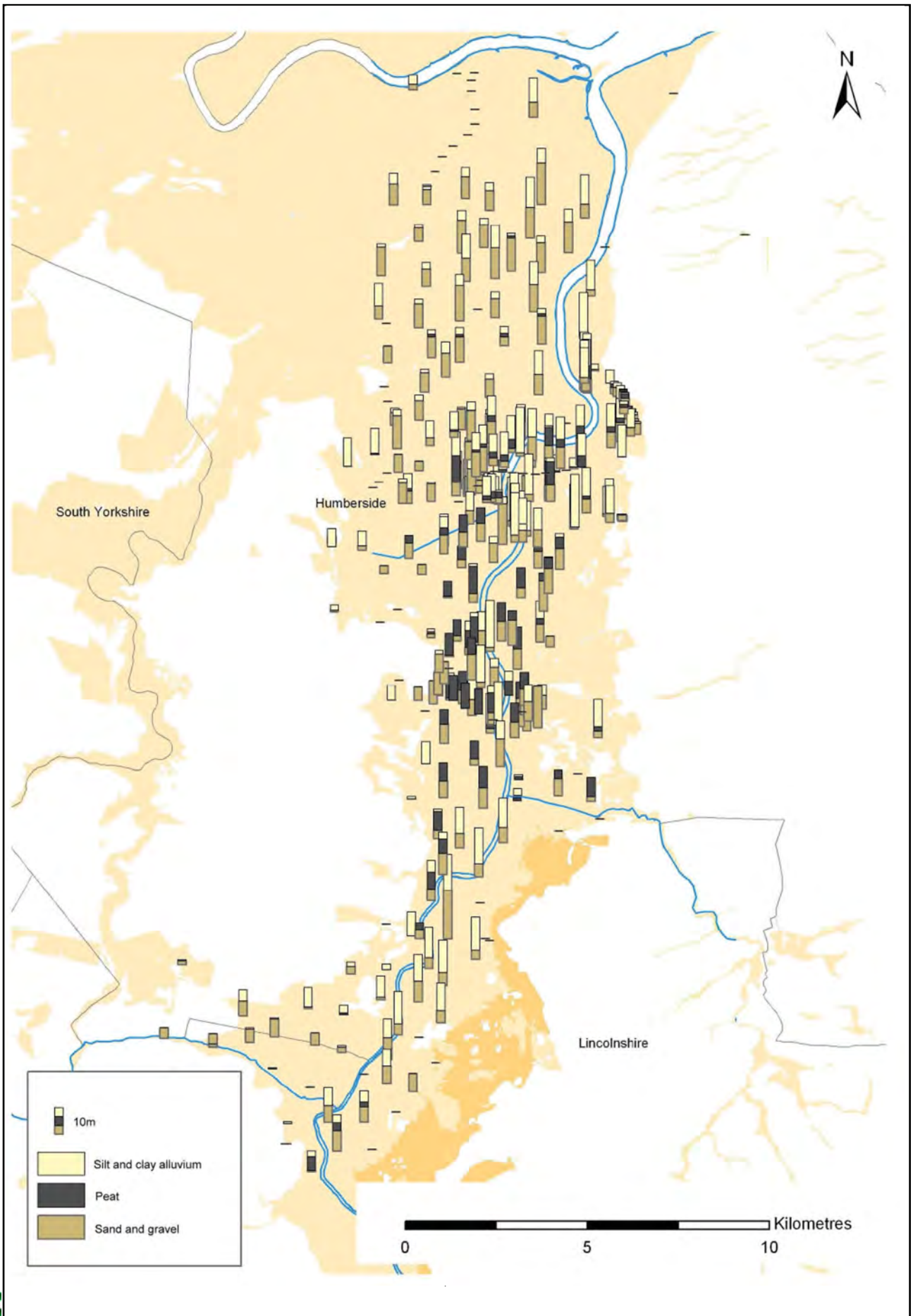


Figure 8: Borehole records across the River Trent (reproduced from Challis, 2000)

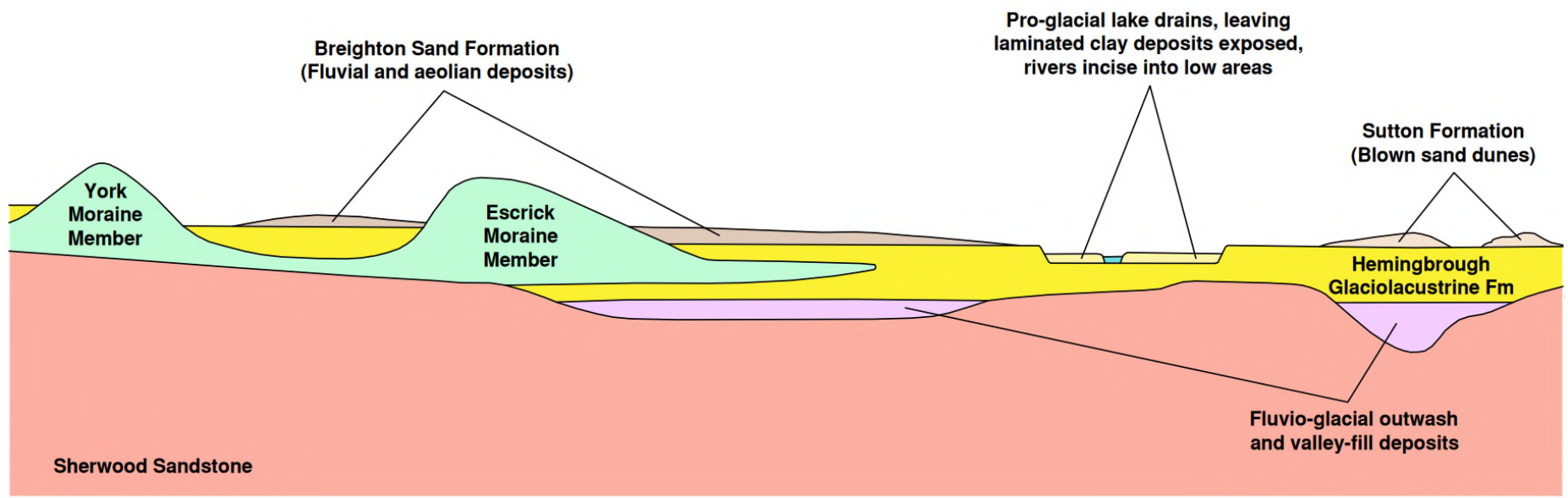


Figure 9: Glacial evolution of the Vale of York (redrawn after Ford et al, 2004)

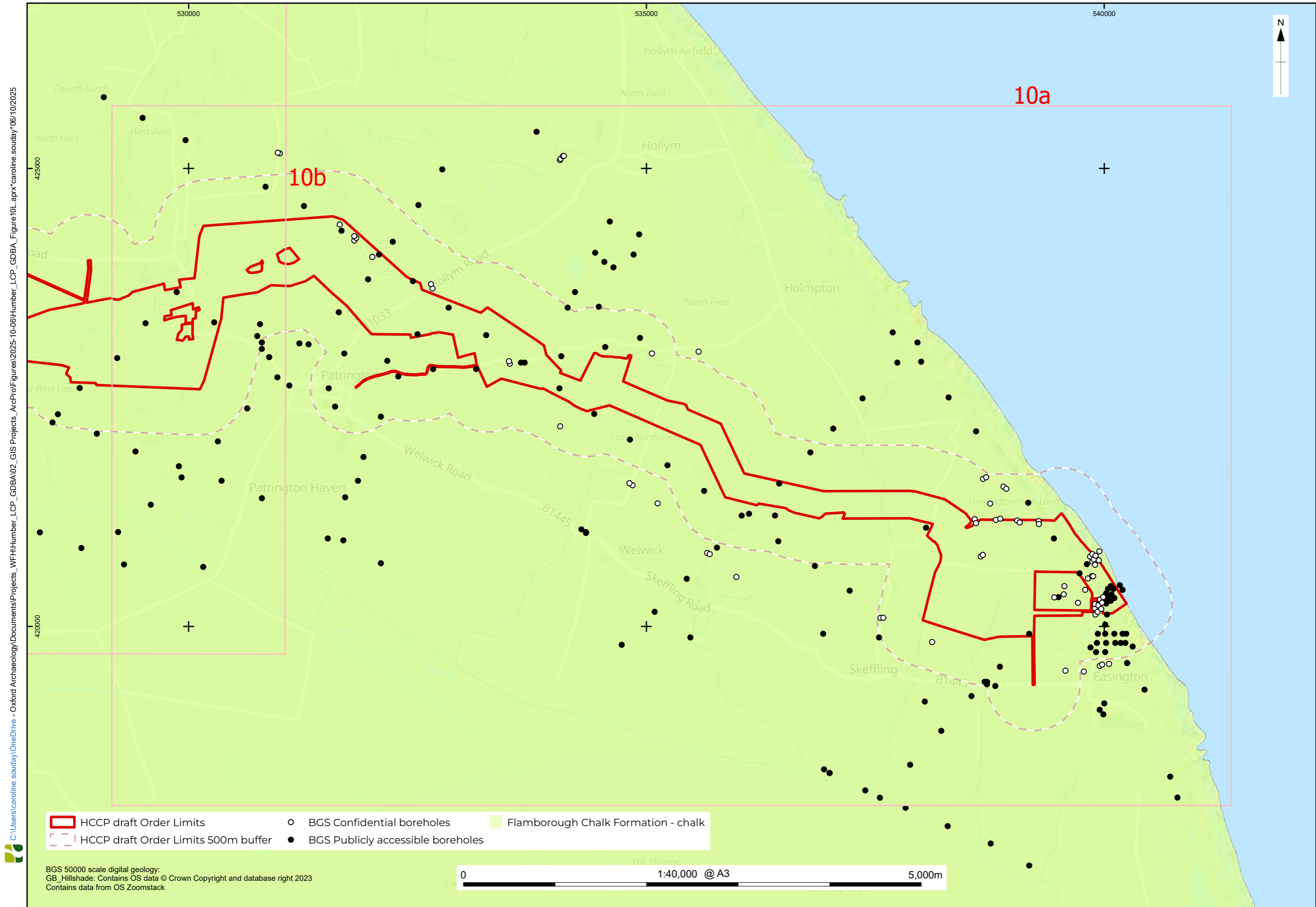


Figure 10a : Holderness (Easington to Winestead): bedrock geology and BGS borehole locations

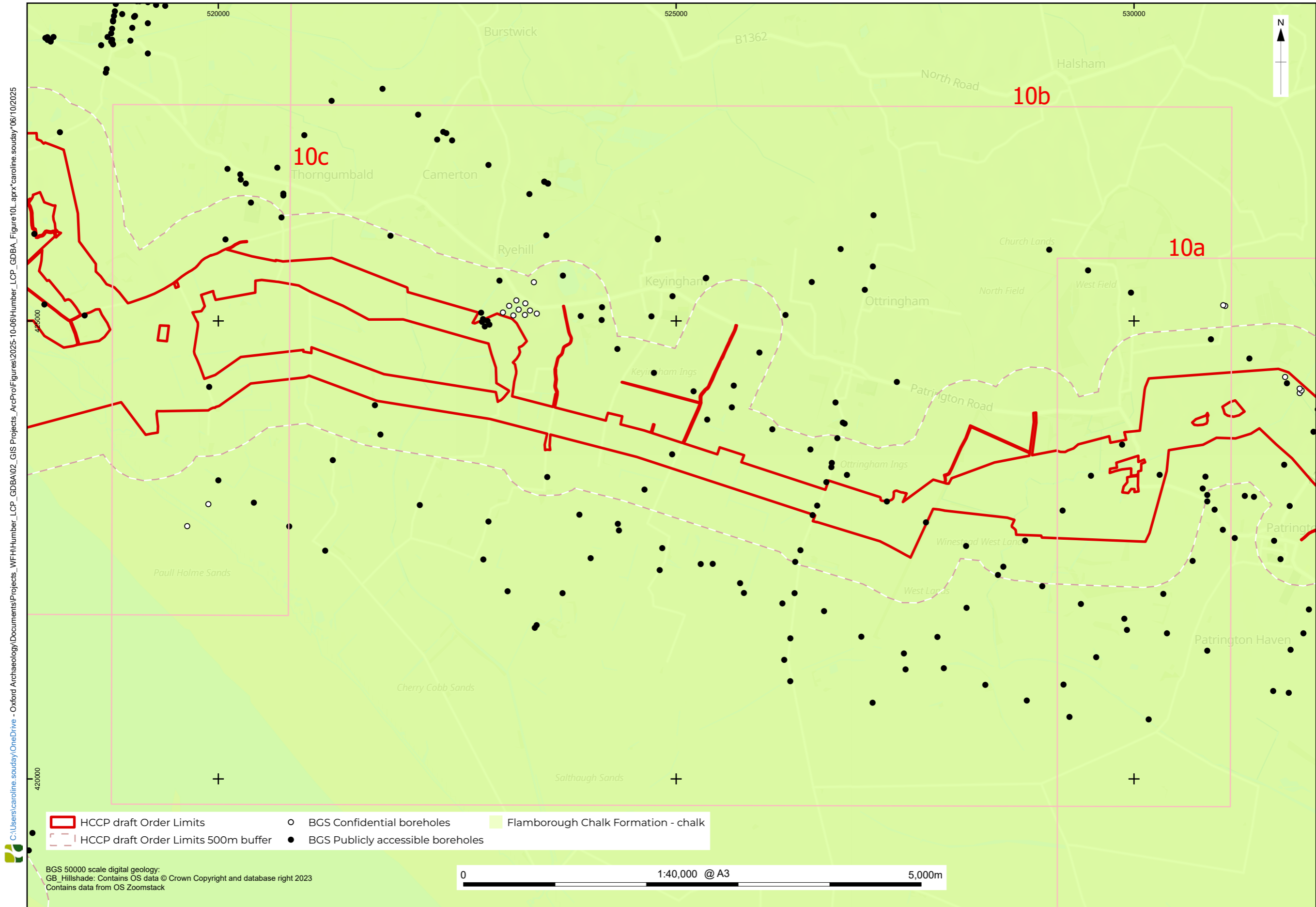


Figure 10b : Humber Estuary (Winestead to Thorngumbold): bedrock geology and BGS borehole locations

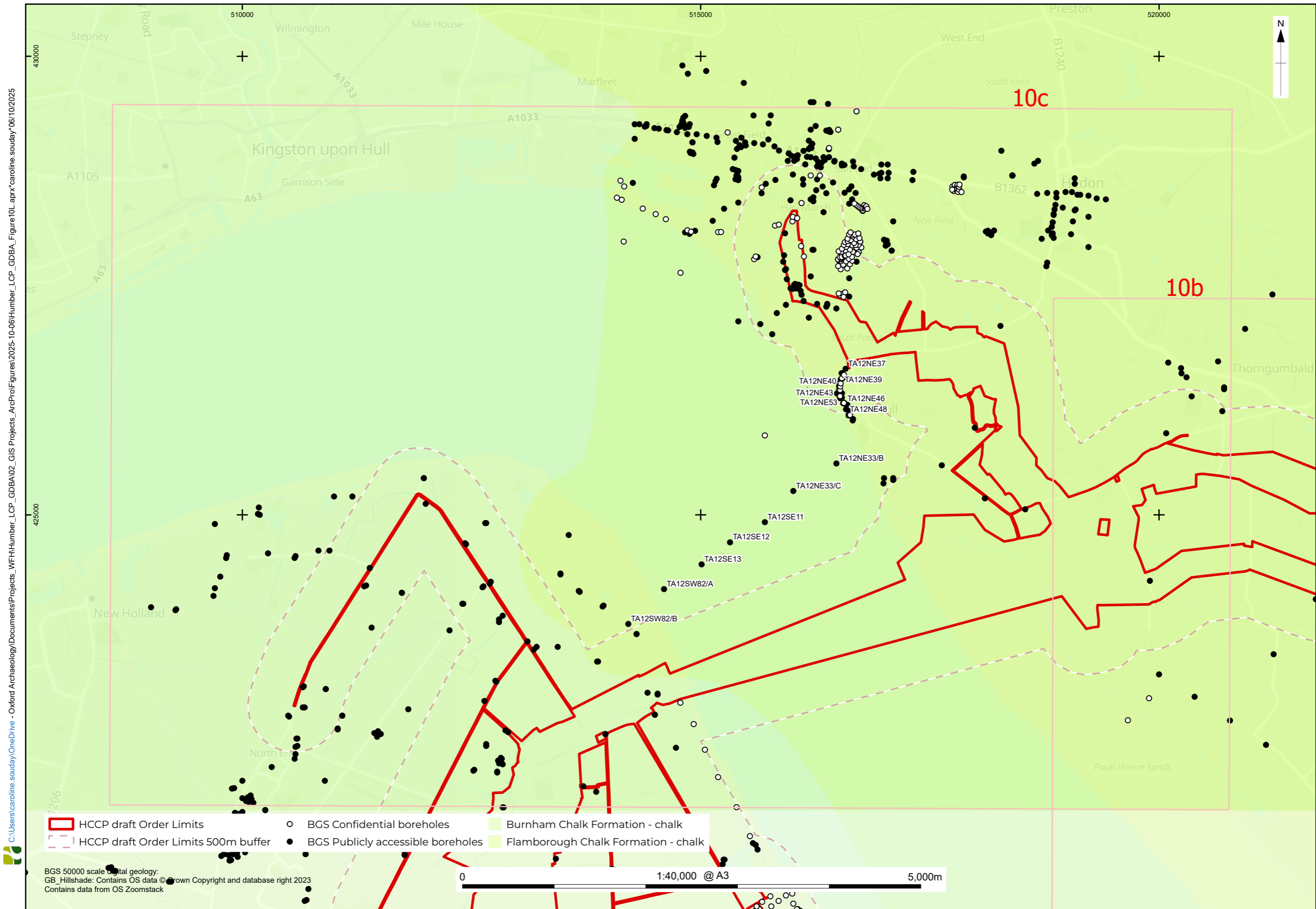


Figure 10c : Humber Estuary/Lincolnshire Wolds (Thorngumbald to Goxhill): bedrock geology and BGS borehole locations

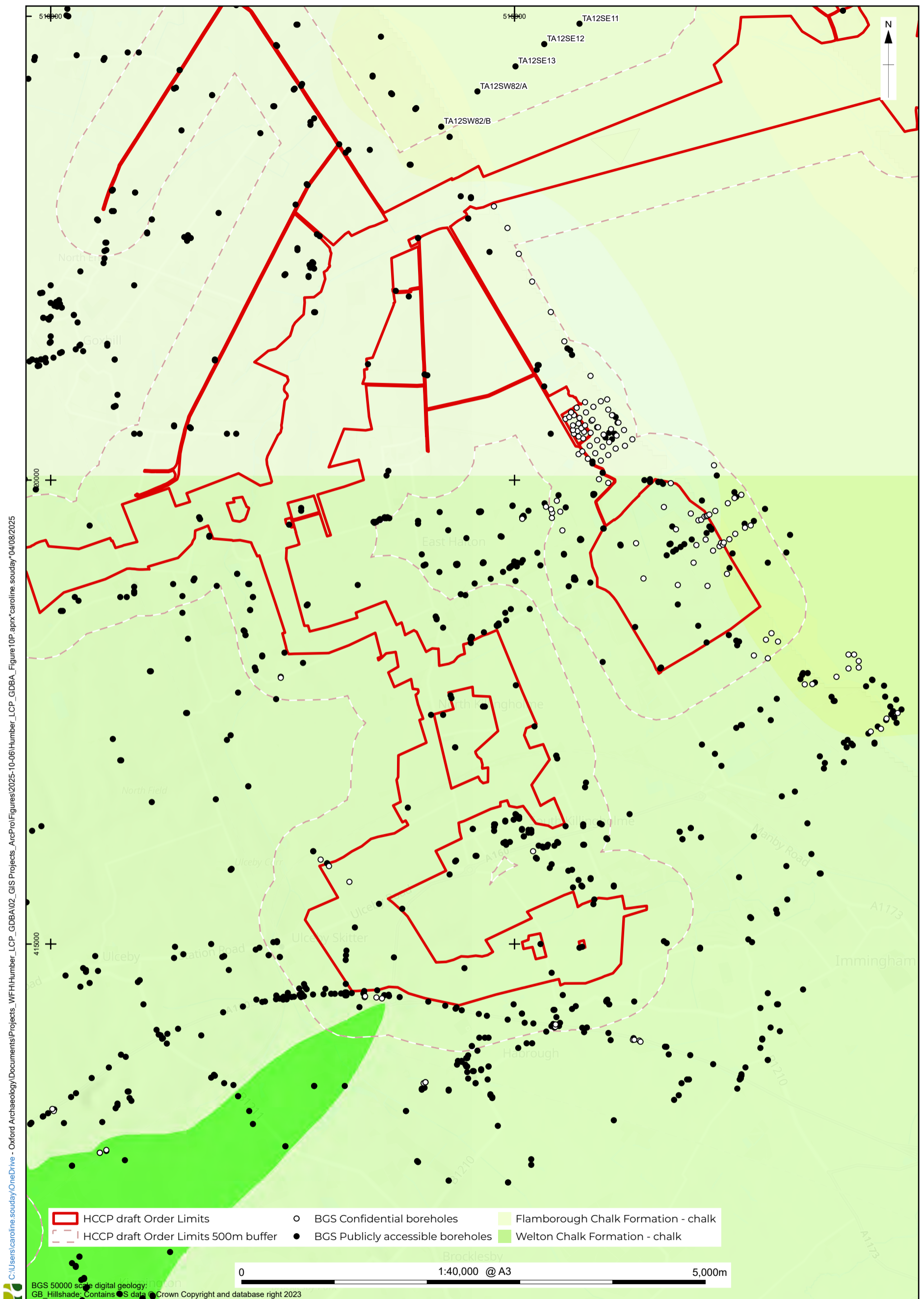


Figure 10d : Lincolnshire Wolds (Goxhill to Killingholme Refineries): bedrock geology and BGS borehole locations

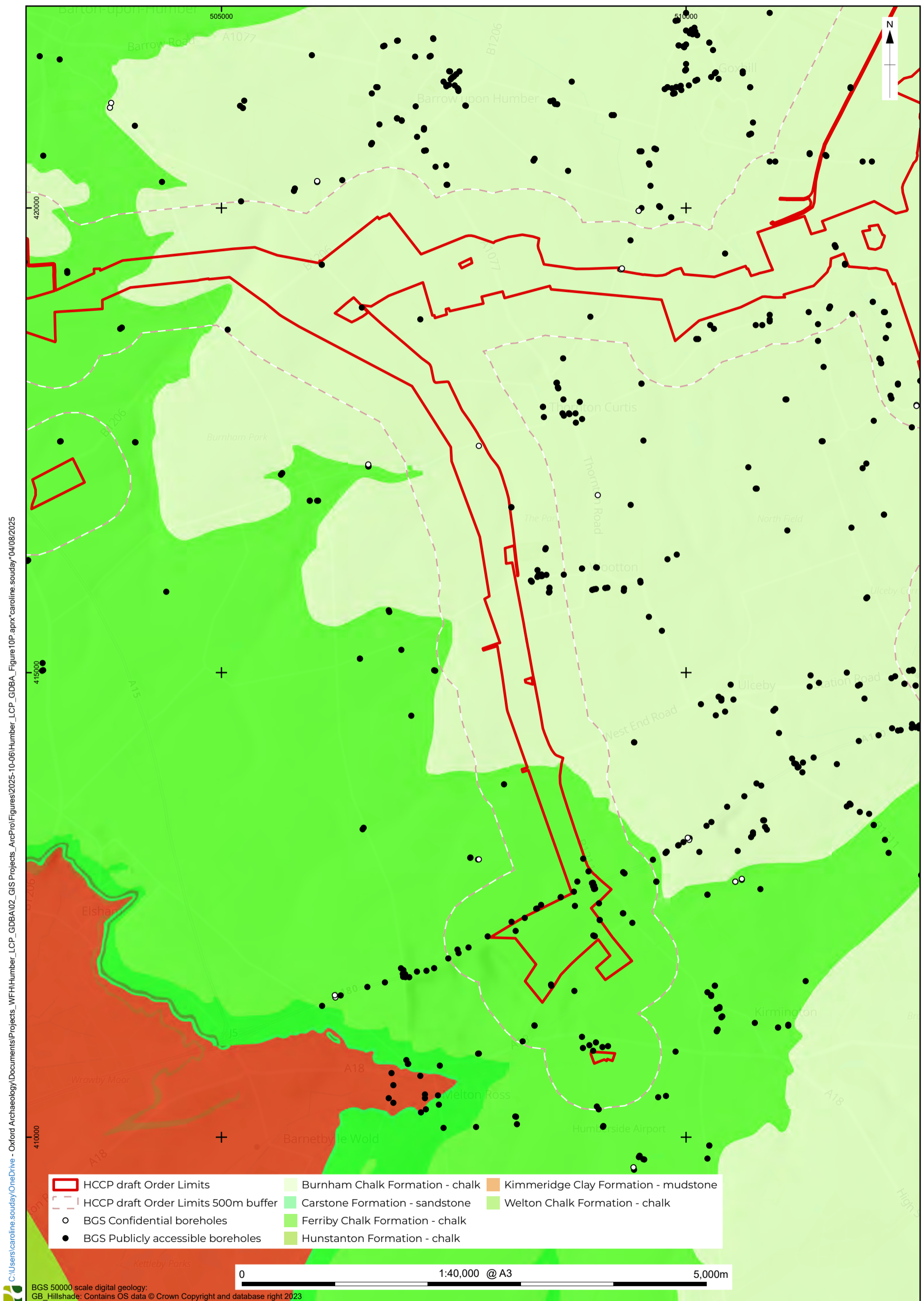


Figure 10e : Lincolnshire Wolds (Goxhill to Barton-upon-Humber and Humberside Airport): bedrock geology and BGS borehole locations

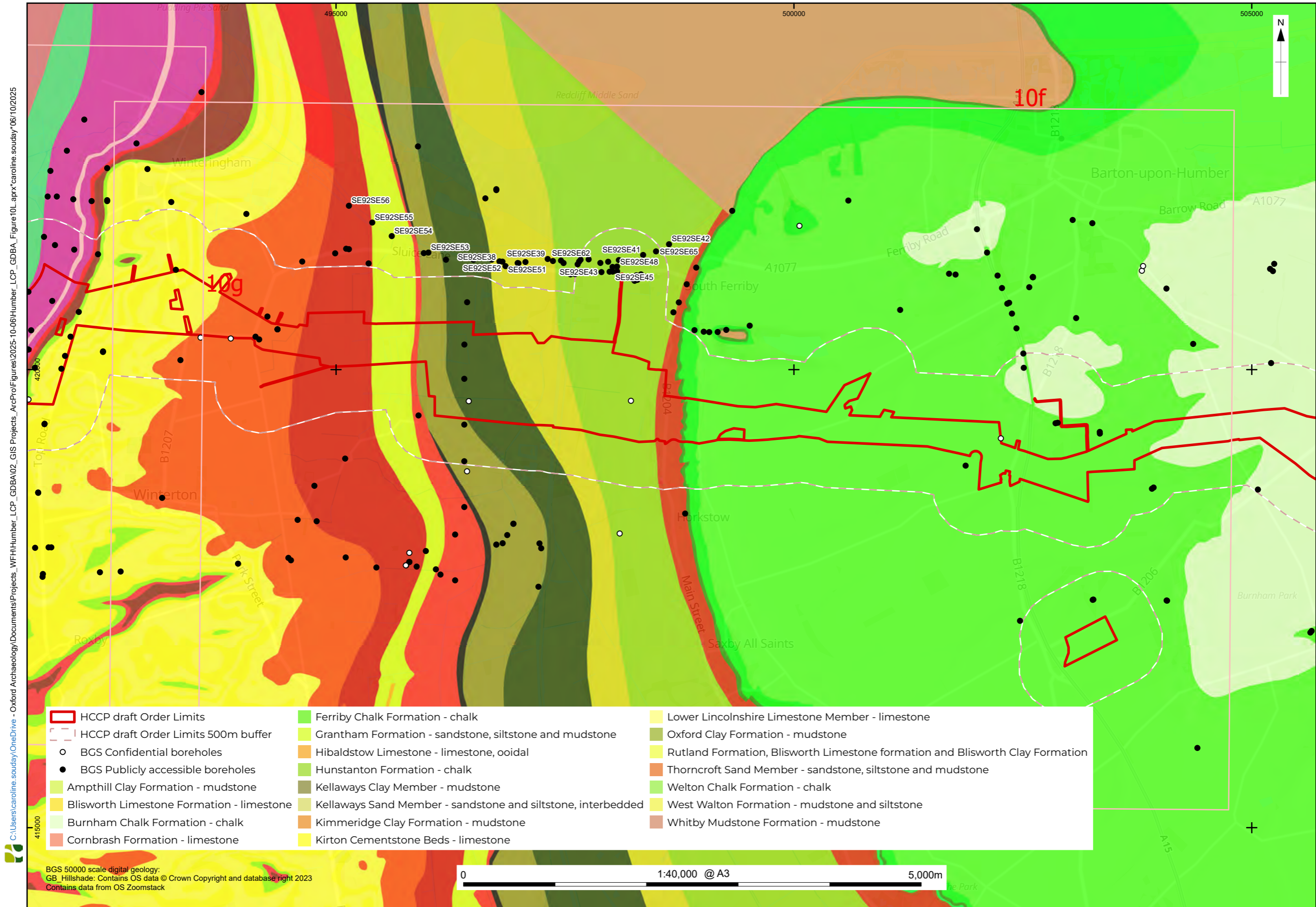


Figure 10f : Lincolnshire Wolds/Ancholme Valley/Lincoln Edge (Barton-upon Humber to Winterton): bedrock geology and BGS borehole locations

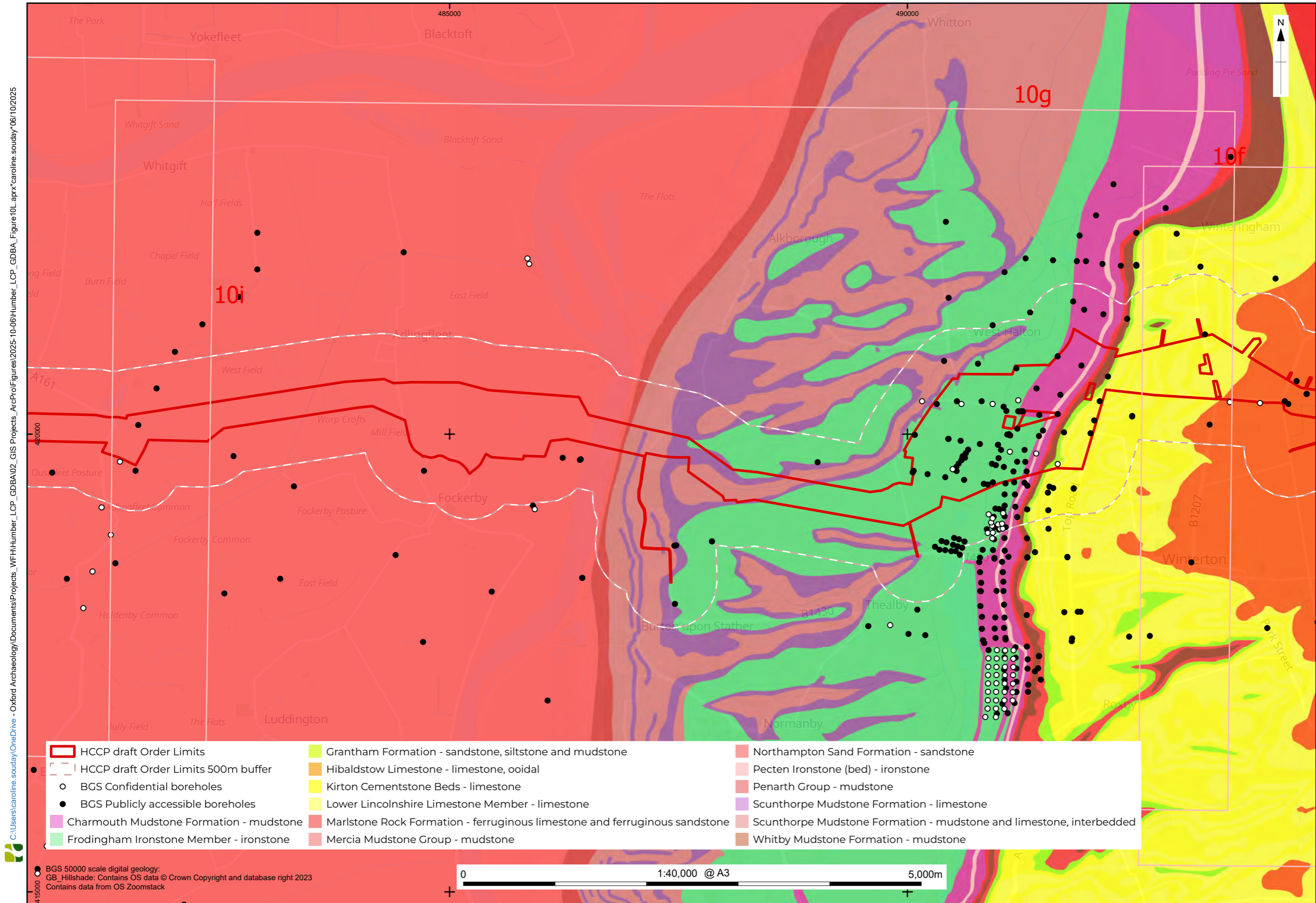


Figure 10g : Lincoln Edge/Trent Valley (Winterton to Adlingfleet Common): bedrock geology and BGS borehole locations

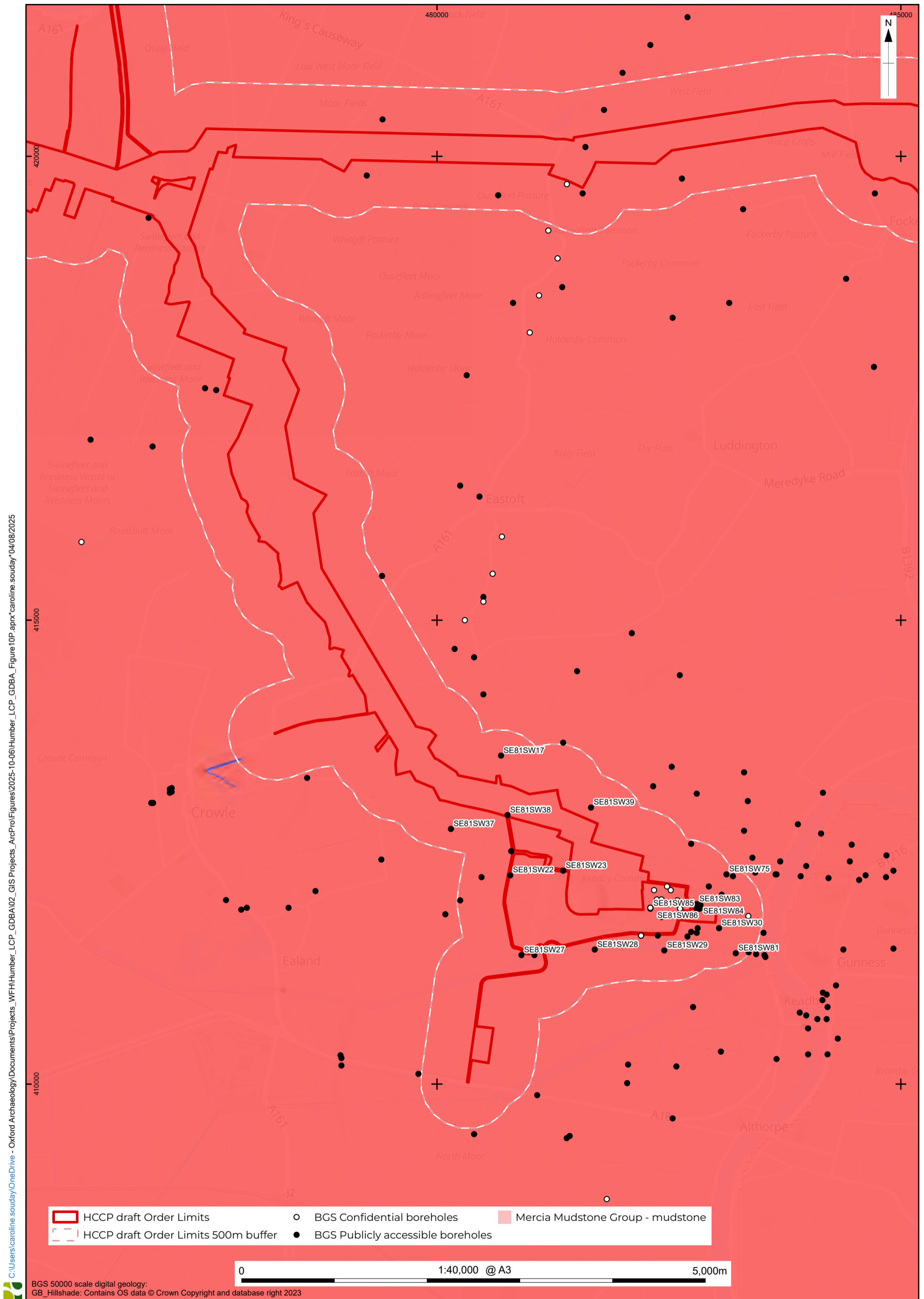


Figure 10h : Trent Valley/Humberhead Levels (Adlingfleet Common to Keadby Power Station): bedrock geology and BGS borehole locations

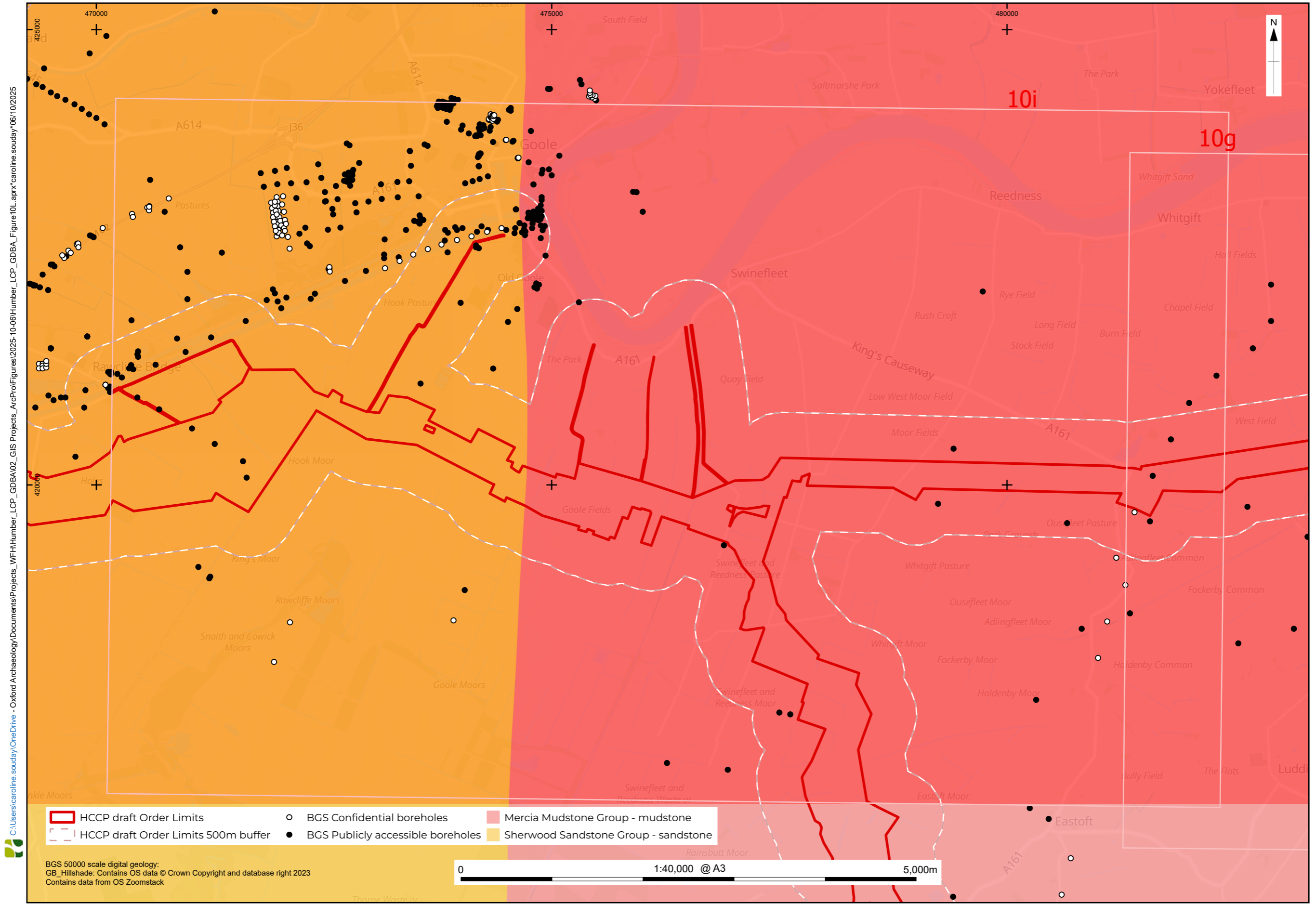


Figure 10i : Humberhead Levels (Adlingfleet Common to Rawcliffe Bridge): bedrock geology and BGS borehole locations

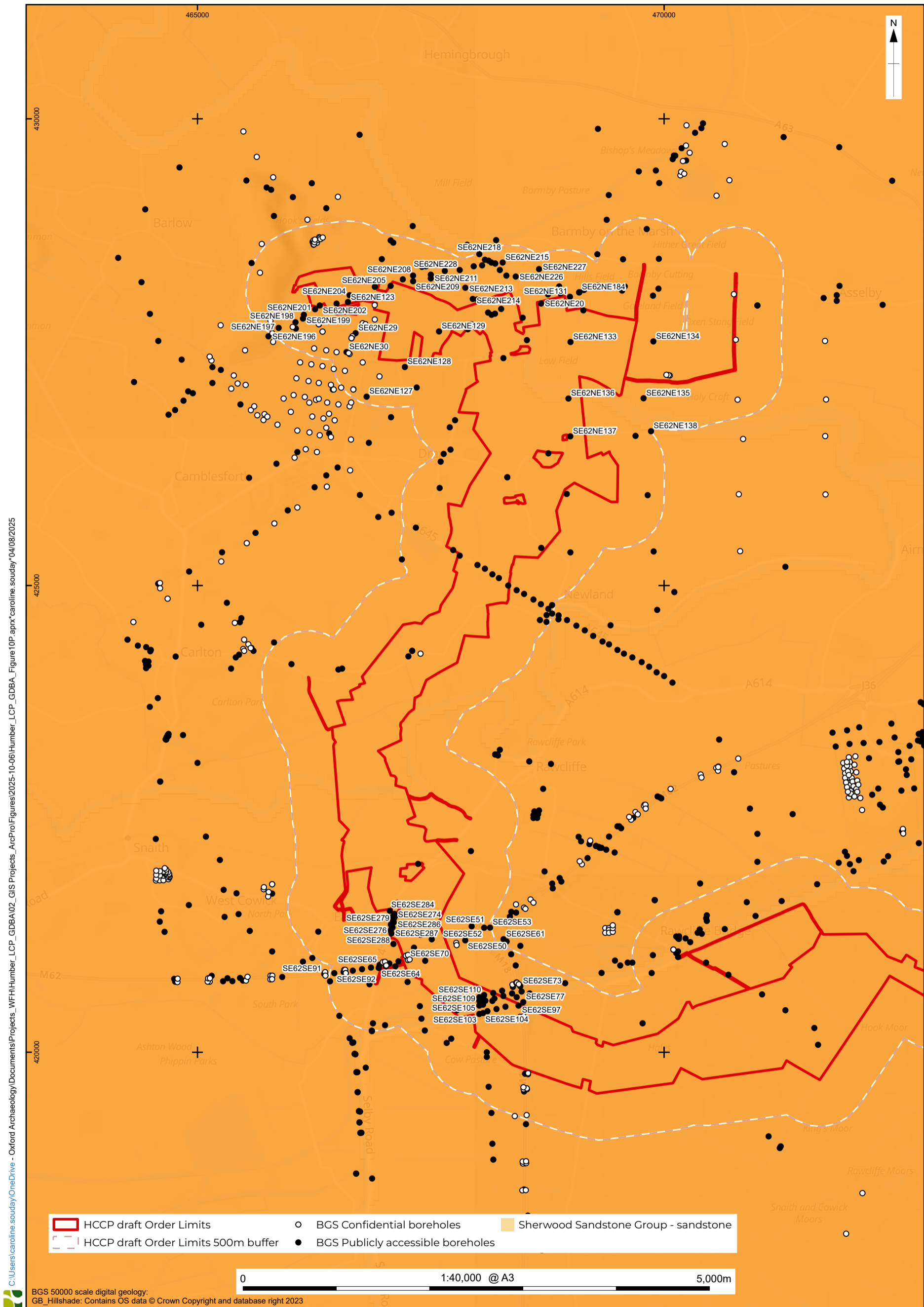


Figure 10j : Humberhead Levels (Rawcliffe Bridge to Drax Power Station): bedrock geology and BGS borehole locations

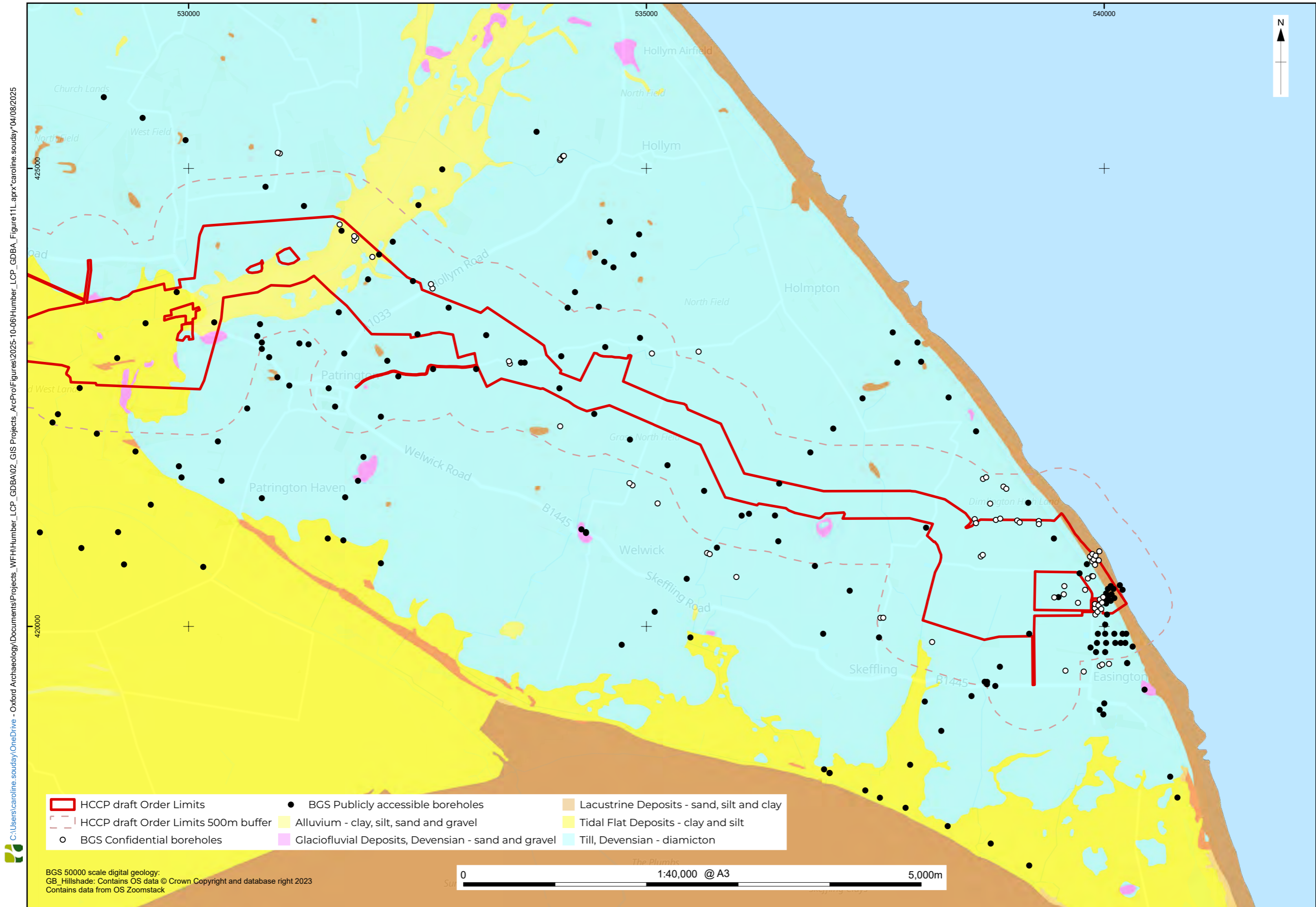


Figure 11a : Holderness (Easington to Winestead): superficial geology and BGS borehole locations

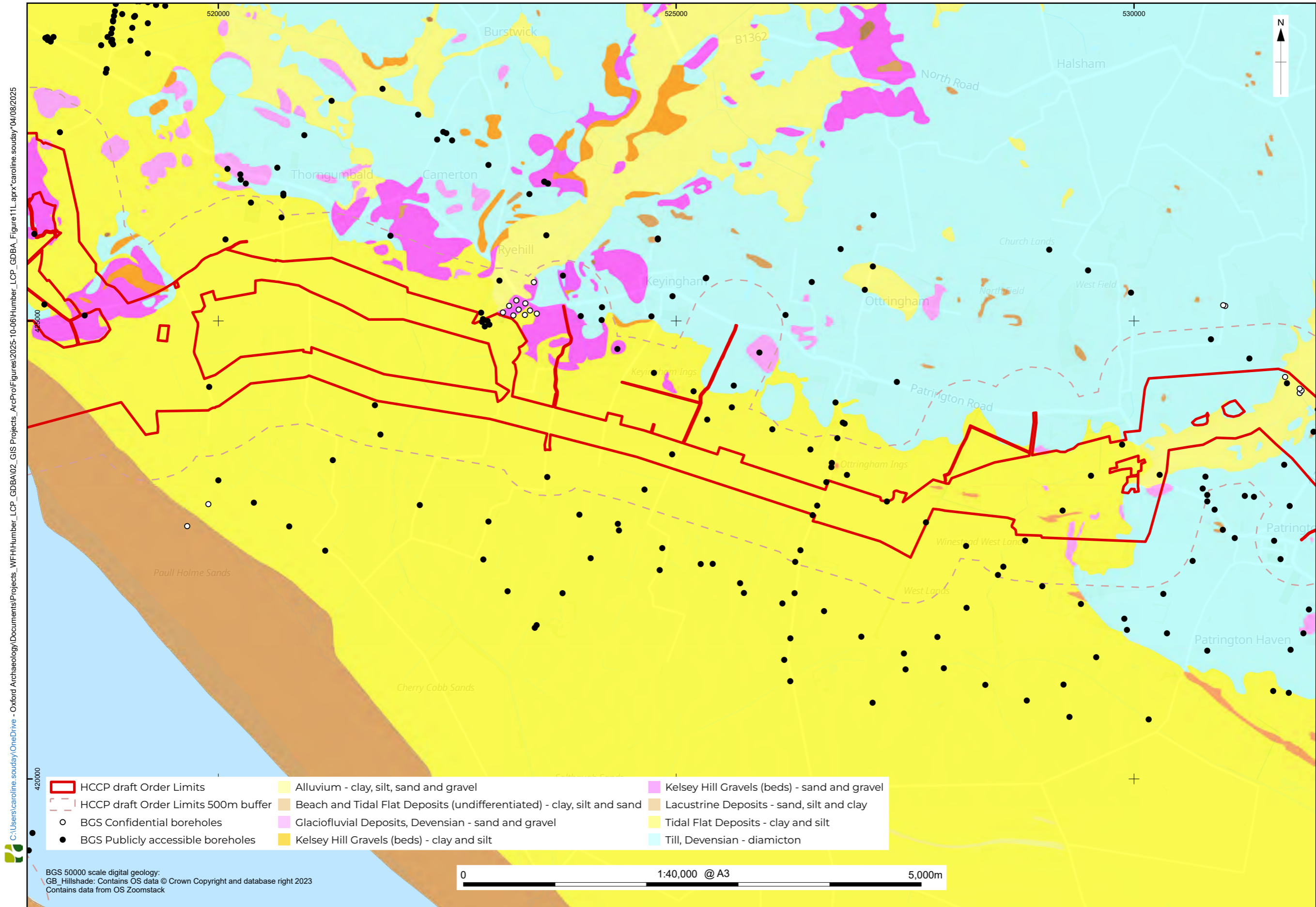


Figure 11b : Humber Estuary (Winestead to Thorngumbold): superficial geology and BGS borehole locations

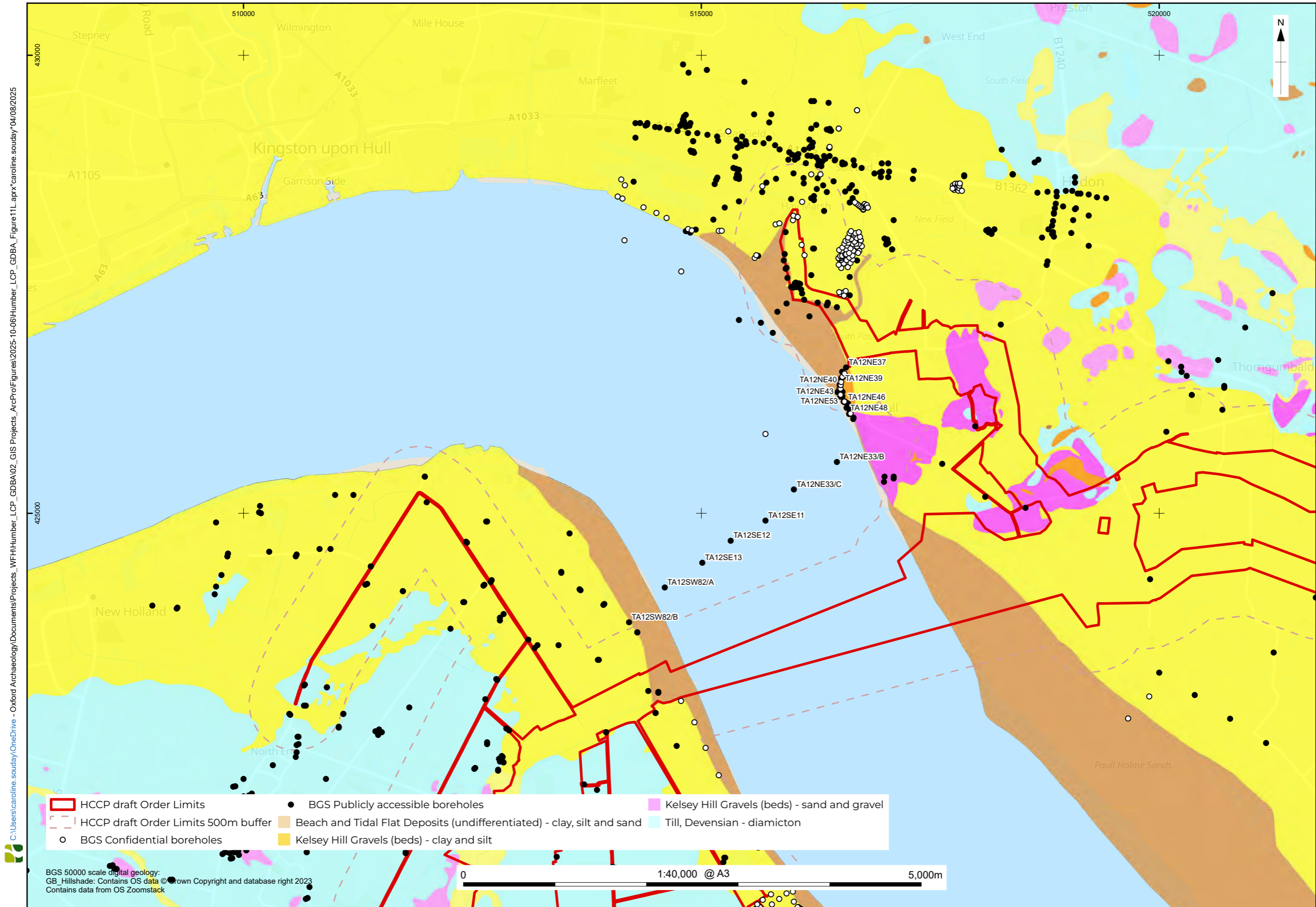


Figure 11c : Humber Estuary/Lincolnshire Wolds (Thorngumbold to Goxhill): superficial geology and BGS borehole locations

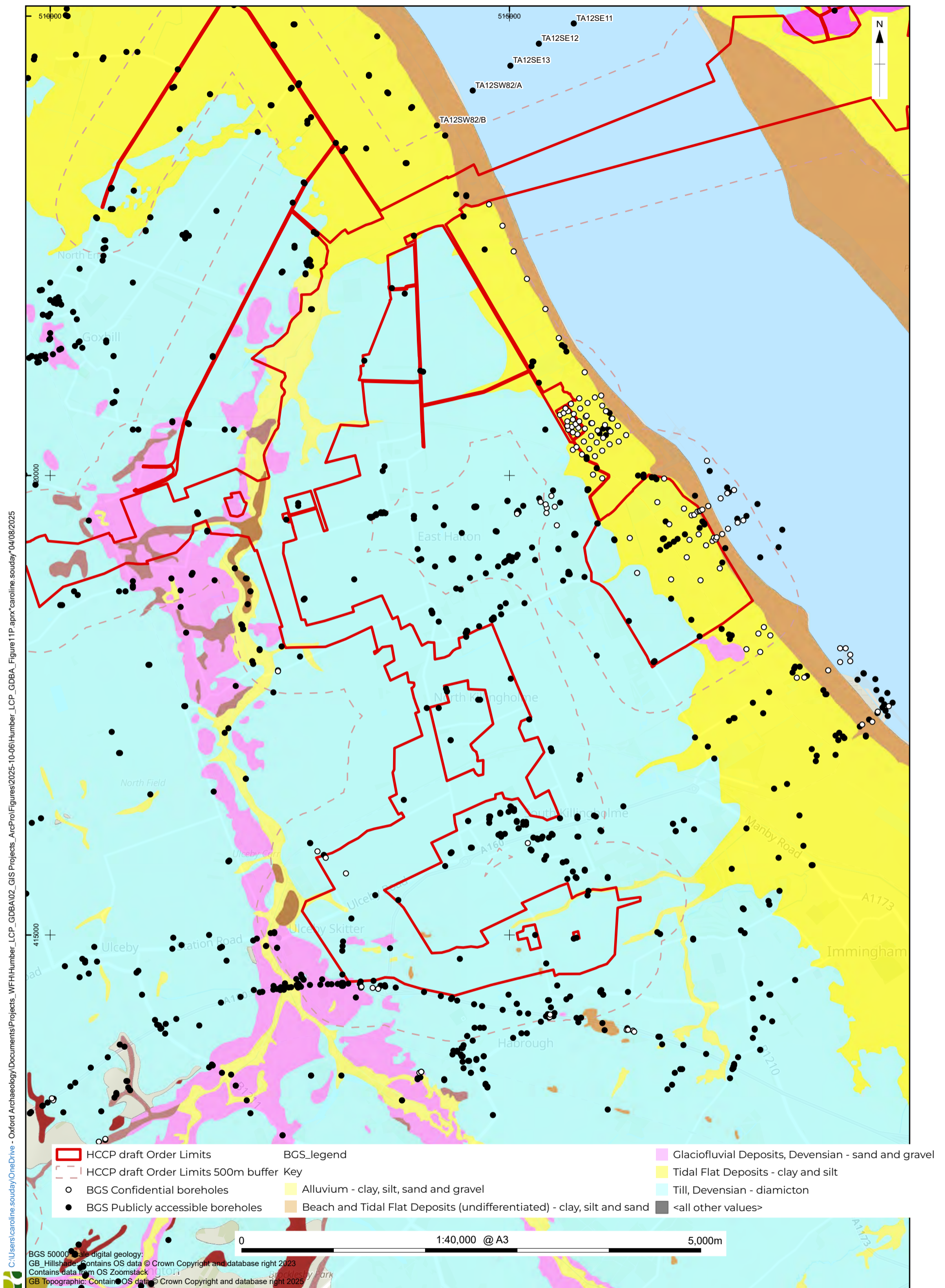


Figure 11d : Lincolnshire Wolds (Goxhill to Killingholme Refineries): superficial geology and BGS borehole locations

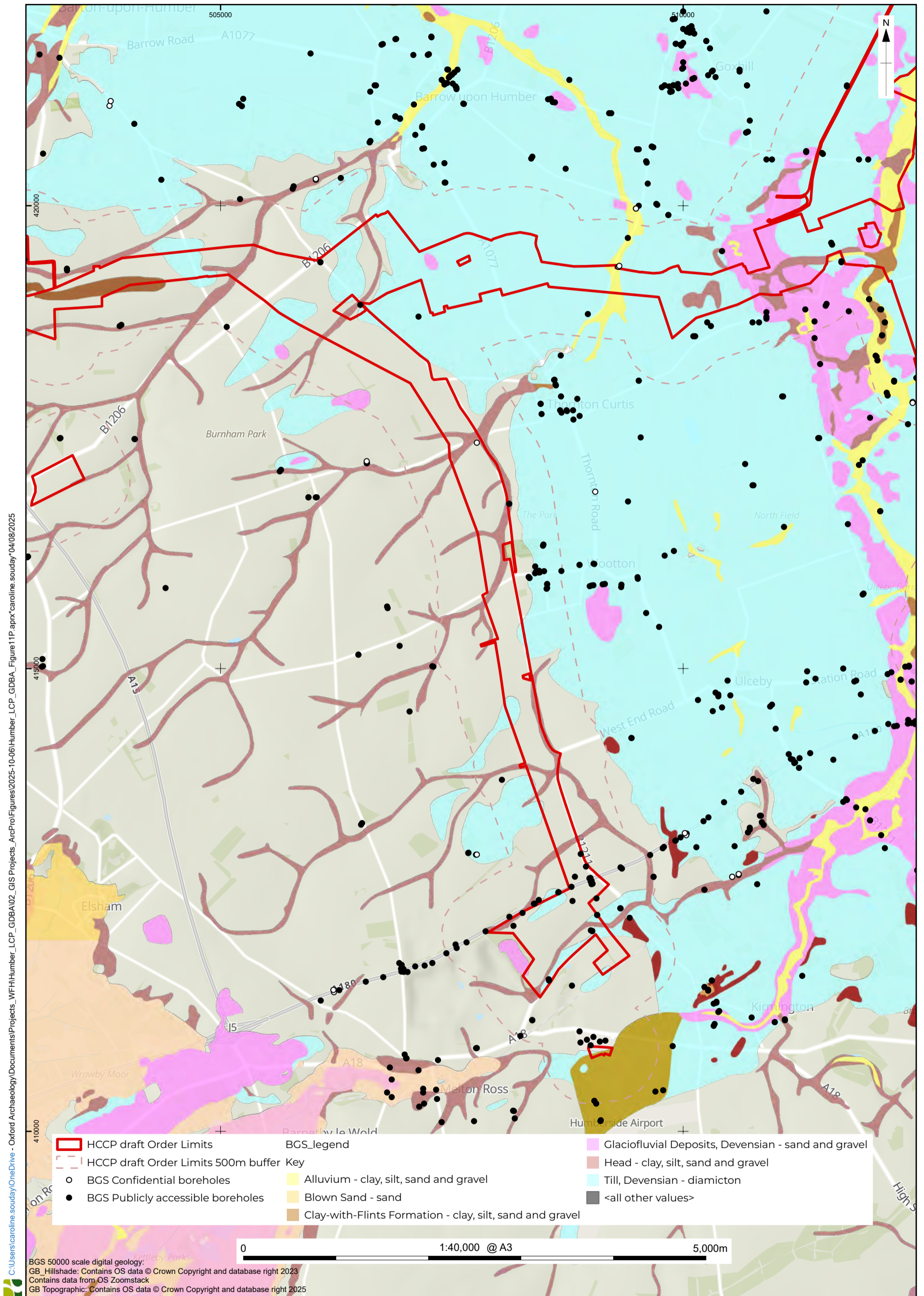


Figure 11e : Lincolnshire Wolds (Goxhill to Barton-upon-Humber and Humberside Airport): superficial geology and BGS borehole locations

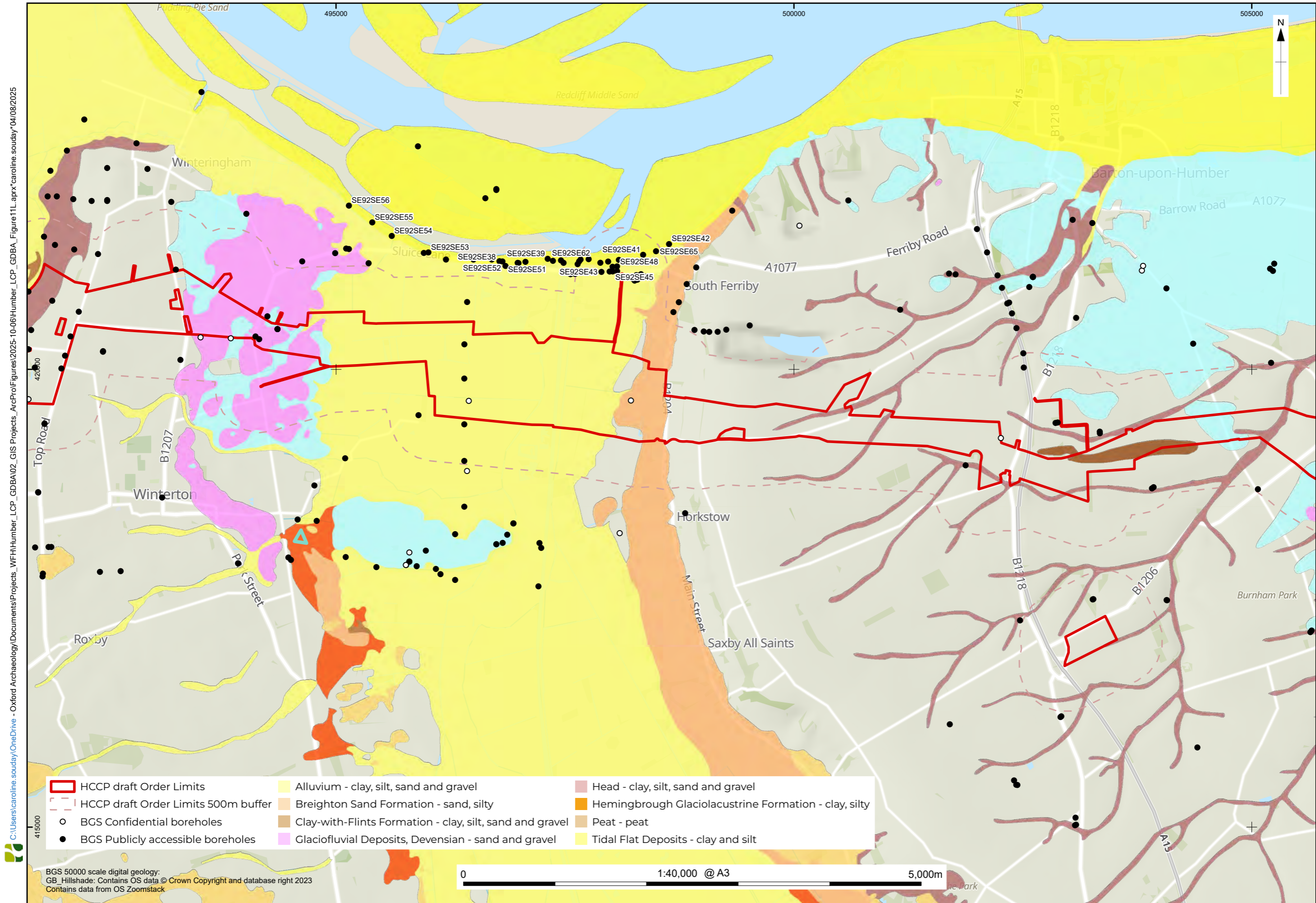


Figure 11f : Lincolnshire Wolds/Ancholme Valley/Lincoln Edge (Barton-upon Humber to Winterton): superficial geology and BGS borehole locations

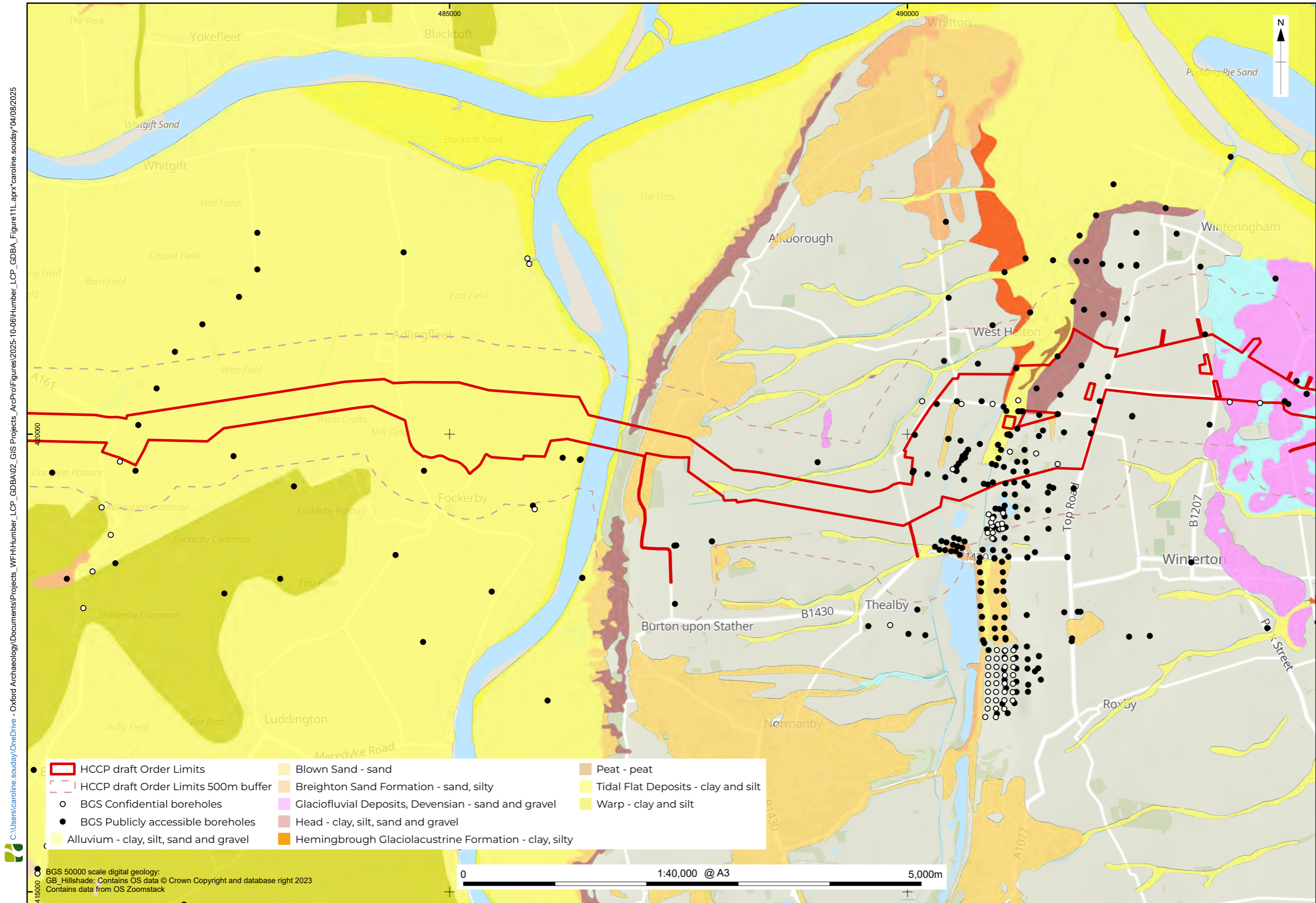


Figure 11g : Lincoln Edge/Trent Valley (Winterton to Adlingfleet Common): superficial geology and BGS borehole locations

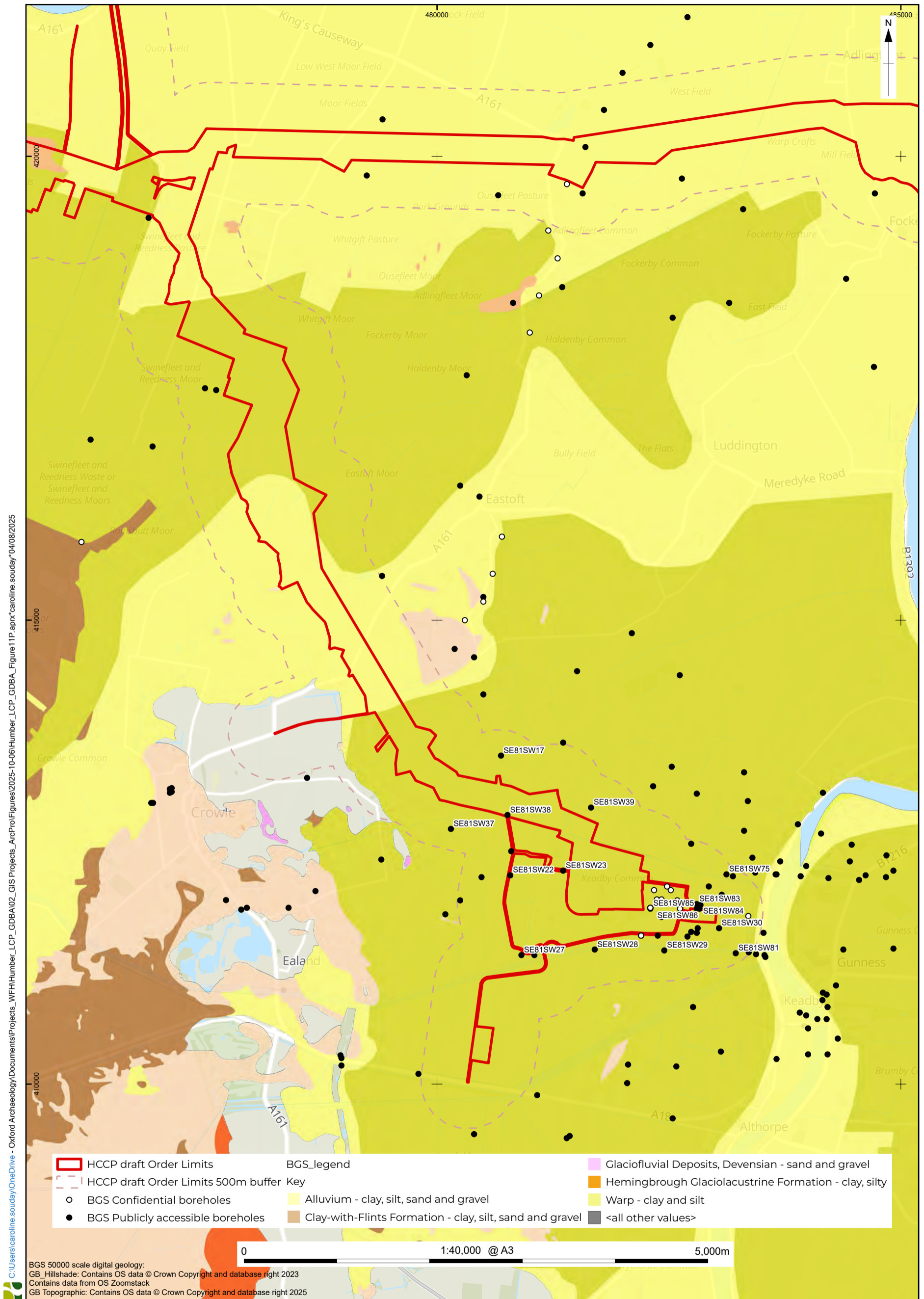


Figure 11h : Trent Valley/Humberhead Levels (Adlingfleet Common to Keadby Power Station): superficial geology and BGS borehole locations

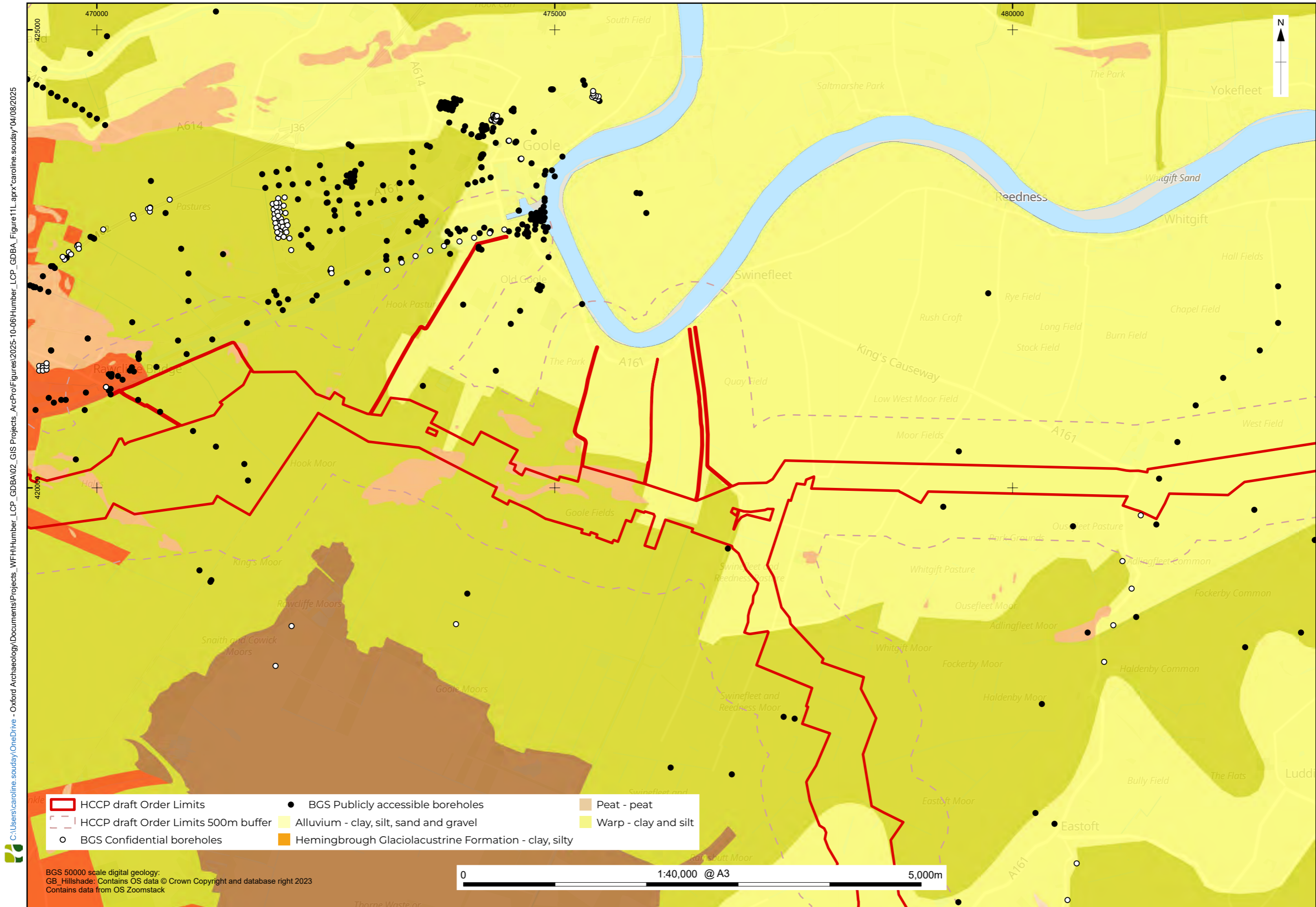


Figure 11i : Humberhead Levels (Adlingfleet Common to Rawcliffe Bridge): superficial geology and BGS borehole locations

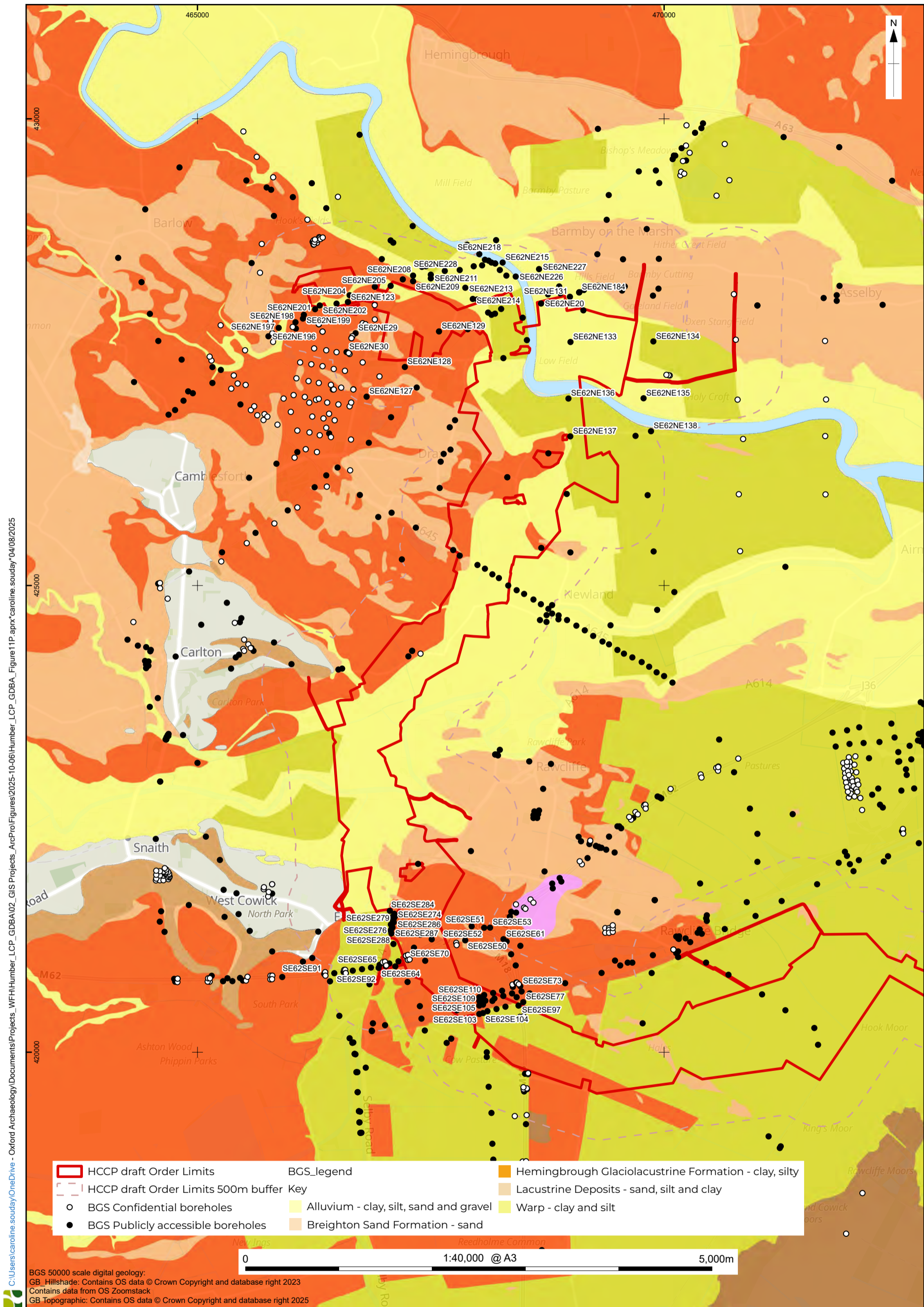


Figure 11j : Humberhead Levels (Rawcliffe Bridge to Drax Power Station): superficial geology and BGS borehole locations

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Figure 12a : Holderness (Easington to Winestead): LiDAR DTM

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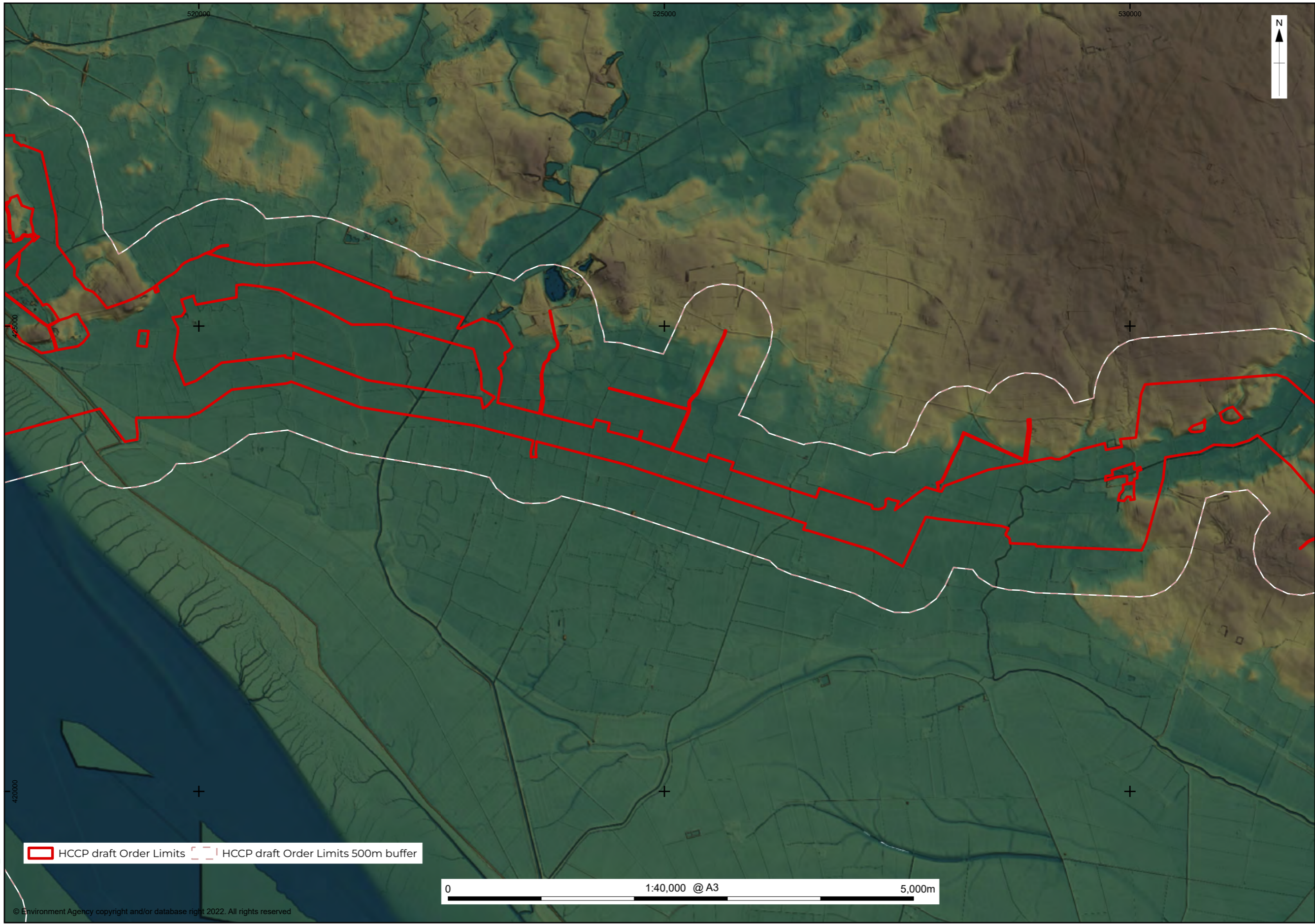


Figure 12b : Humber Estuary (Winestead to Thorngumbold): LiDAR DTM

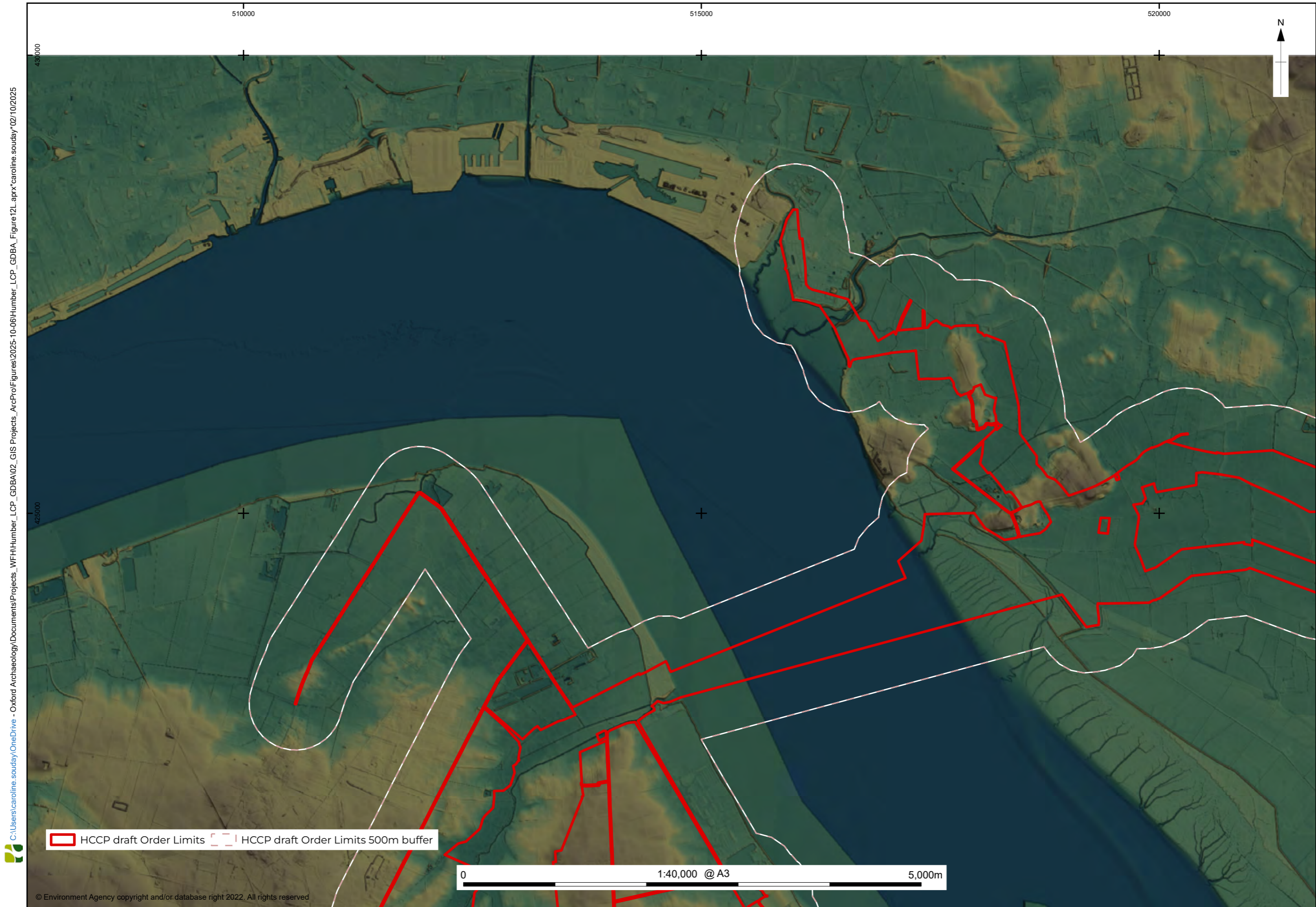


Figure 12c : Humber Estuary/Lincolnshire Wolds (Thorngumbold to Goxhill): LiDAR DTM



Figure 12d : Lincolnshire Wolds (Goxhill to Killingholme Refineries): LiDAR DTM

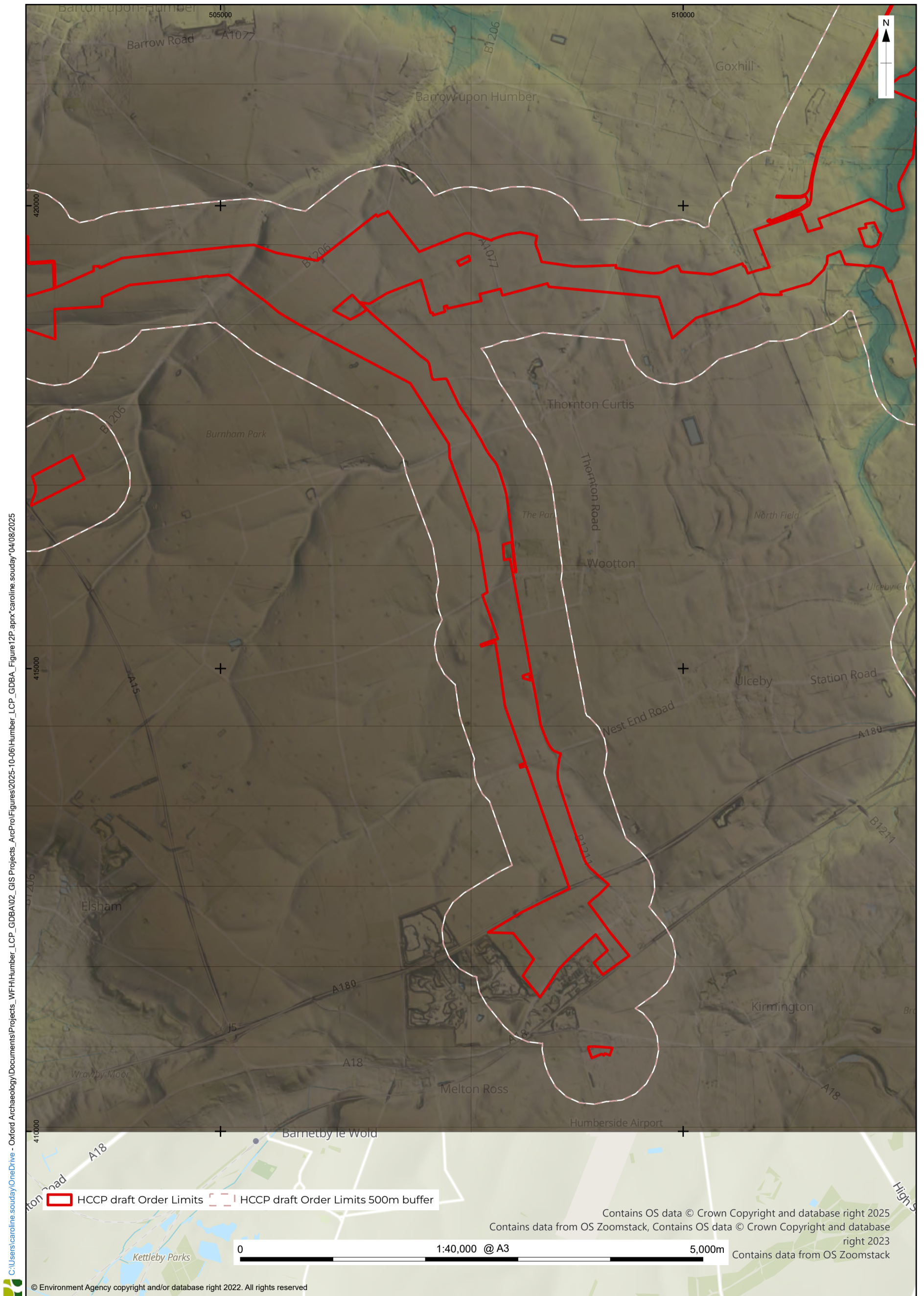


Figure 12e : Lincolnshire Wolds (Goxhill to Barton-upon-Humber and Humberside Airport): LiDAR DTM

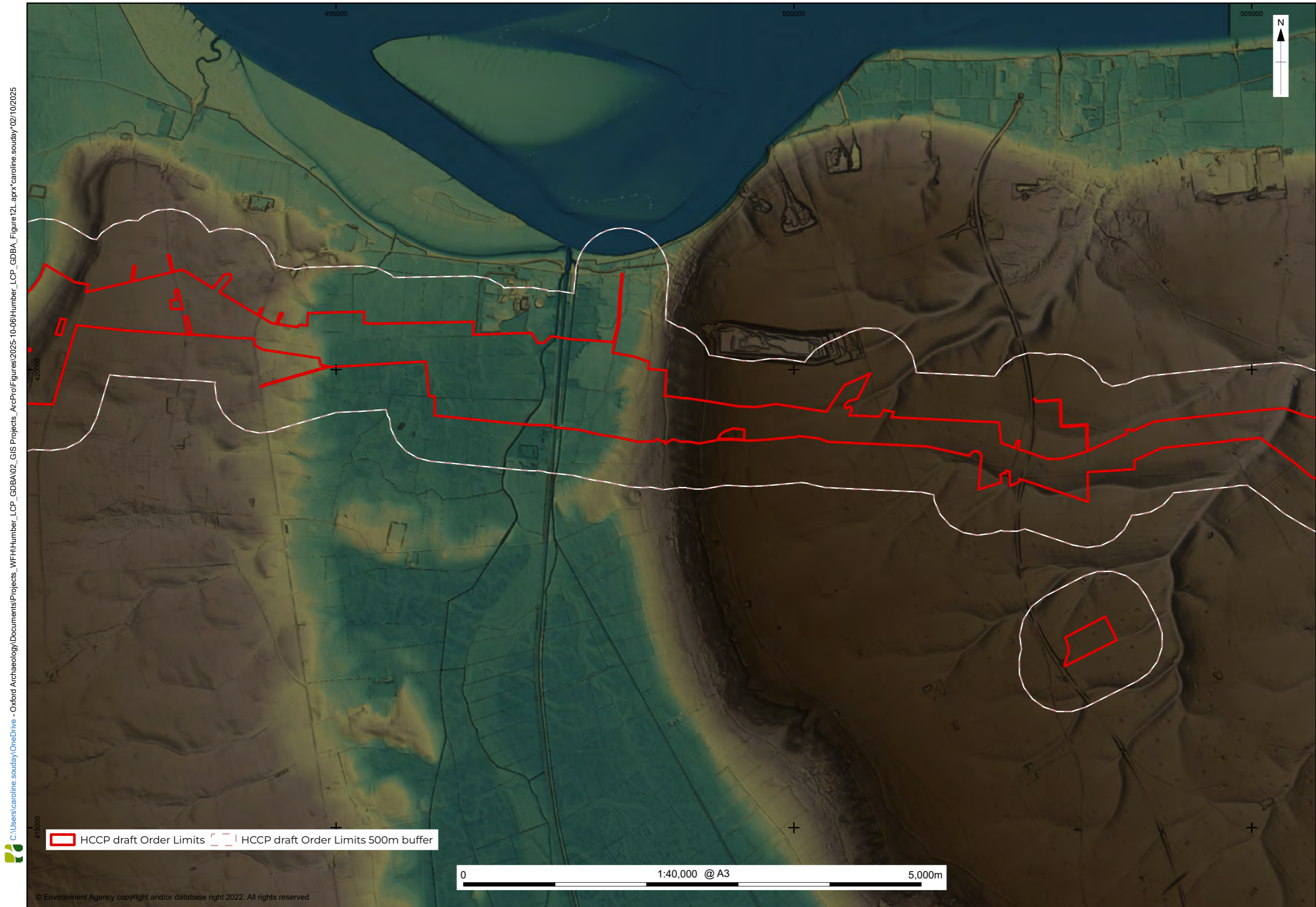
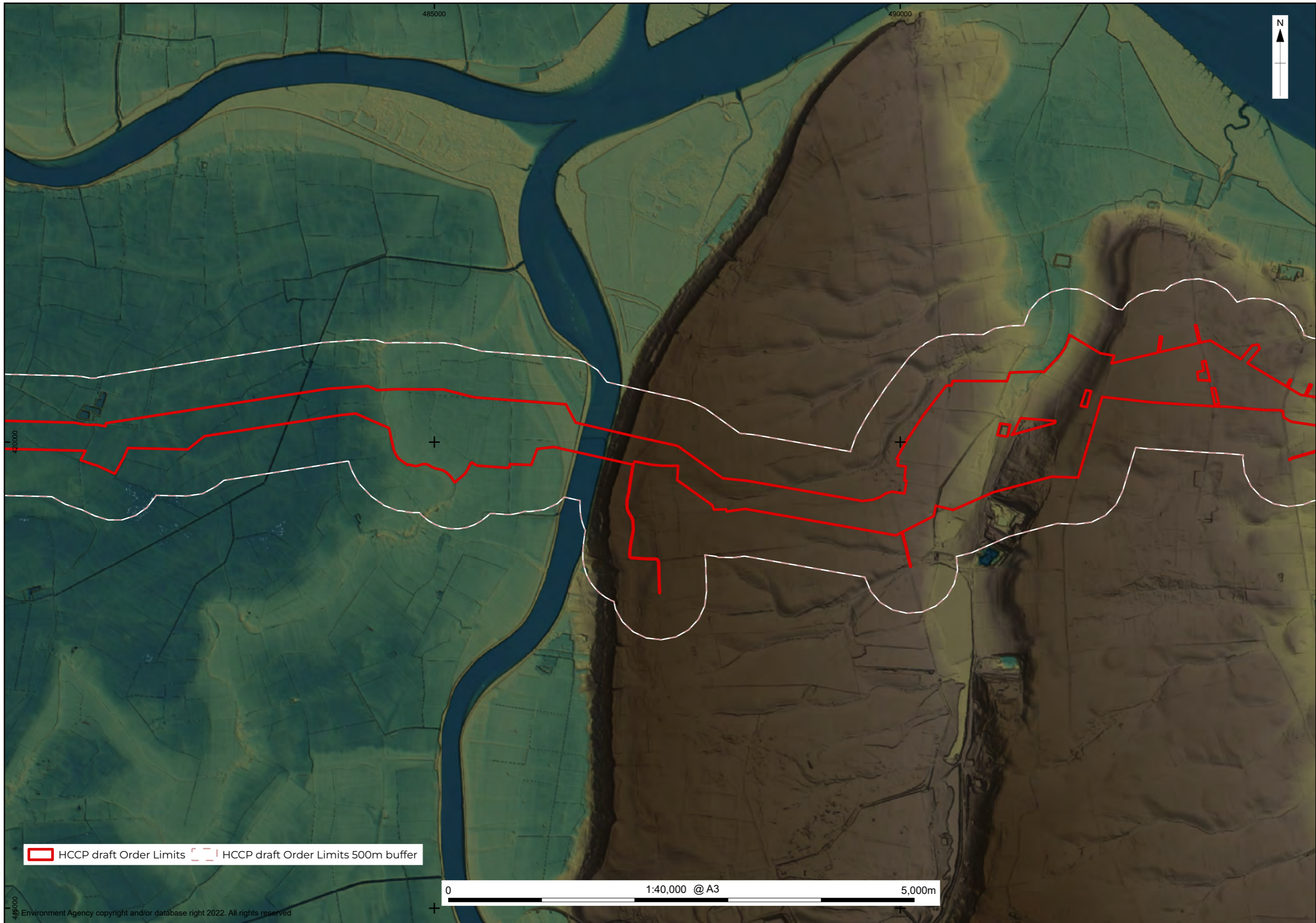


Figure 12f: Lincolnshire Wolds/Ancholme Valley/Lincoln Edge (Barton-upon Humber to Winterton): LiDAR DTM

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Figure 12g : Lincoln Edge/Trent Valley (Winterton to Adlingfleet Common): LiDAR DTM

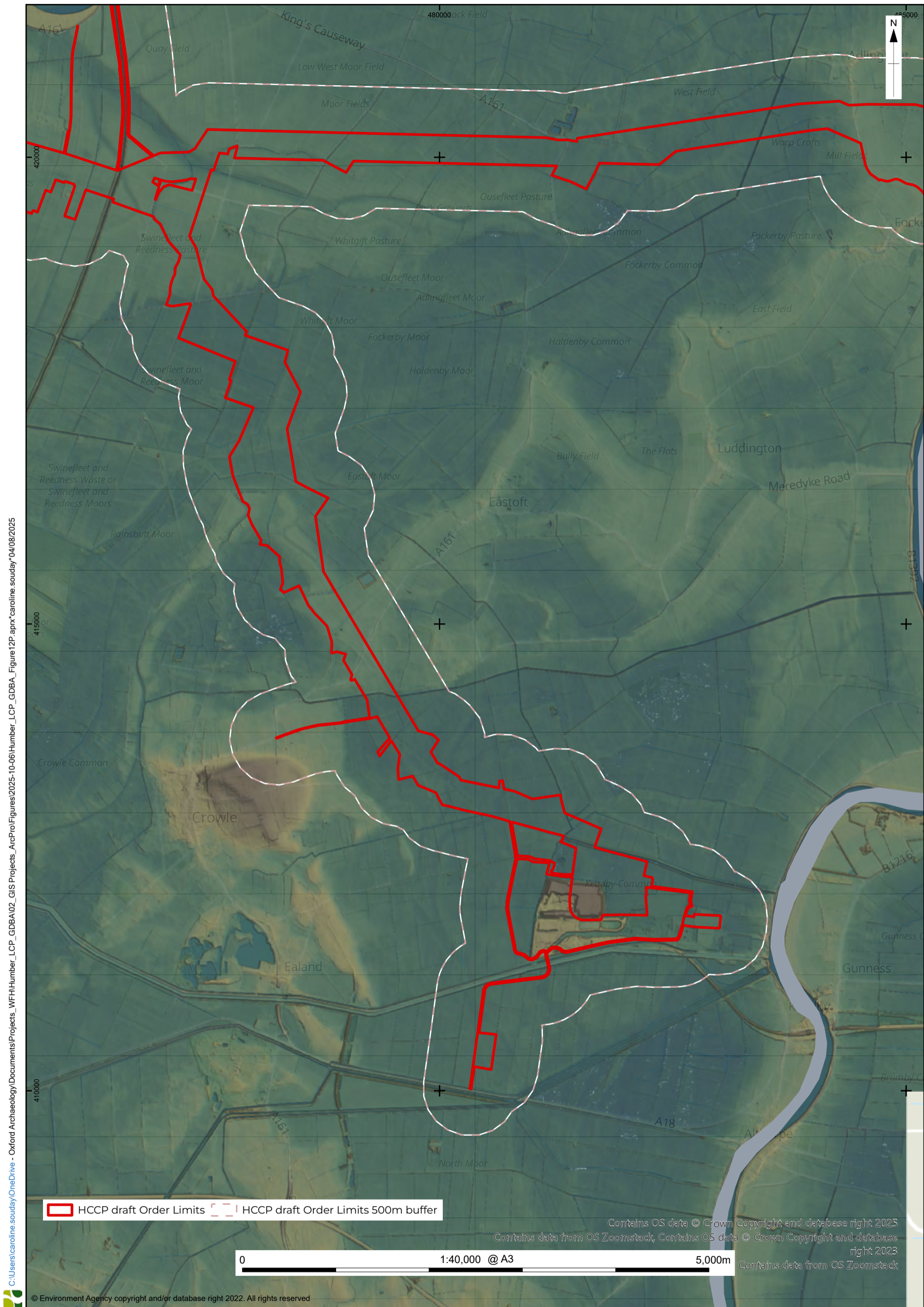
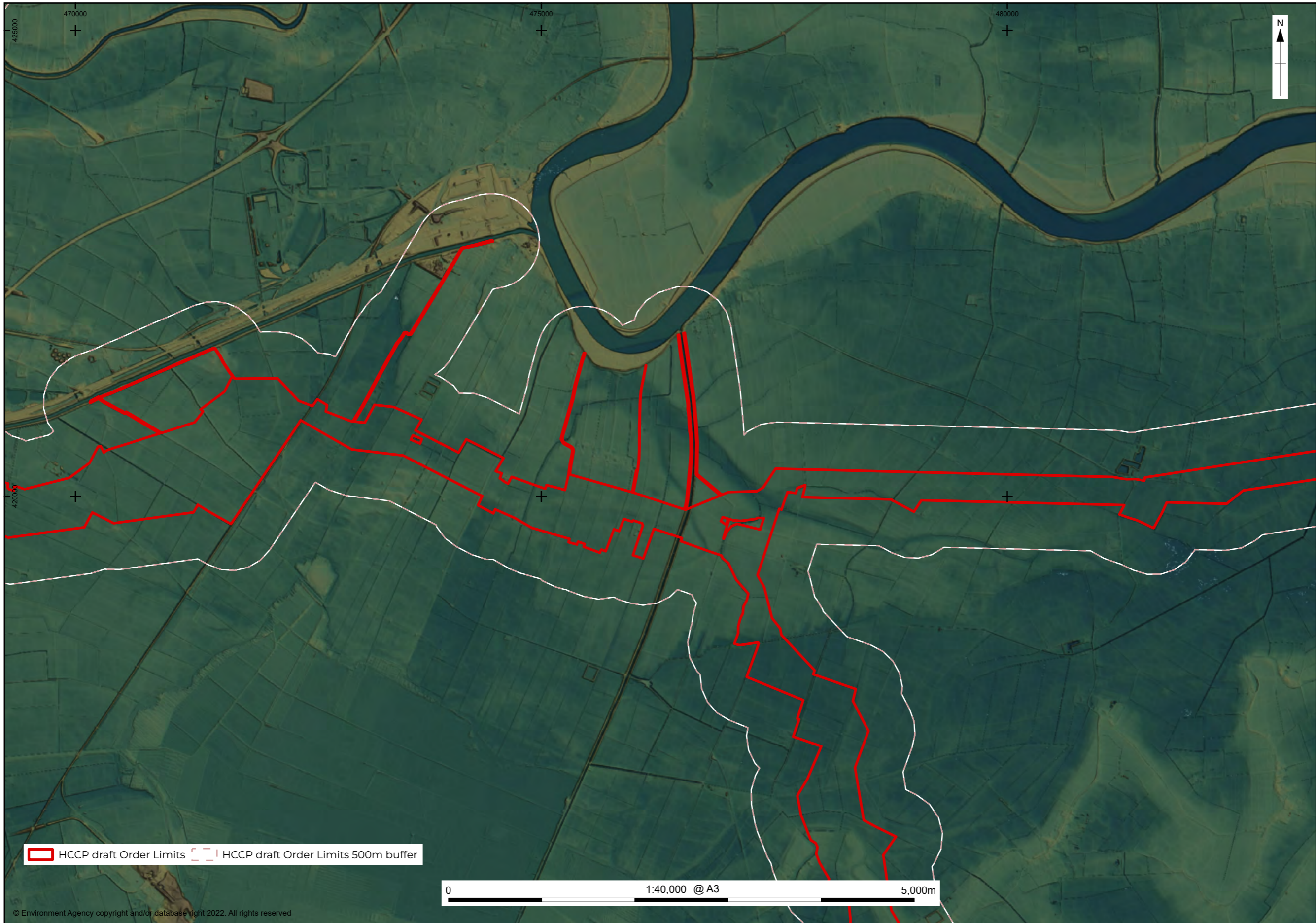


Figure 12h : Trent Valley/Humberhead Levels (Adlingfleet Common to Keadby Power Station): LiDAR DTM

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Figure 12i : Humberhead Levels (Adlingfleet Common to Rawcliffe Bridge): LiDAR DTM

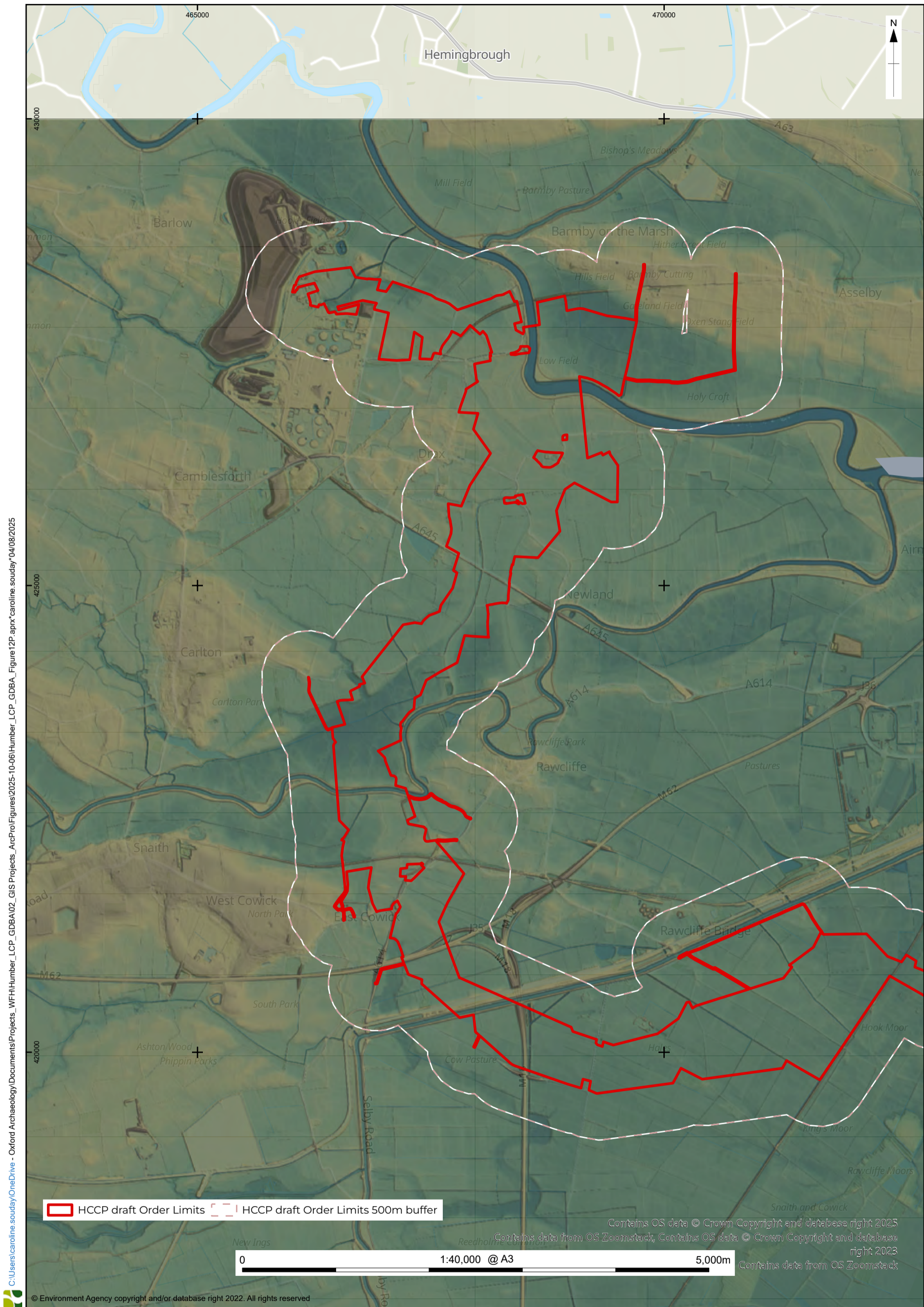


Figure 12j : Humberhead Levels (Rawcliffe Bridge to Drax Power Station): LiDAR DTM

APPENDIX A HISTORIC BOREHOLE DATA

Table A1: Summary list of BGS borehole records for potential use in future deposit modelling

Borehole Reference Number	Easting	Northing	Depth (mbgl)	Landscape Character Area (LCA)
TA12NE33/B	516480	425560	52.73	Humber Estuary
TA12NE33/C	516010	425260	56.69	Humber Estuary
TA12SE11	515700	424920	46.79	Humber Estuary
TA12SE12	515320	424700	46.33	Humber Estuary
TA12SE13	515010	424460	52.43	Humber Estuary
TA12SW82/A	514600	424190	46.33	Humber Estuary
TA12SW82/B	514210	423810	52.43	Humber Estuary
TA12NE37	516580	426592	13.9	Humber Estuary
TA12NE39	516528	426477	8.7	Humber Estuary
TA12NE40	516510	426401	13.3	Humber Estuary
TA12NE43	516487	426323	9.2	Humber Estuary
TA12NE46	516572	426212	14.1	Humber Estuary
TA12NE48	516585	426151	7.9	Humber Estuary
TA12NE53	516522	426287	5	Humber Estuary
SE92SE38	496784	421182	25	Ancholme Valley
SE92SE39	497311	421208	29	Ancholme Valley
SE92SE40	497971	421178	22.95	Ancholme Valley
SE92SE41	498353	421252	25	Ancholme Valley
SE92SE42	498636	421369	21.45	Ancholme Valley
SE92SE43	497898	421065	6.45	Ancholme Valley
SE92SE44	497987	421069	6.45	Ancholme Valley
SE92SE45	498021	421070	6.45	Ancholme Valley
SE92SE46	498069	421073	6.45	Ancholme Valley
SE92SE47	498019	421121	6.45	Ancholme Valley
SE92SE48	498068	421125	6.45	Ancholme Valley
SE92SE49	497654	421180	20	Ancholme Valley
SE92SE50	497456	421191	20	Ancholme Valley
SE92SE51	496983	421164	20	Ancholme Valley
SE92SE52	496817	421179	20	Ancholme Valley
SE92SE53	496008	421278	20	Ancholme Valley
SE92SE54	495608	421458	20	Ancholme Valley
SE92SE55	495395	421606	20	Ancholme Valley
SE92SE56	495140	421789	20	Ancholme Valley

Humber Carbon Capture Pipeline, East Riding of Yorkshire, North Lincolnshire and North Yorkshire

SE92SE57	496992	421161	12.5	Ancholme Valley
SE92SE58	497068	421175	12.45	Ancholme Valley
SE92SE59	497368	421186	15.45	Ancholme Valley
SE92SE60	497484	421164	24.2	Ancholme Valley
SE92SE61	497638	421150	12	Ancholme Valley
SE92SE62	497670	421200	27.7	Ancholme Valley
SE92SE63	497758	421204	12	Ancholme Valley
SE92SE64	497886	421165	12	Ancholme Valley
SE92SE65	498494	421291	15	Ancholme Valley
SE92SE66	498088	421196	12	Ancholme Valley
SE81SW17	480690	413540	12.6	Trent Valley
SE81SW22	480790	412250	15.4	Trent Valley
SE81SW23	481360	412300	11.4	Trent Valley
SE81SW27	480910	411390	15.1	Trent Valley
SE81SW28	481700	411450	13.7	Trent Valley
SE81SW29	482450	411440	15.5	Trent Valley
SE81SW30	483040	411680	15.5	Trent Valley
SE81SW37	480150	412750	9.14	Trent Valley
SE81SW38	480760	412900	17.22	Trent Valley
SE81SW39	481660	412980	9.14	Trent Valley
SE81SW75	483120	412260	16.3	Trent Valley
SE81SW81	483220	411410	14	Trent Valley
SE81SW83	482800	411940	15	Trent Valley
SE81SW84	482840	411930	15	Trent Valley
SE81SW85	482800	411890	15.5	Trent Valley
SE81SW86	482830	411890	15	Trent Valley
SE62NE123	466612	428037	23.39	Humberhead Levels
SE62NE127	466812	427023	36.58	Humberhead Levels
SE62NE128	467222	427341	25.3	Humberhead Levels
SE62NE129	467588	427722	25.91	Humberhead Levels
SE62NE131	468991	428093	22.86	Humberhead Levels
SE62NE133	468997	427609	24.99	Humberhead Levels
SE62NE134	469885	427615	25.91	Humberhead Levels
SE62NE135	469780	427006	25.6	Humberhead Levels
SE62NE136	468975	427003	24.99	Humberhead Levels
SE62NE137	468995	426598	23.93	Humberhead Levels
SE62NE138	469860	426653	24.38	Humberhead Levels
SE62NE184	469090	428140	3.05	Humberhead Levels
SE62NE196	465760	427670	5	Humberhead Levels

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SE62NE197	465870	427760	5	Humberhead Levels
SE62NE198	466050	427820	5	Humberhead Levels
SE62NE199	466140	427900	5	Humberhead Levels
SE62NE20	468682	428021	27.13	Humberhead Levels
SE62NE200	466130	427860	5	Humberhead Levels
SE62NE201	466260	427960	5	Humberhead Levels
SE62NE202	466310	428000	5	Humberhead Levels
SE62NE203	466490	428020	5	Humberhead Levels
SE62NE204	466630	428110	5	Humberhead Levels
SE62NE205	466900	428200	5	Humberhead Levels
SE62NE206	467070	428210	3	Humberhead Levels
SE62NE207	467200	428280	3	Humberhead Levels
SE62NE208	467310	428320	3	Humberhead Levels
SE62NE209	467310	428260	3	Humberhead Levels
SE62NE210	467500	428330	3	Humberhead Levels
SE62NE211	467500	428290	3	Humberhead Levels
SE62NE212	467650	428370	3	Humberhead Levels
SE62NE213	467870	428190	5	Humberhead Levels
SE62NE214	467950	428070	5	Humberhead Levels
SE62NE215	468270	428460	1.65	Humberhead Levels
SE62NE216	468050	428430	2	Humberhead Levels
SE62NE218	468020	428550	17.5	Humberhead Levels
SE62NE219	468080	428490	17.5	Humberhead Levels
SE62NE220	468120	428480	21.5	Humberhead Levels
SE62NE221	468150	428460	17.8	Humberhead Levels
SE62NE222	468190	428450	22.57	Humberhead Levels
SE62NE223	468240	428380	17.5	Humberhead Levels
SE62NE224	468310	428320	1.7	Humberhead Levels
SE62NE226	468410	428310	4.25	Humberhead Levels
SE62NE227	468660	428390	5	Humberhead Levels
SE62NE228	467810	428380	3.75	Humberhead Levels
SE62NE229	467960	428420	2.9	Humberhead Levels
SE62NE29	466694	427703	92	Humberhead Levels
SE62NE30	466597	427501	123	Humberhead Levels
SE62SE103	468020	420410	12.19	Humberhead Levels
SE62SE104	468060	420420	12.19	Humberhead Levels
SE62SE105	468020	420500	12.19	Humberhead Levels
SE62SE106	468060	420510	12.19	Humberhead Levels
SE62SE107	468020	420550	12.19	Humberhead Levels

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SE62SE108	468070	420560	12.19	Humberhead Levels
SE62SE109	468020	420590	12.19	Humberhead Levels
SE62SE110	468070	420610	12.19	Humberhead Levels
SE62SE274	467108	421467	10.7	Humberhead Levels
SE62SE275	467097	421412	11.2	Humberhead Levels
SE62SE276	467071	421302	7.8	Humberhead Levels
SE62SE277	467109	421483	0.7	Humberhead Levels
SE62SE278	467102	421426	1.3	Humberhead Levels
SE62SE279	467093	421388	1.2	Humberhead Levels
SE62SE280	467076	421317	1.3	Humberhead Levels
SE62SE281	467105	421439	1.2	Humberhead Levels
SE62SE282	467072	421368	5.65	Humberhead Levels
SE62SE283	467091	421451	2.65	Humberhead Levels
SE62SE284	467061	421515	2.65	Humberhead Levels
SE62SE285	467118	421458	2.65	Humberhead Levels
SE62SE286	467103	421392	2.65	Humberhead Levels
SE62SE287	467090	421337	4.65	Humberhead Levels
SE62SE288	467078	421273	6.65	Humberhead Levels
SE62SE50	467869	421199	15	Humberhead Levels
SE62SE51	467938	421349	15	Humberhead Levels
SE62SE52	468072	421334	16.1	Humberhead Levels
SE62SE53	468135	421335	30	Humberhead Levels
SE62SE61	468279	421211	30	Humberhead Levels
SE62SE64	466941	420904	30	Humberhead Levels
SE62SE65	466951	420936	30	Humberhead Levels
SE62SE67	467012	420956	30	Humberhead Levels
SE62SE68	467056	420951	18	Humberhead Levels
SE62SE69	467154	420974	18	Humberhead Levels
SE62SE70	467251	421000	18	Humberhead Levels
SE62SE71	468168	420635	30	Humberhead Levels
SE62SE72	468264	420659	42.7	Humberhead Levels
SE62SE73	468459	420707	41.6	Humberhead Levels
SE62SE74	468107	420440	30	Humberhead Levels
SE62SE75	468204	420463	30	Humberhead Levels
SE62SE76	468300	420488	46.5	Humberhead Levels
SE62SE77	468491	420537	41.6	Humberhead Levels
SE62SE79	468182	420576	28.5	Humberhead Levels
SE62SE80	468277	420603	30	Humberhead Levels
SE62SE81	468371	420630	53	Humberhead Levels

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SE62SE82	468473	420651	30	Humberhead Levels
SE62SE91	466358	420838	20	Humberhead Levels
SE62SE92	466466	420847	20	Humberhead Levels
SE62SE93	466565	420860	20	Humberhead Levels
SE62SE94	466664	420874	20	Humberhead Levels
SE62SE95	466763	420890	20	Humberhead Levels
SE62SE96	466859	420907	20	Humberhead Levels
SE62SE97	468440	420500	18.29	Humberhead Levels

Table A2: Summary list of borehole/augur data from previous geoarchaeological projects for potential use in future deposit modelling

Location	Project Name	Reference	Landscape Character Area (LCA)
Paull	Easington to Paull Pipeline / Feeder 9 Replacement Pipeline Tunnel	OA, 2012; 2021	Humber Estuary
Goxhill	Feeder 9 Replacement Pipeline Tunnel	OA, 2016; 2022	Humber Estuary
East Halton Skitter	Humber Link Pipeline	NAA, 2000	Humber Estuary
Keadby	Keadby Power Station and Wind Farm	Headland Archaeology, 2013; 2018; SSE Thermal, 2021; Timpany, 2012; Trent and Peak Archaeology, 2021; York Archaeological Trust, 2022	Trent Valley
Airmyn	Humber Wetlands Survey	Van de Noort and Ellis, 1999	Humberhead Levels
Carlton	Humber Wetlands Survey	Van de Noort and Ellis, 1999	Humberhead Levels

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