

Outer Dowsing Offshore Wind Preliminary Environmental Information Report

Volume 2, Appendix 4.1: Landfall Assessment & Offshore ECC Route Optioneering

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Abbreviations

Acronym	Meaning
AfL	Agreement for Lease
AIS	Air Insulated Switchgear
AQMA	Air Quality Management Area
BEIS	Department for Business, Energy & Industrial Strategy, now Department for Energy Security and Net Zero (DESNZ)
BRAG	Black, Red, Amber and Green
CDG	Central Design Group
CES	Crown Estate Scotland
CION	Connections and Infrastructure Option Note
CLB	Cable Lay Barges
CLG	Community Liaison Group
CLV	Cable Laying Vessel
DCO	Development Consent Order
DERFA	Department for Environment, Food & Rural Affairs
DESNZ	Department for Energy Security and Net Zero
DLUHC	Department for Levelling Up, Housing and Communities
ECC	Export Cable Corridor (offshore ECC or onshore ECC)
EIA	Environmental Impact Assessment
ES	Environmental Statement
ESO	Electricity System Operator
ETG	Expert Topic Group
GIS	Gas Insulated Switchgear
HDD	Horizontal Directional Drilling
HER	Historic Environment Record
HND	Holistic Network Design
HRA	Habitats Regulations Assessment
IDRBNR	Inner Dowsing, Race Bank and North Ridge
IHLS	International Herring Larval Survey
IMO	International Maritime Organisation
LCoE	Levelised Cost of Energy
LNR	Local Nature Reserve
MCA	Maritime and Coastguard Agency
MCZ	Marine Conservation Zone
MHWS	Mean High Water Spring
MMO	Marine Management Organisation
MoD	Ministry of Defence
MPS	Marine Policy Statement
MW	Mega Watt
NATS	National Air Traffic Services
NERC	Natural Environment and Rural Communities
NGESO	National Grid Electricity System Operator
NHLE	National Heritage List for England

Acronym	Meaning
NNR	National Nature Reserve
NPPF	National Planning Policy Framework
ODOW	Outer Dowsing Offshore Wind (The Project)
OnSS	Onshore Substation
ORCP	Offshore Reactive Compensation Platform
OSPAR	Oslo / Paris convention (for the Protection of the Marine Environment of the North-East Atlantic)
OTNR	Offshore Transmission Network Review
OWF	Offshore Windfarm
PEIR	Preliminary Environmental Information Report
PEXA	Practice and Exercise Areas
PLGR	Pre-lay grapnel runs
PQQ	Pre-Qualification Questionnaire
RAF	Royal Air Force
RIAA	Report to Inform Appropriate Assessment
SAC	Special Area of Conservation
SoCC	Statement of Community Consultation
SPA	Special Protection Area
SPZ	Source Protection Zones
SSSI	Site of Special Scientific Interest
TCE	The Crown Estate
TJB	Transition Joint Bay
TOs	Transmission Operators
TSS	Traffic Separation Scheme
UK	United Kingdom

Terminology

Term	Definition
Array area	The area offshore within the PEIR Boundary within which the generating stations (including wind turbine generators (WTG) and inter array cables), offshore accommodation platforms, offshore transformer substations and associated cabling are positioned.
Baseline	The status of the environment at the time of assessment without the development in place.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for a Nationally Significant Infrastructure Project (NSIP) from the Secretary of State (SoS) for Department for Energy Security and Net Zero (DESNZ).
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude of an impact with the sensitivity of a receptor, in accordance with defined significance criteria.
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment

	requirements of the Environmental Impact Assessment (EIA) Regulations, including the publication of an Environmental Statement (ES).
Environmental Statement (ES)	The suite of documents that detail the processes and results of the Environmental Impact Assessment (EIA).
Habitats Regulations Assessment (HRA)	Habitats Regulations Assessment. A process which helps determine likely significant effects and (where appropriate) assesses adverse impacts on the integrity of European conservation sites and Ramsar sites. The process consists of up to four stages of assessment: screening, appropriate assessment, assessment of alternative solutions and assessment of imperative reasons of over-riding public interest (IROPI) and compensatory measures.
Impact	An impact to the receiving environment is defined as any change to its baseline condition, either adverse or beneficial.
Intertidal	Area where the ocean meets the land between high and low tides.
Joint bays	A joint bay provides a secure environment for the assembly of cable joints as well as bonding and earthing leads. A joint bay is installed between each length of cable.
Landfall	The location at the land-sea interface where the offshore export cable will come ashore.
Mitigation	Mitigation measures, or commitments, are commitments made by the Project to reduce and/or eliminate the potential for significant effects to arise as a result of the Project. Mitigation measures can be embedded (part of the project design) or secondarily added to reduce impacts in the case of potentially significant effects.
National Grid's OnSS	Onshore substation which is owned and operated by National Grid
Offshore Export Cable Corridor (ECC)	The Offshore Export Cable Corridor (Offshore ECC) is the area within the Preliminary Environmental Information Report (PEIR) Boundary within which the export cable running from the array to landfall will be situated.
Offshore Reactive Compensation Station (ORCP)	Platforms located outside the array area which house electrical equipment and control and instrumentation systems. They also provide access facilities for work boats.
Offshore Substation (OSS)	Platforms located within the array area which house electrical equipment and control and instrumentation systems. They also provide access facilities for work boats and helicopters.
Onshore Export Cable Corridor (ECC)	The Onshore Export Cable Corridor (Onshore ECC) is the area within which the export cable running from the landfall to the onshore substation will be situated.
Onshore Infrastructure	The combined name for all onshore infrastructure associated with the Project from landfall to grid connection.
Onshore substation (OnSS)	The Project's onshore substation, containing electrical equipment to enable connection to the National Grid

Outer Dowsing Offshore Wind (ODOW)	The Project.
PEIR Boundary	The PEIR Boundary is outlined in Figure 3.1 of Volume 1, Chapter 3: Project Description and comprises the extent of the land and/or seabed for which the PEIR assessments are based upon.
Pre-construction and post-construction	The phases of the Project before and after construction takes place.
Preliminary Environmental Information Report (PEIR)	The PEIR is written in the style of a draft Environmental Statement (ES) and provides information to support and inform the statutory consultation process in the pre-application phase. Following that consultation, the PEIR documentation will be updated to produce the Project's ES that will accompany the application for the Development Consent Order (DCO).
Receptor	A distinct part of the environment on which effects could occur and can be the subject of specific assessments. Examples of receptors include species (or groups) of animals or plants, people (often categorised further such as 'residential' or those using areas for amenity or recreation), watercourses etc.
study area	Area(s) within which environmental impact may occur – to be defined on a receptor-by-receptor basis by the relevant technical specialist.
Subsea	Subsea comprises everything existing or occurring below the surface of the sea.
The Applicant	GT R4 Ltd. The Applicant making the application for a DCO. The Applicant is GT R4 Limited (a joint venture between Corio Generation, TotalEnergies and Gulf Energy Development (GULF)), trading as Outer Dowsing Offshore Wind. The project is being developed by Corio Generation (a wholly owned Green Investment Group portfolio company), TotalEnergies and GULF.
The Planning Inspectorate	The agency responsible for operating the planning process for Nationally Significant Infrastructure Projects (NSIPs).
The Project	Outer Dowsing Offshore Wind including proposed onshore and offshore infrastructure
Transition Joint Bay (TJBs)	The offshore and onshore cable circuits are jointed on the landward side of the sea defences/beach in a Transition Joint Bay (TJB). The TJB is an underground chamber constructed of reinforced concrete which provides a secure and stable environment for the cable.
Trenched technique	Trenching is a construction excavation technique that involves digging a narrow trench in the ground for the installation, maintenance, or inspection of pipelines, conduits, or cables.
Trenchless technique	Trenchless technology is an underground construction method of installing, repairing and renewing underground pipes, ducts and cables using techniques which minimize or eliminate the need for excavation. Trenchless technologies involve methods of new pipe installation with minimum surface and environmental disruptions. These techniques may include Horizontal Directional Drilling (HDD), thrust boring, auger boring, and pipe ramming, which allow ducts to be installed under an obstruction without breaking open the ground and digging a trench.

4 Landfall Assessment

4.1 Introduction

- 4.1.1 This Appendix provides the full assessment relating to Stage 2 Identification of the Landfall Zones and Export cable Landfall Options and Stage 4 Identification of the Offshore ECC Route Options of the Site Selection Process as detailed in Chapter 4 Site Selection and Consideration of Alternatives.

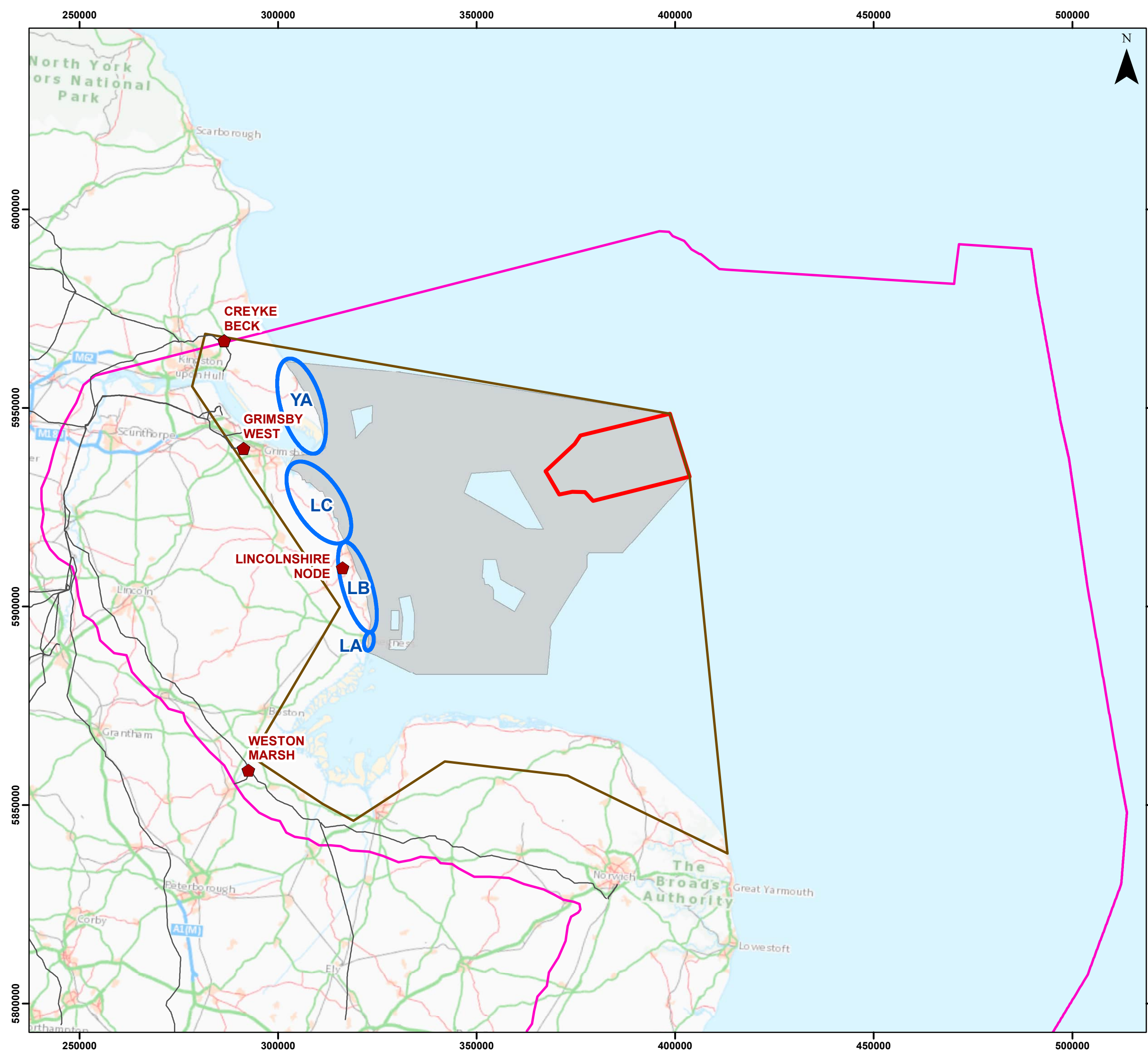
4.2 Identification of the Landfall Zones and Export cable Landfall Options

Overview

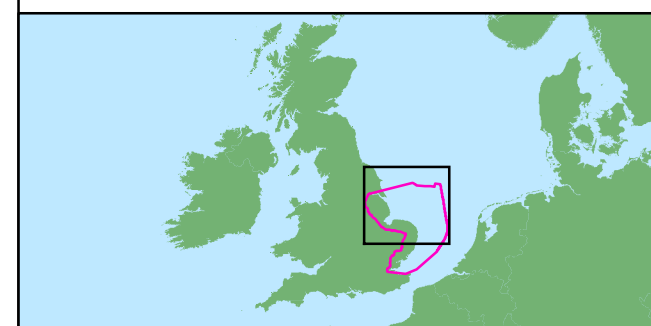
- 4.2.1 In August 2021, the Project accepted a preliminary grid connection offer, under the CION process for a 1.5GW connection in the Humber region. This was subsequently superseded by the OTNR process and the accompanying HND process as described in PEIR Chapter 4 Site Selection. At the time of writing, the Project's final grid connection location has not been confirmed but the Pathway to 2030 HND report has concluded that connection options are proposed at either Lincolnshire Node (a new connection point to be developed by National Grid) or a connection in the vicinity of the existing overhead lines at Weston Marsh; these options remain subject to further evaluation by NGENSO prior to a grid connection offer being made
- 4.2.2 In order to progress development work in parallel with the completion of the Pathway to 2030 HND process, the Applicant chose to progress a landfall assessment to consider landfall options (and associated offshore and onshore cable route options) for the grid connection interface points identified by the HND, and ultimately focusing on the proposed grid connection options at Lincolnshire Node or Weston Marsh.
- 4.2.3 The study area for the landfall assessment was therefore determined by the initial study area identified by the HND for the east coast Round 4 projects; this covered a large proportion of the central east coast of England, from the Yorkshire coast (south of Flamborough Head) down to the north coast of Norfolk (Figure 4.1). It is noted that in parallel to this, The Crown Estate developed a study area for considering export cable corridors for the Project for the purposes of the Plan-Level HRA which covered a somewhat smaller area compared to the initial HND study area but nonetheless still encompassed the coastline from south Yorkshire to north Norfolk, also shown in Figure 4.1.
- 4.2.4 The initial landfall assessment considered landfall character and opportunity across this study area, undertaking a BRAG assessment utilising the method described below and considering both environmental constraints, and electrical or civil engineering factors. As the HND process evolved and preferences on likely grid connection options emerged, the landfall assessment focused on the most likely outcomes. For example the HND communicated at a relatively early stage that connections into the north Norfolk region were unlikely to progress into the detailed HND evaluation. This was primarily due to the very constrained nature of the coastline due to designated sites and the number of existing connections into that coast, meaning remaining landfall options were considered to be highly constrained. Similarly connections through the Wash and the Humber Estuary were eliminated at a relatively early stage due to their constrained nature and the presence of the number of important environmental designations (SPA, RAMSAR, SSSI).
- 4.2.5 The preliminary BRAG assessments, based on GIS data analysis and desk top study were validated by site visits by the Project development team and technical advisers to the most promising landfall locations across Yorkshire and Lincolnshire, as identified by the preliminary BRAG work.

Landfall Assessment Methodology

- 4.2.6 The purpose of the landfall assessments was to identify, rank and prioritise potential landfall options within the study area to identify a discrete number of options which could be taken forward for further evaluation as potential landfalls for the Project, maintaining optionality with respect of the uncertainty of the grid connection location whilst the HND progressed.
- 4.2.7 To this end, with such an extensive study area, it was clear that the whole study area could not be assumed to be viable for any grid interface option, and it was therefore necessary to divide the study area into “landfall sectors”, with parts of the coastline being relevant as landfall options for different grid interface options. The study area was divided up into four sectors (Figure 4.1), based on the presence of major infrastructure (cables or pipelines) making landfall, on the basis that a nearshore crossing of these infrastructure would likely be unfeasible. The Yorkshire study area considered a single landfall sector (YA) due to its size and single grid interface option for that study area. The Lincolnshire study area was divided into three sectors (LA, LB & LC), with the southerly sector (LA) bounded to the north by the Lincs OWF cables making landfall. The central sector (LB) went from the Lincs OWF cable landfall to the Easington pipeline landfall and the northerly sector (LC) from there to the Humber Estuary.
- 4.2.8 The only grid interface location for the YA sector was Creyke Beck substation. The remaining three interface points were in Lincolnshire (Figure 4.1), with different landfall sectors considered suitable for specific interface points (based on an aim to minimise onshore cable routing distances as far as possible). For a Grimsby West connection, only sector LC was considered viable. For Weston Marsh, sectors LA and LB were considered viable and for Lincolnshire Node, sector LB was considered viable.
- 4.2.9 The assessment was undertaken in a phased manner, by firstly identifying ‘opportunity areas’ (areas that were not obviously highly constrained and therefore not suitable for cable landfall), then applying further engineering and environmental constraints to enable a semi-quantitative analysis of the potential suitability of locations within the appraisal area as a landfall. Following a series of site visits as a ground truthing exercise, the constraints analysis was further updated. Finally, the constraints analysis, alongside information from the site visits and expert opinion, was utilised to develop a short-list of landfall options for the Project, which was continually refined as the most likely grid connection points emerged from the HND process.
- 4.2.10 To enable a robust, high-resolution assessment of the landfall options, the landfall sectors were divided up into small “sections”, based on the presence of constraints (Figure 4.2). For example, where a pipeline made landfall, this would act as a division in the sections, also, the buffers around pipelines or extents of designated sites would be the bounding points for different landfall sections. This allowed for each landfall sector to be examined at a high-resolution for suitable landfalls, without blocking out suitable areas which might otherwise be disguised if using an arbitrary distance based measure for dividing up the coastline. These sections were named sequentially based on the landfall sector within which it is present (i.e. LA1, LA2, etc. for sections within landfall sector LA and the same for the other sectors).



- Legend**
- Array Area
 - ◆ Onshore Substation
 - Offshore ECC Area of Search
 - Landfall Sector
 - OTNR Area of Search
 - Plan Level HRA Cable Route Area of Search



Coordinate System: WGS 1984 UTM Zone 31N
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 Scale: 1:900,000

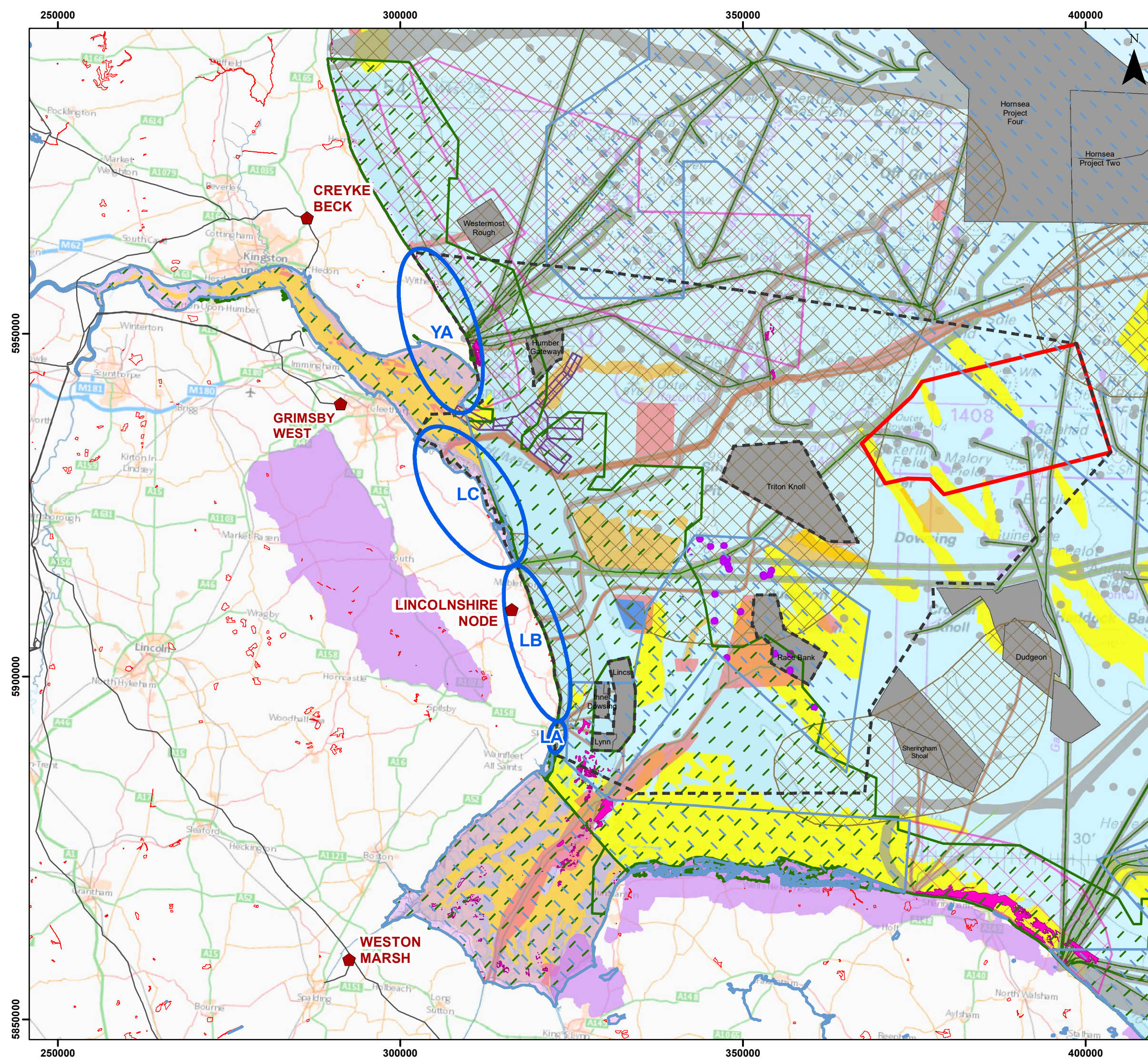
Preliminary Environmental Information Report
 Offshore Area of Search and Potential Onshore Connection Locations
 Figure 4.1



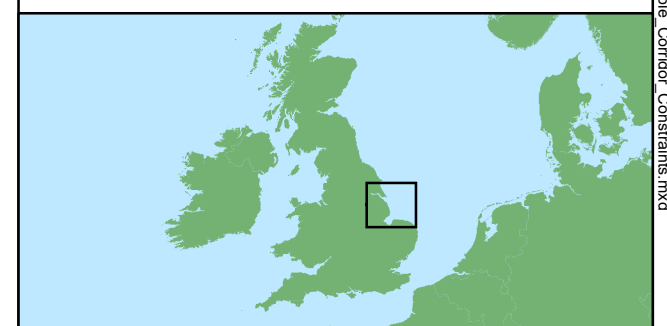
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- ### Legend
- Array Area
 - Onshore Substation
 - Offshore ECC Area of Search
 - Landfall Sector
 - Offshore Wind Farm
 - Offshore Subsea Cables/Infrastructure
 - Cable - Active
 - Cable - Not In Use
 - Pipeline - Active
 - Pipeline - Not In Use
 - Pipeline - Abandoned
 - Ships Routing Measures Areas
 - Aggregates - Production Agreement Area
 - Aggregates - Exploration and Option Area
 - Disposal Sites
 - Marine Conservation Zone
 - Sites of Special Scientific Interest
 - Ramsar Site
 - Areas of Outstanding Natural Beauty
 - Special Protection Areas
 - Special Areas of Conservation
 - Herring Spawning Grounds (1998)
 - Annex I Reef
 - Annex I additional areas managed as reef
 - Annex I Sandbank



Coordinate System: WGS 1984 UTM Zone 31N
 0 10 20 km
 Scale: 1:525,000

Preliminary Environmental Information Report
 Offshore Cable Corridor Constraints Mapping

Figure 4.2



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The BRAG Analysis

Phase 1 – Developable Area

- 4.2.11 The first phase of the BRAG analysis was to identify ‘developable areas’ within the landfall appraisal study area. An initial constraints list was agreed for this first phase, with constraints being either "black" (i.e. not developable) or "clear" (i.e. developable).
- 4.2.12 The constraints criteria considered for this first phase as "black" were:
- Residential properties; and
 - Existing infrastructure at the coast (e.g. existing cables, pipelines, etc.) and a 50m buffer either side.

Phase 2 – Detailed Constraints Analysis

- 4.2.13 The second detailed phase of the BRAG analysis was to provide a semi-quantitative scoring for a wide range of other engineering and environmental constraints, including further analysis of the previously considered constraints (Figure 4.2).
- 4.2.14 The constraints considered for the detailed BRAG analysis were as follows:
- Engineering:
 - Amenity – Land use, access, urban development;
 - Bathymetry – suitability for access by a cable vessel/barge;
 - Potential for trenchless technique operations, such as Horizontal Directional Drilling (HDD), and suitable area for HDD operations and cable joint pits;
 - Transition joint bay (TJB) compound clearance/feasibility;
 - Open cut trenching conceptual feasibility;
 - Nearshore and landfall seabed sediments constraints;
 - Nearshore and landfall Cable Laying Vessel (CLV) accessibility constraints;
 - Landfall morphology appraisal (i.e. cliff-like morphology vs. low lying beach); and
 - Presence of wrecks and other seabed obstruction at landfall and in the nearshore area.
 - Environmental:
 - Environmental designations and associated constraints;
 - Proximity to other cables/pipelines at the coast and in the nearshore area; and
 - MoD areas (e.g. firing ranges).
- 4.2.15 Criteria were determined for each factor to align with the BRAG approach. The scores assigned were:
- Black (landfall not possible) = section removed;
 - Red (landfall possible with moderate/high issues) = 3
 - Amber (landfall possible with minor/moderate issues) = 2; and
 - Green (landfall possible with no/minor issues) = 1.

- 4.2.16 These criteria were used to create a matrix to allow comparison of the possible landfall sites. The whole study area was assessed for a subset of the above constraints and this allowed for the identification of 'sectors' of the coastline to be established where possible landfalls could be identified. Following this assessment, a more detailed engineering appraisal was also undertaken for each sector.
- 4.2.17 Separate totals were determined for each sector based on the environmental and engineering constraint categories. An overall score was determined from the totals with all constraints weighted equally, with the exception of nationally designated sites which were given a higher weighting. The presence of a nationally designated site that overlapped with the landfall area or the immediately adjacent onshore or offshore areas, meant that the sector was automatically allocated a minimum Amber rating for the environmental constraints appraisal. An overall score was then calculated for each sector from the combined scores of the engineering and environmental constraints.
- 4.2.18 Where a constraint or boundary of a constraint (e.g. either a pipeline made landfall, the edge of a pipeline buffer, or edge of a designated site) interacted with the high water mark, this was used to divide the study area up into "sections", which were then labelled sequentially depending on the relevant landfall sector.
- 4.2.19 It should be noted that while BRAG exercise help to highlight the key areas of consideration for each of the sites; the ultimate selection process intends to take a holistic view of the results of this analysis alongside site visits to ground truth and professional judgement.

Site Visits

- 4.2.20 Site visits were undertaken to act as a ground truthing exercise for the BRAG analysis and allowing for further details to be assessed at each of the potential landfall locations visited.

Finalisation of the BRAG Analysis

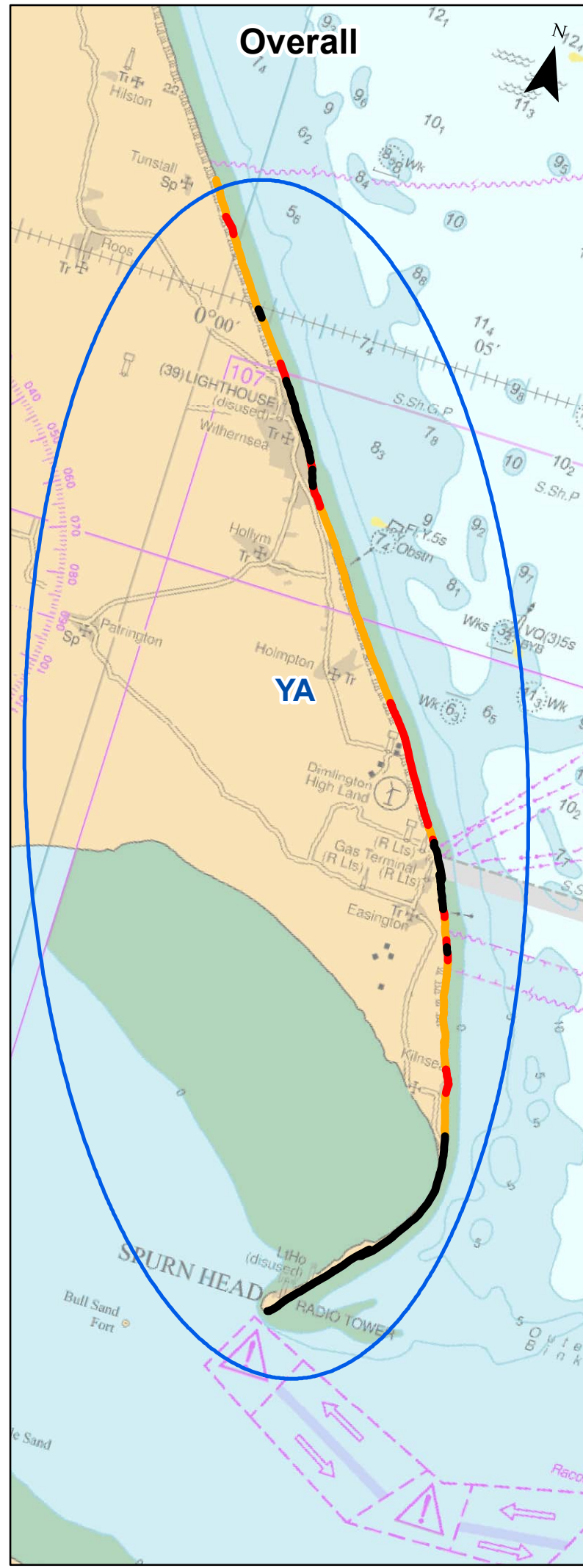
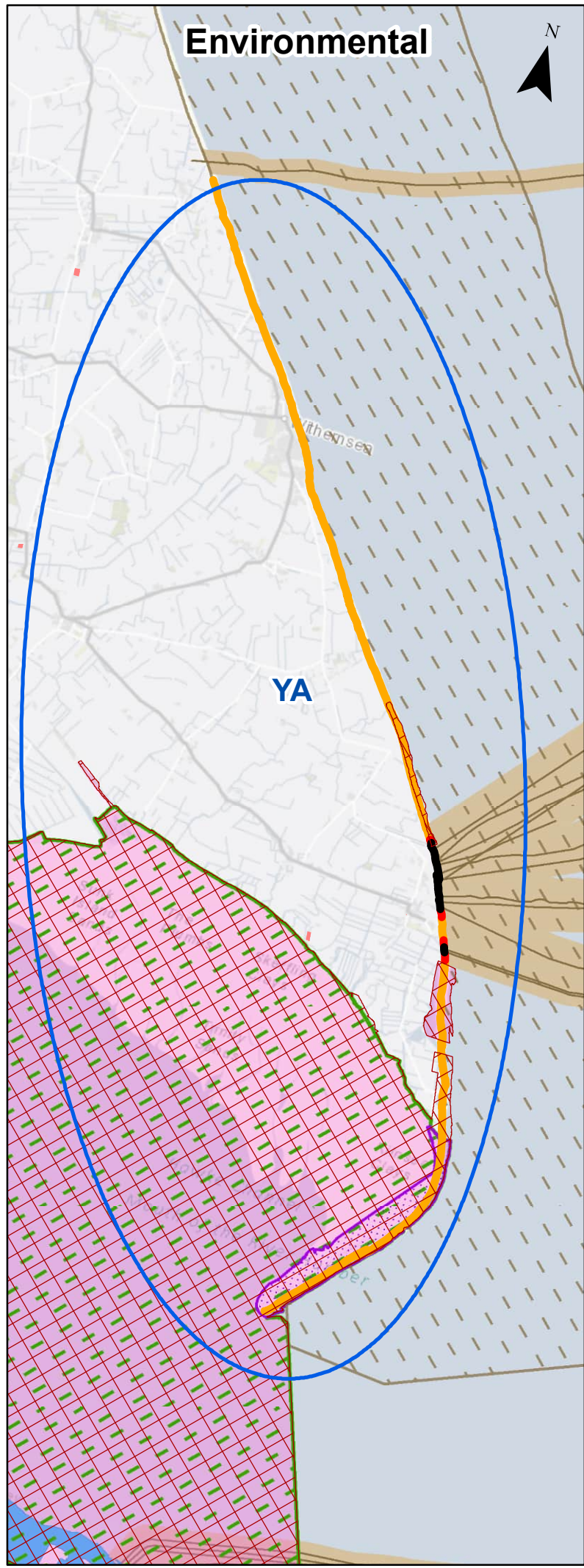
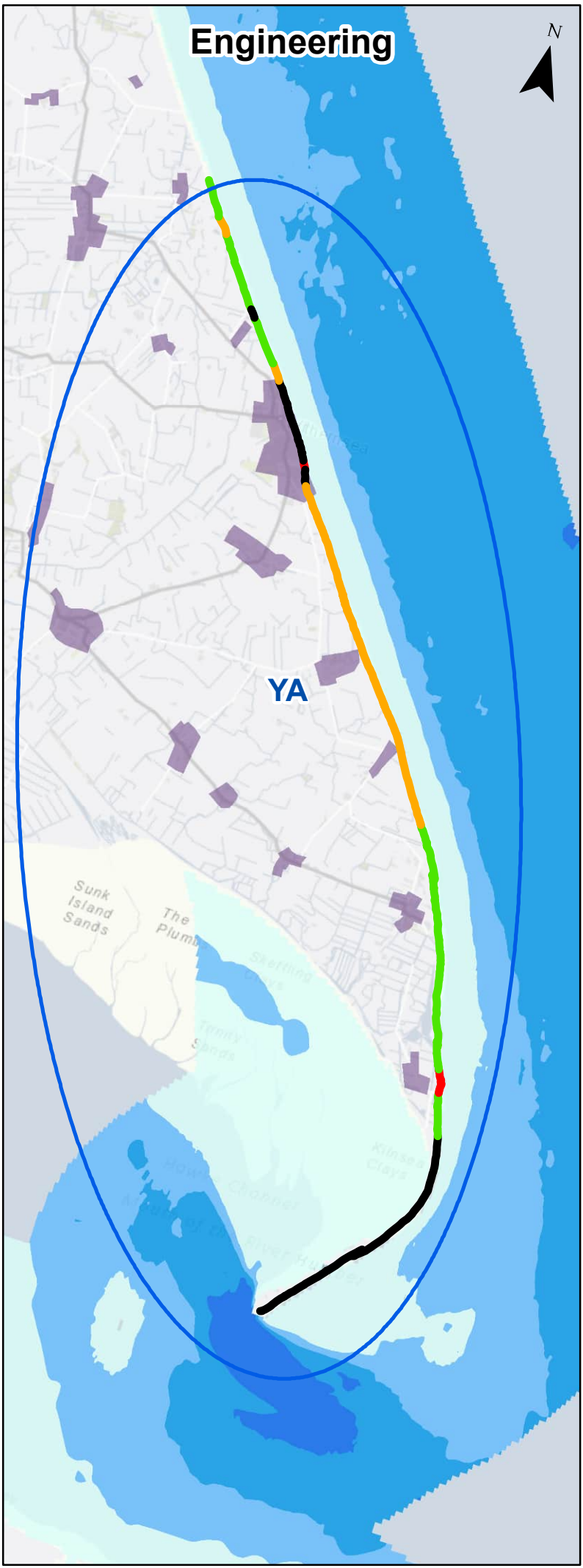
- 4.2.21 The results of the site visits were used to refine the BRAG analysis scoring where appropriate for those landfall options visited, and an updated matrix was then created, to aid in the identification of the preferred landfalls options.

Offshore and Onshore ECC

- 4.2.22 Note that the landfall appraisal also took account of the environment immediately landward and seaward of the coast to evaluate any constraints on the onwards routeing of cables from the identified landfall. For example, constraints such as the presence of wrecks or other obstructions, shipping activity or sites used for aggregate dredging or disposal in the nearshore were considered when assessing the suitability of a landfall for an offshore cable laying operation. Ultimately, the suitability of any given landfall also relies on the ability to bring an offshore cable route to the coast at that point, and the ability to route a cable route onshore towards the grid connection location.

Recommendations for Landfall Options

- 4.2.23 The combination of the BRAG matrix, site visits, feasibility of the cable routing to and from the landfall and expert opinion, led to a short-list of recommended landfall options being taken forwards for further appraisal and refinement, and subject again to the ongoing refinement of grid connection options emerging from the HND process (Figure 4.5).
- 4.2.24 The short-listed landfalls were further considered, and the outcomes of the evaluations are discussed in the rest of this report section.



Legend

- Landfall Sector
- Urban Region
- Marine Conservation Zone
- Scheduled Monuments
- National Nature Reserve
- Special Area of Conservation
- Sites of Special Scientific Interest
- Ancient Woodland Inventory
- Ramsar Site
- RSPB Reserves
- MoD Danger Area - Cowden
- Cable / Pipeline
- Buffer from Cable / Pipeline

Depth

- >15m
- 10 - 15m
- 5 - 10m
- 0 - 5m

BRAG Rating

- Green
- Amber
- Red
- Black



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0 2.5 5 km

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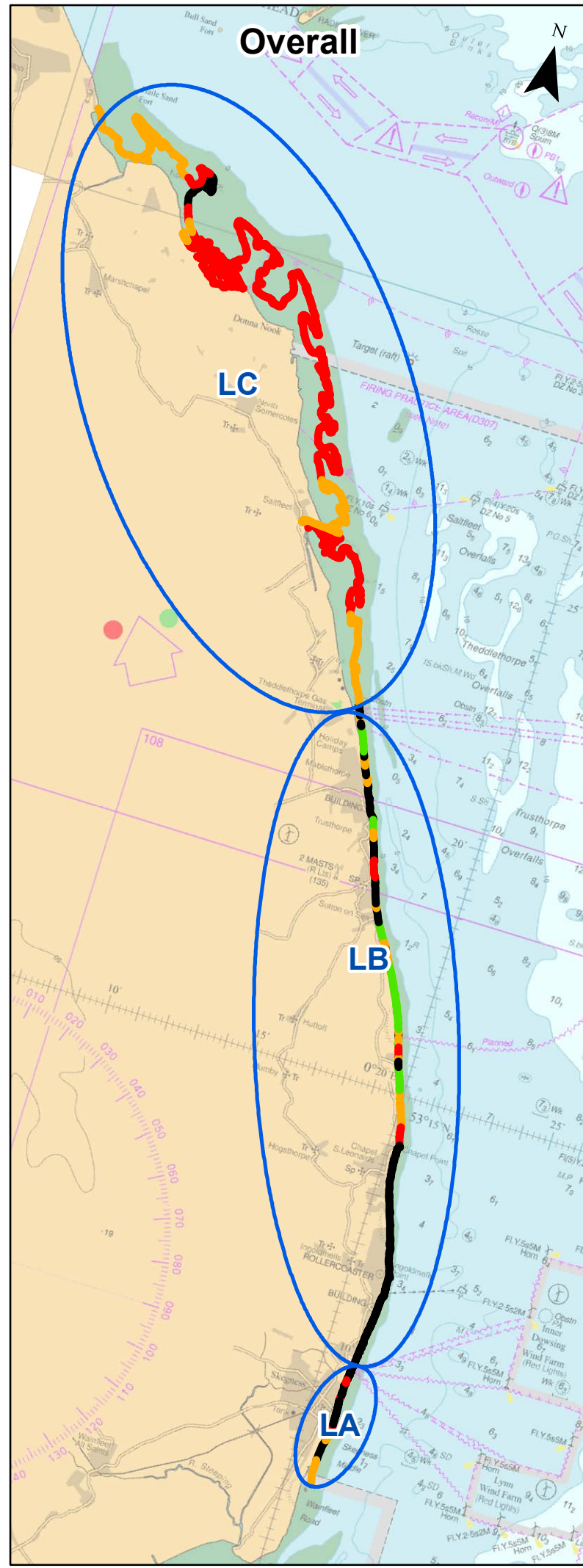
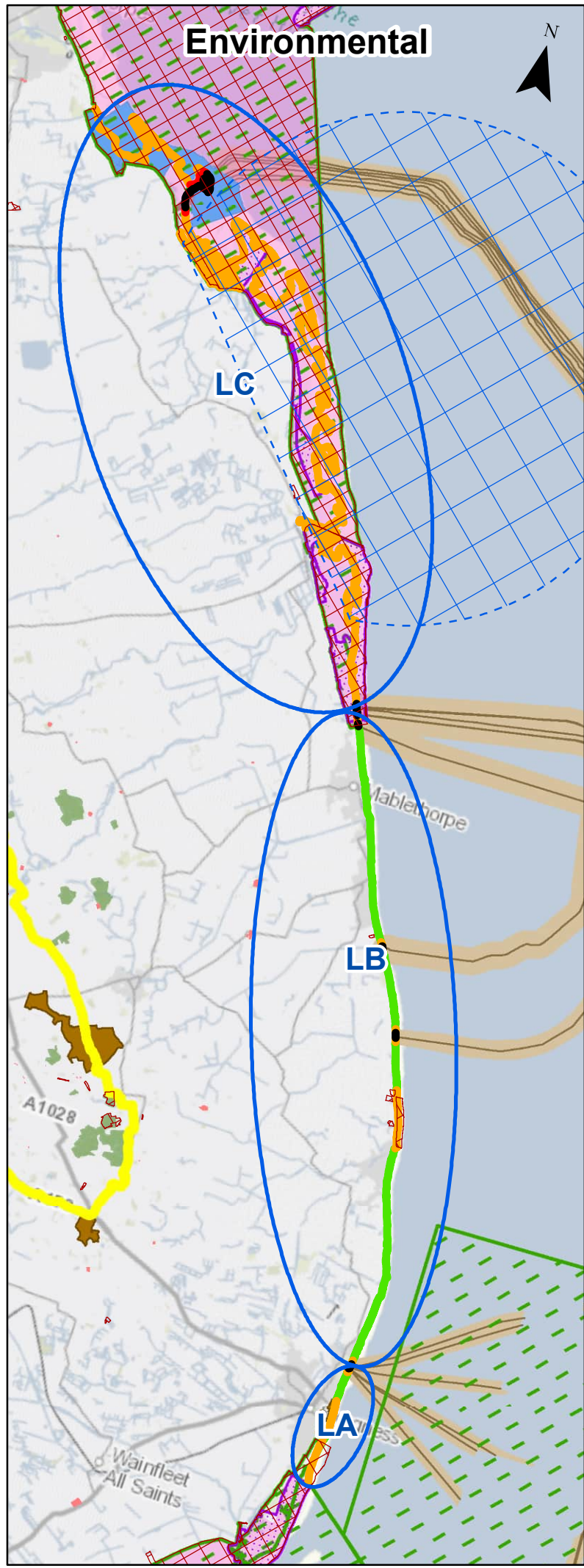
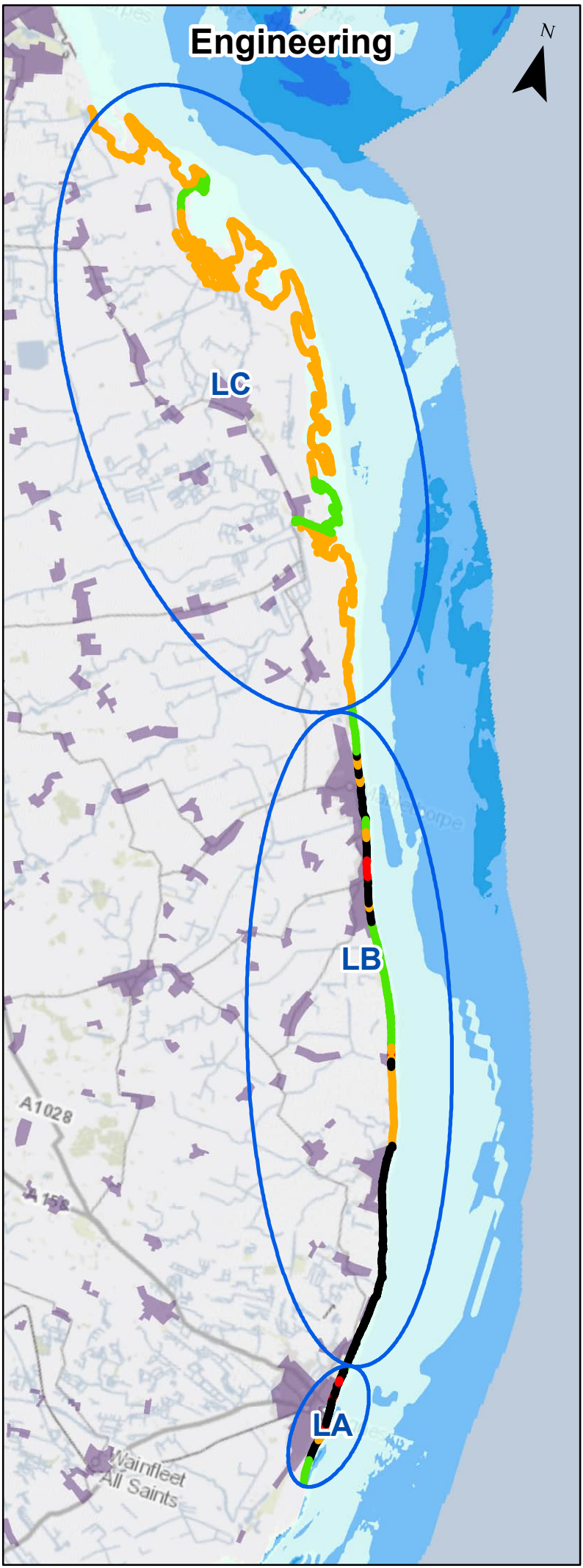
Preliminary Environmental Information Report

Final BRAG Analysis Output (Yorkshire)

Figure 4.3



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Legend

- Landfall Sector
- Urban Region
- Areas of Outstanding Natural Beauty
- Parks and Gardens
- Scheduled Monuments
- National Nature Reserve
- Special Area of Conservation
- Sites of Special Scientific Interest
- Ancient Woodland Inventory
- Ramsar Site
- RSPB Reserves
- MoD Airspace Danger Area - Donna Nook
- Cable / Pipeline
- Buffer from Cable / Pipeline

Depth

- >15m
- 10 - 15m
- 5 - 10m
- 0 - 5m

BRAG Rating

- Green
- Amber
- Red
- Black



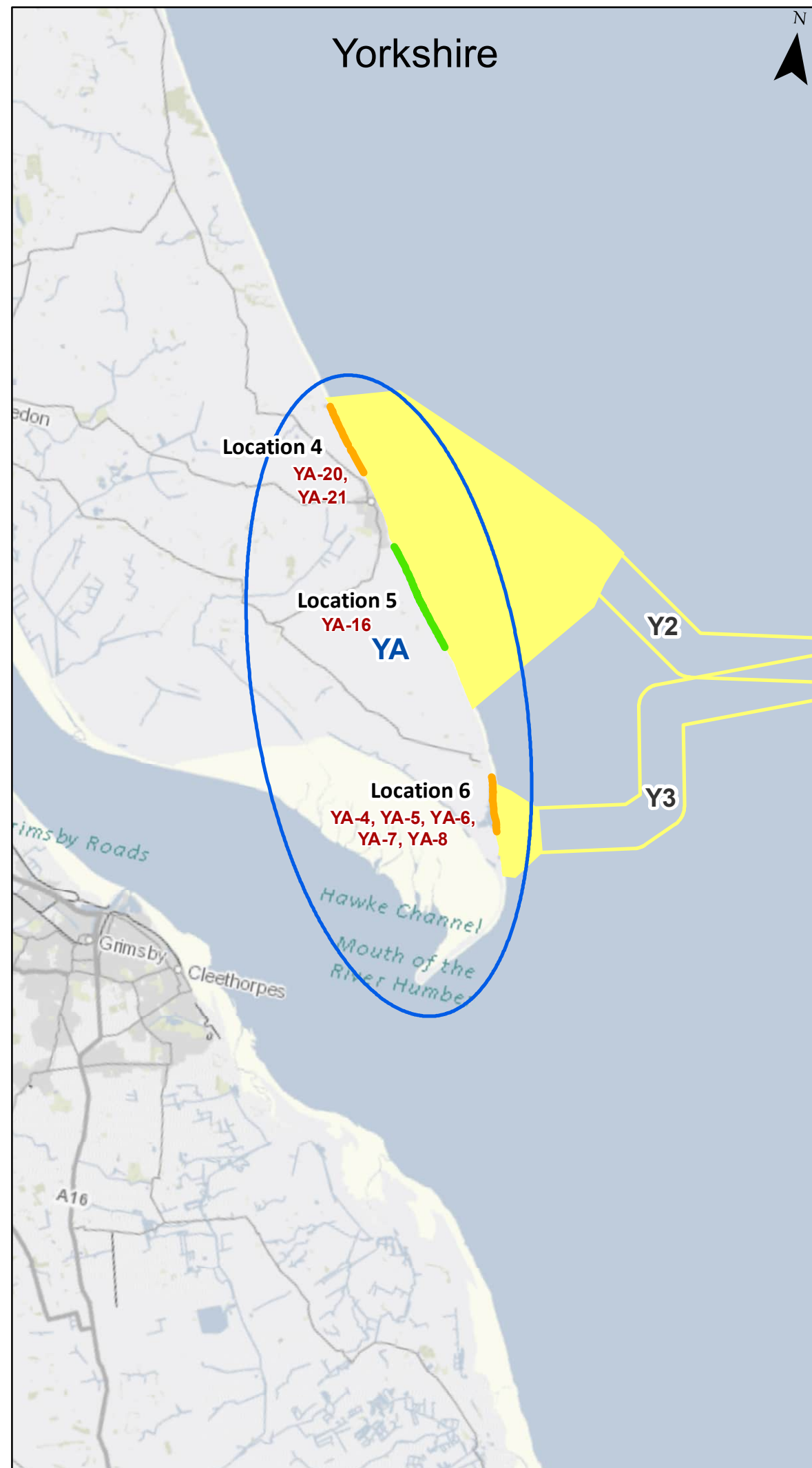
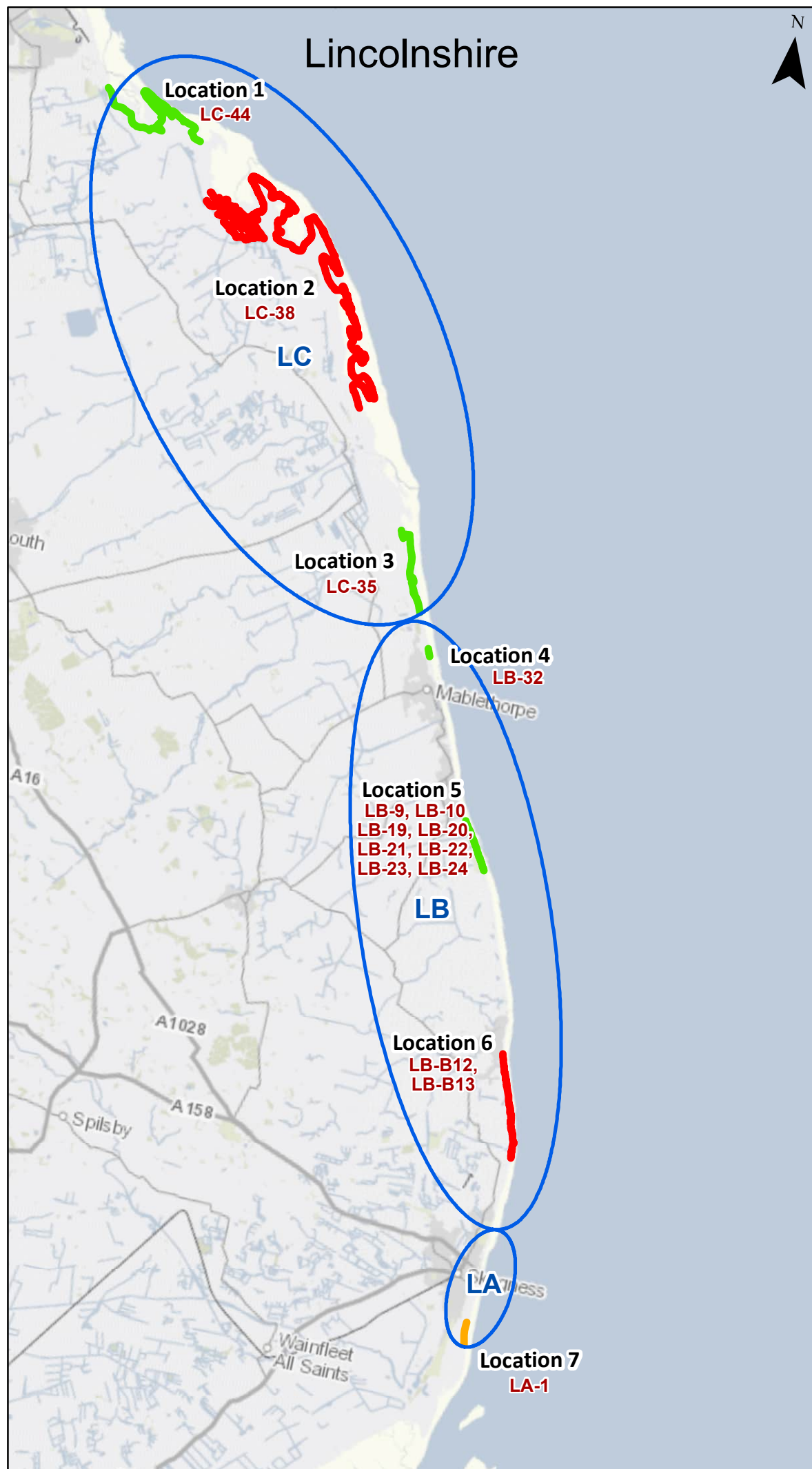
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Preliminary Environmental Information Report
 Final BRAG Analysis Output (Lincolnshire)

Figure 4.4



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Legend

- Landfall Sector
- Offshore Cable Route Options with Fans

Landfall Location Recommendation

- Yes
- Maybe
- No



Coordinate System: WGS 1984 UTM Zone 31N

0 5 10 km

Scale: 1:200,000

Preliminary Environmental Information Report

Landfall Locations in the Context of the
Landfall Assessment Regional Codes

Figure 4.5



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Yorkshire Landfall Evaluation

Location 1 – YA-21, YA-20

- 4.2.25 Section YA-21 in Yorkshire was initially classified as Amber, having a low score for engineering constraints, with the main environmental constraint being the presence of the Holderness Inshore Marine Conservation Zone (MCZ) in the immediately adjacent offshore area.
- 4.2.26 A site visit was undertaken to the south of section YA-20 (immediately south of YA-21, with the hamlet of Waxholme dividing the sections). Sections YA-20 and YA-21 were both visible from the vantage point, being a patch of recreational land adjacent to a carpark near Withernsea Sands holiday park.
- 4.2.27 Sections YA-20 and YA-21 both have high cliffs (estimated at 15m), with a short sandy beach at the base. Clear signs of erosion were present, with slumping visible. Inland of the landfall appears to comprise primarily arable fields. Existing access to the coastal area appeared to be limited.

Environmental Considerations

- 4.2.28 The sections are bounded by caravan parks to the north and south, with arable land adjacent to the coast throughout the sections. The hamlet of Waxholme is situated between the sections.
- 4.2.29 The landfall is positioned within the Greater Wash Special Protection Area (SPA) and the Holderness Inshore MCZ both of which incorporate up to mean high water springs (MHWS).
- 4.2.30 The coastline was characterised by a sandy beach bounded by cliffs, with no apparent specific ecological sensitivities at the landfall.
- 4.2.31 There would be a need for an extensive pipeline crossing relatively close inshore due to the presence of converging pipelines which make landfall at the Easington gas terminal.
- 4.2.32 This section also presents a number of onshore environmental constraints in the immediate landward area, mostly concentrated in the north where the inland area is dominated by flood zone and Network Enhancement Zone 1. Towards the south, fewer constraints are present, and there is potential to identify a route across the agricultural land in that area.

Engineering Considerations

- 4.2.33 The landfall features a cliff-like morphology with cliff's elevation of approximately 15m from the beach level. The area adjacent to the beach is a large field with sufficient clearance to accommodate the TJBs. There is the potential to undertake a Trenchless drilling construction method (subject to further engineering studies), while the potential feasibility for open cut trench is substantially reduced due to the elevation above the beach. The intertidal area appears to be relatively extended and shallow, featuring muddy sandy surface sediments. It is anticipated that the landfall morphology should not represent an issue for the cable landing. A flat-bottomed cable installation barge might be required to approach shallow areas of the intertidal region.

Location 2 – YA-16

- 4.2.34 Section YA-16 was initially classified as Amber, having a medium scoring for engineering constraints, with the main environmental constraint being the presence of the Holderness Inshore MCZ which extends up to MHWS.
- 4.2.35 A site visit was undertaken at an approximately central location of this section, accessed via a short footpath to the coast from the road, near Hollym.
- 4.2.36 The section is characterised by low cliffs (3 to 5m) with a short sandy beach at the base. The coast is backed by arable fields. Direct access to the coast is limited.

Environmental Considerations

- 4.2.37 The section is bounded by Withernsea to the north and Dilmington Cliff Site of Special Scientific Interest (SSSI) to the south.
- 4.2.38 The landfall is positioned within the Greater Wash SPA and the Holderness Inshore MCZ both of which extend up to MHWS.
- 4.2.39 The coastline was characterised by a sandy beach bounded by low cliffs, with no apparent specific ecological sensitivities at the landfall.
- 4.2.40 There would be a need for an extensive pipeline crossing relatively close inshore due to the presence of converging pipelines which make landfall at the Easington gas terminal.
- 4.2.41 The northern and southern extremes in the immediate landward area of this landfall are constrained by Network Enhancement Zone 1 and Fragmentation Action Zone, however there is opportunity to route a cable across the agricultural land in the centre of the appraisal area, north of Nevills Drain.

Engineering Considerations

- 4.2.42 The landfall features cliffs with low elevation facing a relatively extended intertidal region. The area adjacent to the beach is a large field with sufficient clearance to accommodate the TJBs. There is the potential to undertake both Trenchless drilling and open cut trench landfall construction method (subject to further engineering studies). Consideration of the rate of coastal erosion will be required at this location. Literature sources (East Riding of Yorkshire Council, 2021) suggest that the area is affected by a rate of cliff erosion of approximately 1.8m annually. This would require a detailed assessment of the location of the TJB, to ensure the structural stability of the concrete chambers is kept through the lifetime of the Project.
- 4.2.43 Nearshore and landfall seabed sediments appear to be muddy/sandy over relatively extended intertidal flats. The landfall morphology should not represent an issue for the cable landing. A flat-bottomed cable installation barge might be required to approach the shallow areas of the intertidal region. From a nearshore routing perspective, the landfall approaches are constrained by the Westernmost Rough OWF to the north and ten pipelines to the south making landfall at Easington. Should this landfall be selected, 16 third party assets in total will need to be crossed by the Project export cables.

Location 3 – YA-8, YA-7, YA-6, YA-5, YA-4

- 4.2.44 Sections YA-4 to YA-8 were initially classified Amber, having a low-medium scoring for engineering constraints, with the main consenting constraint the presence of the Holderness Inshore MCZ which extends to MHWS.
- 4.2.45 A site visit was undertaken within sections YA-7 and YA-8, with observation of the other sections from a vantage point.
- 4.2.46 Sections YA-7 and YA-8 are characterised by low cliffs with sandy beach at the base, with sections YA-4, YA-5 and YA-6 comprising a sloped sandy beach, with no cliffs. Access is possible to the north of section YA-8 via a metalled road.

Environmental Considerations

- 4.2.47 The section is bounded by the Humber Gateway OWF cable to the north and Kilnsea Wetlands to the south. Sections YA-4, YA-5 and YA-6 have lagoons adjacent to the beach and are situated within the Lagoons SSSI.

- 4.2.48 The Humber Gateway offshore windfarm export cable landfall constrains the available space within section YA-8 however, section YA-7 is backed by arable fields with lagoons only present within sections YA-6, YA-5 and YA-4.
- 4.2.49 The landfall is positioned within the Greater Wash SPA and the Holderness Inshore MCZ both of which extend up to MHWS.
- 4.2.50 There would be a need for an extensive pipeline crossing relatively close inshore due to the presence of converging pipelines which make landfall at the Easington gas terminal.
- 4.2.51 The whole of this stretch of coast is covered by various SPA, Ramsar and SSSI designations. Away from the coast the land is densely populated with agricultural drains which would require specialist techniques to cross.

Engineering Considerations

- 4.2.52 These potential landfall locations feature a generally low-lying sandy beach facing relatively extended muddy/sandy intertidal flats with no noticeable physical obstructions at landfall. Following the site walkover, there seems to be a sufficient area for TJB construction across the large fields adjacent to the beach with good access from public roads. Due to the favourable coastal morphology, there is the potential for trenchless drilling and open cut trenching landfall construction methods to be feasible.

Lincolnshire Landfall Evaluation

Location 1 – LC-44

- 4.2.53 Section LC-44 was initially classified Amber, having a medium scoring for engineering constraints, with the main environmental constraint being the presence of the Humber Estuary SAC, SPA and Ramsar.
- 4.2.54 A site visit was undertaken from the Horseshoe Point carpark walking north along the sea defence.
- 4.2.55 The sections are all characterised by an extensive sandy/muddy beach (up to 2km intertidal area), backed by saltmarsh and sand dunes and a man-made sea defence. There is good access to the rear of the sea defence via metalled roads.

Environmental Considerations

- 4.2.56 Section LC-44 is bounded to the north by the limits of the study area (Grimsby Unitary Council boundary) and the Hornsea OWF (One & Two) export cables to the south. The section has a small saltmarsh and sand dune present at the southern extent, with the saltmarsh not present and much more extensive sand dunes present at the north of the site. The section is situated within the Humber Estuary SAC which includes the saltmarsh and sand dune features amongst other features. It is also situated within the Humber Estuary SPA, which is an important area for overwintering birds.
- 4.2.57 The offshore cable routes approaching this landfall may need to pass through a number of designated sites in the immediate offshore environment including, potentially, the Holderness Offshore MCZ, the Greater Wash SPA and the Humber Estuary SAC, SPA and Ramsar. At the north of this sector, there may be constraints related to the Humber Approaches Traffic Separation Scheme (TSS) which controls traffic entering and leaving the Humber estuary as well as interactions with other sea users, including a need to avoid the offshore Tetney pipeline mooring point and designated anchorages in the approaches to the Humber. A military firing range is present just offshore of the more southerly sectors of this areas.
- 4.2.58 This landfall is also heavily constrained in the immediate landward area by a combination of SSSI, SAC and Ramsar designations, and the presence of the flood zone. There are no obvious routes away

from the coast that can avoid these designated areas.

- 4.2.59 Arable fields are present landward of the sea defence. Due to the nature of the sea defence and designated features, accessibility arrangements for access to the intertidal are considered challenging.

Engineering Considerations

- 4.2.60 This potential landfall location features a generally low-lying morphology facing an extended muddy/sandy intertidal flat constrained by the environmental designations and the presence of a military firing range which are classified as obstructions at landfall. Although there seems to be a sufficient area for TJB construction across the beach, the nature of the area utilisation, operations and environmental designation will inevitably constrain the construction works. There is the potential for trenchless drilling and open cut trenching landfall construction methods to be feasible, however this will most likely be more challenging compared with other potential landfalls. It is worth noting that trenchless drilling will most likely approach the limit in terms of borepath length due to the entry point having to be located back towards the fields.

Location 2 – LC-38

- 4.2.61 Section LC-38 was initially classified Red, having a high scoring for engineering constraints and with the main environmental constraint being the presence of the Humber Estuary SAC, SPA and Ramsar.
- 4.2.62 A site visit was made to the Donna Nook carpark. The site is characterised by extensive sand dunes, with saltmarsh seaward of the dunes, with a wide extensive intertidal area. Access is possible to the beach via existing tracks.

Environmental Considerations

- 4.2.63 Section LC-38 is bounded by the Hornsea cables to the north and the village of Saltfleet to the south. The section has extensive sand dunes and saltmarsh habitats visible at the coast. Section LC-38 also contains the Donna Nook seal colony.
- 4.2.64 Donna Nook is part of the training area for the Royal Air Force (RAF), designated as an MoD firing range, with targets used in training clearly visible within the section, directly offshore.
- 4.2.65 The section is situated within the Humber Estuary SAC and SPA, and would likely be subject to restrictions on works during sensitive periods for the features of these sites, including seals, due to the proximity of this section to haul out and breeding sites.
- 4.2.66 The offshore cable routes for this landfall would also likely be required to pass through a number of designated sites in the immediate offshore area, including those for seabed features. Specifically, the offshore cable routes may be required to pass through the Holderness Offshore MCZ, the Greater Wash SPA and the Humber Estuary SAC, SPA and Ramsar. Some cabling options for this sector may also pass through the Silver Pit, a deep-water channel due east of the Humber estuary which although not currently designated is known to be of conservation interest and also an area used extensively by the commercial fishing industry.
- 4.2.67 This landfall is heavily constrained in the immediate landward area by a combination of SSSI, SAC and Ramsar designations, and the presence of the flood zone. There are no obvious routes away from the coast that can avoid these designated areas.

Engineering Considerations

- 4.2.68 This potential landfall location features a generally low-lying morphology, with large fields facing very extended muddy/sandy intertidal flats in the nearshore, limiting installation methodologies. There is a sufficient area for TJB construction across the large agricultural fields adjacent to the

beach, with trenchless and open cut construction methods to be potentially feasible.

- 4.2.69 Approaching the landfall and across the beach there is evidence of wrecks showing portion of hull or superstructure. This feature might increase the degree of complexity for the cable pull in.

Location 3 – LC-35

- 4.2.70 Section LC-35 was initially classified Amber, having a medium scoring for engineering constraints, with the main environmental constraint being the presence of the Humber Estuary SAC, SPA and Ramsar.
- 4.2.71 A site visit was made to the beach from Crook Bank carpark. The site is characterised by extensive sand dunes at the rear of the beach, with extensive intertidal sandflats.

Environmental Considerations

- 4.2.72 The section is bounded by the Donna Nook MoD military danger area to the north and the Theddlethorpe pipelines to the south.
- 4.2.73 The section is situated within the Humber Estuary SAC and Saltfleet- Theddlethorpe Dunes and Gibraltar Point SAC which includes the sand dune feature amongst other designations. It is also situated within the Humber Estuary SPA.
- 4.2.74 The offshore cable routes for this landfall would be required to pass through a number of designated sites in the near offshore environment, including those for seabed features. Specifically, the cable routes may be required to pass through the Holderness Offshore MCZ, the Greater Wash SPA and the Humber Estuary SAC, SPA and Ramsar. Some cabling options for this sector also pass through the Silver Pit.
- 4.2.75 This landfall sector is also heavily constrained in the near landward area by a combination of SSSI, SAC and Ramsar designations, and the presence of the flood zone. There are no obvious routes away from the coast that can avoid these designated areas.

Engineering Considerations

- 4.2.76 This potential landfall location features a generally low-lying morphology, with large fields facing extended muddy/sandy intertidal flats. There is a sufficient area for TJB construction across the large agricultural fields adjacent to the beach, with trenchless drilling and open cut trenching landfall construction methods considered to be potentially feasible.
- 4.2.77 Approaching the southern portion of the landfall there is evidence of wrecks showing portion of hull or superstructure in proximity of the Theddlethorpe pipelines landing area. The presence of the Theddlethorpe pipelines and the wreck in the southern portion of the landfall will reduce the feasible cable landing area.

Location 4 – LB-32 and LB-33

- 4.2.78 Sections LB-32 and LB-33 were initially classified Green, having a low scoring for engineering and environmental constraints. A black area separates these sections due to existing beach access.
- 4.2.79 A site visit was made via the footpath adjacent to the Seal Sanctuary Wildlife Centre. The site is characterised by a high dune system and a medium width intertidal area.

Environmental Considerations

- 4.2.80 The sections are bounded by the Theddlethorpe pipelines to the north and Mablethorpe to the south. The Haven/Golden Sands Holiday Park is just inland of section LB-33, with possible recreational land landward of section LB-32.

- 4.2.81 The landfall sectors in this area are not situated within any designated sites, although there are extensive dune systems backing the beach with a reasonably high elevation.
- 4.2.82 The offshore export cable routes for this landfall would be required to pass through a number of designated sites in the near offshore environment, including those for seabed features. Specifically, the offshore export cable routes may be required to pass through the Inner Dowsing, Race Bank and North Ridge (IDRBNR) SAC and the Greater Wash SPA. Some cabling options for this sector also pass through the Silver Pit.
- 4.2.83 Potential offshore cable routes may also require relatively nearshore cable crossings due to the existing infrastructure within the area, including the Viking Link subsea interconnector cables and the Triton Knoll offshore windfarm export cables.
- 4.2.84 The immediate onshore area landward of the landfalls in this sector is identified as restorable habitat and Network Enhancement Zone 1, which could be crossed with suitable mitigation. Beyond this there is a potential onshore cable route, noting that this could not avoid existing large caravan parks.

Engineering Considerations

- 4.2.85 The landfall features an open low-lying beach backed by sand dune systems while the northern area features large intertidal flats. The southern portion of the landfall features a limited area to locate the TJB, therefore if this landfall is taken forwards the TJB will need to be located within a caravan park adjacent to the beach. From a nearshore vessel accessibility perspective, the presence of the out of service Theddlethorpe pipeline will restrict the cable landing corridor area.

Location 5 – LB-24 – LB-19

- 4.2.86 Sections LB-24 to LB-19 were initially classified Green, having a low scoring for engineering and environmental constraints. A black area separates these sections due to the presence of the landfall for the Viking Link subsea interconnector cables, with Amber areas adjacent to the Viking Link indicating the required buffer area.
- 4.2.87 Site visits were made to sections LB-24 to LB-19 from the carpark south of Sutton-on-Sea and accessed via the sea wall. The area is characterised by a man-made sea wall backing the beach with small, semi-stabilised sand dunes seaward of this.

Environmental Considerations

- 4.2.88 The sections are bounded by the urban area of Sutton-on-Sea to the north and the Triton Knoll offshore windfarm export cables to the south. Inland of the seawall from sections LB-24 to LB-19, publicly available mapping (Ordnance Survey) suggests that there is a golf course, but the site visit confirmed that this now appears to be disused (for an extensive period of time) and is now being used as a public access recreational area. Signs of possible use of this area as a landfill were noted, but this was not confirmed and would require further evaluation.
- 4.2.89 The area is not within any designated sites, although small sand dunes were present seaward of the sea wall and appeared to be stabilising.
- 4.2.90 The offshore export cable routes for this landfall would be required to pass through a number of designated sites in the near offshore environment, including those for seabed features. Specifically, the offshore export cable routes may be required to pass through the IDRBNR SAC and the Greater Wash SPA. Some cabling options for this sector also pass through the Silver Pit.
- 4.2.91 Potential routes may also require relatively nearshore cable crossings due to the existing infrastructure within the area, including the Viking Link subsea interconnector cables and the Triton Knoll offshore windfarm export cables.

- 4.2.92 Much of the study area landward of the landfall sector is dominated by flood zone and sand dunes, with the Sea Bank Clay Pits SSSI immediately inland from the coast. However, there is a possible export cable route away from the coast leading towards the southwest. This route would avoid the SSSI and the large concentration of potentially sensitive receptors identified further to the north.

Engineering Considerations

- 4.2.93 The landfall features an open and low-lying sandy beach backed by a concrete dyke. There is a large agricultural field located approximately 500m landward from the dyke adjacent to the location of the Viking Link subsea interconnector TJB. Given the presence of the Viking Link cables it can be concluded that this area has already proven to be feasible for trenchless drilling and therefore there is the likelihood that the same construction method could be undertaken without major issues.

Location 6 – LB-10 and LB-9

- 4.2.94 Sections LB-10 and LB-9 were initially classified as Amber, having a medium scoring for engineering constraints, with the main environmental constraints being the Sea Bank Clay Pits SSSI and the Chapel Point to Wolla Bank SSSI.
- 4.2.95 Site visits were made to sections LB-10 and LB-9 from the Wolla Bank carpark. The area is characterised by tall sand dunes backing the beach.

Environmental Considerations

- 4.2.96 This section of coast is bounded by Chapel St Leonards to the south and the residential and holiday properties at Anderby Creek to the north. The entire length of this section of beach is lined by tall sand dunes, which are protected by a programme of artificial beach nourishment/replenishment undertaken in the spring/summer for the past eight years. To the west of the dunes, much of the area is wetland, which is important bird habitat, before passing into intensely farmed agricultural land on the west side of Roman Bank/Anderby Road. It should be noted that through discussion with the beach replenishment contractors, the presence of a 600m long 800mm diameter pipe that is buried along the length of the beach in this location was made aware to the Project, which is used for the annual replenishment programme. This is a hazard that would need to be accounted for when considering the area as a landfall for export cable installation.
- 4.2.97 The offshore cable routes for this landfall would be required to pass through a number of designated sites in the near offshore environment, including those for seabed features. Specifically, the offshore export cable routes may be required to pass through the IDRBNR SAC and the Greater Wash SPA.
- 4.2.98 The landfall is situated adjacent to the wetlands south of Anderby Creek which are a designated local wildlife site, specifically Anderby Marsh Local Nature Reserve (LNR) and Wolla Bank LNR, whilst further south, the Sea Bank Clay Pits SSSI spans both sides of the main road. Any cable routes within this sector would need to be installed by Trenchless drilling from the west side of Roman Bank to avoid any direct impact on the LNR, SSSI and sand dune ecosystems.

Engineering Considerations

- 4.2.99 Wolla Bank landfall features an open and low-lying sandy beach stretching for approximately 2km length south of Anderby Creek. The landfall is backed by sand dune systems facing a relatively extended and flat agricultural land.
- 4.2.100 South of Anderby Creek across the Wolla Bank beach there is a distinctive seasonal shift in the foreshore width, the timing of this shift is affected by nourishment activities.
- 4.2.101 There is evidence of localised tidal ponds and groynes which appear to be covered by sand. The area behind the sand dune features a relatively extended sea bank with drains.

- 4.2.102 North of the landfall, in proximity to the boundary with Anderby Creek, there is an outfall pipe owned by the Environment Agency and marked with a permanent buoy.

Location 7 – LB-B13 and LB-B12

- 4.2.103 Sections LB-B13 and LB-B12 were originally classified as Black due to the extensive caravan parks situated landward of the coast and the associated constraints relating to available space for the TJB and onwards onshore routeing.
- 4.2.104 Site visits were made to sections LB-B12 and LB-B13 from the end of Trunch Lane by the Golden Anchor Holiday Park and a carpark by Lakeside Leisure. The landfall was characterised by a sandy beach backed by small sand dunes and a man-made sea wall.

Environmental Considerations

- 4.2.105 The sections are bounded by Chapel St Leonards to the north and the Butlins holiday resort to the south. The whole length of this section is backed by caravan parks landward of the concrete sea wall. At the north of LB-B12, there appeared to be a gap in the caravan parks, with only a small number of caravans between the coast and arable land. However, from site visit observations, it was noted that there appeared to be continued development of this area. Furthermore, there are ponds which are possibly linked to drainage adjacent to the sea wall.
- 4.2.106 The area is not within any designated sites, however small sand dunes were present seaward of the sea wall and appeared to be stabilising.
- 4.2.107 The offshore cable routes for this landfall would be required to pass through a number of designated sites in the near offshore environment, including those for seabed features. Specifically, the cable routes may be required to pass through the IDRBNR SAC and the Greater Wash SPA.

Engineering Considerations

- 4.2.108 The landfall features an open and low-lying sandy beach in proximity of a residential area. The landfall features a limited area to locate the TJB, therefore if this landfall is shortlisted, the TJB compound will need to be located within a caravan park adjacent to the beach. Only Trenchless drilling installation would be feasible at this location due to the highly developed nature of this area, its public use and the presence of caravan parks.

Location 8 – LA-1

- 4.2.109 Section LA-1 was originally classified as Amber, having a low scoring for engineering constraints, with the main environmental constraint being the presence of the Saltfleetby-Theddlethorpe Dunes and Gibraltar Point SAC and Gibraltar Point SSSI.
- 4.2.110 A site visit was made to the north of the section, via a footpath from Seacroft Esplanade. The landfall was characterised by relatively extensive intertidal area with a very large dune system.

Environmental Considerations

- 4.2.111 The section is bounded by Skegness to the north and the boundary of the Wash SPA. Immediately landward of the dune system is a residential road and large residential properties, behind which is the Seacroft Golf Club.
- 4.2.112 The section is situated within the Saltfleetby-Theddlethorpe Dunes and Gibraltar Point SAC and Gibraltar Point SSSI which is designated in part for the sand dune system.
- 4.2.113 The offshore cable routes for this landfall would be required to pass through a number of designated sites in the near offshore environment, including those for seabed features. Specifically, the cable routes may be required to pass through the IDRBNR SAC and the Greater Wash SPA.

4.2.114 This section is dominated by the presence of the Gibraltar Point area, designated as SSSI, SPA Ramsar and a National Nature Reserve (NNR). These areas are further constrained in the landward environment by Flood Zone 3 and the presence of a Source Protection Zone (SPZ) throughout as well as the presence of the coastal saltmarsh. There is no obvious route away from the coast at this location that can avoid these designated sites.

Engineering Considerations

4.2.115 The landfall features a relatively large and extended muddy intertidal region with sufficient access to the beach from the southern direction. There is a sufficient space to locate the TJB compound in the field behind Drummond Road, however, this will affect the Trenchless drilling pull in length, which may be beyond the design limit. Due to the coastal morphology and the presence of residential areas facing the landfall, it is unlikely that an open cut trench solution would be feasible. This would also result in a more complex onshore routing, due to the presence of the golf course and residential properties, which would increase the overall cost of installation.

Preferred Landfall Options

4.2.116 Following the BRAG analysis and site visits for the landfall appraisals, a number of landfall sectors were identified as preferred options for the various assumed grid connection options for the Project and therefore the focus for associated offshore and onshore cable routeing to the grid connection options being considered separately by the HND process, namely:

- Creyke Beck (Yorkshire – sector YA):
 - Landfall YA-16 was identified as the preferred landfall for a Yorkshire grid connection option, with this site identified as the least constrained from both an environmental and engineering perspective. This landfall does not overlap with any designated sites or notable sensitive habitats, and is considered to be feasible for multiple cable installation options; it is backed by open arable land, facilitating the onwards onshore routeing to the grid connection point.
- Killingholme or Grimsby (north Lincolnshire – sector LC):
 - Landfall LC-35 was identified as the least constrained landfall for a grid connection option in north Lincolnshire. This section was identified as having medium to high engineering constraints and medium to high environmental constraints, but, by comparison, was considered to be less constrained than other available options within the sector. However, due to the relatively high level of both environmental and engineering constraints identified, it was concluded that this landfall would only be considered further if a north Lincolnshire connection was confirmed by the HND process, as less constrained options clearly exist for grid connection points in other locations in Lincolnshire.
- Lincolnshire Node or Weston Marsh (Lincolnshire – sector LB):

- Aggregates and disposal sites;
- Navigational markers;
- Main shipping routes and IMO routing measures;
- Bathymetry (specifically where crossings may be required with existing assets);
- High-density fishing areas;
- Sensitive habitats; and
- Designated sites.

4.3.5 Following the identification of these constraints, potential cable corridors with a minimum width of 1.5km, and up to 2km where possible, were developed. Corridors were designed to minimise in so far as possible overlap with the identified constraints, whilst also observing the following engineering requirements to enable a technically feasible corridor:

- Observation of feasible bend radii;
- Appropriate seabed geology and sedimentology for cable laying;
- Minimum separation distances of 250m from existing cables and 50m from existing pipelines, where reasonably practicable; and
- Third-party assets to be crossed at right-angles, where reasonably practicable.

4.3.1 A number of iterations of the corridor development were carried out alongside a high-level analysis of the developed corridors, to ensure that all feasible routes were identified for the evaluation, and consequently a number of alternative routes were developed to each landfall fan area.

4.3.2 A significant constraint for the offshore ECC for the Project is the presence of Triton Knoll to the east, with this reducing the available exit points from the array area, alongside the high number of wrecks to the north of the Project array area.

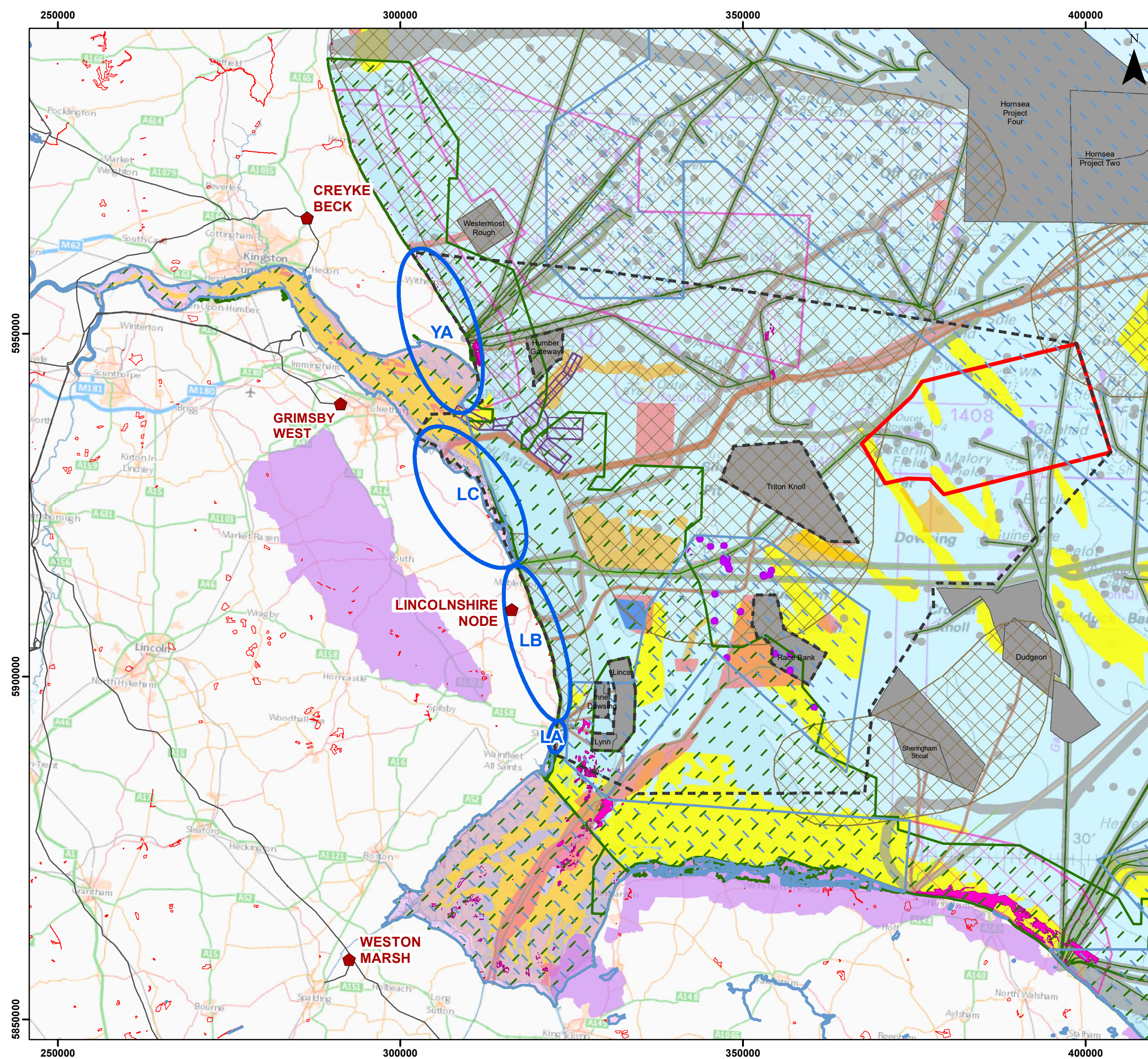
4.3.3 As part of the iterative process for corridor development, in the first round, the Inner Silver Pit was avoided due to the combination of the engineering challenges expected for cabling for that area, combined with known environmental features of that area of seabed plus the relatively high density shipping which takes place. However, in later rounds, a corridor through this bathymetric feature was designed to try and enable a connection to the more southerly landfalls which avoided all, or the majority of, the Inner Dowsing, Race Bank and North Ridge SAC. During the development of the L2 corridor options which passed through the Inner Silver Pit to the southerly landfalls, it was not possible to avoid all the features of the SAC. Whilst the corridor (L2b) did avoid the sandbank feature of the site, it was not possible to avoid the high density known areas of *Sabellaria spinulosa* reef to the south of Inner Silver Pit.

4.3.4 In addition, whilst in the first instance, part of the design criteria was to minimise the length of the cable corridor where possible to reduce overall impacts, at a later iteration, a longer offshore route (L6) (Figure 4.14) was designed to the LA landfall sector to avoid in so far as possible the Inner Dowsing, Race Bank and North Ridge SAC, which provided an alternative to corridor L5 to that sector which avoided the sandbank features of the SAC (noting the same unavoidable overlap with the *S. spinulosa* reef within the nearshore).

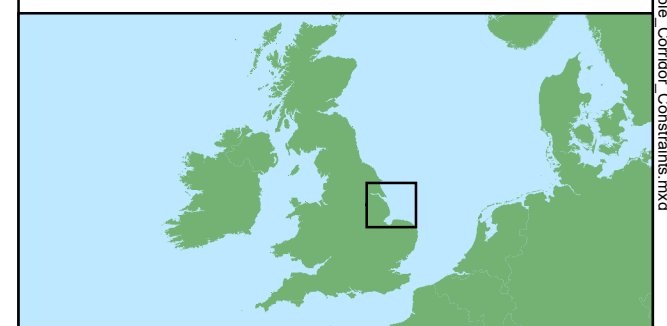
4.3.5 Overall, during the development of route options to the southerly landfall sectors, it was not possible (through any route option) to avoid all features of the SAC. For example, for those routes which were designed to avoid the sandbank features, it was not possible to avoid the known areas of high density *S. spinulosa* reef and vice versa.

Corridor Evaluation

- 4.3.6 Following the development of all the corridors through the iterative design process, each corridor was evaluated for engineering feasibility and technical and environmental risk. Due to the limited number of overall routes to each landfall sector, a quantitative analysis was not considered appropriate, as any scoring of preference would be out of a maximum of three routes (for the LB landfall sector), with others having less options. Furthermore, to the discrete nature of each landfall sector only being suitable for specific onshore grid interface options, a comparison between the corridors to each landfall sector was not considered appropriate.
- 4.3.7 The engineering evaluation considered the following elements for each corridor:
- Bathymetric limitations on cable installation (minimum and maximum water depths);
 - Slope angles and implications for cable installation tools;
 - Seabed features;
 - Cable burial (seabed sediments);
 - Risk of anchor strike/fishing gear interactions;
 - Cable crossings of existing infrastructure; and
 - Available sea-space for cable repairs/maintenance during the operational phase.
- 4.3.8 The environmental evaluation considered the following elements for each corridor:
- Presence of designated sites and likelihood of impacts to the features of those sites;
 - Non-designated sensitive habitats and species (e.g. fish spawning grounds);
 - Possible reductions in water depth (e.g. at cable crossings) and impacts to shipping receptors;
 - Fishing grounds; and
 - Presence of other infrastructure (other marine users).
- 4.3.9 A qualitative evaluation of the combined engineering and environmental risks and challenges for each cable corridor is presented below, with conclusions drawn as to the more viable route option for each landfall presented in paragraph 4.3.98 *et seq.*



- ### Legend
- Array Area
 - Onshore Substation
 - Offshore ECC Area of Search
 - Landfall Sector
 - Offshore Wind Farm
 - Offshore Subsea Cables/Infrastructure
 - Cable - Active
 - Cable - Not In Use
 - Pipeline - Active
 - Pipeline - Not In Use
 - Pipeline - Abandoned
 - Ships Routing Measures Areas
 - Aggregates - Production Agreement Area
 - Aggregates - Exploration and Option Area
 - Disposal Sites
 - Marine Conservation Zone
 - Sites of Special Scientific Interest
 - Ramsar Site
 - Areas of Outstanding Natural Beauty
 - Special Protection Areas
 - Special Areas of Conservation
 - Herring Spawning Grounds (1998)
 - Annex I Reef
 - Annex I additional areas managed as reef
 - Annex I Sandbank



Coordinate System: WGS 1984 UTM Zone 31N
 0 10 20 km
 Scale: 1:525,000

Preliminary Environmental Information Report
 Offshore Cable Corridor Constraints Mapping

Figure 4.6



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Identification of Offshore Export Cable Route Corridor Options for Appraisal

Yorkshire

- 4.3.10 Only a single offshore corridor (Y1) was identified to the Yorkshire (YA) landfall sector, with a number of deviations nearshore to accommodate each of the preferred landfall options within the sector (Figure 4.6). The routeing to the Yorkshire landfall sector was highly constrained by known wrecks and existing infrastructure, with the Holderness Inshore and offshore MCZs being unavoidable.
- 4.3.11 The analysis of the corridor and landfall deviation options, comprising consideration of the engineering feasibility and the environmental and consenting constraints, is presented in section 4.2.

Lincolnshire

- 4.3.12 Seven offshore export cable corridor options were identified to the preferred landfall options identified on the Lincolnshire coastline, split between the different landfall sectors (LA, LB and LC) (Figure 4.6). The routeing to the Lincolnshire landfall sectors was highly constrained in particular by a combination of the Inner Dowsing, Race Bank and North Ridge SAC, known wrecks, other marine users and the Inner Silver Pit bathymetric feature.
- 4.3.13 The analysis of the export cable corridor options, comprising consideration of the engineering feasibility and the environmental constraints, is presented in the following sections.

Yorkshire Route Evaluation

Yorkshire 1 (Y1)

- 4.3.14 Offshore export cable route option Y1 extends from the northern edge of the Project array area to the preferred landfalls in landfall sector YA (Figure 4.7). Route Y1 was designed to allow for a connection location at or in the vicinity of the Creyke Beck National Grid substation, one of the options being considered at that time by the HND. This offshore export cable route option as shown is approximately 95km in length and has a maximum water depth of approximately 50m.

Designated Sites

- 4.3.15 During the design of the Y1 route, it was not possible to avoid the Holderness Offshore MCZ when approaching the Yorkshire coastline, due to the presence of a number of hard constraints within the area, including existing subsea cables, pipelines, wrecks or other seabed obstructions and also the existing offshore windfarms in the area.
- 4.3.16 This MCZ is a known spawning and nursery ground for several fish species, including lemon sole (*Microstomus kitt*), plaice (*Pleuronectes platessa*), and European sprat (*Sprattus sprattus*). Ocean quahog (*Arctica islandica*), a slow maturing bivalve mollusc has also been recorded within the Holderness Offshore MCZ. Ocean quahog are listed as a threatened / declining species under the Oslo and Paris Convention of the Northeast Atlantic (OSPAR). The protected habitats within this MCZ include subtidal mixed sediments, subtidal coarse sediments, and subtidal sand (all protected to recover to favourable condition), as well as North Sea glacial tunnel valleys (to maintain favourable conditions).
- 4.3.17 The Y1 route option also passes through the northern part of the Greater Wash SPA for all landfall connection options with landfall sector YA. The Greater Wash SPA is designated for the protection of the red-throated diver (*Gavia stellata*), common scoter (*Melanitta nigra*), and little gull (*Hydrocoloeus minutus*) during the non-breeding season. The sandwich tern (*Sterna sandvicensis*), common tern (*Sterna hirundo*) and little tern (*Sternula albifrons*) are also protected during the breeding season. A key concern for red-throated diver and common scoter in particular would be

displacement and disturbance to the birds whilst rafting on the sea surface during offshore export cable installation.

- 4.3.18 Export cable route corridor option Y1 also passes through part of the Southern North Sea SAC. This SAC is designated for the protection of harbour porpoise (*Phocoena phocoena*).

Non-Designated Sensitive Habitats

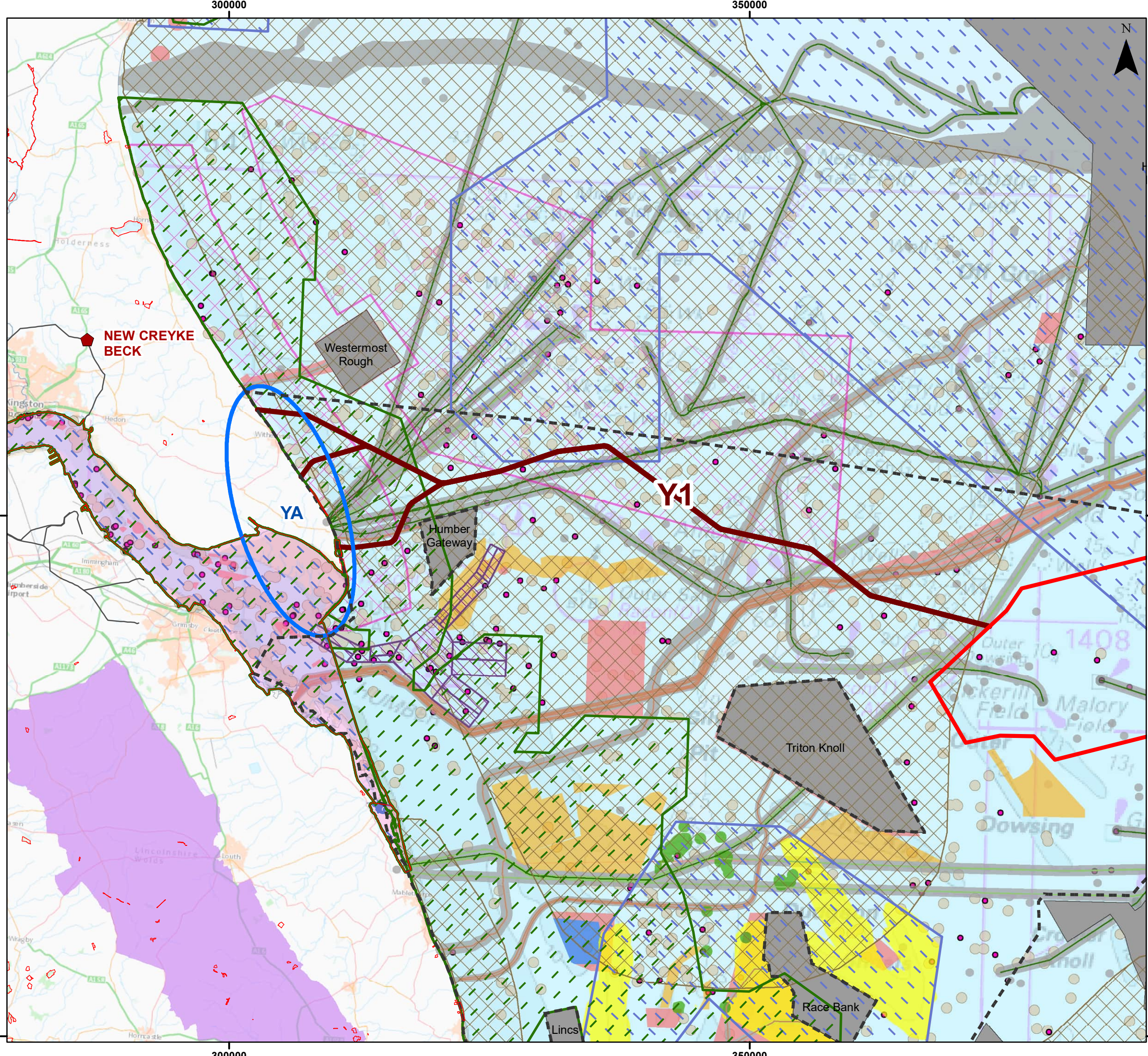
- 4.3.19 Export cable route option Y1 passes entirely through a known herring (*Clupea harengus*) spawning ground, known as the Banks herring ground. A key concern for herring would be any percussive piling during construction of offshore reactive compensation platform(s) (ORCP) if this were required within the export cable route corridor, in addition to potential effects from suspended sediments generated by cable installation works.

Other Marine Users

- 4.3.20 Export cable route Y1 (and associated landfall diversions) requires a high number of subsea cable or pipeline crossings, with some of the nearshore crossings involving the export cables crossing multiple existing assets in relatively shallow water. The extent of these crossings and the shallow water within which they will take place may result in potentially significant navigational hazards arising.
- 4.3.21 All export cable route options which exit from the northern boundary of the Project array area cross an area of locally high intensity fishing activity, to the north of the Triton Knoll offshore windfarm (associated with the northern part of the Inner Silver Pit feature). The Yorkshire nearshore area is also recognised as being of high importance for commercial shellfisheries (targeting crab and lobster), with numerous spawning grounds for shellfish species also thought to be present.
- 4.3.22 Export cable route Y1 crosses the closed Disposal Site that was sed for the Hornsea Project Two export cable . Considering that, when crossing this site, the route will also have to cross the Hornsea Project One and Two export cables, the disposal site is not likely to have any impact as this section of the route is already expected to need special consideration and is not likely to be buried.
- 4.3.23 The only minor item that affects the deviation to the most southerly landfall is that the route is expected to lie within approximately 1.5km of the Humber Gateway offshore windfarm. It may mean that there is slightly more marine traffic near the cable route due to windfarm-related activity.

Cable Installation and Technical Risks

- 4.3.24 Whilst most wrecks and seabed obstructions can be avoided so that they lie outside of the export cable route corridor buffer zone, in some of the most congested zones, the wrecks and obstructions do lie near the boundaries of the cable corridor buffer. However, the minimum distance between the route and the wrecks is around 850m, which is a substantial distance and therefore it is concluded that known wrecks would not be too much of a concern.
- 4.3.25 Export cable route Y1 has to cross a number of third-party cable and pipelines nearshore and are concentrated over a relatively short distance.
- 4.3.26 In terms of cable installation and burial, no high level risks are highlighted: maximum water depth is not expected to pose an issue for installation, the seabed sediment is likely to allow for simultaneous lay and burial, and the metocean and bathymetry of the route are not likely to restrict cable installation vessel selection.

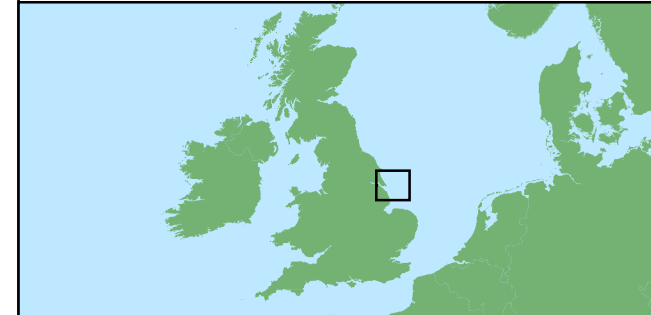


Legend

- Array Area
- ◆ Onshore Substation
- Offshore ECC Area of Search
- Offshore Cable Route Options
- Landfall Sector
- Offshore Wind Farm
- Cable - Active
- Cable - Not In Use
- Pipeline - Active
- Pipeline - Not In Use
- Pipeline - Abandoned
- Ships Routing Measures Areas
- Subsea Obstruction
- Wreck with 500m Buffer
- Aggregates - Production Agreement Area
- Aggregates - Exploration and Option Area
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- Sites of Special Scientific Interest
- Ramsar Site
- Areas of Outstanding Natural Beauty
- Herring Spawning Grounds (1998)
- Special Protection Areas
- Special Area of Conservation

SAC Components

- Annex I Sandbank
- Annex I Reef



Coordinate System: WGS 1984 UTM Zone 31N

0 10 20 km

Scale: 1:350,000

Preliminary Environmental Information Report

Proposed Export Cable Corridor Option Y1
Connecting to Landfall Sector YA

Figure 4.7



OUTER DOWSING
OFFSHORE WIND



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Lincolnshire Route Analysis

Lincolnshire 1 (L1)

4.3.27 Offshore export cable route option L1 extends from the northern boundary of the Project array area, with three connection points identified to landfall in sector LC (Figure 4.8). This offshore export cable route corridor option was developed to allow onwards routing to a grid connection point at or in the vicinity of the Grimsby West National Grid substation (which at the time of evaluation was still being evaluated by the HND). This offshore export cable route corridor option is up to 72km in length and has a maximum water depth of 70m.

Designated Sites

- 4.3.28 Offshore export cable route option L1 and the various landfall diversions avoid any offshore designated sites; however the route and all of the landfall diversions make landfall within numerous intertidal-coastal designated sites. The two northern landfall options fall within the Humber Estuary SAC, SPA, Ramsar and SSSI, whilst the more southerly landfall diversions lie within the Saltfleetby-Theddlethorpe and Gibraltar Point SAC. The most northerly landfall option would require a crossing of extensive saltmarsh and sand dune features.
- 4.3.29 All the L1 landfall options also fall within the Humber Estuary SPA and would also require the offshore export cables to cross the Greater Wash SPA. Neither site can be avoided should this route option be taken forwards.

Non-Designated Sensitive Habitats

4.3.30 Export cable route option L1 passes through the Banks herring ground. Whilst there is overlap with the historical spawning ground, recent data from International Herring Larval Survey (IHLS) suggests that active spawning grounds are situated to the east and north of Flamborough Head. Nonetheless, any percussive piling from an ORCP within the export cable route corridor, may lead to concerns over impacts on spawning herring.

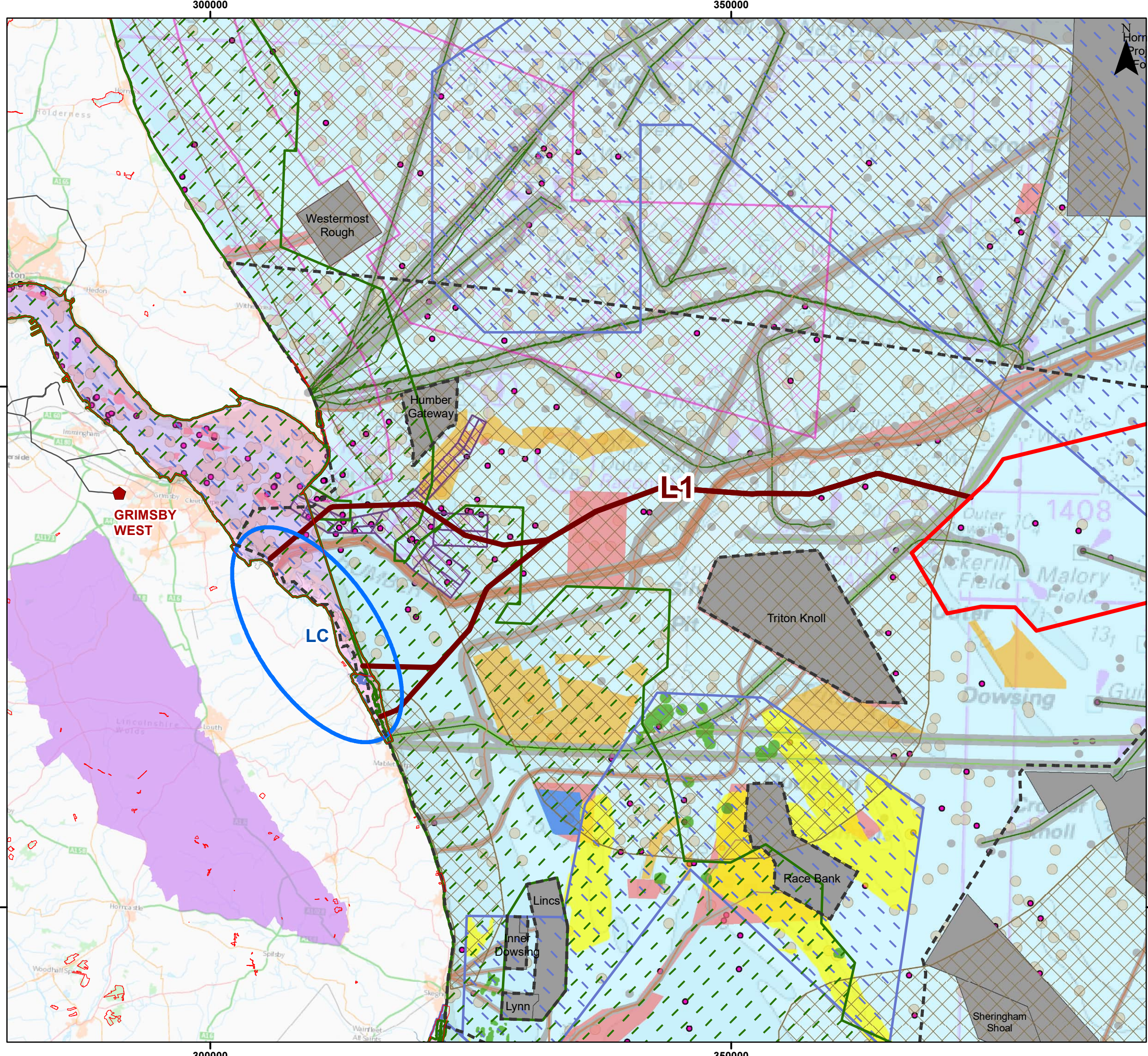
Other Marine Users

- 4.3.31 The southern landfall options for export cable route option L1 overlap in the nearshore area with the Donna Nook MoD Danger Area, with the central landfall option falling fully within this Danger Area.
- 4.3.32 The offshore part of the L1 export cable route option also passes through the closed Spurn Head disposal ground. Whilst being closed reduces some of the concerns around this site, issues may still arise due to the heterogenous nature of the seabed and the unknown sediment/debris content within and adjacent to the disposal site. Pre-lay grapnel runs (PLGR) will be required to clear out any potential hindrances; and additional protection may also need to be deployed where burial is not possible (mattress, rock dump, etc.).
- 4.3.33 This offshore export cable route corridor would also likely experience a relatively high level of marine traffic as it is adjacent to the Humber estuary TSS and an anchorage area is also within 5km of the route. The northern most landfall export cable route for L1 would pass through the centre of the main TSS for the Humber Estuary.

Cable Installation and Technical Risks

- 4.3.34 Whilst the number of cable crossings required for export cable route option L1 are relatively low, the southern landfall options require multiple crossings of the Hornsea Project One and Two export cables and crossings of the Viking Link subsea interconnector cables, including in potentially shallow waters.
- 4.3.35 Vessel selection may also need to be appropriately considered due to the shallow water depths

identified in some of the nearshore areas. The most northerly landfall approach is deemed to be extremely challenging due to the presence of the TSS posing a very high risk to cable integrity throughout the lifetime of the Project, in addition to the high number of wrecks present and the very shallow bathymetry.

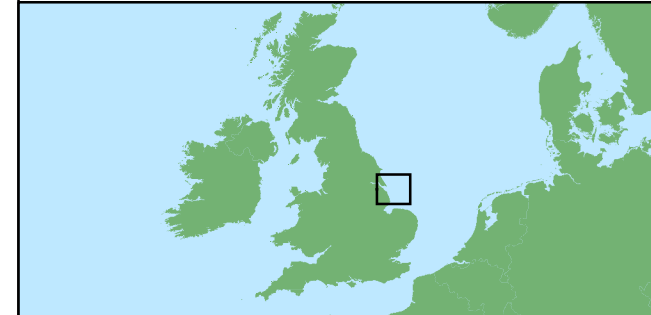


Legend

- Array Area
- ◆ Onshore Substation
- Offshore ECC Area of Search
- Offshore Cable Route Options
- Landfall Sector
- Offshore Wind Farm
- Offshore Subsea Cables/Infrastructure
- Cable - Active
- Pipeline - Active
- Pipeline - Not In Use
- Pipeline - Abandoned
- Ships Routing Measures Areas
- Subsea Obstruction
- Wreck with 500m Buffer
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- Ramsar Site
- Areas of Outstanding Natural Beauty
- Herring Spawning Grounds (1998)
- Special Protection Areas
- Special Area of Conservation

SAC Components

- Annex I Sandbank
- Annex I Reef



Coordinate System: WGS 1984 UTM Zone 31N

0 10 20 km

Scale: 1:350,000

Preliminary Environmental Information Report

Proposed Export Cable Corridor Option L1
Connecting to Landfall Sector LC

Figure 4.8



OUTER DOWING
OFFSHORE WIND



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Lincolnshire 2a (L2a)

- 4.3.36 The L2a offshore export cable route corridor option avoids all designated sites offshore, but both of the landfall options fall within a number of designated sites. This export cable route was designed to reach landfalls which would be appropriate for onwards routing to a grid connection location at or in the vicinity of the Grimsby West substation (which at the time of evaluation was still being evaluated by the HND) (Figure 4.9). This offshore export cable route corridor is up to 66.4km in length, with a maximum depth of 93.7m.

Designated Sites

- 4.3.37 Export cable route option L2a and the landfall diversions avoid any offshore designated sites. However, the two landfall deviations overlap with numerous designated sites. The more northern landfall option falls within the Humber Estuary SAC, SPA, Ramsar and SSSI, with the southern landfall option falling within the Saltfleetby-Theddlethorpe and Gibraltar Point SAC. Both these landfall locations have extensive dune systems present.
- 4.3.38 Both the L2a landfall options fall within the Humber Estuary SPA and also cross the Greater Wash SPA. Neither site can be avoided for this landfall sector should this route option be taken forwards.

Non-Designated Sensitive Habitats

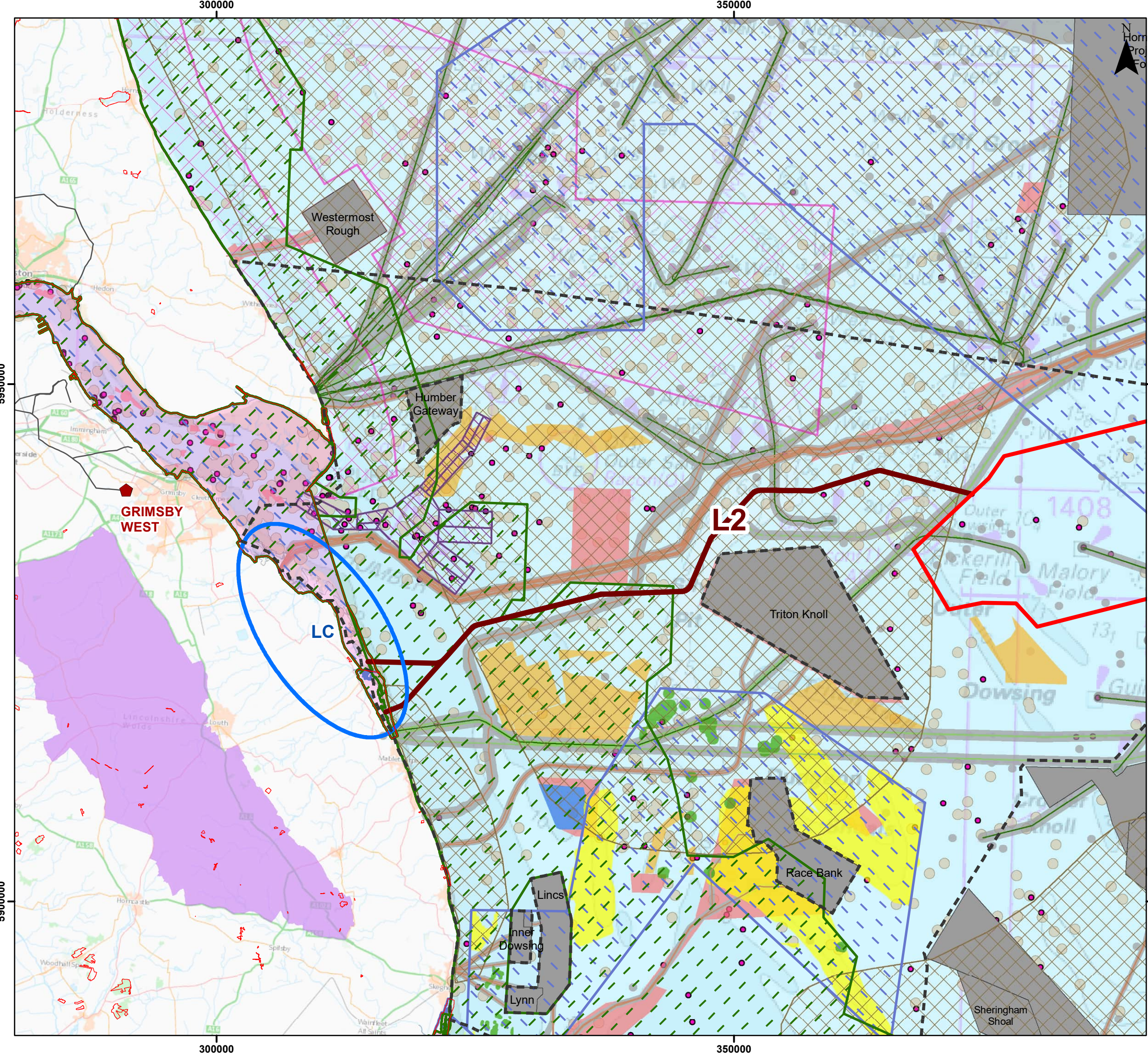
- 4.3.39 The L2a export cable route options also pass through and cross the Inner Silver Pit. This is a glacial tunnel valley, which, although not currently designated, is known to contain a number of sensitive habitats and species, including Sabellaria spinulosa (*S. spinulosa*) and Mytilus edulis biogenic reefs and the Atlantic Quahog. It is also known to be heavily used by the commercial fishing industry.
- 4.3.40 Export cable route L2a route option also passes through the Banks herring ground. Whilst there is overlap with the historical spawning ground, recent data from IHLS suggests that active spawning grounds are situated to the east and north of Flamborough Head. Nonetheless, any percussive piling from an ORCP within the export cable route corridor, may lead to concerns over impacts on spawning herring.

Other Marine Users

- 4.3.41 The landfall options for offshore export cable route corridor option L2a overlap in the nearshore area with the Donna Nook MoD Danger Area, with the central landfall option falling fully within this Danger Area. This will require significant discussions with the MoD to agree safe routing, if deemed possible, and to manage operations between organisations to avoid conflicts. The feasibility of this has not been evaluated in detail and no discussions were held with the MoD at the route evaluation stage.

Cable Installation and Technical Risks

- 4.3.42 The offshore export cable route corridor traverses through Inner Silver Pit, a long subsea trench with a water depth of up to 95m. Whilst the water depth does not pose a risk to installation, the route needs to enter and exit Inner Silver Pit by overcoming some sizeable slopes. The bathymetry and slope indicate that the slope is expected to be up to 15 degrees (and potentially more). This was considered to make installation and burial of the cable extremely difficult.
- 4.3.43 To provide further data on the potential exit of the route from the Inner Silver Pit, a discrete number of geophysical survey lines were run over the western slope of the feature. This confirmed a number of additional installation challenges, including possible localised slope failures, sections with low sediment thickness, and bedrock exposures, as well as confirming the presence of bottom trawling activity. Overall, it was considered that cable installation in this area would be unfeasible due to the challenges provided by the slope angle and instability.

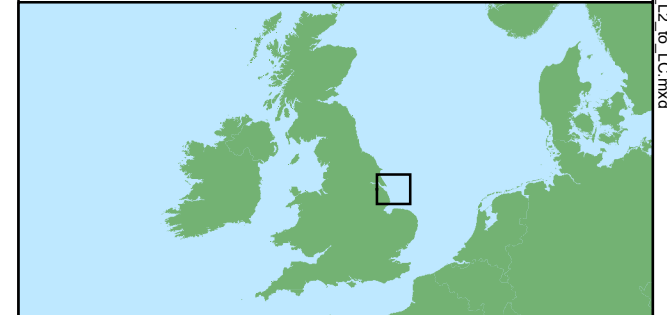


Legend

- Array Area
- ◆ Onshore Substation
- Offshore ECC Area of Search
- Offshore Cable Route Options
- Landfall Sector
- Offshore Wind Farm
- Cable - Active
- Cable - Not In Use
- Pipeline - Active
- Pipeline - Not In Use
- Pipeline - Abandoned
- Ships Routing Measures Areas
- Subsea Obstruction
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- Aggregates - Exploration and Option Area
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- Ramsar Site
- Areas of Outstanding Natural Beauty
- Herring Spawning Grounds (1998)
- Special Protection Areas
- Special Area of Conservation

SAC Components

- Annex I Sandbank
- Annex I Reef



Coordinate System: WGS 1984 UTM Zone 31N

0 10 20 km

Scale: 1:350,000

Preliminary Environmental Information Report

Proposed Export Cable Corridor Option L2
Connecting to Landfall Sector LC

Figure 4.9



OUTER DOWSING
OFFSHORE WIND



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Lincolnshire 2b (L2b)

- 4.3.44 The L2b export cable route option was designed to reach landfalls which could be appropriate for onwards routing to a grid connection location at or in the vicinity of either Lincolnshire Node or Weston Marsh (Figure 4.10). This offshore export cable route corridor is up to 75km in length with a maximum water depth of 95m.

Designated Sites

- 4.3.45 Offshore export cable route option L2b partially overlaps with the IDRBNR SAC where the route exits the Inner Silver Pit. Due to the engineering challenges associated with routing through the Silver Pit together with the presence of other hard constraints, it is not possible to entirely avoid the IDRBNR SAC. The northern section of the IDRBNR SAC south of the Silver Pit is known to contain areas of *S. spinulosa* reef, with specific sections of the SAC in this area identified as key locations for this feature.
- 4.3.46 The L2b landfall option also crosses the Greater Wash SPA, which cannot be avoided should this route option be taken forwards.

Non-Designated Sensitive Habitats

- 4.3.47 The L2b offshore export cable route options pass through the full length of the Inner Silver Pit. This is a glacial tunnel valley, which is known to contain a number of sensitive habitats and species, including *S. spinulosa* and *Mytilus edulis* biogenic reefs and the Atlantic Quahog.
- 4.3.48 Offshore export cable route L2b option passes through the Banks herring ground. Whilst there is overlap with the historical spawning ground, recent data from IHLS suggests that active spawning grounds are situated to the east and north of Flamborough Head. Nonetheless, any percussive piling from an ORCP within the export cable route corridor, may lead to concerns over impacts on spawning herring.

Other Marine Users

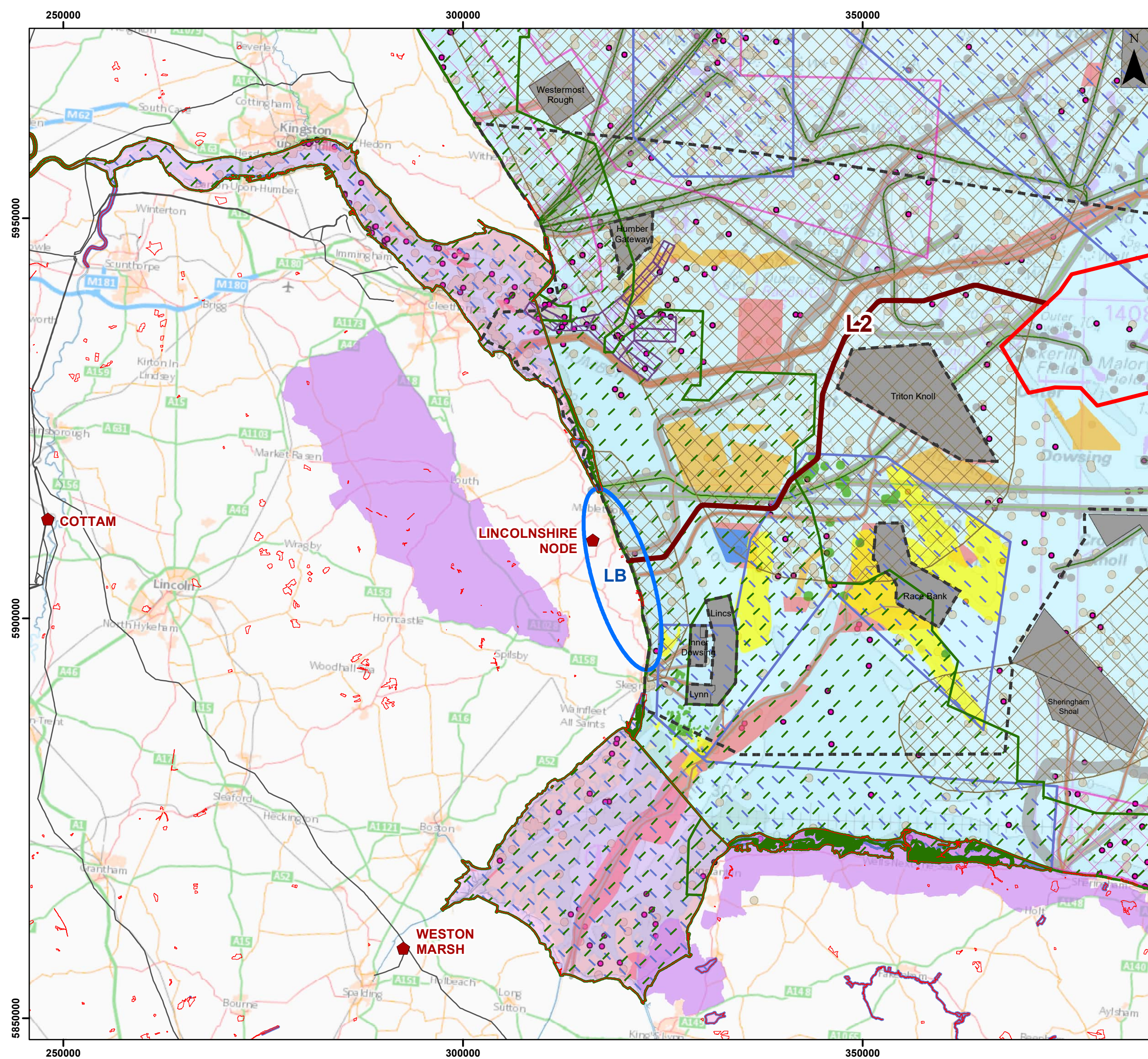
- 4.3.49 The Inner Silver Pit is known to be subject to a relatively high intensity of commercial fishing activity, predominantly using towed gear. Additionally, part of offshore export cable route L2b runs between the existing Triton Knoll offshore windfarm export cables and a disused subsea pipeline, with the gap between the assets being only 1.8km in places. In addition to several wrecks in this sector, the offshore export cable route corridor buffer zone becomes quite limited at the site which may restrict repair option for all three assets (the Project cables, the Triton Knoll cables and the pipeline).

Cable Installation and Technical Risks

- 4.3.50 The offshore export cable route corridor runs through the Silver Pit, a long subsea trench with a water depth of up to 95m. Whilst the water depth does not pose a risk to installation, the route needs to enter and exit Silver Pit by overcoming some sizeable slopes. The water depth and slope indicate that the slope is expected to be up to 15 degrees (and potentially more). This was considered to make installation and burial of the cable extremely difficult.
- 4.3.51 A discrete number of geophysical survey lines were run over the western slope of the Silver Pit feature to further inform route appraisal. This confirmed a number of additional installation challenges, including possible localised slope failures, sections with low sediment thickness, bedrock exposures and widespread practice of bottom trawling.
- 4.3.52 There may also be difficulties apposed for any future cable repair operation (i.e. Omega Bight Laydown) at Inner Silver Pit. Whilst there should be sufficient seabed space, the laydown operation may be very limited as the bight/quadrant approaches the slopes of Inner Silver Pit.
- 4.3.53 The tidal currents are fast enough to flush out fine-grained sediment in the southern section of Silver

Pit. This could also lead to a risk of high rates of cable exposure.

- 4.3.54 Overall, it was considered that cable installation in this area would be unfeasible due to the challenges provided by the slope angle and instability.

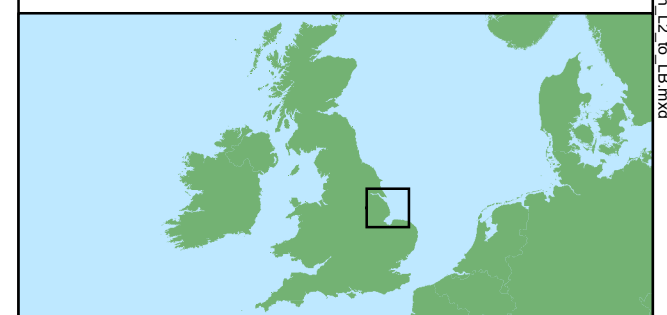


Legend

- Array Area
- ◆ Onshore Substation
- Offshore ECC Area of Search
- Offshore Cable Route Options
- Landfall Sector
- Offshore Wind Farm
- Cable - Active
- Cable - Not In Use
- Pipeline - Active
- Pipeline - Not In Use
- Pipeline - Abandoned
- Ships Routing Measures Areas
- Subsea Obstruction
- Wreck with 500m Buffer
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- Sites of Special Scientific Interest
- Ramsar Site
- Areas of Outstanding Natural Beauty
- Herring Spawning Grounds (1998)
- Special Protection Areas
- Special Area of Conservation

SAC Components

- Annex I Sandbank
- Annex I Reef



Coordinate System: WGS 1984 UTM Zone 31N
 0 10 20 km
 Scale: 1:450,000

Preliminary Environmental Information Report
 Proposed Export Cable Corridor Option L2
 Connecting to Landfall Sector LB

Figure 4.10



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Lincolnshire 3 (L3)

- 4.3.55 This offshore export cable route corridor was designed to reach landfalls which would be appropriate for an onward routeing to a grid connection location at or in the vicinity of either the Lincolnshire Node or Weston Marsh (Figure 4.10). This offshore export cable route option is up to approximately 80km and has a maximum water depth of approximately 35m.

Designated Sites

- 4.3.56 Offshore export cable route option L3 passes through the IDRBNR SAC. In defining the proposed route corridor, any known areas of Sabellaria reef were mapped and avoided; however, it was not possible to fully avoid the sandbank features of the site, with part of the North Ridge sandbank at the eastern extent of the SAC being unavoidable for this route. At the western edge of the SAC, there are two offshore export cable route sub-options that have been designed to meet the landfall deviations, with these sub-options having been developed to potentially avoid the presence of an aggregates dredging licence option and exploration area (known as aggregates area 1805). Depending on whether the option on this aggregate site is taken forward by the operator, it may be possible to avoid the Inner Dowsing sandbank by routeing through the aggregate site. However, in the event that it is not possible to route through the aggregates option area, it would be necessary to also cross the Inner Dowsing sandbank at the western edge of the SAC.
- 4.3.57 Whilst the L3 export cable route option has been designed to avoid any known areas of *S. spinulosa* reef with the SAC, it is nonetheless recognised that it is likely that there will be areas of confirmed or potential biogenic reef identified during the export cable route characterisation surveys (and pre-construction surveys) beyond those currently known/mapped.
- 4.3.58 The L3 export cable route option also crosses the Greater Wash SPA, which cannot be avoided should this route option be taken forwards.

Non-Designated Sensitive Habitats

- 4.3.59 Export cable route L3 passes through the Banks herring ground. Whilst there is overlap with the historical spawning ground, recent data from IHLS suggests that active spawning grounds are situated to the east and north of Flamborough Head. Nonetheless, any percussive piling from an ORCP i within the export cable route corridor, may lead to concerns over impacts on spawning herring.
- 4.3.60 Natural England have advised that other projects that have been developed off this part of the Lincolnshire coast have identified extensive areas of geogenic (stony) reef. It is likely that some potential reef would be recorded along the L3 offshore export cable route option (within and outside the IDRBNR SAC). As habitats protected under the NERC Act (2008), best efforts would need to be made to avoid these habitats, both within and outside any designated sites, which could constrain the offshore export cable route. It is likely that some reef could be recorded along the L3 route option; however, if identified, in most instances it should be possible to avoid such features through micro-siting of the cable within the corridor.

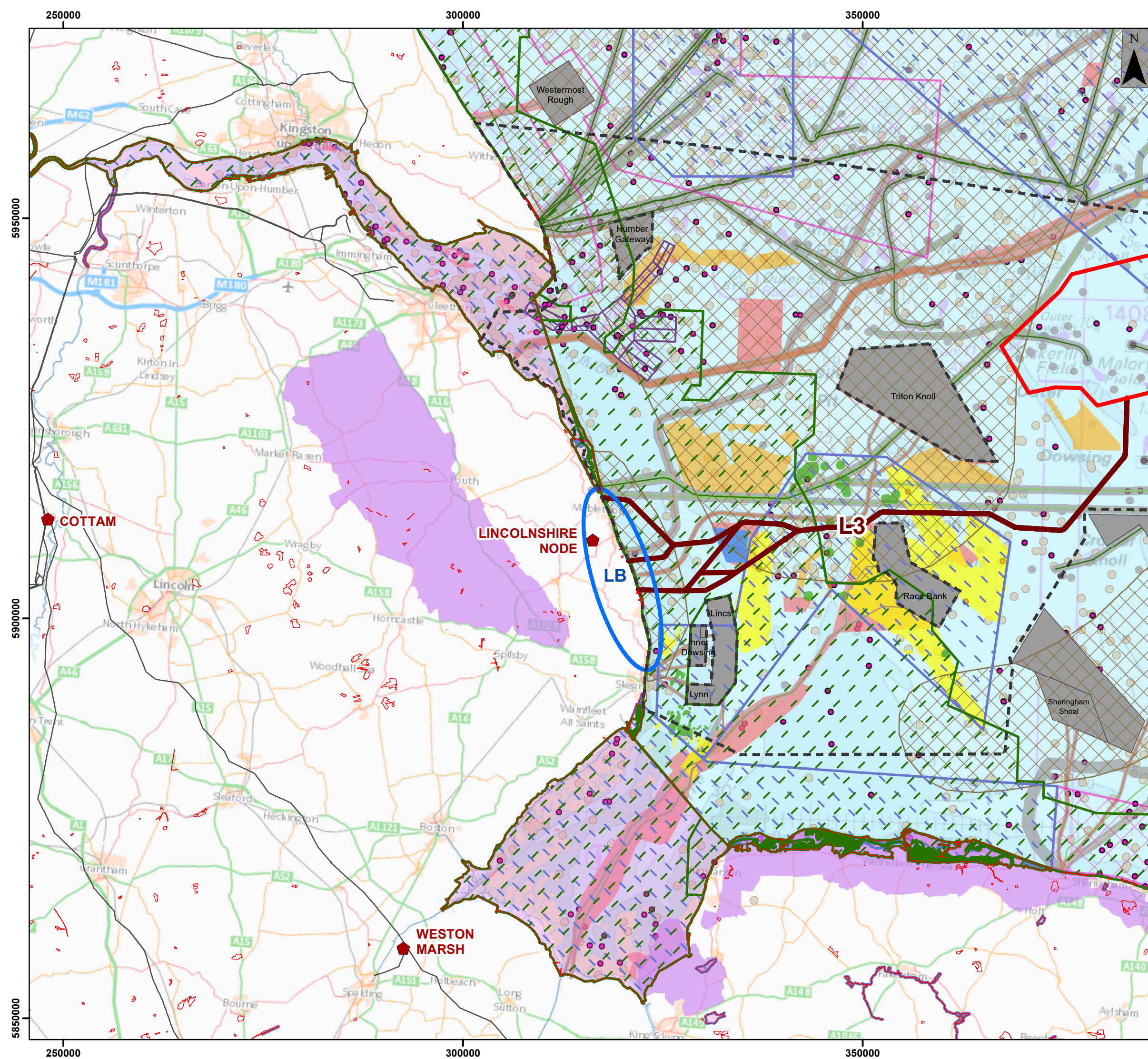
Other Marine Users

- 4.3.61 One of the deviations for this offshore export cable route overlaps with the corner of a marine aggregate exploration and option lease area (Area 1805) which is due to expire in 2024 (unless the option is taken up). If the option is not progressed by the option lease holder, this would not then be a constraint on the Project routing offshore export cables through this area. If the option is progressed, it is possible that the overlap area would not be progressed to licensing (e.g., if it was shown the area was not a focus for the aggregates resource) or that the route could be micro-sited around this lease area.

- 4.3.62 The aggregate option lease area also overlaps with an inactive disposal site, which the L3 export cable route option would also pass through. This disposal site may pose some constraint on the potential designation of the cable route as disposal areas for use by the Project during construction as it is understood that overlap between disposal areas is not permitted.
- 4.3.63 The proximity of the offshore export cable route corridor to the existing Race Bank and proposed Dudgeon Extension offshore windfarms increases the likelihood of higher vessel traffic within the region.
- 4.3.64 The two more northerly landfall options (LB32 and LB19) would require relatively nearshore crossings of existing subsea cables (i.e., the Triton Knoll offshore windfarm export cable and the Viking Link subsea interconnector cables). For this reason, the southern deviation to LB9 and LB 10 at Wolla Bank is preferred.

Cable Installation and Technical Risks

- 4.3.65 Whilst most wrecks and seabed obstructions are located outside of the buffer zone around the route corridor, in some of the most congested zones, the wrecks and obstruction do lie near the boundaries of the buffer zone. However, the minimum distance between the export cable route centreline and the nearest wreck is around 700m, which is a substantial distance and therefore wrecks are not considered to be a major constraint.
- 4.3.66 The offshore export cable route corridor has a relatively small amount of crossing with other existing seabed assets but, for large sections, it lies in relatively close proximity to existing subsea pipelines.
- 4.3.67 Some areas are relatively shallow and may mean that extra precaution needs to be taken with cable installation vessel selection (shallow draught, ability to ground, etc.) and/or timing of installation relative to tidal heights.



- ### Legend
- Array Area
 - ◆ Onshore Substation
 - Offshore ECC Area of Search
 - Offshore Cable Route Options
 - Landfall Sector
 - Offshore Wind Farm
 - Cable - Active
 - Cable - Not In Use
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 - Herring Spawning Grounds (1998)
 - Special Protection Areas
 - Special Area of Conservation
- #### SAC Components
- Annex I Sandbank
 - Annex I Reef



Coordinate System: WGS 1984 UTM Zone 31N
 0 10 20 km
 Scale: 1:450,000

Preliminary Environmental Information Report
 Proposed Export Cable Corridor Option L3
 Connecting to Landfall Sector LB

Figure 4.11



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Lincolnshire 4 (L4)

- 4.3.68 The L4 offshore export cable route option was designed to reach landfalls which would be appropriate for an onwards routeing to a grid connection location at or in the vicinity of either the Lincolnshire Node or Weston Marsh connections (Figure 4.12). This offshore export cable route is up to approximately 90km in length and has a maximum water depth of approximately 30m.

Designated Sites

- 4.3.69 Offshore export cable route option L4 passes through the IDRBNR SAC. This offshore export cable route was designed to avoid any known areas of *S. spinulosa* reef; however, due to this route aiming to avoid the constrained routing to the north of Race Bank offshore windfarm and in order to reach the LB landfalls, this export cable route option does cross the SAC sandbank features.
- 4.3.70 Whilst the L4 export cable route option has been designed to avoid any known areas of *S. spinulosa* reef with the SAC, it is recognised that it is likely that there will be areas of biogenic reef identified within the characterisation surveys (and pre-construction surveys) beyond those currently known/mapped which will need to be mitigated for.
- 4.3.71 The L4 export cable route option also crosses the Greater Wash SPA, which cannot be avoided should this route option be taken forwards.

Non-Designated Sensitive Habitats

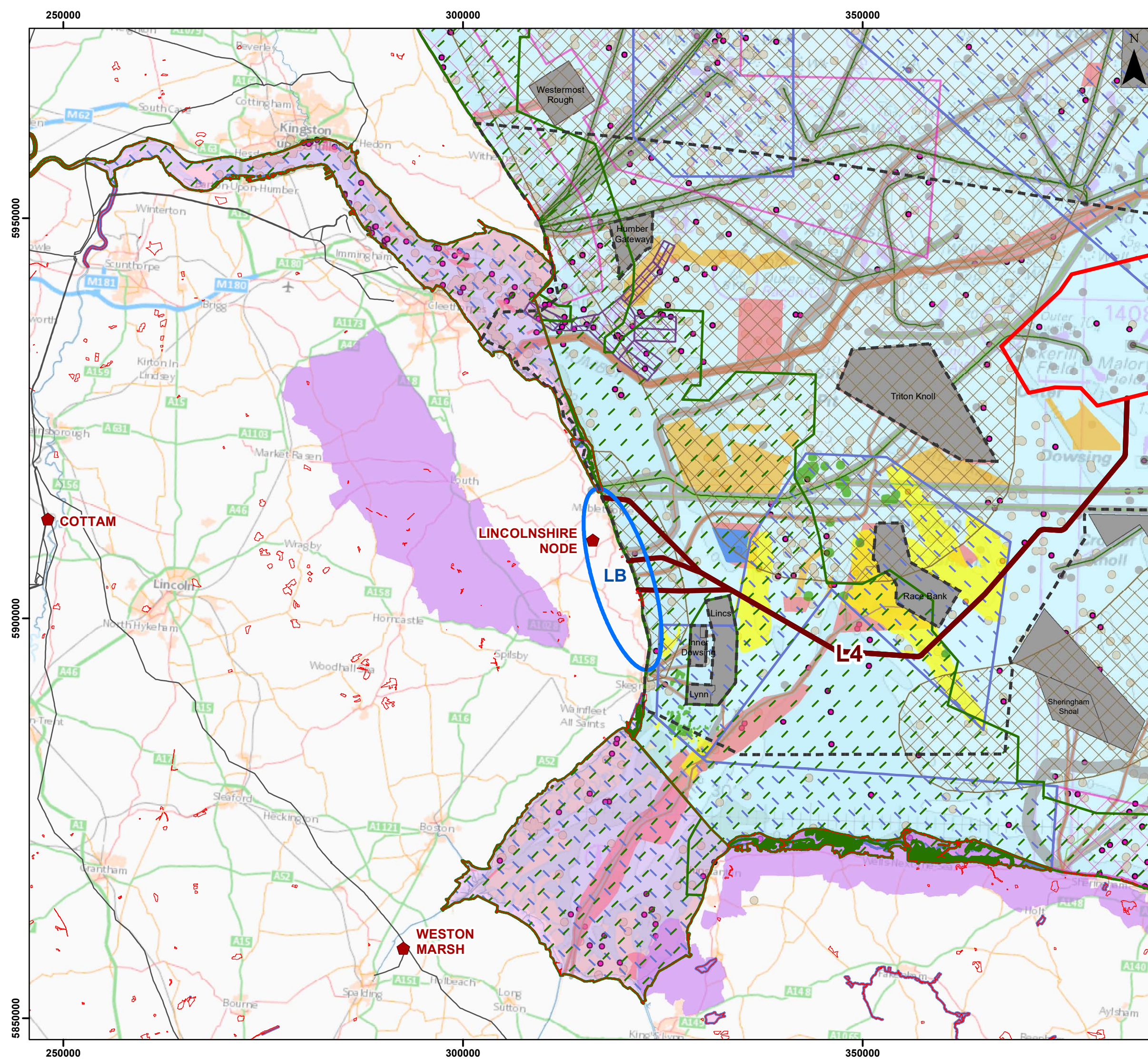
- 4.3.72 The offshore export cable route crosses the Docking Shoal sandbank which, whilst not designated or part of the IDRBNR SAC, is an extensive sandbank of environmental interest and impacts to this sandbank may have the potential to give rise to indirect effects to designated sites in the wider area.
- 4.3.73 Offshore export cable route option L4 also passes through the Banks herring ground. Whilst there is overlap with the historical spawning ground, recent data from the IHLS suggests that active spawning grounds are situated to the east and north of Flamborough Head. Nonetheless, any percussive piling from within the export cable route corridor, may lead to concerns over impacts on spawning herring.
- 4.3.74 Natural England have advised that other projects developed off this part of the Lincolnshire coast have identified extensive areas of geogenic reef within the nearshore region. It is possible that some reef would be recorded along the L4 export cable route option (within and outside the IDRBNR SAC). As habitats protected under the NERC Act (2008), best efforts would need to be made to avoid these habitats, both within and outside any designated sites, which could constrain the final export cable route. It is likely that some reef could be recorded along the L4 export cable route option; however, if identified, in most instances it should be possible to avoid through micrositing of the cable within the cable route corridor.

Other Marine Users

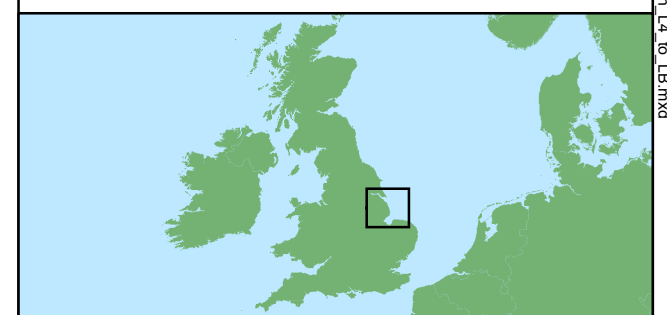
- 4.3.75 This offshore export cable route option requires a crossing of the Race Bank offshore windfarm cables on the Docking Shoal sandbank feature. Due to the shallow nature of this area, it is considered likely that this may pose a concern for navigational depth around the crossing, with a requirement to consult with MCA over any resulting navigational risk.
- 4.3.76 The proximity of the route to the Race Bank and Dudgeon Extension offshore windfarms also increases the likelihood of higher vessel traffic within the region.
- 4.3.77 The two more northerly landfall options (Landfall 32 and Landfall 19) would require relatively nearshore crossings of existing subsea cables (i.e., the Triton Knoll offshore windfarm export cables and the Viking Link subsea interconnector cables). For this reason, Landfall 9 and Landfall 10 are preferred.

Cable Installation and Technical Risks

- 4.3.78 The area south of the Project array area is generally less congested with wrecks and seabed obstructions and is therefore not so much a primary driver in the routing as most of the other routes developed. For the most part, the route has plenty of space to micro-site the cable within the broader route corridor.
- 4.3.79 The biggest risk for this export cable route is considered to be the occasional sections of relatively shallow water depths that may cause accessibility difficulties that will restrict cable installation vessel selection.



- ### Legend
- Array Area
 - Onshore Substation
 - Offshore ECC Area of Search
 - Offshore Cable Route Options
 - Landfall Sector
 - Offshore Wind Farm
 - Cable - Active
 - Cable - Not In Use
 - Pipeline - Active
 - Pipeline - Not In Use
 - Pipeline - Abandoned
 - Ships Routing Measures Areas
 - Subsea Obstruction
 - Wreck with 500m Buffer
 - Aggregates - Production Agreement Area
 - Aggregates - Exploration and Option Area
 - Disposal Sites
 - Marine Conservation Zone
 - Sites of Special Scientific Interest
 - Ramsar Site
 - Areas of Outstanding Natural Beauty
 - Herring Spawning Grounds (1998)
 - Special Protection Areas
 - Special Area of Conservation
- #### SAC Components
- Annex I Sandbank
 - Annex I Reef



Coordinate System: WGS 1984 UTM Zone 31N
 0 10 20 km
 Scale: 1:450,000

Preliminary Environmental Information Report
 Proposed Export Cable Corridor Option L4
 Connecting to Landfall Sector LB

Figure 4.12



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Lincolnshire 5 (L5)

- 4.3.80 This offshore export cable route option was designed to reach a landfall which would be appropriate for an onwards routing to a grid connection location at or in the vicinity of Weston Marsh (Figure 4.13). This offshore export cable route option is up to approximately 85km in length and has a maximum water depth of approximately 35m.

Designated Sites

- 4.3.81 Offshore export cable route option L5 passes through the IDRBNR SAC. The route was designed to minimise cable route distances to reach the LA landfall sector; this offshore export cable route crosses the sandbank features of the SAC and passes through an area of known *S. spinulosa* reef in the nearshore region. Whilst it is currently assumed that much of this known reef could likely be avoided through micro-siting of the cable route, it is possible that, due to the density of the known reef combined with the potential for further reef areas to be identified in site characterisation surveys, it may not be possible to avoid cables installation through some reef features. Whilst *S. spinulosa* reef can recover within a relatively short timescale, installation through these features and particularly placement of cable protection where this was necessary, may give rise to a further risk of adverse effects and a requirement for derogation.
- 4.3.82 The landfall location (LA sector) for the L5 export cable route option is located within the Saltfleetby-Theddlethorpe Dunes and Gibraltar Point SAC, which is designated at Gibraltar Point for the extensive sand dune systems. These sand dunes will pose limitations on the offshore export cable installation method available at these landfalls, with the dune system at Gibraltar Point (the LA landfall) being hundreds of metres in length.
- 4.3.83 The L5 export cable route option also crosses the Greater Wash SPA, which cannot be avoided. The L5 export cable route option passes through an area recorded as supporting a medium to high density of common scoter and a high intensity area for red-throated diver.

Non-Designated Sensitive Habitats

- 4.3.84 Offshore export cable route option L5 also crosses the Docking Shoal sandbank which, whilst not designated as part of the IDRBNR SAC, is an extensive sandbank of wider environmental interest and impacts to this sandbank may have the potential to give rise to indirect effects to designated sites in the wider area.

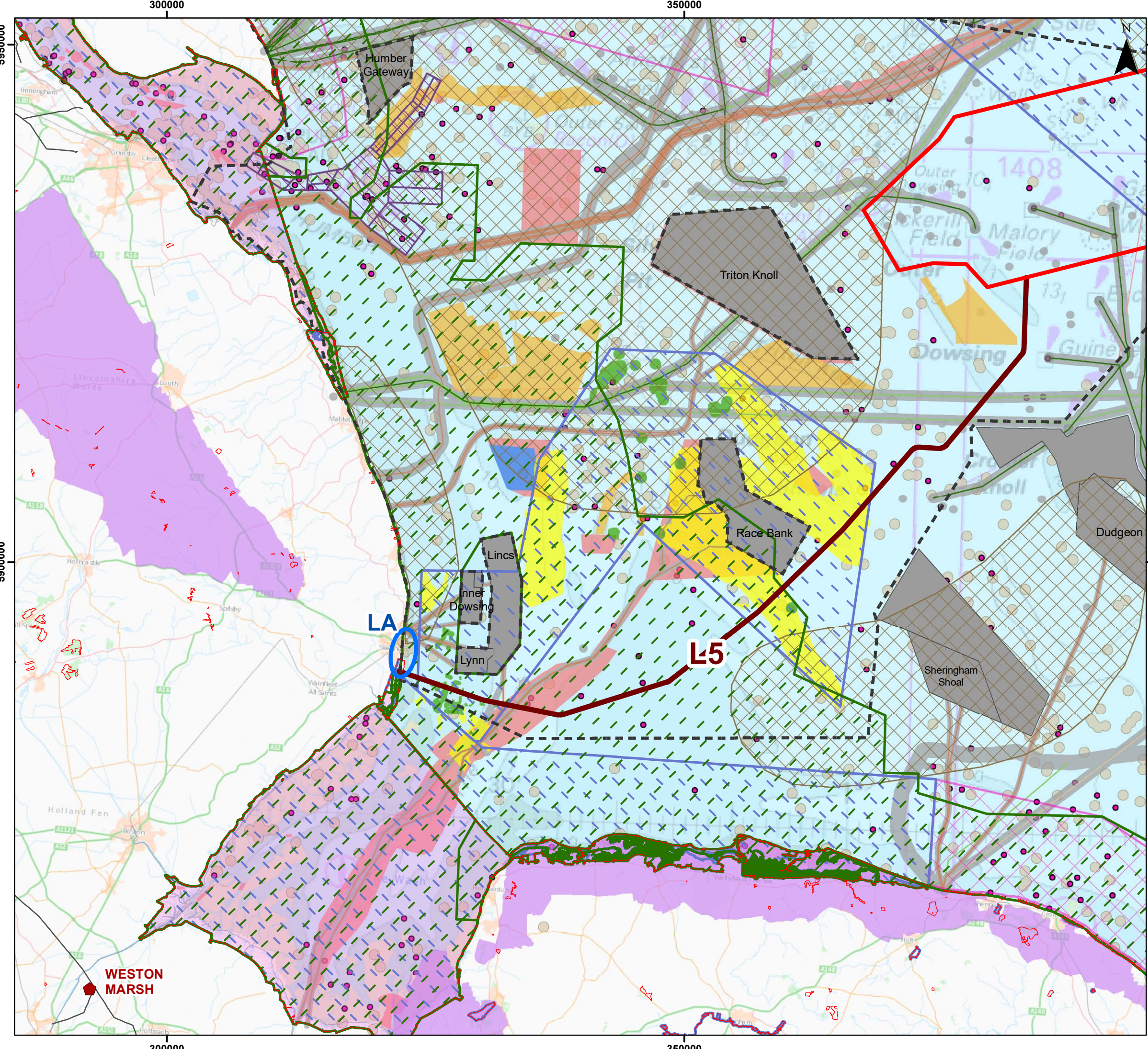
Other Marine Users

- 4.3.85 This export cable route option requires a crossing of the Race Bank offshore windfarm cables on the Docking Shoal feature. Due to the shallow nature of this area, it is considered likely that this may pose something of a concern for navigational depth around the crossing, with requirement to consult with MCA over resulting navigational risk.
- 4.3.86 The proximity of the offshore export cable route to the Race Bank and Dudgeon Extension offshore windfarms increases the likelihood of higher vessel traffic within the region.

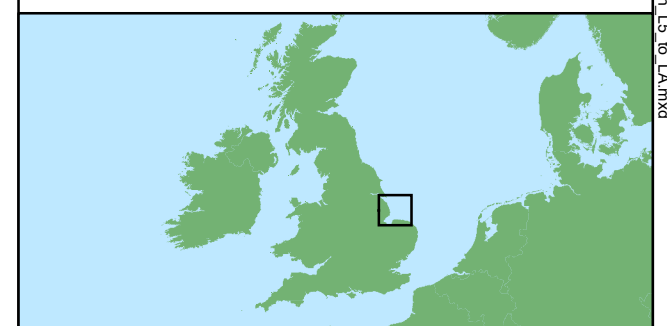
Cable Installation and Technical Risks

- 4.3.87 The area south of the Project site is generally less congested with wrecks and seabed obstructions and is therefore not so constrained in terms of offshore export cable routing compared to other route options.
- 4.3.88 The biggest risk for this offshore export cable route is the presence of shallow water depths, especially in the approaches to the landfall and at Burnham Flats. As a result large sections of the offshore export cable route are likely to need shallow draught vessels such as Cable Lay Barges (CLB) rather than more conventional cable laying vessels. Potentially, the vessel may also need to be able

to ground at low tide which would severely limit the operating window for cable installation.



- ### Legend
- Array Area
 - Onshore Substation
 - Offshore ECC Area of Search
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 - Landfall Sector
 - Offshore Wind Farm
 - Cable - Active
 - Cable - Not In Use
 - Pipeline - Active
 - Pipeline - Not In Use
 - Pipeline - Abandoned
 - Ships Routing Measures Areas
 - Subsea Obstruction
 - Wreck with 500m Buffer
 - Aggregates - Production Agreement Area
 - Aggregates - Exploration and Option Area
 - Disposal Sites
 - Marine Conservation Zone
 - Sites of Special Scientific Interest
 - Ramsar Site
 - Areas of Outstanding Natural Beauty
 - Herring Spawning Grounds (1998)
 - Special Protection Areas
 - Special Area of Conservation
- #### SAC Components
- Annex I Sandbank
 - Annex I Reef



Coordinate System: WGS 1984 UTM Zone 31N
 0 10 20 km
 Scale: 1:350,000

Preliminary Environmental Information Report
 Proposed Export Cable Corridor Option L5
 Connecting to Landfall Sector LA

Figure 4.13



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Lincolnshire 6 (L6)

- 4.3.89 This offshore export cable route option was designed to reach a landfall which would be appropriate for an onwards routing for a grid connection location at or in the vicinity of Weston Marsh (Figure 4.14). This offshore export cable route is up to approximately 95km in length and has a maximum water depth of approximately 35m.

Designated Sites

- 4.3.90 Offshore export cable route option L6 passes through the IDRBNR SAC. The offshore export cable route option was designed to avoid any sandbanks within the SAC by routing around the eastern edge of the SAC; however, it is not possible to avoid the nearshore area of known *S. spinulosa* reef at the south-western extent of the SAC on the approach to the landfall. Whilst it is currently assumed that much of this known reef could likely be avoided through micro-siting of the cable route, it is possible that, due to the density of the known reef and combined with the potential for further reef areas to be identified during characterisation surveys, it may not be possible to avoid cable installation through areas of reef. Whilst *S. spinulosa* reef can recover within a relatively short timescale, installation through these features, including the necessity to deploy cable protection, may give rise to a further risk of adverse effects and a requirement for derogation.
- 4.3.91 The landfall location (LA sector) for the L6 export cable route option is located within the Saltfleetby-Theddlethorpe Dunes and Gibraltar Point SAC, which is designated at Gibraltar Point for the extensive sand dune systems. These sand dunes will pose limitations on the installation method available at these landfalls, with the dune system at Gibraltar Point (the LA landfall) being hundreds of metres in length.
- 4.3.92 The L6 offshore export cable route option also crosses the Greater Wash SPA, which cannot be avoided. The L6 export cable route option passes through an area supporting a medium to high density of common scoter and a high intensity area for red-throated diver.

Non-Designated Sensitive Habitats

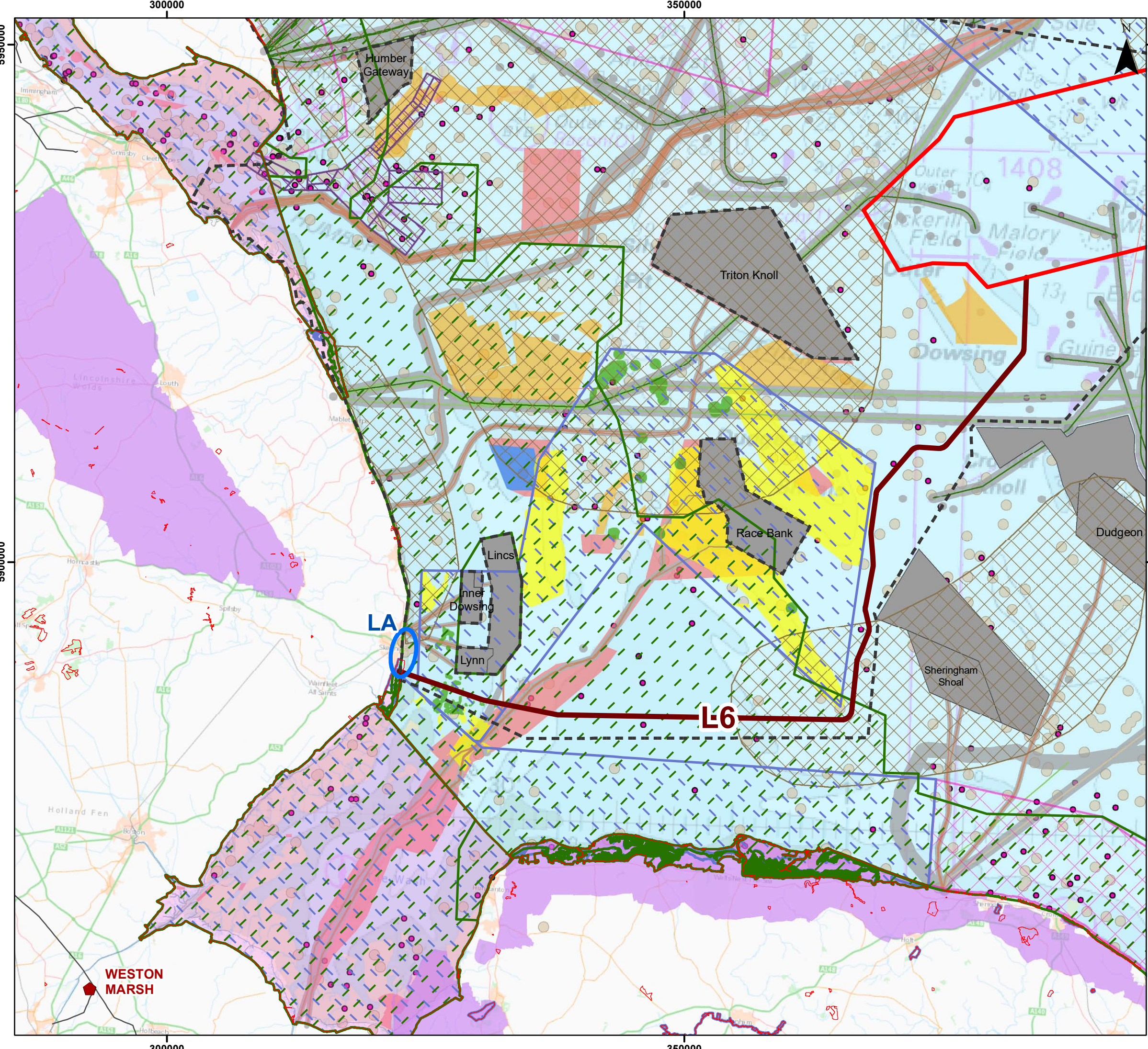
- 4.3.93 Offshore export cable route option L6 also crosses the Docking Shoal sandbank which, whilst not designated or part of the IDRBNR SAC, is an extensive sandbank of environmental interest and impacts to this sandbank may give rise to indirect effects to designated sites in the wider area.

Other Marine Users

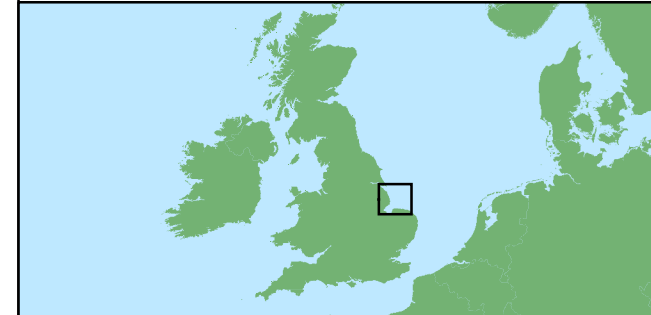
- 4.3.94 This offshore export cable route option also requires a crossing of the Race Bank offshore windfarm export cables on the Docking Shoal feature. Due to the shallow nature of this area, it is considered likely that this may pose something of a concern for navigational depth around the crossing, with requirement to consult with MCA over resulting navigational risk.
- 4.3.95 The proximity of the offshore export cable route to the Race Bank and Dudgeon Extension offshore windfarms also increases the likelihood of higher vessel traffic within the region.

Cable Installation and Technical Risks

- 4.3.96 The area south of the Project site is generally less congested with wrecks and seabed obstructions and is therefore not so constrained in terms of offshore export cable routing compared to other route options.
- 4.3.97 The biggest risk for this offshore export cable route is the presence of shallow water depths, especially in the approaches to the landfall and at Burnham Flats. As a result large sections of the offshore export cable route are likely to need shallow draught vessels such as Cable Lay Barges (CLB) rather than more conventional cable laying vessels. Potentially, the vessel may also need to be able to ground at low tide which would severely limit the operating window for cable installation.



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- #### SAC Components
- Annex I Sandbank
 - Annex I Reef



Coordinate System: WGS 1984 UTM Zone 31N

0 10 20 km

Scale: 1:350,000

Preliminary Environmental Information Report

Proposed Export Cable Corridor Option L6
Connecting to Landfall Sector LA

Figure 4.14



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Preferred Offshore Routes

- 4.3.98 Following the evaluation of the engineering and environmental constraints for the various identified offshore export cable routes, the potential offshore route corridors were compared to identify the preferred route options to each of the landfall sectors (and corresponding to the various grid connection options that were being considered by the HND at the time of the route evaluation process):
- Yorkshire:
 - Only one viable offshore export cable route was identified for a Yorkshire connection option, with routeing feasible to all the landfall options identified on this coastline.
 - Lincolnshire – LC sector:
 - Export cable route L1 was identified as the preferred option to the LC landfall options. However, the northerly deviation to the northerly landfalls was considered to be unviable due to the interaction with the Humber Estuary TSS. The deviations to the more southerly landfalls were deemed to be potentially viable, although the nearshore sections of the export cable routes were likely to be highly constrained due to the shallow bathymetry and the fact that the offshore export cable route would require a number of crossings of significant existing subsea infrastructure.
 - Export cable route L2a was considered not feasible as a route to the landfalls in the LC sector due to the technical challenges of routeing through the Inner Silver Pit.
 - Lincolnshire – LB sector:
 - None of the identified export cable routes to the LB landfall sector avoid the IDRBNR SAC, however each has different degrees of overlap with the site and the various designated features.
 - Export cable route L2b passes through the centre of the Inner Silver Pit and was not considered feasible for cable installation; this route also passes through an area of known *S. spinulosa* reef within the IDRBNR SAC. Due to the engineering constraints within the Inner Silver Pit, export cable route L2b is not considered feasible.
 - Export cable routes L3 and L4 both pass directly through the IDRBNR SAC, crossing the sandbank features of the site to varying degrees. L3 provides for the shortest export cable route through the SAC and the least overlap with the sandbank features compared to L4. As such, L3 is considered to be the preferred offshore export cable route to landfall section LB, with the deviation to the southern landfall options (landfalls LB9 and LB10) being preferred due to this option avoiding any nearshore cable crossings. Landfall 10 is preferred over Landfall 9 due to the greater avoidance of the coastal SSSIs.
 - Lincolnshire – LA sector:
 - Export cable route L6 is the preferred route to reach landfall sector LA due to the avoidance of any overlap with the sandbank features of the SAC, albeit that both L5 and L6 export cable routes unavoidably cross through a known area of *S. spinulosa* in the nearshore part of the SAC. The length of export cable route L5 and L6 may also restrict the transmission options for the Project and the crossing of the Race Bank offshore windfarm export cables on the Docking Shoal may also pose some risks. In

addition, the landfall is significantly constrained by environmental designations at the coast.