Outer Dowsing Offshore Wind

Preliminary Environmental Information Report

Volume 1, Chapter 3: Project Description

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OUTER DOWSING OFFSHORE WIND

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Abbreviations

Acronym	Expanded name
AD	Associated Development
AfL	Agreement for Lease
BEIS	Department for Business, Energy & Industrial Strategy (now the Department for Energy Security and Net Zero (DESNZ))
CAA	Civil Aviation Authority
CBRA	Cable Burial Risk Assessment
DCO	Development Consent Order
DECC	Department of Energy & Climate Change, now the Department for Energy Security and Net Zero (DESNZ)
Defra	Department for Environment, Food and Rural Affairs (Defra, not DEFRA)
DESNZ	Department for Energy Security and Net Zero, formerly Department of Business, Energy and Industrial Strategy (BEIS), which was previously Department of Energy & Climate Change (DECC)
DPV	Dynamic Positioning Vessel
EA	Environment Agency
ECC	Export Cable Corridor
EEA	European Economic Area
EIA	Environmental Impact Assessment

Acronym	Expanded name
EPP	Evidence Plan Process
ES	Environmental Statement
ETG	Expert Topic Group
FLiDAR	Floating LiDAR
GBS	Gravity Base Structure
GT R4 Ltd	The Applicant. The special project vehicle created in partnership between Corio Generation (a wholly owned Green Investment Group portfolio company), Gulf Energy Development and TotalEnergies
HDD	Horizontal Directional Drilling
HLV	Heavy Lifting Vessel
HRA	Habitats Regulations Assessment
HSE	Health and Safety Executive
HV	High Voltage
HVAC	High Voltage Alternating Current
IDB	Internal Drainage Boards
JB	Joint Bays
JUV	Jack Up Vessel
LAT	Lowest Astronomical Tide
LB	Link Boxes
LEDPP	Landscape and Ecology Design Principles Plan
LiDAR	Light Detection and Ranging
MCA	Maritime Coastguard Agency
MDS	Maximum Design Scenario
MGN	Marine Guidance Note
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MMO	Marine Management Organisation
MSL	Mean Sea Level
NEQ	Net Explosive Quantity
NERC	Natural Environment and Rural Communities
NGESO	National Grid Electricity System Operator
NGET	National Grid Electricity Transmission
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
ODOW	Outer Dowsing Offshore Wind (The Project)
OP	Offshore Platform
ORCP	Offshore Reactive Compensation Platform
OnSS	Onshore Substation
OSS	Offshore Substation
PEIR	Preliminary Environmental Information Report
PLGR	Pre-Lay Grapnel Run
SAC	Special Area of Conservation
SCADA	Supervisory Control and Data Acquisition
SoS	Secretary of State

Acronym	Expanded name
SOV	Service Operations Vessel
SSSI	Site of Special Scientific Interest
SWMP	Site Waste Management Plan
TCE	The Crown Estate
THLS	Trinity House Lighthouse Service
TJB	Transition Joint Bay
TP	Transition Piece
TSHD	Trailing Suction Hopper Dredger
UKHO	UK Hydrographic Office
UXO	Unexploded Ordnance
WSI	Written Schemes of Investigation
WTG	Wind Turbine Generator
WTW	Water Treatment Works
XLPE	Cross Linked Polyethylene Cable

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.
Array cables	Cables which connect the wind turbines to each other and to the offshore substation(s).
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).
Dynamic Positioning (DP)	A computer-controlled system to automatically maintain a vessel's position and heading by using its own propellers and thrusters
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).
Evidence Plan	A voluntary process of stakeholder consultation with appropriate Expert Topic Groups (ETGs) that discusses and, where possible, agrees the detailed approach to the Environmental Impact Assessment (EIA) and information to support Habitats Regulations Assessment (HRA) for those relevant topics included in the process, undertaken during the pre-application period.

Term	Definition
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.
Haul Road	The track within the onshore ECC which the construction traffic would use to facilitate construction.
Heavy Lift Vessel (HLV)	A ship designed to move very large loads that cannot be handled by normal ships.
High Voltage Alternating Current (HVAC)	High voltage alternating current is the bulk transmission of electricity by alternating current (AC), whereby the flow of electric charge periodically reverses direction.
Impact	An impact to the receiving environment is defined as any change to its baseline condition, either adverse or beneficial.
Indicative Working Width	The indicative working width within the Export Cable Corridor (ECC), required for the construction of the onshore cable route.
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.
Link boxes	Underground chambers or above ground cabinets next to the cable trench housing electrical earthing links.
Maximum Design Scenario	The maximum design parameters of the combined project assets that result in the greatest potential for change in relation to each impact assessed
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
National Policy Statement (NPS)	A document setting out national policy against which proposals for Nationally Significant Infrastructure Projects (NSIPs) will be assessed and decided upon
Non-statutory consultee	Organisations that the Applicant may be required to (under Section 42 of the 2008 Act) or may otherwise choose to engage during the pre-application phases (if, for example, there are planning policy reasons to do so) who are not designated in law but are likely to have an interest in a proposed development.

Term	Definition
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 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	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).
Project Design envelope	A description of the range of possible elements that make up the Project's design options under consideration, as set out in detail in the project description. This envelope is used to define the Project for Environmental Impact Assessment (EIA) purposes when the exact engineering parameters are not yet known. This is also often referred to as the "Rochdale Envelope" approach.
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.
Statutory consultee	Organisations that are required to be consulted by the Applicant, the Local Planning Authorities and/or The Inspectorate during the pre-application and/or examination phases, and who also have a statutory responsibility in some form that may be relevant to the Project and the DCO application. This

Term	Definition
	includes those bodies and interests prescribed under Section 42 of the Planning Act 2008.
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
Transboundary impacts	Transboundary effects arise when impacts from the development within one European Economic Area (EEA) state affects the environment of another EEA state(s)
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.
TJB compound	Area within which the TJBs are situated.
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 cable ducts	Ducts which are installed during trenchless works to maintain the bore for which cables or other items can be installed, generally made of plastic or metal.
Trenchless entry pits	A pit which is dug to facilitate the trenchless works, the starting point of the works.
Trenchless exit pits	A pit which is dug to facilitate the trenchless works, the end point of the works.
Trenchless technology 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. Trenchless techniques may include amongst other technologies Horizontal Directional Drilling (HDD), thrust boring, auger boring, and pipe ramming, which allow ducts to be installed under an obstruction while minimising overground disturbance.
Trenchless works compound	An area required for storage, logistics, management and operations at the location at which trenchless works are to be or likely to be carried out.
Trenchless works location	The location at which trenchless works are to be or likely to be carried out.

Term	Definition
Wind turbine generator (WTG)	All the components of a wind turbine, including the tower, nacelle, and rotor.

3 Project Description

3.1 Introduction

3.1.1 This chapter of the Preliminary Environmental Information Report (PEIR) presents the description of the design of Outer Dowsing Offshore Wind (hereafter referred to as 'the Project'). It will include the Project's design and components for both the onshore and offshore infrastructure, as well as the main activities in association with the whole lifecycle of the Project (construction, operation and maintenance, and decommissioning).

3.1.2 The Design Envelope approach has been adopted to include sufficient flexibility within the project design to allow for further refinement during detailed design assuming the Development Consent Order (DCO) application is successful. Therefore, within this chapter, a range of parameters and a series of options are set out for the Project. Following PEIR submission and consultation, the design will be refined prior to consent application and submission. The final design will be developed from within the parameters stated within the project description after consent has been granted.

3.1.3 The project description sets out:

- Design Envelope Approach;
- Commitments;
- Consultation;
- Project Location;
- Project Infrastructure Overview;
- Offshore Infrastructure Construction;
- Onshore Infrastructure Construction; and,
- Operation and Maintenance (O&M).

3.2 Design Envelope Approach

Need for Project Design Flexibility

3.2.1 Within this PEIR, a range of parameters for each aspect of the Project are defined and the Maximum Design Scenario (MDS) for each receptor and/or impact is identified and considered for this preliminary assessment. This process, and these parameters, will be further refined following consultation to inform the Environmental Impact Assessment (EIA) process for the Environmental Statement (ES) and the final DCO application. This approach to design flexibility is known as the 'Project design envelope' approach or the 'Rochdale Envelope' approach (The Inspectorate, 2018). The project's maximum and worse impacts are assessed within the PEIR and so the Project can vary within the envelop without further assessment.

3.2.2 At this stage of the Project, the description is intended to be indicative and the Project design envelope is imperative to allow for flexibility, allowing for further refinement pre- and post-consent. Such choices requiring this design flexibility include, for example, WTG foundation selection, specific siting of infrastructure, and choice of construction or installation methods. This ensures that future refinements in the windfarm development prior to the finalisation of the project design can be reasonably accommodated during the post-consent phase, whilst also allowing the Applicant to optimise the project economics to provide best value to the UK consumer.

3.2.3 The final design will also be dependent on factors such as ground conditions, wave and tidal conditions, project economics and procurement approach. Therefore, this chapter sets out a series of options and range of parameters, encompassed in the Project design envelope which is intended to represent a realistic MDS for the Project.

3.2.4 As noted in the Inspectorate Advice Note Nine (The Inspectorate, 2018), the Rochdale Envelope approach will be employed where the developer may not know the exact specifications of infrastructure that will comprise the proposed project. The note states that:

"The Rochdale Envelope assessment approach is an acknowledged way of assessing a Proposed Development comprising EIA development where uncertainty exists and necessary flexibility is sought".

3.2.5 The use of the Rochdale Envelope approach is also recognised in the Overarching National Policy Statement (NPS) for Energy (NPS EN-1) (DECC, 2011a) and the NPS for Renewable Energy Infrastructure (NPS EN-3) (DECC, 2011b). It is the approach that has been used in the majority of DCO applications for offshore windfarm projects in the UK. The Applicant notes that the revised draft NPS's retain a recognition of the use and importance of the Rochdale Envelope approach (DESNZ, 2023a; DESNZ, 2023b).

3.2.6 In the case of offshore windfarms, the current NPS EN-3 (paragraph 2.6.42) recognises that:

"Owing to the complex nature of offshore windfarm development, many of the details of a proposed scheme may be unknown to the applicant at the time of the application, possibly including:

Precise location and configuration of turbines and associated development;

Foundation type;

Exact turbine tip height;

Cable type and cable route; and

Exact locations of offshore and/or onshore substations."

3.2.7 NPS EN-3 (paragraph 2.6.43) (DECC, 2011b) continues:

"The IPC should accept that windfarm operators are unlikely to know precisely which turbines will be procured for the site until sometime after any consent has been granted. Where some details have not been included in the application to the Secretary of State, the applicant should explain which elements of the scheme have yet to be finalised, and the reasons. Therefore, some flexibility may be required in the consent. Where this is sought and the

precise details are not known, then the applicant should assess the effects the Project could have to ensure that the Project as it may be constructed has been properly assessed (the Rochdale Envelope)".

3.2.8 NPS EN-3 (footnote 23 to paragraph 2.6.43) (DECC, 2011b) also states that:

"The 'Rochdale Envelope' is a series of maximum extents of a project for which the significant effects are established. The detailed design of the Project can then vary within this 'envelope' without rendering the ES inadequate."

3.2.9 The design envelope approach is widely recognised and is consistent with the Inspectorate Advice Note Nine: Rochdale Envelope (The Inspectorate, 2018). Page 11 of that note states that:

"The 'Rochdale Envelope' is an acknowledged way of dealing with an application comprising EIA development where details of a project have not been resolved at the time when the application is submitted."

3.2.10 Therefore, as the EIA process assesses the maximum extent and worse impacts based on the project's maximum extent, the Project design envelope approach has been taken to allow for robust and meaningful environmental assessments of the Project. A result of lesser impact if the project's final footprint is less than the maximum extent, allows for flexibility for the future design refinement and decisions.

3.2.11 Draft NPS EN-3 (paragraph 3.6.2 footnote 10) (DESNZ, 2023) also recognises the use of the Rochdale Envelope:

"Case law, beginning with R v Rochdale MBC Ex p. Tew [2000] Env.L.R.1 establishes that while it is not necessary or possible in every case to specify the precise details of development, the information contained in the ES should be sufficient to fully assess the project's impact on the environment and establish clearly defined worst case parameters for the assessment. This is sometimes known as 'the Rochdale Envelope'"

3.2.12 Throughout the Draft NPS EN-3 there is recognition of the need for flexibility, continuing the position from NPS EN-3 (DECC, 2011b).

3.2.13 Draft NPS EN-3 (Paragraph 3.8.87) (DESNZ, 2023).

"Owing to the complex nature of offshore windfarm development, many of the details of a proposed scheme may be unknown to the applicant at the time of the application to the Secretary of State. Such aspects may include:

- *the precise location and configuration of turbines and associated development;*
- *the foundation type and size;*
- *the installation technique or hammer energy;*
- *the exact turbine blade tip height and rotor swept area;*
- *the cable type and precise cable route;*
- *the exact locations of offshore and/or onshore substations. "*

3.2.14 Draft NPS EN-3 (paragraph 3.6.1 and 3.6.2) (DESNZ, 2023) also supports this by stating:

"Where details are still to be finalised applicants should explain in the application which elements of the proposal have yet to be finalised, and the reason why this is the case.

Where flexibility is sought in the consent as a result, applicants should, to the best of their knowledge, assess the likely worst case environmental, social and economic effects of the proposed development to ensure that the impacts of the project as it may be constructed have been properly assessed."

3.2.15 The requirement for flexibility is further recognised in the Draft NPS EN-1 (paragraph 4.2.11 - 4.2.12) (DESNZ, 2023):

"In some instances, it may not be possible at the time of the application for development consent for all aspects of the proposal to have been settled in precise detail. Where this is the case, the applicant should explain in its application which elements of the proposal have yet to be finalised, and the reasons why this is the case.

Where some details are still to be finalised, the ES should, to the best of the applicant's knowledge, assess the likely worst case environmental, social and economic effects of the proposed development, to ensure that the impacts of the project as it may be constructed have been properly assessed"

Relationship to the Maximum Design Scenario

3.2.16 A realistic MDS has been assessed throughout this PEIR, avoiding excessive conservatism in the EIA process by, for example, not considering unrealistic overly precautionary scenarios. This is achieved by assessing the parameters not necessarily in a combination of the maximum design parameters for each component. For example, the maximum seabed disturbance will not coincide with the maximum number of piles, as the first relates to Suction Jacket foundations, whilst the second relates to piled Jacket foundations. Therefore, the maximum design scenario is chosen on a "receptor by receptor" and an "impact by impact" basis, based on a range of build-out scenarios. The details of these MDSs are set out within the topic chapters of this PEIR and summarised within each technical chapter (Volume 1, Chapters 7 to 31).

3.3 Consultation

3.3.1 Consultation is a key part of the DCO application process. Consultation regarding this Project description has been conducted through the publication of the Scoping Report (Outer Dowsing Offshore Wind, 2022), with relevant stakeholders through both the Evidence Plan Process (EPP) and one to one consultation as appropriate for the stakeholder. Consultation has also been undertaken with members of the public through Public Information Days, Community Liaison Groups, mail shots and via the Project website and newsletters.

3.3.2 Statutory consultation is being carried out supported by the production of this PEIR, under the requirements of Sections 42, 47 and 48 of the 2008 Act, with relevant comments received being considered in developing the final project design that will form the basis of the DCO application. An overview of the consultation process is presented within Volume 1, Chapter 6: Consultation Process.

3.3.3 Through this consultation the Project has identified a number of issues that have led directly to design changes and commitments that will be made to construction methodologies. These include:

- The development of an alternative ECC to Weston Marsh; and
- The commitment to trenchless construction methods below Internal Drainage Board (IDB) and Environment Agency (EA) maintained infrastructure.

3.4 Project Location

3.4.1 A geographical overview of the location of the offshore and onshore project infrastructure is presented in Figure 3.1.

Array Area

3.4.2 The Project array area (within which the generating station will be located) currently covers an area of 500km^2 and lies approximately 54km east of the Lincolnshire coast at its closest point. Water depths vary across the array area between approximately -5.6m to -48.1m relative to Lowest Astronomical Tide (LAT).

3.4.3 As part of the ongoing Environmental Impact Assessment (EIA) process and in consultation with relevant stakeholders, and in response to a condition of the Agreement for Lease (AfL) with The Crown Estate (TCE), the Applicant will reduce the size of the array area to 300km^2 without impacting the overall generation capacity of the project.

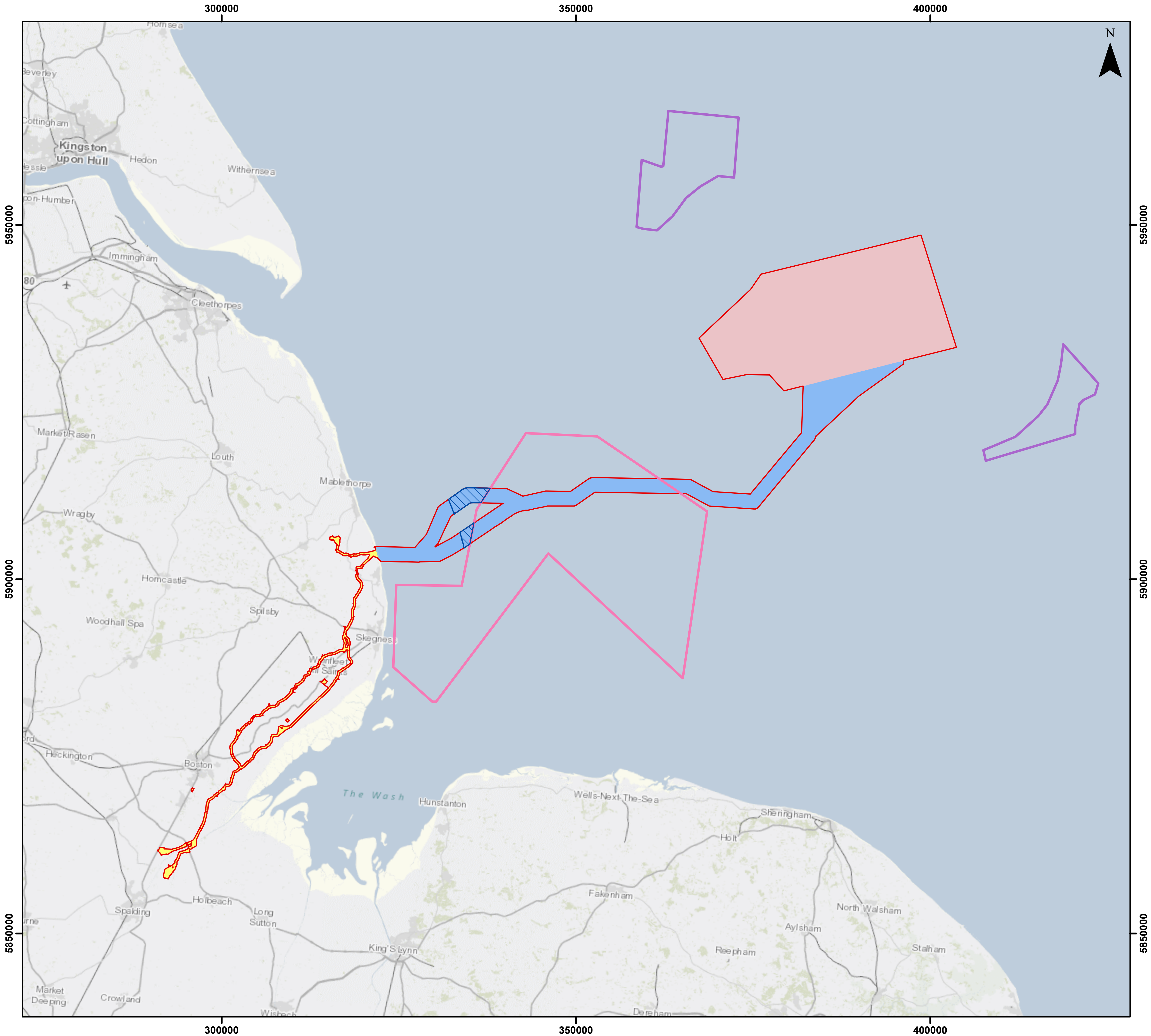
Offshore Export Cable Corridor (ECC)

3.4.4 To connect the array area to the National Grid Electricity Transmission System (NGET), export cables will be required, located within an offshore Export Cable Corridor (ECC) running from the array area to the Lincolnshire coast, which will then link to the onshore ECC.

3.4.5 The offshore ECC exits to the south of the array area, with a fan leading from the southern edge of the array. The offshore ECC will be a maximum of 101.4km in length and 2km in width. The waters depths along the ECC range from a maximum of -33.5m to +2.77m relative to LAT. The offshore ECC crosses some existing pipelines to the south of the array area, before turning west to pass through the Inner Dowsing, Race Bank and North Ridge Special Area of Conservation (SAC), south of the existing Triton Knoll offshore windfarm export cables. At the western extent of the Inner Dowsing, Race Bank and North Ridge SAC, the offshore ECC splits at this preliminary stage, to provide optionality on final routing, before the two sections join to the east of Wolla Bank, where the offshore ECC makes landfall. Further details can be found in Volume 1, Chapter 4: Site Selection and Consideration of Alternatives.

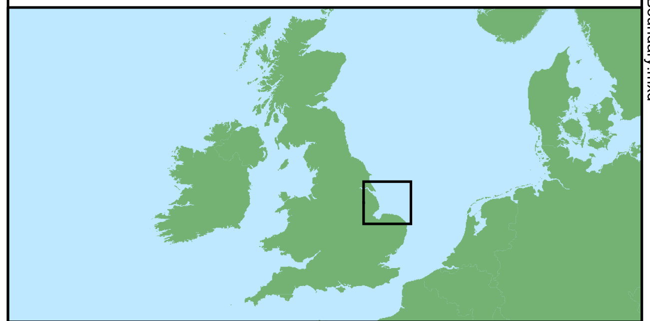
3.4.6 The landfall for the offshore export cables is planned to be at Wolla Bank, on the Lincolnshire coastline, south of Anderby Creek (Figure 3.2).

3.4.7 Onshore export cables will be laid within an onshore ECC from the landfall to a substation located in the vicinity of the grid connection; currently, subject to the grid connection offer that will be made by National Grid, this will be either at a location inshore of the landfall to the west of the village of Huttoft (referred to as the 'Lincolnshire Node') or in an area of south Lincolnshire, to the northeast of Spalding, in an area referred to as Weston Marsh'.



Legend

- Onshore and Offshore PEIR Boundary
- Array Boundary
- Offshore Export Cable Corridor
- Onshore ECC Corridor and Substations
- ORCP Search Area
- Artificial Nesting Structure Search Area
- Biogenic Reef Restoration Search Area



Coordinate System: WGS 1984 UTM Zone 31N

0 10 20 km

Scale: 1:500,000

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Offshore and Onshore PEIR Boundary

Figure 3.1

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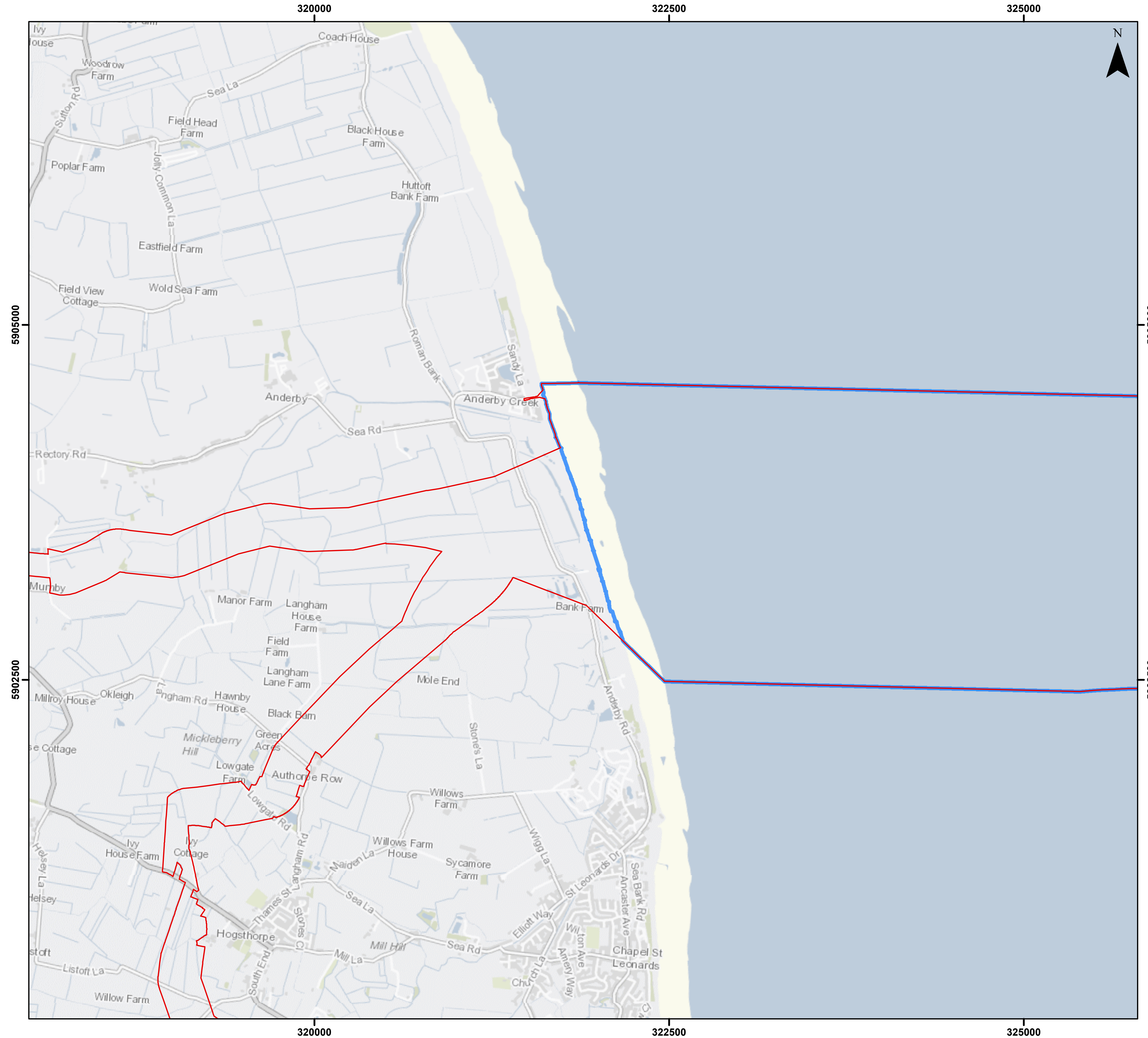
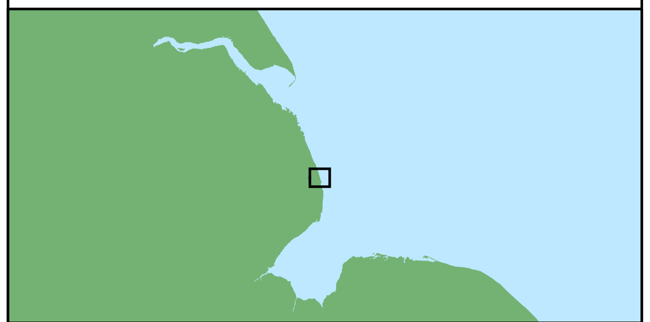


Legend

- Onshore and Offshore PEIR Boundary
- Offshore Export Cable Corridor



Coordinate System: WGS 1984 UTM Zone 31N

0 0.5 1 km

Scale: 1:25,000

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Landfall Location for the Offshore Export Cable Corridor

Figure 3.2

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Onshore Export Cable Corridor (ECC)

3.4.8 The offshore ECC will make landfall at Wolla Bank, to the south of Anderby Creek (Figure 3.3), where cables will be installed using trenchless techniques to pass under the

- intertidal area,
- sand dunes,
- coastal Lincolnshire Wildlife Trust sites (Anderby Marsh, Wolla Bank Reedbed, and Wolla Bank Pit),
- the Clay Pits Site of Special Scientific Interest (SSSI) and
- the Wolla Bank to Chapel Point SSSI,

3.4.9 to connect into the transition joint bay (TJB) compound on agricultural land to the west of Roman Bank. Three options are currently being explored for the substation location, which is due to be decided by NG. These three options have three potential routes.

3.4.10 From the transition joint bays, the onshore ECC runs to the grid connection point at either the Lincolnshire Node east of Alford, or Weston Marsh, to the north of Spalding (two OnSS locations are being considered at Weston Marsh, one to the north of the river Welland and one to the south). The width of the PEIR redline boundary is 300m. Whilst the width of the cable corridor may fluctuate along the route to account for specific environmental or engineering constraints, the Project will require a typical working width of 80m during cable construction, reducing to a typical 60m wide corridor post construction. Where trenchless crossing techniques are required, this working width may need to be larger to accommodate this type of crossing. The maximum distance to the Weston Marsh OnSS is approximately 80km and to Lincolnshire Node OnSS is approximately 11km. The following sections describe the spatial extent of the onshore ECC options that are assessed within the PEIR. To make navigation of this section easier for the reader, the ECCs have been split into the sections presented below and within Figure 3.3 and Figure 3.5.

Table 3.1: Onshore ECC Project Parameters

Project Parameter	Dimension
Typical width of PEIR redline boundary	300m
Typical construction working width	80m
Typical post construction easement	60m
Approximate length of cable corridor to Weston Marsh	80km
Approximate length of cable corridor to Lincolnshire Node	11km

Landfall to Lincolnshire Node

3.4.11 The Landfall to Lincolnshire Node ECC option has a total length of approximately 11km from the landfall at Wolla Bank to the southern edge of the substation search area north of Thurlby.

3.4.12 This onshore ECC option has been divided into two segments, divided by identifiable land boundaries, in this case the A52, as presented in Figure 3.3:

- LN1 - Landfall to A52 – Mumby; and

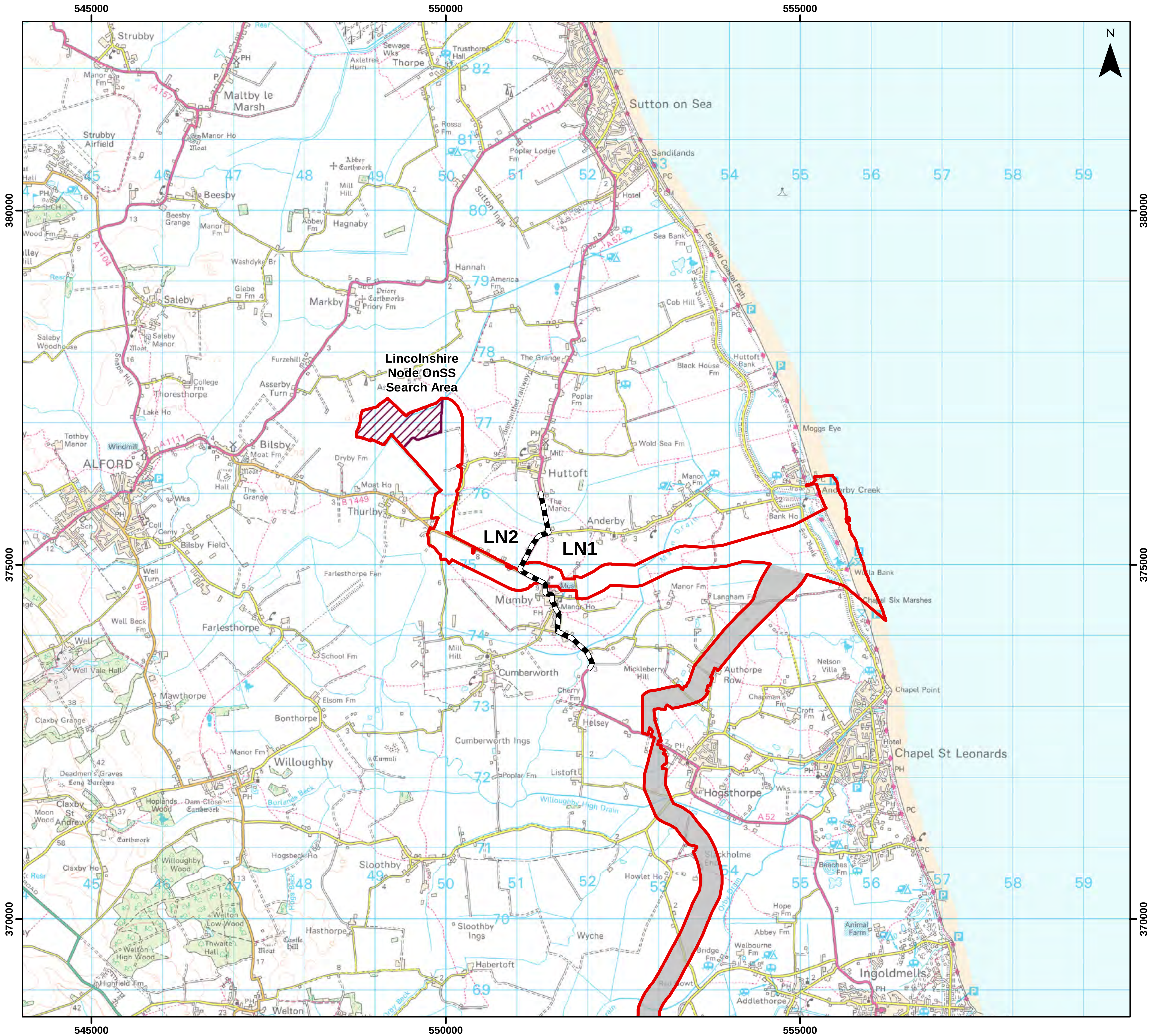
- LN2 - A52 – Mumby to Lincolnshire Node.

Table 3.2: Lincolnshire Node Onshore ECC Segment Description

Segment	General Direction	Link to Figure	Key Features and Receptors
LN1	West	Figure 3A1:LN1 - Landfall to A52 – Mumby	▪ Agricultural land, ▪ Main Drain, ▪ Small copse of trees ▪ A52
LN2	Northwest	Figure 3A2:LN2 - A52 – Mumby to Lincolnshire Node	▪ Agricultural land, ▪ Hedges, ▪ Small copse and lines of trees ▪ A52

Lincolnshire Node OnSS Search Area

3.4.13 The Lincolnshire Node OnSS search area comprises an approximate 53ha area of agricultural land north of Thurlby and south of Asserby. The site is bisected by the Boy Grift Drain and is bound on its southern edge by a line of trees/hedge that demark another drainage ditch. The interior of the search area is entirely agricultural with no other distinguishing features. Another small copse is located on the western edge of the search area.



Legend

- Onshore PEIR Boundary
- Onshore Segment Break
- Lincolnshire Node OnSS Search Area

Sources:

Coordinate System: British National Grid

0 1 2 km

Scale: 1:50,000

Preliminary Environmental Information Report

Landfall to Lincolnshire Node
ECC Sections

Figure 4.3

OUTER DOWSING OFFSHORE WIND

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Landfall to Weston Marsh

3.4.14 The location of the grid connection at Weston Marsh has not yet been finalised. At present, two options for the OnSS location are under consideration, which comprise:

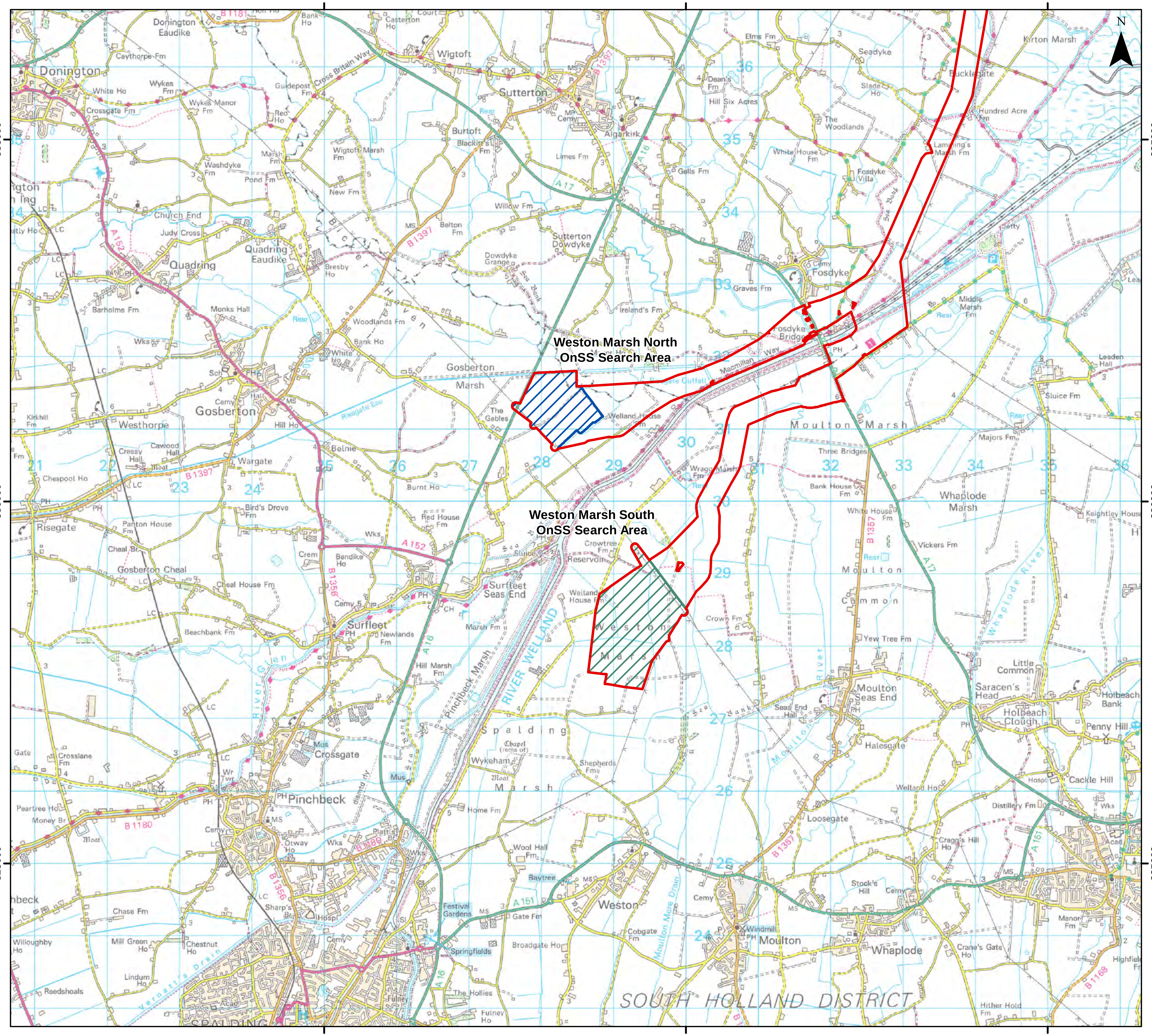
- Weston Marsh North - located on agricultural land on the north side of the River Welland, east of the A16 and south of the Risegate Eau (Drain); and
- Weston Marsh South - located on agricultural land in the vicinity of the existing Tee-Junction adjacent to the existing National Grid 400kV overhead electrical transmission lines on the south side of the River Welland.

3.4.15 These two options are shown on Figure 3.4. Both options have a maximum length of approximately 80km.

3.4.16 The onshore ECC, which would connect to either of these two substation locations would follow the same corridor from landfall, only differing when it meets the River Welland, with one option remaining on the north side of the river, and the other option crossing. The onshore ECC is divided and further described in the following pages. The divided ECC sections are stipulated below.

- WM1 - Landfall to A52 – Hogsthorpe;
- WM2 - A52 – Hogsthorpe to Marsh Lane;
- WM3 - Marsh Lane to A158 – Skegness Road;
- WM4 - A158 – Skegness Road to Low Road;
- WM5 - Low Road to Steeping River;
- WM6 - Steeping River to Ivy House Farm / Marsh Yard;
- WM7 - Ivy House Farm / Marsh Yard to Staples Farm;
- WM8 - Staples Farm to Crowhall Lane;
- WM9 - Crowhall Lane to Church End Lane;
- WM10 - Church End Lane to The Haven;
- WM11 - The Haven to Marsh Road;
- WM12 - Marsh Road to Fosdyke Bridge;
- WM13 - Fosdyke Bridge to Weston Marsh Substation North; and
- WM14 - Fosdyke Bridge to Weston Marsh Substation South.

3.4.17 These sections are shown on Figure 3.5.



Legend

- Onshore PEIR Boundary
- Weston Marsh North OnSS Search Area
- Weston Marsh South OnSS Search Area

Sources:

Coordinate System: British National Grid

0 1 2 km

Scale: 1:50,000

Preliminary Environmental Information Report

Potential OnSS Site Locations at Weston Marsh North and Weston Marsh South

Figure 4.4

OUTER DOWSING OFFSHORE WIND

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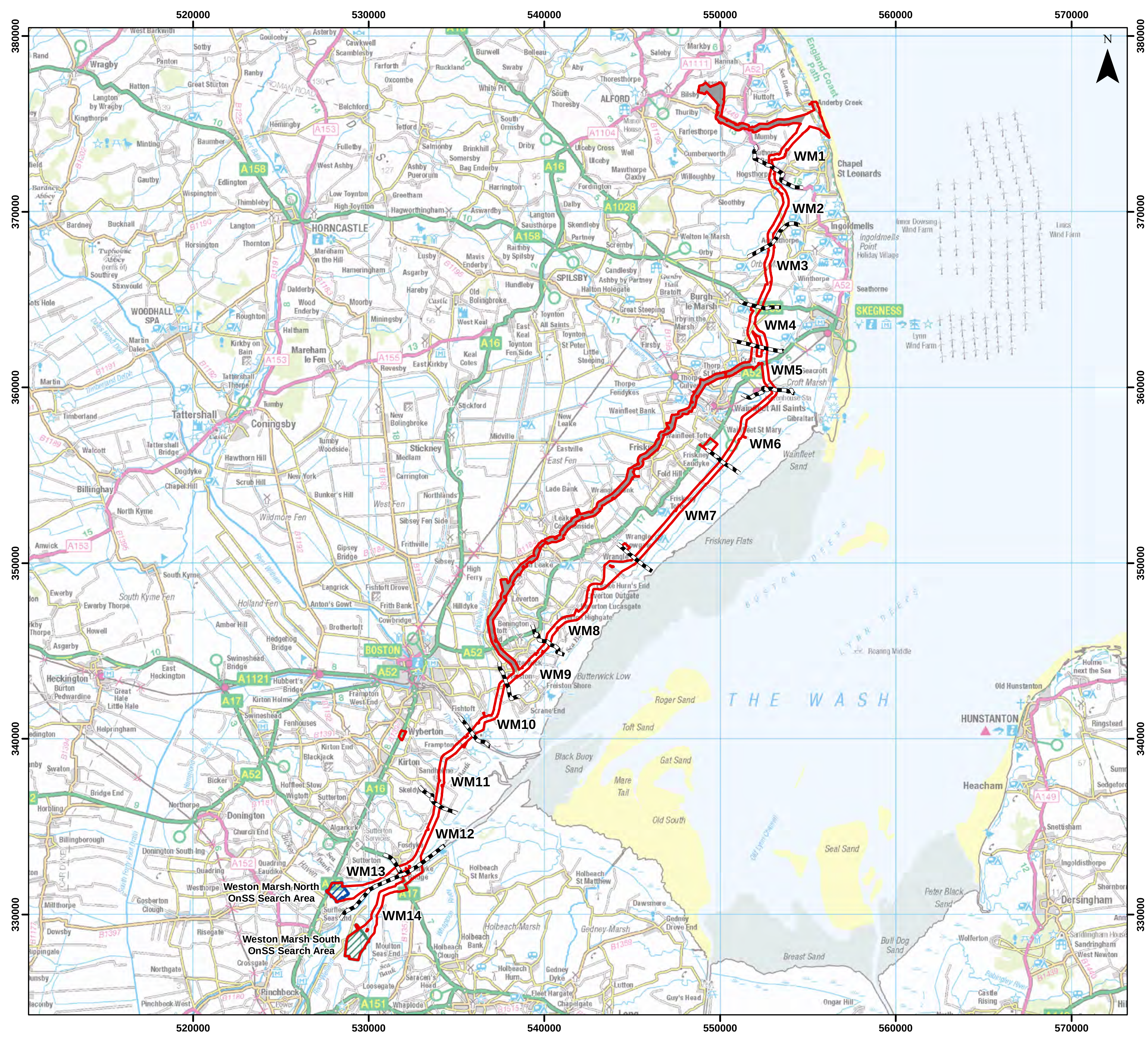

Legend

- Onshore PEIR Boundary
- Onshore Segment Break
- Weston Marsh North OnSS Search Area
- Weston Marsh South OnSS Search Area

Sources:

Coordinate System: British National Grid

0 5 10 km

Scale: 1:200,000

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Landfall to Weston Marsh ECC Sections

Figure 4.5

OUTER DOWSING OFFSHORE WIND

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Table 3.3: Weston Marsh Onshore ECC Segment Description

Segment	General Direction	Link to Figure	Key Features and Receptors
WM1	Heading west from landfall	Figure 3A3:WM1 - Landfall to A52 – Hogsthorpe	▪ Lincolnshire Wildlife Trust Anderby Marsh ▪ Agricultural Land ▪ Wigg Drain ▪ Large pond ▪ Langham Road and Lowgate Road ▪ A52
WM 2	South	Figure 3A4:WM2 - A52 – Hogsthorpe to Marsh Lane	▪ Agricultural land ▪ Willoughby High Drain and Orby Drain ▪ Listoft Lane and Sloothby High Lane
WM 3	South	Figure 3A5:WM3 - Marsh Lane to A158 – Skegness Road	▪ A158 ▪ Caravan site ▪ Fishing ponds ▪ Agricultural land ▪ Ingoldmells Road and Younger's Lane
WM 4	South	Figure 3A6:WM4 - A158 – Skegness Road to Low Road	▪ Agricultural land ▪ Catchwater Drain ▪ Rookery Farm ▪ Billgate Lane and Middlemarsh Road
WM 5	South	Figure 3A7:WM5 - Low Road to Steeping River	▪ Agricultural land ▪ A52 ▪ Croft Drain ▪ Havenhouse railway lines ▪ Top Yard Farm Caravan site ▪ Ponds ▪ Rose Cottage
WM 6	South west	Figure 3A8:WM6 - Steeping River to Ivy House Farm / Marsh Yard	▪ Agricultural land ▪ Sea Bank and Sea Lane
WM 7	South west	Figure 3A9:WM7 - Ivy House Farm / Marsh Yard to Staples Farm	▪ Agricultural land ▪ Wrangle Drain ▪ Sea Lane
WM 8	West south west	Figure 3A10:WM8 -	▪ Agricultural land

Segment	General Direction	Link to Figure	Key Features and Receptors
		Staples Farm to Crowhall Lane	▪ Hurns End, Sea Lane, Oldfield Lane, Lucasgate-Spicer's Lane and Churchway
WM 9	South west	Figure 3A11:WM9 - Crowhall Lane to Church End Lane	▪ Agricultural land ▪ Sea Lane, Crowhall Lane, Shore Road and Watery Lane
WM 10	South west	Figure 3A12:WM10 - Church End Lane to The Haven	▪ Hobhole Drain ▪ Southfield Farm ▪ Pilgrim Fathers Memorial Site ▪ Cut End Road, Woad Lane, Southfield Lane, The Graft, Scalp Road, Clampgate Road, Grovefield Lane and Mickleham Lane
WM 11	South south west	Figure 3A13:WM11 - The Haven to Marsh Road	▪ Frampton Road, Sandholme Lane ▪ Agricultural land ▪ Wyberton Branch Drain, Wyberton Marsh Pump Drain, Boundary Drain, Junction Drain, Frampton Towns Drain
WM 12	South west	Figure 3A14:WM12 - Marsh Road to Fosdyke Bridge	▪ Agricultural land ▪ Kirton Drain ▪ Thompson's Lane, Pot Lane, Cravens Lane, Wash Road and Pullover Lane ▪ Ponds
WM 13	South west	Figure 3A15:WM13 - Fosdyke Bridge to Weston Marsh Substation North	▪ Agricultural land ▪ Five Town Drain, Risegate Eau and Bicker Creek ▪ The Mooring's Café ▪ Graves Farm ▪ Bram Lea ▪ Risegate Eau Pumping Station
WM 14	South south west	Figure 3A16:WM14 - Fosdyke Bridge to Weston Marsh Substation South	▪ Agricultural land ▪ A17 ▪ Lord's Drain ▪ The Old Row Coastguard

Landfall to Weston Marsh Alternative ECC Route

3.4.18 Following the publication of the Scoping Report and preliminary non-statutory public consultation held in October 2022, a number of questions were raised by landowners and members of the public about the complexity of constructing the onshore ECC across the agricultural land south of the A52.

3.4.19 These questions were related to:

- Potential geotechnical complications due to the presence of 'running sands' which could affect the future depth of cover to the cable and ability to run heavy machinery across the area during construction;
- Drainage complications due to the presence of a large networks of agricultural field drains, and
- The potential economic effect from damage to high value crops.

3.4.20 To address these concerns, the Project has developed and is considering an alternative section of onshore ECC that has been designed to avoid these issues. At this stage, both of these route options are under consideration, and a decision on which is taken forward will be subject to the findings of further study, and the outcome of the OTNR. This alternative route runs approximately parallel to the initial portion of the Landfall to Weston Marsh onshore ECC but located approximately 3km further west on the west side of the A52. These sections are shown on Figure 3.6. However, both options are still under consideration.

3.4.21 This potential alternative section of the ECC route option has been divided into the following sections:

- A1 - Low Road to Steeping River;
- A2 - Steeping River to Fodder Dike Bank/Fen Bank;
- A3 - Fodder Dike Bank/Fen Bank to Broadgate;
- A4 - Broadgate to Ings Drove; and
- A5 - Ings Drove to Church End Lane.

Table 3.4: Alternative Weston Marsh Onshore ECC Segment Description

Segment	General Direction	Link to Figure	Key Features and Receptors
A1	South west	Figure 3A17:A1 - Low Road to Steeping River	▪ Pinchbeck Lane, Church Lane, Croft Lane, East End Road, B1195, Brewster Lane, Collision Gate and Crow's Bridge. ▪ Lymn River ▪ Agricultural land ▪ Railway line ▪ Wainfleet Relief Channel and Weir Dike
A2	South west	Figure 3A18:A2 - Steeping River to Fodder Dike Bank/Fen Bank	▪ Church lane, Scaldgate Road, Burgh Road ▪ Agricultural land ▪ Woodland ▪ Hall Gate Road farm track
A3	South west	Figure 3A19:A3 - Fodder Dike Bank/Fen Bank to Broadgate	▪ Cranberry Lane, Mill Hill, Small End Road, Skirmore Road, Patmans Lane and Ivery Lane ▪ Agricultural land
A4	South west	Figure 3A20:A4 - Broadgate to Ings Drove	▪ Agricultural land ▪ Residential properties close to Cragmire Lane, Double Bank, Manor Lane, Seadyke Lane, Fold Hill Road, the B1184 (Church Road), Pode Lane and Skip Marsh Lane ▪ Woodland
A5	South south west	Figure 3A21:A5 - Ings Drove to Church End Lane	▪ Benington Ings and Ings Bank ▪ Agricultural land ▪ A52 ▪ Butterwick Road, Girls School Lane and Shore Road ▪ The Leverton Solar Park and Substation ▪ Lowfields Lodge

Legend

- Onshore PEIR Boundary
- Onshore Segment Break

Sources:

Coordinate System: British National Grid

0 2 4 km

Scale: 1:80,000

Preliminary Environmental Information Report

Landfall to Weston Marsh
Alternative ECC Route Sections

Figure 4.6

OUTER DOWSING OFFSHORE WIND

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3.5 Project Infrastructure Overview

3.5.1 The Project will be comprised of wind turbine generators (WTGs), offshore substations (OSSs), array, interlink and export cables, accommodation platforms and all the necessary associated development required to transmit the power generated by the turbines to the connection to the National Grid transmission network (the grid connection location). It will also comprise of any additional associated development and ancillary works required to construct, operate and maintain the Project, such as, for example, metocean measuring instruments such as wave buoys and Floating LiDAR (FLiDAR).

3.5.2 The Project will have a maximum of 93 WTGs installed to meet a maximum installed generating capacity of 1500MW (1.5GW). The WTGs will be connected in strings, branches or loops to offshore substations via array cables with the offshore substations then connected to shore by up to four offshore export cables.

3.5.3 The Project has confirmed that only a single transmission technology type, specifically High Voltage Alternating Current (HVAC) (i.e. specifically excluding High Voltage Direct Current (HVDC) technology), will be used and this forms the basis of the relevant assessments in this PEIR.

3.5.4 Depending on the final export cable parameters and the offshore substation location within the array area, up to two Offshore Reactive Compensation Platforms (ORCPs) may also be required, which will be situated within the ORCP search area within the offshore ECC (Figure 3.2).

3.5.5 At the landfall, the offshore export cables will be jointed to the onshore export cables at transition joint bays. There will be up to 12 cables within four onshore circuits in up to four trenches connecting to an OnSS to allow the power to be transferred to the National Grid via a National Grid Substation.

3.5.6 In addition, depending on the final grid connection location and agreement with NGET, the Project may also seek consent for the construction of the National Grid Substation as part of the DCO application.

Overview of Main Project Components

3.5.7 The key components of the Project are summarised in Table 3.5 and subsequently described in the following sections.

Table 3.5: Key project components

Project location	Infrastructure component	Detail	Details included in:
Array	Wind Turbine Generators (WTGs)	The WTGs convert wind energy to electricity. Key components include rotor blades, gearboxes (if required for WTG model), transformers, power electronics and control equipment. Offshore turbine models are continuously evolving and improving; therefore, the exact wind	Table 3.6

Project location	Infrastructure component	Detail	Details included in:
		turbine model will be selected post-consent from the range of models available at the time of procurement, with a range of maximum parameters for turbines identified herein rather than a specific turbine output rating.	
Array	Offshore Platforms (OPs)	OPs include offshore substations (OSS), which collect the power generated by WTGs through the array cables, convert the electricity from the array voltage to the transmission voltage and transmit the power to the offshore export cables. They also may include accommodation platforms to host personnel during the operational lifetime of the windfarm.	Table 3.12
Array	Foundations	WTGs and OPs will be supported by foundation structures permanently attached to the seabed. These are typically fabricated from steel or concrete. A limited number of foundation designs is currently being considered. These designs are described in Section 3.6	Table 3.7 to Table 3.11
Array	Array cables	Subsea cables that will connect the WTGs to each other and to one of the offshore substations, typically in strings, branches or loops.	Table 3.16
Array and offshore ECC	Scour and cable protection	In order to protect the seabed around the foundation structures from scour and to protect the array, export and interlink cables in the event that full or adequate burial cannot be achieved (or where other seabed assets are crossed), protection materials may be placed on the seabed.	Table 3.20
OSS	Interlink cables	Subsea cables that will that connect the OPs. Cable parameters may be either as per array cables or offshore export cables.	Table 3.16 Table 3.18
Offshore ECC	Offshore export cables	Cables connecting the OSSs to the onshore export cables at the landfall on the adjacent coastline.	Table 3.18
Offshore ECC	Offshore Reactive Compensation Platforms	Depending on the final export cable route length, it may be necessary to compensate for the reactive power within the supply by installing up to two ORCPs.	Table 3.12

Project location	Infrastructure component	Detail	Details included in:
Landfall	Landfall and Transition Joint Bay	The landfall is the area where the offshore export cables are brought ashore and jointed to the onshore cables in TJBs.	Table 3.25
Onshore ECC	Onshore export cables	Cables installed following the route between the landfall and the OnSS.	Table 3.27 Table 3.31.
Onshore substation (OnSS)	Onshore Substation Site	The OnSS will include the necessary electrical plant to meet the requirements of the National Grid Electricity System Operator (NGESO).	Table 3.32
Onshore ECC	Grid connection	Cables connecting the OnSS to the National Grid substation.	Section 0
National Grid connection location	Grid connection	Assumed to be proximal to the OnSS options.	Section 0

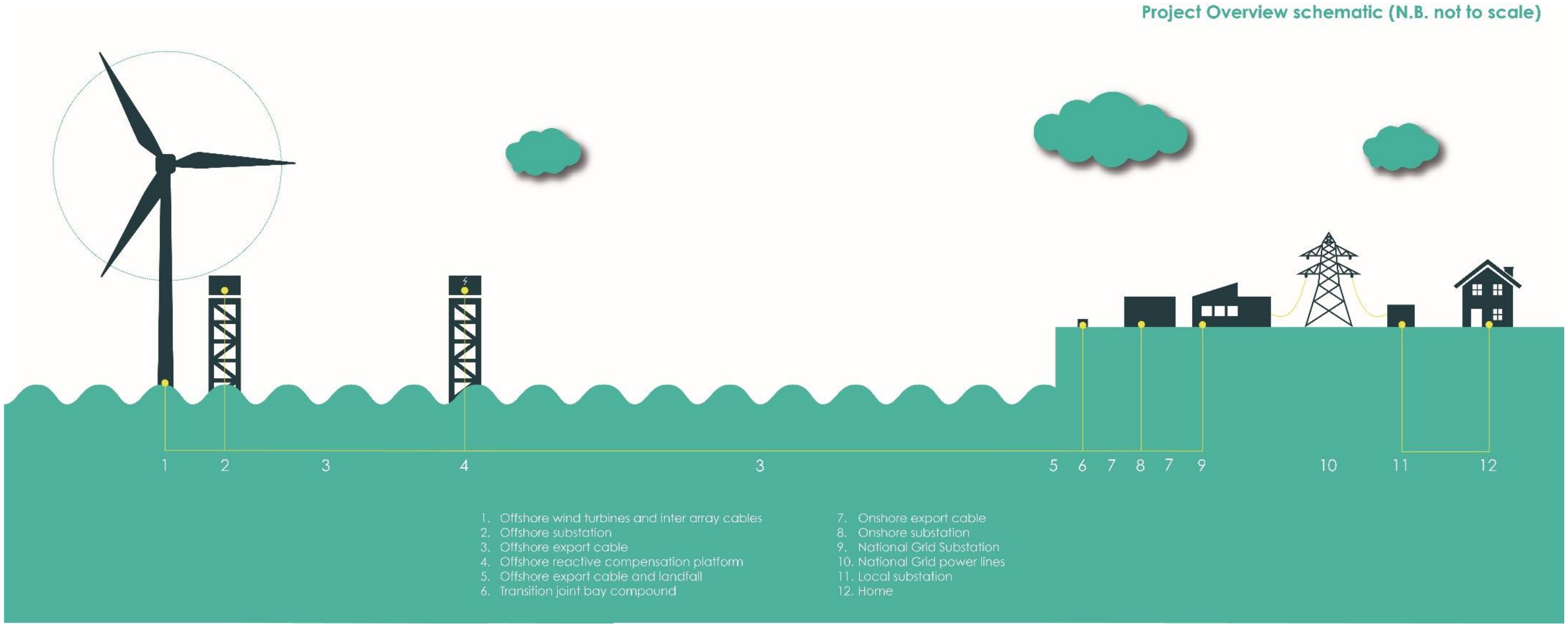

Figure 3.7: Key project components

3.6 Offshore Infrastructure Construction

Wind Turbine Generators (WTGs)

Design

3.6.1 The indicative key design parameters for the WTGs are presented in Table 3.6. The WTGs will incorporate tapered tubular towers supporting a nacelle housing mechanical and electrical generating equipment and with three rotor blades attached to the nacelle rotor hub (Figure 3.8). All WTGs will be located within the offshore array area; note that the final layout of the WTGs will be determined post-consent but will be subject to final approval and governed by agreed layout principles. The final selection of the WTG to be used will be identified post-consent. However, to inform the assessment, four variations of WTG parameters (i.e. WTG types), based on maximum rotor sizes have been identified.

Table 3.6: WTG indicative key design parameters

Parameters	Design Envelope
Maximum number of WTGs	93
Indicative maximum number of WTGs assuming maximum rotor diameter	50
Maximum blade tip height above LAT (m)	403
Maximum rotor diameter (m)	340
Minimum height of lowest blade tip against mean sea level (m)	30

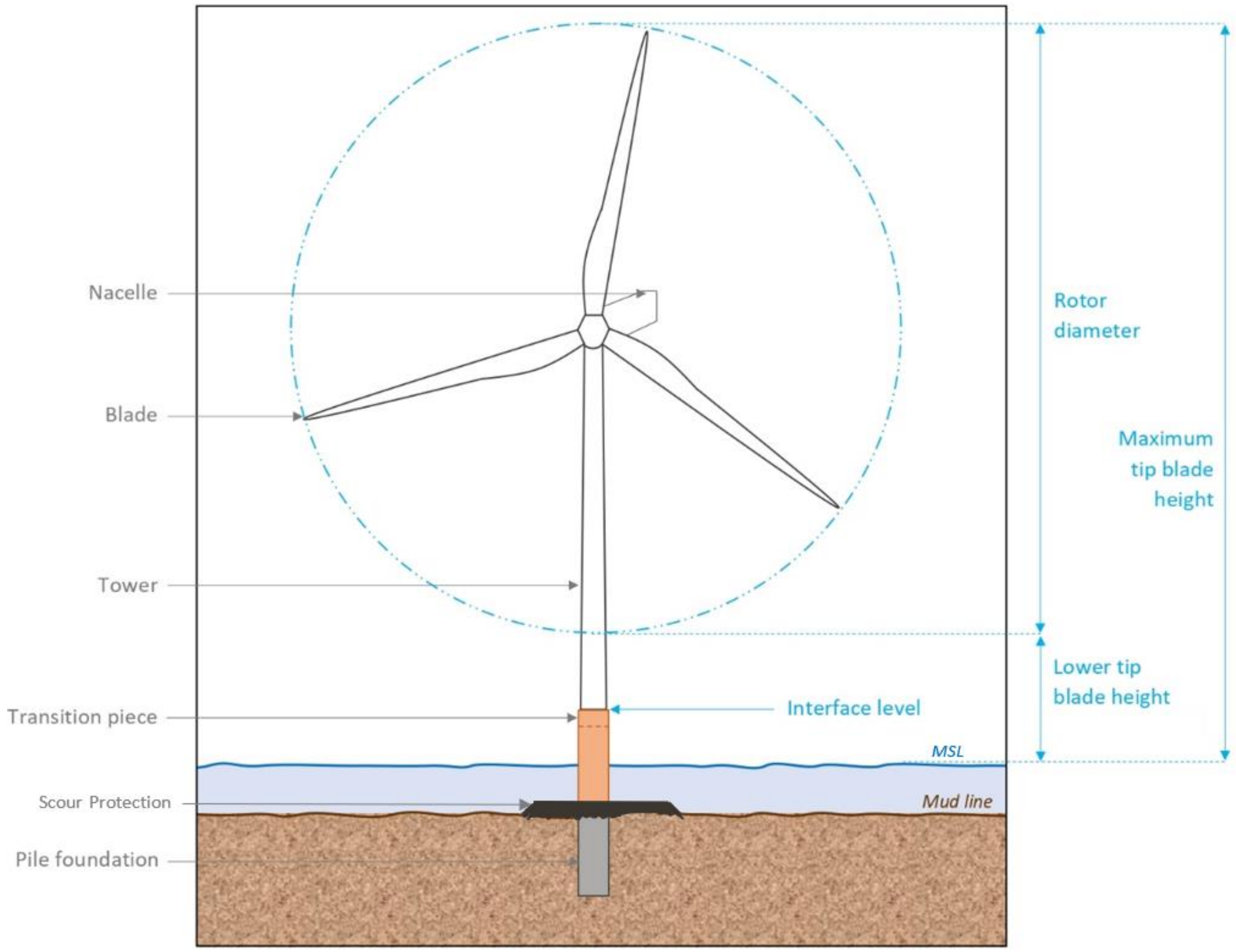

Figure 3.8: Typical Wind Turbine Generator

WTG Installation

3.6.2 Generally, turbines are installed using the following process:

- Wind turbine generators (WTGs) are installed upon their respective foundation type (see paragraph 3.6.6 *et seq.*);
- WTG components (blades, nacelles, and towers) are collected from port by the installation vessel, typically a jack up vessel (JUV) to ensure a stable platform for installation vessels when on site.
- JUV operations with a maximum disturbance area of 1,500m^2 per operation. Typically, the JUV will carry all of the necessary components to complete the installation of several WTGs during each trip.
- Where additional components are brought to the installation location by supply vessels such as barges, there may be a requirement to anchor alongside the installation vessel. For such operations, there will be a maximum of 388 anchoring operations with a maximum disturbance of 800m^2 per operation for the construction phase;

- The installation vessel will transit to the Project array area and the components will be lifted onto the pre-installed transition piece or foundation substructure, by the crane on the installation vessel. Each wind turbine generator will be assembled on site in this fashion with technicians fastening components together as they are lifted into place. The exact methodology for the assembly is dependent on WTG type and installation contractor, and will be defined in the pre-construction phase after grant of consent; or
- Alternatively, the WTG components may be loaded onto barges or dedicated transport vessels at port and installed as above by an installation vessel that remains on site throughout the installation campaign.

3.6.3 The total duration of the installation campaign for wind turbine generators is estimated to be a maximum of 19 months.

3.6.4 Each installation vessel or barge may be assisted by a range of support and transport vessels. These are typically smaller vessels that may be tugs, guard vessels, anchor handling vessels, or similar. These vessels will primarily make the same movements to, from and around the Project array area as the installation vessels they are supporting. Working distances are shown in Figure 3.10.

3.6.5 For the purposes of the EIA, assumptions have been made on the maximum number of vessels and helicopters and the number of return trips to the Project array area from port/airfield that are required throughout construction (Table 3.21).

Foundations

3.6.6 The factors influencing the choice of WTG and OP foundation for a specific project typically include (but may not be limited to):

- HSE and operational considerations;
- the type of wind turbine to be used;
- the nature of the ground conditions on the site;
- the water depth;
- sea conditions (i.e. prevailing wave and current climate); and
- supply chain constraints and overall cost.

Design

3.6.7 The foundation type selected will ultimately be dependent on the final detailed site investigations, engineering design studies and the procurement process. At this stage, a range of foundation types is being considered, based on what the Applicant currently knows about the prevailing site conditions and key design considerations, and is summarised in Table 3.7. Details on foundation installation methodologies are presented in Table 3.14.

Table 3.7: WTG foundation options

Type	Description	Example figure	Details provided in
Monopile foundation	Monopile foundations are tubular structures, consisting of a number of sections of rolled steel plates welded together. In most cases a Transition Piece (TP) is fitted over the monopile and secured via a bolted or grouted connection. In other cases, the monopile will connect directly to the wind turbine tower flange (a TP-less solution).	Figure 3.11	Table 3.8
Gravity base structure (GBS) foundation	GBS are typically concrete structures which are floated or transported via barge or installation vessel to site and then ballasted when in the correct location. The stability of the foundation is achieved by its weight.	Figure 3.12	Table 3.9
Pin piled jacket foundation	Piled jacket foundations are formed of a steel lattice construction (comprising tubular steel members and welded joints). The foundation is secured to the seabed by hollow steel pin-piles sitting within a sleeve or leg which is part of the jacket. Piling may take place either once the jacket is in position (post-piling), or alternatively piles can be pre-piled prior to jacket installation. The piles rely on frictional and end bearing properties of the seabed for support. Unlike monopiles, there is no separate TP; the TP and ancillary structures are fabricated as an integral part of the jacket.	Figure 3.13	Table 3.10
Suction bucket jacket foundation	Suction bucket jacket foundations are formed of a steel lattice construction (comprising tubular steel members and welded joints) fixed to the seabed by suction caissons. The suction buckets are typically hollow steel cylinders, capped at the upper end, which are fitted underneath the legs of the jacket structure. Seabed stability is achieved principally via skin friction of the suction bucket walls with the surrounding soils. Unlike monopiles, but similar to piled jacket foundations, there is no separate TP; the TP and ancillary structure is fabricated as an integrated part of the jacket structure and is not installed separately offshore.	Figure 3.14	Table 3.11

Figure 3.9: Foundation types and key parameters

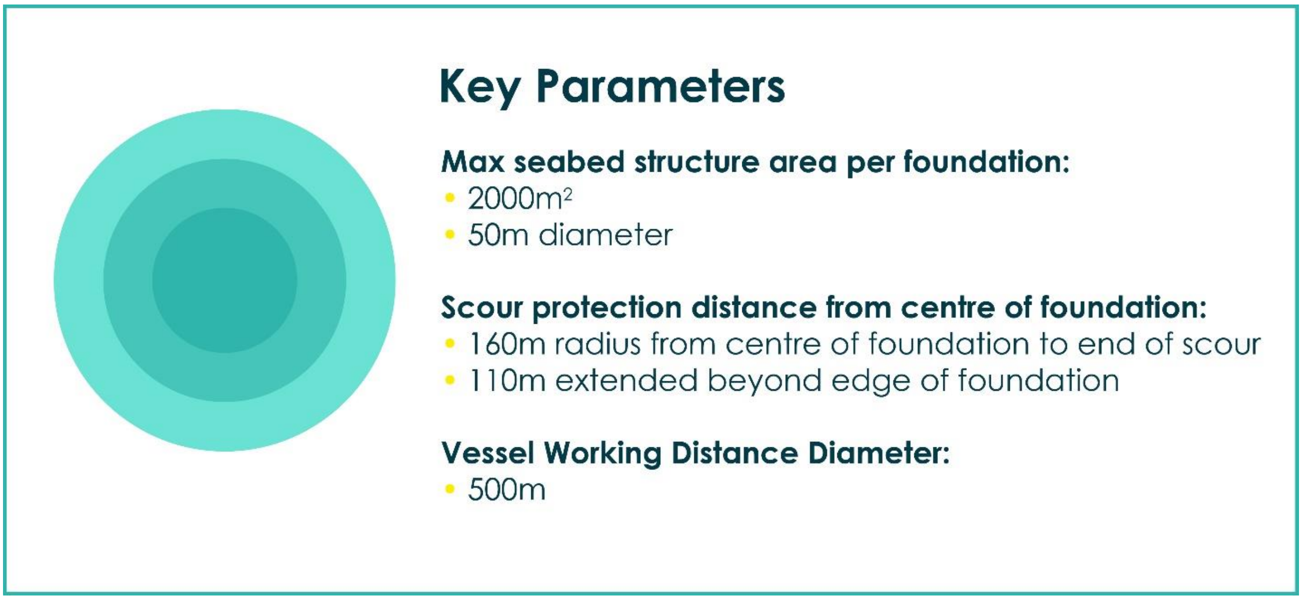

Figure 3.10 Key distance parameters including maximum foundation, scour protection and working distance diameters.

Monopile Foundations

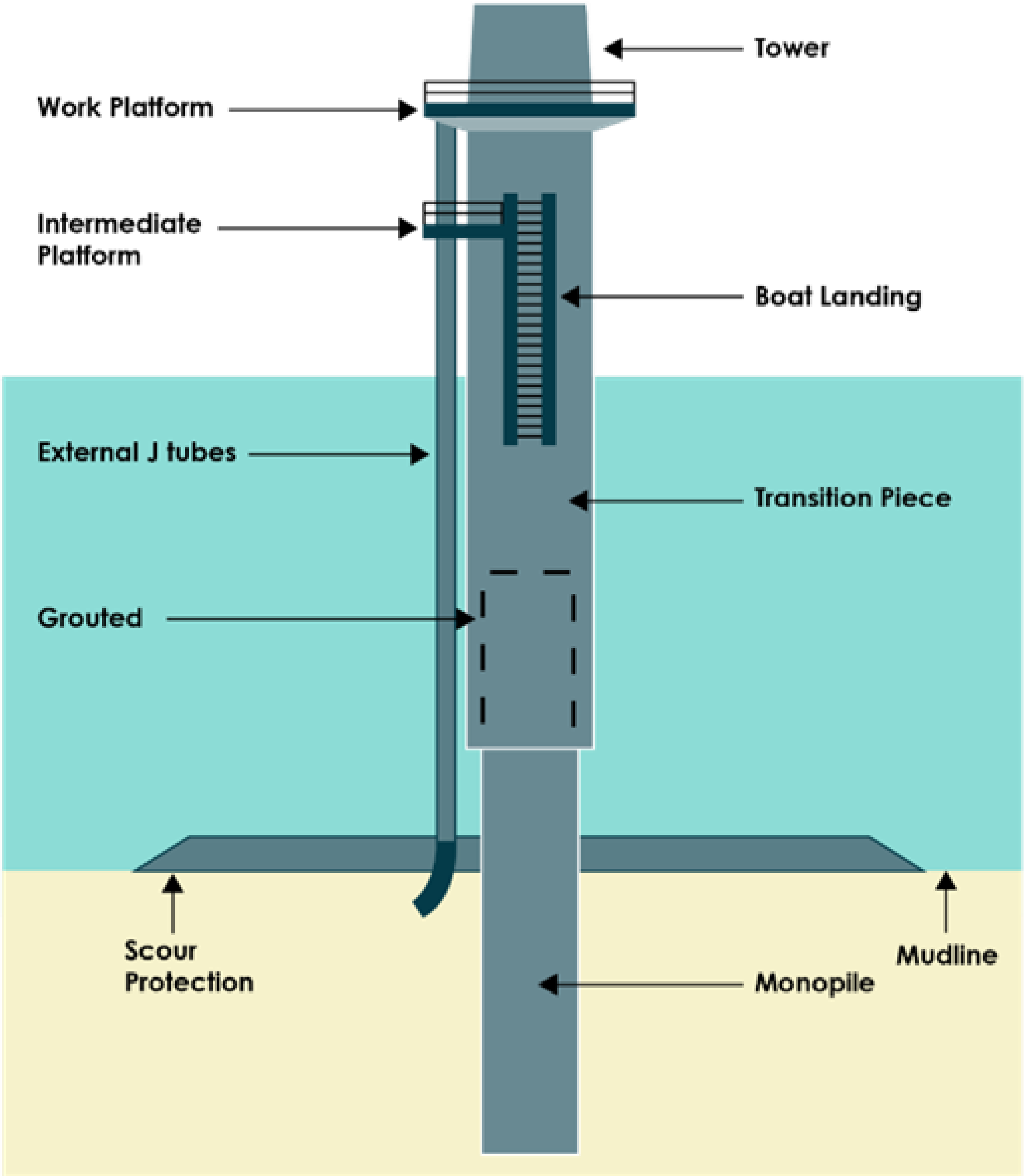

Figure 3.11: Example of indicative monopile foundation

Table 3.8: Maximum design parameters for monopile foundations

Parameter	WTG Type 1	WTG Type 2	WTG Type 3	WTG Type 4	OP
Number of piles (per foundation)	1				
Maximum diameter of monopile at seabed (m)	12.5		13		14
Maximum diameter of monopile at sea surface (m)	12.5		13		14
Maximum typical embedment depth below seabed (m)	48		50		
Maximum footprint on the seabed per foundation (excluding scour protection) (m^2)	125		135		160
Maximum Seabed scour protection area (m^2)	4,300		4,700		5,390
Maximum seabed total footprint (m^2)	4,425		4,835		5,550
Average drill spoil volume (m^3)	2,850		3,250	3,300	8,000
Maximum seabed preparation spoil volume (m^3)	2,220		2,420		2,775
Maximum scour protection volume per foundation (m^3)	12,900		14,100		16,170
Maximum piling duration (hours)	8				8

GBS Foundations

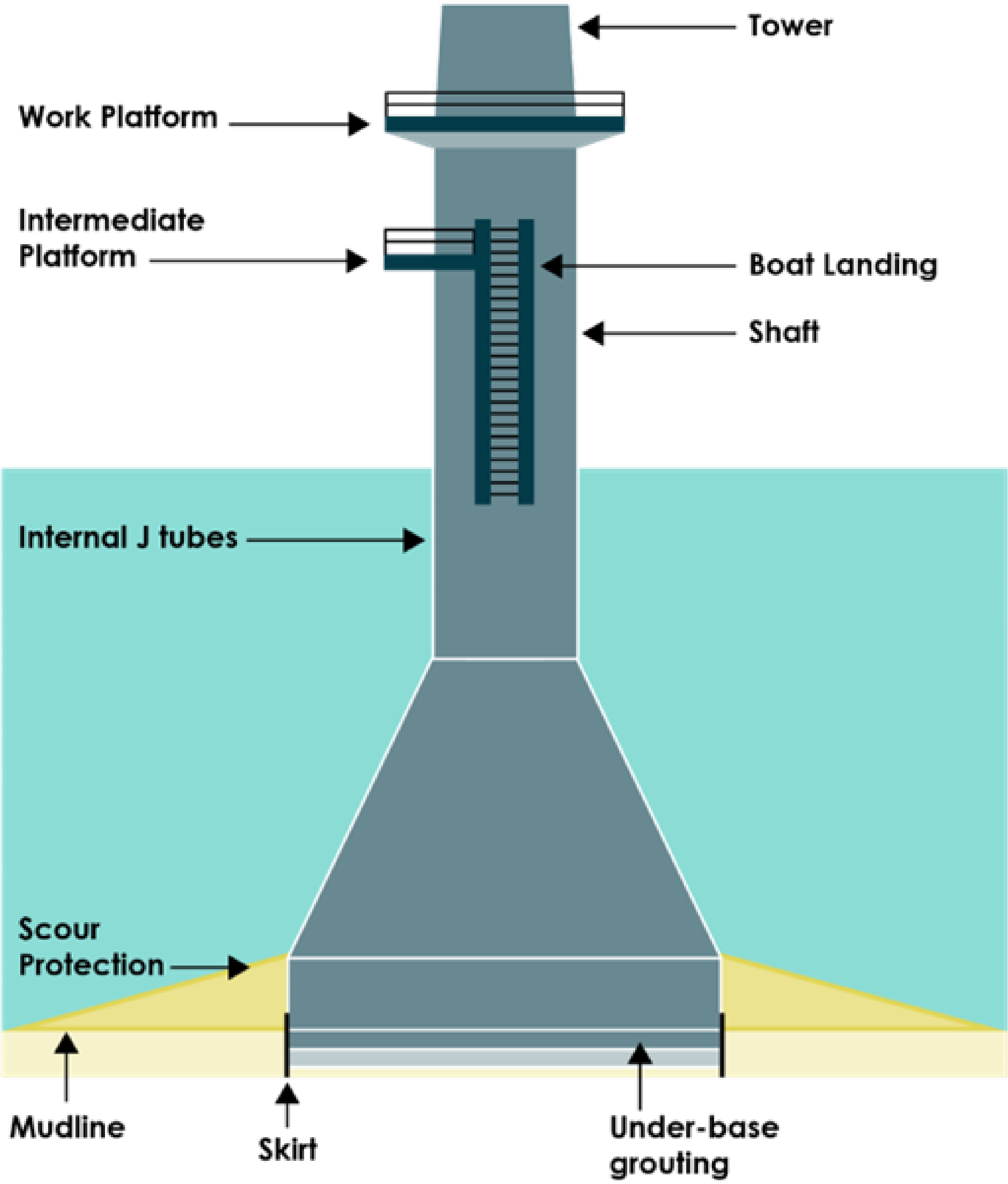

Figure 3.12: Example of indicative GBS monopile foundation type

Table 3.9: Maximum design parameters for GBS foundation type

Parameter	WTG Type 1	WTG Type 2	WTG Type 3	WTG Type 4	OP
Maximum length and width at seabed level (m)	50 (circular)		55 (circular)		72 X 36
Maximum area on seabed per foundation (excluding scour protection) (m^2)	2000		2400		2592
Maximum length and width at LAT (m)	14 (circular)		16 (circular)		16 (circular)
Seabed preparation buffer around base (m)	24				
Structure height relative to LAT (m)	20.5				25
Seabed preparation depth (m)	4.8				
Maximum seabed scour protection area (m^2)	10,300		12,500		13,650
Maximum seabed total footprint (m^2)	12,300		14,900		16,242
Maximum seabed preparation spoil volume (m^3)	36,300		40,100		48,500
Maximum scour protection volume (m^3)	30,900		37,500		41,000

Pin-piled Jacket Foundations

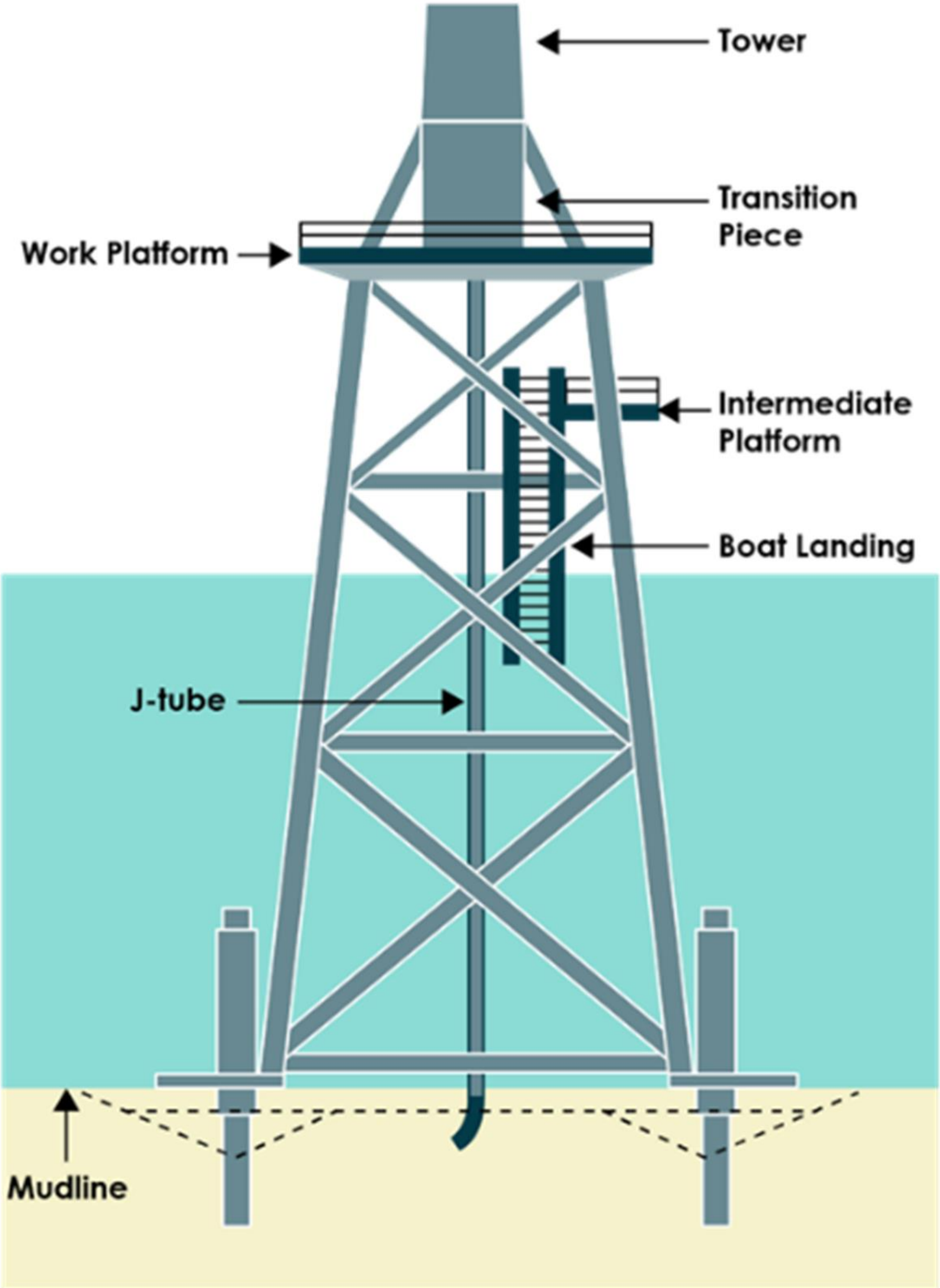

Figure 3.13: Example of indicative pin piled jacket foundation type

Table 3.10: Maximum design parameters for pin piled jacket foundations

Parameter	WTG Type 1	WTG Type 2	WTG Type 3	WTG Type 4	OP
Maximum number of piles per foundation	4				24
Number of piles per leg	1				3
Number of legs per foundation	4				8
Maximum separation of adjacent legs at seabed level (m)	36				80
Maximum separation of adjacent legs at LAT (m)	30				80
Maximum platform height above LAT (m)	32				
Maximum leg diameter (m)	4				
Maximum pile diameter (m)	5				
Maximum footprint on the seabed per foundation (excluding scour protection) (m^2)	78.6				1,500
Maximum seabed scour protection area (m^2)	1000				9,600
Maximum seabed total footprint (m^2)	1,078.6				9,800
Average drill spoil volume (m^3)	650		1750	1800	16,500
Maximum Seabed preparation spoil volume (m^3)	540				7,200
Maximum scour protection volume (m^3)	3,000				28,800
Maximum piling duration (hours)	8				8

Suction Based Jacket Foundations

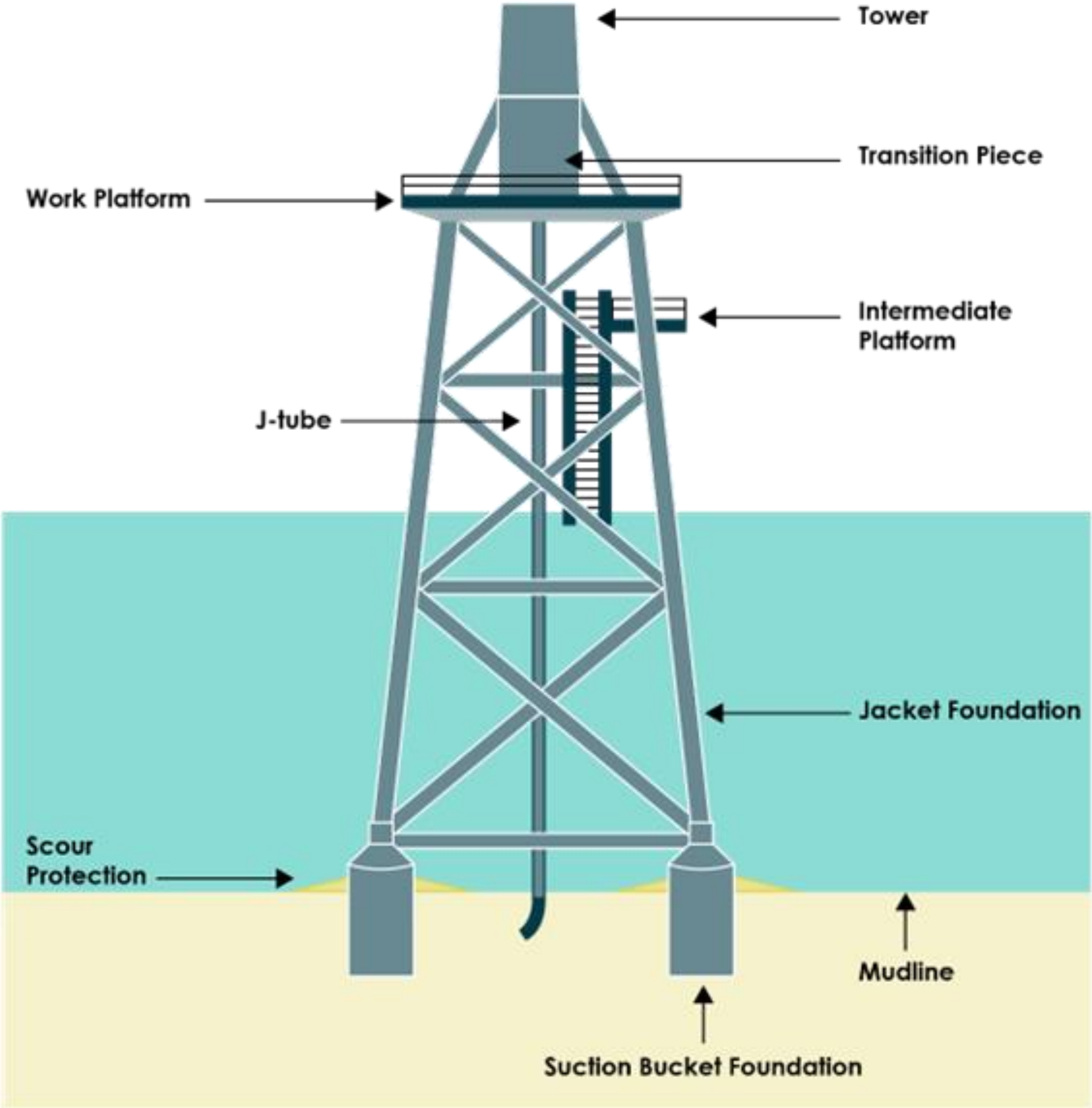

Figure 3.14: Example of indicative suction bucket jacket foundation type

Table 3.11: Maximum design parameters for suction bucket jacket foundation type

Parameter	WTG Type 1	WTG Type 2	WTG Type 3	WTG Type 4	OP
Maximum number of legs per jacket foundation	4				8
Maximum separation of adjacent legs at seabed level (m)	36				80
Maximum separation of adjacent legs at LAT (m)	30				80
Maximum suction bucket diameter (m)	18		20		
Maximum suction bucket height above seabed (m)	3				
Maximum typical embedment depth below seabed (m)	20				
Maximum number of suction buckets per foundation	4				8
Maximum footprint on the seabed per foundation (excluding scour protection) (m^2)	324		400		2,550
Maximum seabed scour protection area (m^2)	7,800		8,850		17,050
Maximum seabed total footprint (m^2)	8,200		9,300		19,600
Maximum seabed preparation spoil volume (m^3)	4,100		4,650		9,800
Maximum scour protection volume (m^3)	23,400		26,550		51,150

Foundation Installation

3.6.8 Table 3.14 summarises the steps required for installation for each of the foundation types.

Offshore Substations (OSSs)

3.6.9 OSSs are offshore structures housing electrical equipment to provide a range of functions, such as transforming the voltage. The key design parameters for the different OSS types are detailed below.

3.6.10 The OSSs will collect the electricity generated by the WTGs via the array cables. The electricity will then be "stepped up" before transmission (to reduce energy losses) by the offshore and onshore export cables to the interface with the National Grid transmission network. The voltage at the array cables will be 66kV or 132kV, interlink cables will be 66kV, 132kV, 220kV or 275kV and offshore export cables will be 220kV or 275kV.

3.6.11 Up to four separate smaller OSSs may be required or up to two separate OSSs if they are built to the larger design. All OSSs will be located within the Project array area.

Design

3.6.12 Each of the OSSs will comprise a platform with one or more decks, attached to the seabed by means of a foundation (see Table 3.8 to Table 3.11), containing equipment required to switch and transform electricity generated at the WTGs as well as means to facilitate helicopter access. They will also house auxiliary equipment and facilities for operating, maintaining, controlling the OSSs and to access the OSSs by vessels and helicopters. Accommodation, storage, workshop and logistic facilities for operating and maintaining the WTGs may also be included, such as LiDAR.

3.6.13 Key equipment in the OSSs shall include grid transformers, auxiliary/earthing transformers, fixed shunt reactors, harmonic filters, if required, HV and MV switchgear, Auxiliary systems and LV switchgear, Protection and metering equipment, SCADA, Emergency/standby generators, HVAC, UPS and battery systems, fire fighting systems, lighting, NavAids, systems for vessel access and/or retrieval, potable water supply, black water separation, storage (including stores, fuel, and spares), communication systems, control hub facilities and lifting equipment (main crane, service cranes, and gantry cranes).

3.6.14 The maximum design parameters for the OSSs are shown below in Table 3.12.

Table 3.12: Maximum design parameters for offshore substations

Parameters	Substation type	
	Large OSS	Small OSS
Number of independent structures	2	4
Topside – maximum main structure length (m)	160	90
Topside – maximum ancillary structure width (m)	110	90
Topside – maximum height (including auxiliary structures, such as helipad, crane, lightning	100	90

Parameters	Substation type	
	Large OSS	Small OSS
protection, but excluding antennae and masts) (m LAT)		
Topside maximum elevation from upper level of foundation to roof deck (m)	60	30
Topside - footprint (m^2)	17,600	8,100

Installation

3.6.15 OSSs are generally installed in two stages, firstly the foundation will be installed as described in Table 3.14, followed by the lifting of the topside from a transport vessel/barge, onto the foundation. The foundation and topside may be transported on the same transport vessel/barge, or separately. The foundation may also be transported by the installation vessel. Vessel requirements for the installation will be shown in Table 3.21 and Table 3.22.

Offshore Reactive Compensation Platform (ORCP)

3.6.16 Long distance, large capacity HVAC transmission systems can require reactive compensation equipment to reduce the reactive power generated by the capacitance of the offshore export cable to maximise the amount of power delivered to the National Grid transmission system. The electrical equipment required, primarily shunt reactors and HV switchgear will be in the form of HVAC ORCPs.

3.6.17 In order to reduce the area of the PEIR Boundary the ORCPs would only be located within the existing boundary already considered. The ORCPs would be located in the Project offshore ECC, rather than in the Project array area. For the purposes of the PEIR assessments, an ORCP search area of approximately 15km^2, approximately 12km from the shore, along the Project cable corridor has been identified. This search area has been chosen based on primarily electrical design studies, while aiming to avoid the SAC.

3.6.18 The final location of the ORCPs within the identified search area will be defined post-consent in the detailed design stage. The siting will consider factors including final electrical design, water depth, ground conditions, marine traffic, proximity to shore, other existing/planned offshore infrastructure and other engineering and economic considerations.

3.6.19 The external design of the ORCPs will be structurally similar to the OSSs. These will comprise a platform with one or more decks, including means to facilitate helicopter access. They will contain equipment required to provide reactive power compensation and housing auxiliary equipment and facilities for operating, maintaining, controlling the ORCPs and to access the ORCPs by vessels and helicopters.

3.6.20 The maximum number of ORCPs would be two. The maximum design parameters for the ORCPs would be as per the small OSS presented in Table 3.12.

3.6.21 Installation will be as for the OSSs. The vessel requirements for installation of the ORCPs are shown in Table 3.21 and Table 3.22.

Offshore Accommodation Platforms

3.6.22 The Project may construct one offshore accommodation platform to allow up to 50 operations staff to be housed at the Project array area for several weeks at a time, and to allow spares and tools to be stored at the Project array area. This is with the aim to reduce trips and time spent in transit to the Project array area. It will also decrease down time for faults and repairs. The accommodation platform will be located within the Project array area. The offshore accommodation platform would be accessed by vessel and/or helicopter and may have associated captive vessels to access the turbines and substations.

Design

3.6.23 The offshore accommodation platform is comprised of a platform with one or more decks and means to facilitate helicopter access, attached to the seabed by means of a foundation. It will contain accommodation, storage, workshop and logistic facilities for operating and maintaining the WTGs and housing auxiliary equipment, facilities for operating, maintaining and controlling the OSSs and to access the OSSs by vessels and helicopters. The maximum design parameters for the offshore accommodation platform are presented in Table 3.13.

Table 3.13: Indicative key design parameters for offshore accommodation platform

Parameters	Design Envelope
Maximum number of offshore accommodation platform	1
Capacity	50
Length and Width (m)	84 x 84
Main structure height above LAT (m)	70.2
Structure height max above LAT (m)	80.2

Installation

3.6.24 The installation procedure would be as described for the OSSs. The vessel requirements for this process are presented in Table 3.21.

Foundation Installation

3.6.25 Table 3.14 summarises the steps required for installation for each of the foundation types.

Table 3.14: Foundation installation summary

Activity	Foundation Type			
	Monopile	Piled Jacket	Suction Bucket Jacket	Gravity Base
Site Preparation	Usually minimal. If preconstruction surveys show the presence of boulders or other seabed obstructions at foundation locations, these may be removed if the foundation cannot be micro-sited.		As well as boulder and obstruction removal this foundation type may also require some seabed levelling, to ensure that all of the buckets / gravity bases for each structure can be placed at the same level. The suction buckets require minimised slope or changes in topography, in order to form a sealed chamber within each bucket, once the foundation has landed and partially embedded under self weight into the seabed.	
Transport to Site	Either on the installation vessel (either JUV or Dynamic Positioning Vessel (DPV)), or on feeder barges.			Brought to site on barges or installation vessels or alternatively they can be floated to site. Structures designed to be buoyant and towed them to site using tugs.
Installation	Lift monopile into the pile gripper on the side of the installation vessel; Lift hammer onto monopile and drive monopile into seabed to required embedment depth; Lift hammer from monopile and remove pile gripper; Lift transition piece onto monopile; and	Piling template placed on seabed; Piles installed; Jacket lowered onto piles OR Jacket lowered onto seabed; Piles installed Pin piles are driven, drilled or vibrated into the seabed.	Jacket lowered onto seabed; at the desired embedment, the suction bucket voids are grouted and valves sealed.	Foundations lowered to the seabed in a controlled manner either by pumping in water, or installation of ballast (or both).

Activity	Foundation Type			
	Monopile	Piled Jacket	Suction Bucket Jacket	Gravity Base
	Secure transition piece. Where conventional piling is unable to achieve necessary pile penetration, additional methods may be used (e.g. drilling, vibro-piling and/or electro-osmosis).			
Finalisation	Transition piece bolted or grouted to the monopile. The grout used is an inert cement mix that is pumped into a specially designed space between the transition piece and the monopile.	As the there is no separate transition piece, there is no requirement for installing an additional structure offshore.	A thin layer of grout is injected under each bucket to fill the air gap and ensure contact between the soil within the bucket, and the top of the bucket itself. As there is no separate transition piece, there is no requirement for installing an additional structure offshore.	None.
Vessels	The full vessel requirements for installation of foundations are shown Table 3.21.			

Seabed Preparation

3.6.26 Some form of seabed preparation may be required for each foundation type. Seabed preparations may include, but are not limited to, seabed levelling and removing surface and subsurface debris such as boulders, lost fishing nets or lost anchors. If debris is present below the seabed surface, then excavation may be required for access and removal.

3.6.27 Gravity base foundations need to be placed in pre-prepared areas of seabed. Seabed preparation would involve levelling and dredging of the soft mobile sediments as required, as well as any boulder and obstruction removal. Unexploded ordnance (UXO), boulder and sandwave clearance for foundations are further discussed below in the Ancillary Operations section.

3.6.28 It is likely that dredging would be required if using gravity base foundations. If required, dredging vessels would be used with suction hoppers or similar, and the spoil would be deposited on site adjacent to the turbine locations. In some cases, it may be necessary to place a layer of gravel on the seabed prior to installation of gravity base foundations.

Piling

3.6.29 The MDS for monopiles installation (piling) will be a maximum of eight hours of piling activity (per pile) and jacket pin piles will assume a maximum eight hour duration (per pin). The number of positions where piling work exceeds eight hours, is typically a small percentage, around 5% or less; this exceedance will be due to breaks in the construction work caused by reasons such as particularly challenging ground conditions or breakdown of equipment and therefore does not reflect an uninterrupted period of hammer strike piling duration. The primary consideration in the development of a pile driving sequence is the total energy imparted into the pile to drive it to the required depth. As such, the exact piling scenario is dependent on the maximum hammer energy and number of strikes, with the duration of the event a function of this. The pile driving scenario presented below is considered to be the MDS in terms of energy imparted over the minimum timescale. The piling duration could be up to eight hours but would be unlikely to exceed the total energy for the scenario herein (i.e. the scenario may be longer and with more strikes but using lower energies to result in the same total piling energy).

3.6.30 The maximum hammer energy for the Project is 6,600kJ for monopiles. The rationale for using a maximum hammer energy is to maximise the opportunity to successfully drive all the piles. The maximum energy is considered within the MDS, however this will only be when necessary and is likely to be significantly lower for the majority of the time. In effort to minimise fatigue loading on the monopiles and reduce the likelihood of equipment breakdown, hammer energies are continuously set at the minimum required. They will typically start low at around 10% energy and gradually increase to the maximum required for the final metres.

3.6.31 Due to pin piles being smaller, they have a lower maximum energy of 3,500kJ. The current expected pile driving parameters for both foundation types are detailed in Table 3.15.

3.6.32 The definition of maximum hammer energy may allow the maximum piling durations to be reduced. Other reasons why higher hammer energies are required include the greater effectiveness at pile driving (due in part to the additional weight of the hammer) and greater reliability, since they are working far under their design rating for much of the time. Knowledge of the anticipated construction work will improve as additional geoscience survey campaigns are undertaken and corresponding design work is completed for the Project.

Table 3.15: Typical piling scenario for pile installation

% of max hammer blow energy	10%	50 %	75 %	100 %
Monopile blow energy	660	3300	4950	6600
Pin pile blow energy	350	1750	2625	3500
Strike rate (bl/min)	10	30	30	30
Duration – monopile (mins)	10	30	45	260
Duration – pin pile (mins)	10	30	30	155

3.6.33 If piling is not possible due to the presence of rock or hard soils, the material may be drilled out before the monopile or jacket pin pile is driven to the required depth(known as relief drilling) or the drilling may take place prior to installation, a casing installed by jacking or driving, and then the pile is placed inside the casing and the annulus is filled with grout (known as drilled and grouted installation). The grout is pumped via dedicated pipework directly to the annulus, with volumes and flow monitored by the vessel team. If drilling is required, it is conducted at an indicative speed of 0.1 to 1.5m/hr with any spoil arising from the drilling disposed of adjacent to the foundation location on the sea surface.

3.6.34 There would be no more than two piles being driven simultaneously, and no more than two piles being drilled simultaneously across the Project array area.

3.6.35 It may also be possible that the piles are installed via another novel method such as vibro-piling or electro-piling. For vibro-piling the pile is embedded via vibration rather than hammering or drilling. For electro-piling, a localised electric current is used to reduce the friction between the pile surface and the surrounding sediment, reducing the energy required to drive the pile to the required depth. If any such methods were employed, the noise emissions would be less than those resulting from the piling operations using a conventional hammer.

Offshore Cables (Array, Export & Interlink)

Array Cables

3.6.36 Array cables will link the turbines to the OSSs. A small number of WTGs will typically be grouped together on the same cable string, branch or loop connecting to the OSSs, and multiple array cables will connect back to each OSS.

3.6.37 The cable system will use HVAC technology. The array cables will consist of several conductor cores, usually made from copper or aluminium surrounded by layers of insulating material, as well as material to armour the cable for protection from external damage. The maximum design parameters for the array cables are presented in Table 3.16.

Table 3.16: Indicative key maximum design parameters for the array cables

Parameters	Design Envelope
Indicative external cable diameter (mm)	260
Total length of cable (km)	351
Voltage (kV)	66 or 132

Offshore Interlink Cables

3.6.38 The Project may require cables to interconnect between the OSSs to provide redundancy in the case of cable or grid transformer failure elsewhere, or to connect to the offshore accommodation platform to provide power for operation. The cables will have a similar design and installation process to the array and export cables (details within Table 3.19). The parameters for design and installation of the offshore interlink cables are presented in Table 3.17.

Table 3.17: Indicative maximum design parameters for offshore interlink cables.

Parameters	Design Envelope
Number of circuits/cables	6
Total length of cables/circuits (km)	123.75
Voltage (kV)	66, 132, 220 or 275

Cable Installation

3.6.39 Currently the following installation (burial) methodologies are being considered for the array and interlink cables:

- Jet-trenching;
    - Pre-cut and post-lay ploughing or simultaneous lay and plough;
- Mechanical trenching (such as chain cutting);
- Dredging (typically Trailer Suction Hopper Dredger (TSHD) and backhoe dredging or water injection dredging);
- Mass flow excavation (MFE)/Controlled flow excavation (CFE);
- Rock cutting;
- Burial sledge;
- Jet sledding (hybrid of jet trencher and cable plough); and
- Vertical injector burial (for very deep burial).

3.6.40 The cables will either be directly buried using the above techniques or pulled into a duct/pipe that will be installed using the above techniques as shown in Figure 3.15 and Figure 3.16.

3.6.41 Seabed preparation may be required prior to the installation of the cables, including, for example, the potential removal of debris, boulders and/or sandwaves as described in paragraph 3.6.26

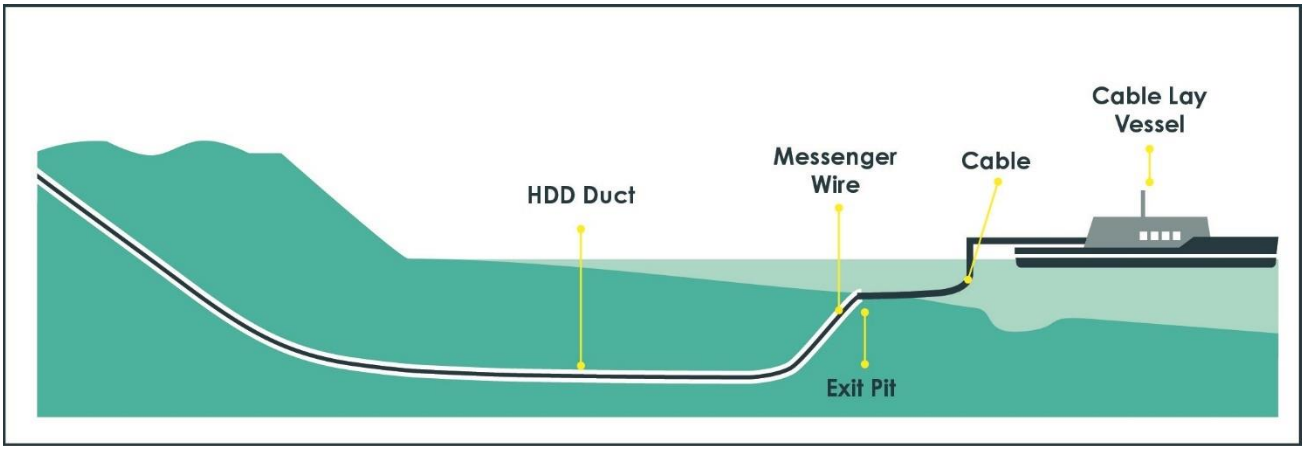

Figure 3.15: Cable Laying Vessel from the landfall exit pit offshore.

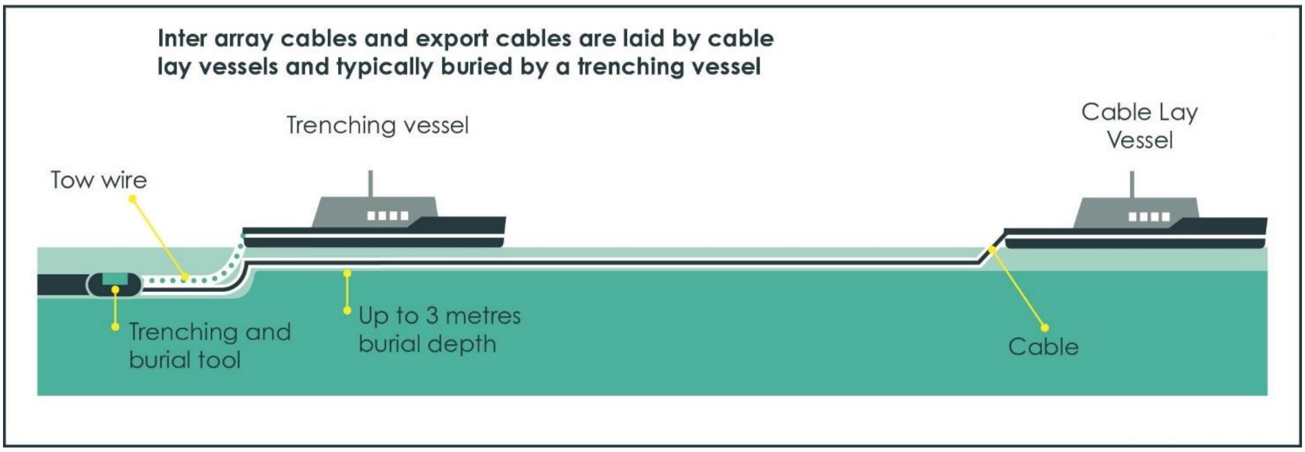

Figure 3.16 Inter array and export cable laying vessel and trenching vessel

Offshore Export Cables

3.6.42 The transmission technology proposed for the Project will be HVAC technology. Table 3.18 presents the design envelope for the offshore export cables.

Table 3.18: Indicative key maximum design parameters for offshore export cables

Parameters	Design Envelope
Maximum number of circuits	4
Indicative cable insulation technology	XLPE cables
Maximum cable voltage (kV)	220 or 275kV
Indicative external cable diameter (mm)	390
Maximum offshore cable length per export cable (km)	128.7
Indicative export cable corridor width for construction (km)	2.1
Maximum width of seabed disturbed during installation excluding anchors and crossings per cable (m)	25

Installation

Table 3.19: Indicative maximum design parameters for cable installation.

Parameter	Maximum design parameters		
	Array cables	Interlink	Offshore export corridor
Installation methodology	Surface lay, mechanical trenching, dredging, jetting, ploughing, controlled flow excavation, vertical injection, rock cutting.	Surface lay, mechanical trenching, dredging, jetting, ploughing, controlled flow excavation, vertical injection, rock cutting.	Mechanical trenching, dredging, jetting, ploughing, controlled flow excavation, vertical injection, rock cutting.
Burial depth (below mobile sediments) (m)	3		
Total length of cable (km)	351	123.75	514.8
Boulder and sandwave clearance width (m), per cable	30		
Cable installation width (m)	18		
Total seabed disturbed (m^2)	12,636,000	4,455,000	9,266,400
Boulder clearance – seabed disturbance (m^2)	6,318,000	2,227,500	4,633,200
Sandwave clearance – seabed disturbance (m^2)	6,318,000	2,227,500	4,633,200
Sandwave clearance spoil volume (m^3)	10,108,800	3,564,000	7,413,120
Burial spoil: jetting (m^3)	421,200	148,500	617,760
Jetting excavation rate soft soil (soft or loose soil) (m/hr)	300 (125)		
Ploughing excavation rate medium soil (hard soil) (m/hr)	125 (55)		
Burial spoil: ploughing/ mass flow excavation (m^3)	5,616,000	1,980,000	8,236,800
Duration total (months)	24	24	24

Scour Protection

3.6.43 Scour protection is designed to prevent WTGs and OP foundations from being undermined by hydrodynamic and sedimentary processes, resulting in seabed erosion and subsequent scour hole formation. The shape of the foundation structure is an important parameter influencing the potential depth of scour hole formation.

3.6.44 Mitigation measures for scour around foundations include mattress protection, sand bags, stone bags and frond mats. The most frequently used solution is the placement of large quantities of crushed rock around the base of the foundation structure ('rock placement'). There are a number of "ecological" types of scour protection which have started to enter the market in recent years which promote the colonisation of marine life. It is possible that one of these options would be used in place of the "standard" options presented herein, however it cannot be confirmed at this stage. Any "ecological" scour protection options would not exceed the seabed footprint of the methods presented below.

3.6.45 For the Project, a typical scour protection solution may comprise a rock armour layer resting on a filter layer of smaller graded rocks. The filter layer can either be installed before the foundation is installed or afterwards. Alternatively, by using heavier rock material with a wider gradation, it is possible to avoid using a filter layer and pre-install a single layer of scour protection.

3.6.46 The amount of scour protection required will vary for the different foundation types being considered for the Project (Table 3.8 - Table 3.12). Flexibility in scour protection choice is required to ensure that anticipated changes in available technology and Project economics can be accommodated within the Project design.

Cable Protection

3.6.47 As far as practicable, all offshore cables will be buried to a sufficient depth below the seabed, with target burial depth determined by the findings of a Cable Burial Risk Assessment as part of the final project design process, however, the minimum target burial depth will be 1m.

3.6.48 However, where it is not possible to bury cables (array, interlink and export) to an adequate depth it may be necessary to install cable protection to prevent scour forming around cables and to minimise the risk of cable exposure, and to both protect the cable asset and ensure cables are not snagged by other sea users.

3.6.49 An analysis of the requirement for the cables to cross existing infrastructure (such as existing or proposed subsea cables and pipelines) is described below in section 3.6.57.

Rock Placement

3.6.50 Rocks of different grade sizes are placed from a fall pipe vessel over the cable. Initially smaller stones are placed over the cable as a covering layer. This provides protection from any impact from larger grade size rocks, which are then placed on top.

3.6.51 This rock grading generally has mean rock size in the range of 90 to 125mm and maximum rock up to 250mm. The rocks generally form a trapezium shape, up to a maximum of 2m above the surrounding seabed level (depending on the requirements of the CBRA) with a 3:1 gradient (Figure 3.17).

3.6.52 It may be necessary to place larger sized rocks if protection from larger anchors is required (e.g. rocks of up to circa 500mm diameter where cables cross busier shipping routes). In such cases the berm width would be 16m. The cross section may vary dependent on the nature of the expected scour. The length of the berm is dependent on the length of cable which is either unburied or has not achieved target depth. The trapezium shape is designed to provide protection from both direct anchor strikes and anchor dragging.

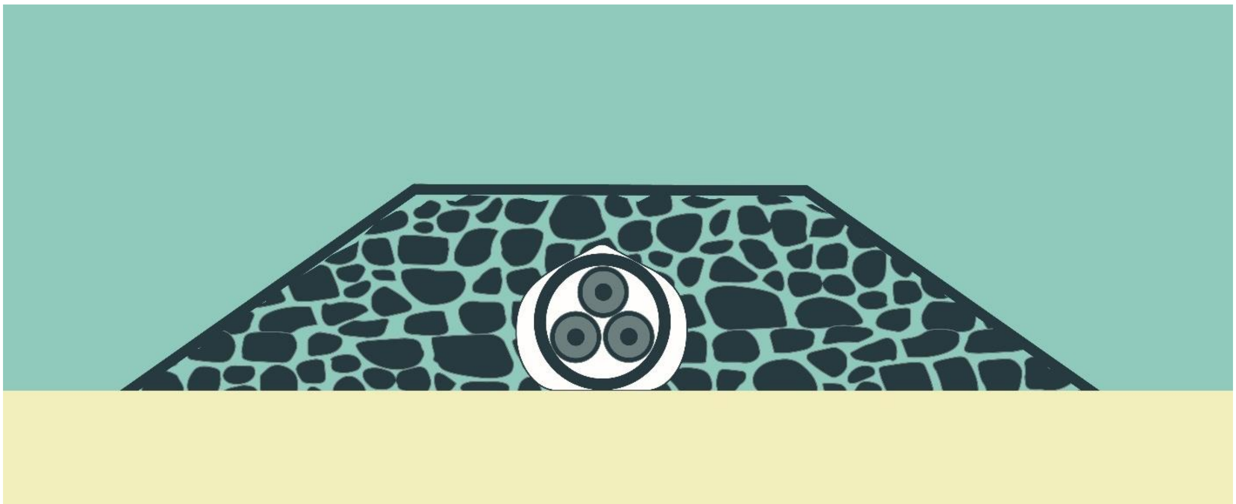

Figure 3.17 Cable Protection, Rock Placement

Mattresses

3.6.53 Mattresses generally have dimensions of 6m by 3m by 0.3m. They are formed by interweaving a number of concrete blocks with rope and wire. They are lowered to the seabed on a frame. Once positioning over the cable has been confirmed, the frame release mechanism is triggered, and the mattress is deployed (Figure 3.18). This single mattress placement will be repeated over the length of cable which is either unburied or has not achieved target depth. Mattresses provide protection from direct anchor strikes but are less capable of dealing with anchor drag. Should this protection method be used for crossings, a mattress separation layer may first be laid on the seabed.

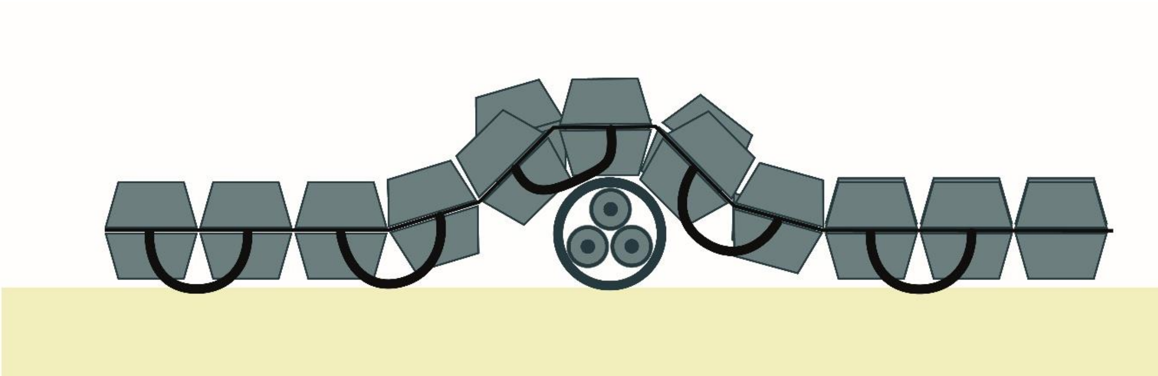

Figure 3.18 Cable Protection, Concrete Mattress Cross Section

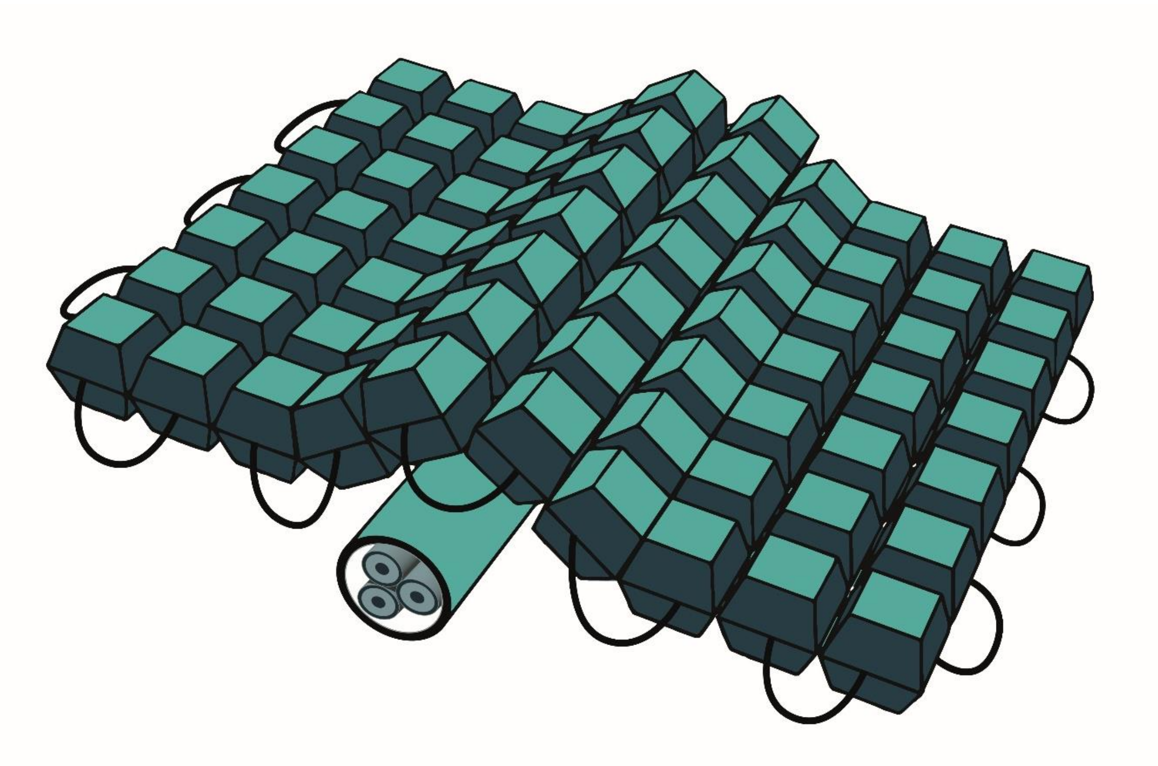

Figure 3.19 Cable Protection, Concrete Mattress 3D

Frond Mattresses

3.6.54 Frond mattresses are installed following the same procedure as general mattress placement operations. The fronds are designed with the aim to form protective, localised sand berms.

Rock Bags

3.6.55 Rock bags consist of various sized rocks constrained within a rope or wire netting containment. They are placed via a crane and deployed to the seabed in the correct position.

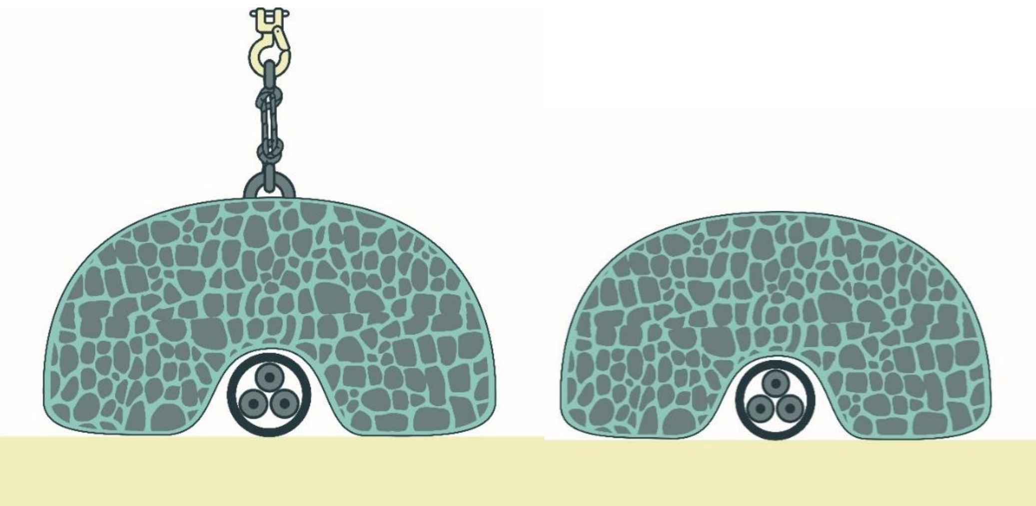

Figure 3.20 Cable Protection, Rock Bags with and without chains to facilitate removal where required

Seabed Spacers

3.6.56 Propriety separation consists of plastic, or metal, half shell sections that are bolted together forming a circular protection barrier around the cable. Additionally, rock may be placed on top to provide protection from anchors or fishing gear. As they are placed onto the cable during installation, they cannot be used for remedial protection. Thus, their only use is for crossings or areas, such as rock, where it is known that burial will not be achieved.

Crossings

3.6.57 Within the Project offshore export cable corridor and array area there are several oil and gas pipelines that connect to production wells in the North Sea, which the array, interlink and/or export cables will have to cross (as summarised in Table 3.20 below). The design and methodology of these crossings will be confirmed in agreement with the relevant asset owners. An example of a type of crossing is that a berm of rock will be placed over the existing asset for protection, known as a pre-lay berm, or separation layer. The Project cable will then be laid across this, at an angle close to 90 degrees. The Project cable will then be covered by a second post lay berm to ensure that the export cable remains protected and in place.

3.6.58 The rock berms will be inspected at regular intervals and may need to be replenished with further rock placement dependent on their condition. This operational rock placement would not exceed 25% of the estimated rock volume and would occur in areas where rock placement was in place (i.e. no new areas of cable protection above what is deployed during construction).

Table 3.20: Maximum Design Parameters for Cable Protection

Parameter	Maximum design parameters		
	Array cable	Interlink	Offshore export cables
Height of rock berm (m)	2	2	2
Width of rock berm at seabed (m)	16	16	16
Percentage of route requiring protection (%)	25	25	25
Cable protection: maximum rock size (m) (if required to protect from anchor strike)	D50 = 0.125	D50 = 0.125	D50 = 0.125
Cable protection area (m^2)	1,404,000	495,000	2,059,200
Rock dumping volume for cable protection volume (m^3)	1,579,500	556,875	2,316,600
Number of crossings	20	12	20
Cable/pipe crossings: length of rock berm at seabed (m)	500	500	500
Cable/pipe crossings: rock berm area (m^2)	160,000	96,000	160,000
Cable/pipe crossings: rock berm volume (m^3)	180,000	108,000	180,000

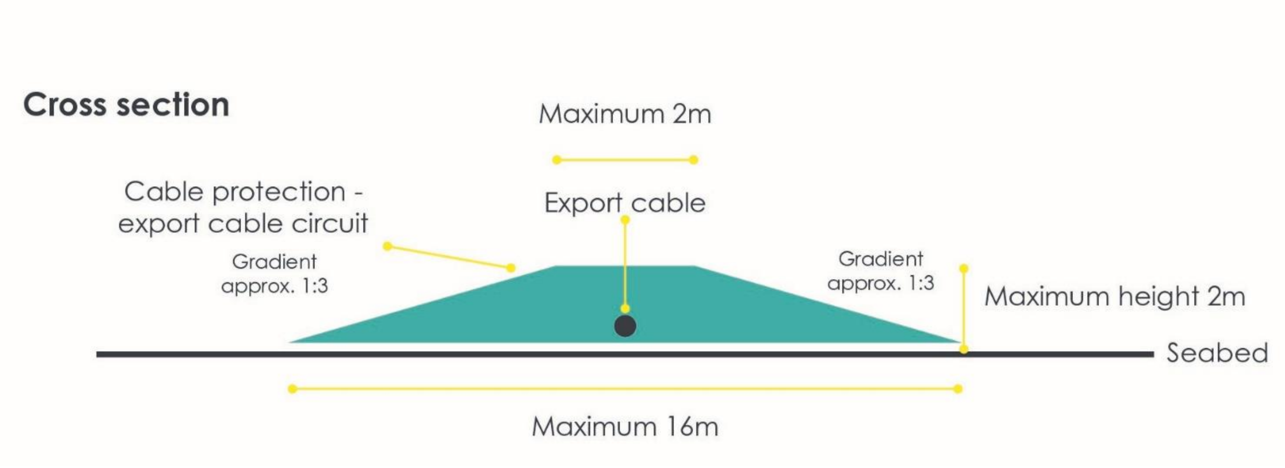

Figure 3.21: Rock protection cross section

Surface Infrastructure Layout

3.6.59 Designing and optimising the layout of the windfarm infrastructure is a complex, iterative process considering many inputs and constraints including;

- Site conditions:
  - Wind speed and direction;
  - Water depth;
  - Ground conditions;
  - Environmental constraints (anthropogenic and natural);
  - Seabed obstructions (e.g. wrecks, UXO, existing cables); and
  - Order limits (i.e. site boundary).
- Design Considerations:
  - Turbine type;
  - Installation set-up;
  - Foundation design;
  - Electrical design; and
  - Operation and maintenance requirements.

3.6.60 The Project requires flexibility in the location and layout of the WTGs and other offshore surface infrastructure, to ensure that anticipated changes in available technology and project economics can be reasonably accommodated within the Project design envelope. However, to inform the EIA, a number of indicative layouts containing up to 93 potential WTG positions and the five potential platform positions (OSSs and accommodation platform) have been developed to represent the worst case for specific topics. The layouts are presented as appropriate in the relevant chapters and, in each case, conform to the layout principles set out below.

3.6.61 The final layout of the WTGs will be developed as part of the final project design process, for approval by the MMO in consultation with relevant consultees (and specifically MCA and THLS) and will conform to these layout principles.

3.6.62 The layout principles are design criteria based on existing guidance from relevant stakeholders (e.g. MCA and THLS) that will be used to determine the final WTG layout.

3.6.63 The layout principles are as follows:

- The layout will have a minimum of one line of orientation subject to a safety justification for all infrastructure;
- All infrastructure within the array area, including existing assets at the point of construction, will be aligned;
- Spacing between infrastructure will be no less than 605m from the blade tips of any WTGs; and
- "Boundary" layouts and grid layouts may be considered.

Vessel Activity

3.6.64 During the construction of the Project, a number and variety of vessels will be utilised for installation, support and transport of personnel, equipment and infrastructure to the Project array area and the offshore ECC.

3.6.65 The currently estimated total vessel numbers, vessel movements and durations are presented in Table 3.21 and Table 3.22 Each vessel movement represents a return trip to and from the Project array area.

3.6.66 Currently, it would be expected that the busiest period during construction, in terms of vessel traffic, would be when up to 8 vessels (major installation and commissioning vessels) would be operating in a given 5km^2 active construction area. This level of activity is unlikely to occur across the entire array area at any one time, rather this intensity is expected across up to approximately three or four 5km^2 blocks.

Table 3.21: Total values for vessel activities during construction

Vessels	Number of Vessels	Indicative maximum Number of Return Trips Per Vessel Type
WTG Installation		
Installation vessel (JUV or anchored)	2	47
WTGs installation - Number of support vessels (including SOV, service vessels for pre-rigging of towers, diver vessels)	18	1376
Transport vessels	10	140
WTG Foundation Installation		
Installation vessel (JUV or DP HLV)	3	40
Support vessels (including tugs crew boats, drilling vessels and guard boats)	10	50
Transport/feeder vessels (including tugs)	8	372
Anchored transport/feeder vessels	8	372

Vessels	Number of Vessels	Indicative maximum Number of Return Trips Per Vessel Type
Substation Installation (All OSSs, ORCPs and Accommodation Platform)		
Installation vessel	2	24
Support vessel	12	96
Transport vessel	4	48
Substation Foundation Installation (All OSSs, ORCPs and Accommodation Platform)		
Installation vessel	2	16
Support vessel	12	48
Transport vessel	4	32
Array and Offshore Interlink Cable Installation		
Main cable laying vessel	3	22
Main cable burial vessel	2	16
Support vessel	14	1022
Offshore Export Cables Installation		
Main cable laying vessel	3	20
Main cable jointing vessel	3	16
Main cable burial vessel	3	16
Support vessel	16	1070

Table 3.22: Total values for helicopter activities during construction

Construction Activity	Maximum Number of Helicopter Return Trips
WTG Installation	176
WTG Foundation Installation	93
Substation Installation (All OSSs, ORCPs and Accommodation Platform)	40
Substation Foundation Installation (All OSSs, ORCPs and Accommodation Platform)	28
Array and Offshore Interlink Cable Installation	22
Offshore Export Cables Installation	16

Aids to Navigation and Marking

3.6.67 All surface infrastructure throughout all stages of the Project (including WTGs, and OPs) will be marked in accordance with relevant guidance from THLS, the Civil Aviation Authority (CAA) and the MCA. The positions of all infrastructure will be conveyed to the UK Hydrographic Office (UKHO) so that they can be incorporated into Admiralty Charts and the Notice to Mariners (NtM) procedures.

3.6.68 Lighting and marking of subsea structures will be discussed with THLS, having a statutory duty as a General Lighthouse Authority, where there may be a risk to shipping. In this case, the marking would be based on the recommendations of the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA, 2021).

Safety Zones

3.6.69 During construction and decommissioning, the Project will apply for a 500m safety zone around surface piercing infrastructure that is under active construction. Safety zones of 50m will be in place for incomplete structures at which construction activity may be temporarily paused such as installed monopiles without transition pieces or where construction works are completed but the Project has not yet been commissioned.

3.6.70 During the operation and maintenance phase, the Project may apply for a 500m safety zone around manned infrastructure (such as offshore accommodation platform) in order to ensure the safety of the individuals aboard. The Project may also apply for 500m safety zones for infrastructure undergoing major maintenance (for example a blade replacement).

3.6.71 Further information regarding the Safety Zones which the Project intends to apply for post-consent will be outlined in the Safety Zone Statement to be prepared to accompany the final DCO application.

Ancillary Operations

3.6.72 Several activities will be required to prepare the seabed prior to construction. These activities are detailed below.

Unexploded Ordnance Clearance

3.6.73 It is common to encounter UXO originating from World War I, World War II or military training activity during construction. This poses a health and safety risk where it coincides with the planned location of infrastructure and associated vessel activity, and therefore it is necessary to survey for and carefully manage UXO.

3.6.74 If found, a risk assessment will be undertaken and items of UXO are either avoided, removed or detonated in situ.

3.6.75 Detailed pre-construction surveys will be completed post-consent to determine the precise nature of the seabed. As the detailed pre-construction surveys are yet to be completed, at this stage it is not possible to determine how many items of UXO will require clearance. As a result, a separate Marine Licence will be applied for pre-construction for the removal of any UXO which may be identified in pre-construction surveys and which pose a potential risk to construction activities. To define a design scenario for consideration in the EIA a review of recent publicly available information on UXO disposal has been undertaken. A range of charge sizes are expected to be found across the PEIR boundary, with a maximum charge size likely to be up to 800kg net explosive quantity (NEQ).

Boulder Clearance

3.6.76 Geophysical surveys will be undertaken within the Project array area and offshore ECC and will be used to inform boulder clearance requirements.

3.6.77 Where large volumes of boulders are present, micrositing of cables around these would be onerous and impractical. If left in-situ, these boulders can pose the following risks to the Project:

- Exposure of cables and/or shallow buried cables, which might lead to the requirement for post-lay cable protection such as rock dumping or concrete mattressing;
- Obstruction risk to the cable installation equipment, leading to damage and/or multiple passes and therefore, a delayed cable installation programme (with no guarantee of achieving target burial depth); and
- Risk of damage to the cable assets.

3.6.78 Based on current industry experience within similar geological conditions, the following assumptions are made;

- Boulders greater than 0.3m in any dimension, which are located within the footprint of any infrastructure, may necessitate removal;
- For cables within the Project offshore ECC, a corridor of up to 30m per cable (circuit) must be cleared to ensure that all the export cable burial tools being considered in the envelope can operate in the cleared corridors; and
- For cables within the Project array area, a corridor of up to 30m must be cleared per cable circuit as this width is sufficient for the operation of the cable burial tools under consideration.

3.6.79 There are two key methods of clearing boulders, ploughing or use of a subsea grab. Where a high density of boulders is seen, the expectation is that a plough will be required to clear the cable installation corridor. Where medium and low densities of boulders are seen, a subsea grab is expected to be employed.

3.6.80 Since geophysical/geotechnical information of sufficient spatial resolution is not currently available the worst case scenario is used for PEIR is presented in Table 3.23. Final numbers of boulders to be cleared will be confirmed following high resolution pre-construction surveys.

Table 3.23: Maximum design parameters for boulder clearance

Parameters	Maximum Value
Array Area	
Array cable clearance corridor width per cable (circuit) – ploughing (m)	30
Export and interlink cable clearance corridor width per cable (circuit) – ploughing (m)	30
Clearance corridor width – subsea grab (m)	30
Total clearance impact area (km^2)	16.6
Offshore ECC	
Clearance corridor width per cable (circuit) – ploughing (m)	30
Clearance corridor width – subsea grab (m)	30
Total seabed Potential Disturbed (Full Corridor Width) (km^2)	6.2
Total clearance impact area (km^2)	7.2

Pre-Lay Grapnel Run

3.6.81 Following the pre-construction route survey and boulder clearance works, a Pre-Lay Grapnel Run (PLGR) and an associated route clearance survey of the final cable route will be undertaken. A vessel will be mobilised with a series of grapnels, chains, recovery winch and survey spread suitable for vessel positioning and data logging. Any items recorded will be recovered onto deck where possible and disposed of onshore. The results of this survey will be used to determine the need for any further clearance. The PLGR work will take account of and adhere to any archaeological protocols developed for the Project.

3.6.82 These works will be within the 30m footprint of seabed disturbance (sandwave and boulder clearance), within which is the 18m footprint for trenching in the Project offshore export cable corridor and therefore any footprint for PLGR disturbance is already accounted for.

Sandwave Clearance

3.6.83 In some areas within the Project array area and along the offshore ECC, existing sandwaves and similar bedforms may be required to be attenuated or lowered to mudline in the section corresponding to the cable corridor prior to cable installation. This is done for two reasons. Firstly, many of the cable installation tools require a relatively flat seabed surface in order to work properly as it may not be possible to install the cable up or down a slope over a certain angle, nor where the installation tool is working on a camber. Secondly, the cable must be buried to a depth where it may be expected to stay buried for the duration of the Project's lifetime. Sandwaves are generally mobile in nature therefore the cable must be buried beneath the level where natural sandwave movement would uncover it. Sometimes this can only be done by removing the mobile sediments before installation takes place. It has been determined the maximum design parameters for sandwave clearance is up to 60% of the cable lengths for the array cables and interlink cables and up to 30% for the export cable. Further details on the expected extent of sandwave clearance within the array and offshore ECC will be provided at ES.

3.6.84 The result of the found maximum design parameters for sandwave clearance are shown in Table 3.24. Values will be updated upon the completion of pre-construction high resolution geophysical surveys for inclusion in the ES.

Table 3.24: Maximum design parameters for sandwave clearance

Parameters	Maximum Value
Array Area	
Sandwave clearance impact width – array, interlink and export cables (m)	30
Sand-wave clearance: Array cables (m^3)	10,108,800
Sand-wave clearance: Interlink cables (m^3)	3,564,000
Sand-wave clearance: Export cable (Within Array Area Only) (m^3)	1,572,480
Sand-wave clearance: Total in array area (export cables, array cables, interlink cables) (m^3)	15,245,280
Offshore ECC	
Sandwave clearance impact width (m) per cable (circuit)	30
Sandwave clearance – total (m^3)	5,840,640

Wave Buoys

3.6.85 The Project will require two wave buoys for the full construction period, one of which will be decommissioned following completion of construction, and the other retained for the first three years of operation. The exact mooring locations are within the array areas.

3.7 Landfall construction

Overview

3.7.1 The offshore cables will be brought ashore at the cable landfall (Figure 3.2), with techniques for the installation of the offshore export cables across the intertidal areas to be by trenchless techniques (for example Horizontal Directional Drilling (HDD)), this will be carried out from the TJB site. The technical feasibility of the approaches will be assessed via an intrusive geotechnical survey campaign, currently programmed for Q2 and Q3 2023, with the findings being used to inform the ES where possible. Other factors such as ground conditions and cable design will also be considered to determine which methodology is the most appropriate.

3.7.2 The offshore export cables will be jointed to the onshore cables in TJBs on the landward side of the landfall site. A TJB is an underground concrete structure hosting the joint between the offshore and onshore export cable circuits. One TJB is needed per export cable circuit. Six TJBs will be used within a TJB compound, allowing for two failures. They ensure that the joining is constructed within a clean and dry environment and protect the cable joint post construction. The TJBs are covered once the joints are installed and commissioned and the land above is reinstated. The TJB shall be buried with a flush surface finish. Access covers will be required for access to the service/link pits that will be set flush with the surrounding ground level. If the detailed design of the landfall requires the TJB to be raised above the existing ground level, the immediate ground level around the TJB would also be raised so that the covers remain buried or flush with the surrounding land. The maximum increase above the existing ground level would be 1.5m with a maximum raised area of 1.8ha. The TJB will be located a minimum of 80m west of Roman Bank. Construction access to the TJB will be via the construction haul road, from a temporary access point on the A52. In the unlikely event that access is required for any reason during the operational period, this will be from Roman Bank.

3.7.3 It is not expected that access to the TJBs will be required once the Project is operational, except in the event of a cable fault or failure.

3.7.4 Landfall installation will be undertaken from the TJB site on the west side of Roman Bank, however beach access may be required for emergency access. A number of potential access options have been identified via existing access points (Figure 3.15 and Figure 3.22). Some improvement works to the access points may be required to enable construction works access.

3.7.5 Landfall work includes:

- Construction of required accesses and haul road;
- Construction of Landfall Compound;

- Trenchless Cable Installation Works;
- Construction of Transition Joint Bays;
- Installation and testing of Offshore High Voltage (HV) Cables;
- Installation and testing of Onshore High Voltage Cables;
- Transition Jointing Offshore/Onshore Cables;
- Backfilling of Joint Bays; and,
- Reinstatement Works.

3.7.6 Trenchless Works may include offshore works (Figure 3.22, Figure 3.15 and Figure 3.16):

- Excavation of exit pit; and
- Pull-in of duct from offshore towards to TJB (may conclude in opposite direction); and, capping and burial of duct end.

Construction

3.7.7 During the intertidal works for the Project a landfall logistics compound will be required. It will house the TJB works and any trenchless works that are required. The location will be within the landfall area (Figure 3.15). The maximum design parameters for the TJBs and Project intertidal area are shown in Table 3.25.

3.7.8 The duration of the activities is shown in Table 3.25 and demonstrates that the activities vary in duration, with some being significantly shorter than the overall construction window. The overall timeframe is required to allow flexibility for activities to shift and other variables such as weather and the timings of offshore and onshore works reaching landfall. The overall duration additionally includes time for the mobilisation and demobilisation of vessels and equipment.

Table 3.25: Maximum design parameters for TJBs and landfall works

Parameters	Design Envelope
Number of TJB (allowing for two failures)	6
TJB maximum width (m)	9
TJB maximum length (m)	23
TJB depth (m)	6
TJB maximum area (m^2)	207
Total construction area for TJBs (m^2)	1,242
Landfall logistics compounds (m^2)	90,000
Durations of works (start-finish) (months)	36

Trenchless Techniques

3.7.9 One of the trenchless techniques which may be used is HDD. This involves drilling a long borehole underneath the Project intertidal area using a drilling rig within the TJB works area (Figure 3.22). This technique avoids interactions with surface features by installing ducts under the intertidal area and out to sea through which the offshore export cables can be installed. The site for the HDD works will be set up as follows:

- Access will be conducted from the haul road which will be built along the onshore ECC or from approved routes;
- Demarcation of the required compound will be made using suitable fencing;
- Topsoil will be removed and stored within the allocated compound areas;
- Stone and tarmac (if required) will be imported for final surfacing, followed by site setup works and welfare facilities deliveries.

3.7.10 At the start and the end point of the planned drill, two pits will be dug, allowing for the drilling rig to drill horizontally and the ducts to be installed. Two pits will be required per duct, one on the landward and one offshore. The trenchless techniques exit pits will likely be located up to 2,000m from the TJB.

3.7.11 The process uses a drilling head controlled from the rig to drill a pilot hole along a predetermined profile to the exit point. The pilot hole is widened using larger drilling heads until the hole can fit the cable ducts. Drilling mud is pumped to the drilling head during the drilling process, stabilising the hole and ensuring it does not collapse.

3.7.12 The trenchless techniques exit pits will be located below mean low water springs (MLWS). Exit pits will be excavated or dredged to the required depth. Management and contamination methods for the drilling mud will be implemented at the exit pit, where practicable and as agreed with the relevant regulator. A more detailed plan of the landfall construction methodology will be defined once further site-specific surveys and feasibility studies have been conducted.

3.7.13 There will be up to four exit pits open at one time and if a pit is required to be dredged, they will be backfilled immediately following duct installation.

3.7.14 After installation of the ducts, it is likely that the pits would be temporarily filled in until the time for cable pull-in. The ducts would then need to be re-exposed (dredged) to pull in the cables. Alternatively, the ducts would be placed on a rock mattress with rock bags placed over once the HDD is completed. These would be lifted the following season for cable pull in. In either scenario, the ducts and cable will be buried once cable installation is completed.

3.7.15 Where possible, excavated material will be reused for backfilling. Some additional material (e.g. rocks) may be necessary to make up for any loss, or in case the onward plough cannot bury the cable within the exit pit.

3.7.16 The landfall HDD works are anticipated to take up to a maximum of 36 months to complete (for all cables). Residual works may be required beyond 36 months to be completed after commissioning. Additionally, there may be temporary access required to parts of the beach and intertidal area during activities such as cable pulling or excavation, but wherever possible access will be maintained across the beach and public diversions established. Should PRoWs be required to be closed for the purposes of ensuring public safety, the Project will work with the County Council Public Rights of Way Officer to agree a timescale for the works that reduces disruption as far as reasonably practicable. At this stage, it is not anticipated that access to the beach would need to be limited.

Table 3.26 Maximum design parameters for landfall trenchless works

Parameters	Design Envelope
Trenchless cable ducts	6
Diameter of ducts (m)	1.2
Length of ducts (km)	2
Trenchless entry pit area (m^2)	200
Trenchless entry pit depth (m)	6
Trenchless burial depth maximum (m)	25
Trenchless burial depth minimum (m)	5
Trenchless exit pits number	6
Trenchless exit pit area (m^2)	1000
Trenchless exit pit excavated material volume (m^3)	5000
Trenchless exit pits depth (m)	5
Temporary onshore/intertidal Trenchless exit pit working area (m^2)	2500

3.7.17 Overall, individual trenchless operations are seasonally constrained and, as a base case, shall take up to 12 months, with a contingency for extra 3 months in the event of drilling delay or unforeseen circumstances. An indicative program is described below:

- Maximum 3 months site set up;
- 4.5 months pit fully open, drilling and duct pull-in or push taking place; and
- Maximum 4.5 month reinstatement (including backfill).

3.7.18 In addition to the above 12-month window, there may be an additional requirement for localised spot remediation, and inspection and monitoring.

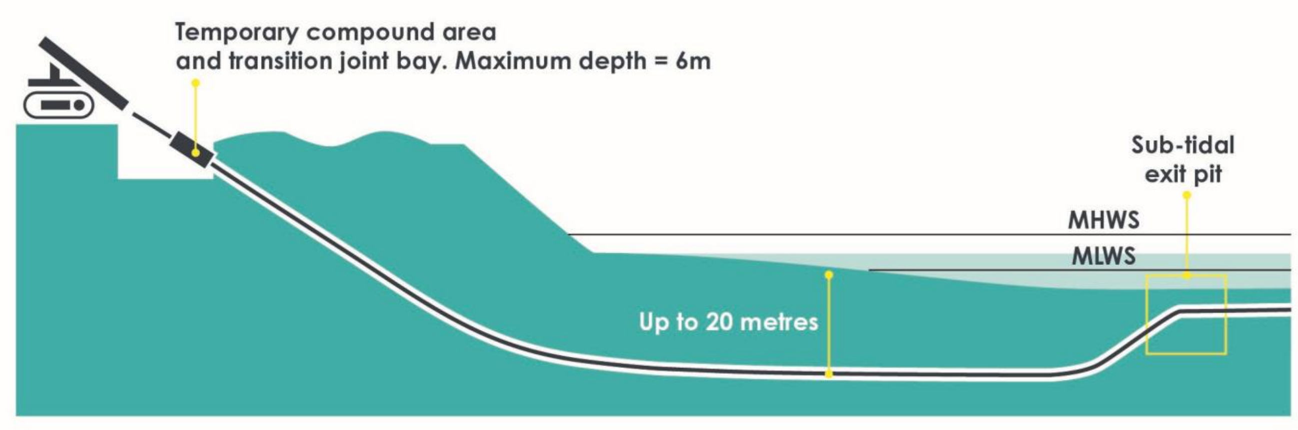

Figure 3.22: Trenchless installation schematic

3.8 Onshore Infrastructure Construction

Onshore Export Cables

3.8.1 The Project onshore ECC will consist of an 80m wide onshore temporary corridor, within which a typical 60m wide permanent easement post installation is located. An overview of the Project is presented in Figure 3.1.

Components of the onshore export cable corridor

Onshore Export Cables

3.8.2 The indicative key parameters for the onshore export cables are presented in Table 3.27. Small fibre optic cables may also be buried alongside the onshore export cables in order to allow for communication and cable monitoring to the windfarm for the various control systems in place for the Project.

Table 3.27: Indicative key design parameters for onshore export cables maximum design scenario

Parameters	Design Envelope
Maximum number of export cable circuits	4
Maximum number of cables	12
Indicative Power Cable insulation technology	XLPE
Maximum cable voltage (kV)	220kV or 275kV
Indicative length of cable corridor (km)	80
Indicative external cable diameter (mm)	180
Width of cable construction corridor (m)	80
Minimum cable trench depth (m)	0.9
Maximum cable trench depth (m)	3
Typical width cable trench at surface, per cable (m)	5

3.8.3 Cable installation techniques are well-established and incorporate environmental management and mitigation measures as standard practice. Precise installation methods will differ according to the nature of the environment through which the cable is being installed. Most of the cable route will be constructed using an open cut method of cable construction. Where an open trench approach is not possible, for example, due to significant obstructions (e.g. a major road or watercourse), non-trenching techniques may be employed, such as Horizontal Directional Drilling (HDD).

3.8.4 During construction of the cable trenches the topsoil and subsoil will be stripped and stored on site within the temporary working corridor of the Project onshore ECC. The procedures followed will be in line with best practice and agreed through the Soil Management Plan and Air Quality Management Plan both which will form part of the Code of Construction Practice.

3.8.5 The cables will be installed in the Project’s onshore ECC, with an expected width of 80m. The layout of the Project export corridor can be seen in Figure 3.1. The width of the permanent and the temporary areas may change where obstacles are encountered.

3.8.6 The Project considers that 80m would provide sufficient design flexibility to allow for micrositing. This is based on experience from similar operations on previous projects. The exact design, spacing and configuration of this and all trenchless works will be defined in the detailed design phase, once a contractor is appointed and crossing methodologies are agreed with affected third parties.

3.8.7 The cables will be buried in multiple separate trenches (up to four trenches, each containing one circuit) the details of which are presented in Table 3.27. The onshore export cables will typically be installed in sections of between 450 and 2,000m at a time.

3.8.8 The installation of the onshore export cable is a linear construction project with an expected overall construction duration of up to 36 months in total. The construction work of the installation of export cables involves a number of discrete activities undertaken along the length of the cable route, the duration of each activity at any location being dependent on the nature of construction activity being undertaken.

3.8.9 These discrete construction activities can be broadly described as preliminary right of way works, trenchless works, cable trenching, installation and jointing works and re-instatement works. The preliminary works aim to secure and prepare the cable route corridor for the main construction activities to follow and generally consist of fencing, vegetation clearance, preparation of access routes, drainage works, topsoil removal and storage and construction of the haul road. Such preliminary work activities would move progressively through the full cable route, allowing full access to the cable route for the main construction activities to follow.

3.8.10 The main construction activities of trenchless work, cable trenching, installation and jointing would move progressively along the corridor, optimal progress being dependent on the availability of resources, weather conditions or other engineering challenges which may arise during the works. To allow for the maximum flexibility in completing the works in a safe and efficient manner, the main activities are completed sequentially at any location prior to the next activity commencing. As such, works at any location would be intermittent, the duration being determined by the nature of the activity, until all the main construction works are completed, and all cables are installed, jointed and successfully tested.

3.8.11 On completion of the main activities, the corridor would be prepared to be reinstated and handed back to the landowner. Such activities would include the removal of the haul road, installation of further drainage, reinstatement of topsoil and removal of temporary fencing and access arrangements. Such reinstatement works are very much weather dependent, the works being carried out in favourable weather conditions.

3.8.12 As such, whilst the completion of the overall cable installation works can be expected to take up to 36 months in total, discrete works at any location would be take a considerably shorter period as would be expected of a linear project. However, to complete the works in the most time efficient and optimal manner, the entirety of the cable route corridor would be expected to be available for most of the 36 months, from the initial preparation of the route to the final reinstatement at the completion of the works.

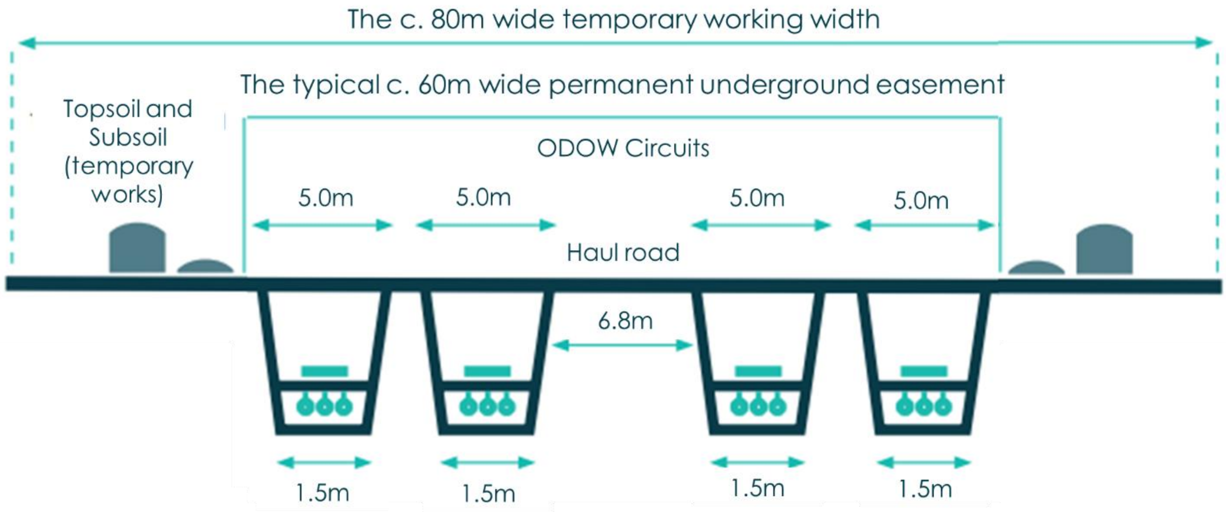

Figure 3.23: Example onshore cable construction corridor cross section for 4 HVAC cable circuits (12 cables)

Joint Bays and Link Box

3.8.13 Jointing bays (JBs) (an underground concrete structure holding the joint between sections of the onshore export cables) will be required. The detailed design of these components will be defined post-consent. They are typically concrete lined pits that provide a clean and dry environment for jointing the section of cables together. They are likely to be completely buried and the land above reinstated. The maximum design parameters are presented in Table 3.28.

3.8.14 Link boxes (LBs) and earth pits (collectively referred to as LBs) will also be required along the Project onshore ECC. These are smaller pits, compared to JBs, which house connections between the cable shielding, joints for fibre optic cables and other auxiliary equipment. The majority of the land above the link boxes will also be reinstated, however, they may require manhole type covers for access during the operational phase. The maximum design parameters for LBs are presented in Table 3.28.

Table 3.28: Maximum design parameters for joint bays (JBs) and Link Boxes (LBs)

Parameters	Design Envelope
Maximum number of JBs	700
Maximum number of LBs	700
Maximum distance between JB/LB on one circuit (m)	2000
Most likely minimum distance between JB/LB on one circuit (m)	450
JB maximum width (m)	9
JB maximum length (m)	23
JB maximum area (m^2)	207
JB maximum depth	2.5
JB maximum total area (m^2)	144,900
LB maximum width (m)	4.5

Parameters	Design Envelope
LB maximum length (m)	4
LB maximum area (m^2)	18
LB maximum depth	2.5
LB maximum total area (m^2)	12,600
Total area (m^2)	157,500
Spoil volume per JB (m^3)	518
Spoil volume per LB (m^3)	45
Total excavated volume (m^3)	393,750

Access Points

3.8.15 A total of 20 access points will be required from the public highway to access construction works and logistics compounds for the Project (Figure 27.10). Temporary access points off the highway will be installed to facilitate vehicular access from the road, and into the Project onshore ECC during construction.

3.8.16 Access will be required from the start of construction for all access points identified (Figure 27.10). Temporary access points have been assessed for the effect on the road network in Volume 1, Chapter 27: Traffic and Transport. Detailed design of roadworks has not been fully developed and assessed at the point of PEIR.

3.8.17 Further details on access will be documented in the Traffic Management Plan within Volume 1, Chapter 27: Traffic and Transport.

Haul Road

3.8.18 To provide access to the Project onshore ECC and limit damage to the agricultural land, the haul road will be installed in its entirety as part of the preconstruction cable works at the start of construction. The haul road, typically 6.8m wide (Table 3.29) will extend the full length of the Project onshore ECC (except at gaps where the Project has committed to trenchless works only). The haul road provides vehicular access along the Project onshore ECC off the public highway and will be used where needed throughout the installation of the export cable and for the duration of construction activities.

3.8.19 In general, the haul road would remain for the duration of the construction works, only being removed prior to final reinstatement. Where it is applicable, the Project may be able to remove sections of haul road that are not subject to further expected traffic prior to the completion of the construction works. However, it would not be possible to indicate where and when such haul road removal could be undertaken at this stage of the Project development.

3.8.20 The haul road will run parallel to the cables along the onshore ECC. Where there are obstacles that must be crossed by the haul roads, such as drainage ditches, temporary culverts or bridges may be installed in agreement with the asset owner.

3.8.21 The haul road will be utilised during installation and will be made up of a maximum of 1m (average 0.6m) of crushed aggregate with a geotextile or other type of protective matting; or plastic or metal plates or grating or other suitable methodology. The exact specification of the road will be determined upon appointment of a principal contractor.

3.8.22 Crushed aggregate and geotextile membrane will be removed once construction is completed. Compacted soil from HGVs will revert to the natural state prior to construction.

Table 3.29: Maximum design parameters for onshore cable access and haul roads

Parameters	Design Envelope
Haul road width (m)	6.8
Haul road hardstanding width at passing places (m)	8
Maximum depth of haul road (m)	1
Average aggregate depth of haul road (m)	0.6
Indicative haul road thickness (mm)	600

Temporary Logistics Compounds

3.8.23 Logistics compounds of various sizes will also be required along the Project onshore ECC. Primary logistics compounds will be required for laydown and storage of materials, plant and staff, as well as space for small temporary offices, welfare facilities, security and parking. Secondary logistics compounds will also be required for crossings of other infrastructure e.g. roads, to house operations such as trenchless works. They will also be required around JB and LB construction. All logistics compounds will be removed, and sites restored to their original condition when construction has been completed, however it may be necessary to retain some compounds for slightly longer periods during the commissioning and demobilisation stages of the Project. The maximum design parameters for logistics compounds are presented in Table 3.30.

3.8.24 All logistics compounds will be required to support the construction of the onshore export cables. A primary logistics compound would be built as a focal hub for the principal contractor, sub-contractors and the client for the duration of the works and would be constructed before the cable route works commence at any location and would remain for the duration of the Project. It may be necessary to retain part of the compound during the commissioning stages of the Project. The logistics compounds will be in place for period of up to 36 months and would include, but not be limited to;

- Office accommodation, including all desks, seating, office storage, welfare etc. to accommodate all staff (approximately 50);
- Meeting Rooms;
- All relevant utility services, power, water, heating, lighting telecommunications, internet and Wi-Fi connections;
- Printing, scanning and copying facilities;
- Car parking for all project staff;
- First aid facilities;
- Canteen facilities;

- Drying, storage and changing facilities for Personal Protective Equipment;
- Material storage;
- Waste storage;
- Cable drums;
- Security fencing; and
- Security.

3.8.25 The onshore route compounds shall be used as logistics bases and secure areas for storage of materials, construction plant, personnel welfare and personal transport, and for performing location specific works such as Horizontal Directional Drilling. Consequently, activities to support the above could include:

- Crane lifting, and telehandler manoeuvring and stacking of materials
- Site preparation and construction activities, such as excavation, concrete pouring, and trench construction
- Maintenance and manoeuvring of heavy transport vehicles and construction plant

3.8.26 Careful site segregation within the compound shall ensure separation between personnel areas (such as welfare containers and offices) and construction areas. The compounds shall be developed so as to mitigate puddling and pooling, or dusty conditions deriving from non-surfaced access roads. Similarly, the compounds shall ensure controlled security access and a minimum level of lighting suited to the hours of working and security requirements (As outlined in the Outline Artificial Light Emissions Management Plan 8.1.10).

3.8.27 Secondary logistics compounds may also operate as support bases for the onshore construction works as the cable work fronts pass through an area. They may house portable offices, welfare facilities, localised stores, as well as acting as staging posts for localised secure storage for equipment and component deliveries.

3.8.28 Storage locations would also be required along the Project onshore ECC. These would operate as areas where some limited additional storage may be provided in addition to that land provided for along the onshore ECC.

Table 3.30: Maximum design parameters for logistics compounds

Parameters	Design Envelope
Primary logistics compound – indicative length and width (m)	300 x 150
Primary logistics compound – maximum area (m^2)	45,000
Secondary logistics compound - indicative length and width (m)	80 x 60
Secondary logistics compound – maximum area (m^2)	4,800
Total number of primary logistics compounds	18
Total number of secondary logistics compounds	54
Logistics compound use - duration per compound (months)	36
Total number of trenchless works locations	200
Total number of trenchless works compounds	400
Trenchless works compounds - length and width (m)	150 x 30
Trenchless works compound construction duration per compound (months)	36

Parameters	Design Envelope
Trenchless works compound maximum area (each) (m^2)	4,500

Installation of the Onshore Export Cables

Demarcation of the Cable Corridor

3.8.29 The export cable route and works areas will be fenced along the length of the ECC. The type of fencing to be used will be dependent on the ground conditions and use along the route. Discrete work areas will be fenced off as required.

Cable Installation

3.8.30 During construction of the cable trenches the topsoil will be stripped and subsoil excavated. Both will be stored on site within the temporary working corridor as construction of each section of the onshore ECC advances. The topsoil and subsoil will be stored in separate stockpiles. Once the topsoil is stripped temporary haul roads will also be installed along the onshore ECC to allow trench excavation to take place. Topsoil will only be stored in bunds along the cable corridor adjacent to where it is removed.

3.8.31 The trenches will be excavated using a mechanical excavator, and the export cables will be installed into the open trench from a cable drum delivered to site. The cables are buried in a layer of imported backfill material that ensures a consistent structural and thermal environment for the cables. The maximum volumes of imported stabilised backfill material (i.e. that not originating from the excavated trench) are presented in Table 3.31. However, this value is considered to be a maximum and will not be required at most locations along the onshore ECC. All excavated material from the trenches will remain on site, unless deemed unsuitable for re-use.

3.8.32 The remainder of the trench is then backfilled with the excavated material. Hard protective tiles or protective tape and marker tape are also installed in the cable trenches above the cables to ensure the cable is not damaged by any third-party. Once the onshore export cables are installed and the trenches backfilled, the stored topsoil will be replaced, and the surrounding land reinstated back to its previous use. Isolated sections may not be able to return so previous use, such as where access points to joint bays are constructed within agricultural land.

3.8.33 Alternatively, ducts can be installed in the trenches in the same manner as above, and the cables can then be pulled through the ducts from the JBs. This technique decouples the trenching from the cable installation and therefore can provide more flexibility for the installation process to optimise works and delivery of components.

3.8.34 The dimensions of the export cable trenches are presented in Table 3.31. The electrical cables must be spaced out in order to minimise the mutual heating effect of one cable on another, this enables the cables to effectively carry the large power volumes required without overheating and damaging the cable.

Table 3.31: Maximum design parameters for onshore export cable installation.

Parameters	Design Envelope
Trench width at base (m)	1.5
Trench width at surface (m)	5

Parameters	Design Envelope
Width of permanent easement (m)	60
Width of temporary construction corridor (m)	80
Corridor area - permanent (m^2)	4,800,000
Corridor area - temporary and permanent (m^2)	6,400,000
Minimum depth target (m)	0.9
Trench maximum depth of stabilised backfill (m)	1.5
Total installation duration (months)	36 months

3.8.35 The onshore export cables will need to cross infrastructure and obstacles such as roads, railways, and rivers. Main rivers, IDB and EA maintained assets, flood defences, main roads and railways will be crossed by trenchless techniques where technically practical. Buried cables will not be affected by flood risk or lead to increased flood risk or erosion caused by the impacts of climate change.

3.8.36 It may be preferable, for commercial, technical, environmental reasons or a combination of all three, for certain crossings to be carried out as an open cut crossing, rather than a trenchless method. This requirement will be determined in consultation with the relevant stakeholders and/or asset owners. These crossings could range from smaller drains, gas and power distribution infrastructure and small roads, to high pressure gas pipelines. For some sensitive infrastructure, such as high-pressure gas pipelines the area around the pipeline must be carefully excavated by hand and the asset supported before installation of the cables below the pipelines can take place. This is preferred by some asset owners as visual confirmation of the integrity of the asset can be maintained throughout the works. All crossings are assumed to be open cut for the purpose of assessment, except where specified in Section 3.8.36, as this would have the greatest impact.

3.8.37 The detailed methodology for all crossings will be agreed with the relevant stakeholders such as third-party asset owners, and other statutory stakeholders. The Project have prepared a draft Onshore Crossing Schedule which list all potential onshore crossing points across the 300m PEIR Boundary (see Document Reference 8.1.8).

Project Onshore Substation (OnSS)

3.8.38 In respect of the Weston Marsh connection, discussions with National Grid on the opportunity to coordinate the Project works with its future works are still ongoing.

3.8.39 In the event that National Grid direct the Project to a grid connection at Lincolnshire Node, then the Project will only consent the Project alone OnSS infrastructure, as the infrastructure required to connect it to the National Grid will be consented through a separate DCO application as part of National Grid's wider Lincolnshire Green Project.

3.8.40 The Project will require the construction of Project specific onshore electrical infrastructure facilities. These facilities may include:

3.8.41 One OnSS containing the electrical components for transforming and converting the power exported through the onshore cables to 400kV and to adjust the power quality and power factor, as required to meet the GB NGESO Grid Code for supply to the National Grid, including 400kV cables between substation and National Grid. The onshore substation will comply with the technical standard National Grid TS 'GIS and Other Substation Building Design' with a minimum design working life of 40 years or the latest guidance.

3.8.42 Grading, earthworks and drainage will be undertaken initially within the onshore electrical infrastructure facilities footprint. Foundations will then be installed which will either be ground-bearing or piled, based on the prevailing ground conditions.

3.8.43 The proposed building substructures will be predominantly composed of steel and cladding materials although brick/block-built structures are sometimes employed. The structural steelwork is likely to be fabricated and prepared off site and delivered to site for erection activities. The steelwork may be erected with the use of cranes. Cladding panels (typically composite) may be delivered to site ready to erect and be fixed to the steelwork. In addition, there could be unhoused equipment, such as different switchgear and protective devices, grid transformers, shunt reactors, dynamic reactive compensation equipment, harmonic filters and water tanks. Noise enclosers and lightning masts may be constructed to an approximate height of 30m.

3.8.44 A key aspect of the substation installation will be the delivery of the transformers, shunt reactors, dynamic reactive power compensators (e.g. static synchronous compensators), and harmonic filters. Due to their size and weight, these items will be classified as Abnormal Indivisible Loads (AILs) and delivered via specialist means and offloaded with the use of cranes, Self-Propelled Modular Transporters (SPMTs) or skids. The majority of the remaining equipment is anticipated to be erected with the use of small mobile plant and lifting apparatus.

3.8.45 The onshore electrical infrastructure facilities will be required throughout the lifetime of the Project. Their key parameters are presented in Table 3.32. The detailed design of the OnSS will take place post-consent, but further information regarding the Design Principles can be found in Appendix 3 of this Chapter - Onshore Substation Design Principles.

Table 3.32: Indicative key design parameters for the OnSS MDS

Parameters	Design Envelope
Maximum number of substations	1
Indicative site area (up to the permanent fencing) per onshore substation (m^2)	180,000
Indicative temporary working area per onshore substation (m^2)	270,000
Maximum building height (m)	19
Maximum lightning protection height (m)	30

Additional Associated Development

3.8.46 Subject to the confirmation of the grid connection by NGESO as part of the Offshore Transmission Network Review (OTNR), the Project may seek to incorporate additional infrastructure into the Project's DCO application to provide rights for NGET to enable the connection of the Project to the existing National Electricity Transmission System. The detail of this infrastructure has yet to be provided by NGET and could involve underground cables and/or a NGET substation and/or associated enabling works (such as connection to, and/or reinforcement of, overhead lines) which would be consulted upon prior to the Project's DCO application. Discussions are ongoing with NGESO and NGET in this regard and a decision on this approach will be determined following publication of the PEIR and receipt of a final grid connection agreement from NGESO.

3.9 Operation and Maintenance (O&M)

3.9.1 During the operational period (anticipated to be approximately 35 years), scheduled and unscheduled monitoring and maintenance activities will be required. The maintenance activities will be categorised as either preventative or corrective maintenance. Preventive maintenance will be undertaken according to a service schedule, whereas corrective maintenance will be needed to cover unexpected repairs, component replacements, retrofit campaigns and breakdowns. An Outline Operation and Maintenance plan will be produced for DCO Application.

Offshore

3.9.2 A number of different vessel types may be required for O&M activities. During the operational phase of the Project there will be no planned maintenance or replacement of the subsea cables, however repairs may be required should the cable fail or be damaged. Periodic surveys will be undertaken to ensure the cables remain buried and/or sufficiently protected and, if they do become exposed, then corrective maintenance will be undertaken (such as deployment of cable protection or reburial).

3.9.3 Maintenance staff can access the windfarm from a range of O&M vessels (e.g. crew transfer vessels, supply vessels, autonomous surface vessels (ASVs)) and/or helicopters or could be maintained using an offshore base (such as an accommodation vessel, Service Offshore Vessel (SOV), or mother ship).

3.9.4 The O&M base (onshore, offshore or both) will be determined by the O&M strategy following final decision (i.e. post-consent) when the technical specifications of the development are known, including the location of the O&M base(s) and the WTG type.

3.9.5 The EIA will seek to assess expected maintenance activities based on experience and best practice, however additional consents or licences may be required during the life of the Project for unforeseen activities.

Table 3.33 MDS for offshore O&M activities

Parameter	Maximum design parameter
Operation and maintenance vessels - CTVs:	10
Operation and maintenance vessels - SOVs	2
Operation and maintenance vessels - supply vessels	12

Parameter	Maximum design parameter
Helicopters: capacity (persons)	8
JUVs	4
Onshore facilities area - offices (m2)	2500
Onshore facilities area - workshop and warehouse (m2)	2000
Harbour facilities – quayside length (m)	100
Operational hours	24/7

Onshore

3.9.6 Onshore, the O&M requirements will be largely corrective, accompanied by infrequent on-site inspections of the onshore ECC. However, all onshore infrastructure will be constantly monitored remotely, and there may be O&M staff visiting the OnSS to undertake works when necessary (currently expected to be once per week).

3.9.7 The OnSS will not be manned; and security at the substation will be provided through the use of perimeter fencing and closed-circuit television (CCTV). Security lighting used will be in line with the Outline Artificial Light Emissions Management Plan (document 8.1.10) Periodic access to TJBs may also be required for inspection.

3.10 Decommissioning

3.10.1 At the end of the operational lifetime of the offshore windfarm, it is anticipated that all of the offshore structures above the seabed level, together with all subsea cables, will be completely removed. Onshore, it is expected that cable would be left in-situ to avoid adverse effects on the environment and communities.

3.10.2 The decommissioning sequence will generally be the reverse of the construction sequence (reverse lay) and involve similar types and numbers of vessels and equipment.

3.10.3 Closer to the time of decommissioning, it may be decided that removal of infrastructure would lead to greater environmental impacts than leaving components in situ, in which case certain components may not be fully decommissioned. Any final decommissioning methodology will adhere to industry best practice, rules and regulations at the time of decommissioning.

3.10.4 In addition, at the appropriate time and subject to a new consent, it is possible that there may be an option to repower the Project by partially or fully replacing the windfarm components to extend the Project operational period.

3.10.5 A Decommissioning Plan will be developed providing further details on the decommissioning of the Project in accordance with the Outline Decommissioning Plan to be submitted with the DCO application.

3.11 Project Construction Programme

3.11.1 It is anticipated, that if granted consent, the windfarm will be operational by 2030, with construction currently expected to commence in 2026. An indicative programme detailing the expected timescales and overlaps for the key elements of the Project are shown in Figure 3.24 below. A more detailed programme will be provided in the ES to inform the detailed assessments (including in-combination and cumulative assessments).

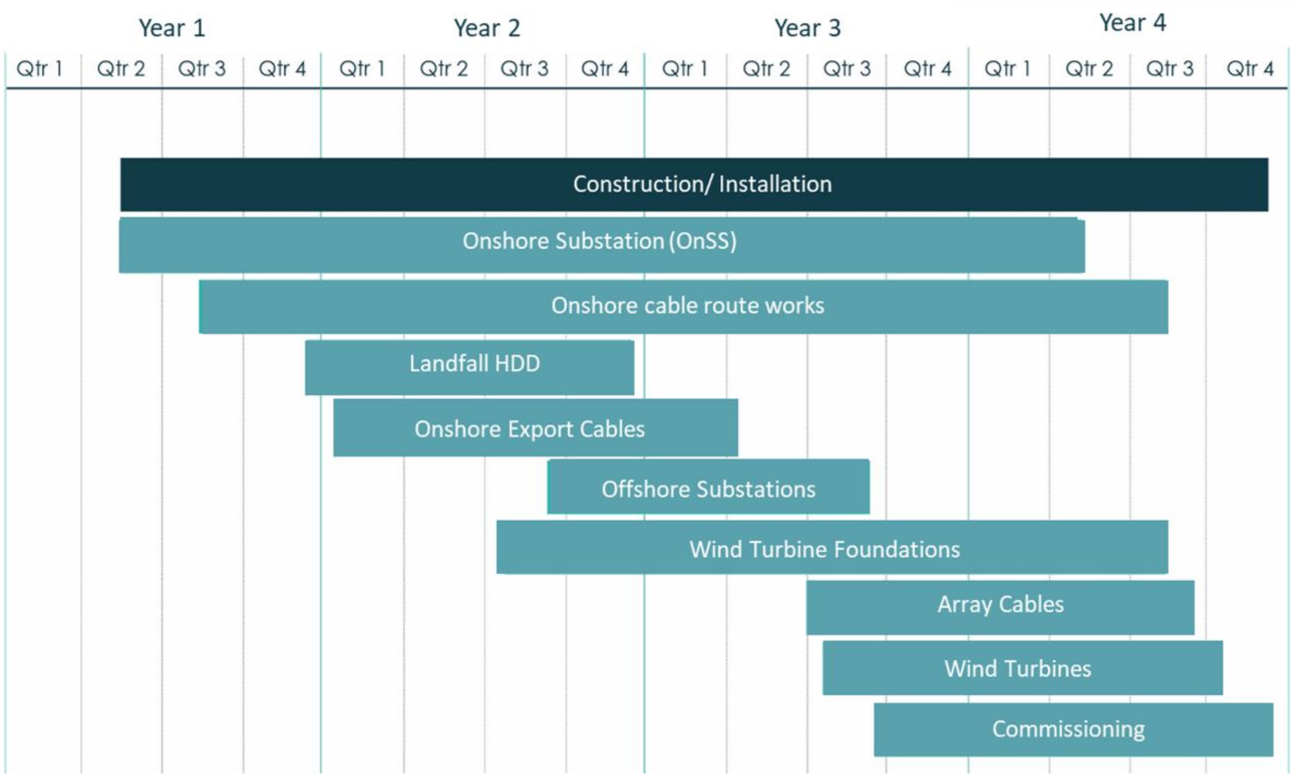

Figure 3.24 Indicative Construction Programme

3.12 Construction Management

Commitments

3.12.1 The Applicant has systematically identified the potential impacts and presented in this PEIR the preliminary assessment of the consequential effects on the environment, taking into account a variety of embedded mitigation measures to avoid, reduce or eliminate relevant environmental impacts. The commitments include, for example, avoidance and best practice and design commitments, which are classified into primary or tertiary measures in accordance with IEMA 'Guide to Shaping Quality Development' (IEMA, 2015) definitions.

3.12.2 The Project has incorporated primary (embedded) mitigations, which are measures which form intrinsic parts of the design and construction and/or operational process. These embedded design commitments are described in Table 3.34.

Table 3.34: Embedded mitigations which form the basis of the PEIR

Commitment topic	Description	How will it be secured?
General		
A Site Waste Management Plan	A Site Waste Management Plan (SWMP) will be developed in accordance with the Outline SWMP, with consideration of the latest relevant available guidance.	Within DCO
Agreements with existing pipeline and cable operators	Where potential interaction between the Project and other infrastructure or marine users are identified, owners and operators will be consulted, and standard legal agreements, for example crossing or proximity agreements, will be put in place	Secured by commercial agreements with pipeline and cable operators.
Archaeological Receptors	All intrusive construction activities will be routed and micro-sited to avoid any identified Archaeological Exclusion Zones (AEZs) as outlined in the Outline Marine WSI to protect any known and identified marine archaeological receptors and allow the rerouting and micro-siting of seabed structures and cables.	Within DCO
Habitats of Principal Importance	The Project will undertake a review of the latest available benthic datasets and data from pre-construction surveys. Windfarm infrastructure will be micro-sited around Annex I habitats, wherever reasonably practicable (subject to agreement with the Marine Management Organisation (MMO)) to an extent not resulting in a hazard for marine traffic and Search & Rescue capability.	Within DCO
Contamination	A contaminated land and groundwater plan will be prepared to identify any contamination and any remedial measures which may be required.	Within DCO
MGN654 Compliance	The Project will ensure compliance with MGN654 where appropriate.	Within DCO
Project Layout	The Project commits to agree layout principles with the MMO, in consultation with the MCA and Trinity House.	Within DCO
Working Schedule	Except where otherwise agreed in the code of construction practice, construction of the onshore works and construction-related traffic movements to or from the site of the relevant work shall only take place	Within DCO

Commitment topic	Description	How will it be secured?
	between 0700 hours and 1900 hours Monday to Saturday with no activity on Sundays or bank holidays. If agreed in advance with the relevant planning authority construction of the onshore works and construction related traffic movements to or from the site of the relevant work may take place outside the hours specified above for certain works, including— ▪ where continuous periods of construction are required for works such as concrete pouring and finishing, electrical circuit pulling and jointing, and testing; ▪ for the delivery and unloading of abnormal loads; ▪ for the landfall works; ▪ any other time critical element of the onshore works; and ▪ or as otherwise agreed in the code of construction practice. All construction works which are to be undertaken outside the hours specified above must be agreed in advance with the relevant planning authority, except in respect of trenchless techniques— ▪ where continuous 24 hour working is required, the undertaker shall notify the relevant planning authority in advance of such works; and ▪ where a trenchless technique is to take place within 100m of an occupied dwelling, the works shall take place in accordance with the construction hours specified in paragraph (1) unless otherwise agreed in advance with the resident of that dwelling and notified to the relevant planning authority.	
Offshore		
Cable Protection	The installation of the offshore export cables at landfall will be undertaken by HDD or other trenchless methods, with the punch out to be in the subtidal zone. Any rock protection utilised within the subtidal zone will not exceed LAT.	Within DCO

Commitment topic	Description	How will it be secured?
Offshore Cables	Where possible, cable burial will be the preferred option for cable protection for the offshore subsea array, interlink and export cables.	Within DCO
Offshore cables	Where offshore export cables must cross third-party infrastructure, such as existing cables and pipelines, both the third-party asset and the installed cables will be protected.	Within DCO
Installation of the Offshore Export Cables	The installation of the offshore export cables at landfall will be undertaken by trenchless techniques (HDD).	Within DCO
Wind Turbine Array Layout	The Project commits to agree layout principles for the design of the offshore wind turbine array with the MMO, in consultation with the Maritime Coastguard Agency (MCA) and Trinity House, and to adopt those principles in the design of the final turbine layout.	Within DCO
Scour and Cable Protection	Where scour and/or cable protection is required, the guidance in MGN654 will be adhered to with respect to changes to under-keel clearance of greater than 5% which will only be adopted following consultation with, and agreement by, the MCA and approval by the MMO.	Within DCO
Scour Protection Management Plan	A Scour Protection Management Plan will be developed post-consent and prior to construction, for approval by the MMO. This will include details of the need, type, quantity, installation methods and locations for scour and cable protection.	Within DCO
Windfarm Array Area	Reduction from approximately 500km^2 to 300km^2 is required prior to construction in line with TCE AfL.	Within AfL
Onshore		
Coastal Path Impacts	Impacts on the English Coast Path national route will be minimised through site design considerations and phasing within working constraints for the landfall construction.	Within DCO
Badger Access	Where required, provision will be made for badger access in relevant construction areas, when work is not taking place in order to ensure normal movements as far as reasonably possible. Provision will be made to ensure avoiding the entrapment of any animals within relevant construction areas.	Within DCO

Commitment topic	Description	How will it be secured?
	Checks will be made prior to the start of any works to ensure no animals are trapped. Appropriate checks will be made as required by the Ecological Clerk of Works (ECoW).	
Onshore Substation Design Principles	Detailed design will be developed for the Onshore Substation (OnSS) in accordance with the Onshore Substation Design Principles which will include details regarding design and access. Examples of such detailed design information includes (but are not limited to): building heights and form; site layout; external appearance and colours; vehicular and pedestrian access.	Within DCO
Disturbance to Public Rights of Way (PRoWs)	The Outline Public Access Management Plan will set out the approach that will be taken to manage public access to the PRoW affected during construction. Disturbance to PRoWs will be temporary where reasonably practicable and PRoWs will be reinstated as soon as reasonably practical. This will include details of temporary and permanent diversions, closures, gated crossings and signage to be provided during construction.	Within DCO
Effects on Environmental Agency Main River or Ordinary Watercourse	Where works to a main river or ordinary watercourse are necessary, the appropriate permits and consents will be sought from the relevant authority as required. Details of the locations and work undertaken on any Environment Agency main river or associated flood defences, including any reports or records, will be submitted to the Environment Agency. For works undertaken on or near all other watercourses an Ordinary Watercourse Consent will be sought.	Within DCO
Fences, walls, ditches and drainage outfalls	Fences, walls, ditches and drainage outfalls will be retained along the onshore export cable corridor and landfall, where possible. Where it is not reasonably practicable to retain them, any damage will be repaired and reinstated as soon as reasonably practical. The Environment Agency, or internal drainage board (IDB) will be notified if damage occurs to any Environment Agency main river or related flood infrastructure.	Within DCO
Access Points	Temporary access points off the highway will be installed to facilitate vehicular access from the road, and into the onshore cable corridor during	Within DCO and Access to Works Plans

Commitment topic	Description	How will it be secured?
	construction. The access points will be constructed in line with the local authorities' requirements, relevant appropriate standards and in accordance with the principles established in the Outline Construction Traffic and Travel Management Plan.	
Infrastructure Drainage Strategy	Infrastructure Drainage Strategy will be developed for the permanent onshore operational development in accordance with the Outline Drainage Strategy to be produced for DCO Application. The Outline Drainage Strategy will include measures to ensure that existing land drainage is reinstated and/or maintained. This will include measures to limit discharge rates and attenuate flows to maintain greenfield run-off rates at the Onshore Substation. The final Drainage Strategy will be developed in line with the latest relevant drainage guidance notes in consultation with the Environment Agency, Lead Local Flood Authority and relevant Internal Drainage Board as appropriate.	Within DCO
Joint Bays	Joint Bays will be completely buried, with the land above reinstated except where access will be required from ground level, e.g. via link box chambers and manholes.	Within DCO
Landscape Management Plan	The Project will comply with the Landscape and Ecological Management Strategy which will be developed in accordance with the Landscape and Ecology Design Principles Plan (LEDPP) to be submitted at DCO Application in line with the current Landscape & Ecology Design Principles Plan (document reference 8.7). The Landscape and Ecological Management Strategy will include details of mitigation planting at the onshore substation site, including the number, location, species and details of management and maintenance of planting. Where practical, landscape mitigation planting will be established as early as reasonably practicable in the construction phase.	Within DCO
Great Crested Newt presence	In areas of confirmed presence, or potential for great crested newt (i.e. within 250m of an identified great crested newt pond) appropriate exclusion fencing	Within DCO

Commitment topic	Description	How will it be secured?
	will be erected and working areas 'trapped out' prior to the commencement of relevant onshore construction works, in line with great crested newt mitigation guidelines, English Nature, 2001 or the latest available relevant guidance.	
Onshore Export Corridor	The onshore export cable corridor (ECC) (inclusive of the 400kV export cables) will be completely buried underground for its entire length. No overhead pylons will be installed as part of the consented works for the Project.	Within DCO
Onshore Substation effect on Existing Watercourses	Where the permanent access track to the OnSS may be required to pass over an existing watercourse, the crossing will be appropriately designed to maintain floodplain capacity and/or flow conveyance, where reasonably practicable. This shall include an allowance for the predicted effects of climate change.	Within DCO
Onshore Substation effect on Flood Risk	The OnSS will be appropriately designed to manage floodplain capacity and/or flow conveyance so that there is no increase in flood risk, where reasonably practicable. A Flood Risk Assessment for the OnSS will be submitted at DCO Application.	Within DCO
Operational Noise Levels	With regards to the operational noise, the requirement and feasibility of any mitigation measures will be dependent on the significance of the effects of noise and vibration. The requirement and feasibility of any mitigation measures will be consulted upon with statutory consultees throughout the EIA process.	Within DCO
Operational Site Lighting	Operational site lighting at the OnSS will be designed in accordance with latest relevant available guidance and legislation and the details of the location, height, design and luminance of lighting to be used will be provided as part of detailed design for the onshore substation. The design of operational site lighting will accord with the Artificial Light Emissions Management Plan an outline of which has been provided alongside this PEIR (document reference 8.1.10) which will form part of the final Code of Construction Practice.	Within DCO

Commitment topic	Description	How will it be secured?
Ponds	Where reasonably possible, ponds identified during the route planning and site selection process have been avoided. During construction any newly identified ponds will be avoided through, for example, micro-siting of the onshore export cable or the use of trenchless construction techniques, to prevent direct interaction with the ponds in question, where reasonably practicable.	Within DCO
Site Reinstatement	All onshore logistics compounds will be removed and sites will be reinstated once construction has been completed.	Within DCO
Soil Storage	Topsoil and subsoil will be stored in separate stockpiles in line with DEFRA Construction Code of Practice for the Sustainable Use of Soils on Construction Sites PB13298 or the latest relevant available guidance. Any suspected or confirmed contaminated soils will be appropriately separated, contained and tested before removal (if required).	Within DCO
Substation Drainage Design	The drainage design at the onshore substation will include Sustainable Drainage System (SuDS) measures including filter drains, swales, attenuation and flow control structures for the operational drainage of the OnSS. Surface water will be discharged from the site at a controlled rate which will be determined during the detailed design stage. Appropriate consideration will be given to maintaining the existing floodplain capacity and–/or flow conveyance during extreme rainfall events. These principles are provided in the Outline Drainage Strategy (Supplementary Document 8.9).	Within DCO
Trenchless Techniques	All trenchless crossings will be undertaken in a manner that minimises construction vibration as far as reasonably practicable. Some discreet crossing locations may require works which result in more vibration than others, in order to complete that specific crossing while maintaining function for example certain road or rail crossings.	Within DCO
Vegetation Clearance	Where hedgerows and/or trees require removal, this will be undertaken prior to topsoil removal. Sections of hedgerows and trees which are removed will be replaced using similar or more diverse hedgerow species.	Within DCO

Commitment topic	Description	How will it be secured?
Vegetation Protection	Trees identified to be retained within the Onshore Crossing Schedule will be fenced off and worked around. Where works are required close to trees that will remain in situ, techniques will be used to safeguard the root protection zone.	Within DCO
Vegetation Removal	All vegetation requiring removal will be undertaken outside of the bird breeding season. If this is not reasonably practicable, the vegetation requiring removal will be subject to a nesting bird check by a suitably qualified ECoW. If nesting birds are present, the vegetation will not be removed until the young have fledged or the nest failed.	Within DCO
Vegetation Removal/ Replacement	Where agreed with landowners, removed hedgerows and trees will be replaced with hedgerows of a more diverse and locally native species composition than that which was removed.	Within DCO
Working Areas	All temporary and permanent working areas of the onshore ECC, logistics compounds and the OnSS site will be clearly marked and secured with appropriate fencing.	Within DCO

3.13 References

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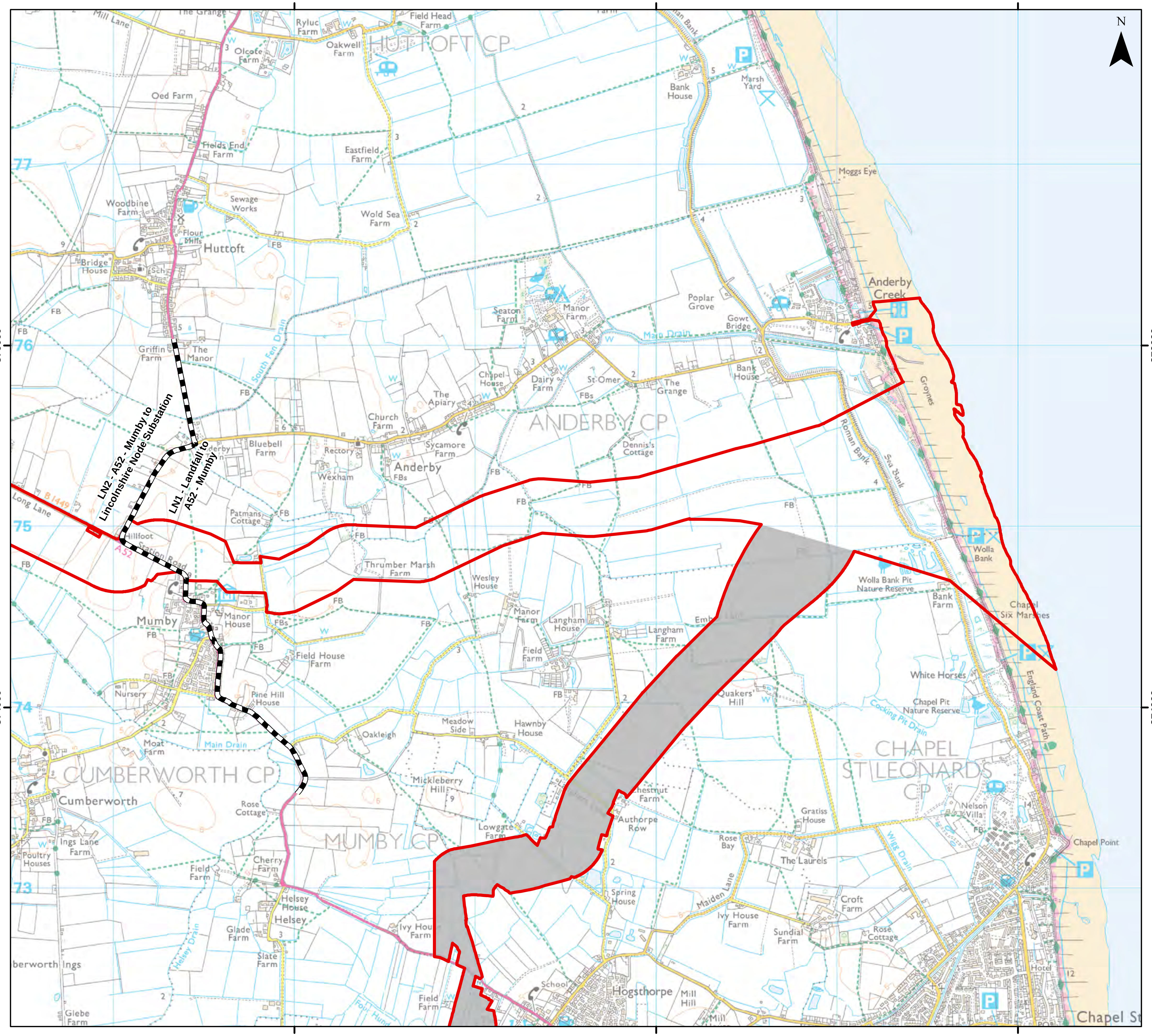
4 Annex A –



Legend

- Onshore PEIR Boundary
- Onshore Segment Break

Sources:

Coordinate System: British National Grid

0 0.5 1 km

Scale: 1:20,000

Preliminary Environmental Information Report
Onshore ECC Segment Maps Appendix
LN1 - Landfall to A52 - Mumby

Figure 3A1

Date: 16/05/2023
Produced By: JRS
Revision: 0.1

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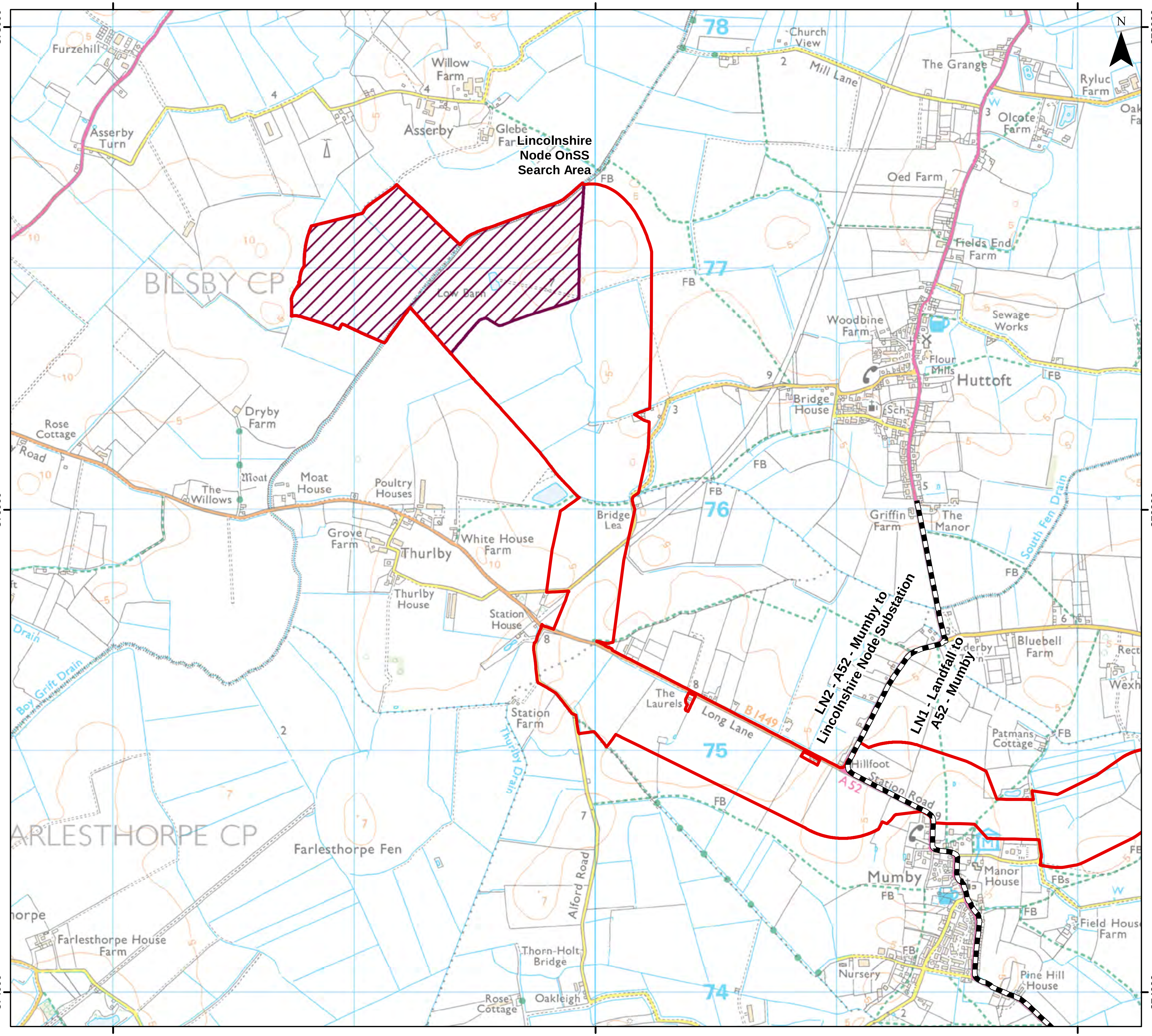
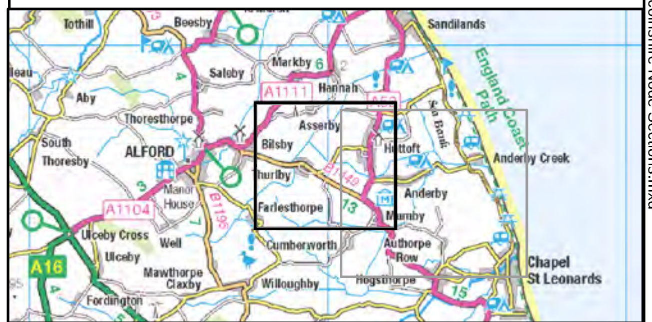


Legend

- Onshore PEIR Boundary
- Onshore Segment Break
- Lincolnshire Node OnSS Search Area

Sources:



Coordinate System: British National Grid

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Scale: 1:15,000

Preliminary Environmental Information Report
Onshore ECC Segment Maps Appendix
LN2 - A52 - Mumby to Lincolnshire Node Substation

Figure 3A2

OUTER DOWSING OFFSHORE WIND

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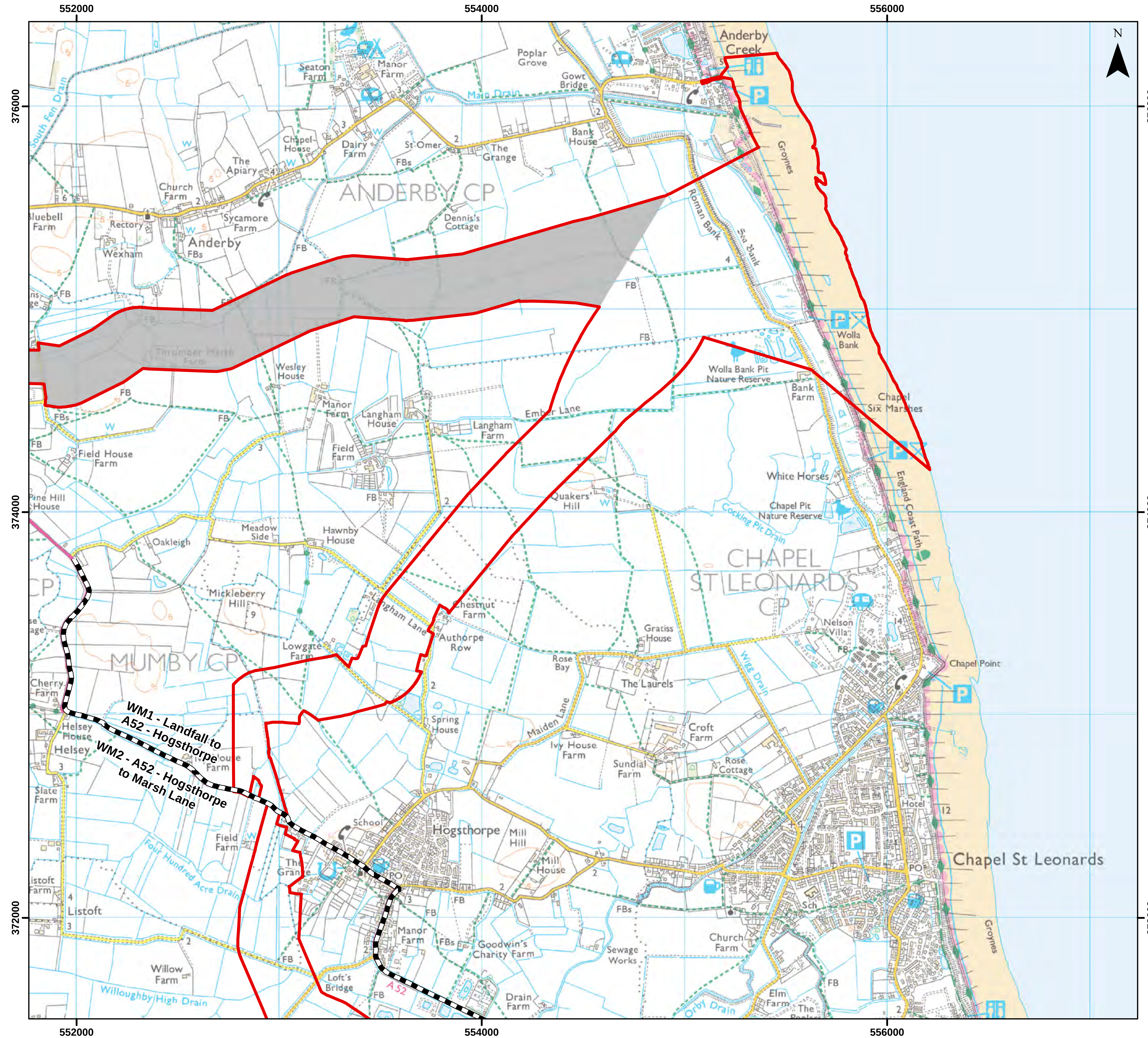

Legend

- Onshore PEIR Boundary
- Onshore Segment Break

Sources:

Coordinate System: British National Grid

0 0.5 1 km

Scale: 1:17,500

Preliminary Environmental Information Report
Onshore ECC Segment Maps Appendix
WM1 - Landfall to A52 - Hogsthorpe

Figure 3A3

OUTER DOWSING OFFSHORE WIND

Date: 16/05/2023
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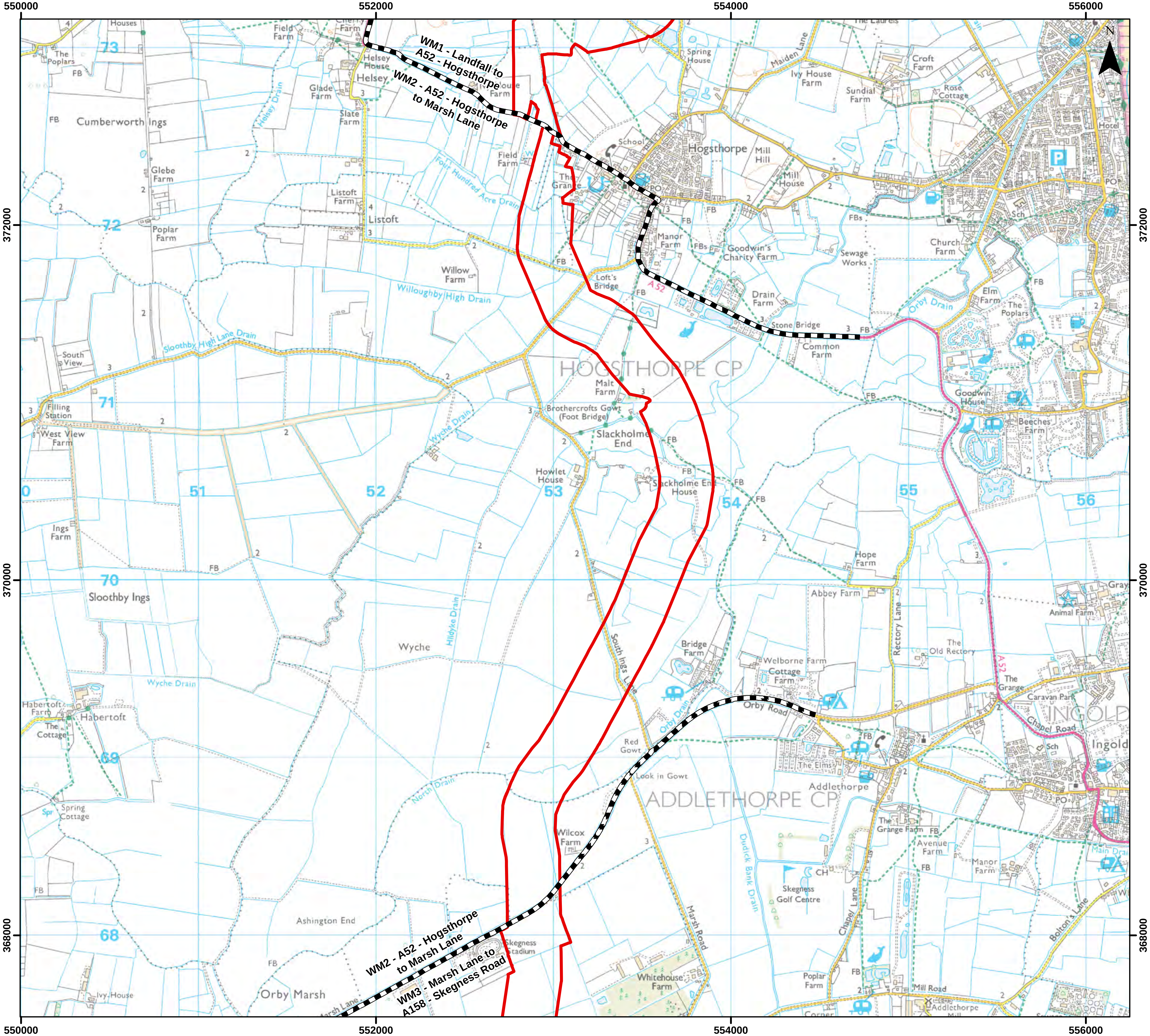

Legend

- Onshore PEIR Boundary
- Onshore Segment Break

Sources:

Coordinate System: British National Grid

0 0.5 1 km

Scale: 1:20,000

Preliminary Environmental Information Report
Onshore ECC Segment Maps Appendix
WM2 - A52 - Hogsthorpe to Marsh Lane

Figure 3A4

OUTER DOWSING OFFSHORE WIND

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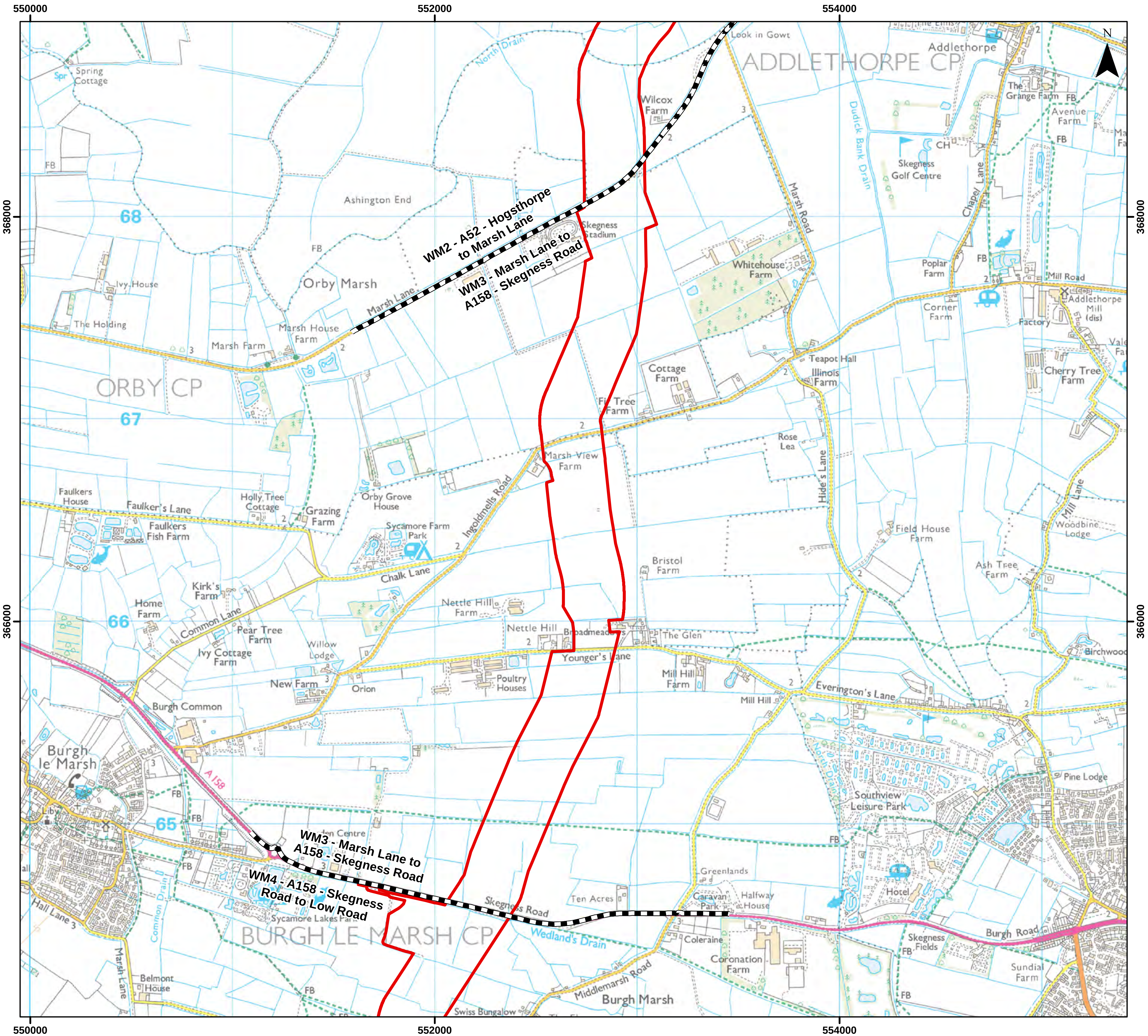
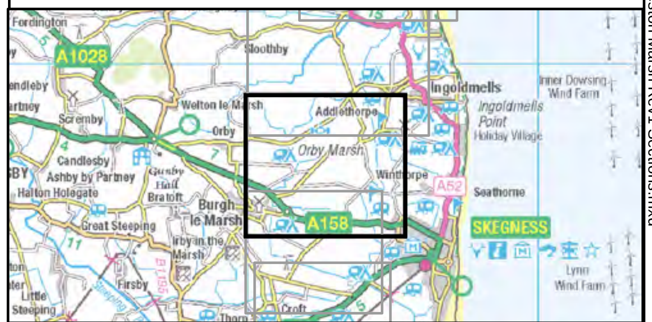


Legend

- Onshore PEIR Boundary
- Onshore Segment Break

Sources:



Coordinate System: British National Grid

0 0.5 1 km

Scale: 1:17,500

Preliminary Environmental Information Report
Onshore ECC Segment Maps Appendix
WM3 - Marsh Lane to A158 - Skegness Road

Figure 3A5

OUTER DOWSING OFFSHORE WIND

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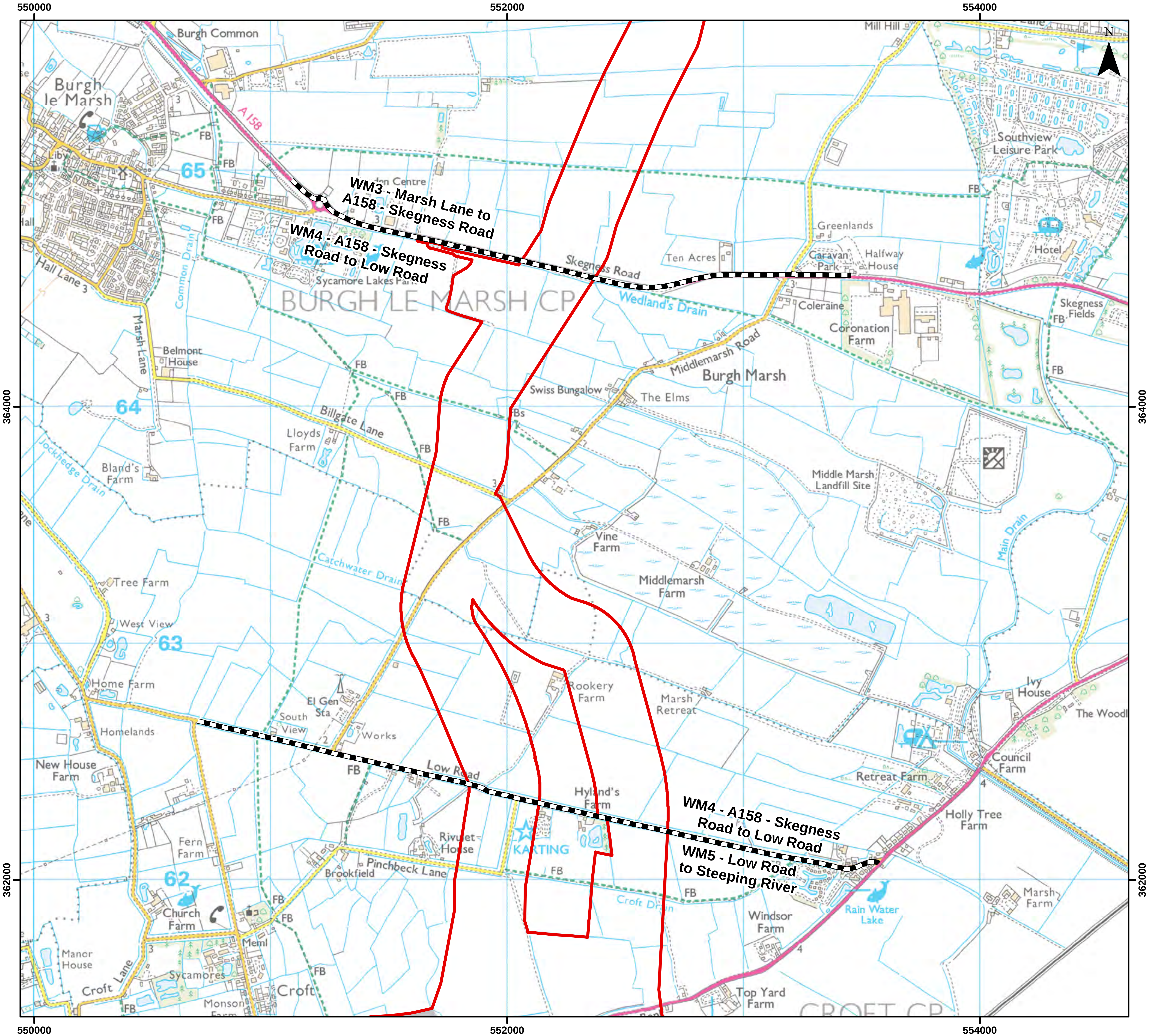
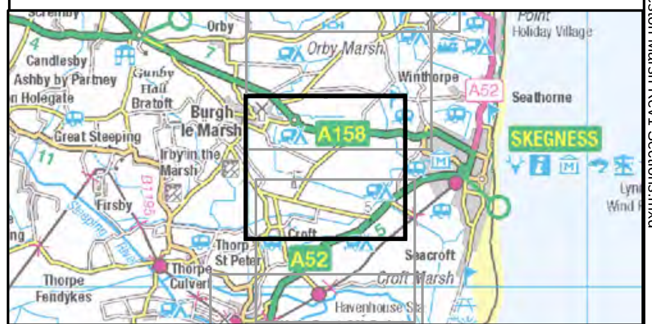


Legend

- Onshore PEIR Boundary
- Onshore Segment Break

Sources:



Coordinate System: British National Grid

0 0.5 1 km

Scale: 1:15,000

Preliminary Environmental Information Report
Onshore ECC Segment Maps Appendix
WM4 - A158 - Skegness Road to Low Road

Figure 3A6

OUTER DOWSING OFFSHORE WIND

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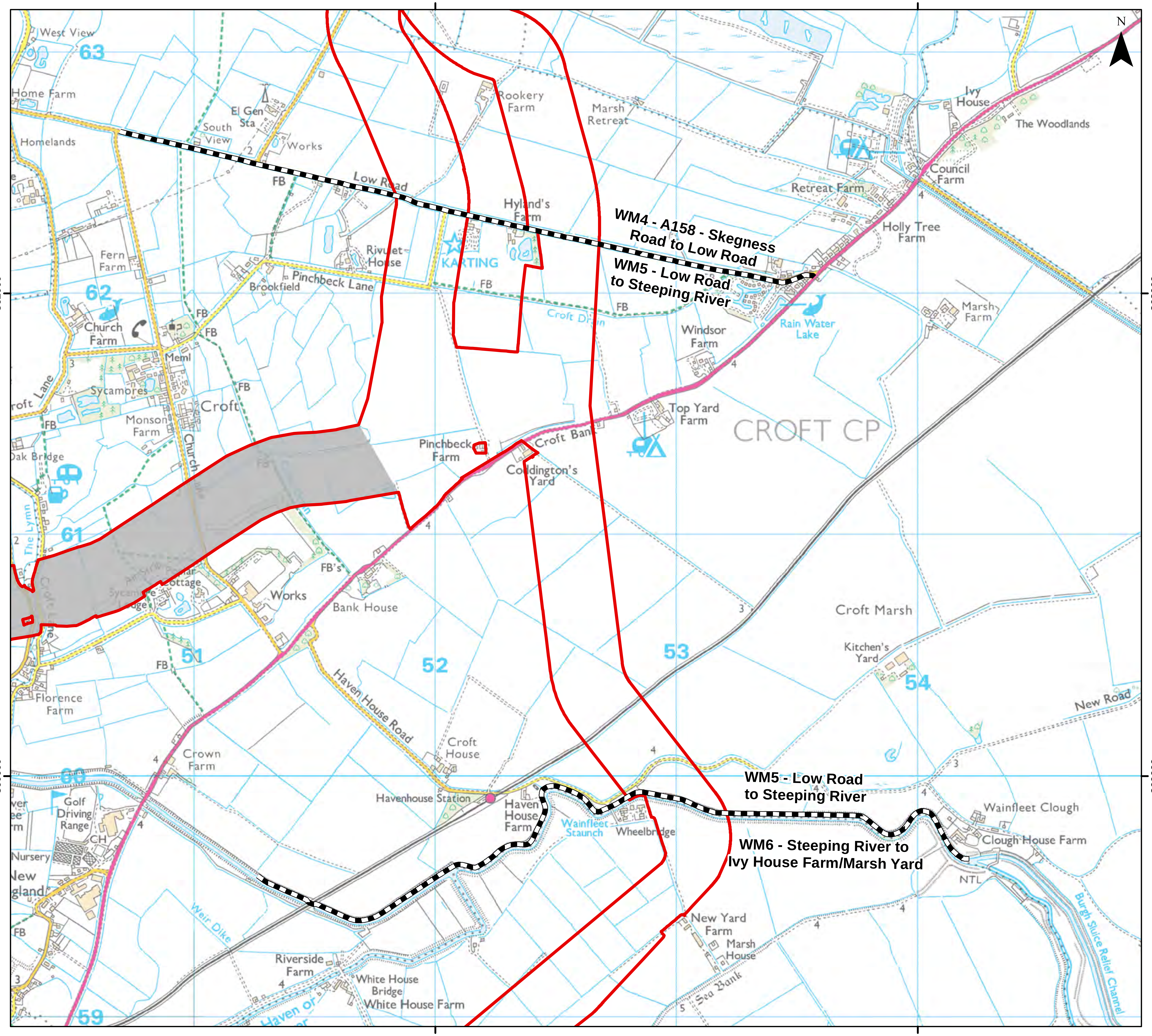
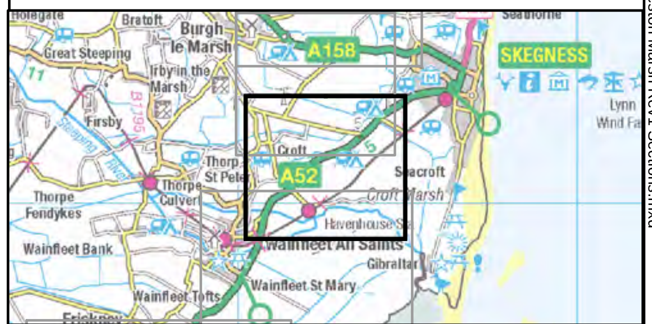


Legend

- Onshore PEIR Boundary
- Onshore Segment Break

Sources:



Coordinate System: British National Grid

0 0.5 1 km

Scale: 1:15,000

Preliminary Environmental Information Report
Onshore ECC Segment Maps Appendix
WM5 - Low Road to Steeping River

Figure 3A7

OUTER DOWSING OFFSHORE WIND

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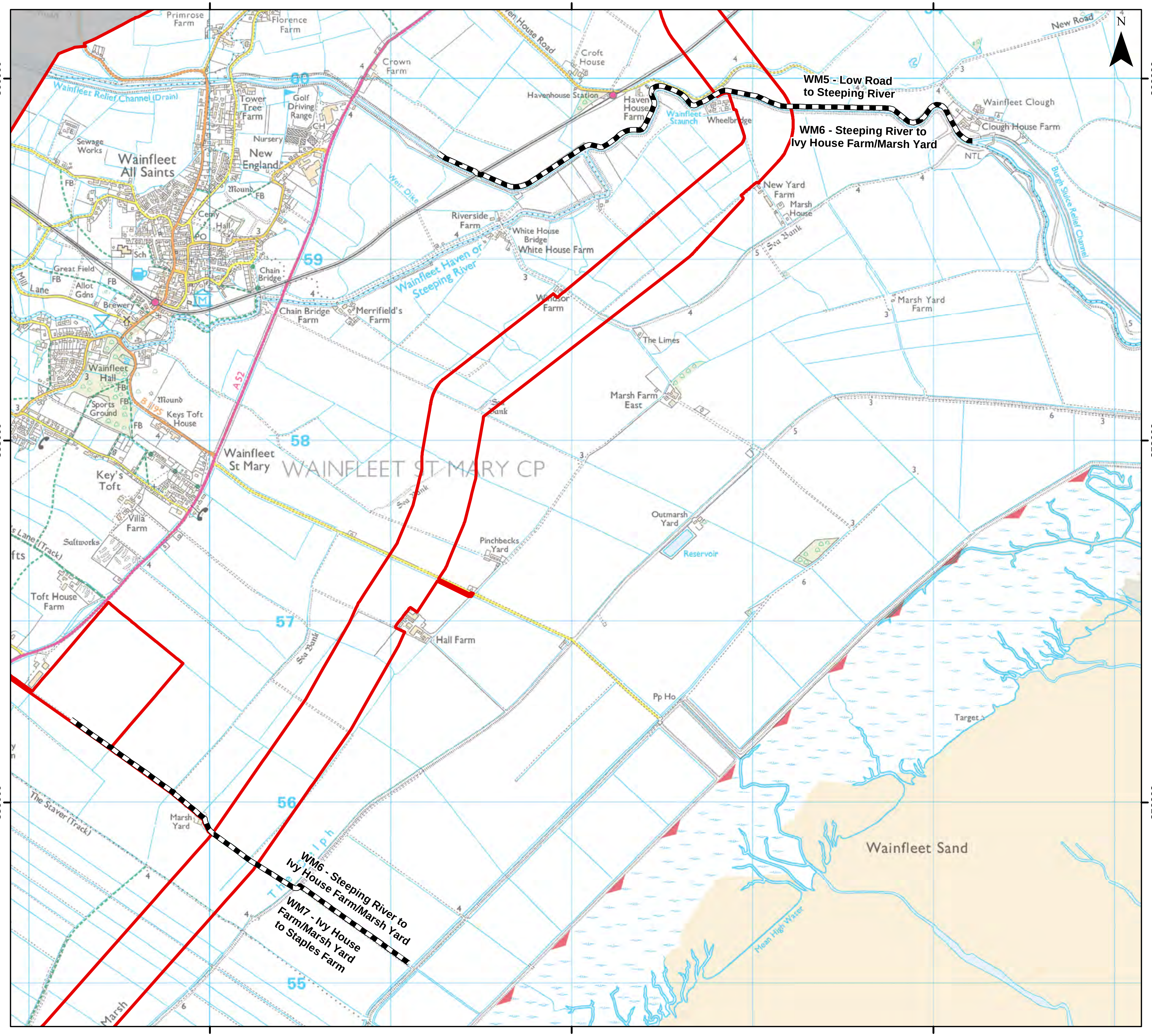

Legend

- Onshore PEIR Boundary
- Onshore Segment Break

Sources:

Coordinate System: British National Grid

0 0.5 1 km

Scale: 1:20,000

Preliminary Environmental Information Report
Onshore ECC Segment Maps Appendix
WM6 - Steeping River to Ivy House Farm/Marsh Yard

Figure 3A8

OUTER DOWSING OFFSHORE WIND

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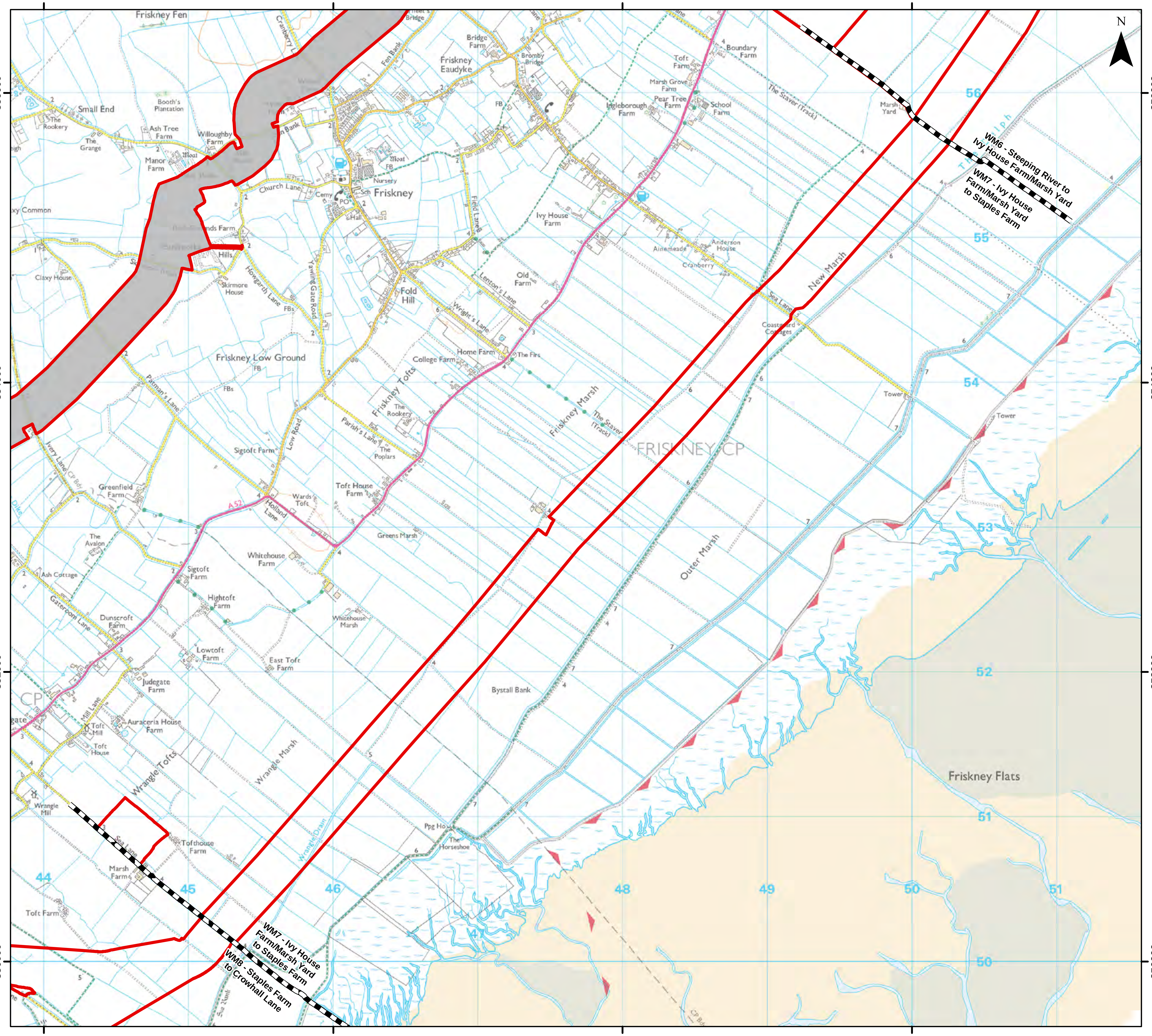

Legend

- Onshore PEIR Boundary
- Onshore Segment Break

Sources:

Coordinate System: British National Grid

0 0.5 1 km

Scale: 1:25,000

Preliminary Environmental Information Report
Onshore ECC Segment Maps Appendix
WM7 - Ivy House Farm/Marsh Yard to Staples Farm

Figure 3A9

OUTER DOWSING OFFSHORE WIND

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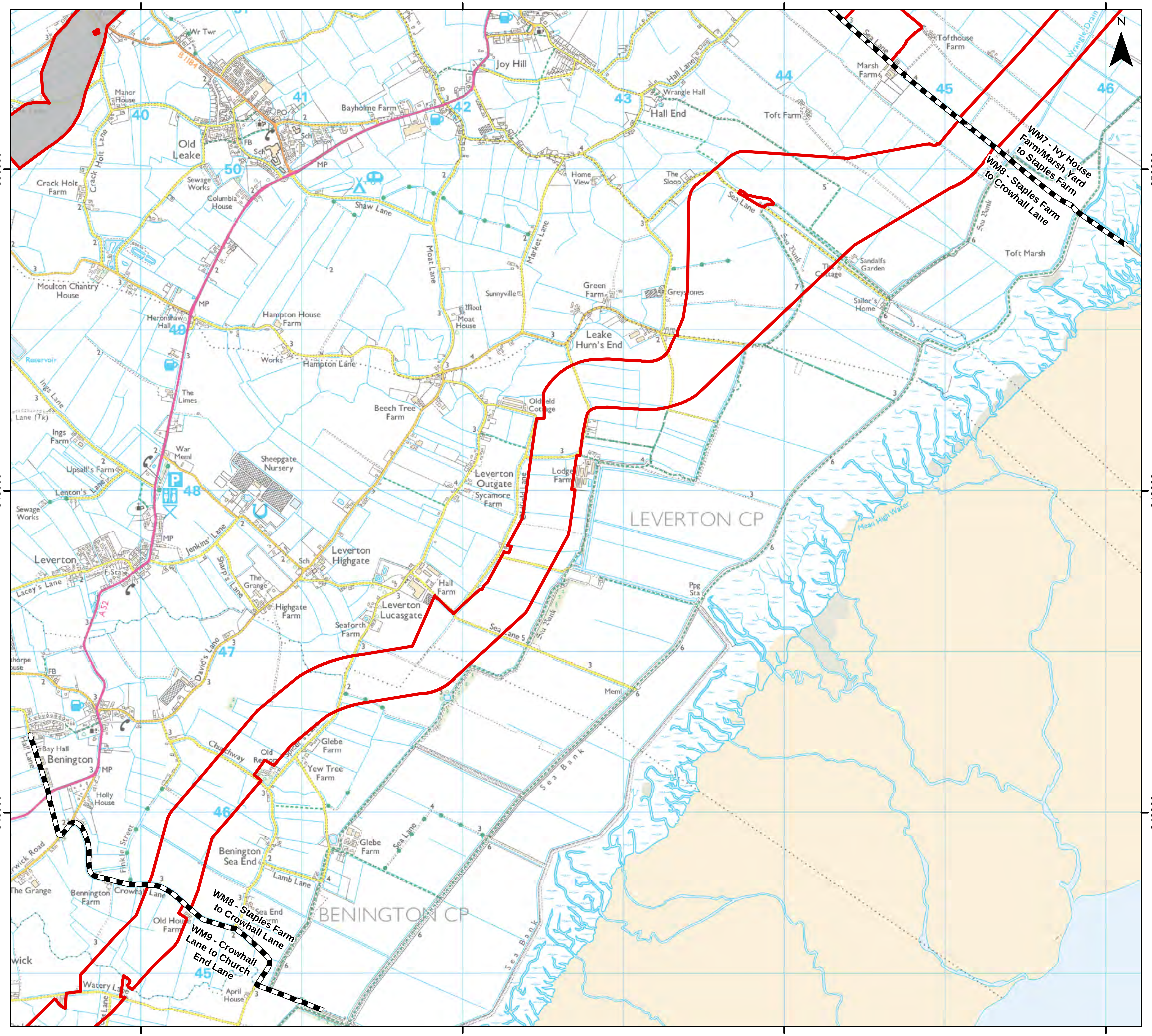

Legend

- Onshore PEIR Boundary
- Onshore Segment Break

Sources:

Coordinate System: British National Grid

0 0.5 1 km

Scale: 1:22,500

Preliminary Environmental Information Report
Onshore ECC Segment Maps Appendix
WM8 - Staples Farm to Crowhall Lane

Figure 3A10

OUTER DOWSING OFFSHORE WIND

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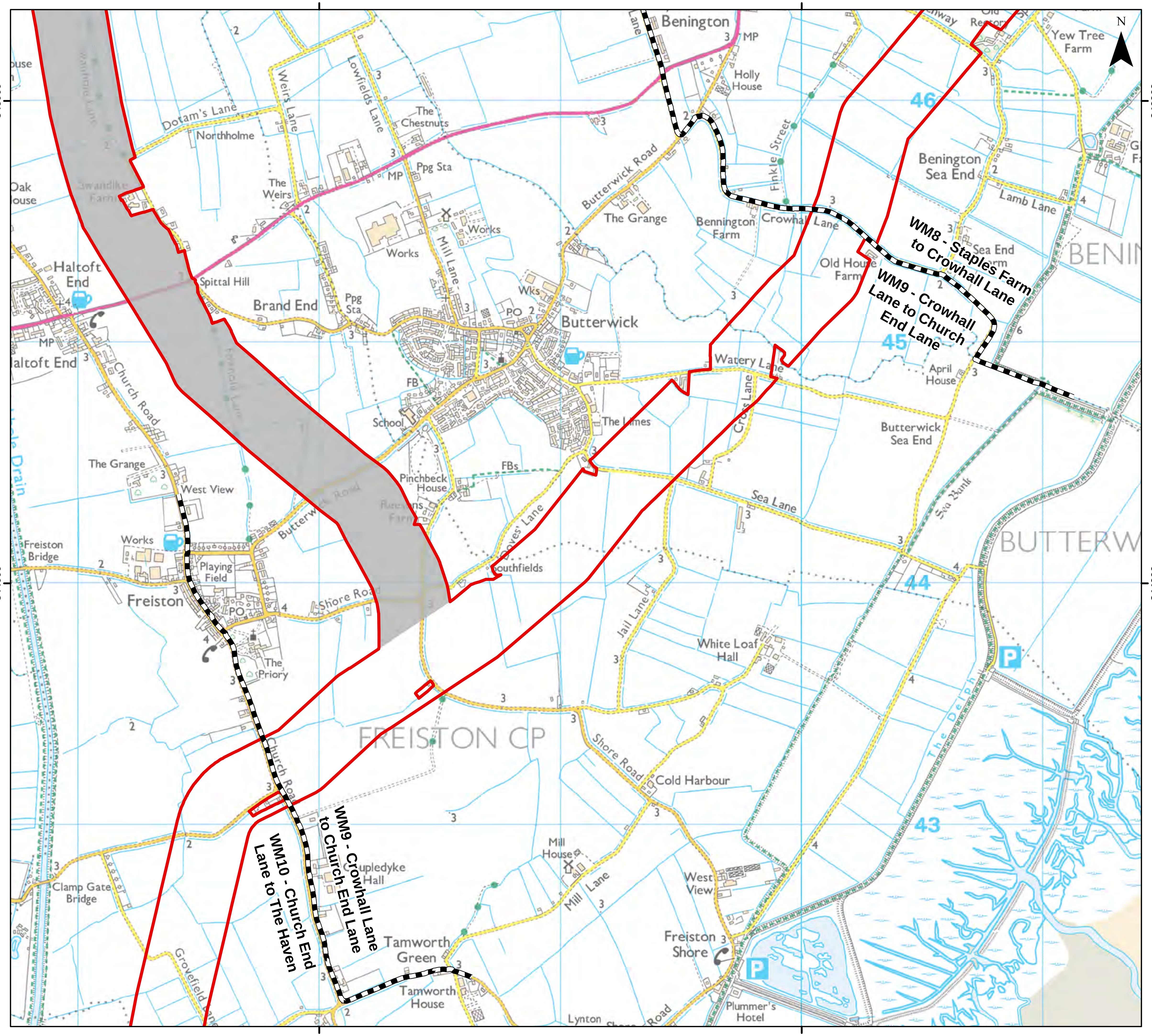

Legend

- Onshore PEIR Boundary
- Onshore Segment Break

Sources:

Coordinate System: British National Grid

0 0.5 1 km

Scale: 1:15,000

Preliminary Environmental Information Report
Onshore ECC Segment Maps Appendix
WM9 - Crowhall Lane to Church End Lane

Figure 3A11

OUTER DOWSING OFFSHORE WIND

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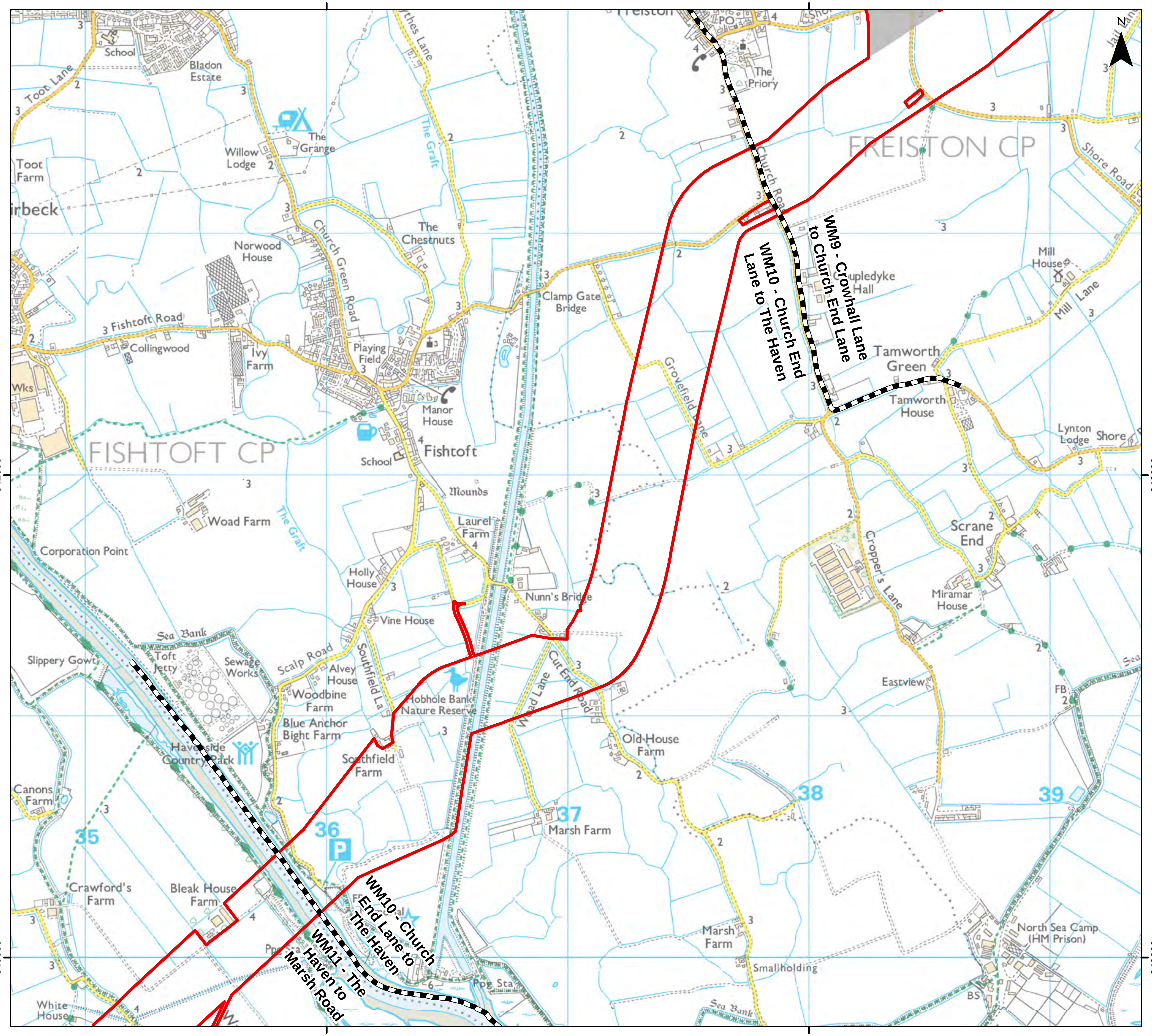
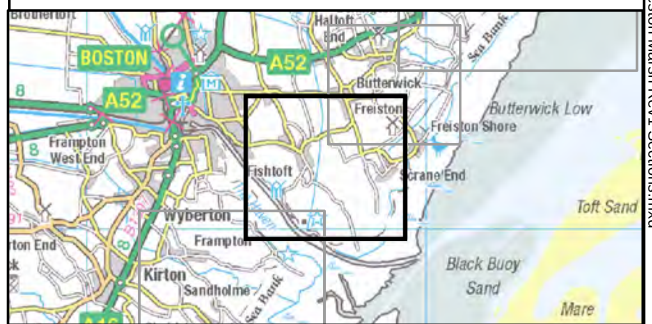


Legend

- Onshore PEIR Boundary
- Onshore Segment Break

Sources:



Coordinate System: British National Grid

0 0.5 1 km

Scale: 1:15,000

Preliminary Environmental Information Report
Onshore ECC Segment Maps Appendix
WM10 - Church End Lane to The Haven

Figure 3A12

OUTER DOWSING OFFSHORE WIND

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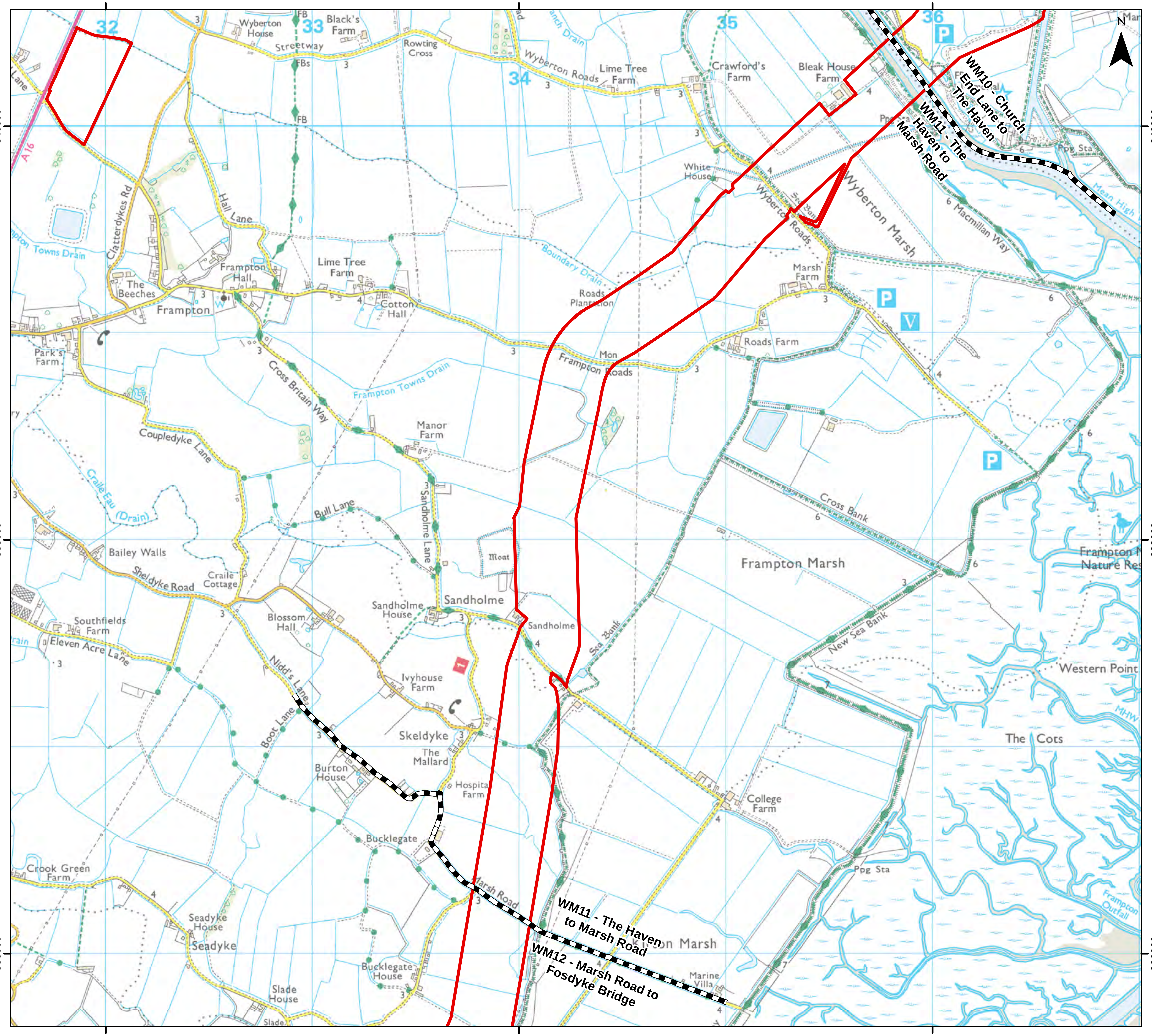
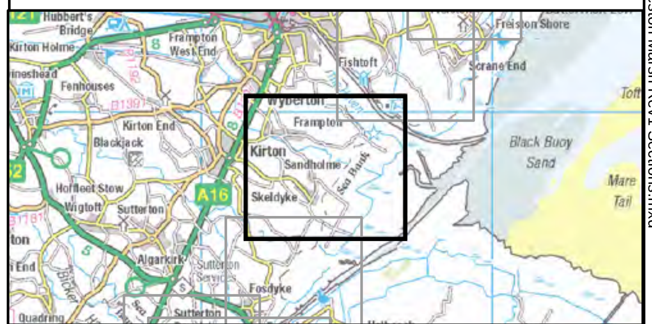


Legend

- Onshore PEIR Boundary
- Onshore Segment Break

Sources:



Coordinate System: British National Grid

0 0.5 1 km

Scale: 1:17,500

Preliminary Environmental Information Report
Onshore ECC Segment Maps Appendix
WM11 - The Haven to Marsh Road

Figure 3A13

OUTER DOWSING OFFSHORE WIND

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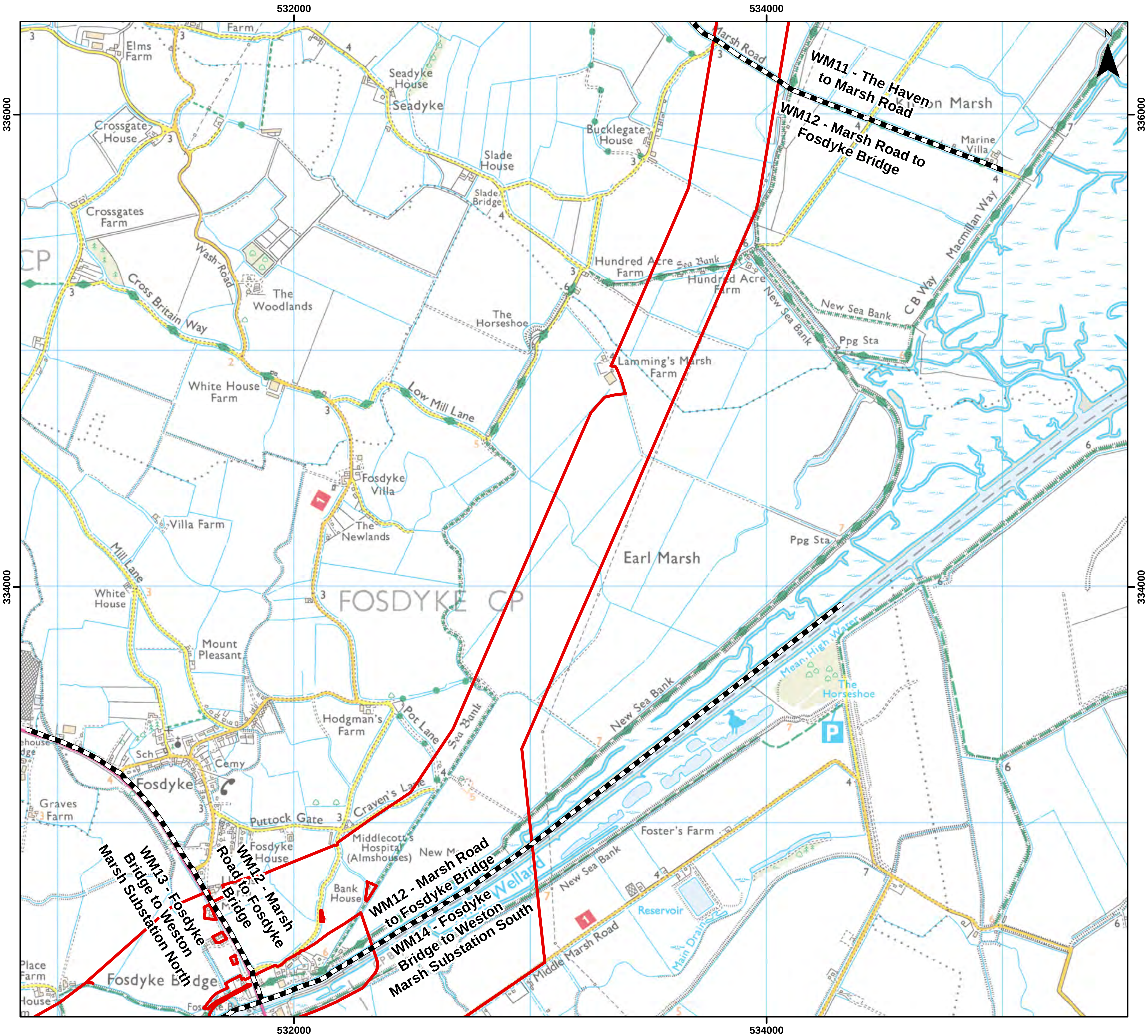
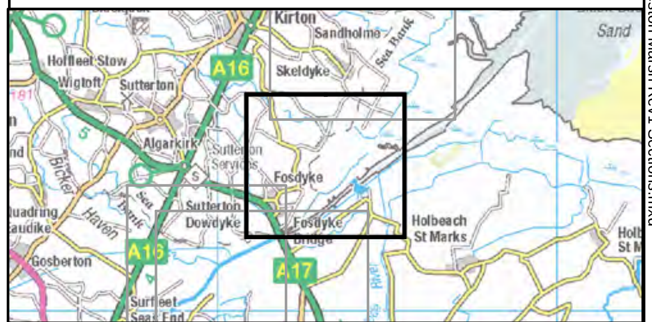


Legend

- Onshore PEIR Boundary
- Onshore Segment Break

Sources:



Coordinate System: British National Grid

0 0.5 1 km

Scale: 1:15,000

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Onshore ECC Segment Maps Appendix
WM12 - Marsh Road to Fosdyke Bridge

FIgure 3A14

OUTER DOWSING OFFSHORE WIND

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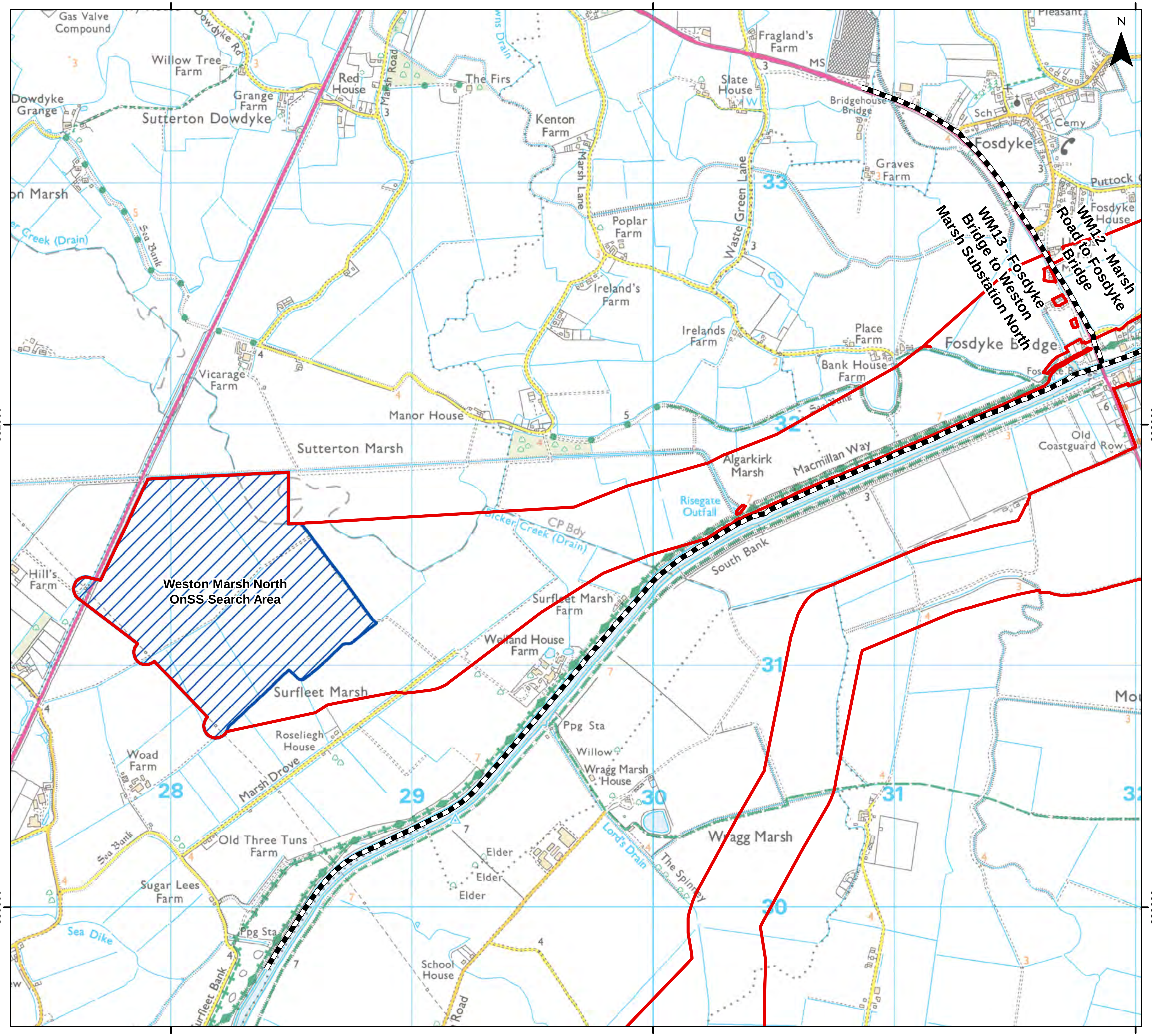
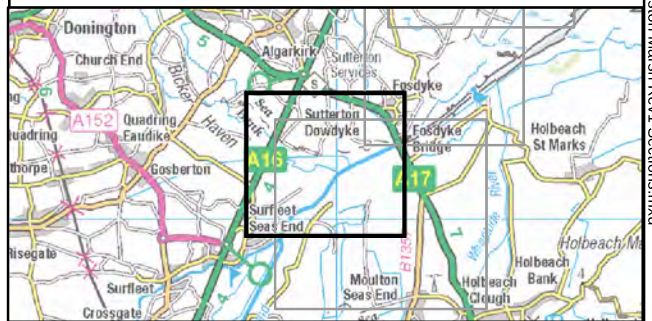


Legend

- Onshore PEIR Boundary
- Onshore Segment Break
- Weston Marsh North OnSS Search Area

Sources:



Coordinate System: British National Grid

0 0.5 1 km

Scale: 1:15,000

Preliminary Environmental Information Report
Onshore ECC Segment Maps Appendix
WM13 - Fosdyke Bridge to Weston Marsh Substation North

Figure 3A15

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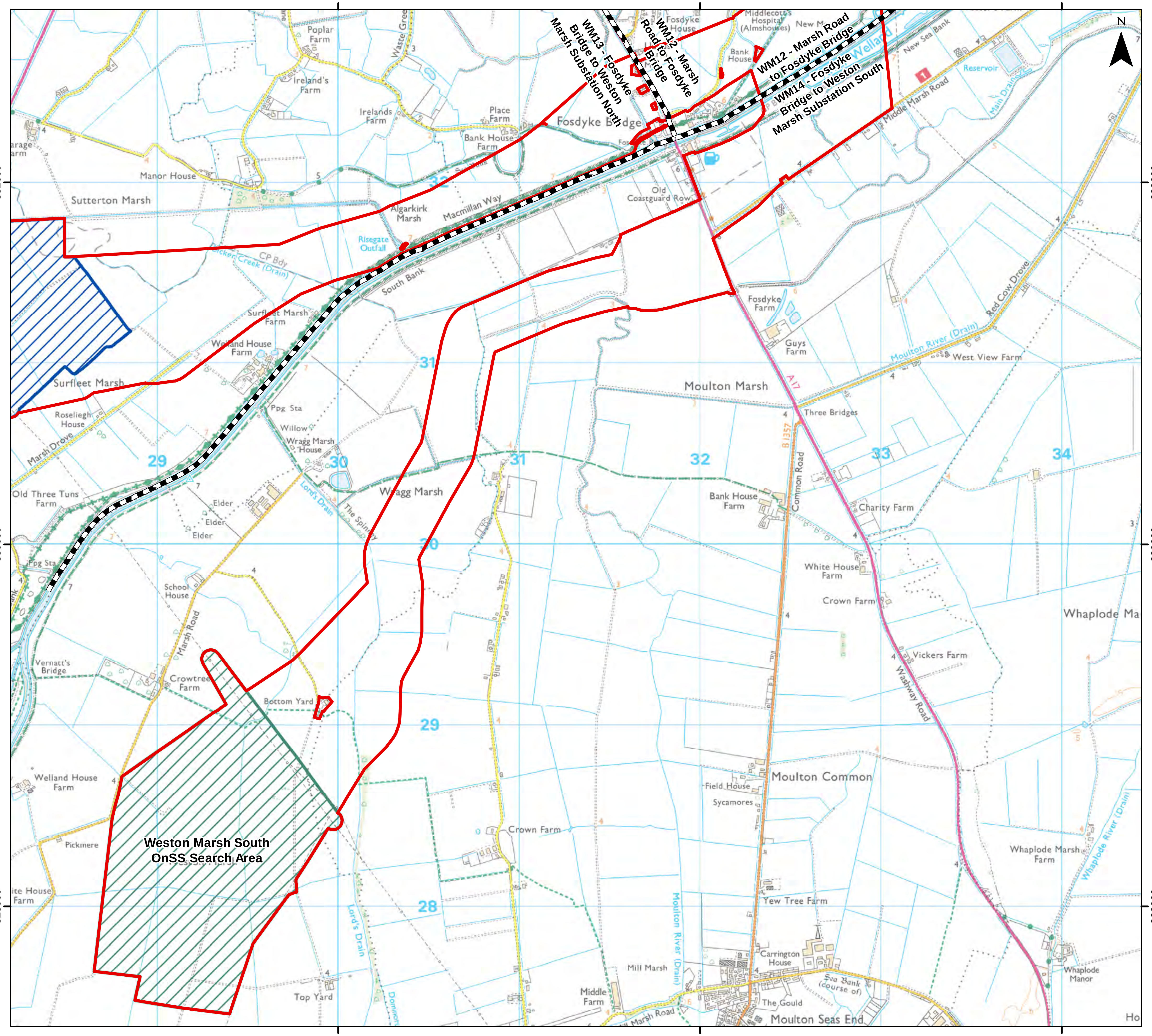
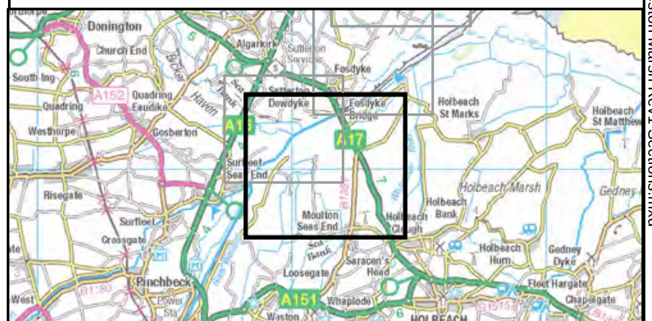


Legend

- Onshore PEIR Boundary
- Onshore Segment Break
- Weston Marsh North OnSS Search Area
- Weston Marsh South OnSS Search Area

Sources:



Coordinate System: British National Grid

0 0.5 1 km

Scale: 1:20,000

Preliminary Environmental Information Report
Onshore ECC Segment Maps Appendix
WM14 - Fosdyke Bridge to Weston Marsh Substation South

Figure 3A16

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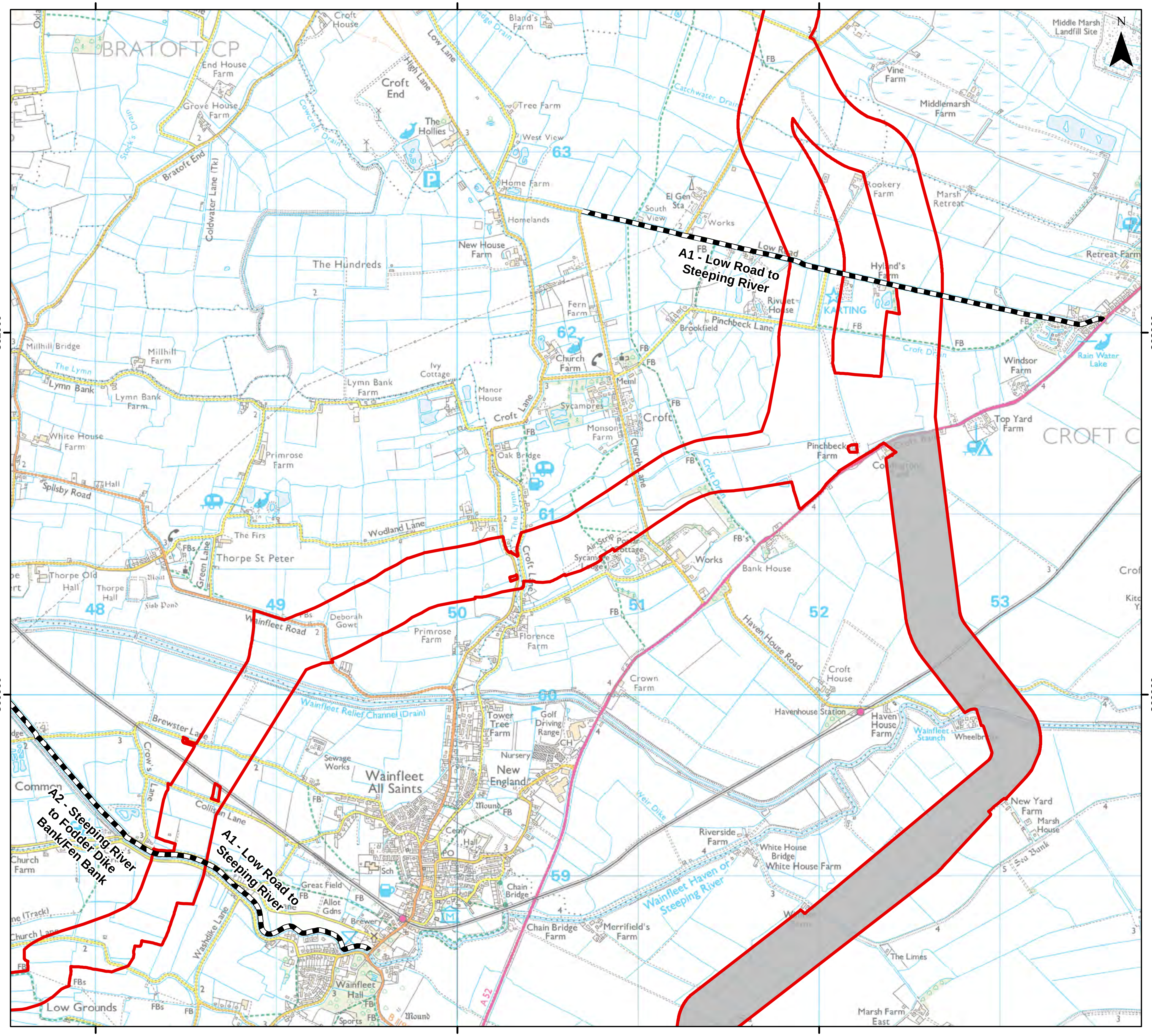
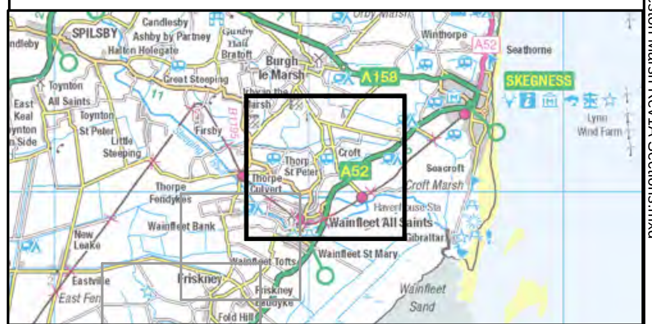


Legend

- Onshore PEIR Boundary
- Onshore Segment Break

Sources:



Coordinate System: British National Grid

0 0.5 1 km

Scale: 1:20,000

Preliminary Environmental Information Report
Onshore ECC Segment Maps Appendix
A1 - Low Road to Steeping River

Figure 3A17

OUTER DOWSING OFFSHORE WIND

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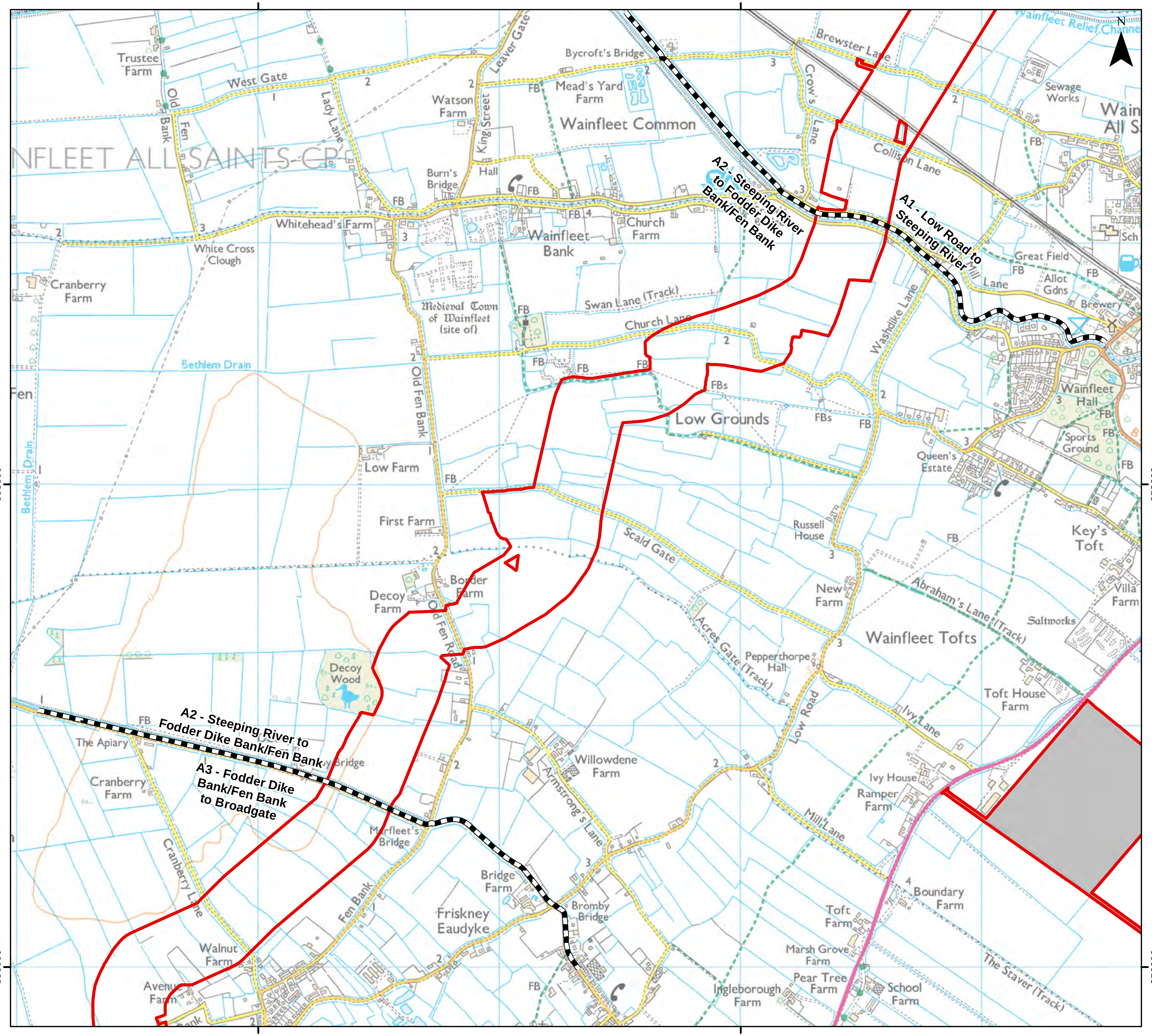
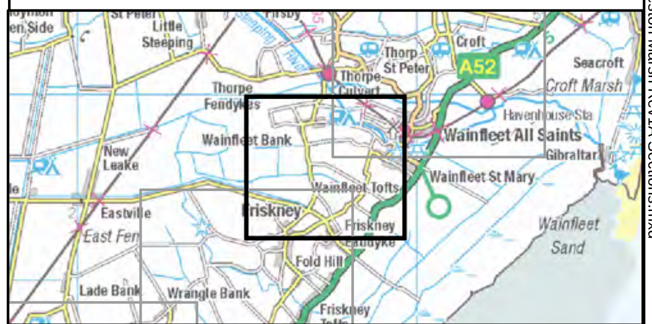


Legend

- Onshore PEIR Boundary
- Onshore Segment Break

Sources:



Coordinate System: British National Grid

0 0.5 1 km

Scale: 1:15,000

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Onshore ECC Segment Maps Appendix
A2 - Steeping River to Fodder Dike Bank/Fen Bank

Figure 3A18

OUTER DOWSING OFFSHORE WIND

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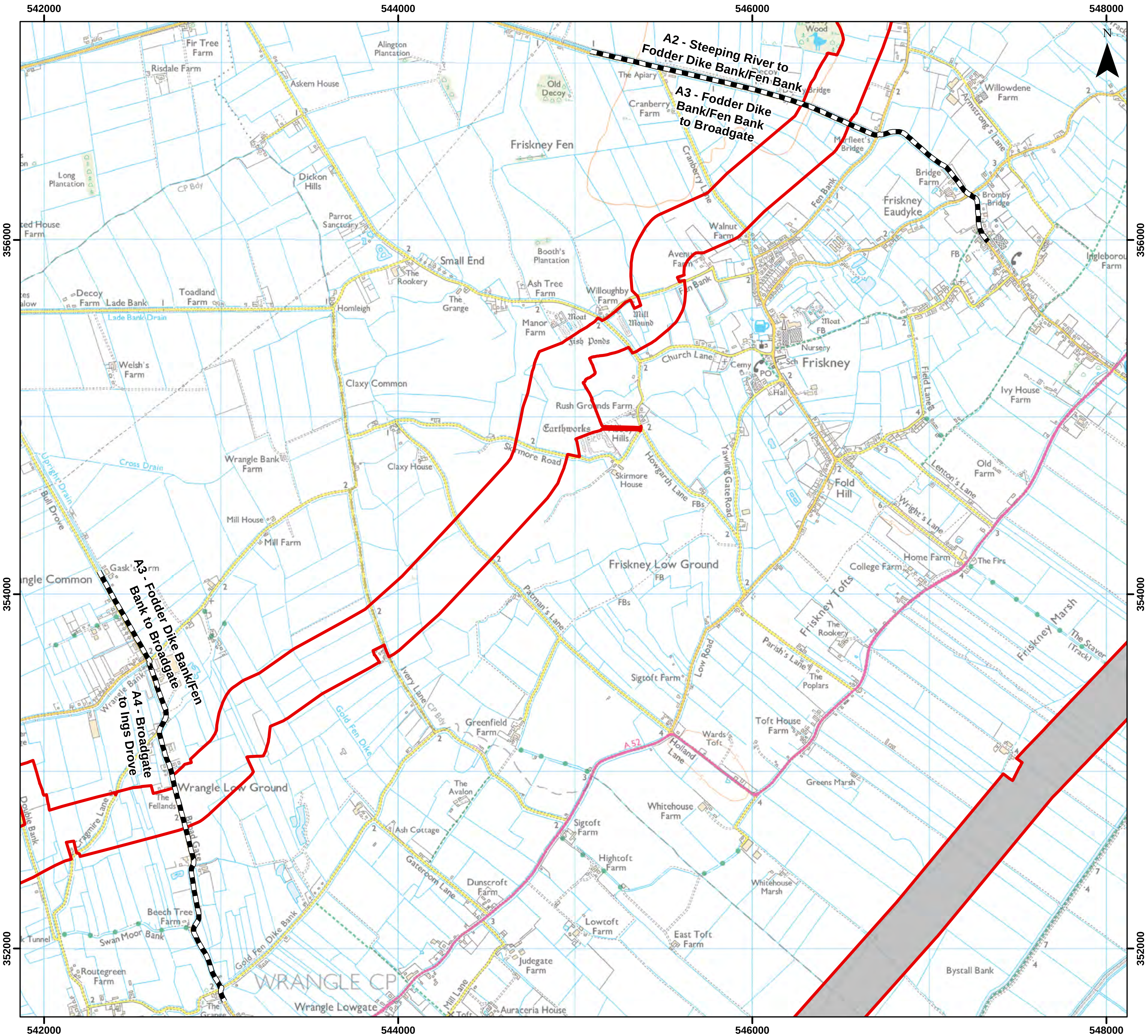

Legend

- Onshore PEIR Boundary
- Onshore Segment Break

Sources:

Coordinate System: British National Grid

0 0.5 1 km

Scale: 1:20,000

Preliminary Environmental Information Report
Onshore ECC Segment Maps Appendix
A3 - Fodder Dike Bank/Fen Bank to Broadgate

Figure 3A19

OUTER DOWSING OFFSHORE WIND

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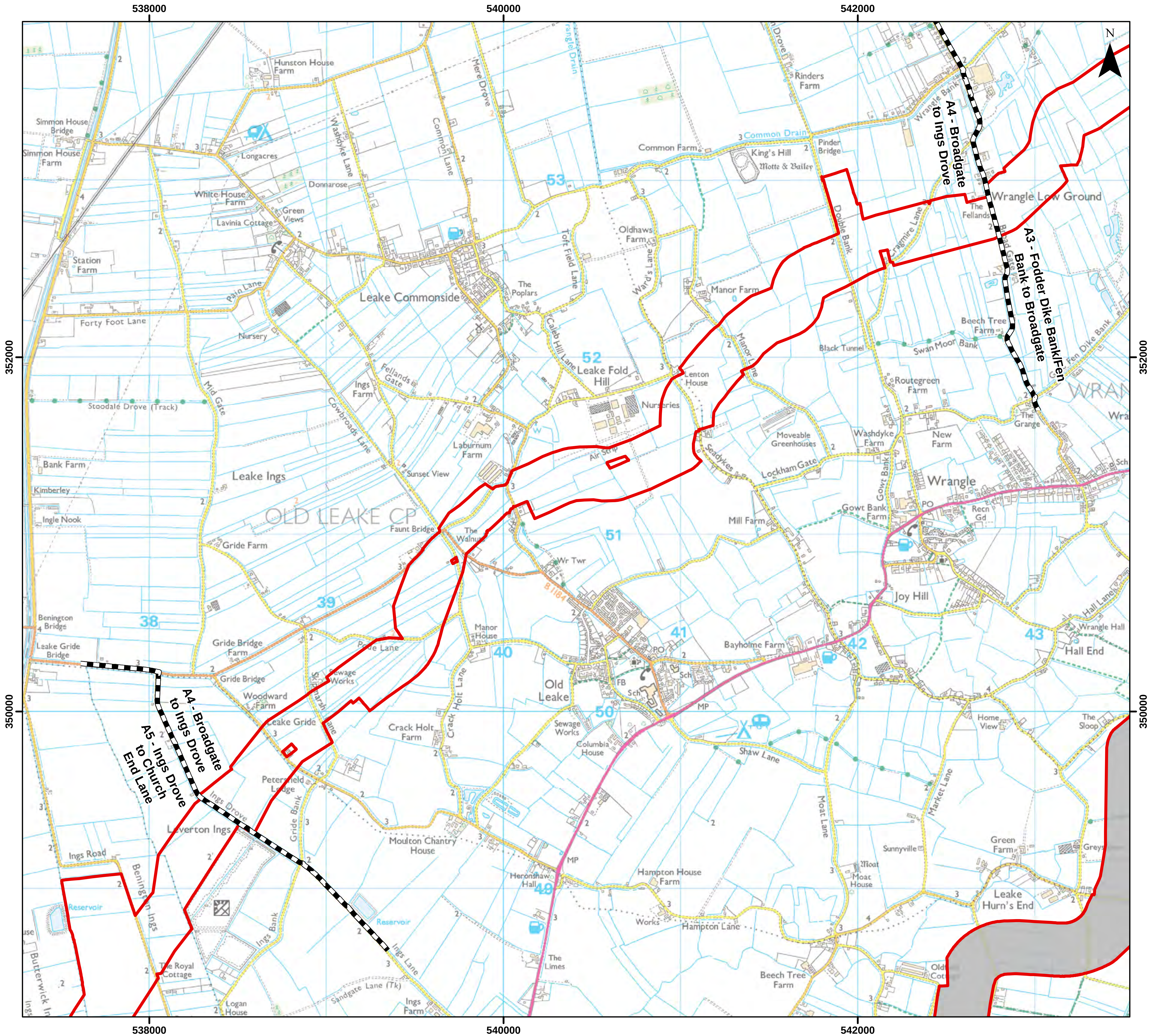

Legend

- Onshore PEIR Boundary
- Onshore Segment Break

Sources:

Coordinate System: British National Grid

0 0.5 1 km

Scale: 1:20,000

Preliminary Environmental Information Report
Onshore ECC Segment Maps Appendix
A4 - Broadgate to Ings Drove

Figure 3A20

OUTER DOWSING OFFSHORE WIND

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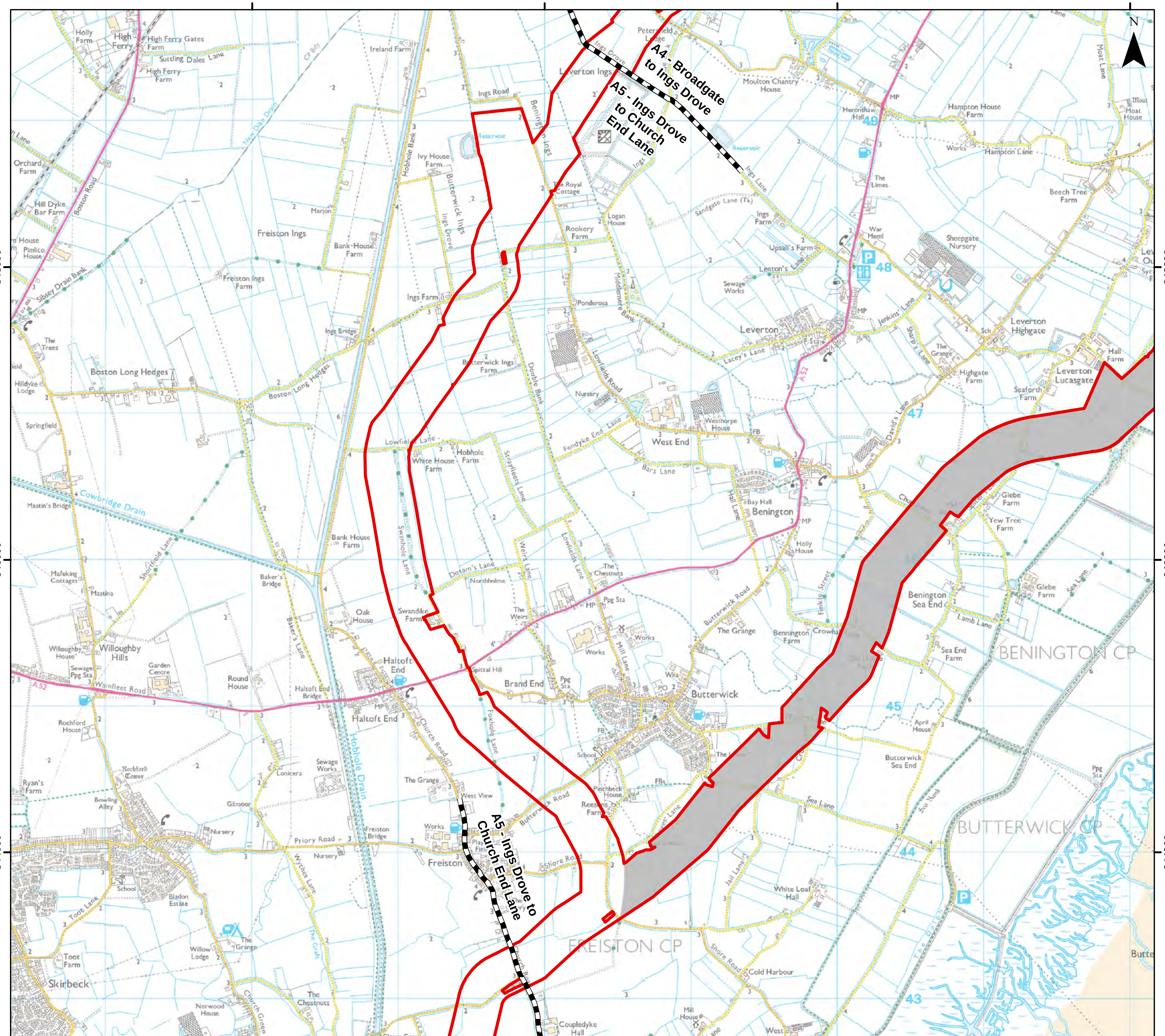

Legend

- Onshore PEIR Boundary
- Onshore Segment Break

Sources:

Coordinate System: British National Grid

0 0.5 1 km

Scale: 1:25,000

Preliminary Environmental Information Report
Onshore ECC Segment Maps Appendix
A5 - Ings Drove to Church End Lane

Figure 3A21

OUTER DOWSING OFFSHORE WIND

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