Environmental Impact Assessment Report - Volume 2A

Chapter 5
Project Description

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

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Energy for generations

ORIEL WIND FARM PROJECT

Environmental Impact Assessment Report
Chapter 5: Project Description

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Contents

Tables

Figures

5 PROJECT DESCRIPTION

5.1 Introduction

This chapter of the Environmental Impact Assessment Report (EIAR) provides a description of the Oriel Wind Farm Project (hereafter referred to as 'the Project'), which will have a maximum export capacity of 375 MW. It sets out the design, size and other features of the onshore and offshore infrastructure. It also describes the activities associated with the construction, operational and maintenance, and decommissioning phases of the Project.

Supplementary information on the project description is provided in:

- Appendix 5-1 to Appendix 5-10: Management plans;
- Appendix 5-11: Supporting information demonstrating the Applicant's experience on other offshore wind farm projects;
- Appendix 5-12: Construction Methodology - Onshore Cable;
- Appendix 5.13: UXO Desk Study;
- Appendix 5-14: Cable Rating Report; and
- Appendix 5-15: Engineering Services Report – Onshore Substation.

Details on the design and construction of the offshore and onshore infrastructure of the Project are described in sections 5.5 and 5.6 respectively. The construction programme and information on employment is presented in section 5.6.5.

Details on the operational and maintenance phase activities are provided in section 0, while decommissioning activities are presented in section 5.9.

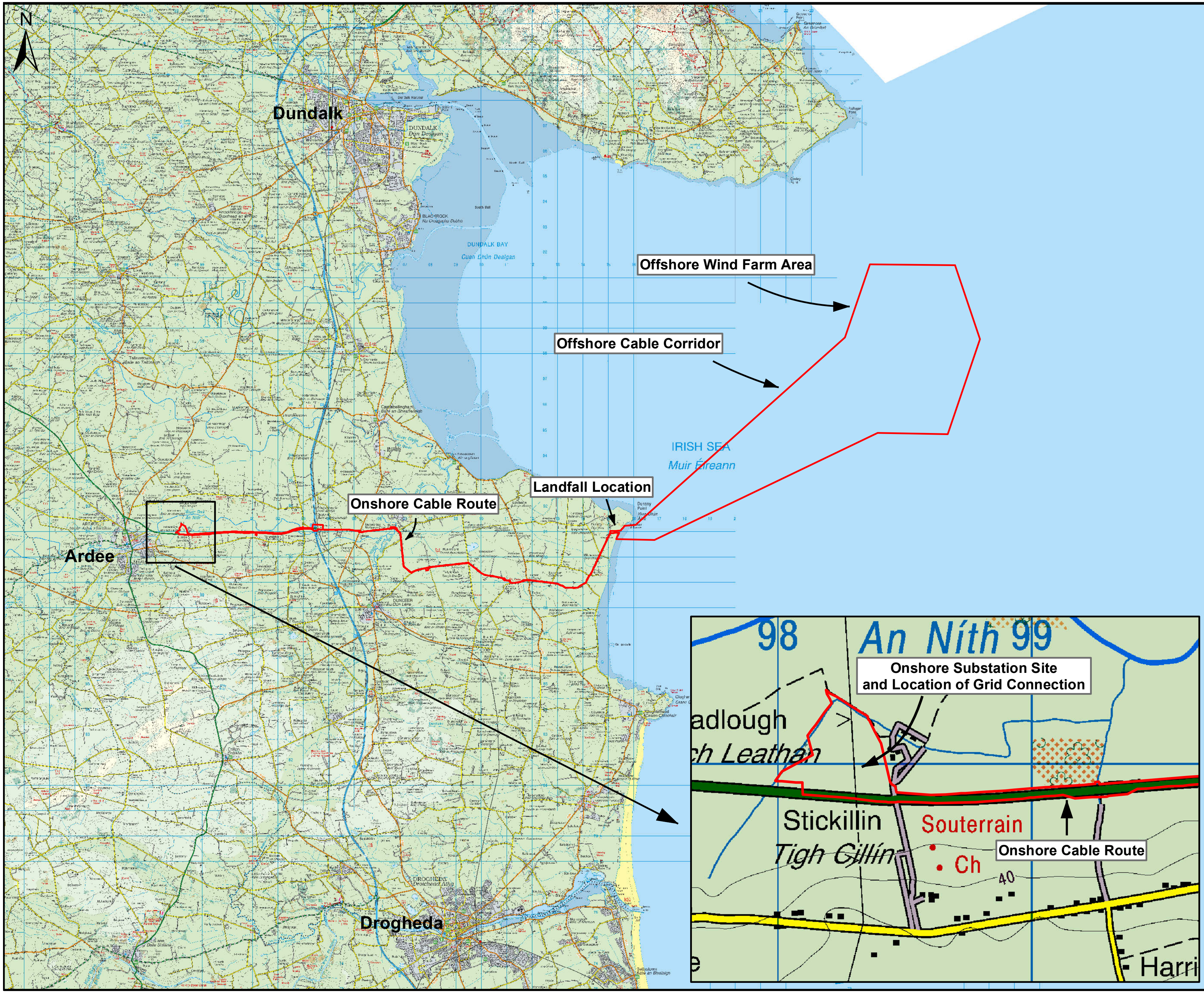
Information on the measures and controls that have been included in the Project are presented in section 5.10 along with information on emissions, use of natural resources and health and safety.

5.2 Project boundary

Figure 5-1 provides an overview of the Project, which is divided into the following main elements:

- The offshore wind farm area: This is where the offshore wind farm infrastructure will be located. This area will include the offshore wind turbines (also referred to as wind turbine generators (WTGs or turbines) including their foundations, the offshore substation (OSS) and its foundation, the inter array cables (between each of the WTGs and the OSS) and a short section of the offshore cable from the OSS;
- The offshore cable corridor: This is where the offshore cable will be largely located. The offshore cable extends from the offshore wind farm area to a landfall location south of Dunany Point;
- The onshore cable route: This is where the onshore underground cables and associated underground components (joint bays and link boxes) will be located; and
- The onshore substation site: This is where the onshore substation as well as the connections to the existing electricity transmission grid will be located.

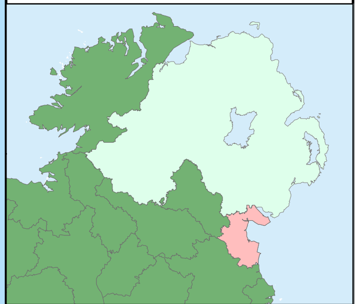
The extent and geographic location of each of these elements is explained in further detail below. Further details on the baseline environment are provided in the topic assessment chapters presented in volumes 2B and 2C.



Legend

Planning Application Boundary

Data Sources: OWL, OSi.



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Project

Oriel Wind Farm Project

Figure 5.1:
Overview of Oriel Wind Farm Project

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Issue Details

Drawn By:	NR	Project No.	MDR1520b
Checked By:	CC	File Ref:	
Approved By:	CC		MDR1520bArc3072F03
Scale:	1:200,000 @ A4	Projection:	ITM (IRENET95) Geographic Co-ordinates: ETRS89
Date:	12/03/2024		

NOTE: 1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels are referred to Ordnance Datum, Malin Head.

5.2.1 Offshore wind farm area

The offshore wind farm area is located off the coast of County Louth to the east of Dundalk Bay, approximately 22 km east of Dundalk town centre, 18 km east of Blackrock, 5 km south of the Cooley Peninsula and 10 km north-east of Dunany Point. The closest wind turbine will be approximately 6 km from the closest shore on the Cooley Peninsula.

The offshore wind farm area covers approximately 27.7 km^2 and is broadly hexagonal in shape with a length of approximately 5.3 km west to east and 6.6 km north to south (see Figure 5-1).

5.2.2 Offshore cable corridor

One offshore export cable will be installed within the offshore cable corridor that connects the offshore wind farm area to a landfall approximately 700 m south of Dunany Point. The offshore cable corridor is contiguous to the High Water Mark (HWM) at the landfall and to the south western boundary of the offshore wind farm area.

The offshore cable corridor is approximately 11 km in length and covers an area of approximately 25 km^2 and is shown in Figure 5-1.

The offshore cable corridor is approximately 4 km at its widest point, southwest of the offshore wind farm area, and narrows to approximately 640 m at its narrowest point, just before landfall south of Dunany Point. The offshore export cable will be installed in a trench approximately 3 m wide within this corridor (see section 5.5.8). The exact location of this trench within the corridor will be confirmed at construction phase. However, the installation of the offshore export cable at any location within the corridor has been assumed for the purposes of the assessments to inform this EIAR.

5.2.3 Onshore cable route

The single offshore export cable is joined to three onshore cables within an underground transition joint bay (TJB) close to the landfall. The onshore cables will be installed within a single trench of approximately 1 m in width, along an onshore cable route that connects the TJB to the substation site at Stickillin, east of Ardee on the N33. The length of the onshore cable route is approximately 20.1 km, principally located along public roads.

5.2.4 Onshore substation site

The onshore substation will be located in an agricultural field in the townland of Stickillin. The field has an existing access from the N33 national road which provides access to the field and existing agricultural buildings. It is located approximately 3 km east of the town of Ardee, County Louth. The existing 220 kV overhead line from the Louth substation (east of Dundalk) to Woodland substation (south of Dunshaughlin, County Meath) passes from north to south over the field.

The agricultural field is approximately 9.7 hectares in area. The onshore substation site is approximately 3.1 hectares in area and is located to the east of the existing overhead line. The substation site will therefore occupy approximately one third of the existing agricultural field.

5.3 Project infrastructure overview

The Project will comprise of offshore and onshore infrastructure. An overview of the infrastructure is presented below and schematically in Figure 5–2.

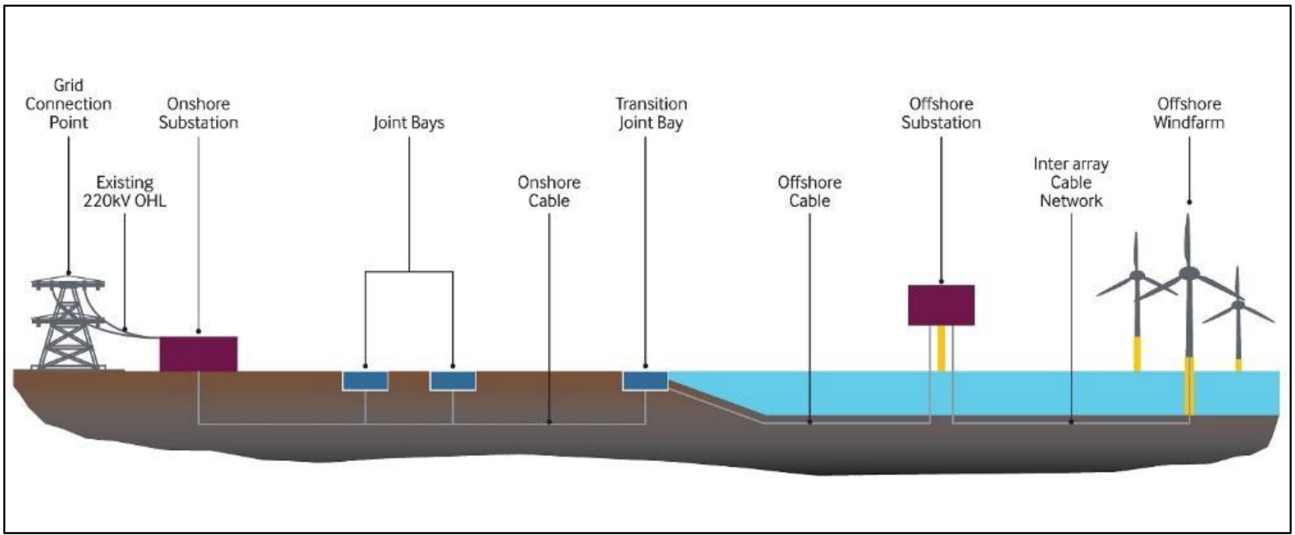


Figure 5–2: Key components of the Project.

5.3.1 Offshore infrastructure

Wind turbines

The Project will comprise of 25 wind turbines (also referred to as wind turbine generators (WTGs)) located within the offshore wind farm area. These wind turbines will be mounted on foundations which will be fixed to the seabed. The dimensions of the main components of the wind turbines (blade, tower, hub) are presented in section 5.5.3 and the layout of the wind turbines is described and shown in section 5.3.

Monopile foundations

A monopile foundation for each wind turbine and the OSS is proposed. This foundation type was selected based on the site geology. The dimensions and parameters of the foundation design and the proposed method of installation are presented within section 5.5.5.

Inter-array cables

The WTGs will be connected by a network of 41 km of 66 kV subsea inter-array cables to an offshore substation also located within the offshore wind farm area. The design, installation methodology, cable protection and approximate route of the inter-array cables within the offshore wind farm area are described in section 5.5.6.

Offshore substation

The OSS will be mounted on a fixed monopile foundation. The OSS will transform the generated electricity from 66 kV to 220 kV High Voltage Alternating Current (HVAC). The location, design and dimensions for the OSS are provided in section 5.5.7. The offshore substation equipment will be maintained by the Transmission Asset Owner (TAO) and operated by the Transmission System Operator (TSO).

Offshore cable

A single offshore export cable consisting of three internal cores will export the power from the OSS through to landfall approximately 700 m south of Dunany Point. The design of the offshore cable is presented in section 5.5.8 and a description of works at the landfall is described in section 5.5.9.

5.3.2 Onshore infrastructure

Landfall - Transition Joint Bay (TJB)

The offshore export cable will be connected to three separate land-based cables also operating at 220 kV HVAC in an underground TJB located close to the landfall and above the HWM. The design of the TJB is presented in section 5.5.9.

Onshore export cables

Three onshore export cables will be installed in a single trench which will be routed principally along public roads to a new 'loop-in' onshore substation located below the existing 220 kV overhead line (OHL) from Louth to Woodland. The onshore cables will divert off the public road at five locations to enable the cables to pass below the Port Stream at Togher, the Port Stream at Clonmore, the River Dee at Drumcar, the M1 motorway and the Dublin to Belfast rail line and the River Dee at Richardstown on the N33. The onshore cables will pass below the Salterstown Stream, within the public road. The infrastructure to allow the cables to pass below five of these locations will be installed using horizontal directional drilling (HDD). The Port Stream at Clonmore will be crossed by trenching methods. These installation methods are presented in section 5.6.

Onshore substation

The onshore substation will consist of three compounds: Compound 1 will contain Gas Insulated Switchgear (GIS) located inside a building. Compound 2 will contain outdoor Air Insulated Switchgear (AIS) and will form part of the transmission system for the offshore grid. The entrance compound, which will include a telecommunications building, standby diesel generator and car parking. The onshore substation equipment will be maintained by the TAO and operated by the TSO.

Transmission cables from the GIS substation in Compound 1 will connect to the existing overhead power line through two new Line Cable Interface Masts (LCIM). An existing 220 kV ESB tower adjacent to the substation compounds will be replaced by the two LCIM towers to enable this connection.

5.4 Project design and flexibility

The design of the Project has established the project design parameters for the purposes of providing a comprehensive environmental assessment of the potential impacts of the Project included in the assessments in volumes 2B and 2C of the EIAR. The potential impacts resulting from climate change have been considered in the design of the offshore infrastructure such as the height of boat landings have been designed to allow for sea level rise and higher storm surge events.

The process to define the Project used extensive offshore and onshore surveys, design assessments and passed through several iterations. The design provides engineering parameters that allow meaningful analysis of the Project to be undertaken for the purpose of EIA.

The project design is assessed on a topic by topic and impact by impact basis in volumes 2B and 2C of the EIAR. The project design parameters for each individual topic are set out within the individual topic chapters of this EIAR. Where maximum design parameters have been used to inform the assessment, these have also been stated.

Where design parameters are unconfirmed due to design flexibility, the parameters and details are outlined in this chapter. The assessments are based on the details that have potential to result in the most impact.

5.4.1 Surveys to inform the project design

A wide range of surveys have informed the design of the Project. Offshore surveys were undertaken under Foreshore Licence (FS006459, granted 10 May 2019). Relevant surveys included:

- Geophysical surveys of the offshore wind farm area and offshore cable corridor August - September 2019 and November – December 2022;
- Geotechnical boreholes in the offshore wind farm area and offshore cable corridor March - April 2020;
- Offshore wind and metocean measurement campaign October 2019-December 2020;
- Onshore wind measurement at landfall March 2020-present; and
- Site investigation surveys of the onshore substation, onshore cable route and landfall – May 2021 and October 2021.

The above surveys were robust and sufficient to inform the project design and the assessments provided in volumes 2B and 2C.

A future offshore geotechnical survey (under Foreshore Licence FS007383 issued 17 May 2023) is planned. This will drill a minimum of one borehole at each proposed foundation location and along the inter-array cable routes and the offshore cable corridor to inform the final detailed design of each foundation and the cable installation. This survey has been consented under Foreshore Licence. A further site investigation campaign will be undertaken at the onshore substation and along the onshore cable route to inform the detailed design and procurement of the onshore substation and onshore cable. Activities associated with site investigations are considered in the relevant assessments included in volume 2C.

5.4.2 Design flexibility

The design of the Project is well advanced, and the Applicant has made every effort to finalise details of the Project, insofar as possible. There are some details of the design requiring finalisation, which cannot be completed in advance of submission of the application. Therefore, the Applicant submitted an application for an opinion under Section 287B of the Planning & Development Act, 2000 as amended, for consideration of the design flexibility required for the Project.

A description of details or groups of details where design flexibility was sought are provided in sections 5.5 5.6 under the sub-heading 'Design flexibility' together with details on the opinion from An Bord Pleanála.

5.5 Description of offshore infrastructure

The following sections provide a description on the design and size of the offshore infrastructure of the Project (WTG, foundations, inter-array cables, offshore export cable etc.) including the TJB where the offshore export cable will connect to the onshore cables. Information on the construction methodology is also provided in the sections below.

5.5.1 Construction port

The main offshore structures (WTGs, OSS, foundations and offshore cables) will be fabricated at a number of manufacturing sites across Europe or elsewhere, to be determined as part of a competitive procurement process following award of consent.

A marshalling harbour will be required to stockpile and pre-assemble components for the foundations and wind turbines. The fabricated components will be delivered to the marshalling harbour by ship, before pre-assembly and then delivered by ship directly to the offshore wind farm area for installation/final assembly. Space in a construction port can only be contracted when the construction programme is finalised and timelines are known and therefore the final construction port will not be known at the time of application.

A port that has the required facilities and consents/permissions for the pre-assembly operations will be used. There are suitable ports that are being considered for the Project within the Irish Sea and Celtic Sea including those with existing consents such as Belfast Port or Mostyn Harbour (Wales) and ports with proposed development plans for offshore wind pre-assembly facilities such as Rosslare Europort and Port of Cork. The activity of delivery and installation of the pre-assembled components to the site has been considered within the environmental assessment and a sailing distance of 350 nm from the centre of the wind farm has been used. This distance includes all potential ports for the pre-assembly operations.

Components, such as the prefabricated OSS and the offshore cables, will be delivered directly from the manufacturing facility to the offshore wind farm area when required.

5.5.2 Site preparation activities

A number of site preparation activities may need to be undertaken within the offshore wind farm area and along the offshore cable corridor prior to the commencement of construction. An overview of these activities is provided in the subsections below.

Geophysical and geotechnical surveys have been conducted across the offshore wind farm area and offshore cable corridor to inform the project design to date as described in section 5.4.1. These surveys have indicated suitable seabed conditions and seabed preparation is expected to be confined to localised areas around wind turbine foundations, inter-array and offshore cable corridor and the offshore substation. In particular, the seabed studies to date have indicated the absence of existing pipelines, cables, significant sand waves or boulder fields within the offshore wind farm area.

Unexploded ordnance (UXO)

UXO can pose 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.

A desk study for potential UXO contamination (see appendix 5.13: UXO Desk Study) has been carried out within the offshore wind farm area and offshore cable corridor. Based on the research and the risk assessment undertaken, it was concluded that there is low risk of encountering UXO during the development of the Project. Additionally, geophysical surveys have been undertaken across the site and high-resolution surveys at each foundation location; these geophysical surveys have not identified the potential for UXO.

As such, UXO clearance is not anticipated to be required, however Explosives Site Safety Guidelines which follow UK MGN 323 (M+F) and relevant training will be prepared and implemented during the construction phase. In addition, Remotely Operated Vehicle (ROV) inspection work will be undertaken, if required, on any potential items of UXO identified within the array area and offshore cable corridor. If UXOs are found, the location of infrastructure will be adjusted to avoid the obstacle.

Pre-lay grapnel run

While it is understood that there are no existing or out-of-service cables within the offshore wind farm area or along the offshore cable corridor a pre-lay grapnel run (PLGR) and an associated route clearance survey of the final cable route (inter array and offshore cable) will be undertaken following the pre-construction route survey. A multi-purpose vessel will be mobilised with a series of grapnels, chains, recovery winch and survey spread suitable for vessel positioning and data logging.

The PLGR work will take account of and adhere to any archaeological protocols developed for the Project or required by a planning authority.

Boulder clearance and sand wave removal

Boulder clearance or sand wave removal may be required if there are areas identified where positioning of cables around these features is not feasible and that there is a risk that cable installation tools could snag the feature. If required, a corridor of up to 15 m may be cleared through an area of boulders or sand waves for cable installation. A maximum of 10% of the inter-array cable route may be required for clearance. This would result in a total offshore wind farm area clearance of 61,500 m^2 of seabed material. A maximum of 10% of the offshore cable route may be required for clearance. This would result in the clearance of 16,500 m^2 of seabed material. To implement the boulder and sand wave clearance a displacement plough that scrapes along the surface of the seabed would be used. The plough would only be lightly ballasted to clear boulders whilst not leaving a deep depression in the seabed. This method may be combined with a subsea grab for the relocation of larger boulders outside the offshore cable corridor. The subsea grab would be aided by a Remotely Operated Vehicle (ROV) for positioning of the grab onto boulders and the recording of their new position.

The boulder clearance and sand wave removal work will take account of and adhere to any archaeological protocols developed for the Project or required by a planning authority.

5.5.3 Wind turbines

The Project will comprise of 25 wind turbines. The key wind turbine design parameters for the Project are presented in Table 5.1. These are the project design parameters that have informed the assessments. The parameters are defined relative to Lowest Astronomical Tide[1] (LAT). All wind turbines will be marked for aviation and navigation purposes (refer to section 5.5.11).

Each wind turbine will be a three-bladed, horizontal rotor axis type, designed for offshore conditions. The blades will be connected to a central hub, forming a rotor which turns a shaft connected to a generator. The generator is part of the drive train, which will be located within a containing structure, known as the nacelle, situated adjacent to the rotor hub. Together it is referred to as the rotor nacelle assembly. A hoist platform is mounted on the roof of the nacelle to allow for emergency access and egress.

The nacelle will be mounted on top of a tubular steel tower structure affixed to the foundation which forms the connection to the subsea soil. Further information on foundation design and installation is detailed in section 5.5.5. The nacelle will be able to rotate or 'yaw' on the vertical axis in order to face the incoming wind direction. The colour of the components will be light grey (RAL 7035 or 9010) apart from the hoist platform, navigation markings and the foundation. An illustration of this design is presented in Figure 5-3.

Table 5.1: Project design parameters for the WTGs.

Wind Turbine Parameter	Value
Number of WTG	25
Minimum height of lowest blade tip above LAT (m)	27 m
Maximum blade tip height above LAT (m)	270 m
Hub height above LAT (m)[2]	145-152 m
Rotor diameter (m)	236 m
Rotor cut-in/cut-out wind speed (m/s)	Cut in: 2.6 m/s Cut out: 28-35 m/s
Nominal rotor speed (revolutions per minute (rpm))	7.8-8.4

Design flexibility

The design flexibility opinion by An Bord Pleanála under section 278B of the Planning and Development Act 2000, as amended and the Planning and Development Regulations 2001, as amended, states that the following details of the Project may be confirmed after the proposed application has been decided:

- The final height of offshore infrastructure.

The final height of the wind turbines will be confirmed following detailed geotechnical investigations and analysis of ground conditions.

[1] Lowest Astronomical Tide (LAT) is defined as the lowest tide level which can be predicted to occur under average meteorological conditions and under any combination of astronomical conditions.

[2] Wind turbine hub height will vary within the range stated across the Project offshore wind farm area. The design and height of each wind turbine foundation is specific to the subsoil geology and geotechnical properties at each wind turbine location. The foundation height will affect the hub height of each wind turbine (see section 5.5.5 for further information).

The wind turbine hub height will vary within the range 145-152 m above Lowest Astronomical Tide (maLAT) across the wind farm site due to the specific height of each foundation.

A preferred wind turbine model of 15 MW is selected and the wind turbine rotor diameter is fixed at 236 m (i.e. 118 m radius). A maximum tip height of 270 maLAT (152 maLAT + 118 m) and a minimum tip height of 27 maLAT (145 maLAT – 118 m) is presented and assessed in the EIAR.

A monopile foundation design has been selected. This has been determined from metocean, geophysical and geotechnical studies completed to date. The height of each foundation will be determined as part of a construction contract and will be specific to the water depths and soil conditions at each foundation location. The height of the foundation is the determining factor in the final hub height of each wind turbine.

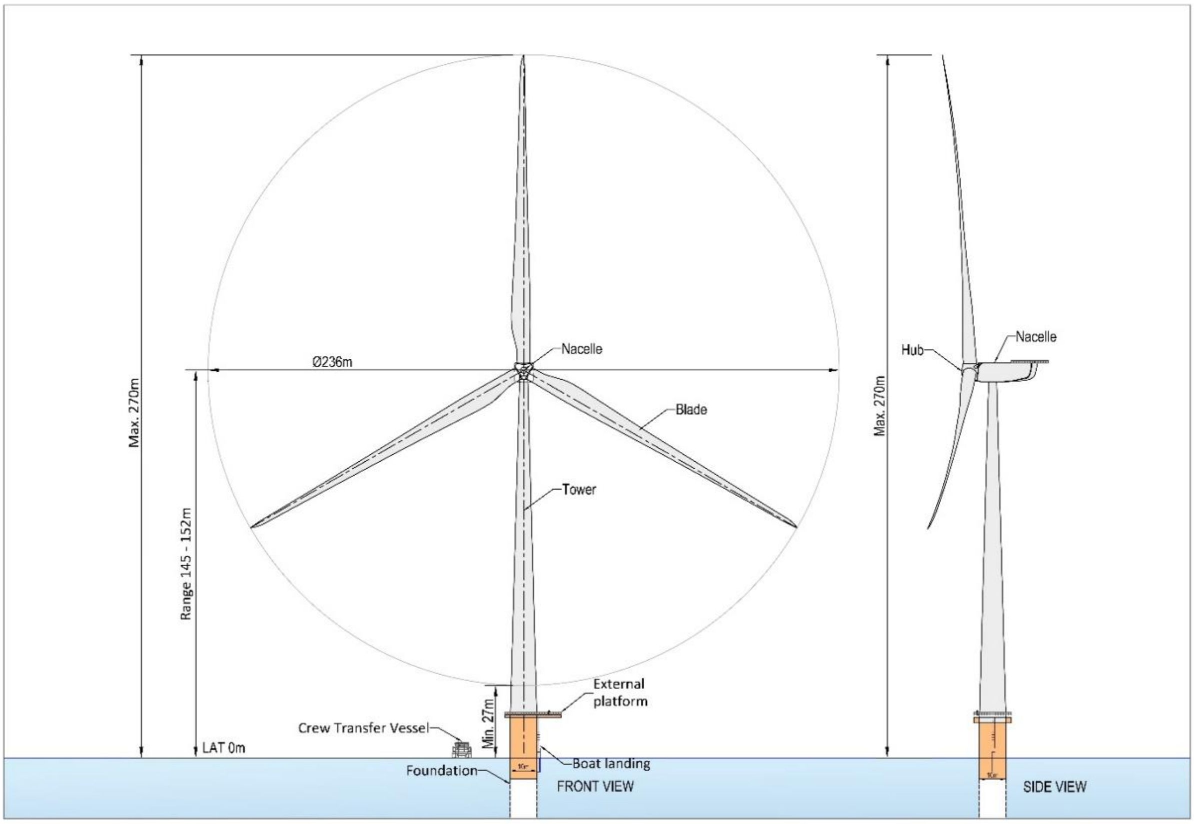


Figure 5-3: Illustration of the proposed wind turbine design.

Oils and fluids

Each wind turbine will contain components that require lubricating oils, hydraulic oils and coolants for operation. A diesel generator may be installed for restart in the case of power failure or the WTG may have built-in idle mode generation for unassisted restart. The diesel fuel and generator are included and assessed as a design parameter. Table 5-2 presents the maximum requirements for oils and fluids in a single wind turbine.

Table 5-2: Requirements for wind turbine oils and fluids for a single wind turbine.

Parameter	Maximum Requirement
Grease (l)	500
Hydraulic oil (l)	1000

Parameter	Maximum Requirement
Gear oil (l)	2,500
Total lubricants (l)	~12,000
Transformer Silicon/Ester oil (litres/kg)	8000
Diesel Fuel (l)	2000
SF6 (kg)	15
Nitrogen (litres at 1 bar abs pressure)	63,000
Glycol/Coolants	1800
Damping Liquid (Water/Glycol) (litres)	14000

All turbines have primary and secondary containment systems installed to ensure that all fluids can be captured within either the nacelle or the tower in the event of leakage, thereby minimising leaks to the environment.

Noise emissions

Due to the rotation of the rotor and other moving components (e.g. gearbox, yaw motors, etc.) the wind turbine will create noise. The noise level of the rotor depends on several parameters such as rotor blade shape, wind speed and rotational speed. However, the maximum sound power level of the WTG will not be greater than 118.0 dBA (airborne). This is assessed in chapter 25: Noise (airborne) and Vibration and detail on the octave band spectra are presented in the Noise Modelling Methodology (see volume 2C, appendix 25-2).

Installation and commissioning

The wind turbines will be installed and commissioned using the following process:

- Wind turbine components will be collected from the marshalling harbour by an installation vessel. This vessel will typically be a Jack-Up Vessel (JUV) to ensure a stable platform for the WTG installation task when on site. For this Project, JUVs with up to six legs with an area of up to 250 m^2 per foot are proposed. Separate components of blades, nacelles and towers for a number of wind turbines are normally loaded onto the installation vessel.

- The installation vessel will then transit to the offshore wind farm area and the components will be lifted onto the pre-constructed foundation structure by a crane on the installation vessel (illustrated in Figure 5-4). Each wind turbine will be assembled on site in this manner with technicians fastening components together as they are lifted into place. The exact methodology for the assembly is dependent on wind turbine model and installation contractor; and will be defined in the pre-construction phase following consent.

- Alternatively, the wind turbine 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.

- The commissioning of the wind turbines is done directly from the installation vessel or from another vessel such as a service operation vessel (SOV) or crew transfer vessel (CTV). The activities may require several visits to each WTG. Once the WTG is connected to the OSS via the inter-array cables (see section 5.5.6), energised and tested it is in normal operational mode.

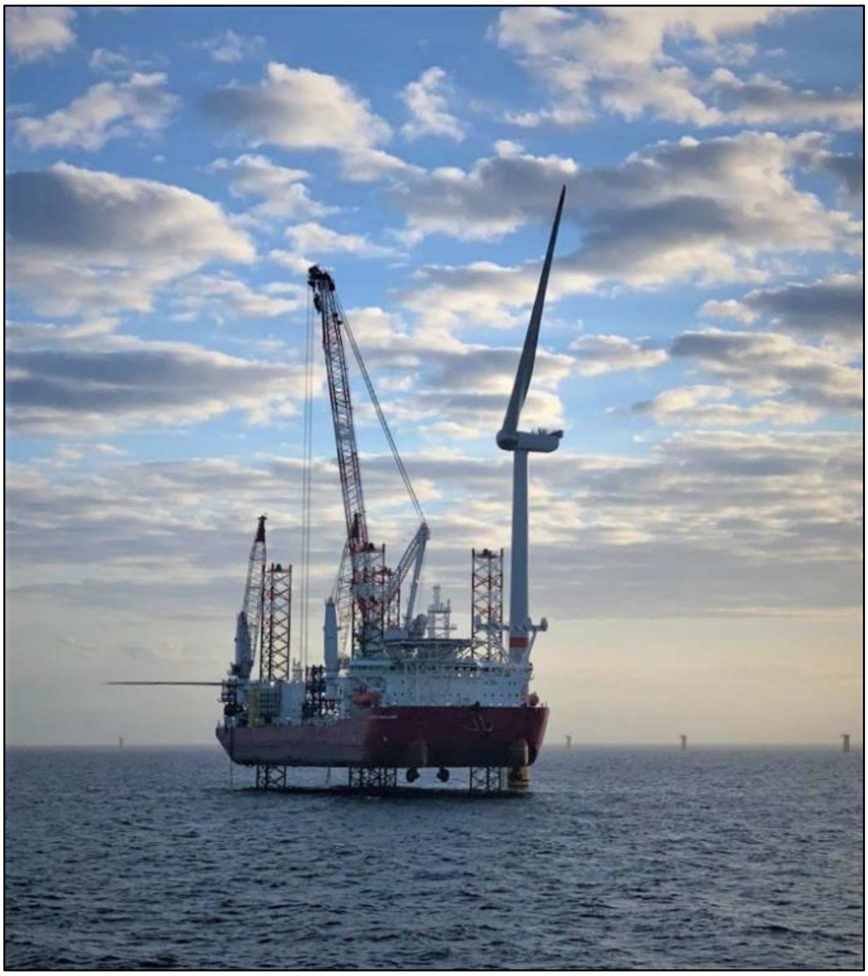


Figure 5-4: Installation vessel installing wind turbine blades.

Each installation vessel may be assisted by a range of support vessels. These are typically smaller vessels including service operating vessels for commissioning, crew transfer vessels and guard vessels. These vessels will primarily make the same movements to, from and around the wind farm as the installation vessels that they are supporting.

The construction programme is presented in section 5.7. The total duration of the WTG installation campaign for the wind turbines is expected to be six months.

Table 5.3 presents the maximum number of vessels and the number of return trips to the offshore wind farm area from port during the wind turbine installation campaign.

Table 5.3: Wind turbine installation vessel numbers.

Vessel Type	Maximum number of vessels	Maximum number of return trips per vessel type
Main Installation Vessels (Jack-up Barge/DP vessel)	1	13
Commissioning Vessel (SOV)	1	13
Guard Vessels	1	20
Crew Transfer Vessels	3	180

Operation and control

Wind turbines operate within a set wind speed range dependent on the specific turbine model. At approximately 2.6 m/s the WTG will start to rotate and generate electricity and at 13-16 m/s the WTG will reach nominal power output with approximately 8 rotor rotations per minute. In higher wind speed conditions, the wind turbine will pitch the blades (rotate blades on their own axis) to reduce the thrust to keep a constant power output. At 25 m/s the wind turbine output starts to decrease gradually towards zero. This enables the wind turbine to shut down in very high wind speeds to protect the wind turbine and foundation, whilst enabling a gradual ramp-down of the power output to support the operation of the electricity transmission grid. The cut-out wind speed depends on WTG type and is between 28 and 35 m/s.

Each wind turbine will have its own autonomous control system to carry out functions like yaw control and ramp down in high wind speeds. In case of severe alarms or faults the turbine can perform an automatic emergency stop which will stop the rotor within seconds. The same applies if the communication to shore is interrupted for a long period or the system detects an unsafe state (e.g. high wind speeds, grid outage etc.).

All wind turbines of a wind farm are connected to a central Supervisory Control and Data Acquisition (SCADA) system for control of the wind farm remotely at the operational and maintenance base. This allows functions such as remote wind turbine shutdown if faults occur or curtailment of the wind farm by the grid operator. The SCADA system will communicate with all components of the wind farm via ethernet through fibre optic cables which are embedded within the export and inter-array cables. Individual wind turbines can also be operated manually from within the wind turbine nacelle or tower base to control the wind turbine for commissioning or maintenance activities.

Access and egress

The WTGs are normally accessed and egressed to/from a vessel via a boat landing or a stabilised gangway to an external platform which is part of the foundation structure. In the event of an emergency the wind turbine can be accessed directly by hoist from a helicopter to a platform on top of the nacelle. Emergency access by winch down from a helicopter will be designed in accordance with relevant Irish Aviation Authority (IAA) guidance and standards. Figure 5-5 illustrates the normal access to wind turbine foundation (transition piece) via a stabilised gangway.

5.5.4 Wind farm area layout

The Project layout has been designed such that it complies with the following principles:

- All surface offshore infrastructure is confined within the area designated by the Maritime Area Consent (MAC) for the Project;
- A minimum spacing of 4 x maximum rotor diameter (i.e. at least 944 m) is maintained between the centre points of all wind turbines;
- The wind turbine layout meets the requirements to facilitate Search and Rescue (SAR) as detailed in chapter 13: Shipping and Navigation (volume 2B);
- The wind turbine layout seeks to avoid clustering of wind turbines from key viewpoints; and
- The wind turbine layout seeks to avoid visual overlap with background landscape from land-based viewpoints.

The layout as shown in Figure 5-6 was developed through an iterative process which considered the landscape and seascape visual impacts and to maximise use of the available wind resource and minimise turbulence and wake effects between turbines within the constraints of the principles presented above. The process to define the layout is presented in chapter 4: Consideration of Alternatives.

Figure 5-5: Access of external platform (yellow) via stabilized gangway from a CTV (shown in red).

The layout has rows of five turbines orientated in an approximate northwest to southeast direction with a minimum separation between turbines of 944 m (four times the rotor diameter). The offshore substation is located in the southwest area of the array. Four SAR corridors with a minimum spacing of 500 m are maintained between the turbines with a north-northeast heading.

Design flexibility

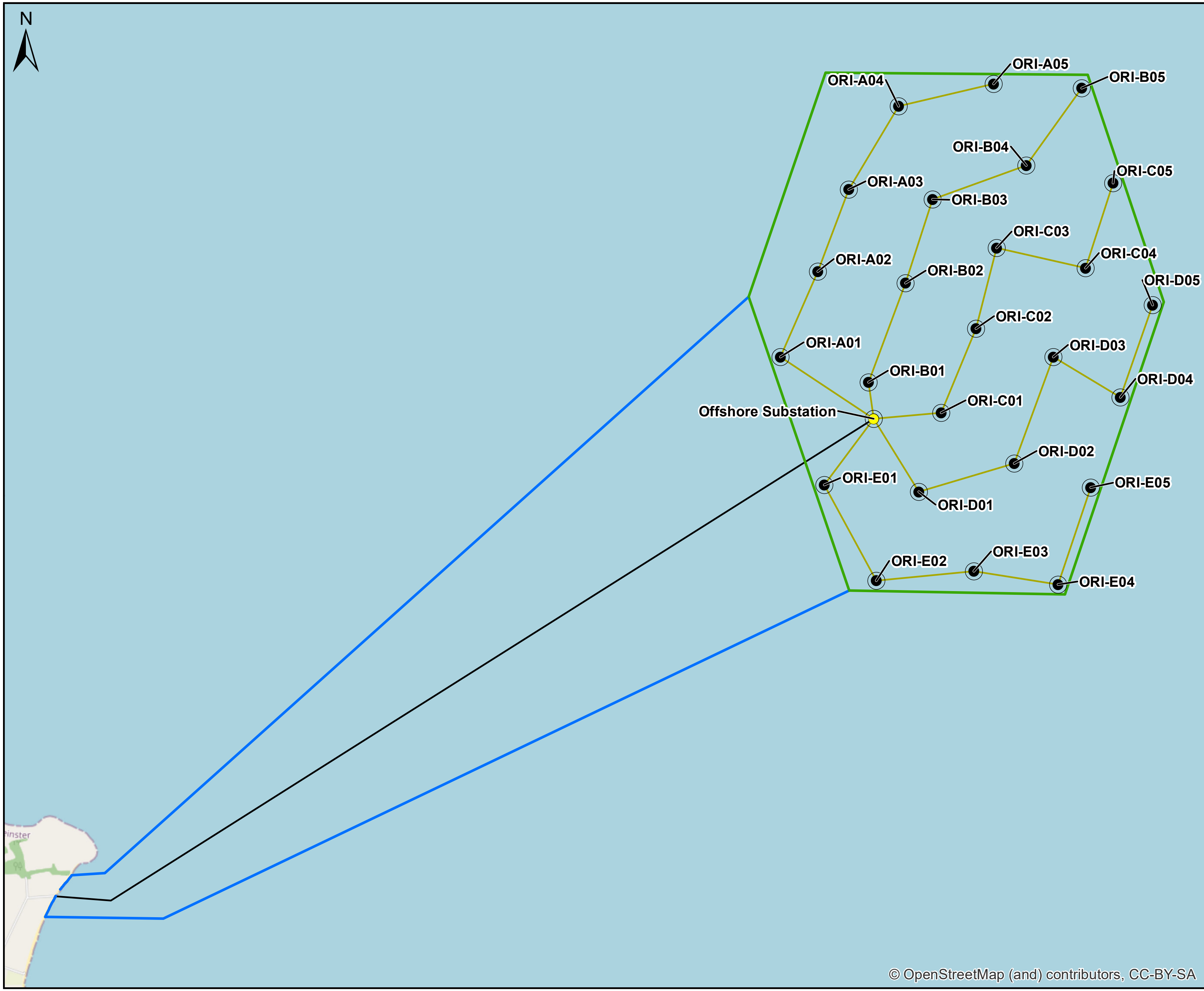
The design flexibility opinion by An Bord Pleanála under section 278B of the Planning and Development Act 2000, as amended and the Planning and Development Regulations 2001, as amended, states that the following details of the Project may be confirmed after the proposed application has been decided:

The final exact location of each offshore wind turbine and the offshore substation.

The final exact location of each wind turbine will be confirmed following geotechnical investigations and analysis of ground conditions.

The locations of the WTG and OSS may require adjusting within a 50 m radius should an obstruction to the foundation be identified. Detailed geophysical studies have been completed for each proposed foundation location. Future geotechnical investigation and trial drilling of each location will be completed prior to construction as part of a foreshore licence (see section 5.4.1). Variable ground conditions across the offshore wind farm area have been identified and ground conditions such as boulders would result in the requirement to move the foundation.

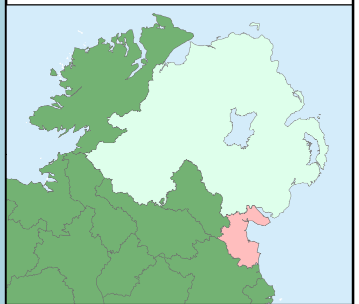
A 50 m radius of lateral deviation in the final location of each offshore wind turbine (and the offshore substation) is proposed and is sufficient to identify alternative, feasible locations.



Legend

- Offshore Wind Farm
- Offshore Cable Corridor
- Inter-array Cable
- Export Cable
- Offshore Substation
- WTG

Data Sources: OWL, OSi



Client

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project

Oriel Wind Farm Project

Title

Figure 5-6: Wind farm layout

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Issue Details

Drawn By: NR	**Project No.** MDR1520b
Checked By: CC	**File Ref:**
Approved By: CC	MDR1520bArc3105F01
Scale: 1:65,000 @ A4	**Projection:** ITM (IRENET95) Geographic Co-ordinates: ETRS89
Date: 24/11/2023	

NOTE:
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5.5.5 Foundations

The WTGs and OSS are attached to the seabed by foundation structures. A monopile foundation is proposed for the Project. Each monopile foundation will be specifically designed for the ground conditions and metocean conditions encountered at each WTG location and the OSS location and to the available and appropriate installation methodology. A graphic illustrating the foundation design is presented in Figure 5-7 and a photograph of the monopile drilled installation is presented in Figure 5-8 for information.

The height and depth of each foundation is dependent on the loading requirements from each structure (WTG and OSS) and the specific geology encountered at each site. The final design of each foundation will be completed following the procurement and contracting process after consent. The final height of each foundation is the determining factor in the final hub height of each wind turbine. The wind turbine hub height will vary within the range 145-152 m above LAT across the wind farm site due to the final height of the top of each foundation above LAT.

The foundations will be fabricated offsite and stored at a suitable port facility or fabrication yard with the appropriate pre-existing consent/licence/permit and transported to site when required. Specialist vessels will transport and install the foundations. Scour protection (typically rock) may be required on the seabed and will be installed before and/or after foundation installation. The design has assumed that scour protection will be required and this has been considered in the assessments in volume 2B and 2C.

Monopile foundations typically consist of a single steel tubular section, consisting of a number of sections of rolled steel plate (called cans) which are welded together. A transition piece is fitted over the monopile and secured via bolts or grout. The transition piece includes boat landing features, ladders, a crane, and other ancillary components as well as a flange for connection to the wind turbine tower. The transition piece is painted yellow and marked per relevant regulatory guidance from the Commissioner of Irish Lights (CIL), Marine Survey Office (MSO) and IAA and may be installed with the monopile or separately following the monopile installation.

The design parameters of the monopile foundations, including associated scour protection, are presented in Table 5.4 below. Further details on the foundation design are described in the following sections.

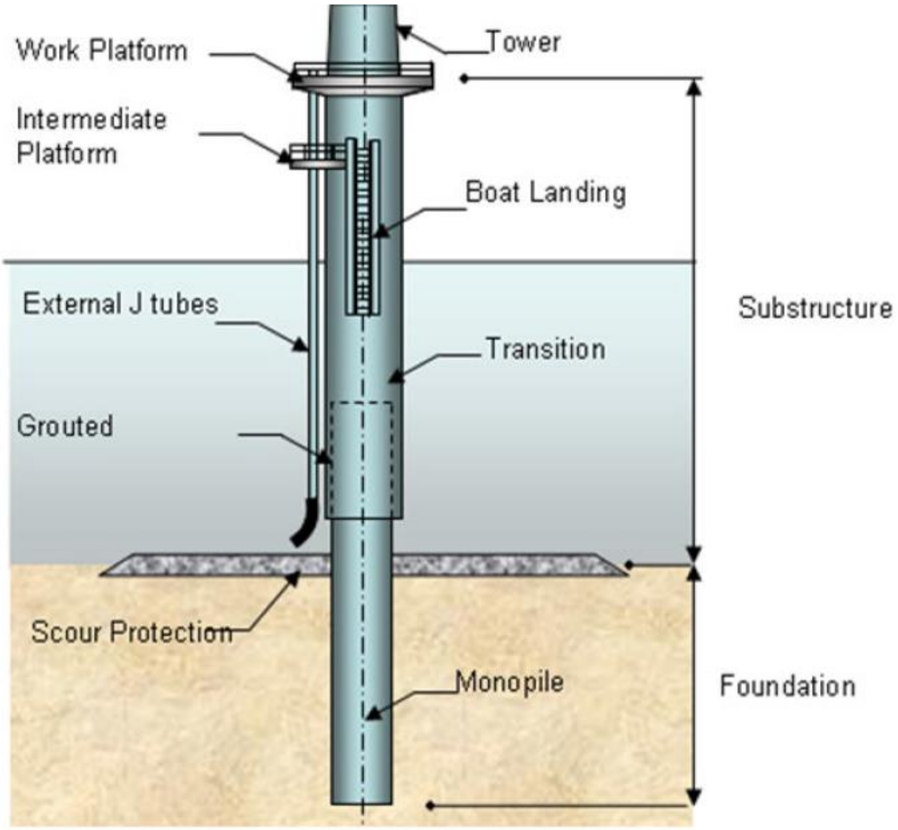


Figure 5-7: Illustration of Monopile foundation design.

Figure 5-8: Monopile foundation installation from a JUV.

Table 5.4: Project design parameters for monopile foundations.

Element	Design parameter (WTGs + OSS)
Monopile	
Total number of structures	26 (25 WTGs + 1 OSS)
Maximum diameter of monopile (m)	9.6
Pile penetration depth (below seabed) (m)	35.0
Seabed footprint per pile (m^2)	72.4
Scour protection	
Scour protection material type	Rock
Scour protection material height (m)	1.0
Scour protection footprint per pile (m^2)	1,810
Scour protection volume per pile (m^3)	1,810
Total Project scour protection volume (m^3)	47,060
Total seabed footprint	
Total Project seabed footprint including scour protection (m^2)	47,060
Grout	
Grout volume per pile (m^3)	320
Drill characteristics	
Maximum drilling duration (per pile)	6
Maximum drill depth	35.0
Volume of drill arisings per pile (m^3)	3,200
Total Project volume of drill arisings (m^3)	83,200

Installation

Monopiles (and transition pieces) will be transported to site either on the installation vessel (either JUV or Dynamic Positioning Vessel (DPV)), or on feeder barges.

Once on site, the monopiles will be lifted into position and installed by driving with assistance from a hydraulic hammer up to a maximum resistance and then by drilling to the required embedment depth. The methodology is described below.

One installation vessel will be used, with one piling or drilling event taking place at any one time. The details for the vessels and numbers of trips required are presented in Table 5.5. Monopile installation may take place over a total installation period of six months, dependent on weather and vessel down-time.

Seabed preparations for monopile installation are usually minimal as the area requiring preparation is limited to the foundation diameter (see section 5.5.2). If pre-construction surveys show the presence of boulders or other seabed obstructions at foundation locations, these may be removed if the foundation location cannot avoid the obstruction.

Table 5.5: Vessel requirements for monopile foundations.

Vessel type	Maximum number of vessels (WTGs and OSS)	Maximum number of return trips per vessel (WTGs + OSS)
Main Installation Vessels (Jack-up Barge/DP vessel)	1	26
Guard Vessels	1	20
Crew Transfer Vessels	1	38
Scour Protection Installation Vessels	1	4

All monopile foundation installations will require a combination of piling followed by drilling (drive, drill and grout method). The modelled (noise) piling scenario (see appendix 10-2: Subsea Noise Technical Report) (volume 2B) for monopiles assumes a maximum piling duration of 8 hours per pile (average duration 5 hours per pile). A single installation vessel is proposed and there will be no concurrent piling of foundations.

The maximum hammer energy proposed for the Project is 3,500 kJ for monopiles and this is considered the maximum design parameter. However, the actual energy used when piling will be significantly lower for the majority of the time and the driving energy will be raised to 3,500 kJ only when absolutely necessary.

Following a preliminary analysis of ground conditions at the site, the Project currently expect the average hammer energy during piling installation to be 2,500 kJ. The highest hammer energy (3,500 kJ) will be required when the pile reaches maximum resistance, which is expected to be at rockhead.

The proposed monopile piling durations for each energy level is provided in Table 5.6. This has formed the basis for the subsea noise modelling of monopile installation provided in appendix 10-2: Subsea Noise Technical Report (volume 2B).

Table 5.6: Piling durations for monopile installation using a maximum hammer energy of 3,500 kJ.

Activity/stage	Hammer Energy	Piling Duration – Monopiles (minutes)
Initiation	525 kJ	1
Soft start	525 kJ	20
Ramp up	525 – 2,500 kJ	9
Piling	2,500 kJ	150
Full power piling	3,500 kJ	120
Total piling duration	-	300 (5 hours)

When percussive piling installation is not possible due to the presence of rock or hard soils a drill will be inserted into the monopile and material will be drilled out to the required depth. An inner pile will then be inserted into the outer pile and the annulus between the piles filled with grout.

In the event that the foundation installation encounters an unexpected obstacle such as a large buried boulder the foundation may be relocated in the adjacent area. A 50 m radius of lateral deviation is included with the assessment.

Soil and rock arising from the drilling (the “drill arisings”) will be returned to the area adjacent to the foundation location through a fall pipe below the sea surface to minimise dispersion of the drill arisings. This activity will be the subject of a separate Dumping at Sea Permit obtained from the EPA. The maximum volume of drill arisings for the wind farm foundation installation is presented in Table 5.4 above.

Scour protection

Scour protection will be installed around each foundation to prevent scour holes developing around the structures.

The preferred scour protection solution will 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 (‘pre-installed’) or afterwards (‘post-installed’). 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.

The amount of scour protection required will vary dependent on the seabed material and metocean conditions present at each foundation location. The scour protection will be determined after detailed design of the foundation structure, considering a range of aspects including geotechnical data, marine processes, meteorological and oceanographic data, water depth, foundation type and maintenance strategy.

Scour protection will be brought directly by sea from a rock quarry by a dedicated vessel designed for the purpose. The selection of the rock quarry will be included as part of the foundation installation contract. Hard rock quarries in southern Norway have been used for other offshore wind farm projects.

The maximum diameter of the rocks used would be 1 m and the maximum thickness of scour protection layer would be 1.0 m. Scour protection parameters have been presented for the monopile foundation in Table 5.4 above.

5.5.6 Inter-array cables

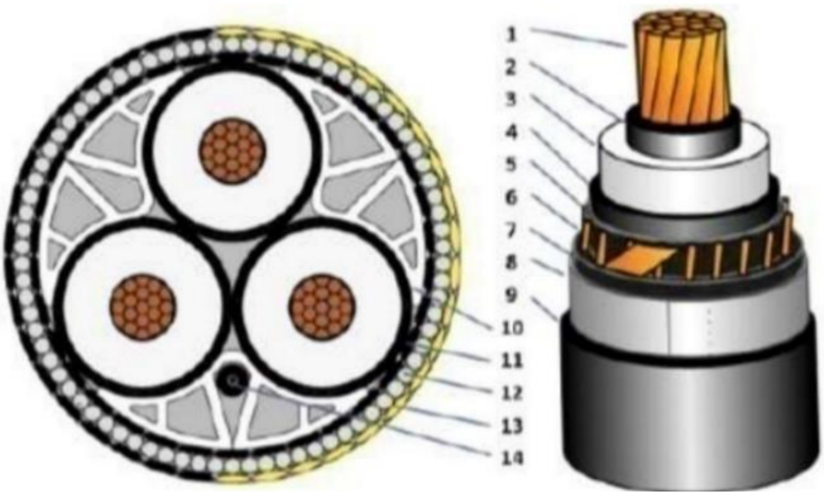
Inter-array cables will carry the electrical current produced by the WTGs to the OSS in a layout as shown on Figure 5-6. A small number of wind turbines (approximately five) will be joined together on the same cable ‘string’ connecting those wind turbines to the OSS. Five cable ‘strings’ will therefore connect back to the OSS. The inter-array cable system will use 66 kV AC technology.

Design

The inter-array cables will consist of a number of conductor cores, usually made from copper or aluminium surrounded by layers of solid insulating material, as well as material to armour the cable for protection from external damage. A diagrammatic representation of the cross-section of the cable is presented in Figure 5-9. No mineral oils or other fluids are contained within the cable. The design parameters for the inter-array cables are presented in Table 5.7.

Table 5.7: Project design parameters for inter-array cables.

Parameter	Design parameter
Cable diameter (mm)	250
Total length of cable (km)	41
Voltage (kV)	66



No.	Description	Details
1	Conductor	Longitudinally water blocked compact stranded copper, Class 2 to IEC 60228
2	Conductor screen	Extruded bonded semi-conductive compound
3	Insulation	XLPE (cross linked Polyethylene)
4	Insulation screen	Extruded bonded semi-conductive compound
5	Water blocking	Semi conductive water swelling tape
6	Metal sheath	Helically applied copper wires with equalising tape
7	Water blocking	Semi-conducting water - swelling tape
8	Radial water barrier	Longitudinal aluminium foil bonded to sheath
9	Inner sheath	Polypropylene sheath
10	Lay-up	Three power cores are laid up with fillers (polypropylene yarns or shaped extruded) and up to 3 fibre optic cables
11	Armour bending	Polypropylene Yarns
12	Armouring	Galvanised Steel Wires with Bitumen
13	Outer serving	Polypropylene Yarns
14	Fiber Optic Cable	1 x Optical Fibers Cable with 48 fibres (48 Single mode)

Figure 5-9: Cross section of inter-array cable design.

Installation

Inter-array cables will be installed from a dedicated cable-laying vessel. This vessel will be positioned through dynamic positioning and the vessel will therefore only need to anchor in the wind farm area in emergency situations (e.g. loss of power).

Inter-array cables will be installed into the seabed via jetting or ploughing methods where feasible or surface laid and protected with concrete/steel mattress and rock. Jetting modifies the seabed with high-speed water jets so that the pre-laid cables sink by their own weight to a pre-determined depth. In the case of ploughing, a subsea plough is towed by the cable installation vessel to bury the cables simultaneously with the laying process. The plough lifts a wedge of soil and places the cable at the base of the trench before the wedge of soil backfills over the cable due to gravity. The cables will be buried below the seabed wherever possible, to a minimum burial depth of 0.5 m and a maximum burial depth of 3 m. The final selected installation method and target burial depth will be defined prior to construction based on a detailed cable burial risk assessment (CBRA) (see section 5.10). This depth is likely to vary across the offshore wind farm area due to the differing soil substrates. The design parameters for inter-array cable installation are presented in Table 5.8.

Inter-array cable installation will take place over a total installation period of six months. The details for the vessels and numbers of trips required are presented in Table 5.9 below. The maximum amount of cable installation vessel trips assumes one cable per return trip. The CTV return trips assumes there is no service (hotel) vessel in the field during the cable termination works. In case a service vessel is employed, the number of CTV return trips will be reduced.

Table 5.8: Project design parameters for inter-array cable installation.

Element	Design parameter
Installation methodology	Ploughing or jetting
Maximum Burial depth (m)	3.0
Trench width (m)	1.0
Width of seabed disturbance from installation tool (m)	10.0
Total Project area of seabed disturbance (km^2)	0.41

Table 5.9: Inter-array cable installation vessel requirements.

Vessel type	Maximum number of vessels	Maximum number of return trips per vessel
Cable Installation Vessels	1	5
Guard Vessels	1	20
Crew Transfer Vessels	1	150
Cable Protection Installation Vessels	2	25

Cable protection

Where the cable cannot achieve target burial depth due to ground conditions, cable protection will be deployed. Cable protection will include either rock placement and/or concrete/steel mattresses. It is anticipated that up to 50% of the inter-array cable route may require cable protection. Potential cable protection options are described below. No cable crossings are required and therefore subsea cable bridging is not proposed.

Table 5.10 provides the design parameters for cable protection.

The maximum potential lengths of inter-array cable and the maximum portion of the cable requiring protection by rock or concrete mattress have been assessed in the EIAR.

Mattress Placement

Mattresses generally have dimensions of 6 m by 3 m by 0.3 m. They are formed by interweaving a number of concrete blocks with rope and wire and 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. This 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.

Table 5.10: Project design parameters for inter-array cable protection.

Parameter	Design parameter
Cable protection material (type)	Rock placement, concrete mattresses
Maximum Length of cables requiring cable protection (m)	20,500
Cable protection height (m)	2.0
Cable protection width (m)	10.0
Total Project cable protection footprint (m^2)	205,000
Total Project cable protection volume (m^3)	300,000
Proportion of inter-array cable route with cable protection (%)	50

Design flexibility

The design flexibility opinion by An Bord Pleanála under section 278B of the Planning and Development Act 2000, as amended and the Planning and Development Regulations 2001, as amended, states that the following details of the Project may be confirmed after the proposed application has been decided:

The final route and length, of the offshore cable and offshore inter-array cables

Due to the potential for unexpected ground conditions and obstructions, the final route and length of the offshore inter array cables will be confirmed during construction.

A preferred route for each inter-array cable (5 no.) has been identified following detailed geophysical and geotechnical site investigations. A deviation to these routes within the offshore wind farm area could be required. For the purposes of assessment, 41 km of cable routes within the offshore wind farm area have been assessed.

Should obstacles be encountered during the installation of the inter-array cables, the following construction methodology will be implemented:

- Locate and define extent of obstacle;
- Implement Marine Archaeological Mitigation Plan (appendix 5-10); and
- Relocate obstacle using a grab or amended route to avoid the obstacle along the route of the inter array cable.

5.5.7 Offshore substation (OSS)

A OSS is a prefabricated structure housing electrical equipment to provide a range of functions such as regulating and increasing the voltage level to reduce electrical losses and monitoring, protection and control of the electrical infrastructure. The OSS location is presented on Figure 5-6. The location has been determined taking account of ground conditions, the SAR corridors and the most efficient cable routing amongst other considerations. The OSS will not be manned but once functional will be subject to periodic operational and maintenance visits. A description of the OSS is provided below.

Design

The OSS will comprise a platform with decks, attached to the seabed by means of a monopile foundation, containing equipment required to switch and transform electricity generated by the wind turbines to a higher voltage and provide reactive power compensation. It will house auxiliary equipment and facilities for operating, maintaining, and controlling the substation. There will be a telecommunications mast on one corner of the platform and a crane.

Access and egress to the OSS will be by SOVs and CTVs in a similar arrangement to the WTGs (see section 5.5.3). The OSS will not be equipped with a helideck but will include a hoisting area on the roof deck for emergency access by helicopter.

The OSS will collect the electricity generated by the operational WTGs via the inter-array cables. The voltage will be "stepped up" by one or two transformers on the OSS before transmission to the onshore electrical infrastructure by the offshore cable. The design parameters for the offshore substation topside are presented in Table 5.11. The design parameters for the offshore substation foundation was described in section 5.5.5.

The OSS will be coated in a marine grade coating system. Corrosion protection measures will be applied to all equipment installed in non-climatised conditions. To limit the visibility against the sky, the OSS topside structure will be coated in a light grey colour.

Table 5.11: Project design parameters for the offshore substation (OSS).

Element	Design parameter
Topside structure	
Height of main structure (above LAT) (m)	40
Height of lightning protection (above LAT) (m)	48
Height of crane (above LAT) (m)	48
Height of telecommunications mast (above LAT) (m)	56
Topside length (m)	40
Topside width (m)	30
Topside weight (t)	3,000
Consumables (maximum volumes)	
Diesel fuel (litres)	10,000
Grey Water (litres)	3,000
Black Water (litres)	1,000
Transformer coolant oil (m^3)	230
UPS Batteries (kg)	3,000
Fire Suppression Systems	5,000 litres foam + 5,000 kg Argonite
HVAC coolant (litres)	1,000
SF6 (kg)	1,750

The OSS will be equipped with a drain system to collect and contain any leakages from equipment containing environmentally damaging fluids. This sealed system will ensure no discharge of fluids to the marine environment. The HV transformer(s) will have a sump area in the deck structure, covered with flame retardant grating. A double walled sump tank on the cable deck will be connected to the sump area via an overflow pipe in the transformer room(s) to ensure the total volume of the transformer oil and additional water/foam mixture during fire extinguishing can be contained. An oil/water separator will prevent rainwater collecting in the sump area. The main diesel oil tank is double walled and bunded.

The external and internal lighting system on the OSS will be designed according to relevant standards such as:

- IEC 61892 (Part 1 to 7): Mobile and Fixed Offshore Units - Electrical Installation;
- GL: GL Rules IV Industrial Services Chapter 6 Offshore Installation;
- EN 12464: Lighting of Workplaces;
- EN 1838: Lighting application – Emergency lighting;

- DNV-OS-D201: Electrical installations;
- DNV-ST-0145: Offshore substations for wind farms;
- 2004/108/EC: EMC Directive;
- DS/EN 61000-6: Electromagnetic compatibility; and
- 2006/95/EC: Low Voltage Directive.

When the OSS is manned, all lighting on the topside will be switched on. In unmanned mode, the lighting around the boat landing, helicopter hoist area and outside platform marking will always remain on.

Installation

The OSS is generally installed in two phases, the first phase will be to install the foundation for the structure which will be as for the wind turbine foundation structures (see section 5.5.5). Secondly, a Heavy Lift Vessel will lift the topside from a transport vessel/barge, onto the pre-installed foundation structure. The Heavy Lift Vessel may also be used to transport the offshore substation topside to the site. A photograph of an OSS installation is presented in Figure 5-10.

Figure 5-10: Heavy Lift Vessel installing an OSS Topside.

OSS installation and commissioning may take place over a total period of three months. The vessel requirements for this process are presented in Table 5.12**.**

Table 5.12: OSS installation vessel numbers and movements.

Vessel	Numbers	Number of return trips
Main Installation Vessels (Jack-up Barge/DP vessel)	1	1
Tug/Anchor Handlers	2	2
Guard Vessels	1	20
Crew Transfer Vessels	2	35

Design flexibility

The design flexibility opinion by An Bord Pleanála under section 278B of the Planning and Development Act 2000, as amended and the Planning and Development Regulations 2001, as amended, states that the following details of the Project may be confirmed after the proposed application has been decided:

- The final height of offshore infrastructure; and
- The final exact location of each offshore wind turbine and the offshore substation.

The final exact location of the OSS will be confirmed following geotechnical investigations and analysis of ground conditions.

The location of the OSS may require adjusting within a 50 m radius should an obstruction occur during installation. Detailed geophysical studies have been completed for the proposed foundation location. Future geotechnical investigation and trial drilling of each location will be completed prior to construction as part of a foreshore licence (see section 5.4.1). Variable ground conditions across the offshore wind farm area have been identified and ground conditions such as boulders would result in the requirement to move the foundation.

A 50 m radius of lateral deviation in the final location of the offshore substation is proposed and is sufficient to identify alternative, feasible locations.

The final height of the OSS will be confirmed following detailed geotechnical investigations and analysis of ground conditions.

A monopile foundation design has been selected. This has been determined from metocean, geophysical and geotechnical studies completed to date. The height of each foundation will be determined as part of a construction contract and will be specific to the water depths and soil conditions at each foundation location. The height of the foundation is the determining factor in the final height of the OSS. The proposed maximum height of the OSS structure including the crane is 48 maLAT.

5.5.8 Offshore export cable

A single HVAC offshore cable rated at 220 kV will be used for the transfer of power from the offshore substation to the landfall. The cable will be located within the offshore cable corridor identified in Figure 5-1. The cable will be buried below seabed level where possible and additional protection measures as outlined below will be used where burial is not possible due to any physical constraints posed by seabed sediment conditions.

Design

The export cable will consist of three conductor cores, usually made from copper or aluminium. These will be surrounded by layers of solid insulating material as well as material to armour the cable for protection from damage and material to keep the cable watertight. No mineral oils or other fluids are contained within the cable. Export cables are typically larger in diameter than inter-array cables (350 mm for the offshore cable compared with 250 mm for the inter-array cables). The design parameters for the offshore cable are presented in Table 5.13. A cross-sectional illustration of a typical export cable is presented in Figure 5-11.

Table 5.13: Project design parameters for offshore cable.

Parameter	Design parameter
Number of offshore cables within offshore cable corridor	1
Export cable voltage (kV)	220
Offshore Cable Type	HVAC
Maximum external cable diameter (mm)	350
Maximum length of offshore cable (km)	16

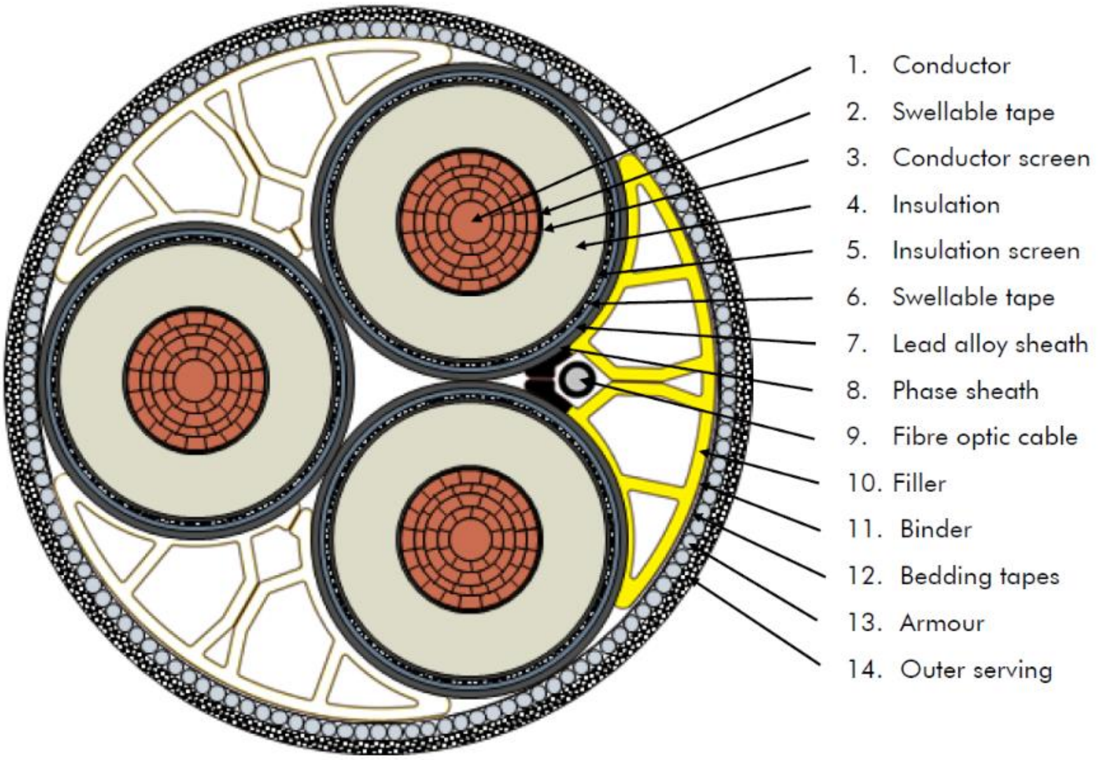


Figure 5-11: Cross-section of offshore cable.

Installation

The offshore cable installation methodology, as well as the burial depth and any requirement for protection measures, will be defined by a detailed CBRA (see section 5.10) to be prepared, by the chosen cable installation contractor. Typically, the cable will be buried between 0.5 m to 3 m. The CBRA will inform cable burial depth which will be dependent on ground conditions as well as external risks. This assessment will be undertaken prior to construction. The installation techniques will consist of a combination of ploughing and jetting. Jetting modifies the seabed with high-speed water jets so that the pre-laid cables sink by their own weight to a pre-determined depth. In case of ploughing, cable ploughs are towed by the cable installation vessel to bury the cables simultaneously with the laying process. The plough lifts a wedge of soil and places the cable at the base of the trench before the wedge of soil backfills over the cable due to gravity. The design parameters for installation of the offshore cable are presented in Table 5.14.

Table 5.14: Project design parameters for the offshore cable installation.

Element	Design parameter
Installation methodology	Ploughing or jetting
Maximum Burial depth (m)	3
Trench width (m)	3
Width of seabed disturbance from installation tool (m)	10
Total Project area of seabed disturbance (km^2)	0.16

Cable Protection

Where the cable cannot achieve target burial depth due to ground conditions, cable protection will be deployed. Cable protection may include rock placement and/or concrete/steel mattresses, as described in section 5.5.6. It is anticipated that 50% of the offshore cable may require cable protection. Table 5.15 provides the design parameters for cable protection.

Table 5.15: Project design parameters for offshore cable protection.

Element	Design parameter
Cable protection material (type)	Rock placement and/or concrete/steel mattresses
Length of cables requiring cable protection (m)	8,000
Cable protection height (m)	2.0
Cable protection width (m)	10.0
Total cable protection footprint for offshore cable (m^2)	80,000
Total cable protection volume for offshore cable (m^3)	160,000
Proportion of offshore cable with cable protection (%)	50

Export cable installation may take place over a total installation period of three months. Cable installation and route preparation will be undertaken by specialist vessels, the vessel requirements for offshore cable installation are presented in Table 5.16. Based on previous experience within the Applicant's Project Team at other offshore wind farms, it is possible that a small JUV or a flat top barge may also be used for offshore cable installation in shallow water.

Table 5.16: Installation vessel numbers and movements for installation of the offshore cable.

Vessel	Number	Number of return trips
Cable Installation Vessels	1	1
Guard Vessels	1	20
Crew Transfer Vessels	1	20
Cable Protection Installation Vessels	2	5

Design flexibility

The design flexibility opinion by An Bord Pleanála under section 278B of the Planning and Development Act 2000, as amended and the Planning and Development Regulations 2001, as amended, states that the following details of the Project may be confirmed after the proposed application has been decided:

The final route and length, of the offshore cable and offshore inter-array cables

Due to the potential for unexpected ground conditions and obstructions, the final route and length of the offshore cable will be confirmed during construction.

An offshore cable corridor has been identified following detailed geophysical and geotechnical site investigations. For the purposes of assessment, a 16 km of offshore cable route within the offshore wind farm area have been assessed.

Should obstacles be encountered during the installation of the offshore cables, the following construction methodology will be implemented:

- Locate and define extent of obstacle;
- Implement Marine Archaeological Mitigation Plan (appendix 5-10); and
- Relocate obstacle using a grab or amended route to avoid the obstacle along the route of the inter array cable.

5.5.9 Landfall and Transition Joint Bay (TJB)

The offshore cable will make landfall approximately 700 m south of Dunany Point, Co. Louth.

The offshore cable will be installed in a buried trench in the intertidal area and will connect to the TJB located above the high water mark.

A geotechnical investigation of the landfall above the high water mark was conducted in 2021. This included the drilling of four cable percussion boreholes, a rotary borehole and a geophysical survey of seismic refraction and electrical tomography. The investigation determined that the subsoil deposits were suitable for installation of the cable at the landfall within a dug trench. The technique for installation is described in the following sections.

Intertidal area - export cable installation

Figure 5-12 below details the typical phases which would apply when floating in a cable at the proposed landfall. The offshore cable will be pulled ashore at high tide or alternatively rolled in on rollers and lowered into an open trench within the beach. The trench will then be backfilled as the tide recedes.

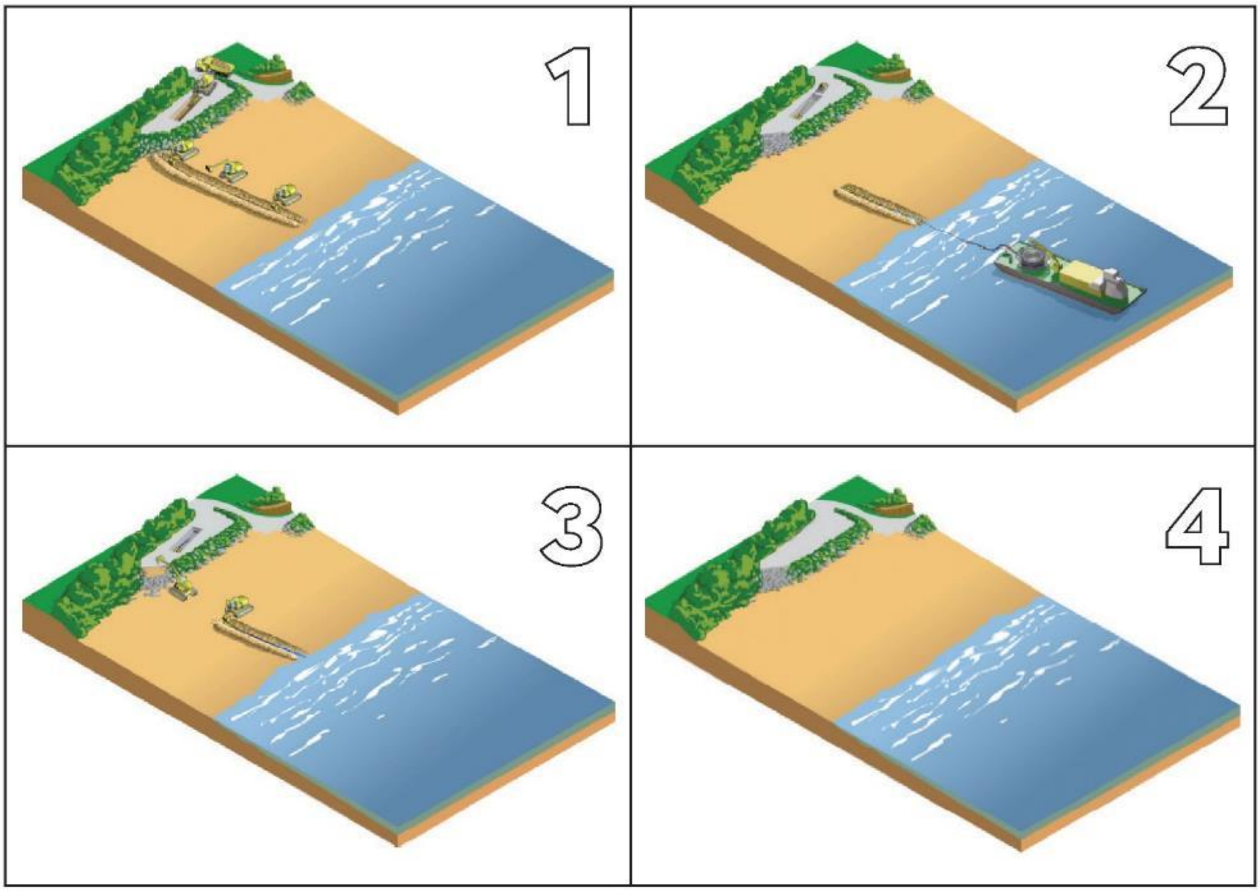


Figure 5-12: Schematic showing phases of installing a cable trench at a landfall.

A 30 m wide working area will be defined between the high water mark and the low water mark along the route of the offshore cable. Prior to the cable laying vessel arriving on site, a trench will be excavated on the beach to provide a cable route between the low water mark and the high water mark.

The trench will be backfilled immediately after installation of the cable and the beach returned to its prior condition. The exact location of the cable will be recorded using precise survey grade equipment. A winch wire will be pulled offshore where it will connect to the cable which is floated towards the shoreline using work boats. For long float in operations, a jack up barge (backhoe excavator) may be required for the excavation and reinstatement through the intertidal zone and also during the floating to control the cable location between the TJB and cable laying vessel.

The barge will be positioned ideally no more than 1 km from the shoreline. Divers will typically be used to remove the floats at the low water mark and rollers will be positioned along the beach to guide the cable along the trench. The cable can be floated ashore during high tide or alternatively pulled along the beach through rollers during low tide. Once the cable is anchored at the TJB, the cable laying vessel can continue out to sea laying the cable along the seabed as it transits to the OSS location. The excavated trench out to the low water mark will then be backfilled and the ground reinstated.

The final method for installation will be dependent on the results from the detailed site investigation for the intertidal area (which will be undertaken as part of an existing Foreshore Licence) and the contractor selected for the work. A photograph illustrating the cable installation techniques is presented in Figure 5-13 for information.

Figure 5-13: Photo showing installation of a cable in a trench at a landfall.

Alternatively, self-powered bespoke installation tools may be used. These are usually tracked vehicles, that excavate a trench, lay the cable, and then bury the cable simultaneously. These are ROV type systems, controlled from and connected to the offshore installation vessel.

A photograph of a cable laying vessel and equipment is presented in Figure 5-14 for information.

A graphic of a typical arrangement for the TJB based winch is presented in Figure 5-15.

Figure 5-14: Photo showing example of an intertidal cable burial using a plough.

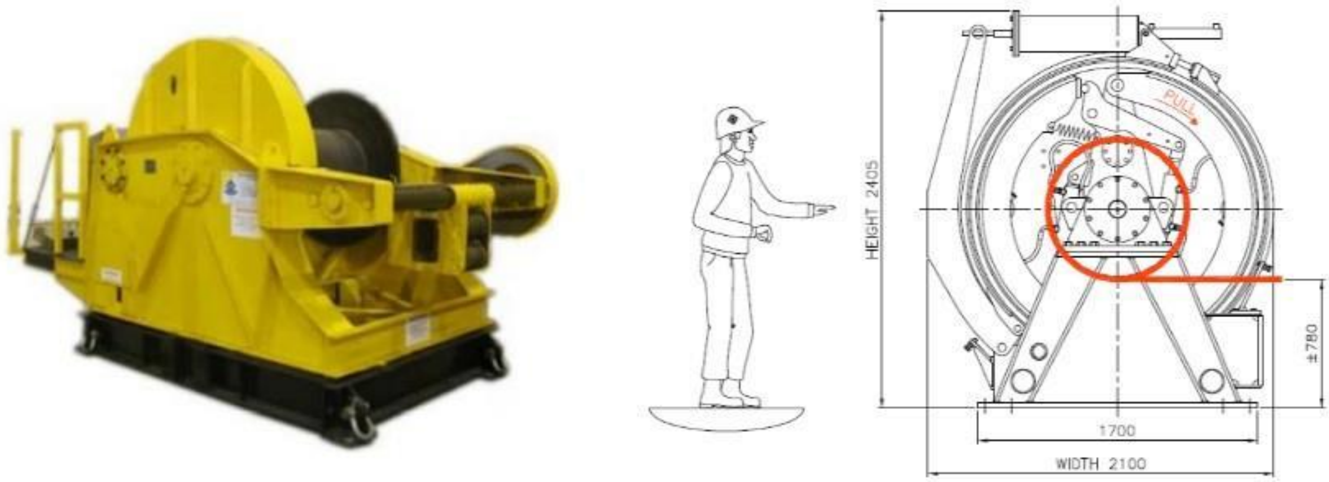


Figure 5-15: Typical shore based winch arrangement.

The project design parameters for open trench installation at the intertidal area are presented in Table 5.17 and for installation equipment to the site are presented Table 5.18. Following completion of the cable installation, the working corridor will be reinstated to its previous condition. Any surplus soil will be taken off site by a waste licenced contractor to an appropriate licenced waste facility for reuse where possible.

Table 5.17: Project design parameters for landfall open trench installation.

Element	Design Parameter
Number of trenches	1
Landward of HWM	
Width of trench (m)	5 m at top and 1.5 m at base
Length of trench (m)	10 m – 200 m (between HWM and TJB)
Depth of trench (m)	3
Working areas either side of trench (m)	15
Intertidal (HWM to LWM)	
Width of trench (m)	5 m at top and 1.5 m at base
Length of trench (m)	800
Depth of trench (m)	3
Area of trenches (m^2)	4,000
Volume of material excavated from trenches (m^3)	12,000
Working areas either side of trench (m)	15
Installation duration	
Installation duration	3 months

Table 5.18: Open trench installation vessels/equipment.

Vessel/Equipment	Numbers	Number of return trips
HGV return trips - mobilisation	2	10
HGV return trips - trenching operations	3	30
HGV return trips - demobilisation	2	10
Tug/Anchor Handlers	1	1
Cable Installation Vessels	1	1
Guard Vessels	1	1
Survey Vessels	1	1
Crew Transfer Vessels	1	1

Transition Joint Bay (TJB)

The offshore cable is connected to the onshore cables at the TJB. The TJB is a fully buried concrete chamber which is located close to the high water mark to minimise the length of the offshore cable on land. This is due to the technical properties of the tricore marine cable which has limits on its thermal properties along its length.

The design parameters for the TJB are presented in

Table 5.19 and the maximum number of return trips for installation equipment to the site are presented in Table 5.20.

The purpose of the TJB is to ensure that the jointing of the export cables can take place in a clean, dry environment and also to protect the joints once completed. Once the joints are completed the TJB is covered and the land above reinstated. It is not expected that access to the TJB will be required during the operation of the wind farm, however, the link box and communication chamber will be located adjacent to the TJB with access for monitoring of the cable joints during the operational phase. These will also be reinstated but will have maintenance covers for access. A hard stand area for crane operations will be constructed adjacent to the TJB. This will be covered and the land above reinstated once the TJB is completed. However, it will be available should a future maintenance operation require opening of the TJB.

Two options for the location of the TJB have been identified and are presented on Figure 5-16 (map 12 of 12). The options are described below.

- **Option 1** is located close to the beach end of the laneway along the southern boundary of Dunany Demesne. The offshore cable would transition across the intertidal area and be pulled into the TJB by a winch system either within the laneway or in the adjacent field through a pulley system (see Figure 5-15). The TJB has been located to avoid impact on the cliff and its top will be buried at depth of approximately 1.1 to 1.5 m below existing ground level. During excavation for the TJB the adjacent cliff will be stabilised through the installation of temporary sheet piling which will be removed following reinstatement.

- **Option 2** is located in the field at the southern boundary of Dunany Demesne. An open trench would be dug through the glacial till of the cliff and the export cable would be pulled into the TJB by a winch located in the field (see Figure 5-15). The open trench would be stabilised through the installation of temporary sheet piling. The trench would then be backfilled on completion, the sheet piling removed, and the cliff stabilised through replanting with existing vegetation species.

The geotechnical site investigations to date have demonstrated that the installation of temporary sheet piles by driving or vibro-action is possible; installation by driving becoming more probable should stiff or dense ground conditions be encountered. Should bracing of the installed piles be practicable, it may be possible to reduce pile embedment depth. Alternatively, pre-boring may be deemed appropriate, where driving conditions are difficult. Following installation of the cable or construction of the transition joint bay, these piles will be removed by excavator. The duration of installation will be dependent on construction programming and staging; but is not expected to exceed two weeks.

The location for the TJB is dependent on cable and soil properties which cannot be determined until the cable contracts have been concluded and the final cable is selected (see further details in subsection titled ‘design flexibility’ below).

Transition Joint Bay (TJB) access track

The EirGrid functional specifications require permanent vehicular access to the TJB. For this a single vehicle width access track along the southern boundary of the field will be constructed (if option 2 is used). The access track will be gated at the entrance to the field to prevent unauthorised access. The existing access to the beach at Dunany will be used for access to option 1.

Engineering stone fill will be laid and compacted and maintained as required for the duration of the construction works. Once the construction works are completed, the engineered stone fill will remain in situ to allow maintenance access. It may be necessary to carry out repairs to this access track over the lifetime of the cable circuit due to general wear and tear from maintenance traffic. In the case of a fault during the operational phase of the cable circuit the access track will facilitate a repair of the cable circuit.

A temporary construction compound will be required for the works. The location of the compound is shown on Figure 5-16 (map 12 of 12).

Table 5.19: Design parameters for TJB

Parameter	Dimensions
Number of TJBs	1
TJB area of temporary excavation required (m^2)	100 (option 1) 300 (option 2)
Depth of excavation (m)	2.0
Area of TJB (m^2)	32.5
Volume of material excavated from TJB (approximate) (m^3)	110 (option 1) 200 (option 2)
Landfall construction compound (m^2)	4,120

Table 5.20: TJB installation equipment.

Equipment	Numbers	Number of return trips
HGV return trips - mobilisation		20
HGV return trips - TJB		100
HGV return trips - demobilisation		20

Design flexibility

The design flexibility opinion by An Bord Pleanála under section 278B of the Planning and Development Act 2000, as amended and the Planning and Development Regulations 2001, as amended, states that the following details of the Project may be confirmed after the proposed application has been decided:

The location and layout of the landfall transition joint bay.

The final location of the TJB will be confirmed on examination of the electrical and thermal properties of the selected offshore cable and the ground conditions at the landfall.

As outlined above, two options for the location of the TJB are presented and assessed in the EIAR. The two options are in close proximity and approximately 40 m from each other. Option 1 is close to the beach at Dunany above the high water mark. Option 2 is in an agricultural field adjacent to the beach (see Figure 5-16 (map 12 of 12). Both options will be examined to determine which is most suitable for the properties of the selected offshore cable.

5.5.10 Construction vessel activities

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 offshore wind farm area and the offshore cable corridor. These have been provided in the above sections relevant to the installation of each component of the Project.

The total vessel numbers and vessel movements (return trips from a marshalling harbour to site and back again) are collated in Table 5.21 below. Each vessel movement represents a return trip to and from the offshore wind farm area or offshore cable corridor (as appropriate).

Table 5.21: Total installation vessel numbers and movements.

Vessel	Numbers	Number of return trips
Main Installation Vessels (Jack-up Barge/DP vessel)	1	40
Commissioning Vessel	1	28

Vessel	Numbers	Number of return trips
Tug/Anchor Handlers	2	12
Cable Installation Vessels	1	6
Guard Vessels	1	20
Survey Vessels	1	8
Crew Transfer Vessels	1	325
Scour/Cable Protection Installation Vessels	1	36

5.5.11 Aids to navigation, colour, marking and lighting

The lighting and marking of the wind turbines and the OSS is presented in appendix 5.8: Lighting and Marking Plan. This is based on the recommendations of the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA, 2013) and will be agreed with the CIL, Irish Coast Guard (IRCG), the MSO, the IAA and the Department of Defence (DoD).

The positions of all infrastructure (including wind turbines, the OSS and subsea cables) will be conveyed to the CIL and the UK Hydrographic Office (UKHO) so that they can be incorporated into Admiralty Charts and the Notice to Mariners procedures.

5.5.12 Safety zones and advisory clearance distances

During construction and decommissioning the Applicant will implement advisory safety zones of 500 m in radius around individual structures undergoing installation. Safety zones of 50 m will be advised for incomplete structures at which construction activity may be temporarily paused (and therefore the 500 m safety zone has lapsed) such as installed foundations or where construction works are completed but the wind farm has not yet been commissioned.

During the operational and maintenance phase, the Project may also implement advisory safety zones of 500 m radius around infrastructure undergoing major maintenance (for example a blade replacement).

The Applicant will also recommend that advisory clearance distances of 500 m radius are observed around cable installation vessels and cable repair vessels.

All safety notices will be advised through Marine Notices published by the Marine Survey Office of the Department of Transport.

5.6 Description of onshore infrastructure

The following sections provide a description on the design and size of the onshore infrastructure of the Project, together with relevant information on construction methods and techniques for the installation of the onshore cable and associated infrastructure (sections 5.6.1 and 5.6.2) and the onshore substation (section 5.6.3 and 5.6.4). Supplementary information on the construction methodology of the onshore cable is provided in appendix 5-12.

5.6.1 Onshore cable

The single offshore cable will connect to three onshore cables at the TJB to transfer the power onwards to the onshore substation. The three onshore cables will be installed in the same trench and buried for the entirety of the length from the TJB to the onshore substation.

This 220 kV circuit has been designed and will be installed in compliance with the EirGrid’s functional specification for underground cables. It is the policy of EirGrid that, in so far as possible, high voltage underground cables shall only be installed under public roads to allow for standard construction methods and operational access. Furthermore, the cable route has been designed in accordance with a wide range of technical, environmental and socio-economic considerations which have been detailed in chapter 4: Consideration of Alternatives.

Onshore cable route

The route of the onshore cable is shown on Figure 5-16 (maps 1 - 12). It is located within the following townlands in Co. Louth: Dunany, Mitchelstown, Port, Nicholastown (Barony of Ferrard), Boycetown, Togher, Clonmore, Tullydonnell, Corstown (Electoral Division of Drumcar in the Barony of Ardee), Corstown (Electoral Division of Dunleer in the Barony of Ferrard), Drumcar, Mullincross, Charleville, Dromgoolestown, Richardstown (Electoral Division of Stabannan in the Barony of Ardee), Harristown, and Stickillin.

The onshore cable route commences at the laneway that runs along the southern boundary of Dunany Demesne (see Figure 5-16 map 12) and follows local roads heading south through the townlands of Roadstown, Mitchelstown and Port before heading westwards on local roads through Boycetown, Togher and Clonmore (see map 9). At Keenan’s Cross, it continues westwards through Tullydonnell before heading northwards through Corstown.

The route then crosses under the River Dee at Drumcar Bridge (see Figure 5-16 map 5) and continues along local roads, heading in a westerly direction. At Mullincross, the route crosses the R132, and then at Charleville the route passes under the M1 motorway and Dublin to Belfast Rail Line (see Figure 5-16 map 3). It then follows the N33 and crosses under the River Dee (see Figure 5-16 map 3) for a second time before continuing westwards to tie-in to the existing overhead line at the onshore substation site, in the townland of Stickillin (see Figure 5-16 map 1).

Where the onshore cables are required to pass under obstructions such as the River Dee or M1 motorway the onshore cable route diverts to agricultural fields adjacent to the road from where ducts are drilled under the obstruction and the onshore cable installation undertaken (see section 5.6.2 Crossings).

Cable route wayleave

Once installed a permanent wayleave of 5 m in width will be maintained at all locations where the onshore cable route is installed away from the public road. This is in accordance with the functional specification of EirGrid.

A new permanent access track will be constructed to the TJB (option 2 only) to allow for maintenance. The access track will be approximately 4 m wide and is shown on map 12 (Figure 5-16). The existing public access lane will be used if option 1 is constructed.

Cable design

The onshore cable will be a single circuit connection consisting of three conductor cables, each in a separate duct. These ducts along with two fibre-optic communication cables are arranged within a single trench as illustrated in Figure 5-17. The cable will consist of copper or aluminium conductors wrapped with various materials for insulation, protection, and sealing. The cables are supplied in section lengths of approximately 700 m. Each section of cable is joined in the joint bays (JBs). Cable installation is described in section 5.6.2 ‘Cable Pulling and Jointing’.

Table 5.22 presents the design parameters for the onshore cable. Fibre-optic cables will also be integrated in the cables to allow for communication with the control systems on the wind turbines and OSS. A telecommunications mast at the proposed onshore substation will provide the primary communication from the substation to the EirGrid control centre.

The EirGrid functional specification requires a secondary communication from the proposed onshore substation at Stickillin. Therefore, two separate fibre-optic ducts w will be installed within the cable trench, which will be increased to 1.5 m in width from the proposed 220 kV substation to the existing Drybridge to Louth 110 kV overhead line for a length of approximately 3 km along the N33. It will connect into the existing 110 kV double pole set in a field to the south of the N33 in the townland of Richardstown..”. The ducts will allow a fibre connection into the existing electricity network to provide communications to the proposed 220 kV substation.

The potential generation of electromagnetic fields (EMF) is a factor of cable current. A calculation of EMF for the onshore cables is presented in appendix 5.14: Oriel Wind Farm Cable Rating Report. The potential for EMF generation from the onshore cable is considered in chapter 18: Population and Human Health (volume 2C).

Joint bays, link boxes and communication chambers

JBs will be required along the onshore cable route to connect the sections of cable. JBs are concrete lined chambers, that provide a clean and dry environment for jointing the sections of cable together. JB dimensions are presented in Table 5.22. JBs are designed to be covered over following reinstatement. A total of 29 joint bays are required along the onshore cable route (see locations shown in Figure 5-16).

26 JBs are proposed to be located below the public road. Three JBs will be located in agricultural land, these are proposed to be located on the edge of fields and will be covered over to allow the land to be used for agriculture practices. JBs will only require access in the event of a cable failure requiring replacement or maintenance.

Link boxes and communication chambers (C2) will also be required along the onshore cable route adjacent to each JB. These are smaller chambers, compared to JBs, which house connections between the cable shielding, joints for fibre optic cables and other auxiliary equipment. The land above the link boxes and C2s will also be reinstated, however, they will be finished with manhole covers for access during the operational and maintenance phase.

The design parameters for the JBs, link boxes and communication chambers are presented in Table 5.22.

Table 5.22: Project design parameters for the onshore cable, joint bays, link boxes and communication chambers.

Element	Design parameters
Number of trenches to install onshore cable	1
Details of cable pipes (if any)	3 x 200 mm SDR21 HDPE & 2 x 125 mm SDR17.6 HDPE
Details of concrete (if any)	Ducts Laid in CBGM (CL 822) Compacted to CL.813.1 of TII.
Standard trench width	700 mm
Trench length	20.1 km
Trench depth	1,425 mm
Surface area of trenches (700 mm* wide trench) (m^2)	c. 14,070m^2 based on 700 mm x 20.1 km
Volume of material excavated (per metre of trench)	circa 1 m^3
Working Areas (width either side of trench) (m)	Varies depending on site restrictions circa 5 m
Number of joint bays and link boxes	29 each
Area of joint bays (m^2)	20
Area of Communications (C2) Chamber (m^2)	2.5
Area of Link Box (m^2)	2.5
Volume of material excavated (per joint bays) (approximate) (m^3)	40 m^3
Area for each Passing Bay (approximately 60 m x 10 m) including storage areas (topsoil, materials and equipment) and temporary works at each joint bay	c. 600 m^2

* This does not include for non-standard trench design, e.g. when obstacles are encountered.

Legend

- Planning Application Boundary
- Line Cable Interface Mast (LCIM)
- Proposed Joint Bay Locations
- Proposed Onshore Cable Route
- Proposed fibreoptic cable route
- Compound 1 - GIS
- Compound 2 - AIS
- Cable Pulling Temporary Hardstand
- Temporary Construction Compound (substation)
- Temporary Construction Compound (underground cable installation)
- Temporary Storage Area
- Temporary Construction Area
- Proposed Access Tracks

Data Sources: OWL; OSi.

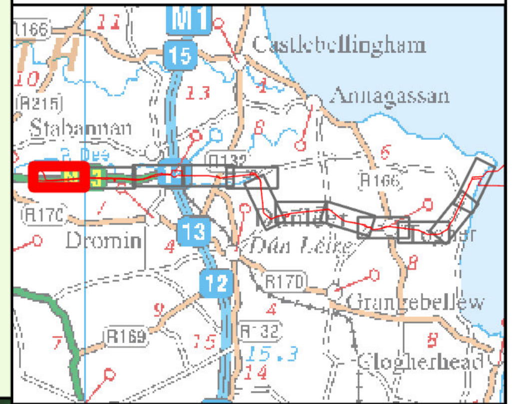


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Figure 5-16: Onshore Cable Route

Map 1 of 12

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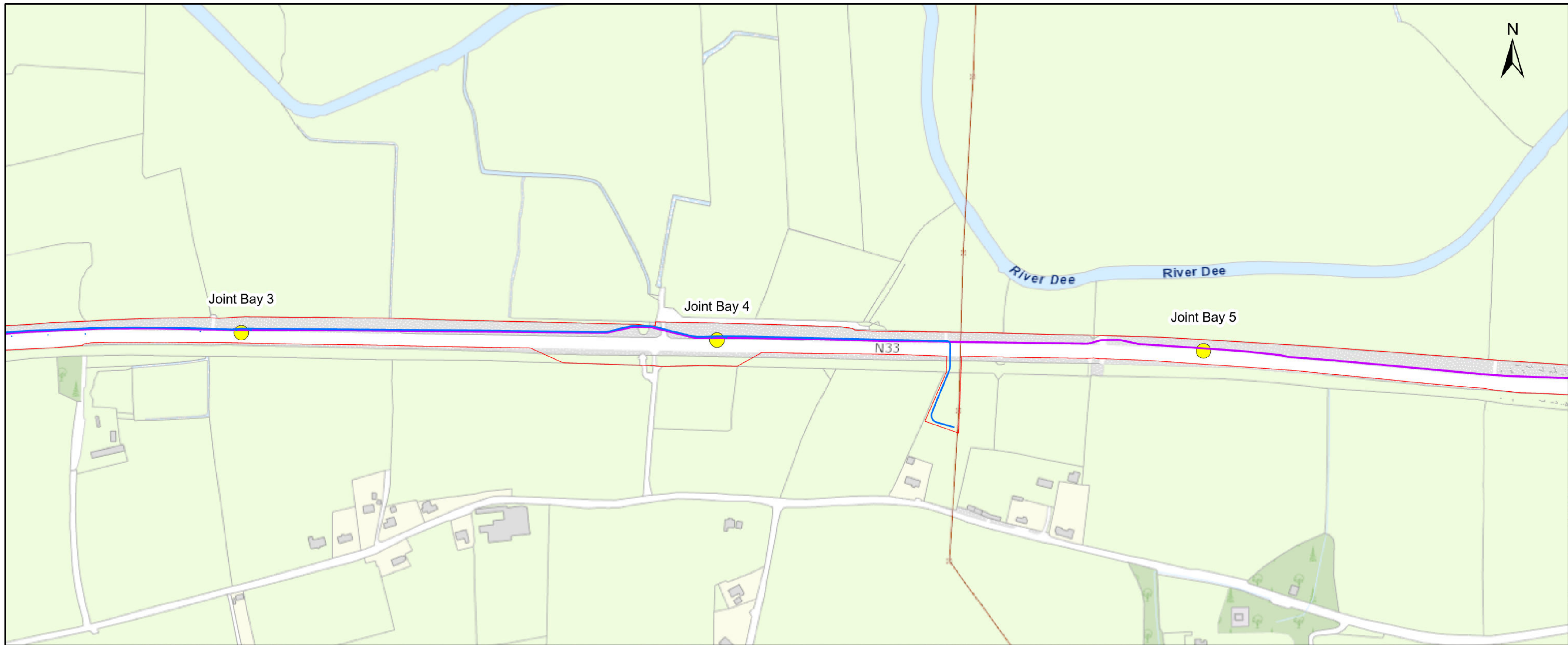

Legend

- Planning Application Boundary
- Proposed Joint Bay Locations
- Proposed Onshore Cable Route
- Proposed fibreoptic cable route

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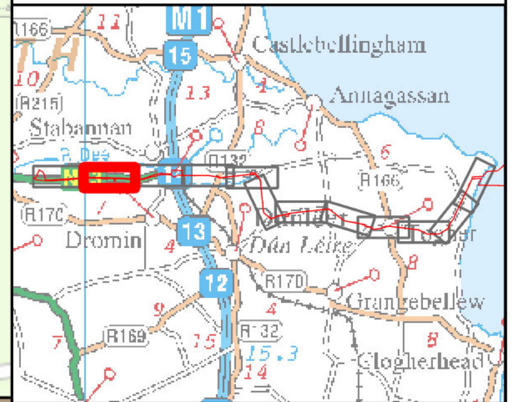

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Figure 5-16: Onshore Cable Route

Map 2 of 12

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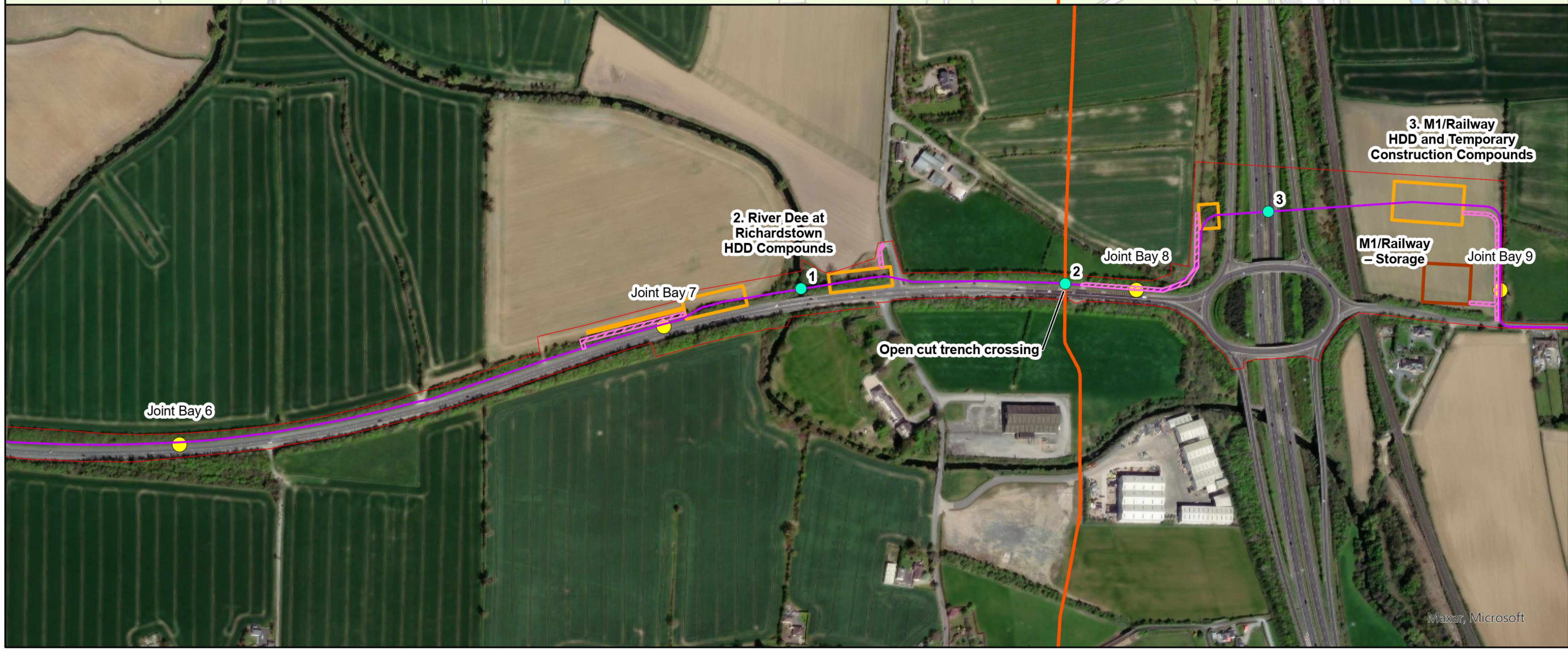

Legend

- Planning Application Boundary
- High Pressure Transmission Gas Main
- Proposed Joint Bay Locations
- Proposed Onshore Cable Route
- Onshore Cable Crossing 1-8
- Proposed HDD Compounds
- Temporary Construction Compounds
- Proposed Access Tracks

Data Sources: OWL; OSi.

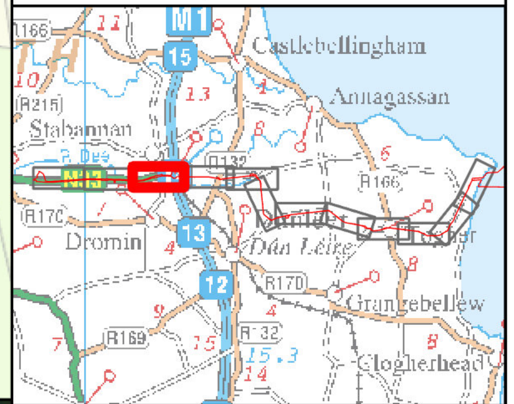

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Figure 5-16: Onshore Cable Route

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- Planning Application Boundary
- Proposed Joint Bay Locations
- Proposed Passing Bay
- Proposed Onshore Cable Route

Data Sources: OWL; OSi.

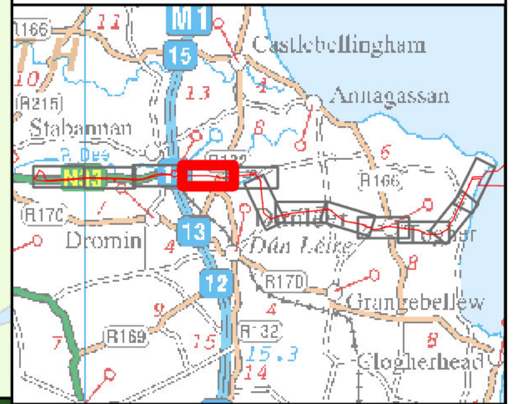

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Figure 5-16: Onshore Cable Route

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- High Pressure Transmission Gas Main
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- Proposed Onshore Cable Route
- Onshore Cable Crossing 1-8
- Proposed HDD Compounds
- Proposed Access Tracks
- Drill Staging Area

Data Sources: OWL; OSi.

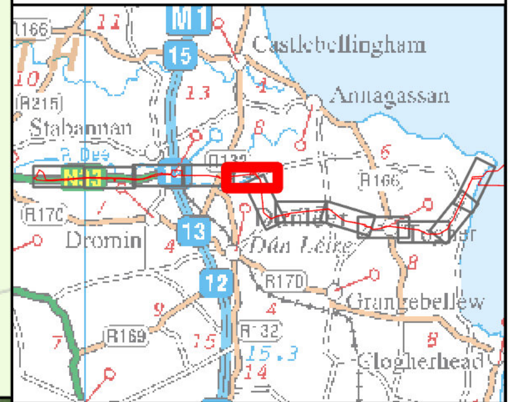

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Figure 5-16: Onshore Cable Route

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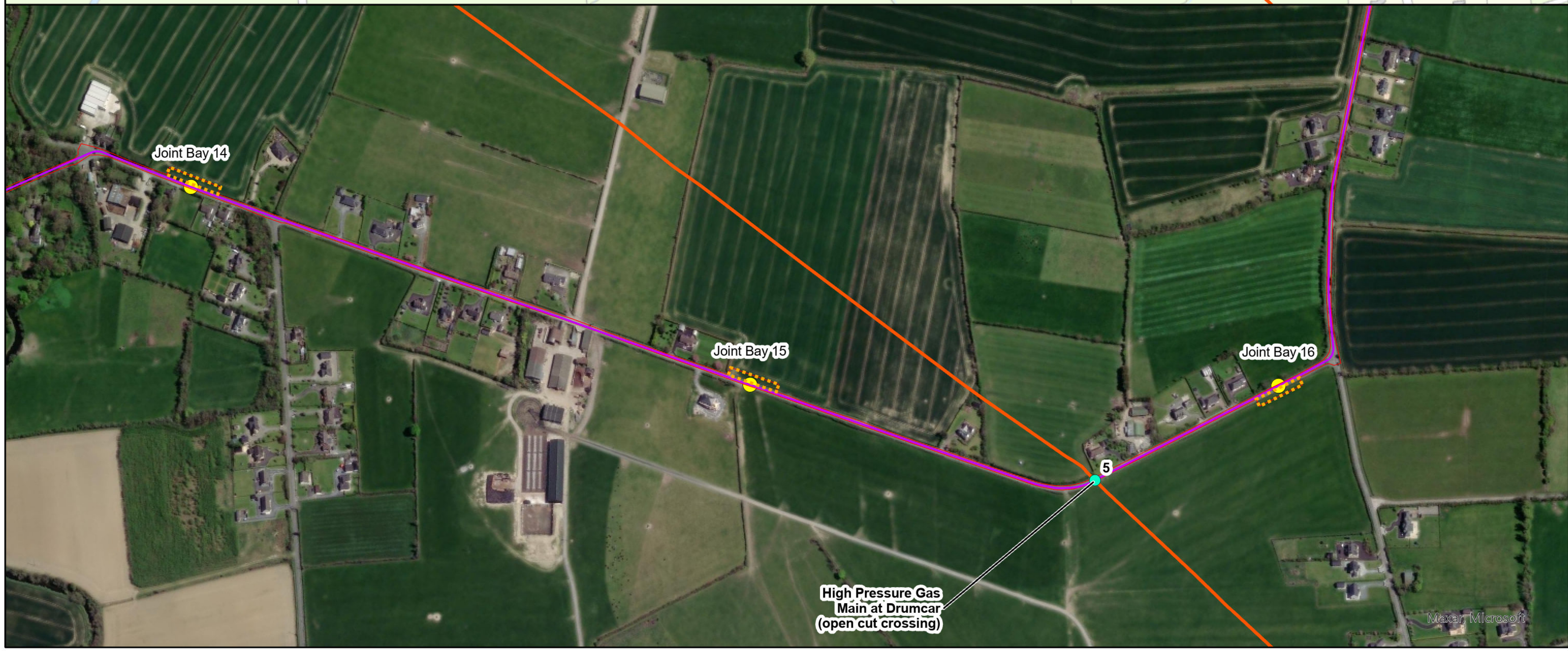

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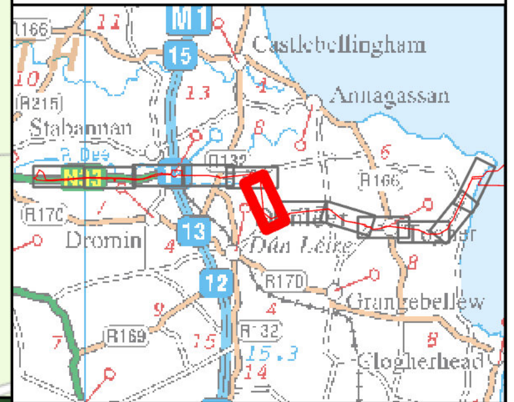

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Figure 5-16: Onshore Cable Route

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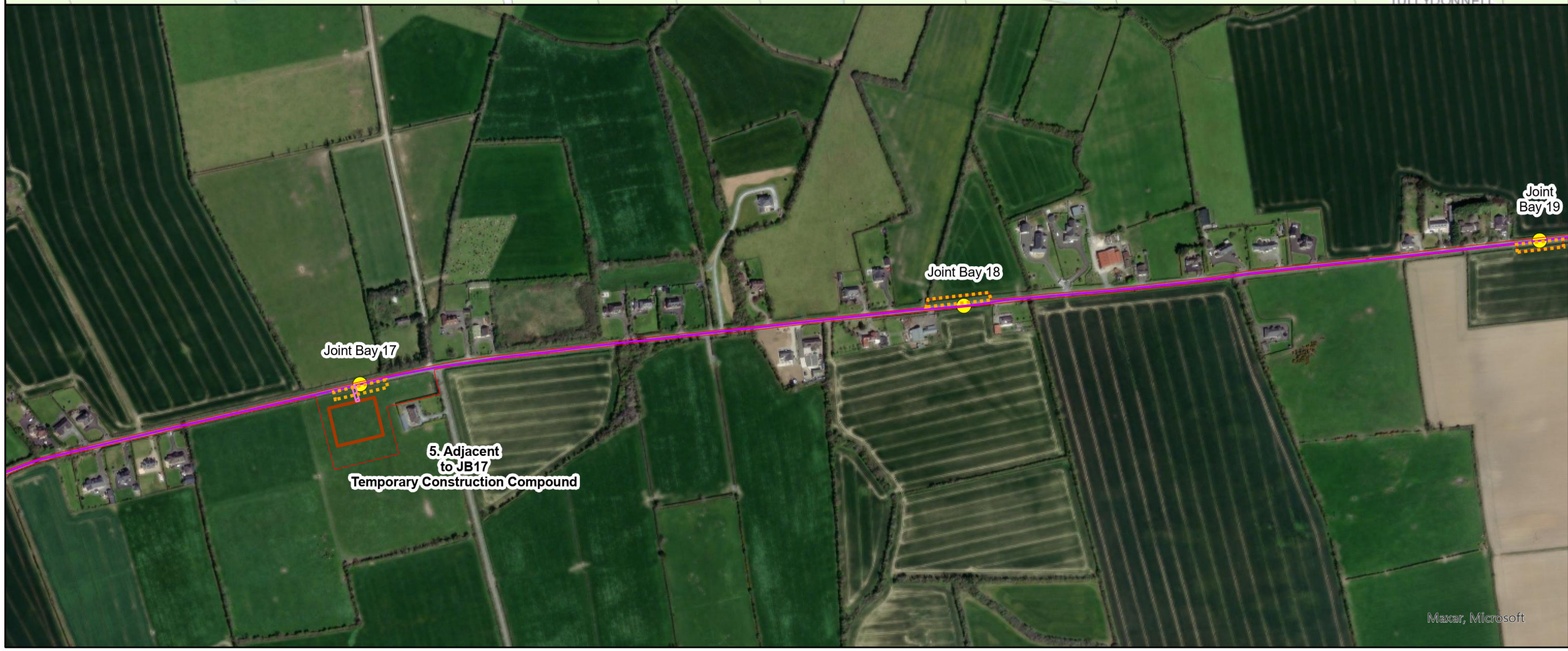

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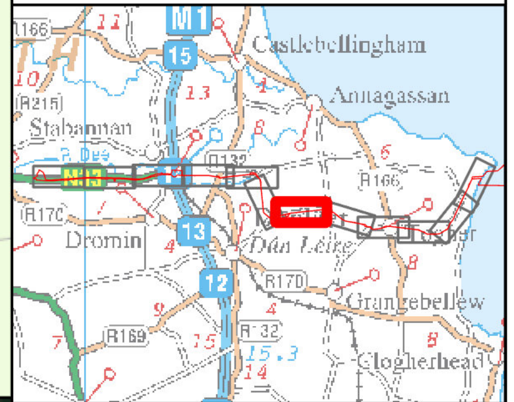

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Figure 5-16: Onshore Cable Route

Map 7 of 12

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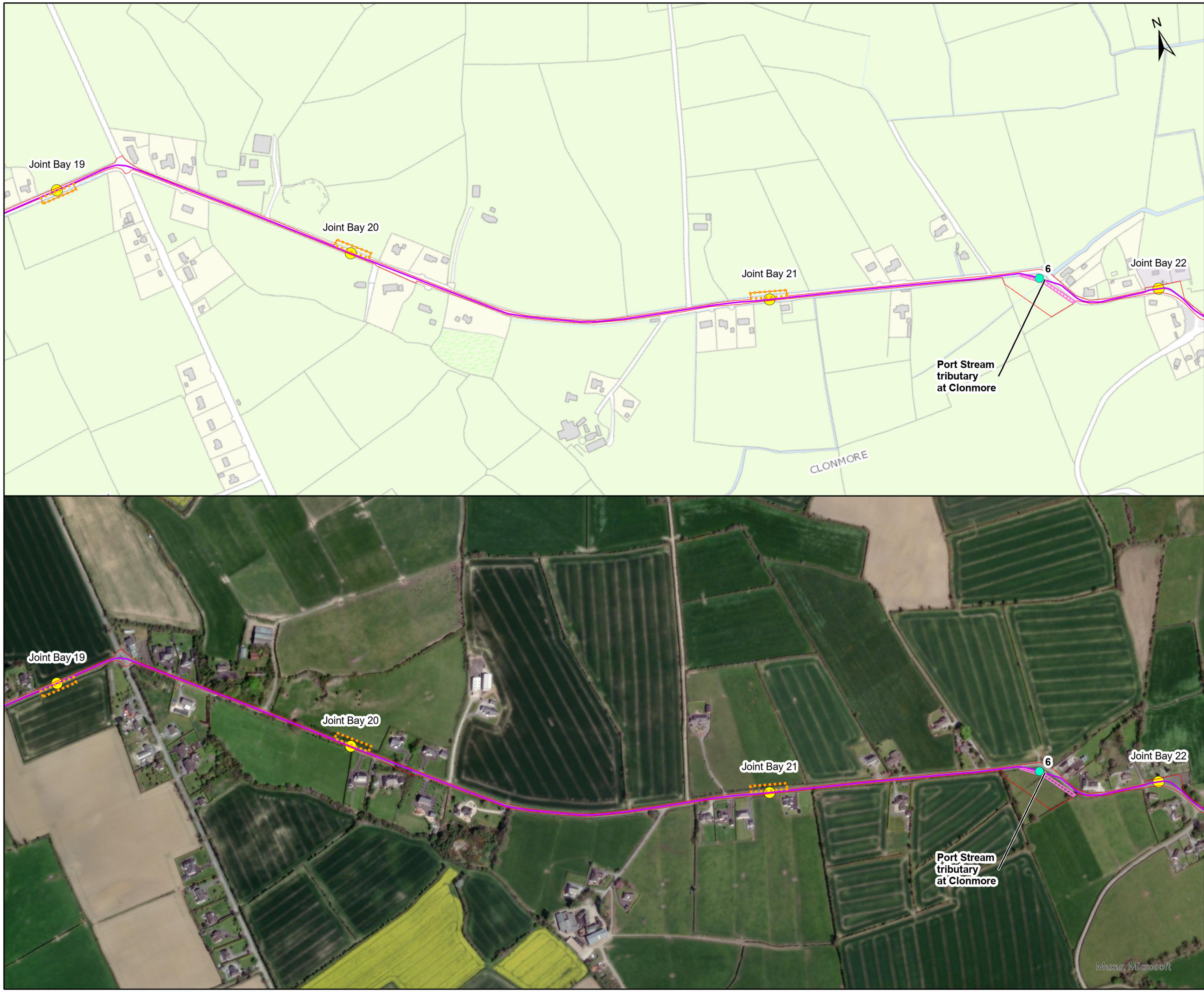
Issue Details

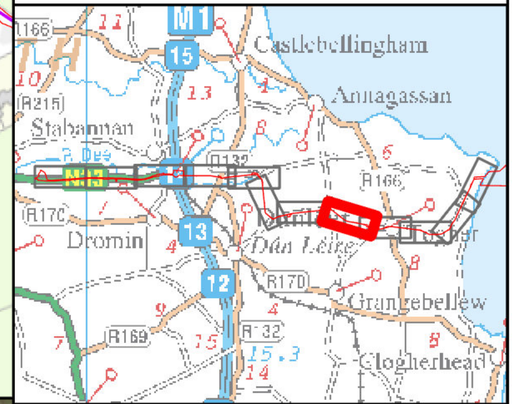
Drawn By: NR	**Project No.** MDR1520b
Checked By: CC	**File Ref:**
Approved By: CC	MDR1520bArc3083F01
Scale: 1:6,000 @ A3	**Projection:**
Date: 21/03/2024	ITM (IRENET95)



Legend

- Planning Application Boundary
- Proposed Joint Bay Locations
- Proposed Passing Bay
- Proposed Onshore Cable Route
- Onshore Cable Crossing 1-8
- Proposed Access Tracks

Data Sources: OWL; OSi.



Client

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project

Oriel Wind Farm Project

Title

Figure 5-16: Onshore Cable Route

Map 8 of 12

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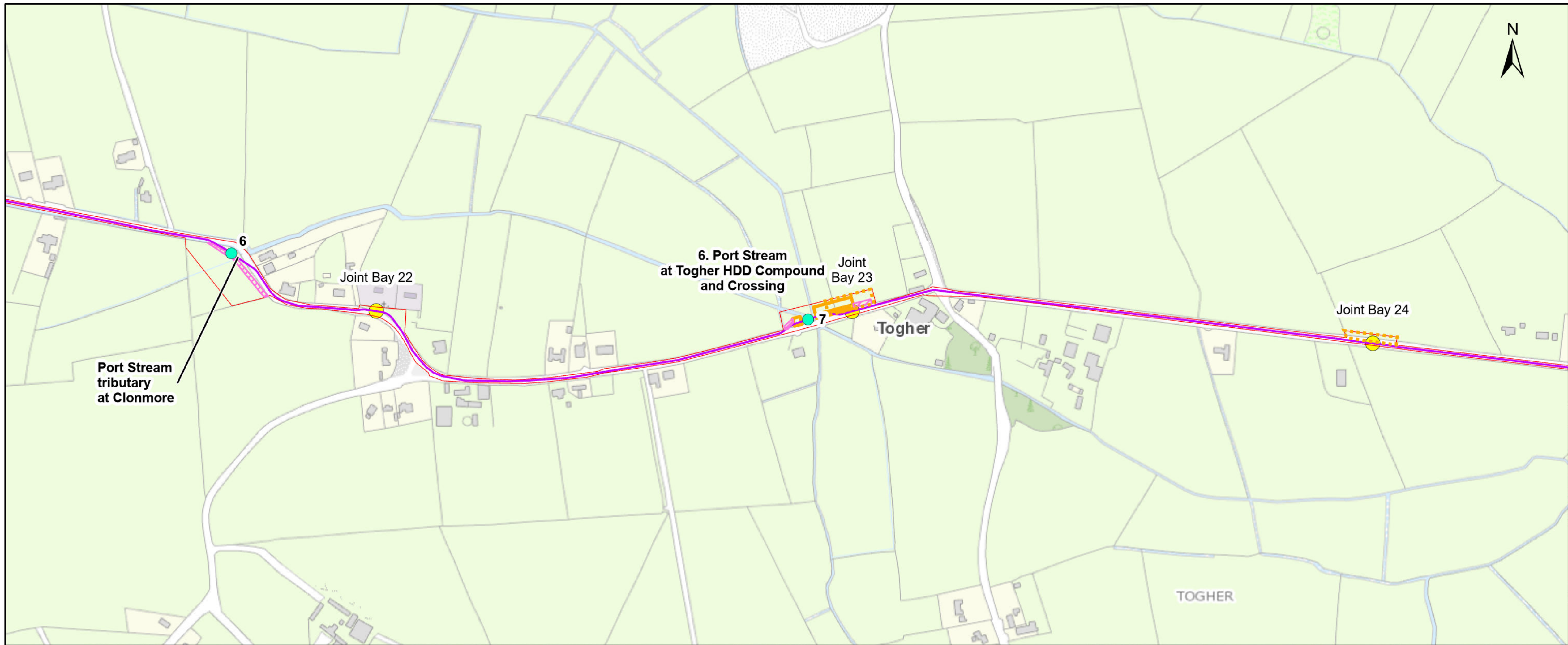
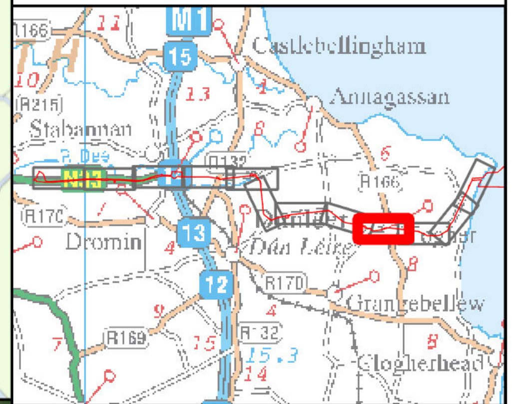


Legend

- Planning Application Boundary
- Proposed Joint Bay Locations
- Proposed Passing Bay
- Proposed Onshore Cable Route
- Onshore Cable Crossing 1-8
- Proposed HDD Compounds
- Proposed Access Tracks

Data Sources: OWL; OSi.



Client

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project

Oriel Wind Farm Project

Title

Figure 5-16: Onshore Cable Route

Map 9 of 12

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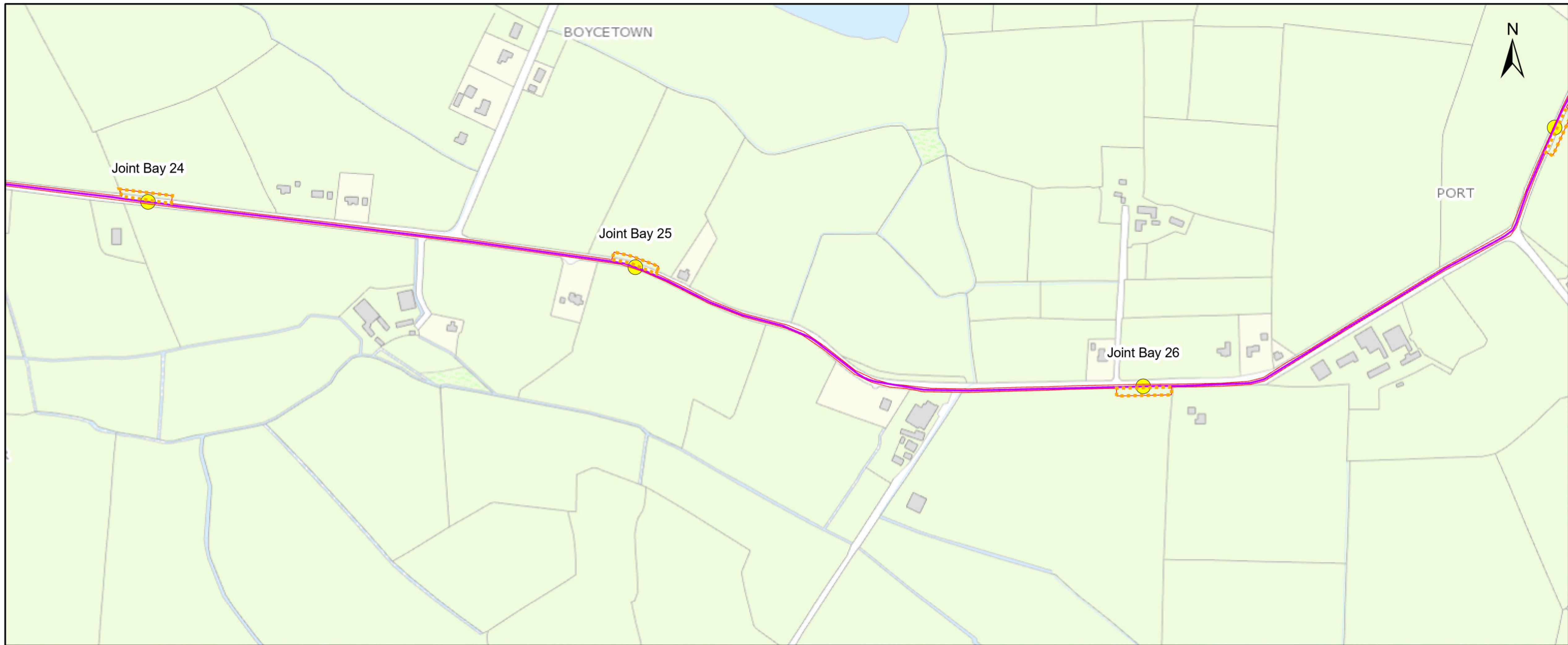
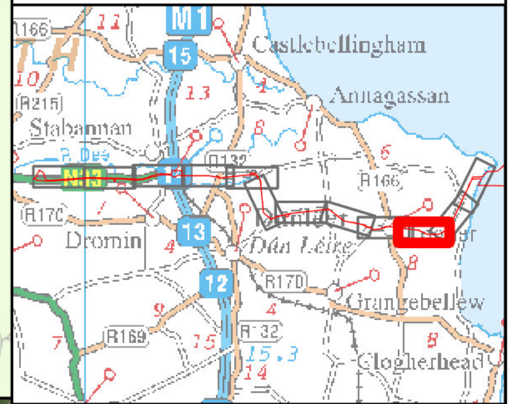


Legend

- Planning Application Boundary
- Proposed Joint Bay Locations
- Proposed Passing Bay
- Proposed Onshore Cable Route

Data Sources: OWL; OSi.



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ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project

Oriel Wind Farm Project

Title

Figure 5-16: Onshore Cable Route

Map 10 of 12

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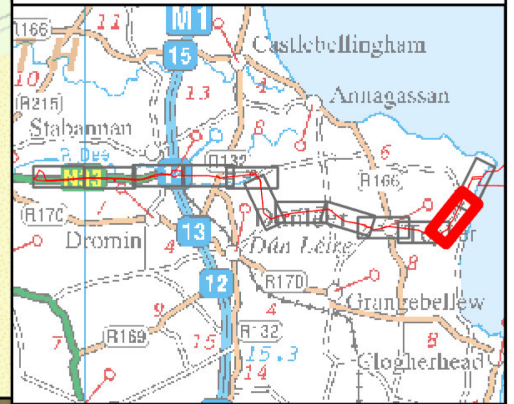
Date: 21/03/2024	

Legend

- Planning Application Boundary
- Proposed Joint Bay Locations
- Proposed Passing Bay
- Proposed Onshore Cable Route
- Onshore Cable Crossing 1-8
- Proposed HDD Compounds

Data Sources: OWL; OSi.



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Project

Oriel Wind Farm Project

Title

Figure 5-16: Onshore Cable Route

Map 11 of 12

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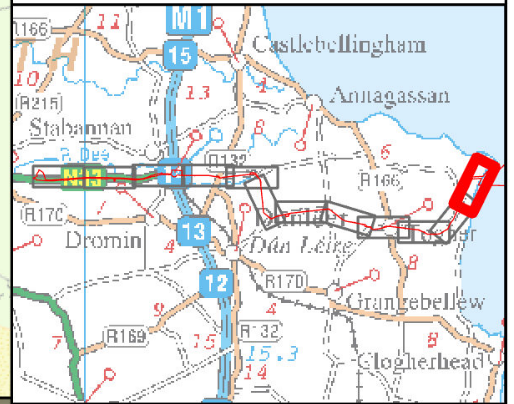
Legend

- Planning Application Boundary
- Proposed Joint Bay Locations
- Proposed Passing Bay
- Temporary Construction Compounds
- Proposed Access Tracks
- Proposed Onshore Cable Route
- Proposed Transition Joint Bay Option One
- Proposed Transition Joint Bay Option Two

Data Sources: OWL; OSi.



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Project

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Title

Figure 5-16: Onshore Cable Route

Map 12 of 12

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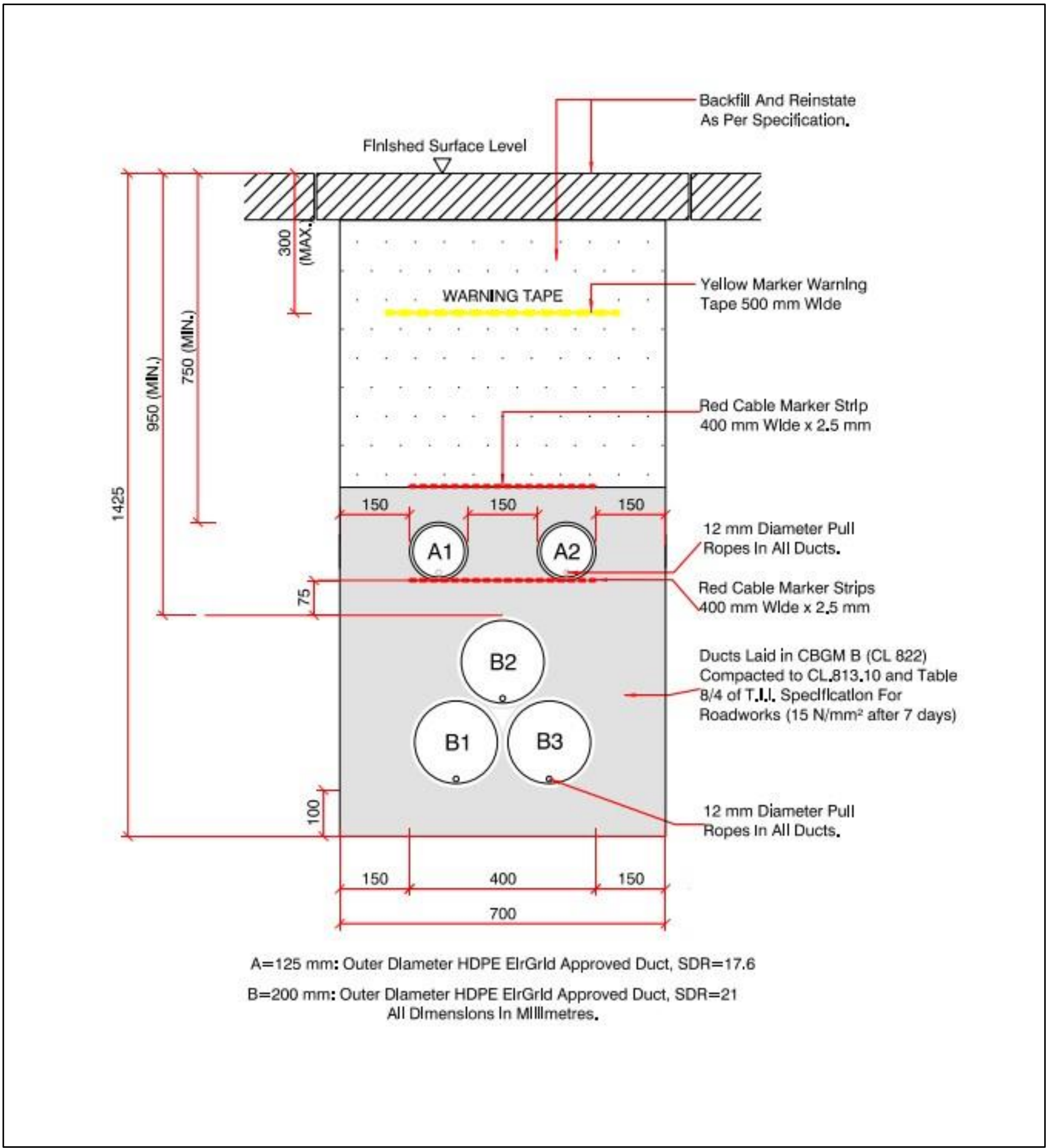


Figure 5-17: Cross-section of a 220 kV onshore cable arrangement.

5.6.2 Onshore cable installation

Site investigations

Site investigations along the proposed cable route will be carried out in advance of construction. These site investigations will include trial holes along the roadway to confirm the final depths and to gather information on the road cover available over existing bridges and culverts.

Site investigations including trial holes and / or boreholes will also be required at locations where trenchless methods (see section 5.6.2 crossings) are proposed to determine the geotechnical properties of the soil. This information will be required to finalise the HDD design.

Preconstruction surveys

Prior to any construction taking place a number of pre-construction biodiversity surveys will be required as outlined in chapter 19: Onshore Biodiversity (volume 2C).

Surveys to confirm the locations of utilities will also be undertaken (see chapter 29: Material Assets in volume 2C).

Construction corridor

To construct the onshore cable, part of the public road will be utilised to allow for trenching and installation of the onshore cables and ducting and to maintain traffic access. Wider working areas will be required to provide access for the construction of the onshore cable at the following locations where the onshore cable route deviates off the public road (see Figure 5-16 maps 1-12):

- Onshore substation (see map 1 of 12);
- River Dee at Richardstown (on the N33) (see map 3 of 12);
- M1 and Dublin-Belfast Rail Line (at Charleville) (see map 3 of 12);
- River Dee at Drumcar Bridge (see map 5 of 12);
- Port Stream at Togher (see map 1 of 12); and
- Landfall (see map 9 of 12).

The full road width will be required for the cable crossing at Salterstown Stream (map 11) because HDD will be required for this crossing.

Site preparation / enabling activities

Prior to works commencing, temporary construction compounds and site access roads will be set up at seven locations along the onshore cable route as shown on Figure 5-16 and detailed in Table 5-24.

Onshore cable trenching and ducting

For the majority of the length of the cable route, an open cut trench and ducting method will be used to install the onshore cable. A summary of the sequence of the trenching and ducting works along the public network is provided below, however further details are provided in appendix 5-12: Construction Methodology - Onshore Cable. Details on the installation of the onshore cable, off the public road are outlined under the section titled ‘crossings’ below:

- A road planer or other approved method will be used to remove the trench section of the road surface.
- Excavate approximately 12 m lengths of the trench with due attention to the presence of other services and to the grade of the trench. Hand dig when within 500 mm of services and around trees as required.
- Simultaneously load and remove soil offsite for reuse, recovery or disposal at a licensed facility and in accordance with the waste hierarchy. In grassed areas the excavated soil will be stored within the temporary construction corridor for future reinstatement.
- Grade, smooth and trim trench floor when the required depth and width have been obtained.
- Place ducts, bedding layer of Cement Bound Granular Mixture B (CBGM B), cable protection strips and backfill as shown in Figure 5-15.
- Permanent reinstatement of roads and grassland sections in compliance with the 'Purple Book'[3], to the standard required and in accordance with the pre-application consultation with Louth County Council, subject to change during the road opening licencing process. For unsurfaced/grass sections, the trench will be reinstated with the excavated material to allow soil to be seeded (see chapter 20: Land and Agriculture for measures regarding the reinstatement of lands in volume 2C).
- Clean and test the ducts in accordance with the specification and install draw rope in each duct and seal all ducts.

All surface water and groundwater that requires pumping during trenching will be treated prior to discharge in accordance with the measures set out in in chapter 21: Soils, Geology and Hydrogeology and chapter 22: Hydrology and Flood Risk (volume 2C).

Construction of joint bays and cable pulling

The construction of the JBs (at locations shown on Figure 5-16) will follow the sequence below. Further details are provided in appendix 5-12: Construction Methodology - Onshore Cable:

- Excavate area for installation of joint bay and prepare bottom of excavation with blinding layer. Removal of excavated material offsite for reuse, recovery or disposal at a licensed facility;
- Joint bays will either be constructed:
  - In-situ construction with 200 m thick reinforced concrete side walls (Figure 5–18); or
  - Installation of pre-cast concrete construction (Figure 5-19).
- Temporary reinstatement of surface and placement of joint bay covers.

All surface water and groundwater that requires pumping during construction of the JBs will be treated prior to discharge in accordance with the measures set out in in chapter 21: Soils, Geology and Hydrogeology and chapter 22: Hydrology and Flood Risk (volume 2C).

[3] guidelines_for_managing_openings_in_public_roads_apr._2017.pdf (rmo.ie)

Figure 5–18 Photo showing joint bay under construction (in-situ).

Figure 5-19 Photo showing joint bay under construction (pre-cast)

Cable pulling and jointing

The cable is supplied in pre-ordered lengths on large cable drums. The cable length on each drum is specific to the distance between joint bays with approximately 700 m lengths on each cable drum. The cable is installed in the following sequence:

- Set up cable pulling winch next to joint bay and connect cables to the winch rope (see Figure 5-20);
- Pull each cable from previous joint bay through ducts to the cable winch;
- Once the cables are pulled into the joint bay a jointing container is positioned over the joint bay and the cable jointing procedure is carried out in this controlled environment (See Figure 5-21);
- Following the completion of jointing and duct sealing works in the joint bay, cement-bound sand in approximately 200 mm layers is placed and compacted to the level of the cable joint base to provide vertical support;
- Cable protection strip is then placed prior to backfill with cement-bound sand to a depth of 250 mm below surface; and
- Permanent reinstatement (see Figure 5-22) is undertaken including placement of warning tape at 400 mm depth below finished surface.

Figure 5-20 Photo of cable pulling procedure.

Figure 5-21: Photo of jointing container.

Figure 5-22: Permanent reinstatement of road surface over trench.

Figure 5-23 Photo of passing bay.

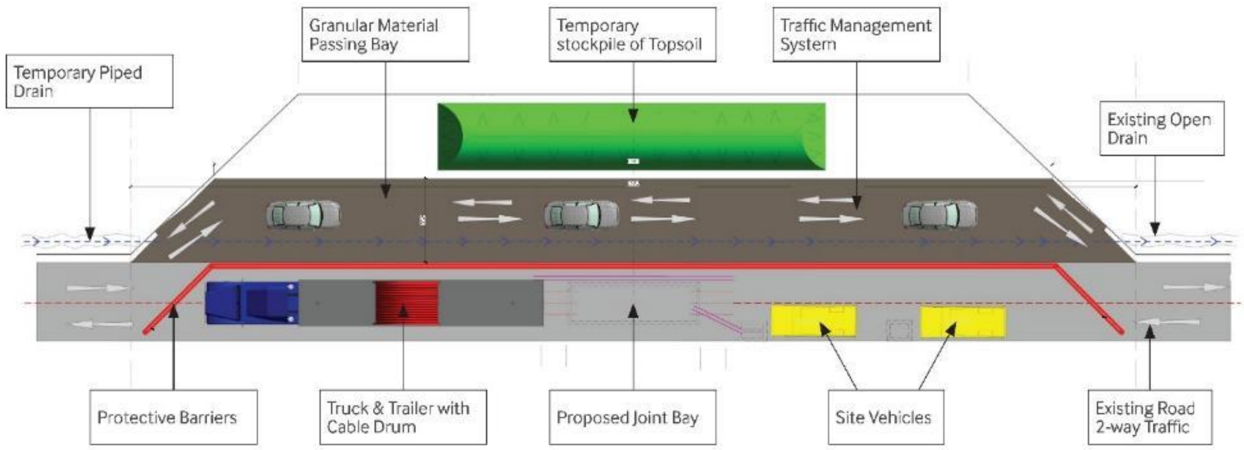
Passing bays

At 16 locations along the onshore cable route, temporary traffic passing bays will be installed adjacent to JBs to enable through traffic during the construction and cable installation at the JBs (locations are presented on Figure 5-16). The passing bay arrangement is presented in Figure 5-24. The remaining 13 JBs are located either off-road or located on the wider primary road, avoiding the requirement for temporary passing bays to maintain through traffic (Figure 5-23).

As with all road works, traffic management procedures will be required when installing the cable within the public road. Access for through traffic will be maintained along all roads through the installation of the passing bays. Advisory diversion routes avoiding the active works will be signed. Local access to properties will be maintained by the contractor at all times. This will be completed with the use of temporary metal cover plates for sections of open trench. For the regional roads to the east of the M1, one carriageway will be closed with use of the other carriageway restricted and controlled by temporary traffic lights or a “stop and go” traffic management system for the duration of the works. Traffic management and corresponding works will be carried out with the agreement of Louth County Council. The proposed Construction Traffic Management Plan (CTMP) is presented in appendix 5-9.

The following sequence is proposed to construct and reinstate the passing bays once joint bays are constructed.

1. Removal of vegetation to a licensed facility. Measures to protect biodiversity will be implemented as outlined in chapter 19: Onshore biodiversity;
2. Erect temporary stockproof fencing;
3. Excavate topsoil and store for reinstatement;
4. Place suitable sub-base on geotextile member and compact using road roller to allow passing bay to be used by traffic during the cable laying and jointing operations;
5. Following completion of cable pulling and jointing, the passing bay will be reinstated with the excavated soil, and the temporary stockproof fencing removed; and
6. The hedgerow will be replanted as outlined in chapter 19: Onshore Biodiversity (volume 2C).



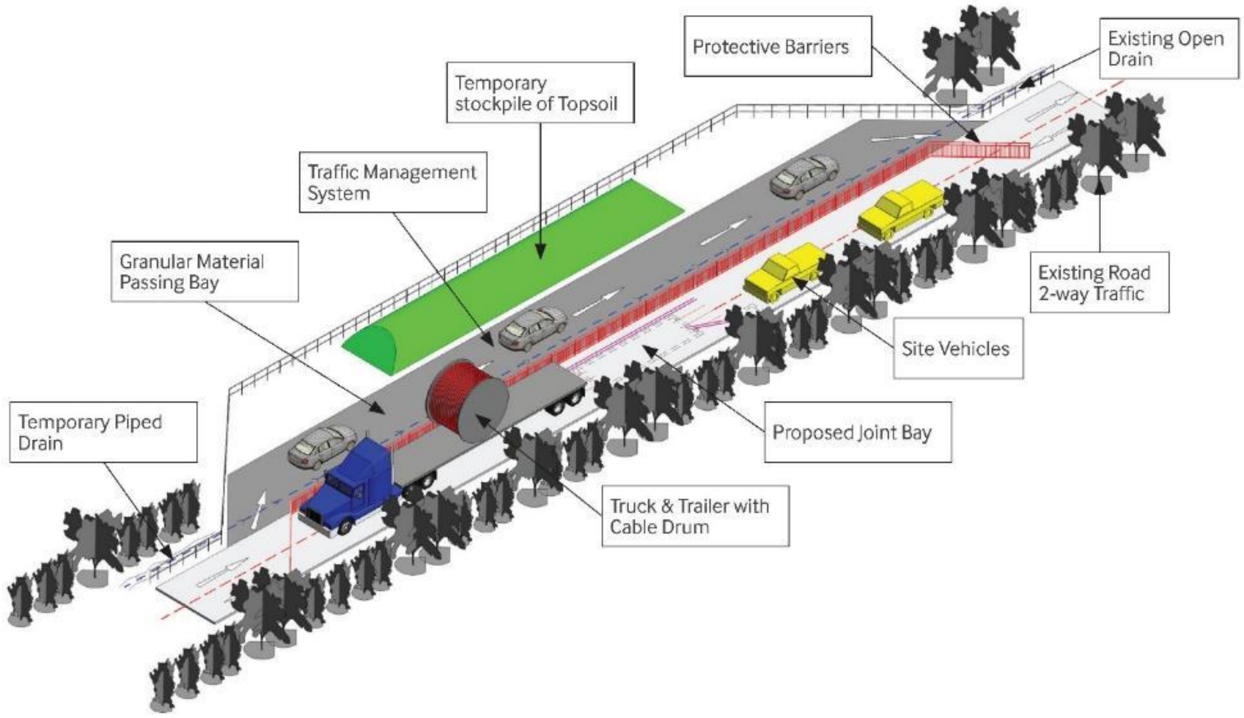


Figure 5-24: Typical passing bay arrangement (plan view (top) and isometric view).

Crossings

The onshore cable will cross a number of obstacles along its route. The methodology for each of these crossings is detailed below and summarised in Table 5.23. Further details on the methodologies are provided in appendix 5-12: Construction Methodology – Onshore Cable.

Table 5.23: Proposed crossing methods.

No.	Cable Crossing	Proposed Method	Map ref. on Figure 5-16
1	River Dee at Richardstown, N33	HDD	Field (see map 3 of 12)
2	High Pressure Gas Main at Richardstown N33	Open Trench	Road (see map 3 of 12)
3	M1 Motorway and Dublin Belfast Rail Line at Charleville	HDD	Field (see map 3 of 12)
4	River Dee at Drumcar	HDD	Field (see map 5 of 12)
5	High Pressure Gas Main at Drumcar	Open Trench	Road (see map 5 of 12)
6	Port Stream tributary at Clonmore	Open trench	Field (see map 9 of 12).
7	Port Stream at Togher	HDD	Field (see map 9 of 12).
8	Salterstown Stream	HDD	Road (see map 11 of 12).

Note: The crossing of the Port Stream at Clonmore also includes a smaller crossing of the Ardballan Stream.

The cable route may also cross small streams and agricultural ditches. It is possible that the onshore cable can be installed within the existing roadway for these crossing, however if sufficient depth is not available then the alternative will be to install cables with the open trench method. Any agricultural land drains along the onshore cable route will also be traversed using open trench methods as outlined below.

There will also be a number of crossings of existing utilities/services along the cable route. These crossings will also be carried out using open cut trenching.

Horizontal Directional Drilling (HDD)

The use of HDD methods is proposed for crossings of watercourse and other obstacles as it allows installation of the onshore cable underneath the watercourse / obstacle thereby avoiding direct impact. Although there is potential for runoff from the HDD works on either side of the crossings, measures will be put in place to minimise such impacts as outlined in chapter 19: Onshore Biodiversity and chapter 22: Hydrology and Flood Risk (volume 2C).

Horizontal Directional Drilling (HDD) involves drilling a long borehole approximately 600-900mm in diameter underneath the obstacle (e.g., river, motorway, rail line) using a drilling rig located in the onshore cable construction corridor. The generally arrangement for HDD is provided in Figure 5-25 and shown in the photo in Figure 5-26.

Drill entry and exit pits are excavated at both ends of the planned drill to below the level required for the cable. The drilling into the ground is at a shallow angle. The process uses a drilling head controlled from the rig to drill a pilot hole along a predetermined profile based on an analysis of the ground conditions and cable installation requirements. This pilot hole is then widened using larger drilling heads until the hole is wide enough to fit the cable ducts. Bentonite is pumped to the drilling head during the drilling process to stabilise the hole and ensure that it does not collapse. Prior to the drilling taking place, an exit pit may be excavated passed the obstacle within the onshore cable construction corridor in order for the HDD profile and ducts to stop at the required installation depth for the cable.

A transition chamber is required at HDD locations to ensure that the cables are not damaged when transitioning between the different inner duct diameters of the HDD and standard cable trench. A transition chamber is approximately 1.7 m by 1.2 m concrete chamber. The transition chamber will be opened during cable installation to allow the smooth transition of the cable between the two different duct sizes and to ensure the cable is not damaged during this transition. The transition chamber will then be sealed, and the ground fully reinstated once the cable is installed.

Once the HDD drilling has taken place the ducts (within which the cable will be installed) are pulled through the drilled hole from the drill staging area. The length of the drill staging area will match that of the length of the bored hole.

The size of the HDD compounds is dependent on the amount of equipment that is required to construct the crossing, which in turn is primarily governed by the length of the HDD or its complexity. The required area has been included within the planning application boundary for the Project. The temporary construction compounds, which will be used during the HDD construction are shown in Figure 5-16 and are described further below.

The crossing of the M1 and Dublin Belfast Rail Line will be undertaken using HDD methods. These proposals have been discussed with Irish Rail and the works will be completed to Irish Rail specifications and required standards.

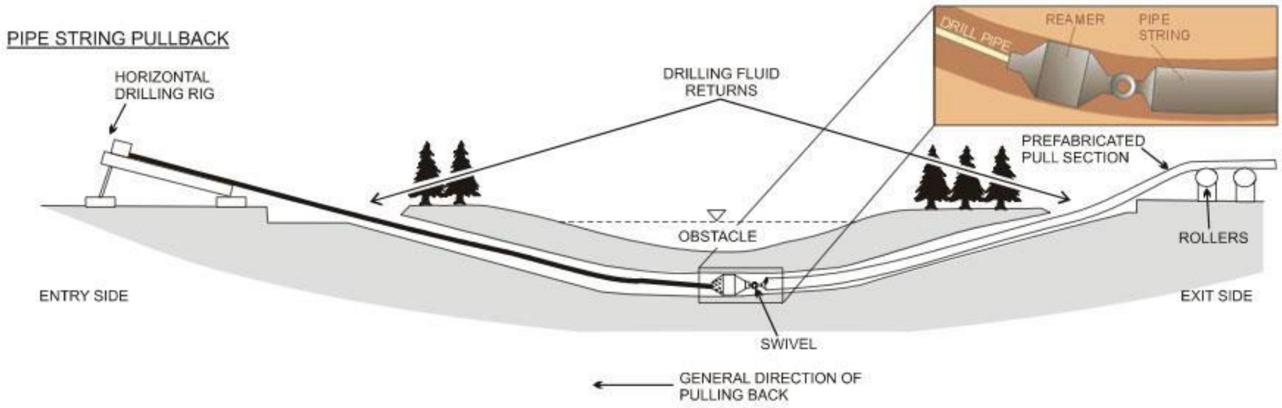


Figure 5-25: General arrangement for HDD.

Figure 5-26: Standard HDD site on local road where HDD was used to go underneath a bridge (bridge parapet walls visible).

Open trench crossings (ditches, drains)

The onshore cable will traverse a number of drains and ditches. The proposed methodology for these crossings is by open trench method which will be carried out as follows:

1. The flume pipe(s) will be set out on the bed of the existing ditch or drain. Alternatively, a pump may be used to transfer the stream water to the other side of the dam;
2. A dam will be constructed using sandbags and suitable clay material around the flume pipe(s) and across the drain so that all the flows are diverted through the pipe(s);
3. Silt traps comprising of a geotextile membrane will be placed downstream of the trenching location prior to construction, to minimise silt loss;
4. The proposed cable trench will be excavated in the dry ditch and under the flume pipe(s). If required, a temporary pump sump will be created, and a pump used to remove any additional water to tanker for offsite disposal with a licensed waste contractor;
5. Cable ducts will be installed and encased in concrete within the stream bed or a precast concrete slab will be installed which incorporates the ducts; and
6. Following the installation of the cable ducts, the stream bed will be re-instated with original or similar material and any spawning gravels (if present) replaced under the supervision of the aquatic ecologist.

Measures are outlined in chapter 19: Onshore Biodiversity regarding the protection of watercourses including seeking prior approval of all construction methodologies from the Inland Fisheries Ireland (IFI).

Appropriate measures will be put in place by the contractor to prevent ground damage on the access routes to watercourse crossings on both banks, particularly where the ground is soft or slopes steeply toward a crossing. This will manage and control potential sedimentation of the watercourse from damaged access tracks. Works in proximity to watercourses will be carefully managed and measures will be put in place to protect the watercourse as outlined in the following chapters in volume 2C:

- Chapter 19: Onshore Biodiversity;
- Chapter 21: Soils, Geology and Hydrogeology; and
- Chapter 22: Hydrology and Flood Risk.

Utility crossings

The location of existing utilities/services has been identified by requesting utility/service records from service providers along the onshore cable route (see chapter 29: Material Assets and the planning drawings). There will be a number of crossings of existing utilities/services along the cable route. It is proposed that the crossings will be carried out by using open cut trenching, however, should circumstances arise during construction regarding the depth of the utility, there may be a requirement to use HDD. Should HDD be necessary, such works will take place within the planning application boundary.

The preference is to cross beneath an existing utility/service where possible as this reduces the possibility of cable faults from third party excavations. The actual separation between the cable ducts and the existing utility service will be decided in conjunction with the utility service provider adhering to their guidelines/codes of practices. Where possible, crossing of existing services will be carried out at right angles. The duct installation contractor will provide a standard minimum 300 mm vertical clearance between the proposed ducts and the existing services to be crossed. The installation contractor will ensure a minimum distance of 500 mm horizontal separation is maintained between the edge of the power ducts and existing services. The duct installation contractor will protect all services against damage due to trenching, ducting, backfilling and compaction.

It may not always be possible to locate under an existing service and therefore an above service crossing may be required. The minimum depth to the top of the cable ducts is 450 mm below ground level in this case as per the Health and Safety Authority's Code of Practice for Avoiding Danger from Underground services. The cable duct if being installed at 450 mm cover depth will have additional mechanical protection by using steel plates and A393 steel mesh above the concrete the cable ducts are encased in. There may be also a requirement to realign an existing utility/service due to a conflict and this will be arranged through consultation with the third-party service provider.

Gas Pipeline and Water Crossings

Crossing of a high-pressure gas pipeline is required at Drumcar and on the N33 at Richardstown. There are also a number of crossings of the Uisce Éireann network. The gas crossings will be undertaken under the guidance and control of the asset owner, Gas Networks Ireland (GNI). The water crossings will be undertaken under the guidance and control of the asset owner, Uisce Éireann (UI). Typically, the area around the existing utility will be carefully excavated by hand within 500 mm of an asset and the asset supported before installation of the cables below the pipelines can take place. This is generally the preferred method of the asset owner as visual confirmation of the integrity of the asset can be maintained throughout the works. A length of 12 m of excavation will be exposed on each side of the pipeline to allow for bending of ducts and to avoid obstacles.

Temporary construction compounds

The HDD construction compounds will be provided with suitable surfacing, typically this will be constructed from stone. The compound will be secured by fencing and provided with lockable gates to control access. Appropriate drainage measures including treatment prior to pumping to tanker for disposal offsite at a waste licensed facility will be implemented to control surface run-off from the compound.

Seven temporary construction compounds are proposed to support the installation of the onshore cable. Details of these compounds are provided in Table 5-24 and locations are shown on Figure 5-16.

The construction compounds will require hard standing suitable for the temporary placement of site facilities (such as offices, briefing rooms, catering facilities, storage etc. typically housed in port-a-cabins) and to allow plant and materials to be stored safely and securely. Temporary access tracks for construction traffic will be required to provide access to the landfall, onshore substation site and to the HDD locations. Further details on the main construction compound are documented in the CEMP (see appendix 5.1).

All construction compounds will be removed, and sites restored to their original condition when construction and commissioning of the Project has been completed.

Table 5-24: Location of temporary construction compounds and proposed activities.

Temporary construction compound location	Proposed compound activities	New temporary access required	Map ref. on Figure 5-13	Details	Duration compound will be in place
Site of onshore substation at Stickillin	Storage	No, the site will be accessed along a temporary access track from existing entrance to the onshore substation on the N33.	Map 1	This compound will operate as a base for the onshore construction works (including onshore cable and onshore substation) and will house the offices, and stores, as well as acting as a staging post and secure storage for onshore equipment and component deliveries. Footprint will be approximately 12,860 m^2.	27 months
River Dee at Richardstown	HDD Compounds (east and west of River Dee)	Yes, new access from N33 for the west side of the compound. For the east side, an existing access will be used.	Map 3	The River Dee passes below the N33 road at Richardstown, approximately 500 m west of the M1. It is proposed to cross below the river in the fields immediately north of the N33. This crossing is approximately 180 m in length, to a minimum depth of 5 m below the river, with the drive pit located in a field to the east of the river and the reception pit located in a field to the west of the river. These compounds will be in place for the duration of the HDD crossing. Equipment for the HDD includes bentonite batching, pumping and recycling equipment, the drill unit and areas for pipe strining and storage. Footprint will be approximately 4,000 m^2.	3 months
M1/Railway	Storage and HDD Compounds (east and west of M1/Railway)	Yes, new access from N33 for the west side of the compound. For the east side, an existing farm gate access will be used.	Map 3	The crossing under the M1 motorway and Dublin-Belfast rail line is approximately 250 m long, to a minimum depth of 7 m below the rail and motorway infrastructure, with the drive pit located in a field to the east of the railway line and to the north of the N33 and the reception pit located in a field to the west of the M1 and also to the north of the N33. Three temporary compounds are proposed at this crossing. A compound either side for the HDD and a separate compound for storage of plant and equipment for the onshore cable construction. Footprint will be approximately 7,500 m^2.	HDD compounds - 3 months Storage compound – 18 months.
River Dee at Drumcar	HDD Compounds	Yes, new access from local road for the east side of the compound. For the west side, an existing farm gate access will be used.	Map 5	The River Dee crossing at Drumcar Bridge is approximately 90 m in length, to a minimum depth of 5 m below the river, with the drive pit located in a field to the east of the Drumcar Bridge and the reception pit located in a field to the west of Drumcar Bridge. Footprint will be approximately 2,300 m^2.	3 months
Adjacent to JB17	Storage	Yes, new access from local road.	Map 7	A site adjacent to JB17 will provide storage for plant and equipment for the onshore cable installation. Footprint will be approximately 3,000 m^2.	18 months
Port Stream at Togher	HDD Compounds	Yes, new access from local road to access both compounds.	Map 9	The stream crossings at Port approximately 50 m in length, to a minimum depth of 5 m below the stream, with the drive pit and reception pit located in the fields to the north of the local Dunleer to Togher Road. Footprint will be approximately 750 m^2.	1 month

Temporary construction compound location	Proposed compound activities	New temporary access required	Map ref. on Figure 5-13	Details	Duration compound will be in place
Dunany; Landfall	Storage	Yes, new access off private road.	Map 12	A site at the proposed landfall will be the base for the construction of the TJB and the export cable pull. The compound will provide storage for plant and equipment. Footprint will be approximately 4,120 m^2.	18 months

5.6.3 Onshore substation

The proposed onshore substation will contain equipment required to filter, monitor and control electricity received from the offshore wind farm. The onshore substation equipment will be maintained by the Transmission Asset Owner (TAO) and operated by the Transmission System Operator (TSO).

Location

The proposed onshore substation will be located in the townland of Stickillin, east of Ardee (see Figure 5-16 (map 1 of 12). The substation will connect to the existing Woodland to Louth 220 kV overhead line which traverses the substation site. The extent and layout of the proposed onshore substation is presented in Figure 5-27.

Design

The substation will comprise of the following main elements:

Compound 1 Gas (GIS) (Onshore Transmission Connection): This compound will contain the 220 kV Gas Insulated Switchgear (GIS) infrastructure within a building with a gross floor area of approximately 2,155 m^2 (two storeys) and a height of approximately 17 m. The entire compound has an area of approximately 4,600 m^2. Associated development within the compound will include a lattice steel telecommunication mast of approximately 36 m in height and six lightning finials of approximately 3 m in height located on the parapet of the GIS building. There will be 5 No. car parking spaces located within this compound. An access road 5 m in width will loop around the building and connect with the entrance compound. An MV/LV house transformer will be located near the main entrance to the compound. The compound will be bounded by a secure palisade fence 2.6 m in height.

Compound 2 (AIS) (Offshore Transmission System): The compound will contain a control building with six lightning finials of approximately 3 m in height located on the parapet of the building. The compound will also contain 220 kV Air Insulated Switchgear (AIS) for the TSO's control in accordance with the grid connection offer and will include equipment for dynamic and/or static reactive power compensation, harmonic filtering and switching. In summary, the AIS compound will contain the following type of equipment:

- 1 x 220 kV AIS busbar;
- 1 x 220 kV statcom bay including statcom building;
- 1 x 220 kV transformer bay;
- 2 x 220 kV harmonic filter bays;
- 1 x 220 kV shunt reactor bay;
- 2 x 220 kV cable bays;
- 1 x control building; and
- 1 x MV/LV house transformer.

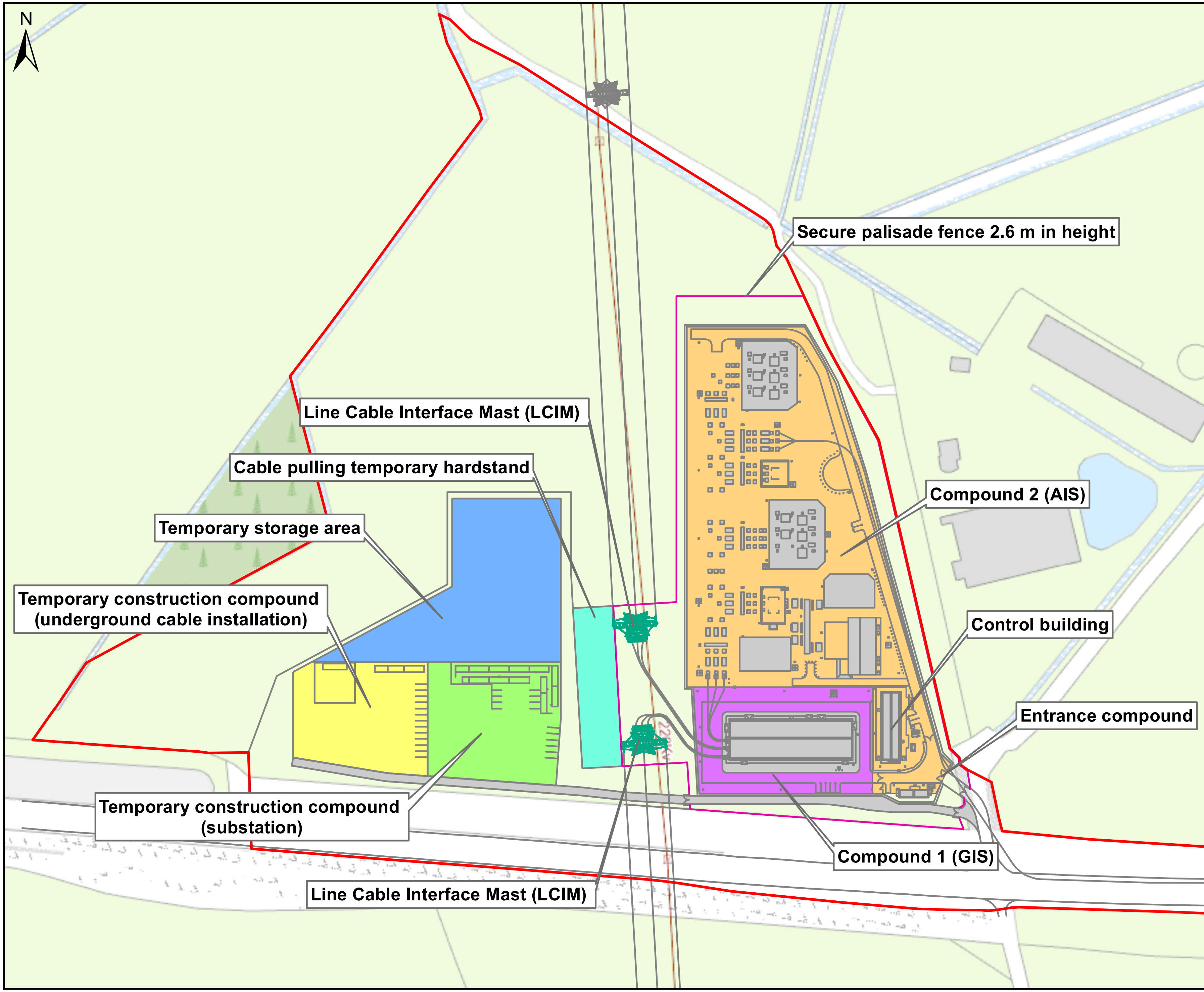
The compound has an area of approximately 17,200 m^2. 12 No. lightning monopoles of approximately 20 m in height will be placed within the compound for lightning protection and will include a lattice steel telecommunication mast of approximately 36 m in height. There will be 4 No. car parking spaces located within this compound. The compound will be bounded by a green palisade fence 2.6 m in height. An access road of 5 m in width will run alongside the eastern and northern palisade fences and connect with the entrance compound.

Entrance Compound: The entrance is shared by compound 1 and compound 2 with an area of approximately 600 m 2. The compound will contain a telecommunications building, which will be 15 m x 4 m and a height of 4 m. It will also contain a backup bunded diesel generator. There will be 1 No. car parking space located within this compound. The area will be bounded by a secure palisade fence 2.6 m in height.

Works below ground level: There will be 2 No 220 kV underground network circuits from the GIS building to the new line cable interface mast (LCIMs). There will also be 1 No. 220 kV underground circuit to the Compound 2 (AIS). The depths of excavations for construction of the onshore substation infrastructure will not exceed 2 m below ground level (bgl). A new underground drainage network will be installed as part of works. The depths of excavation for construction of pipework, inspection chambers and other related underground elements will not exceed 3 m below the proposed finished floor level or 2 m below the existing ground level.

Line Cable Interface Masts (LCIM): Two LCIMs will be constructed in the agricultural field adjacent to the onshore substation. An existing 220 kV tower (approximately 31 m in height) will be decommissioned to allow for the construction of the two new LCIMs. The LCIMs will be approximately 27 m in height to facilitate the connection of the overhead lines to the underground cables, which will run from the towers into a termination point in the GIS building in Compound 1. This will result in the removal of a section of existing OHL (approximately 50 m).

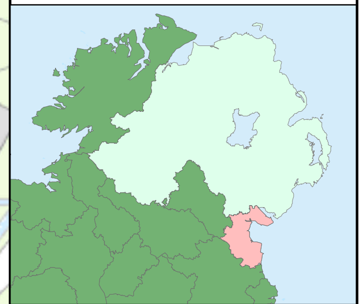
Ancillary Elements and Landscaping: The substation (containing the Compound 1, Compound 2 and an entrance compound) and palisade fence are bounded within a post and rail property fence 1.4 m in height. There is planting of native trees proposed along the northern boundary of Compound 2. A single main entrance to these areas will utilise the existing access route off the N33 national road. Existing vegetation on either side of the entrance will be trimmed back to achieve the required sightlines.



Legend

- Planning Application Boundary
- Secure palisade fence 2.6 m in height
- Compound 1 - GIS
- Compound 2 - AIS
- Cable Pulling Temporary Hardstand
- Temporary Construction Compound (substation)
- Temporary Construction Compound (underground cable installation)
- Temporary Storage Area

Data Sources: OWL



Client

ORIEL WINDFARM
OFFSHORE RENEWABLE ENERGY

Project

Oriel Wind Farm Project

Title

Figure 5-27:

Layout of onshore substation

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Issue Details

Drawn By: NR	**Project No.** MDR1520b
Checked By: CC	**File Ref:** MDR1520bArc3126F03
Approved By: CC	
Scale: 1:2,500 @ A4	**Projection:** ITM (IRENET95) Geographic Co-ordinates: ETRS89
Date: 03/04/2024	

NOTE:
1. This drawing is the property of RPS Group Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels are referred to Ordnance Datum, Malin Head.
3.

Design parameters

The design parameters and major components for the onshore substation are presented in Table 5.25.

Table 5.25: Design parameters and major components for the onshore substation

Dimensions	Parameter (approximately)
Area of footprint of substation (Compounds 1 and 2)	230 m x 130 m
Height of buildings	17 m GIS Building (Compound 1) 11 m Control Building (Compound 2) 10 m Statcom Building (Compound 2) 4 m Telecommunications Building (Entrance Compound)
Building(s) Area	20 m x 60 m GIS Building (Compound 1) 10 m x 34 m Control Building (Compound 2) 14 m x 28 m Statcom Building (Compound 2) 15 x 4 m Telecommunications Building (Entrance Compound)
Telecommunication Mast	36 m height
Terminal towers/line-cable interface mast	2 No. 27 m High Lattice Steel Structure for 220 kV OHL Termination

The following sections describe the Project:

Compound 1 (GIS) Main Structures

The 220 kV GIS building will comprise of a two-storey structure. It will house the new gas insulated switchgear (containing Sulphur Hexafluoride (SF_6) or similar insulating gas), insulated circuit breakers, busbars, disconnectors and other high voltage equipment. Auxiliary services equipment, such as control and telecoms equipment and low voltage switchgear will be located in the relay room, an emergency diesel generator which will be located in the generator room, batteries in the battery room and welfare facilities (i.e. toilets, messroom) will also be located within the building. The underground cables will connect into the substation via below ground cable entries which will not exceed 2 m below ground level and will be designed to prevent any water ingress.

The GIS building will comprise a structural steel frame clad with profiled metallic sheet wall and roof cladding. Internal walling of masonry will be adopted, except where specific load carrying requirements necessitate the use of reinforced concrete walls.

The GIS building cladding will be factory finished according to EirGrid specification. The roof will be shallow pitched and constructed of profiled metal decking on purlins spanning between rafters. Internally the building will have access gantries and walkways for access to equipment. These will be constructed of stainless/galvanized steel open grating type flooring supported on steel beams and columns.

External doors and escape doors will generally comprise metal flush doors with galvanised steel frames. Fire doors will comply with BS 476-22:1987 - Fire tests on building materials and structures.

The colour proposed for the building is a dark green. The final colours and finishing will be agreed with the planning authority prior to construction.

An image of an existing ESB 220 kV GIS Substation building with house transformer in the foreground is presented in Figure 5-28.

Figure 5-28: Photo of 220 kV GIS Substation Building.

Six lightning protection finials, approximately 3 m in height, are required to be installed on the roof of the GIS building. One at each corner of the building and 2 in the centres of the longest façade.

A steel telecommunication mast, approximately 36 m in height, is proposed to be installed adjacent to the proposed substation site to facilitate communications between the substation and the existing substations in Maynooth and Woodland. Antennas will be located at the top of the mast, and these will be connected by cables to telecommunications equipment housed in the substation control building. An external ladder will be permanently fixed to the mast to allow for maintenance access.

An earth grid will be installed below the ground in a grid arrangement approximately 600 mm below the finished surface. The earth grid will consist of bare stranded copper conductor. The purpose of the earth grid is to ensure personnel and public safety during electrical faults that may occur on the transmission grid.

Compound 2 (AIS) Main Structures

Control Building

The Control Building in Compound 2 will house auxiliary service equipment, such as control and telecoms equipment and low voltage switchgear located in the control room, an emergency diesel generator located in the generator room, batteries located in the battery room, stores room and welfare facilities (i.e. toilets, changing room, etc.} will also be located within the building.

The building size is approximately 34 m by 10 m and comprises of two storeys. The building will comprise a structural steel frame clad with profiled metallic sheet wall and roof cladding. Internal walling of masonry will be adopted, except where specific load carrying requirements necessitate the use of reinforced concrete walls.

The building cladding will be factory finished according to EirGrid specification. The roof will be shallow pitched and constructed of profiled metal decking on purlins spanning between rafters.

External doors and escape doors will generally comprise metal flush doors with galvanised steel frames. Fire doors will comply with BS 476-22:1987 - Fire tests on building materials and structures. The colour proposed for the external galvanized steel doors is a dark green.

The colour proposed for the building is a dark green. The final colours and finishing will be agreed with the planning authority prior to construction.

Statcom Building

The Statcom Building in Compound 2 will house auxiliary service equipment, such as control and telecoms equipment and low voltage switchgear located in the control room, batteries located in the battery room, cooling equipment in the cooling room, and power and electronic equipment located in the valve room will also be located within the building.

The building size is approximately 14 m by 28 m and comprises a story and a half. The building will comprise a structural steel frame clad with profiled metallic sheet wall and roof cladding. Internal walling of masonry will be adopted, except where specific load carrying requirements necessitate the use of reinforced concrete walls.

The building cladding will be factory finished according to EirGrid specification. The roof will be shallow pitched and constructed of profiled metal decking on purlins spanning between rafters.

External doors and escape doors will generally comprise metal flush doors with galvanised steel frames. Fire doors will comply with BS 476-22:1987 - Fire tests on building materials and structures. The colour proposed for the external galvanized steel doors is a dark green.

The colour proposed for the building is a dark green. The final colours and finishing will be agreed with the planning authority prior to construction.

Other Equipment

Equipment to be included within Compound 2 is summarised in Table 5.26 below. All AIS equipment is individually supported by galvanized steelwork and reinforced concrete bases. The surrounding area is filled with aggregate 804 stone to the finished ground level. Individual equipment is connected together with aluminium conductor tubes and connectors.

A lighting plan has been designed in line with those used on similar sized substations. Directional light fittings have been incorporated within the plan in order to minimise light pollution in the surrounding area. Lighting is only used as required, for access and security.

Table 5.26: Equipment Components within Compound 2 (AIS).

Equipment	Example Photograph
220 kV AIS busbar A 220 kV air insulated busbar spans the length of Compound 2 (approximately 100 m in length). The busbar connects to each of the individual 220 kV AIS bays including the onshore cable, harmonic filter, reactor, statcom, bays. It is 10 m height and supported at 16 m intervals. Post insulators can be grey or brown in colour. Galvanized steelwork is supported by reinforced concrete bases and the finished ground level the compound completed in aggregate 804 stone.	
220 kV Cable Bays The onshore cable bays consist of outdoor air insulated switchgear which include disconnector (busbar, line and earth), current transformers, voltage transformers, circuit breaker, lightning/surge arresters, post insulators and cable sealing ends.	
220 kV Statcom Bay A statcom is a ‘static synchronous compensator’ which is installed to support voltage and power factor regulation. The statcom bay consists of a 220 kV / MV power transformer, an MV busbar and MV statcom equipment. Equipment includes a busbar disconnector, instrument transformers, circuit breaker, lightning/surge arresters and post insulators. A 220 kV / MV power transformer and bushing will have a combined height of approximately 9 m. The transformer will be located within an oil retention bund of approximately 12 m by 18 m and surrounded by 8.5 m high reinforced concrete blast walls to the north and south the transformer. The transformer contains approximately 78,400 kg of mineral oil insulation use to insulate and cool the transformer cores.	

Equipment	Example Photograph
220 kV Shunt Reactor Bay The 220 kV reactor will use AIS bushing to connect to the 220 kV bays. 220 kV bushing which are approximately 4 m tall bring the combined height of the reactor to 7.5 m. The reactor will be located within an oil retention bund of approximately 13.5 m by 13 m and enclosed by 8 m high reinforced concrete blast walls to the north and south the rector. The reactor contains approximately 27,250 kg of mineral oil insulation use to insulate and cool the transformer cores.	
220 kV Harmonic Filter Bay Compound 2 will house two 220 kV harmonic filters bays. The harmonics filter bay consists of a 220 kV bay and a 220 kV filter bay that includes capacitor banks, reactors and resistors to provide filtering capacity to the 220 kV busbar. Each harmonic filter bank is enclosed within a compound of 34 m by 28 m and contains 3 capacitor banks, 3 reactors, 3 resistors, surge arresters and unbalance current transformers.	

Twelve lightning protection monopoles of approximately 20 m in height will be placed within the compound for lightning protection.

A second steel telecommunication mast, approximately 36 m in height, is proposed to be installed adjacent to the proposed substation site to facilitate communications between the substation and the existing substations in Maynooth and Woodland. Antennas will be located at the top of the mast, and these will be connected by cables to telecommunications equipment housed in the substation control building. An external ladder will be permanently fixed to the mast to allow for maintenance access.

An earth grid will be installed below the ground in a grid arrangement approximately 600 mm below the finished surface. The earth grid will consist of bare stranded copper conductor. The purpose of the earth grid is to ensure personnel and public safety during electrical faults that may occur on the transmission grid.

Entrance Compound

The entrance compound is shared by Compound 1 and Compound 2 with an area of approximately 600 m^2.

It will contain a telecommunications building with a size of approximately 15 m by 4 m and a height of 4 m. This building will be of steel construction and will have false flooring for inner cabinet cabling. External doors and escape doors will generally comprise metal flush doors with galvanised steel frames. Fire doors will comply with BS 476-22:1987 - Fire tests on building materials and structures. The colour proposed for the building is a dark green. The final colours and finishing will be agreed with the planning authority prior to construction.

The back up bunded diesel generator will also be located in this area for emergency power, if required.

An earth grid will be installed below the ground in a grid arrangement approximately 600 mm below the finished surface. The earth grid will consist of bare stranded copper conductor. The purpose of the earth grid is to ensure personnel and public safety during electrical faults that may occur on the transmission grid.

Line Cable Interface Masts (LCIM)

The two new LCIMs will be steel lattice towers with a height of approximately 27 m and will comprise conductors, associated hardware (including insulators, spacers and fittings and the facility to connect shield wires). A shield wire protects the towers against lightning. Each of the four tower legs will be separately anchored below ground in a block of reinforced concrete.

The typical tower foundations for each leg of an LCIM is approximately 4.5 m^2 squared, with a depth of approximately 4.5 m. A photo showing an example of the proposed LCIM design is presented on Figure 5-29.

Figure 5-29: Photo of 220 kV Line Cable Interface Mast with shield-wire facility.

Demolition

An existing ESB 220 kV tower adjacent to the proposed substation compounds will be replaced by the two ‘loop-in’ towers to enable this connection. The existing tower and foundations will require demolition prior to the installation of the two new LCIM. The demolished material will be managed as outlined in chapter 30: Resource and Waste Management.

Services and utilities

During the operational phase, the substation will generally be unmanned and remotely monitored/operated by EirGrid. Operations at the substation will involve six to eight visits per month, quarterly inspection visits and maintenance visits when required.

The provision of electrical supply, water supply and control of foul and stormwater are described in the sections below.

Electricity Supply

The electricity supply for each compound will be provided by a connection to separate house transformers from the Medium Voltage (MV) supply. These MV/LV house transformers will be bunded and located on concrete plinths close to each building.

Emergency backup diesel generators (less than 500 KVA each) will also provide independent power for the ancillary electrical services in Compound 1 and Compound 2, and will be used in rare cases, such as the loss of main power. In Compound 1 the generator will be located in a dedicated room within the GIS building with appropriate fire rating and ventilation. The generator fuel tank, to be located in the room with the generator, will be bunded. In Compound 2 the generator will be located in a dedicated room within the control building with appropriate fire rating and ventilation. The generator fuel tank, to be located in the room with the generator, will be bunded.

Water Supply

Water supply for welfare facilities will be provided by way of a rainwater harvesting unit from the roofs on-site. A supply of bottled water will also be stocked on site as required for potable use, which is appropriate give that the substation will generally be unmanned.

Foul Water

During construction, portable chemical toilets will be provided for the duration of the works and all waste material will be removed from site and disposed of to an appropriately licensed facility.

During the operational and maintenance phase, foul water will be discharged to a proprietary wastewater holding tank and collected periodically for off-site treatment by a licensed waste disposal contractor.

The holding tank has been sized conservatively on the basis of maintenance personnel being on site for 2-3 days each week (although this is not anticipated to occur in reality) and an emptying frequency of twice per year. No storm water collection elements (gullies, downpipes, etc.) will be connected to the foul water system.

Surface Water drainage

Surface water drainage for the Project have been designed to mimic the natural drainage patterns of the site in accordance with the Best Management Practices (BMPs) of SuDS (The SuDS Manual CIRIA, 2015). The surface water drainage design will replicate greenfield drainage conditions for the site. Should surface water be discharged from site, the design will ensure only high quality, treated runoff leaves the site at a controlled rate.

Most of the proposed compound will be surfaced with permeable stone and surface water generated on this area will largely infiltrate to ground as per the greenfield conditions. Surface water that does not infiltrate will be collected by a system of land drains around the perimeter of the compound. The surface water drainage is split between the GIS Building and Control Building, Statcom Building and the transformer bunds. The surface water generated from these elements will be collected in an underground drainage network and conveyed to separate attenuation and infiltration systems. Discharges from both networks will be at a controlled rate via a grassed surface water swale (incorporating check dams to capture sediment) to the surface watercourse which runs adjacent to the north of the site.

Surface water generated on the impermeable elements of the Project will be collected in an underground drainage network and conveyed to an attenuation and infiltration system. Discharge from the site shall be limited through the use of a vortex flow control unit directly downstream of this point. This system will be designed to ensure sufficient capacity for the 1:100-year storm event (as defined by Met Éireann) including an additional allowance for climate change to ensure no overflow from the infiltration system shall be required. The infiltration rates will be determined by soakaway tests carried out in accordance with BRE Digest 365. The soakaway tests will be carried out as part of site investigations following planning submission.

Piped underground drainage incorporating downpipes, gullies, access junctions (AJs) (i.e. small, prefabricated inspection chambers) and manholes will collect stormwater from building roof areas. A land drain network will include catchpits. Catch-pit chambers will have a 300 mm sump provided which will allow for the capture of silt and sediment.

Collected stormwater runoff from bunded areas will pass through a Class 1 full retention oil separator prior to discharging through a proposed BMS Stormbreaker (or equivalent approved) stormwater attenuation / infiltration system. The infiltration rates will be determined by soakaway tests carried out in accordance with BRE Digest 365. This system will be designed to ensure sufficient capacity for the 1:100-year storm event (as defined by Met Éireann) including an additional 20% allowance for climate change to ensure no overflow from the infiltration system shall be required, provided ground conditions allow for it.

Drains will incorporate catchpit manholes to remove any grit or silt which may be washed into runoff during the operational and maintenance phase of the onshore substation.

The proposed electrical transformer and the diesel generator in the facility are oil filled equipment and as such are placed within impermeable bunds. In order to provide for treatment of surface water generated in the bunds, it is proposed to install an ‘Entexol SCS001’ or equivalent approved oil sensitive bund dewatering system with a 1 litre per second low shear vortex pump and oil separation detection within each bund. The bunds will also include an ‘Entexol SCS002’ Integrated Class 1 Full Retention Oil Separator. This system will ensure only non-contaminated water enters the site surface water drainage network. The bund dewatering system will be fitted with a high oil level alarm and will be connected back to the station control panel which is connected to a manned control centre via the station’s Supervisory Control and Data Acquisition (SCADA) telecom relay system.

The proposed Klargester (or equivalent approved) Class 1 Bypass Fuel Separator will provide treatment in accordance with BS EN 858 to treat any contaminated runoff from compound roads and car park spaces.

Access and Parking

An existing access track with entrance from the N33 will be upgraded in accordance with the TII Publication DN-GEO-03060 (2023). The access track will be upgraded to 6 m in width for approximately 38 m in length. The access track will comprise a tarmac finish road sloped to facilitate "over the edge" drainage to precast road gullies. Access is shared with neighbouring farmers who have a right-of-way to the common entrance.

In accordance with TII Publication DN-GEO-03060 (June 2023), permanent visibility splays will be required which have an ’x’ value of 3 m and a ‘y’ value of 215 m. A minimal amount of hedge trimming along the N33 will be required to achieve this visibility envelope (see appendix 5.9: Construction Traffic Management Plan). Alternatively, adopting the relaxed standard value for ‘x’ which is a distance of 2.4 m may achieve the visibility envelope with no hedge trimming. These design measures will ensure that the substation compound access has adequate sight lines and will allow access for all type of vehicles which are required during the operational phase of the substation.

Ancillary car parking will be provided within the Compound 1 area, Compound 2 area and the entrance compound.

Landscaping

New areas of planting are proposed at the onshore substation site to enhance the landscape character and visual resources.

Design Flexibility

The design flexibility opinion by An Bord Pleanála under section 278B of the Planning and Development Act 2000, as amended and the Planning and Development Regulations 2001, as amended, states that the following details of the Project may be confirmed after the proposed application has been decided:

> The final design for the type and siting of outdoor equipment within the proposed onshore substation compound.

The final design for the type and siting of outdoor equipment within the onshore substation will be confirmed on procurement of the equipment prior to construction.

The onshore substation design adheres to the requirements of the current EirGrid functional specification and utilises current best available technology. Detailed parameters for the buildings, two new line cable interface masts (towers to support the existing overhead line) and outdoor equipment are presented in the sections above. Contracts for the construction of the substation cannot be finalised in advance of consent. Equipment suppliers and installation contractors will have variations in the dimensions and layout of specific outdoor equipment. Advances in technology may amend the size, location and type of equipment within the substation compound.

All final installed equipment will be of a similar type and perform a similar function to the equipment presented and assessed in the application.

5.6.4 Onshore substation construction

Site investigations

Site investigations at the substation site will be carried out in advance of construction. These site investigations will include for example trial holes and slit trenching to confirm the final depths for foundations.

Site preparation and enabling activities

Prior to works commencing a temporary construction compound will be set up in the area shown on Figure 5-16 (see map 1 of 12). This compound will include site offices, stores, delivery, offloading areas, welfare facilities, parking areas and security accommodation. A temporary construction access track will be installed from the proposed temporary construction compound to the main substation entrance that accesses onto the N33 national road. The temporary construction compound and access track will be reinstated on completion of construction.

The substation site and its access road will be prepared by removing vegetation and stripping topsoil and sub soils (i.e. down to the clay or sand layer below topsoil) before placing a capping layer of crushed stone to formation level.

The onshore substation site will require approximately 20,650m^3 of material to be excavated. The works include site levelling and roadways, building excavations, High-Voltage (HV) equipment foundations, and ancillary works. Any material that cannot be reused on site, will be removed from site by a licenced waste contractor for reuse, recovery or disposal in line with the waste hierarchy (see chapter 30: Resource and Waste Management in volume 2C).

A security fence will be erected around the substation site and the contractor's areas. Site lighting for security will operate within the hours of darkness and will be directional to avoid unnecessary illumination. Site lighting for the illumination of construction operations will operate within the hours of construction.

Construction activities

The following lists the general sequence of construction phase activities and a short summary for each.

Site mobilisation:

- Set up temporary construction compound and access;
- Demarcation of construction work areas, clearance, and site levelling to prepare the works area;
- Install security measures, erect temporary heras fencing and signage;
- A wheel wash will be put in place at the substation entrance for the duration of construction works; and
- Topsoil will be stripped using excavators. The topsoil will be managed as outlined in chapter 30: Resource and Waste Management.

Construction of drainage system: The operational stage drainage network described in section 5.6.3 will not be installed at the outset of construction works. Given this is a greenfield site, drainage of the site will need to be managed carefully. Sediment control in the construction stage is an important consideration to ensure that only high quality, treated runoff leaves the site. Erosion control measures to prevent runoff flowing across exposed or excavated ground and becoming polluted with sediments will be provided for on-site as required during the construction stage. Erosion control measures include:

- Minimising the area of exposed ground and ensuring excavation will not proceed faster than the rate of construction;
- Monitoring of the weather forecast prior to planning excavation works; and
- Providing impermeable mats (plastic sheeting) as covers to mounded excavated material and open excavations during periods of heavy rainfall.

Other drainage runoff controls such as settlement tanks, catchpit, silt fences and silt traps will be temporarily provided adjacent to excavations and installed before starting site clearance and earthworks if deemed necessary by the supervising Engineer.

Entrance reconfiguration: This will involve the widening of the existing entrance off the N33 and re-grading of existing track to accommodate deliveries. Hedge trimming may need to be carried out to accommodate required visibility splays (see CTMP in appendix 5.9). This will be undertaken outside the bird breeding season (see volume 2C, chapter 19: Onshore Biodiversity). Temporary fence and gates will be installed.

Temporary construction compound and access road: The temporary construction compound and access road will be excavated to suitable formation level. Imported stone will then be placed, compacted and graded to form access road and compound area.

Cable pulling temporary hardstand: This will be very similar to the temporary construction compound. Engineering stone fill will be laid and compacted and maintained as required for the duration of the works. The cable drums/cable winch need a stable area due to their weight and ensure the cable is installed safely. This hardstand area may also be used for pulling of permanent cable solution to LCIM’s. Once the works are completed, the engineered stone fill will be removed, and the land will be reinstated to its original condition.

Demolition of existing ESB 220 kV Tower: This will involve the erection of temporary structures, which the existing OHL will be transferred to, in order to facilitate the decommissioning of the existing tower. It will also include the erection of 2 No. permanent LCIM’s and reconnecting of OHL to new LCIM’s.

Substation Compounds 1 and 2: The areas of the substation compound will be marked. The topsoil will be stripped and stockpiled for later use in landscaping/construction activities. All remaining material excavated to achieve desired formation levels will be reused on site where possible or otherwise removed from site by a licenced waste contractor for reuse, recovery or disposal in line with the waste hierarchy (see chapter 30: Resource and Waste Management). Imported stone will then be placed and compacted in layers to required level of 62 mAOD.

GIS Substation Building, Statcom Building, Control Building and Telecommunications Building

- **Foundation Works**: Foundation works will commence once the groundworks have been completed to the required level. The foundation installation will involve excavation, form work, steel reinforcement, and concrete placement. Foundations will be designed in accordance with the relevant EirGrid functional specifications. Excavated material will either be reused on-site for landscaping or disposed of off-site in accordance with applicable requirements.

- **Transformer (associated with Statcom building) bunding**: bunds for oil containment will be constructed in accordance with guidelines and EirGrid functional specifications.

  Earth Grid: the purpose of the earth grid is to dissipate fault currents, which is required for health and safety measure. When the foundations have been set, the copper earth grid will be installed into the soil in and around the foundation and will cover the entire substation compounds. The earth grid installation and permitted operating limits will be in accordance with the relevant EirGrid functional specifications.
- **Structural steel**: Following the installation of the foundation and earth grid, construction activities will shift to the erection of structural steelwork.
  - The GIS building in Compound 1 will be comprise of a two-story steel building over partial basement constructed in accordance with the required functional specification.
  - The control building in Compound 2 will comprise of a two-story steel building constructed in accordance with the required functional specification.
  - The statcom building will comprise a story and a half, steel building constructed in accordance with the required functional specification.
  - The telecommunications building will comprise a single-story steel building constructed in accordance with the required functional specification.
- **Cladding and building finishing works**: These will be undertaken once the structural frame and steel support structures are completed.
- **Complete electrical installation:** The electrical equipment will then be installed and tested in readiness for the connection of the offshore wind farm to the transmission grid.

Commission and test plant: This will entail testing all substation equipment and documenting results to allow for back feed energisation. This is described in section 5.6.5.

Demobilise temporary construction compound and access road: All equipment and temporary buildings will be removed from site, and the temporary access road reinstated as per landowner agreements.

Erect gates signs etc: Once the construction of the onshore substation is complete, the site will be secured, and the supporting infrastructure finalised in readiness for the operational phase.

Temporary works reinstatement: The temporary access route, and the temporary construction areas around the LCIM's including the cable pulling temporary hardstand, will be reinstated as close as possible to their original condition in accordance with the relevant ESB/ IFA Code of Practice for Survey and in consultation with the landowner.

5.6.5 Commissioning of onshore infrastructure

The commissioning activities ensures that equipment is installed properly and has the performance and interrelated functioning and communications needed for safe and reliable operation. Commissioning validates performance parameters before energizations and grid connection. The onshore commissioning phase will be completed by the principal Contractor and can take approximately six months to complete.

5.7 Construction programme

A high-level indicative construction programme is presented in Figure 5-30.

A 33 month programme is proposed. This includes 27 months for construction of the onshore infrastructure and 15 months for construction of the offshore infrastructure. The programme illustrates the likely duration of the installation activities associated with each of the major components, and how they may progress in relation to each other. The duration and the overlap between activities has been presented to inform the assessments in the EIAR.

The installation of the onshore cable is expected to take 27 months including site preparation activities (see section 5.6) and reinstatement. However, work is expected to progress along the onshore cable with a typical active works duration of six weeks at any particular location. Construction is expected to be carried out by two teams, working on different sections of the route.

A contractor carrying out standard 220 kV trenching and ducting specification will complete between 30 to 50 m linear metres of trench in a roadway per day depending on the ground conditions. The onshore cable will be installed in sections of 600 to 800 m in length, with each section of cable delivered on a cable drum from which it is spooled out as it is installed.

Figure 5-30: Proposed construction programme for the Project.

5.7.1 Construction working hours

Hours of construction (associated lighting) will be as follows:

- Monday to Saturday (inclusive) - 8:00am to 6:00pm; and
- Sunday and Bank Holidays - no operations and no associated lighting other than that required for security or safety.

Specific activities such as large concrete pours or delivery of large equipment (e.g. transformers) which require specific road control may occur outside these hours. The local authority and affected local stakeholders will be informed prior to these activities.

5.7.2 Construction employment

The construction (and decommissioning) of the Project will require approximately 140 Full Time Equivalent (FTE) jobs to construct the onshore infrastructure and approximately 100 FTE jobs for the offshore infrastructure. The majority of these jobs will require a particular level of specialist expertise.

5.8 Operational and maintenance phase

This section provides a description of the reasonably foreseeable planned and unplanned operational and maintenance activities for the Project. The design life of the Project is 40 years.

Operational and maintenance activities will be planned, controlled and monitored from an onshore operations and maintenance (O&M) base located at an existing harbour in County Louth or County Down. Three harbours (Kilkeel, Warrenpoint and Greenore) have suitable facilities and are approximately one hour sailing time from the offshore wind farm area.

A CTV will be located at the port to transfer crews to the offshore wind farm area for operations and maintenance. The port will provide access for personnel onto the CTV and a harbour side crane for lifting tools and general spares onto the CTV.

Operational and maintenance staff of both the Applicant and the WTG manufacturer will be co-located at the operations and maintenance base. Support facilities (office and warehouse space) will be leased for the Project within the local environs. Facilities will be leased by the Applicant and/or by the WTG manufacturer depending on the final procurement contract terms. These commercial contracts will not be concluded until operational timelines are known.

The support facilities required for operations and maintenance include:

1. Office space for operations and asset management (approximately 500 m^2) with welfare facilities and an attached controlled warehouse (approximately 1,000 m^2).
2. Office space for maintenance planning and preparation (approximately 500 m^2) with changing room facilities (10-30 persons) and a nearby controlled warehouse (approximately 5,000 m^2).
3. Secure outside storage.

The operational and maintenance phase will create approximately 30 full time equivalent jobs. The number of persons based at the facility will fluctuate depending on the maintenance schedule but is expected to be between 10 and 30 persons.

5.8.1 Offshore activities

Routine operational activities

30 operations and maintenance personnel will be based at the O&M base during routine periods of operations for the site. This number will increase during periods of maintenance as outlined in the sections below. The site office and facilities for these activities are set out in in the section above.

For normal operations, CTVs will be used for routine transfer of personnel, tools and equipment to and from the port to the wind farm site. CTV vessels are typically 26 m long with a deadweight of 30 tonnes A CTV accommodates 24 operations personnel in addition to the vessel crew (three personnel).

The CTV will in general operate during daylight hours with operations from 08:00 to 18:00. During winter, the vessels may leave and enter port during darkness. For a typical day offshore, a single CTV will be loaded with all personnel and required tools and equipment for the day. The CTV will then transit from the O&M base to the offshore wind farm area and deploy the operations personnel at the wind turbine requiring work or the OSS. The transit time from the O&M base is expected to be between 40 and 60 minutes. The CTV will normally remain onsite at the offshore wind farm area until the completion of the required work and then return to the O&M base. It may be necessary to occasionally operate the CTV outside normal hours for longer tasks or urgent action. The CTV may also sometimes transit to and from the O&M base more than once each day. The CTV will be obliged to abide by all rules for navigation and speed when entering and existing the port.

Routine inspections and seabed surveys

Routine inspections and seabed surveys will take place over the lifetime of the Project to ensure integrity of the Project infrastructure. The expected frequency and type of inspections and seabed surveys are presented in Table 5.27.

Table 5.27: Frequency of activities required for inspections and seabed surveys required during O&M.

Activity	Vessel Type	Frequency
Inspections		
Foundations: Inspections of foundations, including transition piece and ancillary structures (e.g. J-tubes), above and below sea level. Includes removal of any marine growth from foundations, transition pieces or access ladders	Crew transfer vessel	1 campaign per year per WTG
WTGs: Scheduled and unscheduled maintenance inside/outside the WTG. Includes replacement of consumables (e.g. filters, oils, lubricants) and minor repairs and replacements within the WTG (e.g. motors, pumps, fuses) as well as troubleshooting	Crew transfer vessel or service operation vessel (weather and setup dependant)	5-9 days per location per year (preferably in low wind season; multiple locations can be visited per day)
OSS: Inspections inside/outside the OSS. Includes replacement of consumables (e.g. oils, lubricants) and minor repairs and replacements within the OSS	Crew transfer vessel	24 inspections per year
Inter-array cables: Inspection of the cable and any cable protection, including at their entry into J-tubes on the WTG/OSS	Remote Operating Vessel (ROV) and Crew transfer vessel	1 survey campaign every 5 years.
Export cable: Inspection of the cable and any cable protection, including at its entry into J-tubes on the OSS	Survey vessel with geophysical survey equipment	1 survey per year

Activity	Vessel Type	Frequency
Geophysical surveys		
Foundations: survey of seabed and assets	Survey vessel with geophysical survey equipment	1 survey campaign every 5 years.
Inter-array and offshore cables: survey of seabed and any cable protection	Survey vessel with geophysical survey equipment	1 survey campaign every 5 years.

Repairs and replacements of navigational equipment

Any faulty navigation aids will be repaired or replaced to maintain availability of all lights, marks and sound signals. The expected frequency and type of repairs and replacements of navigation equipment is presented in Table 5.28.

Table 5.28: Frequency of activities required for repairs and replacements of navigational equipment.

Activity	Methodology	Frequency
Repairs and replacements of electrical equipment such as lighting, navigation lights and transponders.	Crew transfer vessel	1 per WTG over Project lifetime

Painting

The foundation structures (above seawater level), wind turbines and offshore substation may require painting over the lifetime of the project to protect the structures from corrosion. The design parameters for painting are presented in Table 5.29.

Table 5.29: Design parameters for painting.

Activity	Methodology	Frequency
Foundations: Application of paint or other coatings to protect the foundations from corrosion (internal/external), including surface preparation	Crew transfer vessel	30 days per year
WTG: Paint or other coatings applied (internal/external). Coatings on the blades and minor paint repairs to tower and nacelle	Crew transfer vessel or service operation vessel (weather and setup dependant)	10 days per year
OSS: Paint or other coatings applied (internal/external).	Crew transfer vessel	10 days per year

Major component replacement

This activity allows for the replacement of major foundation, offshore substation or wind turbine components, for example davit cranes, transformers, wind turbine blades, blade bearings, hub generators, yaw rings or nacelles. Works conducted under this activity would likely require a jack-up vessel (JUV) supported by at least one CTV. The design parameters for this activity are presented in Table 5.30.

Table 5.30: Design parameters for major component replacement.

Activity	Methodology	Frequency
Replacement of major components such as blades, gearboxes, transformers or generators.	JUV	1 campaign per year for average of 2 major component replacements. Average of 7 days per year.

Cable repair or reburial activities

Cable repair activities will take place in the event a fault is detected in the inter-array or offshore cables. Failure of a cable system would be detected by the wind farm protection system. Cable repair activities would involve excavation of the faulty cable section, jointing of the new cable section to the existing cable, cable lay and cable reburial using similar techniques to those described for cable installation, and post-works survey.

Cable reburial activities will take place in the event a cable becomes exposed over time. A cable exposure event would be detected during the regular seabed survey activities described above. Cable reburial activities would involve cable reburial using similar techniques to those described for cable installation (see section 5.5.6).

The project design parameters for cable repair or reburial activities are presented in Table 5.31The project design parameters in terms of width of seabed disturbance during these activities is anticipated to be similar to that described for the cable installation activities during the construction phase.

Table 5.31: Design parameters for cable repair or reburial.

Activity	Methodology	Frequency
Cable repair		
Inter-array cable repair: Repair and replacement of array cable section/whole inter-array cable.	Cable repair vessel	1 per 5 years
Export cable repair (subtidal): Repair and replacement of offshore cable section.	Cable repair vessel	1 per 10 years
Cable reburial		
Inter-array cable reburial: Reburial of exposed inter-array cable section.	Cable reburial jetting trencher	1 per 5 years
Export cable reburial (subtidal): Reburial of exposed offshore cable section	Cable reburial jetting trencher	1 per 10 years

Vessel activities

During the operational and maintenance phase of the Project, vessels will be required to support the activities described above. Generally, vessels will be limited to a CTV operating day to day from the O&M base and involved in the routine maintenance of the Project. Larger vessels will be required to support any major component replacement activities or cable repair/reburial activities.

The vessel numbers anticipated for the operational and maintenance phase are presented in Table 5.32 below. Helicopter access would be used in the event of an emergency only.

Table 5.32: Operational and maintenance phase vessel return trips.

Vessel	Number of return trips
Crew Transfer Vessels (CTV)	Up to 300 per year
Service Operation Vessel	Up to 50 per year
Jack-up Vessels (JUV)	1 campaign per year
Cable repair vessels	1 cable repair or reburial per 5 years
Maximum Return Trips to Offshore Wind Farm Area or Offshroe Cable Corridor	**352 per year**

5.8.2 Onshore activities

Onshore maintenance activities

The onshore operation and maintenance requirements for the onshore cable will be largely corrective (because there is limited requirement for preventative maintenance on the onshore cable), accompanied by infrequent on-site inspections of the onshore cable (approximately every 3 years). The onshore cable will be consistently monitored remotely by EirGrid. Link boxes and C2 chambers will require inspection during the operational and maintenance phase.

Operation and maintenance requirements for the onshore substation will be both preventative and corrective. The onshore infrastructure will be consistently monitored remotely by EirGrid from their control centre. In addition, there will be operation and maintenance staff visiting the onshore substation to undertake works on a regular basis. Operations at the substation will involve six to eight visits per month, quarterly inspection visits and maintenance visits when required. These visits will result in one vehicle (van) requiring access to the onshore substation.

The switchgear in the onshore substation will contain sulphur hexafluoride (SF_6) or an alternative approved insulating gas if this becomes available. SF_6 is a non-toxic gas but has a high CO_2 equivalence if released to the atmosphere. Gas handling on-site is primarily limited to the construction and decommissioning phases of a substation development. Specialised gas handling and maintenance procedures and training are incorporated into the management systems. Maintenance of SF_6 gas containing equipment will be undertaken in accordance with specified operating procedures. Alternatively, a specialist switchgear provider (such as the original equipment provider) may be employed, to undertake maintenance of SF_6 gas containing equipment. The electrical switchgear equipment will also be equipped with a pressure or density monitoring device which will detect any loss of SF6 gas containing equipment.

It is not expected that the TJB will need to be accessed during the operation of Project, however link boxes and C2 chambers will require inspection during the operational and maintenance phase. The link boxes and C2 chambers have manhole covers to allow for inspection. These visits will be undertaken by a technician and use of one vehicle (van).

Routine inspections and any maintenance requirement such as replacement of components for the LCIMs will be undertaken by ESBN and incorporated into the standard processes and protocols for the existing 220 kV OHL.

Security

The Project and its components will be suitably secured throughout all phases of the Project to ensure those working on the Project can work in safety and the supply of electricity to the Irish National Grid remains secure. Any above ground onshore infrastructure such as the onshore substation will be housed in secure gated compounds, as will any ongoing construction work. The onshore cable is buried and will not be accessible from the surface. Any accessible parts such as the link boxes C2 chambers will be accessible only through secure manhole covers.

Surface water drainage

Surface water drainage at the onshore substation and any drainage associated with the joint bays would be inspected on an annual basis. Maintenance of the drainage including any repair requirements will be carried out. This maintenance will include emptying and cleaning of the attenuation/infiltration systems and oil water separator systems in the onshore substation, in compliance with the manufacturers specification.

5.9 Decommissioning phase

At the end of the operational lifetime of the Project, it is anticipated that all structures above the seabed or ground level will be completely removed.

The offshore decommissioning sequence will generally be the reverse of the construction sequence and involve similar types and numbers of vessels and equipment. Decommissioning will be carried out in accordance with a Rehabilitation Schedule supported by a decommissioning bond which will be agreed with the Maritime Area Regulatory Authority (MARA) prior to construction commencing.

It is also proposed that a decommissioning programme of works be developed in advance of decommissioning. This programme will include information such as:

- Project background information;
- Description of items to be decommissioned;
- Proposed decommissioning approach and updated assessment taking into consideration the following:
  - changes in the baseline environment and sensitivities at the time of decommissioning;
  - changes in technology to undertaking the proposed works;
  - changes in legislation and guidance.
- Proposed stakeholder engagement; and
- Post decommissioning management and monitoring strategy.

It is proposed that preparation of this programme would commence on completion of construction of the Project and be reviewed on an annual basis (to include any updates). Engagement with stakeholders on the programme should commence five years in advance of decommissioning.

5.9.1 Offshore infrastructure decommissioning

Wind Turbines and OSS Topside

Wind turbines and OSS topside will be removed by reversing the methods used to install them for disassembly and reuse, recycling or disposal onshore.

Foundations

Monopile foundations would be cut approximately 2 m below the seabed and removed, with due consideration made of likely changes in seabed level. This could be achieved by inserting pile cutting devices. Once the piles are cut, the foundations could be lifted and removed from the site. At this time, it is not thought to be reasonably practicable to remove entire piles from the seabed, but that the sections of pile that remain in the seabed are fully buried. Any scour protection will be left in situ.

Offshore cables

Currently there is no statutory requirement for removal of decommissioned cables and removing buried cables is difficult. It may be agreed with the relevant authorities that the best environmental option is to leave buried cables in-situ, recording their location and terminating, sealing and burying their ends.

For the purposes of ensuring that this application assesses the maximum range of activities it has been assumed that all buried cables will be removed during decommissioning, though any cable protection installed will be left in situ.

Any surface laid cables would be removed to ensure that they don’t become hazards to other users of the seabed.

Equipment similar to that used for cable installation would be used to remove burial material and expose the cables. As a result, the area of seabed impacted during the removal of the cables would be the same as the area impacted during the installation of the cables. Divers and/or ROVs may be used to support the cable removal vessels.

Once the cables are exposed, grapples would be used to pull the cables onto the decks of cable removal vessels. The cables would be cut into manageable lengths and returned to shore. Once onshore, it is expected that the cables would be deconstructed to recover and recycle the copper and/or aluminium and steel within them.

5.9.2 Onshore decommissioning

Onshore cable

It is expected that onshore cables would be removed by disconnecting each section at the joint bay and pulling them through the cable ducts. This operation would be a reverse of the installation operation and result in the same impacts.

The structures associated with the joint bays will be removed only if it is feasible with minimal environmental disturbance or if their removal is required to return the land to its former use.

Onshore substation

The components of the onshore substation have varying life expectancies. Transformers typically remain operational for up to 50 years, and some components can be extended beyond this period. The case for decommissioning the onshore substation will be reviewed in discussion with the TSO and the regulator in light of any other existing or proposed future use of the onshore substation. If complete decommissioning is required, then all of the electrical infrastructure will be removed, and any waste will be taken off site by a licenced waste contractor and managed in accordance with the waste hierarchy and where required to be disposed, this will be done under licence from the appropriate authority.

Foundations will be broken up and the site reinstated to its original condition.

5.10 Environmental management

5.10.1 Measures included in the Project

As part of the project design process, a number of measures have been proposed to reduce the potential for impacts. As there is a commitment to implementing these measures, they are considered inherently part of the design of the Project. These measures are considered standard industry practice for this type of development. These measures are presented in each of the assessment chapter 7 to chapter 31 and are integrated into the description of the Project and have therefore been considered in the assessments presented in the EIAR. This is in line with EPA guidance which states that “*in an EIAR it may be useful to describe avoidance measures that have been integrated into the project proposal”* (EPA, 2022).

Table 5.33 provides a list of all the assessments where measures included in the Project are provided and where these are outlined in each EIAR chapter.

Table 5.33: EIAR Table references where measures included in the Project are provided.

Assessments	Chapter and section reference where measures are outlined
Marine Processes	Chapter 7, Section 7.9.2, Table 7-11
Benthic Subtidal and Intertidal Ecology	Chapter 8, Section 8.8.2, Table 8-12
Fish and shellfish ecology	Chapter 9, Section 9.8.2, Table 9-10
Marine mammals and megafauna	Chapter 10, Section 10.8.2, Table 10-12
Offshore ornithology	Chapter 11, Section 11.8.2, Table 11-14
Commercial fisheries	Chapter 12, Section 12.1.10, Table 12-7
Shipping and navigation	Chapter 13, Section 13.8.2, Table 13-9
Aviation, military and communications	Chapter 14, Section 14.8.2, Table 14-6
Marine archaeology	Chapter 15, Section 15.8.2, Table 15-9
Infrastructure, marine recreation and other users	Chapter 16, Section 16.8.2, Table 16-6
Climate	Chapter 17, Section 17.8.2, Table 17-15
Population and Human Health	Chapter 18, Section 18.8.2, Table 18-10
Onshore Biodiversity	Chapter 19, Section 19.8.2
Land and Agricultural	Chapter 20, Section 20.8.2, Table 20-7
Soils, Geology and Hydrogeology	Chapter 21, Section 21.8.2, Table 21-10
Hydrology and Flood Risk	Chapter 22, Section 22.8.2, Table 22-21
Air Quality	Chapter 23, Section 23.8.2, Table 23-10
Cultural Heritage	Chapter 26, Section 26.8.2, Table 26-10
Seascape, Landscape and Visual Amenity	Chapter 27, Section 27.8.3, Table 27-29
Traffic and Transport	Chapter 28, Section 28.8.2, Table 28-17
Material Assets	Chapter 29, Section 29.8.2, Table 29-8
Resource and Waste Management	Chapter 30, Section 30.8.2, Table 30-8

5.10.2 Management plans

The measures included in the Project include a number of management plans, which the Applicant is committed to implementing. These management plans are considered standard industry practice for offshore wind development.

These management plans have been prepared to support the EIAR and are provided as appendices to chapter 5. These management plans will be further developed prior to construction. These are summarised in Table 5.34. Final management plans will be submitted for approval to the consent authority or other relevant stakeholders prior to construction, as indicated in Table 5.34.

Table 5.34: Management plans.

Reference	Management Plan	Submission stage	Purpose
Appendix 5-1	Construction Environmental Management Plan (CEMP)	At least six months prior to construction.	The CEMP provides information relating to the environmental management during the construction of the onshore infrastructure of the Project.

Reference	Management Plan	Submission stage	Purpose
Appendix 5-2	Environmental Management Plan (EMP) (including Marine Pollution Contingency Plan)	At least six months prior to construction.	The EMP provides the overarching framework for environmental management during the construction and operational phases of the Project.
Appendix 5-3	Marine Invasive Non-Native Species Management Plan (MINNSMP)	At least six months prior to construction.	The MINNSMP sets out the approach to invasive species management and mitigation in respect of the Project, providing an outline of the measures proposed to be implemented to facilitate biosecurity control and to minimise potential impacts on the local and wider environment.
Appendix 5-4	Marine Mammal Mitigation Plan (MMMP)	At least six months prior to construction.	The MMMP includes details of the refined piling methodology and anticipated duration of pile-driving, details of soft-start piling procedures and anticipated maximum piling energy required, and details of any mitigation and monitoring to be employed during pile-driving.
Appendix 5-5	Marine Megafauna: Vessel Code of Conduct	At least six months prior to construction.	The Vessel Code of Conduct provides best practice guidelines to be followed in cases of any interaction between vessels and marine megafauna within Irish waters.
Appendix 5-6	Fisheries Management and Mitigation Strategy (FMMS)	At least six months prior to construction.	The FMMS provides an overview of the Applicant's approach to fisheries liaison, including an outline of the measures proposed to be implemented to facilitate co-existence with commercial fishing and to minimise potential impacts.
Appendix 5-7	Emergency Response Co-operation Plan (ERCoP)	At least six months prior to construction.	The ERCoP addresses emergency response and coordination arrangements for the construction, operational and maintenance and decommissioning phases of the Project.
Appendix 5-8	Lighting and Marking Plan (LMP)	At least six months prior to construction.	The LMP provides the aviation and navigational lighting and marking arrangements for the Project.
Appendix 5-9	Construction Traffic Management Plan (CTMP)	At least six months prior to construction.	The CTMP focuses on ensuring adequate localised traffic management during the construction phase of the Project and ensuring that safe access to all dwellings, businesses and schools is retained.
Appendix 5-10	Marine Archaeological Management Plan (Marine AMP)	At least six months prior to construction.	The Marine AMP sets out the procedure for the recording and reporting of any archaeological material discovered during the construction phase.

5.10.3 Residues, emissions and waste

The EIA Directive requires a description of the expected residues and emissions and wastes arising from the Project and a description of the likely significant effects resulting from the emission of pollutants, noise, vibration, light, heat and radiation, the creation of nuisances, and the disposal and recovery of waste. Table 5.35 sets out where this is addressed in the EIAR.

Table 5.35: Residues and emissions.

EIAR Requirement	How and where considered in the EIAR
Annex IV 1(d) Description of the project, including in particular: an estimate, by type and quantity, of expected residues and emissions (such as water, air, soil and subsoil pollution, noise, vibration, light, heat, radiation) and quantities and types of waste produced during the construction and operation phases; and **Annex IV 5(c)** description of the likely significant effects of the project on the environment resulting from, the emission of pollutants, noise, vibration, light, heat and radiation, the creation of nuisances, and the disposal and recovery of waste.	An estimate by type and quantity, of expected noise, vibration are provided in chapter 25: Noise (Airborne) and Vibration and subsea noise details are provided in appendix 10-2: Subsea Noise Technical Report. The potential impacts associated with the emission of noise and vibration and associated nuisances are assessed in: Chapter 25: Noise (Airborne) and Vibration; Chapter 9: Fish and Shellfish Ecology; Chapter 11: Marine Mammals and Megafauna An estimate by type and quantity, of expected atmospheric emissions is provided in chapter 23: Air Quality. An estimate by type and quantity, of expected emissions to water is provided in chapter 7: Marine Processes and chapter 22: Hydrology and Flood Risk. An estimate by type and quantity, of expected emissions to soil and subsoil is provided in chapter 21: Soils, Geology and Hydrogeology. An estimate by type and quantity, of expected radiation is provided in chapter 18: Population, Human Health; chapter 9: Fish and Shellfish. There are minimal expected emissions from heat. There are minimal requirements for lighting and therefore expected emissions from light are not expected to be significant. Recommendations are proposed for directional lighting where required. The disposal and recovery of waste is considered in chapter 30: Resource and Waste Management

5.10.4 Natural resources

The EIA Directive requires a description of the likely significant effects resulting from the use of natural resources. Table 5.36 sets out where this is addressed in the EIAR.

Table 5.36: Natural resources.

EIAR Requirement	How and where considered in the EIAR
Annex IV 5(b) A description of the likely significant effects of the project on the environment resulting from, the use of natural resources, in particular land, soil, water and biodiversity, considering as far as possible the sustainable availability of these resources	The use of natural resources is outlined in the EIAR as follows. Disturbance to land, soil and water (including seabed) is assessed in Chapter 7: Marine Processes and chapter 21: Soils, Geology and Hydrogeology; chapter 22: Hydrology and Flood Risk Disturbance to biodiversity is assessed in: Chapter 8: Benthic Subtidal and Intertidal Ecology; Chapter 9: Fish and Shellfish Ecology; Chapter 10: Marine Mammals and Megafauna; Chapter 11: Offshore Ornithology Chapter 19: Onshore Biodiversity; and Chapter 31: Bats in the Marine Environment. The Project will have a maximum export capacity of 375 MW. Energy demand during operational and maintenance phase is minimal as outlined in chapter 29: Material Assets.
Annex IV 1(c) Description of the project, including in particular: a description of the main characteristics of the operational phase of the project (in particular any production process), for instance, energy demand and energy used, nature and quantity of the materials and natural resources (including water, land, soil and biodiversity) used	

5.10.5 Health and Safety

The Applicant has a focus on safety. The Applicant's Quality, Health, Safety and Environment Management (QHSE) policy ensures that their wind farms are safe by design and that the processes and procedures are adhered to. There is a clearly defined safety culture in place in order to avoid incidents and accidents.

There will be constant controls to ensure that the safety measures are observed and followed, and the Project has built a safe workplace for its employees and contractors.

The focus on QHSE is intended to ensure that everyone feels safe, in a highly controlled and safety-driven environment. This is the Project's first priority. It is done by closely monitoring all matters relating to health and safety.

References

BS: British Standards Institution (1987) BS 476-22:1987 – Fire Tests on Building Materials and Structures – Method for Determination of the Fire Resistance of Non-Loadbearing Elements of Construction, May 1987.

CIRIA: Construction Industry Research and Information Association (2015) The SuDS Manual (C753F), December 2015.

DNV: Det Norske Veritas (2020, amended 2021) DNV-ST-0145 – Offshore Substations, 2020.

DNV: Det Norske Veritas (2011) DNV-OS-D201 – Electrical Installations, 2011.

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