Dublin Array
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EIAR Volume 2: Introductory Chapters
Chapter 6: Project Description

Kish Offshore Wind Ltd

RWE SLR GoBe APEM Group

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Dublin Array Offshore Wind Farm

Environmental Impact Assessment Report

Volume 2, Chapter 6: Project Description

Contents

Figures

Tables

Acronyms

Term	Definition
ABP	An Bord Pleanála
AEZ	Archaeological Exclusion Zone
AIS	Automatic Identification System
AToN	Aids to Navigation
CTV	Crew Transfer Vessel
CBRA	Cable Burial Risk Assessment
CFE	Controlled Flow Excavation
CBGM	Cement Bound Granular Material
CIL	Commissioners of Irish Lights
CIP	Cable Installation Plan
CPS	Cable Protection Systems
CPT	Cone Penetration Test
CWP	Codling Wind Park
3D UHRS	Deep 3D Ultra-High Resolution Seismic
DART	Dublin Area Rapid Transit
DLRCC	Dún Laoghaire-Rathdown County Council
DP	Dynamic Positioning
DPM	Direct Pipe Method
DoL	Depth of Lowering
Dublin Array	Dublin Array Offshore Wind Farm
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EPA	Environmental Protection Agency
FFL	Finished Floor Level
GCP	Grid Connection Point at existing Carrickmines 220kV substation
GIS	Gas Insulated Switchgear
GW	Gigawatt
Ha	Hectare
HAT	Highest Astronomical Tide /Metres Relative to Highest Astronomical Tide
HDD	Horizontal Directional Drilling

Term	Definition
HDPE	High-Density Polyethylene
HGV	Heavy-Goods Vehicle
HPPE	High-Performance Polyethylene
HV	High Voltage
HVAC	High Voltage Alternating Current
IAA	Irish Aviation Authority
IAC	Inter Array Cable
IALA	International Association of Aids to Navigation
ICG	Irish Coast Guard
INFOMAR	Integrated Mapping for the Sustainable Development of Ireland’s Marine Resource
IPP	Independent Power Producer
IPS	Intermediate Peripheral Structure
JB	Joint Bay
JUV	Jack-Up Vessel
kJ	Kilojoule
km	Kilometres
km^2	Square kilometres
kV	Kilovolt
l	Litre
mLAT	Lowest Astronomical Tide (metres Relative to Lowest Astronomical Tide)
LVAC	Low-Voltage Alternating Current
m	Metre
MAC	Maritime Area Consent
MAG	Magnetometer
MAPA	Maritime Area Planning Act 2021 as amended
MARA	Maritime Area Regulatory Authority
MDO	Maximum Design Option
MBES	Multibeam Echosounder
MDPE	Medium-Density Polyethylene
MEWP	Mobile Elevated Platform
MFE	Mass Flow Excavator
MHWS	Mean High Water Springs

Term	Definition
MLWS	Mean Low Water Springs
MSL	Mean Sea Level
MV	Medium Voltage
MW	Megawatt
NAS	Noise Abatement System
NIS	Natura Impact Statement
O&M	Operations and Maintenance
OD	Ordnance Datum
OES	Onshore Electrical System
Onshore ECR	Onshore Export Cable Route
Offshore ECC	Offshore Export Cable Corridor
ORE	Offshore Renewable Energy
OSP	Offshore Substation Platform
OSS	Onshore Substation
PCE	Pre-Connection Enquiry
PDA	Planning and Development Act, 2000, as amended
PE	Polyethylene
PLGR	Pre-lay Grapnel Run
pUXO	Potential Unexploded Ordnance
RD	Rotor Diameter
ROV	Remotely Operated Vehicle
RoRo	Roll on/Roll Of
RWE	RWE Renewables Ireland Ltd (a wholly owned subsidiary of RWE AG)
SCADA	Supervisory Control and Data Acquisition
SAR	Search and Rescue
SBI	Shallow 3D Sub-Bottom Imaging System
SBP	Sub-bottom Profiler
SEA	Strategic Environmental Assessment
SF6	Sulphur Hexafluoride
SISAA	Supporting Information for Screening for Appropriate Assessment
SLB	Simultaneous Lay and Burial
SPMP	Scour Protection Management Plan

Term	Definition
SPS	Significant Peripheral Structure
SSS	Sidescan Sonar
t	Tonne
TCC	Temporary Construction Compound
TJB	Transition Joint Bay
TMP	Traffic Management Plan
TSHD	Trailing Suction Hopper Dredger
TSO	Transmission System Operator
UK	United Kingdom
USBL	Ultra-short Baseline
UXO	Unexploded Ordnance
VTS	Vessel Transport Services
WTG	Wind Turbine Generator

Glossary

Term	Definition
Array area	The area within which the WTGs and OSP will be located.
Borehole	A borehole is a deep, narrow hole drilled into the ground or seabed to collect subsurface samples and conduct in-situ testing. In offshore projects, boreholes provide detailed information about sediment layers and geotechnical properties critical for foundation design and installation.
Cable Plough Trials	Cable plough trials are tests conducted to evaluate the effectiveness of a cable plough, a tool designed to bury cables beneath the seabed. These trials assess the plough's performance in different sediment types, helping determine its suitability for secure cable installation along a planned route.
Carrickmines GCP	The existing 220 kV substation at which the Dublin Array project is proposed to connect to the existing national electricity transmission network.
Chainage	A linear reference system used to measure distances along an onshore cable route, typically marked in meters from a defined starting point. It is used to identify specific locations or features along the route for design, construction, and maintenance purposes.
CPT	A geotechnical investigation method used to determine the properties of soil by measuring the resistance of a cone-shaped probe as it is pushed into the ground.
Depth of Lowering	The vertical distance from the seabed to the top of a buried asset, such as a subsea cable, to ensure sufficient cable protection.
Geophysical survey	A geophysical survey is a method of collecting data about the physical properties of the subsurface, often using techniques such as sonar, seismic reflection, magnetometry, and non-intrusive ground-penetrating radar. In a marine context, it helps characterise seabed conditions and identify hazards.
Geotechnical survey	A geotechnical survey is an investigation of the physical and mechanical properties of the seabed and subsurface soils. This survey involves sampling and testing sediment layers to assess soil strength, composition, and stability.
J-tube	J-tubes are tubes that route and protect cables as they travel up the foundation from the seabed to the base of the wind turbine generator tower or offshore substation platform.
Landfall Site	The location for the two underground TJBs at Shanganagh Cliffs where the onshore and offshore ECRs join also including the associated temporary infrastructure to support the Landfall Site TCC.
Offshore Infrastructure	Wind turbine generators, offshore substation platform, inter array cables offshore export cables and landfall works below MHWS.
Offshore Export Cable Corridor (ECC)	The Offshore Export Cable Corridor (north and south route) (one corridor and two routes),
Onshore Electrical System (OES)	All of the proposed Dublin Array transmission infrastructure from the TJB to the Carrickmines GCP i.e. the TJBs, onshore underground cables and associated infrastructure, the OSS and the onshore grid connection point.

Term	Definition
OES Works	Works to construct and install the OES.
Offshore Transmission Assets	Collective term for OSP and export cables to the transition joint bay.
Onshore Compensation Compound	Part of the OES, the substation required to facilitate the grid connection.
Onshore Export Cable Route	The term used to describe the 7.4 km route of the onshore cables and associated infrastructure between the TJBs and the OSS
Onshore infrastructure	The OES and the O&M Base of the Dublin Array.
Onshore grid connection	The two 220 kV transmission circuits connecting the OSS to the Carrickmines GCP.
Onshore Substation	The proposed Dublin Array onshore substation site in the townland of Jamestown.
Operation and Maintenance Base (O&M Base)	This is the location from where the daily operations and normal repairs, replacement of parts and structural components, and other activities needed to preserve the offshore assets will be conducted.
Maximum Design Scenario (Maximum DS)	The design scenario that is assessed for each impact and which will result in the greatest impact (e.g. largest footprint, longest exposure, or largest dimensions). Unless otherwise identified in the assessment it can be assumed that any other design scenario for that impact will result in no greater environmental significance than that assessed and presented in the EIAR.
Micro-siting	Micro-siting refers to the process of optimizing the location of wind turbines, offshore substation platform and subsea cables based on the specific conditions encountered during the detailed design and construction phase. This includes adjusting the positions incrementally to account for factors like terrain, environmental conditions, and any unforeseen obstacles that may arise. The locational limits of deviation for micro-siting are set out in this report.
Multi-beam Echosounder	A sonar system that emits multiple sound beams to map the seafloor in high detail. It measures the depth and contours of underwater terrain by recording the time it takes for each sound beam to return from the seabed, producing precise bathymetric data.
Highest Astronomical Tide (HAT)	The Highest Astronomical Tide (HAT) is the highest level of tide that can be predicted to occur under normal meteorological and astronomical conditions.
Offshore Infrastructure	WTGs, OSPs, inter array cables offshore export cables and landfall works below MHWS.
Pile	A long, structural element driven or drilled into the ground to anchor structures to the seabed, ensuring stability and load-bearing capacity.
Pre-Lay Grapnel Run (PLGR)	This is a preparatory operation used in subsea cable installation. Before laying the main cable, a grapnel (a type of anchor) is dragged along the planned route of the cable on the seabed to clear any obstacles like old cables, debris, or fishing nets.
Sandwave	A sandwave is a dynamic, large-scale bedform composed of sand, commonly found on the seafloor in areas with strong tidal currents which can migrate over time due to currents.

Term	Definition
Sectors	The onshore ECR has been subdivided into seven sectors to aid the reader in identifying specific locations along the 7.4 km route between the TJBs and the OSS.
Sidescan Sonar	An acoustic imaging technique that uses sound waves to create detailed images of the seabed. It emits sound pulses from a device towed behind a vessel, capturing reflected signals to map underwater features and objects,
Sub-bottom Profiler	An acoustic survey tool that penetrates below the seabed, emitting low-frequency sound waves to map sediment layers and geological structures beneath the ocean floor. It provides information on sediment composition and thickness.
Swept Area	The swept area is the circular area that is swept by the turbine blades as they rotate around the hub. It represents the total area where the wind interacts with the turbine
Temporary construction compounds (TCCs)	Four TCCs will be utilised for parking, welfare facilities, site office cabins, construction equipment, construction material laydown and storage for the duration of the OES construction phase with an occupation of up to 36 months. Three locations are identified to temporarily support the installation of the OES: ▪ Landfall Site TCC (Shanganagh Cliffs) ▪ Clifton Park TCC ▪ Leopardstown TCC ▪ OSS TCC
Trailing Suction Hopper Dredger	A type of dredging vessel equipped with suction pipes that remove sediment from the seabed. The dredged material is stored in an onboard hopper and can be transported and deposited elsewhere.
The Applicant	The Applicant for Dublin Array is Kish Offshore Wind Limited on behalf of Kish Offshore Wind Limited and Bray Offshore Wind Limited with the written consent of DLRCC.
Transition Joint Bay	The proposed infrastructure at the landfall location where the offshore and onshore cables connect.
Transition Piece	The transition piece (if used) acts as an interface between the wind turbine generator tower and its foundation.
Unexploded Ordnance (UXO)	Explosive weapons, such as bombs that did not explode when deployed and still pose a risk of detonation.
Vibrocores	Vibrocores are samples extracted from the seabed using a vibrating core barrel to penetrate sediment layers. This method is used to collect relatively undisturbed sediment cores, providing valuable information on sediment composition and stratigraphy for offshore site assessment.
Wind turbine generators (WTG)	All the components of a wind turbine, including the tower, nacelle and rotor.
Water Framework Directive assessment (WFD)	Environmental assessment pursuant to Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy, as amended.

6 Project Description

6.1 Introduction

6.1.1 This chapter of the Environmental Impact Assessment Report (EIAR) provides a description of the offshore infrastructure, the onshore electrical system (OES) and the Operations and Maintenance (O&M) Base associated with the proposed Dublin Array Offshore Wind Farm (hereafter referred to as Dublin Array). It also addresses the proposed methods of construction, operation and maintenance, and decommissioning of the infrastructure.

6.1.2 A summary of the proposed development follows:

- Offshore wind farm infrastructure which will comprise between 39 and 50 number of wind turbine generators (WTGs) with a maximum upper blade tip height (when a rotor blade is in a vertical orientation) of 309.6 m Lowest Astronomical Tide (LAT) and a minimum lower blade tip height of 31.6 m LAT;
- Associated offshore infrastructure including subsea foundations, subsea inter array electricity cables, scour protection, an offshore substation platform (OSP) and offshore electricity export cables;
- Transition Joint Bay (TJB) infrastructure will be located at the proposed landfall location where the offshore export cables will come ashore. The proposed Landfall/TJB is located at Shanganagh Cliffs, Shanganagh;
- The OES is the onshore infrastructure that is necessary to facilitate the operation of the wind farm through the transmission of the electricity generated by the wind farm to the national electricity transmission system. The OES comprises of underground electricity transmission cables, associated fibre-optic communications cables, and the onshore substation (OSS). The proposed OSS will be located adjacent to the former Ballyogan landfill site on Ballyogan Road, Carrickmines. Underground electricity cable circuits will connect the OSS to the existing Carrickmines 220 kilovolts (kV) transmission station operated by ESB Networks and EirGrid; and
- The O&M Base will be located at Dún Laoghaire Harbour which will provide offices and warehouse space, berthing facilities for crew transfer vessels (CTVs) associated with the construction, operation and maintenance of Dublin Array.

6.1.3 This EIAR chapter should be read in conjunction with the following documents;

- Volume 2, Chapter 2: Consents, Policy and Legislation, for details of the policy and regulatory framework for offshore wind development and the consenting process;
- Volume 2, Chapter 3: Environmental Impact Assessment Methodology, for more detail on the methodology which has been used in the assessments which are presented in the EIAR;

- Volume 2, Chapter 5: Consideration of Alternatives, for detail of the alternative locations, technologies, designs, construction methods that have been considered which are relevant to the offshore infrastructure; and

- This chapter should be read in conjunction with all the information, plans, drawings and information accompanying the Application which includes a suite of planning drawings and a Natura Impact Statement (NIS).

6.1.4 This Project Description has informed the EIAR, Supporting Information for Screening for Appropriate Assessment (SISAA) and NIS submitted with the Application, including the elements of Design Flexibility as detailed in Section 6.2 below. Where it is stated in this chapter that certain assumptions and/or parameters are assessed for the purposes of the EIA process, this should be understood as including also for the purposes of preparing the SISAA and NIS, where the context so permits and/or unless stated otherwise in the SISAA and NIS.

6.1.5 Dublin Array will export up to approximately 824 MW of electricity to the national electricity transmission system. At a maximum electrical capacity of 824 MW the wind farm would deliver 24% of Ireland's 2030 offshore wind target of 5 GW[1]. Dublin Array will offset between 1,100,000 and 1,230,000 tonnes of carbon emissions annually and will supply enough renewable electricity to meet the demand equivalent of up to 840,000 average Irish homes.

6.2 Design flexibility

6.2.1 The offshore wind industry is driving rapid developments in advancing new wind turbine technology and innovation in wind farm design. A key component in any wind farm design is the type of WTG selected. This will directly influence foundation design, wind farm layout, cable lengths and routing and the future operation and maintenance strategy. Wind turbine technology is advancing fast with general trend towards larger rotors. The advancement is driven by the need to develop more efficient and economic turbines which deliver the lowest cost of energy to the consumer.

6.2.2 The most efficient WTGs dominating the market today are likely to be replaced by more advanced models in the time frame to deliver Dublin Array. On average it takes four to five years for a new turbine to be taken from concept design to large scale production.

6.2.3 A number of anticipated wind turbines are consequently likely (but not certain) to be commercially available at the time the wind turbines for Dublin Array are procured. Until prototypes are constructed, installed, tested and certified, there is no certainty regarding the date of market entry or data on the relative efficiency, reliability and suitability of each option.

6.2.4 Given the anticipated future changes in the design and availability of wind farm components, with the potential to deliver greater efficiency and reduce environmental impacts, it is not possible to determine the optimum final design configuration for Dublin Array at the current time.

1 The 2024 Climate Action Plan committed to a target of 80% of the national electricity supply to be provided by renewables by 2030, and for at least 5 GW of this to be provided by offshore wind.

6.2.5 An Bord Pleanála (ABP) issued an Opinion under section 287B(2) of the Planning and Development Act, 2000, as amended. (PDA) on 03 December 2024 (Opinion on Flexibility) and confirmed that, due to the specific circumstances of the development, it was satisfied that the proposed development permission application can be made before certain details of the application are confirmed. These details are limited to the following elements of infrastructure;

- Wind Turbine Generator (model):
  - Number of turbines;
  - Maximum rotor diameter (RD);
  - Minimum RD;
  - Maximum blade tip height;
  - Lower blade tip height.
- Offshore Substation Platform:
  - Height (m above LAT);
  - Width;
  - Length.
- Array Layout (wind turbine generator and offshore substation platform):
  - Layout options;
  - Locational Limits of Deviation.
- Foundation Type (WTG and OSP):
  - Foundation types and dimensions;
  - Foundation scour protection techniques.
- Offshore Cables (inter array and export cables):
  - Length and layout;
  - Locational limits of deviation.

6.2.6 The Applicant is seeking development permission for three design options consistent with the Opinion on Flexibility. The details of each design option are set out in this chapter and the parameters for each option have been fully considered and assessed in the EIAR. The EIAR assessment methodology is set out in Volume 2, Chapter 3: EIA Methodology.

6.2.7 Component selection and the final layout of the proposed wind farm will be optimised within the constraints and limitations as set out in the planning application and assessed in the EIAR and any conditions which are attached to the development permission. The components, layout, design, and associated activities of the final development will be selected to ensure that the nature, magnitude, and duration of the environmental effects will not exceed, or be materially different from, those assessed and quantified in this EIAR.

6.2.8 Once development permission is secured, there will be additional post consent verification surveys and investigations undertaken. These surveys will be environmental, archaeological and technical (for example geophysical or geotechnical) in nature. The outputs from these surveys will inform the final detailed design prior to the commencement of construction. Further details on the surveys which have been included in this consent application are outlined in 6.5.19-6.5.21.

Dublin Array design

6.2.9 The design of Dublin Array has established specific parameters to provide a comprehensive environmental assessment of its potential impacts, as detailed in Volumes 2 - 7 of this EIAR.

6.2.10 Informing the development has involved offshore and onshore surveys, design assessments, and multiple design iterations. This process established engineering parameters that enable meaningful analysis for the purpose of the EIA.

6.2.11 The design parameters are assessed in detail within volumes outlined above. Maximum design parameters used for the assessment are also indicated. Where parameters remain unconfirmed at the time of this application, this chapter outlines those details, focusing on aspects with the greatest potential impact on each relevant receptor or group of receptors.

Surveys to inform the design

6.2.12 Offshore surveys were conducted to inform the design include:

- Geotechnical boreholes were carried out in the offshore wind farm array area from April to May 2023;
- Geophysical surveys of the proposed offshore wind farm array area and offshore export cable corridor (Offshore ECC) were conducted from May to August of 2024;
- Site investigation surveys of the nearshore adjacent to the proposed landfall at Shanganagh included 4 boreholes carried out in June 2024;
- Site investigation surveys were carried out from May to June 2024. 26 number vibrocores were carried out in the proposed offshore ECC and array area;
- An ecological and archaeological survey was undertaken using remotely operated vehicle (ROV) equipment in May 2024 in the nearshore area at the proposed landfall site at Shanganagh;

- Geophysical surveys and environmental surveys of the offshore wind farm area and offshore ECC were undertaken between February and May of 2021;
- Wind and metocean measurement campaigns were conducted between June 2021 and January 2023. These included the deployment of a floating LiDAR to record wind data and the deployment of two metocean buoys to record wave and current data.

6.3 Location

6.3.1 Dublin Array is proposed on and adjacent to the Kish and Bray Banks which are located approximately 10 kilometres (km) from shore, immediately southeast of the city of Dublin, off the coast of counties Dublin and Wicklow.

6.3.2 The proposed array area, where the WTGs, OSP, associated foundations and cables will be installed is to be located within an area of approximately 59 square kilometres (km^2).

6.3.3 The offshore export cable circuits will connect the OSP with the onshore transmission system at a landfall proposed to be located at Shanganagh cliffs. The OES is described in further between Section 0 and Section 6.12.

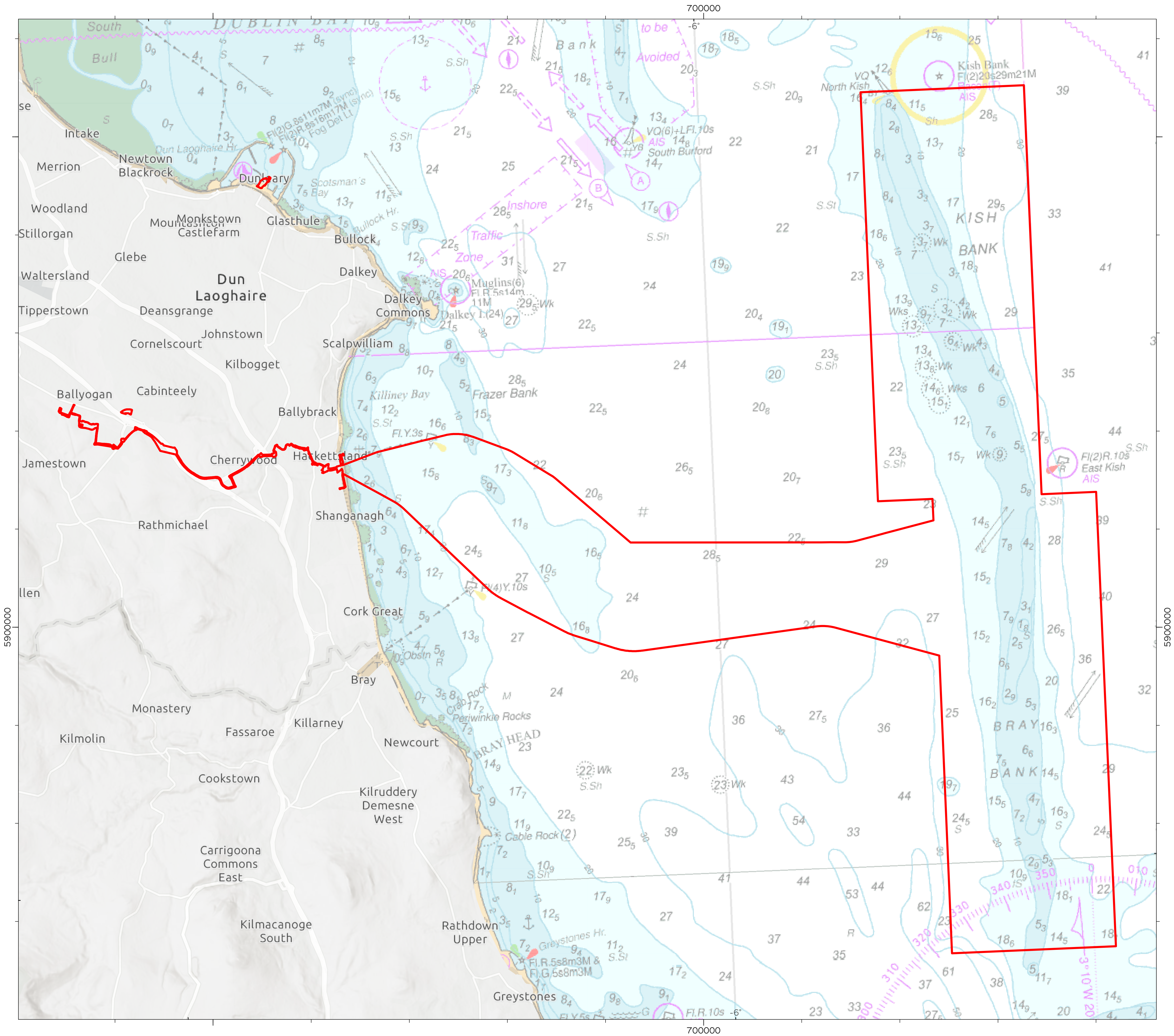
6.3.4 The location of the proposed wind farm array, offshore ECCs and OES are shown in Figure 1.

6.3.5 Although proposed locations and dimensions of the offshore infrastructure (WTGs, OSP and subsea cabling) have been identified in the drawings submitted with the application with strict limits of deviation and have been assessed in the EIAR, their specific positions and dimensions will only be finalised as part of the final procurement and detailed design process. Prior to the commencement of the development, or prior to the commencement of the part of the development to which the detail relates, ABP will be notified in writing of the actual detail of the development.

6.3.6 The temporary occupation area, which is shown on Figure 19, will facilitate the temporary anchoring of vessels required for construction and installation during the construction phase together with the temporary installation of construction navigation marker buoys associated with the installation of WTGs, foundation structures and cables. This is further detailed in Section 6.5.

6.3.7 An O&M Base which will service the offshore infrastructure is proposed to be located at Dún Laoghaire Harbour. This is described further in Section 6.16.

6.3.8 The relevant planning stage drawings detailing the location of all permanent infrastructure proposed as part of this development can be found in Part 2 Planning Drawings of this application.



Planning Application Boundary

DRAWING STATUS
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PROJECT TITLE
Dublin Array

DRAWING TITLE
Overview of Dublin Array Wind Farm Project

DRAWING NUMBER: **005532727-01** FIGURE NUMBER: **6.1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2025-01-10	Ready for release	DB	PM	PK

0 0.6 1.1 1.7 2.2 Kilometres
0 0.3 0.7 1 1.4 Miles

N GRID NORTH

SCALE	1:80,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

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6.4 Offshore elements of Dublin Array

6.4.1 The offshore infrastructure includes:

- Between 39 number and 50 number (No.) WTGs and supporting tower structures depending on the model of turbine selected during the procurement process. The layouts presenting the 50 WTG layout (Option A), 45 WTG Layout (Option B) and 39 WTG layout (Option C) are included in the drawings listed below which have been submitted with this application (Part 2 Planning Drawings);
  - 005059368-08 Site Layout Plans – Offshore Option A (236RD) (Sheet 1 of 4);
  - 005059368-08 Site Layout Plans – Offshore Option B (250RD) (Sheet 2 of 4);
  - 005059368-08 Site Layout Plans – Offshore Option C (278RD) (Sheet 3 of 4).
- WTG foundations with associated secondary steel support, access structures and scour protection[2];
- Up to two meteorological measuring devices mounted on marine buoy(s); and
- Subsea inter array (i.e. within the wind farm) electrical cables connect individual WTGs to each other in strings, and also connect these strings to the proposed OSP.

6.4.2 The offshore electrical transmission assets[3] includes:

- A single OSP, located within the array area;
- Offshore substation foundation with associated support, access structures and scour protection;
- Two submarine electricity export cable circuits (from the offshore substation to land); and
- Cable landfall at Shanganagh Cliffs (near Shankill in County Dublin).

Array layout

6.4.3 The area within which the WTGs, OSP and interconnecting cables will be located is referred to as the Array Area.

2 Scour protection involves placing materials (rocks or concrete mats) around the base of wind turbine foundations to prevent erosion caused by water currents.
3 On completion of construction and commissioning the offshore transmission system will be transferred from the Applicant to Eirgrid, the Offshore Transmission Operator in accordance with Policy Statement on the Framework for Ireland’s Offshore Electricity Transmission System, DECC, 2021.

6.4.4 The layout of the WTGs, OSP and the interconnecting electrical cables are dependent upon a number of factors, including, but not limited to existing ground conditions, wind dynamics, the size of turbines, the presence of marine archaeological and environmental features as well as search and rescue (SAR) lanes.

6.4.5 The wake effect of each turbine in operation affects energy yield and the operability of turbines downwind. Turbine wake effects are greater with larger rotors, which, as a consequence, require greater spacing. It is therefore possible to establish a minimum spacing between turbines, linked to rotor size, as well as the need for appropriate SAR lanes, which prevents clustering in any area of the site. While spacing between turbines may be irregular across the array, the minimum centre-to-centre distance is 944 m subject to any micro-siting correction for individual turbines as may be required based on specific ground and seabed conditions at any particular location. This flexibility also allows for the optimization of energy yield, reduction of wake effects, and adherence to operational and safety requirements, including maintaining adequate SAR lanes and facilitating safe navigation in the vicinity of the wind farm.

6.4.6 The range between the upper and lower limits of the size and quantity of offshore infrastructure associated with each of the three design options are provided in Figures 4-6. The following layout principles have been adopted in all scenarios:

- To facilitate safe navigation in the vicinity of the wind farm and to ensure that all aspects of the development are proposed in the area assessed as part of this EIAR, all wind farm structures, including rotor swept areas, will be located wholly within the Maritime Area Consent (MAC) boundary. There will be no permanent infrastructure located outside the MAC boundary;
- SAR lanes will be aligned across the array area running approximately southwest to northeast and will maintain a minimum width of 500 m between the tips of the turbine blades;
- The final locations of the proposed WTGs and OSP will be within a maximum of 350 m from the locations identified in the three layout options to allow for any unforeseen circumstances or changes arising from procurement, detailed design or installation planning and execution. The locational limit of deviation is consistent with the Opinion on Flexibility issued by ABP, and reflects the potential need to relocate infrastructure in circumstances where;
  - Previously unrecorded archaeology is identified and needs to be avoided. An archaeological exclusion zone (AEZ) will be applied around the find. The extent of the AEZ will be agreed with the Underwater Archaeology Unit, DHLGH.
  - Previously unrecorded sensitive ecological habitat is identified, and micro-siting will facilitate avoiding it; and/or
  - Prevailing ground conditions at the intended location of installation necessitate a move based on the final turbine and foundation detailed design.

Wind turbine generators

6.4.7 The proposed development will comprise of between 39 and 50 No. WTGs dependent on outcomes from the procurement process and the availability of WTG technology in the market.

6.4.8 Each WTG will consist of a tower, nacelle and three rotor blades, supported and fixed to the seabed by means of a foundation. Subject to the detailed design, a transition piece may be used, which acts as the interface between the turbine and the foundation, however, not all foundation designs require a transition piece to be installed. Refer to Figure 2 for details of a WTG.

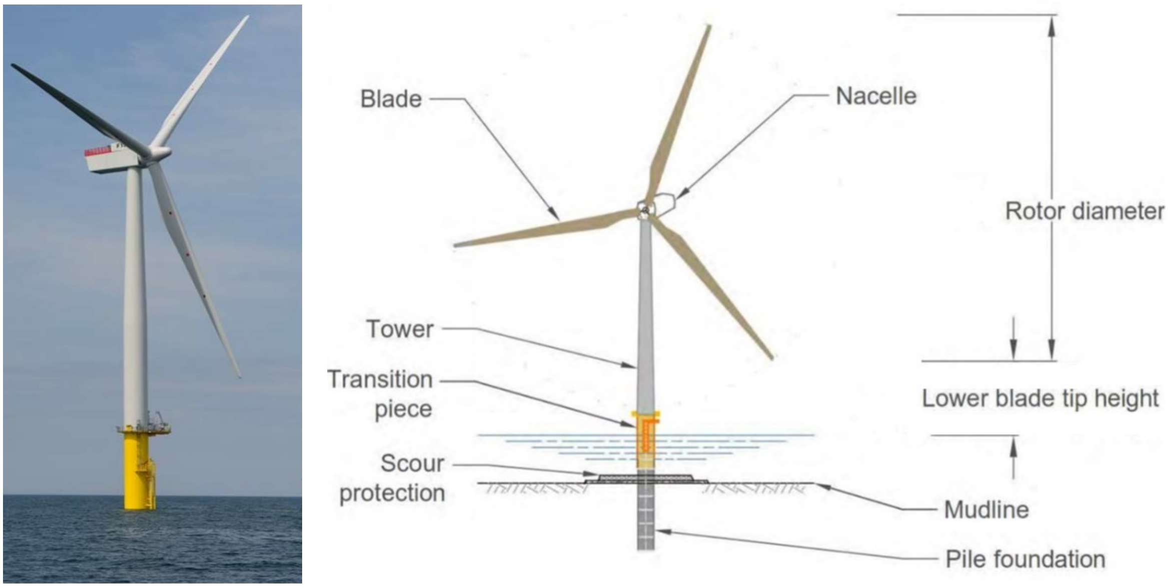


Figure 2 A typical offshore wind turbine generator mounted on a monopile foundation (*not to scale)

6.4.9 The WTG tower is the component which supports the nacelle and rotor. It also gives the necessary height for the WTG to efficiently capture the most energy. The tower structure is likely to consist of up to four tapering steel tubular sections, which are lifted into place and bolted together. Each tower section will arrive on location with pre-installed internal fittings, thus aiding the secondary installation phase.

6.4.10 The nacelle will sit on top of the tubular support tower. The nacelle houses the electro-mechanical elements of the WTG which convert rotational motion of the rotor blades into electrical energy. Figure 2 illustrates the main components of a WTG. Refer to Figure 3 for details of a nacelle.

6.4.11 The rotor will be attached to the nacelle. The energy from the wind turns the rotor and provides the rotational motion to the generator within the nacelle. Increasing the rotor blade length allows more energy to be extracted from the passing wind through a greater swept area. The blades can be feathered or twisted (i.e. changing their pitch) to maintain a particular speed. The nacelle can turn on its horizontal axis so that the rotor blades are positioned to optimise wind capture.

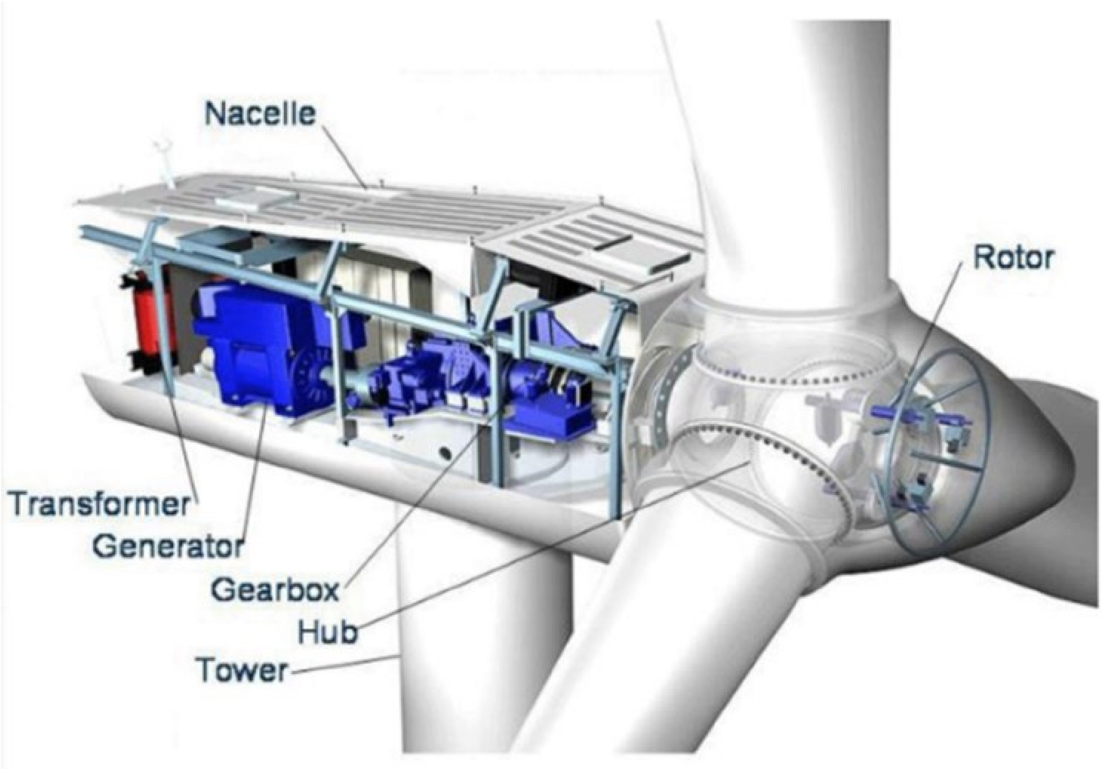


Figure 3 Schematic of the principal components of a nacelle (*not to scale).

6.4.12 An elevation of the three design options proposed for the development are presented in Figure 4 – 6.

6.4.13 A drawing illustrating the difference in size of the three WTG options which are the subject matter of the planning application has been provided in Part 2 Planning Drawings of this application. Refer to '22164-GDG-ZZ-XX-DR-C-1003 - Overlayed WTG - Scale Comparison Plan and Elevation View'.

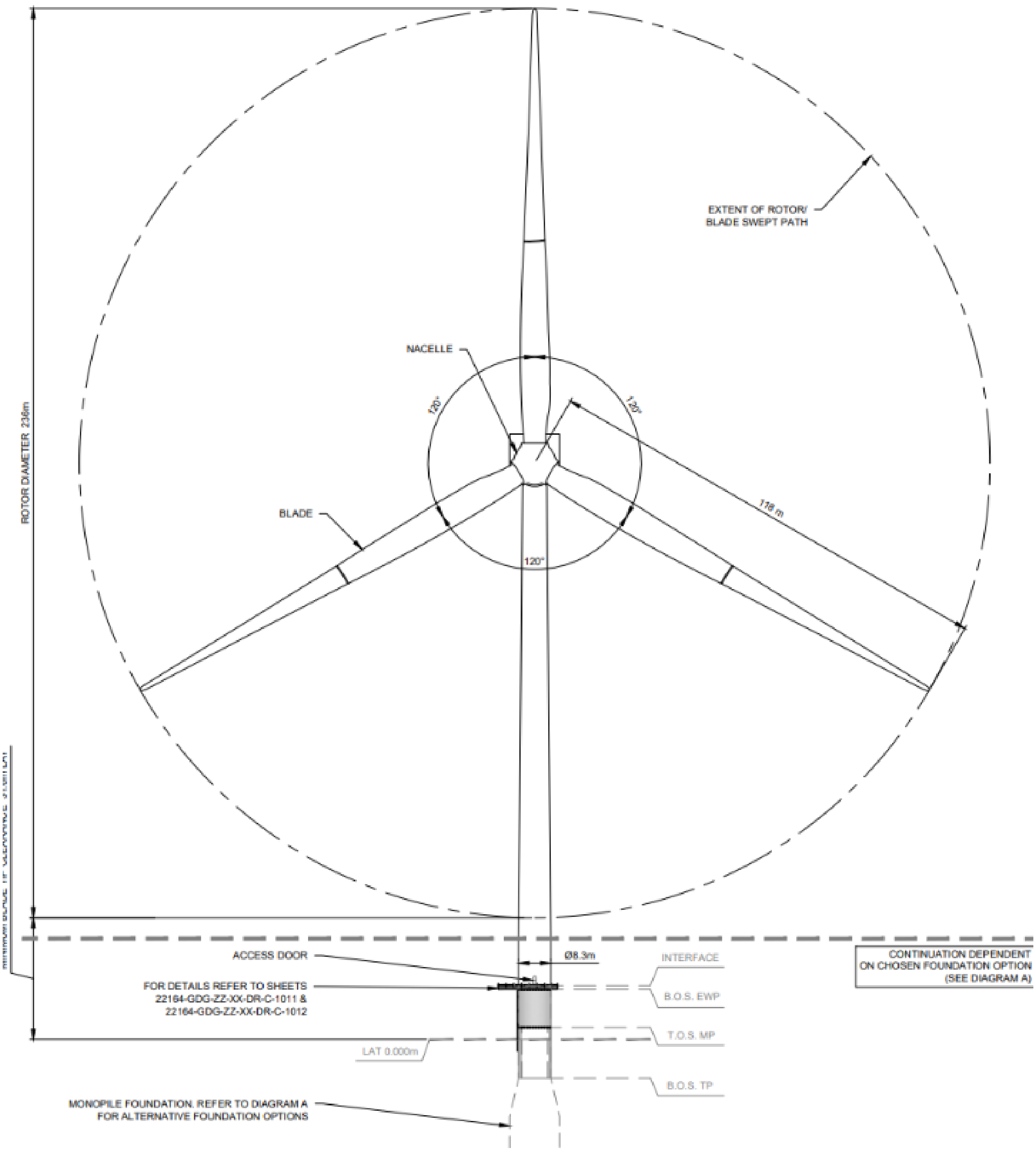


Figure 4 WTG Option A Wind Turbine Generator (236 m Minimum Rotor Diameter) (Refer to drawing 22164-GDG-ZZ-XX-DR-C-1000)

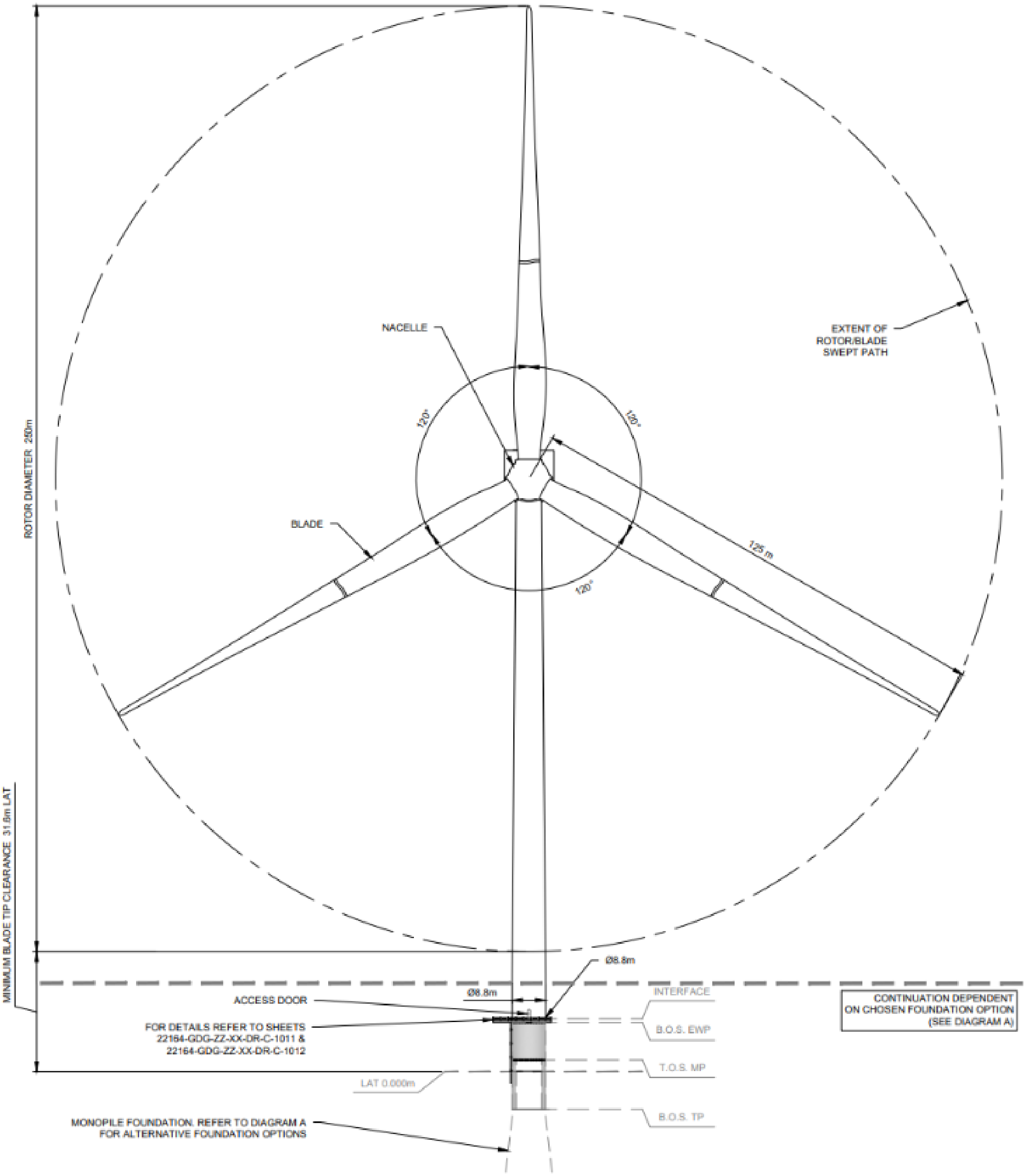


Figure 5 WTG Option B Wind Turbine Generator Swept Area (250 m Minimum Rotor Diameter) (Refer to drawing 22164-GDG-ZZ-XX-DR-C-1001)

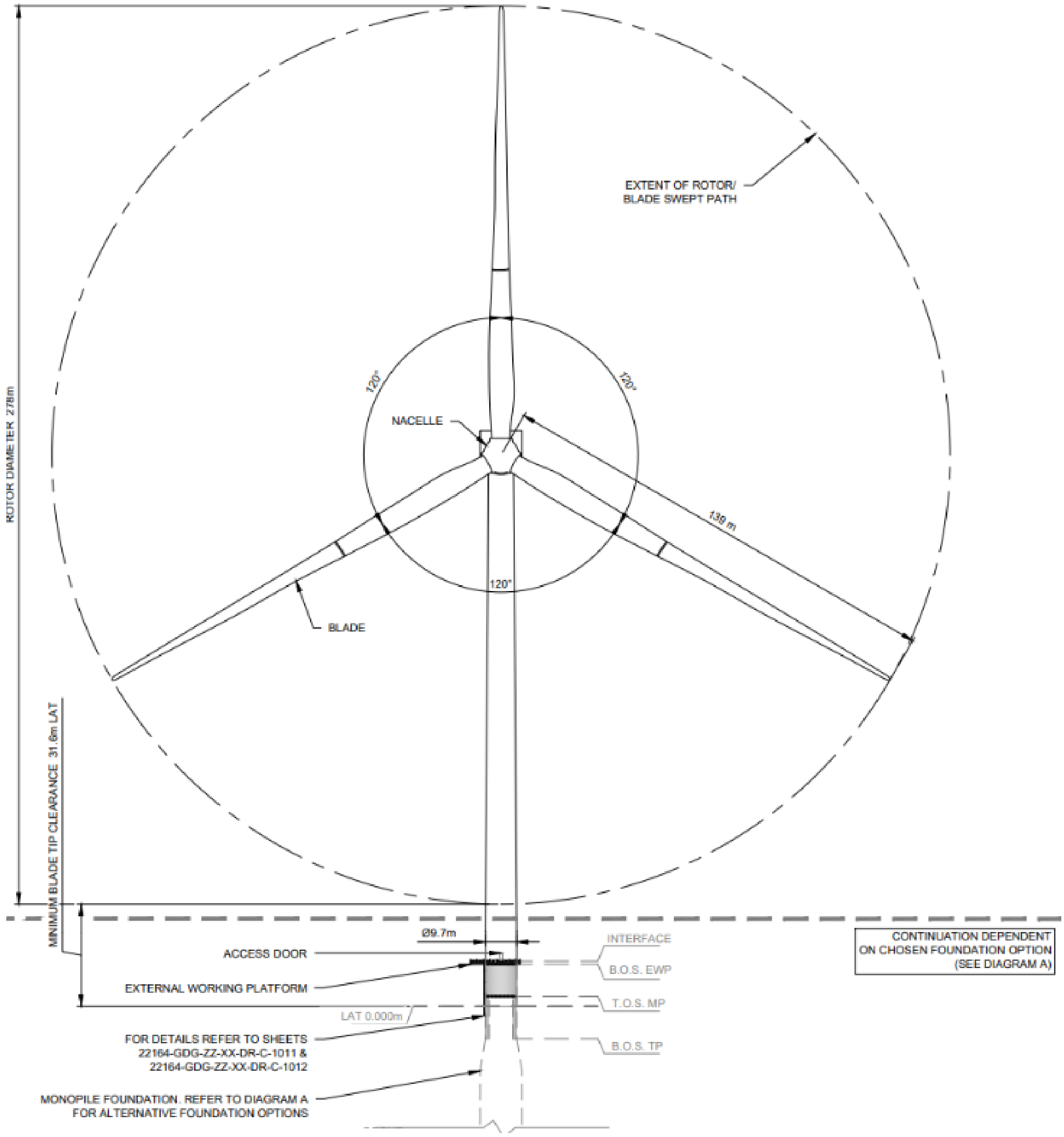
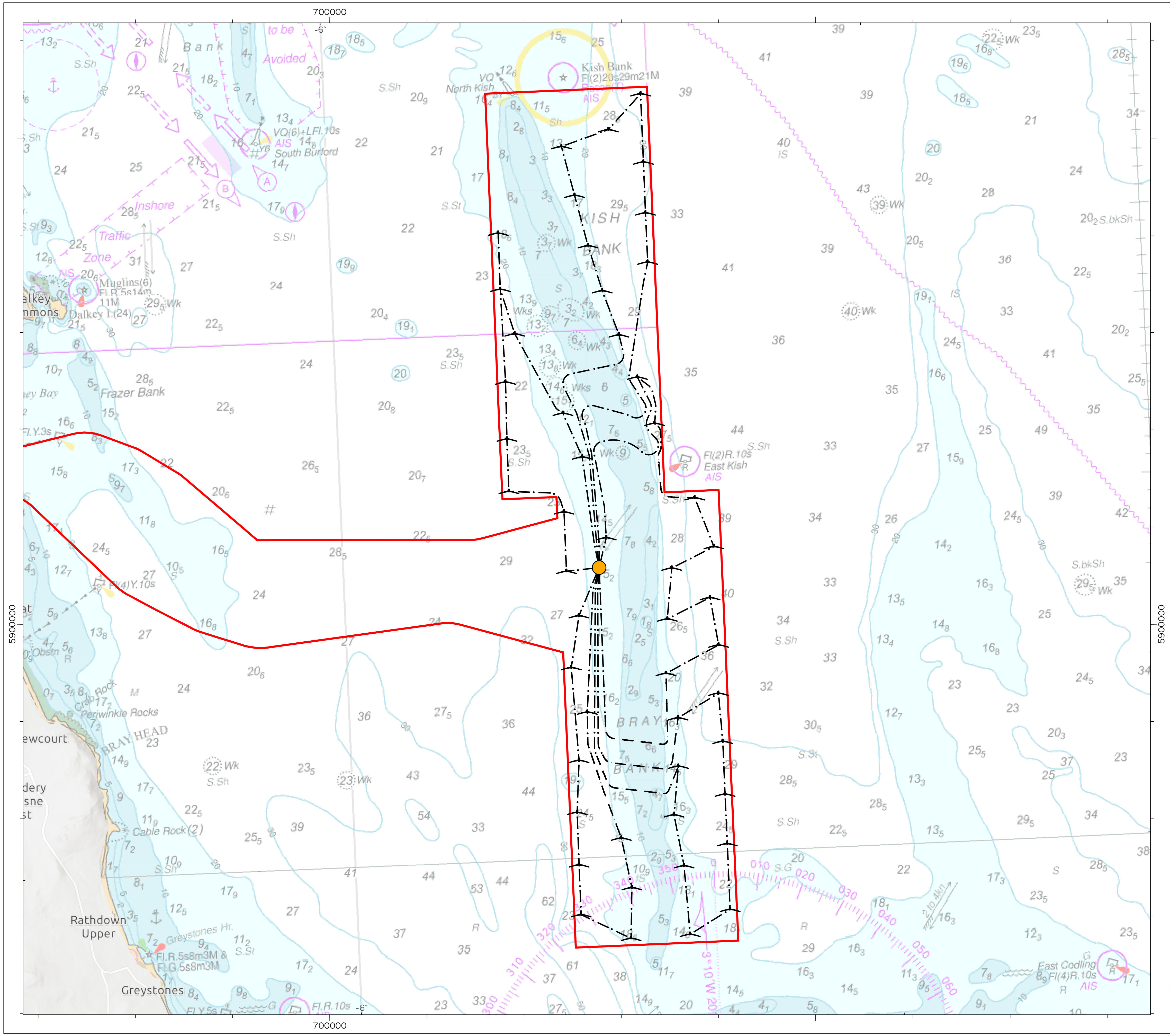


Figure 6 WTG Option C Wind Turbine Generator Swept Area (278 m Maximum Rotor Diameter) (Refer to 22164-GDG-ZZ-XX-DR-C-1002)

6.4.14 Plans of the three design options are shown in Figure 7-9. The locational limits of deviation for each plan are presented in the drawings referenced in 6.4.1.



- Planning Application Boundary
- Wind Turbine Generator (WTG)
- Inter-array Cables (IAC)
- Offshore Substation Platform (OSP)

DRAWING STATUS **PUBLIC**

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PROJECT TITLE **Dublin Array**

DRAWING TITLE **Site Layout Plans Offshore Option A (236RD)**

DRAWING NUMBER: **005532727-01** FIGURE NUMBER: **6.7**

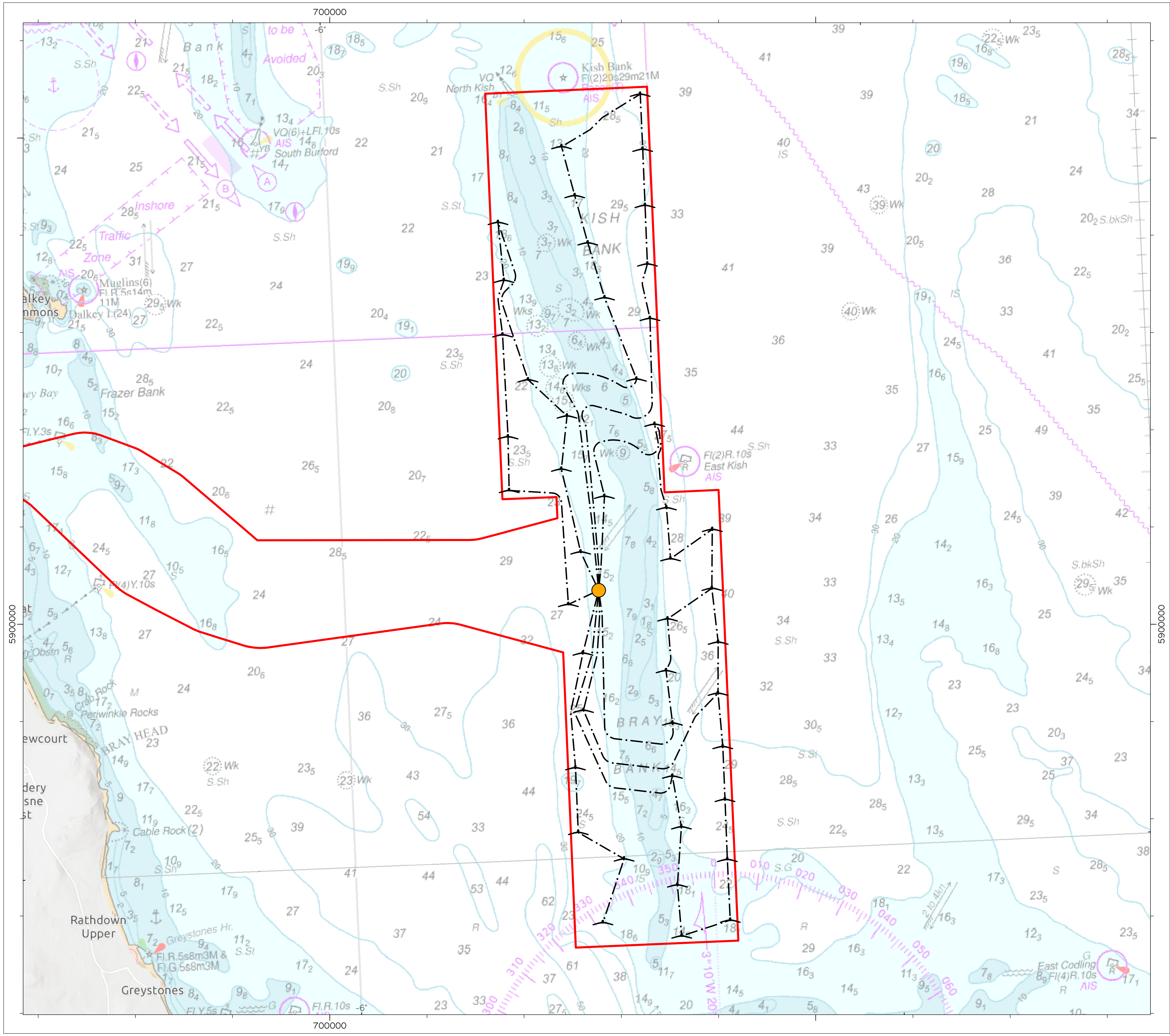
VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2025-01-10	Ready for release	DB	PM	PK

0 0.6 1.1 1.7 2.2 Kilometres
0 0.3 0.7 1 1.4 Miles

N GRID NORTH

SCALE	1:80,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

Dublin Array
Generation for generations
Kish Offshore Wind Limited - Bray Offshore Wind Limited



Planning Application Boundary
Wind Turbine Generator (WTG)
Inter-array Cables (IAC)
Offshore Substation Platform (OSP)

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PROJECT TITLE
Dublin Array

DRAWING TITLE
Site Layout Plans
Offshore Option B (250RD)

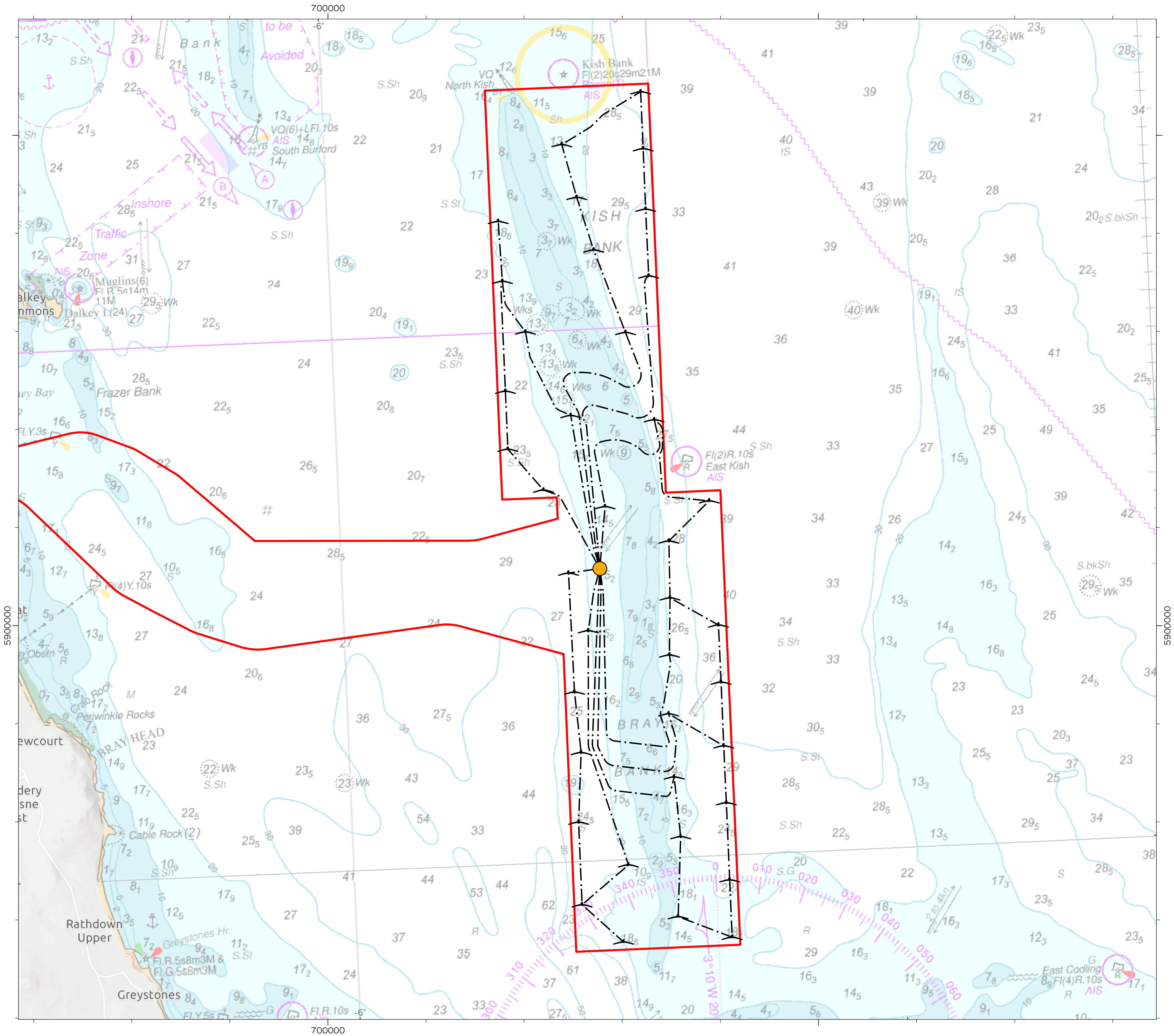
DRAWING NUMBER: **005532727-01** FIGURE NUMBER: **6.8**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2025-01-10	Ready for release	DB	PM	PK

0 0.6 1.1 1.7 2.2 Kilometres
0 0.3 0.7 1 1.4 Miles

SCALE	1:80,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

Dublin Array
Generation for generations
Kish Offshore Wind Limited - Bray Offshore Wind Limited



- Planning Application Boundary
- Wind Turbine Generator (WTG)
- Inter-array Cables (IAC)
- Offshore Substation Platform (OSP)

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PROJECT TITLE
Dublin Array

DRAWING TITLE
Site Layout Plans
Offshore Option C (278RD)

DRAWING NUMBER: **005532727-01** FIGURE NUMBER: **6.9**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2025-01-10	Ready for release	DB	PM	PK

0 0.6 1.1 1.7 2.2 Kilometres
0 0.3 0.7 1 1.4 Miles

SCALE 1:80,000 PLOT SIZE A3
DATUM WGS 1984 VERTICAL REF LAT
PRJ WGS 1984 UTM Zone 29N

Dublin Array
Generation for generations
Kish Offshore Wind Limited - Bray Offshore Wind Limited

6.4.15 The WTGs will bear safety markings and Aids to Navigation (AToN), such as lighting and sound alarms in accordance with Commissioners of Irish Lights (CIL) and Irish Aviation Authority (IAA) requirements, and any other statutory safety agency's specifications. This is further described in Section 6.5.

6.4.16 WTGs function over a wide range of wind speeds and will operate automatically. They are self-starting when the wind speed is sufficient, typically 2 metres per second (m/s) and shutting down automatically to protect themselves from structural damage when the maximum operational wind speed is reached (in storm conditions), approximately 35 m/s.

6.4.17 Since the specific dimensions of the WTGs to be procured cannot yet be confirmed, this is why three turbine class options (Option A, B, and C) are proposed. Consistent with the Opinion on Flexibility, these options represent the expected WTGs available at the time of order placement and define the maximum and minimum dimensions for which approval is sought. The final selection will be influenced by technological, commercial, and market factors. The final turbine hub height will depend on the selected turbine model.

6.4.18 Table 1 provides the key numbers and dimensions of the three WTG models under consideration for the development and for which development permission is being sought.

Table 1 WTG parameters

Item		Parameters		
		Option A Turbine	Option B Turbine	Option C Turbine
1	Rotor diameter (m)	236	250	278
2	Maximum number of turbines (per turbine class)	50	45	39
3	Maximum rotor diameter (m)	278		
4	Minimum rotor diameter (m)	236		
5	Minimum lower blade tip height (m above LAT)	31.6		
6	Maximum upper blade tip height (m above LAT)	309.6		

6.4.19 As a general rule the electrical generating capacity of WTGs increases with Rotor Diameter (RD) and therefore the larger the RD the fewer WTGs are required to meet the target electrical output of the wind farm. The spacing between WTGs also increases in proportion to the RD, to offset the associated increase in turbine wake effects.

6.4.20 Each WTG foundation will include a boat landing system and an external working platform to facilitate access to the WTG by technicians. Internal access will be provided within the tower structure to provide access to the nacelle.

6.4.21 The WTG towers and blades will be coloured light grey (RAL7035), and the foundation structure will be coloured yellow to a minimum distance of 15 m above Highest Astronomical Tide (HAT) for navigational purposes.

6.4.22 The WTGs will typically contain the oils and fluids outlined in Table 2 for ongoing safe operation and maintenance. The quantities described illustrate the maximum normal amount contained within the WTG systems required for correct operation. No oils or fluids are routinely stored in the WTG which are not already part of the system.

6.4.23 Some of these substances will be intended to last the life of the machine, others will be replaced during planned periodic service intervals. Dependant on their purpose this could be annually, every 5 years or sometimes longer.

Table 2 Quantities of oils and fluids per WTG

Material type	Quantity (l) 236 RD	Quantity (l) 250 RD	Quantity (l) 278 RD
Greases	780	819	1086
Drive Train Oil	3,000	3,150	4,205
Hydraulic Oil	1,500	1,575	2,142
Nitrogen	98,000	102,900	137,340
Coolant	17,700	18,585	24,780
Transformer Oil	10,500	11,025	14,730

Ancillary systems

6.4.24 In addition to the components listed above, the structure may also be fitted with a number of ancillary systems. This includes, but is not limited to:

- Navigation lighting;
- Fog horns;
- Identification symbols;
- Lighting for operations at night or in low light;
- Cranes, davits, or hoists;
- Cooling or air conditioning systems;
- Security alarm system;
- Fire protection systems; and
- Back-up power systems.

Offshore structure foundations

6.4.25 Foundation structures are required to securely support the WTGs and the OSP in a vertical position while withstanding physical loads (forces) from the wind and the marine environment. The foundation structures also provide means of safe access to and from the infrastructure.

6.4.26 A wide range of foundation options are available for the offshore infrastructure. The final foundation options will be chosen based on the selected WTGs and OSP taking account of key factors such as seabed conditions, water depth, wind, wave and current regime and economic factors. Consistent with the Opinion on Flexibility the actual details of the foundations to be used will be notified to ABP prior to the commencement of development of that part of the proposed development.

6.4.27 The foundation types which have been short-listed include:

- Monopile;
- Multileg (of which there are two sub-options):
  - Driven or drill-piled multileg; or
  - Suction bucket multileg.

6.4.28 Planning stage design drawings (including layouts and elevations) have been provided in Part 2 Planning Drawings of the planning application with consent being sought for either a monopile or multi-leg foundation solution or a combination of both across the development.

Monopile foundations

6.4.29 The term monopile is used to describe the foundation options based around a single vertical, broadly cylindrical structure. This main support structure may change in diameter across its length via conical tapers.

6.4.30 Monopiles, indicated in Figure 10, are normally constructed from welded steel tubular sections. The monopiles are typically vibrated and/or impact driven into the seabed by a crane-mounted hammer and are designed to be driven to the desired penetration depth to secure the turbine.

6.4.31 Alternatively, piles may be installed by drilling into the seabed or by a combination of driving and drilling. Further detail of pile installation techniques is provided in 6.5.70 below.

6.4.32 The installed pile supports the weight of the WTG or OSP primarily by means of the frictional force between the pile walls and the seabed. The monopile relies on the surrounding geology to provide lateral resistance to the horizontal forces of the wind and the sea. The diameter and length of the monopile required depends on water depth, the prevailing met ocean conditions, the ground conditions, and the size of the WTG or OSP chosen. The foundation design parameters are provided in Table 3.

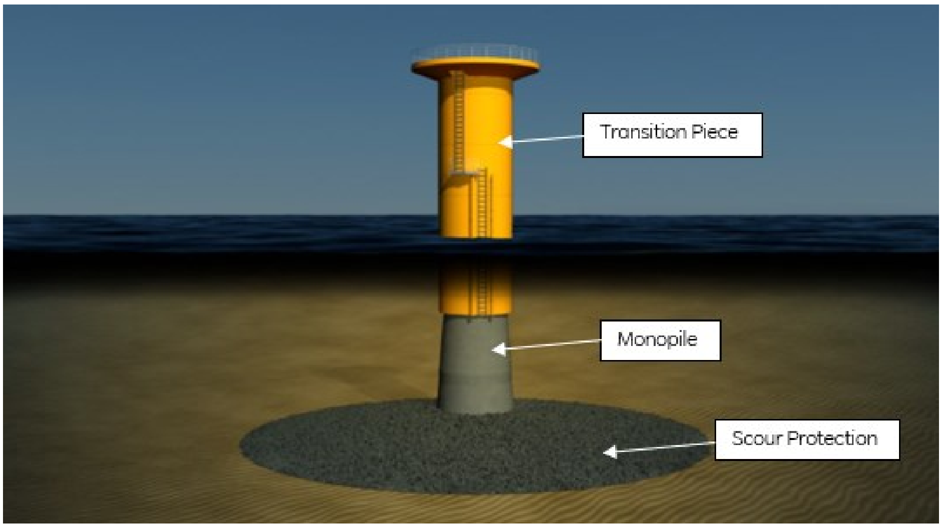


Figure 10 Illustrative example of a monopile foundation supporting a transition piece.

(Source – Forewind Limited, Dogger Bank Teeside A & B)

Table 3 Monopile foundation dimensions

Parameter	OSP	Option A WTG Layout	Option B WTG Layout	Option C WTG Layout
Maximum number of monopiles	1	50	45	39
Maximum individual pile diameter (m)	11	12	13	13
Maximum pile penetration depth (m)	55	60	60	60

Multileg foundations

6.4.33 The term multileg refers to foundations with multiple legs or footings that support structures made up of several large tubular elements, cross-bracing, or lattice frameworks. The multileg options which are under consideration for WTG foundations include three or four legged structures, either supported with driven/drilled piles or with suction bucket footings.

6.4.34 The OSP foundation may also comprise of four legs, each of which supported by a suction bucket or by driven piles at each leg.

Driven or drill piled multileg foundations

6.4.35 Driven or drilled piles are the most commonly used multileg footing. The piles are cylindrical structures, normally constructed from welded steel tubular sections. The piles support the weight of the WTG or OSP primarily using friction between the pile walls and the seabed. The piles rely on the surrounding geology and the separation of the legs of the multileg tower to provide resistance to the horizontal forces of the wind and the sea. The diameter and length of the piles depend on the tower geometry, water depth, the prevailing metocean conditions, the seabed conditions, and the size of the WTGs and OSP which the foundation supports.

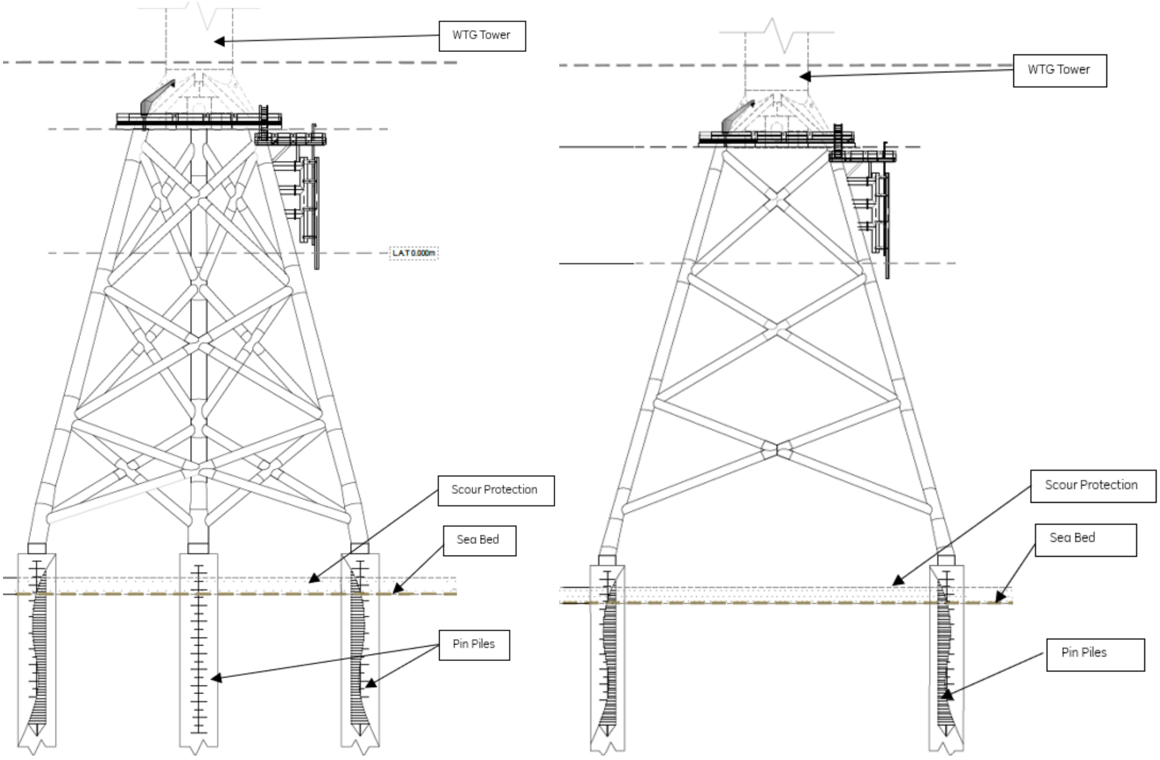


Figure 11 Example of three and four multileg foundations supporting a WTG tower

Table 4 WTG driven or drill-piled 3-legged foundation parameters

Parameter	Option A WTG Layout	Option B WTG Layout	Option C WTG Layout
Maximum number of foundations	50	45	39
Maximum number of piles	150	135	117
Maximum individual pile diameter (m)	4.75	5.25	5.75
Maximum pile penetration depth (m)	70	70	70
Maximum width of foundation at seabed (m)	44.75	50.25	50.75

Table 5 OSP and WTG driven or drilled 4-legged foundation parameters

Parameter	OSP	Option A WTG Layout	Option B WTG Layout	Option C WTG Layout
Maximum number of foundations	1	50	45	39
Maximum number of piles	12	200	180	156
Maximum individual pile diameter (m)	6	4.5	5.0	5.5
Maximum pile penetration depth (m)	55	70	70	70
Maximum width of foundation at seabed (m)	51	44.5	50	50.5

Suction bucket multileg

6.4.36 Multileg suction buckets are cylindrical, or near cylindrical-shaped structures, similar to inverted buckets, which are inserted into the seabed and attached to the base of the foundation main structure.

6.4.37 Supporting brace structures link the bucket to the structure and provide strength and stiffness to the bucket itself. Ballast may be required within the main structure to ensure resistance of uplift forces during operation.

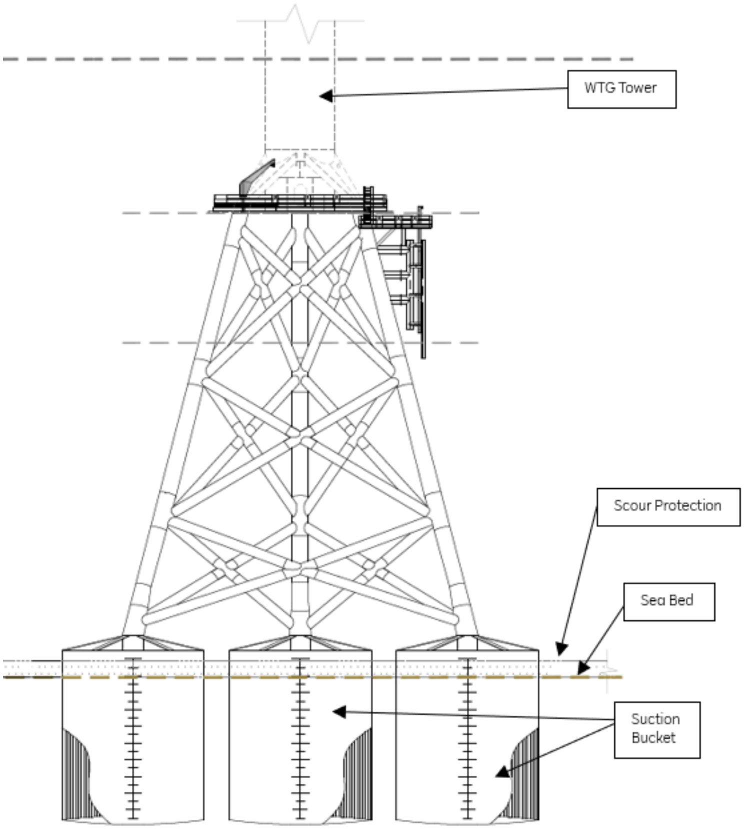


Figure 12 Example of a 3-legged suction bucket foundation supporting a WTG Tower

Table 6 OSP and WTG 4-legged Suction Bucket foundation parameters

Parameter	OSP	Option A WTG	Option B WTG	Option C WTG
Maximum number of foundations	1	50	45	39
Maximum number of Suction Buckets	4	200	180	156
Maximum Suction Bucket diameter (m)	15	15	17	18
Maximum Suction Bucket penetration depth (m)	15	15	17	18
Maximum width of foundation at seabed (m)	37.5	55	62	63

Table 7 OSP and WTG 3-legged Suction Bucket foundation parameters

Parameter	OSP	Option A WTG Layout	Option B WTG Layout	Option C WTG Layout
Maximum number of foundations	Not Applicable	50	45	39
Maximum number of Suction Buckets	Not Applicable	150	135	117
Maximum Suction Bucket diameter (m)	Not Applicable	17	19	20
Maximum Suction Bucket penetration depth (m)	Not Applicable	17	19	20
Maximum width of foundation at seabed (m)	Not Applicable	57	64	65

Additional foundation components

6.4.38 Foundation structures include a range of additional components, some or all of which may be incorporated within a specific foundation design. The key components are described below.

Transition piece

6.4.39 The transition piece (if used) acts as the interface between the tower of the WTG and the foundation. It also serves other purposes, including housing electrical and communication equipment, mounting various ancillary components such as vessel access facilities, main access platforms, and J-tubes if required. The use of a transition piece is optional and turbine foundation designs exist for which they are not required.

6.4.40 Transition pieces (if used) can be integrated at fabrication stage with the foundation but are typically craned into position and connected to the foundation structure after installation via grouted or bolted connections.

J-tubes

6.4.41 J-tubes are tubes that route and protect cables as they travel up the foundation from the seabed to the base of the WTG tower or OSP topside. The tubes are generally curved at the bottom of the foundation structure as it supports the cable as it transitions between travelling horizontally along the seabed to vertically up the foundation.

6.4.42 Additional cable protection system (CPS) may be deployed to ensure the cable is adequately protected in the approach to the respective J-tube and will be determined during the detailed design stage once ground conditions and metocean conditions are fully investigated in pre-construction surveys.

6.4.43 The J-tubes can be housed internally or externally to the foundation structure. The use of J-tubes is optional, and turbine and offshore substation foundation designs exist where they are not required.

Corrosion protection systems

6.4.44 All structures will be equipped with measures for corrosion protection[4]. Corrosion control methods will include the installation of cathodic protection systems, application of protective coatings, and the use of corrosion-resistant materials. Additionally, a corrosion allowance will be factored into the design of all steel structures.

6.4.45 It is anticipated that steel structures will primarily be protected by a combination of cathodic protection and coating systems (paint) that are appropriate for seawater exposure. Steelwork which is permanently submerged is commonly protected by a cathodic protection system of a sacrificial anode type[5] or impressed current cathodic protection (ICCP)[6]. In addition, protective coating systems (such as paint systems, or galvanisation) are commonly applied for protection in the splash zone and above. Areas of steelwork in the submerged and splash zones may also be coated in order to reduce the load on the cathodic protection system.

6.4.46 The selection of the appropriate corrosion protection method will be made during the procurement and detailed design of the structures.

Vessel access system

6.4.47 The design of vessel landing facilities, access ladders, personnel access and rest platforms are driven by the type of vessel or personnel transfer system anticipated to be used in the O&M strategy. Access systems may also be used by third parties as a refuge in emergency situations. WTGs commonly have either one or two vessel landings providing access to the structure.

6.4.48 Access systems are likely to include some combination of the following:

- Access ladders will enable maintenance crew to access the WTGs and OSP from a vessel.

  On some foundation types, stairways may replace ladders for parts of the climb;

- A permanent fender system located on either side of the lower section of the ladders which provides for safe access by personnel from a small vessel;

- Safety equipment, such as fixed inertia reel fall arrest systems are installed to support safe operations while the maintenance personnel undertake works at heights;

- Intermediate access, rest platforms or other safety equipment is installed to assist the personnel.

4 Prevents corrosion by converting all of the anodic (active) sites on the metal surface to cathodic (passive) sites by supplying electrical current (or free electrons) from an alternate source.
5 A sacrificial anode prevents corrosion of a more valuable metal by corroding itself. It is deliberately chosen because it has a more negative electrochemical potential, causing it to corrode instead of the protected metal.
6 ICCP systems use an external power source to deliver protective current to the structure, ensuring adjustable and long-lasting protection against corrosion.

Main access platform

6.4.49 The main access platform is a key element of a WTG structure, frequently located at the top of the foundation and the base of the WTG tower. The platform forms the main working area at the base of the tower and often includes an integral laydown area for spare parts and equipment prior to being lifted up to the nacelle of the WTG. The platform will also be used to mount davit cranes or hoists.

Offshore substation platform

6.4.50 It is proposed to install a single OSP within the array area. The OSP will receive power from the WTGs via inter array cables (IAC). Transformers located on the OSP will increase the voltage of the power received from the WTGs from 66 kV to 220 kV so that the electricity can be efficiently transmitted to shore and onwards to connect to the electricity transmission network.

6.4.51 The OSP will consist of two main parts, the foundation (described in section 6.4.25 to 6.4.37) and the topside which will be installed onto the top of the foundation which will house electrical equipment and other infrastructure required for supporting functions.

6.4.52 The OSP foundation will consist of either a monopile, jacket or suction bucket design. This is dependent on the selected suppliers design specification and will be designed by structural and foundation engineers at detailed design stage.

6.4.53 The topside will consist of a multideck arrangement. Decks will either be open, with modular equipment housings, or the structure will be fully or partially enclosed by means of weather-proof cladding. All weather sensitive equipment will be placed internally in the modular equipment housings.

6.4.54 The specific dimensions of the OSP will only be available following procurement and detailed design which will take place after development permission is secured. Therefore, in accordance with the Opinion on Flexibility from ABP, permission is being sought on the basis of a maximum and minimum range of dimensions of the OSP. Full details of this range are outlined in Table 8 and are also shown on the planning drawings included in Part 2 Planning Drawings of the planning application.

Table 8 Offshore substation platform design parameters as per relevant drawings

Design parameters	
Array side nominal voltage range (kV)	66 kV
Export side nominal voltage range (kV)	220 kV
Minimum topside width (m)	30
Maximum topside width (m)	45
Minimum topside length (m)	30
Maximum topside length (m)	45

Design parameters	
Minimum topside upper elevation above LAT (m)	30
Maximum topside upper elevation (including plant, Equipment, structures and telecommunications mast) above LAT (m).	55

6.4.55 Due to uncertainty in relation to the turbine electrical generating capacity (arising from the potential to avail of turbine technology more effective or efficient than that which is available at the time of application) there are a number of items of primary electrical equipment on the OSP which could potentially change. These potential changes in electrical equipment can also, for some individual items, result in a necessary change to the OSP structure and/or supporting steelwork in order to accommodate the electrical equipment change.

6.4.56 An example is demonstrated in the sizing of the main electrical transformers resulting from a change in the MVA (mega-volt ampere) rating. This could change the size and weight of the transformers (core and tank) and potentially the number of cooling radiators. As a consequence, potential changes to the OSP structure may result from the need for additional steel strengthening and dimensional modifications. In addition, changes to electrical generating capacity can also influence the sizing and weight of switch-room modules and cable management systems with associated change to the OSP structure as necessary.

6.4.57 Reference design drawings (including layouts and elevations) are included in the application for development permission, refer to drawings '200584-LYT-L-2001-01' to '200584-LYT-L-2001-06' in Part 2 Planning Drawings of the planning application documentation. These drawings show a typical number of decks, and the range and scale of plant and equipment such as gas insulated switchgear, transformers, earthing resistors, cabinets, switchboards, diesel generator(s), and ancillary welfare facilities, refuges, access ladders/staircases. While the exact dimensions and locations of these items on the platform are a matter of technical detail, permission is sought for the development within the specified maximum and minimum dimensions of the topside.

6.4.58 The final number of decks, locations, and dimensions of plant, equipment, and ancillary infrastructure will be determined during the detailed design stage post development permission being granted, but the maximum dimensions of the structure will align with the Opinion on Flexibility as issued by ABP.

6.4.59 An example of an OSP is shown below in Figure 13.

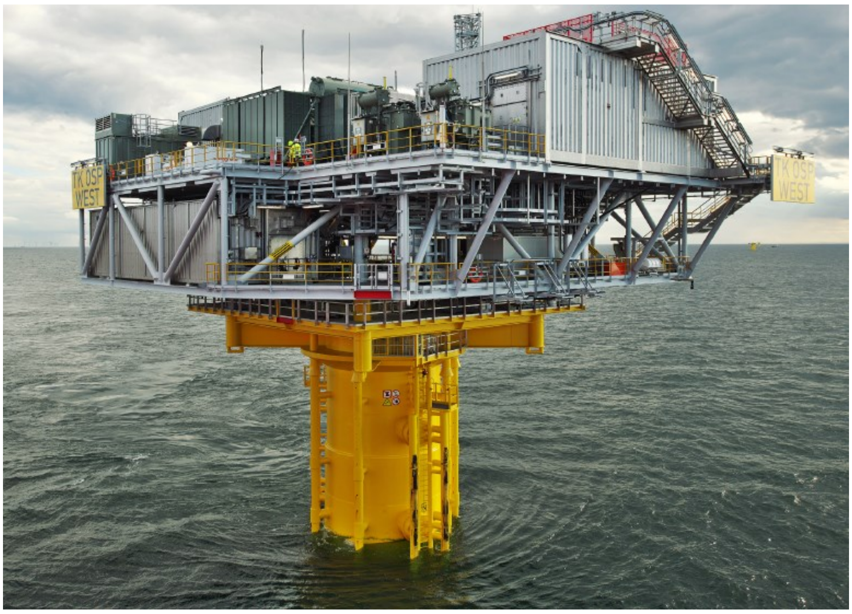


Figure 13 An example of an offshore substation platform on monopile foundation, Triton Knoll Offshore Wind Farm (RWE).

6.4.60 The OSP topside will include:

- Medium Voltage (MV) to High Voltage (HV) step-up power transformers;
- MV and HV switchgear;
- Instrumentation, metering equipment and control systems;
- Standby generators;
- Power storage systems (including batteries), plus associated systems;
- Auxiliary and uninterruptible power supply systems;
- Navigation, aviation and safety marking and lighting;
- Systems for vessel access and/or retrieval;
- Potable water storage;
- Waste water separation;
- Storage facilities (fuel, and spare parts and equipment);
- Offshore accommodation and mess facilities;
- Emergency refuge point for personnel;
- Emergency refuge for third party mariners landings, separate from operational areas;

- Cranes; and
- Communication systems and control facilities.

6.4.61 The OSP will contain the following oils and fluids;

- Transformer oil is required in transformers as an insulator and coolant;
- Diesel fuel for the emergency diesel generator;
- Sulphur hexafluoride (SF6) is required for the gas insulated chamber as an insulator;
- Glycol coolant for the High Voltage Alternating Current (HVAC) system for heat transfer;
- Batteries to provide back-up power supplies in the event of loss of AC power; and
- Grey water is required for washing purposes.

Table 9 Quantities of oils and fluids to be stored in the OSP during the operation phase

Material type	Quantity
Transformer Silicon/ester oil (t)	300
Diesel fuel (l)	3,000
Sulphur hexafluoride (SF6) (kg)	2,000
Glycol coolant (l)	250
Batteries (kg)	5,000
Water (l)	4,000

Offshore cables

6.4.62 Offshore submarine electricity cables transmit the electricity generated by the WTGs to shore via the OSP. Fibre-optic cables, serving the wind farm control systems, are integrated within the offshore power cables to provide data transmission capability. Offshore cables will also provide power to the ancillary systems of the offshore structures.

6.4.63 A schematic showing a typical arrangement of offshore cables is shown in Figure 14. The offshore cables are grouped into the following categories:

- IACs, connecting each wind turbines to each turbine to form strings with each string connecting to the OSP.

6.4.64 Offshore export cables will connect the OSP to the TJB at the landfall onshore, where they are jointed to the onshore export cables.

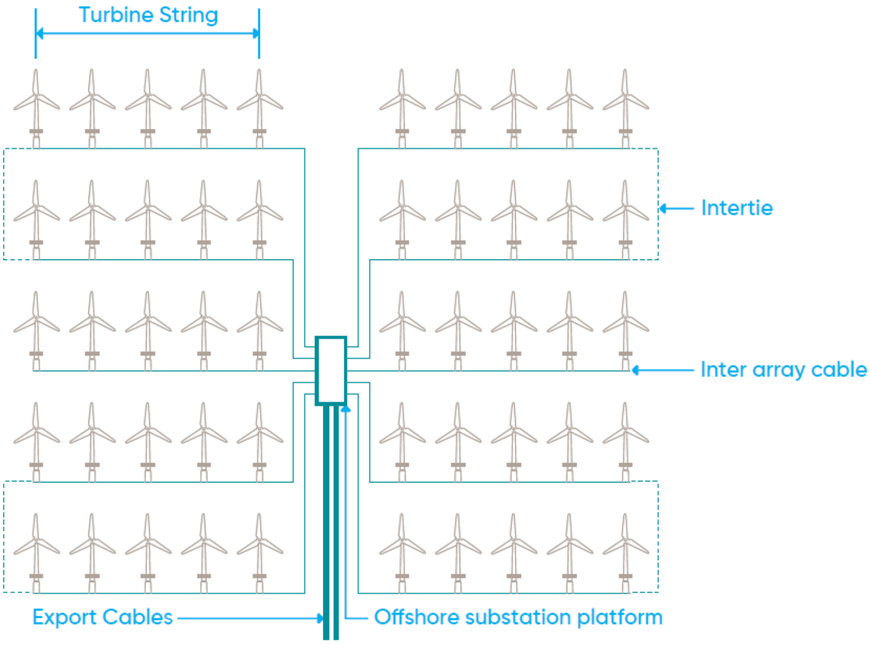


Figure 14 Typical offshore wind farm cable schematic

6.4.65 Two TJBs will be located at Shanganagh Cliffs, which will be the location where the offshore cables are jointed to the onshore export cables. Further details of the TJB can be found in Section 6.9.53.

Inter array cables

6.4.66 The HVAC inter array cabling will collect the electricity generated by the WTGs and transfer the electricity to the OSP. In addition, the IACs will connect the WTGs to the wind farm control system via embedded data cables. Inter-ties will be used to connect strings of IACs to provide alternative routing of electrical power. This will provide greater resilience to the electrical system and together are referred to as the IAC system.

6.4.67 IACs are typically three-core, with a metallic conductor of either copper or aluminium and are suitable for subsea installation. Fibre-optic cables are integrated into the cable bundle to transmit data for the wind farm control systems. Submarine three-core cables are protected by one or more armouring layers, typically made of steel wires, to reduce the risk of damage due to accidental impacts. It is estimated that the IACs will have an overall external diameter of up to 220 mm, depending on the final electrical design. The nominal operating voltage of the IAC system will be 66 kV.

6.4.68 A screen contained within the cable sheath confines the electrical field in the cable. The magnetic field from the cable is considered negligible, with a magnetic field of less than 15 µT at less than 1 m above the cable. The cables will not contain oil or similar toxic materials which could be released into the environment.

6.4.69 The final design and layout of the IAC system will depend on a range of factors, including the wind turbine array layout, environmental considerations, detailed electrical design, seabed conditions and detailed micro-routing requirements. The maximum combined length of all inter array cabling will not exceed 120 km.

6.4.70 It is intended that the IACs will be buried between 0.6 m and 3 m below the undisturbed seabed, however, where the target burial depth cannot be achieved or if the cable is laid on the seabed, secondary protection measures may be applied. Refer to planning drawing '22164-GDG-ZZ-XX-DR-C-1013 - Subsea Cable Burial and Protection Details' for further details on cable burial.

6.4.71 The IACs will be located within 'corridors' 700 m in width between turbines and the approaches to the OSP as indicated in the planning drawings. This locational limit of deviation in the application is consistent with the Opinion on Flexibility. The need for a 700 m wide corridor (i.e. approximately 350 m either side of the indicative cable alignment) is to make allowance for avoiding previously unrecorded archaeology which may be encountered, sensitive ecological habitat or constraints, which may arise from unforeseen ground conditions at the intended WTG installation locations, based on the final selected turbine and foundation configuration.

Export cables

6.4.72 Two HVAC export cables will transfer the electricity from the OSP to the TJBs at the onshore landfall and onto the national electricity transmission grid via the onshore electrical system (OES). The nominal operating voltage of these cables will be 220 kV AC. The maximum combined length of the export cabling between the OSP and the landfall will be between 26 km and 37 km for both export cables (depending on the final route of both cables within the export cable corridor).

6.4.73 The export cables will have a diameter of up to 330 mm. A screen contained within the cable sheath confines the electrical field in the cable. The magnetic field from the cable is less than 30 µT at 1 m above the cable which is considered negligible. They will not contain oil or similar toxic materials which could be released into the environment.

6.4.74 The proposed development includes two 1 km wide export cable 'corridors'. Both of these export cable corridors merge and widen on the approach to the array area to a combined corridor of approximately 2.8 km in width. The export cable corridors converge and narrow on the approach to shore at the landfall to approximately 250 m in width. The two export cables will be installed in just one of the corridors, as shown in Figure 16.

6.4.75 This flexibility will allow the final cable routing to minimise effects on mobile sand waves (i.e. extent of sand wave clearance), previously unrecorded ecological or archaeological features, the configurations of which will need to be verified in pre-construction/installation surveys. In addition, it provides flexibility for final routing to consider efficiency of installation tools which may be available from specialist contractors at the time of installation.

6.4.76 It is intended that the export cables will be buried between 1.5 m and 3 m below the undisturbed seabed, however, where the target burial depth cannot be achieved or if the cable is laid on the seabed, secondary protection measures may be applied. Refer to drawing '22164-GDG-ZZ-XX-DR-C-1013 - Subsea Cable Burial and Protection Details' for further details on cable burial. Refer to Section 6.5 for details relating to installation methodologies for subsea cables. Figure 15 shows a typical subsea cable cross section.

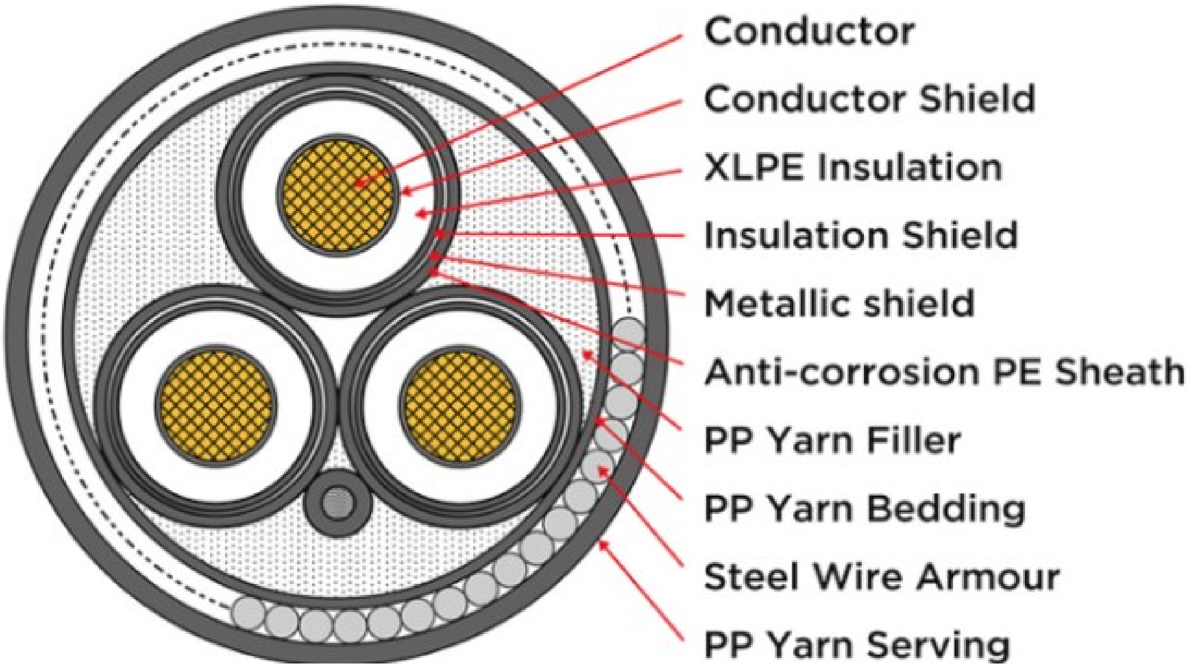
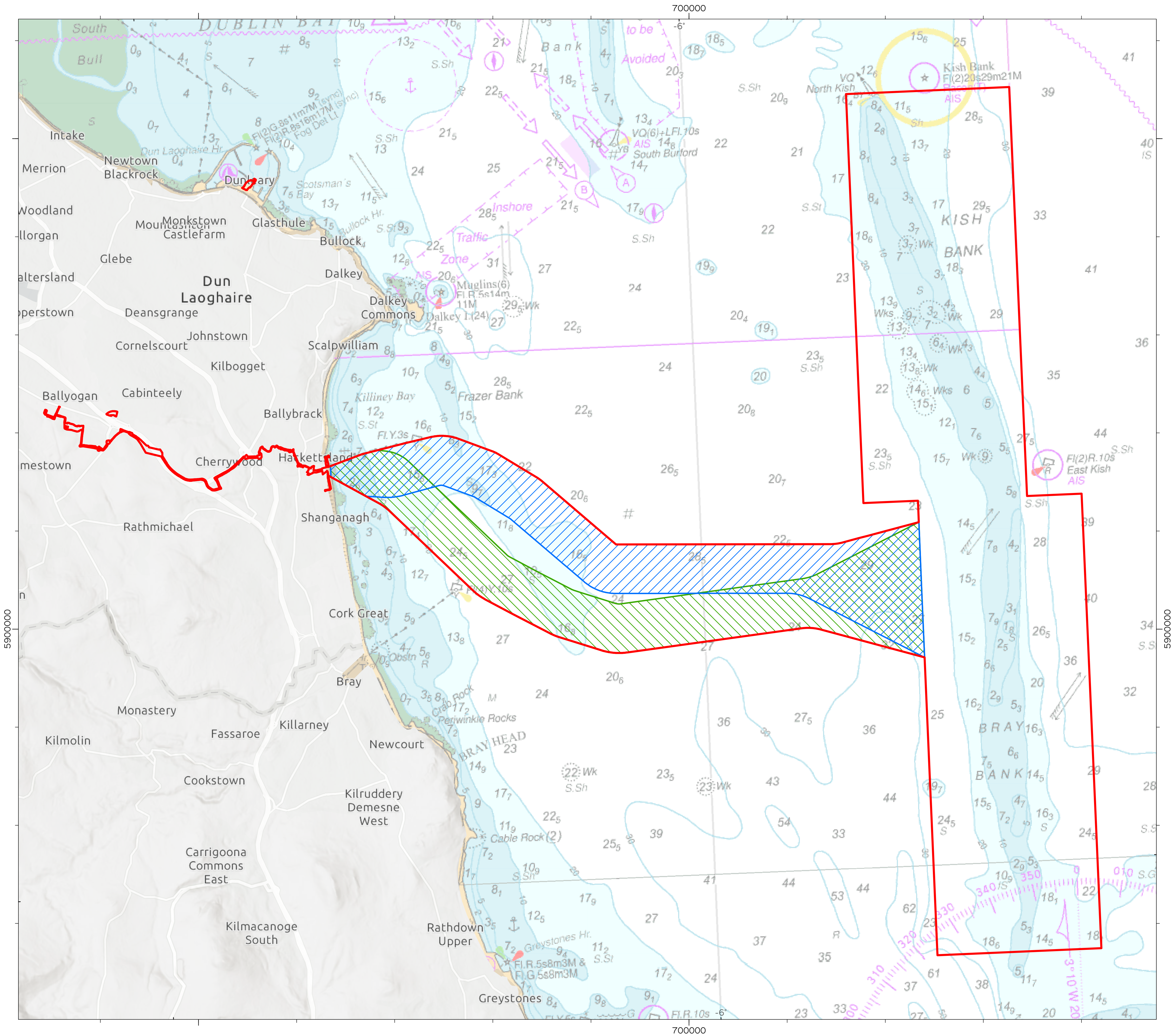


Figure 15 Typical subsea cable cross-section



Planning Application Boundary
Northern Export Cable Corridor; OR
Southern Export Cable Corridor

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PROJECT TITLE
Dublin Array

DRAWING TITLE
Proposed Export Cable Corridors

DRAWING NUMBER: 005532727-01
FIGURE NUMBER: 6.16

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2025-01-10	Ready for release	DB	PM	PK

0 0.6 1.1 1.7 2.2 Kilometres
0 0.3 0.7 1 1.4 Miles
N GRID NORTH

SCALE	1:80,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

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Cable protection systems

6.4.77 Offshore cables will, where possible, be buried in the seabed to the optimal performance burial depth for the specific ground conditions. In some cases, where burial cannot be applied, or where the minimum cable burial depth cannot be achieved, as part of the installation methodology it is necessary to use alternative methods such as rock placement, concrete mattresses or other solutions such as Cable Protection Systems (CPS), flow dissipation devices, bagged solutions or protective aprons to protect the cable from external damage. It should be noted that cable burial is the preferred method of installation, and additional cable protection will only be used as a contingency where cable burial is not appropriate or achievable.

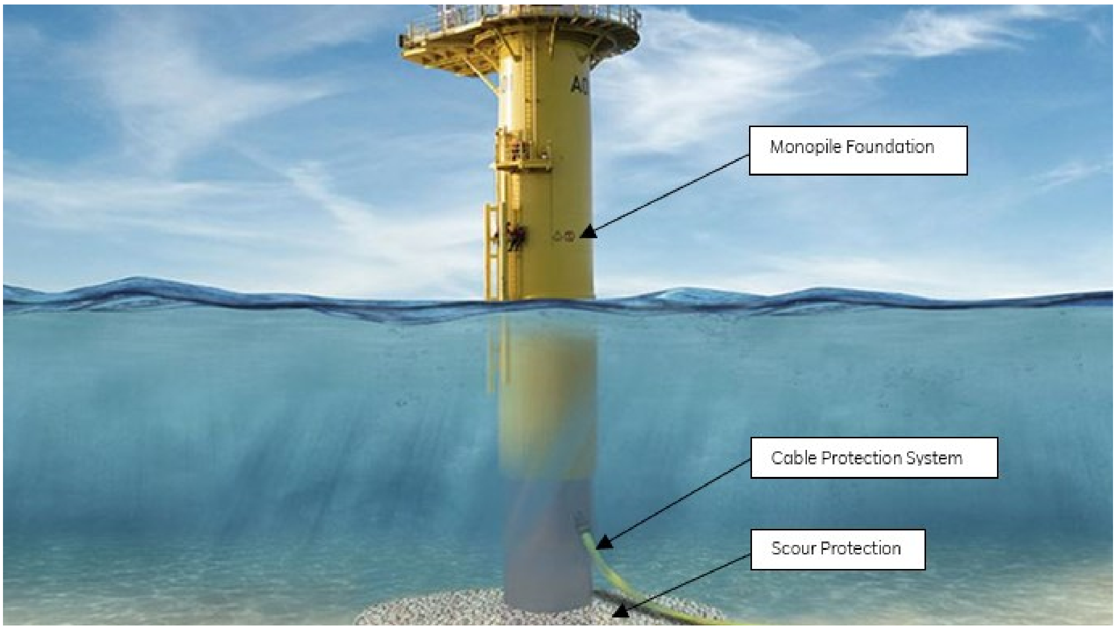


Figure 17 Example of cable protection system for a monopile foundation (Source: www.trelleborg.com)

Scour protection

6.4.78 Scour protection will be installed to prevent foundation structures being undermined by hydrodynamic and sedimentary processes, resulting in seabed erosion and subsequent scour pit formation. The shape of a foundation structure is an important parameter in influencing the potential depth of scour pits, as well as the local hydrodynamic regime and seabed sediment conditions. Scour around foundations is mitigated by the use of scour protection measures, which include concrete mattresses, bagged solutions (containing rock/gravel or similar), protective aprons/coverings, and flow energy dissipation devices (such as frond mats). The most common type of scour protection is the placement of loose crushed rock around the base of the foundation. This is detailed further in section 6.5.48 to 6.5.55 below.

6.4.79 The scour protection can either be installed before or after the foundation is installed. A typical scour protection solution may comprise a rock armour layer resting on a filter layer of smaller graded rocks. Alternatively, by using a heavier rock material with a larger gradation, it is possible to avoid using a filter layer and install a single layer of scour protection.

6.4.80 The quantity of scour protection required will vary depending on the foundation type selected. Flexibility in scour protection choice is required to ensure that anticipated changes in available technologies and foundation design can be accommodated within the design. Consistent with the Opinion on Flexibility the final choice of scour protection solution will be made post-consent in the detailed design phase, taking into account geotechnical data, meteorological and oceanographic conditions, water depth, foundation type and maintenance strategy.

6.4.81 A Scour Protection Management Plan (SPMP) will be developed prior to construction for all offshore infrastructure which will include details of the need, location, type, quantity and installation methods for scour protection which will be undertaken in accordance with the design options, quantities & methods described in this chapter. The details of the scour protection will be notified to ABP prior to the commencement of that part of the development.

Offshore moorings

6.4.82 During the construction stage and operation and maintenance of the wind farm, a variety of vessels will be used to support offshore activities. Mooring buoy equipment (2 no.) will be located in the array area to allow vessels to moor. Mooring equipment can be used in a variety of circumstances, including at night, during lower levels of work, to optimise fuel efficiency while station keeping, or in the event of machinery failures.

6.4.83 Each vessel mooring will consist of a single floating buoy, fabricated from steel or plastic. An example of a typical single buoy mooring can be seen in Figure 18.

6.4.84 Each mooring buoy will be approximately 6 m in diameter and have a draught of approximately 3 m. The height of the buoy above sea level is dependent upon the design selected but is expected to be approximately 2 m.

Figure 18 Example of a single mooring buoy equipment (photograph courtesy of Det Norske Veritas)

6.4.85 A floating line, 5 to 10 metres in length, will be attached to each mooring. This line can be picked up by an approaching vessel that intends to moor at the buoy. Before the vessel is secured to the buoy using a hawser, mooring loops, hooks, or other appropriate systems for a wind farm vessel, the floating line will be utilized. The hawser, which is a line attached to the buoy, will have a length of approximately 2.5 times the water depth at the mooring location.

6.4.86 Each mooring buoy will be equipped with navigational features similar to the FLiDaR as described in paragraph 6.5.23.

6.4.87 The buoys will be fixed to the seabed by a system of one or more anchors (up to six), of the following types:

- Drag anchors (the 'traditional' anchor);
- Plate anchors;
- Suction pile anchors;
- Gravity anchors.

6.4.88 Each anchor will be attached to the mooring buoy by means of a catenary chain, with a diameter of 0.2 to 0.4 m and a length five times the water depth at that location. Approximately three fifths of the chain length will sit on the seafloor.

6.4.89 The drag anchor will have a maximum width of 7 m and penetrate the seabed from 3 m to 6 m. The maximum anchor drag during installation is 80 m.

6.4.90 A gravity anchor has the greatest cross-sectional area a with a diameter of approximately 11 m and a height of between 2 m to 3 m. The total cross-sectional area of a single gravity anchor, associated chain and mooring buoy is 172 m².

6.4.91 Mooring buoy equipment deployment will entail the buoy being floated to site by a suitable anchor handling tugboat (hereafter referred to as a 'tug') with the anchors and associated equipment loaded on the deck of a tug. Once in position the first anchor will be attached to the chain and over-boarded. The chain, attached to a work wire, will be released in sections using a winch. Once the anchor reaches the seabed the vessel will either move away to embed the anchor or will hold position whilst the winch will be in use to achieve embedment. The chain is then attached to the mooring and the work wire removed. The process is repeated for each anchor.

6.5 Offshore construction, operation and maintenance

6.5.1 Offshore construction will generally follow the sequence as set out below. A number of these activities may overlap temporally with each other and coordinated as necessary, with the onshore construction activity:

- Installation of scour protection at foundation locations if required (this may be carried out before or after foundation installation);
- Installation of offshore substation foundation;
- Commencement of turbine foundation installation;
- Installation of offshore substation topside;
- Commencement of turbine installation;
- Installation of cable ducts at landfall;
- Installation of export cables to shore;
- Commencement of inter array cabling installation;
- Commissioning of each string of turbines; and
- Final commissioning.

6.5.2 The offshore construction programme is dependent on several factors, including the availability and lead times for procuring and installing project components. It is anticipated that the offshore construction duration could range from 18 months to 30 months. An overview of a typical offshore construction programme is provided in Table 10, which assumes a 24-month duration.

6.5.3 Specialist contractors shall be appointed to undertake the offshore infrastructure. Therefore, some flexibility is required in the offshore programme to account for contractor and vessel availability. Offshore works will take place 24 hours per day.

6.5.4 Construction of the OES will commence approximately 12 months before the offshore works. This approach helps ensure that the necessary infrastructure, such as substations, cable landfall points, and grid connections, is in place to receive and distribute the power generated offshore. Having the onshore facilities ready first allows for seamless commissioning and testing once the offshore turbines and cables are installed.

6.5.5 An overview of the expected onshore construction programme is given in Section 6.13.

Table 10 Overview of typical offshore construction programme

Activity	Month																						
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Seabed Preparation																								
Foundation (WTG & OSP) installation																								
Export cable lay, burial & Commissioning																								
OSP topside installation & Commissioning																								
Installation of offshore export cable at Landfall (trenchless installation)[7]																								
IAC lay, burial & Commissioning																								
WTG installation & commissioning																								
Commercial Operations Date																								

7 Refer to "Overview of typical Anticipated Construction Programme for the Onshore Electrical System Works" in Section 6.13 for anticipated programme for the installation of offshore export cable ducts at Landfall.

Construction port

6.5.6 The port requirements during the construction phase of the offshore infrastructure comprise of an assembly/marshalling port or use of existing port infrastructure for the key infrastructure components with the provision of a co-ordination base (Dún Laoghaire Harbour). Some components will be brought directly to site from their port of origin. Table 11 lists the ports with existing available space and infrastructure to support assembly/marshalling activities.

6.5.7 On completion of the O&M Base, it will be used for the management of the construction, operation & maintenance and decommissioning phases of Dublin Array. Refer to Section 6.16 for more details.

6.5.8 The ports used for load out of components for transport to the Dublin Array site will be located in proximity to fabrication facilities internationally. Other ports will function as marshalling ports for storage and fit-out and preassembly activities and therefore are more likely to be located within the Irish Sea region.

6.5.9 Specific ports to be utilised for load-out/assembly/marshalling or storage will be dependent on the contractor(s), vessel(s) and detailed design of the construction methodology selected to undertake the works and are therefore currently unknown. Notwithstanding the above there are a wide variety of existing ports internationally and across Europe with existing appropriate space and infrastructure to support the construction of Dublin Array.

6.5.10 The assembly/marshalling port(s) selected will require the following:

- Availability of sufficient marine port space, berthing, deep water and mooring capabilities to accommodate the required heavy lift, construction support, and logistical/transportation vessels;
- Adequate laydown area for pre-assembly and load-out operations;
- Equipment such as cranes to move the relevant components;
- Accessible transportation links and access by water, road or rail; and
- Continuous operational availability (24 hours) during the life of the construction stage.

Table 11 Potential load-out/assembly/marshalling ports

Port	Distance to Development	
	km	Nautical mile
Belfast, Northern Ireland	204	110
Cork, Ireland	288	155
Rosslare, Ireland	120	65
Mostyn, Wales	440	235
Holyhead, Wales	89	48
Port of Tyne, England	790	1460
Hull, England	780	1440
Rotterdam, Netherlands	706	1310
Eemshaven, Netherlands	840	1560
Esbjerg, Denmark	1,900	1,030

Construction vessel activities

6.5.11 During offshore construction, a wide range of vessels will be required. These will include a combination of the following types:

- Large and medium crane vessels, both floating (using Dynamic Positioning (DP) or anchor spreads[8]) and jack-up type;
- Logistics, transportation and feeder vessels[9];
- Tug boats and anchor handling vessels;
- Accommodation vessels;
- CTV for all phases of the development and operations;
- Dredging, seabed preparation, and aggregate handling vessels;
- Diving support vessels;
- Guard vessels;
- General offshore and subsea construction vessels, along with their associated ROVs;

8 In the context of constructing an offshore wind farm, an 'anchor spread' refers to the arrangement and placement of multiple anchors around a vessel or barge to secure it in position.
9 In the context of constructing an offshore wind farm, a 'feeder vessel' refers to a support vessel that transports turbine components, such as blades, towers, and nacelles, from onshore ports or staging areas to the offshore installation site.

- Cable installation and maintenance vessels, and;
- Survey vessels, suitable for the range of pre and post-construction survey activities.

6.5.12 The specific details of the vessels to be used, including their total numbers and movements, will not be finalized until the selection of the WTG and construction contracts are awarded. The WTG selection influences the technical specifications, installation techniques, and the types of vessels required. The selection of vessels is further influenced by the deployment strategy, the capabilities of suppliers and contractors, development timelines, regulatory considerations, environmental constraints, weather conditions, logistical challenges, economic factors, and supply chain logistics.

6.5.13 Table 12 provides vessel numbers for the purposes of the EIA process which assumes for each construction element that there are two vessel spreads[10], which will give rise to the greatest number of construction vessels. It is possible, but unlikely that each construction package will use the maximum quantity of vessels.

6.5.14 Not all construction activities will occur simultaneously, the number of vessels operating simultaneously at the peak is estimated to be 66. The total number of round trips between the Dublin Array site and the selected construction port(s) over the construction phase is estimated to be approximately 2,638 over a maximum of 30 months.

10 In the context of constructing an offshore wind farm, a 'vessel spread' refers to the array of ships and marine vessels deployed to support various aspects of the development. This includes vessels for transporting equipment, installing turbines, laying cables, providing maintenance, and offering support services.

Table 12 Typical construction vessel numbers

Vessel type	Total No. of vessels	No. of round trips to port for all vessels in spread.
Foundation Installation Vessels		
WTG foundation installation vessels (includes tugs and feeders)	18	75
OSP foundation installation vessels		
Rock Placement Vessels		
Scour protection installation vessels (including filter layer and seabed preparation)	1	405
Wind Turbine & OSP Installation Vessels		
WTG installation vessels (includes tugs and feeders)	16	156
OSP topside installation vessels	8	12
Cable Installation Vessels		
Array cable installation vessels (includes support, cable protection and anchor handling vessels)	7	56
Export cable installation vessels (including at landfall) (includes support, cable protection and anchor handling vessels)	8	32
Other Installation Vessels		
Commissioning/Accommodation vessels	1	78
Other (including CTVs, guard vessels and support vessels)	7	1,824
Total	66	2,638

6.5.15 Dependent on vessel capabilities, vessels maybe required to deploy anchors into the seabed or jack-up into position. This is to provide a secure and stable working position whilst undertaking construction activities such as crane operations or the installation of foundations or cables.

Temporary occupation area

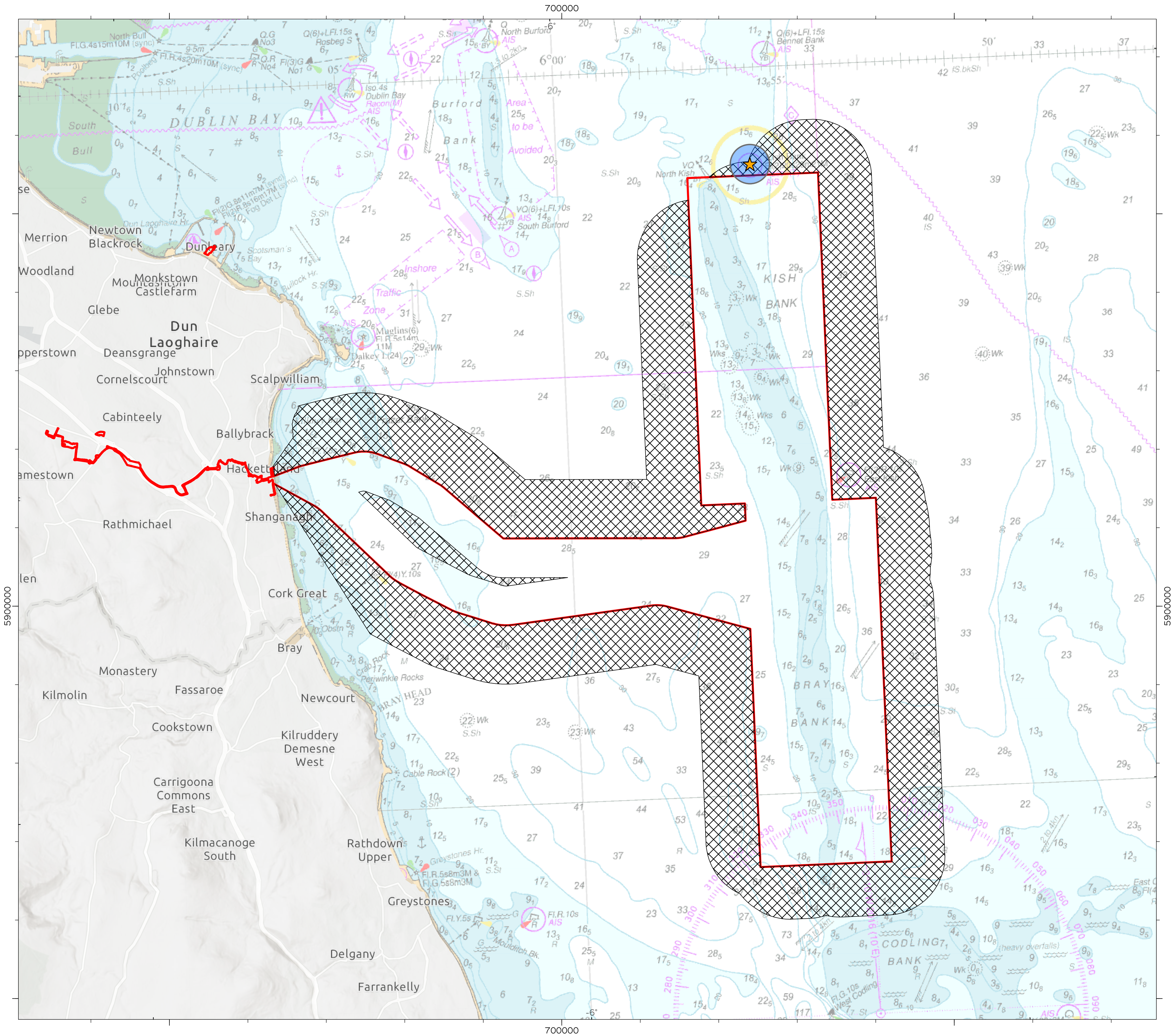
6.5.16 Temporary occupation[11] of parts of the adjacent maritime area may be necessary during construction of the offshore infrastructure to facilitate anchor vessels and to ensure maritime safety. This 'Temporary Occupation Area' adjacent to the Array Area is shown in Figure 19.

6.5.17 The area in which vessels may be temporarily operating or anchored while construction activity is being undertaken will potentially extend up to 1,500 m from the development boundary for the purposes of;

- Jack up construction vessels;
- Anchor spreads associated with works barge;
- Anchor handling vessels; and
- Anchor marking buoys.

6.5.18 The Applicant has undertaken consultations with the CIL in relation to the anchoring of vessels in the vicinity of the Kish Bank Lighthouse. The Applicant is committed to agreeing a method statement with CIL in the event of any wind farm construction or significant maintenance activities within the Temporary Occupation Area which will encroach within 500 m from the centre point of the Kish Lighthouse. A detailed method statement will be provided to the CIL for approval in advance of the commencement of construction activities in the array area.

11 Clause 3.4(b) of the MAC (Reference MAC-003-and-004) provides that, upon written notice to MARA (as Grantor), the holder may temporarily occupy and use so much of the adjacent maritime area where such use and occupation is reasonably required by the Holder to carry out the proposed development, subject to obtaining and complying with all and any necessary permissions and authorisations as may be necessary for such occupation and/or use.



- Planning Application Boundary
- Temporary Occupation Area
- Kish Lighthouse
- Kish Lighthouse 500mR Consultation Zone

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PROJECT TITLE
Dublin Array

DRAWING TITLE
Temporary Occupation Area

DRAWING NUMBER: **005532727-01** FIGURE NUMBER: **6.19**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2025-01-10	Ready for release	DB	PM	PK

0 0.8 1.5 2.3 3 Kilometres
0 0.5 1 1.5 2 Miles
N GRID NORTH

SCALE	1:100,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

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Pre-construction surveys

6.5.19 As noted at section 6.2.12, offshore surveys were conducted prior to the making of the application for development permission. Additional surveys will be required following the grant of permission, both prior to the commencement of construction and following the completion of the construction phase.

6.5.20 With respect to the proposed pre-construction engineering surveys[12], the objective will be to confirm the feasibility of the intended installation techniques and the presence (or absence) of features which are to be avoided, where possible, which will potentially include previously unforeseen marine archaeology and sensitive seabed habitats. These surveys will also inform the need for micro-siting of offshore infrastructure. These surveys will be undertaken post WTG selection, determining the layout and the location for which data is required. The survey data will assist the production of final designs and installation procedures.

6.5.21 Pre-construction surveys and other pre-construction activities will include:

- Further detailed geophysical surveys will be progressed on the defined installation locations of the WTGs, OSP and cables. The survey will provide the necessary up to date details of the seabed conditions in the precise intended locations within the array area and offshore ECC. Sidescan sonar (SSS), multibeam echosounder (MBES), sub-bottom profiler (SBP), and magnetometry equipment will be used to inform detailed design, installation planning, and Unexploded Ordnance (UXO) assessments (see 6.5.32 to 6.5.39). These surveys are outlined in Table 13.
- Detailed geotechnical survey campaigns will also be undertaken in accordance with an existing Foreshore Licence to confirm suitability of the design and siting of the offshore infrastructure. Boreholes, cone penetration tests (CPT), vibrocores, and cable plough trials will be undertaken to confirm the geology at the proposed location of each foundation structure[13]. These surveys are outlined in Table 14.
- Additional survey activities may also be required including ROV or diver inspections of cable routes and identified seabed anomalies. Cable route clearance activities may also be undertaken as required, such as Pre-Lay Grapnel Runs (PLGR).

12Pre-construction surveys are essential as seabed conditions can change significantly over time due to natural processes like sediment movement, which can alter the topography and composition of the seabed. Environmental factors, including marine biodiversity may also have evolved or shifted since the initial surveys were undertaken.

Table 13 Pre-construction geophysical survey summary table

Description	Frequency of survey	Type of vessel	Sensor/technique	Operating frequency
Seabed Mobility Monitoring	Annual until construction	Small geophysical survey vessels	Multibeam Echosounder (MBES) – Sidescan Sonar (SSS) Ultra-short Baseline (USBL)	200 kHz-400 kHz 300-900 kHz 19-34 kHz
Seabed Preparation - Pre-Survey	Once <12 months pre-seabed preparation.	Small and large geophysical survey vessels	Multibeam Echosounder (MBES) Sidescan Sonar (SSS) Sub-bottom Profiler (SBP) Ultra-short Baseline (USBL)	200 kHz-400 kHz 300-900 kHz 2-15 kHz 19-34 kHz
UXO Survey - Cables and Foundations	Once <12 months pre-installation.	Small and large geophysical survey vessels	Multibeam Echosounder (MBES) Sidescan Sonar (SSS) Sub-bottom Profiler (SBP) Magnetometer (MAG) - Ultra-short Baseline (USBL) Shallow 3D Sub-Bottom Imaging System (SBI)	200 kHz-400 kHz 300-900 kHz 2-15 kHz N/A 19-34 kHz 4-14 kHz
UXO Clearance	Once <12 months pre-installation.	Large ID & Clearance DP/anchored vessel	ROV identification and removal Ultra-short Baseline (USBL)	N/A 19-34 kHz
Boulder Survey (Surface and Buried) - Cables	Once <12 months pre-installation.	Small and large geophysical survey vessels	Shallow 3D Sub-Bottom Imaging System (SBI) Ultra-short Baseline (USBL)	4-14 kHz 19-34 kHz
Boulder and Foundation Engineering Survey (Surface and Buried) - Foundations	Once <12 months pre-installation.	Large geophysical survey vessel	Deep 3D Ultra-High Resolution Seismic (3D UHRS)	100 Hz to 5 kHz
Boulder Clearance	Once <12 months pre-installation.	Large ID & Clearance DP/anchored vessel	ROV identification and removal Ultra-short Baseline (USBL)	N/A 19-34 kHz
Pre-installation Visual Inspection	Once <12 months pre-installation.	Small and large geophysical survey vessels	Drop-Down Video (DDV) Ultra-short Baseline (USBL)	N/A 19-34 kHz

Description	Frequency of survey	Type of vessel	Sensor/technique	Operating frequency
Pre-construction archaeological surveys	Once <12 months pre-installation.	Small and large geophysical survey vessels	Multibeam Echosounder (MBES) Sidescan Sonar (SSS) Magnetometer (MAG) Ultra-short Baseline (USBL) Drop-Down Video (DDV)	200 kHz-400 kHz 300-900 kHz N/A 19-34 kHz N/A

Table 14 Pre-construction geotechnical survey summary table

Description	Type of vessel	Activity
Array Area - Foundations - Geotechnical Boreholes	Large geotechnical vessel/DP drill ship Large jack-up barge	Up to 58 geotechnical boreholes with wireline logging to an approximate depth of 65 m below seafloor and an outside diameter of up to 254 mm
Array Area - Foundations - CPT	Large geotechnical vessel/DP drill ship	Up to 61 Deep push or seafloor CPTs to an approximate depth of 65 m below seafloor, with a diameter of approximately 40 mm.
Export Cable Routes/Corridor - CPTs/Vibrocores	Medium geotechnical vessel/DP vessel	Up to 31 Seafloor CPTs with a diameter of approximately 40 mm and 21 vibrocores with a diameter of approximately 150 mm diameter. The target depth of each technique will be approximately 6 m below seafloor. Up to five of each type may be located within the intertidal area.

Meteorological monitoring stations

6.5.22 Meteorological stations provide meteorological and oceanographic data from the offshore windfarm during the construction and operational phases. They are used to warn of inclement weather and assist weather forecasting tasks. These are in place as a safety system for weather critical activities.

6.5.23 Planning permission is being sought for the deployment of two floating light detection and ranging (Floating LiDAR) units within the array area which will be installed during the construction phase and remain in place for the duration of the construction, operation and decommissioning of the development. The Floating LiDAR selected will be robustly designed and constructed for deployment in marine environments. Each unit will be approximately 4 m x 4 m and the height to the top of the mast will be up to 6m. The keel will be between 1 and 2 m deep. An example of a floating LiDAR unit is shown in Figure 20.

6.5.24 Planning permission is being sought for the deployment of two or more metocean buoys within the array area which will be installed during the construction phase and remain in for the duration of the construction, of the development. The metocean buoy selected will be robustly designed and constructed for deployment in marine environments. Each unit will be approximately 3 m x 3 m and the height to the top of the mast will be up to 6m above sea surface. The keel will be between 1 and 2 m below sea surface. An example of a metocean buoy is shown in Figure 20.

6.5.25 Marking, lighting and other navigational safety requirements will meet the agreed requirements of the CIL and the Department of Transport, Marine Survey Office prior to deployment and will be compliant with International Association of Aids to Navigation (IALA) requirements.

6.5.26 Navigation safety features typically include:

- Unit colour – RAL 1023 Yellow;
- Radar reflector;
- Marine lantern;
- Redundant GPS Location;
- Drift alarm; and
- Automatic Identification System (AIS).

6.5.27 Statutory Sanctions from Irish Lights under Section 653(2) of the Merchant Shipping Acts 1894 to 2015 will be obtained to establish AToN and licences from the Commission for Communications Regulation under the Wireless Telegraphy (Radiodetermination, Air Traffic and Maritime Services) Regulations, 2009 will be Obtained to operate AIS, as appropriate and required by these provisions or any amending provisions that may be made and applicable.

6.5.28 The metocean buoys will be anchored using a clump weight mooring system-system will have a single weight, comprising of concrete, steel, steel and concrete to which multiple mooring chains and/ or wires or tension legs will be attached.

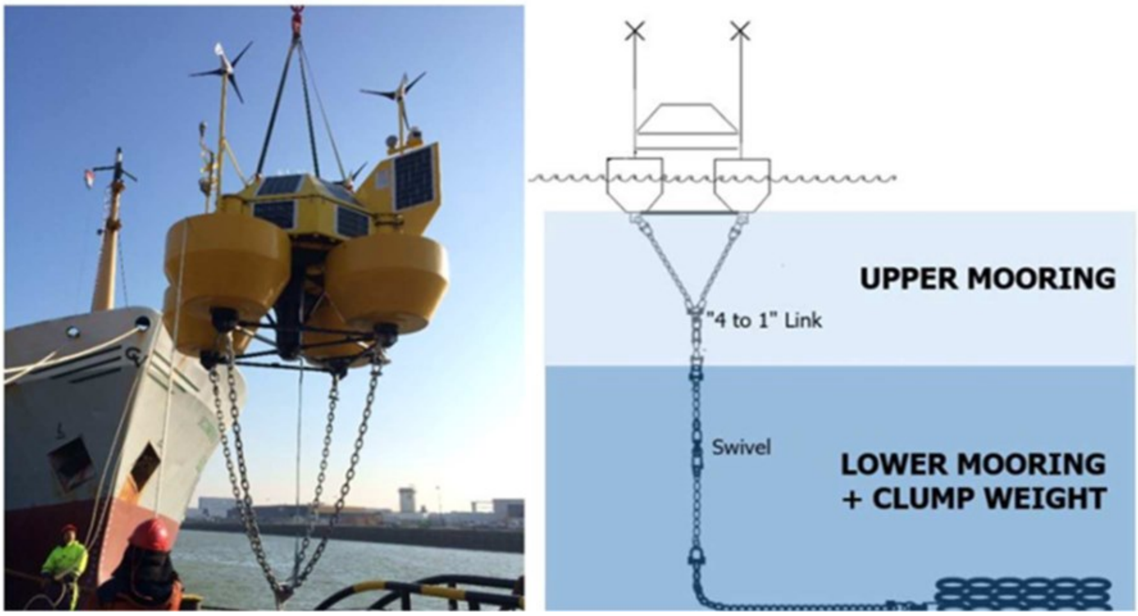


Figure 20 Floating LiDAR unit and typical mooring (EOLOS FLS200) (photograph courtesy of Partrac Ltd)

6.5.29 The Metocean buoys will be pre-assembled at the quayside and subsequently loaded to the deployment vessel by crane.

6.5.30 On arrival at the deployment site the vessel will use DP to establish the required position. The mooring system is first deployed with mooring chain and clump weight being lowered from the vessel by winch or crane.

Post construction surveys

6.5.31 Post-construction surveys will include the surveying of the as-built infrastructure (sub-sea cables, foundations and scour protection), as well as the ongoing monitoring of the infrastructure to monitor its condition which will be used to determine future maintenance surveys and campaigns. These surveys are outlined in Table 15.

Table 15 Post-construction geophysical survey summary table

Description	Frequency of survey	Type of vessel	Sensor/technique	Operating frequency
As-built Cable Survey	Once <6 months post-construction	Small, shallow draught geophysical survey vessel(s)	Multibeam Echosounder (MBES) – Bathymetry Sidescan Sonar (SSS) - Acoustic imagery Ultra-short Baseline (USBL) - underwater positioning Shallow 3D Sub-Bottom Imaging System (SBI) - 3D acoustic profiling	200 kHz-400 kHz 300-900 kHz 19-34 kHz 4-14 kHz
As-built Foundations Survey	Once <6 months post-construction	Small, shallow draught geophysical survey vessel(s)	Multibeam Echosounder (MBES) - Bathymetry Sidescan Sonar (SSS) - Acoustic imagery Ultra-short Baseline (USBL) - underwater positioning	200 kHz-400 kHz 300-900 kHz 19-34 kHz
Scour Monitoring Surveys – Cables	Minimum every 2 years. Ad hoc should necessary maintenance be required.	Small, shallow draught geophysical survey vessel(s)	Multibeam Echosounder (MBES) - Bathymetry Sidescan Sonar (SSS) - Acoustic imagery Ultra-short Baseline (USBL) - underwater positioning Shallow 3D Sub-Bottom Imaging System (SBI) - 3D acoustic profiling	200 kHz-400 kHz 300-900 kHz 19-34 kHz 4-14 kHz
Scour Monitoring Surveys – Foundations	Minimum every 2 years. Ad hoc if any repairs needed.	Small, shallow draught geophysical survey vessel(s)	Multibeam Echosounder (MBES) - Bathymetry Sidescan Sonar (SSS) - Acoustic imagery Ultra-short Baseline (USBL) - underwater positioning	200 kHz-400 kHz 300-900 kHz 19-34 kHz
Asset Monitoring Surveys	Minimum every 2 years. Ad hoc if any repairs needed.	Large DP vessel	ROV inspection Ultra-short Baseline (USBL) - underwater positioning	N/A 19-34 kHz

Unexploded ordnance identification and clearance

6.5.32 The coast of Ireland has experienced low levels of significant scale conflict throughout its history, with the majority of activities occurring in World War I (WWI). As an attempt to disrupt Britain's sea traffic and hamper its military operations, German submarines laid minefields, therefore, there are several sources of potential UXO hazards along the east coast.

6.5.33 There are approximately 42 No. military wrecks along the east coast, of which, 39 No. were sunk during WWI. There is a single wreck attributed to raids by German World War I aircraft, approximately 31 km from the proposed development. However, the Irish mainland, including Dublin, was bombed by the Luftwaffe several times and it is likely that some bomb loads were jettisoned into the sea if the aircraft was under attack or damaged. As a result, munitions such as torpedoes, artillery projectiles and depth charges may be present within the development boundary and could present a hazard to the development.

6.5.34 A risk assessment was undertaken to determine the likelihood of an encounter with a UXO during site investigation activities, cable installation and WTG installation. The risk assessment concluded that the UXO risk within the development boundary varies from low to moderate depending on the activity being undertaken.

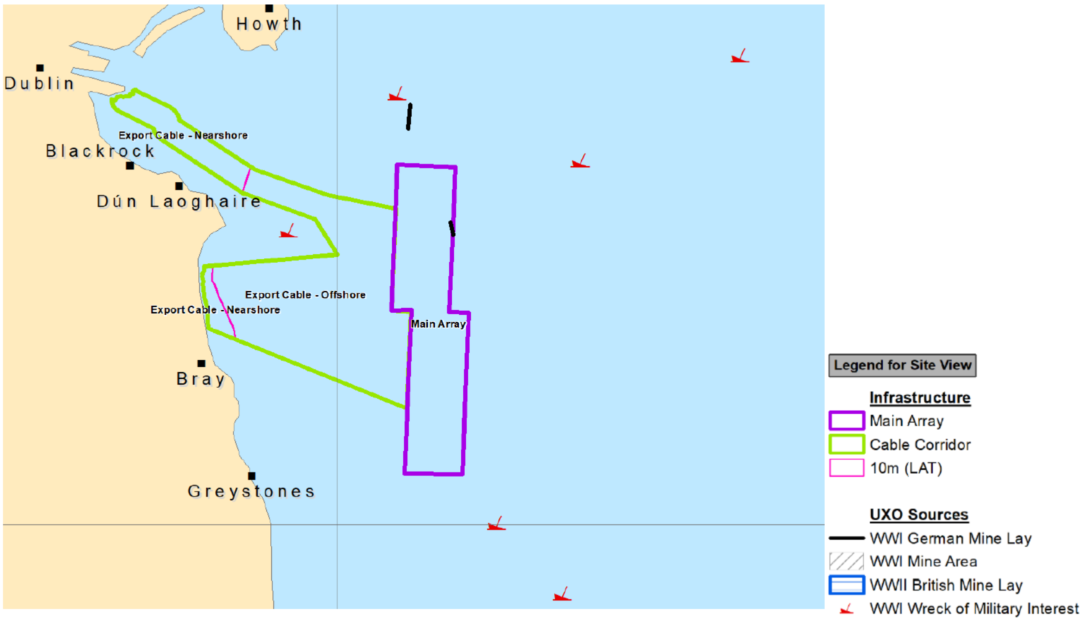


Figure 21 Potential UXO sources in the Irish Sea

6.5.35 Pre-installation, a geophysical survey will be undertaken for the purposes of locating and identifying items that could potentially model as UXO across the site. Once the survey data has been collected, the data will be interrogated by a UXO Specialist Contractor and anomalies that appear to be UXO or potential UXO (pUXO) will be identified by their precise co-ordinates. A UXO assessment will be undertaken, and mitigation proposed to reduce the risk of detonating ordnance to As Low As Reasonably Practicable[14].

6.5.36 UXO and pUXO will be avoided as the primary mitigation. Where possible a buffer area, which provides a suitable safe distance around the anomaly, will be established and avoided by all wind farm activities by micro-siting of all intrusive seabed works.

6.5.37 If they cannot be avoided, they will be subject to the identification and clearance campaign which will then trigger steps 2-4, below, if confirmed as UXO. In the event that a UXO is identified, next steps will be considered based on the following order of preference:

1. Avoidance through micro-siting of infrastructure (e.g. cable routing);
2. Relocation of UXO to a safe area within the development boundary;
3. In situ deflagration of UXO – low order. The low order technique, also referred to as deflagration, causes UXOs to burn out without detonating. A small charge is fired at the explosive, causing the explosive contents to ignite and burn out. The casing of the explosive cracks open, but does not detonate; and
4. In situ detonation of UXO – high order.

6.5.38 Each UXO will be subject to a technical and risk-assessment and the most appropriate mitigation method will be selected. For further information relating to UXO clearance, refer to Volume 3, Chapter 5: Marine Mammals.

6.5.39 A detailed UXO survey will be completed prior to construction, therefore, the type, size and number of possible detonations and the duration of UXO clearance operations is not known at this stage. Data acquired to date indicates a low likelihood of UXO to be present. The MDO is for up to four high order detonations in the EIAR assessment, which could take place anywhere within the array area, offshore ECC and wider temporary occupation area.

14 As Low As Reasonably Practicable (ALARP) – The health and safety principle is that any residual risk shall be as low as reasonably practicable. For a risk to be ALARP it must be possible to demonstrate that the cost involved in reducing the risk further would be grossly disproportionate to the benefit gained. The ALARP principle arises from the fact that infinite time, effort and money could be spent on the attempt of reducing a risk to zero.

Seabed preparation for foundation installation

6.5.40 Installation of foundations for WTGs and the OSP may require seabed preparation to ensure the seabed surface will adequately support the foundation structure in a vertical position.

6.5.41 Seabed preparation can include removal of soft, mobile or uneven sediments, or the levelling of the seabed without the removal of sediments. Method of seabed preparation potentially using a trailing suction hopper dredger (TSHD), or Mass Flow Excavator (MFE). TSHD will involve the use of a specialist vessels equipped with one or more suction pipes, which will be moved slowly over the seabed collecting a mixture of sand and water into the hopper of the vessel. Excess water will flow out of the hopper and the sandy material will be retained. The 'spoil' (comprising primarily sand) will be subsequently discharged by means of doors located at the bottom of the hopper. MFE can also be referred to as water injection dredging and is commonly used for underwater trenching. MFE uses a high-pressure water jet to liquefy the seabed material which then may be removed by TSHD.

6.5.42 Subject to securing a Dumping at Sea Permit from the Environmental Protection Agency (EPA) under the Dumping at Sea Act 1996 as amended, it is anticipated that the 'spoil' arisings generated by seabed preparation will be redeposited within the MAC area (Reference MAC-003-and-004) within areas of similar sediment type. It is anticipated that the spoil materials will be naturally dispersed by the action of tidal currents to form an elongated bedform similar to the surrounding bedform features. Further details of these actions are set out in Volume 3, Chapter 1: Physical Processes.

6.5.43 Some of the excavated material has potential to be re-used as ballast material for structures such as suction bucket foundations, or filter material required for protection against scour and subsea damage.

6.5.44 Table 16 presents the maximum area of seabed preparation required and the greatest volume of spoil which will be generated from each of the three design options. However, seabed preparation in advance of foundation installation may not be required at all locations.

6.5.45 It is likely that foundations could be installed directly onto the seabed in its existing condition. The areas and volumes presented in Table 16 are proposed for the multileg foundations with suction bucket footings. This foundation type will require the largest area of seabed preparation and the greatest volume of spoil of all the foundation options under consideration (see 6.4.276.4.27). The volume of spoil includes that taken from the foundation footprint.

6.5.46 The maximum volumes which are presented is the expected maximum volume to be generated over the duration of the foundation installation period.

6.5.47 The dredging rate for preparing foundation locations, across all foundation options, is expected to be significantly slower—approximately a quarter of standard dredging rates. This reduced rate is due to the number of turns the vessel must make to clear material from each individual foundation location

Table 16 Maximum seabed preparation areas for 4-multileg foundation with suction bucket footing installation and associated spoil volumes[15]

Parameter	OSP	Option A WTG	Option B WTG	Option C WTG
Maximum number of foundations	1	50	45	39
Maximum percentage of locations at which seabed preparation will take place	100%	100%	100%	100%
Maximum length of side (square prepared seabed areas) per foundation (m)	75	65	72	73
Maximum prepared seabed area per foundation (m^2)	5,625	4,225	5,184	5,329
Maximum total seabed area (m^2)	5,625	211,250	233,280	207,831
Maximum average soil thickness removed (m)	0.75	0.75	0.75	0.75
Maximum seabed volume disturbed per foundation16 (m^3)	4,219	3,169	3,888	3,997
Maximum percentage of excavated material that could become spoil	100%	100%	100%	100%
Maximum spoil volume all foundations (m^3)	4,219	158,438	174,960	155,873
Dredging time at each foundation (hr)	17	13	16	16

Protection against foundation scour

6.5.48 Upon installation of the foundations, it is necessary to protect the foundations against scour action around its base. Seabed sediment can be flushed away as a result of water flow around the structure. Scour may result in pits being created at the base of a structure, potentially weakening or undermining the foundation. In addition, the more vulnerable elements of foundation structures, such as J-tubes and cables as they transition between the structure and the seabed, can be damaged by waves and tidal currents if they become exposed and unsupported.

15 Area and volume values are rounded up to nearest whole number.
16 Not necessarily all spoil.

6.5.49 Should scour protection be required, the design chosen will depend on the final foundation type and structural design, specific ground conditions at each foundation location, and the conclusions of a scour assessment. Vulnerable areas, such as the vicinity of the cable exit from the J-tubes, may receive additional protection in the form of localised rock or concrete mattress placement or coverings extending out onto the cables themselves. Cable protection is discussed in detail in Section 6.5.123 to 6.5.135.

6.5.50 Monitoring of the seabed around offshore structures will be conducted post installation, and scour protection may require installation retrospectively should the need be identified.

6.5.51 As with the design of foundations, there is the potential for technological advances in the field of scour protection which may create additional options at the time of construction. Consistent with the Opinion on Flexibility, other scour protection designs will be considered for use prior to the commencement of construction, having regard to the characteristics of the technology and the scope of this EIAR.

6.5.52 Scour protection options include one, or a combination of the following:

- Rock placement;
- Concrete mattresses;
- Flow energy dissipation devices (used to describe various solutions that dissipate flow energy and entrap sediment, and including options such as frond mats, mats of large, linked hoops, and structures covered with long spikes);
- Protective aprons or coverings (solid structures of varying shapes, typically prefabricated in concrete or high-density plastics); and
- Bagged solutions, (including geotextile sand containers, rock-filled gabion bags or nets, and grout bags, filled with material sourced from the site or elsewhere).

6.5.53 The parameters provided in Table 17 relate to a conventional scour protection system which will result in the greatest volume of all the scour systems which could potentially be used. It has been conservatively assumed that all foundations will require protection. However, it is noted that protection against scour or subsea damage may not be required for some foundation designs, in some locations.

6.5.54 The conventional scour protection system parameters outlined in Table 17 comprises of two filter layers which will be installed prior to piling with an armour layer placed on top of the filter layers upon pile installation. An alternative design which comprises a single layer of wide-graded material, which functions as both filter and armour layer and will be placed in-situ before piling. The same footprint is scheduled but will utilise a smaller volume of rock material, approximately two-thirds of that of the conventional system.

6.5.55 The rock will be placed by a specialist vessel or barge using a side tipping system, deposited using a fall pipe vessel or placed using a grab device. The vessel or barge will remain on station by means of multiple anchors or will use a DP system. Other scour protection solutions such as concrete mattresses, rock filled gabion bags and frond mats will be positioned using ROVs and/or divers.

Table 17 Foundation scour protection parameters

	Structure			
	Option A Turbine	Option B Turbine	Option C Turbine	OSP
Maximum number of structures	50	45	39	1
Maximum scour protection diameter at seabed per monopile (including foundation structure) (m)	51	54	54	48
Maximum scour protection area (monopile) (m^2)	102,141	103,060	89,319	1,810
Maximum scour protection diameter at seabed per leg (4 leg, multileg structure) (including foundation) (m)	28	30	31	48
Maximum foundation footprint area of multileg (4 leg structure) including scour protection (m^2),	4,692	5,625	5,852	7,238
Maximum scour protection diameter at seabed per suction bucket leg (4 leg structure) including foundation (m)	60	66	69	60
Maximum foundation footprint area of suction buckets (4 leg structure) including scour protection (m^2)	10,000	12,321	12,996	11,310

Foundation installation

Pile driving

6.5.56 Pile driving also referred to as impact piling involves a large hammer being dropped, or driven, onto the top of a foundation pile, pushing the pile into the seabed. Piles maybe held in place during pile driving by the foundation structure itself, or by frames and pile grippers mounted on a vessel, or the seabed. In these cases, the piling frame maintains the pile orientation until the pile has been installed to a sufficient depth to retain its stability unaided. The pile may reach a point of refusal where it cannot be driven to the required penetration depth due to difficult ground conditions, drilling may then be used reduce the driving resistance and allow the pile installation to be completed (see 6.5.61 for details of pile drilling).

6.5.57 During the piling process acoustic energy is introduced to the surrounding water by a number of pathways. Airborne noise will arise from the impact of the hammer activity with the noise transmitted into the water. The principal source of acoustic energy transferred into the water column during foundation installation is transmitted through the pile itself. The energy transferred from the hammer will cause the pile to compress and flex and create complex structural waves to travel down the pile during each hammer/drive.

6.5.58 The pressure waves will be transferred from the submerged section of the pile into the surrounding water column. A further source of acoustic energy in the water column will arise from lateral pressure waves in the seabed which result from the force exerted by the end of the pile on the substrate (refer to Volume 4, Appendix 4.3.5-7 for Underwater Noise Assessment). Underwater noise, including construction and operational noise, has been assessed as part of this EIAR.

6.5.59 Pile driving is an installation technique for monopile or multileg foundations. As described above in 6.4.33 to 6.4.35, the piles used for multileg foundations are smaller in diameter than monopiles and extend further into the seabed. The hammer energy which will be required to install a pile for a multileg foundation is therefore generally less than that needed to install the larger monopile but due to the increased length of the pile can take longer to install.

6.5.60 The key parameters considered for piling (across all foundation types) are listed in Table 18, Table 19, and Table 20.

Soft start and ramp up

6.5.61 A typical impact piling sequence will begin with a soft start[17] period, where both the hammer energy and blow rate are less than used during the main piling stage. Hammer energy will commence at around 10% of rated hammer energy and then ramp up gradually over the duration of the soft start to full operational energy and blow rate.

17 Soft start is a mitigation technique used during piling operations where the piling hammer energy is gradually increased from a low level to full power over a set period. This method reduces the initial noise and vibration impacts on marine life.

6.5.62 The soft start and ramp up period are standard engineering practices which are necessary during the early stages of installation to maintain pile orientation and stability. These processes also result in the gradual introduction of noise into the marine environment, encouraging both fish and marine mammal species that are sensitive to sound to move away from the noise source.

6.5.63 The impact piling procedure will fully align with the marine mammal mitigation strategy, see Volume 3, Chapter 5: Marine Mammals.

Impact pile sequence and durations

6.5.64 A typical piling sequence progresses as follows:

- Notices to prescribed bodies, local diving groups, mariners, fishers and other relevant sea users are issued informing them of piling times, locations, expected durations, temporary exclusion zones, etc;
- Where noise abatement systems (NAS) are used during piling activities these will be deployed prior to the piling vessel arriving in position[18]. Further details on NAS can be found in Annex A (NAS) of Volume 7, Appendix 4: Marine Megafauna Mitigation Plan;
- Guard vessels may be deployed around the piling area to restrict access of sea users into the piling safety zone;
- Acoustic deterrent devices (such as pingers) may be deployed to allow marine mammals an opportunity to move away from the area of noise. This is discussed in greater detail within Volume 7, Appendix 4; Marine Megafauna Mitigation Plan;
- The pile is lifted into position, typically within a pile guide on the installation vessel and is positioned on the seabed (using a pile template or similar if required for multileg foundations) with pile weight providing initial seabed penetration;
- Piling pre-soft start commences followed by a period of soft start;
- Piling energy and blow rate are ramped up to the required maximum operational power and blow rate. A hammer energy of 6,400 kilojoules (kJ) is the maximum energy which will be used on Dublin Array and therefore has been considered in the EIAR;
- Depending on local geology and technical and economic considerations, drilling may be required, in which case piling will temporarily stop to allow this to be undertaken;
- Piling will continue until the desired penetration has been achieved and pile installation is complete. There will not be any concurrent piling (2 vessels piling at the same time); and

18 Alternative NAS such as casings and resonators are deployed from the piling vessel.

- The installation vessel may install a transition pieces (if used) onto the installed foundation structure before moving to the next piling location to begin the sequence again.

6.5.65 The duration of piling is dependent on the ground conditions encountered. If harder ground conditions are encountered, this will increase the duration of piling activities.

6.5.66 For the calculation of cumulative Permanent Threshold Shift[19] (PTS) onset from monopiles, the assumption has been made that one monopile is installed in a 24-hour period. For the calculation of cumulative PTS-onset from multi-leg pin-piled jackets, the assumption has been made that four pin-piles can be installed at one location in a 24-hour period. No simultaneous impact piling will occur. This is discussed in more detail in the fish and marine mammals assessments within Volume 3, Chapter 5: Marine Mammals of this EIAR.

Table 18 Monopile foundation piling parameters

Parameter	OSP	Option A WTG	Option B WTG	Option C WTG
Maximum pile diameter (m)	11	12	13	13
Maximum pile penetration depth (m)	55	60	60	60
Maximum hammer energy (kJ)	6,400	6,400	6,400	6,400
Max blows (strikes) per minute	30	30	30	30
Estimated pre-soft start duration (hr.)	0.5	0.5	0.5	0.5
Estimated soft start duration (hours)	0.5	0.5	0.5	0.5
Estimated active piling time*[20] per pile including pre soft start and soft start (hours)	3.9	3.9	3.9	3.9

19 Exposure to loud sounds can lead to a reduction in hearing sensitivity (a shift in hearing threshold), which is generally restricted to particular frequencies. This threshold shift results from physical injury to the auditory system and may be temporary or permanent. PTS onset thresholds are further described in Volume 3, Chapter 5: Marine Mammals
20 *Subject to ground conditions encountered and assuming drilling is not required.

Table 19 Three-legged multileg foundation21 piling parameters

Parameter	Option A WTG	Option B WTG	Option C WTG
Maximum pile diameter (m)	4.75	5.25	5.75
Maximum pile penetration depth (m)	70	70	70
Maximum hammer energy (kJ)	4,700	4,700	4,700
Indicative blows per minute	30	30	30
Indicative pre-soft start duration (hr)	0.5	0.5	0.5
Indicative soft start duration (hr)	0.5	0.5	0.5
Indicative active piling time* per pile including pre soft start and soft start (hr)	3	3	3

Table 20 Four-legged multileg foundation[22] piling parameters

Parameter	OSP	Option A WTG	Option B WTG	Option C WTG
Maximum driven pile diameter (m)	6	4.5	5.0	5.5
Maximum driven pile penetration depth (m)	70	70	70	70
Maximum hammer driving energy (kJ)	4,700	4,700	4,700	4,700
Indicative blows per minute	30	30	30	30
Indicative pre-soft start duration (hr.)	0.5	0.5	0.5	0.5
Indicative soft start duration (hr.)	0.5	0.5	0.5	0.5
Indicative active piling time* per pile including pre soft start and soft start (hr.)	3	3	3	3

Pile drilling

6.5.67 As described in 6.5.56, foundation piles are typically installed by impact hammer to the desired penetration depth. However, in some cases the pile may reach a point of refusal and cannot be driven to the required depth due to difficult ground conditions. In this event, it is possible to drill out some or all of the volume of sediment inside the pile to reduce the driving resistance and allow the pile installation to be completed.

21 Parameters provided for 3-legged wind turbine foundation these having the greatest diameter and penetration depth of the multileg foundation options.
22 Parameters provided for 3-legged wind turbine foundation these having the greatest diameter and penetration depth of the multileg foundation options.

6.5.68 Various drilling methodologies are possible, but drills are typically lifted by crane into a part-installed pile and positioned inside the pile during drilling and are removed once pile driving recommences. Drills may either bore out to a diameter equal to the internal diameter of the pile, or they may be capable of expanding their cutting disk below the tip of the pile and boring out to the pile's maximum outer diameter or greater in a process called under-reaming. Seawater will be continuously pumped into the drill area and any drill arisings generated will be flushed out and allowed to disperse naturally at the sea surface. The spoil materials will be naturally dispersed by the action of waves and tides to form an elongated bedform similar to the surrounding bedform features.

6.5.69 For the purpose of the EIA, a precautionary assumption has been made that all monopiles/multileg jacket foundation pile installations will require drilling. It is also assumed that drilling will be required for the offshore platform foundation.

Table 21 Drill arisings – monopile foundation

Parameter	Option A WTG	Option B WTG	Option C WTG
Maximum % of foundations potentially using drilling (%)	100	100	100
Maximum volume of drill arisings per foundation (m^3)	7,964	9,236	9,236
Maximum total volume of drill arisings (m^3)	398,197	415,633	360,215

Table 22 Drill arisings – 4-Legged multileg foundations

Parameter	Option A WTG	Option B WTG	Option C WTG
Maximum % of foundations potentially using drilling (%)	100	100	100
Maximum volume of drill arisings per foundation (m^3)	6,652	7,916	9,291
Maximum total volume of drill arisings (m^3)	332,616	356,256	362,359

Table 23 Drill arising –3-Legged multileg foundations

Parameter	Option A WTG	Option B WTG	Option C WTG
Maximum % of foundations potentially using drilling (%)	100	100	100
Maximum volume of drill arisings per foundation (m3)	5,453	6,442	10,735
Maximum total volume of drill arisings (m3)	272,655	289,922	418,681

Steel monopile installation

6.5.70 Steel monopile foundations will be fabricated at a suitable existing fabrication yard and transported to site (potentially via a lay-down area at the selected staging port). A typical installation sequence for each foundation is as follows:

- Transportation of foundations to offshore site via vessel, barge, or towed float-out potentially with detachable buoyancy, or structural elements filled with air to give positive buoyancy;
- Seabed preparation will be carried out if required as described in Section 6.5.40 to 6.5.47;
- The installation vessel will position itself at the required location and jacks up, anchors, or otherwise holds its position;
- The foundation will be orientated by the installation vessel into a vertical position, with buoyancy assistance if necessary, and lowered onto the seabed;
- Installation of monopiles progressed by driving and/or drilling, as required by site specific conditions, technical and economic viability;
- Installation of a transition piece (if used) and ancillary equipment, such as cable J-tubes and vessel landings, which are not integral to the main structure, including their alignment and fastening (typically grouting, bolting or welding); and
- Installation of scour protection if required, as described in Section 6.5.48 to 6.5.55, or alternatively completed in advance of foundation arrival to the site.

Multileg installation (driven or drill piled)

6.5.71 The installation sequence of the multileg foundation will be similar to that of monopiles (the structures will be transported to site by installation vessels or feeder barges, where they will be lowered onto the seabed). The pin-piles can be installed before or after the jacket is lowered to the seabed. If before, a piling template will be typically placed onto the seabed to guide the pin-piles to the exact required locations. The piles are then installed through the template, which itself is then recovered to the installation vessel, and subsequently pile sleeves fabricated to the main foundation structure are placed over the pin-piles and fixed by grouted joint or other means such as swaging[23].

6.5.72 Alternatively, the need for a piling template can be negated by installing the pin-piles after the jacket has been placed on the seabed. Steel mud mats which rest on the seabed and provide temporary vertical support which prevent subsidence of the structure prior to pile installation, are generally required.

6.5.73 Each multileg main support structure, plus associated piles and pile templates, as required, will be constructed at a suitable fabrication yard and transported to site (potentially via a lay-down area at the selected staging port).

6.5.74 The turbine foundation pin-piles may comprise of installation by driving or drilling or a combination of both techniques, or by means of alternative methods, such as Hi-Lo or Blue piling as determined by site specific soil conditions and technical and cost as outlined in the sections above.

Suction bucket multileg installation

6.5.75 Each suction bucket multileg will be fabricated at a suitable fabrication yard and will be transported to site (potentially via a lay-down area at the selected staging port). A typical installation sequence will be as follows:

- The suction bucket foundation will be fitted with a pump and control unit during installation;
- Installation will be carried out from jack-up barge, DP vessel or anchored barge;
- The foundation will be lifted from the vessel or transport barge and positioned onto the seabed directly at the WTG location, the weight of the bucket structure provides initial seabed penetration;
- Negative pressure will be applied in the bucket structure by means of the pump and it will be embedded until the top sits as close as possible to the seabed. Water jets in the bucket structure maybe utilised to assist penetrating the sediments and controlling the installation process;

23 Process by which internal pressure is temporarily exerted within the pile forcing the pile to expand within the pile sleeve to form a joint.

- A layer of grout will be pumped into the top of the bucket after installation, to provide a uniform bearing surface between the top of the suction bucket and the seabed to facilitate load transfer; and
- If the suction buckets are not pre-connected to the multileg structure and are installed separately, the use of grouting or swaging will connect the multileg to the buckets, similar to a pre-piled pile connection.

Table 24 Wind turbine generators 3-suction bucket foundation parameters

Parameter	Option A WTG	Option B WTG	Option C WTG
Maximum number of buckets per location	3	3	3
Maximum diameter of suction bucket (m)	17	19	20
Maximum penetration depth of suction bucket (m)	17	19	20
Suction bucket height above seabed (m)	5	5	5
Maximum suction bucket spacing centre to centre (m)	40	45	45
Maximum seabed footprint of suction buckets (all turbine foundations) (km^2)	1406.9	1773.6	1829.5

Table 25 – OSP and wind turbine generator 4-suction bucket foundation parameters

Parameter	OSP	Option A WTG	Option B WTG	Option C WTG
Maximum number of foundations	1	50	45	39
Maximum number of buckets per location	4	4	4	4
Maximum diameter of suction bucket (m)	15	15	17	18
Maximum penetration depth of suction bucket (m)	15	15	17	18
Suction bucket height above seabed (m)	5	5	5	5
Maximum suction bucket spacing centre to centre (m)	65	40	45	45
Maximum seabed footprint of suction	2,500	3025	3844	3969

Parameter	OSP	Option A WTG	Option B WTG	Option C WTG
buckets (all foundations) (m^2)				

Grout installation

6.5.76 Grout will be used to bond joints between the wind farm components, including but not limited to, the connection between the foundation and transition piece (if used), between the pile and pile sleeves or jacket, and in the case of a suction bucket, below the base to provide additional contact area between the base and the seabed, and to aid levelling.

6.5.77 Offshore grout consists of a mixture of water, cement and sand plus specialist additives, to form a bonding material (refer to Volume 3, Chapter 2: Marine Water and Sediment Quality). Variants are available for different tasks, with high-performance low-shrinkage types for bonding piles to foundation structures, and low-strength types available for under-base use. Grout will be typically mixed on offshore construction vessels and pumped via pipes into the required areas. Where grouting is used, a system of seals, mechanical separation, or other operational means will be deployed to manage the risk of accidental releases into the environment. Estimated volumes of grout required for each structure type are presented in Table 26.

Table 26 Grout volumes for foundation installation

Parameter	OSP	Option A WTG	Option B WTG	Option C WTG
Monopile Foundation				
Maximum No. of structures	1	50	45	39
Maximum volume of grout per foundation (m^3)	994	1,359	1,477	1,519
Maximum total volume of grout (m^3)	994	67,959	66,467	59,231
Piled 4-legged Multileg Foundation				
Maximum No. of structures	1	50	45	39
Maximum volume of grout per foundation (m^3)	3,836	2,199	2,419	2,636
Maximum total volume of grout (m^3)	3,836	26,507	30,642	29,772
Piled 3-legged Multileg Foundation				
Maximum No. of structures	Not Applicable	50	45	39
Maximum volume of grout per foundation (m^3)	Not Applicable	1,732	1,897	5,282

Parameter	OSP	Option A WTG	Option B WTG	Option C WTG
Maximum total volume of grout (m^3)	Not Applicable	96,604	95,426	215,658
Suction Bucket 4-legged Multileg Foundation				
Maximum No. of structures	Not Applicable	50	45	39
Maximum volume of grout per foundation (m^3)	Not Applicable	530	681	763
Maximum total volume of grout (m^3)	Not Applicable	26,507	30,642	29,772
Suction Bucket 3-legged Multileg Foundation				
Maximum No of structures	Not Applicable	50	45	39
Maximum volume of grout per foundation (m^3)	Not Applicable	511	638	707
Maximum total volume of grout (m^3)	Not Applicable	25,535	28,707	27,567

WTG installation

6.5.78 WTG components will be collected from a suitable port facility either by the installation vessel or transport barge. Installation vessels are typically Jack-Up Vessels (JUV), DP or anchored vessels which provide a stable platform for installation activities when in position on site.

6.5.79 JUVs are installation vessels designed to lower three or more legs onto the seabed and lift themselves out of the water, creating a stable platform for the craning and installation of heavy infrastructure, such as foundations, WTGs, and OSP topsides. The legs of the JUV have a direct impact on the seabed within the footprint of the feet, known as spud cans. Alternatively, multiple anchors may be deployed to position and secure the vessel, which also impacts the seabed and is considered within the overall development footprint.

6.5.80 The WTG components may be loaded onto dedicated vessels at a manufacturing or marshalling port and shipped to the array area for the installation campaign. Further details of construction vessels are provided in paragraphs 6.5.11 to 6.5.15.

6.5.81 Generally, blades, nacelles and towers for approximately three WTGs are loaded separately onto a vessel. Typically, as much pre-assembly will be completed in advance of transit to site, to optimise the installation process.

6.5.82 Once at the turbine location, components will be lifted onto the pre-installed foundation or transition piece by the crane on the installation vessel. Each WTG will be assembled at site in this way with technicians fastening components together as they are lifted into place. The exact methodology to be used for the assembly will be dependent on the WTG selected and the appointed installation contractor.

6.5.83 The WTG structures will be typically installed in sequence, commencing with the foundation. The transition piece (if used) will then be installed, followed by the tower, nacelle and rotor as shown in Figure 22 (moving in sequence from 1 to 6). Alternatively, sections of the structure maybe prefabricated at a suitable shore side facility prior to being transferred to the offshore site.

Figure 22 Sequential photographs of installation of turbine tower, nacelle and blades

Offshore cable installation

6.5.84 Offshore cables will, where possible, be buried below undisturbed seabed to the optimal performance burial depth for the specific ground conditions. Optimal cable burial will protect the cable from damage arising from direct contact from vessel anchors, fishing gear and from scouring effects of tidal currents. Where optimum burial depth cannot be achieved secondary protection measure will be deployed (e.g. concrete mattress, rock berm, grout bags or an equivalent in key areas). Drawing '22164-GDG-ZZ-XX-DR-C-1013 – Subsea Cable Burial and Protection Details' included in Part 2 Planning Drawings of the application, provides information on the target burial depth of offshore cables which range between 0.6 m and 3 m dependent upon the ground conditions encountered and associated level of protection provided in to achieve the optimal burial depth.

6.5.85 The typical key stages of offshore cable installation are;

- Pre-installation surveys;
- Route clearance;
- Pre-sweep and seabed preparation;
- Cable lay and burial;
- Cable protection (if required);
- Cable and pipeline crossings (if required); and
- Post-installation survey & remedial protection.

6.5.86 Pre-installation geophysical route surveys will be conducted prior to the submarine cable installation works commencing. In addition, immediately in advance of installation, a visual inspection and confirmation of the route may be carried out by a ROV. Pre-construction surveys are further detailed in sections 6.5.19 to 6.5.21.

6.5.87 A Cable Burial Risk Assessment (CBRA) will be developed by the appointed Contractor following the completion of the pre-construction surveys and prior to the commencement of cable installation. The key objective of the CBRA methodology is to have a process that defines a target Depth of Lowering[24] (DoL) which is practically and economically achievable whilst providing adequate protection to the buried cable.

A Cable Installation Plan (CIP) will provide information on the installation plan for subsea cables. The CIP will detail pertinent mitigation measures to be used during cable installation and will be applied throughout the construction phase. The CIP and CBRA will be submitted to the consenting authority in advance of construction phase.

24 The Depth of Lowering refers to the vertical distance from the natural seabed level to the final position of the buried subsea cable. This depth is achieved through excavation, trenching, or similar methods and is typically measured to the topmost part of the buried cable.

Cable route clearance

6.5.88 Prior to the installation of submarine cables, the precise route along which the cable burial is planned will be cleared of any seabed debris, such as abandoned or waste fishing debris, which has potential to delay or endanger the progress of burial operations. This will ensure that the selected route for that cable is free from seabed and sub-surface debris or any artificial hazards.

6.5.89 A PLGR will be undertaken to clear the cable route to the proposed structures (WTGs or OSP). The equipment consists of a grapnel (hooked) device which is towed along the precise line of the inter array and export cable route in advance of installation to sweep the route.

6.5.90 The footprint of seabed disturbance from the PLGR will be up to 1 m wide and to a maximum depth of 0.5 m. This EIAR assumes on a conservative and precautionary basis that a PLGR will be required for a 1 m wide corridor along the entire length of inter array and export cable routes. Although the footprint which will require PLGR will likely be less, the precise extent of any necessary PLGR will be dependent on the distribution of seabed and sub-surface debris identified during the pre-installation surveys.

6.5.91 Where seabed features such as sand waves are present, suitable equipment such as sweeps or dredgers, will be used to prepare a smooth surface for cable installation. Other equipment options include water injection dredgers, or MFEs, both of which use controllable jets of water to mobilise sediment from the seabed. The use of a TSHD as discussed in 6.5.41, is the technique which will affect the greatest area of seabed. The MFE is the technique which will result in the greatest volume of sediment to be disturbed. Alternative techniques which could be used during cable installation are outlined in Sections 6.5.104 to 6.5.113 below.

6.5.92 A further PLGR sweep upon sand wave clearance will be carried out to confirm the removal of debris. Table 27 presents the maximum cable route lengths, footprint of seabed disturbance and volumes of spoil generated to prepare areas of seabed where sand waves are present.

Table 27 Cable route sand wave clearance

Parameter	Offshore Export Cable	IACs (excluding Sandbank crossing)	IACs (Sandbank crossing)
Maximum seabed clearance width (m)	40	40	60
Percentage of Cable length requiring seabed clearance (%)	70	50	100
Maximum area of seabed affected (m^2)	1,027,600	2,400,000	360,000
Maximum volume of sediment disturbed (m^3)	4,110,400	9,600,000	1,200,000

Cable lay and burial

6.5.93 Offshore cables will be installed by a dedicated cable laying vessel, using either a multi-point anchoring or DP system. Nearshore, and in areas where water depths of less than 10 m can restrict the use of typical cable installation vessels due to vessel draught, a shallow draught barge may be deployed. The barges will typically be positioned using a multipoint anchor spread and moved incrementally along the route by winches hauling against the anchors.

6.5.94 The cable installation vessels will be equipped with specialist cable handling equipment and will have support vessels in attendance, where necessary. The cables will be stored on carousels or drums mounted on the deck of the vessels, and the cables then deployed onto the seabed using the cable handling equipment.

6.5.95 Cable lay and burial alternatives include one or a combination of the following:

- Direct burial during the laying campaign which involves the cables being laid and buried as part of a single activity;
- Pre-trenching will involve trenches being created separately in advance, with the cables then subsequently being laid into the trench as a separate activity; and
- Post-lay burial will entail the cables being laid separately in advance; cables are then subsequently buried as a separate activity. Typically, the duration of cable exposure will be a short number of hours. During this time any unburied lengths of cable will be protected using a guard vessel.

6.5.96 A typical cable installation vessel is shown in Figure 23.

Figure 23 Cable laying vessel (Source: Van Oord)

6.5.97 The direct burial installation methodology comprises of the following steps;

- The cable laying vessel will approach the first wind farm structure (WTG or OSP) with the cables on a carousel situated on the deck. The CPS will be fitted to the cable end which will then be floated from the vessel to the structure;

- The cable end will be attached to a pre-installed messenger wire running down the inside of the foundation and exiting from the cable entry hole at the base. The cable will then carefully pulled up through the foundation;
- When the cable reaches the pre-determined cable termination point in the structure, the pulling operation ceases, and the end of the cable will be terminated into an electrical equipment enclosure;
- At the cable laying vessel, the cable will be loaded through the cable burial equipment (burial plough or trenching tool), which will then be deployed to the seabed. The cable will be simultaneously laid and buried as the cable burial equipment moves away from the foundation position;
- Whilst cable laying is in progress, the cable lay vessel will be approaching the second structure to which the cable must connect. Once the cable is in the proximity of the second structure, cable laying will cease, and the burial equipment will be recovered to deck; and
- The end of the cable will be passed from the vessel where it will be floated towards the second offshore structure, pulled through the foundation and connected as described above. On the seabed, at the approach to the foundation structure, cable lengths of approximately 100 m may not be buried to the targeted burial depth during this procedure, and will be subsequently protected using the techniques described in 6.5.123 to 6.5.135.

6.5.98 Where pre-trenching will be undertaken the trench will be excavated in advance of the cable lay, and subsequently the trench filled with the excavated material during the cable lay process or allowed to re-fill naturally.

6.5.99 Where post-lay burial will be undertaken, the cables will be temporarily laid on the seabed surface, awaiting either alternative cable protection or post-lay burial methods, such as jetting. In these cases, the cables are laid directly from the vessel in the correct position on the seabed by carefully controlling the vessel's position and speed, as well as the speed of the cable carousel.

6.5.100 During cable installation and particularly during the pull-in of the cable to the foundations, a ROV will be used to inspect the works and confirm positioning.

6.5.101 Cables will be buried where feasible as it will provide the best protection for the cable, in the shortest time with the lowest cost. In the event that optimum burial is not achieved, during the initial cable lay and burial process, successful burial may be achieved by remedial burial. Remedial burial measures will involve utilising an alternative cable burial technique or a more powerful machine to achieve the required burial depth over the relevant section of cable. The selected cable burial option will be one of the technologies described in 6.5.104-6.5.113.

6.5.102 A detailed CBRA will be carried out to identify the most suitable target burial depth and level of protection along the cable route. The assessment will include consideration of cable operating characteristics, sediment type, and potential risk of damage to the cable from mobile sediments or external activities such as fishing or vessel anchoring.

6.5.103 Cable burial is expected to be possible in the majority of seabed conditions identified within the development area. Burial methodologies will include ploughing, mechanical trenching/cutting and/or jetting techniques, as appropriate to the location. The use of different cable burial techniques will vary depending on the site conditions and the technology available at the time. The key parameters associated with each installation technique are provided in Table 28 and Table 29.

Table 28 Offshore export cable installation parameters

Parameter	Plough	Jetting	Mechanical trenching	Burial sled	MFE25
Maximum length of export cable (km)	36.7	36.7	36.7	36.7	36.7
Trench width (m)	12	4	1.5	1.5	6
Width of seabed disturbance (m)	15	15	15	15	15
Depth of trench (m)	3	3	3	3	3
Area of seabed disturbance (km²)	0.55	0.55	0.55	0.55	0.55
Volume of seabed excavation (km³)	1.32	0.44	0.17	0.17	0.66

Table 29 Offshore inter array cable installation parameters

Parameter	Plough	Jetting	Mechanical trenching	Burial sled	MFE
Maximum length of IAC (km)	120	120	120	120	6 (5% of route)
Trench width (m)	12	4	1.5	1.5	6
Width of seabed disturbance (m)	15	15	15	15	15
Depth of trench (m)	3	3	3	3	3
Area of seabed disturbance (km²)	1.8	1.8	1.8	1.8	1.8
Volume of seabed excavation (km³)	4.3	1.4	0.5	0.5	0.1

25 Mass Flow Excavators

Ploughing

6.5.104 Ploughing techniques are suitable for a large range of seabed conditions. Some plough systems, such as rock cutters or vibrating share ploughs, have potential to be deployed in soil types up to the strength of weak rock. Ploughs can be combined with jetting equipment to improve performance in sand.

6.5.105 Ploughing techniques cause minimal disturbance of the seabed. The cable plough lifts a wedge of sediments, typically less than two metres wide, places the cable beneath the wedge, and then lowers the sediments back into their original position, ensuring simultaneous reinstatement of the seabed. The width of the plough unit will be up to 15 m, however the footprint in contact with the seabed will be less than this. The impacted footprint of seabed to be disturbed is expected to be a 12 m wide strip, which is expected to create a trench to a depth of approximately 3 m.

Jetting

6.5.106 Jetting (or jet trenching) techniques will involve the injection of pressurised water jets into the seabed to fluidise a trench of approximately 3 m deep and up to 4 m in width, enabling the cable to sink under its own weight, safely into the seabed. The fluidised material subsequently resettles, giving a degree of immediate burial. The remaining trench will quickly backfill as a result of natural sediment processes until pre-installation conditions are reached.

6.5.107 Cable jetting devices will include tracked and thruster propelled ROV trenchers. The area of seabed disturbance has assumed that a 4 m wide strip of seabed will be impacted to provide a precautionary assumption.

6.5.108 The jetting technique may be used together with ploughing or other cable burial methods.

Mechanical trenching

6.5.109 Mechanical trenchers are self-propelled, tracked vehicles. Tracked cable burial vehicles are launched from the support vessel by crane. Once lowered to just above the sea bed, the pre-laid cable is located using a combination of cable detection, underwater cameras and/or ROV assistance. The tracks are positioned to straddle the cable and then it is loaded into the trencher. The loading procedure varies slightly between machines but almost all examples working in Northern Europe are now diverless. As the vehicle makes forward progress, many have the capability to automatically steer along the line of the cable with an auto-tracking capability linked to the cable tracking system fitted to the front of the trencher. Manual control by the operator is also available.

6.5.110 Some mechanical trenchers have been designed specifically with cable burial in mind. The cutting mechanism comprises a series of high-specification tungsten carbide picks mounted on a rotating chain or on a wheel. They are typically conical in shape and about 25 mm in diameter.

6.5.111 Mechanical trenchers can be used to simultaneously bury the cable as it is laid but are more commonly configured for post-lay burial.

Burial sledge systems

6.5.112 Burial sledge systems comprise of a vehicle towed behind the installation vessel, which moves on skids over the seabed and from which both jetting and mechanical trenching can be undertaken. This process is also called Simultaneous Lay and Burial (SLB). The width of the burial sledge is approximately 15 m, with the width of the tracks which will directly contact the seabed shall be less than 15 m.

Mass flow excavators

6.5.113 MFE, also known as Controlled Flow Excavation (CFE), uses an impeller and duct system suspended from a vessel a short distance above the cable to direct a high-volume, low-pressure flow towards the seabed. This process fluidizes and entrains seabed material, creating an excavation trench that can be over 5 m wide and approximately 2 to 3 m deep, depending on seabed conditions.

6.5.114 MFE can also be effectively used for backfilling a trench after cable installation by employing high-pressure water jets to displace seabed material back into the trench. This method fluidizes the surrounding sediment, allowing it to naturally settle over the cable, creating a secure and stable covering.

6.5.115 The non-contact nature of MFE minimizes disturbance to the installed cable and the surrounding environment while ensuring efficient, uniform backfilling that protects the cable and maintains seabed integrity.

Sandbank crossing

6.5.116 The process of laying inter-array cables across the Kish and Bray Banks involves a detailed, multi-step procedure to ensure both stability and protection of the cables.

6.5.117 To achieve effective burial below the stable seabed, initial removal of sand will be necessary. This will be accomplished using a TSHD, although alternative methods such as backhoe dredging or water injection dredging may be employed based on contractor preference.

6.5.118 Up to six crossings of the Kish and Bray banks will be required to connect the WTGs to the OSP, with each crossing spanning approximately 1,000 m. Three crossings will be located on the Kish Bank and three on the Bray Bank. On each bank, the crossings will be spaced at intervals of no less than 500 m. Each crossing will contain one inter-array cable.

6.5.119 These crossings require precise planning and execution to navigate the mobile bathymetry present in the sand bank. The crossings will be located to traverse the low points/natural troughs of the sand waves in an effort to minimise the excavation required.

6.5.121 A typical installation sequence is outlined below;

- The contractor will excavate a trench of approximately 60 m width at the seabed, 20 m width at the base of the trench, and approximately 4 m in depth. This depth ensures cables are laid beneath the mobile sand waves in the stable seabed. Excavated material will be temporarily stored alongside the trench during installation;
- It is anticipated that the trench will remain open for up to 20 days between the excavation and reburial activities. Should natural deposition of material occur between the excavation of the trench and the installation of the cable, the cable installation process may involve fluidising of the material in the trench in order to achieve the optimal cable burial depth;
- Prior to the laying of the inter-array cable, a final trench sweep may be carried out to ensure that the route is clear of obstructions, hazards, and debris before the cables are laid;
- Following the installation of the inter-array cables, the excavated material will be utilised as backfill to ensure the cable is adequately backfilled. Backfilling may be carried out by means of THSD or MFE, or a combination of both methods; and
- Post-lay surveys will be carried out along all cable routes, including at the sandbank crossing locations, which will record the as-built seabed level and evidence that the seabed, as far as is reasonably practicable, has been returned to a comparable condition to its pre-construction state.

6.5.122 Protective measures, such as installing concrete mattresses, may be used across the IAC to safeguard the cables and minimize potential damage from anchoring, fishing activities or from changes due to the mobile seabed. The process ensures the integrity of all subsea cables for their long-term stability.

Cable protection installation

6.5.123 Cable protection will be deployed as part of the installation methodology to protect the cables on the approach to offshore infrastructure (WTGs and OSP), extending up to 100m from the structures where necessary. It may also be utilised where optimum burial cannot be achieved or where there is an increased risk to the cable from external factors, such as anchor strike. Vessel anchors will penetrate more deeply in areas of soft soils with small particles, such as clay. In such conditions, the cable will be more vulnerable to anchor strike. In areas of mobile sand waves, buried cable may become exposed over time, in such conditions secondary protection will be applied.

6.5.124 Protection measures may be placed alone or in combination and secured to the seabed where required. Where appropriate, cable clips (also known as cable anchors, or anchor clamps) may be utilised to secure cables to the seabed. The final methods, quantities and designs used will be determined as part of detailed design after development permission has been secured and in advance of commencement of construction. The following cable protection technologies described below have been identified to address a range of potential requirements.

Rock or gravel burial

6.5.125 Protection by rock burial also referred to as rock placement involves installation of a rock 'berm' over the cable. Rock burial is one of most technically robust and commonly used techniques. Rock berm design, and rock grade and density, will be specified to ensure stability in the local environment.

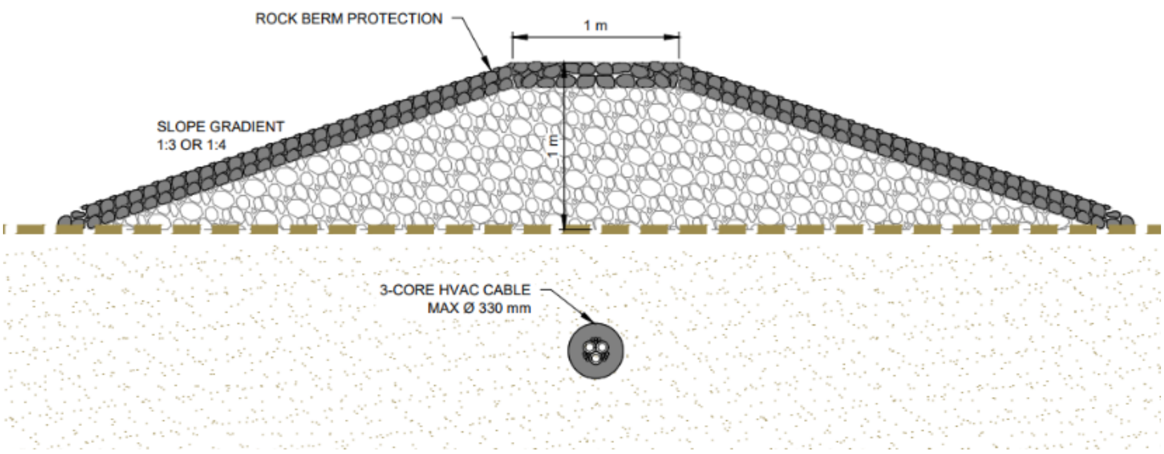


Figure 24 Illustrative rock berm protection above seabed

6.5.126 Rock protection will be deployed from specialist ships or barges using techniques such as side casting, where rock will be pushed overboard with lateral hydraulic slides and discharged onto the seabed. Alternatives include fall-pipe systems; where rocks are fed into a funnel at the top of a fall-pipe and discharged at a controlled rate as guided by sensors at the base of the pipe, which will be steered remotely. The final berm dimensions will be confirmed by bathymetric surveys before and after rock placement.

Figure 25 Typical rock placement vessel (source; Boskalis)

Concrete mattresses

6.5.127 Concrete mattresses will consist of a number of concrete blocks linked together by flexible cables. There are a number of design options available for concrete mattresses. The most suitable concrete mattress will depend on a number of factors including specific application, function and environmental conditions. Designs include options with smoothly tapered edge sections intended to have reduced impact upon trawling, and mattresses with integrated flow energy dissipation devices, such as frond mats.

6.5.128 The concrete mattresses will be installed by a crane lifting the mattress over the cables in a pre-determined pattern to hold the cables in place and provide protection against fishing gear and vessel anchors.

Flow energy dissipation devices

6.5.129 Flow energy dissipation devices are designed to trap local, mobile sediments in order to generate a protective covering. A common example includes frond mats, which use flexible buoyant strips (fronds) which will gently reduce the water velocity above the mats and are similar in appearance to a sea grass bed. The mats allow mobile sediments to become deposited and trapped around the fronds and gradually build a sand layer on the mats, protecting any cables below.

6.5.130 Alternative flow energy dissipation devices include designs where large hoops are linked together into a mat and act similarly to a frond mat, and designs which are covered with long rigid spikes to slow the water flow.

Protective aprons or coverings

6.5.131 Protective aprons refer to solid structures of varying shapes, typically prefabricated in concrete or high-density plastics. They include plastic casings of which can protect the cable on the seabed at the base of a foundation or prefabricated concrete half-pipe structures which fit over the cable to provide robust, over-trawlable protection, potentially with no need for burial. In some cases, protective aprons maybe equipped with flow energy dissipation devices.

Bagged solutions

6.5.132 Bagged solutions will include geotextile sand containers, rock-filled gabion bags or nets, and grout bags. Bags are typically lowered into position by crane from a surface vessel, individually or in groups. These options are often used in proximity to a foundation base since precise placement is possible.

6.5.133 Development permission is sought for any, or a combination of, the cable protection installation methods described above, subject to the necessary detail being confirmed prior to the commencement of development of that part of the proposed development.

6.5.134 The final selection will be determined by the final WTG and OSP locations and foundation designs, following the detailed design and procurement phase of the proposed development These elements relate to normal construction practises and installation methodologies that are intrinsic to a proposed development of this nature. The parameters and quantities assessed in this EIAR have been developed based upon consideration of the likely maximum length of cables requiring protection.

6.5.135 The conditions, for which burial may not be feasible include areas of hard rock at the seabed or in areas of mobile sand waves where buried cable may become exposed over time. In such conditions, secondary protection will be applied. Precautionary estimates of the length of cables which may require secondary protection have been made to ensure that the assessments of environmental impacts are based on values which will not be exceeded during construction and are outlined in Table 30.

Table 30 Secondary cable protection parameters

Parameter	Quantity
Maximum IAC protection volume (m^3)	120,000
Maximum export cable protection footprint (m^2)	73,000
Maximum export cable protection volume (m^3)	42,700

Offshore cable crossings

6.5.136 Dublin Array offshore submarine cables will not cross any existing third-party cables or pipelines.

6.5.137 The two Dublin Array submarine electricity export cables from the OSP to landfall will cross three planned submarine electricity export cables from the proposed Codling Wind Park (CWP)[26] development, with a potential therefore for six cable crossings. Export cables will cross each other in a corridor approximately 1 km wide and 3 km long located on the west side of the Kish and Bray Banks which will be east of the Fraser Bank indicated on Figure 26. The installation programme for both developments will be similar, but it is not currently known which of the two will advance first to lay their export cables and which will have to install crossings above these cables.

6.5.138 The assessment of environmental impacts in this EIAR takes into consideration the potential crossing the proposed CWP export cables. Development permission is sought to install the crossings of Dublin Array export cables either under or over the CWP export cables, subject to the necessary detail being confirmed prior to the commencement of development of that part of the proposed development.

6.5.139 In addition, the environmental assessment has assessed a scenario where two proposed crossings of the Dublin Array IACs with the Dublin Array export cables, should such a circumstance need to be installed.

6.5.140 The following cable crossing installation principles will be implemented;

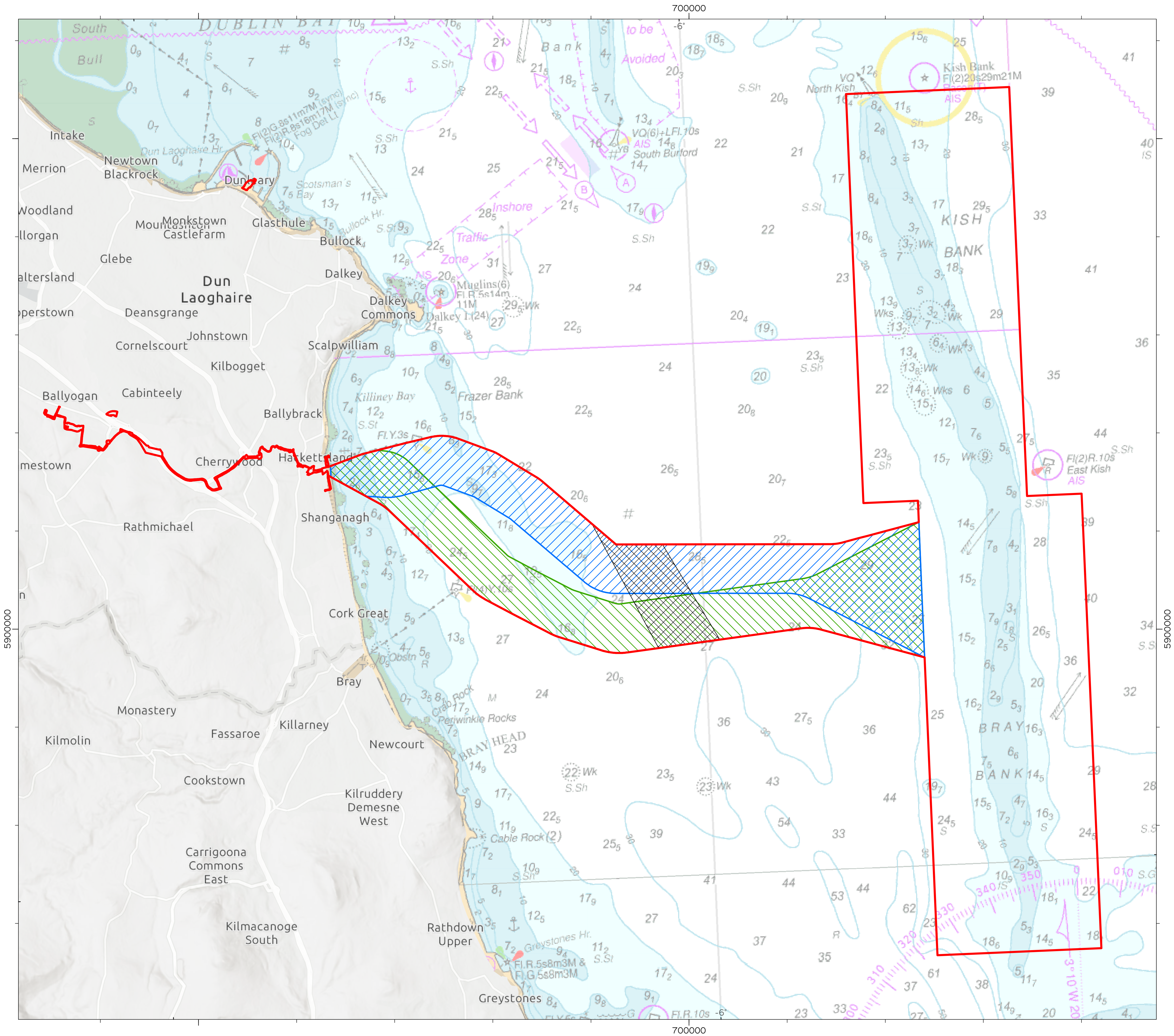
- Vertical separation between cables will be a minimum of 300 mm in addition to burial depths of the first cable;
- The minimum mattress thickness will be 300 mm and constructed of high-density concrete;
- Pre lay mattress(s) will be installed over the pre-installed (buried) cable perpendicular to the direction of the lay of the crossing cable;
- Top mattresses or rock armour will be installed (subject to crossing agreement), which will cover approximately 50 m on each side of the first cables;
- The profile of crossing will not reduce navigable depth by greater than 5% of surrounding charted depths referenced to chart datum; and
- The horizontal crossing angle will be between 60 – 90˚ but will endeavour to achieve as close to 90˚ as possible.

26 Codling Wind Park ABP Case Reference Number 320768 submitted 06/09/2024

6.5.142 The installation of a cable crossing based on the use concrete mattresses will undertake the following process:

- The proposed crossing locations will be surveyed to confirm the precise location and burial depth of the existing assets, and the crossing will be designed accordingly;
- The first cables will be laid to the nominal burial depth defined by the responsible Developer using standard cable burial methods. The precise location and burial depth of the first cables will be recorded and the suitability of the crossing design confirmed;
- Concrete mattresses (referred to as 'pre-lay' mattress(es)) will be laid perpendicular to the orientation of the first cables. Mattresses will be lifted using a lifting frame on the mattress installation vessel and placed into the required position onto the seabed;
- Standard burial techniques (as outlined in Sections 6.5.93 - 6.5.113) will be deployed for the second cables which will each terminate at an agreed safe distance from the crossing location. This will take into account grade in/grade out distances and proximity of the cable installation vessel proximity to the crossing point. The cables will be surface laid on the approach to the crossing point, over the mattress, perpendicular to the orientation of the first cables and until a safe distance on the other side of the crossing has been achieved, where cable burial will recommence. The grade out on approach to the crossing will be a greater distance from the crossing than the grade in point beyond the crossing. The second cables may have half-shell castings installed onto the cable as they are deployed from the laying vessel for additional protection in the region of the crossing;
- The surface laid sections of cable will be protected by a combination of trenching and burying between the crossing point and the start/end of cable burial and laying of concrete post-lay mattresses or rock at and between the crossing points aligned with the orientation of the second cables;
- Rock burial will be carried out on the mattress edges, to stabilise them and avoid secondary seabed scour around the mattresses; and
- In the circumstances where the crossing will be protected by rock the same methodology will be followed with pre-lay mattress(es) installed and the crossing cable surface laid over the crossing. The second laid cable will then be protected by a combination of trenching and burying between the crossing point and the start/end of cable burial and laying of filter and armour layer rock as depicted in Figure 28.

6.5.143 The final crossing will be subject to an agreement between the Applicant, CWP and EirGrid.



- Planning Application Boundary
- Northern Export Cable Corridor; OR
- Southern Export Cable Corridor
- Codling Wind Park Export Cable Crossing Zone

DRAWING STATUS

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MAP NOTES / DATA SOURCES:

PROJECT TITLE

Dublin Array

DRAWING TITLE

Dublin Array & CWP Cable Crossing Locations

DRAWING NUMBER: 005532727-01

FIGURE NUMBER: 6.26

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2025-01-10	Ready for release	DB	PM	PK

0 0.5 1 1.5 2 Kilometres
0 0.4 0.8 1.2 1.6 Miles

N GRID NORTH

SCALE	1:80,000	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

Dublin Array
Generation for generations
Kish Offshore Wind Limited - Bray Offshore Wind Limited

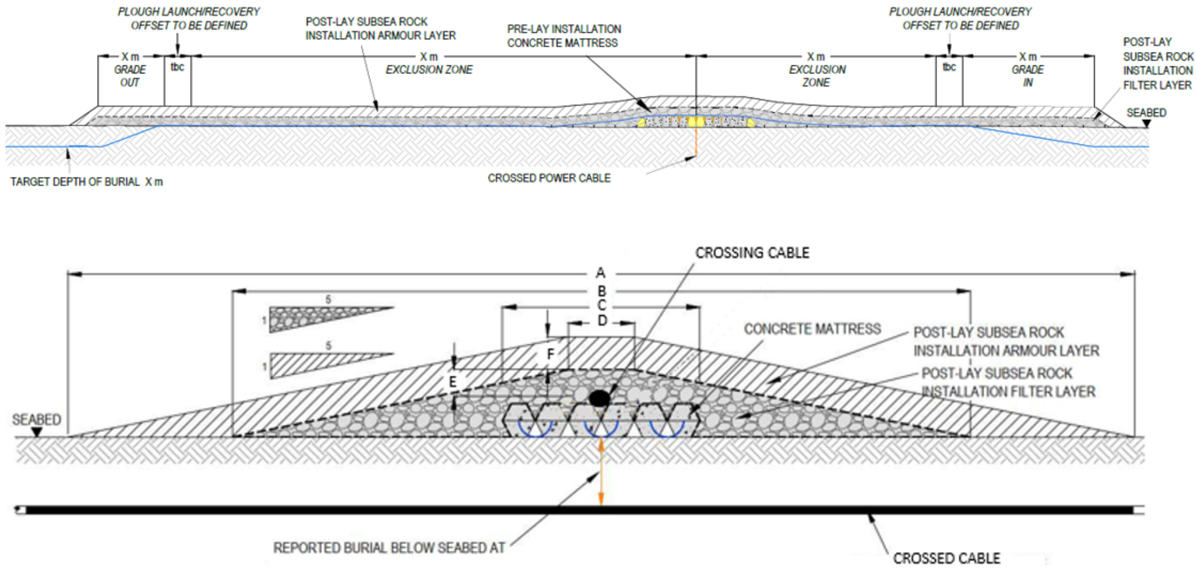


Figure 27 Cable crossing showing standard mattress configuration[27]

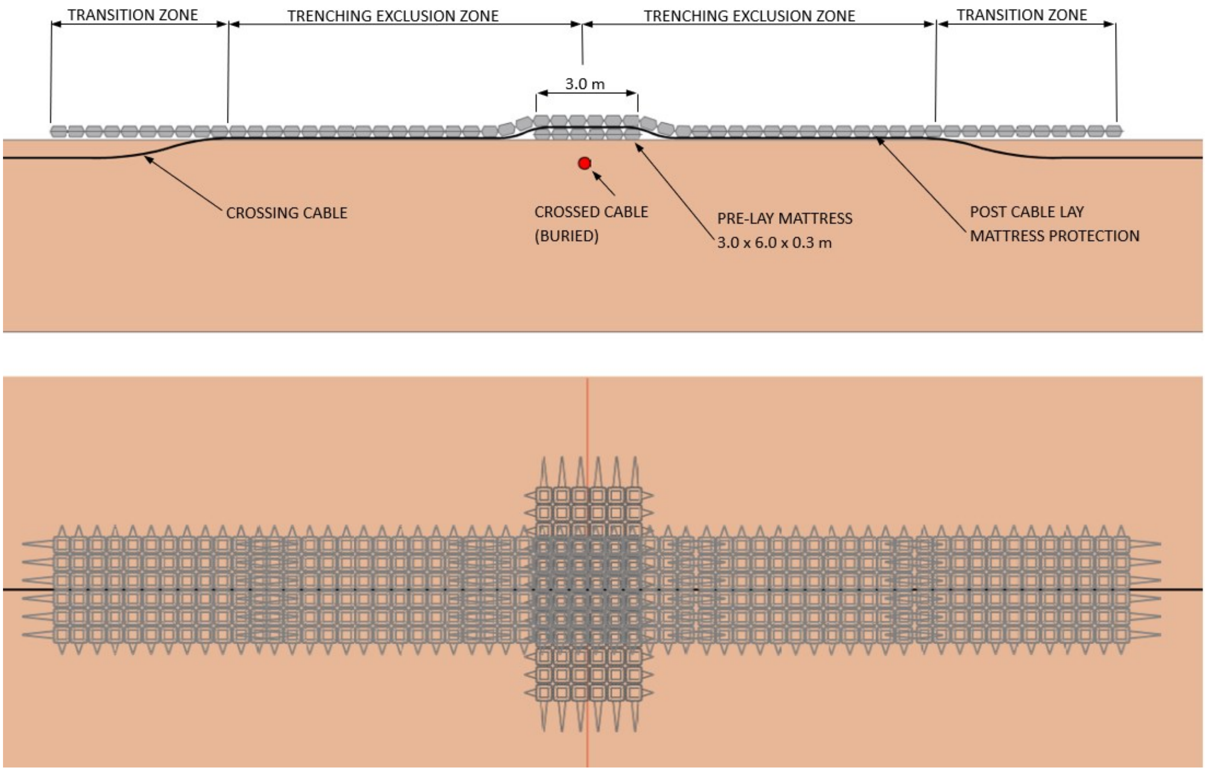


Figure 28 Schematic showing standard crossing example with pre and post lay concrete mattresses

27 Final configuration of cable crossing to be determined & agreed with CWP and Eirgrid prior to construction

Table 31 Cable crossing parameters

Parameter	Quantity
Maximum number of export cable crossings	6
Maximum total footprint of export cable crossings (m^2)	15,000
Maximum volume of export cable crossing material (m^3)	9,000
Maximum number of inter array and inter platform cable crossings	2
Maximum total footprint of inter array and inter platform cable crossings (m^2)	5,000
Maximum volume of inter array and inter platform cable crossing material (m^3)	2,900

Export cable landfall

6.5.144 The two offshore export cables will come ashore at the proposed landfall, located at Shanganagh Cliffs to the south of the Uisce Eireann Shanganagh Wastewater Treatment Plant where they will connect to the OES in two TJBs. The TJBs will be located on land above and set back from the cliff edge by approximately 90 m.

6.5.145 Before the cables can be brought ashore, two cable ducts will be installed using a trenchless technique, such as horizontal directional drilling (HDD) or Direct Pipe Method (DPM). Trenchless installation methods will enable the cable ducts and cables to be installed beneath the cliff and beach, eliminating the need for open-cut techniques.

6.5.146 The trenchless technique will commence at the TJB locations and involve either drilling or tunnelling from an entry pit onshore, beneath the cliff and beach to emerge, or punch out at the exit pit in the seabed, a maximum length of 850 m offshore in water depths of up to 10 m below mean high water springs (MHWS).

6.5.147 The punch out location of the two cable ducts in the seabed will be approximately 50 m apart. A minimum distance of 30 m will be maintained between the trenchless exit point and the Shanganagh municipal wastewater treatment plant outfall to prevent any impacts from changes to the hydrodynamic and sediment regime in this area. The separation distance will also ensure there is no direct overlap with the existing outfall. The two exit pits will be located to the south of the outfall, and the offshore cable route will proceed east to the offshore array from this point.

6.5.148 A detailed description of the trenchless techniques at the landfall to accommodate the installation of the offshore export cables have been described in detail in Section 6.9.

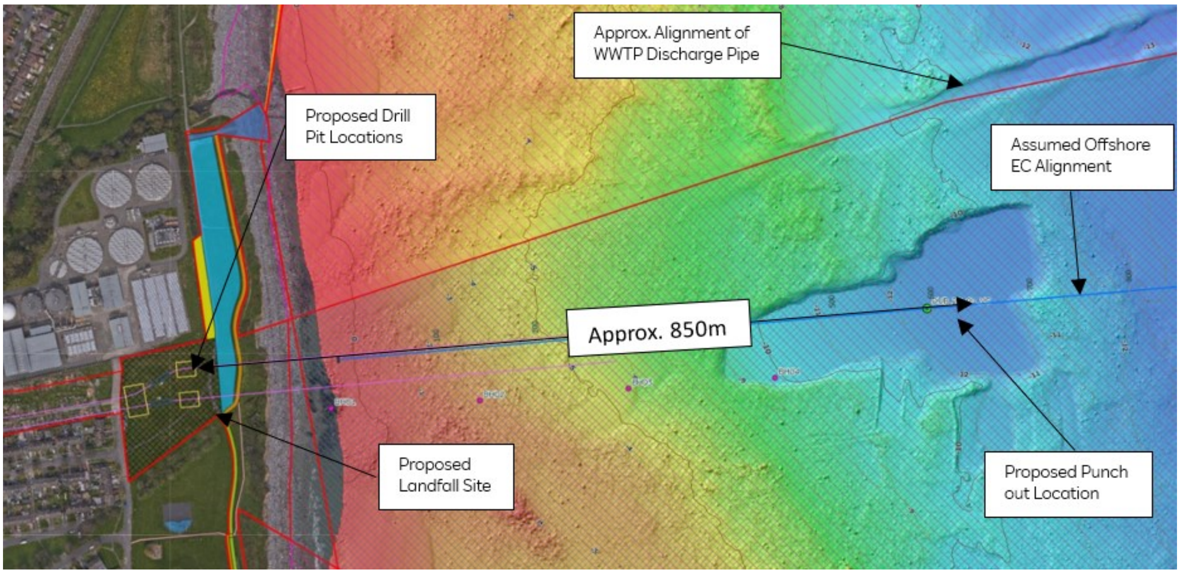


Figure 29 Schematic showing proposed punch out location from trenchless duct installation

Offshore commissioning

6.5.149 During the commissioning of the offshore wind farm infrastructure, the appointed Contractor will perform inspections and tests to verify that all components are complete, fully operational, and safe for integration into the wind farm's operational framework.

6.5.150 Commissioning activities encompass detailed inspections and tests of both the infrastructure and the electrical components of the WTGs and the OSP, including evaluations of mechanical and structural elements, as well as a review of quality records. Some components may require multiple inspections over time as part of the commissioning process.

6.5.151 Once each WTG is completed and connected to the IACs, which are terminated and tested at both the WTG and OSP ends (or between WTGs if mid-string), the commissioning team performs mechanical and electrical (M&E) checks, including Supervisory Control and Data Acquisition (SCADA) control system tests. Each WTG is then energized under WTG safety protocols to enable initial power generation. For WTGs configured in strings to the OSP, all WTGs in the string are confirmed ready for 'hot commissioning' (under load). Following energization, each WTG undergoes reliability testing to identify and resolve any faults, after which it is formally handed over to the wind farm operator.

6.5.152 An example commissioning plan for a wind turbine includes:

- Testing and inspection of control systems for the generator, switchgear, transformers, gearbox (if applicable), yaw control, and meteorological instruments;
- Testing of safety systems in both static and operational modes;

- Inspection and testing of ancillary systems such as lifts, cranes, fans, and hydraulic systems;
- Verification of WTG components against a standard commissioning checklist; and
- Energization of the WTG to enable initial power generation.

6.5.153 An example commissioning plan for the OSP includes:

- Hook-Up and Cold Commissioning: After the OSP topside is installed and export cables are pulled in and terminated, assets undergo mechanical and electrical completion checks;
- Stage 1 Commissioning: Once shore power is available, the platform is energized under electrical safety rules, enabling climate control, monitoring, and conditioning systems; and
- Stage 2 Commissioning: Following sufficient power generation from installed WTGs, HV equipment on the OSP is tested to confirm correct operation under load.

6.5.154 EirGrid will provide functional specifications detailing their requirements for the commissioning of transmission assets and will coordinate joint inspections with the Dublin Array team, with access to inspection and test reports. For the electrical completion of transmission assets such as export cables, joints, and TJBs, EirGrid requires independent verification checks and reports, in accordance with their certification specifications.

Offshore Transmission System Operator

6.5.155 From start of operation until asset transfer (a duration of approximately 18 months) the Applicant will have responsibility for the operation and maintenance of the offshore infrastructure as well as the onshore electrical system.

6.5.156 Following an envisaged proving period of 18 month the transmission assets will be transferred to EirGrid (Offshore Transmission System Operator (TSO) in accordance with Offshore Electricity Transmission System Policy. Assets to be transferred to EirGrid will include all associated plant, equipment and systems from the OSP and all related infrastructure back to the grid connection point (GCP) at the existing Carrickmines 220 kV transmission station.

6.5.157 The offshore windfarm including the WTGs and supporting structures, inter array cabling and associated control, protection and telecommunication equipment will remain in the ownership and operation of the Applicant.

6.5.158 On handover of the assets to EirGrid, they will take responsibility for the operation and maintenance of the OSP, offshore export cables, TJBs, onshore export cables, OSS and associated transmission control, protection and telecommunications equipment. All other plant equipment and systems will be operated and maintained by the Applicant for Dublin Array[28].

Navigation and aviation safety

6.5.159 The OSP, WTGs and associated support structures will be marked according to the requirements of the CIL, the Irish Coast Guard (ICG), the IAA, the Department of Defence and the Marine Survey Office, which will be developed in consultation with these bodies. The final marking and lighting requirements will ultimately depend upon the final design; however, indicative requirements are expected to be as follows:

- Transition pieces will be painted yellow to at least 15 m above HAT;
- Significant Peripheral Structures (SPS) will have yellow lights with a flashing range to be agreed with Irish Lights;
- Intermediate Peripheral Structure (IPS) will be selected and installed with yellow flashing light with a flashing range to be agreed with Irish Lights;
- The distances between SPSs and IPSs will be agreed with Irish Lights;
- AToN on each individual structure will be placed below the arc of the rotor blades;
- Sound signals will be installed where required by Irish Lights;
- Individual turbines and offshore substations will be marked with a unique alphanumeric identifier which is clearly visible at a range not less than 150 m at both day and night-time. Down lighters will be used to ensure that identifiers are appropriately lit and remain visible at night with the same range as daytime;
- The wind farm will be marked with flashing red aviation warning lights, showing a Morse ‘W’ pattern, as required by the aviation and maritime lighting authorities and visible to night vision goggles. It is expected that all of the peripheral turbines will be required to be lit, typically with lights fitted to turbine nacelles; and
- The positions of all offshore infrastructure and sub-sea cables will be conveyed to the UK Hydrographic Office so that they can be incorporated onto Admiralty Charts and the Notice to Mariners procedures. All relevant ‘as built’ details will also be supplied to the ICG, IAA CIL, Maritime Area Regulatory Authority (MARA), fishing community, and the local rescue services.

28The handover of these assets to EirGrid is relevant to the assessment of the O&M and Decommissioning phases of Dublin Array.

6.5.160 Prior notification through a Notice to Aviators of construction and decommissioning together with the notification and charting of the array area prior to and during the operation and maintenance phase will enable aviators to be aware of the location and development parameters (height and lighting).

6.5.161 Should there be a requirement for the Applicant to obtain a 'crane licence' before operating cranes in the construction, operation and maintenance and decommissioning phases; licences will be obtained from the appropriate authority ahead of requirement.

6.5.162 Reference should also be made to the Volume 3, Chapter 3.10: Shipping and Navigation and Volume 3, Chapter 12: Aviation and Radar and their associated appendices.

Offshore operations and maintenance

6.5.163 Once operational, Dublin Array will require regular maintenance throughout its lifetime which is expected to be a maximum of 35 years. The MACs for Dublin Array have been awarded for a period of 45 years (to include the development, construction, operational and decommissioning phases of the development). A full-time dedicated team of approximately 80 personnel including technicians and associated support staff will be required to operate and maintain the wind farm, who will be based at a dedicated O&M Base in Dún Laoghaire Harbour. Further information on the O&M Base can be found in Section 6.16.

6.5.164 Maintenance activities fall into two categories: preventative and corrective. Preventative maintenance is carried out according to regular scheduled services, whereas corrective maintenance covers unexpected repairs, component replacement, retrofit campaigns and breakdowns.

6.5.165 Dublin Array will be designed with an optimised operation and maintenance concept over its lifetime, which will be managed from a control room located at the O&M Base. Each turbine will be controlled by local microprocessors, which in turn will be monitored by a centralised SCADA system which will be located within the O&M Base. The SCADA system and other communication requirements for Dublin Array will be linked to the onshore communication network via optical fibre cables which will form an integral part of HVAC subsea cables. Should a turbine develop a fault, this can usually be diagnosed remotely, and the WTG shut down automatically if required.

6.5.166 Factors governing the development of an O&M strategy include:

- Health & Safety requirements in transferring crew members and O&M technicians to and from offshore structures;
- O&M port location and the associated transit duration from O&M Base to the array;
- Weather downtime;
- Turbine selection and the associated cost-benefits of each option; and
- Responsibility scope of the transmission assets.

6.5.167 The final O&M strategy will be developed as part of the final detailed design process in consultation with the main component and service providers.

6.5.168 Due to the proximity of Dublin Array to the shoreline, the wind farm will typically be serviced by small CTVs operating daily from the O&M Base in Dún Laoghaire Harbour. In addition, there will be a requirement for heavy lift and cable laying vessels to visit the array area for major component exchanges, cable repair or other remedial works. When required these larger vessels will transit to site from their home port or via a staging port.

Maintenance activities

6.5.169 During the O&M phase, a number of periodic inspections and surveys will be undertaken. These will include inspection of WTGs, OSP and foundation components, corrosion, coatings, cable protection and scour protection. Some inspections will be carried out manually, others using remote sensing techniques.

Maintenance of turbines and associated plant

6.5.170 Each WTG will be subject to routine inspection. Blade surveys may be conducted by drone, launched and controlled by personnel on a CTV positioned close to the turbine. Routine servicing of generators, gearboxes (if applicable), transformers and switchgear will also take place.

6.5.171 Lubricants and hydraulic oils which are changed during these service visits will subsequently be disposed of via licensed recycling contractors onshore. Other disposable service items such as filters will be disposed of via licensed solid waste disposal routes.

6.5.172 Planned maintenance and inspections will be carried out to change out consumables and worn parts to ensure optimal operation. In the event of malfunction, components will be removed and replaced with equipment of similar specification or more advanced technology if appropriate and available. The faulty component will be removed and disposed of via a licensed recycling/disposal waste contractor onshore. Parts will be recycled or refurbished whenever possible.

6.5.173 For certain types of unscheduled maintenance, for example in the event of a breakdown of a large component such as a blade, main bearing and generator or a gearbox, it may be necessary to mobilise large transportation and crane vessels or jack up barges to complete the repairs. Some turbines provide the ability to mount an additional integral winch in the nacelle or the top of the tower which can be used to lower equipment such as transformers or converters to sea level.

Maintenance of foundations

6.5.174 Each foundation will be subject to routine inspections which, where possible, will be organised to coincide with other maintenance activities on the WTG/OSP to reduce the number of visits. The inspections will range from the structural integrity of the foundation (including paint coverage and corrosion) to HV equipment maintenance. It is estimated that approximately four visits a year to each foundation will be required and the findings of the inspections may require further remedial works to take place such as painting and removal of marine growth. The use of ROVs may be required for some of the periodic inspections and subsequent rectification works. The use of dive personnel will be minimized to reduce health and safety risks unless absolutely necessary.

Maintenance of subsea cables

6.5.175 The buried subsea cables will be inspected periodically, the frequency determined on a risk basis, to ensure cable burial and integrity. This operation will potentially involve a working crew of four people on a small vessel, deploying an ROV to inspect the infrastructure, alternatively an appropriately equipped survey vessel. In the event of cable damage or exposure being identified, repairs will require a range of services to be mobilised to site. This could involve cable laying vessels and rock dumping barges.

6.5.176 Up to seven inter array or export cable repairs, or for the reburial of cables that may become exposed due to movement of seabed sediments over the 35-year lifespan of the wind farm[29]. For the purposes of assessing the likely significant effects of the proposed O&M phase of the development, it has been assumed that the following lengths of cable will be pulled from the trench for each repair:

- Export cable – 600 m;
- IAC – 3.3 km; and
- Up to five reburial events, each a maximum of 10 km may be required over the life time of the wind farm.

6.5.177 Reburial will be achieved using techniques described in 6.5.93 to 6.5.113.

Maintenance of offshore substation platform

6.5.178 The OSP will be subject to regular inspections and annual planned maintenance. Post the proving period, EirGrid will have the responsibility for the long-term maintenance of the OSP and associated balance of plant.

29 Whereas cable repairs may be licensable by MARA, permission is nonetheless required where the requirement for EIA cannot be excluded. Accordingly, permission is being expressly sought from ABP for cable repairs as part of this Application, and up to seven such repairs are assumed for EIA purposes.

Operations and maintenance vessels

6.5.179 The following sections identify the type of vessels that will be required during the operational and maintenance phase of the development.

6.5.180 Vessel movements will be co-ordinated by the Dublin Array O&M Base in Dún Laoghaire Harbour. Dedicated entry and exit points to the array area for all vessels will be established. Designated routes to and from the array area for vessels will be put in place which will avoid crossing main shipping routes at the southwest corner of the site where sea room between the wind farm and the shallows of the Moulditch bank[30] and associated buoy is constrained.

6.5.181 All vessels will carry AIS so that vessel positions can be monitored. A communication protocol will be agreed with Dublin Port Vessel Transport Services (VTS) and Dún Laoghaire Harbour Master to co-ordinate construction or maintenance activities with vessel movements to and from Dublin Port (if required) and Dún Laoghaire Harbour.

Crew transfer vessels

6.5.182 CTVs will carry maintenance staff between the O&M Base at Dún Laoghaire Harbour and the offshore wind farm infrastructure. CTVs are typically 21 – 28 m in length with an operational speed of 20 to 30 knots and will be licenced to carry up to 24 passengers.

6.5.183 Approximately 1095 round trips will be made by CTV each year to the wind farm, with frequency peaking during the summer months when the majority of planned activities are likely to occur.

Service operation vessel

6.5.184 Service operation vessels (SOVs) are specialised vessels designed to support the O&M of offshore wind farms. SOVs are equipped with advanced facilities to accommodate technicians and crew members for extended periods at sea, typically returning to port every 2 weeks. SOVs often including sleeping quarters, dining areas, and recreational spaces. They are designed with features like DP systems, which allow them to maintain precise positions even in challenging weather, making them highly effective in offshore environments. SOVs are generally equipped with helipads to enhance accessibility and operational flexibility.

6.5.185 SOVs may be typically used during the operation and maintenance phase during larger, less frequent, maintenance or repair campaigns where the SOV will enable technicians to stay close to the site for longer durations, improving response times and reducing transit costs.

6.5.186 These vessels can also be deployed during the construction phase of an offshore wind farm to support installation activities, though dedicated installation vessels are more commonly used for heavy-lift tasks like turbine assembly.

30 The Moulditch Bank is a shallow bank consisting of coarse gravel and large stones, extending nearly 2 km from the shore, close to Greystones, in Co. Wicklow.

Lift vessels

6.5.187 Heavy lift vessels will be required for replacement of large wind farm components. Such vessels will not be based at the O&M Base in Dún Laoghaire but will be brought to site from other base ports as required, with components to be loaded onto the vessel at the point of manufacture or at a staging port.

Cable maintenance vessels

6.5.188 Cable maintenance vessels will be required in the event of cables requiring reburial, repair or secondary cable protection requiring maintenance. A single campaign would typically last approximately 7-10 days.

6.5.189 As with the lift vessel, cable maintenance vessels will not be based at the O&M Base but will travel direct to site from their home port or via a staging port.

6.6 Offshore decommissioning

6.6.1 A Decommissioning and Restoration Plan has been included in Volume 7, Appendix 2 of the EIAR. It has been prepared in accordance Section 75 of the MAP Act 2021 (as amended), and Condition 5.1 of the following MACs:

- Reference No. 2022-MAC-003 and 004;
- Reference No. 20230012; and
- Reference No. 240020.

(hereinafter referred to collectively as the 'MACs').

6.6.2 The Decommissioning and Restoration Plan includes three rehabilitation schedules, one for each MAC.

6.6.3 The purpose of the Decommissioning and Restoration Plan is to describe how the Applicant proposes to rehabilitate that part of the maritime area, and any other part of the maritime area, adversely affected by the permitted maritime usages the subject of the MACs. It has been assessed within the EIAR, SISAA, NIS and WFD that accompany this application for development permission.

6.6.4 If development permission is granted by ABP for the permitted maritime usages the subject of the MACs, the three schedules (and any relevant planning conditions) will be provided to MARA for the purpose of being attached to the relevant MACs.

6.6.5 Given the passage of time between the submission of this application for development consent and the carrying out of decommissioning works, and the likely evolution of scientific and technological knowledge relating to decommissioning, this Decommissioning and Restoration Plan (which for the avoidance of doubt includes the rehabilitation schedules) will be kept under review by the Applicant as the development progresses. In particular, it will be reviewed having regard to the following:

- The baseline environment assessment at the time rehabilitation works is proposed to be carried out;
- What, if any, adverse effects have occurred that require rehabilitation;
- Technological developments relating to the rehabilitation of marine environments;
- Changes in what is accepted as best practice relating to the rehabilitation of marine environments;
- Submissions or recommendations made to the Applicant by interested parties, organisations and other bodies concerned with the rehabilitation of marine environments; and/or
- Any new relevant regulatory requirements.

6.6.6 If the outcome of the Applicant's review is that a rehabilitation schedule requires alteration, the Applicant will apply to the relevant competent authority to alter the terms of its development permission, so as to alter the rehabilitation schedule, prior to the expiration of the development permission. Separately, if MARA forms the opinion that one or more of the schedules is no longer appropriate, MARA may serve a notice requiring the Applicant to make an alteration application to the competent authority in respect of the rehabilitation schedule. Any material alteration of the terms of the Applicant's development permission, based on the regulatory regime in place today, will involve further environmental assessment and public participation, and any decision made by the competent authority will be judicially reviewable. The public will therefore have a full opportunity to participate in any such future process. The regulatory regime in place at the time of carrying out the decommissioning works is expected to be similar.

6.6.7 Further, pursuant to Section 96(3) of the MAP Act, the Applicant acknowledges that the obligation to rehabilitate under Section 96(1) of the MAP Act, as amended, does not relieve the Applicant from having to apply for and obtain any other authorisations (whether the authorisation takes the form of the grant of a licence, consent, approval or any other authorisation) required under the MAP Act or any other enactment in order to enable the Applicant discharge this obligation.

6.6.8 In all circumstances, the Applicant's obligation to rehabilitate that part of the maritime area, and any other part of the maritime area, adversely affected by the permitted maritime usage the subject of the MACs, will be complied with.

Decommissioning of wind turbine generators

6.6.9 The removal of the structure involves the approximate reverse sequence of the installation process as follows;

- Assessment of the potential hazards during planned decommissioning and development of suitable procedures for mitigating them;
- Assessment of potential risk of pollutants entering the environment and development of suitable procedures for mitigating them;
- Disconnecting of wind turbines from electrical distribution network and SCADA system (Including any additional condition monitoring and communications systems);
- Mobilisation of decommissioning vessels;
- Removal of any potentially hazardous or polluting materials from the turbine;
- With the use of appropriate vessels, remove rotor blades, nacelle and tower sections; and
- Transport all components to onshore facility for processing and reuse/recycling/disposal.

Decommissioning of foundations

Piled foundations

6.6.10 It is anticipated that piled foundations will be cut approximately 2 m below seabed level and the upper section removed. Current methods for cutting piles include abrasive water jet cutters or diamond wire cutting. The final method chosen will be dependent on the technologies available at the time of decommissioning.

6.6.11 The methodology includes:

- Deployment of ROVs or divers to inspect each pile footing and reinstate lifting attachments if necessary;
- Mobilise a jack-up barge/heavy lifting vessel;
- Deploy crane hooks from the decommissioning vessel and attach to the lift points;
- Cut piles internally at a defined depth below seabed level;
- Inspect seabed for debris and remove debris where necessary;
- The decommissioned components will be transported back to shore by lifting onto a jack-up or heavy lift vessels, barge, or by buoyant tow;

- Transport all components to an onshore site where they will be processed for reuse/recycling/disposal; and
- Inspect seabed and remove any remaining debris. The scour protection system will remain in place to prevent seabed lowering in the vicinity of the monopile location.

Suction bucket foundations

6.6.12 Suction bucket foundations (if used) will be removed using approximately the reverse of the process required to install them. This could include use of a pump system to apply pressure inside the buckets and allow the foundation to be released and extracted from the seabed.

6.6.13 During the release process, any seawater or ballast inside the foundation shaft could be pumped out to make the structure buoyant, so that it can be recovered by an appropriate barge for transport from the site.

Decommissioning of offshore cabling

6.6.14 It is proposed that the buried assets such as cables will be left in situ when Dublin Array is decommissioned. This is considered preferable from an environmental perspective because this approach minimises disturbance of the seabed and preserves the marine habitat that will have established itself, over the buried assets, during the life of the wind farm.

6.6.15 However, as stated above, there is potential for this approach to change, depending on a range of matters, to include consultation with MARA. It may be the case that, when the decommissioning phase commences, the optimal approach in respect of cables is in fact to remove them from the sea. In this regard, both options in relation to cables (leaving in situ and removal) have been assessed where relevant in the EIAR, SISAA and NIS.

6.6.16 If required, the Applicant will apply to the relevant competent authority to alter the terms of its development permission, so as to alter the rehabilitation schedule, prior to the expiration of the development permission. Any material alteration of the terms of the Applicant's development permission, based on the regulatory regime in place today, will involve further environmental assessment and public participation, and any decision made by the competent authority will be judicially reviewable.

Decommissioning of offshore substation platform

OSP topside

6.6.17 The offshore substation topside will be removed during the decommissioning phase and returned to shore for decommissioning, recycling and where necessary disposal. The decommissioning programme will be expected to be similar to the decommissioning method employed for the wind turbine structures:

- Assessment of the potential hazards during planned decommissioning and development of suitable procedures for mitigating them;
- Assessment of potential risk of pollutants entering the environment and development of suitable procedures for mitigating them;
- Disconnecting of offshore platform from grid and SCADA system (including any additional condition monitoring and communications systems);
- Mobilisation of decommissioning vessels. It should be noted that a heavy lift vessel may be required for some tasks;
- Removal of any potentially hazardous or polluting materials from the offshore platform;
- With the use of appropriate vessels remove topside structure; and
- Transport all components to onshore facility for processing and reuse, recycling and/or disposal.

OSP foundation

6.6.18 The decommissioning of the foundations will be in line with the descriptions given for the wind turbine foundations in 6.6.10 - 6.6.11.

Decommissioning of meteorological monitoring stations and mooring buoys

6.6.19 The metocean buoys and vessel mooring buoys will be disconnected from their anchoring systems and marker buoys will be attached to the anchor chain to enable subsequent recovery of the anchoring system. The metocean and vessel buoys will be recovered to the deck of a vessel by winch or crane or attached to the vessel to be towed ashore. The anchoring system will then also be recovered to the vessel deck and taken to shore. Once onshore all components will be processed for reuse/recycling or disposal.

6.7 Management Plans

6.7.1 Management plans are standard industry practice for offshore wind development, relating to all aspects of the project namely pre-construction, construction, operational and, in certain circumstances, decommissioning. The Applicant's management plans identify a range of measures, the purpose of which is to avoid, prevent or reduce likely significant effects on the environment and significant adverse effects on the relevant European sites in view of their conservation objectives. The management plans will be kept under review as the planning application and proposed development progresses to ensure that they remain suitable for the project as consented. This is particularly important where the proposed development is the subject of an Opinion on Flexibility pursuant to Section 287B of the Planning Act. In this circumstance, it may be necessary to update the management plans to replace or add additional measures to reflect the specific details of the consented project, which the Applicant cannot do pre-planning.

6.7.2 However, to maintain consistency with the environmental assessment in this EIAR any updates that may be made will be limited to the replacement of measures which will achieve the same avoidant, preventative or reductive effect. Accordingly, the final management plans will represent the same level of environmental protection as the current planning stage management plans. The final management plans will also be provided to the relevant consenting and compliance authorities to demonstrate how the relevant commitments are being managed through the project lifecycle. These are summarised in Table 32 and can be found in Volume 7 of this EIAR.

Table 32 Management plans

Application document reference	Planning stage management plan	Summary of document
Volume 7 Planning Stage Plans 7.1	Project Environmenental Management Plan (PEMP)	The PEMP is a project-specific plan developed to ensure that appropriate environmental management practices are followed during the project lifetime. An outline PEMP for Dublin Array is included in the application. The PEMP includes; ▪ Environmental Vessel Management Plan; ▪ Dropped Objects Plan; ▪ Marine Pollution Contingency Plan; ▪ Marine Biosecurity Plan; and ▪ Waste Management and Disposal Plan.
Volume 7 Planning Stage Plans 7.2	Decommissioning and Restoration Plan	The Decommissioning and Restoration Plan describes measures for the decommissioning of Dublin Array. An outline Rehabilitation Schedule is included in the application.
Volume 7 Planning Stage Plans 7.3	Fisheries Mitigation and Management Strategy (FMMS)	The Fisheries Mitigation and Management Strategy (FMMS) sets out the approach to fisheries liaison, including an outline of the measures proposed to

Application document reference	Planning stage management plan	Summary of document
		be implemented to facilitate coexistence with commercial fishing activities. A planning stage FMMS is included in the application.
Volume 7 Planning Stage Plans 7.4	Marine Megafauna Mitigation Plan (MMMP)	The Marine Megafauna Mitigation Plan (MMMP) sets out the appropriate controls to manage environmental risks associated with marine megafauna during the construction of Dublin Array. The MMMP will include consideration of all relevant works associated with construction of Dublin Array: including geophysical surveys, pile driving activities and UXO clearance.
Volume 7 Planning Stage Plans 7.5	Lighting and Marking Plan	The Lighting and Marking Plan (LMP) sets out proposed marine and aviation lighting and marking of Dublin Array.
Volume 7 Planning Stage Plans 7.6	Vessel Management Plan	Vessel Management Plan (VMP) has been produced to document the associated measures that will be in place.
Volume 7 Planning Stage Plans 7.7	Archaeology Management Plan	An Archaeology Management Plan (AMP) document summarising the responsibilities and commitments of all parties involved in the protection of marine archaeology will be produced and agreed.
Volume 7 Planning Stage Plans 7.7	Protocol of Archaeological Discovery (PAD)	The implementation of a Protocol of Archaeological Discovery (PAD) facilitating dialogue between on-site offshore development contractors, the Applicant, the archaeological curators, and the retained archaeologist mitigating the impact on unexpected archaeological discoveries. The PAD will be appended to the AMP.
Volume 7 Planning Stage Plans 7.8	Construction Environmental Management Plan)	The CEMP is a project-specific plan developed to manage and mitigate environmental impacts during the construction phase of the onshore component of Dublin Array. The outline CEMP includes details including a construction Traffic Management Plan (TMP) and an invasive species management plan which will be developed further post consent prior to construction commencing.

6.8 Onshore electrical system of Dublin Array

Introduction

6.8.1 The proposed onshore electrical system (OES) comprises all of the onshore electrical transmission infrastructure above the High Water Mark (HWM) associated with Dublin Array. This includes the transition joint bays (TJBs) at Shanganagh Cliffs, a new onshore substation and the onshore export cables connecting the TJB and onshore substation to the national transmission network. The Dublin Array onshore transmission infrastructure is cumulatively referred to as the OES.

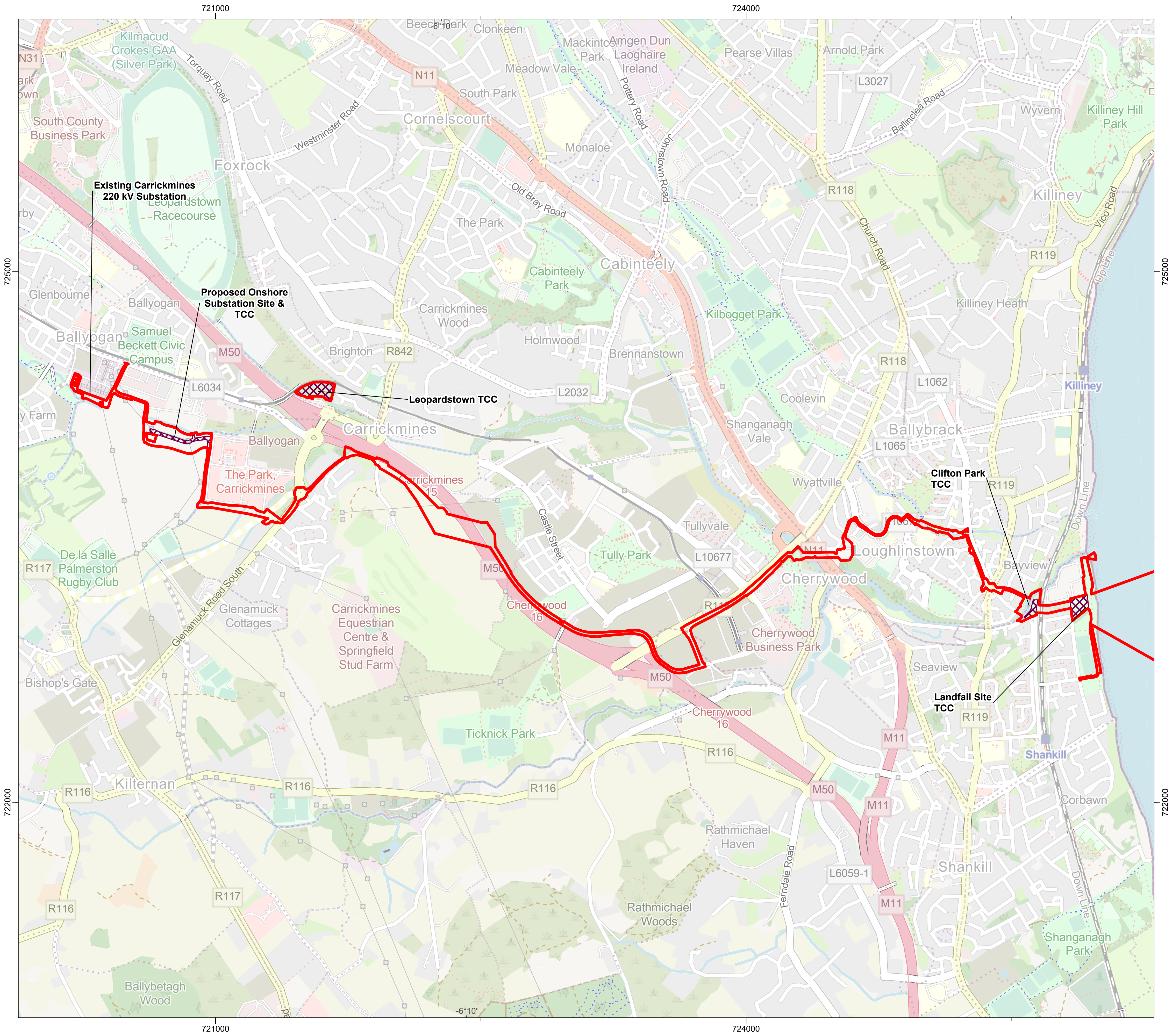
6.8.2 The Applicant will construct all components of the OES, operate and maintain the infrastructure until the proving period has concluded at which time the ownership of all of the electricity transmission infrastructure from the offshore substation platform to the onshore substation will be transferred to EirGrid to own, maintain and operate as the Transmission System Operator (TSO). This is in line with the Commission for the Regulation of Utilities (CRU) Decision Paper (CRU/2022/14)[31]. The infrastructure contained within the OES has been designed in compliance with EirGrid's Functional Specifications[32],[33] to align with standard transmission design.

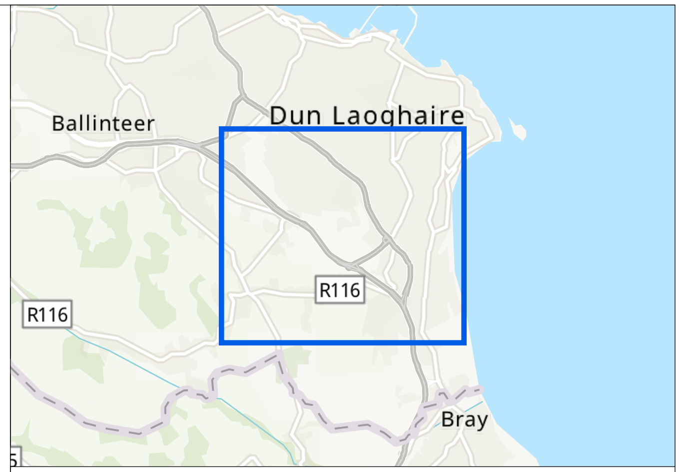
6.8.3 The following sections provide a description of the OES infrastructure components, how they will be constructed and maintained. The OES description covers the transition joint bays (TJB) at the Landfall Site, the onshore export cables and associated infrastructure, the onshore substation (OSS) in Jamestown and the grid connection between the OSS and the existing 220 kV substation in Carrickmines, referred to as the Carrickmines grid connection point (GCP).

6.8.4 The entire OES will be situated within the functional area of Dún Laoghaire Rathdown (DLR), extending in an east – west direction from the Landfall Site at Shanganagh Cliffs to the Carrickmines GCP. The location of the OES is illustrated in Figure 30.

6.8.5 Typical working hours during construction will be from 07:00 to 19:00 Monday – Friday and from 08:00 to 14:00 Saturday. Certain work activities may be undertaken at night and/or at weekends. Working outside normal hours may also be necessitated through considerations of safety or weather and sub-contractor availability. Exceptional construction activities will be carried out in consultation with DLRCC.

31 Offshore Grid Connection Assessment – Phase 1 Projects (CRU, 2022) [https://cruie-live-96ca64acab2247eca8a850a7e54b-5b34f62.divio-media.com/documents/CRU202214-Decision-Offshore-Grid-Connection-Assessment-Phase-1-Projects2.pdf]
32 OFS-SSS-417-R1 Onshore Compensation Compound (OCC) Civil and Building Works
33 OFS-CAB-101-R2 220 kV and 400 kV Underground Cable Function Specification





Application Site Boundary
Temporary Construction Compound (TCC)

DRAWING STATUS
PUBLIC

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PROJECT TITLE
Dublin Array

DRAWING TITLE
Project Description: Onshore Electrical System (OES) and TCC Site Location

DRAWING NUMBER: **Figure 30**
PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2025-01-21	DRAFT	JK	SW	AE
02	2025-01-16	PUBLIC	JK	SW	AM

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0 0.13 0.25 0.38 0.5 Miles

SCALE 1:22,148 | PLOT SIZE A3
DATUM IRENET95 | VERTICAL REF OD/LAT/MLLW
PRJ IRENET95 Irish Transverse Mercator

SLR

Dublin Array
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Overview of the Onshore Electrical System

6.8.6 The onshore electrical system (OES) describes all of the onshore electrical transmission infrastructure above the high water mark (HWM) associated with the Dublin Array development. The primary infrastructure components are outlined below.

Transition Joint Bays – Landfall Site

6.8.7 The Landfall Site for Dublin Array is proposed at Shanganagh Cliffs at the open green space area adjacent to the Uisce Éireann Shanganagh Waste Water Treatment Plant (WWTP). It is the location where the offshore submarine export cables make landfall at the coastline and join with the onshore export cables in an underground plinth called a transition joint bay (TJB), of which there are two proposed.

6.8.8 The offshore export cable ducts will be installed from this location using trenchless technology, as set out in Section 6.9.29 onwards. Once the ducts have been installed, the offshore cable circuits will then be pulled through the ducts onto land.

6.8.9 There will be two export cable circuits. Each of the offshore export cable circuits will be jointed to the onshore export cable circuits at an underground TJB. Each TJB will require a co-located underground link box chamber and communication chamber. These chambers will have an inspection/manhole cover at surface level for periodic inspection and monitoring for future maintenance purposes.

6.8.10 More detail is set out in Section 6.9 onwards.

Onshore export cables

6.8.11 The onshore export cable route (onshore ECR) will run in an east to west direction between the TJBs at Shanganagh Cliffs to the proposed onshore substation (OSS) at Jamestown. The onshore ECR is the cumulative term for the two 220 kV electrical transmission circuits, telecommunications cables, cable ducts and associated cable joint bays (JVs), transition chambers, link box chambers and communication chambers along the onshore ECR. This infrastructure is described in detail in Section 6.10.

6.8.12 The total length of the onshore ECR between the TJBs and the OSS is 7.4 km. The onshore ECR has been sub-divided into seven sectors to aid the reader in identifying specific locations along the ECR. These are described in Figure 55 to Figure 61.

6.8.13 The two circuits and associated infrastructure will be installed in two underground trenches side by side along the onshore ECR predominantly using standard open cut trenching construction techniques.

6.8.14 At eight points along the onshore ECR the route will cross under significant transport networks and watercourses. Trenchless drilling techniques (horizontal directional drilling (HDD) or similar) will be utilised at these locations to avoid disruption by open-cut trenching and to reduce the impact to on the riparian river corridors, as described in Section 6.10.63.

6.8.15 The eight trenchless crossing locations are identified using TX-01, TX-02…TX-08 references as set out in Table 35.

Onshore substation and grid connection

6.8.16 A new OSS is proposed in the townland of Jamestown, near the existing 220 kV Carrickmines substation. The Carrickmines substation has been identified by EirGrid as the point at which Dublin Array will connect to the existing national electricity transmission network and is referred to as the Carrickmines GCP.

6.8.17 The OSS will comprise a new compound of transmission infrastructure including a Gas Insulated Switchgear building (GIS building), Statcom buildings, shunt reactors, harmonic filters and associated plant, equipment, control and protection systems. A full description is included in Section 6.11.

6.8.18 Two underground 220 kV circuits will connect the OSS to the Carrickmines GCP. The grid connection circuits shall each be approximately 800 m in length.

Temporary construction compounds

6.8.19 Three main temporary construction compounds (TCCs) are proposed to support the construction phase of the OES. These will be located at the Landfall Site, Clifton Park and Leopardstown as set out in Table 33.

6.8.20 The OSS site in Jamestown (described further in Section 6.11) is the fourth main TCC which will specifically support the OSS construction activities.

6.8.21 They will also be used for the provision of parking, welfare facilities, site office cabins as well as construction equipment and material laydown and storage for the duration of the construction phase with an occupation period of up to 36 months. All TCCs will be removed at the end of the construction phase, and sites reinstated in consultation with DLRCC.

6.8.22 A number of smaller localised TCCs will be utilised during the construction phase along the onshore ECR, specifically at trenchless crossing point locations to ensure the health and safety of the public while work is underway.

Table 33 The main temporary construction compounds to support the onshore ECR construction activities

TCC Name	Landfall Site TCC	Clifton Park TCC	Leopardstown TCC
Location	Shanganagh Cliffs	Clifton Park (Sector 1)	Leopardstown, Carrickmines Little
Approximate size (m^2)	9,500 m^2	4,000 m^2	14,000 m^2
Site Layout	Figure 62	Figure 63	Figure 63
Use	Construction of the TJBs; Trenchless crossing under the DART/Railway Line (TX-01); Trenchless crossing activities under Shanganagh Cliffs to install the offshore export cable ducts; Storage; Welfare.	Trenchless crossing under the DART/Railway Line (TX-01); Trenchless crossing activities under Shanganagh River (TX-02); Storage; Welfare.	Storage; Welfare.
Main Access	Shanganagh Cliffs	Via Shanganagh Wood	Via Leopardstown Racecourse access road north of the M50 (Junction 15)
Description of existing site	See Section 6.9.2	Open greenspace area bordered to the north and west by Shanganagh River, to the east by the DART/railway line and to the south by Shanganagh Wood road. Bordered to the north, west and east by treeline and hedgerows.	A brownfield site with deteriorated artificial surfaces. Overgrown vegetation and shrubs across the site. An unused access gate is situated off the Leopardstown Racecourse Access Road south of the site via Glenamuck Road North (R842). The light rail Luas line demarcates the site to the north and west. Castle Villas housing estate borders the east of the site.

6.9 Landfall Site

Introduction

6.9.1 The location of the Landfall Site is at Shanganagh Cliffs, south County Dublin. The Landfall Site describes where the offshore export cables meet the shoreline and transition to the onshore export cables at underground plinths referred to as TJBs. The TJBs are the start of the onshore ECR running east – west to the OSS in Jamestown, and onwards to the Carrickmines GCP.

6.9.2 Shanganagh Cliffs is a housing estate and public green space accessible by the bridge over the DART/railway line from Rathsallagh Drive. The housing estate and green space extend between Corbawn Avenue and Seafield to the Uisce Éireann Shanganagh-Bray Waste Water Treatment Plant (WWTP). The Shanganagh Cliffs housing estate is bounded to the west by the DART/railway line and the green space is demarcated by the sea cliffs and beach to the east. The open green space at Shanganagh Cliffs accommodates sports playing pitches, sports storage containers, a playground and pedestrian and cycle tracks providing public access from Shanganagh Cliffs along the green space south to Seafield and north past the WWTP and onto the beach via an existing ramp. The ramp onto the beach is also reachable by foot via a pedestrian DART tunnel accessible from Bayview, north of the WWTP and Shanganagh River outflow.

6.9.3 The Landfall Site will accommodate one of the three main TCCs (the Landfall Site TCC) along the onshore ECR and support the construction of the TJBs, the installation of the cable ducts for the onshore ECR (TX-01) and the offshore export cable ducts.

6.9.4 An area of approximately 9,500 m^2 will be securely fenced off at the start of the construction phase around the proposed location of the TJBs, to form the Landfall Site TCC, which will include laydown areas and a vehicular access track. A public access way will be provided to ensure safe access to and from the beach areas at Shanganagh Cliffs.

6.9.5 Figure 32 shows the Landfall Site location and proposed public access during the construction phase.

Landfall Site Temporary Construction Compound

6.9.6 The Landfall Site is an area of approximately 9,500 m^2 surrounding the TJB locations will be securely fenced off at the start of the construction phase to support local construction activities and provide storage for the wider onshore ECR construction phase. The Landfall TCC site layout is illustrated in Figure 33.

6.9.7 The two TJBs will be located within the Landfall Site TCC. The offshore export ducts and cables will be installed underneath the cliffs and beach and onwards towards the OSP. This will be done using trenchless techniques as described in Section 6.9.31 onwards. Similarly, the onshore export cables will be routed under the DART/railway line using trenchless installation technology and this is described in Section 6.10.65.

6.9.9 The Landfall Site TCC will support three main construction activities:

- Construction and installation of the TJBs as described in Section 6.9.56;
- Trenchless installation of the offshore export cable ducts under the beach and cliffs as described in Section 6.9.29; and
- Trenchless crossing of the onshore export cable route under the DART/railway line and Shanganagh community gardens as described in Section 6.10.65.

Public access and construction traffic

6.9.10 The Landfall Site TCC will be securely fenced with secure gated access from the public road to the west of the compound. This entrance will be used for light good vehicle (LGV) access (inset no. 1 of Figure 32).

6.9.11 The main access for construction heavy goods vehicle (HGV) traffic will follow the existing path from the Shanganagh Cliffs public road via the existing gate opposite the bridge over the DART railway line (inset 2 of Figure 32). This path is proposed to be upgraded and widened to 4 m suitable for the delivery of plant, equipment and construction materials. The 500 m long access track will incorporate four 3 m wide passing bays to facilitate two-way traffic movement and to reduce traffic waiting on the public road at the entrance. The upgraded HGV access track will be segregated from the surrounding public areas using mesh security fencing and wooden posts as shown in Figure 31.

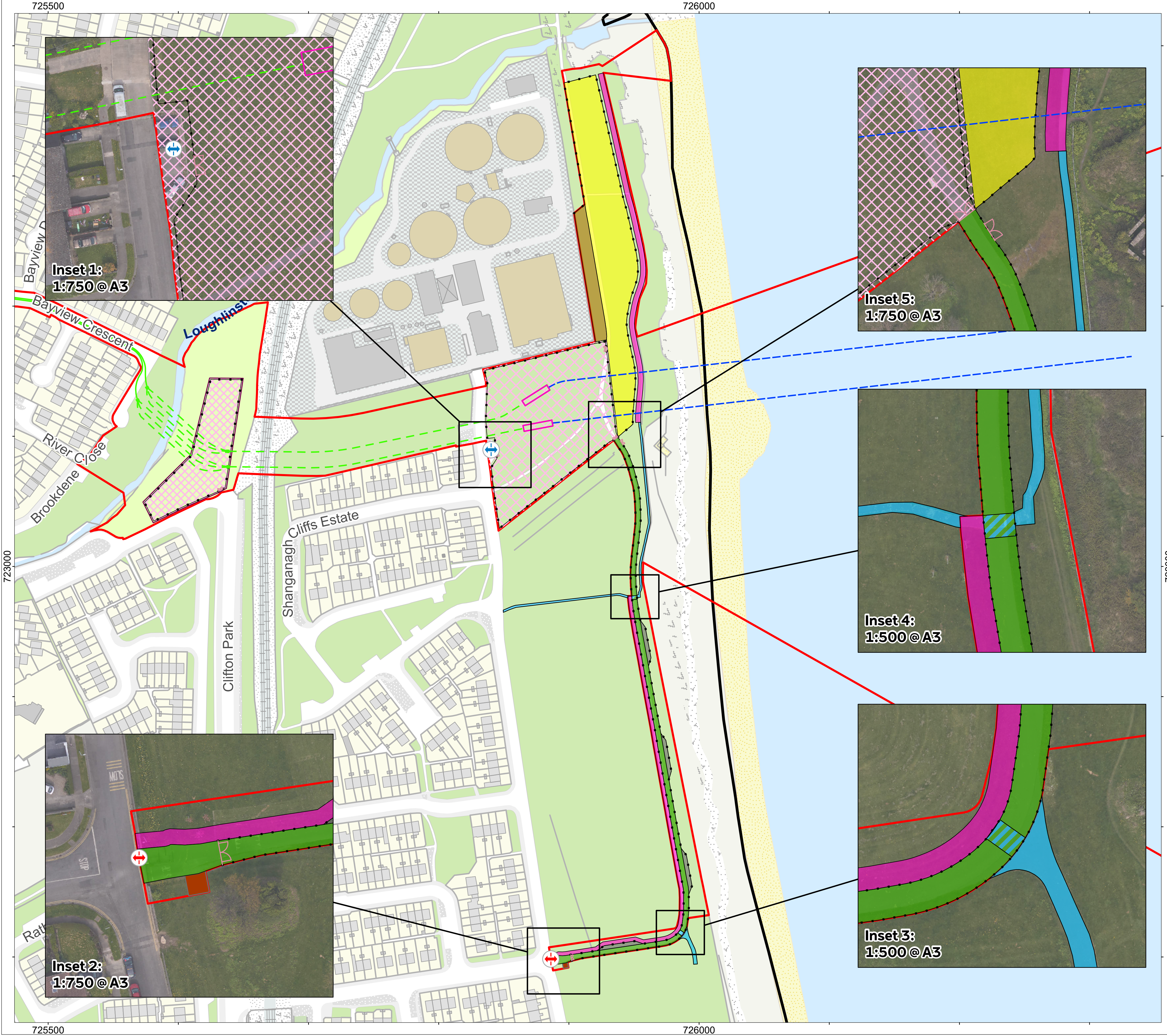
Figure 31 Example image of security fencing around the Landfall Site TCC HGV access track

Diverted and upgraded paths

6.9.12 An additional 3 m wide diverted pedestrian path will be constructed to maintain a secure public access alongside the HGV access track. Two gated pedestrian crossing points will be located to facilitate access via Seafield (inset 3 of Figure 32) to the south and to retain the path connection from the playground crossing the HGV access track perpendicularly (inset 4 in Figure 32). The existing paths south of the TCC will remain accessible throughout the operation of the Landfall Site TCC.

6.9.13 An additional area of approximately 6,500 m^2 to the east between the existing WWTP and the existing fence line along the cliffs will be temporarily fenced off from public access to facilitate cable duct laydown and assembly during the trenchless crossing activities (full description of these activities is set out in Section 6.9.29). This area is identified on Figure 32 in yellow. Once the export cable ducting has been installed, the duct laydown and assembly area will be reduced and will become publicly accessible on a phased basis. The construction programme is set out in Table 10, section 6.13.

6.9.14 The existing 1 m wide path running parallel to the existing fence along the cliffs will be widened to 3 m for 270 m from the Landfall Site TCC entrance (inset 5 in Figure 32) to the existing beach ramp. This track will be publicly accessible to pedestrians, cyclists, maintenance and emergency vehicles to access the beach throughout the construction phase and occupation of the Landfall Site TCC.



Application Site Boundary
LGV access/egress
HGV access/egress

Landfall Site Components

Temporary construction compound
Cable duct laydown and assembly area
Topsoil storage area
HGV access track
Existing pedestrian path
Gated crossing
Upgraded/diverted path
Passing bay
Site access security hut
Temporary Compound Fence
Temporary Gate
High Water Mark - National Water Marks

Export Cable Route Components

Offshore Cable
Onshore ECR (Trenched)
Onshore ECR (Trenchless)
Transition Joint Bay

DRAWING STATUS

PUBLIC

DISCLAIMER

MAP NOTES / DATA SOURCES:

Esri UK, Esri, TomTom, Garmin, Foursquare, GeoTechnologies, Inc, METI/NASA, USGS ©Ordnance Survey Ireland 2024 © Tailte Eireann. (CYSL50270365) Not to be used for Navigation.

PROJECT TITLE

Dublin Array

DRAWING TITLE

Figure 32
Landfall Site Temporary Construction Compound Site Access and Public Access

DRAWING NUMBER: **005532727-01**

PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2025-01-02	Ready for release	DB	CCF	PK

0 10 20 30 40 50 60 70 80 90 100 Meters
0 10 20 30 40 50 60 70 80 90 100 Yards

N
GRID NORTH

SCALE 1:3,000 PLOT SIZE A3
DATUM IRENET95 VERTICAL REF ODN/LAT/MLLW
PRJ IRENET95 Irish Transverse Mercator

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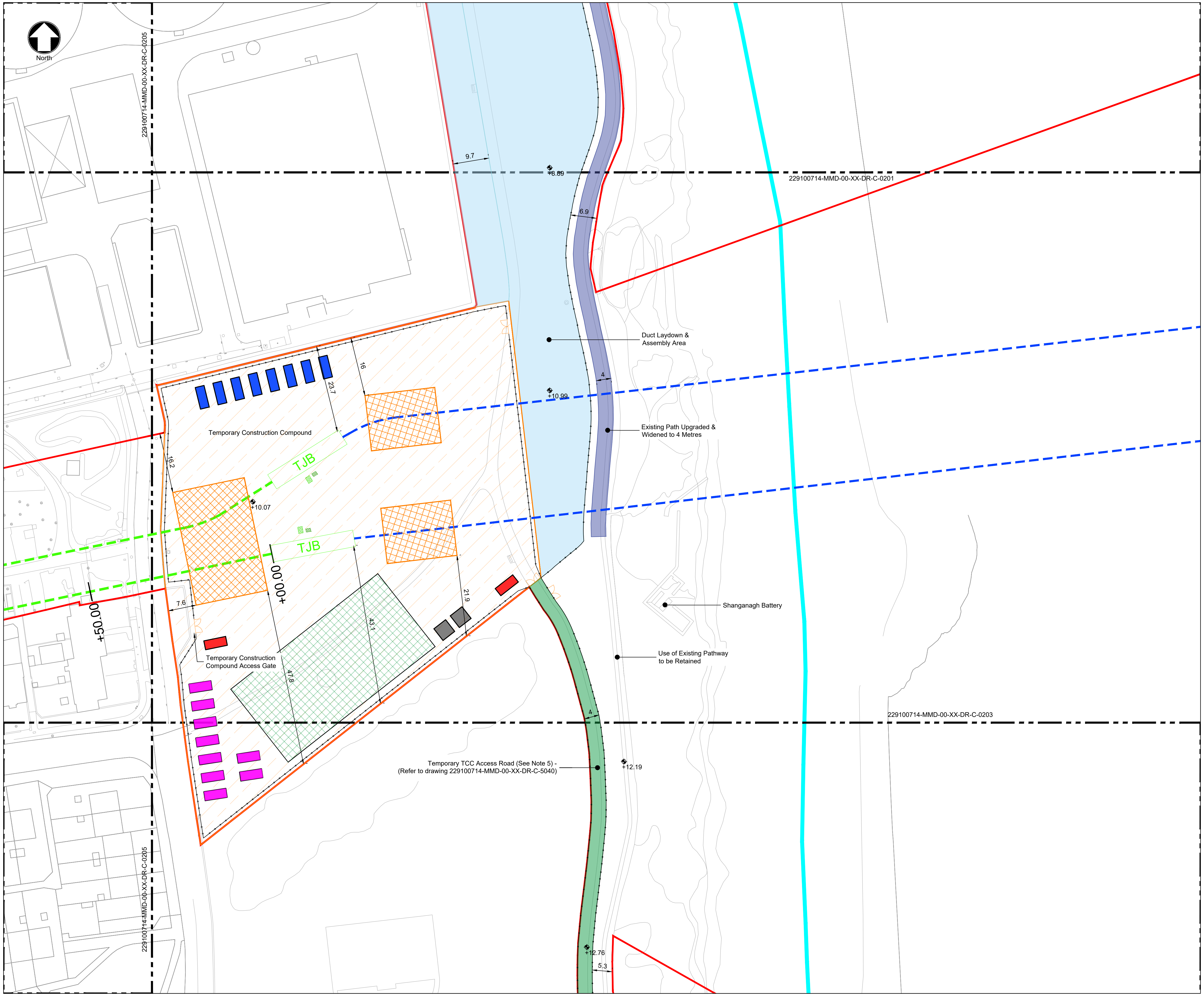
Landfall Site TCC layout and set up

6.9.15 The Landfall Site TCC will comprise the following components:

- Security hut and gate to control access and egress and provide security;
- Signage and lighting;
- HGV access track (4 m);
- Passing bays (3 m);
- Diverted pedestrian track (3 m) segregated by mesh security fencing from the HGV access track;
- Vehicle parking;
- Workshops and stores;
- Welfare facilities and site offices;
- Temporary power, either via connection to existing electricity supply or from diesel generator on-site;
- Water tanks;
- IT/telecommunication connection;
- Material & equipment storage (HV cable drums, fibre optic cable drums, ducts, and cable installation equipment, etc.);
- Temporary topsoil storage;
- Construction waste/recycling storage including drilling mud (naturally occurring non-toxic lubricant for the drill operations);
- Secure bunded area for fuel storage and chemicals, and generators; and
- Surface water runoff management.

6.9.16 The area will be lit using directional task focussed lighting on site. The lights will be downward facing to prevent light slip beyond the main works/task area. Vehicle and pedestrian access routes around the car park and to the offices will be lit using motion sensitive lighting within the secured TCC.



NOTES

1. For planning purposes only. Not for construction.
2. All dimensions are in metres unless otherwise noted.
3. Where levels are shown, all levels are in metres above Malin Head datum.
4. The identified location of the underground cable infrastructure, compound and work areas and associated infrastructure development, including joint bays and underground chambers are indicative for the purpose of the application for Approval. The final extent and location of such will be identified in detailed design.
5. The existing 3 metre wide pedestrian path is to be upgraded and widened to a 4 metre wide Temporary Construction Compound (TCC) access road. This will be retained as a 4m wide pedestrian path following demobilisation of the TCC. The four passing bays will be removed and reinstated as agreed with the Local Authority.

KEY PLAN

KEY TO SYMBOLS

- 220kV Trenchless Crossing
- Application Site Boundary
- High Water Mark
- Submarine Cable
- Temporary Fence
- Temporary Trenchless Crossing Compound
- Temporary Construction Compound
- Upgraded Path
- Duct Laydown & Assembly Area
- Temporary TCC Access Road
- TJB Transition Joint Bay
- Transition Chamber
- Communications Chamber
- Link Box Chamber
- Car Parking
- Storage Cabins
- Offices/Welfare
- Security Hut
- Generator & Fuel Tank

REFERENCE DRAWINGS

229100714-MMD-00-XX-DR-C-0200	Key Plan for Onshore Site Layout Plans
229100714-MMD-00-XX-DR-C-0201	Onshore Site Layout Plan - Sheet 01
229100714-MMD-00-XX-DR-C-0203	Onshore Site Layout Plan - Sheet 03
229100714-MMD-00-XX-DR-C-0205	Onshore Site Layout Plan - Sheet 05
229100714-MMD-00-XX-DR-C-0051	220kV Cable - Inroad Cross Sections
229100714-MMD-00-XX-DR-C-0052	220kV Cable - Offroad Cross Sections
229100714-MMD-00-XX-DR-C-0053	220kV Cable - Precast Joint Bay
229100714-MMD-00-XX-DR-C-0054	220kV Cable - Communications Chamber
229100714-MMD-00-XX-DR-C-0055	220kV Cable - Link Box Chamber
229100714-MMD-00-XX-DR-C-0056	220kV Cable - Trefoil Crossing Above Service
229100714-MMD-00-XX-DR-C-0057	220kV Cable - Flat Crossing Above Service
229100714-MMD-00-XX-DR-C-0058	220kV Cable - Trefoil Crossing Below Service
229100714-MMD-00-XX-DR-C-0059	220kV Cable - Flat Crossing Below Service
229100714-MMD-00-XX-DR-C-0061	220kV Cable - Transition Chamber
229100714-MMD-00-XX-DR-C-0062	220kV Cable - Transition Joint Bay

EcoDoc NUMBER:
005396089-04

DRAWING STATUS

PUBLIC

DISCLAIMER

MAP NOTES / DATA SOURCES:

OS Mapping Ref: OS3457

PROJECT TITLE:
Dublin Array Offshore Wind Farm

DRAWING TITLE:
Onshore Site Layout Plan - Sheet 02

DRAWING NUMBER: 229100714-MMD-00-XX-DR-C-0202
SHEET NUMBER: 02 OF 32

VER	DATE	REMARKS	DRAW	CHECK	APRD
PL1	2024-10-18	For Submission	SHY	DMC	TK
PL2	2024-11-04	For Submission	SHY	DMC	TK
PL3	2024-11-13	For Submission	SHY	DMC	TK

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PLOT SIZE: A1 | PRJ: IRENET95 IRISH TRANSVERSE MERCATOR

Metres 15 0 15 30
1:500
GRID NORTH

MOTT MACDONALD

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6.9.17 The Landfall Site TCC will be enclosed by a 3.5 m high perimeter acoustic barrier (i.e. close boarded fence/plywood hoarding), which will be installed around the southern and western perimeters of the Site. The barrier will remain in-situ for the duration of the construction phase which will accommodate work areas, loading/unloading zones, construction material storage, site vehicle parking, and welfare facilities as shown in Figure 33.

6.9.18 The site boundaries will be set out using Global Positioning System (GPS) or total station equipment and temporary hoarding, fencing, signage etc. will be erected, as required, to delineate the extent of the site, prevent unauthorised access and protect the surrounding environment.

6.9.19 A PAS128:2022[34] compliant utility survey will be undertaken to identify any existing utilities. If the pre-construction utility survey check work identifies existing utilities crossing the site, these will be located on site using an appropriate technique and equipment, such as Cable Avoidance Tool (CAT)/Ground Penetrating Radar (GPR) equipment, and the location clearly set out prior to any site clearance and excavations, so they can be safely exposed and positively identified, worked around or diverted.

6.9.20 The compound will require a level and stable surface which will require minor earthworks on site. The existing surface will require stripping of topsoil, typically 300 mm deep. Imported clean natural stone such as Clause 801 - 803 (Transport Infrastructure Ireland, Specification for Roads Works Series 800, Road Pavements) will be placed and compacted on top of a geotextile separation membrane between the stone and the subsoil.

6.9.21 Any topsoil or subsoil excavated during preparatory works will be stored in an area within or directly adjacent to the TCC as described in

6.9.22 Figure 32, in line with best practice, ensuring they can be reinstated appropriately after construction. The excavated material will be stockpiled, and its side slopes will be appropriate with the type of material, to ensure slope stability.

6.9.23 Stores and offices will be set-up, parking areas, laydown areas and pedestrian walkways will be created within the TCC. Double height stacked office units will be used as a potential noise mitigation measure around the drill rig for the offshore trenchless crossing activity. For the TCC welfare, temporary power supply will be supplied by diesel generator and the temporary water supply will be via on-site water storage tanks with water delivered to the TCC as required. Waste water will be collected in holding tanks and emptied as required. The waste water will be tanked off-site by a licensed service provider for treatment at a licensed waste water treatment facility.

34 PAS 128:2022 is a Publicly Available Specification developed by the British Standards Institution (BSI) to provide a standardized approach to underground utility detection, verification, and mapping.

6.9.24 The Landfall Site TCC will initially support the construction activities associated with the TJBs and trenchless crossings. The entry pit for the trenchless crossing underneath the cliffs and beach will be located within the Landfall Site TCC as shown in Figure 33. The exit pit for the trenchless crossing under the DART/railway line (TX-01 as per Table 35) will similarly be located within the Landfall Site TCC and the internal layout will be adapted to allow for these activities as required during the construction phase. Once the cable ducts and TJBs have been installed, the Landfall Site TCC will operate as a storage TCC to support the onshore ECR construction activities.

Trenchless installation techniques for the offshore cable ducts

6.9.25 In recognition of the natural configuration of the sea cliffs at Shanganagh, an early project design decision was taken not to bring the subsea cables onshore using a trenched 'open cut' solution. A feasibility assessment of various engineering installation methods was completed to identify a trenchless (i.e. below ground) methodology appropriate for local site conditions at Shanganagh. Following a review of the below ground geological profile prevailing at the intended location of the landfall, two different trenchless installation techniques were identified as being suitable - HDD and DPM. Either method is suitable for use with a negligible impact on the stability of the cliff.

6.9.26 Either method involves drilling at a minimum depth of 20 m below the cliff edge and minimum 10 metres below the cliff base with either end of the drill profile set back sufficient distances (landside a minimum of 80 metres and seaside a minimum of 600 metres) from the cliff face to maintain the integrity of the cliff morphology within the limits of the longitudinal profile limitations of the technique being employed. HDD and DPM use rotary rather than percussive drilling limiting the nature and extent of any ground borne vibration arising from same. The detailed design will be developed to take into account the anticipated levels of vibration from the proposed drilling equipment to ensure the integrity of the cliff. The drill profile will be established to take into account the capacity/size of the drill rig being utilised and the vibration levels generated by the drill operations to ensure the integrity of the cliff is not compromised during drilling. The HDD drill profile will be designed to ensure the HDD bores can achieve the maximum possible depth beneath the cliffs whilst maintaining the electrical design parameters of the cable in order to minimise the impact of the drilling technique on the stability of the cliffs.

6.9.27 Pre-construction verification vibration monitoring will be undertaken in the vicinity of the cliffs as part of the detailed design to gather background data on vibration levels under normal conditions. This data will be examined to establish a suitable vibration limit which will be maintained during drilling to ensure the integrity of the cliffs are maintained. Vibration monitoring points will then be undertaken in the vicinity of the cliffs for the duration of the drilling to inform the drilling management process thereby protecting the integrity of the cliffs.

6.9.28 Once the Landfall Site TCC, HGV access tracks and path diversion have been established, the next phase of activities will be to install the offshore export cable ducts under the beach and cliffs.

6.9.29 The Landfall Site is located within the extent of the Killiney Bay County Geological Site (Site code DLR007) and is considered to be a geological feature of high value on a local scale and is included in the Dún Laoghaire-Rathdown County Development Plan (DLRCDP).

6.9.30 An onshore site investigation at the Landfall Site was undertaken in September 2022, and a further nearshore/intertidal site investigation campaign was also carried out in June 2024 which included geotechnical and geo-environmental studies and testing to understand the geology and geomorphology of Shanganagh Cliffs. The Land, Soils and Geology Technical Baseline Report is included in Appendix 6.5.3-1 and the site investigation reports can be found in Appendix 6.5.3-2 and 6.5.3-2. The ground conditions of the Landfall Site at Shanganagh Cliffs are described in Volume 5, Chapter 3: Land, Soils and Geology of this EIAR.

6.9.31 Either of two trenchless techniques Horizontal Directional Drill (HDD) or Direct Pipe Method (DPM) are suitable installation techniques to bring the offshore export cable ducts under the beach and cliffs to the TJBs. Both of these trenchless techniques have been assessed as part of the EIAR.

Horizontal directional drill for the offshore export cable ducts

6.9.32 A temporary trenchless crossing compound measuring approximately 20 m x 15 m will be established within the Landfall Site TCC which will contain essential equipment, including the drill rig, fluid mixing and recycling systems, pumps, and temporary steel casings. This will be the site of the drill entry pit, shown in Figure 33. An entry pit is the term used to describe the excavation used in trenchless installation methods like HDD or DPM, serving as the entry point for equipment and operations, including drilling rigs, pipe thrusters, and fluid management systems.

6.9.33 A mud recycling plant will be located within the trenchless crossing compound. The mud recycling plant will facilitate the recycling of drilling fluid by removing drill cuttings. This will reduce the total water demand. Figure 34 shows a typical HDD rig and mud recycling plant.

6.9.34 An excavator will be used to excavate the drill entry pit, which will measure approximately 4 m x 2 m x 1.5 m deep. Offshore, a jack up vessel or dredger will be used to excavate the seabed at the exit pit (maximum excavation pit of 30 m long, 5 m wide and 2.5 m deep). The excavated material will be side cast on the seabed adjacent to the exit pit and will be reused to backfill the excavation following cable duct installation.

6.9.35 To manage the forces generated during drilling, the HDD rig is securely anchored, by installing temporary sheet piles to provide a solid anchor. Once the rig is in place at the onshore entry pit, drilling proceeds along the planned alignment towards the offshore exit pit. Two bores of 1,250 mm diameter, one for each circuit (submarine cable), will be required to accommodate the offshore export cable ducts.

6.9.36 The drilling process will commence by creating a pilot hole, which extends from the onshore entry point to the offshore punch-out at the exit pit. Drilling mud (a mixture of water and bentonite clay) is pumped through the drill string to clear ground material in front of the drill bit. The slurry of bentonite mud and ground material cuttings flows back to the mud pit at the entry point onshore, where material cuttings are then pumped into the mud recycling plant. These cuttings are separated from the fluid, allowing the drill mud fluid to be reused in the drilling operation.

6.9.37 As the drill approaches the offshore exit pit in the seabed, the drill head will stop short of punch-out. The bentonite mud mixture will be flushed out of the drill string at which point the drilling will recommence and complete the final 10 m. This will prevent bentonite release at the exit pit.

6.9.38 Following completion of the pilot hole, reaming operations begin to incrementally widen the borehole. Back reaming is a process used in HDD where a reamer is pulled back through the borehole after the initial pilot hole has been drilled. The purpose of back reaming is to enlarge the pilot hole to the desired diameter, allowing space for the installation of conduits such as cables ducts. The reamer, typically a cutting tool attached to the drill string, operates by gradually widening the borehole as it is pulled back towards the entry point. Each reaming pass uses progressively larger reamers until the borehole reaches the necessary diameter for the final installation off the cable ducts. Drilling fluid circulates throughout this process to stabilise the borehole walls, clear cuttings, and reduce the risk of bore collapse.

6.9.39 Following the creation of the borehole, the cable ducts will be installed to create a stable, protected pathway for the offshore export cable. The ducts will be laid out on roller sets, as shown in Figure 10, in a designated area marked as “cable ducting laydown area” in Figure 32. The ducts will be welded together on-site using either butt fusion welding or electrofusion welding. Once welded, the ducts will undergo testing to ensure integrity prior to installation.

6.9.40 Pre-assembled and sealed to prevent water ingress, the prefabricated ducts are transported to the beach on rollers, where the duct string is towed out to sea. Pedestrian access to the beach will be under the supervision and control of the contractor in order to facilitate this phase safely over a limited number of days.

6.9.41 Vessels support the alignment of the duct, positioning it precisely with the direction of the drilled hole. Depending on conditions, one or more vessels may assist in keeping the duct string in line during the alignment process.

6.9.42 Once the duct is properly aligned, the pulling head on the duct is connected to the pullback assembly on the drill string using a shackle connection. After the connection is made, the pulling assembly is lowered to the seabed, and the drill rig begins pulling the duct string back toward land. Once the pulling head enters the borehole, the pull back operation proceeds and continues until the pulling head reaches the drilling rig.

6.9.43 This sequence is repeated for each of the two circuits. Once both duct strings are secured, the export cables will be pulled through the installed ducts using a cable pulling winch positioned at the entry pit within the Landfall Site TCC. Specialised rollers and guides will be used to minimise tension and prevent cable damage during the pull-in process. The cable will be pulled into the TJB, where it will be prepared for joining to the onshore export cables. Depending on the final construction programme, the period between the HDD and duct installation activity and the offshore export cables being pulled onshore could be up to 12 months.

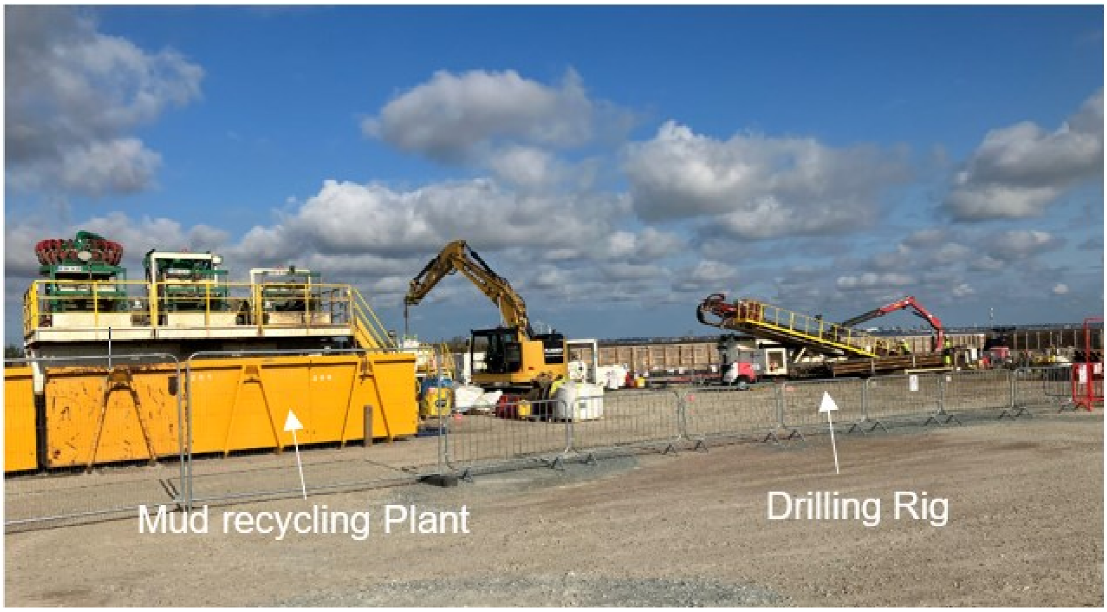


Figure 34 Example image of an HDD drilling rig and mud recycling plant (Source Stockton Drilling)

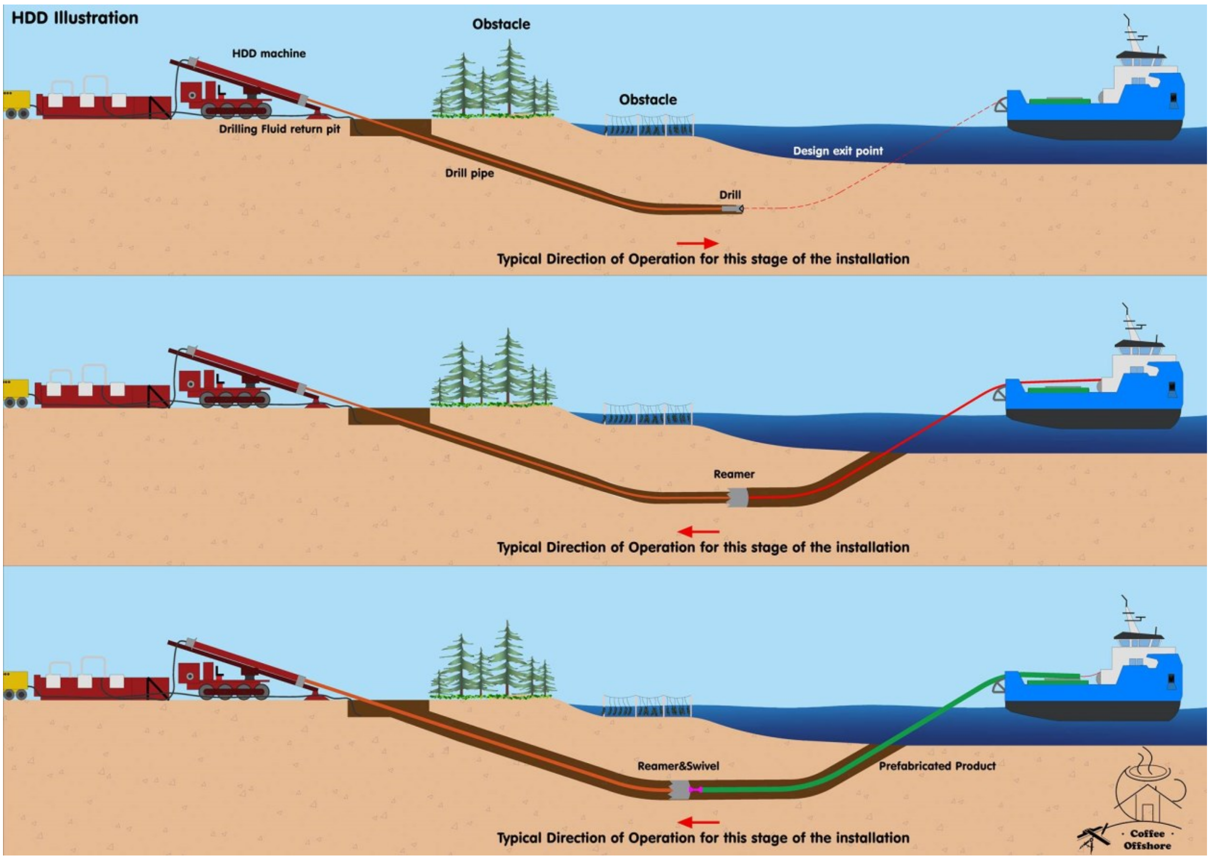


Figure 35 Schematic profile of HDD (Source Coffee Offshore)

Figure 36 Example image of duct welding container (Source Stockton Drilling)

Direct pipe for the offshore export cable ducts

6.9.44 Direct Pipe Method (DPM) is a trenchless drilling technique that combines elements of micro-tunnelling and HDD to simultaneously excavate a borehole and install a steel pipe in place of cable ducts. This method uses a pipe thruster to push pre-assembled steel pipes behind a micro-tunnel boring machine (MTBM), ensuring precise alignment and minimizing ground disturbance.

6.9.45 Similar to HDD, an entry pit at the Landfall Site TCC will be excavated to house the pipe thruster and MTBM. The pipe thruster would be deployed in a sheet piled entry pit approximately 3 m deep x 5 m wide x 20 m long with a reinforced concrete slab to the base.

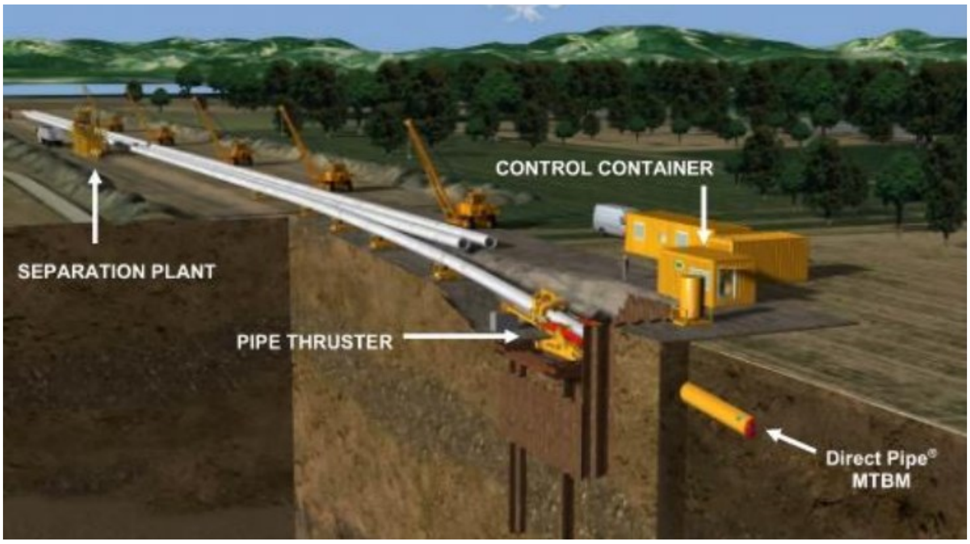


Figure 37 Indicative DPM entry pit arrangement (Source www.herrenknecht.com)

6.9.46 The entry pit will be reinforced with sheet piles or concrete to ensure stability during operations. Offshore, a jack up vessel or dredger will be used to excavate the seabed at the exit pit in the subtidal area. The exit pit will be excavated to retrieve the MTBM upon completion of tunnelling (maximum excavation pit of 30 m long, 5 m wide and 2.5 m deep). The drill length will be between 600-850 m. The excavated material will be side cast on the sea bed and will be reused to backfill the excavation following cable installation. Two boreholes of 1,600 mm diameter, one per circuit, will be required.

6.9.47 The DPM process uses a pipe thruster unit to push pre-assembled steel pipe sections behind the MTBM as it advances. The MTBM at the front of the pipe uses a rotating cutting head to excavate material while maintaining the alignment along the pre-determined path. The MTBM will drill the bore at full 1.2 m diameter. Excavated material is transported back to the surface through a slurry pipe connected to the MTBM. The slurry will be processed within the Landfall Site TCC using separation equipment (similar to the mud recycling plant shown in Figure 10) to recycle the drilling fluid and remove spoil.

6.9.48 The steel pipe sections will be welded at Shanganagh Cliffs in the area marked as "cable duct laydown area" in Figure 32 before being connected to the thruster. During the installation, the pipe thruster will apply controlled force to advance the pipe while preventing deformation or buckling.

6.9.49 As the MTBM nears the offshore exit pit, ROVs and survey equipment are used to guide the MTBM to the exit pit. Once the cutting head surfaces, it is disconnected and retrieved by marine plant, leaving the installed steel pipe in place. An example of this activity is illustrated in Figure 38.

6.9.50 These steps will be repeated for the second circuit.

Figure 38 Example image of MTBM recovery of steel pipe and drill head from seabed (Source Stockton Drilling)

6.9.51 After the steel pipe is successfully installed for both circuits, internal inspections are conducted to confirm structural integrity and ensure the bore is free from obstructions. The pipe is then cleaned and prepared for the export cable installation as described before for HDD.

6.9.52 Once both pipes are secured, the export cables will be pulled from the offshore cable installation vessel through the installed pipes using a cable pulling winch positioned at the entry pit. Specialised rollers and guides will be used to minimise tension and prevent cable damage during the pull-in process. The offshore export cables will be pulled into the TJB where it they will be joined to the onshore export cables.

Transition Joint Bay key design parameters

6.9.53 Transition Joint Bays (TJBs) are required to facilitate the connection between the offshore and the onshore export cables. Each TJB will have a concrete plinth base buried below ground measuring 18 m x 4.5 m x 2 m as illustrated in Figure 39-41 (also refer to planning drawings 229100714-MMD-00-XX-DR-C-0062 and 229100714-MMD-00-XX-DR-C-0062).

6.9.54 Each TJB will require an excavated area of 26.5 m x 8.5 m x 2 m. Once the TJBs have been installed and the cables jointed, the TJB's will be backfilled to the required engineering specification and the topsoil and grass reinstated in consultation with DRLCC.

6.9.55 Each TJB will be co-located with a link box chamber (described in Section 6.10.12) and a communications chamber (described in Section 6.10.14). A description of the onshore export cables is set out in Section 6.10. These chambers will be underground in close proximity to the TJB and are illustrated in Figure 48 and Figure 50 respectively. The two chambers will require an additional excavation area of 5.4 m x 2.4 m x 1.75 m. The link box chambers and communications chambers will have a visible inspection manhole cover similar to Figure 51. This will be the only visible infrastructure in-situ after construction during the operational phase.

Figure 39 Export cable joints laid over the concrete plinth of a TJB (Source - Grimsby, Hornsea 2 Offshore Wind Farm)

Transition Joint Bay construction

6.9.56 Typically, TJBs are positioned close to the shoreline to minimise the onshore installation distance of the offshore export cables, as shorter distances will reduce the pulling tension when the offshore export cables will be pulled onshore. The offshore cables are described in Section 6.4 and Section 6.5.

6.9.57 The two plinths will be constructed side by side within an excavated pit of approximately 212 m^2 each. The sides of the pit will be angled safely at 45° as illustrated in Figure 40 or braced using trench support or sheet piling. Crushed stone will be laid in the 4.5 m x 22.5 m base of each TJB. The concrete base measuring 2 m x 18 m will be situated on top of the crushed stone to provide a flat clean working environment on which to join the export cables. The TJBs are likely to be constructed after the cable ducts (or steel pipes if DPM is used) have been installed under the beach and DART/railway line and prior to cable pulling.

6.9.58 Once the export cables are joined at the TJBs, the pit will be back filled with a combination of the excavated material stored on site and suitable material such as Cement Bound Sand (CBS).

6.9.59 Once the export cables are joined, the TJBs will be covered and the surface area above reinstated in consultation with DLRCC. It is not anticipated that the TJBs will require further access during the operational phase, except for unplanned activities such as unforeseen repairs, as set out in Section 6.14.7. An example of a single TJB under construction is shown in Figure 40.

Figure 40 Example image of a typical TJB under construction with offshore export cable pulled in (right) and two link boxes, each with manholes for electrical and communication cable joints after reinstatement (left). (Source – RWE Renewables UK Ltd.)

Figure 41 Example image of export cables being jointed in a controlled environment (Source – RWE Renewables UK Ltd.)

Temporary Construction Compound site demobilisation & reinstatement

6.9.60 Once the steel pipes or ducts have been installed for DPM or HDD respectively, the demobilisation process will involve dismantling equipment, backfilling entry pits and restoring the site. Typically, the process will involve;

- The MTBM or HDD rig will be disconnected and retrieved from the onshore entry pit within the Landfall Site TCC;
- Sheet piles (if used) will be removed, and the onshore entry pit will be back filled with suitable material and compacted; and
- Remaining drilling fluids and cuttings from the mud recycling system will be disposed of in compliance with the Waste Management Act. The recycling unit will be dismantled and removed.

6.9.61 A Waste Management Plan is included in Volume 7, Appendix 8.

6.9.62 On completion of the works, the Landfall Site TCC will be retained for storage to support the construction of the onshore ECR. When the onshore ECR construction activities are completed, the TCC will be decommissioned in reverse order and reinstated in consultation with DLRCC. All hardstanding will be removed except the 4 m wide access track and 3 m wide upgraded pedestrian tracks, which will be retained for continued public use. Decommissioning is described in Section 6.15.6.

6.9.63 The stone hard standing within the Landfall Site TCC will be removed using necessary plant and equipment and for removal off site in accordance with waste management regulatory requirements.

6.9.64 Once the Landfall Site TCC has been cleared and the topsoil replaced; the green area will be reseeded and monitored to ensure reinstatement is successful, following consultation with DLRCC.

6.10 Onshore Export Cable Route

Onshore ECR key design parameters

6.10.1 The onshore export cable route (onshore ECR) connects the TJBs at Shanganagh Cliffs to the OSS located 7.4 km west in Jamestown. The route traverses the townlands of Shanganagh, Hackettsland, Ballybrack, Loughlinstown, Cherrywood, Glebe, Laughanstown, Carrickmines Great, and Jamestown. The route is primarily located on public roads and greenspaces with some sections crossing privately owned agricultural lands.

6.10.2 The proposed onshore ECR will consist of two separate three-phase 220 kV circuits, each installed in their own parallel underground trench along the 7.4 km route. Each circuit will require associated underground infrastructure, which have been described further in the subsequent sections. This infrastructure includes;

- Onshore export cables;
- Joint bays;
- Link box chambers;
- Communication chambers and associated communication cables;
- High density polyethylene (HDPE) cable ducts; and
- Transition chambers.

6.10.3 The majority of the proposed infrastructure described along the onshore ECR will be installed underground through either standard open-cut trenching or trenchless techniques. There will be manhole inspection covers flush with the existing surface level to access the link box chambers and communication chambers co-located with each joint bay. The proposed locations of the joint bays are set out in Figure 55 to Figure 61. On private lands there will be short sections of new access tracks constructed to allow EirGrid (the future asset owner) to access the joint bay locations for inspections and maintenance.

6.10.4 All of the infrastructure set out in Section 6.10.5 to 6.10.19 is in accordance with EirGrid functional specification.

Onshore Export Cables

6.10.5 The Dublin Array onshore export cables will be comprised of two 220 kV high-voltage alternating current (HVAC) transmission circuits. Each circuit will contain three cables contained in individual HDPE ducts of 200 mm diameter each with three ducts in each trench. An additional two telecommunication cables will be installed above the onshore export cables in each of the two trenches. Typical cross sections are illustrated in Figure 42 and Figure 43.

6.10.6 The cables which will be installed in HDPE ducts and will be arranged predominantly in a trefoil arrangement as shown in Figure 42 (cables bunded together in a triangular shape), with flat lay configuration at crossing points if required as shown in Figure 43 (cables laid adjacently and horizontally).

6.10.7 The two trenches will be installed alongside each other along the entire 7.4 km route between the respective TJBs and the OSS.

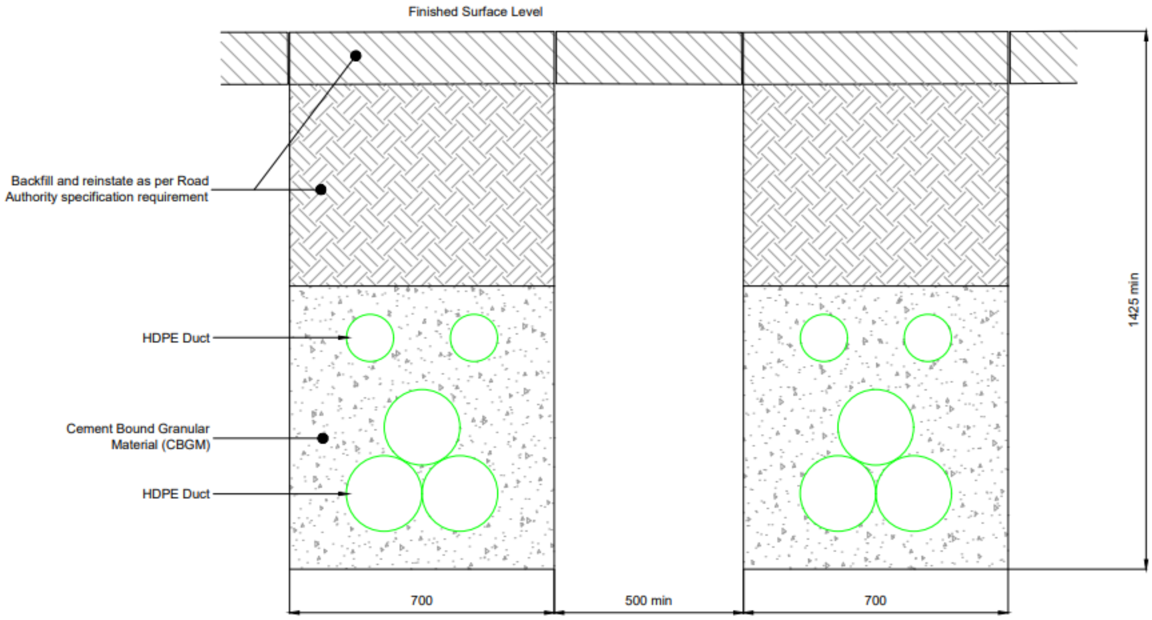


Figure 42 Typical cross section of a double 220 kV circuit trench in trefoil formation: extracted from planning drawing no. 229100714-MMD-00-XX-DR-C-0051

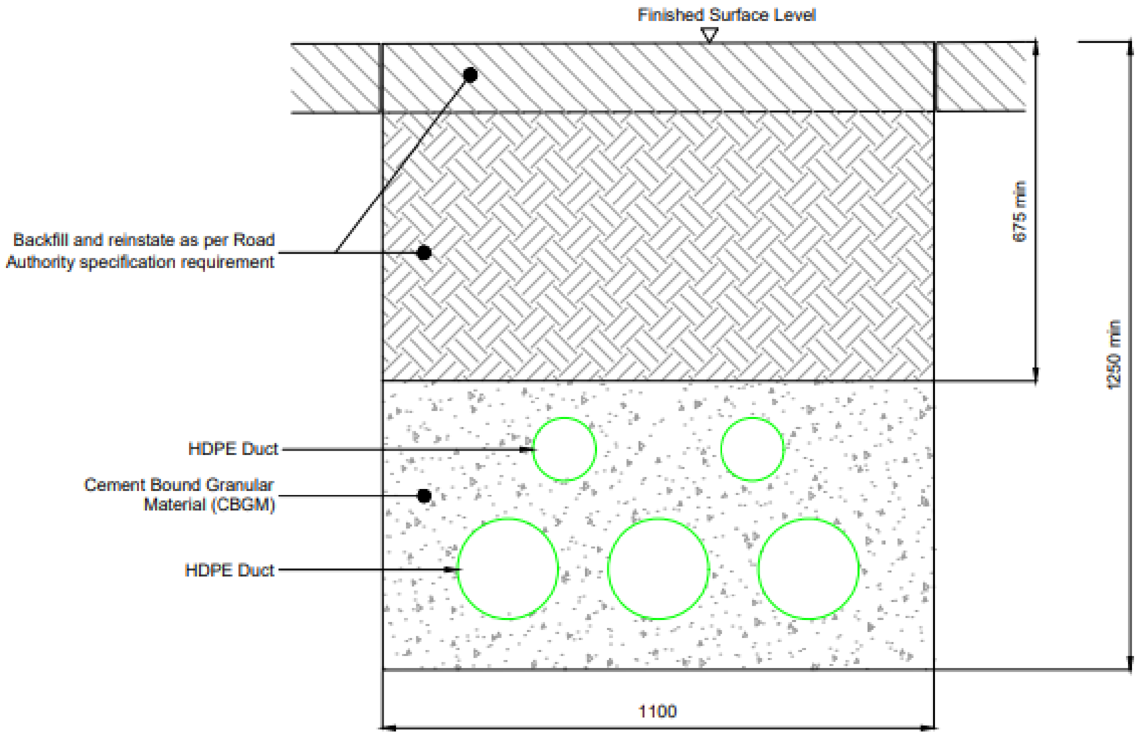


Figure 43 Typical cross section of a single 220 kV circuit trench in flat formation: extracted from planning drawing no. 229100714-MMD-00-XX-DR-C-0051

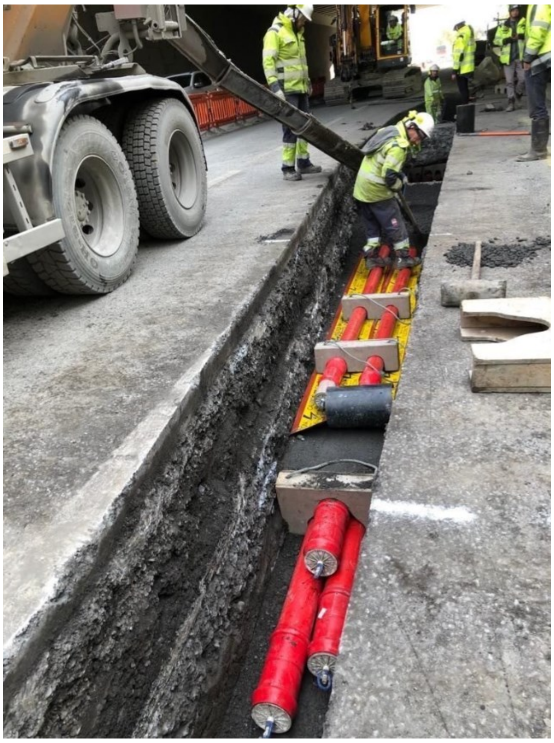


Figure 44 Example image of cable ducts in a trench in the road arranged in trefoil formation, with telecommunication ducts positioned above

Joint Bays

6.10.8 Cable joint bays (JBs) will be required at intervals of approximately 600 to 850 m along the onshore ECR. JBs are underground pre-cast concrete chambers measuring 8 m long x 2.5 m wide. They facilitate the joining of individual lengths of export cable sections. Figure 45 shows a typical detail of a JB.

6.10.9 Up to 10 sets of joint bays (20 JBs in total) will be installed at strategic locations along the onshore ECR to facilitate cable installation and to support the operation and maintenance of the export cables throughout the operational lifetime of the proposed development. Figure 46 is an example image of HV cable sheaths in a joint bay. Figure 47 shows the concrete lid over a JB during reinstatement.

6.10.10 Co-located with each JB will be a smaller link box chamber, described in Section 6.10.12 and a communications chamber, described in Section 6.10.14.

6.10.11 The majority of the JBs will be located within public roads where they will be easily accessible for future maintenance by EirGrid. If JBs are required to be located in greenfield/agricultural private lands, an access track will be constructed to provide future maintenance access, as described in Section 6.10.72.

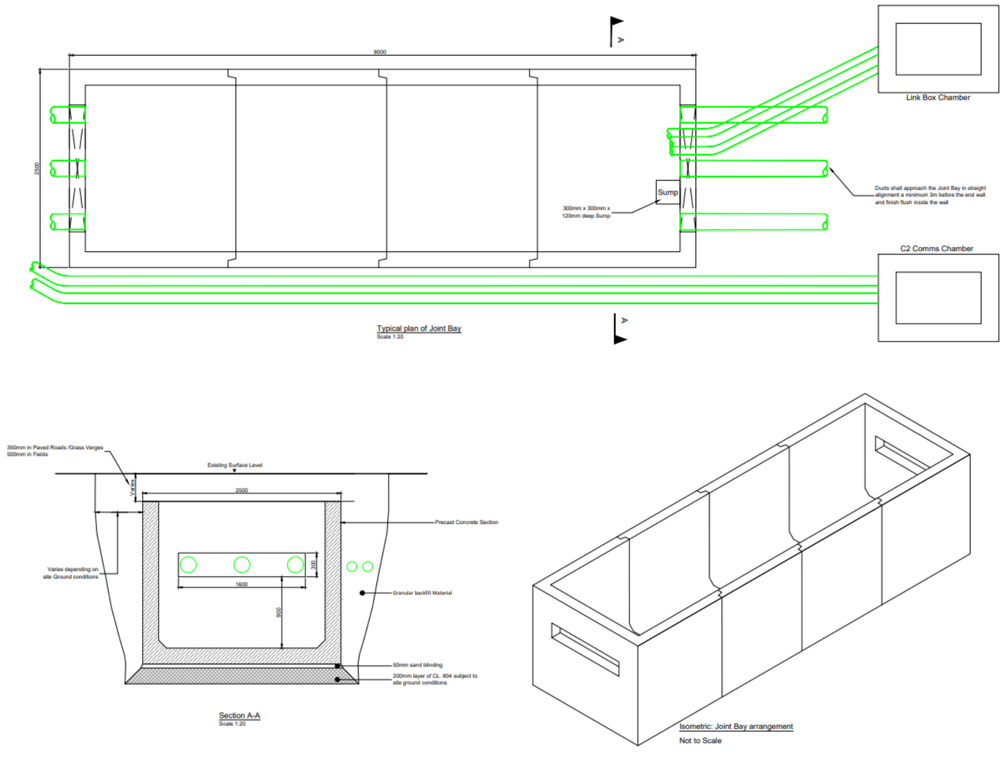


Figure 45 Typical detail of a joint bay - extract from planning drawing no. 229100714-MMD-00-XX-DR-C-0053

Figure 46 Example of HV cable joints in a concrete joint bay

Figure 47 Example image of a concrete slab in the base of an excavated joint bay (Source - Grimsby, Hornsea 2 Offshore Wind Farm)

Link box chamber

6.10.12 A link box chamber measuring 1.75 m long x 1.25 m wide will be co-located with each TJB and JB. The link box chambers will allow for testing and earthing of the cable sheaths to control the build-up of induced currents. They will be installed below ground and feature removable concrete lids as shown in Figure 48.

6.10.13 These chambers will be similar to other utility manhole inspection covers and the covers will be flush with the existing surface level in roads, footpaths and greenspaces, as shown in Figure 49.

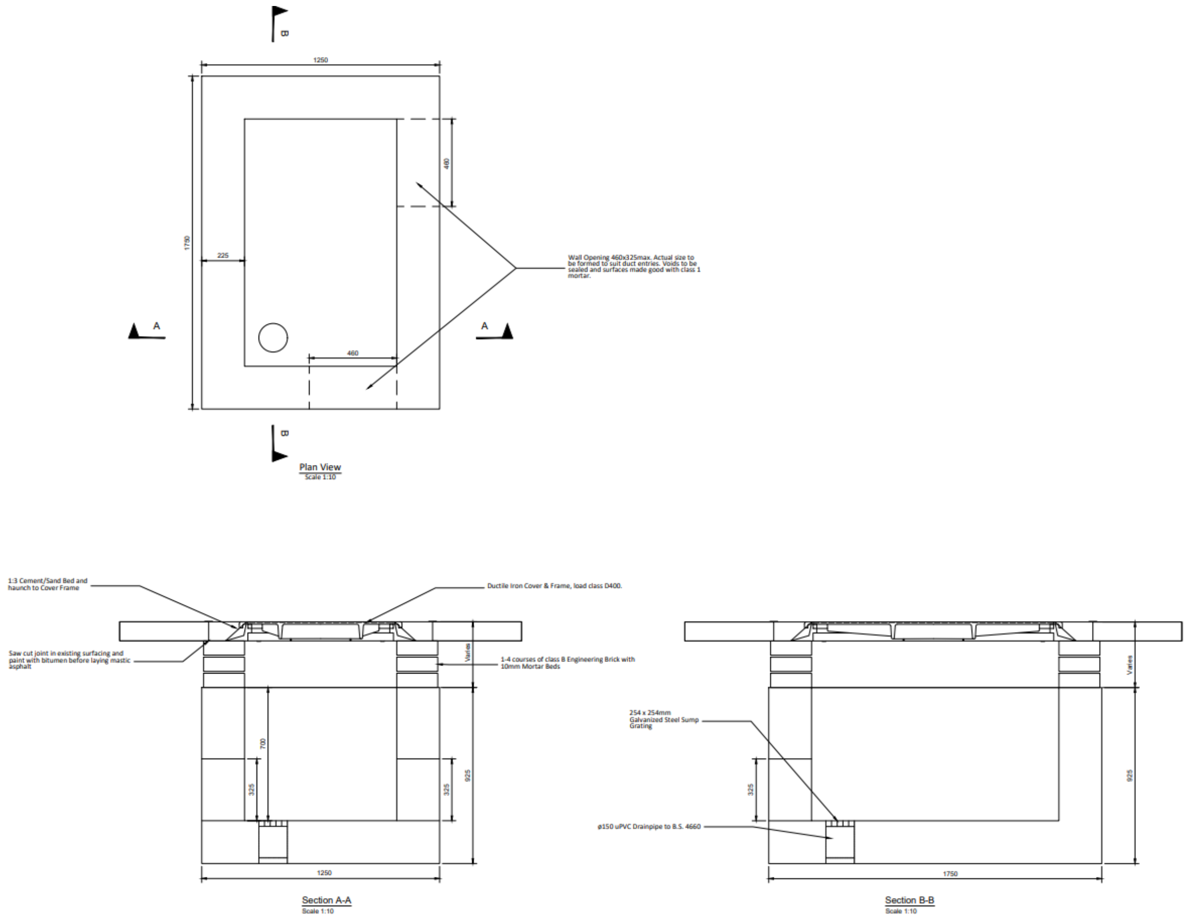


Figure 48 Typical detail of a link box chamber – extracted from planning drawing no. 229100714-MMD-00-XX-DR-C-0055

Figure 49 Example of an open Link Box Chamber Inspection cover

Communications chamber

6.10.14 Communication chambers measuring 1.3 m long x 1.03 m wide x 1.29 m deep will be installed alongside JBs and TJBs to allow inspection of the telecommunication fibre optic circuits. These will be typical of utility inspection chambers and will be located adjacent to the joint bays, as illustrated in Figure 50.

6.10.15 The telecommunications ducts/fibre optic cables will be contained in HDPE ducts measuring 125 mm in diameter each, positioned above the onshore export cables as illustrated in Figure 42. Figure 51 is an example image of a manhole inspection cover in the road.

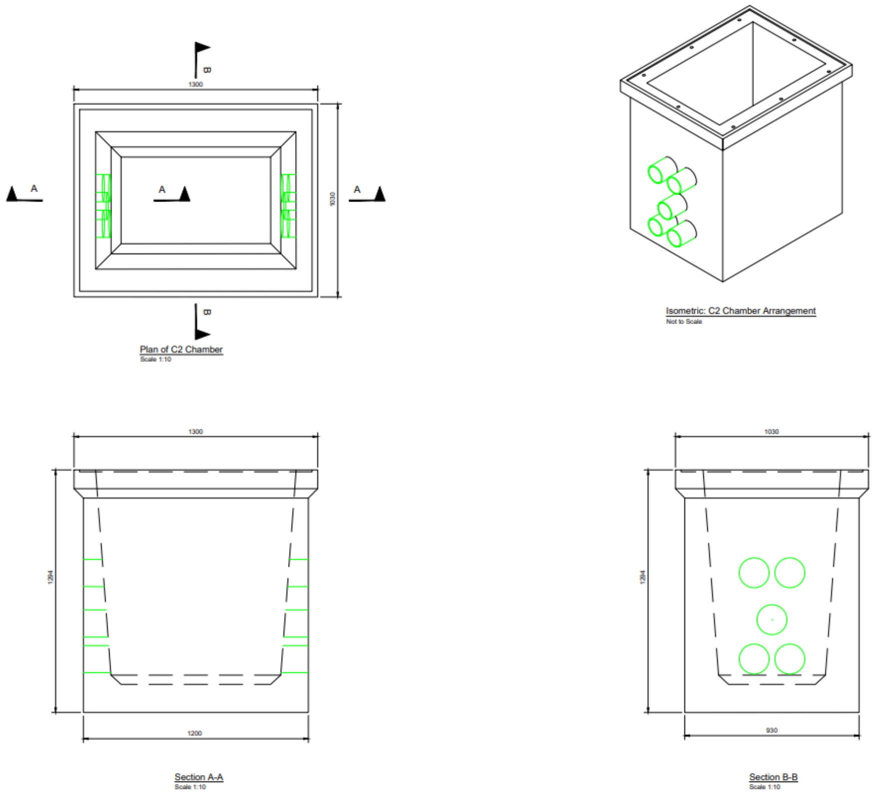


Figure 50 Typical detail of a communication chamber - extracted from planning drawing no. 229100714-MMD-00-XX-DR-C-0054

Figure 51 Example of an inspection cover in the road

Transition chambers

6.10.16 Transition chambers will be located at trenchless crossings, the locations of which are detailed further in Figure 55 to Figure 61 and Table 35. These chambers provide a support during cable pulling at the trenchless crossing locations where ducts of differing sizes may vary from the standard. The transition chamber facilitates the onshore export cables to be pulled through the ducts smoothly without snagging between JBs. The chambers can also be used to add additional grease to the cables to support during cable pulling.

6.10.17 Transition chambers will measure 1.2 m long x 1.7 m wide by 1.45 m deep. Figure 52 illustrates the typical design of an underground transition chamber.

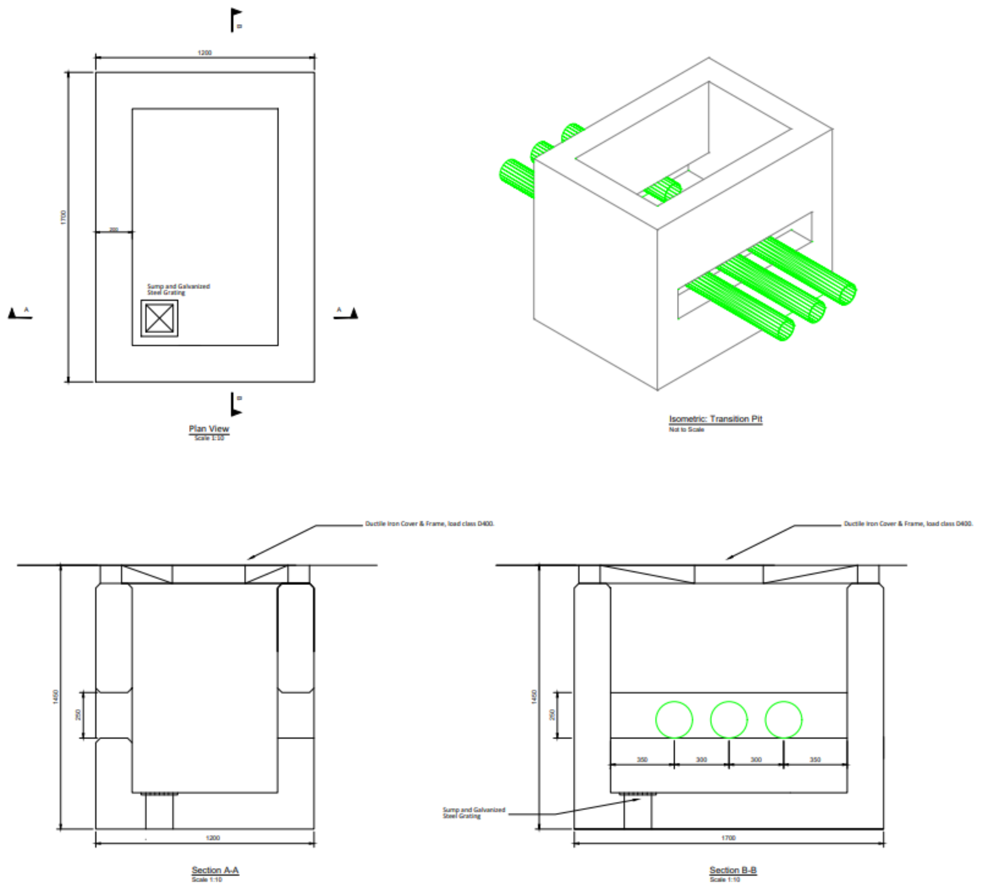


Figure 52 Typical detail of a transition chamber – extract from planning drawing number 229100714-MMD-00-XX-DR-C-0061

Route marker posts

6.10.18 Marker posts are normally only installed at the boundary of private lands. However, it is likely that marker posts, similar to that shown in Figure 53 will also be installed at boundaries between public roads and public land.

6.10.19 Route marker posts will be provided at positions agreed with EirGrid (line of sight, at bends locations, and property boundaries) along the onshore ECR. Route marker posts will have the following typical dimensions: 1700 mm high and 92 mm wide.

Figure 53 Typical HV cable marker post

Onshore Export Cable Route sector breakdown

6.10.20 The onshore ECR will predominantly follow the local road network within the extent of the road carriageway or adjacent soft verge in publicly accessible areas. The onshore ECR traverses the townlands of Shanganagh, Hackettsland, Ballybrack, Loughlinstown, Cherrywood, Glebe, Laughanstown, Carrickmines Great and Jamestown. Some sections of the onshore ECR traverse privately owned agricultural lands. This is detailed further in the following sections.

6.10.21 The onshore ECR between the TJBs and the OSS has been subdivided into seven sectors and a description of each one is set out below with a reference to Table 34 and Figure 55 to Figure 61. A copy of the planning drawings for the ECR are included in Part 2 Planning Drawings of this planning application.

Table 34 Onshore ECR sector breakdown

Sector No.	TX No.	Key Locations	Chainage in the planning drawings (east to west)
1	TX-01 TX-02 TX-03 TX-04	Shanganagh Cliffs Dart/Railway Line Clifton Park / Shanganagh River Bayview Shanganagh Road Achill Road	0 – 950 m
2	TX-04 TX-05	Loughlinstown Linear Park Gleanntan Loughlinstown Drive (L1067) DLRCC Parks Depot Eurofound	950 m – 2,000 m
3	TX-06	Cherrywood Park Wyattville Road (R118)	2,000 m – 2,950 m
4	TX-06 TX-07	Cherrywood Avenue Beckett Road Kilternan Link Road	2,950 m – 5,750 m
5	-	Golf Lane	5,750 m – 6,150 m
6	TX-08	Glenamuck Road South (R842) Glenamuck District Distributor Road	6,150 m – 6,350 m
7	TX-08	Carrickmines Great Jamestown	6,350 m - 7,050 m

Sector 1

6.10.22 Sector 1 is shown in Figure 55. Sector 1 starts at the access road to the Uisce Éireann Shanganagh-Bray WWTP at Shanganagh Cliffs (0 – 50 m). The Clifton Park TCC will be established in the area of public greenspace bordered by Shanganagh River to the west and the DART railway line to the east. This open greenspace area will support the onshore ECR construction phase as one of the three main TCC sites and is described in Figure 30 and Figure 62.

6.10.23 The Clifton Park TCC will be the entry pit for two trenchless crossings along the onshore ECR, one under the DART/railway line and Shanganagh Community Gardens (TX-01) and another under Shanganagh River (TX-02) into Bayview Glen. The onshore ECR will then be installed within the road carriageway of the residential roads of Bayview Glen and Bayview Crescent by standard open-cut trenching techniques.

6.10.24 At Bayview Glade the onshore ECR will then leave the Bayview housing estate and cross under the regional Shanganagh Road(R119)/Killiney Hill Road roundabout (TX-03). The entry pit will be located at the green space to the west of the roundabout adjacent to the access road to Cromlech Fields housing estate and the exit pit for TX-03 will be located in Bayview Glade.

6.10.25 The onshore ECR will proceed west and will be installed in the grass verge and pedestrian path to the west of Shanganagh Road using open-cut trench techniques. Two JBs (chainage 800 m) are proposed to be installed in the grass verge and pedestrian path between Aran Drive and Shanganagh Road approximately 200 m north of the roundabout. The onshore ECR will then route west onto Achill Road and cross under the Kill o’ the Grange Stream (TX-04) and continues west, progressing into Sector 2.

Sector 2

6.10.26 Sector 2 is shown in Figure 56. The onshore ECR will route west from TX-04 along the grass area north of the Kill o’ the Grange Stream within Loughlinstown Linear Park. There are two JBs (chainage 1,000 m – 1,100 m) proposed approximately 20 m north of the Kill O’ the Grange Stream. The onshore ECR will then cross under the Kill o’ the Grange Stream a second time (TX-05) and follow the existing pedestrian path north, turning west onto the road of Gleanntan and then proceeding in the road carriageway of Loughlinstown Drive (L1067). Another two JBs (chainage 1,600 m) are proposed in Loughlinstown Drive between Cherry Court and The Oaks.

6.10.27 The onshore ECR will advance west onto the residential street Cherrywood and follow the road south for approximately 130 m. The ECR will then enter through the western side of the DLRCC Parks Depot by creating a temporary opening in the steel mesh fence to facilitate the cable installation using open-cut trenching method.

6.10.28 The onshore ECR will then route into the privately owned grounds of Eurofound and a trenchless crossing (TX-06) will be employed under the N11 to Cherrywood Park from east to west. The temporary trenchless crossing compound for the entry pit associated with TX-06 under the N11 will be established in the open green space of the lawn by the entrance to Eurofound.

Sector 3

6.10.29 Sector 3 is shown in Figure 57. The exit pit for the trenchless crossing under the N11 and Loughlinstown River (TX-06) will be located in Cherrywood Park and a temporary trenchless crossing compound will be established. The onshore ECR will then route west onto Wyattville Road (R118). The cables will be installed within the southbound road carriageway using standard open-cut trenching techniques for approximately 690 m. Two JBs (chainage 2,450 m) are proposed to be located along Wyattville Road (R118) approximately 200 m west of Cherrywood Park. The western extent of Sector 3 is at the junction of Cherrywood Avenue.

Sector 4

6.10.30 Sector 4 is shown in Figure 58. From Wyattville Road (R118) the onshore ECR routes south onto Cherrywood Avenue for approximately 200 m using standard open-cut trenching techniques. The onshore ECR route will then be routed along the planned Beckett Road.

6.10.31 Beckett Road is a planned road set out in the consented Cherrywood Planning Scheme[35], a Strategic Development Zone in the adopted DLRCDP 2022-2028. The first 1.4 km of Beckett Road was consented in November 2022 (planning application reference DZ21A/1017)[36] and is planned to commence construction in 2025. Beckett Road is planned to be completed by 2026. This 1.4 km road section connects from Cherrywood Avenue and will run under Wyattville Road (R118) as an underpass. Beckett Road will run parallel with the east side of the M50 with future junction connection to Bishop's street and Mercer Drive. The extent of the consented 1.4 km section of Beckett Road ends at Mercer Drive. It is set out as H – G – F – E2 in Figure 54 of the Cherrywood Planning Scheme.

6.10.32 Four JBs are proposed to be located within this 1.4 km section of Beckett Road (chainage 3,300 m – 3,350 m and 4,000 m). Ducts are planned to be installed in this section of Beckett Road to facilitate installation of utility connections, including the onshore export cables for the proposed Dublin Array development. This will mean that no new trenches will be required to be excavated in this 1.4 km section of Beckett Road in the future as the planned cables will be pulled through the pre-installed ducts.

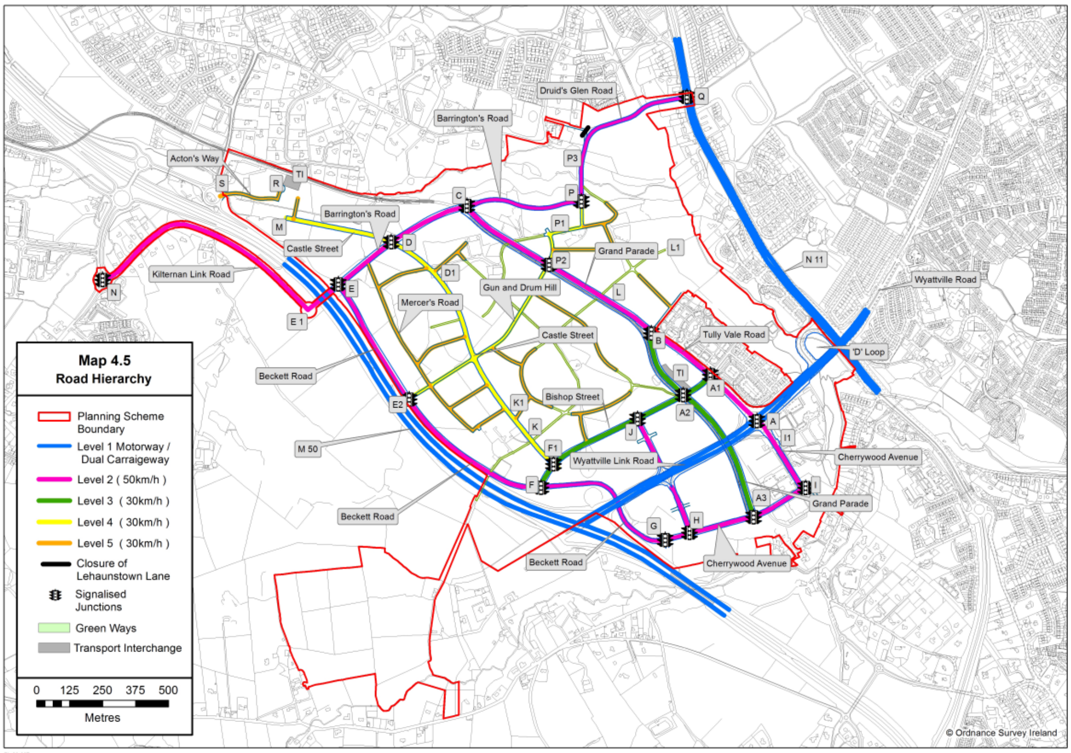


Figure 54 Physical Infrastructure of the Cherrywood Planning Scheme

6.10.33 There is another 500 m section of Beckett Road planned in the Cherrywood Planning Scheme (E2 – E) for which there is no consent or live planning application.

35 https://www.dlrcoco.ie/planning/cherrywood-sdz

36 https://planning.agileapplications.ie/dunlaoghaire/application-details/91425

6.10.34 From the Mercer Drive junction of Beckett Road (E2), the onshore ECR will continue north parallel to the east of the M50 in private agricultural lands for approximately 250 m. The onshore ECR trench is proposed to be located underneath the proposed 500 m section of future road carriageway of Beckett Road (E2 - E). A 3 m wide access track is proposed to run alongside the cable trench to provide future access to two proposed JBs (chainage 4,700 m) located within the agricultural fields approximately 200 m north of Beckett Road (E2).

6.10.35 Approximately 50 m north of the area where the JBs are proposed to be located, the onshore ECR will cross northwest under the M50 using trenchless techniques (TX-07).

6.10.36 The planned future Kilternan Link Road (KLR) is another road infrastructure project that is set out in the Cherrywood Planning Scheme but is not yet constructed or consented (E - E1 – N). The KLR is planned to connect at the northern extent of Beckett Road (E) at the junction with Barrington's Road. The indicative design for the KLR proposes an overpass over the M50 and upgrades to Golf Lane and Old Glenamuck Road as far as the roundabout (N) with Glenamuck Road South (R842).

6.10.37 The onshore ECR is proposed to route alongside the future planned alignment of the KLR on the west side.

6.10.38 Two JBs are proposed within the northern extent of the agricultural fields adjacent to Golf Lane (chainage 5,500 m – 5,550 m).

Sector 5

6.10.39 Sector 5 is shown in Figure 59. The onshore ECR will route within the road carriageway of Golf Lane and Old Glenamuck Road travelling south towards the roundabout at Glenamuck Road South (R842) for approximately 500 m. The cables will be installed using standard open-cut trench techniques.

Sector 6

6.10.40 Sector 6 is shown in Figure 60. The onshore ECR will proceed to cross the roundabout and travel south along Glenamuck Road South (R842). Two JBs are proposed approximately 120 m south of the roundabout within the road (chainage 6,200 m). The onshore ECR continues south on Glenamuck Road South for approximately 40 m where the onshore ECR exits the road to the west, entering into a privately owned greenfield agricultural landholding. The onshore ECR will then cross under the Glenamuck District Distributor Road (GDDR) at TX-08 via trenchless techniques. The GDDR is currently under construction and is expected to be completed in advance of the onshore ECR construction phase.

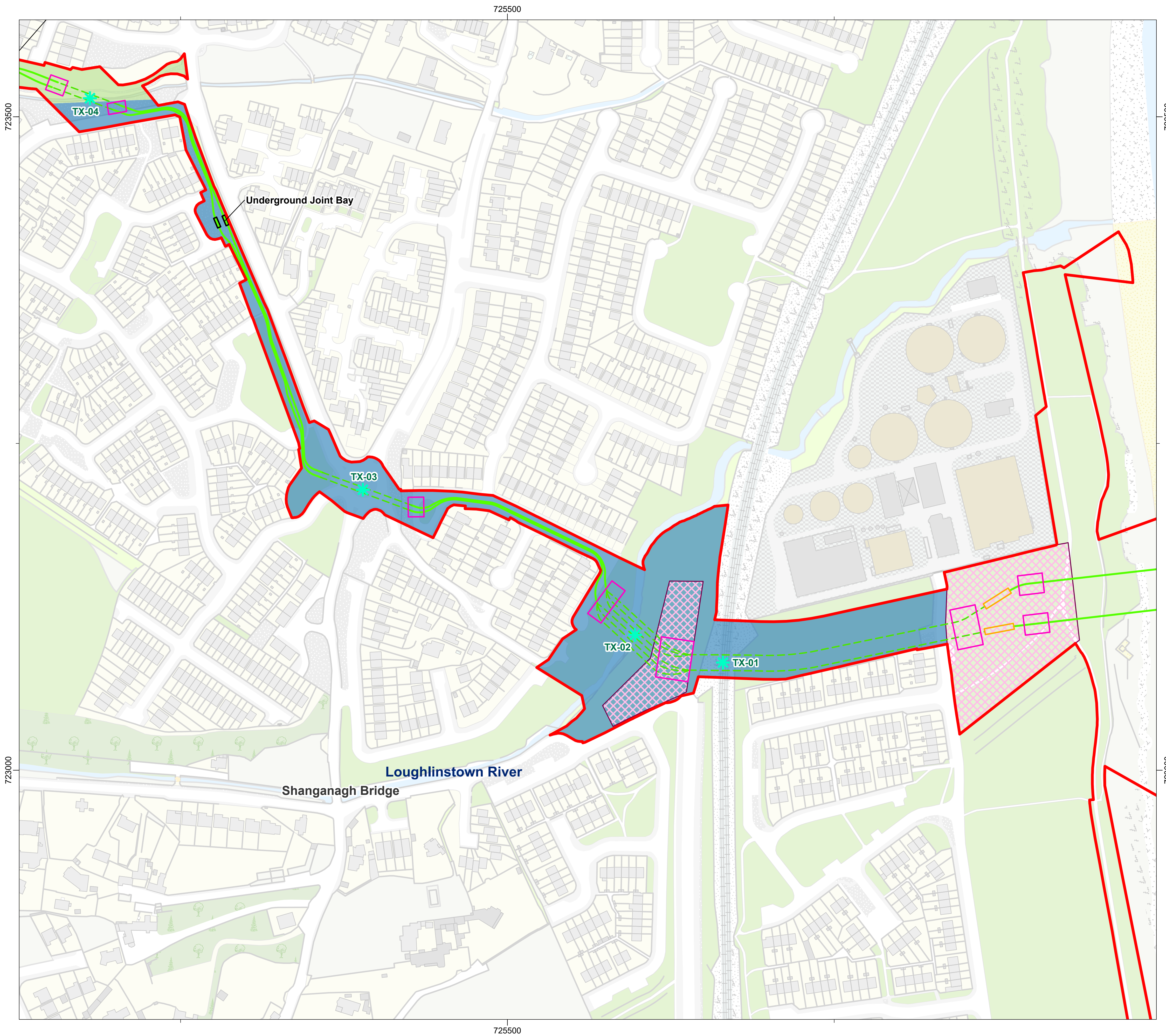
Sector 7

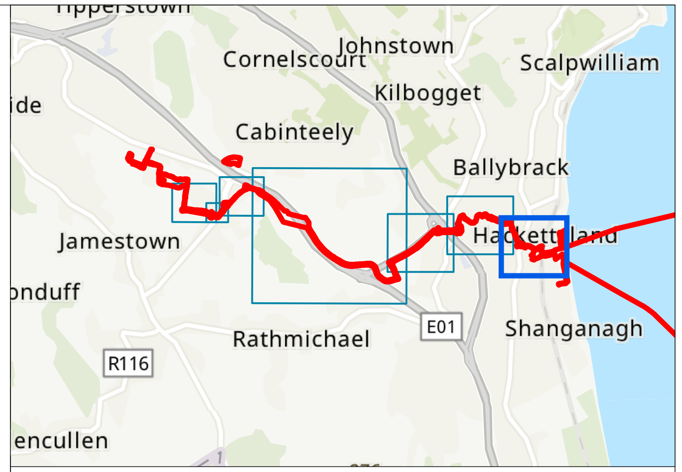
6.10.41 Sector 7 is shown in Figure 61. The onshore ECR will cross under the GDDR (TX-08) into agricultural fields to the south of the Carrickmines Retail Park and route west along the southern boundary of the Carrickmines Retail Park for approximately 300 m. The cables will be installed using open-cut trenching and will cross two small watercourses (Golf Stream).

6.10.42 The onshore ECR will then route north towards the OSS at Jamestown for approximately 320 m. The cables will be located within the extent of the existing access track.

6.10.43 Two JBs are proposed approximately 40 m south of the OSS (chainage 7,000 m). The extent of Sector 7 is defined by the existing fence line.

6.10.44 A full description of the OSS site location in Jamestown is set out in Section 6.11.





Application Site Boundary

Onshore Electrical System (OES) Design

- TJB
- Temporary Trenchless Crossing Compound
- Underground Joint Bay
- Onshore Export Cable Route (trenchless)
- Onshore Export Cable Route (trenched)
- Trenchless Crossing Centre Point
- Temporary Construction Compound (TCC)

Export Cable Route (ECR) Sector

- Sector 1
- Sector 2

DRAWING STATUS

PUBLIC

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Project Description: Sector 1 of the Onshore ECR

DRAWING NUMBER: **Figure 55**

PAGE NUMBER: **1 of 7**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2025-01-21	DRAFT	JK	AB	AE
02	2025-01-17	PUBLIC	JK	SW	AM

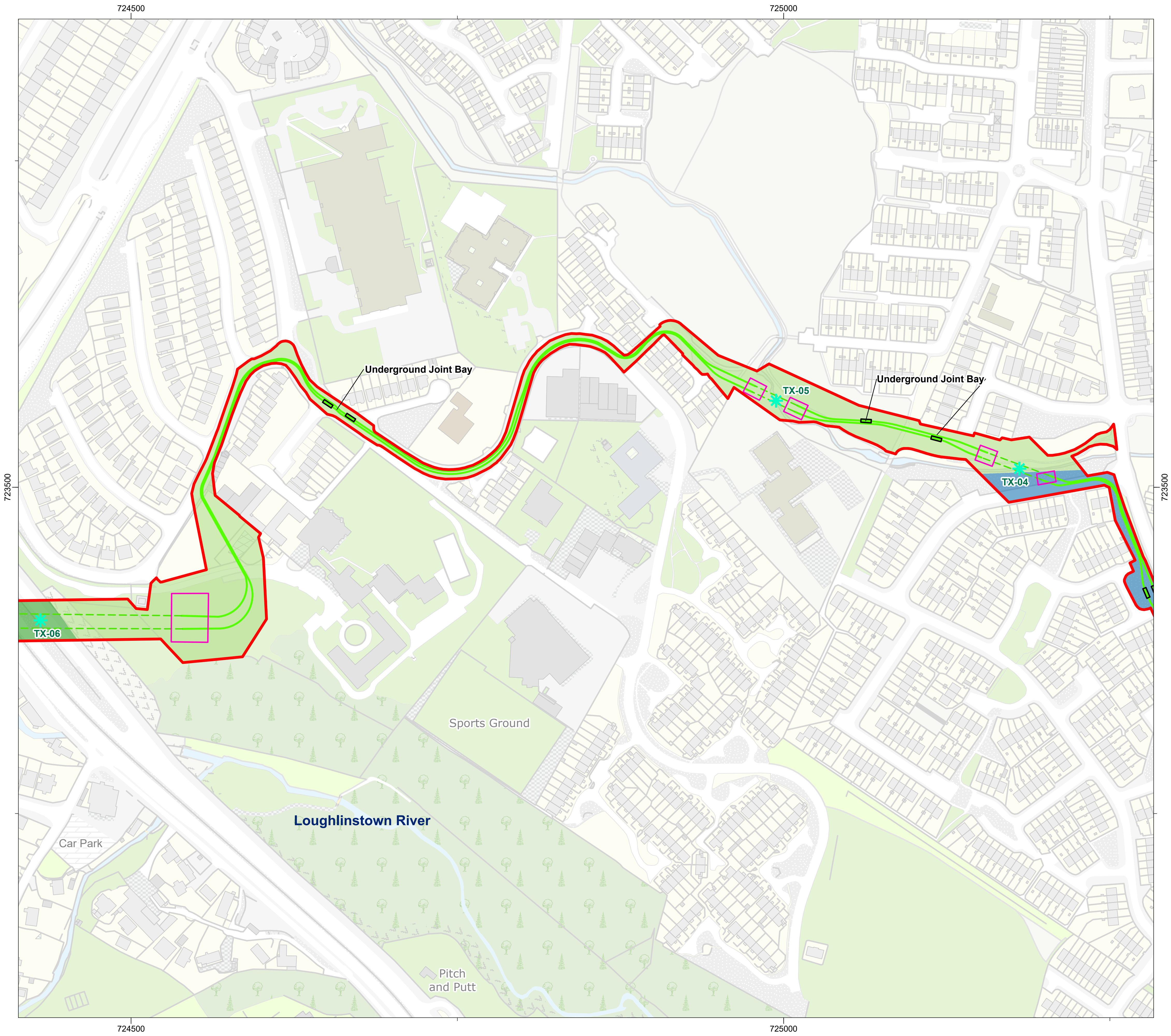
0 25 50 75 100 m
0 75 150 225 300 Feet

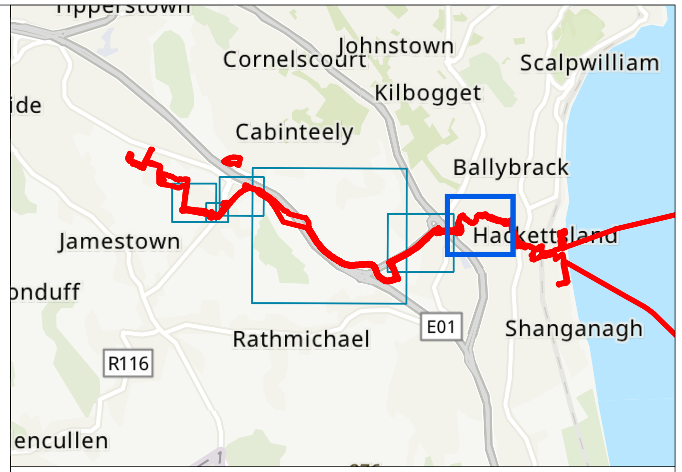
N GRID NORTH

SCALE	1:3,000	PLOT SIZE	A3
DATUM	IRENET95	VERTICAL REF	ODN/LAT/MLLW
PRJ	IRENET95 Irish Transverse Mercator		

SLR

Dublin Array
Generation for generations
Kish Offshore Wind Limited - Bray Offshore Wind Limited





- Application Site Boundary

Onshore Electrical System (OES) Design

- Temporary Trenchless Crossing Compound
- Underground Joint Bay
- Onshore Export Cable Route (trenchless)
- Onshore Export Cable Route (trenched)
- Trenchless Crossing Centre Point

Export Cable Route (ECR) Sector

- Sector 1
- Sector 2
- Sector 3

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Project Description: Sector 2 of the Onshore ECR

DRAWING NUMBER: **Figure 56**

PAGE NUMBER: **2 of 7**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2025-01-21	DRAFT	JK	AB	AE
02	2025-01-17	PUBLIC	JK	SW	AM

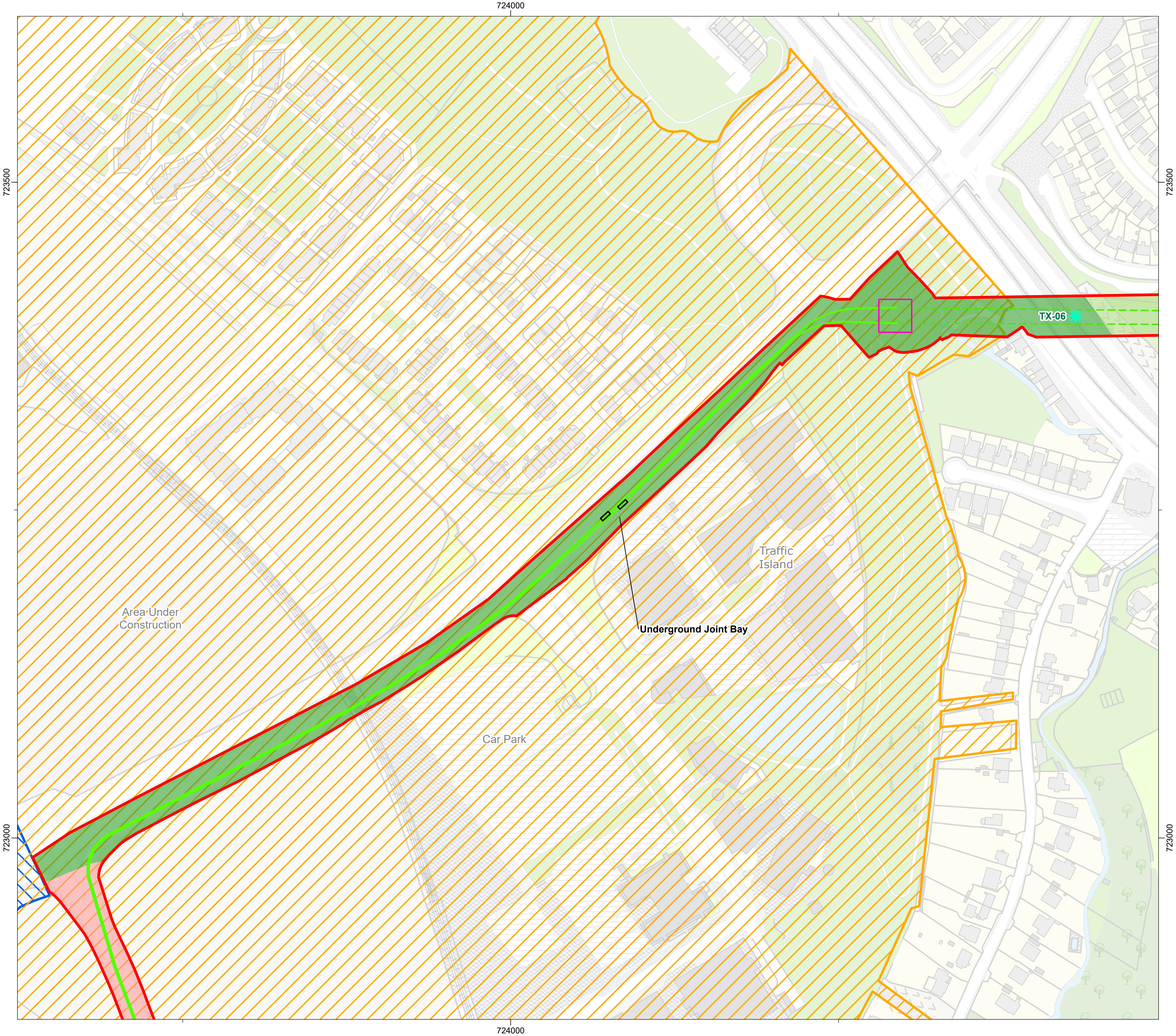
0 25 50 75 100 m
0 75 150 225 300 Feet

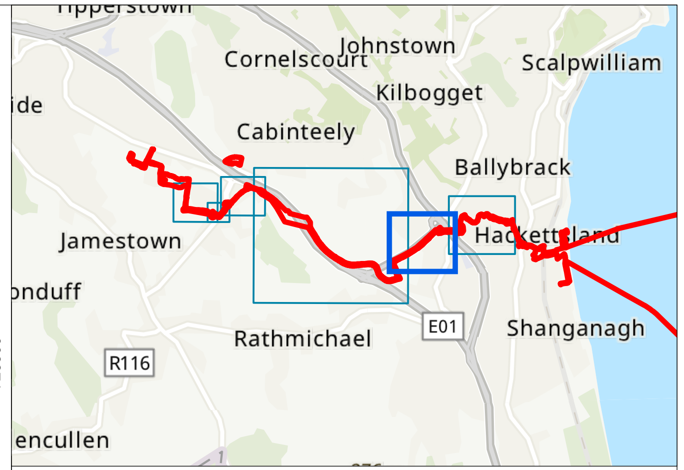
N GRID NORTH

SCALE	1:3,000	PLOT SIZE	A3
DATUM	IRENET95	VERTICAL REF	ODN/LAT/MLLW
PRJ	IRENET95 Irish Transverse Mercator		

Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited





Application Site Boundary

Onshore Electrical System (OES) Design

Temporary Trenchless Crossing Compound

Underground Joint Bay

Onshore Export Cable Route (trenchless)

Onshore Export Cable Route (trenched)

Trenchless Crossing Centre Point

Export Cable Route (ECR) Sector

Sector 2

Sector 3

Sector 4

Neighboring Planning Applications

Cherrywood SDZ

Consented Beckett Road

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Project Description: Sector 3 of the Onshore ECR

DRAWING NUMBER: **Figure 57**

PAGE NUMBER: **3 of 7**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2025-01-21	DRAFT	JK	AB	AE
02	2025-01-17	PUBLIC	JK	SW	AM

0 25 50 75 100 m

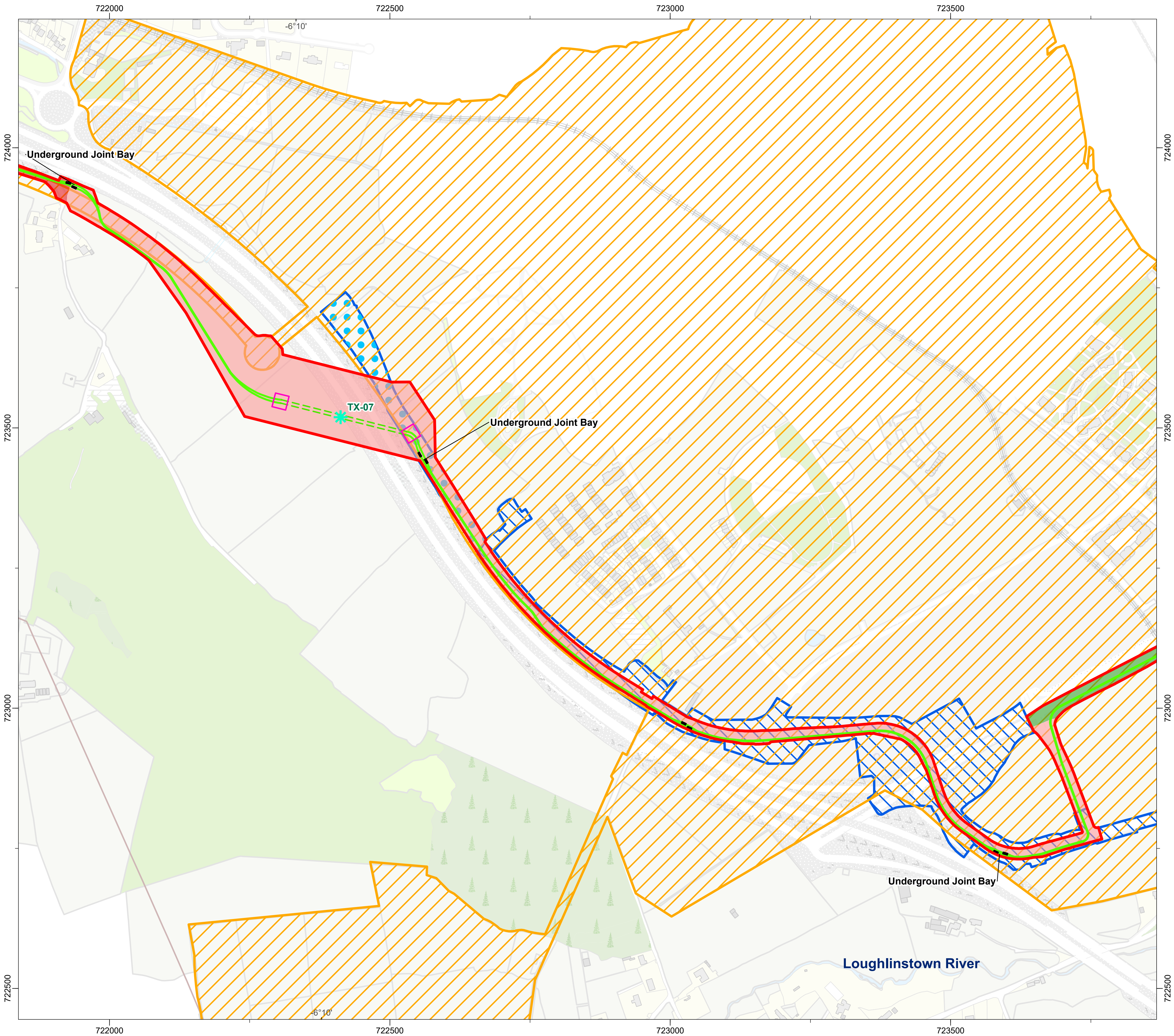
0 75 150 225 300 Feet

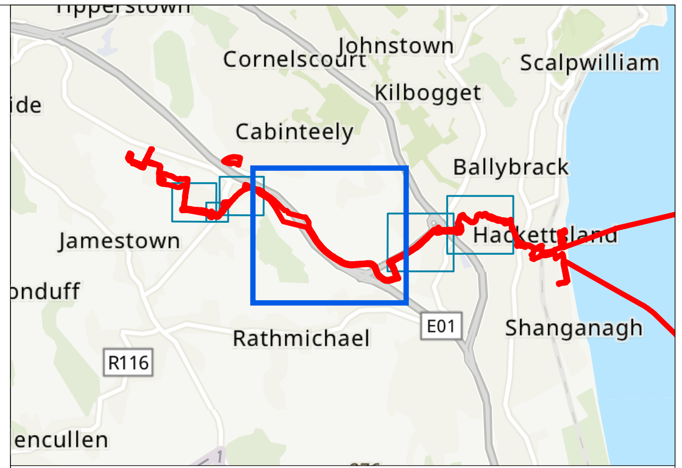
N GRID NORTH

SCALE	1:3,000	PLOT SIZE	A3
DATUM	IRENET95	VERTICAL REF	ODN/LAT/MLLW
PRJ	IRENET95 Irish Transverse Mercator		

SLR

Dublin Array
Generation for generations
Kish Offshore Wind Limited - Bray Offshore Wind Limited





Application Site Boundary

Onshore Electrical System (OES) Design

- Temporary Trenchless Crossing Compound
- Underground Joint Bay
- Onshore Export Cable Route (trenchless)
- Onshore Export Cable Route (trenched)
- Trenchless Crossing Centre Point

Export Cable Route (ECR) Sector

- Sector 3
- Sector 4
- Sector 5

Neighboring Planning Applications

- Cherrywood SDZ
- Consented Beckett Road
- Proposed Beckett Road Extension

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PROJECT TITLE **Dublin Array**

DRAWING TITLE **Project Description: Sector 4 of the Onshore ECR**

DRAWING NUMBER: **Figure 58** PAGE NUMBER: **4 of 7**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2025-01-21	DRAFT	JK	AB	AE
02	2025-01-17	PUBLIC	JK	SW	AM

0 50 100 150 200 m
0 125 250 375 500 Feet

N GRID NORTH

SCALE 1:7,000 PLOT SIZE A3
DATUM IRENET95 VERTICAL REF ODN/LAT/MLLW
PRJ IRENET95 Irish Transverse Mercator

SLR

Dublin Array
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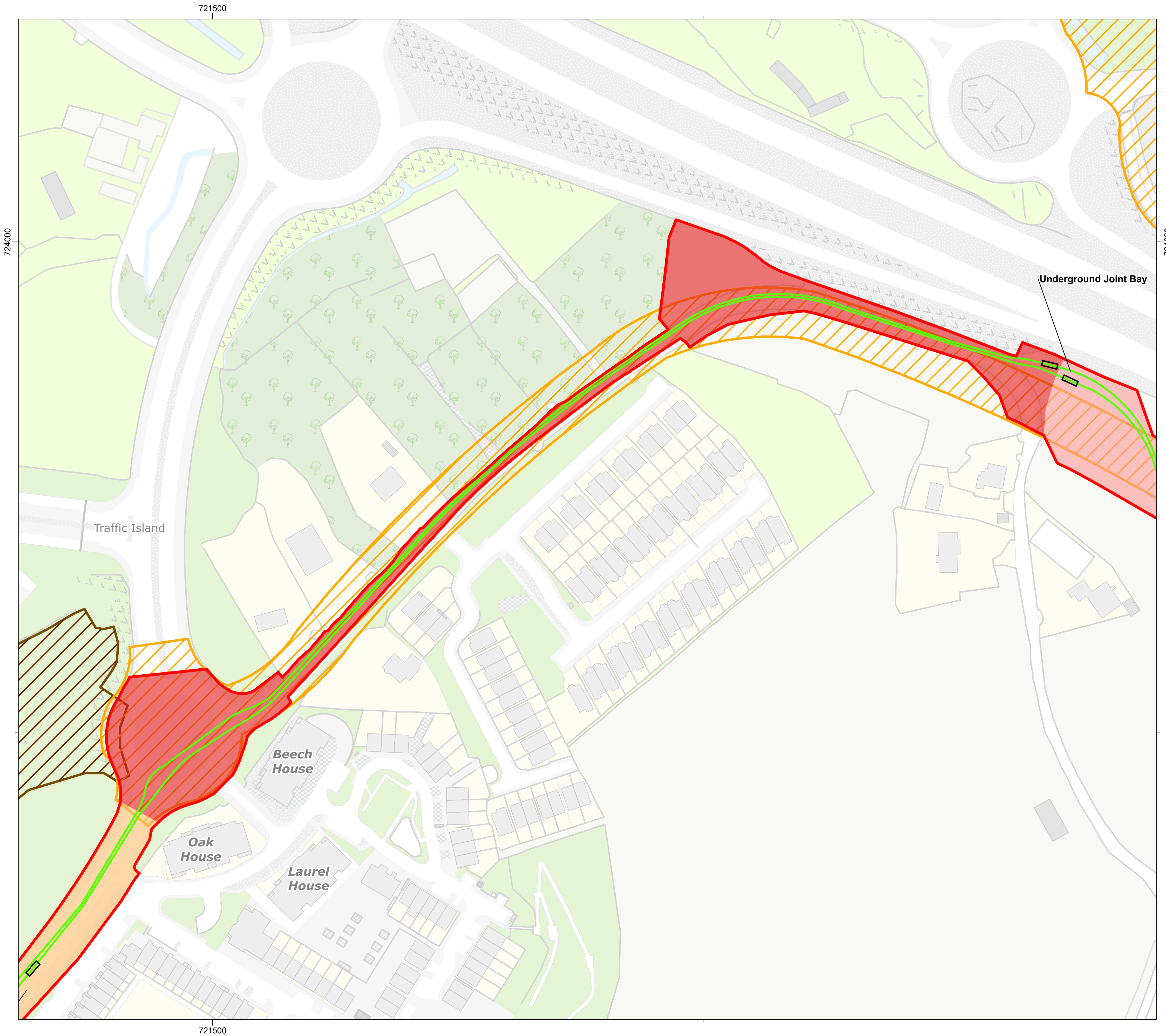

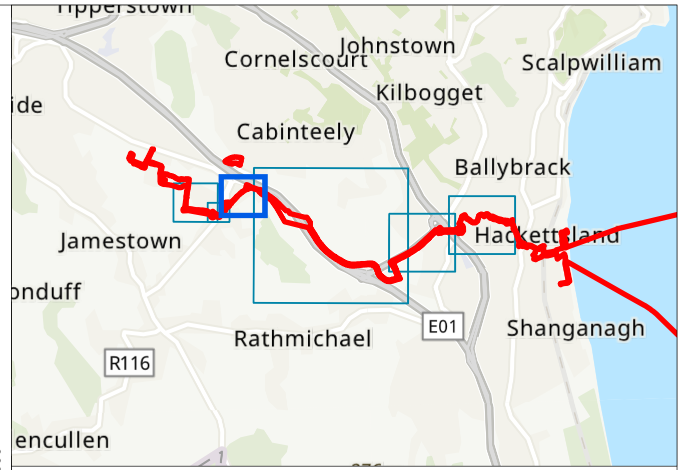

Application Site Boundary

Onshore Electrical System (OES) Design

Underground Joint Bay

Onshore Export Cable Route (trenched)

Export Cable Route (ECR) Sector

Sector 4

Sector 5

Sector 6

Neighboring Planning Applications

Cherrywood SDZ

Glenamuck District Distributor Road

DRAWING STATUS

PUBLIC

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MAP NOTES / DATA SOURCES:

PROJECT TITLE

Dublin Array

DRAWING TITLE

Project Description: Sector 5 of the Onshore ECR

DRAWING NUMBER: **Figure 59**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2025-01-21	DRAFT	JK	AB	AE
02	2025-01-17	PUBLIC	JK	SW	AM

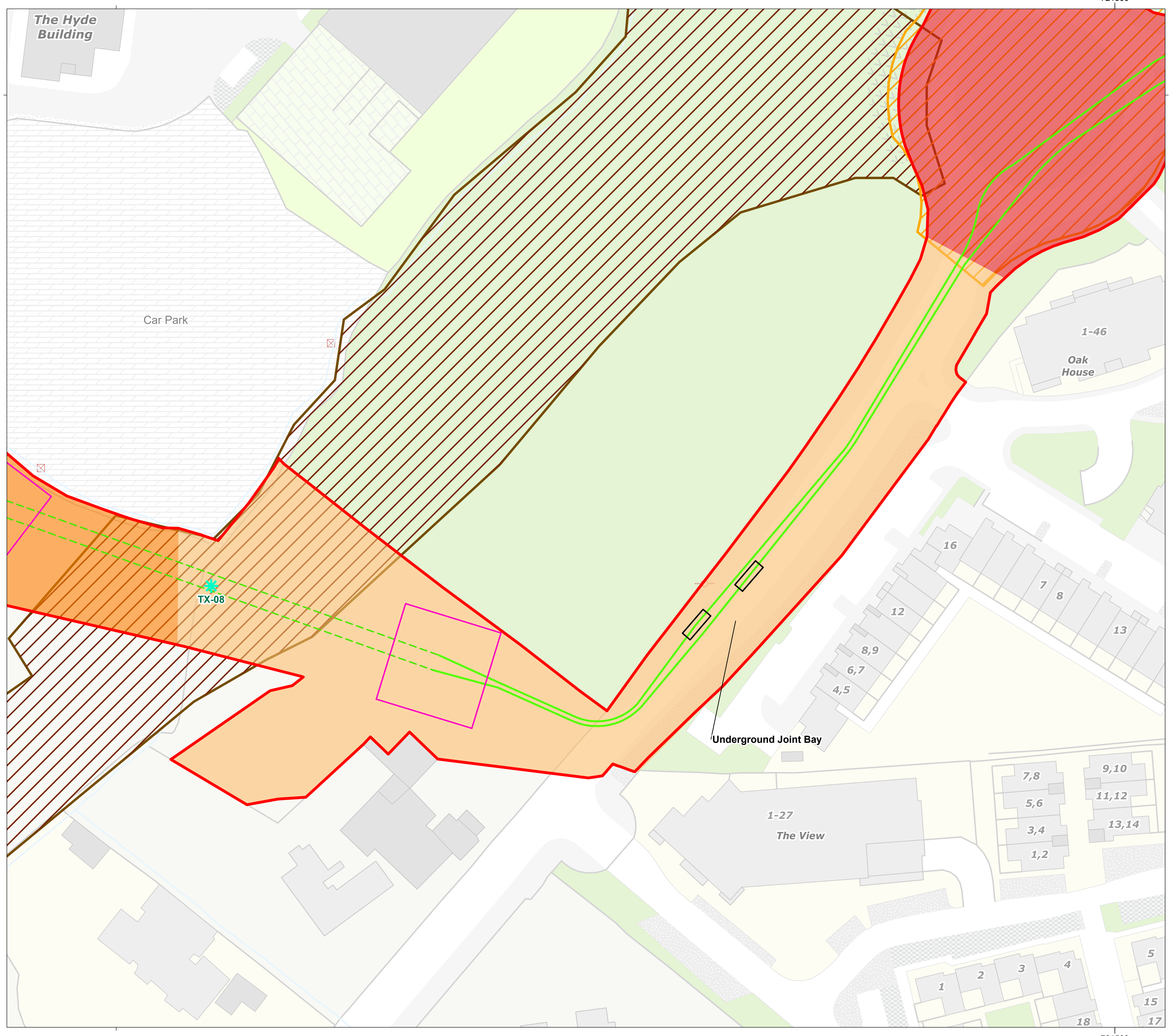
0 10 20 30 40 Meters
0 50 100 150 200 Feet

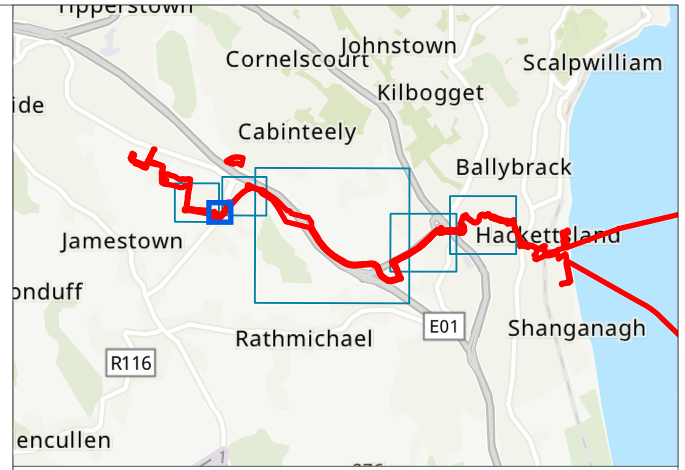
N GRID NORTH

SCALE	1:2,000	PLOT SIZE	A3
DATUM	IRENET95	VERTICAL REF	ODN/LAT/MLLW
PRJ	IRENET95 Irish Transverse Mercator		

SLR

Dublin Array
Generation for generations
Kish Offshore Wind Limited - Bray Offshore Wind Limited





Application Site Boundary

Onshore Electrical System (OES) Design

- Temporary Trenchless Crossing Compound
- Underground Joint Bay
- Onshore Export Cable Route (trenchless)
- Onshore Export Cable Route (trenched)
- Trenchless Crossing Centre Point

Export Cable Route (ECR) Sector

- Sector 5
- Sector 6
- Sector 7

Neighboring Planning Applications

- Cherrywood SDZ
- Glenamuck District Distributor Road

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Project Description: Sector 6 of the Onshore ECR

DRAWING NUMBER: **Figure 60**

PAGE NUMBER: **6 of 7**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2025-01-21	DRAFT	JK	AB	AE
02	2025-01-17	PUBLIC	JK	SW	AM

0 5 10 15 20 Meters
0 25 50 75 100 Feet

N

SCALE	1:1,000	PLOT SIZE	A3
DATUM	IRENET95	VERTICAL REF	LDN/LAT/MLLW
PRJ	IRENET95 Irish Transverse Mercator		

SLR

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Generation for generations
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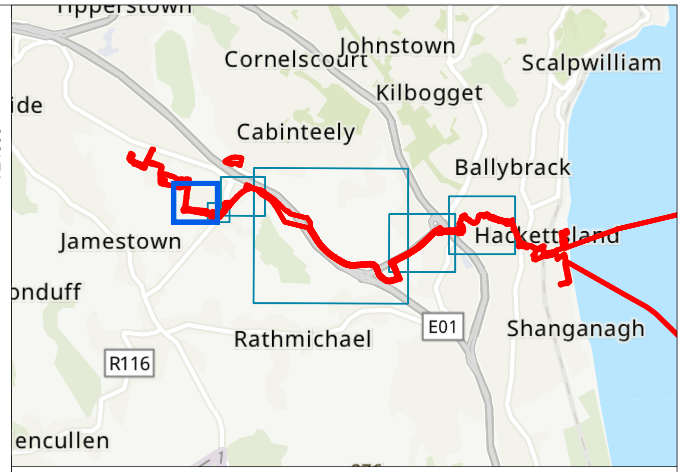

- Application Site Boundary

Onshore Electrical System (OES) Design

- Onshore ECR Watercourse Crossing (trenched)
- Temporary Trenchless Crossing Compound
- Underground Joint Bay
- Onshore Export Cable Route (trenchless)
- Onshore Export Cable Route (trenched)
- Trenchless Crossing Centre Point
- Temporary Construction Compound (TCC)

Export Cable Route (ECR) Sector

- Sector 6
- Sector 7

Neighboring Planning Applications

- Glenamuck District Distributor Road

DRAWING STATUS

PUBLIC

DISCLAIMER

MAP NOTES / DATA SOURCES:

PROJECT TITLE

Dublin Array

DRAWING TITLE

Project Description: Sector 7 of the Onshore ECR

DRAWING NUMBER: **Figure 61**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2025-01-21	DRAFT	JK	AB	AE
02	2025-01-17	PUBLIC	JK	SW	AM

0 10 20 30 40 Meters
0 50 100 150 200 Feet

N GRID NORTH

SCALE 1:2,000 PLOT SIZE A3
DATUM IRENET95 VERTICAL REF ODN/LAT/MLLW
PRJ IRENET95 Irish Transverse Mercator

SLR

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Onshore ECR construction activities and methodology

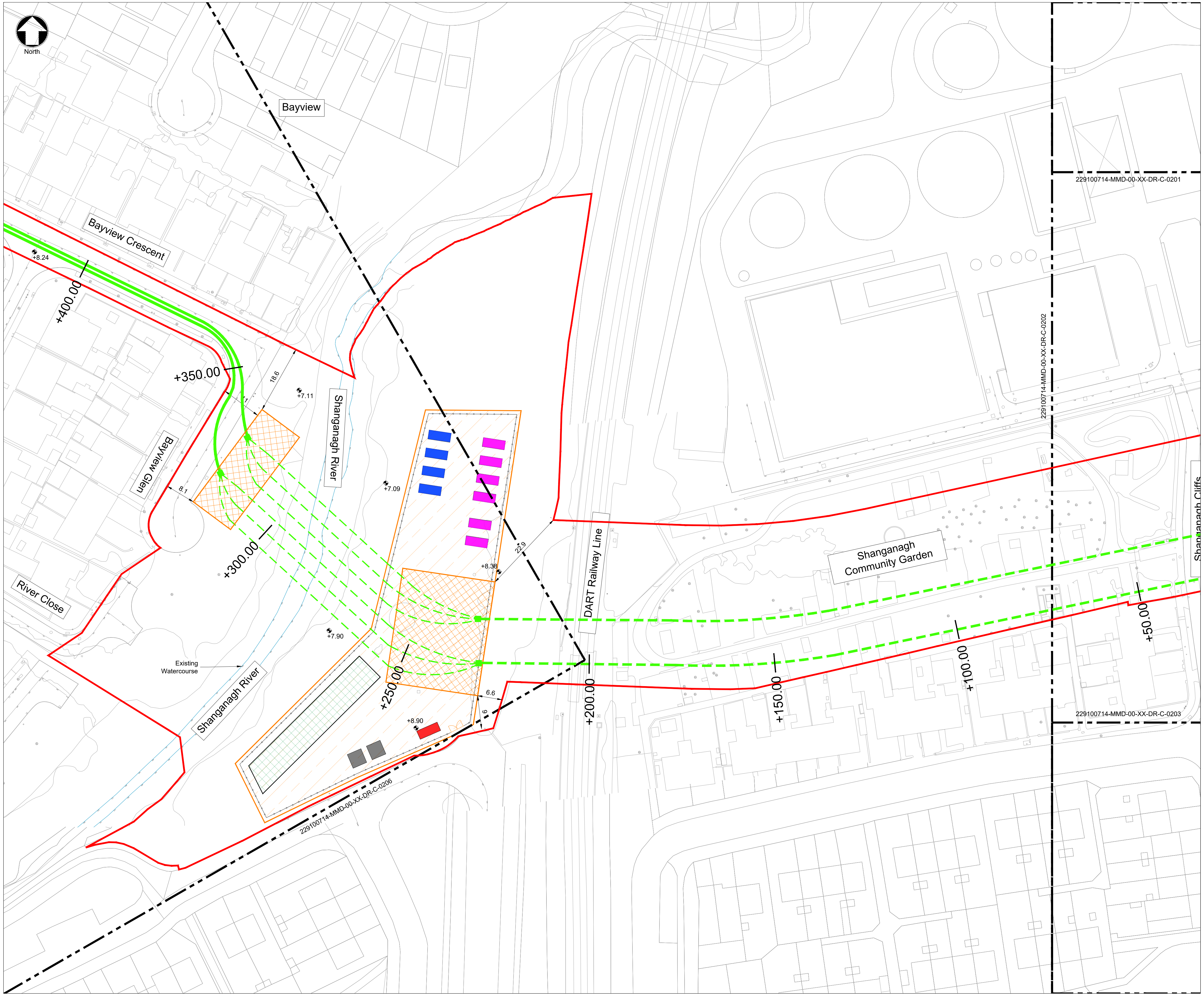
6.10.45 The onshore ECR construction activities will require the following:

- Pre-construction construction design and scheduling phase;
- Site mobilisation and set up of main TCCs;
- Cable duct installation at trenchless crossing locations;
- Open cut trenching and duct installation;
- Construction of joint bays;
- Cable pulling and jointing; and
- Surface reinstatement and demobilisation.

6.10.46 Three main TCCs will be required for the duration of the onshore ECR construction phase to accommodate the temporary storage of site offices, construction materials plant and equipment. The locations are shown in Figure 30 and described in Table 33. They include:

- The Landfall Site TCC (Shanganagh Cliffs); see drawing reference 229100714-MMD-00-XX-DR-C-0202 on page 125
- Clifton Park TCC (Sector 1); and see drawing reference 229100714-MMD-00-XX-DR-C-0205 overleaf
- Leopardstown TCC see drawing reference 229100714-MMD-00-XX-DR-C-0232 overleaf

6.10.47 These three main TCCs will accommodate all welfare facilities, canteen facilities, storage containers, meeting rooms, offices, and car parking for all staff working on the construction of the onshore ECR and TJBs at the Landfall Site. These compounds will also serve as storage areas for heavy-duty plant, onshore export cable drums, communications cable drums, HDPE cable ducting, and other construction materials needed for construction along the onshore ECR.



NOTES

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2. All dimensions are in metres unless otherwise noted.
3. Where levels are shown, all levels are in metres above Malin Head datum.
4. The identified location of the underground cable infrastructure, compound and work areas and associated infrastructure development, including joint bays and underground chambers are indicative for the purpose of the application for Approval. The final extent and location of such will be identified in detailed design.

KEY PLAN

KEY TO SYMBOLS

- 220kV Cable Trench
- Application Site Boundary
- Temporary Fence
- Temporary Trenchless Crossing Compound
- Temporary Construction Compound
- Underground Trenchless Crossing
- Transition Chamber
- Car Parking
- Storage Cabins
- Offices/Welfare
- Security Hut
- Generator & Fuel Tank

REFERENCE DRAWINGS

229100714-MMD-00-XX-DR-C-0200	Key Plan for Onshore Site Layout Plans
229100714-MMD-00-XX-DR-C-0204	Onshore Site Layout Plan - Sheet 04
229100714-MMD-00-XX-DR-C-0206	Onshore Site Layout Plan - Sheet 06
229100714-MMD-00-XX-DR-C-0051	220kV Cable - Inroad Cross Sections
229100714-MMD-00-XX-DR-C-0052	220kV Cable - Offroad Cross Sections
229100714-MMD-00-XX-DR-C-0056	220kV Cable - Trefoil Crossing Above Service
229100714-MMD-00-XX-DR-C-0057	220kV Cable - Flat Crossing Above Service
229100714-MMD-00-XX-DR-C-0058	220kV Cable - Trefoil Crossing Below Service
229100714-MMD-00-XX-DR-C-0059	220kV Cable - Flat Crossing Below Service
229100714-MMD-00-XX-DR-C-0061	220kV Cable - Transition Chamber

EcoDoc NUMBER: 005396089-04

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OS Mapping Ref: OS3457

PROJECT TITLE: Dublin Array Offshore Wind Farm

DRAWING TITLE: Onshore Site Layout Plan - Sheet 05

DRAWING NUMBER: 229100714-MMD-00-XX-DR-C-0205

SHEET NUMBER: 05 OF 32

VER	DATE	REMARKS	DRAW	CHECK	APRD
PL1	2024-10-18	For Submission	SHY	DMC	TK
PL2	2024-11-04	For Submission	SHY	DMC	TK
PL3	2024-11-13	For Submission	SHY	DMC	TK

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PLOT SIZE: A1 | PRJ: IRENET95 IRISH TRANSVERSE MERCATOR

Metres 15 0 15 30 — 1:500

N GRID NORTH

MOTT MACDONALD

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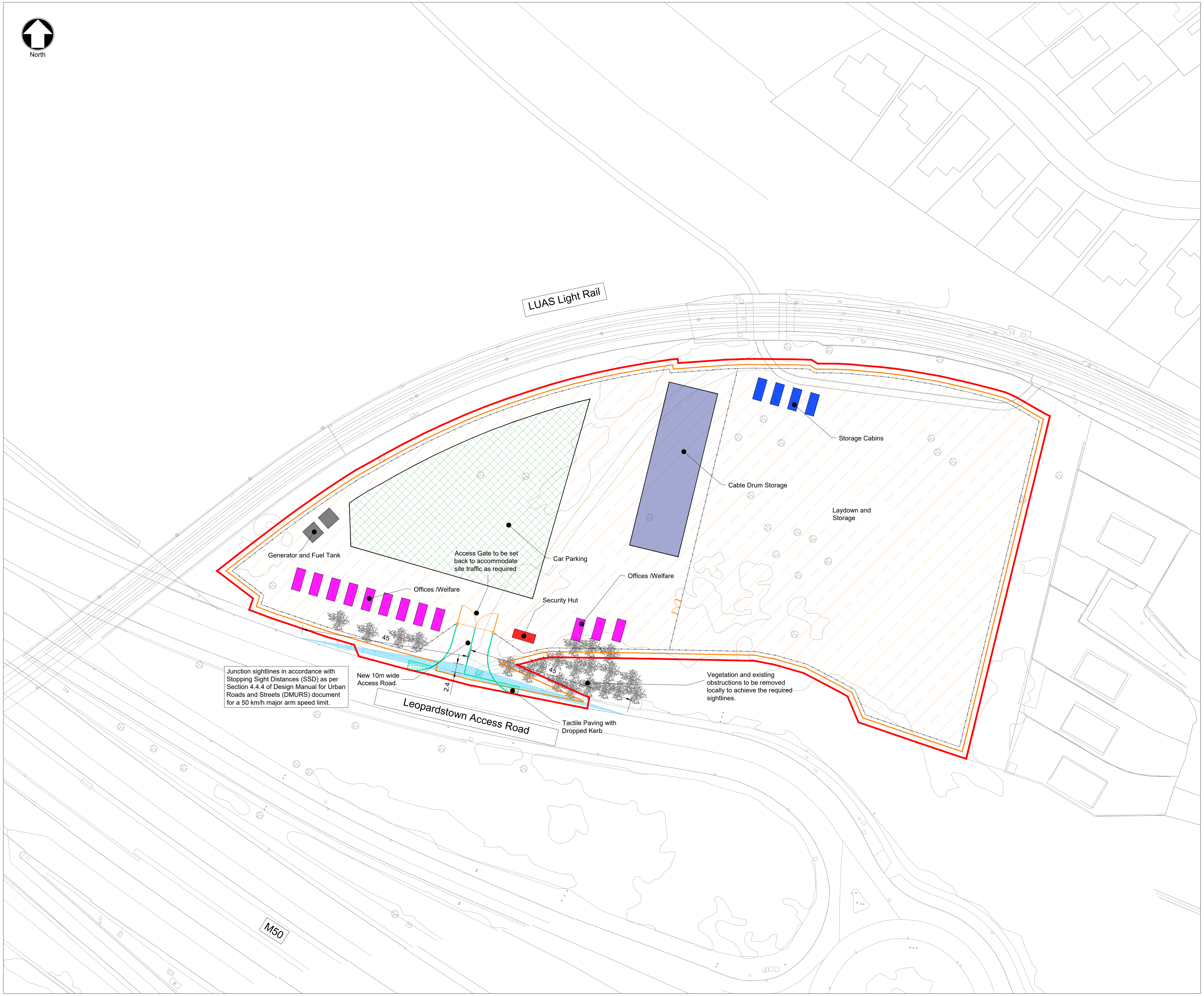

NOTES

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2. All dimensions are in metres unless otherwise noted.
3. Where levels are shown, all levels are in metres above Malin Head datum.
4. The identified location of the underground cable infrastructure, compound and work areas and associated infrastructure development, including joint bays and underground chambers are indicative for the purpose of the application for Approval. The final extent and location of such will be identified in detailed design.

KEY PLAN

KEY TO SYMBOLS

- Application Site Boundary
- Temporary Fence
- Temporary Construction Compound
- Storage Cabins
- Cable Drum Storage
- Car Parking
- Offices/Welfare
- Security Hut
- Generator & Fuel Tank
- Sightlines

REFERENCE DRAWINGS

229100714-MMD-00-XX-DR-C-0200 Key Plan for Onshore Site Layout Plans

EcoDoc NUMBER:
005396089-04

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OS Mapping Ref: OS3456

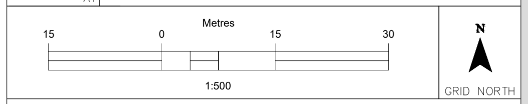
PROJECT TITLE:
Dublin Array Offshore Wind Farm

DRAWING TITLE:
Onshore Site Layout Plan - Sheet 32

DRAWING NUMBER: 229100714-MMD-00-XX-DR-C-0232
SHEET NUMBER: 32 OF 32

VER	DATE	REMARKS	DRAW	CHECK	APRD
PL1	2024-10-18	For Submission	SHY	DMC	TK
PL2	2024-11-04	For Submission	SHY	DMC	TK
PL3	2024-11-13	For Submission	SHY	DMC	TK

SCALE: 1:500 | DATUM: IRENET95 | VERTICAL REF:
PLOT SIZE: A1 | PRJ: IRENET95 IRISH TRANSVERSE MERCATOR



MOTT MACDONALD

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Kish Offshore Wind Limited - Bray Offshore Wind Limited

Site mobilisation and set up of main TCCs

6.10.48 The establishment of the TCCs will be the first activity in the construction programme, described in Section 6.13. The Leopardstown TCC will be secured by means of secure hoarding which will be approximately 2.5 m in height. A security access gate will be installed at the entrance to each TCC.

6.10.49 The Clifton Park TCC will require an acoustic barrier to mitigate noise from TX-01 and TX-02 of 3 m high hoarding. The impacts of noise and vibration across the OES are assessed in Volume 5, Chapter 5 of this EIAR.

6.10.50 Fencing will not encroach the precautionary zones or root protection areas of any trees comprising Loughlinstown Woods proposed Natural Heritage Area.

6.10.51 Prior to construction works commencing, a survey of the existing assets/services will be undertaken and identified in accordance with PAS 128:2022. All services will be positively identified and marked up on the site hazard drawing.

6.10.52 Each TCC will be prepared by removing the topsoil from within the fenced site using an excavator. The topsoil will be appropriately stored within the compound in accordance with best practice until it is required during reinstatement of the area following the completion of the works. Any required earthworks will be undertaken to achieve a suitable working platform for the TCC.

6.10.53 Wherever possible, vegetation which could support nesting birds (e.g. trees, scrub or long grass) will be cleared outside the main bird breeding season (March to August inclusive) to avoid damage to, or destruction of nests. Where this is not possible vegetation to be cleared will be checked for active nests by the Ecological Clerk of Works (ECoW) no more than two days prior to clearance. If active nests are found, vegetation clearance in the applicable area (to be determined by the ECoW on a nest-specific basis) will be delayed until the relevant nesting attempt(s) has finished. In order to avoid birds potentially nesting within piles of cut vegetation, all cleared vegetation will be removed from working areas immediately following clearance.

6.10.54 Appropriate temporary drainage measures will be implemented as part of the TCC enabling works to manage surface water run-off and prevent water polluted with sediment and/or other contaminants leaving the site. This will include the implementation of measures such as filter drains, silt fencing or soakaways. Where required the surface water will be stored and removed off-site by a licensed service provider for treatment at a licensed wastewater facility

6.10.55 Temporary junction improvements will be undertaken as required at the TCC access to allow safe access from the public road. At Leopardstown TCC a temporary at-grade priority junction, which is 30 m wide at its widest point, is proposed at the site entrance from the public road, as illustrated in Figure 63. The junction will be suitable for access/egress to and from the Leopardstown TCC for HGVs and will achieve the sightlines required for entering the public road with its 50 kph speed limit. The junction will have asphalt surfacing and is proposed to connect into a 10 m wide access road in to the Leopardstown TCC.

6.10.56 The temporary access roads will be formed from the junctions with the public road into each TCC car park. Temporary access roads will typically be approximately 4 m wide, in certain locations particularly at the Landfall Site TCC, short sections of the road will be widened to approximately 7 m to facilitate passing bays for construction traffic movements. At Leopardstown TCC the access road is proposed to be 10 m wide and will be bound with an asphalt surfacing.

6.10.57 Stores and offices will be set-up, parking areas and laydown areas will be created within the TCC. For the TCC welfare, temporary power supply will be supplied by diesel generator and the temporary water supply will be via on-site water storage tanks with water delivered to the TCC as required. Waste water will be collected in holding tanks and emptied as required. The waste water will be tanked off-site by a licensed service provider for treatment at a licensed waste water treatment facility.

6.10.58 Engineering stone fill will be laid and compacted on all areas within the TCC, with the exception of the internal access road and shall be maintained as required for the duration of the works. Areas used for temporary construction will be returned to their pre-construction condition once works are completed.

Onshore ECR construction phase

6.10.59 The onshore export cable ducts will primarily be installed using standard open-cut trenching technique as described in 6.10.76 onwards.

6.10.60 To facilitate construction within public land, a road opening licence will be required from DLRCC under Section 13 of the Roads Act 1993. A Traffic Management Plan (TMP) will be approved by DLRCC in advance of works commencing on site. The TMP will outline the location of traffic management signage, together with the location of any necessary road closures and the routing of appropriate diversions. Where diversions are required, these will be approved by DLRCC in advance of the preparation of the TMP.

6.10.61 Construction works will be set back from any river and stream channels, except for the two open-cut trenched crossings at Sector 7, and where it is not possible to maintain an adequate set back to prevent runoff going to the watercourse. Additional control measures such as silt fences will be deployed.

6.10.62 Preliminary site works will be required before construction commences within each onshore ECR sector. These may include:

- Securing the construction site along the onshore ECR with the installation of site fencing, traffic management signage pedestrian walkway routes; and
- Utility diversions and installation of temporary site drainage where required.

Trenchless crossing activities along the onshore ECR

6.10.63 Along the onshore ECR, there are interfaces with significant transport networks and watercourses. In order to avoid disruption and reduce the overall impact of the construction of the onshore ECR, trenchless techniques are proposed to install cable ducts at these locations as opposed to standard open-cut trenching.

6.10.64 Eight trenchless crossings are proposed along the onshore ECR. The locations are shown on Figure 55 through to Figure 61 and have also been listed in Table 35.

Table 35 Trenchless crossing locations along the onshore ECR

Reference No.	Obstacle	Location	Sector No.	Chainage in Planning Drawings (east to west)
TX-01	DART/Railway Line	Shanganagh Cliffs – Clifton Park	1	0 – 250 m
TX-02	Shanganagh River	Clifton Park – Bayview Glen	1	250 – 350 m
TX-03	Shanganagh Road – Killiney Hill Road Roundabout (R119)	Bayview Glade - Shanganagh Road	1	500 – 600 m
TX-04	Kill o' the Grange Stream	Achill Road - Loughlinstown Linear Park	1 & 2	950 – 1,000 m
TX-05	Kill o' the Grange Stream	Loughlinstown Linear Park	2	1,150 - 1,200 m
TX-06	N11, Loughlinstown River	Eurofound – Cherrywood Park	2 & 3	1,900 – 2,200 m
TX-07	M50	Carrickmines Great	4	4,700 – 5,000 m
TX-08	Glenamuck District	Carrickmines Great	6 & 7	6,300 – 6,450 m

Reference No.	Obstacle	Location	Sector No.	Chainage in Planning Drawings (east to west)
	Distributor Road, Golf Stream			

6.10.65 Trenchless crossing techniques involve drilling underneath an obstacle such as a motorway to avoid disruption by standard trenching. The preferred trenchless drilling technique along the onshore ECR is Horizontal Directional Drill (HDD) or similar. Given that two onshore export cables will be installed, two bores will be required at each trenchless crossing location. High value nesting habitats such as riparian woodland will be retained by utilising trenchless technology (HDD or similar technology) rather than trenching thus avoiding impacting these habitats. The following sections describe the proposed HDD activities along the onshore ECR.

6.10.66 The “entry pit” is the term used to describe the location of the drill and the “exit pit” is the location where the borehole ends on the opposite side of the obstacle. Temporary trenchless crossing compounds will be established on either side of the constraint or obstruction to facilitate the set-up of the necessary plant and equipment. Limited surface excavation works will be required to create the entry and exit pits in the trenchless crossing compounds. The distance that the entry or exit pit will be from the obstacles will be determined during the detailed design stage of the project and will depend on factors such as the length of the crossing, the height differential of the land either side of the constraints or obstructions, the required cover depth from the constraints or obstructions and the local ground conditions.

6.10.67 The larger trenchless crossing compounds will typically be 25 m x 25 m on the drill entry pit side of the crossing subject to space availability as shown indicatively on Figure 55 to Figure 61 61. The entry pits will be securely fenced using 3 m high hoarding to reduce noise impacts. The drill exit pit will require a smaller compound and will be securely fenced using mesh security fencing. The HDD drilling rig will be located on the entry pit side, along with the power generator, control room, drill pipes, drilling mud supply and a drilling mud storage tank. Sufficient space to lay out the cable ducts within the exit pit compound will also be required.

6.10.68 The trenchless crossing activities will comprise the following:

- Prior to the commencement of any works, the entry pit and exit pit will be marked out and utility surveys will be undertaken in accordance with PAS 128:2022. Any services in the area will be clearly marked and where required, trial-pit excavations will be carried out in order to prove any services which may be near the horizontal drilling zone, and all services will be exposed. It may be required to demobilise street lighting temporarily during the works; however, lighting towers will be used as a temporary replacement;

- With services identified, the excavation of the entry pit and the exit pit can then commence. This process will be carried out using a tracked excavator and a banksman will be present during excavations to ensure safe systems of work are followed;

- The topsoil will be removed and stored in an appropriate area for reuse at the reinstatement stage. The excavation will commence downwards in layers, until the size and depth of both pits have been achieved. The excavated material will be stored a safe distance away from the excavation and will be reinstated upon completion of the works;
- The drill rig equipment will be set up within the temporary trenchless crossing compound at the entry pit. The excavated drill pit will collect drill mud returns, the pumps will move the fluid from the pit into the recycling plant/tanks;
- The pilot bore will then commence using a remote steering tracking system. Information is sent from the remote tracking system to a screen at the drill rig operator station where corrections can be made by the rig operator if and when required. Drilling fluid is pumped through the drill rods during this process which is an essential part of the drilling process;
- On completion of the pilot bore, the drill head is removed, and the reamer is attached. The reamer passes are then undertaken, and this process is repeated until the drill hole is opened to the appropriate size for the HDPE cable ducting to be installed. A mixture of bentonite clay and clean water (Drill mud) will be used to stabilize the hole and remove the cuttings out from the drill hole in addition to cooling the reamer;
- Once the final ream is undertaken, the HDPE cable duct is attached and pulled through the bore. The final condition of the bore will consist of the HDPE cable duct surrounded by the remaining drill mud; and
- Drilling mud will be monitored at all stages of the drilling operations to ensure that no loss of fluid occurs down the bore. This monitoring is done by the drill rig operator and the drill mud engineer on site. This can be done by observing the returns coming back in the pit and monitoring the pressure at the face of the drill. The drill operator can adjust the drill pump pressure as required, depending on ground conditions. This monitoring occurs during the back reaming and pipe installation process.

6.10.69 A typical rig which would be suitable to install these bores is shown in Figure 64.

Figure 64 Example image of a typical HDD Rig set up (DD-440T) (Source J. Murphy & Sons Limited)

Table 36 Trenchless crossings indicative entry/exit pit locations

TX Reference	Entry Pit	Exit Pit
TX-01	West (Clifton Park)	East (Shanganagh Cliffs)
TX-02	East (Clifton Park)	West (Bayview Glen)
TX-03	West (Shanganagh Road –R119)	East (Bayview Glade)
TX-04	North (Loughlinstown Linear Park)	South (Achill Road)
TX-05	West (Loughlinstown Linear Park)	East (Loughlinstown Linear Park)
TX-06	East (Eurofound)	West (Cherrywood Park)
TX-07	East	West
TX-08	East	West

6.10.70 The trenchless crossings along the onshore ECR are short minor crossings and will take an estimated 15 working days to drill both bores assuming standard working hours.

6.10.71 Three of the eight trenchless crossings along the onshore ECR are more significant as they require longer drill length in more complex ground conditions. These three trenchless crossings will take approximately 40 working days to drill both bores assuming standard working hours. 24 hr operation has been assessed within this EIAR at these trenchless crossing locations to assess suitability of continued drilling activity.

- TX-01 (DART/railway line);
- TX-06 (N11); and
- TX-07 (M50).

Joint Bay construction activities

6.10.72 The locations of joint bays (JB) along the onshore ECR are indicated in Figure 55 to Figure 61 and in the Sector descriptions in Section 6.10.22 to 6.10.43. The JBs will require future access for maintenance and inspection purposes by EirGrid. The proposed locations have been strategically identified to provide future access within mostly public roads and footpaths. The main consideration during the construction of the JBs will be the length, width and depth of the excavation required to facilitate its installation.

6.10.73 The excavation for the placement of JBs along the ECR may be undertaken first to ensure there are no delays to the cable duct installation crew when they reach each joint bay location to pull the cables through the installed cable ducts.

6.10.74 A detailed TMP will be developed to facilitate a minimum carriageway width of 2.5 m for vehicles and a 0.5 m wide safe zone to the working area.

6.10.75 JBs will be constructed approximately every 600 to 850 m resulting in 20 JBs along the onshore ECR. The following methodology will be used when installing JBs along the onshore ECR:

- A safe working zone will be established around the JB. In areas which are more spatially restricted, such as roads, temporary sheet piles will be installed to safely support the excavation. A sump will also be excavated to provide a drainage point for de-watering the excavation;
- The JBs will be constructed to comply with the EirGrid engineering specifications and constructed from precast concrete sections delivered to site and lifted into place by a lorry mounted crane;
- The perimeter of the excavation will be backfilled with engineered stone fill material up to design levels in readiness for asphalt surfacing. The link box chambers and communications chambers will be installed adjacent to the JBs; and
- Once the JBs and ducts have been installed the road will be temporarily reinstated to allow traffic to operate as normal. The cables will be pulled at the JB locations and the areas on either side of the JB will be prepared to support the cable drum and pulling equipment (see 6.10.92 - 6.10.100 for details).

Figure 65 Example of transmission cables being installed at a joint bay (Source – Sorensens Civil Engineering - Celtic Interconnector)

Figure 66 Example of a joint bay concrete lid with the manhole inspection cover for the communications chamber adjacent (Source – Sorensens Civil Engineering - Celtic Interconnector)

Open cut trench construction in public roads

6.10.76 The onshore export cables will be installed on a rolling basis along the onshore ECR. Where no obstacles or constraints exist within or near the ECR, it is expected that progress rates for the open cut trench excavation and installation of ducts for the two circuits will be:

- 20 m linear per day duct installed within roads; and
- 40 m linear per day duct installed within open greenspace.

6.10.77 These rates will reduce where obstructions and underground utility services are encountered.

6.10.78 Where the onshore ECR is proposed to be installed in public roads, trench boxes or trench sheets and bracing, as seen in Figure 67, will be used in excavations to ensure the stability of the open trench.

6.10.79 A detailed TMP will be developed to facilitate a minimum carriageway width of 2.5 m for vehicles and a 0.5 m wide safe zone between the carriageway and the work zone. All prestart safety checks will be undertaken, these will include daily permit to dig, which will identify the safety checks before work commences.

6.10.80 The supervising person responsible for the working party will identify the hazards, the controls measures and safe systems of work procedures prior to breaking ground.

6.10.81 On completion of setting out the proposed alignment of the onshore ECR, the road surface shall be cut to the required trench width using an excavator and the pavement removed from site for disposal.

6.10.82 Once the trench has been excavated to the required depth a trench box or trench sheets and lateral bracing supports will be installed. Sand bedding shall be placed to the correct depth and compacted prior to installation of the ducts. The base of the trench will be prepared by laying a base fill material of cement bound granular mixture (CGBM). HDPE ducting for each cable and separate ducts for fibre optic bundle will be laid on the base fill material and surrounded with compacted CGBM material before being backfilled with an engineered stone fill material as per EirGrid specification. All road surfaces will be reinstated to TII specification.

Figure 67 Example image of open cut trench in public road supported by trench box

Open cut trench construction in green space and agricultural fields

6.10.83 The construction methodology of the ducting installation within green space areas or agricultural fields is generally the same as that for duct installation on hard surfaced or public roadway as described above.

6.10.84 Similar to the public road, the work area is fenced off to ensure safety and to minimise public access during construction. Any vegetation within the trench corridor will be cleared, and topsoil is stripped and stored for reuse during reinstatement works.

6.10.85 Trenches will be excavated, and, where required, temporary access tracks utilising bog mats or trackways will be utilised to minimise disruption of adjacent grassed areas from construction vehicles and plant. Footpath diversions may also be implemented with appropriate temporary signage installed as required in park areas such as Loughlinstown Linear Park in Sector 2.

6.10.86 A permanent access track of 3 m wide will be constructed to access the JBs in green field north of the Beckett Road in Sector 4, east of the M50. This track will be constructed first and utilised during construction on the onshore ECR, JBs and crossing under the M50 (TX-07).

6.10.87 The onshore export cables will be installed at greater depths in agricultural lands to facilitate 1 m backfill of topsoil. This depth will support continued farming activities as normal.

Open cut trench construction across watercourses

6.10.88 There are two stream crossings in Sector 7 where the onshore export cables will be installed by open-cut trenching techniques as opposed to trenchless techniques. Open cut crossings can be constructed quicker than trenchless crossings for minor watercourses, and dependent on the surrounding ground levels and depth of the watercourse can also require less space during construction. The two watercourses are minor in nature. A method statement will be developed in consultation with Inland Fisheries Ireland.

6.10.89 The construction method will involve the installation of a dam at either side of the cable crossing location to create a dry section of the stream to facilitate installation of the HDPE cable ducts. Methods such as sheet pilling or an aqua dam will be used to construct the temporary dam. To maintain the flow of the stream it is proposed to over-pump from upstream of the dam to downstream of the works area.

6.10.90 The trench will then be excavated in the dry area to the required depth. The ducts will be placed, and a concrete surround poured around the ducts with a steel reinforcement mesh set in the concrete above the ducts. Cement bound granular mixture (CBGM) will then be backfilled on top of the concrete surround to the required depth and the riverbed reinstated above the CBGM. The dam will then be removed and the stream returned to its natural state.

6.10.91 These two crossing locations in Sector 7, identified in Figure 61, are the only points along the onshore ECR where open-cut trenching will be used to cross a watercourse. The impact on watercourses is assessed in Volume 5, Chapter 4 of this EIAR.

Cable pulling operations

6.10.92 Once the cable ducts and joint bays have been installed along the full extent of the onshore ECR, the cables will be pulled through the ducts at the joint bay locations.

6.10.93 Prior to cables being installed in the ducts, ropes (typically between 6 and 12 mm in diameter) will be installed in the ducts between joint bays. Compressed air will be used to push the rope through the duct between JBs.

6.10.94 Once the rope has been successful fed to the JB, both ends of the rope shall be tied to a secure position at the JB, typically to a winch.

6.10.95 A foam cylindrical sponge and a brush mandrel will be used to clean the ducts of any debris using the pre-installed rope. Lubricant will also be added to the ducts at this stage (if deemed necessary) in preparation for the installation of cable. The above procedure shall be repeated for all ducts between JBs along the ECR.

6.10.96 All cables will be tested prior to being pulled through the cable ducts. Once testing has been completed, the cable drum will be loaded onto an HGV trailer for transportation to the JB, which will follow an approved TMP.

Figure 68 Example of a cable being pulled through a joint bay (source – Sorensens Civil Engineering - Celtic Interconnector)

6.10.97 The onshore export cables will have factory-fitted pulling eyes which will be utilised for the cable installation. Once the cable roll is lifted into position at the joint bay, the cable pulling eye will be fitted to the preinstalled rope in the duct. Cable lubricant is applied to the cable as it enters the duct. Cable pulling will proceed and the operation will be continuously monitored at the duct entry point, cable lubrication point and at the winch, ensuring there are no issues which may cause damage to the cables.

6.10.98 Once the cable has been pulled to the required location at the JB, cable pulling will cease. The cable will be suitably supported within the JB to ensure it does not get damaged prior to being jointed with the next section of cable. The installation process is repeated for the next section of export cable.

6.10.99 Once consecutive cables have been installed, the cables will be joined together at the JB. A temporary shelter will be placed over the joint bay to provide a safe and clean environment for an engineer to work in while connecting the two cable ends, as shown in Figure 65.

6.10.100 The cable will be energised on completion of the full length between the OSS at Jamestown and the offshore substation platform.

Materials management

6.10.101 The onshore works will require materials imported during the construction stage. A breakdown of the volume of the materials required are presented in Table 37.

Table 37 Estimate of materials used in construction of the onshore OES

Imported Materials	Units	Expected Quantity
Asphalt	Tonnes	7,000-8,000
CGBM	m^3	6,500-7,000
Engineering Fill/Crushed stone	Tonnes	6,000-7,000
Concrete (for joint bays, link boxes, comms chambers)	m^3	100
Concrete (foundations & slabs)	m^3	2,000-2,200
Length of onshore export cable	m	46,200
Length of onshore fibre cable	m	15,400
Length of onshore earthing cable	m	15,400
Geogrid/Geotextile	m^2	33,000
HDPE Ducting	m	77,000
Water (For trenchless installations)	l	1,575,000
Drilling Fluid	Kg	2,250
Steel Reinforcement	Tonnes	1,000
Link box lids	No.	20
Communication chamber lids	No.	20
Cable Joint Kits	No.	60
JB pre-cast concrete slabs	No.	80

6.10.102 Excavated topsoil and subsoils from the green space and agricultural fields will be temporarily stored on-site for final surface reinstatement. Any waste material from trench excavation which is not suitable for re-use will be removed and disposed of at a licensed disposal facility in compliance with waste management regulatory requirements.

6.10.103 The quantities of materials anticipated to be excavated and disposed of in a licenced facility during the construction of the proposed development are set out in Table 38. Further details are set out in the CEMP, attached in Volume 7, Appendix 8. The transport of material to and from the works areas will be managed in accordance with the construction traffic management measures.

6.10.104 Table 38 sets out the estimated waste materials from the construction of the OES. The materials are anticipated to go to a licenced landfill facility unless denoted with an Asterix (*); those materials are planned to be recycled.

Table 38 Estimate of waste materials from the construction of the OES

Waste Material Type	Units	Expected Quantity
Asphalt (*)	Tonne	650
Concrete (*)	m^3	80 - 100
Engineering Fill/Crushed stone (*)	Tonne	4,500-5,500
Geogrid/Geotextile (*)	m^2	10,000 – 12,000
Topsoil (*)	Tonne	1,400 – 1,600
Subsoil (Excavation)	m^3	28,000 – 30,000
Drill Fluid Removal (*)	m^3	700 – 1,200
Trenchless bore material (HDD)	m^3	600 - 700
Trenchless bore material (DPM)	m^3	1,000 – 1,200

6.11 Onshore substation

Onshore substation location

6.11.1 The proposed development will include the construction of a new onshore substation (OSS) in the townland of Jamestown, Ballyogan. The new OSS will be located 500 m west of the existing Carrickmines 220 kV substation, the grid connection point (GCP). A grid connection route will connect the OSS to the Carrickmines GCP.

6.11.2 The existing OSS site is located within the extent of the Ballyogan Landfill and Recycling Park Waste Licence, described in Section 6.11.6. It is a brownfield site characterised by dry meadows and grassy verges. The eastern extent of the site is bound by the Carrickmines Retail Park, the Ballyogan Stream to the north and an existing fence line and track bordering the former extent of the landfill waste area to the south.

6.11.3 An electricity overhead line traverses the northern boundary, and several underground electricity distribution services and utility services associated with the Carrickmines 220 kV substation, and the landfill are located within the site and along the access track. An operational landfill gas compound and methane stripping plant are located to the west of the site, commercially operated by a licence holder on behalf of DLRCC.

6.11.4 The archaeological remains of the Ballyogan Linear Earthwork (Ref. No. DU02401), known as the 'Pale Ditch' runs parallel north of the Ballyogan Stream. The impacts on archaeology and cultural heritage are assessed in Volume 5, Chapter 8 of this EIAR. The Ballyogan Recycling Centre and An Post sorting office are located north of the Pale Ditch, accessible directly from the Ballyogan Road (L0634). To the west sits the DLR Operations Centre, Maintenance Depot and car park.

Site access

6.11.5 The main access to the OSS will be via Ballyogan Road (L6034), using the existing entrance through the DLR Operations Centre and landfill gas compound. To facilitate the proposed OSS and associated construction works the access track will be upgraded and extended to access the two gate entrances proposed along the western boundary of the OSS. As part of the OSS a new access track will be constructed to reach the compound buildings and outdoor equipment, as shown in Figure 69.

Ballyogan landfill and recycling park

6.11.6 The proposed OSS will be located within the boundary of the active waste licence for the Ballyogan Landfill Facility and Recycling Park. Waste Licence W0015-01 was issued to DLRCC by the Environmental Protection Agency (EPA) on 25th August 2000 and remains the current licence. The extent of the waste licence area is approximately 59.5 hectares (ha), 43 ha of which were previously used for landfilling, 7.5 ha consists of the site entrance and service roads, site compound, constructed wetland and other services. The Ballyogan Recycling Park occupies a further 9 ha. The OSS sits in an area formerly used as a leachate lagoon however the area has been remediated to grassland.

6.11.7 The Ballyogan Landfill is currently in the aftercare and management phase having ceased acceptance of waste on 29th March 2005. DLRCC are currently transitioning the area formerly used for landfill waste into a public amenity park which will be named Jamestown Park.

6.11.8 DLRCC plan to develop pedestrian and cycle paths connecting through the planned Jamestown Park from Clay Farm to the Ballyogan Road. Details of the proposed plans are set out in the Ballyogan Environs Local Area Plan[37]. A Masterplan for Jamestown Park was developed in 2006 but has not been implemented to date and these lands are not yet open to the public.

6.11.9 An access track approximately 5 m wide follows the perimeter of the landfill. Geophysical and geotechnical surveys carried out in 2023 (Refer to Volume 6, Appendix 6.5.3-1 Land, Soils and Geology Technical Baseline Report) concluded that the HDPE waste liner aligned with the French drain running alongside the access track, and that the access track and former lagoon area and location of the OSS is in waste-free ground.

6.11.10 The proposed OSS site will occupy 2 ha outside of the former landfilling area, with 1.7 ha retained for the OSS footprint and the remaining area used for enabling works, temporary storage, and laydown areas during the construction phase. Surface water and leachate pipes identified from the Services Plan of the Ballyogan Landfall Facility traverse the site underground, along with medium voltage (MV) and high voltage (HV) electrical infrastructure both above and below ground. Part of the Uisce Éireann underground sewer network runs into the extent of the waste near the Carrickmines GCP, outside of the OSS boundary and crosses under the proposed onshore grid connection route between the OSS and GCP.

6.11.11 The existing Carrickmines GCP is located adjacent to the OSS on the Ballyogan Road (L6034). A grid connection of two underground circuits of 750 m will run between the OSS and the Carrickmines GCP, as described in Section 6.12.

37 Ballyogan & Environs Local Area Plan | Dún Laoghaire-Rathdown County Council

Onshore substation key design parameters

6.11.12 The OSS will comprise a fully enclosed compound with a finished footprint of 1.7 ha and a perimeter wall with stone cut cladding. Figure 69 shows the proposed OSS site layout. Further details of the proposed OSS are shown in Part 2 Planning Drawings, which are contained within the submission documents.

6.11.13 The OSS will condition the electricity to match the current acceptable level required by the grid operator EirGrid. The electricity will then be distributed to the national electricity network at the Carrickmines GCP.

6.11.14 The proposed OSS will consist of buildings, plant, equipment and ancillary devices to ensure appropriate operation, protection, control and monitoring of the transmission system.

It will provide necessary voltage regulation, reactive power compensation, and harmonic filtering to ensure compliance with transmission system operational parameters as well as safe and the reliable operation of Dublin Array and the national transmission system.

6.11.15 The OSS compound will consist of three, purpose built buildings, which comprise of a building housing the main 220 kV Gas Insulated Switchgear (GIS) and two Statcom (Static Synchronous Compensator) buildings. The GIS building will house the central control systems, automation systems, telecommunications systems, and monitoring equipment. The two Statcom buildings will contain converter, protection and control equipment associated with the Statcoms.

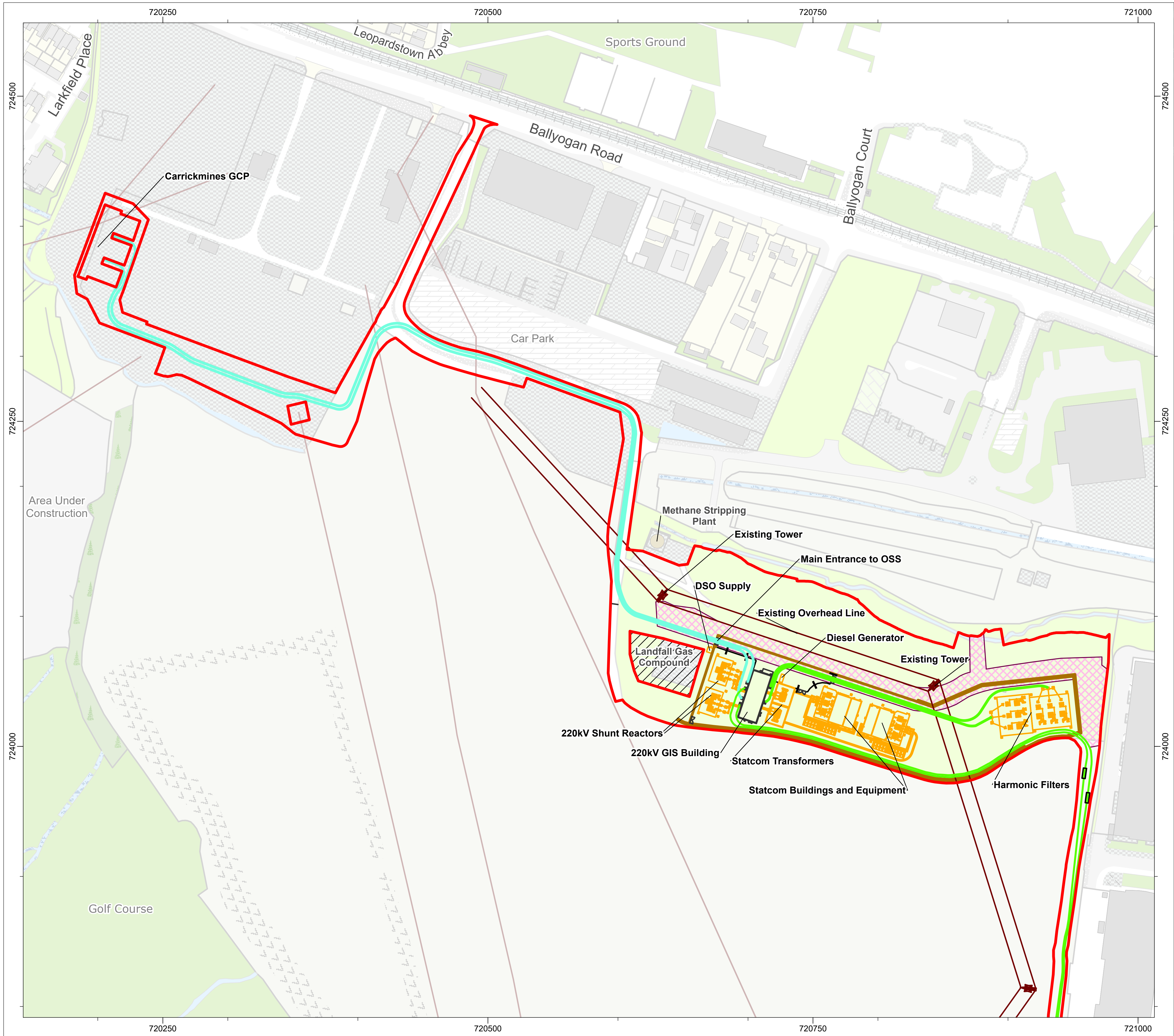
6.11.16 In addition to the indoor equipment the OSS will consist of several items of outdoor air-insulated plant including shunt reactors, Statcom step down transformers, auxiliary transformers and two harmonic filters compounds. These units will be enclosed within internal separately fenced compounds. The compounds will include a safe vehicular access track and be enclosed by the external perimeter wall.

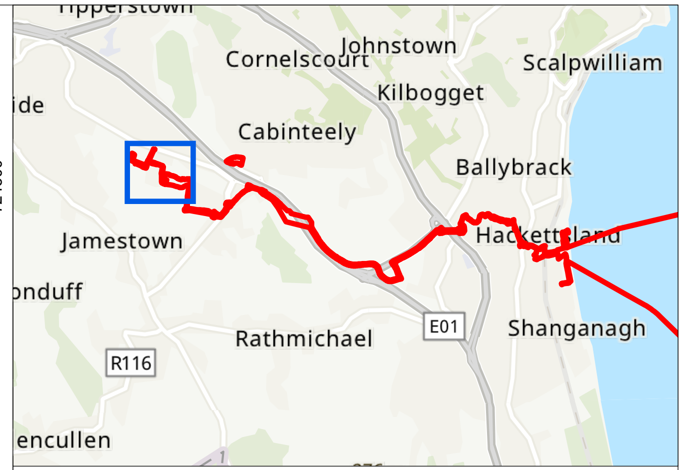
6.11.17 The proposed final OSS will include the provision of landscaping, internal hardstanding, access roads, with six car parking spaces, lighting, lightning monopole masts (18 m high), two entrance gates and a perimeter wall, and other associated ancillary works, as illustrated in Figure 69.

6.11.18 A standby diesel generator will be installed for emergency power supply and is located along the northern extent of the Statcom step down transformers. The OSS finished surface level will have a maximum height of +89 m OD Malin, meaning that the maximum overall height of all structures associated with the works will be no more than +107 m OD.

6.11.19 To facilitate the construction of the OSS, site preparation works will be undertaken including the provision of a TCC onsite. The construction works will involve necessary earth works and the construction of the operational stage site drainage with an attenuation tank.

6.11.20 Details of OSS utilities are described in Section 6.11.41.





Application Site Boundary

Onshore Electrical System (OES)

Underground Joint Bay

Onshore Export Cable Route (Trenched)

Onshore Grid Connection

Onshore Substation (OSS)

220 kV GIS Building

Substation Equipment

Fence

Boundary Wall (4 m)

Existing Overhead Lines and Towers

Landfill Gas Compound (**NOT PART OF SITE APPLICATION**)

Temporary Construction Compound (TCC)

DRAWING STATUS

PUBLIC

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Project Description:
Layout of the proposed Onshore Substation

DRAWING NUMBER: **Figure 69**

PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2025-01-21	DRAFT	JK	AB	AE
02	2025-01-16	DRAFT	JK	SW	AE

0 25 50 75 100 Meters
0 50 100 150 200 Feet

N
GRID NORTH

SCALE	1:3,000	PLOT SIZE	A3
DATUM	IRENET95	VERTICAL REF	ODN/LAT/MLLW
PRJ	IRENET95 Irish Transverse Mercator		

Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

DSO supply and diesel generator

6.11.21 A Distribution System Operator (DSO) Supply building is proposed to provide a point of interface between EirGrid and Customer (ESB). The building will house HV plant, control and protection panels, Low voltage switchgear.

6.11.22 The façade will be insulated wall panelling with cladding with the final; colour to be agreed with DLRCC.

6.11.23 A backup generator, similar to that pictured in Figure 70, will be located east of the GIS building, adjacent to the six proposed carparking spaces north of the Statcom step-down transformers.

Figure 70 Example image of a back-up diesel generator beside a Statcom building

220 kV shunt reactor

6.11.24 Two 220 kV shunt reactor compounds are proposed to be located adjacent to the main entrance on the western end of the OSS. Each compound will have an internal galvanised steel palisade fence measuring 2.6 m high to restrict access. Figure 71 and Figure 72 illustrates the proposed infrastructure.

6.11.25 Long sections of HVAC export cables produce reactive power. A Shunt Reactor is similar to that of a power transformer and acts as an inductor. The inductor can be used to limit the reactive power produced within the export cable. The cable will contain a level of capacitive power which will need to be reduced. The capacitive reactive power may impact the operation of circuit breakers within the OSS before it is transmitted to the Carrickmines GCP.

6.11.26 The shunt reactors will resemble light grey cylinders measuring 9 m tall, as shown in Figure 72. The compounds will each measure 14 m x 20 m.

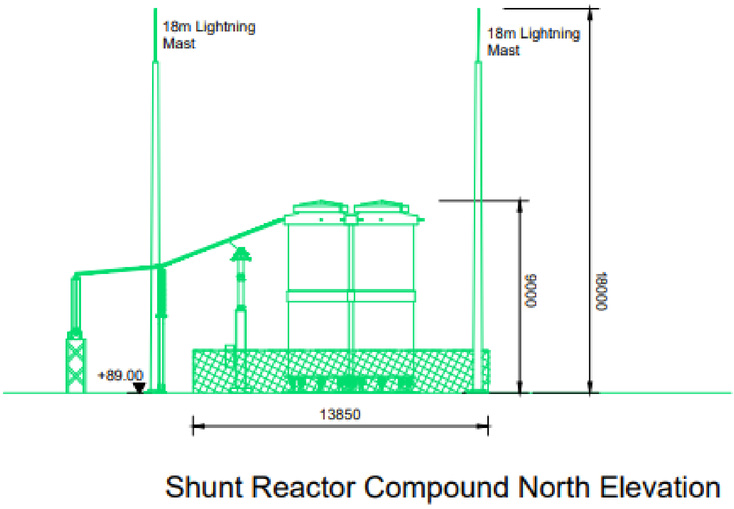


Figure 71 220 kV Shunt Reactor – extract from planning drawing no. 229100714-MMD-00-XX-DR-C-5022

Figure 72 Example image of shunt reactors in an onshore substation compound, with lightning protection

220 kV GIS building

6.11.27 The largest building proposed is the 220 kV GIS Building. It will house the electrical HV switching plant which will include GIS and will have a 38.75 m x 15.25 m footprint and a height of 15 m over 2 storeys. Figure 73 illustrates the proposed layout.

6.11.28 The GIS building will be steel framed, as illustrated in Figure 74. The façade will be clad in colour 00 A 01 ash grey/oyster grey/Portland from BS 4800 or similar, as agreed with DLRCC and EirGrid.

6.11.29 Five lightning rods will be installed on the roof measuring 2.5 m high, bringing the total height of the GIS Building to 17.5 m high. Two green roof areas measuring 160 m² are proposed subject to final agreement with DLRCC as part of the Sustainable Urban Drainage (SuDS) plan in the DLRCC County Development Plan.

6.11.30 The ground floor will house the primary GIS, a workshop, storeroom and stairwell to the first floor. Figure 76 is an example image of equipment being installed into a GIS building. The first floor will house the main EirGrid control room, battery room, store room, IPP room (Control & Monitoring) and welfare facilities.

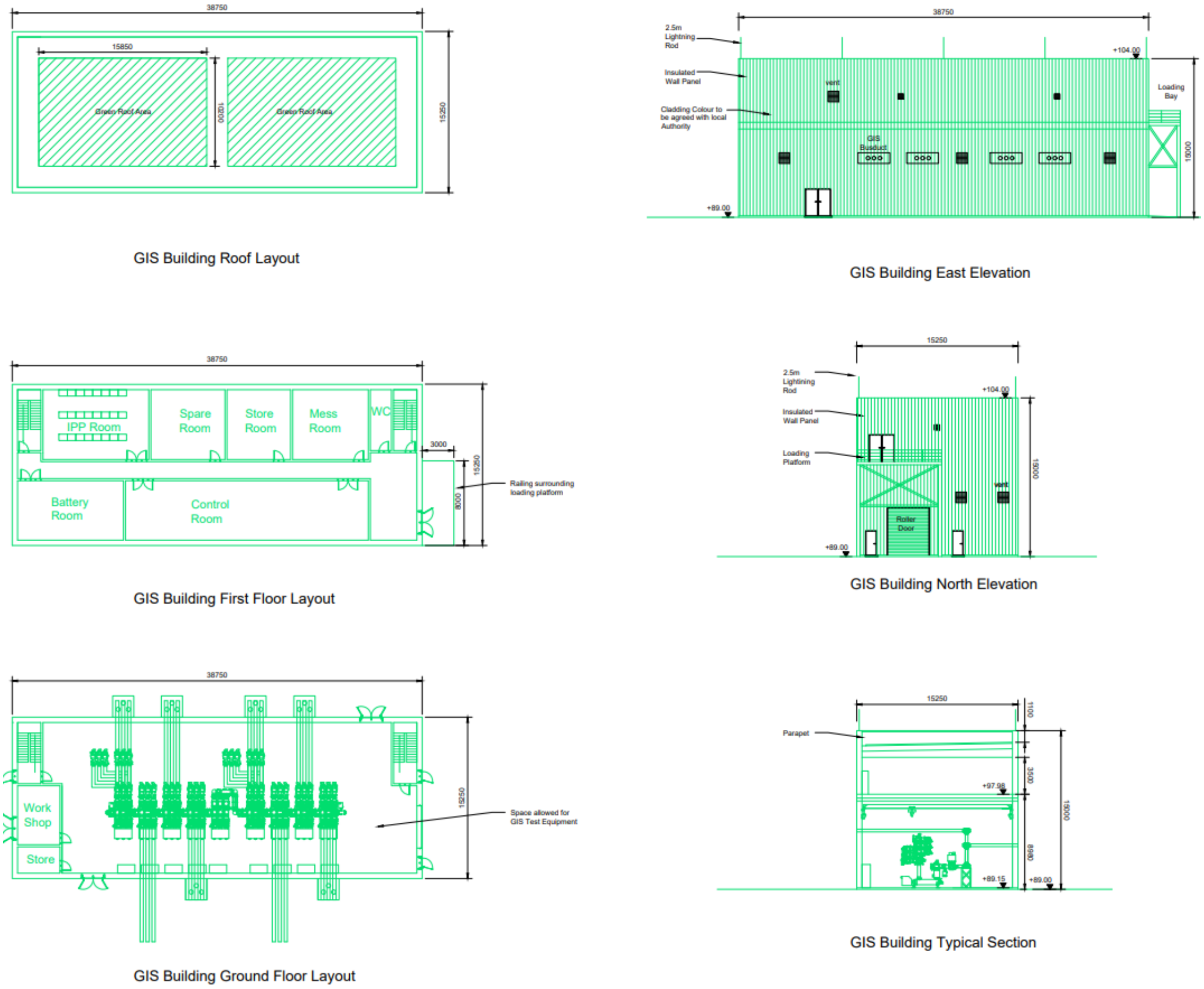


Figure 73 GIS Building Arrangement – extract from planning drawing no. 229100714-MMD-00-XX-DR-C-5020

Figure 74 Example image of a GIS building steel frame under construction

Figure 75 Example image of a GIS building with green cladding

Figure 76 Example image equipment being installed inside the ground floor of a GIS Building

Statcom buildings and transformers

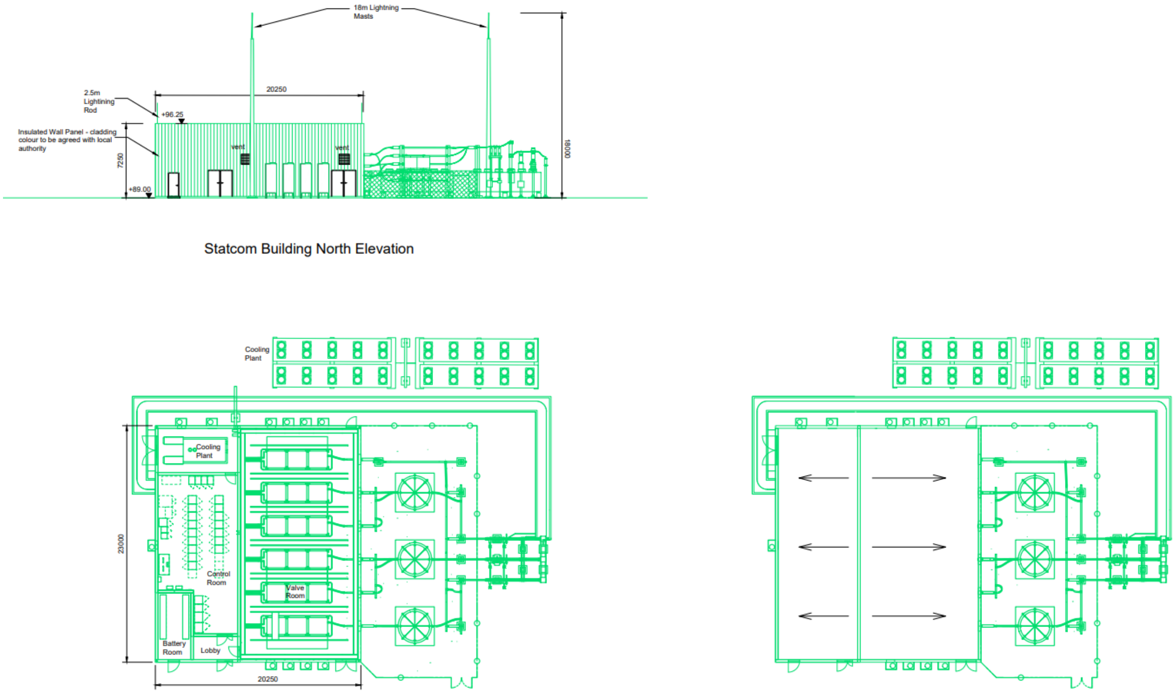
6.11.31 The facility comprises 3 main areas:

- The Statcom buildings;
- The Statcom transformers; and
- The Statcom outdoor equipment.

6.11.32 Two 220 kV Statcom buildings and accompanying equipment are proposed in the centre of the site, to ensure EirGrid grid code compliance. The two buildings will be single storey measuring 7.25 m high and 20.25 m long x 23 m wide. The façade will be metal cladding and the colour to be agreed in consultation with EirGrid and DLRCC. Lightening protection will be installed around Statcom buildings similar to Figure 78.

6.11.33 The Statcom buildings will house an AC/DC room, battery room, voltage source converter and cooling room and the main control room. Adjacent will be the external cooling system.

6.11.34 The statcom equipment outdoors will house reactors, auxiliary transformer and switchgear beside the main Statcom metal clad enclosed building. The proposed statcom arrangement is shown on Figure 77.



Statcom Building North Elevation

Statcom Building Ground Floor Layout

Statcom Building Roof Layout

Figure 77 Typical detail of the OSS Statcom building arrangement[38]

38 Extract from drawing 229100714-MMD-00-XX-DR-C-5021

Figure 78 Example image of a Statcom building with lightning protection

Harmonic filters

6.11.35 Two harmonic filters, one for each circuit, will be located at the eastern end of the OSS. The harmonic filters (as shown in Figure 79) are to ensure the proposed OSS is in compliance with EirGrid Grid Code requirements and will contain HV capacitors, resistors and inductors and associated HV switchgear.

6.11.36 Each harmonic filter will be located within a compound measuring 30 m x 25 m. The internal galvanised steel palisade fencing will be 2.6 m high with a gate to restrict access. Each harmonic filter compound will contain the following outdoor transmission infrastructure:

- 3 No. capacitator banks;
- 3 No. reactors;
- 3 No. resistors;
- Surge arrestors; and
- Unbalance current transformers.

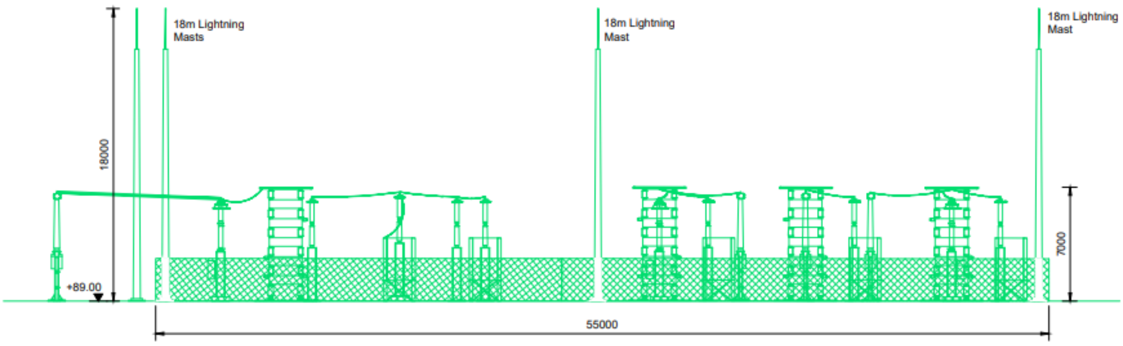


Figure 79 Typical harmonic filter compound arrangement – extract from drawing 229100714-MMD-00-XX-DR-C-5022

Boundary wall, entrance and landscaping

6.11.37 A 4 m high masonry wall (as measured from ground level within the OSS) with stone cut cladding will secure the perimeter of the OSS. A retaining wall will be required around the perimeter apart from the north-western side. The combined height the retaining wall and perimeter wall will vary up to a maximum height of 8 m in certain areas.

6.11.38 A landscaping plan has been prepared for the surrounding area of OSS in consultation with DLRCC Parks and is set out in the "OSS – Landscaping Plan" drawing reference 229100714-MMD-00-XX-DR-C-0250.

6.11.39 The plan describes the proposed tree planting mix northwest of the OSS adjacent to the Ballyogan Stream and a proposed wildflower meadow bordering the area around the north and west extent of the OSS boundary. A native scrub belt is proposed around the boundary of the OSS perimeter wall.

6.11.40 The plan also outlines the proposed management and maintenance of the planted areas during the initial two – three years post planting.

Utilities

6.11.41 The OSS will have the following utilities;

- Potable water;
- Foul drainage and wastewater storage tank;
- Surface water drainage system including flow control and attenuation tank;

- Oily water system including full retention oil/fuel interceptors;
- Telecoms & IT; and
- Low Voltage & MV electricity supplies.

Potable water

6.11.42 Potable water for the site will be provided by a new watermain connection, which is proposed to be connected to the existing watermain to the south of the DLRCC Operations Centre. A new watermain pipe is proposed along the existing access road to the south of the DLRCC Operations Centre and the proposed site access road to the OSS, to the welfare facilities in the GIS building.

6.11.43 The watermain connection for the OSS is included in planning drawing number 229100714-MMD-00-XX-DR-C-5050 title "OSS – Site Drainage and Watermain Layout".

Foul drainage

6.11.44 Once operational, personnel visits to the substation will be infrequent, resulting in minimal foul wastewater generation. Wastewater from the welfare facilities in the GIS building will be temporarily stored in an appropriately sized holding tank and periodically removed from the site by a licensed service provider for treatment at a licensed wastewater facility.

Surface water drainage system

6.11.45 A gravity-based surface water drainage system will be provided to prevent flooding during the critical 1 in 100 year storm event including a 20% allowance for climate change. A green roof has been included on the GIS Building to attenuate rainfall and a below ground attenuation tank has been included within the footprint of the compound. A flow control device will be required to limit flow to the drainage system outfall located at Ballyogan Stream to the north of the OSS.

6.11.46 The drainage system will include a full retention hydrocarbon separator (oil/fuel interceptor) at the outfall to the bunds of the proposed oil filled plant with a further bypass oil interceptor proposed prior to the final outfall.

6.11.47 Within the operational drainage design for the OSS, the storm water components been designed in accordance with and comply with the requirements of the Greater Dublin Regional Code of Practice for Drainage Works. The applicant will apply to the local authority for a license to discharge treated storm water runoff from the OSS site.

Telecoms and electricity supply

6.11.48 The low-voltage alternating current (LVAC) supply will be provided via a connection from the local ESBN network. This will be supplemented by an onsite diesel generator located in the GIS building. The diesel generator will be located in a dedicated generator room. The generator will be rated at approximately 200 kVA and will have an integrated fuel tank.

External lighting

6.11.49 External lighting is proposed via wall mounted lights and 4.5 m high hinged lighting poles strategically located on the OSS platform to achieve the appropriate illumination level to allow for safe operation and maintenance of the OSS.

6.12 Onshore grid connection

6.12.1 The conditioned electricity at the OSS will be connected to the Carrickmines GCP via two 220 kV transmission circuits. These circuits will be similar to those employed from the TJBs to the OSS, described in Section 6.10.2 and a referred to as the “grid connection”. The route will run generally east – west along the existing internal access road to the DLRCC Operations Centre in Ballyogan. The route will be a total 750 m in length and installed by standard open-cut trenching.

6.12.2 The grid connection route will run under the main access road into the OSS and north along the road. After 140 m the route will then turn west with the road alignment for 200 m passing the DLRCC Operations Centre carpark. At the eastern boundary of the Carrickmines GCP the route will turn south and follow the boundary wall of the Carrickmines GCP in the grass verge. The grid connection will then enter the Carrickmines GCP along the southern boundary. On entering the Carrickmines GCP boundary, the grid connection will connect into the existing GIS building and terminated at two allocated HV bays controlled and operated by ESB Networks and EirGrid.

6.12.3 Figure 40 illustrates the onshore grid connection route between the OSS and the Carrickmines GCP.

Onshore substation construction activities and methodology

Site preparation

6.12.4 As indicated on Figure 69, an area around the proposed OSS site will be used as a TCC. This will be required for the full duration of the onshore construction programme (set out in Section 6.13). The TCC will be used on a daily basis for the storage of construction materials, deployment of plant and machinery, and to provide welfare and site management facilities.

6.12.5 Access will be via the existing entrance (referred to as the 'Blue Gate') from Ballyogan Road and the existing access road for the DLRCC Operations Centre. It is anticipated that temporary construction related safety signage and vehicle directional signage will be established on the roadside on the establishment of the TCC.

6.12.6 Enabling works will be required to establish the TCC and OSS platform. This will require the removal of vegetation and topsoil, followed by any required earthworks and site levelling works to create a suitable TCC platform. The TCC surfacing would then be typically constructed from engineered stone aggregate and asphalt surfacing. Construction areas will be securely fenced, and pedestrian walkways will be segregated from designated vehicle/plant movements routes within the TCC. Where possible, one-way vehicle movements shall be established.

6.12.7 Appropriate temporary drainage measures will be implemented as part of the TCC enabling works to manage run-off and prevent water polluted with sediment and/or other contaminants leaving the site. This will include the implementation of measures such as filter drains, silt fencing, soakaways, infiltration trenches and settlement ponds/tanks. Where water is held in temporary locations it will be tanked off-site by a licensed service provider for treatment at a licensed wastewater facility.

6.12.8 The construction area will be secured by temporary fencing and provided with lockable gates to control access and egress. Gate entry will be controlled with 24 hrs site security.

6.12.9 Foundations and temporary utility services such as water, LV power, IT telecoms and drainage will be constructed and installed prior to the site offices, welfare facilities and storage containers being delivered and installed on site.

6.12.10 Car parking areas and traffic management controls, safety instruction signage, segregation barriers will be established, and site security arrangements will be required such as CCTV, security controlled access, safety lighting and perimeter fencing.

6.12.11 Containers will be required for site offices, toilet facilities, canteen, drying facilities, workshops, construction related materials and small tool storage. An open space lay down area will also be required for equipment, plant and larger construction material storage.

Civil works

6.12.12 The site will be surveyed to locate existing underground services such as electricity, IT and landfill services. Any area which is to be excavated will be subject to utilities surveys in accordance with PAS128:2002. Techniques such as GPR (ground penetrating radar) survey and CAT (cable avoidance tool) scanning will be used. Any identified services will be marked for diversion. In the case of existing landfill services, any relocation will be conducted in compliance with the EPA and the DLRCC as the waste licence holder.

6.12.13 Site vegetation and topsoil clearance will commence followed by earthworks to create a level platform from compacted engineering fill to facilitate the installation of the OSS infrastructure and achieve the design level of the OSS platform. This phase of works will also include the construction of retaining walls around the north and east boundary of the OSS site. Permanent access roads to the OSS and internal access roads inside the OSS will also be constructed and final surfacing of these roads may be completed later in the programme. Segregated vehicle and plant movement routes will be established to the working areas. Pedestrian walkways for construction staff will be established into the OSS works area from the TCC and welfare facilities. During the ground works stage, some sections of cable ducts will be installed below ground, using open cut trenching to facilitate the installation of the onshore export cable and communication cables into the OSS site.

6.12.14 Due to the presence of the existing 110 kV overhead Line (OHL) a temporary safety exclusion zone will be installed around the OHL during construction. The exclusion zone will be set back 10 m from the edge of the OHL and will be demarcated, with appropriate warning signage. A crossing point with height restrictions will also be installed to allow crossing of the exclusion zone. Where works are required inside the exclusion zone, the works will be risk assessed, and appropriate mitigation measures will be implemented as set out in the risk assessment and method statement for the construction activity at detailed design.

6.12.15 An earth grid is a critical requirement for the safe and reliable operation of an onshore HV substation. It ensures effective grounding of the substation equipment, providing a low-resistance path for fault currents and lightning discharges to prevent hazardous voltages and protect both personnel and equipment. The typical construction sequence for an earth grid begins with site preparation and excavation to accommodate the buried conductors. Conductors, typically made of copper are laid out in a grid pattern across the substation footprint, with vertical ground rods installed at strategic locations to enhance grounding performance. The grid is connected to all metallic structures, equipment, and enclosures within the substation. Once the conductors are installed, the system is tested for resistance compliance with design and regulatory standards. Finally, the grid is backfilled with soil, ensuring the substation's safety and functionality throughout its operational life.

6.12.16 Following this the construction of buildings and electrical equipment foundations will commence.

6.12.17 The proposed OSS layout, as show in Figure 69, consists of various buildings, equipment, towers, roads and hardstanding areas as described in Section 6.11 which each require appropriate foundations to support the structural loads and ensure the functionality of the OSS during operation. The OSS will have various reinforced concrete foundations to provide support to buildings, bunds and external electrical equipment. Piled foundations (precast concrete piles) may be installed to support the structures subject to detailed foundation design.

6.12.18 All foundation excavations will be suitably fenced to prevent unauthorised access. Foundation excavations may be supported temporarily by interlocking steel sheet piles if deemed at detailed design. Blinding concrete will be placed to provide a level base for the foundations and steel fixers to work from. Once the blinding has cured, formwork and reinforcement steel will be erected before concrete is poured to form the concrete foundations.

6.12.19 The superstructure of the buildings will be structural steel, which will be erected by mobile cranes and steel erectors working from mobile elevated platforms (MEWPS). Metal cladding and insulation will be fixed to the walls and roofs of the Statcom and GIS buildings which will seal the building from external weather elements and will allow the internal building fit out to commence.

6.12.20 Concrete bunds for oil filled plant such as the Statcom transformers will be constructed with appropriate plinths to house the oil filled plant. The bunds shall be connected to the oily water system and fuel/oil interceptors. The bund shall be filled with stone and/or include a proprietary fire extinguishing grating to act as a flame trap. Fire enclosure/wall construction will be dependent on its design and the timelines for the delivery of oil filled plant.

6.12.21 Concrete will be poured for the final internal road surfacing and the external access road asphalt surfacing will be laid if this was not completed earlier in the construction process. Permanent drainage will be completed, and high resistivity stone chippings will be placed in open areas with asphalt hardstanding areas provided in the vicinity of the GIS and Statcom buildings.

6.12.22 The area around the works area will be reinstated and landscaped as per the OSS Landscaping plan (planning drawing no. 229100714-MMD-00-XX-DR-C-0250 submitted as part of this application) and agreed with DLRCC.

Electrical works

6.12.23 Cables will be pulled in through the installed ducts to connect the onshore ECR to the electrical equipment at the OSS.

6.12.24 The internal electrical fit out of the GIS and Statcom buildings includes all services such as power, lighting, heating, ventilation, water supplies, waste water, telecoms IT, fire and security alarm systems. Following completion of the building services the delivery and installation of primary and secondary HV equipment, the multi-core wiring and cabling, testing and commissioning of the equipment will commence.

6.12.25 Following the completion of civil and electrical works at the OSS, the Contractor will demobilise from the TCC and undertake any required reinstatement works at the TCC.

6.12.26 The timeline for completion of the OSS construction works is outlined in Table 39.

Commissioning

6.12.27 The commissioning of the onshore infrastructure will take approximately 6 months. All equipment will be tested prior to energisation to ensure that the equipment is installed correctly to reliably function during operation. Commissioning will validate the performance parameters before energization and grid connection into the national transmission grid network at the Carrickmines GCP.

6.13 Onshore Electrical System programme

6.13.1 The installation of the OES, excluding surveys and site preparation, is anticipated to take approximately 36 months. The programme illustrates the typical duration of the installation activities associated with each of the major onshore components, and how they may progress in relation to each other.

6.13.2 The onshore construction is likely to commence in advance of the offshore construction program. It is likely that the latter part of the OES programme will be concurrent with offshore construction operations.

6.13.3 Construction of the OSS is likely to commence in an early phase of the overall construction programme as shown in Table 39.

Table 39 Overview of typical construction programme for the Onshore Electrical System works

Activity	Y1				Y2				Y3				Y4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Landfall Site																
Site Preparation																
Installation of offshore export ducts at Landfall (trenchless installation)																
Onshore ECR activities (incl. TJBs)																
Cable pulling and jointing (onshore & offshore)																
Demobilisation & Reinstatement																
Duct laydown and assembly area																
Onshore Export cable route																
Cable ducts and JB installation (including trenchless crossings)																
Cable Pulling & Jointing																
Commissioning																
Landfall Site TCC																
Clifton Park TCC																
Leopardstown TCC																
Onshore substation																
Site Preparation																
Civil Works																
Electrical Works																
Commissioning																
OSS TCC																

6.14 Onshore Electrical System operational phase

6.14.1 Following a proposed eighteen month proving period, the transmission assets will be transferred to EirGrid, the TSO in accordance with Offshore Electricity Transmission System Policy. All assets which are included in the OES, from the Landfall Site to the final GCP at Carrickmines, will be transferred to EirGrid, along with offshore export cables running from the TJB back to the OSP.

6.14.2 From start of operation until asset transfer (up to 18 months) the Applicant will have responsibility for the operation and maintenance of the transmission assets.

6.14.3 On handover, EirGrid will take responsibility for the operation and maintenance of all of the transmission infrastructure from the OSP to the Carrickmines GCP, including the TJBs, onshore export cables, OSS and grid connection and associated control, protection, and telecommunications equipment. All other offshore infrastructure will be operated and maintained by Dublin Array.

6.14.4 Onshore operation and maintenance (O&M) activities can be categorised as preventative and corrective. Preventative maintenance is according to scheduled services whereas corrective maintenance covers unexpected repairs, component replacements, retrofit campaigns and breakdowns.

6.14.5 Onshore, the operation and maintenance requirements will be largely preventative, accompanied by infrequent on-site inspections of the onshore transmission infrastructure.

6.14.6 The onshore infrastructure will be consistently monitored remotely by the TSO. There may be maintenance staff visiting the OSS to undertake works on a regular basis (expected to be once per week). The OSS will not be manned, and lighting will only be required during scheduled activities.

6.14.7 It is not expected that the TJB will need to be accessed during the operational phase. The co-located link boxes and communication chambers will need to be serviced approximately once a year to ensure correct operation. Occasional access may also be required to the cable in the event of a fault and for repair purposes. Typically, this involves excavating the two adjacent joint bays, pulling the cable back through the ducting and pulling a new cable through.

6.15 Onshore Electrical System decommissioning

6.15.1 As stated above, the construction, operation and maintenance works associated with the OES will be managed by the Applicant until the end of the proving period and handover of ownership to EirGrid. As the enduring asset owner, EirGrid will become responsible for decommissioning of the transferring assets at the end of their deemed lifetime.

6.15.2 Accordingly, this planning application does not seek permission for decommissioning of the OES. However, for the purpose of enabling a comprehensive environmental impact assessment, we have set out below our recommended approach to decommissioning, should EirGrid choose to decommission any aspect of the OES. This approach is informed by the Applicant's experience of decommissioning OSSs and onshore export cables on other projects.

6.15.3 In addition, we have set out below the factors which should inform any decision by EirGrid to decommissioning:

- The baseline environment at the time decommissioning works are carried out;
- Technological developments relating to decommissioning of onshore transmission infrastructure;
- Changes in what is accepted as best practice relating to decommissioning of onshore transmission infrastructure;
- Submissions or recommendations made by interested parties, organisations and other bodies concerned with decommissioning of onshore transmission infrastructure; and
- Any new relevant regulatory requirements.

6.15.4 Further, any decommissioning works must:

- Comply with any decommissioning specific conditions in the Development Consent;
- Ensure that the environmental impacts are consistent or less in scale and magnitude to those predicted in the EIAR, NIS and WFD associated with the Development Consent or any amendment of the Development Consent or any subsequent consent EirGrid might be granted in respect of decommissioning; and
- Comply with the relevant health and safety regulations.

6.15.5 A decommissioning plan, along with an environmental management plan, should be prepared before any decommissioning works begin. If necessary, an application for consent should be made by EirGrid, and submitted to the relevant competent authority, in respect of any decommissioning works which require consent. We would expect any such application to involve further environmental assessment and public participation, and for any decision made by the competent authority to be judicially reviewable.

Decommissioning of the Onshore Export Cables and TJBs

6.15.6 It is recommended that the onshore export cables be removed following the reverse process of the construction phase. The cable lengths should be disconnected at the joint bays and pulled through the cable ducts. All the remaining underground infrastructure, including the TJBs, are anticipated to remain in situ, according to standard best practice. Surveys should be undertaken prior to decommissioning and discussions held with stakeholders to agree the most appropriate approach at the time of decommissioning.

6.15.7 All above-ground infrastructure including marker posts and access tracks, should be dismantled, and the areas fully reinstated. Pre-existing planting should remain undisturbed. Decommissioning should require similar machinery as the construction phase, though with a smaller workforce and shorter duration. All decommissioned materials should be managed according to waste regulations in place at the time.

Decommissioning of the onshore substation and grid connection

6.15.8 The expected asset life of a substation is typically 50 years, though they may continue to operate as part of the national grid beyond this timeframe and some components of the OSS will have longer operational lifespans. When Dublin Array reaches the end of its life, EirGrid may choose to decommission or repower the OSS in consultation with the regulator. This decision would be made in consultation with the regulator and based on the existing or proposed use of the OSS.

6.15.9 If decommissioning, it is recommended that all buildings and above-ground structures be removed. As above, the decommissioning process should follow a reverse programme of the construction process. Decommissioning should require similar machinery as the construction phase, though with a smaller workforce and shorter duration. All decommissioned materials should be managed according to waste regulations in place at the time. It is recommended that the grid connection infrastructure between the OSS and Carrickmines GCP remain part of the Transmission System, owned by ESB Networks and operated by EirGrid, and therefore not decommissioned.

6.16 Operations and Maintenance Base

Introduction

6.16.1 In order to service and maintain the offshore infrastructure, a storage and coordination facility is required (referred to in this document as the O&M Base). The O&M Base will act as a storage and loading area for small and medium spare parts for the wind turbines and small ancillary equipment such as tools and consumables.

6.16.2 The proposed development will provide offices and warehouse space together with berthing facilities for maintenance vessels (hereafter referred to as CTVs) associated with the ongoing operation and maintenance of Dublin Array.

6.16.3 It is anticipated that there will be approximately 80 staff utilising the main office building, comprising of permanent on-site management staff and external contractors. It is anticipated that approximately 25 offshore technicians will be based at the O&M Base on a permanent basis. This may increase during periods of high workload such as outages offshore or during large repair campaigns.

6.16.4 The building will use environmentally sustainable materials in its construction where possible and will minimise the overall energy use during daily operations. It is proposed to incorporate renewable energy into the design of the building in accordance with Building Regulations Part L, 2022, 'Conservation of Energy & Fuel for Buildings Other Than Dwellings'. This will include the use of solar panels and efficient heating systems. The O&M building will be designed such that it will attain a minimum BREEAM[39] standard excellent, ensuring a sustainable and environmentally conscious structure.

6.16.5 The proposed development will be located on, and directly adjacent to St. Michaels Pier, within Dún Laoghaire Harbour, Co. Dublin. Dún Laoghaire Harbour is owned and operated by Dún Laoghaire-Rathdown County Council (DLRCC) who is the statutory harbour authority and is responsible for the management and safety of the harbour.

Existing site location

6.16.6 The range of general harbour activities within Dún Laoghaire Harbour consists of a mix of harbour operation and maintenance activities, commercial and leisure uses ranging from commercial activities on Carlisle Pier, St. Michael's Pier and Traders Wharf, as well as leisure activities on the existing marina's, pontoons and slipways within the harbour. The harbour is enclosed by two piers, East and West Piers which provide shelter within the harbour.

6.16.7 The proposed planning application boundary for the O&M Base in Dún Laoghaire Harbour can be seen in Figure 80. The immediate surroundings of the site are used on a daily basis for harbour related uses. This includes a maintenance depot and service yard for maintenance activities associated with harbour operations by DLRCC. The current infrastructure within the site includes a parking area, office buildings, storage buildings and storage containers. Following the development of an O&M Base, the existing harbour operations[40] by DLRCC will continue.

6.16.8 The site comprises of four distinct areas;

- St. Michael's Pier;
- The existing Ro-Ro ramp;
- Dún Laoghaire Harbour Vehicle Compound/Staging Area; and
- Marine area.

39 BREEAM (Building Research Establishment Environmental Assessment Method) is a globally recognized sustainability assessment method for planning, infrastructure, and buildings. It evaluates developments on various environmental, social, and economic criteria, including energy use, health and wellbeing, pollution, transport, materials, waste, water, land use, and ecology, to promote more sustainable built environments.

40 DLRCC Harbour Section is responsible for the maintenance, management, promotion and conservation of Dún Laoghaire Harbour. This involves working with an extensive array of internal and external stakeholders. They are also responsible for the management of vessels within or on approach to the harbour, aids to navigation, port security requirements, events, cleansing, enforcement of the Harbour Byelaws.

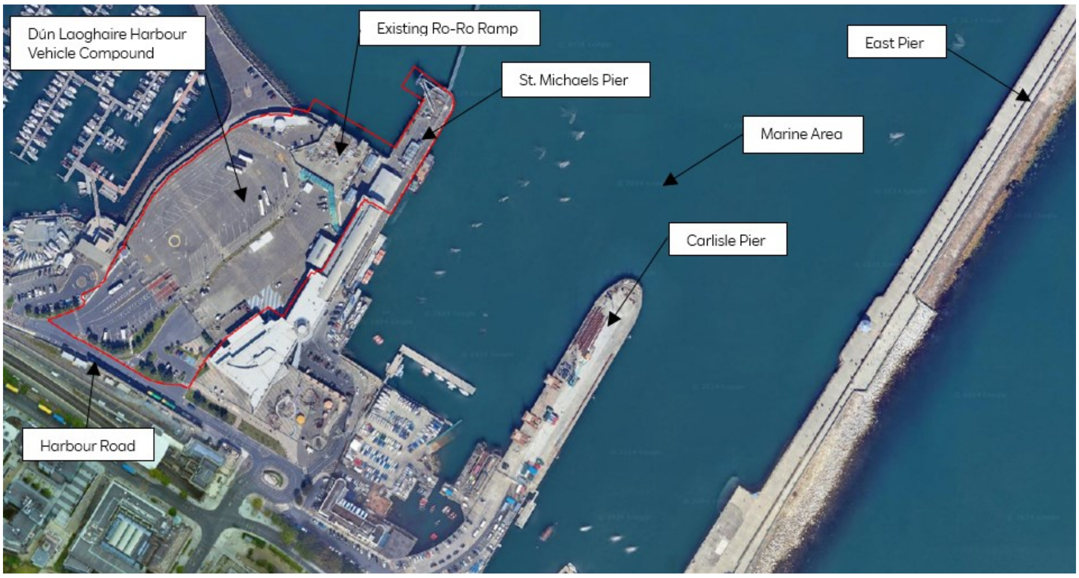


Figure 80 Location of the proposed O&M Base (Source: Google Maps)

6.16.9 The existing St. Michael's Pier was constructed in the 1960s and consists of a series of reinforced concrete vertical and raking piles supporting a concrete slab deck. A concrete edge upstand beam forms a waterside edge to the pier. The concrete slab is currently infilled with a macadam surface at the same level to the upstand edge beam.

6.16.10 St. Michael's Pier is generally flat at an elevation of approximately +4.10 m OD Malin across the pier structure. The existing RoRo ramp situated to the northwest of St. Michael's Pier has elevations ranging from a high of +7.14 m OD Malin at the top of the structure and slopes to approximately +4.40 m OD Malin at the bottom of the ramp. The two existing concrete tower structures have an existing elevation of approximately +14.26 m OD Malin.

6.16.11 The existing services on site include a foul network, potable water supply network, surface water drainage network with an oil interceptor, public lighting, and electrical ducting.

6.16.12 The pier is currently used for a range of existing harbour operations such as a storage area for the harbour maintenance team and includes a number of storage containers. The pier also supports the existing single storey harbour maintenance building which is subject to demolition under this application.

Figure 81 Existing single storey harbour maintenance building which is planned for demolition under this application

6.16.13 A redundant roll on/roll off (RoRo) ramp structure is located at Berth 5 within the harbour which is the subject of demolition under this application. This ramp was previously used for the drive on drive off car ferry terminal. The ferry terminal was previously used for the Stena Line ferry service between Dún Laoghaire and Holyhead. Ferry operations ceased in 2015, and the structure is now redundant. This area is currently used as a storage area for the harbour maintenance team. Two large reinforced concrete towers were constructed as part of the Ro-Ro ramp for the ferry terminal development works and remain in-situ. It is proposed to demolish these structures as part of these works.

Figure 82 Existing RoRo ramp structure and reinforced concrete towers

6.16.14 An existing fender which was previously used during berthing operations at the ferry terminal is located off the head of St. Michael's Pier, as shown in Figure 83.

6.16.15 . The fender system consists of a large fender panel supported on two large, steel tubular piles which are driven into the rock beneath the seabed. The tubular steel piles are supported laterally by horizontal and diagonal steel bracing which is fixed to the deck of St. Michael's Pier.

6.16.16 Dún Laoghaire Harbour attracts cruise liners during the months of April through to September. The existing yard within the harbour which was previously used as a vehicle compound area during ferry operations is currently used by DLRCC as a staging area during cruise liner operations (for passenger arrival and departure). This area is also used as an events area outside of the cruise season, including concerts, markets, fairs, ice skating rink and recreational events which includes event car parking (permitted under planning application number D12A/0192).

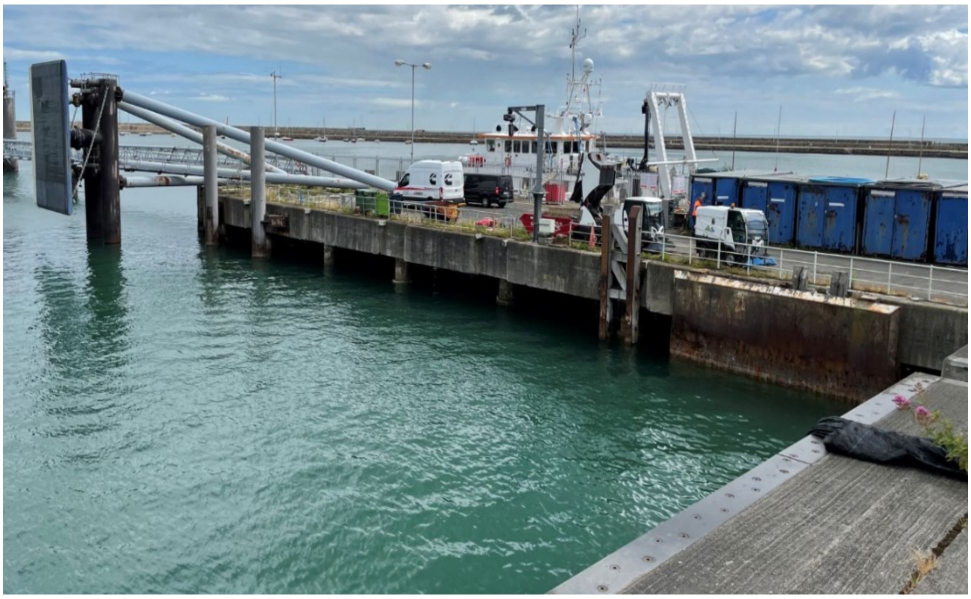


Figure 83 St. Michael's Pier and fender from the existing RoRo ramp

Figure 84 Existing vehicle compound area/staging area

Planning Application Boundary

DRAWING STATUS

PUBLIC

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MAP NOTES / DATA SOURCES:

PROJECT TITLE

Dublin Array

DRAWING TITLE

Existing Dún Laoghaire Harbour Site Plan

DRAWING NUMBER: **005532727-01** FIGURE NUMBER: **6.85**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2025-01-10	Ready for release	DB	PM	PK

0 20 40 60 80 Meters
0 20 40 60 80 Yards

N GRID NORTH

SCALE	1:2,500	PLOT SIZE	A3
DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

Generation for generations
Kish Offshore Wind Limited - Bray Offshore Wind Limited

Description of the works

6.16.17 The proposed works which form part of this development application include the demolition of existing harbour infrastructure, including the existing single storey Harbour Maintenance Building located on St. Michael's Pier. This building is currently in use by DLRCC harbour maintenance team. All ancillary storage containers as well as the existing pavement build-up (hardcore fill and tarmacadam down to the existing concrete deck level) on St. Michael's Pier will be removed off site and disposed of in a suitably licenced waste facility.

6.16.18 The existing mooring fender shown in Figure 86 which is located adjacent to St. Michael's Pier, and which was previously used during berthing operations for the ferry terminal will be partially removed. This will involve the removal of the large tubular steel bracing members which are anchored onto the deck of St. Michael's Pier (refer to Figure 87) as well as the vertical fender panel system which spans between the two large vertical tubular piles. A single tubular pile which is currently driven into the seabed, and which supports the fender panel will not be removed as part of the works and shall remain in situ as the pile is not anticipated to negatively impact the safe navigation of CTVs using the O&M pontoon.

Figure 86 Existing fender structure and supporting steelwork at St. Michael's Pier

Figure 87 Existing fender structure and supporting steelwork at St. Michael's Pier

6.16.19 The existing Ro-Ro ramp located at Berth 5, as shown in Figure 88, will be partially demolished to facilitate the construction of a new concrete pavement slab and hardstanding area. This will involve the removal of the existing reinforced concrete towers, approach ramp and retaining walls and the reduction of ramp levels to match existing levels in the site.

Figure 88 Existing RoRo ramp at Berth 5

6.16.20 A new O&M building will be constructed on St. Michael's Pier and will include office space, meeting rooms, toilet and changing facilities and an operations control centre which will be the main base for the Dublin Array support team. It will also include a warehouse which will store small spare parts for the wind farm and a workshop. The building is arranged over three floors and will provide a total of 2,003 m² of internal floor space, of which 1,019.4 m² will be on the ground floor.

6.16.21 Waste separation and recycling storage facilities (non-recyclable waste, paper and cardboard, glass and plastics) will be provided within the development area.

6.16.22 The existing surface water drainage network will be upgraded in the vicinity of St. Michael's Pier and the proposed hardstanding area. The new drainage network will tie into the existing oil interceptor in the harbour which will clean surface water run off of all sediment and of any potentially hazardous material prior to discharging the surface water into tidal waters within the harbour. Details of the proposed drainage works can be found in drawing 'DUN-WMC-ZZ-XX-DR-C-P0200 - Proposed Drainage Layout' (included in Part 2 Planning Drawings of the planning application, which is contained within the submission documents).

Figure 89 3D representation of the operations and maintenance building and yard

6.16.23 A new ESB substation will be constructed to facilitate a new electrical connection to the O&M building. The proposed sub-station will be provided in line with ESB Networks standard specification. The sub-station will include an electrical transformer, which will convert the incoming ESB MV (10/20 kV) power supply to low voltage (3-Phase) which can then serve the proposed O&M building. This is discussed further in Section 6.16.72.

6.16.24 A new floating pontoon, up to 60 m long and up to 6 m wide will be installed adjacent to the existing Berth 5 quay wall which will facilitate the berthing of CTVs. The proposed pontoon will be anchored to the quay wall by means of steel guide beams. The proposed guide beams will allow the pontoon to rise and fall with the tidal conditions in the harbour. The CTVs will transfer offshore maintenance technicians to the offshore wind farm on a daily basis. Details of the proposed pontoon can be found on the planning drawings 'DUN-RAM-ZZ-XX-DR-CM-0002-00 PROPOSED PLAN', DUN-RAM-ZZ-XX-DR-CM-0003-00 PROPOSED SECTIONS and 'DUN-RAM-ZZ-XX-DR-CM-0004-00 PONTOON FURNITURE' (included in Part 2 Planning Drawings of the Planning Application).

Figure 90 Typical floating pontoon and access gangway used for CTV operations (Source; Inland and Coastal Marina Systems)

6.16.25 The proposed pontoon will be complete with fendering, mooring points (bollards and cleats), emergency ladders, lifesaving equipment, electrical, water and lighting services and signage. A new access gangway will be installed on the existing Berth 5 quay wall to facilitate access to the floating pontoon.

6.16.26 Rock armour was previously installed on the seabed adjacent to Berth 5 to protect the quay wall from scouring during ferry operations. There may be a requirement to undertake levelling or reprofiling works to this rock armour to prevent the pontoon, or CTVs from hitting the armour at low tide. It is anticipated that the armour would be reprofiled by means of an excavator and shall not be recovered to land.

6.16.27 The planning application boundary for the O&M Base encompasses 25,898 m² (2.5898 ha) of land, and includes all land required to construct and operate the proposed development. The area which will be used to operate the O&M Base encompasses 3,664 m² (0.36 ha) of land. The area is sufficient to provide space to safely and efficiently operate all plant, infrastructure and equipment (for loading and unloading vehicles, transfer of equipment to the warehouse as well as the loading and off-loading of equipment and personnel to and from CTVs in addition to general harbour operations.

6.16.28 Given that the proposed works include the demolition of the existing single storey Harbour Maintenance Building located on St. Michael's Pier which is currently owned and operated by DLRCC, the proposed O&M building has been designed to incorporate the necessary space requirements for the DLRCC Harbour Operations team.

6.16.29 It is planned that, subject to future commercial agreements, the DLRCC Harbour Operations team will occupy a portion of the O&M building where they will undertake harbour related operations. This includes office space for the Harbour Master and Harbour Operations team, changing facilities and drying rooms, a workshop and store rooms. Details of the anticipated breakdown in the proposed occupancy of the building are shown in the floor plans which have been submitted as part of this application (refer to drawings DUN-DJI-ZZ-XX-DR-A-21022 Proposed Building Plans, Ground and First Floor and DUN-DJI-ZZ-XX-DR-A-21023 Proposed Building Plans, Second Floor and Roof Plan included in Part 2 Planning Drawings of the Planning Application

6.16.30 As can be seen from the proposed site layout plan in Figure 91, the proposed site layout will have two secure entrances, for both the DLRCC harbour operations team and the Dublin Array operations team.

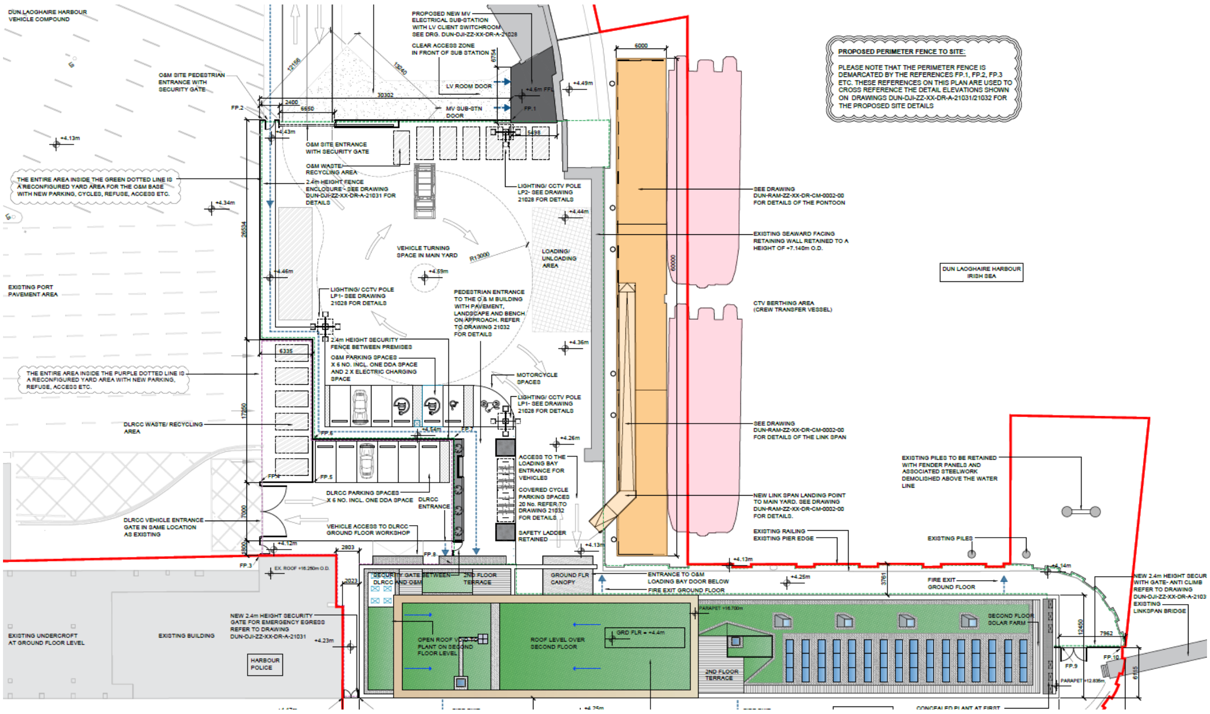

Figure 91 Extract from the Proposed Site Plan –Drawing No. DUN-DJI-ZZ-XX-DR-A-21021

Access and parking

Access

6.16.31 The proposed O&M Base will be accessed via the existing main harbour gate off Harbour Road, to the south of the development. Refer to Figure 92 for an illustration of the existing entry and exit routes to and from the development site.

6.16.32 As part of the development, an entrance gate and fence will be erected around the perimeter of the proposed development to restrict access to approved personnel.

6.16.33 A turning circle will be provided inside the O&M Base yard area. It is anticipated that the main commercial delivery traffic to and from the O&M Base will be standard delivery vans and 20 foot (ft) rigid vehicles however larger vehicles may have to be accommodated for less frequent deliveries. It is anticipated that once operational, no more than two deliveries will be expected daily during general operations.

Figure 92 Existing access to harbour (Source https://www.google.com/maps)

6.16.34 The proposed turning circle provides sufficient space for vehicle turning movements for all the following vehicle types to manoeuvre safely in the area provided within the O&M Base yard;

- Refuse removal truck;
- Fire tender truck;
- 40 ft Articulated heavy-goods vehicle (HGV); and
- 20 ft Rigid heavy-duty vehicle.

6.16.35 Refer to Figure 91 for an extract of the architect's layout showing the parking areas and vehicular movements within the site.

6.16.36 Drawings DUN-WMC-ZZ-XX-DR-C-P0150-P0152 included in Part 2 Planning Drawings of the Planning Application outline the swept path analysis of the various vehicle types outlined above.

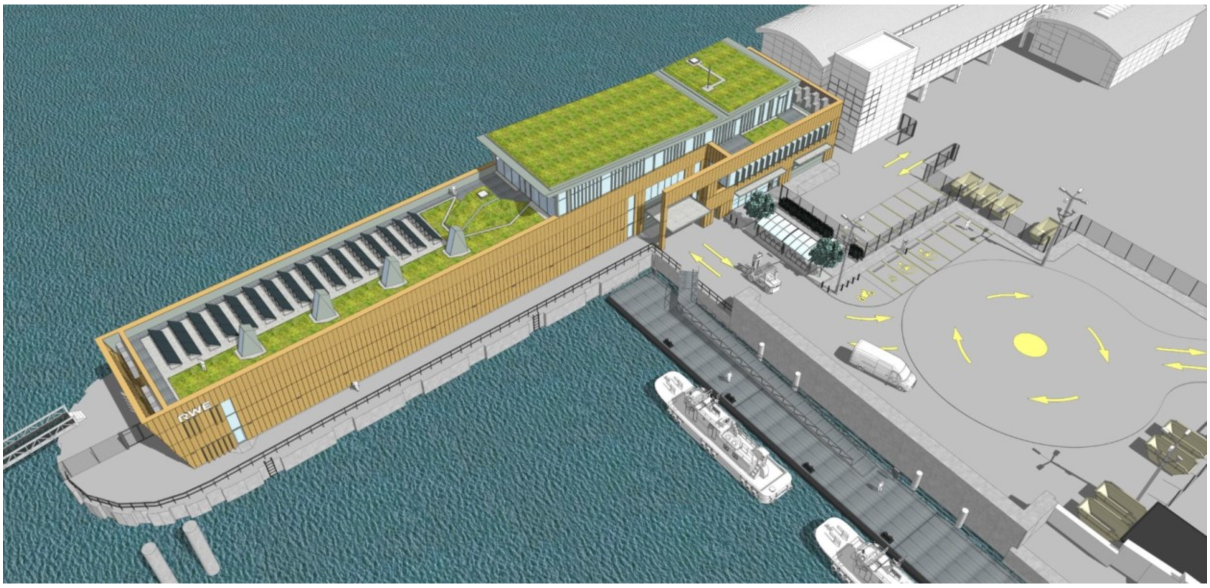

Figure 93 3D Representation of O&M Base yard layout

Parking

6.16.37 Car parking standards are set out in Chapter 12 of the DLRCC Development Management Plan. Parking zones have been established for all areas within the county council's district. According to the supplementary Map T2 Parking Zones (from the development plan), the area directly south of the Harbour is considered zone 2, the Harbour itself however is not indicated in any zone, as can be seen in Figure 94.

6.16.38 Zone 2 parking areas are generally characterised by the following:

- Access to a good level of existing or proposed/planned public transport services;
- A good level of accessibility for pedestrians and cyclists, either existing or planned; and
- Potential capacity to accommodate a higher density of development than surrounding areas.

6.16.39 Refer to Figure 94 for an extract of Map T2 showing the various parking zones.

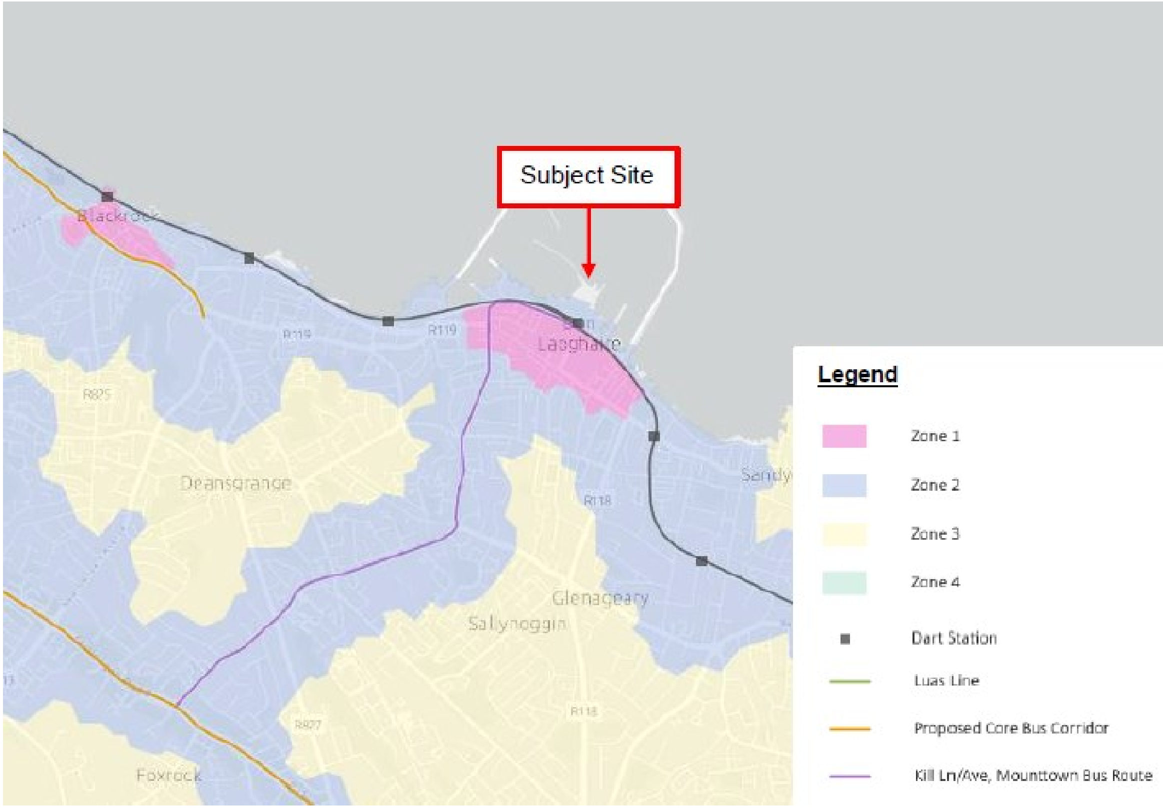

Figure 94 Extract from DLRCC Map T2: Parking Zones

6.16.40 Table 12.6 of Chapter 12 of the DLRCC Development Plan outlines the following car parking standards applicable to a Zone 2 area:

Table 40 DLRCC Car Parking Standards

Land Use (Zone 2)	Standard (GFA*)	Development GFA	Standard
Employment, Offices, Businesses, Professional	1 per 150 m^2	2,003 m^2	13 no. spaces

*GFA refers to Gross Floor Area

6.16.41 Thus, according to the development plan, 13 no. spaces will be considered the standard car parking quantum for the proposed development. However, it is noted that this development is not clearly shown to be within a ‘parking zone’ in the T2 map (as shown in Figure 94). As such, engineering judgement has been used to identify a suitable parking requirement for the development.

6.16.42 It is proposed to provide a total of 12 No. car parking spaces within the overall development area which is 1 no. space less than the standard outlined above. One parking space is assigned for accessible/disabled use. Up to four electric vehicle (EV) charging spaces will be provided for the proposed for the O&M building, which will be shared between DLRCC and the Applicant.

6.16.43 The DLRCC Standard for Cycle Parking & Associate Cycling Facilities for New Developments (2018) has been consulted to establish cycle parking standards for the proposed development. According to Table 4.2 of the above referenced guidelines, the following cycle standard is applicable for a non-residential development:

Table 41 DLRCC cycle parking standards for non-residential developments

Land Use	Cycle Parking Type	Requirement	Gross Floor Area	Cycle Parking (minimum)
Offices	Long-stay	1 per 200 m^2	2,003 m^2	10 No. spaces
	Short-stay	1 per 200 m^2	2,003 m^2	10 No. spaces

6.16.44 A total of 20 No. cycle spaces as a minimum are required for this type of development according to the DLR cycle parking standards. 20 No. cycle spaces will be provided within the O&M yard area, all of which will be covered and secure.

Proposed construction activities

6.16.45 As set out on the relevant drawings accompanying this development consent application, the key components of the proposed O&M Base comprise;

- The demolition of existing structures within the harbour including the existing RoRo ramp structure and associated concrete towers, the existing harbour maintenance building, covered walkways, storage buildings as well as the partial demolition of existing fender structures;
- The construction of a new hardstanding area and installation of the necessary service upgrades including storm water drainage, ESB ducts & cables and foul water network upgrades following demolition works;
- The construction of a new O&M building;
- The construction of a new ESB substation;
- The installation of a new pontoon and gangway adjacent to Berth No.5;
- The installation of a new telecommunication mast (3 m high) on the roof of the O&M building;

- The installation of security fence (2.4 m high) around the perimeter of the site with pedestrian and vehicular access gates;
- Installation of 3 No. lighting & CCTV poles (12 m high) around the site compound;
- 12 No. car parking spaces, which include 2 No. EV charging points with bicycle parking spaces; and
- All associated and ancillary development including TCCs within the existing Dún Laoghaire Harbour vehicle compound.

6.16.46 These activities are further described in the following sections.

Proposed demolition works

6.16.47 The demolition works to the car ferry terminal RoRo ramp and bank seat are outlined in drawing DUN-WMC-ZZ-XX-DR-S-P7000 - Proposed Demolition, General Arrangement, HSS Ramp & Bankseat included in Part 2 Planning Drawings of the planning application.

6.16.48 The proposed works will be undertaken above the existing embedded ground retention systems that are an integral part of the seawall at Berth 5. These important retaining elements including the steel piles, sheet piles and associated ground tie anchors and anchor walls are located below the existing ground level and should not be affected by the proposed works that will be carried out to remove the ramp over these elements.

6.16.49 The detailed methodology for the removal of the access ramp and the local reduction of levels in this area will be agreed between the Applicant, the designer and the contractor prior to these works commencing as the ground anchor ties will be near the surface at this point and will not be protected by a concrete slab.

6.16.50 The existing concrete towers will be removed in sections to avoid heavy impacts on the ground or risk of damaging the below ground embedded elements. Similarly, the removal of the existing reinforced concrete buttressing walls to the bankseat will be carefully managed to ensure the works do not damage the retained elements. These elements will be removed using non-percussive methods (saws, hydro-demolition, etc) rather than demolished using impact methods that may cause vibration damage to the sea wall and anchor rod connections. Where retained elements are locally removed curtailment reinforcement dowel bars will be specified and any exposed reinforcement protected with a suitable concrete repair mortar.

6.16.51 The demolition works will generally consist of the following:

- Removal of the existing reinforced concrete towers down to the top of the existing reinforced concrete base slab. Demolition works will involve low intensity, controlled methods such as saw-cutting concrete into sections, munchers, excavators, etc;

- Removal of the bank seat's connecting 600 mm thick reinforced concrete buttressing walls;
- Removal of the approach ramp including the removal of the 200 mm, 350 mm and 400 mm thick reinforced concrete slab, retaining walls, geogrid membrane and associated foundations;
- Reduction of ramp levels in order to provide a new paved area of similar levels to the existing surrounding marshalling yard area; and
- Removal of all disused fixtures and fittings to the bank seat (hinges, bearings, anchors, etc). All materials will be removed off site to a licenced disposal facility;

6.16.52 The proposed pavement levels in this area will tie-in to the existing pavement levels in the marshalling yard which are ± 4.40 m OD Malin. The new carparking and pavement areas are designed with a minimum fall of 1:150 to ensure appropriate surface water runoff occurs from the pavement into the gullies and the associated surface water network to be constructed below the area.

6.16.53 Refer to drawing No. DUN-WMC-ZZ-XX-DR-C-P0100 included in Part 2 Planning Drawings of the Planning Application for the general pavement arrangement and proposed pavement levels of the development.

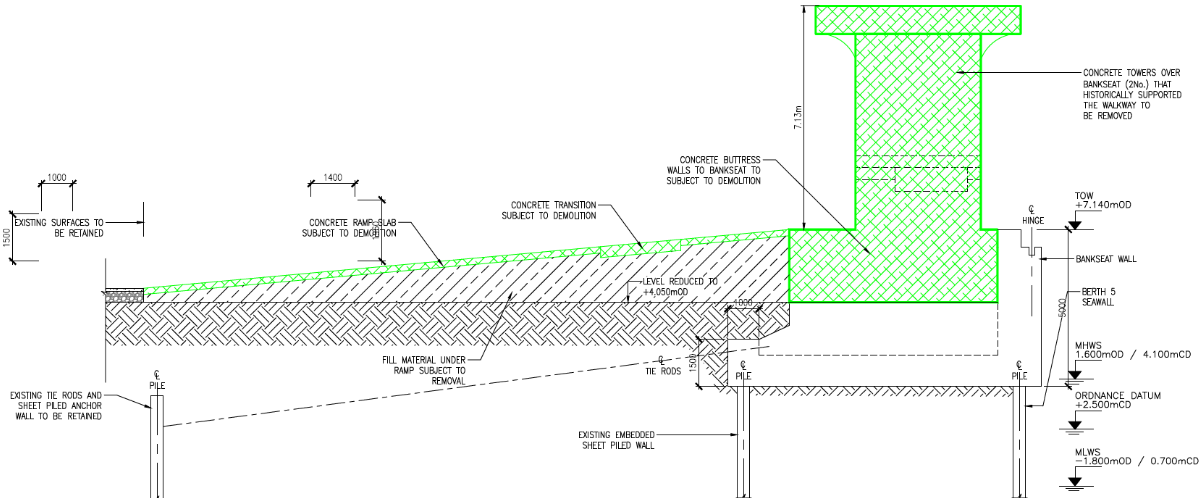

Figure 95 Cross section through Ramp & Bankseat extracted from drawing DUN-WMC-ZZ-XX-DR-S-P7000

6.16.54 The demolition works on St. Michael's Pier will consist of:

- Demolition of the single storey Harbour Maintenance building using low intensity, controlled methods (munchers, excavators, etc.);
- Removal of existing surface finishes and build-up (tarmacadam, hardcore and fill) over the deck of St. Michael's Pier;

- Removal of the existing storage containers and fencing;
- The ferry fender system is currently redundant, as Berth 5 is no longer active, and no vessels or ships are berthing against the fender. It comprises two large diameter (1600 mm) steel tubular pipes driven into the seabed, which support a large steel framed fender plate. Four horizontal bracing struts transfer lateral load from the fender to the deck of St. Michael's Pier, from where this load is transferred to the seabed via the raking pile system under St. Michael's Pier;
- The removal of the four steel bracing members will require a crane to be positioned to support each bracing member with a suitable spreader beam system required while the connections at either end of the steel struts are de-coupled; and
- Following removal of the bracing members, the vertical fender plate system that spans between the two vertical piles will also be removed, to avoid any potential for future berthing, which the vertical piles will no longer be able to support.

6.16.55 Additional demolition works which will take place within the proposed site include the removal of existing storage sheds and the removal of the existing covered walkway and modular kiosk structures. There will be no demolition of O&M structures between March to September inclusive.

6.16.56 Refer to drawings DUN-DJI-ZZ-XX-DR-A-21010 (Existing Site Plan - Sheet 1 - Showing Demolitions and Removals), DUN-DJI-ZZ-XX-DR-A-21011 (Existing Site Plan - Sheet 2 - Showing Demolitions and Removals) and DUN-DJI-ZZ-XX-DR-A-21012 (Existing Contiguous Elevations Showing Demolitions and Removals) included in Part 2 Planning Drawings of the planning application for details on the proposed demolition works.

Operations and maintenance building concept

St. Michael's Pier

6.16.57 St. Michael's Pier was constructed in the 1960s and the pier comprises a series of 990 mm diameter reinforced concrete vertical and raking marine piles supporting a 70 feet (21.4 m) wide concrete slab that forms the deck of the pier. The pier deck is 610 mm thick with the exception of the seaward end of the pier where the reinforced concrete slab locally increases to 1067 mm thick.

6.16.58 A concrete edge beam 610 mm wide and 1676 mm deep forms the waterside edges to the pier. The edge beam upstands approximately 450 mm above the top of the slab, with the slab infilled on top with fill and a macadam surface to the same level as the top of the edge beams.

6.16.59 The 990 mm diameter vertical reinforced concrete marine piles are arranged on a 20-foot (6.096 m) by 25-foot (7.62 m) grid in 4 lines along the length of the pier. Between the vertical piles there are 2 rows of 8 lines of raking or diagonal piles. Towards the seaward end of the pier a further 6 raking piles splay towards the landward end of the pier. The raking piles in both directions provide lateral stability to the pier deck against berthing and mooring forces, wind and notional horizontal loads.

6.16.60 St. Michael's Pier has been subject to on-going inspection and maintenance since DLRCC took control of the assets in the harbour in 2018.

Structural concept

6.16.61 The structural design for the building has been developed with consideration of its location and required functionality. The design:

- Provides a structural solution with a building mass that does not exceed the load-bearing capacities of the existing piles to St. Michael's Pier;
- Provides a structural grid that is cognisant of the functional requirements of the Applicant and of the DLRCC harbour maintenance facility;
- Minimises the depth of transfer structure over the existing deck to St. Michael's Pier;
- Provides a clear path for service routes (as much as possible);
- Minimises the number column transfers between the ground floor and roof; and
- Is capable of rapid construction with the option for pre-fabrication to minimise on-site programme time.

6.16.62 A detailed analysis of the existing reinforced concrete piles to St. Michael's Pier has been undertaken to assess the capacity of the existing piles for support of the proposed O&M building. The record drawings for St. Michael's Pier provided by DLRCC show 990 mm diameter reinforced concrete piles extending to Mudstone strata.

6.16.63 The pile reinforcement typically comprises 12 No. 31.75 mm diameter, vertical bars with 9.5 mm helix links at 229 mm centres. The load-bearing assessment of the existing piles to St. Michael's Pier was confirmed in accordance with the design standard BS 8004:1986 (formerly CP 2004 that was current at the time of construction).

6.16.64 The pile analysis using CADS Bearing Pile Designer (refer to Figure 96 and Figure 97) shows a safe working pile capacity of 2124 Kilonewton (kN) for the vertical piles. The pile analysis for the raking piles indicates a safe working load capacity of 2141 kN in addition to bending and shear force induced from self-weight of the raking pile.

Figure 96 CADS bearing pile designer (version 2.11.2019) – vertical pile

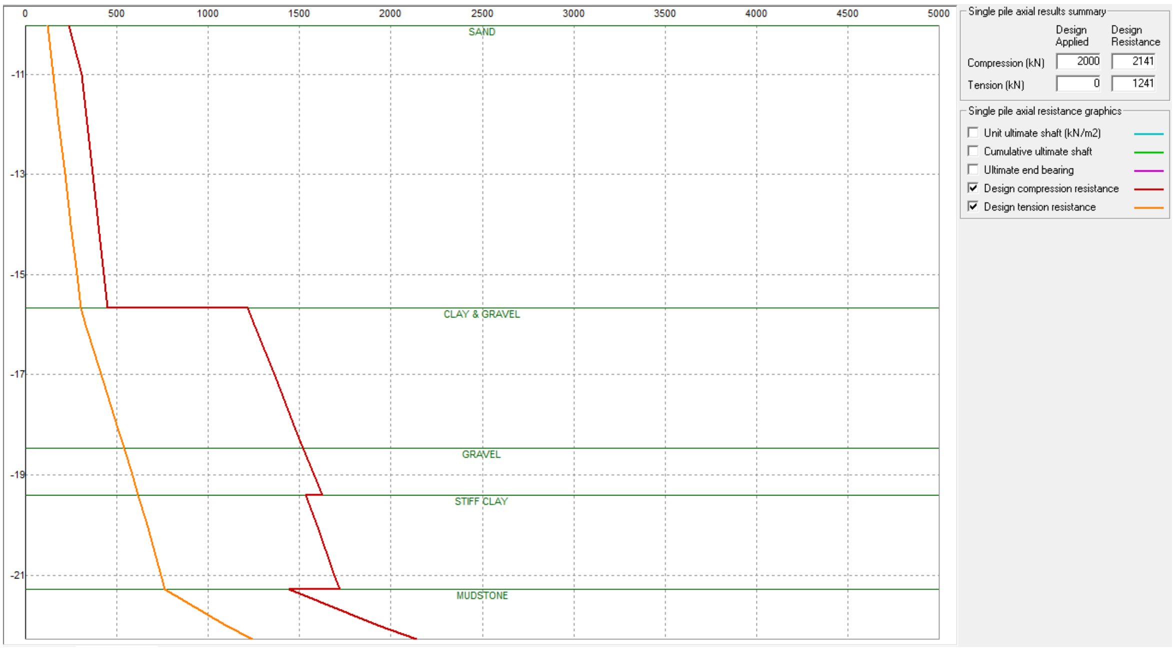

Figure 97 CADS bearing pile designer (version 2.11.2019) – raking pile

6.16.65 For the purposes of verifying the existing foundations, the geological characteristics and parameters outlined in the 'Geotechnical Site Investigation Factual Report for Proposed Cruise Facility' which were undertaken in 2014 for the construction of a cruise berth facility and the dredging of a navigation channel within the harbour[41] have been adopted in the analysis of the existing piles.

6.16.66 The additional building load from the proposed O&M building will be limited to the above capacities of the existing piles. This design constraint has informed the choice of building materials and form of structure. The analysis carried out has confirmed that the piles have sufficient capacity to support the proposed O&M Base on top of the pier.

6.16.67 In order to avoid load being applied to the existing pier deck, a new ground floor transfer structure will be located over the existing pier deck with new steel bearing supports to the new structure located directly over the existing piles.

6.16.68 It is proposed to use a steel frame with composite concrete on metal deck floor slabs in the construction of the O&M building. This structural solution provides economy of design and speed of construction, whilst maintaining a building weight allowance that is within the capacities of the existing St. Michael's Pier structure. All materials used in the construction of the O&M building are expected to be transported to site by road.

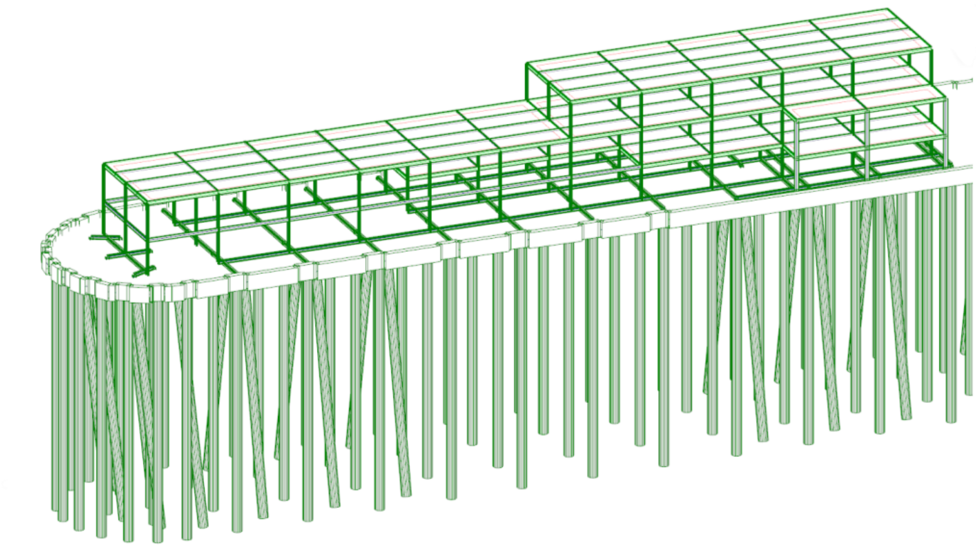

Figure 98 Proposed structure over St. Michael's Pier [extract Structural Analysis Model]

6.16.69 A steel frame with composite concrete on metal deck floor slab has a number of benefits over a conventional concrete frame approach:

- High strength to weight ratio;

41 ABP Case Number PA0042.

- Greater opportunity for off-site prefabrication;
- Higher quality of finish due to off-site construction;
- Less requirement for temporary works;
- Less formwork and shuttering on site;
- Faster construction time on site (early stage first-fix Mechanical, Electrical, and Plumbing); and
- Longer achievable floor spans for shallow floor zone.

6.16.70 The super-structure will use traditional construction techniques. The steel beams and stanchions will be erected on a floor-by-floor basis using mobile cranes to lift the bolted section into position. The metal decks on each floor will provide a safe working platform to guide the sections into position. The bolted steel sections will arrive on site by with prefixed edge protection and off-site applied painted fire protection, to limit the amount of site works required.

6.16.71 Wind and weather will be monitored, and crane usage will be restricted as required during inclement weather to ensure safety of all personnel. Containment barriers will be set up around the perimeter of the deck to St. Michael's Pier to ensure there is no run off of concrete into the harbour. Concrete wash out facilities will also be provided on site with appropriate containment structures to capture any spilled concrete or wash water.

6.16.72 The proposed substation will be required for the development given the new electricity load to the ESB network. The proposed substation will be a 10 KV to 400-volt transformer. The building will be designed and constructed to meet ESB Networks 'Construction Standards for MV Substation Buildings' guidance document. The building will include masonry block walls with plaster finish with a flat roof construction.

ESB substation

6.16.73 ESB Networks are the statutory body responsible for providing electrical power supplies to all buildings within the Republic of Ireland. The existing electricity supply networks in the area of the proposed development have been identified and there is existing infrastructure in the vicinity of the site which will be suitable for providing the required connection to the network.

Existing infrastructure

6.16.74 Information obtained from ESB Networks indicate two possible locations for connections to be made to the existing MV network (refer to Figure 99). There is one existing below ground MV supply to the west of the site in Harbour Road and a second below ground MV supply to the south of the site in Queens Road, adjacent to the existing DART railway station.

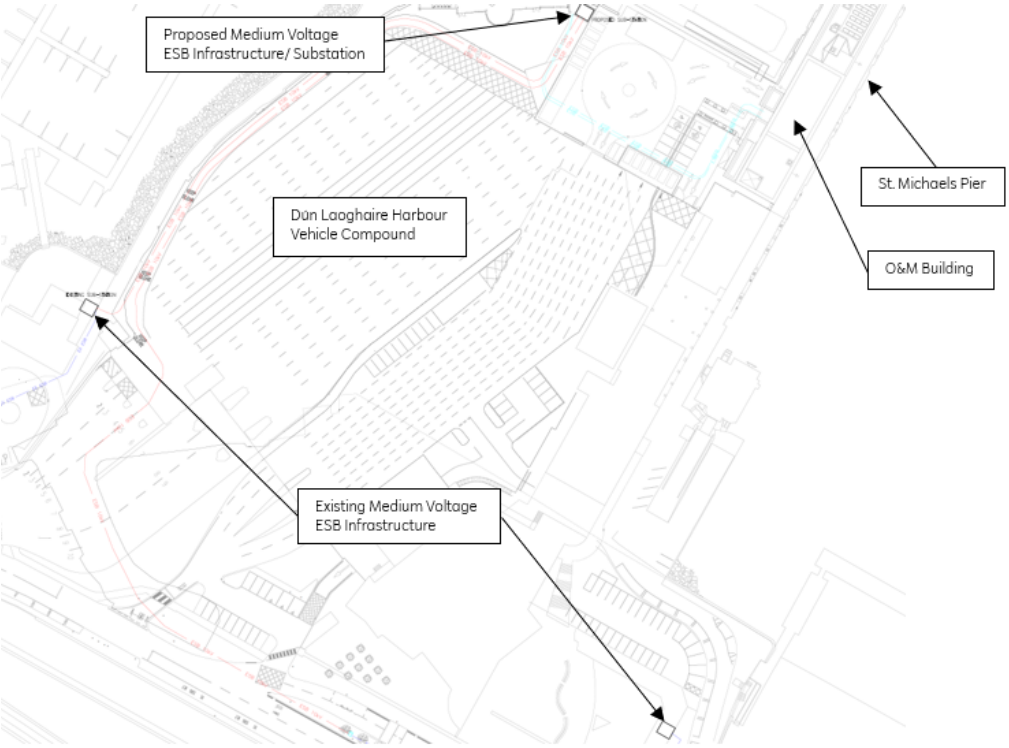

Figure 99 Existing ESB Infrastructure adjacent to the O&M development

Proposed infrastructure

6.16.75 Provision has been made in the proposed development, as detailed in the Architectural drawings (DUN-DJI-ZZ-XX-DR-A-21021 (Proposed Site Plan - Sheet 2) and DUN-DJI-ZZ-XX-DR-A-21028 (Proposed Sub Station & Site Lighting Poles), for an ESB substation (approximately 7.6 m long x 4.3 m wide x 2.9 m high) to ensure an adequately sized electrical supply can be provided. The proposed sub-station will be provided in line with ESB Networks standard specification. The sub-station will include an electrical transformer, which will convert the incoming ESB MV power supply to low voltage which can then serve the proposed O&M building.

6.16.76 The 10/20 kV electricity supply required to feed the sub-station will enter the site and will be routed to the sub-station location via below ground ducting. The duct-routes will be agreed with ESB Networks design engineers and ducting will be installed fully in compliance with ESB Networks codes of practice. Ducting will typically be 125 mm red PVC ducting and will be installed approximately 600 mm below the finished surface.

6.16.77 A switch room (as shown in Figure 101) will be provided adjacent to the ESB sub-station which will house the Applicants meters and switchgear. Ducting will be provided from this switch room into the O&M building.

6.16.78 During the detailed design stage, the final electrical load of the building will be determined, and this will form the basis of a formal application to ESB Networks. ESB Networks will then be responsible for selecting the correct size of transformer.

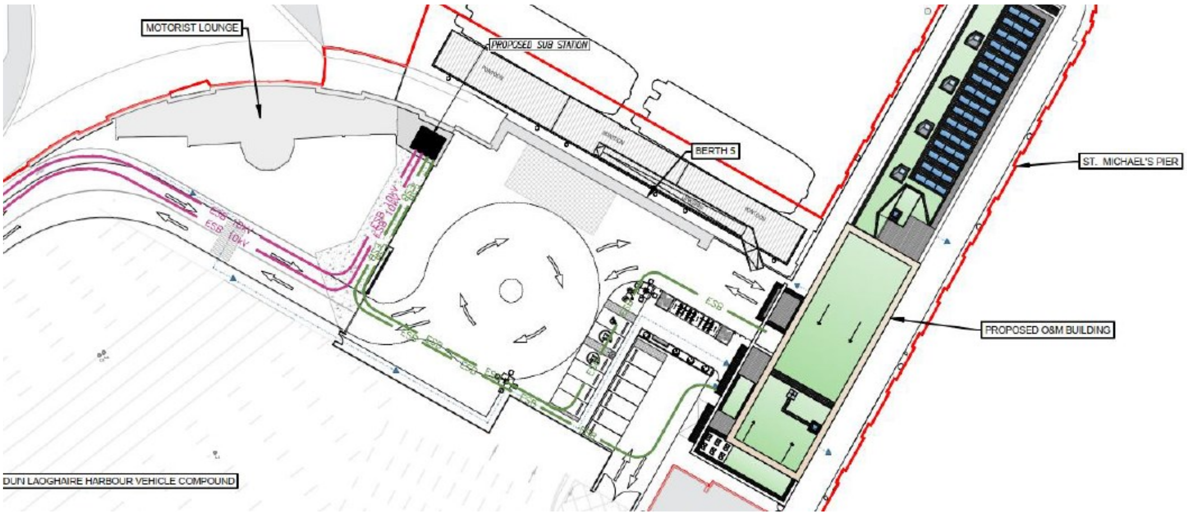

Figure 100 Proposed ESB infrastructure

Figure 101 Freestanding MV substation adjoining a customer’s switch room (Source ESB Networks Construction Standards for MV Substation Buildings)

Services and utilities

6.16.79 All existing services (fresh water, wastewater, drainage and electricity) will be retained on site where possible. Details of the existing and proposed connections are outlined further in the following sections.

Water supply

6.16.80 An existing water supply network is available within the harbour and extends to St. Michael's Pier which currently services the site, including the existing harbour maintenance building. Several fire hydrants and water meters also exist on the site, including fire hydrants on St. Michael's Pier. All existing services within the development boundary will be retained where possible for re-use. New underground infrastructure, where necessary, will be built to accommodate the proposed building's water demand on the public system.

6.16.81 A pre-connection enquiry (PCE) for the water and wastewater connection requirements of the proposed development was submitted by Waterman Moylan on behalf of Kish Offshore Wind Limited and Bray Offshore Wind Limited to Uisce Éireann on 28 June 2023. Uisce Éireann confirmed feasibility of connection for this development to the existing network on the 09 January 2024.

6.16.82 New infrastructure, where necessary, will be built to accommodate the proposed O&M building. It is proposed to connect the proposed O&M building to the existing infrastructure adjacent to the existing Ferry Terminal building.

6.16.83 A water supply will also be provided to the CTVs via a sluice valve located landside of the proposed access gangway. In addition, a new fire hydrant proposed as part of the development for firefighting purposes. These vessels will require refilling of their freshwater tanks. It is currently expected that each vessel will need to be replenished to a volume of 20,000 litres (l) once per week. The details relating to the method and timing of filling the freshwater tank will be agreed with Irish Water at detailed design stage. It is worth noting that the CTVs will only require filling at night when they return from the WTGs to the O&M Base and when demand from the water network from other users will be at its lowest.

6.16.84 An estimate of water demand from the public water supply system for the proposed development, calculated using the total area of offices and canteens, using Irish Waters expected office with canteen demand of 100 l/h/d has been completed. Details of the water demand calculation is included below.

Table 42 Calculation of total water demand

Description – Industrial Usage	Area (m^2)/Unit	Flow (l/h/day)	Population	Total Daily Discharge (l/d)
Office with Canteen	591.20	100	60*	6,000
CTV Water Tank		20,000**	1	20,0000
Total				26,0000

* The population for the office with canteen calculation is taken as 1 person per 10 m^2.
**the full CTV 20,000l tank will need filling in one day. During peak months of maintenance at the wind farm, there may be two vessels, each filling once per week on alternate nights.

6.16.85 The average total water requirement, from the public supply, for the development, is estimated at 6.0 m^3/day. The peak demand during filling of the CTVs will be 26 m^3/day.

Watermain network design

6.16.86 Watermains suitable for works and approved by Uisce Éireann shall be used in the works, i.e. polyethylene (PE), with PE80 or PE100 rating (MDPE, HDPE or HPPE).

6.16.87 Generally, the minimum depth of cover from the finished ground level to the external crown of a watermain will be 900 mm when installing watermain below roads or footpaths. Depths may be altered to avoid obstructions, including separation distances between other utility services, and reduced if concrete encased. Similar to the proposed foul drainage, the watermain network will be concrete encased throughout the pipe network for the development.

6.16.88 Details of the proposed connection to the existing supply network can be found on drawing 'DUN-WMC-ZZ-XX-DR-C-P0300 – Proposed Watermain Layout Sheet 1 of 2' and 'DUN-WMC-ZZ-XX-DR-C-P0301 - Proposed Watermain Layout Sheet 2 of 2'.

Foul water

6.16.89 The buildings within the development area are currently serviced by an on-site foul pump station which pumps via a 200 mm diameter rising main to a 450 mm diameter gravity combined foul sewer within Crofton Rd (N31). The existing harbour maintenance building which is proposed for demolition under this application is currently serviced by an existing 150 mm diameter gravity foul sewer which connects into the on-site pump station. The existing pump station was designed to cater for the old Stena Line ferry terminal and as such is considered to have adequate capacity to cater for the discharge from the proposed O&M Base.

6.16.90 The proposed O&M building will be constructed over the existing suspended concrete pier. The level of the existing pier surface is approximately +4.10 m OD Malin throughout and consists of macadam and fill material with a minimum thickness of 450 mm over a suspended concrete deck slab. The top of the concrete deck slab is at approximately +3.650 m OD Malin and is supported over the water on piles.

6.16.91 Over the footprint of the building the macadam and fill over the concrete deck slab will be removed. The ground floor finished floor level (FFL) of the proposed O&M building will be +4.40 m OD Malin with drainage and services laid in the 750 mm floor zone between the FFL and top of the existing concrete deck slab. The drainage will connect into the foul outfall currently serving the existing maintenance building, which is to be demolished.

6.16.92 The foul drainage outlet pipes from the building will be concrete encased throughout the pipe network (constructed within the proposed fill on top of the pier's concrete slab), resulting in a lesser coverage requirement for the pipes. It is proposed to allow 250 mm cover at the connection points of the foul network at the building outlets.

6.16.93 In addition to general office waste, the CTVs used on the offshore wind farm will need to discharge foul water from their onboard storage tank into the foul drainage system at the site. Each vessel will have a sewage water capacity of approximately 410 l (0.4 m^3) which will be discharged weekly to the existing pump station on site via a proprietary system integrated into the pontoon structure.

6.16.94 Based on the Uisce Éireann Code of Practice for Wastewater Infrastructure and the EPA Wastewater Treatment Manual Guidelines, the foul flow from the proposed development, calculated using the total area of offices, canteens and other facilities in the proposed building and the CTV sewage tank requirements, will be as follows:

Table 43 Calculation of proposed foul water demand

Description – Industrial Usage	Area /Unit (m^2)	Population /No.	Flow l/h/day	Infiltration Factor	Total Discharge (l/d)
Office with Canteen	591.20	60*	100	1.1	6,600
CTV Sewage Tanks		1	20,000**	1.1	22,000
Total					28,600

* The population for the office with canteen calculation is taken as 1 person per 10 m^2.
** Discharging once per week

Calculation of Proposed Peak Foul Flow		
Total Daily Discharge (from above table)	28,600	l/d
Dry Weather Flow (DWF)	0.33	l/s
Peak Foul Flow (= 6 x DWF)	**1.986**	**l/s**

6.16.95 The proposed total peak foul flow from the development is 1.986 l/s and the proposed network will connect into the existing 150 mm diameter gravity sewer already servicing the existing building in the development. These flows will be conveyed by gravity to the on-site pump station.

Surface water drainage

6.16.96 The subject site is considered a brownfield site (i.e. previously developed) with existing structures and hard standing parking areas covering the entirety of the development area.

6.16.97 Two surface water catchments currently exist on site, one catchment collects and conveys runoff from the existing ferry ramp, which is proposed to be demolished and replaced by a car parking and vehicle turning area, and the existing Dún Laoghaire Harbour vehicle compound west of the existing Ferry Terminal Building. The second catchment collects and conveys runoff from the pier and existing maintenance building on St Michael's Pier, which is to be demolished and replaced by the new O&M building. The existing catchment areas will remain unchanged. The surface water drainage in the remainder of Dún Laoghaire Harbour vehicle compound will also remain unchanged as part of the development. Refer to Figure 102 for an illustration of the surface water catchment areas.

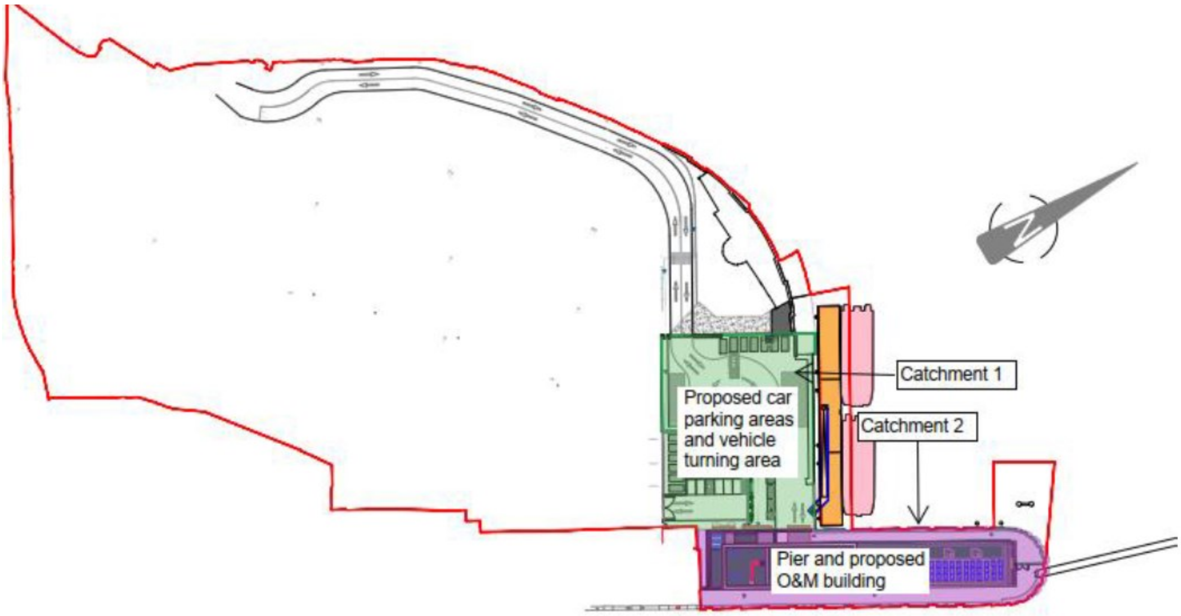

Figure 102 Surface water catchment areas

6.16.98 The existing surface water network, consisting of a single 225 mm diameter pipe, is located directly west of the proposed O&M building (Refer to DUN-WMC-ZZ-XX-DR-C-P0400 - Existing Services drawing). This network solely serves surface water catchment No.1 and collects runoff from parking areas via gullies. The existing network is connected to an existing type 1 oil interceptor which discharges surface water into the Irish Sea at Berth No.5.

6.16.99 Surface water runoff from catchment no. 2 is currently discharged through St. Michael's Pier directly into the Irish sea, via cores in the concrete pier.

6.16.100 It is intended that the current hardstanding nature of catchment No.1 will be maintained throughout the proposed development. Consequently, the stormwater runoff from this area will remain unchanged in both its nature and quantity prior to the development commencing. The runoff will continue to be collected by newly constructed gullies in the proposed parking and vehicle turning area, then directed to the existing type 1 oil interceptor, before being discharged into the Irish Sea. For a visual representation of the existing and proposed surface water network, please refer to drawing number DUN-WMC-ZZ-XX-DR-C-P0200 - Proposed Drainage Layout.

6.16.101 An intensive green roof system is proposed within Catchment no. 2 on the roof of the O&M building, covering at least 50% of the total roof area on site. This percentage represents the extent of roof area which provides growing medium for vegetation, in compliance with the requirements of the DLRCC Development Plan 2022-2028. Green roof areas are located on the first and second floor roofs and on the top floor roof.

The runoff will be conveyed from the green roof via rainwater down pipes into the Irish Sea through existing gullies/cores in the concrete pier.

6.16.102 This percentage represents the extent of roof area which provides growing medium for vegetation, in compliance with the requirements of 'Appendix 7 - Sustainable Drainage System Measures' of the DLRCC Development Plan 2022-2028. Green roof areas are proposed on the first floor, second floor and top floor roofs. The runoff will be conveyed by gravity from the green roof via rainwater down pipes into the Irish Sea through existing cores in the concrete pier.

6.16.103 Generally, intensive roofs are defined as having a minimum substrate depth of 200 mm. Figure 103 illustrates a typical green roof on a large building structure (sourced from thermohouse.ie).

Figure 103 Typical green roof image (Source https://www.thermohouse.ie/blog/)

6.16.104 According to the DLRCC Stormwater Management Policy document (2020), all green roof proposals must meet the requirements of Appendix 7-2: Green Roof Policy of the County Development Plan 2022-2028.

6.16.105 Intensive green roofs can be described as:

'Intensive Green Roofs or Roof gardens provide similar benefits as a small urban park. They have a deep layer of soil, which can support a range of plants, trees and shrubs. Native species (plants which will grow naturally in the local area) can provide a rich habitat for wildlife. Intensive Green Roofs are designed to include access for people.'

6.16.106 Green Roofs can be designed to give a wide range of benefits. These include:

- Reducing the amount of surface water running off the roof and so reducing the risk of flooding. Completed projects show a reduced annual run-off of at least 40% and more usually 60-70%. In some cases, for Intensive green roofs, the water retention can be up to 90%;
- Providing habitat (homes), shelter and feeding opportunities for wildlife;
- Contribute to sustainable drainage systems and water quality improvement;
- Helping to meet the targets of our biodiversity action plan;
- Improving the character and appearance of the building and the wider area;
- Offering an opportunity to boost the environmental credentials of a business;

- Providing extra heat and noise insulation;
- Keeping the building cool in the summer;
- Increasing the lifespan of the roof membrane;
- Helping to reduce the amount of dust and pollutants in the air; and
- Creating new open space for relaxation, providing potential for the creation of usable green spaces.

6.16.107 The proposed green roof ensures runoff is treated to the standards outlined in the Greater Dublin Strategic Drainage Study and to add value to the biodiversity potential of the development. Refer to drawing No. DUN-WMC-ZZ-XX-DR-C-P0200 for the proposed drainage network design.

6.16.108 It is proposed that the development will not attenuate surface water before discharging the runoff. The O&M Base site is located adjacent to (and on) the Irish Sea therefore any surface water discharged from the 2.5 ha site will not cause downstream flooding or impact downstream infrastructure. Added to this, the current site is fully developed hardstanding surface. With the addition of the sizeable green roof infrastructure on the proposed building, the surface water runoff will be substantially slowed and treated before being discharged into the Irish Sea – this is considered a notable improvement on the current surface water network and associated discharge.

Surface water network design

6.16.109 The allowable flow discharging from the development is referred to as the ‘outflow limit’, also referred to as the greenfield runoff rate of a site. As no surface water will be attenuated on the site and as there is no downstream infrastructure that may be damaged by unrestricted outflow rates, the ‘allowable outflow’ rate is not a relevant calculation for this development. The surface water will be discharged at the flow rate generated by the pipe network and the associated pipe diameters and gradients.

6.16.110 Calculations for pipe sizes and gradients are based on surface water runoff from hardstanding areas such as the building’s roof, the parking areas, footpaths and the pier area, with a storm return period of 5 years.

6.16.111 Strict separation of surface water and wastewater will be implemented within the development. Drains will be laid in such a manner as to minimise the risk of inadvertent connection of waste pipes to the surface water system.

6.16.112 Surface water local drains will be a minimum of 150 mm diameter and generally will consist of PVC (to IS 123:1964) or concrete socket and spigot pipes (to IS 6:2004). These drains will be laid to comply with the requirements of the Building Regulations 1997-2010 and Technical Guidance Document H – Drainage and Waste Water Disposal (2016) and will be laid strictly in accordance with the requirements of DLRCC.

SUDS design

6.16.113 Surface water will be managed in accordance with the Greater Dublin Strategic Drainage Study (GDSDS) Regional Drainage Policies Volume 2, for New Developments and The SuDS CIRIA Manual.

6.16.114 These documents specify that surface water run-off is to be managed as close to its source as possible, with the re-use of rainwater within the buildings prioritised.

6.16.115 Sustainable Urban Drainage Systems (SUDS) have been developed and are in use to alleviate the detrimental effects of traditional urban stormwater drainage practices that typically consisted of piping run-off of rainfall from developments to the nearest receiving watercourse. Surface water drainage methods that take account of quantity, quality, and amenity issues are collectively referred to as SUDS. They are typically made up of one or more structures, built to manage surface water run-off. The use of SUDS to control run-off also provides the additional benefit of reducing pollutants in the surface water by settling out suspended solids, and in some cases providing biological treatment.

6.16.116 A stormwater management or treatment train approach assures that run-off quantity and quality are improved. The following objectives of the treatment train provide an integrated and balanced approach to help mitigate the changes in stormwater run-off flows that occur as land is urbanised and to help mitigate the impacts of stormwater quality on receiving systems:

- Source control: conveyance and infiltration of run-off; and
- Site Control: reduction in volume and rate of surface run-off, with some additional treatment provided.

6.16.117 The applicant has considered the use of all appropriate SUDS measures as part of the site SUDS strategy, details are outlined in Table 44.

Table 44 SUDS measures

SUDS stage	SUDS measure	Measure outline	Use on site
Source Control	50% Intensive Green Roof	Intensive green roofs are roofs with a vegetated surface that can provide interception and treatment of rainwater. They also provide evapotranspiration from the roof's plants and substrate, reducing run-off volumes and the burden on the drainage network.	It is proposed to use a 50% intensive green roof on the building's roof for both treatment, interception.
Site Control	Petrol/Oil Interceptor	Petrol or oil interceptors are structures that intercept and separate out pollutants (petrol, oils, and other pollutants) from the surface water before conveying the water back into the drainage system.	An oil interceptor currently exists at the discharge point of the existing surface water network, into the Irish Sea. It is proposed to connect into this existing system.

Construction phase

6.16.118 General construction phase activities are summarised below. The site preparation and temporary works will include:

- Demarcation of the construction works area, clearance and site levelling to prepare the works area;
- Installation of temporary construction hoarding to secure the site;
- Installation of site set-up (site office, welfare, etc);
- A temporary laydown area will be located to the west of St. Michael's Pier at the location of the former Dún Laoghaire Harbour vehicle compound. Access will be through the existing harbour gates off Harbour Road. All construction works will be directed to use this entrance only during the construction stage. Refer to drawing DUN-DJI-ZZ-XX-DR-A-21005 (Proposed Construction Logistics Plan) for an outline of the phasing of the proposed works;
- Temporary facilities will be provided during the construction phase which will include construction phase car parking, the provision of welfare facilities and laydown areas as necessary;

- The storage of fuel and refuelling of construction machinery will be undertaken within bunded hardstanding areas only. The quantity of fuel stored on site will be kept to a minimum to limit the risk of fuel spills on site. This plan will be developed by the appointed contractor.

6.16.119 The main civil works will include:

- The demolition works to the RoRo ramp, and the structures on St. Michael's Pier. This will also include the removal of the existing fill surface on the pier, reducing the level to the original concrete deck. The existing fender structure and supporting steelwork will also be partially demolished. Stockpiling of material on site may be required before it is transported to a licenced waste disposal facility;
- Construction of the foundations of the ESB substation will commence after the completion of the demolition works and will involve excavation, installation of formwork, steel reinforcement and concrete placement. The foundations and building structure will be designed in accordance with the ESB Networks 'Construction Standards for MV Substation';
- All construction waste from excavations or which has been generated from demolition activities will be removed off site and disposed of in a suitably licenced facility;
- Construction of a new concrete pavement slab in the location of the demolished HSS ramp will commence on completion of the demolition works;
- Construction of the foundations of the O&M building will commence and will involve the installation of a new load transfer structure over St. Michael's Pier to support the spread of the loading from the O&M building to the supporting piles below;
- Commencement of the construction of the O&M building by means of a bottom-up construction of the vertical elements, floor slabs and building services;
- Installation of external façade and building finishes;
- Installation of the CTV pontoon & gangway and associated services; and
- Installation of external finishes, landscaping, services, drainage, signage and perimeter fencing.

6.16.120 A fire detection and alarm system will be specified during the detail design stage of the O&M building in compliance with the 'Technical Guidance Document B- Fire Safety'.

6.16.121 Following the completion of the construction of the O&M building, the contractor will demobilise all plant, offices and fencing from the temporary laydown area site compound and the area will be returned to DLRCC for general harbour operations.

6.16.122 A preliminary indicative construction schedule for the proposed development is outlined in the table below. It should be noted that activities may occur concurrently.

Table 45 Indicative O&M Construction Schedule

Construction phase	Activity	Approximate timeline
Site Preparation	Erection of temporary site fencing & hoarding; Erection of site offices; Location of onsite services.	8 weeks
Demolition	Demolition of RoRo ramp structures, concrete towers and levelling; Demolition of existing Harbour Maintenance Building; Demolition of elements of the existing fender structure; Clearance of existing surface on St. Michael's Pier.	12 weeks
O&M Building	Construction of new concrete pavement at the location of the demolished RoRo ramp; Construction of new foundations for O&M building; Construction of new O&M building including all civil elements (drainage, etc.); Construction of new substation building, including laying all electrical cables for the development; Installation of floating pontoon and access gangway; Erection of site O&M Base fencing, secure access gates, lighting masts and site CCTV; Installation of pontoon infrastructure & fit out for services.	78 weeks
O&M Building	Fit out of structures – O&M building, proposed substation and pontoon.	24 weeks
Final Commissioning	Commissioning of all structures and demobilising from site.	4 weeks
Total Build Period		126 weeks

Operation and maintenance phase

6.16.123 The O&M Base purpose is to provide supporting services (control, monitoring, storage, welfare) for the offshore wind farm during the projects lifecycle.

6.16.124 The O&M Base building has been designed to accommodate offices and control facilities which will be used in connection with the planning and management of the offshore maintenance operations. A typical control centre (RWE's Arkona Offshore Wind Farm) is shown in Figure 104.

Figure 104 Control centre at RWE's Arkona Offshore Wind Farm O&M building in Sassnitz, Germany

6.16.125 The building will also include warehouse storage to store various small equipment which will be used in the maintenance of offshore infrastructure.

6.16.126 Major components like generators, blades, main bearing, blade bearings or spare cable will not be stored on the O&M Base. The warehouse will store:

- Mechanical and electrical spare parts such as WTG blade brake disc and pads, filters, circuit brakers, sockets, switches, sensors, junction boxes and smoke detectors;
- Tools and equipment required for maintenance tasks, such as torque wrenches, hydraulic tools, and diagnostic devices;
- Personal protective equipment (PPE) for technicians, including helmets, harnesses, and protective clothing;
- Lubricants, cleaning agents, and fasteners used regularly during maintenance activities; and
- Emergency supplies, first aid kits and emergency response equipment to handle unforeseen incidents.

Figure 105 Warehouse storage area at RWE's Arkona Offshore Wind Farm O&M building in Sassnitz, Germany

6.16.127 Daily operations at the base will include the delivery of spare parts, materials and supplies to the O&M warehouse. There will not be any heavy engineering or manufacturing processes at the site.

Figure 106 Arkona Offshore Wind Farm O&M building in Sassnitz, Germany

6.16.128 Approximately 80 persons will work at the O&M Base, including approximately 25 offshore technicians. Technicians will arrive at the O&M Base, change into clothing/PPE suitable for offshore use, and embark on a CTV moored at the pontoon. The pontoon has been designed to accommodate 2 CTVs, however, an additional two CTVs may be rafted[42] to the CTVs berthed on the pontoon. On returning from offshore activities at the proposed wind farm, the technicians will use the Base to change, wash/dry and store clothing/PPE and equipment used offshore. There will not be any permanent overnight accommodation at the facility.

6.16.129 As access to the wind farm is required at all times, the O&M Base will need to be accessible 24 hours per day, 7 days per week. However, normal operating hours will typically involve a shift pattern of 0800 to 1800 hrs for office staff and 0600 to 2000 hrs for the offshore technicians. There will not be any planned deliveries to the O&M Base after 1800 hrs. There will be limited activity outside of these hours which include access to the building by office staff and the engineering staff. However, during periods of wind farm outage and other periods of high workload there may be a need for shifts to operate up to 2200 hrs.

6.16.130 It will be necessary to illuminate the site during the hours of darkness for safety and security reasons. A detailed lighting scheme design will be undertaken as part of the detailed design but will include single or twin head LED bulkhead light on poles, with a maximum height of 12 m in the parking areas and fluorescent lights, either wall mounted, with a maximum height of 8 m, in the warehouse area of the site. Lux level between 20 and 30 is anticipated depending on the use of the area being lit. Motion sensor lights will be used to ensure lighting on site is minimised only to when required

6.16.131 Deliveries to site will generally consist of small loads delivered by light goods vehicles (on average 2 deliveries per day) with an occasional HGV expected on rare occasions. Traffic will access the internal O&M Base via the main harbour gates off Harbour Road. Deliveries will be moved to/from the warehouse area using a forklift truck.

Decommissioning

6.16.132 As outlined in Section 6.6, a Decommissioning and Restoration Plan has been included in Volume 7 Appendix 7.2 of the EIAR. It has been prepared in accordance Section 75 of the MAP Act 2021 (as amended), and Condition 5.1 of the following MACs which relate to the O&M Base:

- Reference No. 20230012; and
- Reference No. 240020.

(hereinafter referred to collectively as the 'MACs').

42 A vessel that is temporarily secured alongside another vessel, rather than mooring independently. This technique is commonly used in harbours or during offshore operations when space is limited or for easy access between vessels.

6.16.133 As outlined in the Decommissioning and Restoration Plan, the O&M building will be either re-purposed for an alternative use or demolished following the decommissioning of the offshore infrastructure.

6.16.134 Following the decommissioning of the offshore infrastructure the fencing and pontoon will be removed, and the hardstanding area will be used by DLRCC for general harbour operations.

Registered office:
Unit 5,
Desart House,
Lower New Street,
Kilkenny
www.RWE.com