DublinArray
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EIAR Volume 4: Offshore Infrastructure Technical Appendices Appendix 4.3.3-1 Technical Baseline Report – Benthic Subtidal and Intertidal Ecology

Kish Offshore Wind Ltd

RWE SLR GoBe APEM Group

www.dublinarray-marineplanning.ie

Dublin Array Offshore Wind Farm

Environmental Impact Assessment Report

Volume 4, Appendix 4.3.3-1: Technical Baseline Report – Benthic Subtidal and Intertidal Ecology

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Glossary

Term	Definition
Abundance	Number of individuals in a community.
Array area	The area within which the WTGs and OSP's will be located.
Bathymetry	The depth of water in an ocean, sea or lake.
Benthic ecology	Benthic ecology encompasses the study of the organisms living in and on the sea floor, the interactions between them and impacts on the surrounding environment.
Biotope	A region of habitat associated with a particular ecological community.
Day grab	The Day Grab comprises two stainless steel bucket sections mounted within a stainless steel frame that ensures the grab is square and level to the seabed when it is deployed. Once lowered and the frame has made contact with the seabed, the latch plates on the buckets unlock and they are released. As the grab is retrieved the bridles connected to the buckets come under tension and the buckets close collecting the sediment sample before the grab is brought back to the surface.
Diversity	Number of different species in a community.
Dredge sampling	The dredge is used to sample organisms living on a rocky bottom or benthic species in sediment. The dredge is pulled by a boat and operates at any depth on a cable or line, generally with a hydraulic winch. The dredge digs into the ocean floor and brings the sample to the surface.
Drop Down Video (DDV)	A non-invasive, passive survey method in which imagery of habitat is collected, used predominantly to survey marine environments.
EIAR	Environmental Impact Assessment Report – a report to inform an Environmental Impact Assessment.
Offshore Export cable corridor (ECC)	The Offshore Export Cable Corridor (north and south route) (one corridor and two routes)
Geophysical	Relating to the physics of the earth.
Intertidal	The area of the shoreline which is covered at high tide and uncovered at low tide.

Term	Definition
Lowest astronomical tide	The lowest tide level which can be predicted to occur under average meteorological conditions and under any combination of astronomical conditions.
Macro	Large scale.
Mean High-Water Springs (MHWS)	MHWS is the highest level that spring tides reach on the average over a period of time (often 19 years). The height of MHWS is the average throughout the year (when the average maximum declination of the moon is 23.5°) of two successive high waters during those periods of 24 hours when the range of the tide is at its greatest.
Mean Low Water Springs (MLWS)	MLWS is the average of the levels of each pair of successive low waters when the range of the tide is greatest. The height of MLWS is the average throughout a year of the heights of two successive low waters during those periods of 24 hours (approximately once a fortnight) when the range of the tide is greatest.
Mini-Hamon grab	Comprises a stainless-steel box shaped sampling scoop mounted in a triangular frame, ideal for sampling seabed sediments, as well as sampling for benthic macrofauna.
Subtidal	The region where the seabed is below the lowest tide.
Total Organic Carbon (TOC)	The total amount of carbon found within an organic compound.
Zone of Influence (ZoI)	The area or 'zone' where impacts from the proposed development may impact upon benthic and intertidal ecology receptors.

Acronyms

Term	Definition
DBT	Dibutyl Tin
DCCAE	Department of Communications, Climate Action and Environment
DECC	Department of Environment, Climate and Communications
Dublin Array	Dublin Array Offshore Wind Farm
Offshore ECC	Export Cable Corridor
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
INFOMAR	Integrated Mapping for the Sustainable Development of Ireland's Marine Resource - a DECC funded joint programme between the Geological Survey Ireland and the Marine Institute
JNCC	Joint Nature Conservation Committee

Term	Definition
LAT	Lowest Astronomical Tide
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
NIS	Natura Impact Statement
NPWS	National Parks and Wildlife Service
O&M	Operations and Maintenance base
OSP	Offshore Substation Platform
OWF	Offshore Wind Farm
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PSA	Particle Size Analysis
SAC	Special Ares of Conservation
SPA	Special Protection Area
SSC	Suspended Sediment Concentration
TBT	Tributyltin
THC	Total Hydrocarbon
TOC	Total Organic Carbon
WTG	Wind Turbine Generator
ZoI	Zone of Influence

Biotopes

Biotope (JNCC, 2015 Classification) / EUNIS Code	Definition
IR.HIR	Atlantic and Mediterranean high energy infralittoral rock
IR.LIR	Low energy infralittoral rock
LR.HLR	High energy littoral rock
CR.HCR	High energy circalittoral rock
LR.FLR.Eph.EphX EUNIS Code MA4211	Ephemeral green and red seaweeds on variable salinity and/or disturbed eulittoral mixed substrata

Biotope (JNCC, 2015 Classification) / EUNIS Code	Definition
LR.MLR.BF.Fser.R EUNIS Code MA125441	*Fucus serratus* and red seaweed on moderately exposed lower eulittoral rock
SS.SBR.SMus.ModMx EUNIS Code MC2232	*Modiolus modiolus* beds on open coast circalittoral mixed sediment
SS.SCS.CCS.MedLumVen EUNIS Code MC3212	*Mediomastus fragilis*, *Lumbrineris spp*. and venerid bivalves in circalittoral coarse sand or gravel
LR.FLR.Eph.EntPor EUNIS Code MA123H	*Porphyra purpurea* or *Enteromorpha* spp. on sand-scoured mid or lower eulittoral rock
LR.HLR.FR EUNIS Code MA123	Robust fucoid and/or red seaweed communities
LR.MLR.BF.Rho EUNIS Code MA1245	*Rhodothamniella floridula* on sand scoured lower eulittoral rock
LR.HLR.MusB.Sem.LitX EUNIS Code MA12233	*Semibalanus balanoides* and *Littorina spp*. on exposed to moderately exposed eulittoral boulders and cobbles
LR.MLR.BF.PelB EUNIS Code 1241	*Pelvetia canaliculata* and barnacles on moderately exposed littoral fringe rock
LR.MLR.BF.FspiB EUNIS Code MA1242	*Fucus spiralis* on exposed to moderately exposed upper eulittoral rock
LR.LLR.F.Pel EUNIS Code MA123B	*Pelvetia canaliculata* on sheltered littoral fringe rock
LR.LLR.F.Fspi EUNIS Code MA123C	*Fucus spiralis* on sheltered upper eulittoral rock
LR.LLR.F.Asc.X EUNIS Code MA123E2	*Ascophyllum nodosum* on full salinity mid eulittoral mixed substrata
IR.MIR.KR.Ldig.Bo EUNIS Code	*Laminaria digitata* forest on boulders
LS.Lsa.MuSa.Lan EUNIS Code MB12172	*Lanice conchilega* in littoral sand
LS.LCS.Sh.BarSh EUNIS Code MA3211	Barren littoral shingle
LS.LSa.St.Tal EUNIS Code MA5211	Talitrids on the upper shore and strand-line
LS.LSa.FiSa.Po.Aten EUNIS Code MA52412	Fine sands with *Angulus tenuis* community complex and / Polychaetes and *Angulus tenuis* in littoral fine sand
SS.SMx.CMx.MysThyMx EUNIS Code MC4213	*Kurtiella bidentata* and *Thyasira* spp. in circalittoral muddy mixed
SS.SSa.IFiSa.IMoSa EUNIS Code MB5231	Infralittoral mobile clean sand with sparse fauna
SS.SCS.ICS.Glap EUNIS Code MB3235	*Glycera lapidum* in impoverished infralittoral mobile gravel and sand
SS.SSA.CFiSa.ApriBatPo EUNIS CODE MC5212	*Abra prismatica, Bathyporeia elegans* and polychaetes in circalittoral fine sand
SS.SSA.IFiSa.NcirBat EUNIS Code MB5233	*Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand

Biotope (JNCC, 2015 Classification) / EUNIS Code	Definition
SS.SSA.CMuSa.AalbNuc EUNIS Code MC5214	*Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment
SS.SMx.CMx.OphMx EUNIS Code MC4215	*Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment
SS.SCS.CCS.PomB EUNIS Code MC3211	*Spirobranchus triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles
SS.SSa.IMuSa.FfabMag EUNIS Code MB5236	*Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand
SS.SCS.ICS EUNIS Code MB32	Infralittoral coarse sediment
SS.Smu.CsaMu.AfilMysAnit EUNIS Code MC6211	*Amphiura filiformis*, *Mysella bidentata* and *Abra nitida* in circalittoral sandy sud

1 Introduction

1.1 Overview

1.1.1 Dublin Array Offshore Wind Farm (Dublin Array) is a proposed offshore wind farm on the Kish and Bray Banks. The Kish and Bray Banks are located, approximately 10 km off the east coast of Ireland, immediately south of Dublin city off the coast of Dublin and Wicklow counties. Dublin Array will be located within an area of approximately 59 km^2, in water depths ranging from 2 metres to 50 metres lowest astronomical tide (LAT).

1.1.2 This technical baseline should be read in conjunction with the following documents included within the Environmental Impact Assessment Report (EIAR):

- Volume 3, Chapter 1: Physical Processes (hereafter referred to as the Physical Processes chapter): to be referenced for an overview on the surficial sediment properties, suspended sediments and seabed features. This chapter also provides an assessment of the potential impacts of the project upon the marine geology, oceanography and physical processes;
- Volume 3, Chapter 2: Marine Water and Sediment Quality (hereafter referred to as the Marine Water and Sediment Quality chapter): to be referenced for a review of the marine water and sediment quality receiving environment. This chapter also provides an assessment of the potential impacts of the project upon marine water and sediment quality;
- Volume 3, Chapter 3: Benthic and Intertidal Ecology (hereafter referred to as the Benthic and Intertidal Ecology Chapter); to be referred to for an assessment of the potential impacts of the project upon benthic and intertidal ecology;
- Volume 3, Chapter 4: Fish and Shellfish Ecology (hereafter referred to as the Fish and Shellfish Ecology Chapter): to be referenced for a detailed description of the fish and shellfish ecology of the site. This chapter also provides an assessment of the potential impacts of the project upon fish and shellfish ecology;
- Volume 4, Appendix 4.3.3-2: Marine Intertidal Ecological Survey Report (hereafter referred to as the Intertidal Survey Report): to be referred to for supporting information regarding the intertidal Particle Size Analysis (PSA) survey, in addition to sediment sampling analysis and interpretation;
- Volume 4, Appendix 4.3.3-3: Subtidal Survey Report Main Array & ECR (hereafter referred to as the Subtidal Survey Report): to be referred to for supporting information regarding the subtidal PSA survey, in addition to sediment sampling analysis and interpretation;

- Volume 4, Appendix 4.3.3-5: Underwater Image Analysis Report: to be referred to for supporting information on the extents of reef features within the nearshore; and
- Volume 4, Appendix 4.3.1-1: Physical Processes Technical Baseline (hereafter referred to as the Physical Processes Technical Baseline): to be referenced for a detailed description of the surficial sediment properties, suspended sediments and seabed features.

1.2 Purpose of this Report

1.2.1 The purpose of this technical baseline report is to robustly characterise the subtidal and intertidal benthic environment present within the offshore footprint of the offshore infrastructure which is comprised of the array area (area containing the wind turbines, Offshore Substation Platform, associated foundations, inter-array cables and associated infrastructure) and Offshore Export Cable Corridor (Offshore ECC) and surrounding area. This information will inform the offshore EIA.

1.3 Report Structure

1.3.1 This report is structured as follows:

- Section 1 - Introduces the report and outlines its aims;
- Section 2 - Presents the methodology and data sources applied to characterise the receiving environment;
- Section 3 - Presents the characterisation of the existing receiving environment for the benthic ecology assessment;
- Section 4 - Presents the characterisation of the future receiving environment in the absence of the proposed development proceeding;
- Section 5 - Presents any uncertainties or data gaps which were identified during the baseline characterisation; and
- Section 6 - Provides a high-level summary of the findings of this report.

2 Methodology

2.1 Approach

2.1.1 The methodology for baseline characterisation is the collation of site-specific data collected across the array area and Offshore ECC, along with supporting data collated following a desktop review. Site-specific subtidal and intertidal surveys have been undertaken across the study area (defined in Section 2.2) to provide up to date information on the benthic subtidal and intertidal ecology resources. The fully detailed methodologies and analyses of the Dublin Array site-specific surveys are available within the subtidal survey report, intertidal survey report and Underwater Image Analysis Report

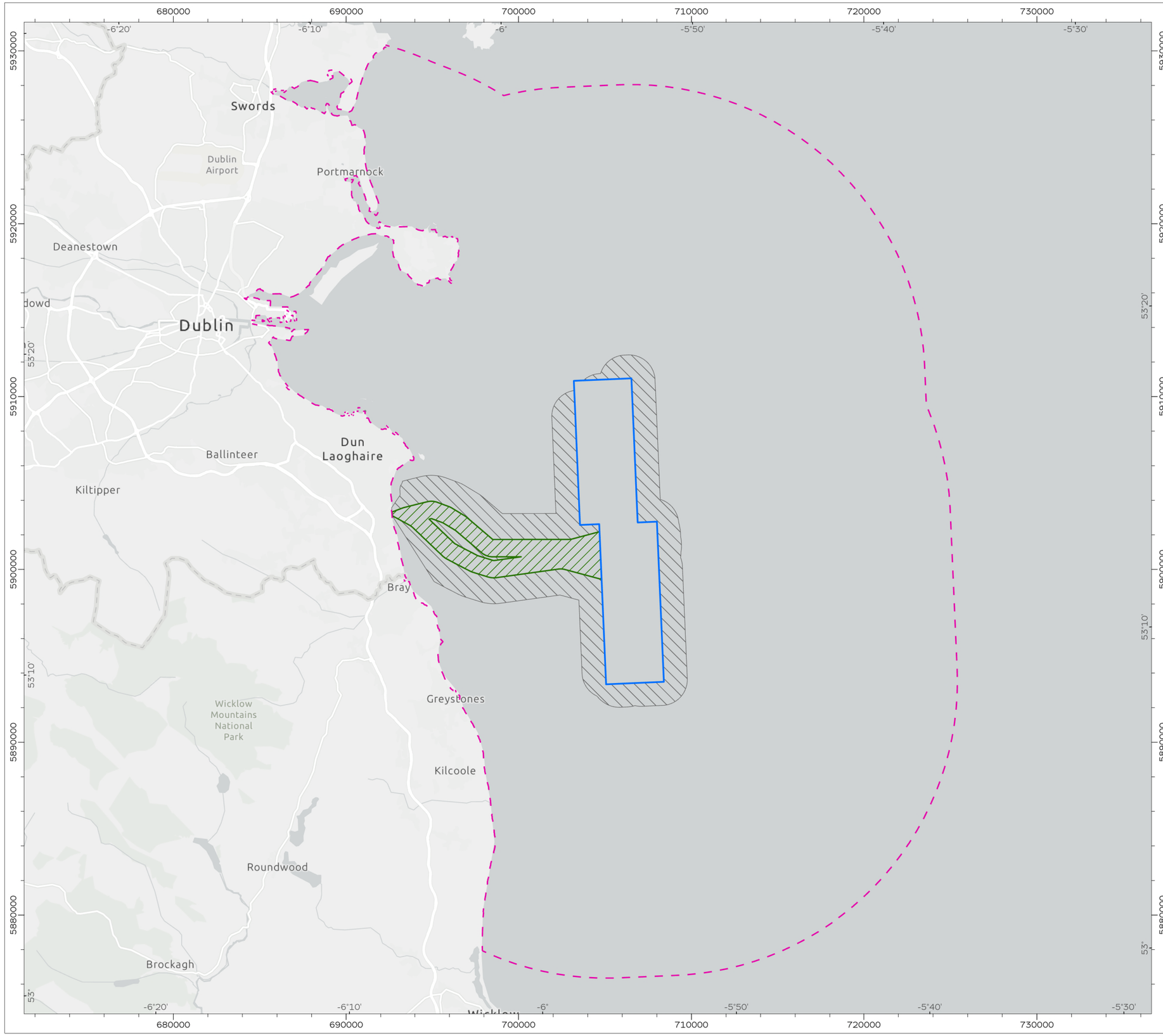
2.1.2 A detailed desktop review of currently available data (as of August 2024) has been undertaken in order to establish the baseline describing benthic subtidal and intertidal ecology resources within the study area (Section 2.2, Figure 1) and the wider region of the western Irish Sea surrounding the offshore infrastructure. A comprehensive list of the data utilised to inform the baseline characterisation is provided in Table 2.

2.2 Study Area

2.2.1 For the purposes of this chapter, the subtidal study area is defined as the project boundary, which includes all offshore works including array area, Offshore ECC[1] and temporary occupation area, together with the secondary impact Zone of Influence (ZoI), as shown in Figure 1. The secondary ZoI has been defined as 17 km[2] using a spring tidal excursion based on the project specific hydrodynamic modelling which indicated a spring tidal excursion as being 16 km (Physical Processes Modelling and Design Options Comparison Report: Volume 4, Appendix 4.3.1-5). Therefore, a study area of a 17 km buffer around Dublin Array is considered to be precautionary and to encapsulate the area within which all of the potential significant secondary or indirect effects on the benthic environment might occur. The benthic ecology study area is limited to the marine and coastal environment below Mean High Water Springs (MWHS).

2.2.2 The intertidal study area is defined by the intertidal zone extending up to the MHWS mark within the Offshore ECC (Figure 2). This study area has been defined in order to reflect the extent of potential direct impacts within the intertidal area, considered within the assessment.

[1] Activities undertaken within the temporary occupation area, namely the use of jack-up vessels and anchors during the construction, O&M, and decommissioning phases have been screened out within the physical processes chapter for suspended sediment and deposition with their use not resulting in notable changes in SSC and associated sediment deposition, however the use of a buffer ensures a precautionary approach is taken.
[2] All distances are taken from the outer boundary of all offshore works incorporating the offshore infrastructure, the buffer also incorporates the temporary occupation area and as such are inherently precautionary



Array Area

Temporary Occupation Area

Export Cable Corridor

Benthic Ecology Study Area (17km Buffer)

DRAWING STATUS

FINAL

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MAP NOTES / DATA SOURCES:

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Dublin Array Offshore Wind Farm Subtidal Study Area

DRAWING NUMBER: **1**

PAGE NUMBER: **1 of 1**

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0 1 2 3 4 nm

GRID NORTH

SCALE 1:225,000 PLOT SIZE A3

DATUM WGS 1984 VERTICAL REF LAT

PRJ WGS 1984 UTM Zone 29N

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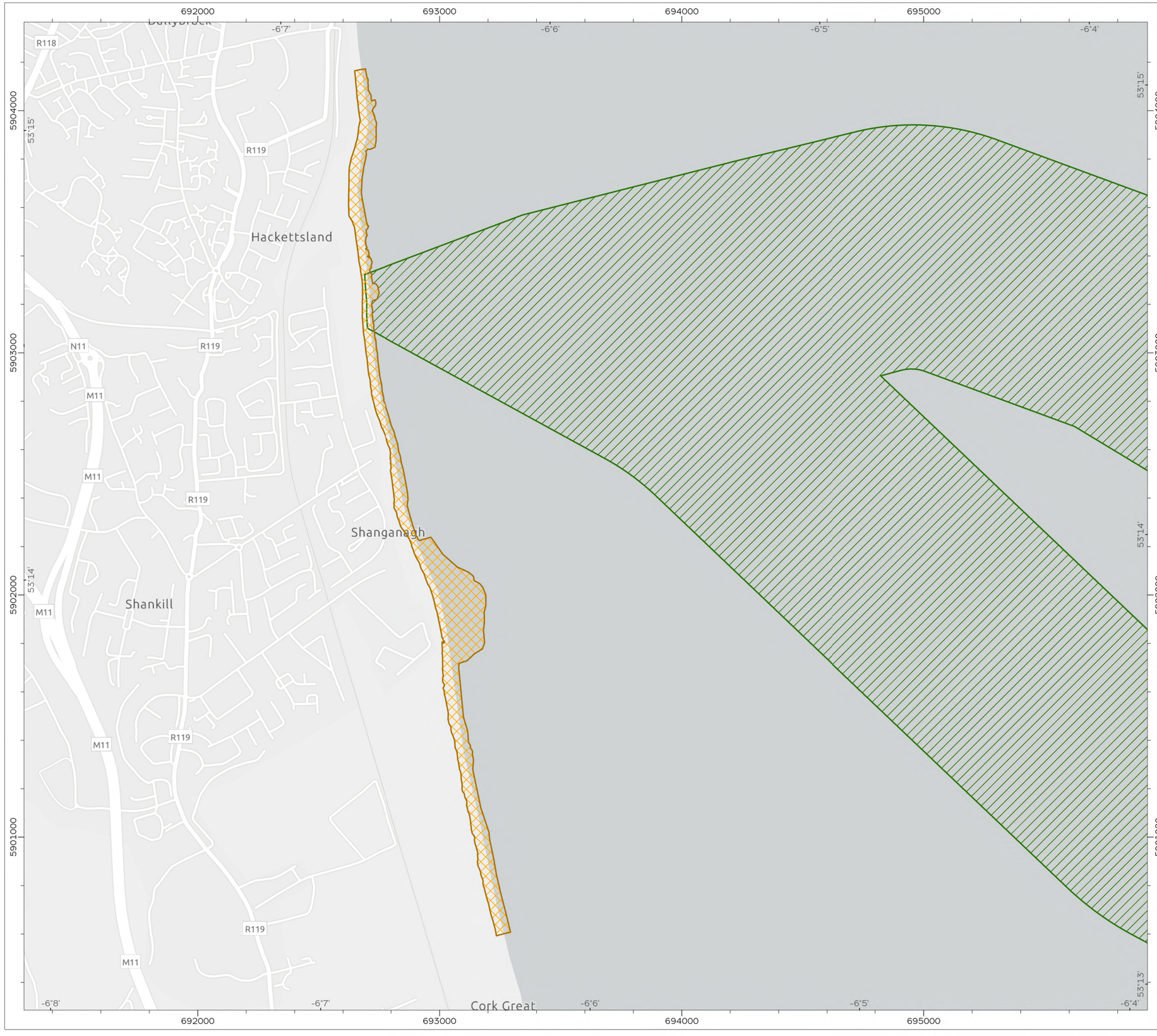

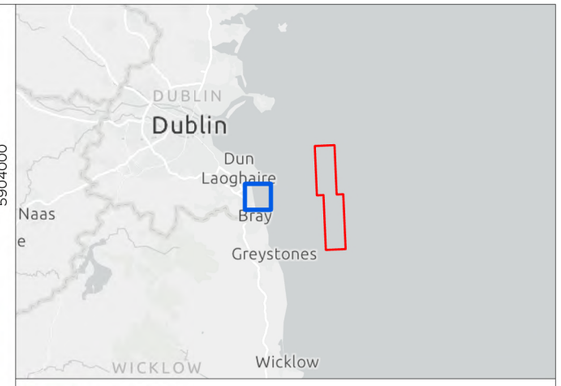

Export Cable Corridor

Intertidal Survey Area

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Dublin Array Offshore Windfarm Intertidal Study Area

DRAWING NUMBER: **2**

PAGE NUMBER: **1 of 1**

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DATUM	WGS 1984	VERTICAL REF	LAT
PRJ	WGS 1984 UTM Zone 29N		

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2.3 Baseline Data

2.3.1 Site-specific subtidal and intertidal surveys undertaken to characterise the baseline for the assessment were carried out in the offshore habitats of the array area and Offshore ECC in 2021 and 2024. The surveys are summarised in Table 1 below.

2.3.2 The site-specific surveys provide a robust and current dataset utilised to characterise the benthic environment. It is contended that any natural variation between sample date and this application submission will result in no significant changes in these environments, and as such these data provide a suitable baseline for this study. These data are supported by a detailed desktop review undertaken for the Dublin Array benthic subtidal and intertidal ecology study areas.

2.3.3 The supporting data sources used to inform the baseline are provided in Table 2 below.

Table 1 Dublin Array Site Specific Benthic and Intertidal Survey Summary

Title	Summary	Coverage of Dublin Array
Fugro, (2021). WPM1, WPM2 & WMP3 – Main Array & ECR – Benthic Ecology Monitoring Report. Dublin Array Offshore Site Investigation (Ireland, Irish Sea).	Benthic subtidal survey undertaken 14 February to 19 March 2021, consisting of drop-down video (DDV) along 29 transects and grab sampling at 28 stations. DDV was undertaken to inform seabed habitat classification. Grab sampling was undertaken using a 0.1m^2 Hamon Grab, with all samples subject to faunal and particle size analysis (PSA). Day grabs (0.1m^2) were undertaken at 15 of the grab stations for chemistry sampling (with a focus on muddy habitats).	Coverage of the Dublin Array offshore ECC and array area.
Aquafact International Services Ltd, (2021). Marine Intertidal Ecological Survey, Shanganagh & Poolbeg, Co.Dublin. Report for Kish Offshore Wind Ltd & Bray Offshore Wind Ltd.	Walkover surveys, intertidal transects and faunal cores undertaken 30 March and 1 April 2021 in the intertidal areas of the landfall site.	Coverage of intertidal study areas.
Dublin Array Offshore Wind Farm - Underwater Image Analysis (APEM, 2024)	Identification and characterisation of reef habitats in Killiney Bay from DDV analysis.	Covers shallow subtidal area off Shanganah landfall.

Table 2 Key sources of pre-existing benthic subtidal ecology data

Data Source	Type of data	Spatial coverage	Limitations
Scally *et al.* (2020).	Sublittoral and littoral benthic sampling for EU Habitats Directive Article 17 reporting.	North Dublin Bay SAC and South Dublin SAC which are 16km west of the array area.	Relevant to inshore areas only.
Integrated Mapping for the Sustainable Development of Ireland's Marine Resource (INFOMAR, 2006-2016).	INFOMAR is a twenty-year programme to map the physical, chemical and biological features of Ireland's seabed. INFOMAR is funded by the Department of Communications, Climate Action and Environment (DCCAE), and delivered by joint management partners Geological Survey Ireland and the Marine Institute. This baseline draws upon the predictive substrate modelling which characterises the sediment type.	Point data across the whole of the benthic ecology study area and the wider Irish Sea region. Complete modelled coverage up to MHWS.	Data from a variety of surveys over a temporally variable period.
EMODnet broad-scale seabed habitat map of Europe (EUSeaMap, 2021).	Interactive map of benthic data and habitat maps.	Complete coverage up to MHWS. Figure 4.	Predictive habitat mapping.
Dublin Port Company Maintenance Dredging. Assessment of Potential Benthic and Fisheries Impacts (Aquatic Services Unit, 2019).	A total of 22 subtidal samples collected in Dublin Bay in June 2016, using a 0.1 m^2 van-Veen grab for PSA, organic matter and faunal analysis. DDV data were also collected at 15 stations.	Samples have been collected around Burford Bank dump site 6 km west of the array area and 6 km north of the Offshore ECC but within the benthic subtidal study area.	Relevant to inshore areas only
Marine Ecological Assessment of Dublin	Historic subtidal benthic surveys were undertaken across Dublin Array	Overlap with Dublin Array and wider benthic subtidal and intertidal	Qualitative data due to methodologies employed, although biotope

Data Source	Type of data	Spatial coverage	Limitations
Array Wind Farm (Aquafact International Services Ltd., 2017[3]).	and the wider subtidal benthic study area. A total of 22 samples were collected in October 2017 using a biological dredge sampler for PSA organic matter and faunal analysis. Intertidal survey of the proposed Offshore ECC and landfall site was undertaken in July 2017. Walkover survey and collection of five replicate sediment cores were collected along a transect (upper, mid and low locations) to be analysed for fauna and PSA.	ecology study area (Kish and Bray Banks and southern Offshore ECC including landfall area).	identification represents useful reference.
A marine ecological study of the Kish and Bray Banks for a proposed offshore wind farm development: Re-characterisation survey (EcoServe, 2008*).	Historic benthic surveys (intertidal and subtidal) undertaken across the array area, Offshore ECC and landfall. Intertidal survey of the proposed landfall site. Walkover survey and collection of two core samples at the landfall location to be analysed for fauna and Particle Size Analysis (PSA).	Overlap with Dublin Array and wider benthic subtidal and intertidal ecology study area (Kish and Bray Banks and southern Offshore ECC including the intertidal).	Historic data. Qualitative data due to methodologies employed, although biotope identification represents useful reference
Benthic surveys of sandbanks in the Irish	Two subtidal grab surveys were undertaken on Blackwater and Kish Banks during 2005. 12 stations (with	Overlap with Dublin Array and wider benthic subtidal and intertidal	Historic data.

[3] https://www.gov.ie/en/foreshore-notice/60c81-bray-offshore-wind-ltd/

Data Source	Type of data	Spatial coverage	Limitations
Sea (Roche *et al.*, 2007*).	5 replicates) were sampled using a 0.1 m^2 Day grab to be analysed for fauna and PSA. The survey was undertaken in support of National Parks and Wildlife Services (NPWS) baseline characterisation of sandbanks.	ecology study area (Kish Bank and Blackwater Bank).	
Marine Institute 2014 - Water Framework Directive (WFD) monitoring.	Sublittoral benthic sampling for WFD compliance.	Tolka Estuary, inner Dublin Bay and Killiney Bay.	Relevant to inshore areas only.
Marine sites, habitats and species data collected during the BioMar survey of Ireland (Picton *et al*. 1997).	Sublittoral benthic sampling for characterisation of sandbank habitats.	Kish Bank.	Historic data.
Short autumn Survey of seagrass (*Zostera noltii*) in Dublin Bay, October 2021 (Hagan & Dubsky, 2021)	Mapping of intertidal seagrass beds on Sandymount/Merrion Strand, Bull Island and the coastline from Irishtown beach to the Poolbeg lighthouse.		Short autumn survey of seagrass (Zostera noltii) in Dublin Bay, October 2021 (Hagan & Dubsky, 2021)
Littoral and sublittoral Reef habitats of Dún Laoghaire Rathdown County Council area (MERC Consultants, 2022)	Identification and mapping of intertidal and subtidal reef habitat between Dún Laoghaire and Bray.	Covers shallow subtidal area off Shanganah landfall.	Relevant to inshore areas only.

3 Receiving Environment

3.1 Benthic Subtidal Ecology

3.1.1 The following sections summarise what is currently known of the existing benthic habitats and communities within the benthic ecology subtidal and intertidal study areas, based on a review of site specific (Table 1) and pre-existing data sets (Table 2).

3.1.2 The subtidal and intertidal site-specific survey reports include the detailed methodologies, statistical analyses, and interpretation of physiochemical and biological information the results of which are summarised below.

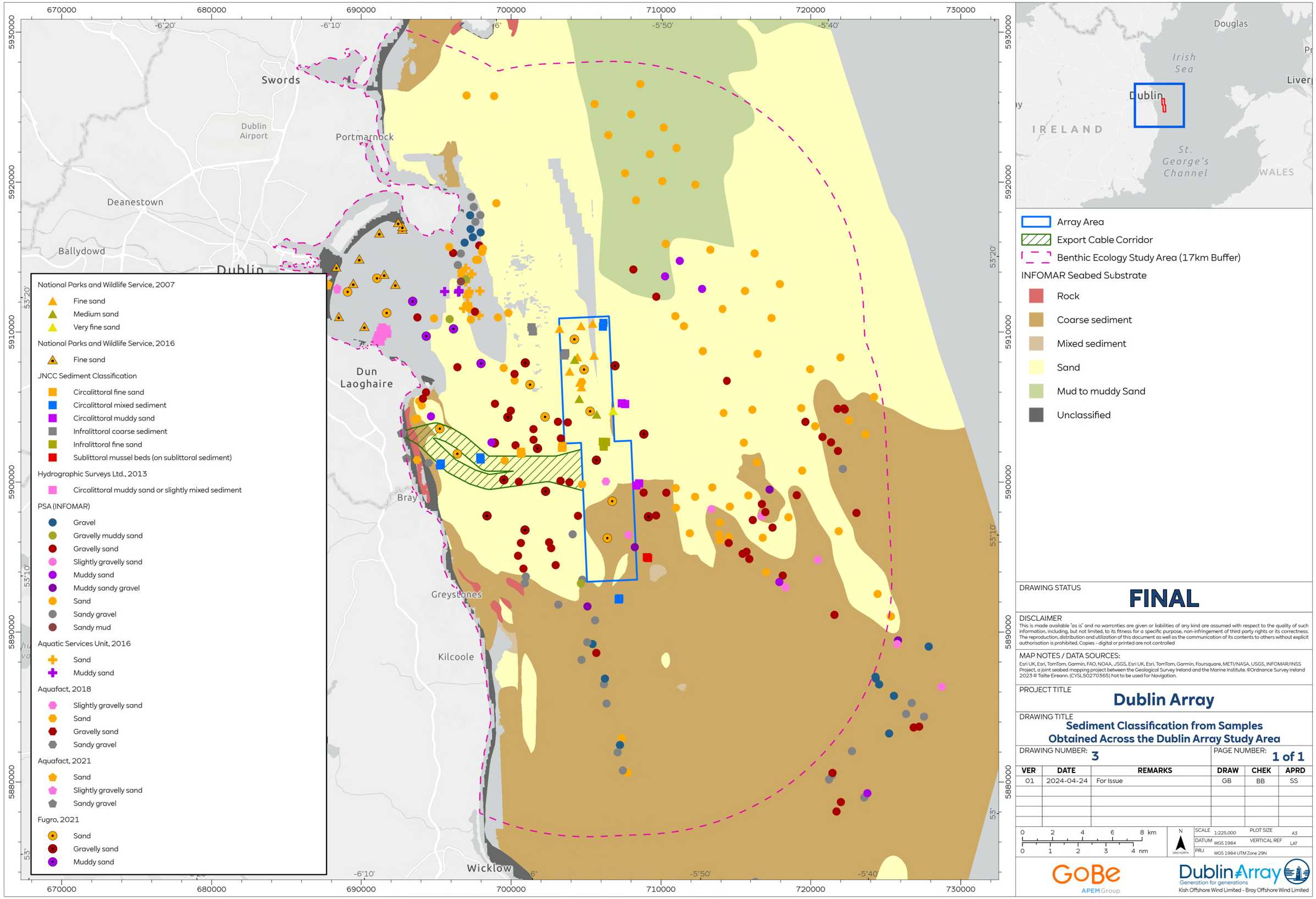
Subtidal Sediments

3.1.3 The Kish and Bray Banks are submarine banks located within the array area, consisting mainly of sand and gravel. The northern 10-12 km of the bank system is called the Kish bank. South of this point the bank system extends a further 10 km and is known as the Bray bank. The banks are approximately 2.2 km wide at their widest point.

3.1.4 Subtidal site-specific surveys (Fugro, 2021) defined a relatively homogenous predominantly sandy seabed at28 sites, specifically sand (12 sites), gravelly sand (12 sites) and muddy sands (four sites).

3.1.5 The site-specific particle size data has been presented alongside the supporting baseline data in Figure 3. Integrated Mapping for the Sustainable Development of Ireland's Marine Resource (INFOMAR) predictive substrate modelling supports these findings, characterising sediments in the northern half of the array area as predominantly sand and the southern half of the array area as sand and coarser gravelly material. Wheeler *at al*. (2001) reported that the Kish and Bray Banks were characterised by sands with variable proportions of coarser material. The INFOMAR model defines the inshore portion of the Offshore ECC as predominantly sand with some gravels present. Further offshore, the Offshore ECC is characterised primarily as gravelly sands and sands, with a stretch of sandy mud to muddy sands situated across the mid-section. The INFOMAR modelling data and data from the site-specific survey across the subtidal areas of the project (Fugro, 2021) is further supported by characterisation data previously collected from the study area (EcoServe, 2008 and Aquafact, 2017), Dublin Port dredge disposal site (Aquatic Services Unit, 2019) and the Irish Sea Sandbanks data (Roche *et al*., 2007) which all recorded similar particle size distributions across the site.

3.1.6 These observations indicate a generally good agreement between the regional sediment data (INFOMAR), historical data and the site-specific data collected. Therefore, the information detailed here is considered to be representative and appropriate for the purposes of EIA.



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PROJECT TITLE

Dublin Array

DRAWING TITLE

Sediment Classification from Samples Obtained Across the Dublin Array Study Area

DRAWING NUMBER: **3**

PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
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GRID NORTH

SCALE 1:225,000 PLOT SIZE A3
DATUM WGS 1984 VERTICAL REF LAT
PRJ WGS 1984 UTM Zone 29N

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Kish Offshore Wind Limited - Bray Offshore Wind Limited

Organic Content of the Sediment

3.1.7 Terrestrially derived carbon from run-off and fluvial systems, combined with primary production from sources (including planktonic blooms), contribute to the Total Organic Carbon (TOC) levels recorded in marine sediments. TOC represents the proportion of organic detritus present. Organic detritus is metabolised by heterotrophic bacteria but is also consumed directly by a wide range of marine invertebrates and is therefore an important source of food for benthic fauna (Sanders, 1958; Pearson and Rosenberg, 1978; Snelgrove and Butman, 1994). Organic enrichment (i.e. elevated levels of sediment TOC) can lead to benthic community changes which may be characterised by lower diversity and increased abundance along with changes in trophic functioning and increasing dominance of small, stress tolerant species; these changes are driven by impacts associated with increased deposition and changes in sediment chemistry associated with the elevated supply of organic material (Pearson and Rosenberg, 1978).

3.1.8 TOC levels in sediments collected during the site-specific subtidal survey were relatively low with recorded values of between < 0.02 % and 1.43 %, with a mean of 0.23 % - the majority of values were between 0.05 and 0.51% (Fugro, 2021). Higher levels of TOC tended to be found at inshore sites while the lowest values were recorded further offshore in association with the coarser sediments of the southern half of the array area and the offshore portion of the Offshore ECC.

3.1.9 There was a clear positive correlation between TOC and proportion of silt and clay, as would be expected. The fine fraction of sediments retain more organic matter than coarser fractions, a pattern related to a greater adsorption capacity of fine-grained particles due to the proportionally greater surface area available for adsorption, compared to coarser material (Keil and Hedges, 1993; Burdige, 2007). Moreover, fine-grained particles enhance the preservation of organic matter through reduced redox potential and/or remineralisation rates (Hedges and Keil, 1995; Dauwe *et al*., 2001; Burdige, 2007).

3.1.10 Some variation in TOC levels were evident between those reported by Fugro (2021) and a previous study (Aquafact, 2018) which recorded a mean TOC of 1.3% - over five times that in the later survey. However, these variations are clearly related to the proportion of silt and clay, with the sediments with higher reported TOC having an average silt and clay content of 4.2% compared to 0.5% in sediments with lower TOC.

3.1.11 Sediment characteristics identified from the site-specific surveys were consistent with those reported historically from this area with substrates being predominantly sandy in nature with variable proportions of gravel and fines.

Sediment Contaminants

3.1.12 Contaminant levels are often examined in isolation, without reference to the possible effects associated with the natural variability of sediment characteristics. Muds and silts tend to have naturally higher levels of metals compared with coarser sands owing to a large surface area, oxyhydroxide and organic coatings which readily sequester metals compared to coarser sands and gravels which are generally accepted as carrying a much lower contamination risk (Luoma and Davis, 1983; Waldichuck, 1985; Loring, 1991;). Consequently, information regarding sediment granulometry is an important step in assessing the potential contamination risk to the marine environment if sediments are disturbed as a result of development.

3.1.13 Sediments throughout most of the proposed development area are dominated by sand, and as such, sediment bound contaminants are predicted to be low. Results from the site-specific survey (Fugro, 2021) confirmed these predictions, with levels of sediment bound contaminants found to be low in the array area and within the majority of the Offshore ECC. The level of metals present in the sediment samples collected within the array area and Offshore ECC were analysed in accordance with the Guidelines for the Assessment of Dredged Material for Disposal in Irish Waters (Cronin *et al*, 2006) and addendum (Marine Institute, 2019) which provide upper and lower Irish Action Levels. All contaminants with concentrations below the lower action level (Class 1) are considered a low risk to the marine environment. Concentrations between the lower and upper action levels (Class 2) are considered marginally contaminated. Concentrations higher than the upper action level (Class 3) are considered likely to cause harm to a marine environment.

3.1.14 There were no occurrences of contaminants exceeding the lower Irish Action Level in subtidal sediments, with the exception of one site within the array area located at the south of the Kish and Bray Banks, where the arsenic concentration was marginally higher than the lower action level; this concentration is characterised as Class 2 (i.e. marginally contaminated) and is not considered to constitute an environmental risk.

3.1.15 Inter-tidal sampling at the landfall locations demonstrates low contaminant levels in the beach sediments, with arsenic the only parameter which exceeded the lower Action. Whilst aluminium levels appear high at all of the intertidal sediment samples and at two from the Offshore ECC (ST03 and ST24), the samples align with expected contaminant levels (pers. comm, Cronin, 2021). All samples collected for the project reported levels of Dibutyl Tin (DBT) and Tributyl Tin (TBT) that were well below the Irish Sediment Quality Lower Level (Table 2); samples taken at landfall all reported levels less than 1 µg/kg for both contaminants.

3.1.16 None of the sediment samples collected across the array area and Offshore ECC as part of the site specific survey exhibit Polycyclic Aromatic Hydrocarbon (PAH) or Polychlorinated Biphenyl (PCB) levels in exceedance of the Irish Sediment Quality Guidelines. In addition, analysis of the Total Hydrocarbon (THC) and n-Alkanes revealed no elevated levels (Fugro, 2021). Furthermore, levels of Dibutyltin (DBT) and Tributyltin (TBT) were well below the Irish Sediment Quality Lower Level. Consequently, sediments from the array area and Offshore ECC are considered to be Class 1 where organic chemical are concerned. For a full breakdown of the sediment contaminants sampling, results and analysis see Fugro (2021), while a summary of the results is presented within the Marine Water and Sediment Quality chapter which also includes the historical background of the study area in terms of sediment contaminants.

Subtidal Benthic Communities

3.1.17 Sandy sediments that characterise the Kish and Bray Bank sand bank features are colonised by burrowing polychaete worms, crustaceans and bivalve molluscs. Epifauna at the surface of the sandbank may also include mysid shrimps, gastropods, crabs and fish. Sand-eels (*Ammodytes* spp.), an important food for birds, often inhabit sandy sediments, whereas coarse stable material, such as shells or stones is inhabited by hydroids, bryozoans and ascidians (Roche *et al*., 2007).

3.1.18 Site-specific surveys undertaken across the array area and the Offshore ECC (Fugro, 2021) complement this, with macrofaunal communities identified as comprising infaunal and epifaunal taxa, dominated by polychaetes and molluscs. Crustaceans and other groups were less represented by comparison. Characterising polychaetes identified from the site-specific surveys included *Spirobranchus lamarcki*, *Lumbrineris cf. cingulata*, *Pholoe baltica*, *Ophelia borealis*, *Nephtys cirrosa*, *Spiophanes bombyx* and *Owenia borealis*. Mollusc species included opportunistic species such as the bivalves *Nucula nucleus*, *Kurtiella bidentata*, *Abra alba*, *Nucula nitidosa*, *Fabulina fabula* and *Tellimya ferruginosa*, along with the gastropod *Euspira nitida*. Overall, it is concluded that the faunal communities identified are indicative of a dynamic seabed and typical of a high energy environment.

3.1.19 Site-specific surveys (Fugro, 2021) and supporting historic data (Aquafact, 2017; Aquatic Services Unit, 2019; EcoServe, 2008; and Roche *et al*., 2007; INFOMAR, 2006-2016) collected from across the study area identified the presence of the following subtidal biotopes (the distribution of the biotopes is presented in Figure 4).

- ***Fabulina fabula* and *Magelona mirabilis* with venerid bivalves and amphipods in infralittoral compacted fine muddy sand (SS.SSa.IMuSa.FfabMag / EUNIS Code MB5236):** The biotope is described as stable, fine, compacted sands and slightly muddy sands in the infralittoral and littoral fringe, hosting communities dominated by venerid bivalves. Communities at three of the site-specific survey sites within Dublin Bay were assigned this biotope (Fugro, 2021).

- **Infralittoral coarse sediment** (**SS.SCS.ICS / EUNIS Code MB3):** This biotope was recorded across the array area, and the nearshore section of the southern Offshore ECC. The biotope is described as being typical of moderately exposed habitats with coarse and/or gravelly sand, shingle and gravel in the infralittoral, subject to disturbance by tidal streams and wave action. As consequence of the physical disturbance, the fauna of this habitat is restricted to robust infaunal polychaetes, crustaceans and venerid bivalves (EEA, 2022).

- ***Abra alba* and *Nucula nitidosa* in circalittoral muddy sand or slightly mixed sediment (SS.SSa.CMuSa.AalbNuc / EUNIS Code MC5214):** This biotope is representative of non-cohesive muddy sands or slightly shelly/gravelly muddy sand characterised by the bivalves *Abra alba* and *Nucula nitidosa*. Other important taxa include *Nephtys* spp., *Chaetozone setosa* and *Spiophanes bombyx* with the bivalve *Fabulina fabula* also common in many areas. The echinoderms *Ophiura albida* and *Asterias rubens* may also be present. During the site-specific surveys this biotope was identified at seven stations spread throughout the array and Offshore ECC (Fugro, 2021). It was also recorded across the wider study area in other characterisation surveys (Aquafact, 2017; Aquatic Services Unit, 2016; EcoServe, 2008; and Roche *et al*., 2007; INFOMAR, 2006-2016).

- ***Amphiura filiformis*, *Mysella bidentata* and *Abra nitida* in circalittoral sandy mud (SS.SMu.CSaMu.AfilMysAnit / EUNIS Code MC6211)**: This biotope is often found in cohesive sandy mud off wave exposed coasts with weak tidal streams in muddy sands in moderately deep water. It is characterised by super-abundant populations of the brittlestar *Amphiura filiformis* with the bivalves *Kurtiella bidentata* and *Abra nitida.* Other important taxa may include the sipunculid *Thysanocardia procera* and the polychaetes *Nephtys incisa*, *Phoronis* sp. and *Pholoe* sp., with cirratulids also common in some areas. Other taxa such as the polychaete *Nephtys hombergii*, the sea potato *Echinocardium cordatum*, bivalve *Nucula nitidosa,* and the crustaceans *Callianassa subterranea* and *Eudorella truncatula* may also occur in offshore examples of this biotope. This biotope was identified at four site specific surveys in outer Dublin Bay (Fugro, 2021), which agrees with the findings of historical surveys (Aquafact, 2017; Aquatic Services Unit, 2016; EcoServe, 2008; Roche *et al*., 2007; INFOMAR, 2006-2016).

- ***Mediomastus fragilis*, *Lumbrineris spp*. and venerid bivalves in circalittoral coarse sand or gravel (SS.SCS.CCS.MedLumVen / EUNIS Code MC3212)**: This biotope is classified as being one that 'may occur within', is 'contained within' or is considered 'typical of' Annex I Habitats as designated under the Habitats Directive (Council Directive 92/43/EEC). This biotope is characterised by circalittoral gravels, coarse to medium sands, and shell gravels, sometimes with a small amount of silt and is generally found in relatively deep water (generally over 15-20 m). It may be characterised by polychaetes such as *Mediomastus fragilis*, *Lumbrineris* spp., *Glycera lapidum* with the sea urchin *Echinocyamus pusillus*. Other taxa may include Nemerteans, the polychaetes *Protodorvillea kefersteini*, *Owenia fusiformis*, and *Spiophanes bombyx* and the brittlestar *Amphipholis squamata* along with amphipods such as *Ampelisca spinipes*. The biotope was one of the most recorded biotopes identified within the aarray area and Offshore ECC as well as within the wider benthic study area as indicated by supporting historic surveys (Aquafact, 2017; Aquatic Services Unit, 2016; EcoServe, 2008; and Roche *et al*., 2007; INFOMAR, 2006-2016).

- ***Kurtiella bidentata* and *Thyasira spp.* in circalittoral muddy mixed sediment (SS.SMx.CMx.MysThyMx / EUNIS Code MC4213)**: This biotope is often found in moderately exposed or sheltered, circalittoral muddy sands and gravels where a community characterised by the bivalves *Thyasira* spp. (often *Thyasira flexuosa*), *Kurtiella bidentata* and the polychaete *Prionospio fallax* may develop. Infaunal polychaetes such as *Lumbrineris gracilis*, *Chaetozone setosa* and *Scoloplos armiger* are also common whilst amphipods such as *Ampelisca* spp. and the cumacean *Eudorella truncatula* may also be found in some areas. The brittlestar *Amphiura filiformis* may also be abundant at some sites. Conspicuous epifauna may include encrusting bryozoans *Escharella* spp., particularly *Escharella immersa*. This biotope was recorded in historic surveys across the Dublin Array project boundary (both in the array area and OffshoreECCs) (Aquafact, 2017; Aquatic Services Unit, 2016; EcoServe, 2008; Roche *et al*., 2007; INFOMAR, 2006-2016).

- **Infralittoral mobile clean sand with sparse fauna (SS.SSa.IFiSa.IMoSa / EUNIS Code MB5231)**: This biotope is characterised by medium to fine sandy sediment in shallow water, often formed into dunes, on exposed or tide-swept coasts and often contains very little infauna due to the mobility of the substratum. Some opportunistic populations of infaunal amphipods may occur, particularly in less mobile examples in conjunction with low numbers of mysids such as *Gastrosaccus spinifer*, the polychaete *Nephtys cirrosa* and the isopod *Eurydice pulchra*. Sand eels *Ammodytes* sp. may occasionally be observed. Common epifaunal species such as the crabs *Pagurus bernhardus*, *Liocarcinus depurator* and *Carcinus maenas* and the common starfish *Asterias rubens* may be encountered and are the most conspicuous species present. This biotope was also recorded offshore in historical surveys across the Dublin Array benthic study area (Aquafact, 2017; Aquatic Services Unit, 2016; EcoServe, 2008; *Roche et al*., 2007; INFOMAR, 2006-2016).

- ***Glycera lapidum* in impoverished infralittoral mobile gravel and sand (SS.SCS.ICS.Glap / EUNIS Code MB3235)**: This biotope is characterised by infralittoral mixed slightly gravelly sands on exposed open coasts where impoverished communities characterised by the polychaete *Glycera lapidum* (agg.) may be found. *Glycera lapidum* is quite widespread and may occur in a variety of coarse sediments. However, *G. lapidum* is rarely considered a characteristic species and where this is the case it is normally due to the exclusion of other species. Consequently, it is considered that habitats containing this biotope may be subject to continual or periodic sediment disturbance from wave action, which prevents the establishment of a more stable community. Other taxa include spionid polychaetes such as *Spio martinensis* and *Spiophanes bombyx*, the catworm *Nephtys* spp. and in some areas the bivalve *Spisula elliptica*. It is possible that SCS.Glap is not a true biotope, rather an impoverished, transitional community, which in more settled conditions develops into other more stable communities. This biotope was recorded in complex with other biotopes described below and was recorded within the northern part of the array area in other studies (Aquafact, 2017; Aquatic Services Unit, 2016; EcoServe, 2008; Roche *et al*., 2007; INFOMAR, 2006-2016).

- ***Abra prismatica*, *Bathyporeia elegans* and polychaetes in circalittoral fine sand (SS.SSA.CFiSa.ApriBatPo / EUNIS Code MC5212):** This biotope is often found in circalittoral and offshore medium to fine sands between 25 m and 100 m depth. The community is characterised by the bivalve *Abra prismatica*, the amphipod *Bathyporeia elegans* and polychaetes such as *Scoloplos armiger*, *Spiophanes bombyx*, *Aonides paucibranchiata*, *Chaetozone setosa*, *Ophelia borealis* and *Nephtys longosetosa* may be found. Crustacea such as the cumacean *Eudorellopsis deformis* and the polychaetes such as *Ophelia borealis*, *Travisia forbesii* or *Ophelina neglecta* are often present in this biotope and the brittlestar *Amphiura filiformis* may also be common at some sites. This biotope was recorded within the northern part of the array area and at locations to the north of the Offshore ECC both from site-specific surveys and during historical studies from the area (Aquafact, 2017; Aquatic Services Unit, 2016; EcoServe, 2008; Roche *et al*., 2007; INFOMAR, 2006-2016).

- ***Nephtys cirrosa* and *Bathyporeia* spp. in infralittoral sand (SS.SSA.IFiSa.NcirBat / EUNIS Code MB5233)**: This biotope is representative of well-sorted medium and fine sands characterised by the catworm *Nephtys cirrosa* and the amphipod *Bathyporeia* spp., which occur in the shallow sublittoral to at least 30 m depth. This biotope occurs in sediments subject to physical disturbance, because of wave action (and occasionally strong tidal streams). The magelonid polychaete *Magelona mirabilis* may be frequent in this biotope in more sheltered, less tideswept areas whilst in coarser sediments the opportunistic polychaete *Chaetozone setosa* may be commonly found. The faunal diversity of this biotope is considerably reduced compared to less disturbed biotopes (such as FfabMag) and for the most part consists of the more actively-swimming amphipods. Sand eels *Ammodytes* spp. may occasionally be observed in association with this biotope (and others) and spionid polychaetes such as *Spio filicornis* and *S. martinensis* may also be present. Occasional the sand mason *Lanice conchilega* may be visible at the sediment surface. This biotope was recorded across the Kish Bank within the northern array area in supporting studies (Aquafact, 2017; Aquatic Services Unit, 2016; EcoServe, 2008; Roche et al., 2007; INFOMAR, 2006-2016).

- ***Ophiothrix fragilis* and/or *Ophiocomina nigra* brittlestar beds on sublittoral mixed sediment (SS.SMx.CMx.OphMx / EUNIS Code MC4215)**: This biotope is representative of circalittoral sediment dominated by brittlestars (hundreds or thousands per m^{-2}) forming dense beds, living on boulder, gravel or sedimentary substrata. *Ophiothrix fragilis* and *Ophiocomina nigra* are the main bed-forming species. Brittlestar beds vary in size and usually have a patchy internal structure, with localized concentrations of higher animal density. This biotope was recorded at a station within the nearshore portion of the Offshore ECC in supporting studies (Aquafact, 2017; Aquatic Services Unit, 2016; EcoServe, 2008; Roche *et al*., 2007; INFOMAR, 2006-2016).

- ***Modiolus modiolus* beds on open coast circalittoral mixed sediment (SS.SBR.SMus.ModMx / EUNIS Code MC2232)**: This biotope is classified as one that 'may occur within', is 'contained within' or is considered 'typical of' Annex I Habitats as designated under the Habitats Directive (Council Directive 92/43/EEC). This biotope is characterised by muddy gravels and coarse sands in deeper water of continental seas which venerid bivalves with beds of the horse mussel *Modiolus modiolus*. The clumping of the byssus threads of the *M. modiolus* creates a stable habitat that attracts a very rich infaunal community with a high density of polychaete species including *Glycera lapidum, Paradoneis lyra, Aonides paucibranchiata, Laonice bahusiensis, Protomystides bidentata, Lumbrineris spp., Mediomastus fragilis* and syllids such as *Exogone* spp. and *Sphaerosyllis* spp. Bivalves such as *Spisula elliptica, Timoclea ovata* and other venerid species are also common while brittlestars such as *Amphipholis squamata* may also occur. This biotope was reportedly located outside of the southern array area in supporting studies (Aquafact, 2017; Aquatic Services Unit, 2016; EcoServe, 2008; Roche *et al.,* 2007; INFOMAR, 2006-2016).

- ***Spirobranchus triqueter* with barnacles and bryozoan crusts on unstable circalittoral cobbles and pebbles (SS.SCS.CCS.PomB / EUNIS Code MC3211)**: This biotope is characterised by ubiquitous robust and/or fast-growing ephemeral species which can colonise pebbles and unstable cobbles and slates which are regularly moved by wave and tidal action. The main cover organisms tend to be restricted to calcareous tube worms such as *Spirobranchus triqueter* (or *P. lamarcki*), small barnacles including *Balanus crenatus* and *Balanus balanus* bryozoan and coralline algal crusts. Scour action from the mobile substratum prevents colonisation by more delicate species. Occasionally in tide-swept conditions tufts of hydroids such as *Sertularia argentea* and *Hydrallmania falcata* are present. This biotope was recorded across the near shore portion of the Offshore ECC in supporting studies (Aquafact, 2017; Aquatic Services Unit, 2016; EcoServe, 2008; Roche *et al*., 2007; INFOMAR, 2006-2016).

- **Polychaetes and *Angulus tenuis* in littoral fine sand (SS.LSa.FiSa.Po.Aten / EUNIS Code MA52412)**: This biotope complex is likely to occur on the mid and lower shore on moderately wave-exposed and sheltered coasts, with predominantly fine sand which remains damp throughout the tidal cycle. The sediment is often rippled, and an anoxic layer may occasionally occur below a depth of 10 cm, though it is often patchy. The infaunal community is dominated by the abundant bivalve *Angulus tenuis* together with a range of polychaetes. The presence of polychaetes may be seen as coloured burrows running down from the surface of the sediment. Polychaetes that are characterising for this biotope include *Nephtys cirrosa*, *Paraonis fulgens* and *Spio filicornis*. Burrowing amphipods *Bathyporeia* spp. may occur in some examples of this biotope. This biotope was recorded north of the Offshore ECC and surrounding area in supporting studies (Aquafact, 2017; Aquatic Services Unit, 2016; EcoServe, 2008; Roche *et al*., 2007; INFOMAR, 2006-2016).

3.1.20 At the most inshore site, located 1km offshore of the landfall, the seabed was characterised by pebbles, cobbles and boulders with the biotope Atlantic and Mediterranean high energy infralittoral rock (IR.HIR / EUNIS Code MC15) identified (Fugro, 2021). This biotope is classified as one that 'may occur within', is 'contained within' or is considered 'typical of' Annex I Habitats as designated under the Habitats Directive (Council Directive 92/43/EEC). The biotope is described as a rocky habitat in the infralittoral zone subject to, exposed to extremely exposed, wave action or strong tidal streams; epibiota include kelp, such as *Laminaria hyperborea* with foliose seaweeds and invertebrates, the latter becoming more prominent in areas of strong water movement (EEA, 2022).

3.1.21 Reef habitat conforming to the EU Annex I habitat Reef (EU Habitat code 1170) has been identified from the shallow sublittoral running parallel to the shore between Killiney in the north and Bray in the south, a distance of approximately 5 km, and extending approximately 1.25 km offshore (MERC Consultants, 2022). The habitats were surveyed by a combination of DDV and dive surveys from which the following biotope complexes were identified:

- **Sand or gravel affected or disturbed kelp and seaweed communities (IR.HIR.Ksed / EUNIS Code MB123):** Infralittoral rock habitats, subject to disturbance through mobility of the substratum (boulders or cobbles) or abrasion/covering by nearby coarse sediments or suspended particulate matter (sand). The associated communities can be quite variable in character, depending on the particular conditions, which prevail. Infralittoral rock in wave and tide-sheltered conditions, supporting silty communities with *Laminaria hyperborea* and/or *Laminaria saccharina*. Associated seaweeds are silt-tolerant and include a high proportion of delicate filamentous types. Some areas, particularly in the lower infralittoral zone, are subject to intense grazing by urchins and chitons and may have poorly developed seaweed communities.

- **Echinoderms and crustose communities on Atlantic circalittoral rock (CR.MCR.EcCr / EUNIS Code MC122):** This habitat type occurs on wave-exposed, moderately strong to weakly tide-swept, circalittoral bedrock and boulders. Echinoderms, faunal (*Parasmittina trispinosa*) and algal crusts (red encrusting algae) dominate this biotope, giving a sparse appearance. Echinoderms present include the starfish *Asterias rubens*, the brittlestar *Ophiothrix fragilis* and the sea urchin *Echinus esculentus*. There may be isolated clumps of the hydroids *Nemertesia antennina* and *Abietinaria abietina*, *Alcyonium digitatum*, the anemone *Urticina felina* and the cup coral *Caryophyllia smithii*. Other species present may include the polychaete *Pomatoceros triqueter* and the top shell *Calliostoma zizphinum*.

3.1.22 Further work was undertaken in this area in Spring 2024 with the aim of further identifying the characteristics and extent of geogenic or any biogenic reef (APEM, 2024). The survey comprised seven transects of between 120 and 325m running parallel to the shore at distances of between 300 and 750m from the shoreline along which still and video imagery was captured. Analysis of the images indicated the presence of five biotopes or biotope complexes.

- **Circalittoral fine mud (SS.SMu.CFiMu / EUNIS Code MC611)**: Sublittoral muds, occurring below moderate depths of 15-20 m, either on the open coast or in marine inlets such as sealochs. The seapens *Virgularia mirabilis* and *Pennatula phosphorea* are characteristic of this habitat type together with the burrowing anemone *Cerianthus lloydii* and the ophiuroid *Amphiura* spp. The relatively stable conditions often lead to the establishment of communities of burrowing megafaunal species, such as *Nephrops norvegicus*.

- **Dense foliose red seaweeds on moderately exposed Atlantic infralittoral silty rock (IR.MIR.KR.XFoR / EUNIS Code MB121B):** Upward-facing surfaces of shallow, infralittoral bedrock and boulders in areas of turbid water dominated by dense red seaweeds, with the notable absence of kelp. The stable rock, which can be cobbles or boulders but is more typically bedrock, is usually silted. Individual species of foliose red seaweeds such as *Plocamium cartilagineum* or *Calliblepharis ciliata* often dominate. Other red seaweeds likely to be present include *Phyllophora crispa*, *Rhodymenia holmesii, Halurus flosculosus, Cryptopleura ramosa, Hypoglossum hypoglossoides, Heterosiphonia plumosa* and coralline crusts. The brown seaweed *Dictyota dichotoma* is sometimes present, although never abundant. This biotope does not generally occur below kelp park but rather occurs on shallow, silted rock on which kelp would normally grow in less turbid conditions. The fauna can be variable but is generally typified by the presence of silt-tolerant animals such as encrusting sponges, particularly *Dysidea fragilis* and *Halichondria panicea*, the hydroid *Tubularia indivisa*, bryozoan crusts and scattered *Sabellaria spinulosa* and *Balanus crenatus*. In the summer months the seaweeds can become heavily encrusted with the bryozoan *Electra pilosa* and the ascidian *Molgula manhattensis* which can also form dense mats on the rock. The polychaete *Lanice conchilega* can be present, where sandy and muddy patches occur. Where this biotope occurs on chalk bedrock, such as off the Sussex coast, the piddock *Pholas dactylus* is often found bored into the rock.

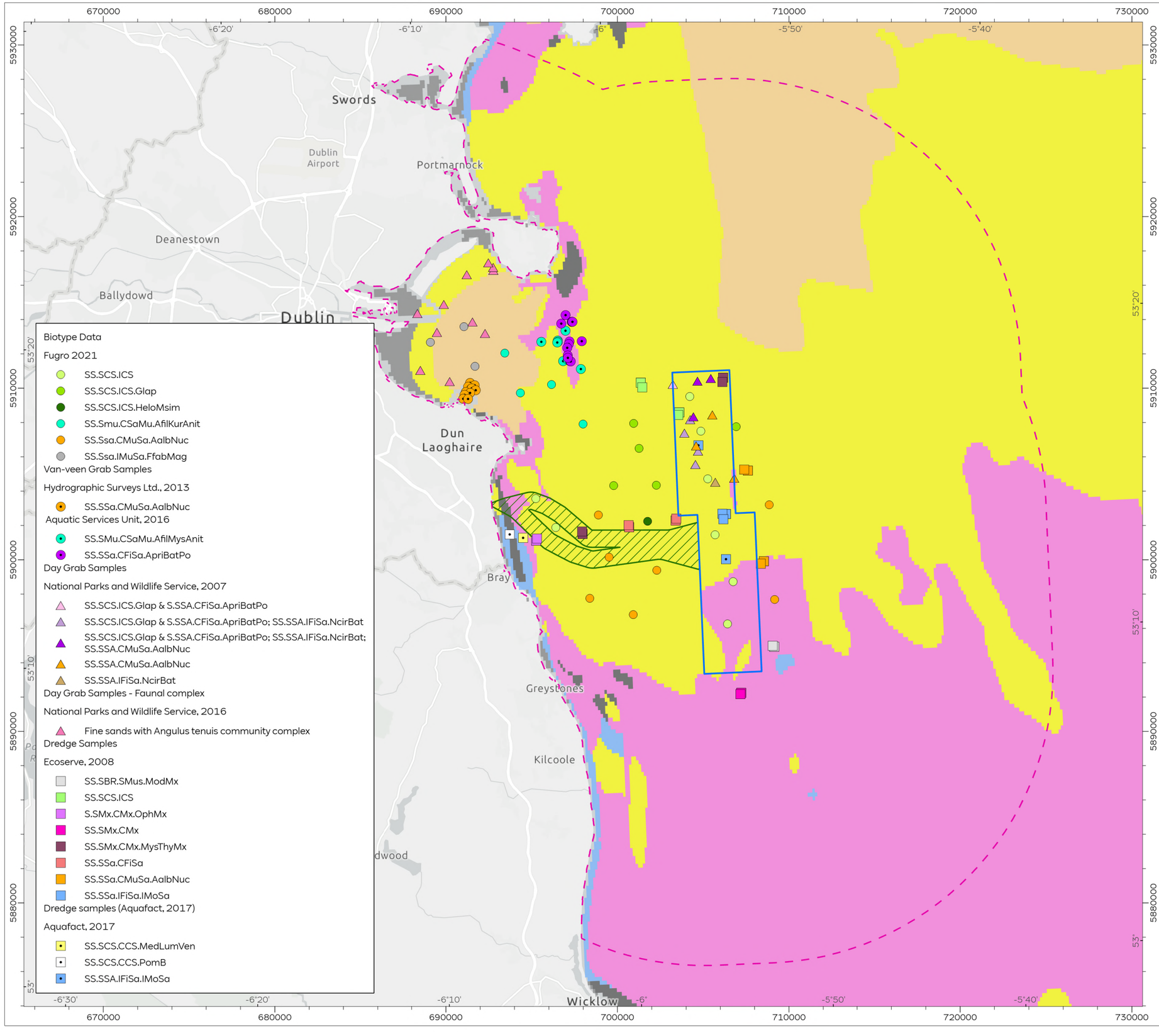
- **Faunal communities of Atlantic circalittoral mixed sediment (SS.SMx.CMx / EUNIS Code MC421):** Mixed sediment habitats in the circalittoral zone, including well mixed muddy gravelly sands or very poorly sorted mosaics of shell, cobbles and pebbles embedded in or lying upon mud, sand or gravel. Due to the variable nature of the seabed a variety of communities can develop which are often very diverse. A wide range of infaunal polychaetes, bivalves, echinoderms and burrowing anemones such as *Cerianthus lloydii* are often present in such habitat and the presence of hard substrata (shells and stones) on the surface enables epifaunal species to become established, particularly hydroids such as *Nemertesia* spp and *Hydrallmania falcata*.

- **Faunal turf communities on Atlantic circalittoral rock (CR.HCR.FaT / EUNIS Code MC121):** This habitat type occurs in wave-exposed, tide-swept narrows and straits on circalittoral bedrock and boulders. This complex is characterised by its diverse range of hydroids, bryozoans and sponges forming an often dense, mixed faunal turf. Other species found within this complex are *Alcyonium digitatum, Urticina felina, Sagartia elegans, Actinothoe sphyrodeta, Caryophyllia smithii, Pomatoceros triqueter, Balanus crenatus, Cancer pagurus, Necora puber, Asterias rubens, Echinus esculentus* and *Clavelina lepadiformis*. The anemones *Sagartia elegans, Actinothoe sphyrodeta, Urticina felina, Corynactis viridis* and *Metridium senile* are all found within this complex. Other species present in this high-energy complex are the sponges *Esperiopsis fucorum* and *Pachymatisma johnstonia*, the bryozoans *Alcyonidium diaphanum* and *Flustra foliacea, Cancer pagurus, Sertularia argentea* and *Asterias rubens*.

- **Kelp and seaweed communities on Atlantic infralittoral rock (IR.HIR.KFaR / EUNIS Code MB121):** Rocky habitats in the infralittoral zone dominated by kelp and seaweeds in areas exposed to extremely exposed wave action or strong tidal streams, typically the rock supports a community of kelp *Laminaria hyperborea* with foliose seaweeds and fauna, the latter tending to become more prominent in areas of strongest water movement.

3.1.23 No evidence of biogenic reef was observed within the survey area. However, the slender seapen *Virgularia mirabilis* and possible *Nephrops norvegicus* burrows were observed on some of the transects, but not in sufficient abundance to be classified as the threatened and/or declining 'sea pen and burrowing megafauna communities' habitat.

3.1.24 Geogenic reef, in the form of stony reef as characterised in Irving (2009), was identified on all seven of the transect with habitats captured in 40% of images analysed being considered to be medium resemblance stony reef and 9% met the criteria for low resemblance stony reef. As shown in Figure 8, the remainder was categorised as 'Not Reef'.



Biotype Data

Fugro 2021

- SS.SCS.ICS
- SS.SCS.ICS.Glap
- SS.SCS.ICS.HeloMsim
- SS.Smu.CSaMu.AfilKurAnit
- SS.Ssa.CMuSa.AalbNuc
- SS.Ssa.IMuSa.FfabMag

Van-veen Grab Samples

Hydrographic Surveys Ltd., 2013

- SS.SSa.CMuSa.AalbNuc

Aquatic Services Unit, 2016

- SS.SMu.CSaMu.AfilMysAnit
- SS.SSa.CFiSa.ApriBatPo

Day Grab Samples

National Parks and Wildlife Service, 2007

- SS.SCS.ICS.Glap & S.SSA.CFiSa.ApriBatPo
- SS.SCS.ICS.Glap & S.SSA.CFiSa.ApriBatPo; SS.SSA.IFiSa.NcirBat
- SS.SCS.ICS.Glap & S.SSA.CFiSa.ApriBatPo; SS.SSA.IFiSa.NcirBat; SS.SSA.CMuSa.AalbNuc
- SS.SSA.CMuSa.AalbNuc
- SS.SSA.IFiSa.NcirBat

Day Grab Samples - Faunal complex

National Parks and Wildlife Service, 2016

- Fine sands with Angulus tenuis community complex

Dredge Samples

Ecoserve, 2008

- SS.SBR.SMus.ModMx
- SS.SCS.ICS
- S.SMx.CMx.OphMx
- SS.SMx.CMx
- SS.SMx.CMx.MysThyMx
- SS.SSa.CFiSa
- SS.SSa.CMuSa.AalbNuc
- SS.SSa.IFiSa.IMoSa

Dredge samples (Aquafact, 2017)

Aquafact, 2017

- SS.SCS.CCS.MedLumVen
- SS.SCS.CCS.PomB
- SS.SSA.IFiSa.IMoSa

- Array Area
- Export Cable Corridor
- Benthic Ecology Study Area

Seabed Substrate (EUSeaMap, 2016)

- Sandy mud to muddy sand
- Sand
- Mixed sediment
- Coarse sediment
- Rock or other hard substrata
- Seabed

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Biotype (JNCC Marine Habitat Classification, 2015) and Faunal Complex Classifications Across the Zone of Influence

DRAWING NUMBER: **4**

PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-04-29	For Issue	GB	BB	SS

0 2 4 6 8 km

0 1 2 3 4 nm

N GRID NORTH

SCALE 1:225,000 PLOT SIZE A3

DATUM WGS 1984 VERTICAL REF LAT

PRJ WGS 1984 UTM Zone 29N

GoBe APEM Group

Dublin Array Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

3.2 Intertidal Ecology

3.2.1 The planned landfall is located to the south of Dublin at Shanganagh (Figure 1).

Intertidal Sediments

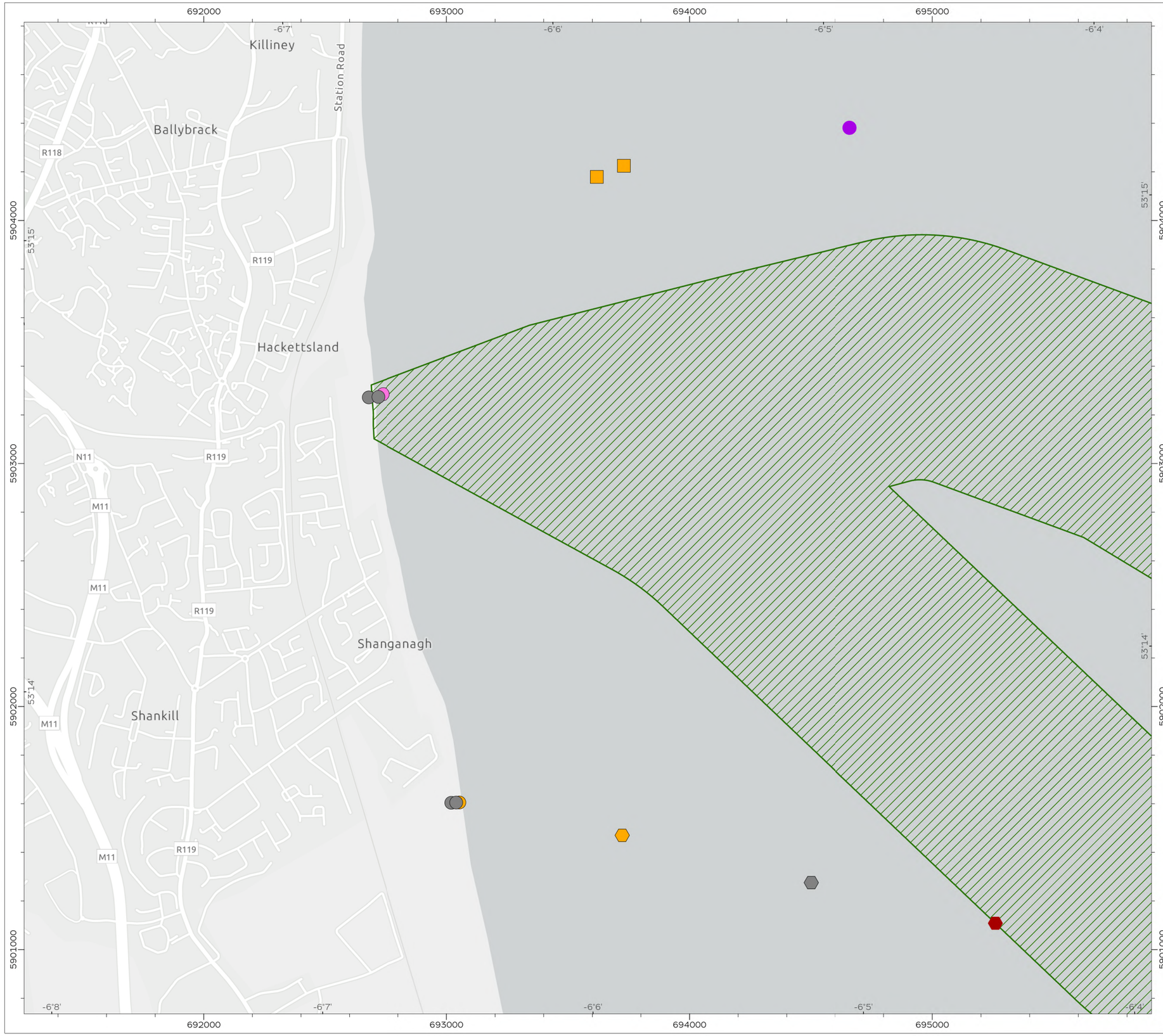
3.2.2 Site-specific intertidal survey PSA results for six stations, ranging from the upper to lower shore extents, identified sand as the predominant sediment present, with samples classified as sand, sandy gravel or slightly gravelly sand (Aquafact, 2021). Fines represented less than 0.3% of all intertidal samples.

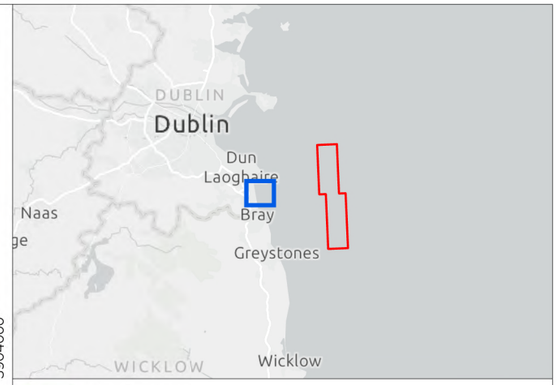
3.2.3 These observations are further supported by historic information which indicated that the upper shore consisted of a 10-20 m band of cobbles and pebbles with occasional boulders, which graded into finer gravel and coarse sand down the shore (Aquafact, 2021). This zone was classified as 'Barren littoral shingle' (LS.LCS.Sh.BarSh / EUNIS Code MA3211). The infaunal analysis revealed low numbers of oligochaetes and talitrid amphipods similar to the 'Talitrids on the upper shore and strand-line' (LS.LSa.St.Tal / EUNIS Code MA5211) biotope which commonly coexists with the LS.LCS.Sh.BarSh biotope where driftlines of algae and other debris accumulate on the upper shore. Low faunal returns were consistent with low levels of organic carbon in the sediment (Aquafact, 2017).

3.2.4 The mid shore consisted of boulders and cobbles covered with ephemeral green algae (*Ulva intestinalis*) with some *Porphyra purporea*, consistent with the biotope 'Ephemeral green and red seaweeds on variable salinity and/or disturbed eulittoral mixed substrata' (LR.FLR.Eph.Eph.X / EUNIS Code 4211). This biotope was present along almost the full length of the survey area varying in width from c. 6 m to <1 m. Along most of the shore this was bounded by the low shore sandy sediments. The lower shore along the transect length was consistent with the 'Polychaetes and *Angulus tenuis* in littoral fine sand' (LS.LSa.FiSa.Po.Aten / EUNIS Code MA5412) biotope. The sediment type in this zone was characterised as slightly gravelly sand (predominantly) fine sand. Organic carbon content was low (1.39%). Towards the southern end of the study area, where the lower shore consisted of boulders, cobbles and pebbles instead of sand, the ephemeral zone merged into a *F. serratus* dominated lower shore. A small transitional band of *F. vesiculosus* mixed with *F. serratus* and the limpet *Patella vulgata* and barnacles *Semibalabus balanoides* separated the two zones. Numerous red seaweeds were present in the lower shore and the biotope was '*Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock' (LR.MLR.BF.Fser.R / EUNIS Code MA12441) (Aquafact, 2017).

3.2.5 Photographs were collected during a site-visit in January 2019, these photos demonstrated cobbles and pebbles with occasional bounders in the upper section which graded into a finer gravel and coarse sand down the shore, similar to that recorded during the Aquafact (2017) survey (Plate 1). This zone was classified as 'Barren littoral shingle' (LS.LCS.Sh.BarSh /EUNIS Code MA3211).

Plate 1 - Photograph of the intertidal area at Shanganagh (north view), collected during site work.





Export Cable Corridor

Folk Classification

Aquafact, 2018
- Sand
- Gravelly sand
- Sandy gravel

Aquafact, 2021
- Sand
- Slightly gravelly sand
- Sandy gravel

PSA (INFOMAR)
- Muddy sand
- Sand

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Sediment Classification from Samples Obtained Across the Dublin Array Landfall Site

DRAWING NUMBER: **5**

PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-04-29	For Issue	GB	BB	SS

0 0.1 0.3 0.4 0.6 km
0 0.07 0.15 0.22 0.3 nm

N GRID NORTH

SCALE 1:16,000 PLOT SIZE A3
DATUM WGS 1984 VERTICAL REF LAT
PRJ WGS 1984 UTM Zone 29N

GoBe APEMGroup

Dublin Array Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

Organic Content of the Sediment

3.2.6 As mentioned, organic detritus is an important source of food for benthic fauna (Snelgrove and Butman, 1994), although an over-abundance of TOC may lead to community changes and a reduction in diversity. Site-specific surveys undertaken by Aquafact (2021) recorded low values of TOC ranging from 0.1% to 0.22%, which were not unexpected given the coarse nature of the sediment. Observations made within historic surveys across Dublin Array (Aquafact, 2017) were consistent with the site-specific surveys (Aquafact, 2021), with low values recorded ranging from 0.74% to 1.39%.

Sediment Contaminants

3.2.7 As mentioned, site-specific surveys (Aquafact, 2021) identified the predominant surficial sediment as sand. Intertidal sampling at the Landfall location demonstrates low contaminant levels in the beach sediments, with only the lower Irish Action Levels exceeded for arsenic. While exceedance of the lower arsenic Action Level occurred at all sites, the reported concentrations were consistently well below the upper I Action Level and are therefore considered as being marginally contaminated according to the guidelines detailed by Cronin *et al*. (2006). As no other sediment bound metal concentration exceeds the relevant lower Action Level it is considered that the levels of arsenic do not constitute an ecological risk.

3.2.8 No PAH concentrations exceeded the Irish Sediment Quality Guidelines lower Action Level. Analysis of the THC and n-Alkanes was also undertaken, with no samples reporting elevated levels. All samples collected for the project reported levels of DBT and TBT that were well below the Irish Sediment Quality Lower Action Level with all reported concentrations being less than 1 µg/kg for both contaminants (Aquafact, 2021). For a full breakdown of the sediment contaminants sampling, results and analysis, see Aquafact (2021), in addition a summary of the results is presented within the Marine Water and Sediment Quality chapter.

Intertidal Benthic Communities

3.2.9 As noted above, the landfall is characterised by cobbles, shingle and medium sand. Faunal cores collected along two transects in the intertidal zone as part of site-specific surveys (Aquafact, 2021) yielded sparse results with 10 taxa recorded, consisting of five species of annelids, four arthropods and one mollusc species. The sparsity of fauna recorded is to be expected, especially in areas classified as 'barren littoral shingle' (LS.LCS.Sh.BarSh / EUNIS Code MA3211).

3.2.10 Site-specific walkover surveys of the landfall site (Aquafact, 2021) and supporting historic data collected across the area (Aquafact, 2017) identified the presence of the following biotopes (the distribution of the biotopes is presented in Figure 6):

- **Barren littoral shingle (LS.LCS.Sh.BarSh / EUNIS Code MA3211):** This biotope is described as typically inhabiting freely draining sandy beaches, particularly on the upper and mid shore, which lack a macrofaunal community due to their continual mobility. This biotope was observed in site-specific surveys (Aquafact, 2021) along much of the northern Shanganagh Beach area just below the Barren Littoral shingle biotope where upper shore merges into the middle to lower shore and the sediment particle size decreases. Supporting historic survey data (Aquafact, 2017) was consistent with these findings, recording the biotope along the upper shore at landfall.

- ***Lanice conchilega* in Atlantic littoral sand (LS.LSa.MuSa.Lan / EUNIS Code MA5255):** This biotope was encountered in a small patch in the northern stretch of the Shanganagh Beach. This biotope is described as occurring on flats of medium fine sand, most often on the lower shore. It also occurs on the lower part of a predominately rocky or boulder shore where patches of sand occurs between scattered boulders, cobbles and pebbles. The sediment supports dense populations of the sand mason *Lanice conchilega*.

- ***Laminaria digitata* and under-boulder fauna on sublittoral fringe boulders (IR.MIR.KR.Ldig.Bo / EUNIS Code MB12172):** This biotope was encountered in the extreme low water and was recorded in two locations along the Shanganagh/Shankill Beach in site-specific surveys (Aquafact, 2021). The biotope is described as occurring on moderately exposed to sheltered boulder shores. Upper surfaces of the boulders are colonized by dense growth of the kelp *Laminaria digitata*, beneath which are a variety of seaweeds including *Mastocarpus stellatus*, *Chondrus crispus*, *Palmaria palmata*, *Lomentaria articulata*, *Osmundea pinnatifida*, *Rhodothamniella floridula*, encrusting red algae, *Cladophora rupestris* and *Ulva intestinalis.*

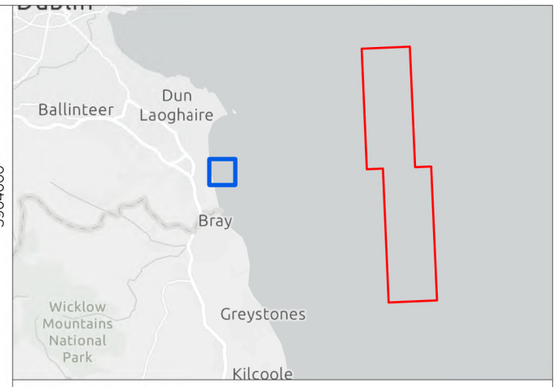
- **Ephemeral green and red seaweeds on variable salinity and/or disturbed eulittoral mixed substrata (LR.FLR.Eph.EphX / EUNIS Code MA4211)**: This biotope was recorded at the landfall in historic survey data (Aquafact, 2017) and is described as Eulittoral mixed substrata (pebbles and cobbles overlying sand or mud) that are subject to variations in salinity and/or siltation, characterised by dense blankets of ephemeral green and red seaweeds. The main species present are *Enteromorpha intestinalis, Ulva lactuca* and *Porphyra spp*., along with colonial diatoms covering the surface of the substratum. Small numbers of other species such as barnacles *Semibalanus balanoides* and *Elminius modestus* are confined to any larger cobbles and pebbles or on the shells of larger individuals of the mussel *Mytilus edulis*. Common shore crab (*Carcinus maenas*) and common periwinkle (*Littorina littorea*) can be present among the boulders, cobbles and seaweeds, while gammarid amphipods can be found in patches underneath the cobbles. In common with the other biotopes found on mixed substrata, patches of sediment are typically characterised by infaunal species including bivalves, for example, *Cerastoderma edule* and polychaetes *Arenicola marina* and *Lanice conchilega*.

- ***Fucus serratus* and red seaweed on moderately exposed lower eulittoral rock (LR.MLR.BF.Fser.R / EUNIS Code MA12441)**: This biotope was recorded in the Landfall area in historic survey data (Aquafact, 2017), and is described as moderately exposed lower eulittoral bedrock characterised by mosaics of the wrack *Fucus serratus* and turf-forming red seaweeds including *Osmundea pinnatifida*, *Mastocarpus stellatus* or *Corallina officinalis*. The hydroid *Dynamena pumila* can occur in dense populations on the *F. serratus* fronds whilst the sponge *Halichondria panicea* can cover the bedrock beneath. Other red seaweed species may be present under the fucoid canaopy including *Palmaria palmata*, *Lomentaria articulata*, *Membranoptera alata* and *Chondrus crispus*. Green seaweeds such as *Cladophora rupestris*, *Enteromorpha intestinalis* and *Ulva lactuca* are present though usually in small numbers. In addition, such shores provide a greater number of permanently damp refuges between the stones and underneath the seaweed canopy. Within these micro-habitat's species such as the limpet *Patella vulgata*, the barnacle *Semibalanus balanoides* or the whelk *Nucella lapillus* can be found in lower abundance than higher up the shore. If boulders are present, then Common periwinkle and the Common shore crab can be found on or underneath the boulders.

- **LR.MLR.BF.Fser.R/LR.FLR.Eph.EphX mosaic**: A biotope exhibiting elements of both LR.MLR.BF.Fser.R and LR.FLR.Eph.EphX was observed throughout the length of Shanganagh/Shankill Beach where the substrate was comprised large boulders and cobbles in site-specific surveys (Aquafact, 2021).

- **Talitrids on the upper shore and strand-line. (LS.LSa.St.Tal / EUNIS Code MA5211)**: This biotope was recorded at landfall in historic survey data (Aquafact, 2017), and is described as a community of sandhoppers (talitrid amphipods) that may occur on any shore where drift lines of decomposing seaweed and other debris accumulate on the strandline. The biotope occurs most frequently on medium and fine sandy shores but may also occur on a wide variety of sediment shores composed of muddy sediment, shingle and mixed substrata, or on rocky shores. The decaying seaweed provides cover and humidity for the sandhopper *Talitrus saltator*. In places where larger amounts of weed regularly accumulates *Talorchestia deshayesii* is often present. Oligochaetes, mainly enchytraeids, can occur where the stranded debris remains damp as a result of freshwater seepage across the shore or mass accumulation of weed in shaded situations. On shingle and gravel shores and behind saltmarshes the strandline talitrid species tend to be mainly *Orchestia* species. Abundances of the characterising species tend to be highly patchy.

- **Polychaetes and *Angulus tenuis* in littoral fine sand (LS.LSa.FiSa.Po.Aten / EUNIS Code 52412):** This biotope was located along the lower shore at landfall in historic survey data (Aquafact, 2017). This biotope is described in full in paragraph 3.1.18 above.



Export Cable Corridor

Shanganagh Biotopes (Aquafact, 2021)

- IR.MIR.KR.Ldig.Bo
- LC.LCS.Sh.BarSH
- LR.FLR.Eph.Eph.X
- LR.MLR.BF.Fser.R
- LR.MLR.BF.Fser.R/LR.FLR.Eph.Eph.X
- LS.Lsa.FiSa.Po.Aten
- LS.Lsa.MoSa.BarSa
- Ls.Lsa.MuSa.Lan

DRAWING STATUS

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MAP NOTES / DATA SOURCES:

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Intertidal Biotypes at the Dublin Array Landfall Site

DRAWING NUMBER: **6**

PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-04-24	For Issue	GB	BB	SS

0 0.1 0.3 0.4 0.6 km

0 0.07 0.15 0.22 0.3 nm

GRID NORTH

SCALE 1:16,000 PLOT SIZE A3

DATUM WGS 1984 VERTICAL REF LAT

PRJ WGS 1984 UTM Zone 29N

GoBe APEM Group

Dublin Array Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

3.3 Designated Sites

3.3.1 As part of this report a review has been undertaken to identify designated sites within the Dublin Array benthic subtidal and intertidal ecology study areas, which are either designated for benthic and intertidal ecology interest or habitats/species which are dependent on or associated with benthic and intertidal ecology.

3.3.2 The nature designations that have been considered comprise European sites [i.e., SAC and Special Protection Areas (SPA)], which are listed in Table 3 along with the benthic features for which they have been selected; the spatial distribution of these sites in relation to the array area and Offshore ECC are shown in Figure 7. Marine monitoring of six Annex I Habitats in present in Irish marine SACs provides the most recent conservation assessment of these features (Scally *et al*. 2020).

3.3.3 The assessment of the potential effects on the qualifying interests of these designated sites is presented within the Natura Impact Statement (see Part 4 Habitats Directive Assessments of the planning application) that accompanies the EIAR as part of the documentation submitted to An Bord Pleanála.

3.3.4 In preparation for the designation of national MPAs in Ireland under the forthcoming MPA Act, a study has been undertaken based on the ecological sensitivity of the western Irish Sea with the aim of identifying areas of comparatively higher and lower ecological sensitivity. This work will help inform planning decisions and establish methods and develop an evidence base which can inform future identification, designation and management of Irish MPAs (MPAAG, 2023).

3.3.5 Benthic features for which the Natura 2000 sites have been selected include:

3.3.6 **Sandbanks which are slightly covered by sea water all the time**: Sandbanks in Irish waters are found predominantly in the Irish Sea (Roche*, et al*., 2007). Sandbanks which are slightly covered by seawater all the time are listed under Annex I of the EU Habitats Directive (92/43/EEC). Annex I highlight natural habitat types of community interest whose conservation requires the designation of an SAC. To date, Ireland has designated two Irish Sea sandbanks as SACs, Blackwater Bank and Long Bank, both of which are located to the south of the Dublin Array off the coast of County Wexford.

3.3.7 Scally *et al*. (2020) reported that this habitat has been assessed as being at Favourable conservation status and no pressures have been identified and noted no change to the conservation status since the last reporting period in 2013. However, it noted that future threats were considered to include:

- Changes to the habitat as a result of natural causes, e.g. natural forces leading to a change in the area or general topographical feature of the habitat are considered a neutral threat;
- The development of windfarms on shallow sandbanks in the vicinity of SACs designated for this habitat has the potential to lead to an indirect impact on the habitat; and

- Impacts from benthic dredging (fisheries) is also considered to be a potential threat to this habitat.

3.3.8 **Reef:** The Scally *et al*. (2020) report indicated that the overall assessment of the conservation status of this habitat to Unfavourable-Inadequate, although when considering inshore Reefs habitat alone, it was assessed as being in favourable conservation status.
The report noted no change to the conservation status of this habitat since the last reporting period in 2013. However, it noted that future threats were considered to include:

- The invasive alien species *Sargassum muticum* has been noted as an increased pressure on intertidal reef areas where it has become established in rock pools within this habitat;
- The collection of marine algae, particularly *Ascophyllum nodosum,* on a commercial scale, has been carried out on intertidal reefs within Irish SACs for many years and continues to have a medium impact on this habitat. The mechanical harvesting of subtidal kelp beds is now identified as a potential future threat; and
- The use of tangle nets for the capture of cray fish has been identified as a significant threat to subtidal reef habitat.

3.3.9 **Mudflats and sandflats not covered by seawater at low tide:** Scally *et al*. (2020) noted that while nationally the conservation status for this feature was considered Unfavourable-Inadequate due to conditions at three out of 21 sites in which it is a qualifying feature, the conservation status in South Dublin Bay and the North Dublin Bay SACs were considered favourable. Mudflats and sandflats are also a qualifying feature for both Baldoyle Bay SAC and Malahide Estuary SAC, although these sites were not assessed the report.

3.3.10 The report noted the main pressures on this habitat included:

- Increased sedimentation as a result of surface waters via storm overflows or urban run-off in estuaries surrounded by or downstream of large urban settlements and maintenance dredging was considered to be a significant factor in the changes observed to sediment composition and observed species changes; and
- In some cases, the pressures acting on an area were unknown. This was particularly the case where changes in benthic sediment communities occurred, but no obvious source of the impact could be identified.

3.3.11 **Estuaries:** The overall conservation status of Estuaries has been assessed as Unfavourable-Inadequate by Scally *et al*. (2020), with the report noting the main pressures on this habitat included:

- Nutrient enrichment of enclosed bays with poor mixing was particularly evident;
- The main contributing factors to increased nutrient enrichment to the intertidal flats was considered to be diffuse pollution as a result of agricultural and forestry activities and wastewater discharges; and

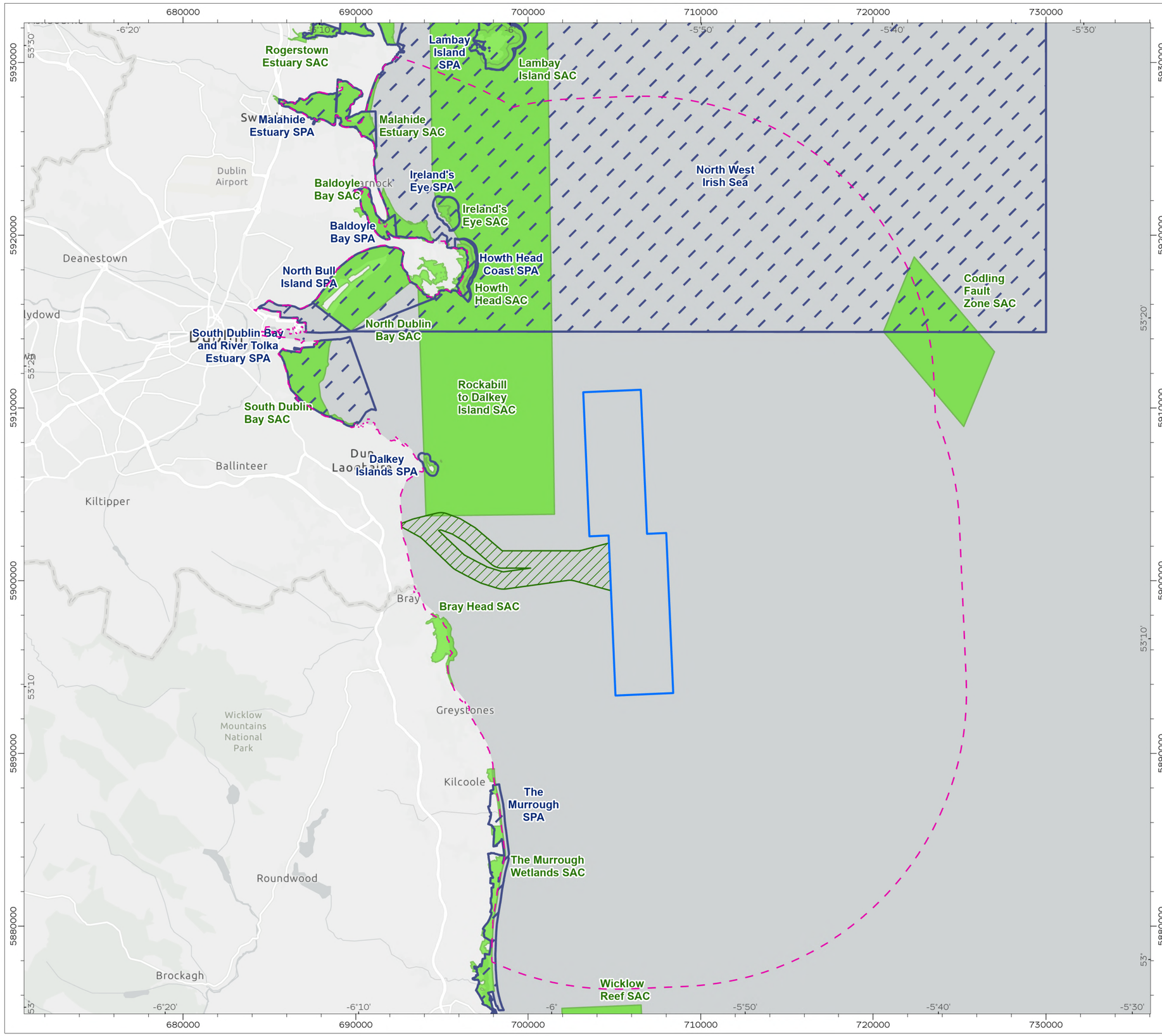
- In some cases, the pressures acting on an area were unknown.

3.3.12 Further details of designated sites are available in Volume 3, Chapter 8: Nature Conservation.

Table 3 All Natura 2000 sites within the secondary ZoI of the proposed windfarm site and nearest distance to the array area and Offshore ECC.

Site code	Site name	Relative location to the OffshoreECC	Relative location to array areas	Benthic Feature of interest for which the site is selected
Special Areas of Conservation (SACs)				
003000	Rockabill to Dalkey Island SAC	Offshore ECC crosses through this SAC	1.7 km east of Kish Bank site	Reefs
000210	South Dublin Bay SAC	8.5 km north	14.9 km east of Kish Bank site	Mudflats and sandflats not covered by seawater at low tide
000206	North Dublin Bay SAC	12 km north	12 km north-east of Kish Bank site	Mudflats and sandflats not covered by seawater at low tide
000999	Baldoyle Bay SAC	17 km north	12.3 km north-west of Kish Bank site	Mudflats and sandflats not covered by seawater at low tide
000205	Malahide Estuary SAC	23 km north	18 km north-west of Kish Bank site	Mudflats and sandflats not covered by seawater at low tide
003015	Codling Fault Zone SAC	19 km east	15 km east of Kish Bank site	Submarine structures made by leaking gases
Special Protection Areas (SPAs)				
004172	Dalkey Islands SPA	2.5 km north	8 km west of Kish Bank site	These sites have been designated to protect internationally important birds, however the subtidal and intertidal habitats will provide important food
004024	South Dublin Bay and River Tolka Estuary SPA	7 km north west	11.9 km west of Kish Bank site	
004006	North Bull Island SPA	12 km north	10 km north-west of Kish Bank site	

004113	Howth Island SPA	25 km north	8.8 km north-west of Kish Bank site	resources for many bird species that use the site.
004016	Baldoyle Bay SPA	17 km north	13.9 km north-west of Kish Bank site	
004025	Malahide Estuary SPA	23 km north	18.5 km north-west of Kish Bank site	
004186	The Murrough SPA	12 km south	8.7 km south-west of Bray Bank site	
004326	North West Irish Sea SPA	13 km north	6 km north of Kish Bank site	



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MAP NOTES / DATA SOURCES:

PROJECT TITLE

Dublin Array

DRAWING TITLE

Natura 2000 Sites within the Benthic Ecology Study Area

DRAWING NUMBER: **7**

PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-04-24	For Issue	GB	BB	SS

0 2 4 6 8 km
0 1 2 3 4 nm

N GRID NORTH

SCALE 1:225,000 PLOT SIZE A3
DATUM WGS 1984 VERTICAL REF LAT
PRJ WGS 1984 UTM Zone 29N

GoBe APEM Group

Dublin Array Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

3.4 Features of conservation interest

3.4.1 As part of this report a review has been undertaken to identify benthic features of conservation interest within the Dublin Array benthic subtidal and intertidal ecology study area. Features of Conservation Interest are those features that are particularly threatened, rare, or declining species and habitats which are listed in the Habitats Directive Annex 1 (habitats) and Annexes II, IV and V (species). It should be noted that any potential effects on qualifying features within designated sites have been considered in the NIS (see Part 4 Habitats Directive Assessments of the planning application) and Volume 3 Chapter 8: Nature Conservation. Any features of conservation importance that lie outside these designated sites are identified within this section of the report, and any potential effects on these features are considered in the Benthic and Intertidal Ecology chapter.

3.4.2 Reef habitat category includes bedrock, stony and biogenic variants. Stony reefs may comprise areas of boulders or cobble (cobbles are generally considered as being between 64 mm and 256 mm in diameter, and boulders as being greater than 256 mm in diameter) which arise from the seafloor and provide a suitable substratum for the attachment of benthic communities of algae (when shallow enough) and animal species (Irving, 2009). It should be noted that geogenic reef features are a qualifying interest of the Rockabill to Dalkey Island SAC.

3.4.3 The distribution of geogenic reef features is not subject to natural change due to their geogenic origins resulting in substrata being relatively stable and unlikely to be affected by localised pressures. However, natural variations in community structure occur which are likely related to changes in the supply of planktonic propagules and survival following settlement, factors which are influenced primarily by biological interactions and direct climatic effects (JNCC, 2007).

3.4.4 Biogenic reefs are solid, massive structures created by accumulations of organisms, usually rising from the seabed, or at least clearly forming a substantial, discrete community or habitat which is very different from the surrounding seabed. The structure of the reef may be composed almost entirely of the reef building organism and its tubes or shells, or it may to some degree be composed of sediments, stones and shells bound together by the organisms (Holt *et al*., 1998).

3.4.5 The extent in Irish waters of geogenic and biogenic reef habitats combined is calculated as being 9,474 km^2 (West *et al*., 2024).

3.4.6 Geogenic reef features are defined by substrate rather than the resident community; resulting in a wide range of topographical reef forms such as vertical rock walls, horizontal ledges, sloping or flat bedrock, broken rock, boulder fields, and aggregations of cobbles. The surveys described below indicate that within the study area geogenic reef features are comprised primarily boulder fields and aggregations of cobbles.

3.4.7 Site-specific surveys (Fugro, 2021) identified an area of cobbles and boulders in the nearshore section of the Offshore ECC (station ST12), between Killiney and Bray. This area was classified as the biotope 'Atlantic and Mediterranean high energy infralittoral rock' (IR.HIR). These areas were assessed for potential resemblance to stony reef habitats in accordance with the criteria outlined in Irving (2009) and Golding *et al*. (2020). Stony reefs are ecologically important for increasing the seabed complexity and providing habitats to organisms that would not otherwise occur, thus enhancing biological diversity.

3.4.8 Three main characteristics of a habitat are considered when determining whether an area of the seabed should be considered as a stony reef: composition, elevation and extent. The resulting measure of 'reefiness' is divided into four scores of low, medium and high 'reefiness' and not a reef (Irving, 2009).

3.4.9 When determining whether an area of the seabed could be considered as Annex I stony reef, if a habitat is scored as medium or high then it can be considered as contributing to the Natura 2000 network of qualifying reefs in terms of the EU Habitats Directive. If a 'low' is scored in any of the three characteristics considered in determining 'reefiness', then a strong justification is required for this area to be considered as contributing to the Natura 2000 network of qualifying reefs in terms of the EU Habitats Directive (Irving, 2009).

3.4.10 Two areas were identified to be of 'medium' resemblance to a stony reef during the Fugro (2021) survey.

3.4.11 Subsequent DDV surveys of this nearshore portion of the Offshore ECC identified further examples of habitat of 'medium' resemblance to a stony reef (APEM, 2024), with three biotopes typical of Annex I reef habitat identified ('Dense foliose red seaweeds on moderately exposed Atlantic infralittoral silty rock' - IR.MIR.KR.XFoR; 'Faunal turf communities on Atlantic circalittoral rock' - CR.HCR.FaT; 'Kelp and seaweed communities on Atlantic infralittoral rock' - IR.HIR.KFaR). Stony reefs are ecologically important for increasing the seabed complexity and providing habitats to organisms that would not otherwise occur, thus enhancing biological diversity. Stony reef habitats are classified as an Annex I habitat within The Interpretation Manual of European Union Habitats - EUR28 (European Commission, 2013).

3.4.12 A further study in the nearshore area mapped an area of 206ha of shallow reef habitat extending approximately 5km from Killiney in the north to Bray in the south (MERC Consultants, 2022). The area encompasses the inshore portion of the ECC from which the biotopes 'Kelp and seaweed communities on sediment-affected or disturbed Atlantic infralittoral rock' (LR.HIR.Ksed/EUNIS Code MB123) and Echinoderms and crustose communities on Atlantic circalittoral rock' (CR.MCR.EcCr/EUNIS Code MC122) were identified. It was concluded that the reef area represents a potentially significant area of sensitive reef habitat, especially in the context of the relatively low extent of this habitat on the east coast of Ireland.

3.4.13 Further studies were conducted in spring 2024 to better inform the extent and characteristics of the reef habitat (APEM, 2024). The survey included seven transects of between 120 and 325 m running parallel to the shore at distances of between 300 and 750 m from the shoreline along which still and video imagery was captured. The survey area corresponded to rock and boulder habitat identified by broad-scale seabed habitat map of Europe (EUSeaMap, 2021) (Figure 8).

3.4.14 Analysis of the images indicated the presence of five biotopes or biotope complexes. The most widespread habitat complex recorded in the survey area was 'Circalittoral fine mud' SS.SMu.CFiMu / EUNIS Code MC611), followed by 'Dense foliose red seaweeds on moderately exposed Atlantic infralittoral silty rock' (IR.MIR.KR.XFoR / EUNIS Code MB121B) in the central and western extent. 'Faunal communities of Atlantic circalittoral mixed sediment' (SS.SMx.CMx / EUNIS Code MC421) were recorded on six of the transects, but was most prevalent in the east of the survey area (Figure 8). The eastern area also included larger boulders that were classified as 'Faunal turf communities on Atlantic circalittoral rock' (CR.HCR.FaT / EUNIS Code MC121). The least frequently recorded habitat was 'Kelp and seaweed communities on Atlantic infralittoral rock' (IR.HIR.KFaR / EUNIS Code MB121), which was restricted to the western most transects, which were closest to the shore.

3.4.15 Geogenic reef, in the form of stony reef as characterised in Irving (2009), was identified on all seven of the transects surveyed by APEM (2024). Overall, 40% of images contained habitat considered to be medium resemblance stony reef, while 9% contained habitat which met the criteria for low resemblance stony reef. As shown in Figure 8, the remainder was categorised as 'Not Reef'.

3.4.16 This confirmed the observations reported previously concerning the presence and relative importance of a significant area of reef features in the nearshore portion of the Offshore ECC characterised by biotopes that 'may occur within', be 'contained within' or are 'typical of' Annex I reef habitats.

3.4.17 No biogenic reef habitat was identified during the survey.

692500
693000
693500
-6°6'40"
-6°6'15"
-6°5'50"
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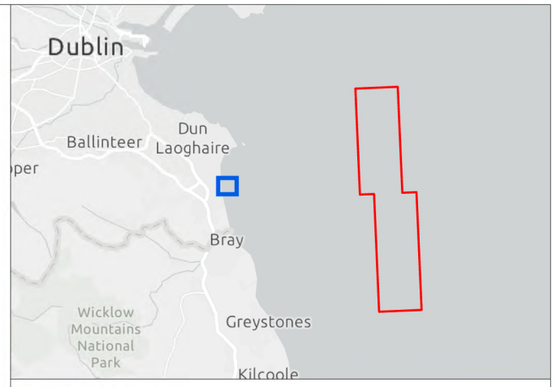
and



Export Cable Corridor

Stony Reef Assessment

- Low Resemblance Stony Reef
- Medium Resemblance Stony Reef
- Not Reef
- Obstructed View of Substrate

EMODnet Seabed Substrate (Folk 7)

- 3. Coarse substrate
- 5. Rock and boulders

DRAWING STATUS

FINAL

DISCLAIMER

MAP NOTES / DATA SOURCES:

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PROJECT TITLE

Dublin Array

DRAWING TITLE

Stony Reef Assessment of Nearshore Section of Offshore ECC

DRAWING NUMBER: **8**

PAGE NUMBER: **1 of 1**

VER	DATE	REMARKS	DRAW	CHEK	APRD
01	2024-04-24	For Issue	GB	BB	SS

0 0 0.1 0.1 0.2 km
0 0 0 0 0 nm

N GRID NORTH

SCALE 1:5,000 PLOT SIZE A3
DATUM WGS 1984 VERTICAL REF LAT
PRJ WGS 1984 UTM Zone 29N

GoBe APEM Group

Dublin Array Generation for generations

Kish Offshore Wind Limited - Bray Offshore Wind Limited

3.4.18 The surveys also identified that the Kish and Bray Banks represent examples of the Annex I habitat 'Sandbanks which are slightly covered by sea water all the time', due to the following observed characteristics:

- The feature is permanently submerged;
- Water depths are seldom greater than 20 m; and
- Seabed sediments are predominately composed of sand.

3.4.19 It should be noted that, at the time of writing, the Kish and Bray Banks are not designated as a European site and have not been proposed for designation.

3.4.20 Site-specific surveys (Aquafact, 2021) across the intertidal study area reported the presence of potential reef habitats in the landfall area. These included 'Ephemeral green and red seaweeds on variable salinity and/or disturbed eulittoral mixed substrata' (LR.FLR.Eph.EphX/EUNIS Code MA4211) and '*Fucus serratus* and red seaweed on moderately exposed lower eulittoral rock' (LR.MLR.BF.Fser.R/EUNIS Code MA12441). Reef habitats on hard compact substrata (including rock, boulders and cobbles) are classified as an Annex I habitat (European Commission, 2013).

3.4.21 Intertidal reefs are also present in the Dún Laoghaire-Rathdown area where 12ha of bedrock, boulders and cobbles were reported by MERC Consultants (2022). Two dominant habitat complexes were present, 'Low energy littoral rock' (LR.LLR) and 'Moderate energy littoral rock' (LR.LMR). The most commonly identified biotopes were: '*Ascophyllum nodosum* on full salinity mid eulittoral rock' (LR.LLR.F.Asc.FS/EUNIS Code MA123E1);. '*Ascophyllum nodosum* on very sheltered mid eulittoral rock' (LR.LLR.F.Asc/EUNIS Code MA123E); '*Fucus vesiculosus* and barnacle mosaics on moderately exposed mid eulittoral rock' (LR.MLR.BF.FvesB/EUNIS Code MA1243); and '*Fucus serratus* and red seaweeds on moderately exposed lower eulittoral rock' (LR.MLR.BF.Fser.R/EUNIS Code MA12441). All areas of reef recorded in the area conform to the EU Annex I habitat "Reefs".

3.4.22 The Broad Scale Predictive Habitat Map (EUSeaMap, 2019) indicates a band of sublittoral geogenic reef extending along the inshore section of the Offshore ECC between Killiney and Bray. This band, which is approximately 200 and 400 m wide in sections, occurs approximately 500 m from the shore. Three geogenic reef habitats are described from this area which include 'High energy circalittoral rock' (CR.HCR), 'High energy infralittoral rock' (IR.HIR) and 'Low energy infralittoral rock' (IR.LIR). Geogenic reef habitats are classified as an Annex I habitat (European Commission, 2013).

3.4.23 During the Ecoserve (2008) survey a significant number of the horse mussel *Modiolus modiolus* were recorded at a station to the south of the Dublin Bay array area, outside the current project boundary. The biotope '*Modiolus modiolus* beds on open coast circalittoral mixed sediment' (SS.SBR.SMus.ModMx/EUNIS Code MC2232), was therefore recorded. *Modiolus modiolus* beds are considered a type of Annex I biogenic reef habitat and an OSPAR listed habitat. However, this station was resampled during the Aquafact (2017) re-characterisation campaign and no beds of *Modiolus modiolus* were identified, with the station classified as '*Mediomastus fragilis*, *Lumbrineris* spp. and venerid bivalves in circalittoral coarse sand or gravel' (SS.SCS.CCS.MedLumVen/EUNIS Code MC3212). However, due to the patchy nature of benthic communities and the limited coverage of the seabed by benthic sampling techniques the presence of *Modiolus* and associated biogenic reefs cannot be discounted, although data discussed here would indicate that any extent is likely to be limited. Biogenic reef habitats are classified as an Annex I habitat (European Commission, 2013).

3.4.24 Intertidal eelgrass beds have been identified in south Dublin Bay, outside the current project boundary with the biotope 'Zostera noltei beds in littoral muddy sand' (LS.LMp.LSgr.Znol / EUNIS Code MA6231) recorded. This habitat is included in the OSPAR List of Threatened and/or declining species and habitats. The purpose of the list is to guide the OSPAR Commission in setting priorities for further work on the conservation and protection of marine biodiversity.

3.4.25 No other features of conservation importance have been recorded across the Dublin Array benthic ecology study areas, following a detailed review of existing datasets.

4 Future Receiving Environment

4.1.1 An assessment of the future receiving environment (without the proposed development) has been carried out and is described within this section. The receiving environment is not static and will exhibit some degree of natural change over time related to naturally occurring cycles and processes. Therefore, when undertaking impact assessments, it will be necessary to place any potential impacts in the context of the envelope of change that might occur naturally over the timescale of the project.

4.1.2 Further to potential change associated with existing cycles and processes, it is necessary to take account of the potential effects of climate change on the marine environment. The quality of the marine environment, in particular, the integrity of marine ecosystems, is still at risk from the impact of global climate change, especially rising sea temperatures with an increase in sea surface temperature of 0.6°C per decade observed in Irish waters since 1994 (Department of Housing, Local Government and Heritage, 2021). Marine ecosystems are impacted by warming temperatures, changing wind patterns, shifting oceanic circulation patterns, increasing acidification and altering precipitation rates and hence salinity. These changes have the potential to change the distribution, abundance, size and behaviour of aquatic organisms (NPWS, 2019). Climate change impacts will change species distribution, reproduction, growth, migration and interactions. (EPA, 2014). Studies of the benthic ecology over the last three decades have shown that biomass has increased by at least 250 to 400%; opportunistic and short-lived species have increased; and the abundance of long-living sessile animals has decreased (Krönke, 1995; Krönke, 2011).

4.1.3 Sea surface temperatures in Irish waters have shown a progressive warming from the mid-1990s (Cámaro García and Dwyer, 2020). The warming observed in the last three decades has been particularly strong in parts of the north-east Atlantic, with the sea surface around Ireland warming at rates up to six times greater than the global average (Dye *et al.,* 2013).

4.1.4 Furthermore, most literature to date focuses specifically on temperature, with regards to the effects of climate change on marine habitats. Climatic warming also causes deoxygenation within the water column. Over decadal timescales, there has been a measurable decline in dissolved oxygen content in the global ocean in response to ocean warming (Mahaffey *et al*., 2020), with a further 7% decrease predicted for the year 2100 (IPCC, 2013). It was concluded from 26 years of monitoring a benthic community within the Firth of Clyde that benthic communities had been affected by the decreasing levels of oxygen. This finding agreed with other short-term studies (Breitburg *et al*., 2018, Levin *et al*., 2009). Specific changes included changes in morphology, burrow depth, bioturbation and feeding mode (Caswell *et al*., 2018).

4.1.5 As such, the baseline in the Dublin Array study area described in Section 3 is a 'snapshot' of the present benthic ecosystem within a gradually yet continuously changing environment. Any changes that may occur during the 35-year design life span of Dublin Array should be considered in the context of both greater variability and sustained trends occurring on national and international scales in the marine environment.

5 Data Gaps or Uncertainties

5.1.1 Grab sampling and video surveys, while providing detailed information on the sediment types (and fauna) present, represent point samples that must be interpreted in combination with the other appropriate datasets. As noted, grab surveys have been previously conducted in the area and these show good validation against the regional data. Various factors can limit the quality of existing datasets such as age of the data, survey methodology and sample processing protocols. However, it is considered that methodologies associated with the supporting datasets employed are analogous with site specific surveys reported here. Similarly, the age of the supporting datasets are not considered as undermining their applicability as no major changes in the communities have occurred in the study area in relation to natural or abiotically driven factors since the relevant data was acquired. Therefore, the regional data are considered sufficient to characterise the study (and wider) area. However, despite the above uncertainties, the seabed in the study area is well studied and surveyed and there is robust data available to characterise the physical environment which itself is one of the main factors driving community patterns (Rhoads, 1974).

5.1.2 Classification of survey data into benthic habitats/biotopes, while highly useful for assessment purposes, has two main limitations:

- Difficulties in defining the precise extents of each biotope, even when using site specific geophysical survey data to characterise the seabed; and
- There is generally a transition from one biotope to another, rather than fixed limits and therefore, the boundaries of where one biotope ends and another starts often cannot be precisely defined.

5.1.3 Consequently, the biotopes presented in the technical report which underpin this assessment should not be considered as definitive, nor should habitat boundaries be considered to be fixed. They do however represent a robust characterisation of the receiving environment.

5.1.4 Despite the above uncertainties, it should be noted that there is robust data available describing sediment characteristics and benthic communities present within the study area, and this is sufficient for the purposes of characterisation for EIA. The seabed in the area is well studied and surveyed with comprehensive coverage of the array area and Offshore ECC and benthic study area, and as such, this evidence base is considered to be sufficiently robust to inform a benthic impact assessment and for an overall high confidence to be placed on the assessment.

6 Summary

6.1.1 This technical report has been written to provide a characterisation of offshore components of the Dublin Array in terms of the subtidal and intertidal benthic habitats and communities, surficial sediments and seabed features across the defined benthic subtidal and intertidal ecology study areas.

6.1.2 The subtidal benthic habitats and species present within the Dublin Array benthic ecology study area, as recorded during site-specific surveys and from a review of desktop information, were analogous with communities from similar habitats found in the wider Irish Sea region. Differences in the benthic communities generally reflected the differences in the sediment types present.

6.1.3 The array area includes the Kish and Bray Banks, two submarine banks consisting mainly of sand and gravel, with fine and medium sands recorded across the Kish Bank within the northern array area, with coarser mixed sediments (slightly gravelly sand and gravel) found across the Bray Bank (southern array). Sandbanks in Irish waters are found predominantly in the Irish Sea (Roche *et al*., 2007).

6.1.4 The nearshore portion of the offshore ECC is characterised by a mixture of sand, sandy gravel, gravelly sands and mixed sediments, with predominantly gravelly sands and sands further offshore towards the array area.

6.1.5 Contaminants recorded across the array area and Offshore ECC were low and considered to represent no ecological risk. Organic content was recorded as low across the Offshore ECC and the array in the desktop review and site-specific surveys.

6.1.6 Subtidal benthic communities were defined across the site, and were indicative of a dynamic seabed, with communities identified as those associated with high energy environments. Benthic subtidal biotopes recorded across the array area and Offshore ECC are similar to those from the wider region as identified within desktop reviews and site-specific surveys.

6.1.7 Of the biotopes identified, the following were classified as habitats that represent potential Annex I habitats:

- IR.HIR - Atlantic and Mediterranean high energy infralittoral rock;
- IR.LIR - Low energy infralittoral rock;
- CR.HCR - High energy circalittoral rock;
- SS.SBR.SMus.ModMx / EUNIS Code MC2232 - *Modiolus modiolus* beds on open coast circalittoral mixed sediment; and
- SS.SCS.CCS.MedLumVen / EUNIS Code MC3212 - *Mediomastus fragilis, Lumbrineris spp*. and venerid bivalves in circalittoral coarse sand or gravel.

6.1.8 The intertidal area was comprised a mosaic of biotopes commonly associated with the substrates present and tidal height. The upper shore was comprised cobbles and pebbles with gravel and coarse sand further down the shore. The mid shore was primarily boulders and cobbles, while the low shore was primarily gravel and sand.

6.1.9 Intertidal sediment bound contaminants were low reflecting the granulometric nature of the sediments.

6.1.10 The intertidal communities reflected the substrates present and were analogous with those found inhabiting similar habitats elsewhere in the region.

6.1.11 The presence of the Annex I habitat 'Sandbanks which are slightly covered by sea water all the time' was identified on the Kish and Bray Banks due to the following observed characteristics:

- The feature is permanently submerged;
- Water depths are seldom greater than 20 m; and
- Seabed sediments are predominately composed of sand.

6.1.12 To conclude, this technical report has satisfied the aims and the objectives of the study by providing a comprehensive characterisation in terms of the benthic subtidal and intertidal habitats, surficial sediments and seabed features across the Dublin Array benthic subtidal and intertidal ecology study areas.

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Unit 5,
Desart House,
Lower New Street,
Kilkenny
www.rwe.com

Registered office:
Unit 5,
Desart House,
Lower New Street,
Kilkenny