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ARKLOW BANK
DUMPING AT SEA PERMIT APPLICATION SUPPORTING INFORMATION

RAMBOLL ENVIRON

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1. INTRODUCTION

1.0.1 Ramboll Environ UK Ltd has been commissioned by Arklow Energy Limited (herein referred to as "the client") to undertake the collation of supporting information to be included with a Dumping at Sea Permit application form.

1.0.2 The purpose of a Dumping at Sea Permit is to regulate the dumping of material at sea under the Dumping at Sea Act 1996 (the "Act"). The Act implements the requirements of the international Conventions regulating the disposal of dredged materials at sea: i.e. the London Convention (1972, including the 1996 Protocol) and the OSPAR Convention for the Protection of the Marine Environment of the North East Atlantic (1992).

1.0.3 The Act defines "dumping" as any deliberate disposal in the marine environment (including side-cast dredging, plough dredging, water injection dredging and other such dredging techniques) of a substance or material from or in conjunction with a vessel or aircraft or offshore installation. The Act also sets out the detail of the permitting process.

1.1 Background to the Application

1.1.1 The Arklow Bank Wind Park is an existing 25 megawatt (MW) offshore wind farm generating electrical power for the Wicklow region of Ireland. The wind farm consists of seven 3.6 MW turbines; each supported by a steel monopile foundation and is located on the Arklow Bank (Figure 1.1).

1.1.2 The Arklow Bank Wind Park was granted a Foreshore Licence in January 2002 by the Minister for Communications, the Marine and Natural Resources (now the Department for Environment, Community and Local Government).

1.1.3 Arklow Bank is a shallow water sandbank in the Irish Sea, around 13 km to the east of Arklow, County Wicklow. Arklow Bank covers an area of approximately 27 km by 2.5 km. Water depths on the Bank generally vary between 2 m and 25 m, although there are areas on the Bank which have water depths of less than 1 m. The Arklow Bank Wind Park is located towards the centre of the Bank, with water depths varying between 2 m and 5 m (Lowest Astronomical Tide (LAT)).

1.1.4 Arklow Bank is subjected to strong tidal currents (up to five knots in both north-easterly and south-westerly directions). Sandwaves are present on the Bank, which are approximately 30 m in length and a few metres in amplitude; these provide evidence of seabed sediment transport occurring in a north-easterly direction on the landward side of the Bank and south-westerly direction on the seaward side. Due to shallow water overlying the Bank, breaking waves are often present, even during low swell conditions.

1.1.5 The morphology of Arklow Bank is generally asymmetrical over the southern part and more symmetrical over the northern. Over the asymmetrical part of the Bank, the steepest slope is on the seaward side. This asymmetry of the Bank induces extreme sea states on either side of the Bank crest.

1.1.6 Overall Arklow Bank is considered to be a highly dynamic sandbank. Bathymetric monitoring surveys have been undertaken by the client between 2004 and 2015, which have monitored the accretion of sand around the turbines on the central area of the Bank.

1.1.7 The accretion of sand (specifically around Turbines 3 and 4, and potentially others over time) has compromised the safe navigation of maintenance and service vessels directly accessing the turbines on the Bank during particular states of the tide. The maintenance and service vessels require a minimum depth of 2.4 m (Chart Datum Arklow) for safe access to the turbines during all states of the tide.

1.1.8 An area of seabed has been identified to the east of the turbines, within which seabed levelling is required to provide the required depth for safe access to the turbines. In this application seabed leveling consists of using a plough dredge to move material from areas of higher seabed to those of lower seabed until a desired depth is achieved. In order to undertake the seabed levelling

within this area, a Dumping at Sea Permit is required from the Environmental Protection Agency (EPA).

1.1.9 The client is applying for a multi-year Dumping at Sea Permit for a maximum period of eight years and maximum tonnage of 99,999 wet tonnes. The exact area and wet tonnage to be levelled during each year cannot be determined at the present time, since this is dependent on the rate of sand accumulation on the seaward side of the turbines and the point at which this impedes safe access by maintenance vessels.

1.1.10 However, an area to the east of Turbines 3 and 4 has been identified for the initial seabed levelling campaign. This area has had a significant accumulation of sediment over the previous years, which currently compromises the safe access to the turbines by maintenance vessels.

1.2 Report Layout

1.2.1 The sections of this report have been laid out to correspond with the questions and layout outlined in the Dumping at Sea Permit application form (Version 4). The following application form questions are responded to in the corresponding report sections as detailed in Table 1.1.

Table 1.1 Location of Application Form Question Responses.

Application Form Question Number	Supporting Information Report Chapter Number
A.2 Planning Authority and/or Public Authority	Chapter 2
A.6 Foreshore Act Licence	Chapter 3
B.1 Sediment Chemistry Results	Chapter 4
B.2 Characteristics and Composition of the Substance or Material for Disposal	Chapter 5
C.1 Alternatives to Dumping at Sea	Chapter 6
E.1 Dumping Site Selection	Chapter 7
E.2(i) Characteristics of the Dumping Site	Chapter 8
E.2(ii) Location of the Dumping Site	Chapter 9
E.3 Details of the Dumping Operation	Chapter 10
F.1 Assessment of Impact on the Environment (including Appropriate Assessment Screening and Marine Mammals Risk Assessment)	Chapter 11
G.1 Monitoring Programme	Chapter 12

2. A.2 PLANNING AUTHORITY AND/OR PUBLIC AUTHORITY

2.0.1 The Marine Planning Foreshore Section of the Department of the Environment, Community and Local Government has confirmed that an Environmental Impact Assessment is not required. A copy of this correspondence is provided in Appendix 1.

3. A.6 FORESHORE ACT LICENCE

3.0.1 The Arklow Bank Wind Park was issued a Foreshore Licence in January 2002 by the Minister for Communications, the Marine and Natural Resources (now the Department for Environment, Community and Local Government).

3.0.2 A Foreshore Sub-lease was entered into by Arklow Energy Ltd for the construction and operation of seven turbines currently operating as a demonstration platform as part of the Arklow Bank Wind Park. A copy of the Foreshore Sub-lease is provided in Appendix 2.

3.0.3 The Marine Planning Foreshore Section of the Department of the Environment, Community and Local Government have confirmed that a Dumping at Sea Permit is the only requirement for the proposed seabed levelling within the dumping site and that no amendment or additional Foreshore Licence is required. A copy of the correspondence is provided in Appendix 1.

4. B.1 SEDIMENT CHEMISTRY RESULTS

4.0.1 Consultation with the Marine Institute has confirmed that the collection of sediment samples for chemical analysis is required to support the application. It is acknowledged by the Marine Institute that though the location of the material can be considered remote from anthropogenic sources of contamination, the fact that the site is accreting indicates that the material may originate from elsewhere; therefore the material cannot be classified as undisturbed geological material. A copy of the correspondence with the Marine Institute is provided in Appendix 3.

4.0.2 The Marine Institute has requested that three samples are collected for analysis of sediment chemistry from the following locations:

Table 4.1 Location of samples for sediment chemistry analysis

Sample number	Depth	Longitude	Latitude	Parameters for analysis
S1	Surface	-5.94341	52.79901	1, 2, 3, 4a, 4b, 4c
S2	Surface	-5.94638	52.78686	1, 2, 3, 4a, 4b, 4c, 4d, 4e, 4f, 4g
S3	Surface	-5.94973	52.77665	1, 2, 3, 4a, 4b, 4c

Parameter codes:

1. Visual inspection, to include colour, texture, odour, presence of animals etc.
2. Water content, density (taking into account sample collection and handling).
3. Granulometry, including % gravel (>2 mm fraction), % sand (<2 mm fraction) and % mud (<63 µm).
4. The following determinants for the sand-mud (<2 mm) fraction:

a) total organic carbon;

b) carbonate;

c) mercury, arsenic, cadmium, copper, lead, zinc, chromium, nickel, lithium and aluminium;

d) organochlorines HCH and γ-HCH (Lindane) and polychlorinated biphenyls (PCBs) - to be reported as the seven individual PCB congeners: 28, 52, 101, 118, 138, 153 and 180;

e) total extractable hydrocarbons;

f) tributyltin (TBT) and dibutyltin (DBT); and

g) Polycyclic aromatic hydrocarbons (PAH) – Acenaphthene, Aceanphthylene, Anthracene, Benzo (a) anthracene, Benzo (a) pyrene, Benzo (b) fluoranthene, Benzo (ghi) perylene, Benzo (k) flouranthene, Chrysene, Dibenz (a, h) anthracene, Flourene, Flouranthene, Indeno 1, 2, 3 – cd pyrene, Naphthalene, Phenanthrene, Pyrene.

4.0.3 Furthermore, the Radiation Monitoring Section of the EPA has requested that the three samples collected are also tested for gamma spectroscopy (complex). A copy of the correspondence with the Environmental Protection Agency is included in Appendix 3.

4.1 Sediment Chemistry Results

4.1.1 A summary of the sediment chemistry analysis results are provided below, as well as in Excel format. A full copy of the Excel spread sheet is also provided in Appendix 4. Copies of the laboratory reports are also included in Appendix 5.

4.1.2 The results of the sediment chemistry have been compared to the upper and lower action levels set out in the *Guidelines for the Assessment of Dredge Material for Disposal in Irish Waters*[1]. The results of this comparison are shown in Table 4.2.

4.1.3 The results indicate that arsenic is slightly elevated (exceeding the lower Irish Action Level) at Sampling Point 3. Informal consultation with the Marine Institute by telephone regarding this exceedance has confirmed that this is acceptable. On the basis that the exceedance in arsenic at the single location is acceptable, no further sampling is proposed since all other determinants are below the lower Irish Action Level.

[1] Cronin, M, McGovern, E., McMahon, T. and Boelens, R. (2006) Guidelines for the Assessment of Dredge Material for Disposal in Irish Waters. Marine Environment and Health Series, No. 24. April 2006. ISSN No 1649-0053.

Table 4.2 Results of sediment chemistry analysis with reference to Irish Action Levels

Parameter	Units (dry wt)	Irish Action Level		Sampling Point		
		Lower	Upper	1	2	3
Arsenic	mg kg^{-1}	9	70	7.38	6.29	9.47
Cadmium	mg kg^{-1}	0.7	4.2	0.031	0.025	0.025
Chromium	mg kg^{-1}	120	370	4.62	4.74	5.75
Copper	mg kg^{-1}	40	110	0.797	1.06	1.10
Lead	mg kg^{-1}	60	218	2.31	2.47	2.95
Mercury	mg kg^{-1}	0.2	0.7	0.0011	0.0012	0.0011
Nickel	mg kg^{-1}	21	60	3.73	3.75	4.92
Zinc	mg kg^{-1}	160	410	9.42	9.86	11.5
Σ TBT & DBT	mg kg^{-1}	0.1	0.5	-	<0.008	-
γ-HCH (Lindane)	µg kg^{-1}	0.3	1	-	<0.1	-
HCB	µg kg^{-1}	0.3	1	-	<0.1	-
PCB (individual congeners of ICES 7)	µg kg^{-1}	1	180	-	<0.1	-
PCB (Σ ICES 7)	µg kg^{-1}	7	1260	-	<0.7	-
PAH (Σ 16)	µg kg^{-1}	4000	-	-	<34	-
Total Extractable Hydrocarbons	g kg^{-1}	1.0	-	-	0.00204	-

= exceedance of Lower level = exceedance of Upper level

5. B.2 CHARACTERISTICS AND COMPOSITION OF MATERIAL FOR DISPOSAL

5.0.1 The First Schedule of the Dumping at Sea Act 1996 sets out the criteria which must be considered to allow the EPA to make a decision on whether to grant or refuse an application. The First Schedule is further sub-divided into the following headings and this chapter provides information to fulfil the requirements of (i).

i. Characteristics and composition of the substance or material;
ii. Characteristics of the dumping site and method of deposit; and
iii. General considerations and conditions.

5.0.2 The requirements of (ii) and (iii) are responded to in Chapters 6, 8, 10 and 11 of this report.

5.1 Amount and Composition

5.1.1 The client is proposing to use a plough dredge to undertake seabed levelling within the dumping site over an eight year permit. The maximum amount of material to be levelled within the permit term is up to 99,999 wet tonnes.

5.1.2 The actual amount of material to be levelled cannot be quantified because this is dependent on the accumulation rate of sediment on the seaward side of the turbines, which then compromises the safe access of maintenance vessels to the turbines.

5.1.3 However, an area to the east of Turbines 3 and 4 has been identified for the initial seabed levelling campaign. This area has had a significant accumulation of sediment in previous years, which currently compromises the safe access to the turbines by maintenance vessels during particular states of the tide.

5.1.4 GIS analysis has determined that approximately 10,500 wet tonnes (5,500 m^3) of material will be levelled during the initial seabed levelling campaign in the vicinity of Turbines 3 and 4 to relocate sediment that has accumulated above 2.5 m (Chart Datum (CD) Arklow). This will then allow maintenance vessels to safely access these turbines during all states of the tide.

5.2 Material Form

5.2.1 Benthic sediment samples, using an anchor dredge, have been collected by the client from 2004 to 2011. Sample location D16 was collected from Arklow Bank to the east of Turbine 4 and is considered to be representative of the sediments to be mobilised as part of the seabed levelling campaign.

5.2.2 Sediment analysis of these samples indicated that the sediment is dominated by sand or slightly gravelly sand as described in more detail in Section 5.3.

5.3 Physical Properties (especially solubility, specific gravity and density)

5.3.1 A sub-sample (~400 g) of sediment collected from sample location D16 was removed and transferred into a labelled container for Particle Size Analysis (PSA). The sample was then dried and pre-treated using methods employed by Buchanan and Kain (1984[2]). The dried sample was sieved through a series of nested sieves (Endecott BS410/1986) using an electronic sieve shaker. The sample was ascribed to a sediment type based on Folk (1954[3]) with a size division based on the Wentworth scale.

5.3.2 The PSA results are provided in Table 5.1 and a Particle Size Distribution curve is provided in Figure 5.1. The results indicate that sediment sampled from Arklow Bank is generally dominated

[2] Buchanan, J. B., Kain, J. M. 1984. Measurement of physical and chemical environment. In: Holme, N. A., McIntyre, A. D. (Eds) Methods for the Study of Marine Benthos. Blackwell Scientific Publications, Oxford. Pp 30-50.
[3] Folk, R. L. 1954. The distinction between grain size and material composition in sedimentary rock nomenclature. Journal of Geology 62(4), 344-359.

by very well to moderately well sorted fine to medium sand (classified after Buchanan). It should be noted that the heterogeneous nature of the sediment results in minor differences in sediment composition between the survey years.

Table 5.1 Sample location D16 PSA results 2004 to 2011

Sample year	Percent passing through sieve size								Mean phi	Skewness	Kurtosis	Classification after Buchanan	Folk Triangles after BGS
	4mm	2mm	1mm	0.5mm	0.25mm	0.125mm	0.063mm	<0.063mm					
2011	0.00	0.00	0.06	0.76	37.82	55.91	1.92	3.53	2.39	-0.24	0.84	Moderately well sorted fine sand	Sand
2010	0.00	1.00	0.90	2.50	55.90	39.30	0.30	0.00	2.10	0.46	0.60	Moderately well sorted gravelly medium sand	Slightly gravelly sand
2008	0.00	0.10	0.20	1.10	85.30	12.20	0.20	0.90	1.78	0.30	1.82	Very well sorted medium sand	Slightly gravelly sand
2007	1.00	0.60	0.80	2.20	78.80	13.60	0.10	2.80	1.95	0.56	1.82	Well sorted medium sand	Slightly gravelly sand
2006	0.00	0.28	0.51	55.77	41.52	0.00	0.00	1.93	1.13	0.46	0.58	Moderately well sorted medium sand	Slightly gravelly sand
2005	1.09	0.58	0.39	2.73	48.13	46.77	0.26	0.01	1.95	0.64	0.01	Moderately well sorted medium sand	Slightly gravelly sand
2004	0.28	0.48	0.50	1.17	63.35	34.32	0.06	0.00	1.83	0.20	0.81	Moderately well sorted medium sand	Slightly gravelly sand

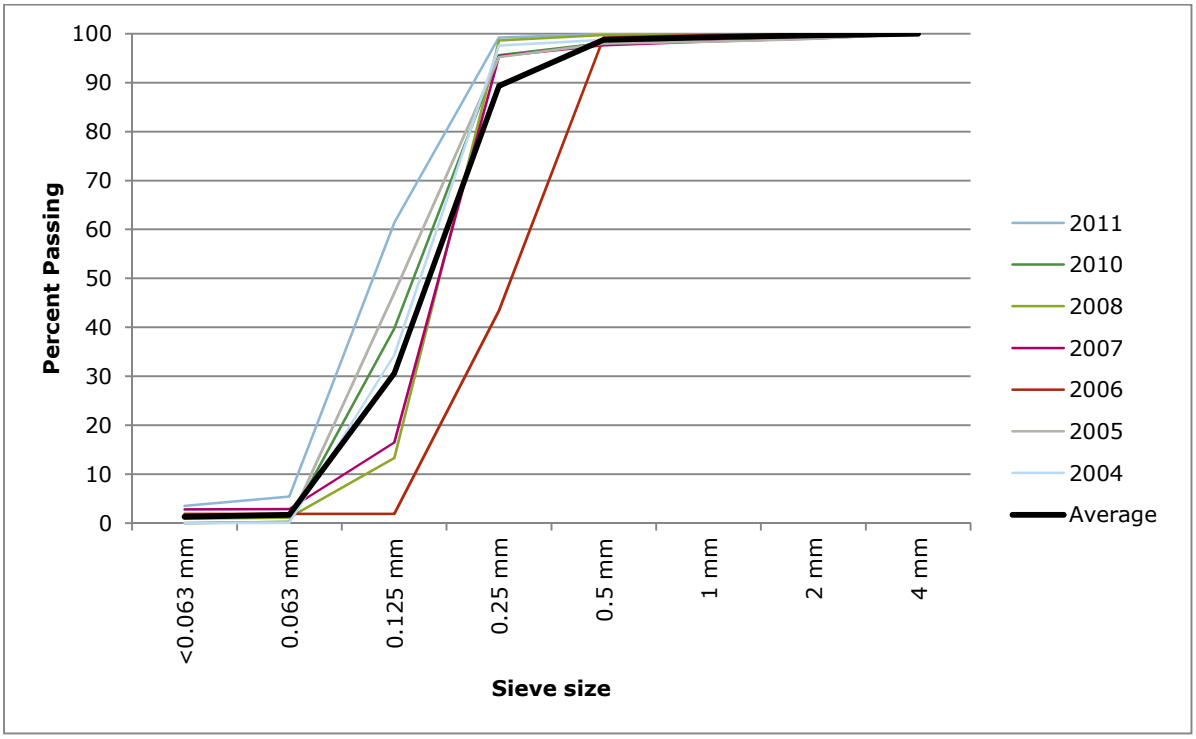


Figure 5.1 Sample location D16 Particle Size Distribution curve

5.3.3 Sediment samples collected as part of the most recent sampling campaign (May 2016) confimed that the sediment of the Bank is made up of sandy sediments. The results of this sampling is shown in Table 5.2.

Table 5.2 Results of sediment sampling (May 2016)

Sampling Site	% Gravel (>2 mm)	% Sand (63 µm – 2 mm)	% Silt / Clay (<63 µm)
S1	0.8	95.4	3.7
S2	0.5	96.6	2.9
S3	7.0	89.6	3.4

5.4 Chemical and Biochemical Properties

5.4.1 Table 4.2 in Section 4.1 shows the results of the sediment chemistry analysis undertaken for three samples from the proposed Dump Site.

5.5 Biological Properties

5.5.1 Benthic sediment samples, using an anchor dredge, have been collected by the client from 2004 to 2011. Sample location D16 was collected from Arklow Bank to the east of Turbine 4 and is considered representative of the biological properties of the seabed levelling area.

5.5.2 A total of one individual (the bristleworm *Ophelia borealis*) was recorded in the 2011 survey (see Appendix 7). Both hornwrack *Flustra foliacea* and sea fir *Abietinaria abietina* were also recorded as present within the anchor dredge sample location D16. The number of individuals recorded in 2011 was lower than those identified in 2010; however the number of taxa remained consistent. Historically, the number of taxa and individuals recorded at sample location D16 decreased between 2004 and 2005, and remained consistently low.

5.5.3 Sample location D16 has been consistently classified according to the JNCC biotope classification (2015[4]) as SS.SSA.IFiSa.IMoSa infralittoral mobile clean sand with sparse fauna. This classification is consistent with the previous benthic surveys undertaken by the client between 2004 and 2011.

5.6 Radioactivity

5.6.1 Consultation with the Office of Radiological Protection, undertaken by the EPA, has confirmed that samples for radiological analysis were last taken from the Arklow area in 2007. The Office of Radiological Protection advised that if samples are being collected for chemical analysis (on the basis of the Marine Institute's advice) then an additional sample for radiological analysis should be taken for completeness.

5.6.2 Three surface sediment samples were collected in May 2016 and sent to the EPA's laboratory in Dublin for analysis. This analysis concluded that the proposed seabed levelling will not result in a radiological hazard. The Office of Radiological Protection confirmed that there was no need to resample (see Appendix 6).

5.7 Toxicity

5.7.1 As the material tested was determined to be uncontaminated, toxicity testing was not considered to be required.

5.8 Persistence in the Environment (Physical, Chemical and Biological)

5.8.1 The strong tidal flows in the vicinity of Arklow Bank account for the regular re-suspension and deposition of material. Sandwaves are present on the Bank, which provide evidence for seabed sediment transport. Additionally breaking waves are often present as a result of the shallow water, even during low swell conditions.

5.8.2 Since the material making up the Bank is relatively mobile and has been proven to be uncontaminated, its chemical and biological persistence in the environment is not considered to be of concern.

5.9 Accumulation and Biotransformation in Biological Materials or Sediments

5.9.1 The material tested was determined to be uncontaminated, therefore testing to determine the accumulation and biotransformation in biological materials and sediments was not undertaken.

5.10 Chemical and Physical Changes of the Material After Release, Including Possible Formation of New Compounds

5.10.1 The material tested was determined to be uncontaminated, therefore testing to determine the chemical and physical change of the material after release was not undertaken.

5.11 Probability of Production of Taints or Other Changes Reducing Marketability of Resources (e.g. Fish and Shellfish)

5.11.1 The material tested was determined to be uncontaminated, therefore the probability of the production of taints or other changes reducing the marketability of resources is considered to be extremely unlikely.

[4] JNCC (2015) The Marine Habitat Classification for Britain and Ireland Version 15.03 [Online]. 12 January 2016. Available from www.jncc.defra.gov.uk/MarineHabitatClassification.

6. C.1 ALTERNATIVES TO DUMPING AT SEA

6.0.1 Alternative processes were reviewed to determine if other more economical or environmentally benign methods of re-use or disposal could be utilised for material from the proposed works to the east of the Arklow Bank Wind Park.

6.0.2 Beneficial re-use and disposal on land were both considered as potential alternatives. This assessment was made based on the information provided within this document.

6.1 Beneficial Re-Use

6.1.1 The utilisation of the material for beneficial re-use was considered as one alternative to dumping at sea. Beneficial re-use was considered in terms of collection of dredged material and transfer to shore for utilisation for repair following coastal erosion or for incorporation as construction material.

6.1.2 The processes and equipment necessary to ensure material is suitable for beneficial re-use include the requirement of additional vessels for retrieval of the material, the separation of silt fractions, dewatering and improvement of the engineering properties, which are all costly and energy intensive.

6.1.3 Furthermore, the exploitation of offshore sand and gravel is well established in the UK and Europe, however these deposits are rarely exploited in Irish waters while terrestrial quarries remain viable. Furthermore, many of the sandbanks and gravel deposits in the Irish Sea, between Wicklow and Wexford, are mobile and are therefore less preferable as a resource for primary aggregate.

6.1.4 Constraints in terms of a feasible location for where this processing can take place and the storage facilities required for material prior to and following treatment present further issues that prevent beneficial re-use from being considered a viable alternative.

6.1.5 The small quantity of material and unknown timing of proposed works as well as no beneficial re-use schemes being identified locally and land constraints in nearby harbours prevents the storage of the material until a suitable beneficial use is identified.

6.1.6 Beyond the initial campaign, both the quantity and timing are unknown and the constraints described above still apply. Furthermore, the campaign nature of the proposed seabed levelling would preclude the use of the material as a regular produce for sale or reuse.

6.1.7 Beneficial re-use is not considered to be a favourable environmental option for the initial campaign or those beyond it and therefore such a process has been discounted as a feasible alternative to dumping at sea.

6.2 Disposal to Landfill

6.2.1 The disposal of dredged material to landfill is presented as an alternative to dumping at sea, providing suitably licenced sites have the requisite capacity and are deemed suitable for the receipt of such material.

6.2.2 Challenges associated this method primarily surround bringing the material ashore, dewatering and transportation by road to the proposed landfill site, which present significant economic costs.

6.2.3 Receiving landfill sites would require the material to be dewatered prior to acceptance, which would involve draining in a lagoon, filter presses, centrifuges or a comparable technology. All dewatering processes would be costly, time-consuming and energy intensive and there is unlikely to be an available location in the vicinity of Arklow to complete this process.

6.2.4 Disposal of material to landfill also means utilising a process which is the lowest priority on the waste hierarchy and as such represents the least favourable environmental option. One of the

key priorities for waste management has been to focus on reducing reliance upon landfill and disposal in accordance with the Landfill Directive (1999)[5].

6.2.5 The quantity and timing of material for disposal beyond the initial campaign is unknown and therefore disposal to landfill is not considered to be practicable or of a reasonable cost. Disposal to landfill is not considered to be a favourable environmental option; therefore such a process has been discounted as a feasible alternative to dumping at sea.

6.3 Assessment of Alternatives

6.3.1 Based on the information gathered during the investigation and the likely environmental, social and economic impacts associated with the potential alternatives it has been determined that the proposed method of dumping at sea is the most suitable method of disposal. Issues are primarily associated with the economic costs of pre-treatment prior to re-use or disposal and the availability of suitable facilities to store, process and manage such material. The quantity and timing of material for beneficial re-use or disposal on land beyond the initial campaign is also unknown and therefore it is not considered to be practicable or of a reasonable cost. Therefore alternative processes have been discounted.

[5] Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste - http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:31999L0031&from=EN – Accessed on 13.01.16

7. E.1 DUMPING SITE SELECTION

7.0.1 "Dumping" is defined by the Dumping at Sea Act 1996 as "any deliberate disposal in the maritime area (including side-cast dredging, plough dredging, water injection dredging and other such dredging techniques) of a substance of material from or in conjunction with a vessel or aircraft or offshore installation".

7.0.2 Consultation undertaken by the client with the Environmental Protection Agency defines that the "Dumping Site" is defined as the entire area where the seabed plough will interact with the seabed, whether removing high peaks of sediment or discharging the collected sediment into lower areas of seabed.

7.0.3 These definitions have been used to determine the size and shape of the Dumping Site required to undertake seabed levelling to the seaward side (east) of the turbines of the Arklow Bank Wind Park. It is initially proposed by the client that seabed levelling will be undertaken in part of the Dumping Site in the vicinity of Turbines 3 and 4, where sediment build up in this area is currently preventing the safe navigable access to these turbines during certain states of the tide. The remaining area of the Dumping Site will be levelled on a campaign basis as and when safe access to the turbines by maintenance vessels becomes compromised by the build-up of sediment, within the time and tonnage limits of any Dumping at Sea Permit granted.

7.0.4 Since the entire area to be defined as the Dumping Site is the same as that being exposed to seabed levelling by the plough, the baseline conditions of the site, including the following, is provided in Section 11.1:

i. Areas of natural beauty or significant cultural or historical importance;
ii. Spawning, recruitment and nursery areas;
iii. Sport and commercial fishing areas;
iv. Aquaculture;
v. Amenity areas;
vi. Exploitable resources, e.g. aggregates;
vii. Shipping lanes;
viii. Ship wrecks;
ix. Areas of specific scientific or biological importance; and
x. Engineering uses of the sea such as undersea cables, pipes, etc.

8. E.2(I) CHARACTERISTICS OF THE DUMPING SITE

8.0.1 The Dumping at Sea Permit application form requires the description of the characteristics of the dumping site, based on the investigations to be provided with the application. The required information regarding the details of the characteristics of the Dumping Site are divided into the following sub-headings:

i. Distance from the nearest shore;
ii. Average, minimum and maximum depth of water;
iii. Sediment characteristics;
iv. Nature of seabed habitats; and
v. Current, flow and tidal regime.

8.1 Distance from the Nearest Shore

8.1.1 The seabed levelling site is located approximately 13 km to the east of Arklow (Figure 1.1). The southern extent of the seabed levelling area is situated approximately 12.5 km from the Wexford shoreline. The northern extent of the seabed levelling area is approximately 9.5 km from the Wicklow shoreline.

8.2 Average, Minimum and Maximum Depth of Water

8.2.1 A bathymetric survey of Arklow Bank was undertaken between 7 April and 10 April 2015 by Island Maritime and Island Shipping.

8.2.2 The average depth within the seabed levelling area was determined to be -3.2 m CD Arklow, while the maximum depth was -7.4 m CD Arklow and minimum depth was -0.8 m CD Arklow. The water depth increases rapidly to the east and west of the bank, with depths increasing to between 25 m and 35 m CD Arklow on the west and between 60 m and 100 m CD Arklow to the east (Figure 8.2).

8.3 Sediment Characteristics

8.3.1 A benthic ecology survey undertaken by the Aquatic Services Unit in June 2011 and further sediment samples were collected in 2016 to support this application. These provide an overview of the key sediment characteristics of Arklow Bank. Particle Size Analysis (PSA) showed the sediment within the Dumping Site to be heterogeneous in nature. The sediments across Arklow Bank are dominated by sands and gravelly sands with mobile surface sediment, deeper areas are dominated by sandy gravels and gravelly sands.

8.3.2 Comparison of information in the Arklow Bank Wind Park EIA[21] of bathymetric surveys with old admiralty charts observe an apparent movement of the bank towards the north and east. This movement is consistent with the main direction of waves and current loading, and the general northerly movement of sediments in the overall area, including the Dumping Site. For further details see Section 5.3.

8.4 Nature of Seabed Habitats

8.4.1 The benthic ecology survey completed by the Aquatic Services Unit in June 2011 identified the predominant biotope on Arklow Bank and the areas to the south and west of the bank as IGS.Mob – sparse fauna in infralittoral mobile clean sand. Habitat of this nature is characterised by sparse infauna, opportunistic amphipods, such as sandeel *Ammodytes* spp. and epifauna such as *Asterias rubens*. For further details see Section 5.5.

8.5 Current, Flow and Tidal Regime

8.5.1 Breaking waves and strong currents contribute to an energetic environment at Arklow Bank. The spring tidal amplitude in the area is between approximately 0.5 m to 1 m. Storm surges can increase surface elevation up to 1.0 m for a 1 in 50 year event. The highest mean water level for Arklow Bank with a return period of 50 years has been calculated as 3.51 m above LAT.

8.5.2 Due to the position of Arklow Bank in the Irish Sea the area receives considerable protection from the Irish mainland to the west, which limits the wave energy reaching the site. Significant Wave Heights were calculated by the 2001 EIA to be approximately 8 m to 9 m, suggesting that a large proportion of waves break when reaching the Bank due to the shallow nature of the water.

8.5.3 Arklow Bank is subject to strong tidal currents with evidence of sand transport in an overall northerly direction to the landward side of the bank and southerly to the seaward side of the bank. The 2001 EIA study observed currents to predominantly move in directions from east to west to west-southwest to east-northeast. Currents of up to 2 m/s were also measured across the Bank during the study. Flow velocities up to 2 m/s were recorded in directions ranging from east to west to west-southwest to east-northeast; measurements were carried out as part of an EU funded research project. This flow velocity is confirmed by a study completed by Sustainable Energy Ireland assessing potential tidal and current energy resources in Ireland[6]

[6] Sustainable Energy Authority of Ireland (2004) Tidal & Current Energy Resources in Ireland

9. E.2(II) LOCATION OF THE DUMPING SITE

9.0.1 A set of co-ordinates in latitude and longitude for the proposed Dumping Site is provided below in Table 9.1.

Table 9.1 Co-ordinates of the proposed dumping site.

Ref	WGS84	
	Latitude	Longitude
A	52.7966	-5.94441
B	52.80224	-5.94366
C	52.81121	-5.94196
D	52.81113	-5.94052
E	52.80219	-5.94233
F	52.79651	-5.94319
G	52.79206	-5.94474
H	52.78484	-5.94624
I	52.77080	-5.95085
J	52.77100	-5.95246
K	52.78494	-5.94759
L	52.79216	-5.94600

9.0.2 ESRI Shape files of the proposed dumping site have been provided to the Environmental Protection Agency along with the application form and this report.

10. E.3 DETAILS OF THE DUMPING OPERATION

10.0.1 The Dumping at Sea Permit application form sets out the criteria which must be considered to allow the EPA to make a decision on whether to grant or refuse an application. The required information regarding the details of the dumping operation is sub-divided into the following headings and this chapter provides information to fulfil those requirements.

i. Date of commencement and duration of the dumping operations;
ii. Name and address of operator contracted to carry out the dumping at sea (if known);
iii. Location and method of dumping; and
iv. Total quantities (in tonnes (wet weight) and cubic meters) to be dumped per day/week/month.

10.1 Date of Commencement and Duration of the Dumping Operations

10.1.1 The date of commencement of the seabed levelling works cannot be determined until the EPA have determined the Dumping at Sea Permit application which is being made by the client and which this report supports.

10.1.2 Assuming that a Dumping at Sea Permit is granted, the date of commencement and anticipated duration of the seabed levelling works will be provided to the EPA at least one week prior to any seabed levelling campaign being undertaken.

10.2 Name and Address of Operator Contracted to Carry Out the Dumping at Sea (If Known)

10.2.1 The operator who will be contracted to carry out the proposed seabed levelling is currently unknown. Details of the operator will be issued to the EPA at least one week prior to any seabed levelling campaign being undertaken.

10.3 Location and Method of Dumping

10.3.1 The location of the proposed dumping site is provided in Chapter 9.

10.3.2 It is proposed by the client that seabed levelling is permitted within the dumping site. This involves the use of a plough, approximately 11 m in width, which is towed behind a vessel.

10.3.3 The plough is considered to be an effective method for the removal of areas of higher seabed level, with layers of sediment being removed at each pass until the desired depth is achieved. The contents of the plough would be released once the water depth increases to a depth greater than the plough depth within the dumping site. It should be noted that material will also be suspended and transported by natural hydrodynamic processes while the plough is in operation.

10.3.4 For plough control, the depth of seabed will be monitored at all times, utilising both the onboard echo sounder and dredge master system, with adjustments made accordingly to the ploughing operation. This will ensure that the desired depth is achieved as quickly and efficiently as possible.

10.3.5 It is anticipated that seabed levelling works will be undertaken during daylight hours only, given that the works are being carried out within 15 m to 20 m of the turbines and associated infrastructure. It is also anticipated that works will be undertaken on all states of the tide.

10.3.6 A full method statement will be provided to the EPA at least one week prior to a seabed levelling campaign being undertaken.

10.4 Total Quantities to be Dumped per Day/Week/Month

10.4.1 The initial seabed levelling campaign is proposed to be undertaken in the vicinity of Turbines 3 and 4. This area has had a significant accumulation of sediment in previous years, which currently compromises the safe access to the turbines by maintenance vessels during particular states of the tide.

10.4.2 GIS analysis has determined that approximately 10,500 wet tonnes (5,500 m^3) of material will be levelled during the initial seabed levelling campaign in the vicinity of Turbines 3 and 4 to relocate sediment that has accumulated above 2.5 m CD Arklow.

10.4.3 It is estimated that the duration for this initial campaign will be complete in a timescales of weeks, although this is weather dependent.

10.4.4 At the present time it is not possible to determine the quantities of sediment to be levelled over the eight year term of the Dumping at Sea Permit being applied for. Monitoring will ensure that the total quantity of sediment being applied (99,999 wet tonnes) for will not be exceeded by future campaigns during this eight year licence term.

11. F.1 ASSESSMENT OF IMPACT ON THE ENVIRONMENT

11.0.1 The First Schedule of the Dumping at Sea Act 1996 sets out the information which must be provided in order to assess the potential impacts of the operations on the receiving environment. This allows the EPA to make a decision on whether to grant or refuse an application. The First Schedule is further sub-divided into the following headings and this chapter provides information to fulfil the remaining requirements of (ii) and (iii).

i. Characteristics and composition of the substance or material;
ii. Characteristics of the dumping site and method of deposit; and
iii. General considerations and conditions.

11.0.2 The requirements of (i) and remaining requirements of (ii) and (iii) are responded to in Chapters 5, 6, 8 and 10.

11.0.3 This chapter also includes a Screening for Appropriate Assessment to assess whether the proposed plough dredging, either individually or in combination with other plans or projects, is likely to have a significant effect on a European Site. The Screening for Appropriate Assessment can be found in Section 11.7 and Appendix 9.

11.0.4 An assessment of the impact on the receiving environment is also included which details how the plough dredging will comply with, or not result in the contravention of the Water Framework Directive (2000/60/EC); the Marine Strategy Framework Directive (2008/56/EC) and the Priority Substances Directive (2008/105/EC). This assessment is provided in Section 11.3.

11.1 Potential Effects of Seabed Levelling

11.1.1 The purpose of this section is to identify and assess the potential source-pathway-receptor links that may be present and which may give rise to impacts on the environment. This assists the process of understanding how the physical effects of the proposed seabed levelling, i.e. mobilisation of the seabed sediments, potentially alter sensitive receptors. Pathways of exposure linking physical effects to the potentially sensitive receptors are also identified.

11.1.2 The potential environmental impact of these effects is discussed in Section 11.5 of this report.

11.1.3 The potential effects on the environment of seabed levelling that are relevant to the seabed levelling proposed are identified as:

i. Seabed disturbance;
ii. Release of sediment in a suspended sediment plume;
iii. Vessel presence; and
iv. Noise and vibration.

11.1.4 The potential environmental effects are discussed in the following sections; however, the assessment of the scale of these potential effects is addressed in Section 11.4 of this assessment.

Seabed Disturbance

11.1.5 The physical disturbance of the seabed, as a result of seabed levelling, has the potential to directly affect the biota that use this habitat, as well as other materials within the removed strata, such as any archaeological remains which may be present. In terms of biota, disturbance of seabed has a direct adverse effect on the benthic communities present within the area affected, predominantly resulting in the removal of both infauna and epifauna in the area impacted by proposed seabed levelling. The potential impacts on benthic communities will also have secondary adverse impacts on species which prey on benthic invertebrates further up the food chain.

11.1.6 Changes in bathymetry as a result of sediment disturbance may not only be confined to within the seabed levelling area. There is potential for bedforms associated to occur outside the seabed levelling area, which may have a slight bathymetric relief. Changing the bathymetry will potentially also have a local impact on hydrodynamics and sediment flux[7].

11.1.7 In water depths which are less than four times the wavelength, the seabed exerts an influence over the wave characteristics. The exact relationship between variables is complex and these alter with changing water depths. However, in simple terms the wave height increases as water becomes shallower while length and wave form velocity decrease[7]. As a general rule, localised lowering of the seabed as a result of seabed levelling will result in a decrease in wave height and increases in both wavelength and velocity, in areas where the seabed exerts an influence over the wave characteristics. Although changes in tidal currents can occur as a result of changes in seabed levels, these changes are typically very modest and produce small changes in tidal currents, in the order of a few centimetre per second during peak ebb and flood flows.

11.1.8 Changes in wave induced currents and tidal flows can also effect the rates and direction of sediment transport. Where increases in current speeds occur, sediment flux is also likely to increase, whereas decreases in current speeds can cause decreases in sediment flux. These changes in flux may lead to potential changes in erosion and deposition.

11.1.9 Changes in sediment flux are also controlled by the characteristics of the seabed sediments (see Chapter 5 for details on the seabed sediments in the vicinity of the proposed seabed levelling area). In areas of finer grained sediment or areas of higher sediment availability, sediment flux is more likely to be affected. Sediment flux is anticipated to be highly localised to the seabed levelling area.

11.1.10 The proposed seabed levelling within the Arklow Bank Wind Park will disturb the surface layers of the seabed, and sediment below it, through the seabed levelling process. The initial seabed levelling campaign will take place in an area of ~8 ha to the east of Turbines 3 and 4. It is estimated that areas of sediment accumulation above 2.5 m Chart Datum (Arklow) will be removed to facilitate the safe navigation of maintenance vessels to these turbines.

11.1.11 The proposed seabed levelling will redistribute the sediment and any biota contained therein in areas of sediment above -2.5 m Chart Datum (Arklow). It is acknowledged that a proportion of the biota may be damaged by this process although due to the high tidal currents and sediment transport regime it is likely that the biota will be adapted to sediment inundation.

11.1.12 The proposal will alter the seabed bathymetry within the area where the seabed levelling is undertaken. The extent of changes to seabed bathymetry beyond this area is unknown; however, it is likely that these will be undetectable within the bedforms that are present on the Bank itself and the wider seabed area.

11.1.13 Changes to wave induced, tidal currents and sediment flux as a result of the proposed seabed levelling is considered insignificant in the surrounding environment. This is in the context of the strong tidal currents and wave induced currents already produced by the bathymetry of the wider Bank and the relatively small areas of seabed that will be impacted by the seabed levelling as a result of the initial and subsequent campaigns.

Suspended Sediment Plume

11.1.14 The action of seabed levelling will lead to the production of a suspended sediment plume in the water column, from the disturbance of the seabed and also from the plough itself. The spatial extent of the plume depends on the particle size; velocity of discharge; and the local hydrodynamic environment (see Section 11.2 for an overview of the anticipated maximum extent of the suspended sediment plume). The potential impact of the plume will also depend on the natural background conditions, for example, where habitats are subject to natural disturbance,

[7] EMU Limited (2012) Anglian Marine Aggregates Regional Environmental Assessment, Volume 1 and 2. Report for the Anglian Offshore Dredging Association

such as Arklow Bank, plume impacts are considered to be minimised relative to areas that are considered otherwise stable.

11.1.15 Elevated concentrations of particulate suspended sediment and its associated deposition on settling, increased turbidity of the water and the potential dispersion of contaminants may affect different functional levels of the ecosystem. The potential effects may include, changes in primary production filter feeding in surrounding benthic communities, temporary changes in migrations and/or movement of fish, survival of pelagic egg and larvae of fish and forage opportunities for visual predators, such as fish, seabirds and mammals[7].

11.1.16 The dispersion of the suspended sediment in the wider environment by natural hydrodynamic processes can potentially alter the nature of the bed sediments locally, which could alter the benthic communities where these changes occur.

Vessel Presence

11.1.17 The presence of the vessel can potentially lead to conflicts with other users of the sea. Potential impacts could occur between the seabed levelling activity and recreational yachting and fishing, for instance. Key to mitigating the effects is to utilise an effective mechanism for liaison with those potentially impacted by the proposed seabed levelling. Noise and vibration effects of the vessel, and the action of the plough on the seabed, are discussed below.

Noise and Vibration

11.1.18 There are a number of different processes that can contribute to the noise and vibration generated by the seabed levelling vessel:

i. Collection noise – noise generated by the collection of sediment in the plough and movement of the plough across the seabed; and
ii. Ship noise – the noise associated with the propeller, engine and thrusters of the vessel.

11.1.19 The noise generated by vessels operating at low speed is predominantly low frequency (below 1 kHz), whilst the movement of the plough through the seabed generates noise of higher frequency than those generated by the ship engine and propeller. Furthermore, the re-suspension of sand generates lower sound levels than that of gravels[7].

11.1.20 The low frequency noise would potentially affect marine species sensitive to this frequency of sound. Hearing specialists, such as herring, and generalists that are relatively sensitive to sound, such as cod, would potentially be affected more than generalists with relatively poor hearing, such as dab or sole. The exception being the harbour porpoise is known to have relatively high sensitivity to most frequencies and both harbour and grey seals also have relatively good underwater hearing at frequencies below 1 kHz.

11.1.21 It is poorly understood how seabed vibrations affect bottom dwelling fish and additionally, little is known about the hearing capabilities of sharks, rays and skates and invertebrates.

11.2 Suspended Sediment Plume

11.2.1 The action of seabed levelling will lead to the production of a suspended sediment plume in the water column, from the disturbance of the plough passing through the upper layers of sediment. The spatial extent of the plume depends upon the particle size of the sediment being suspended, the release location in the water column and the local hydrodynamic environment.

11.2.2 The scale of the suspended sediment plume provides an estimation of the area potentially impacted during seabed levelling. It should be noted that the methodology for the calculation of the suspended sediment plume is based on the following assumptions:

i. The estimated sediment deposition rate is based on the median particle size derived from particle size analysis of sediment samples collected from Arklow Bank between 2004 and 2011, as this is assumed to represent the most common particle size present;
ii. Settlement time of a suspended particle is based on the assumption that the particle is settling from the average sea depth from sea surface to seabed within the seabed levelling area; and
iii. The tidal flow rates utilised are the maximum flow rates measured on site and thus represent the worst case scenario.

Seabed Levelling Sediment Dispersion Analysis

11.2.3 Particle size analysis (PSA) was completed between 2004 and 2011 on samples removed from a single sampling location on Arklow Bank (sample location D16 – see Chapter 5). The proportion of each sediment fraction size was determined for each sample collected and the PSA distribution for the survey years were combined to produce an overall mean PSA distribution (Figure 11.1).

11.2.4 Utilising the distribution graph the median particulate size (D^{50} – 50% passing) was calculated by intersecting the mean PSA distribution line at 50% passing to determine the particle size on the x axis (Figure 11.1); median particle size was calculated to be 0.160 mm.

11.2.5 The median particle size was then used to calculate the settling velocity of the particle in the plume using the sediment settling velocity curve given in Figure 11.2. The grain size is correlated with the settling velocity along the x axis, where a particle of median size of 0.160 mm was estimated to have a settling velocity of 20 mm/s.

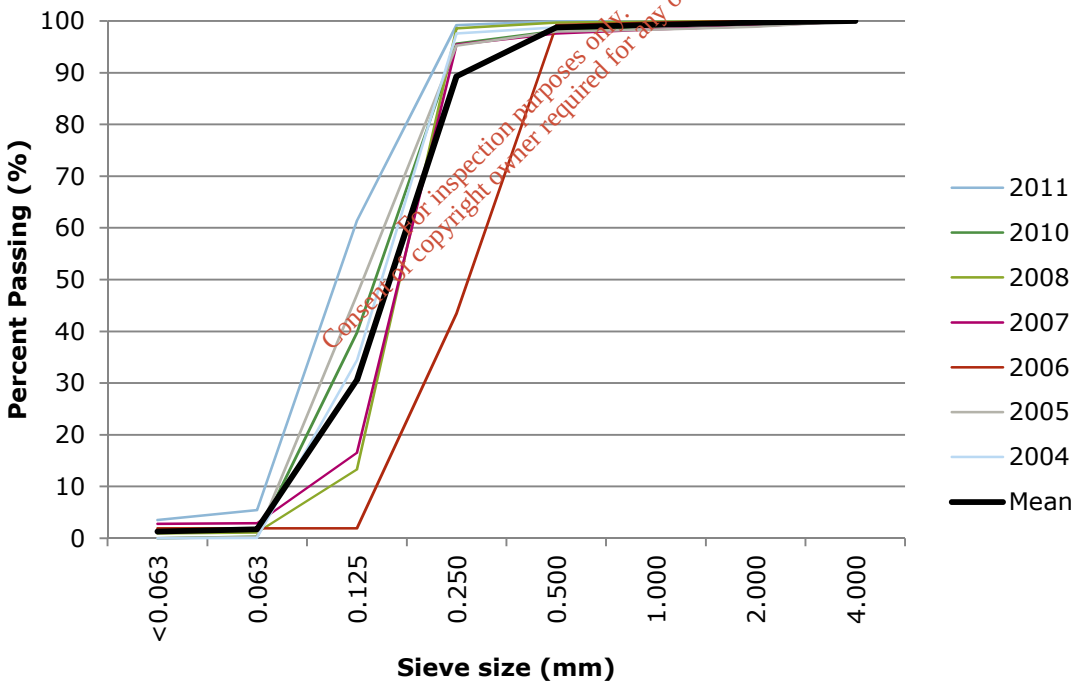


Figure 11.1 Arklow Bank particle size distribution between 2004 and 2011 and the mean distribution for this time period.

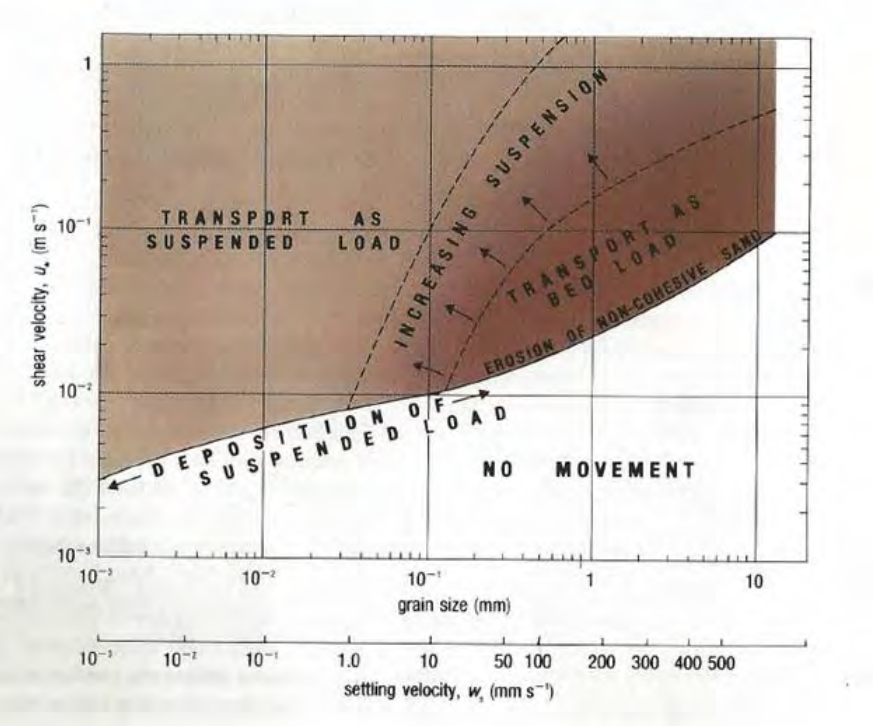


Figure 11.2 Sediment settling velocity curve.

11.2.6 Based on the estimated settling velocity, the length of time taken for a median particle of 0.160 mm to settle on the seabed was determined based on the average depth of the seabed levelling area. The average depth of the area undergoing seabed levelling was calculated using the results of the bathymetric survey undertaken in April 2015[8]. The average depth of the seabed levelling area is 3.24 m. Therefore, settlement time for a median particle is calculated to be 162 seconds.

11.2.7 It should be acknowledged that this settlement time represents the worst case scenario, as the average depth from the sea surface to seabed across the seabed levelling area has been considered in the settlement time. In reality, the majority of the sediment re-suspended into the water column through the process of seabed levelling is much closer to the seabed. Therefore the particles are likely to settle to the seabed faster, meaning a smaller sediment plume will be produced.

11.2.8 Based on the sediment settlement time of 162 seconds and local tidal flows it is possible to calculate the maximum theoretical extent of the sediment plume. The magnitude of tidal flow velocities across Arklow Bank were recorded during the 2001 EIA for the Wind Park[9]. Flow velocities up to 2 m/s were recorded in directions ranging from east to west to west-southwest to east-northeast; measurements were carried out as part of an EU funded research project. This flow velocity is confirmed by a study completed by Sustainable Energy Ireland assessing potential tidal and current energy resources in Ireland[10] (Figure 11.3).

11.2.9 A tidal flow of 2 m/s represents the maximum recorded flows anticipated on Arklow Bank during spring tides and as such it presents the worst case distance that the sediment particles will travel under the influence of the tide whilst settling though the water column to the seabed. Tidal flow during neap tides will be lower and consequently the extent of the sediment plume will be smaller during these periods.

[8] Island Maritime and Island Shipping (2015) Arklow Bank Wind Farm Project. Monitoring Survey April 2015.
[9] EIA Arklow Bank Wind Park (2001) Appendix 10 – Effect of Wind Farm Structures on the Arklow Bank – Murphy Dollard Report
[10] Sustainable Energy Authority of Ireland (2004) Tidal & Current Energy Resources in Ireland

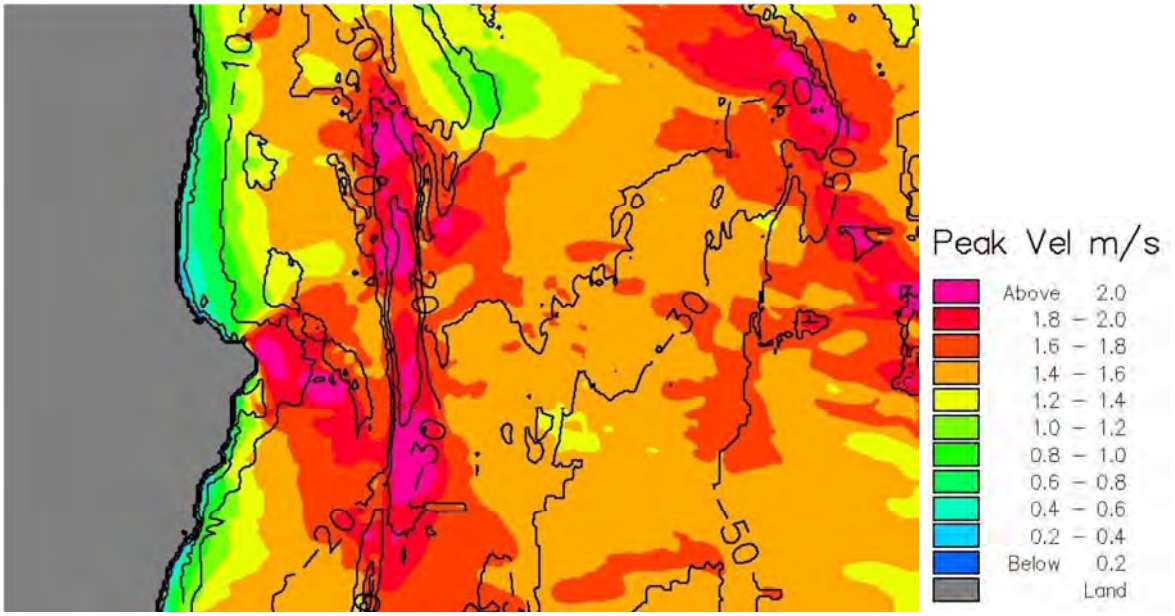


Figure 11.3 Recorded peak flow velocities (m/s) on Arklow and Codling Banks.

11.2.10 Based on the recorded flow velocities and the settlement time for a median size particle it has been calculated that the maximum extent of the sediment plume as a result of the proposed seabed levelling would be 324 m. This estimate represents the worst case scenario, the release of sediment into the water column is anticipated to be closer to the seabed and reduced tidal flow velocities are also expected, meaning a smaller sediment plume is likely to be generated as a result of seabed levelling. Figure 11.4 provides a visual representation of the predicted maximum extent of the sediment plume that could arise as a result of seabed levelling.

11.2.11 For comparison, particles of 0.063 mm (which make up 1.72% of the average sediment sample) are anticipated to have a settling velocity of 7 mm/s. The settlement time is therefore calculated to be 462 seconds. In this time, the particle of 0.063 mm would travel approximately 925 m from the location of the seabed levelling. Whilst it is acknowledged that this is further than the distance calculated for the mean particle size, only an average 1.72% of sediment makes up this sediment fraction.

11.3 Environmental Baseline

Physical Environment

11.3.1 Arklow Bank is described in the 2001 EIA[21] as being located around 13 km to the east of Arklow, County Wicklow. The Bank is stated as being approximately 25 km long and orientated roughly north-south. On the Bank, water depths are stated to generally vary between 2 m and 25 m, however, areas of less than 1 m are also observed. West of Arklow Bank the water depths vary between 25 m and 35 m, whereas to the east, water depths vary between 60 m and 100 m.

11.3.2 The seabed of Arklow Bank is dominated by sand and gravel with mobile surface sediments. The Bank is subject to very strong currents with evidence of sand transport northwards on the landward side of the Bank and southwards on the seaward side. Breaking waves are often present on parts of the Bank, even during low swell conditions.

11.3.3 The substratum ranged from sandy shell to gravel to the west, north and south of the Bank to coarse shell and gravel and some rock to the east of the Bank. The Bank itself consists of mainly sand, cobbles with shells and pebbles at the northern end of the Bank to fine sand at the southern.

Biological Environment

Designations and Areas of Biological Importance

Sites of Conservation Interest

11.3.4 With the exception of the urban centres of Wicklow and Arklow, the entire coastline of the county is classified as an Area of Outstanding Natural Beauty; the width of this zone varies between approximately 1 km and 2 km from the coast.

11.3.5 The site is not a designated Special Area of Conservation (SAC), Special Protection Area (SPA), or a proposed Natural Heritage Area (pNHA). SACs and SPAs have been identified in the wider region and are detailed below including approximate distances from Arklow Bank. Further detail about designated sites can be found in Appendix 9. Of particular note is Wicklow Reef SAC and Blackwater Banks SAC, marine designated sites situated 17 km to the north and 31 km to the south of Arklow Bank respectively (Figure 11.5).

i. Wicklow Reef SAC (17 km);
ii. Blackwater Banks SAC (31 km);
iii. Magherabeg Dunes SAC (13.5 km);
iv. Buckroney-Brittas Dunes and Fen SAC (10 km);
v. Kilpatrick Sandhills SAC (13 km);
vi. Wicklow Head SPA (17 km); and
vii. Cahore Marshes SPA (29.5 km).

11.3.6 Seven pNHAs are currently proposed for terrestrial locations near Arklow Bank (Figure 11.5), location and distance from Arklow Bank is outlined below.

i. Buckroney-Brittas Dunes and Fen (10 km);
ii. Kilpatrick Sandhills (13 km);
iii. Arklow Rock-Askintinny (12.5 km);
iv. Arklow Sand Dunes (12 km);
v. Avoca River Valley (16 km);
vi. Kilgorrman River Marsh (17 km); and
vii. Arklow Town Marsh (13.5km).

Bathing Water Directive

11.3.7 The Bathing Water Directive (76/160/EEC) was transposed into Irish law in 2008 by the Bathing Water Quality Regulations. The objectives of these Regulations are to improve the protection of bather's health and to introduce stricter standards for water quality and a new method of assessment.

11.3.8 The closest bathing water to the proposed seabed levelling is Clogga Beach, which is located approximately 4 km south of Arklow (approximately 13 km from the proposed seabed levelling area). This bathing water has shown Excellent water quality status for 2015, as per the previous 2014 status using the new criteria[11].

11.3.9 Given the distance between the theoretical extent of the plume generated by plough dredging within the proposed seabed levelling area and the location of the closest designated bathing water, no impact is anticipated.

Water Framework Directive, including Priority Substances Directive

11.3.10 The Water Framework Directive (2000/60/EC) has been transposed into Irish law by means of the following Regulations:

i. European Communities (Water Policy) Regulations 2003;
ii. European Communities Environmental Objectives (Surface Waters) Regulations 2009;

[11] http://splash.epa.ie/files/profile/BWPR00358_2016_01_profile.pdf

iii. European Communities Environmental Objectives (Groundwater) Regulations 2010;
iv. European Communities (Good Agricultural Practice for Protection of Waters) Regulations 2010;
v. European Communities (Technical Specifications for the Chemical Analysis and Monitoring of Water Status) Regulations 2011; and
vi. European Union (Water Policy) Regulations 2014.

11.3.11 The Eastern River Basin Management Plan[12] includes the area of coastline from north of Dublin to south of Arklow and extends up to one nautical miles offshore of the mean low water mark. As part of the Water Framework Directive, a European "priority list" of substances posing a threat to or via the aquatic environment was established, with the aim of reducing or eliminating pollution in surface water by the pollutants on the list.

11.3.12 Given the distance between the proposed seabed levelling area, the theoretical extent of the plume generated and the area of coastal waters covered by the Water Framework Directive and the Priority Substances Framework, no impact is anticipated.

Marine Strategy Framework Directive

11.3.13 The Marine Strategy Framework Directive (MSFD) aims to achieve "Good Environmental Status" (GES) of marine waters by 2020. It requires the application of an ecosystem based approach to the management of human activities, enabling the sustainable use of marine goods and services. In Ireland, the Department of Environment, Community and Local Government is the lead body for the implementation of the MSFD.

11.3.14 An initial assessment was undertaken in 2013 that describes the status of Ireland's marine environment, which also established a comprehensive set of environmental targets and associated indicators for the marine waters. Furthermore, Ireland's Marine Atlas was developed to assist the implementation of the MSFD in 2014. The environmental targets relevant to the proposed plough dredging and resulting seabed levelling are described below, along with any recommendations.

11.3.15 The introduction of non-indigenous species that become established and cause unpredictable and irreversible changes to marine ecosystems through predation or competition with indigenous species, or by the modification of habitats and changes to food webs. The Initial Assessment states that "*Good status is achieved when the risks and pathways facilitated by the introduction and spread of non-indigenous species as a result of human activity is significantly reduced by way of appropriate measures".*

11.3.16 Shipping (both commercial and recreational) and aquaculture are reported to be the main sources of non-indigenous species into Irish waters. To reduce the potential for introduction of non-indigenous species into the marine environment, it is recommeneded that where possible local vessels are used to undertake the plough dredging.

11.3.17 The Initial Assessment states that "*Human activities introducing load, low and mid-frequency impulsive sound into the marine environment or that continuous low frequency sound inputs do not pose a significant risk to marine life should be managed to the extent that no significant long terms adverse effects are incurred at a population level, or specifically to vulnerable and threatened species and key functional groups".* The Initial Assessment considered that vessel movements were a major source of underwater sounds, as well as non-renewable energy acivities and coastal infrastructure activities. The Initial Assessment does not establish any harmful sound thresholds for vessel movements because there is difficulty in identifying discernible impacts.

11.3.18 Additional vessel movements will occur as a result of the plough dredging, however, these are within an area where maintenance vessels for the turbines regularly occur. Any noise sensitive

[12] Eastern River Basin District: River Basin Management Plan 2009 – 2015. Available from: http://www.wfdireland.ie/docs/1_River%20Basin%20Management%20Plans%202009%20-%202015/ERBD%20RBMP%202010/ERBD%20RBMP%206%20July%202010.pdf

species are expected to move away from the vessel and the plough dredging. No further mitigation is therefore proposed.

11.3.19 Taking account of the mitigation proposed, along with the scale of the proposed plough dredging, it is anticipated that there are no significant effects on the environmental targets that would result in contravention of the MSFD.

Fisheries

11.3.20 Spawning and nursery areas have been reviewed to determine the species that utilise the vicinity of Arklow Bank. The distribution and spatial extent of both nursery and spawning grounds has been mapped by Ellis *et al*. (2012)[13] and are presented in Figure 11.6.

11.3.21 It is worth noting that the spawning and nursery areas for many species are not fixed, with fish responding to environmental change e.g. water temperature and availability of food. Indeed, not all available areas will be used in any one year, their use depending on the size of the spawning stock. The boundaries presented in Figure 11.6 should not, therefore, be seen as fixed barriers but only indicative of likely distribution.

11.3.22 Spawning grounds are not recorded within the vicinity of Arklow Bank for the key commercial species; however, low intensity spawning grounds are located 21 km north for the following species:

i. Cod;
ii. Sandeel;
iii. Whiting;
iv. Plaice;
v. Sole;
vi. Ling; and
vii. Mackerel.

11.3.23 Low intensity nursery grounds, however, are located over Arklow Bank for species such as cod, anglerfish, tope shark, spotted ray and whiting. The area available to these species as a nursery ground is not exclusively the Bank and areas of high intensity nursery ground are located more than 20 km, either north or south of the Bank.

11.3.24 A number of migratory fish are also known to utilise the rivers and the coastal waters of the east coast of Ireland and hence have the potential to migrate through the general area of the Bank. These species include Atlantic salmon (*Salmo salar*), trout (*Salmo trutta*), European eel (*Anguilla anguilla*), sea lamprey (*Petromyzon marinus*), European sturgeon (*Acipenser sturio*), twaite shad (*Alosa fallax*) and allis shad (*Alosa alosa*).

11.3.25 Basking sharks are also known to utilise the waters of the Irish Sea, although little is known about their distribution, population size or biology. A concentration of sightings is evident off the east, southwest and northern coasts of Ireland between April and November (peaking in June). Sightings data collected by the Marine Conservation Society[14] (Figure 11.7) suggests that the waters in the vicinity of Arklow Bank are not a hotspot for sightings or activity. It should be noted that this does not exclude basking sharks from transiting through these waters.

[13] Ellis, J. R., Milligan, S. P., Readdy, L., Taylor, N., Brown, N. J. (2012) Spawning and nursery grounds of selected fish species in UK waters. Technical report 147. Cefas.

[14] Available from http://www.mcsuk.org/downloads/wildlife/basking_sharks/shark%20density%2087%2005%20frampton.pdf.

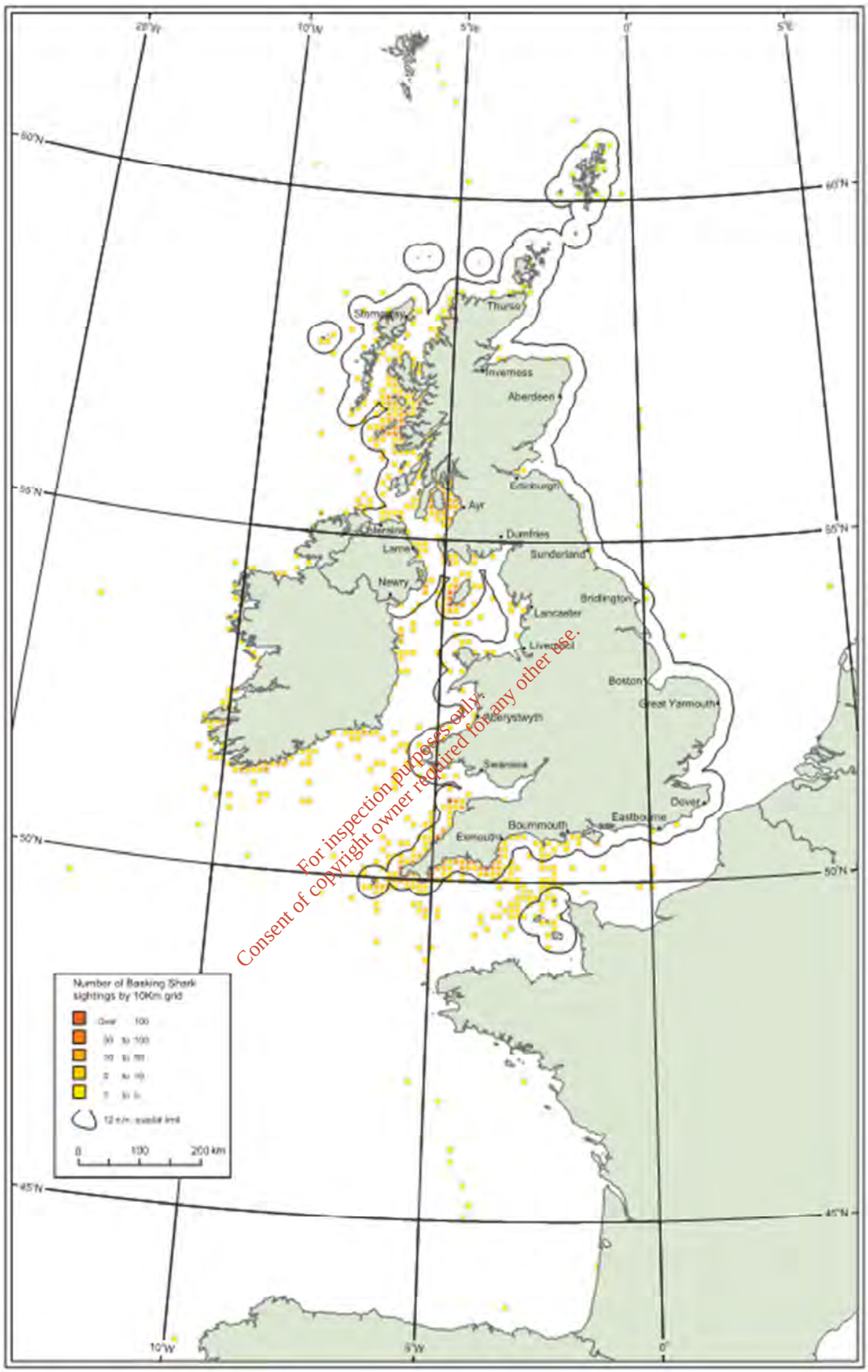


Figure 11.7 Recording sighting of basking shark.

Marine Benthos

11.3.26 Surveys were undertaken in summer and autumn 2000 and spring 2001 for benthic flora and fauna, fish, zooplankton and phytoplankton as well as temperature and salinity profiles. Species diversity and abundance was highest in areas of sandy shell and gravels with cobbles, occurring to the northwest and southwest of the Bank.

11.3.27 Species richness was highest in the northwest where the reef building polychaete, *Sabellaria alveolata* was recorded. Although no statutory designation is assigned to these species, *Sabellaria* sp reef communities are considered very important and are listed in Annex 1 of the EU Habitats Directive (Code 1170: Reefs). They play an important role in stabilising sediments, in addition to improving species diversity and community stability[15]. The distribution of Sabellaria sp from 2006 to 2011 is shown in Figure 11.8. *Sabellaria* sp have been recorded at sites approximately 2.5 km east and 8 km north of Arklow Bank and not within the proposed seabed levelling area. The distribution of *Sabellaria* reef communities throughout the survey area is patchy, which is reflected in the sporadic identification of reef communities at various sampling locations over the years.

11.3.28 Very few species were recorded from sampling sites on the Bank itself although the species included hydroids, bryozoans, hermit crab and the occasional sandeel. All species recorded were considered to be commonly found on the east coast of Ireland. Further surveys undertaken between 2004 and 2011 confirmed little variation at community level to that previously identified.

Birds

11.3.29 Bird surveys have been undertaken twice per month between July and September 2000, and once per month between October 2000 and February 2001. All surveys were completed using the approved JNCC survey method for seabirds.

11.3.30 The surveys noted that Arklow Bank was more important than the surrounding sea area, although significantly less important than other areas such as intertidal habitats of Dublin Bay. The surveys were focussed on the most important species in the vicinity of Arklow Bank, which included:

i. Red throated diver (Gavia stellate);
ii. Fulmar (Flumarus glacialis);
iii. Manx shearwater (Puffinus puffinus);
iv. Gannet (Sula bassana);
v. Little gull (Larus minutus);
vi. Common gull (Larus canus);
vii. Kittiwake (Rissa tridactyla);
viii. Common tern (Sterna hirundo);
ix. Arctic tern (Sterna paradisaea);
x. Guillemot (Uria aalge); and
xi. Razorbill (Alca torda).

11.3.31 In total the survey recorded 29 species of birds, with the most numerous being the guillemot and kittiwake, which are both considered typical of the Irish coastline. Lower numbers of common scoter were recorded which is concurrent with the JNCC observations for the study area[16]. Both the roseate tern (*Sterna dougallii*) and the little tern (*Sternula albifrons*) were recorded during the surveys, which are listed on Annex I of the EU Birds Directive.

[15] Holt, T.J., Rees, E.I., Hawkins, S.J., Seed, R., 1998. Biogenic Reefs (volume IX). An overview of dynamic and sensitivity characteristics for conservation management of marine SACs. Scottish Association for Marine Sciences (UK Marine SACs Project), Oban, Scotland, UK

[16] Pollock C, Reid J, Webb A, Tasker M. 1997. The distribution of seabirds and cetaceans in the waters around Ireland. JNCC, Peterborough.

Marine Mammals and Reptiles

11.3.32 Surveys of marine mammals and reptiles were conducted at the same time as the bird survey discussed in Section 11.3, using the approved JNCC survey method for marine mammals. Species recorded included the list below:

i. Harbour porpoise (*Phocoena phocoena*);
ii. Bottle-nosed dolphin (*Tursiops truncates*);
iii. Risso's dolphin (*Grampus griseus*);
iv. Grey seal (*Halichoerus grypus*);
v. Harbour seal (*Phoca vitulina*); and
vi. Leatherback turtle (*Dermochelys coriacea)*.

11.3.33 All European cetacean species are listed on Annex IV of the EU Habitats Directive (92/43) as species requiring strict protection. Both the harbour porpoise and bottle-nosed dolphin are also listed on Annex II of the EU Habitats Directive. Furthermore, both grey and harbour seals are listed in Annex IV of the EU Habitats Directive.

11.3.34 The site specific survey undertaken to inform the EIA recorded harbour porpoise as the most regularly occurring species with the survey area. Risso's dolphin were also recorded, as were three individual seals (of two species) and a single leatherback turtle.

Human Environment

Cultural Heritage

11.3.35 The 2001 Arklow Windfarm EIA reported that approximately 300 vessels have known to have been wrecked on or close to Arklow Bank between 1670 and 1945. The chartered wrecks were reported in the vicinity of the Bank include a schooner which sunk in 1931; a barque which sunk in 1865 and a vessel of 946 tonnes which stranded in 1950. The wreck of a submarine is also reported on Arklow Bank, although details surrounding the location of the wreck are unknown. The geophysical survey undertaken to support the EIA failed to locate any of these wrecks in their chartered positions.

Commercial Fisheries

11.3.36 The main fishery reported by the 2001 EIA in the Arklow Bank area was common whelk (*Buccinum undatum*) and to a lesser extent blue mussel (*Mytilus edulis*). The main area for whelks was close to shore, inshore of the Bank. The area surrounding Arklow Bank is of importance since it is considered to be a prime area for the settlement of mussel larvae and seed beds, in particular the seabed between the shore and the Bank. This area has provided suitable conditions and habitats for the formation of viable seed beds in the past and has the potential to produce new seed beds in the future.

11.3.37 The 2001 EIA also reported a mixed trawl fishery in deeper waters to the east of the Bank. Dominant species include Atlantic cod (*Gadus morhua*), thornback ray (*Raja clavata*), cuckoo ray (*Raja naevus*), European plaice (*Pleuronectes platessa*), lesser-spotted dogfish (*Scyliorhinus canicula*), codling, turbot (*Scophthalmus maximus*), brill (*Scophthalmus rhombus*), monkfish (*Lophius piscatorius*) and squid.

Non-Living Resources

11.3.38 The exploitation of offshore sand and gravel is well established in the UK and Europe; however, these deposits are rarely exploited in Irish waters while terrestrial quarries remain viable. Codling Bank was dredged under licence in 1998/1999 for material to be used in coastal protection works in Bray, County Wicklow. Many sandbanks and gravel deposits in the Irish Sea, between Wicklow and Wexford are mobile and form an integral part of the coastal system, therefore are less preferable as a resource for primary aggregate.

11.3.39 Coal resources were reported in the 2001 Arklow Windfarm EIA to the north of Arklow Bank, in the Kish Bank basin and off the coast of County Wexford. The resource of County Wexford at that time was considered to be economically unviable due to its depth using current extraction methods. Kish Bank reserves could potentially be viable using land-based conventional mechanised systems or gasification, although mining is considered unlikely in the short term. No economical reserves of oil and gas were identified within the Irish Sea, however, a number of licenced blocks exist within the UK territorial waters.

11.3.40 At the time of publishing the 2001 Arklow Windfarm EIA, wave and tide power was emerging as a new economically viable energy source. Arklow Bank is generally considered unsuitable for wave energy devices due to its short fetch; however, there is acknowledgement of the potential for tidal energy devices due to high current velocities recorded across the bank. At the present time, no sites for wave or tidal energy devices have been developed in the vicinity of Arklow Bank.

11.3.41 The locations of undersea cables have been reviewed in relation to Arklow Bank. There are no new power cables in the vicinity, except those serving the Wind Park itself. One operational undersea telecommunication cable exists offshore of Arklow Bank, beyond the 12 nautical mile limit[17].

11.4 Potentially Sensitive Receptors

11.4.1 The effects on potentially sensitive receptors as a result of the proposed seabed levelling have been identified in the screening process. A number of potential receptors have been screened out of the assessment as described below in Table 11.1.

Table 11.1 Potential receptors screened out

Potential Sensitive Receptor	Outline Reason for Screening Out of Further Assessment
Bathing waters	The closest designated Bathing Water is Clogga Beach, located 4 km south of Arklow and 13 km west of the proposed seabed levelling area. Therefore the potential effects of the proposed seabed levelling are unlikely to interact with the designated bathing waters. These receptors have been screened out of the assessment.
Water Framework Directive (including Priority Substances Directive)	The Eastern River Basin Management Plan extends up to 1 nm offshore of the mean low water mark. Given the distance from the theoretical extent of the plume and the area of sea covered by the Water Framework Directive, this receptor has been screened out of further assessment.
Cables and pipelines	Other than the cables serving the Wind Park itself, there are no other cables or pipelines in the vicinity of Arklow Bank or within the 12 nm limit, therefore the potential effects of the proposed seabed levelling is unlikely to interact with the cables and pipelines receptors to generate a significant impact. These receptors have been screened out of the assessment.
Shipping and navigation	Very limited shipping and navigation occurs in the vicinity of Arklow Bank, with the majority passing to the north or south rather than directly over the Bank. Therefore the potential effects of the proposed seabed levelling are unlikely to interact with shipping and navigational receptors to generate a significant impact. These receptors have been screened out of the assessment.
Recreational activities	Very limited recreational activities occur offshore in the vicinity of Arklow Bank, with the majority being associated more closely with the coastline. Therefore the potential effects of the proposed seabed levelling are unlikely to interact with recreational activities to generate a significant impact. These receptors have been screened out of the assessment.
Aviation	No pathways exist between this potential receptor and the effects of the proposed seabed levelling therefore these have been screened out of the assessment.

[17] KIS-ORCA (2016). Offshore Renewable & Cable Awareness – Irish Sea Kingfisher Awareness Chart. Available at: http://www.kis-orca.eu/media/9304/2016%20Irish%20Sea_LRes.pdf – Accessed on: 04.02.16

Potential Sensitive Receptor	Outline Reason for Screening Out of Further Assessment
Air and climate	No pathways exist between this potential receptor and the effects of the proposed seabed levelling therefore these have been screened out of the assessment.
Archaeology	No wrecks are recorded in the close vicinity of the proposed seabed levelling area. Therefore the potential effects of the proposed seabed levelling are unlikely to interact with archaeological receptors to generate a significant impact. These receptors have been screened out of the assessment.
Common whelk commercial fisheries	The common whelk fishery occurs inshore of Arklow Bank close to the coastline. The suspended sediment plume is only anticipated to extend to a maximum of 324 m from the seabed levelling area; therefore the potential effects of the proposed seabed levelling are unlikely to generate a significant impact on the common whelk commercial fishery. These receptors have been screened out of the assessment.
Cod, sandeel, whiting, plaice, sole, ling and mackerel spawning grounds	These spawning grounds occur a minimum of 21 km from Arklow Bank. Therefore the potential effects of the proposed seabed levelling are unlikely to interact with spawning grounds to generate a significant impact due to the limited dispersion of suspended sediment during seabed levelling. These receptors have been screened out of the assessment.
Thornback ray, ling, mackerel, herring, European hake and blue whiting nursery grounds	The nursery grounds for ling, mackerel, European hake and blue whiting occur a minimum of 84 km from Arklow Bank, while the blue whiting nursery ground is approximately 30 km south of the Bank. Therefore the potential effects of the proposed seabed levelling are unlikely to interact with nursery grounds to generate a significant impact. The nursery ground for thornback ray occurs approximately 4.5 km to the southwest (direction of prevailing tidal currents) of Arklow Bank. The potential effects of seabed levelling are unlikely to interact with these nursery grounds because the tidal currents influencing the behaviour of the suspended sediment plume are orientated northeast to southwest. Therefore the effects of seabed levelling are unlikely to generate significant impacts. These receptors have been screened out of the assessment.
Migratory fish species, including basking sharks	These species are highly transient and are, therefore, likely to avoid any area where a potential effect occurs (such as increased suspended sediment) and return to these areas once the effect has reverted to background levels. Therefore the potential effects of the proposed seabed levelling are unlikely to interact with migratory fish species, including basking sharks, to generate a significant impact. These receptors have been screened out of the assessment.
Sabellaria sp. Habitat	*Sabellaria* sp have been recorded at sites approximately 2.5 km east and 8 km north of Arklow Bank and distribution of reef communities throughout the survey area is sporadic. The full extent of the suspended sediment plume is anticipated to be 324 m and therefore the potential effects of the proposed seabed levelling are unlikely to interact with *Sabellaria* sp. habitat to generate a significant impact. These receptors have been screened out of the assessment.
Birds	These species are highly transient and are, therefore, likely to avoid any area where a potential effect occurs (such as increased suspended sediment) and return to these areas once the effect has reverted to background levels. Therefore the potential effects of the proposed seabed levelling are unlikely to interact with bird species to generate a significant impact. These receptors have been screened out of the assessment.
Areas of conservation importance	The closest area of nature conservation importance (Wicklow Reef SAC) occurs a minimum of 16.7 km from Arklow Bank. Therefore the potential effects of the proposed seabed levelling are unlikely to interact with spawning grounds to generate a significant impact as the maximum extent of the sediment plume is anticipated to be only 324 m. These receptors have been screened out of the

Potential Sensitive Receptor	Outline Reason for Screening Out of Further Assessment
	assessment.
Non-living resources	While there is potential for these resources to exist within the vicinity of Arklow Bank, none are presently being exploited. No pathways exist between this potential receptor and the effects of the proposed seabed levelling therefore these have been screened out of the assessment.
Landscape and visual	No pathways exist between this potential receptor and the effects of the proposed seabed levelling. Therefore these have been screened out of the assessment.
Electromagnetic effects	No pathways exist between this potential receptor and the effects of the proposed seabed levelling therefore these have been screened out of the assessment.

11.4.2 The potential sensitive receptors screened into the assessment include:

i. Blue mussel seed beds;
ii. Mixed trawl commercial fisheries;
iii. Cod, anglerfish, tope shark, spotted ray and whiting nursery ground;
iv. Benthic fauna and flora; and
v. Marine mammals.

11.4.3 The following table assesses the potential for effects of the proposed seabed levelling on the receptors screened in from the baseline review. The preliminary assessment of potential significant effects on sensitive receptors is provided in Table 11.2.

Table 11.2 Potentially sensitive receptors and associated potential effects due to seabed levelling

Potentially Sensitive Receptor	Classification of Potential Effects of the Seabed Levelling			
	Seabed Removal	Release of Suspended Sediment Plume	Vessel Presence	Noise and Vibration
Blue mussel seed beds	✓	✓	-	-
Mixed trawl commercial fisheries	✓	✓	✓	✓
Cod nursery grounds	✓	✓	-	✓
Anglerfish nursery grounds	✓	✓	-	✓
Tope shark nursery grounds	✓	✓	-	✓
Spotted ray nursery grounds	✓	✓	-	✓
Whiting nursery grounds	✓	✓	-	✓
Benthic flora and fauna	✓	✓	-	✓
Marine mammals	-	✓	✓	✓

11.5 Potential Environmental Impact

11.5.1 Through the data provided within the 2001 Arklow Windfarm EIA and subsequent studies carried out in the vicinity of Arklow Bank, it is possible to assess the significance of potential impacts as a result of seabed levelling on sensitive receptors. Effects on sensitive receptors will vary depending on the nature of the receptor and the potential pathways by which they can be affected.

Blue Mussel Seed Beds

11.5.2 The area surrounding Arklow Bank is of importance as it is considered to be a prime area for settlement of mussel larvae and seed beds; of particular relevance is the area between the shore and Arklow Bank. This area has provided suitable conditions and habitats for the formation of viable seed beds in the past and has the potential to produce new seed beds in the future.

11.5.3 Indirect impacts are possible as a result of the release of a suspended sediment plume, which may smother seed beds due to an increase in deposition of suspended material. The position of mussel seed beds vary annually although the area between Arklow Bank and the shore is considered to be of importance for the settlement of mussel larvae and development of seed beds.

11.5.4 The proposed seabed levelling is occurring to the east of the Bank, and not directly within the area highlighted as important for seed bed development. Furthermore, the suspended sediment plume, which is expected to extend a maximum of 324 m from the seabed levelling based on a mean particle size of 0.160 mm, is not anticipated to overlap significantly with the area of importance for seed bed development. Therefore the likelihood of causing a significant impact to mussel seed beds is expected to be limited as a result of the proposed seabed levelling.

Mixed Trawl Commercial Fisheries

11.5.5 Local mixed trawl fisheries are focused on ray, skate, plaice and cod in deeper water. Potential impacts associated with fisheries relate to habitat removal caused by seabed levelling and the associated release of the suspended sediment plume, potentially leading to displacement of fish in the vicinity of the sediment plume area. Noise and vibration caused by seabed levelling is also anticipated to impact upon fish species in the localised area, particularly noise specialists such as cod, which are relatively sensitive to sound.

11.5.6 Given the strong tidal currents and limited fauna and flora recorded on the Bank by benthic surveys, it is unlikely that the Bank and seabed levelling area forms an important habitat for commercial fishery species. Furthermore, mixed trawl commercial fishing takes place both to the west and east of Arklow Bank at a distance sufficient to not be impacted upon by the suspended sediment plume. Fish species targeted by such operations are considered sufficiently mobile to move away from the area of seabed levelling so that they are not be impacted upon by the seabed levelling.

11.5.7 The potential impacts outlined are all temporary in nature and are anticipated to be short term (a few weeks only each year). It is expected that any commercial fish species disturbed during the process of seabed levelling are likely to return to the area once the activity has ceased. Therefore any impacts on commercial fishery species are not expected to be significant.

Cod, Anglerfish, Tope Shark, Spotted Ray and Whiting Nursery Grounds

11.5.8 Nursery grounds are sites where juveniles occur at higher densities, have reduced rates of predation and have faster growth rates than in other habitats[18]. Seabed levelling is anticipated to have a potential impact on the nursery grounds of the five species outlined, where seabed removal and the suspended sediment plume can potentially lead to a loss of habitat, preventing the development of juveniles. Noise and vibration caused by seabed levelling can also potentially affect juveniles within the localised area, particularly noise sensitive species such as cod, potentially causing physiological stress.

11.5.9 Whilst the area in the immediate vicinity of seabed levelling is anticipated to be affected by the proposed operations, nursery grounds for the five species that cover the seabed levelling area are designated as low intensity. The footprint of seabed levelling and associated suspended sediment plume relative to the wider nursery grounds of these species is considered small, as the extent of the nursery grounds extends through the majority of the Irish Sea. Any juvenile fish utilising the nursery ground are expected to temporarily avoid the area directly impacted by

[18] Ellis, J. R., Milligan, S. P., Readdy, L., Taylor, N., Brown, N. J. (2012) Spawning and nursery grounds of selected fish species in UK waters. Technical report 147. Cefas.

seabed levelling. Therefore based on this intensity and small scale of the potentially impacted nursery ground area, only localised impacts are anticipated and are considered acceptable due to the widespread availability of nursery grounds in surrounding sea area.

Benthic Flora and Fauna

11.5.10 Benthic flora and fauna are anticipated to be directly impacted by seabed levelling. Habitat removal will result in the loss of benthic communities within the levelling area including the removal of both infauna and epifauna. Potential impacts on benthic communities will also have secondary impacts on species which prey upon benthic invertebrates further up the food chain.

11.5.11 The suspended sediment plume is also anticipated to potentially impact upon benthic communities. The potential effects may include, changes in primary production filter feeding in surrounding benthic communities which experience an increased level of sediment deposition. Seabed levelling could also potentially alter the nature of bed sediments, which could potentially alter the benthic communities where these changes occur.

11.5.12 Noise and vibrational impacts may affect benthic flora and fauna that is not removed during seabed levelling, potentially causing physiological stress. It is poorly known how seabed vibration affects bottom dwelling fish and additionally, little is known about the hearing capabilities of sharks, rays and skates and invertebrates.

11.5.13 The Arklow Bank area experiences very strong currents, sediment transport and breaking waves. As a result benthic flora and fauna in the area are adapted to a relatively turbulent environment, where sediment inundation is a frequent occurrence. Furthermore, limited diversity of benthic species have been recorded on the Bank during benthic surveys undertaken by the client and the species recorded appear to be stable over time, therefore likely to be adapted to sediment inundation. It is anticipated that benthic flora and fauna have the capacity to recover from sediment deposition arising from seabed levelling and will not experience a significant impact.

Marine Mammals

11.5.14 Potential impacts that may affect marine mammals as a result of seabed levelling are primarily associated with the presence of vessels, noise and vibration associated with the levelling process and the subsequent suspended sediment plume. These potential impacts are covered in greater detail within the Marine Mammal Risk Assessment in Appendix 8.

11.6 Marine Mammal Risk Assessment

11.6.1 The marine mammal risk assessment is provided in Appendix 8.

11.7 Screening for Appropriate Assessment

11.7.1 The screening for Appropriate Assessment is provided in Appendix 9.

12. G.1 MONITORING PROGRAMME

12.0.1 The requirements for monitoring were discussed at a pre-application meeting held with the EPA on 18 November 2015. At that meeting, it was discussed that pre and post seabed levelling surveys will be submitted to the EPA for their reference for each campaign undertaken within the period of the Dumping at Sea Permit. This will allow adherence to the OSPAR Convention.

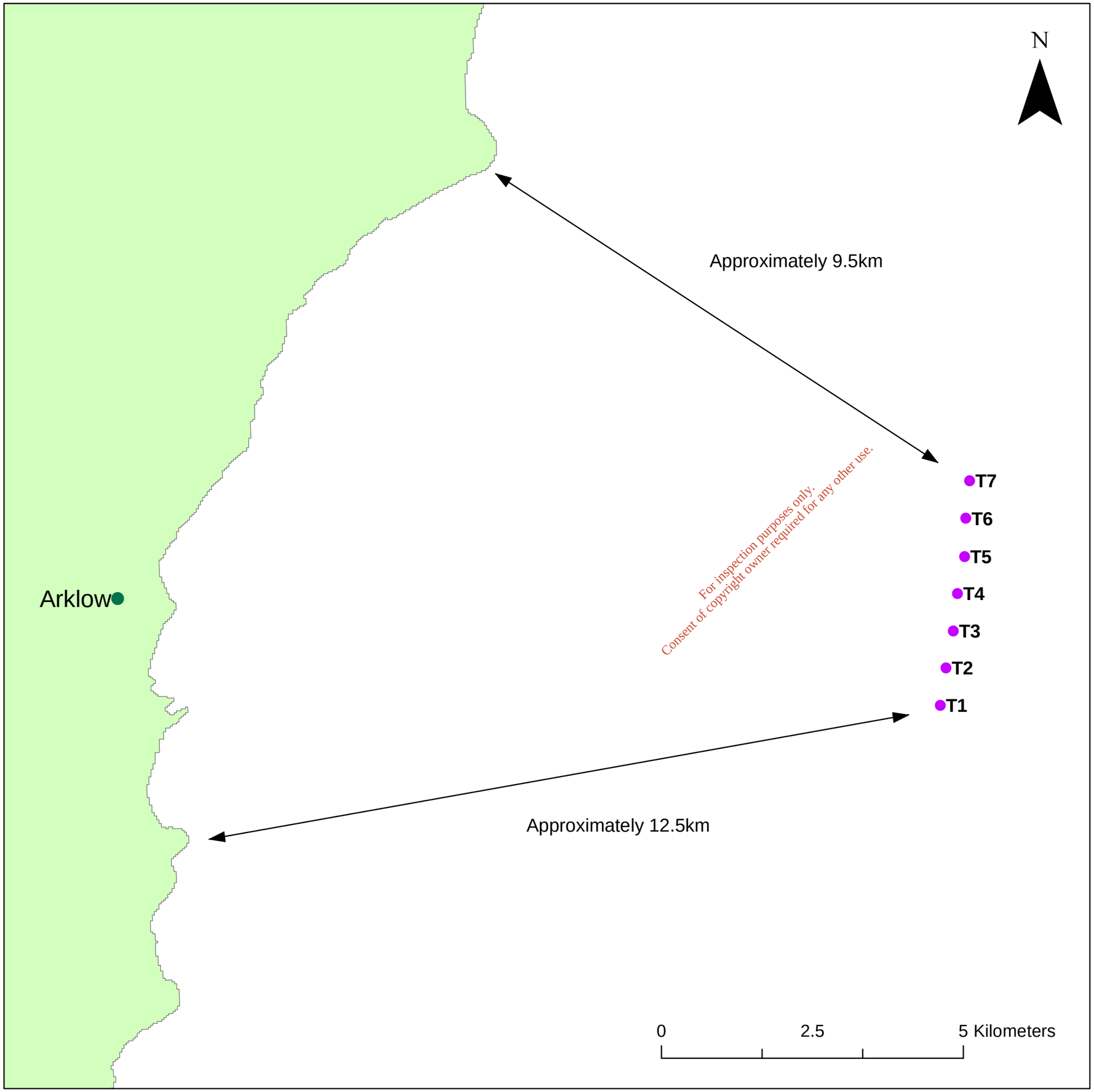
12.0.2 The survey area will include the area directly impacted by the seabed levelling and an area of seabed extending 50 m in all directions surrounding it, wherever possible. GIS analysis would be used to compare the pre and post seabed levelling survey results to determine the volume of sediment that has been mobilised under the Dumping at Sea Permit.

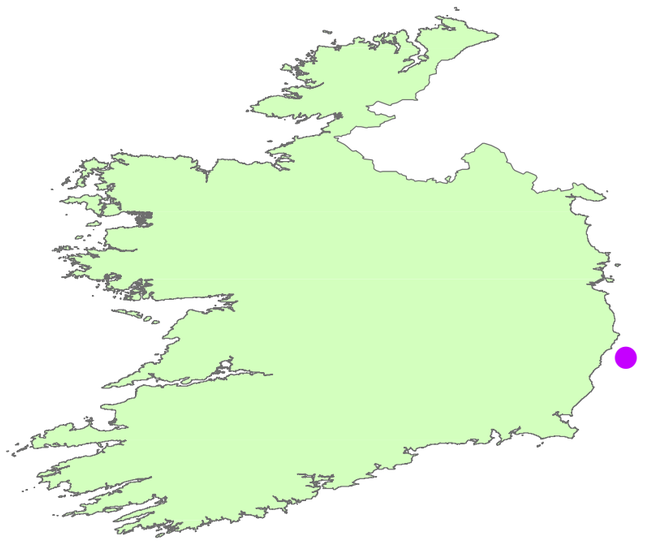
12.0.3 An annual "return letter" will also be provided to the EPA to confirm the amount of tonnage available under the Dumping at Sea Permit taking into account all of the previous seabed levelling campaigns that have been undertaken by the client. A forecast will also be made at that time, which outlines the need for seabed levelling campaigns to be undertaken in the next 12 months, where possible.

12.0.4 The client also commits to providing the following information to the EPA at least one week prior to the commencement of any seabed levelling campaign undertaken within the designated dumping site:

i. Date of commencement of seabed levelling campaign;
ii. Anticipated duration of the seabed levelling campaign;
iii. Name and address of the operator who is commissioned to undertake the seabed levelling campaign; and
iv. A full method statement for the seabed levelling campaign.

FIGURES





Turbines

Ireland

Client

Project Title

Arklow Bank Wind Park Seabed Levelling

Project Number **1620000345**

Figure Title

Site Location Plan

RAMBOLL ENVIRON

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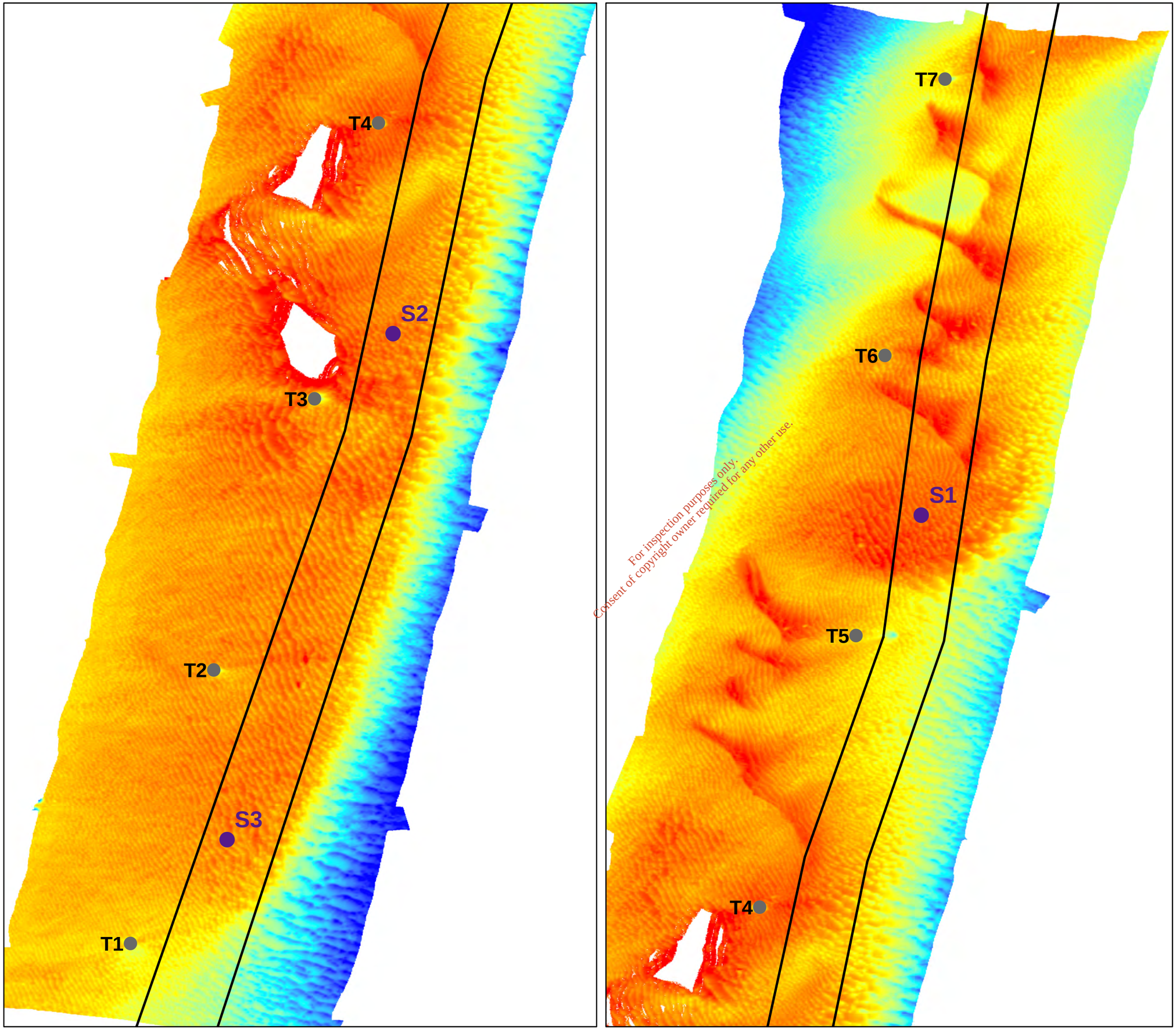
Date	Prepared By
04/06/2015	MP
Figure No.	**Revision**
Figure 1.1	-



Legend

N

Depth

13.45m

0.43m

Turbines

Sampling Points

Dredge Area

Source: Island Maritime & Island Shipping, Arklow Bank Wind Farm Project Monitoring Survey - April 2015.

Client

Arklow Energy Limited

Project Title

Arklow Bank Wind Park Seabed Levelling

Project Number

1620000345

Figure Title

2015 Bathymetry

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Date	Prepared By
26/07/2016	MP
Figure No.	**Revision**
Figure 8.2	-

N

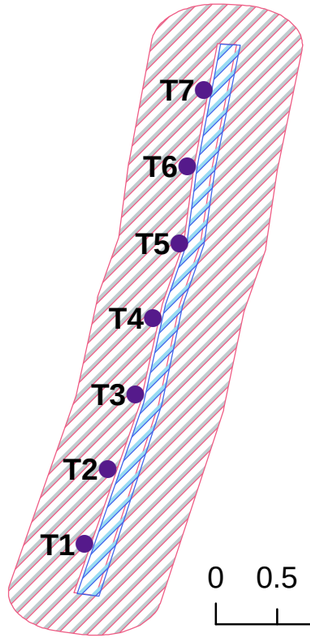
Approximately 9.5km

Approximately 12.5km

Arklow

T7
T6
T5
T4
T3
T2
T1

0 2.5 5 Kilometers



Turbines

Ireland

Seabed Levelling Area

Anticipated Maximum Extent of Plume

Client

Arklow Energy Limited

Project Title

Arklow Bank Wind Park Seabed Levelling

Project Number **1620000345**

Figure Title

Seabed levelling and associated sediment plume

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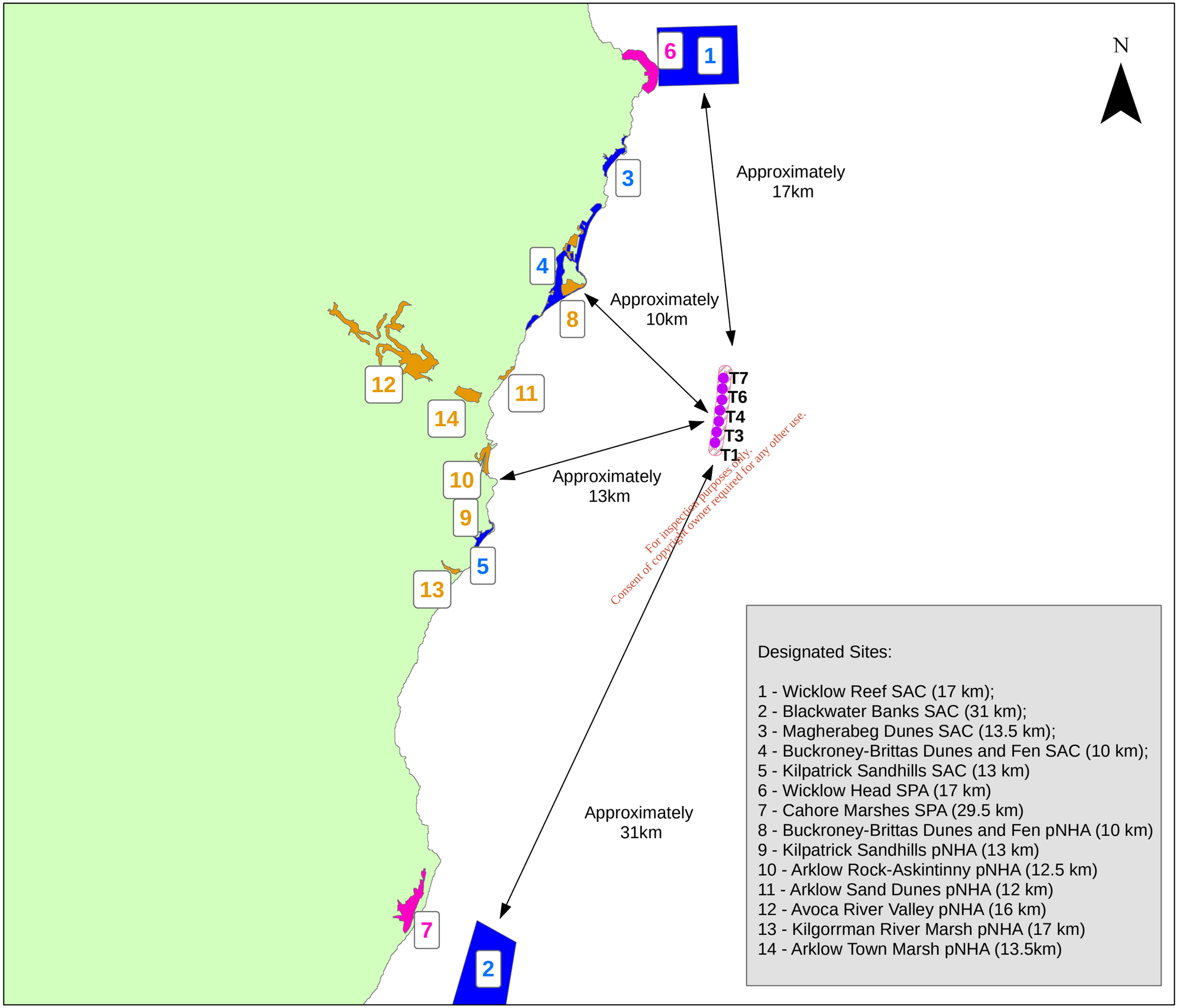
Date	26/07/2016	Prepared By MP
Figure No.	Figure 11.4	Revision -



Designated Sites:

1 - Wicklow Reef SAC (17 km);
2 - Blackwater Banks SAC (31 km);
3 - Magherabeg Dunes SAC (13.5 km);
4 - Buckroney-Brittas Dunes and Fen SAC (10 km);
5 - Kilpatrick Sandhills SAC (13 km)
6 - Wicklow Head SPA (17 km)
7 - Cahore Marshes SPA (29.5 km)
8 - Buckroney-Brittas Dunes and Fen pNHA (10 km)
9 - Kilpatrick Sandhills pNHA (13 km)
10 - Arklow Rock-Askintinny pNHA (12.5 km)
11 - Arklow Sand Dunes pNHA (12 km)
12 - Avoca River Valley pNHA (16 km)
13 - Kilgorrman River Marsh pNHA (17 km)
14 - Arklow Town Marsh pNHA (13.5km)

Turbines
Ireland
Anticipated maximum extent of plume
Special Protection Areas (SPA)
Special Areas of Conservation (SAC)
Proposed Nature Heritage Areas (pNHA)

Client
Arklow Energy Limited

Project Title
Arklow Bank Wind Park Seabed Levelling

Project Number
1620000345

Figure Title
Terrestrial sites of nature conservation

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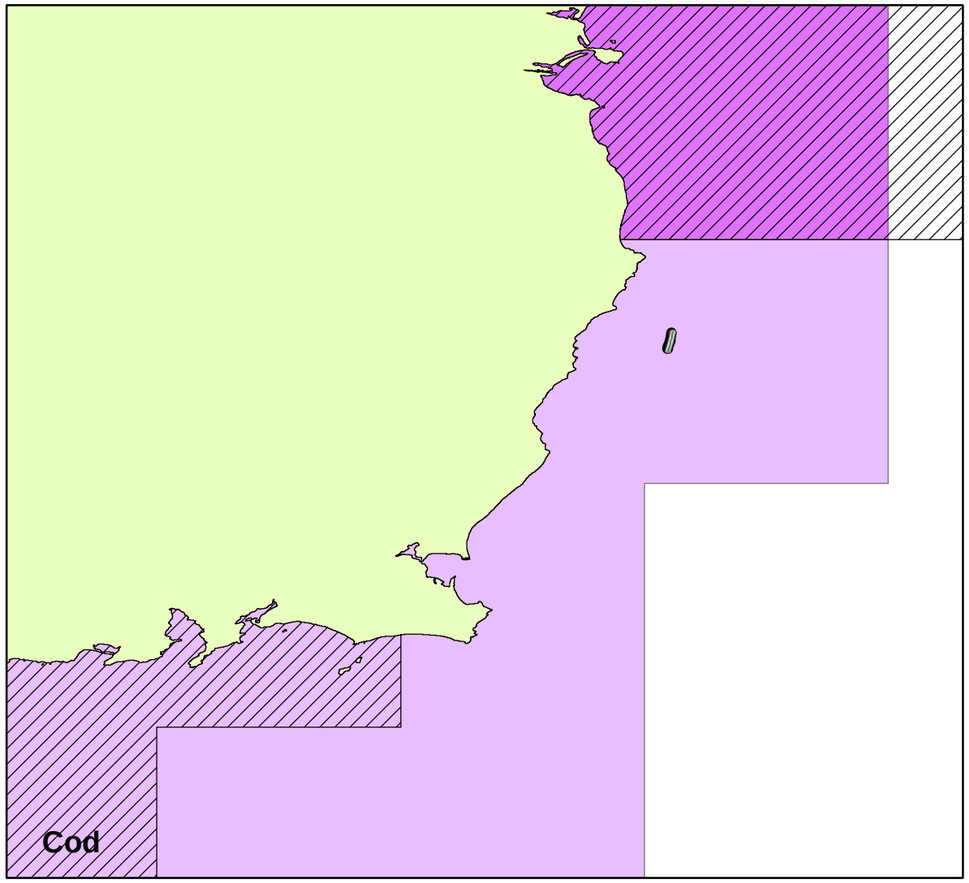
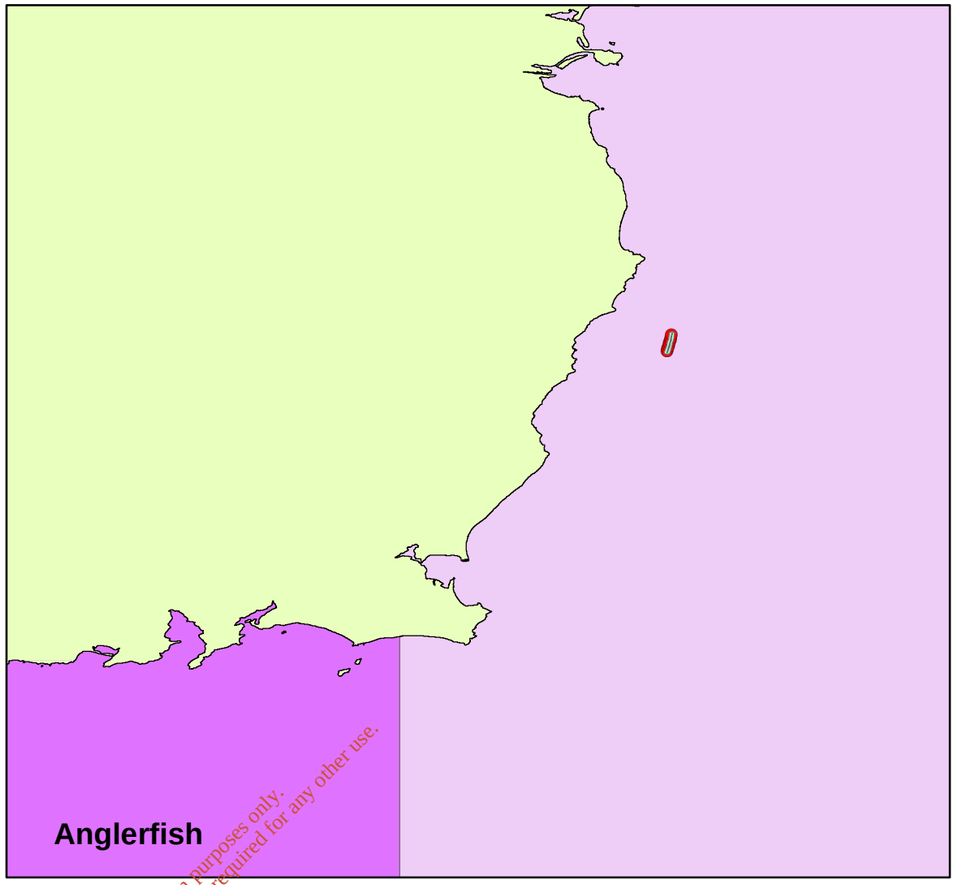
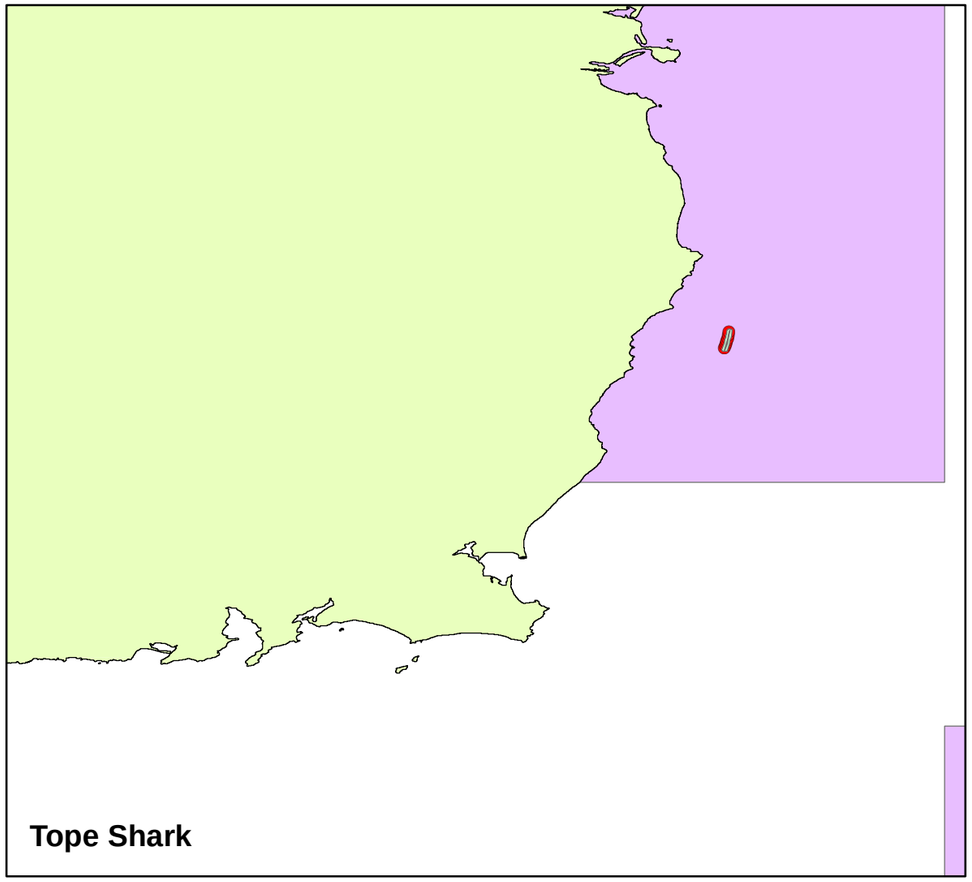
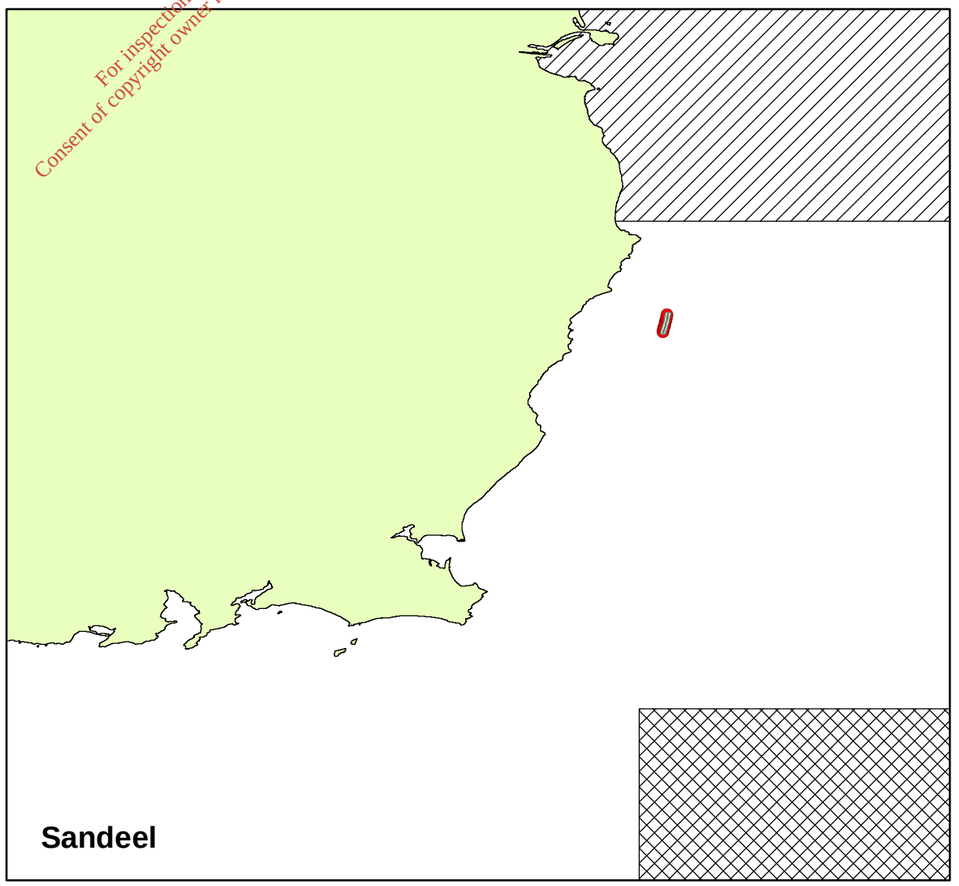
Date	Prepared By
26/07/2016	MP
Figure No.	**Revision**
Figure 11.5	-









N

0 25 50 Kilometers

Turbines

Anticipated maximum extent of plume

Ireland

Spawning grounds

High intensity

Low intensity

Nursery Grounds

Low intensity

High intensity

Data: Ellis, J.R., Milligan, S.P., Readdy, L.,Taylor, N. and Brown, M.J., 2012. Spawning and nursery grounds of selected fish species in UK waters. Technical report 147. Cefas.

Client

Arklow Energy Limited

Project Title

Arklow Bank Wind Park Seabed Levelling

Project Number

1620000345

Figure Title

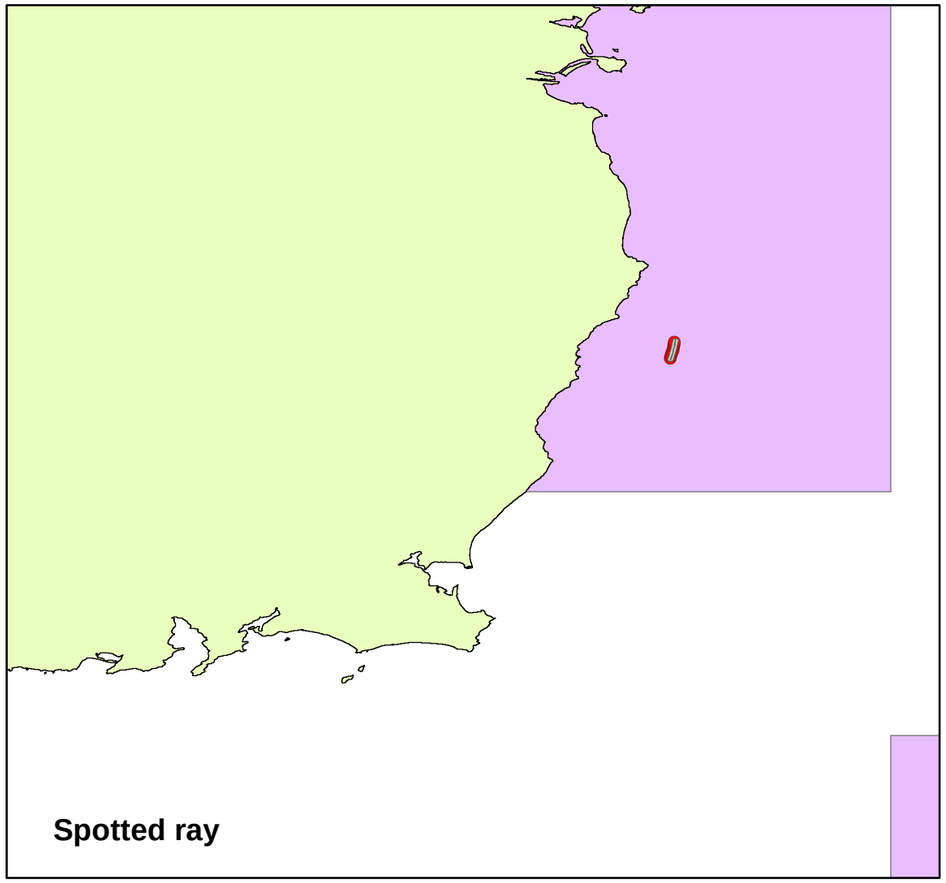
Spawning & nursery grounds

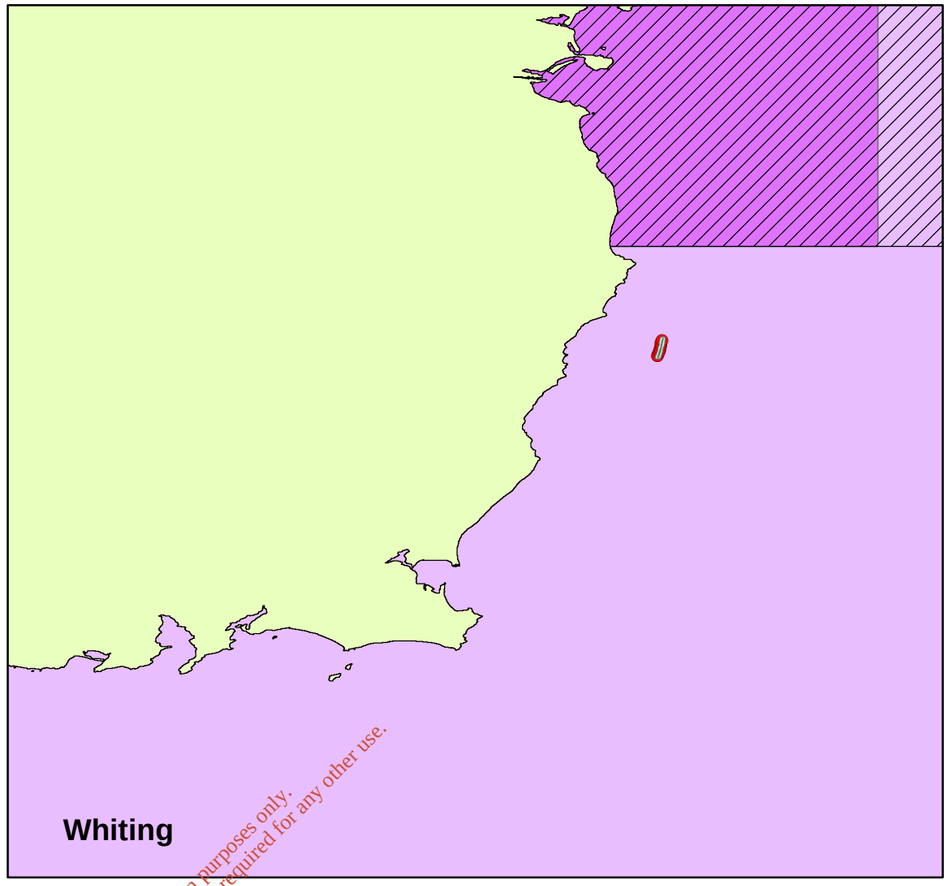
RAMBOLL ENVIRON

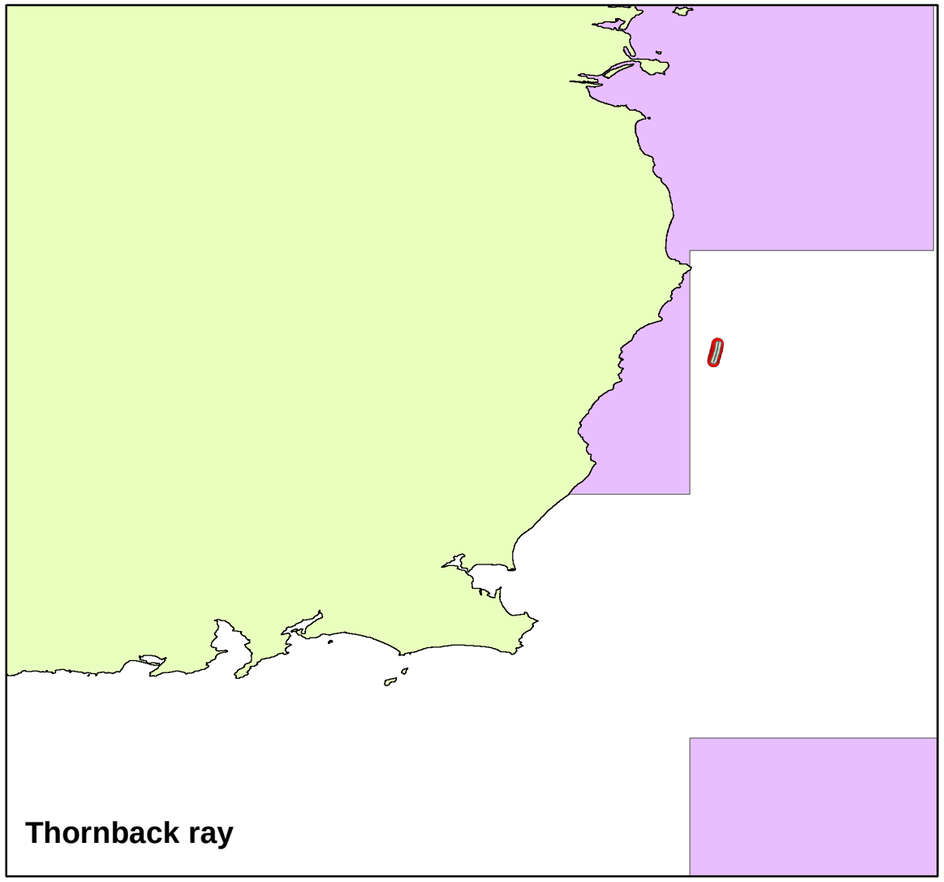
Tel: 023 8081 7500
Fax: 023 8081 7600

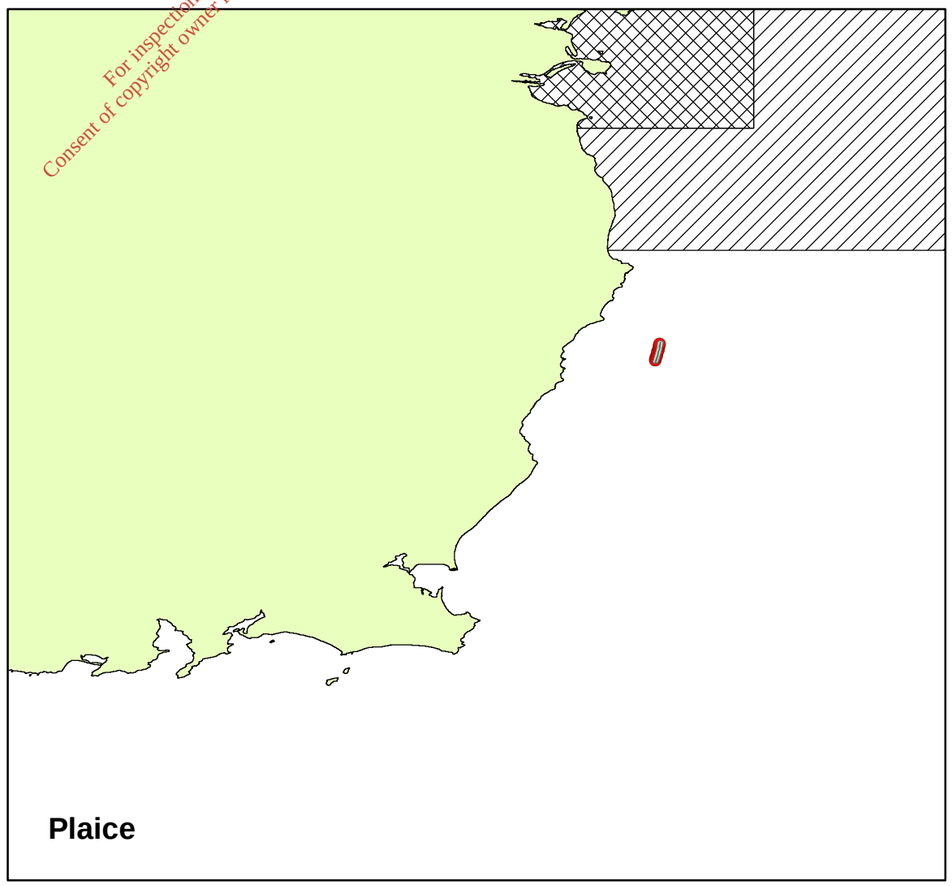
southampton@ramboll.co.uk
www.ramboll-environ.com

Date	Prepared By
26/07/2016	MP
Figure No.	**Revision**
Figure 11.6 A	-









N

0 25 50 Kilometers

Turbines

Anticipated maximum extent of plume

Ireland

Spawning grounds

Low intensity

High intensity

Nursery Grounds

Low intensity

High intensity

Data: Ellis, J.R., Milligan, S.P., Readdy, L.,Taylor, N. and Brown, M.J., 2012. Spawning and nursery grounds of selected fish species in UK waters. Technical report 147. Cefas.

Client

Arklow Energy Limited

Project Title

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Project Number

1620000345

Figure Title

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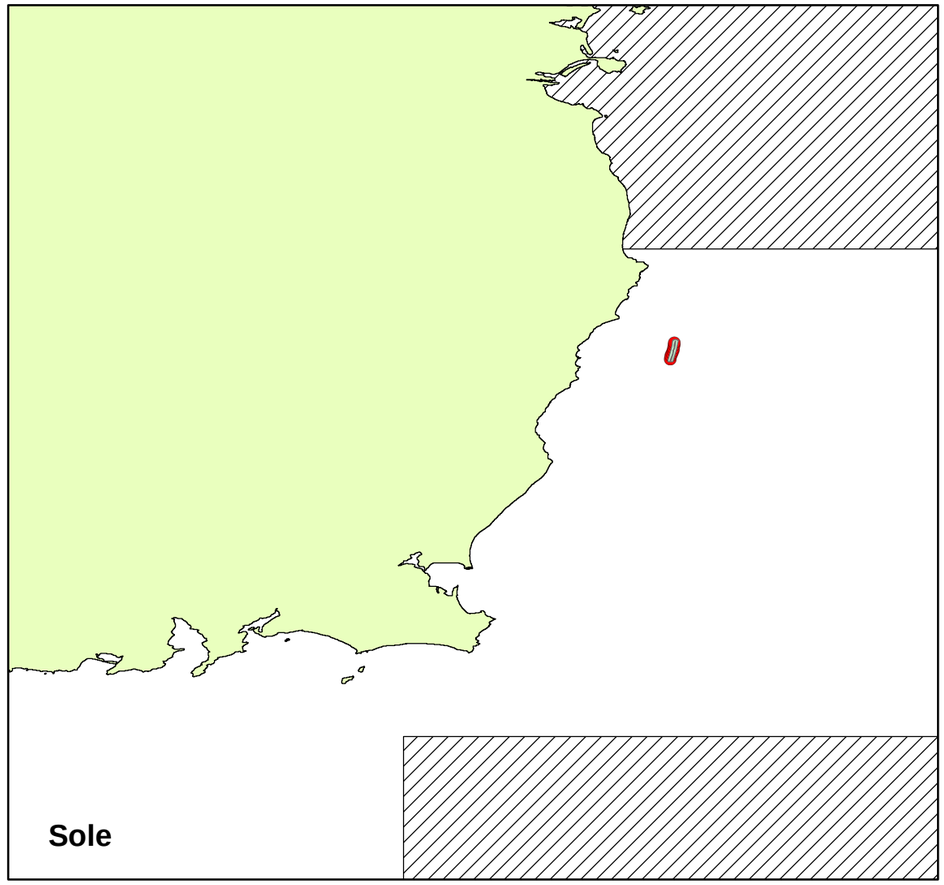
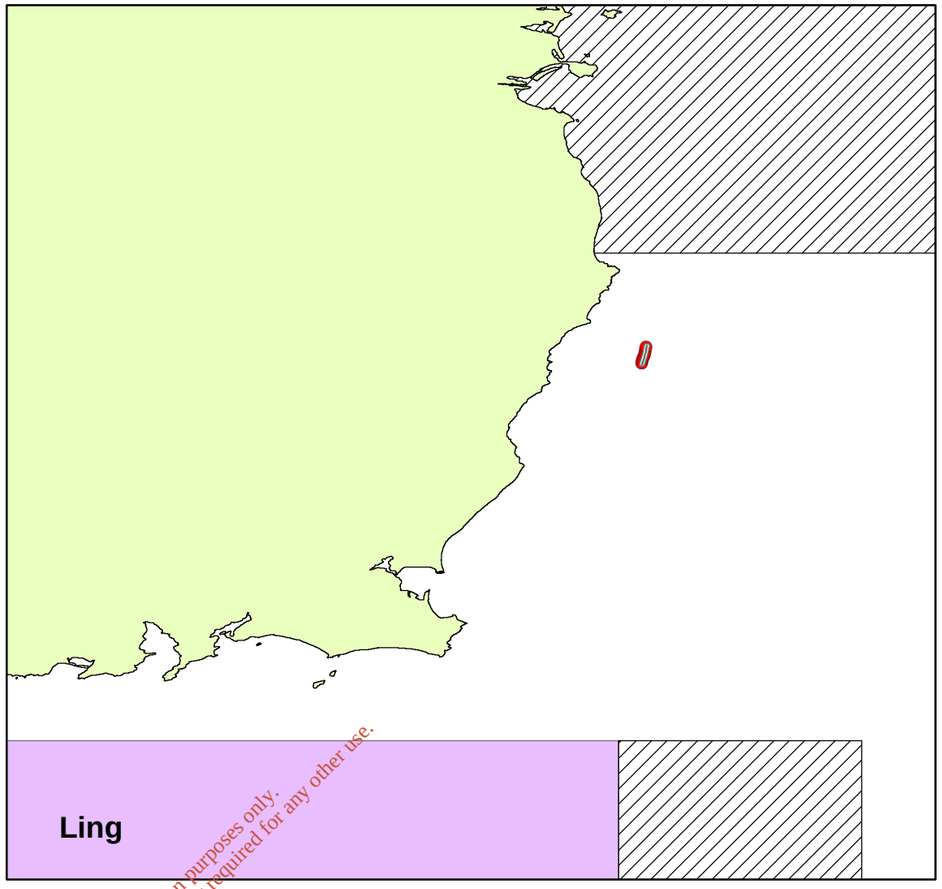
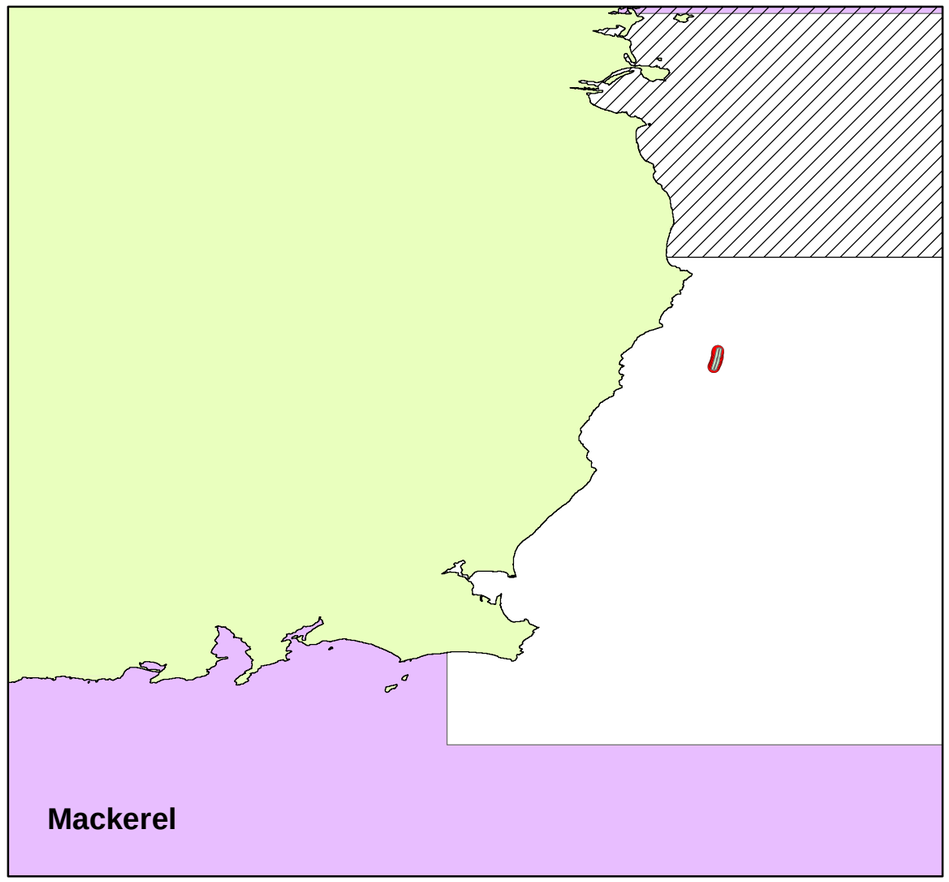
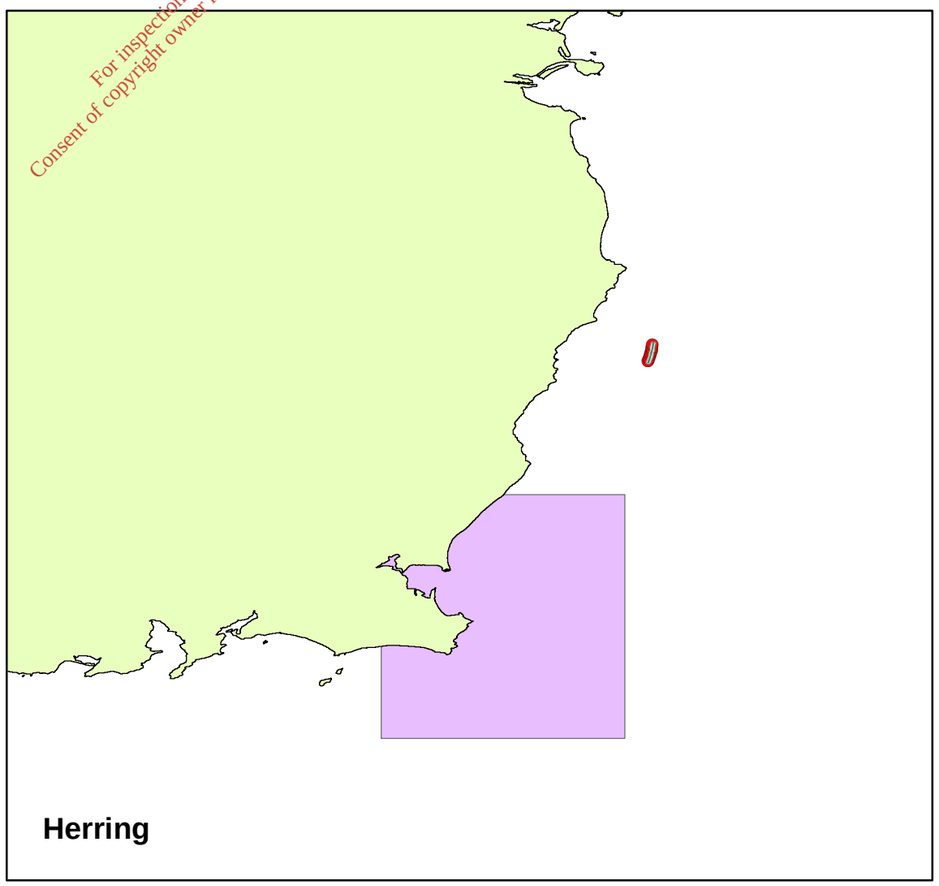
Date	Prepared By
26/07/2016	MP
Figure No.	**Revision**
Figure 11.6 B	-









N

0 20 40 Kilometers

Turbines

Anticipated maximum extent of plume

Ireland

Spawning grounds

Low intensity

High intensity

Nursery Grounds

Low intensity

High intensity

Data: Ellis, J.R., Milligan, S.P., Readdy, L.,Taylor, N. and Brown, M.J., 2012. Spawning and nursery grounds of selected fish species in UK waters. Technical report 147. Cefas.

Client

Arklow Energy Limited

Project Title

Arklow Bank Wind Park Seabed Levelling

Project Number

1620000345

Figure Title

Spawning & nursery grounds

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southampton@ramboll.co.uk
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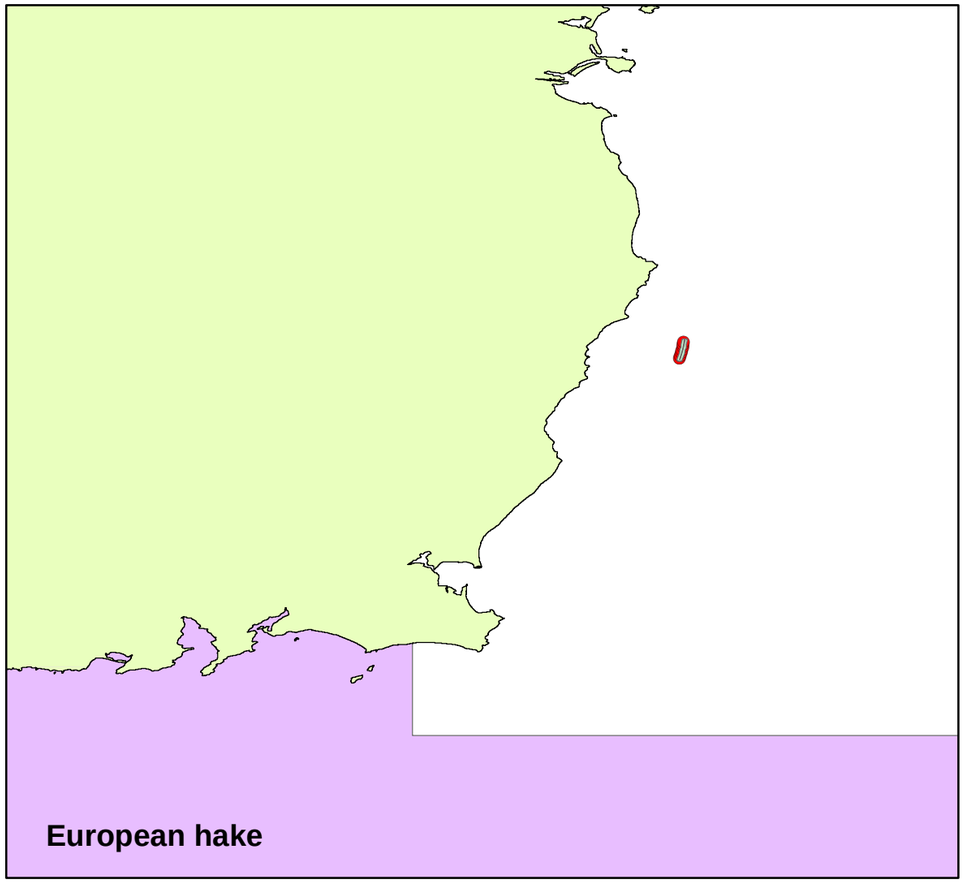
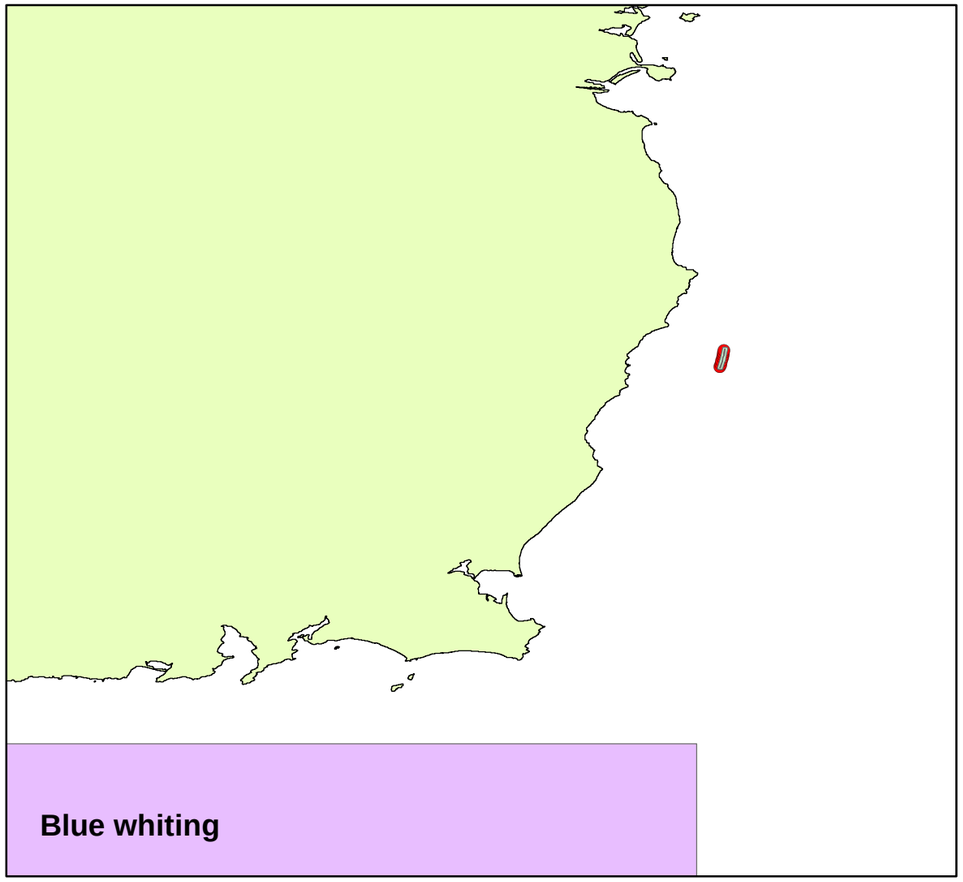
Date	Prepared By
26/07/2016	MP
Figure No.	**Revision**
Figure 11.6 C	-





N

0 25 50 Kilometers

Turbines

Anticipated maximum extent of plume

Ireland

Spawning grounds

Low intensity

High intensity

Nursery Grounds

Low intensity

High intensity

Data: Ellis, J.R., Milligan, S.P., Readdy, L.,Taylor, N. and Brown, M.J., 2012. Spawning and nursery grounds of selected fish species in UK waters. Technical report 147. Cefas.

Client

Arklow Energy Limited

Project Title

Arklow Bank Wind Park Seabed Levelling

Project Number

1620000345

Figure Title

Spawning & nursery grounds

RAMBOLL ENVIRON

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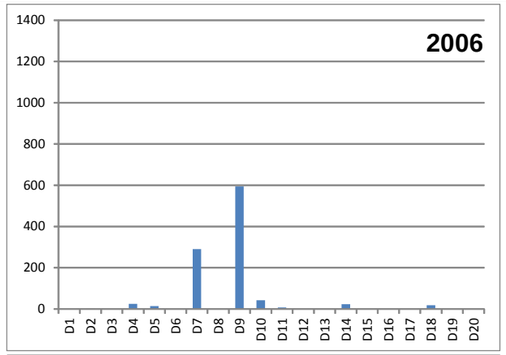
Date	Prepared By
26/07/2016	MP
Figure No.	**Revision**
Figure 11.6 D	-

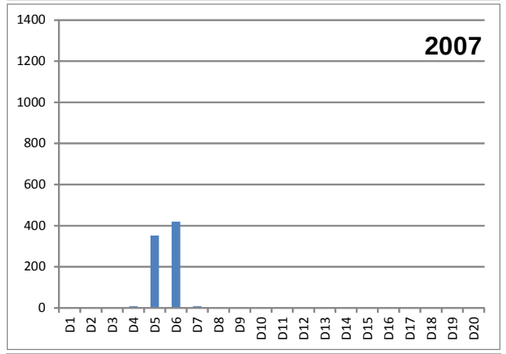
N

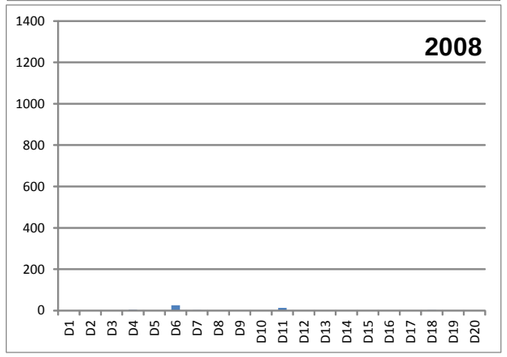
Arklow

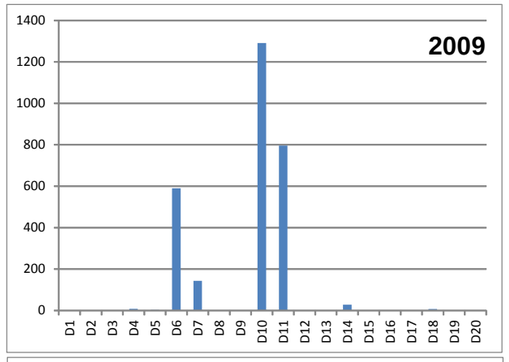
Gorey

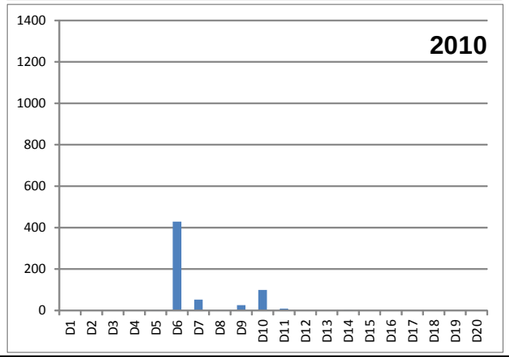
D8 D5 D7 D6 D4 D18 D17 D20 D9 D3 D1 D2 D16 T7 T6 T5 T4 T3 T2 T1 D15 D10 D19 D11 D14 D12 D13











Turbines

Ireland

Anticipated maximum extent of plume

0 2.5 5 Kilometers

Client

Arklow Energy Limited

Project Title

Arklow Bank Wind Park Seabed Levelling

Project Number

1620000345

Figure Title

Sabellaria distribution

RAMBOLL ENVIRON

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Date	Prepared By
26/07/2016	MP
Figure No.	**Revision**
Figure 11.8	-

APPENDIX 1
1.CORRESPONDANCE WITH THE DEPARTMENT OF ENVIRONMENT, COMMUNITIES AND LOCAL GOVERNMENT

From:	Mee, Sarah (GE Capital)
To:	Matt Royall; Kim Moore
Subject:	FW: Arklow Offshore Wind Farm - seabed levelling
Date:	23 November 2015 14:07:01
Attachments:	image001.jpg ATT00001.txt ATT00002.htm

Fyi…

From: Robert Hickey - (DECLG) [mailto:Robert.Hickey@environ.ie]
Sent: 23 November 2015 14:06
To: Mee, Sarah (GE Capital)
Subject: RE: Arklow Offshore Wind Farm - seabed levelling

HI Sarah

I confirm that the Foreshore Section do not require an EIA as we will not be considering the licencing of the proposed works.

Thanks

Rob

From: Mee, Sarah (GE Capital) [mailto:sarah.mee@ge.com]
Sent: 23 November 2015 13:56
To: Robert Hickey - (DECLG)
Subject: RE: Arklow Offshore Wind Farm - seabed levelling

Hi Robert,

We had a pre-application meeting with the EPA last week regarding a Dumping at Sea (DaS) permit and are looking to get our application in prior to the end of the year.

Thank you for again for this clarification that a Foreshore licence or amendment to our current lease is not required for the proposed plough dredging works. Please may you also confirm that the Foreshore section do not require an EIA for the proposed works? This clarification would be helpful for the DaS application.

Kind regards,
Sarah

From: Robert Hickey - (DECLG) [mailto:Robert.Hickey@environ.ie]
Sent: 28 September 2015 11:02
To: Mee, Sarah (GE Capital)
Subject: RE: Arklow Offshore Wind Farm - seabed levelling

Hi Sarah

It is our understanding of the legislation that only a Dumping at Sea (DAS) Permit is required for the proposed plough dredging works.

Kind regards

Rob

From: Mee, Sarah (GE Capital) [mailto:sarah.mee@ge.com]
Sent: 25 September 2015 16:02
To: Robert Hickey - (DECLG)
Subject: RE: Arklow Offshore Wind Farm - seabed levelling

Hi Rob,

Thank you very much for getting back to me. My initial discussions with the EPA outlined the same so will start on that application.

Is there a Foreshore licence or amendment to our current lease that needs to be made in addition?

Kind regards,
Sarah

From: Robert Hickey - (DECLG) [mailto:Robert.Hickey@environ.ie]
Sent: 25 September 2015 15:40
To: Mee, Sarah (GE Capital)
Subject: FW: Arklow Offshore Wind Farm - seabed levelling

Hi Sarah

I apologise for the delay in getting back to you. I can confirm that under the Foreshore and Dumping at Sea (Amendment) Act 2009 plough dredging as proposed will require a Dumping at Sea permit which can be obtained from the Environmental Protection Agency (EPA). The EPA Licensing - Dumping at Sea (DaS) link: http://epa.ie/licensing/watwaste/dumping

Kind regards

Rob

Robert Hickey
Marine Planning – Foreshore Section (MPFS)
Dept. of the Environment, Community and Local Government
Newtown Road
Wexford
Tel: 053-9117365

Robert.hickey@environ.ie

From: Mee, Sarah (GE Capital) [mailto:sarah.mee@ge.com]
Sent: 08 September 2015 14:22
To: Robert Hickey - (DECLG)
Subject: Arklow Offshore Wind Farm - seabed levelling

Robert,

As discussed via phone last week we have seen an accretion of sediment on the Arklow Bank that has now gotten to a point where it is preventing the safe access to two of our turbines (T3 and T4) by our maintenance and support vessels at certain tides. This is strongly restricting our ability to properly operate and maintain the wind turbines.

The Arklow bank is a very dynamic site and we have seen a large changes in the depth of the water during our 11years of operation. We were hoping that this accumulation of sand would move naturally away as others have in the past but it appears it needs a little bit of help. The proposal is to use a plough pulled by a vessel to level the seabed to a depth of 2.5m chart datum (Arklow) around the difficult to access turbines. Sediment would be moved from areas of low water depth to areas of higher water depth and some would be suspended in the water and moved by the tides.

As requested I have filled out your pre-application consultation form at a high level. Please let me know if this is what you were looking for and if you have any questions.

Kind regards,
Sarah

Sarah Mee
Asset Manager – Arklow Offshore Wind Farm
Tel: +44 (0)7770 947748

APPENDIX 2
2.ARKLOW BANK WIND PARK FORESHORE SUB-LEASE

EXECUTION VERSION

SURE PARTNERS LIMITED

ARKLOW ENERGY LIMITED

FORESHORE SUB-LEASE

TABLE OF CONTENTS

SCHEDULES

Schedule 4 **Special Conditions**

Schedule 5 **Form of Auditors Certificate**

THIS SUB-LEASE is made the 10th day of June, 2003

PARTIES

(1) **SURE PARTNERS LIMITED** having its registered office at 8\10 Rock Hill, Main Street, Blackrock, Co. Dublin (the **Lessor**) of the First Part ; and

(2) **ARKLOW ENERGY LIMITED** having its registered office at Toughers Industrial Park, Unit 1C Newhall, Naas, Co. Kildare (the **Lessee**) of the Second Part.

INTRODUCTION

A. On the 11th January 2002 the Minister for Communications, the Marine and Natural Resources (the **Minister**) and the Lessor, a 100% wholly owned subsidiary of Airtricity Holdings Limited, entered into a Foreshore Lease (**Head Lease**) to construct, locate and operate a 500Mw wind farm (the **Arklow Bank Wind Farm**) on the area known as the Arklow Banks (the **Head Leasehold Area**).

B. The terms of the Head Lease permit the Lessor to sub-let part of the Head Leasehold Area subject to prior written consent of the Minister.

C. The Lessee and Zeusford Limited (**Zeusford**), a 100% wholly owned subsidiary of Airtricity Holdings Limited have entered into a Co-Development and Implementation Agreement of even date hereof (the **Co-Development and Implementation Agreement**) whereby they have agreed to work together as co-developers of the first phase of the Arklow Bank Wind Farm comprising 7 Wind Turbines of type GE Wind 3.6s (having a combined Maximum Export Capacity of approximately 25.2Mw) to be installed on the Leasehold Area (as defined below).

D. The Lessee is developing, designing, constructing, funding, owning and operating the Facilities (as defined below).

E. The Lessor has agreed with the consent of the Minister to grant a sub-lease to the Lessee on the terms as set out in this Deed and the Lessor, the Lessee and the Minister have entered into an Agreement of even date herewith (the **Tripartite Agreement**) whereby the Minister has consented to the Sub-Lease or certain terms and conditions.

IT IS HEREBY AGREED AS FOLLOWS:

1. DEFINITIONS AND INTERPRETATION

1.1 In this Lease, unless the context otherwise requires, the following words and expressions have the following meanings:

(1) **1999 Act** means the *Electricity Regulation Act, 1999*;

(2) **AER VI PPA** means a power purchase agreement entered into by the Lessee under the Alternative Energy Requirement;

(3) **Alternative Energy Requirement** means a competitive scheme, initiated and administered by the Government of Ireland or any other competent authority for the support of electricity generating units utilising renewable non-fossil energy and to procure the purchase of electricity from such units by means of short or long term contractual arrangements;

(4) **Affiliate** means in relation to a Party:

(a) any body corporate which is a Subsidiary of that Party;

(b) any body corporate of which that Party is a Subsidiary; or

(c) any body corporate which is a Subsidiary of another body of which that Party is also a Subsidiary;

(5) **Arbitration** has the meaning set out in clause 27.7;

(6) **Assignment** means any assignment, novation, transfer, sub-letting or any other legal or equitable parting with possession of any description, directly or indirectly or in whole or in part;

(7) **Auditor** means any person appointed by the Lessee pursuant to clause 15 to provide an Auditor's Certificate;

(8) **Auditor's Certificate** means a certificate in the form set out in Schedule 5 stating that the Auditor has inspected the records of the Lessee and has certified the Revenues of the Lessee;

(9) **Authorisation to Construct a Generating Station** means an Authorisation to Construct or Reconstruct a Generating Station issued by the CER pursuant to section 16 of the 1999 Act;

(10) **BNEP** means the Best New Entrant Price, published by the CER in respect of each year or, if the Best New Entrant Price ceases to be published, any other index or mechanism which the Minister deems appropriate for determining changes in electricity prices;

(11) **Business Day** means a day that is not a Saturday, Sunday or a public or bank holiday in a place where an act is to be performed or a payment is to be made;

(12) **CER** means the Commission for Energy Regulation established pursuant to section 8 of the 1999 Act;

(13) **Certificates of Practical Completion** means the certificates that the Facilities have been completed in accordance with the Design Basis Document, as attached to the Co-Development and Implementation Agreement as Exhibit E, except in minor respects which do not materially affect the use of the Facilities for their intended purpose, such certificates to be provided by:

(a) the main contractor engaged in relation to the construction and/or installation of such Facilities;

(b) where there is an engineer appointed by the Lessee in relation to the construction and/or installation of such facilities or performance of such works, the engineer.

(14) **Change in Control** means any change in the Control of the Lessee;

(15) **Claim** means any claim, demand, proceedings, liability, action, costs, changes and expenses (including legal expenses on an indemnity basis) made by any person who is not a Party to this Lease;

(16) **Co-Development and Implementation Agreement** means the Agreement of even date herewith made between Zeusford, the Lessor and the Lessee.

(17) **Confidential Information** means any information in whatever form:

(a) in relation to a Party to this Lease or an Affiliate of a Party to this Lease;

(b) in relation to any employee, servant, agent, contractor or advisor of a Party to this Lease or an Affiliate of a Party to this Lease;

(c) in relation to the business, products, services, methods or work of a Party to this Lease or an Affiliate of a Party to this Lease,

(d) which is by its nature commercially sensitive and/or confidential;

(e) which is designated by the Disclosing Party as Confidential Information at the time of disclosure to the Recipient; or

(f) which the Recipient knows or ought reasonably to know is Confidential Information;

but does not include:

(g) this Lease;

(h) information which is or becomes generally available to the public (other than by reason of a breach of this Lease);

(i) information which is known to the Recipient at the time of its disclosure; or

(j) information which is subsequently acquired by the Recipient from a third party on terms that permit it to be disclosed and/or used, provided that such third party is lawfully entitled to disclose the information on such terms;

(18) **Connection Agreement** means any Generator Connection Agreement or Major User Connection Agreement entered into between ESB, or is successor in title, and the Lessor and assigned to the Lessee;

(19) **Consequential Loss** means in relation to a breach of this Lease any indirect or consequential loss (including loss of production, loss of revenue, loss of contract, loss of goodwill, liability under other agreements or liability to third parties) resulting from such breach and whether or not the Party committing the breach knows, or ought to have known, that such indirect or consequential loss would be likely to be suffered as a result of such breach and includes the payment or repayment of any amounts (or any acceleration thereof) to lenders or creditors of any Party from time to time;

(20) **Control** has the same meaning as in section 432 of the *Taxes Consolidation Act, 1997*;

(21) **Cure Notice** has the meaning set out in clause 19.1;

(22) **Default Rate** means the rate of interest payable on overdue income and corporation tax pursuant to section 1080 of the *Taxes Consolidation Act, 1997*;

(23) **Disclosing Party** means a person who discloses Confidential Information;

(24) **Dispute** means a difference or dispute of whatsoever nature arising between all or any of the Parties under or in connection with this Lease;

(25) **Dispute Notice** has the meaning set out in clause 27.2;

(26) **Dispute Resolution Procedure** means the procedure described in clause 27;

(27) **Duchas** means the Heritage Service of the Department of Arts, Heritage, Gaeltacht and the Islands;

(28) **Effective Date** has the meaning set out in clause 3;

(29) **Encumber** means to grant or create or cause or permit to be granted or created any mortgage, lien, pledge, assignment by way of security, charge, hypothecation, security interest, title retention or any other security agreement or arrangement having the effect of conferring security, or other form of encumbrance;

(30) **Environmental Laws** means to the extent applicable to the Facilities and/or the development thereof, any and all laws, directives, rules, statutes, orders, regulations (including EU Directives), ordinances, codes, decrees, requirements of any governmental authority and any and all common law requirements, rules and bases of liability regulating, relating to or imposing liability or standards of conduct concerning pollution or protection of human health or the environmental, as now or may at any time hereafter have effect in Ireland;

(31) **ESB** means the Electricity Supply Board established pursuant to Section 2 of the *Electricity (Supply) Act, 1927*, or such other body for the time being performing the functions of the transmission system operator pursuant to the *European Communities (Internal Market in Electricity) Regulations, 2000* SI 445 of 2000;

(32) **Euro** means the single legal currency of participating member states of the European Union;

(33) **Facilities** means 7 GE 3.6 Mw electricity generating wind turbines, including foundations and necessary associated works, and all cables associated with the windfarm, or any of them;

(34) **Force Majeure** means an event or circumstance or combination of events and/or circumstances not within the reasonable control of a Party which has the effect of delaying or preventing that Party from complying with its obligations under this Lease, including:

(a) acts of terrorists or protesters;

(b) war declared or undeclared, blockade, revolution, riot, insurrection, civil commotion, invasion or armed conflict;

(c) sabotage, acts of vandalism, criminal damage or the threat of such acts;

(d) extreme weather or environmental conditions including lightening, fire, landslide, accumulation of snow or ice, meteorites, volcanic eruption, earthquakes, tidal waves or other natural disasters;

(e) the occurrence of radioactive or chemical contamination or ionising radiation, explosion including nuclear explosion, pressure waves caused by aircraft or other aerial devices travelling at supersonic speeds and impact by aircraft or other vehicles;

(f) any strike or other industrial action (excluding any strike caused by or contributed to by the Lessee or any of its Affiliates);

(g) the act or omission of any contractor or supplier of a Party, provided that the act or omission was due to an event which would have been an event of Force Majeure had the contractor or supplier been a Party to this Lease; or

(h) the unavailability of essential monopoly infrastructure or services required to comply with obligations pursuant to this Lease, including access to electricity transmission or distribution systems, other than due to an act or omission of the Lessee,

provided that Force Majeure will not include:

(i) lack of funds and/or inability of a Party to pay; or

(j) mechanical or electrical breakdown or failure of machinery, plant or other Facilities owned by any Party, other than as a result of the circumstances identified in clauses 1.1(34)(a) to 1.1(34)(h), above;

(35) **Foreshore** has the same meaning as in section 1 of the Foreshore Act;

(36) **Foreshore Act** means the *Foreshore Act, 1933*;

(37) **Foreshore Lease** means a lease granted by the Minister pursuant to section 2(1) of the Foreshore Act;

(38) **Good Industry Practice** means conducting activities in a proper and workmanlike manner in accordance with applicable international standards, methods and customarily used practices, with that degree of diligence and prudence reasonably and ordinarily exercised by skilled and experienced operators engaged in a similar activity under similar circumstances and conditions;

(39) **Head Lease** means the Foreshore Lease dated the 11th January 2002 and made between the Minister and the Lessor.

(40) **IAA** means the Irish Aviation Authority established pursuant to Section 11 of the *Irish Aviation Authority Act, 1993*;

(41) **IMO** means the International Maritime Organisation established pursuant to the Intergovernmental Maritime Consultative Organisation Convention 1948, which was subsequently amended to become the International Maritime Organisation Convention 1982;

(42) **Insolvency Event** means in respect of the Lessee or the Lessor, as the case may be:

(a) the Lessee or the Lessor is unable to pay its debts within the meaning of section 214 of the *Companies Acts 1963 to 1999* or any analogous legislation or any indebtedness of the Lessee or Lessor is not paid when due (save for normal trade debts or any debts which are disputed in good faith), any indebtedness of the Lessee or Lessor is declared to be or otherwise becomes due and payable prior to its specified maturity or any creditor or creditors of the Lessee or Lessor become entitled to declare any indebtedness of the Lessee or Lessor due and payable prior to its specified maturity;

(b) the Lessee or Lessor commences negotiations with any one or more of its creditors with a view to the general readjustment or rescheduling of its indebtedness (except in the course of a solvent amalgamation or reconstruction), or with a view to agreeing a moratorium on its indebtedness or makes a general assignment for the benefit of or a composition with its creditors;

(c) the Lessee or Lessor takes any corporate action or other steps are taken or legal proceedings are started for its winding-up, protection by the court, dissolution, administration or re-organisation or for the appointment of a liquidator, receiver, examiner, administrator, administrative receiver, trustee or similar officer of it or of any or all of its revenues or assets;

(d) a distress, execution or other legal process, which is not being defended or appealed, in respect of a claim of €200,000 or more is levied, enforced or sued out upon or against any substantial part of the property or assets of the Lessee or Lessor;

(e) a person exercises its rights under an Encumbrance to take possession of

the whole or any part of the undertaking, property or assets of the Lessee or Lessor;

(f) the Lessee or Lessor stops or threatens to stop payment of its debts or ceases or threatens to cease to carry on or changes its business or a substantial part of its business;

(g) any judgement or order in an amount equal to or in excess of €50,000 is made or awarded against the Lessee or Lessor and is not wholly stayed or complied with within 21 Business Days; or

(h) the consolidated financial statements of the Lessee or Lessor for any period contain a qualification that such statements do not reflect the financial position of the Lessee or Lessor;

(43) **Installed Capacity** means 25.2 MW;;

(44) **Law** means any Act of the Oireachtas, regulation, statutory instrument, European Community or other international obligation, direction of a regulatory or other competent authority, condition of any consent, authorisation, or other permission granted by any regulatory or other competent authority and any decision of a court of competent jurisdiction, but does not include this Lease;

(45) **Lease** means this Deed, including any Schedule, Attachment or Appendix to it;

(46) **Leasehold Area** means the area defined in Schedule 1;

(47) **Licence to Generate Electricity** means a licence of that name issued by the CER pursuant to section 14(1)(a) of the 1999 Act;

(48) **Licence to Supply Electricity** means a licence o hat name issued by the CER pursuant to section 14(1)(b) of the 1999 Act;

(49) **Longstop Date** means 31 December 2009;

(50) **Maximum Export Capacity** means the maximum permissible amount of electricity to be exported onto the distribution system, expressed in MW, as set out in a connection offer from ESB or Connection Agreement, as the case may be;

(51) **Month** means a calendar month;

(52) **MW** means one or more megawatts of electrical power, as the context requires;

(53) **NHA** means an area which is designated as a national heritage area pursuant to section 18 of the *Wildlife (Amendment) Act, 2000*, or an area which is proposed to

be designated as such;

(54) **Operational Certificate** means the notice issued by ESB specifying the "Operational Date" pursuant to the Connection Agreement;

(55) **Operational Date** means in respect of the Facilities, the date on which the Lessee has provided the Lessor with both:

(i) a copy of all relevant Certificates of Practical Completion in respect of such Facilities; and

(ii) a copy of the Operational Certificate(s) in respect of such Facilities;

(56) **Owner** means GE Arklow Energy C.V., a 100% Affiliate of General Electric Co., acting through it's sole general partner GE Wind, Inc.;

(57) **Party** means a Party to this Lease;

(58) **Phase** means the construction, installation and testing of the Facilities;

(59) **Proposed Generating Capacity** means a total generating capacity for the Phase of approximately 25.2Mw;

(60) **Recipient** means a person who receives Confidential Information from a Disclosing Party;

(61) **Rent** means the sum of €250 per annum;

(62) **Representations and Warranties** means the representations and warranties made by the Lessor pursuant to clause 17.1 and the representations and warranties given by the Lessee pursuant to clause 17.3, as the case may be;

(63) **Revenues** means all revenues associated with operations in the Leasehold Area pursuant to this Lease, including revenues derived from generation of electricity, green credits or advertising (but excluding Value Added Tax). For the avoidance of doubt, in addition to revenues earned by the Lessee, Revenues earned by any Sub-Lessee or any other person entitled to derive revenues from the operation of the Facilities in the Leasehold Area shall be taken into account in calculating revenues associated with operations in the Leasehold Area;

(64) **Royalties** means the amounts which are payable to the Minister by the Lessee pursuant to clause 4.2, calculated in accordance with clause 4.4;

(65) **SAC** means an area which is designated as a special area of conservation by regulation made pursuant to Section 3(1) of the *European Communities Act, 1972*

and Article 3 of Council Directive 92/43/EEC (as amended by 97/62/EC) of 12 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora, or an area which is proposed to be designated as such;

(66) **SPA** means an area which is designated as a special protection area by regulation made pursuant to Section 3(1) of the *European Communities Act, 1972* and Article 4 of Council Directive 79/409/EEC of 2 April 1979 on the Conservation of Wild Birds, or an area which is proposed to be designated as such;

(67) **Sea Level** means the level of high water of medium or ordinary tides in dead calm seas at the location of the wind turbine or where the area is not tidal, the level experienced in dead calm seas;

(68) **Security Holder** means any beneficiary (including any trustee or agent on behalf of such beneficiary), of whom the Lessor has notice, of any Encumbrance granted by the Lessee over this Lease, any Facilities or any contracts pursuant to which revenues are generated in connection with activities pursuant to this Lease;

(69) **Special Conditions** means the terms and conditions set out in Schedule 4;

(70) **Special Force Majeure Event** means:

(a) the Lessee (or its Affiliates) is unable to undertake any construction and/or installation works in the Leasehold Area for a total of 60 days during the Weather Window in any calendar year due to adverse weather conditions at sea as measured by the Now Casting software package for online sea condition prediction or such other method reasonably determined by the Lessor from time to time; or

(b) the Lessee is unable to secure a connection offer from ESB in sufficient time to enable the Lessee to complete the construction and/or installation of the Facilities in any calendar year,

provided that a Special Force Majeure Event will not be deemed to have occurred if the Minister, pursuant to the Head Lease reasonably determines that:

(c) the Lessee has not used all reasonable efforts to complete the construction and/or installation of the Facilities scheduled for completion in that calendar year in the time available; or

(d) the Lessee has not used all reasonable efforts to secure a connection offer in sufficient time that the Lessee could reasonably complete the construction and/or installation of the Facilities in that year;

(71) **Specifications** means the specifications for the design and construction of the Facilities set out in Schedule 2, as amended from time to time by agreement between the Parties;

(72) **Subsidiary** has the same meaning as in section 155 of the *Companies Act 1963*;

(73) **Term** has the meaning set out in clause 3.2;

(74) **Transaction Documents** has the meaning set out in the Co-Development and Implementation Agreement;

(75) **Up-front Fees** means the amounts which are payable to the Minister by the Lessee pursuant to clause 4.2.

(76) **Value Added Tax** means tax chargeable by virtue of the *Value Added Tax Act, 1972*;

(77) **Weather Window** means, in respect of any calendar year, the period from 1 April to 30 September in that year, together with any other period in that year during which the Lessee undertakes or is able to undertake works associated with the construction or installation of the Facilities in the Leasehold Area; and

(78) **Year** means each 12 month period commencing on the Effective Date, or any anniversary of the Effective Date, and terminating on the following anniversary of the Effective Date.

1.2 In this Lease, unless the context otherwise requires:

(1) other grammatical forms of defined terms will have a corresponding meaning;

(2) the table of contents and headings are for convenience only and do not affect interpretation;

(3) words importing persons or Parties include any individual, body corporate, firm, corporation, joint venture, trust, unincorporated association, organisation or partnership and any other entity, in each case whether or not having a separate legal personality, and all references to persons includes their legal successors and permitted assignees;

(4) all monetary amounts are in Euro, unless otherwise specified;

(5) including and similar words are not words of limitation; and

(6) a reference:

(a) to a gender includes a reference to each other gender;

(b) to the singular includes a reference to the plural and vice versa;

(c) to legislation, regulations, directives, orders, directions, instruments, codes or other enactments includes any orders or regulations made pursuant to such legislation or other enactments and includes all amendments, modifications and replacements to such legislation, regulations, directives, orders, directions, instruments, codes or other enactments;

(d) in this Lease to a Party, Schedule, Attachment or Appendix is a reference to a Party, Schedule, Attachment or Appendix to this Lease;

(e) in this Lease to a clause, is a reference to a clause in this Lease (excluding the Schedules); and

(f) in a Schedule to this Lease to a section, is reference to a section in that Schedule.

2. GRANT OF LEASE

2.1 The Lessor hereby demises the Leasehold Area to the Lessee **TO HOLD** unto the Lessee for the Term subject to the terms and conditions set out in this Deed, yielding and paying annually in each and every year the Rent and Royalties in the manner hereafter set forth for the purposes of:

(1) constructing, installing or locating the Facilities;

(2) operating the Facilities as a wind farm to generate electricity;

(3) maintaining, inspecting, testing, commissioning, repairing or decommissioning or replacing all or any of the Facilities; and

(4) carrying out works which are necessary or incidental to the activities described in clauses 2.1(1) to 2.1(3).

2.2 The Lessee must not use the Leasehold Area for any purpose other than the purposes described in clause 2.1.

2.3 For the avoidance of all doubt, this Lease does not include a demise of any minerals on or in the Leasehold Area or the right to get and take such minerals, within the meaning of section 2(7) of the Foreshore Act.

2.4 The Lessee shall reimburse the Lessor for any Value Added Tax properly chargeable by the

Lessor on the creation of the Lease and which is fully recoverable by the Lessee (excluding any applicable interest and penalties).

3. TERM

3.1 This Lease will commence on the date of execution (**Effective Date**).

3.2 Subject to the provisions of clause 24, this Lease will remain in force for a period of 30 years (**Term**).

4. RENT, FEES AND ROYALTIES

4.1 The Rent shall be paid to the Lessor by the Lessee annually in arrear on the 1st day of June in each year.

4.2 In consideration of the grant of this Lease, and to the extent only that the Lessor is liable to the Minister for same under the terms of the Head Lease, the Lessee must pay to the Minister Royalties in accordance with clauses 4.3 and 4.4, and Up-front Fees in the amounts and at the times specified in Schedule 3 (such amounts to be adjusted from the Effective Date in accordance with changes in BNEP).

4.3 The Lessee must pay Royalties to the Minister annually in arrears during the Term in respect of each Year of this Lease, such payment to be made no later than the date which is 3 calendar months after the end of each Year.

4.4 The Royalties which are payable by the Lessee to the Minister are:

(1) until the date which is 5 years after the Operational Date the lesser of:

(a) €3,800 per MW of total Installed Capacity; and

(b) 2.5% of Revenue; or

(2) For each Year subsequent to the date which is 5 years after the Operational Date, the greater of:

(a) €3,800 (adjusted from the Effective Date in accordance with changes in BNEP) per MW of Installed Capacity; and

(b) 2.5% of Revenue.

5. PROPOSED GENERATING CAPACITY

5.1 Unless the prior written consent of the Lessor is obtained, the Lessee must use all reasonable endeavours to ensure that the Maximum Export Capacity specified in the connection offer from ESB is no less than the Proposed Generating Capacity.

5.2 The Lessee must ensure that the Installed Capacity of the Phase is not less than the Proposed Generating Capacity provided that the Lessee will be deemed not to be in breach of this clause 5.2 if the Installed Capacity is no more than 5% less than the Proposed Generating Capacity.

6. COMMENCEMENT OF OPERATIONS

6.1 The Lessee must not commence any works, activities or operations in the Leasehold Area, including any works, activities or operations associated with the construction and/or installation of the Phase, without the prior written consent of the Lessor.

6.2 The Lessor is not obliged to grant consent pursuant to clause 6.1 unless and until:

(1) the Lessee has provided to the Lessor any Connection Agreement and any amendment to any Connection Agreement in accordance with clause 14.3(4)(d);

(2) the Lessee has appointed an Auditor in accordance with clause 15; and

(3) the Lessee has prepared and provided to the Lessor an outline plan for the decommissioning of any partially constructed Facilities and rehabilitation of the Leasehold Area in the event that construction and/or installation of the Phase is commenced but not completed.

6.3 If at any stage during the currency of this Lease, the Lessee ceases to comply with the conditions set out in clause 6.2:

(1) the Lessee must immediately notify the Lessor ; and

(2) at the request of the Lessor, acting on the instructions of the Minister the Lessee shall cease the relevant works, activities or operations until the consent of the Minister is obtained to the Lessee continuing such works, activities or operations.

6.4 The Lessee must endeavour to satisfy it's obligations pursuant to clause 6.2 as soon as is reasonably practicable after the Effective Date.

7. CONSTRUCTION OF WIND FARM

7.1 Subject to clause 7.2, the Lessee must achieve the Operational Date in respect of the Facilities prior to the Longstop Date.

7.2 If the Lessee fails to achieve the Operational Date in respect of the Facilities prior to the Longstop Date, the Lessor will (subject to the approval of the Minister pursuant to the Head Lease), on application by the Lessee, extend the Longstop Date for such period as the Minister sees fit (pursuant to the Head Lease) and subject to such conditions, including monetary conditions, as the Minister may require (pursuant to the Head Lease).

8. COMPLIANCE WITH APPLICABLE LAWS

8.1 The Lessee must at all times comply with all applicable Laws.

8.2 Without prejudice to the generality of clause 8.1, the Lessor must procure in the name of the Lessee and at all times maintain all necessary licences, consents, permissions, permits or authorisations associated with any activities of the Lessee in connection with the Leasehold Area.

8.3 Without prejudice to the generality of clause 8.1, the Lessee must:

(1) have consulted with the Development Applications Unit of Dúchas and must comply with all requirements of Duchas, made in exercise of its statutory functions, in relation to activities in the Leasehold Area or otherwise in connection with this Lease; and

(2) comply with all directions of the IAA given from time to time in relation to the marking and lighting of any Facilities in the Leasehold Area.

8.4 The Lessor shall facilitate and provide all reasonable assistance in connection with the Lessor's obligations under clause 8.3(1) and (2) and to the extent applicable to the construction and operation of the Facilities by the Lessee shall comply with the requirements and directives of Duchas and the IAA.

9. SPECIFICATIONS

9.1 Unless the prior written approval of the Lessor is obtained, the Lessee must ensure that:

(1) all Facilities are constructed and/or installed in accordance with the Specifications and such Facilities at all times comply with the Specifications which were applicable at the date that such Facilities were constructed and/or installed; and

(2) no development, work, construction or installation is undertaken in the Leasehold Area that does not comply with the Specifications.

9.2 The Specifications may be amended from time to time:

(1) by agreement between the Lessee and the Lessor, acting on the instruction of the Minister; or

(2) by the Lessor if it has received a notice in writing from the Minister pursuant to the terms of the Head Lease to do so for reasons of public safety, protection of the environment or consistency with Good Industry Practice.

9.3 If after the expiration of 2 years of continuous operation of the Facilities following the Operational Date, a turbine ceases to be operational for a continuous period of 90 days or for a total period of 180 days in any 365 day period the Lessor may, on the instruction of the Minister;

(1) require that the turbine be replaced;

(2) require that the turbine be removed; or

(3) require that the turbine be removed, together with its foundations and associated equipment

Provided that if the Lessee is at any time unable to repair or replace a turbine, as the circumstances require, as a result of an event of Force Majeure, such periods of Force Majeure will not be counted for the purposes of determining whether a turbine ceases to be operational for a continuous period of 90 days or for a total period of 180 days in any 365 day period.

10. OPERATIONS IN CONNECTION WITH THIS LEASE

10.1 Without prejudice to any other rights and obligations under this Lease or at Law, in exercising any rights or performing any obligations in connection with this Lease, the Lessee must:

(1) comply with the Special Conditions set out in Schedule 4;

(2) ensure that all Facilities or other works of structures in the Leasehold Area are maintained in a good and proper state of repair and condition, which ensures that they will not constitute a public health hazard or danger to persons, animals, marine life or the environment;

(3) not decommission any Facility other than with the prior written consent of the Minister and in accordance with the terms of the Tripartite Agreement;

(4) subject to clause 22, not Encumber this Lease, any Facility or any contracts pursuant to which revenues are generated in connection with activities pursuant to this Lease without the prior written consent of the Lessee;

(5) maintain appropriate resources to ensure the proper exercise of all rights and the performance of all obligations in connection with this Lease, including:

(a) ensuring that all necessary competent persons are engaged to carry out any works, activities or operations pursuant to this Lease; and

(b) using suitable machinery and equipment which is in good repair and condition and maintained to proper safety standards;

(6) use all reasonable endeavours to minimise damage and disturbance to the sea bed, fisheries and all other maritime activities and restore any damage which does occur to the satisfaction of the Lessor;

(7) not undertake any works, activities or operations, other than navigation, outside the Leasehold Area without the prior written consent of the Lessor and, where appropriate, any occupiers of such sea bed;

(8) not, without the prior written consent of the Lessor, carry out any works, activities or operations which are injurious to or interfere unreasonably with fishing, navigation, adjacent lands, approved scientific research or the public interest; and

(9) ensure that adequate warning notices, fencing or other appropriate security and safety measures are in place at all works and structures during construction and, where necessary, for the duration of this Lease.

10.2 Without prejudice to any other remedy under this Lease or at Law, if the Lessee is in breach of any obligation pursuant to clause 10.1, the Lessee may, if notified in writing by the Minister, require that the Lessee rectify such breach, within such reasonable time period as is specified by the Minister to the Lessor in such notice.

10.3 The Lessee must comply with any direction under clause 10.2 within the time specified in the notice.

10.4 If the Minister has notified the Lessor that he or she is of the view that the capability of the Lessee to discharge fully its obligations under this Lease is materially impaired by reason of a change in the managerial, technical or financial competence of the Lessee, the Lessor may notify the Lessee in writing, following which:

(1) the Lessee must take reasonable steps to address the concerns set out in the notice within 30 days of receipt of such notice; and

(2) such concerns must be remedied by the Lessee within a reasonable time following the receipt of such notice (such reasonable time to be determined having regard to the nature of the concerns).

10.5 The Lessor will use reasonable endeavours to procure that:

(1) cables in the Leasehold Area are protected; and

(2) no construction on the Foreshore will impede the effective operation of the Facilities in the Leasehold Area.

11. OTHER ACTIVITIES IN THE LEASEHOLD AREA

11.1 This Lease does not preclude and the Lessee will not have the right to interfere with:

(1) the laying of pipelines or cables of any kind by a person in, on or above the Leasehold Area, provided that this has been approved by the Minister subject to the terms of the Head Lease;

(2) fishing in the Leasehold Area provided that such fishing will not endanger or create unreasonable inconvenience to works, activities or operations under this Lease;

(3) exploration for and development of natural resources of any kind, provided that:

(a) such activities do not endanger or create unreasonable inconvenience to works, activities or operations under this Lease;

(b) the prior written consent of the Lessor is obtained; and

(c) such persons give the Lessee not less than 90 days notice of their intention to engage in such activities;

(4) the carrying out of approved scientific research, subject to Minister consent pursuant to the Head Lease; or

(5) the exercise of any other rights or the undertaking of any other activities permitted by Law.

12. ENVIRONMENTAL IMPACT

12.1 The Lessee must:

(1) install infra-red cameras in the Leasehold Area to monitor bird collisions with the Facilities, in such numbers and at such locations as are agreed with the Lessor

and to maintain an archive of data from such cameras for a period of 30 days and make such data available to the Lessor upon request; and

(2) report any major impact on bird life, whether adverse or beneficial, to the Lessor and BirdWatch Ireland as soon as is reasonably practicable.

13. RECORDS

13.1 The Lessee must at all times ensure that:

(1) books of account, records and vouchers are kept in accordance with normal accounting procedures and in accordance with Section 202 of the *Companies Act, 1990*;

(2) separate books of account, records and vouchers are kept in accordance with normal accounting procedures and in accordance with Section 202 of the *Companies Act, 1990*, in relation to the Revenues;

(3) true and correct plans and sections are maintained of the Leasehold Area, showing all Facilities and other workings, drawn to a scale of not less than 1:2,500; and

(4) all electricity generated in connection with this Lease is properly metered and appropriate records are kept of:

(a) quantities of electricity generated in the Leasehold Area;

(b) quantities of electricity sold from the Leasehold Area;

(c) the prices at and terms on which such electricity is sold;

(d) the persons to whom such electricity is sold; and

(e) the dates on which such electricity is sold.

13.2 The Lessee must keep all records referred to in clause 13.1 at the premises of the Lessee located at its registered office or such other location approved in writing by the Lessor from time to time.

14. MONITORING, REPORTING, INSPECTIONS AND INVESTIGATIONS

14.1 The Lessee must undertake the following monitoring operations in the Leasehold Area:

(1) an ongoing monitoring programme in respect of the integrity both of the windfarm

structure and of the seabed at foundation level, such monitoring to take place every six months during the first 2 years following the Operational Date and annually thereafter, unless the prior written consent of the Lessor is obtained. The results of such monitoring must be communicated to the Lessor as soon as is reasonably practicable after it is available, but in any event within 20 Business Days;

(2) the foundations of each turbine must be monitored for scour every six months during the first 2 years following the Operational Date in respect of each turbine and annually thereafter, unless the prior written consent of the Lessor is obtained. The results of such monitoring must be communicated to the Lessor as soon as is reasonably practicable after it is available, but in any event within 20 Business Days;

(3) during the construction of the Phase and for a period of five years following completion of the Phase, birdlife in the Leasehold Area must be monitored in accordance with best international standards. Copies of reports must be sent to BirdWatch Ireland, Dúchas and the Lessor on a quarterly basis;

(4) sites containing vulnerable species or species of interest (e.g. *Sabellaria sp.*) must be monitored on an ongoing basis during the pre-construction, construction and operational phases of development of the wind farm and the results of such monitoring should be provided to the Lessor on an annual basis;

(5) a selection of sites at key locations in the Leasehold Area, agreed from time to time with the Lessor, must be monitored on an ongoing basis during the pre-construction, construction and operational phases of development of the wind farm to detect any change in habitat or species composition and the results of such monitoring should be provided to the Lessor on an annual basis; and

(6) the establishment and succession of the benthic communities on or adjacent to turbine foundations should be monitored on a regular basis and reports on the results of such monitoring must be provided to the Lessor annually for the first 5 years following the Operational Date.

14.2 Should results of the monitoring referred to in clause 14.1 be such as to cause concern, the Lessor may, on the instructions of the Minister, require that such monitoring be continued or recommenced for such period or periods as he or she deems necessary.

14.3 The Lessee must :

(1) as soon as is reasonably practicable, but in any event within 10 Business Days after becoming aware that it will or may be affected by a Special Force Majeure

Event, notify the Lessor identifying the nature of the Special Force Majeure Event and details of its implications for the construction and/or installation of the Phase and provide such updates or additional information in relation to the potential or actual Special Force Majeure Event as the Lessor may reasonably require from time to time;

(2) provide to the Lessor as soon as is reasonably practicable, but in any event within 6 months after the end of each financial year, the audited statutory accounts in respect of the Lessee and must notify the Lessor of any intention to alter the financial year of the Lessee;

(3) provide an Auditor's Certificate to the Lessor no later than 3 calendar months after the end of each Year;

(4) as soon as is reasonably practicable, but in any event no longer than three calendar months, following receipt by the Lessee, provide the Lessor with copies of the following documents or (where applicable) any amendments or variations to such documents:

(a) any Certificates of Practical Completion in respect of the Facilities;

(b) as built drawings in respect of any Facilities;

(c) any Operational Certificates;

(d) any Connection Agreement; and

(e) any contract with any person which may result in the generation of Revenues including power purchase agreements, agreements for the purchase of green credits or advertising agreements.

(5) provide to the Lessor immediately upon termination of this Lease or otherwise within 20 Business Days after receipt of a request from the Minister:

(a) copies of any records of the Lessee referred to in clause 13.1 other than clause 13.1(4)(e) which are requested by the Lessor

(b) such other information as the Lessor may at any time require in relation to this Lease or any works, activities or operations conducted in connection with this Lease; and

(c) such information required by the Lessor as to the progress and future plans of the Lessee in its works activities and operations in connection with this Lease;

(6) immediately notify the Lessor of any actual or anticipated breach of this Lease;

(7) as soon as is reasonably practicable, notify the Lessor of the making of any Claim arising out of the exercise or purported exercise of the rights granted to the Lessee by this Lease and must furnish to the Lessor all information which the Minister may from time to time require in relation to any such Claim;

(8) notify the Lessor in writing within 5 Business Days of receipt of any notice from any competent authority of non-compliance with any consent, permission, permit, licence or authorisation, which is in any way connected with works, activities or operations pursuant to this Lease;

(9) notify the Lessor in writing within 15 Business Days of any transfer or series of transfers which result in the transfer of more than 45% of the shares in the Lessee;

(10) provide to Met Eireann, subject to such terms as may be agreed between the Lessee and Met Eireann, (but as a minimum subject to Met Eireann using the information only for general forecasting purposes and reserving the release of specific information received on foot of this Lease to such occasions as may be required by court order or to assist in any official enquiry which may be held into any accident or occurrence which resulted in loss of life or threatened loss of life) all information obtained relating to wind, wave and weather conditions within the Leasehold Area. The Lessee may recover from the Lessor any expenses incurred solely as a result of the Lessee complying with this clause 14.3(10);

(11) report to the Lessor annually on the impacts of the marine environment on the foundations including, but not limited to, development of or alteration to eco-systems, weathering and corrosion; and

(12) report bird mortality to the Lessor, Duchas and BirdWatch Ireland which is caused by or reasonably suspected to be caused by the construction and/or operation of the wind farm, providing (where available) numbers, species and details of any contributory factors or other possible causes.

14.4 The Lessor must:

(1) as soon as is reasonably practicable, but in any event no longer than three calendar months, following receipt by the Lessor, provide the Lessee with copies of the following documents or (where applicable) any amendments or variations to such documents:

(a) any Authorisations to Construct a Generating Station in the Leasehold Area;

(b) any Licences to Generate Electricity;

(c) any Licences to Supply Electricity; and

(d) any other licences, consents, permissions, permits or authorisations associated with any activities of the Lessee or the Lessor in connection with the Leasehold Area; and

(2) immediately notify the Lessee of any actual or anticipated breach of this Lease or the Head Lease.

14.5 The Lessor may conduct or cause to be conducted such investigations, inspections and enquiries in connection with this Lease as requested by the Minister and shall be entitled to comment on and query the construction of the Facility in so far as it deviates from the Design Basis Document provided that under no circumstances shall any interference, supervision or obstruction of the Lessee's construction activities in respect of the Facilities, or contravention of the site health and safety requirements/procedures of the Lessee or the EPC contractor, by the Lessor or its representatives be permitted.

14.6 Subject to the proviso in clause 14.5, the Lessee must use all reasonable endeavours to co-operate fully and provide all reasonable assistance in relation to any investigation, inspection or enquiry conducted pursuant to clause 14.5 and to this end the Lessee must, subject to safety requirements prescribed by Law or otherwise agreed between the Parties:

(1) permit and facilitate any person or persons authorised by the Lessor to enter onto and remain in the Leasehold Area;

(2) permit and facilitate any person or persons authorised by the Lessor to inspect the Leasehold Area and any Facilities and other equipment of things located in the Leasehold Area;

(3) permit and facilitate any person or persons authorised by the Lessor to inspect electricity metering equipment and ensure the correct metering of the electricity; and

(4) permit and facilitate any person or persons authorised by the Lessor to inspect and copy, at the Lessor's expense, any records of the Lessee referred to in clause 13.1, or any other books of account, records, returns, data, maps, plans, samples, reports or other information in the possession or control of the Lessee which is required by the Lessor, on the reasonable instruction of the Minister and which is in any way concerned with works, activities or operations pursuant this Lease.

14.7 Information provided to the Lessor, or to which access is granted, pursuant to clauses 14.1,

14.3 and 14.6 must be:

(1) to the best of the Lessee's knowledge, complete, accurate and not misleading in any material particular;

(2) provided within time limits specified in this Lease or by the Lessor, or if no time limit is specified, within a reasonable time; and

(3) other than information which is provided pursuant to clause 14.3(10) provided at the cost of the Lessee.

14.8 The Lessee acknowledges and agrees that, unless the contrary intention is expressed, any investigation, inspection or enquiry undertaken pursuant to this Lease:

(1) is without prejudice to the Lessee's rights and obligations under this Lease or at Law and does not amount to a waiver of any such rights or relieve the Lessee from any such obligations; and

(2) does not amount to an acknowledgement by the Lessor, or any officer, servant or agent of the Lessor, that the Lessee has complied with this Lease, Good Industry Practice or Law in relation to any matters to which the investigation, inspection or enquiry relates.

15. APPOINTMENT OF AUDITOR

15.1 On or as soon as practicable after the Effective Date, the Lessee must notify the Lessor of the identity of the Auditor.

15.2 As soon as practicable after receipt of notification of the identity of the Auditor pursuant to clause 15.1 or 15.3, the Lessor must notify the Lessee whether or not the Auditor is acceptable to the Lessor.

15.3 Subject to clause 15.5, if the Lessor notifies the Lessee pursuant to clause 15.2 that the Auditor notified by the Lessee is not acceptable to the Lessor, the Lessee must, as soon as is reasonably practicable, notify the Lessor of an alternative Auditor.

15.4 The Auditor must at all times be acceptable to the Lessor and the Lessee must not appoint a new Auditor without the prior written approval of the Lessor.

15.5 In the event of any Dispute between the Lessor and the Lessee as to the appointment of an Auditor, the matter will be referred to the President for the time being of the Institute of Chartered Accountants in Ireland whose decision will be binding.

15.6 For the avoidance of doubt, the President of the Institute of Chartered Accountants in Ireland

may decide that an Auditor other than one proposed by the Lessor or the Lessee be appointed.

16. PAYMENT

16.1 All payments by the Lessee in connection with this Lease:

(1) must be made by cheque, bank draft, electronic transfer or money order, delivered on or before the due date for payment, to (with respect to Upfront Fees and Royalties) the Ministers address for service or bank account or such other address notified to the Lessee by the Lessor, at the direction of the Minister in writing and to (with respect to Rent) the Lessor's address for service or bank account or such other address notified to the Lessee by the Lessor ; and

(2) (except to the extent advised by the Lessor as agreed in advance by the Lessor or the Minister, as the case may be, or as otherwise required by Law) must be paid in full, without deduction or set off in respect of any amounts in dispute or any other amounts whatsoever.

16.2 If any sum paid by the Lessee to the Lessor or the Minister is subsequently determined not to have been due and payable, the Lessor will refund the amount to the Lessee, free of interest, deductions or withholdings, as soon as is reasonably practicable after such determination is made.

17. REPRESENTATIONS WARRANTIES AND COVENANTS

17.1 The Lessor represents and warrants to the Lessee that:

(1) it is duly incorporated and organised under the laws of its place of incorporation;

(2) it has corporate capacity and authorisation (internal and external) to enter into and grant this Lease;

(3) the representative signing this Lease on behalf of the Lessee is duly authorised in that behalf;

(4) it is in compliance with all its obligations under the Head Lease;

(5) it has the ability to at all times during the term of this Lease comply with its obligations under the Head Lease; and

(6) it has not Encumbered the Head Lease.

17.2 The Lessor covenants to the Lessee that:

(1) prior to commencement of operations, it will obtain and will maintain for as long as they are required, all necessary consents, permissions, leases and other authorisations of any kind required to undertake the activities that it or the Lessee (or the Lessee's Affiliate) will be undertaking or propose to undertake in the Leasehold Area (other than construction permits in connection with construction works);

(2) at all times during the term of this Lease the Lessor will comply with all applicable Laws;

(3) it will at all times during the term of this Lease comply with its obligations under the Head Lease;

(4) it will not Encumber the part of the Head Lease which corresponds to the Leasehold Area without the prior consent of the Lessee;

(5) it will immediately notify the Lessee if it breaches any of its obligations under the Head Lease and agrees that the Lessee shall have the right to cure any such breach on behalf of the Lessor if the Lessee fails to do so; and

(6) no event of default has occurred under the Head Lease and is continuing nor will an event of default result of entering into this Lease;

(7) it will surrender its portion of the Head Lease relating to the Leasehold Area in the event that Zeusford fails to effect a Change of Control of the Lessee; and

(8) it consents to the registration of this Lease in the name of the Lessee at the Land Registry.

17.3 The Lessee represents and warrants to the Lessor that:

(1) it is duly incorporated and organised under the laws of its place of incorporation;

(2) it has corporate capacity and authorisation (internal and external) to enter into and perform the terms of this Lease; and

(3) the representative signing this Lease on behalf of the Lessee is duly authorised in that behalf.

17.4 The Lessee covenants to the Lessor that:

(1) it will not take any action that would breach or cause termination of the consents, permissions, leases and other authorisations required to undertake the activities

that it will be undertaking or proposes to undertake in the Leasehold Area prior to their expiry date; and

(2) at all times during the term of this Lease, the Lessee will comply with all applicable Laws.

17.5 This Lease expressly excludes any warranty, condition or other undertaking implied at law or by custom and supersedes all previous Leases and understandings between the Parties (other than as expressly provided for in this Lease).

17.6 Each Party acknowledges and confirms that it does not enter into this Lease in reliance on any representation, warranty or other undertaking of any other Party not fully reflected in this Lease.

18. INDEMNITIES; LIMITATION OF LIABILITY AND COSTS

18.1 Subject to clause 32.1, the Lessee hereby indemnifies and agrees to keep indemnified and hold harmless the Lessor and its officers, agents and employees against all Claims arising in connection with

(1) the negligent performance of works in the Leasehold Area by the Lessee or its servants, agents, employees or contractors; or

(2) the negligent exercise of any rights or performance or non-performance of any obligations pursuant to this Lease save to the extent that such actions, loss, claims, damages, expenses and demands are directly attributable to the negligence of the Minister and/or his or her officers, agents and employees.

18.2 The indemnity in clause 18.1 shall not apply if the Lessee's failure to perform its obligations or the loss incurred by the Lessor is caused by the Lessor's failure to perform any of its obligations under this Lease, the Tripartite Agreement or the Head Lease or by the wilful misconduct or negligence of the Lessor, its officers, employees or agents or to the extent that the Lessor is entitled to receive the amount in question pursuant to any of the insurances maintained by it under this Lease. The indemnity in clause 18.1 shall not extend to any Consequential Loss suffered by the Lessor.

18.3 If the Lessor establishes or alleges breach of contract or a right to be indemnified in accordance with this Lease, the Lessor shall be under a duty to take all necessary measures to mitigate the loss which has occurred, provided that it can do so without unreasonable inconvenience or unreasonable cost.

18.4 In no event shall the Lessee, its officers, employees, or agents be liable to the Lessor (on the basis of breach of contract, indemnify, warranty or tort, including negligence and strict or

absolute liability, or breach of statutory duty or otherwise) for any matter arising out of or in connection with this Lease in respect of any Consequential Loss suffered by the Lessor. The Lessor each undertakes not to sue the Lessee, its officers, employees, agents or subcontractors in respect of such Consequential Loss.

18.5 The maximum aggregate liability of the Lessee and it's Affiliates hereunder and under the Transaction Documents shall be €45 million (excluding any Rent, Royalty and Fees payable pursuant to this lease).

19. STEP IN RIGHTS OF SECURITY HOLDERS OR LESSOR

19.1 If the Lessee is in material breach of any material obligation pursuant to this Lease, the Security Holder may give written notice to the Lessee (a **Cure Notice**) describing the obligation which has not been performed and requiring such obligation to be remedied within the period specified in the notice (which period must be reasonable having regard to the nature of the obligation which was not performed).

19.2 If the failure to perform the obligation referred to in the Cure Notice is not remedied within the period specified in such notice, the Security Holder will be entitled, subject to the provisions of Clause 19.13, to engage any personnel, execute any works and to provide and install any equipment which in the opinion of the Security Holder, acting reasonably, may be necessary to secure the performance of the relevant obligations provided that under no circumstances, shall any interference, supervision or obstruction of the Lessee's construction activities in respect of the Facilities by the Security Holder or its representatives be permitted.

19.3 The Security Holder may recover the costs and expenses of exercising all rights under clause 19.2 from the Lessee as a civil debt in any court of competent jurisdiction.

19.4 The rights under this clause 19 are without prejudice to any other remedies available to the Security Holder under this Lease or at Law.

19.5 The Security Holder acknowledges that in the event of it stepping in pursuant to clause 19.2, the Security Holder owes the Lessee a duty of care and to the extent that the Lessee suffers a loss and such loss would not have occurred if the Security Holder had not stepped in pursuant to clause 19.2, to the extent that such losses arise directly out of the breach of such duty of care, then the Security Holder will indemnify the Lessee for such losses.

19.6 Upon the expiry of the circumstances which gave rise to the step-in by the Security Holder, the Security Holder shall promptly step out and refrain from taking any further action in respect of such circumstances.

19.7 If the Security Holder does not exercise its rights of step-in within 30 days of the occurrence

of the event giving rise to such right, or within 30 days after expiry of the Cure Notice, or has failed to cure the breach of obligation within 30 days of step-in, the Lessor may give a Cure Notice to the Lessee and any Security Holder describing the obligation which has not been performed and requiring such obligation to be remedied within the period specified in the notice (which period must be reasonable having regard to the nature of the obligation which was not performed).

19.8 If the failure to perform the obligation referred to in the Cure Notice is not remedied within the period specified in such notice, the Lessor will be entitled, subject to the provisions of Clause 19.13, to engage any personnel, execute any works and to provide and install any equipment which in the opinion of the Lessor, acting reasonably, may be necessary to secure the performance of the relevant obligations provided that under no circumstances, shall any interference, supervision or obstruction of the Lessee's construction activities in respect of the Facilities by the Lessor or its representatives be permitted.

19.9 If the Lessor exercises its rights of step-in the Lessor may recover any damages payable by it to the Minister which would not otherwise be payable under any term of this Lease and the costs and expenses of exercising all rights under clause 19.8 from the Lessee as a civil debt in any court of competent jurisdiction.

19.10 The rights under this clause 19 are the sole rights of the Lessor against the Lessee for breach of these obligations.

19.11 The Lessor acknowledges that in the event of it stepping in pursuant to clause 19.8, the Lessor owes the Lessee a duty of care and to the extent that the Lessee suffers a loss and such loss would not have occurred if the Lessor had not stepped in pursuant to clause 19.8, to the extent that such losses arise directly out of the breach of such duty of care, then the Lessor will indemnify the Lessee for such losses.

19.12 Upon the expiry of the circumstances which gave rise to the step-in by the Lessor, the Lessor shall promptly step out and refrain from taking any further action in respect of such circumstances.

19.13 The Security Holder and the Lessor each acknowledge that so long as the Lessee is diligently endeavouring to operate successfully the technology used in the Facilities, each of the Security Holder and the Lessor will not exercise their rights of step-in under this clause 19.

20. TERMINATION

20.1 The Lessor may, without prejudice to any other remedies available under this Lease or at Law, terminate this Lease by notice in writing to the Lessee upon, or at any time following, the occurrence of any of the following events:

(1) where, in respect of the application for this Lease, material information has been wilfully withheld from the Lessor by the Lessee or material information provided to the Lessor by the Lessee is false or misleading in any particular;

(2) any of the Representations and Warranties of the Lessee in clause 17.3 are not true and correct in any material respect or, at any stage during the Term, any of the Representations and Warranties of the Lessee cease to be true and correct in any material respect;

(3) the occurrence of an Insolvency Event in respect of the Lessee;

(4) failure by the Lessee to pay moneys due to the Minister under this Lease by the due date for payment and such failure is not remedied within 90 days after receipt by the Lessee and any Security Holder of a notice from the Lessor requiring such failure to be remedied;

(5) any material breach or non-observance by the Lessee of any provision of this Lease or applicable Law, which is capable of being remedied and which is not remedied within 90 days after receipt by the Lessee and any Security Holder of a notice from the Lessor requiring such breach or non-observance to be remedied;

(6) any material breach or non-observance by the Lessee of any provision of this Lease or applicable Law, which is not capable of being remedied;

(7) any Assignment of this Lease or Change in Control of the Lessee otherwise than in accordance with clause 22.

20.2 The Lessee may, without prejudice to any other remedies available under this Lease or at Law, terminate this Lease by notice in writing to the Lessor upon, or at any time following, the occurrence of any of the following events:

(1) where, in respect of the application of this Lease, material information has been wilfully withheld from the Lessee by the Lessor or material information provided to the Lessee by the Lessor is false or misleading in any particular;

(2) any of the Representations and Warranties of the Lessor in clause 17.1 are not true and correct in any material respect or, at any stage during the Term, any of the Representations and Warranties of the Lessor cease to be true and correct in any material respect;

(3) the occurrence of an Insolvency Event in respect of the Lessor;

(4) an event of Force Majeure which has extended for a continuous period of 12 months, by giving the Lessor not less than 30 days notice specifying the proposed

date of termination and this Lease will terminate on the date specified in that notice;

(5) termination of the Co-Development and Implementation Agreement pursuant to a Pre-Construction Termination Event (as defined therein) or a Termination Event (as defined therein) due to the default of the Lessee.

20.3 In the event of termination of the Head Lease, the provisions of Clause 8.4 of the Tripartite Agreement shall apply.

20.4 A notice of termination under this clause must be given in accordance with clause 28.

21. RIGHTS AND OBLIGATIONS ON TERMINATION OR EXPIRY

21.1 On termination or expiry of this Lease:

(1) the Lessee must, subject to clauses 21.1(3) and 21.1(4), immediately cease all works, activities or operations in the Leasehold Area and, if required by the Lessor, vacate and deliver up the Leasehold Area or any part of the Leasehold Area to the Lessor;

(2) all rights and powers exercisable by the Lessee pursuant to this Lease will cease and determine, but without prejudice to any obligation or liability arising under any applicable Law or pursuant to this Lease (including any accrued rights or obligations which exist at the date of termination or expiry of this Lease);

(3) all Facilities located within the Leasehold Area, may, with the agreement of the Lessee become the property of the Lessor on payment of compensation equal to the market value of the plant and equipment comprising the Facilities and the Lessor will be responsible for the payment of any stamp duty and other taxes payable on such transfer;

(4) if the Lessor does not purchase the Facilities in accordance with clause 21.1(3) then the Lessee will be afforded sufficient time to remove its plant and equipment comprising the Facilities prior to vacating the Leasehold Area;

(5) any moneys paid to the Lessor under the terms of this Lease will not be repaid;

(6) where the Lease expires or is terminated by the Lessee in accordance with clause 20, neither Party will have liability to the other in respect of such termination or expiry, but rights and liabilities which have accrued prior to termination will subsist; and

(7) if the Facilities are transferred to the Lessor, the Lessee shall furnish to the Lessor all relevant information (but no information proprietary to the Lessee) relating to the development, design, installation and construction of the Facilities to allow the Lessor to complete the construction of and/or operate the Facilities and the Lessee shall also assign to the Lessor all necessary Construction and Generation Licences and any other consents required in connection with the Facilities.

22. ASSIGNMENT AND CHANGE OF CONTROL

22.1 The Lessee must not Assign any interest in this Lease other than to an Affiliate without the consent of the Lessor.

22.2 Any transaction which involves a Change in Control of the Lessee (other than a reorganisation within the General Electric group of companies) or the Lessor must have the prior written approval of the other Party.

22.3 The Lessor will not charge a fee in relation to the grant of any consent pursuant to this clause 22.

23. LESSOR'S CONSENT

23.1 Upon receipt of any application for consent or approval in accordance with this Lease, the Lessor:

(1) any decision, requirement, direction, determination, consent, agreement, permission and/or approval (or any such similar action) of the Lessor is required under this Lease, the Lessor must exercise such powers acting reasonably and must not unreasonably withhold or delay such decision, requirement, direction, determination, consent, agreement, permission and/or approval (or any such similar action) or issue such direction or grant such consent, agreement, permission and/or approval (or such similar action) subject to unreasonable conditions;

(2) will inform the Lessee of such decision in accordance with the time periods specified in this Lease, or if no such time period is specified, within a reasonable time period; and

(3) will, in the event that such decision is to refuse consent, inform the Lessee of the grounds of such refusal when giving its decision, unless precluded from doing so by Law.

23.2 Unless otherwise expressly provided in this Lease or at Law, whenever:

(1) the consent of the Lessor is required under this Lease, the Lessor will not unreasonably withhold or delay such consent or grant such consent subject to unreasonable conditions; or

(2) the Lessor is entitled to impose conditions pursuant to this Lease, the Lessor will only impose such conditions as are reasonable in the circumstances.

23.3 The Lessee acknowledges and agree that, unless the contrary intention is expressed, any approval or consent granted by the Lessor or any servant or agent of the Lessor pursuant to this Lease:

(1) is without prejudice to the Lessee's obligations under this Lease or at Law and does not relieve any Lessee from any such obligations; and

(2) does not amount to an acknowledgement by the Lessor, or any servant or agent of the Lessor that the actions to which the consent or approval relates otherwise comply with Good Industry Practice or Law.

24. FORCE MAJEURE

24.1 Except as otherwise provided by this Lease, where any Party or Parties are rendered wholly or partially incapable of performing all or any of their obligations under this Lease by reason of Force Majeure:

(1) as soon as is reasonably practicable but in any event within 10 Business Days, the Party affected by Force Majeure must notify the other Party, identifying the nature of the event, its expected duration and the particular obligations affected and must furnish reports at such intervals reasonably requested by the other Party during the period of Force Majeure;

(2) this Lease will remain in effect but that Party's obligations, except for any obligation to make payment of money and the obligations of the Lessee pursuant to clause 7.1, and the corresponding obligations of the other Party, will be suspended, provided that the suspension will be of no greater scope and no longer duration than is required by the Force Majeure;

(3) subject to full compliance with this clause 24.1, during suspension of any obligation pursuant to clause 24.1(2), the relevant Party will not be treated as being in breach of that obligation;

(4) the Party affected by the Force Majeure must use all reasonable efforts to remedy its inability to perform all or any of its obligations under this Lease by reason of Force Majeure and to resume full performance of its obligations under this Lease

as soon as is reasonably practicable;

(5) as soon as is reasonably practicable after notification of the Force Majeure, each Party will use all reasonable endeavours to consult with the other Party as to how best to give effect to their obligations under this Lease so far as is reasonably practicable during the period of Force Majeure;

(6) upon cessation of a Party's inability to perform all or any of its obligations under this Lease by reason of Force Majeure, that Party must notify the other Party and

(7) insofar as is possible, any Party affected by an event of Force Majeure must do all things reasonably practicable to mitigate the consequences of the Force Majeure.

24.2 Clause 24.1(4) will not require the settlement of any strike, walkout, lock-out or other labour dispute on terms which, in the sole judgement of the Party involved in the dispute, are contrary to its interests.

25. CONFIDENTIALITY

25.1 Subject to clause 25.2, a Recipient must keep confidential and must not disclose any Confidential Information which the Recipient receives or acquires pursuant to this Lease, other than with the consent of the Disclosing Party.

25.2 It will not be a breach of this clause 25 for a Recipient to disclose Confidential Information:

(1) to the extent required by Law; or

(2) to such of its Affiliates, employees, servants, agents, contractors or advisors who require access to such Confidential Information, provided that such Affiliates, employees, servants, agents, contractors or advisors are:

(a) made aware of the fact that the information is Confidential Information; and

(b) made aware of and bound by the obligations of Recipient under this clause 25.

25.3 For the avoidance of all doubt, the Parties acknowledge that this Lease is a public document and that it will not be a breach of clause 25 for either Party to disclose this Lease to any person.

26. WRITTEN PUBLIC STATEMENTS

26.1 Unless prevented from doing so by Law or the rules of any Stock Exchange, the Lessee must

not without the prior written consent of the Lessor issue any written public statement in connection with this Lease.

27. DISPUTE RESOLUTION

27.1 Subject to clause 27.10, neither the Lessor nor the Lessee may commence proceedings in relation to any Dispute in connection with this Lease without first complying with the provisions of this clause 27.

27.2 Either the Lessor or the Lessee may notify the other Party of the occurrence or discovery of any item or event which the notifying Party acting in good faith considers to be a Dispute under or in connection with this Lease (**Dispute Notice**).

27.3 A Dispute Notice must:

(1) set out the particulars of the issues in dispute in sufficient detail and be accompanied by sufficient supporting documentation (if relevant) to enable the recipient or recipients of the notice to fully understand the Dispute; and

(2) identify an individual to represent that Party in discussions in relation to the Dispute, such individual to have:

(a) expertise or experience in the subject matter of the Dispute; and

(b) authority to negotiate in relation to the Dispute.

27.4 Any recipient of a Dispute Notice must, within 20 Business Days after the date of the Dispute Notice:

(1) appoint an individual to represent that recipient in discussions in relation to the Dispute, such individual to have:

(a) expertise or experience in the subject matter of the Dispute; and

(b) authority to negotiate in relation to the Dispute; and

(2) notify the details of that individual to the sender of the Dispute Notice.

27.5 The nominated representatives must meet as soon as practicable, but in any event not more than 20 Business Days after the date of the Dispute Notice, to attempt in good faith using all reasonable endeavours to resolve the Dispute satisfactorily.

27.6 If a Dispute is not resolved to any Party's satisfaction by the nominated representatives under clause 27.5 within 50 Business Days after the date of the Dispute Notice, the Dispute may, by

notice in writing by any Party to each other Party to the Dispute, be referred for Arbitration in accordance with clause 27.7.

27.7 The following provisions will apply with respect to any Dispute which is referred for Arbitration pursuant to clause 27.6:

(1) The Dispute will be determined by a single arbitrator appointed by agreement between the Parties.

(2) The Parties to the Dispute must meet and, acting in good faith, endeavour to agree upon an arbitrator as soon as is reasonably practicable, but in any event no later than 5 Business Days after the date of the notice under clause 27.6.

(3) Failing agreement on the appointment of an arbitrator within the timeframe set out in clause 27.7(2), the arbitrator will be appointed at the request of any Party, after giving notice in writing to the other Party to the Dispute, by the President for the time being of the Law Society of Ireland.

(4) The provisions of the *Arbitration Acts 1954 and 1998* will apply to the Arbitration.

(5) The language of the Arbitration will be English and, unless otherwise agreed by both Parties, the place of the Arbitration will be Dublin, Ireland.

(6) The Parties will be entitled to call witnesses and will have the right of cross examination.

27.8 Notwithstanding anything else in this clause 27, a person will not be appointed as an arbitrator other than with the prior written consent of all Parties to the Dispute, if that person:

(1) is an employee or agent of:

(a) the Lessee or the Lessor;

(b) the Government of Ireland or any County or political sub-division of Ireland; or

(c) any Department or agency of the Government of Ireland or any County or political sub-division of Ireland;

(2) is otherwise connected with a Party to the Dispute; or

(3) for any reason may be obliged to or may expect favours from a Party to the Dispute.

27.9 Performance of obligations under this Lease will continue during any Dispute Resolution

Procedure pursuant to this clause 27.

27.10 Nothing in this clause 27 prevents any Party from seeking urgent declaratory, injunctive or other interlocutory relief.

28. NOTICES

28.1 Unless this Lease expressly provides otherwise, all notices and communications concerning this Lease will be in writing, in the English language and addressed as follows:

Sure Partners Limited,
8\10 Rock Hill,
Main Street,
Blackrock,
Co. Dublin.

Attention: The Company Secretary

Telephone: + 353 1 288 8333
Facsimile: + 353 1 2831729

Lessor's Bank Account Details for payment of Rent:

Sort Code: 901028
Account No: 14007334

Minister's Bank Account Details for payment of Upfront Fees and Royalties:

and

Arklow Energy,
Toughers Industrial Park,
Unit 1,
Newhall,
Naas,
Co. Kildare

Attention: Thomas Egan
Telephone: + 353 45440301
Facsimile: + 353 45440399
E-mail: Thomas.egan@ps.ge.com

28.2 A Party may change its address for service at any time by notice in writing to the other Party.

28.3 Notices will be deemed served or delivered to the addressee or its office:

(1) if delivered by hand, upon the date of delivery;

(2) if delivered by pre-paid ordinary post within Ireland, 2 Business Days after sending;

(3) if delivered by pre-paid ordinary post outside Ireland, 5 Business Days after sending; or

(4) if delivered by facsimile, at the time that a transmission report is produced by the sender's facsimile machine confirming that the transmission has been satisfactorily completed or, if the transmission report is produced by the sender's facsimile machine other than between 9.00am and 5.00pm on a Business Day at the place of receipt, the notice will be deemed to have been delivered at 9.30am on the following Business Day at the place of receipt.

28.4 The Lessee will notify the Lessor of all payments made to the Minister hereunder.

29. WAIVER

29.1 A waiver of a right or power under this Lease is of no force and effect unless it is given in accordance with clause 28.

29.2 No delay, omission or forbearance by a Party in enforcing a power or right under this Lease will be deemed a waiver of that Party's right to enforce that power or right.

29.3 Any single or partial exercise of any power or right shall not preclude any future exercise of that power or right.

29.4 Any waiver of a power or right in a particular instance will not constitute a future waiver of that power or right in any other circumstance or in any way limit a Party's future ability to exercise that power or right.

30. VARIATION

30.1 No amendment to this Lease will be effective unless it is in writing and signed by both Parties.

31. RELATIONSHIP OF PARTIES

31.1 Nothing in this Lease may be interpreted or construed as creating any agency, association, joint venture or partnership between the Parties.

31.2 No Party has any right, power or authority to enter into any agreement or undertaking for, act on behalf of or otherwise bind the other Party.

32. COSTS AND EXPENSES

32.1 Each Party will pay their own costs and expenses associated with the preparation, negotiation and execution of this Lease.

32.2 The Lessee must pay and discharge all taxes, assessments, duties, charges, impositions and other moneys payable which are now or may in the future be charged or imposed in connection with:

(1) this Lease;

(2) the Lessee's use and or occupancy of the Leasehold Area;

(3) any electricity generated pursuant to this Lease;

(4) any other operations carried out pursuant to this Lease; and

(5) any security provided pursuant to this Lease.

32.3 For the avoidance of all doubt, any amounts quoted in this Lease are exclusive of Value Added Tax.

33. FURTHER ASSURANCE

33.1 Each Party shall afford to the other Party such co-operation, and shall do, execute, acknowledge and deliver, and will cause to be done, executed, acknowledged and delivered, all such further acts, deeds, assignments, transfers, conveyances, notices, powers of attorney and assurances, at the request and costs of the other Party, without limitation, as shall reasonably be required in order to give the Party making the request the full benefit of the rights, powers and obligations under the terms of this Lease including, without limitation, registration of this Lease in the name of the Lessee at the Land Registry or Registry of Deeds.

34. SEVERABILITY

34.1 If any provision of this Lease is or becomes or is declared invalid, unenforceable or illegal by the courts of any jurisdiction to which it is subject or by order of the relevant body of the European Union, that provision will be severed and the remainder of this Lease will remain in full force and effect.

34.2 As soon as is reasonably practicable, but in any event no more than 25 Business Days after a provision of this Lease becomes or is declared invalid, unenforceable or illegal, the Parties must meet and use all reasonable endeavours to agree terms which, to the maximum extent possible, return each of the Parties to the position that they would have been in had the provision not been or not become invalid, unenforceable or illegal.

34.3 The Parties must comply with this Lease as amended in accordance with this clause 34.

35. SURVIVAL OF CLAUSES

35.1 Notwithstanding any other provision of this Lease, clauses 8, 10, 11, 16, 17, 18, 19, 20, 21, 23, 24, 22, 23, 24, 25 and 27 to 37, inclusive will survive termination of this Lease.

36. COUNTERPARTS

36.1 This Lease may be executed in any number of counterparts and the counterparts together will form one and the same Deed.

37. GOVERNING LAW

37.1 This Lease will be governed and construed in accordance with the laws of Ireland.

37.2 The Parties hereby submit irrevocably to the exclusive jurisdiction of the courts of Ireland.

IN WITNESS WHEREOF this Lease has been executed and as Deed and the Parties hereto have hereunto set their hands and affixed their Seals the day and year first herein written.

PRESENT when the Common Seal of
Sure Partners Limited
was affixed hereto:

PRESENT when the Common Seal of
Arklow Energy
was affixed hereto:

SIGNED, SEALED AND DELIVERED for and on behalf of ARKLOW ENERGY LIMITED by its lawfully appointed attorney James Lowe in the presence of

WITNESS:

CLODAGH CURRAN
A & L GOODBODY SOLICITORS
IFSC
NORTH WALL QUAY
DUBLIN 1

OCCUPATION: SOLICITOR

SCHEDULE 1

LEASEHOLD AREA

That part of the area known as the Arklow Banks delineated in the attached drawings.

SCHEDULE 2

THE SPECIFICATIONS

1. The colour of the towers shall be grey (RAL 7035);

2. Unless the prior written consent of the Lessor, on the instruction of the Minister, is obtained, blade tips must be a minimum of 20 metres above Sea Level and towers, including that part of the foundation above Sea Level, must not exceed 100 meters in height above Sea Level;

3. The *subsea/underwater cables* shall not be covered with PVC.

4. All turbines used to hold Class 1 or Class S certifications, or such other certifications approved by the Lessor, on the instruction of the Minister from time to time, from one of the following recognised test houses.

- Germanischer Lloyd Wind (Germany)
- Det Norske Veritas (DNV) Norway (with Risoe in Denmark)
- Underwriter's Laboratories with National Renewable Energy Laboratory (USA)
- Centre of Renewable Energy Sources in Greece
- Certification Institute Wind Energy (CIWI) – the official Dutch certification body;

or from such other certifying body as may be acceptable to the Lessor, on the instruction of the Minister from time to time, in respect of the design, type, and product and, where appropriate certification of components. If deemed appropriate by the certifying body, th Lessor, on the instruction of the Minister may accept site-specific certification of the turbines ana components. A copy of the certificates to refer will be provided to the Minister prior to the commencement of any work on the site;

5. All turbines erected in the Leasehold Area must be of uniform external design and appearance unless otherwise approved by the Lessor, on the instruction of the Minister;

6. All foundations must be in either monopole steel, steel tripod or concrete caisson design; and

The foundation type and method of construction must be agreed in advance with the Lessor, on the instruction of the Minister prior to construction of the foundations.

SCHEDULE 3

UP-FRONT FEES

Due date for payment of Up front Fees	€ (Euro)
1st November 2003	11,500
1st November 2004	23,000
1st November 2005	46,000
1st November 2006	92,000

SCHEDULE 4

SPECIAL CONDITIONS

1. No work shall take place within or which may impact on any SAC, SPA or NHA without the express written consent of Duchas and any such work shall at all times be subject to such terms and conditions as my be required by Duchas for the protection of such SAC, SPA or NHA.

2. All working areas at sea shall be marked in accordance with the requirements of the International Association of Marine Aids to Navigation and Lighthouse Authorities and the requirements of the Marine Voyage System as determined by the Commissioners of Irish Lights.

3. Working vessels shall handle all wastes in accordance with IMO requirements or equivalent.

4. All potential pollutants shall be stored in suitable containers, such as bunded containers in order to minimize the risk of pollution.

5. All waste and/or litter, including potential pollutants produced during construction and/or operation of the wind farm shall be stored and returned to shore for authorized disposal at suitable facilities.

6. Any accidental pollution of the marine environment shall be immediately reported to the Irish Coast Guard and to any other local authorities who are likely to be affected by such pollution.

7. Noise levels shall be maintained at such a level that no noise above 45 decibels can be recorded onshore between the hours of 20:00 and 08:00 daily.

8. All electromagnetic emissions shall meet with the requirements of European Standards EN55011 and EN61000.

9. Suitable type of boat or aircraft landing facilities to allow safe access and egress to be provided to a design approved by the Department of the Marine and Natural Resources.

10. Each structure erected must be provided with scour protection to the satisfaction of the Department of the Marine and Natural Resources. *GE to acquire approval.*

11. Construction of the wind farm shall be subject to the employment of a marine archaeologist or archaeologists licensed by Duchas to monitor all works during all stages of construction

including cable laying.

12. If cable laying through seed mussel beds cannot be avoided it shall not take place between 1 June and 30 September of any year and, in any event, shall be subject to prior consultation with and the agreement of Bord Iascaigh Mara.

13. Each cable route, including cables within the wind farm, shall be subject to an Archaeological survey prior to the commencement of cable laying or associated activities.

14. The landfall zone shall be subject to an inter-tidal assessment prior to commencement of trenching procedures or associated works..

15. Backfill or trenches shall be performed in such a manner as to restore, insofar as is feasible, the seabed to its original state cable trenches shall be restored to their pre-construction level with a material of a similar particle size to that disturbed.

16. All cables must be buried to a depth of not less than 2 metres.

17. Cables should, insofar as is feasible, avoid sensitive or high bio-diversity habitats.

18. Insofar as is feasible, cables should avoid the habitats associated with *Sabellaria sp.* and where disturbed efforts should be made to restore habitats to their condition prior to disturbance.

19. Co-ordinates of all Facilities must be provided to the Lessor, the IAA, Commissioners of Irish Lights, Irish Coast Guard, British Admiralty (Taunton) and any other bodies nominated by the Lessor from time to time, within 30 days after the commencement of construction and/or installation of such Facilities. Such co-ordinates to be provided in a manner to be agreed between the Lessee prior to commencement of construction.

20. The design and construction of any helipads will be subject to the written agreement of the IAA which must be copied to the Lessor prior to construction beginning and this lease will be subject to the Lessee complying with any and all conditions or instructions applied by or given by the IAA.

21. A site specific Health and Safety Statement for the construction of the wind farm must be provided to the Lessor and the National Authority for Occupational Safety and Health (sometimes referred to as the Health and Safety Authority) before commencement of work but the acceptance by the Lessor of such a statement will not be implied as being acceptance by the State of the suitability of the Statement having regard to the requirements of Health and Safety legislation for the time being in force.

22. During construction and/or installation of Facilities, no more than 500 metres of trench will be open at any time without the prior written consent of the Lessor.

23. No turbine may be installed without the prior written approval of the Lessor in relation to the location of the turbine, having regard to the geophysical characteristics of the sea bed at the proposed location of the turbine.

SCHEDULE 5

FORM OF AUDITORS CERTIFICATE

[Date]

To: Attention: Pamela Walsh
Zeusford Limited,
Clonard,
National Management Centre,
Sandyford,
Dublin 16.

Dear Madam

AUDITORS CERTIFICATE

For the purposes of calculating the Royalties payable under the provisions of the Foreshore Lease dated [*] between Sure Partners Limited and Arklow Energy Limited., we have reviewed the accounts of Arklow Energy Limited and hereby certify that, in our opinion, the Revenues set out in the attached schedule are true and correct, for the purposes of calculating the Rent payable by the Lessee, in the relevant assessment period.

SIGNED: (Auditor's name and address.)

DATED:

ARKLOW ENERGY LIMITED
Toughers Industrial Park, Unit 1C, Newhall, Naas, County Kildare
Company Number: 369950

Sure Engineering Limited,
29 Lower Leeson Street,
Dublin 2

20 June, 2003

Re: Fees

Dear Sirs,

Arklow Energy Limited, as lessee (the "Lessee") under the Foreshore Sub-Lease, made between Sure Partners Limited and the Lessee dated 20th of June, 2003 (the "Lease"), **HEREBY AGREES** to pay to Sure Engineering Limited, the fee referred to below annually in arrears, in respect of each year of the Lease, such payment to be made no later than the date which is three calendar months after the end of each year. The fee which is payable by the Lessee to Sure Engineering Limited shall be 0.25% of all Net Revenues (as described below). Net Revenues shall mean for the purpose of this letter all revenues associated with operations in the Leasehold Area, (as further defined in Schedule 1 of the Lease), including revenues derived from generation of electricity, green credits or advertising (but excluding Value Added Tax) less any amounts paid to Sure Partners Limited or any of its affiliates which are received by Arklow Energy under the Alternative Energy Requirement programme.

SIGNED for and on behalf of Arklow Energy Limited

By its lawfully appointed attorney: ...JAMES LOWE..... James D Lowe

In the presence of : ...Elizabeth.....Bradley

Date:.....

ACKNOWLEDGED AND AGREED for and on behalf of Sure Engineering Limited:

By:.....

Date:.....

M-439703-2

An Roinn Cumarsáide,
Mara agus Acmhainní Nádúrtha
Baile Átha Cliath 2.

Department of Communications,
Marine and Natural Resources
Dublin 2.

MS53/1/L V3

16 July 2003

Mr Martin Quinn
Airtricity
National Management Centre
Clonard
Sandyford
DUBLIN 16

Dear Martin,

I am pleased to confirm that it is now in order to commence construction on the Arklow Banks Wind Farm Project- Phase 1 (7 x 3.6 MW).

May I wish every success to this project and to all involved with it.

Yours sincerely

Tom Burke
Assistant Principal
Coastal Zone Management Division

Leeson Lane, Dublin 2
Lána Chill Mochargán
Baile Átha Cliath 2

Telephone: +353 1 678 2000
LoCall 1890 44 99 00
Fax: +353 1 678 2449

email: contact@dcmnr.gov.ie
GTN +1 18

DECOMMISSIONING AND REINSTATEMENT GUARANTEE

THIS DEED is given the 15th day of July, 2003

GIVEN BY

GENERAL ELECTRIC INTERNATIONAL Inc of Two Corporate Drive, Shelton, Connecticut 06484, USA (the "**Guarantor**")

IN FAVOUR OF

THE MINISTER FOR COMMUNICATIONS, MARINE AND NATURAL RESOURCES of Leeson Lane, Dublin 2, Ireland (the "**Minister**");

INTRODUCTION:

A. The Minister has granted the Head Lease to SPL and has consented to the grant of the Sub-Lease by SPL to the Principal, on terms and conditions set out in the Tri-partite Deed.

B. Pursuant to clause 19 of the Head Lease, SPL agreed to provide the Minister with a Decommissioning and Reinstatement Bond in respect of the performance of certain decommissioning and reinstatement obligations. Pursuant to the Tri-partite Deed, the Principal has agreed to assume the decommissioning and reinstatement obligations of SPL in respect of the area which is the subject of the Sub-Lease.

C. Pursuant to the Tri-partite Deed, the Minister has agreed to waive SPL's obligation to provide a Decommissioning and Reinstatement Bond in respect of the area which is the subject of the Sub-Lease, if and for so long as the decommissioning and reinstatement obligations of the Principal under the Tri-partite Deed are performed by the Principal and guaranteed in a manner which is acceptable to the Minister.

D. It has been agreed between the Minister, SPL, the Principal and the Guarantor that such decommissioning and reinstatement obligations of the Principal will be secured by this guarantee and indemnity from the Guarantor.

IT IS HEREBY AGREED AS FOLLOWS:

1. **DEFINITIONS AND INTERPRETATION**

1.1 In this Deed, unless the context otherwise requires:

Business Day means a day that is not a Saturday, Sunday or a public holiday in a place where an act is to be performed or a payment is to be made;

Deed means this Deed of Guarantee and Indemnity;

Default Rate means EURIBOR + 1%;

Default Amount means all amounts due by the Principal under the Relevant Obligations and not paid by the Principal on demand and then demanded from the Guarantor under this Deed;

EURIBOR means:

(a) the percentage rate per annum equal to the offered quotation which appears on the page of the Telerate Screen which displays an average rate of the Banking Federation of the European Union for the Euro (being currently page 248) for such period at or about 11.00am (Brussels time) on the quotation date for such period or, if such page or such service ceases to be available,

such other page or such other service for the purpose of displaying an average rate of the Banking Federation of the European Union agreed by the parties; or

(b) if no quotation for the Euro for the relevant period is displayed and the parties have not agreed an alternative service on which a quotation is displayed, the arithmetic mean (rounded upwards to four decimal places) of the rates at which each of the Reference Banks was offering to prime banks in the European interbank market deposits in the Euro of an equivalent amount for such period at or about 11.00am (Brussels time) on the quotation date;

Facilities has the same meaning as in the Tri-partite Deed;

Foreshore has the same meaning as in the Tri-partite Deed;

Head Lease means the lease granted by the Minister to SPL on 11 January 2002, pursuant to section 2(1) of the Foreshore Act 1933, and includes any renewal, replacement or extension of such lease;

Leasehold Area has the same meaning as in the Tri-partite Deed;

Principal means Arklow Energy Limited an Irish corporation having its registered office at Toughers Industrial Park, Unit 1C, Newhall, Naas, Co. Kildare;

Reference Banks means each of Bank of Ireland, Allied Irish Banks, p.l.c. and Ulster Bank Limited;

Relevant Obligations means all of the obligations of the Principal in relation to the decommissioning of the Facilities and the reinstatement of the Leasehold Area and, if necessary, any adjacent Foreshore and to meet any liabilities that may be incurred by the Minister or otherwise in relation to any decommissioned Facility whether pursuant to the Head Lease, the Sub-Lease, the Tri-partite Deed or otherwise, described in clauses 4 and 5.1 of the Tri-partite Deed;

SPL means Sure Partners Limited having its registered office at Main Street, Blackrock, County Dublin;

Security Amount means €8,000,000 or such other amount as may be notified by the Minister to the Principal pursuant to clause 5.6(4) of the Tri-partite Deed to be the adjusted Security Amount under the Tri-partite Deed and from the date of such notice, the Security Amount for the purposes of this Deed shall be deemed to be the amount set out in such notice;

Sub-Lease means the sub-lease of the Leasehold Area from SPL to the Principal, dated 20 June 2003, and includes any renewal, replacement or extension of such deed; and

Tri-partite Deed means the document of that name entered into between the Minister, SPL and the Principal, dated 20 June 2003, and includes any renewal, replacement or extension of such deed.

1.2 In this Deed, unless the context otherwise requires:

(a) unless otherwise defined in this Deed, capitalised terms in this Deed shall have the same meaning as in the Tri-partite Deed;

(b) other grammatical forms of defined terms will have a corresponding meaning;

(c) headings are for convenience only and do not affect interpretation;

(d) words importing persons or parties include any individual, body corporate, firm, corporation, joint venture, trust, unincorporated association, organisation or partnership and any other entity, in each case whether or not having a separate legal personality, and all references to persons includes their legal successors and permitted assignees;

(e) an act which is required to be done on a day which is not a Business Day must be done instead on the next Business Day;

(f) all monetary amounts are in euro, unless otherwise specified;

(g) "including" and similar words are not words of limitation; and

(h) a reference:

(i) to a gender includes a reference to each other gender;

(ii) to the singular includes a reference to the plural and vice versa;

(iii) to legislation, regulations, directives, orders, directions, instruments, codes or other enactments ("**enactments**") includes any orders or regulations made pursuant to enactments and any amendments, modifications or replacements to such enactments; and

(iv) in this Deed to a party or clause, is a reference to a party to or clause of, as the case may be, this Deed.

2. GUARANTEE AND INDEMNITY

2.1 In consideration of the Minister consenting to the grant of the Sub-Lease to the Principal and consenting to the variation of the Head Lease, the Guarantor hereby unconditionally and irrevocably covenants to the Minister to procure the proper performance by the Principal of the Relevant Obligations and the Guarantor hereby further unconditionally and irrevocably agrees to indemnify the Minister against all costs, penalties, fees, commissions, expenses, liabilities or claims which he may suffer or incur in carrying out or procuring the carrying out of all or any of the Relevant Obligations PROVIDED ALWAYS that the Minister shall first make a demand in writing for repayment on the Principal before making a demand in writing on the Guarantor. The Minister shall be permitted to make an immediate demand in writing hereunder in the event that the Principal fails to immediately discharge the amount demanded from it in connection with the Relevant Obligations in accordance with the terms of the Tri-partite Deed, which demand will include a copy of the demand served on the Principal.

2.2 The obligations guaranteed by this Deed include:

(a) in the case of examination or liquidation of, or the granting of court protection to, the Principal, all moneys which would at any time have been owing to the Minister by the Principal in connection with the Relevant Obligations if such examination, or liquidation or court protection had not occurred;

(b) the due performance and compliance by the Principal (but not any other party) with all of the Relevant Obligations;

(c) all interest (after as well as before any demand or judgment) to date of payment, at such rates and upon such terms as may from time to time be payable by the Principal in connection with the Relevant Obligations (or which would have been so payable but for the liquidation or other incapacity of the Principal); and

(d) all legal or other costs, charges and expenses (including taxes) properly incurred and occasioned in the enforcement or discharge of this Deed.

2.3 The Guarantor agrees as a separate and independent condition that any moneys payable as part of the Relevant Obligations which are not recoverable from the Guarantor pursuant to this Deed (whether by reason of any legal limitation, disability or incapacity on or of the Principal or any other reason or circumstance whether known or not to the Minister or the Guarantor) will nevertheless be recoverable (on a full indemnity basis) from the Guarantor as principal debtor and will be paid by it on demand in writing from the Minister, if there has been a demand made first upon the Principal under the Tri-partite Deed for such moneys and the Principal has failed to pay such moneys to the Minister.

2.4 The provisions of clause 2.3 apply irrespective of any indulgence granted by the Minister from time to time and continue in effect notwithstanding any judgment or order for a liquidated sum or sums in respect of any moneys guaranteed or in respect of any amounts due under this Deed.

2.5 The Guarantor agrees as a separate and independent condition that its liability under this Deed will be as a sole and primary obligor and not be merely as surety.

2.6 The total amount recoverable hereunder from the Guarantor shall be limited to the aggregate from time to time of:

(a) the lesser of:

(i) the amount due or owing by the Principal at any time and from time to time in connection with the Relevant Obligations or the amount which the Minister, in his absolute discretion determines would have been recoverable from the Principal but for any legal limitation, disability or incapacity on or of the Principal or for any other circumstance whatsoever; and

(ii) the Security Amount;

(b) any amounts arising under clause 2.2, 2.3, 2.7 and 13.2 hereof;

(c) any default interest under clause 3.1; and

(d) any claim which the Minister may have by virtue of a breach by the Guarantor of any provision of this Deed or under any indemnity set out in this Deed;

PROVIDED HOWEVER that where the Minister determines that he has received an amount in excess of the amount of his claim, he shall refund the excess and PROVIDED FURTHER that the Minister shall first make a demand in writing for repayment on the Principal before making a demand in writing on the Guarantor. The Minister shall be permitted to make an immediate demand in writing hereunder in the event that the Principal fails to immediately discharge the amount demanded from it in connection with the Relevant Obligations in accordance with the terms of the Head Lease and/or the Tri-partite Deed, which demand will include a copy of the demand served on the Principal.

2.7 In addition to, and separate from, the Guarantee contained in clause 2.1, the Guarantor irrevocably agrees to keep the Minister fully and effectively indemnified from and against all costs, claims, charges, damages, expenses and losses (on a full and unqualified indemnity basis) whatsoever as a result of any disability, incapacity, irregularity, defect or informality in any security given by or on behalf of the Principal or any other person in respect of all or any of the liabilities guaranteed by this Deed and together with interest at the Default Rate on such sum from the date that the same was incurred or fell due to the date of payment PROVIDED ALWAYS that the

Minister shall first make a demand in writing for repayment on the Principal before making a demand in writing on the Guarantor. The Minister shall be permitted to make an immediate demand in writing hereunder in the event that the Principal fails to immediately discharge the amount demanded from it in connection with the Relevant Obligations in accordance with the terms of the Head Lease and/or the Tri-partite Deed which demand will include a copy of the demand served on the Principal.

3. **INTEREST**

3.1 Interest shall accrue on any Default Amount from the date of demand on the Guarantor until actual payment (after as well as before judgment) at the Default Rate.

4. **CONTINUING SECURITY**

4.1 This Deed shall not be considered as satisfied by any intermediate payment or satisfaction of the whole or any part of any sum or sums of money owing.

4.2 This Deed will be a continuing security and will extend to cover any moneys referred to in clause 2, which will for the time being constitute the balance due from the Principal to the Minister.

4.3 No payment, security or assurance which may be avoided under any statute and no discharge, settlement or release given or made on the faith of any such payment, security or assurance will prejudice the right of the Minister to recover to the full extent of this Deed and the liability of the Guarantor for the amount of money which is due from the Principal to the Minister on each day will be deemed to be a new debt or liability first accruing on such day.

4.4 Should any moneys, liabilities, interest or other sum not be recoverable from the Guarantor under the terms of this Deed for any reason whatsoever, including:

(a) any legal disability or incapacity of the Principal;

(b) any invalidity or illegality in the incurring of such liabilities on the part of the Principal;

(c) any want of authority in any person purporting to act on behalf of the Principal;

(d) any provision of bankruptcy or insolvency law;

(e) the passage of time under any relevant Act;

(f) any moratorium or any statute decree or requirement of any governmental or other authority in any territory where the Principal is incorporated, resides or carries on business; or

(g) any inability of the Principal to acquire or effect payment in the currency in which such moneys or liabilities or other sums are denominated or to effect payment in the place where such moneys or liabilities or other sums are or are expressed to be payable,

then, whether any such reason or circumstances will have been made known to the Minister or not before the liabilities were incurred, such moneys and liabilities will nevertheless be recoverable from the Guarantor as though it were principal debtor in respect of an equivalent amount and will be paid by the Guarantor forthwith on demand in writing provided a demand has been served first on the Principal and it has failed to immediately pay the sum demanded.

4.5 The Guarantor waives all or any of its rights as surety which may at any time be inconsistent with any of the provisions of clause 4.4.

5. WAIVER OF DEMAND

5.1 For the avoidance of doubt, the Minister is not obliged before making demand under this Deed:

(a) to take any action or obtain judgment against the Principal in any court;

(b) to prove any demand made on the Principal;

(c) to make or file any claim in the insolvency of the Principal; or

(d) to exercise diligence against the Principal under the Tri-partite Deed,

PROVIDED ALWAYS HOWEVER that the Minister shall first make a demand for repayment on the Principal under the Tri-partite Deed before making a demand hereunder on the Guarantor. The Minister shall be permitted to make an immediate demand in writing hereunder in the event that the Principal fails to immediately discharge the amount demanded, which demand will include a copy of the demand served on the Principal.

6. INDULGENCE

6.1 Subject to the provisions of clause 2.7 and subject to the terms of the Tri-partite Deed, the Minister may at all times, without the assent or knowledge of the Guarantor, without prejudice to this Deed and without discharging or in any way prejudicing or affecting the Guarantor's liability pursuant to this Deed, or being accountable for any loss occasioned thereby:

(a) amend or modify the Head Lease and/or the Tri-partite Deed in accordance with their terms;

(b) grant to the Principal or any other person any time or indulgence;

(c) deal with, exchange, release, modify, or neglect or forebear to perfect or enforce any securities or other guarantees or rights (including payment of any moneys) which the Minister may now or at any time have from or against the Principal or another person PROVIDED ALWAYS that the Minister shall first make a demand in writing for repayment on the Principal before making a demand in writing on the Guarantor. The Minister shall be permitted to make an immediate demand in writing hereunder in the event that the Principal fails to immediately discharge the amount demanded from it in connection with the Relevant Obligations in accordance with the terms the Tri-partite Deed, which demand will include a copy of the demand served on the Principal;

(d) compound with, give time for the payment of any moneys, accept compositions from, or make any other arrangement with, the Principal or with any other person or guarantor; or

(e) do or omit to do anything which but for this provision might operate to exonerate or discharge the Guarantor from any of its obligations.

6.2 This Deed will not be discharged nor affected by anything which would not have discharged or affected the Guarantor's liability if the Guarantor had been principal debtor to the Minister instead of Guarantor.

7. FAILURE TO TAKE SECURITY

7.1 The liability of the Guarantor pursuant to this Deed will not be affected by:

(a) any failure by the Minister to take any security or by any invalidity of any security taken; or

(b) by any legal limitation, disability, incapacity or want of any authority of or by the Principal or of any director, manager, official or other person appearing to be acting for the Principal in any matter in respect of those liabilities.

8. NO PROOF IN COMPETITION

8.1 The Guarantor is not to be entitled as against the Minister to any right of proof in the bankruptcy or insolvency of the Principal or other right of a surety discharging his liability in respect of the principal debt, unless and until the all moneys guaranteed by this Deed are completely discharged and satisfied.

8.2 Any moneys or benefits received by the Guarantor in breach of clause 8.1 must be paid to the Minister, and pending such payment are to be held in trust for the Minister.

8.3 For the purpose of enabling the Minister to sue the Principal or prove in its insolvency for the whole of the moneys outstanding in connection with the Relevant Obligations, or to preserve intact the liability of any other person, the Minister may keep any moneys received pursuant to this Deed in a separate or suspense account to the credit of the Guarantor without any intermediate right on the part of the Guarantor to:

(a) sue the Principal;

(b) prove in competition with or so as to diminish any dividend or other advantage that would or might come to the Minister; or

(c) treat the liability of the Principal as diminished,

PROVIDED HOWEVER that once the Minister has received irrevocable payment of all amounts owing to it by the Principal in connection with the Relevant Obligations and without prejudice to its rights under clause 11, all outstanding amounts in the suspense account shall be released to the Guarantor.

8.4 Until the whole of the moneys guaranteed by this Deed are completely discharged and satisfied, the Guarantor will not exercise any rights of subrogation to the rights of the Minister under the Tri-partite Deed or any security held by it or on his behalf.

9. NO COUNTER-SECURITY WITHOUT CONSENT

9.1 The Guarantor has not and must not take from the Principal, either directly or indirectly, without the consent of the Minister any promissory note, bill of exchange, mortgage, charge or other counter-security of any kind which would or might:

(a) impact on the insolvency of the Principal;

(b) to the prejudice of the Minister, increase the proofs in such insolvency; or

(c) diminish the property distributable amongst the creditors of the Principal.

9.2 If the Guarantor takes any counter-security of the type referred to in clause 9.1, or receives the benefit of such counter-security with the consent of the Minister, all moneys received in respect of such counter-security will be held on trust for the Minister as a continuing security for the fulfilment of the Guarantor's obligations under

this Deed and will be forthwith deposited by the Guarantor with the Minister for that purpose.

10. ADDITIONAL TO ALL OTHER SECURITIES

10.1 This Deed will be in addition to and will not be in any way prejudiced or affected by or merge with any collateral or other security now or at any time held by the Minister for all or any part of the moneys guaranteed by this Deed.

10.2 The liability of any person or persons not parties to this Deed for all or any part of the moneys secured by this Deed will not in any way be prejudiced or affected by this Deed.

10.3 Subject to clause 2.7, the Minister will have full power at his discretion to give time for payment to or make any other arrangement with any such other person or persons without prejudice to this Deed or any liability under this Deed.

10.4 Subject to clause 8.3, all moneys received by the Minister from the Guarantor or the Principal and all moneys received by the Minister from any other person liable to pay such moneys may be applied by the Minister to discharge amounts owing from the Principal in connection with the Relevant Obligations or the Guarantor's liabilities hereunder as the Minister may see fit.

11. RETENTION OF SECURITY

11.1 The Minister may retain this or any other security held for the Guarantor's liabilities under this Deed until it is replaced by a Decommissioning and Reinstatement Bond in accordance with clause 19 of the Head Lease, or for a period of:

(a) one month plus any statutory period during which any assurance or security given or payment made by the Guarantor under this Deed may be avoided or invalidated:

(i) after the creation of such assurance or security; or

(ii) after the repayment of all moneys that are or may become due to the Minister from the Principal in connection with the Relevant Obligations where the Minister in his absolute discretion, considers that the payment may be avoided or invalidated,

notwithstanding any release, settlement, discharge or arrangement given or made by the Minister; or

(b) if a petition is presented to a competent Court for an Order for the winding up of the Principal or the Principal commences being wound up voluntarily such longer period as the Minister considers necessary, in which event such security will be deemed to have continued to have been held as security for the payment to the Minister of all or any sums which may at any time be owing by the Guarantor, either pursuant to this Deed or as a consequence of any order made by a competent Court under any bankruptcy or company law.

11.2 No assurance, security or payment which may be avoided under any enactment relating to insolvency and no release, settlement, discharge or arrangement (including a release, settlement, discharge or arrangement of or in relation to this Deed) which may be given or made on the faith of any such assurance, security or payment will prejudice or affect the right of the Minister to recover from the Guarantor to the full extent of this Deed as if such assurance, security payment, release, settlement, discharge or arrangement (as the case may be) had never been granted, given or made where such assurance, release, settlement, discharge, security, payment or arrangement is subsequently avoided.

11.3 Any release, settlement, discharge or arrangement referred to in clause 11.2 will, as between the Minister and the Guarantor, be deemed to have been given or made upon the express condition that it will become wholly void and of no effect if the assurance, security or payment on the faith of which it was made or given is at any time avoided under any of the statutory provisions relating to insolvency or otherwise, such that the Minister will be entitled, at any time after any such avoidance, to exercise all his rights pursuant to this Deed and/or any other rights which as a consequence of this Deed he would have been entitled to exercise, but for such release, settlement, discharge or arrangement.

11.4 Subject to clause 11.5, this Deed is, and at all times will remain, the property of the Minister.

11.5 On the date on which the Minister determines, in his absolute discretion, that all amounts payable now or at any time hereafter by the Principal in connection with the Relevant Obligations have been unconditionally and irrevocably paid in full and the Principal has no further liabilities in connection with the Relevant Obligations and upon:

(a) payment of all amounts owing hereunder; and

(b) payment of all costs, charges and expenses incurred by the Minister in relation to this Deed which are referred to in clause 2.2(d) and any interest payable hereunder,

the Minister will at any time thereafter at the request and cost of the Guarantor execute and do all such acts, deeds and things that may be necessary to surrender or release the Guarantor from its obligations under this Deed and shall return this Deed marked cancelled to the Guarantor.

12. REPRESENTATIONS AND WARRANTIES

12.1 The Guarantor acknowledges at the date hereof that:

(a) it has not relied on any warranty or representation made by or on behalf of the Minister to induce it to enter into this Deed;

(b) it has made, its own independent investigation of the financial condition and affairs of the Principal at the date hereof and assessment of the creditworthiness of the Principal at the date hereof; and

(c) the Minister does not have any duty or responsibility, either now or in future, to provide it with any information or to make any investigations into the financial condition and other affairs of the Principal.

12.2 The Guarantor represents and warrants to the Minister, such warranties and undertakings to continue so long as this Deed remains subsisting, that:

(a) it is validly existing under the laws of the place of its incorporation and has the power and authority to own its own assets, to conduct its business, to enter into this Deed and to exercise its rights and perform its obligations pursuant to this Deed and, as far as it is aware (having made diligent enquiries) all consents, whether governmental or of third party creditors of the Guarantor, and all acts, conditions and things required to be obtained, done, fulfilled and performed by the Guarantor in order to:

(i) enable it lawfully to enter into, exercise its rights under and perform and comply with the obligations expressed to be assumed by it in this Deed; and

(ii) ensure that the obligations expressed to be assumed by it in this Deed are legal, valid and binding,

have been obtained, done, fulfilled and performed and it is not necessary that this Deed be filed, recorded or enrolled with any court or other authority or that any stamp, registration or similar tax be paid on or in relation to this Deed in any jurisdiction other than Ireland;

(b) all corporate and other action required to authorise its execution of this Deed and the Guarantor's performance of its obligations pursuant to this Deed has been duly taken;

(c) the Guarantor will not be required, at the date hereof, to make any deduction or withholding from any payment it may make under this Deed;

(d) the execution of this Deed by the Guarantor and the exercise of its rights and performance of its obligations pursuant to this Deed do not and will not;

(i) conflict with any agreement, mortgage, bond or other instrument to which it is a party or which is binding upon it or any of its assets;

(ii) conflict with any provisions of its Memorandum and Articles of Association or other constitutional documents and rules and regulations; or

(iii) conflict with any applicable law, regulation or official or judicial order;

(e) the claims of the Minister against it under this Deed will rank at least pari passu with the claims of all its other creditors save those whose claims are preferred solely by any bankruptcy, insolvency, liquidation or other similar laws of general application and in any proceedings taken in relation to this Deed:

(i) it will not be entitled to claim for itself or any of its assets immunity from suit, execution, attachment or other legal process; and

(ii) the choice of Irish law as the governing law of this Deed and any judgment obtained in Ireland will be recognised and enforced;

(f) the obligations expressed to be assumed by the Guarantor in this Deed are legal and valid obligations binding on it in accordance with the terms of this Deed;

(g) it has not as at the date of this Deed taken any corporate action nor have any legal proceedings been started against it for its winding-up, dissolution, administration, examination or re-organisation or for the appointment of a receiver, an examiner, administrator, administrative receiver, trustee or similar officer of it or of any or all of its assets or revenues;

(h) it is not in breach of or in default under any agreement to which it is a party or which is binding on it or any of its assets or under any statutory obligation whatsoever (including the payment of any due taxes) to any extent or in a manner which might have a material adverse effect on its ability to perform its obligations under this Deed; and

(i) no action or administrative proceeding of or before any court or agency which might have a material adverse effect on its business or financial condition has been started.

13. PAYMENTS

13.1 All sums payable by the Guarantor under this Deed must be made to the Minister:

(a) in full in such manner as the Minister may direct;

(b) in the same currency as the relative payments were due to be made by the Principal;

(c) subject to clause 13.2 free of any present or future taxes, levies, imposts, duties, charges, fees or withholdings; and

(d) without set-off or counterclaim or any restriction condition or deduction whatsoever.

13.2 If the Guarantor is compelled by law to make any deduction or withholding from any payment due under this Deed for the account of the Minister, the Guarantor must promptly pay to the Minister such additional amount as would result in the net amount received by the Minister being equal to the full amount which would have been receivable had there been no deduction or withholding.

13.3 The Guarantor hereby indemnifies the Minister against any losses or costs incurred by the Minister by reason of any failure of the Guarantor to make the deduction or withholding referred to in clause 13.2.

13.4 If, and to the extent that the Guarantor pays any additional amount under clause 13.2 and the Minister receives and retains the benefit of a refund of tax or credit against tax on its overall net income which is identified by the Minister as attributable to the tax that was so withheld or deducted, the Minister shall, to the extent that the Minister can do so in his sole opinion without prejudicing the retention of the refund or credit and without prejudice to his rights to obtain any other relief or allowance which may be available to him and to conduct his own tax affairs as he sees fit, reimburse to the Guarantor such amount as it shall determine will leave the Guarantor after reimbursement in no better or worse position than it would have been if the payment of the relevant additional amount had not been required.

14. CURRENCY

14.1 Without prejudice to the provisions of clause 13.1(b), if a payment is made by the Guarantor in a different currency from that in which the obligations to the Minister are denominated, the Guarantor's obligations to the Minister will only be satisfied to the extent that the Minister may, in accordance with normal banking procedures, on the Business Day following receipt of the different currency, purchase in the appropriate foreign exchange market, the denominated currency.

14.2 Any amounts which the Minister recovers under any judgment of any Court against the Guarantor in respect of any of the Guarantor's liabilities under this Deed (which is in a currency other than the currency in which the Principal's obligations are denominated) will as soon as is reasonably practicable be converted (if necessary) into the currency or currencies of denomination of the Principal's liabilities.

14.3 If any currency conversion pursuant to clause 14.1 or 14.2 results in an amount which is less than the liabilities of the Guarantor in the denominated currency, the Guarantor agrees as a separate obligation (which will not merge in any judgment), to indemnify the Minister against any such deficiency.

14.4 If any currency conversion pursuant to clause 14.2 results in an amount which exceeds the liabilities in the denominated currency, the Minister will return such excess to the Guarantor as soon as is reasonably practicable.

15. **NOTICES**

15.1 Any notice or demand pursuant to this Deed will be deemed to have been sufficiently given if sent by prepaid post to the registered office of the Guarantor or as agreed by the parties.

15.2 Any such notice or demand sent by post will be deemed to have reached the Guarantor at the expiration of seven days after it has been posted and will be effective notwithstanding that it has been returned undelivered and, in proving such service, it will be sufficient prove that the notice or demand was properly addressed and posted.

16. **CERTIFICATE**

16.1 A certificate in writing signed by a person authorised by of the Minister as to the amount of the Principal's liabilities to the Minister or the total amount recoverable under this Deed will be prima facie evidence for all purposes against the Guarantor, except in the case of manifest error. The Guarantor may dispute the terms of the certificate but pending resolution of any such dispute, all amounts demanded hereunder shall be paid.

16.2 The Minister need not advise the Guarantor of his dealings with the Principal or of any default by the Principal of which the Minister may have knowledge.

17. **SCHEMES OF ARRANGEMENT**

17.1 This Deed will not be discharged, nor will the Guarantor's liability be affected, by any reduction occurring in, or other arrangement being made relating to the Principal's liabilities to the Minister as a result of any arrangement or composition, made pursuant to any of the provisions of the *Companies (Amendment) Act 1990* or any analogous provisions or made pursuant to any proceedings or actions whatsoever and whether or not following the appointment of a receiver, trustee, liquidator, receiver or examiner or any similar officer to the Principal or over all or a substantial part of the assets of the Principal.

17.2 The Guarantor agrees that the amount recoverable by the Minister from the Guarantor under this Deed will be the full amount which would have been recoverable by the Minister from the Principal had no such arrangement or composition been entered into subject to any payments received by the Minister from the Principal under any such arrangement or composition.

18. **ASSIGNMENT**

18.1 The Guarantor shall not assign any interest in this Deed without the prior written consent of the Minister.

18.2 The Minister may only assign the benefit of this Deed to any emanation of the State of Ireland as a result of transfer of statutory functions and by notice in writing to the Guarantor and this Deed may be enforced by any such assignee and proceeded on in the same manner as if such assignee had been named herein instead of the Minister.

19. **WAIVER**

19.1 A waiver is of no force and effect unless it is given in writing.

19.2 No delay, omission or forbearance by a party in enforcing a power or right will be deemed a waiver of that party's right to enforce that power or right.

19.3 Any single or partial exercise of any power or right shall not preclude any future exercise of that power or right.

19.4 Any waiver of a power or right in a particular instance will not constitute a future waiver of that power or right in any other circumstance or in any way limit a party's future ability to exercise that power or right.

20. SEVERABILITY

20.1 If any provision of this Deed is or becomes or is declared invalid, unenforceable or illegal by the courts of any jurisdiction to which it is subject or by order of the relevant body of the European Union, that provision will be severed and the remainder of this Deed will remain in full force and effect.

20.2 As soon as is reasonably practicable, but in any event no more than 10 Business Days after a provision of this Deed becomes or is declared invalid, unenforceable or illegal, the parties must meet and use all reasonable endeavours to agree terms which, to the maximum extent possible, return each of the parties to the position that they would have been in had the provision not been or not become invalid, unenforceable or illegal.

20.3 The parties must comply with this Agreement as amended in accordance with this clause 20.

21. COUNTERPARTS

21.1 This Deed may be executed in any number of counterparts and the counterparts together will form one and the same Deed.

22. GOVERNING LAW

22.1 This Deed will be governed and construed in accordance with the laws of Ireland.

22.2 The parties hereby submit irrevocably to the non-exclusive jurisdiction of the courts of Ireland.

IN WITNESS whereof this Deed has been executed and delivered the day and year first herein **WRITTEN.**

EXECUTED AS A DEED by)
GENERAL ELECTRIC INTERNATIONAL Inc)
in the presence of:)

Karen Haus
Signature of Witness

Karen Haus
Name of Witness

4204 Wild wood Parkway, Atlanta, GA 30339
Address of Witness

Executive Administrator
Occupation of Witness

Steven Zwolinski
Vice President

PRESENT when the Official Seal of the Minister)
for Communications, Marine and Natural)
Resources was affixed and was authenticated)
by the Signature of:)

Signature of Witness

Tom Burke
Name of Witness

Dept. Comms. Marine & Natural Resources
Address of Witness

Civil Servant
Occupation of Witness

Joe Ryan CÉCILE BEAUPRÉ
A person authorised under Section 15(1) of the *Ministers and Secretary's Act, 1924* to authenticate the seal of the Minister.

COVER NOTE

MARSH

THIS IS NOT AN INSURANCE POLICY
Please examine this document carefully including the security and advise us immediately if it is incorrect or does not meet your requirements.

Marsh Ltd
Client & Market Services for
MARINE & ENERGY PRACTICE

GE WIND ENERGY LLC
13000 JAMESON ROAD
TEHACHAPI, CA 93581
USA

FOR ATTN: JANE GIBBS

Date: 29th May 2003

OUR REF: STEPHEN WENT

Please always quote this No: HJ401603 / 1

In accordance with your instructions we have arranged cover as follows:

TYPE: ERECTION ALL RISKS AND THIRD PARTY LIABILITY INSURANCE.

POLICY FORM: J(a) and wording to be agreed by Underwriters.

ASSURED: Principal Assureds:

Arklow Energy Ltd and any financiers and/or subsidiary companies, as were, are or maybe constituted or acquired and any affiliated and/or associated and/or interrelated and/or controlled companies of the above as they now exist or may hereafter be constituted for which the Principal Insured had, has or may have the responsibility for purchasing insurance.

The Minister for Communications, the Marine and Natural Resources (the Minister) and the Lessor (being Sure Partners Ltd), their officers, servants, agents, employees, workers and contractors while they are in, on or transported to the Leasehold Area or any Facility of the Lessee.

The Principal Assured, Arklow Energy Ltd is owned 100% by G E Arklow Energy BV which is in turn owned 1% by G E Wind Inc and 99% by G E Energy Inc.

Other Assureds:

G E Wind GmbH and/or G E Rental Ireland and/or Project Managers and/or Contractors and/or Sub-Contractors and/or Manufacturers and/or Suppliers, Vendors, Licensors, Engineers and Consultants for their respective rights and interests.

MARSH

CONTINUATION SHEET
Page 2 of 11

Attaching to and forming part of Cover Note No: HI401603 / 1

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PERIOD:

Sections 1 and 2

To cover the period of installation, which is scheduled to start on the 19th May 2003 or date to be agreed by Underwriters with expected completion 17th December 2003 insuring in respect of each part, item or portion of the property insured herein which is at risk of an Assured at inception or which becomes at risk of an Assured after inception and shall cover continuously thereafter until completion of the last part item or portion of the property insured herein, or until attachment of separate operating insurance(s).

Subject also to 12 months discovery concurrent with maintenance period that appli[illegible] from provisional acceptance and commencement of operational insurance(s) expected not beyond 17th December 2003 or extensions to be agreed by Underwriters. Additional premium to be agreed by Underwriters.

INTEREST:

Design, Engineering, Fabrication, Construction, Load out, Transit/Tows, Installation, Cable-laying, tie-ins, hook-up, pre-commissioning, testing and all work in connection with the Arklow Bank Wind Park.

Section 1

'All Risks' of physical loss or physical damage in respect of the Arklow Bank Wind Park property as scheduled plus removal of Wreck / Debris and Sue and Labour.

Section 2

Third Party Legal and Contractual Liabilities.

SUM INSURED/ LIMIT - (100%):

Section 1

EUR 39,307,982 being the estimated insurable contract value (ECV) in respect of Phase I.

Plus additional amounts for Removal of Wreck/Debris, Sue and Labour and other coverages as per wording.

Escalation, Sue and Labour and Removal of Wreck/Debris subject to an additional limit of 25% each but not to exceed 50% of Final Contract Value in total.

Section 2

EUR 15,000,000 any one occurrence.

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DEDUCTIBLES (100%):

Section 1

a) EUR 250,000 each and every occurrence not included in b) below.

b) EUR 150,000 each and every occurrence in respect of all cargo and transit movements, other than tows or transits of completed items to offshore site, and all onshore grid extension, switch station installation, onshore cabling and associated maintenance.

Section 2

EUR 100,000 each and every occurrence in respect of Third Party Liability but nil in excess of applicable Contractors underlying policy.

LOCATION:

Worldwide in respect of all property and materials destined for the Arklow Bank Wind Park, offshore Arklow, Eire.

CONDITIONS APPLICABLE TO ALL SECTIONS:

All terms, clauses and conditions as per wording to be agreed to by Underwriters and based on WindCAR 2003.
LEG2/96 Consequences Defect Exclusion as attached.
Additional Work Clause as attached.
Stand-By Charges Clause as attached.
Series Loss Clause as attached.
Offshore Cancellation Cost Clause as attached.
Tests, Leak And/Or Damage Search Costs Clause, Stand-by Charges, Offshore Cancellation Costs and Forwarding Charges Clause each limited to EUR1,500,00 each and every occurrence and EUR3,000,000 in the aggregate.
Warranty Surveyor scope of work as attached.
Warranty Surveyor for blade shipments from Brazil is Ewing International, affiliated with Cargo Solutions.
Warranty Surveyor Fee 2.5% of net premium as incurred, subject receipts.
Premium in respect of Sections 1 and 2 due within 60 days of inception.
In respect of Offshore operation only, Addendum 42B Buy-back to apply, attached – paramount provision deleted.
Subject to Irish law and jurisdiction.
Institute Extended Radioactive Contamination Exclusion Clause CL 356A, attached.
Institute Chemical, Biological, Bio-Chemical, Electromagnetic Weapons and Cyber Attack Exclusion Clause CL 365, attached.
Premium Payment Clause LSW 3000 (60/30) as attached.
Manufacturer's Warranty as attached.

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The Assured may cancel this policy ab initio within 60 days of inception, subject to no losses within this 60 day period in the event that the project is cancelled or delayed due to events beyond the control of the Assured and in the event that no exposure has attached hereunder.

PREMIUM/ RATES: As per worksheet attached. Premiums applicable in respect of Sections 1 and 2 are Adjustable on Final Contract Values.

INFORMATION: Arklow Bank Underwriting Information Pack dated 12th May 2003 deemed exhibited herewith and containing the following documents:

Risk Overview,
Project Schedule and
Turbine Location map.

SEVERAL LIABILITY NOTICE: The subscribing insurers' obligations under contracts of insurance to which they subscribe are several and not joint and are limited solely to the extent of their individual subscriptions. The subscribing insurers are not responsible for the subscription of any co-subscribing insurer who for any reason does not satisfy all or part of its obligations.

HEREON: 100.000000%

Signing Schedule

14.062500%	Lloyd's Underwriter Syndicate No. 0510 KLN
14.062500%	Lloyd's Underwriter Syndicate No. 0457 WTK
14.062500%	Lloyd's Underwriter Syndicate No. 1225 AES
4.687500%	Lloyd's Underwriter Syndicate No. 2623 AFB
4.687500%	Lloyd's Underwriter Syndicate No. 0623 AFB
7.031250%	Lloyd's Underwriter Syndicate No. 1183 TAL
9.375000%	Lloyd's Underwriter Syndicate No. 1209 XL
7.031250%	Lloyd's Underwriter Syndicate No. 2001 AML

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25.000000%	Commonwealth Insurance Company
100.000000%	

Authorised Signatory

The Company may place business with markets with which it or its affiliates are connected.
Also, it may have arrangements with certain markets that generate revenue to the Company based on general trading.
No representation is hereby made in relation to the financial security of insurers hereon.
Marsh Ltd conducts its general insurance activities on terms that are set out in the document "Our Business Principles and Practices".
This may be viewed on our website www.marsh.co.uk/aboutMarsh/principles.html

MARSH

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01/11/02

INSTITUTE EXTENDED RADIOACTIVE CONTAMINATION EXCLUSION CLAUSE

This clause shall be paramount and shall override anything contained in this insurance inconsistent therewith

1. In no case shall this insurance cover loss damage liability or expense directly or indirectly caused by or contributed to by or arising from

   1.1 ionising radiations from or contamination by radioactivity from any nuclear fuel or from any nuclear waste or from the combustion of nuclear fuel

   1.2 the radioactive, toxic, explosive or other hazardous or contaminating properties of any nuclear installation, reactor or other nuclear assembly or nuclear component thereof

   1.3 any weapon or device employing atomic or nuclear fission and/or fusion or other like reaction or radioactive force or matter

   1.4 the radioactive, toxic, explosive or other hazardous or contaminating properties of any radioactive matter. The exclusion in this sub-clause does not extend to radioactive isotopes, other than nuclear fuel, when such isotopes are being prepared, carried, stored, or used for commercial, agricultural, medical, scientific or other similar peaceful purposes.

CL 356 A

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CONTINUATION SHEET
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Attaching to and forming part of Cover Note No: HJ401603/1

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INSTITUTE CHEMICAL, BIOLOGICAL, BIO-CHEMICAL, ELECTROMAGNETIC WEAPONS AND CYBER ATTACK EXCLUSION CLAUSE

This clause shall be paramount and shall override anything contained in this insurance inconsistent therewith

1. In no case shall this insurance cover loss damage liability or expense directly or indirectly caused by or contributed to by or arising from

   1.1 any chemical, biological, bio-chemical or electromagnetic weapon

   1.2 the use or operation, as a means for inflicting harm, of any computer, computer system, computer software programme, computer virus or process or any other electronic system.

CL 365

MARSH

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Attaching to and forming part of Cover Note No: HJ401603 / 1

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PREMIUM PAYMENT CLAUSE

The (Re)Insured undertakes that premium will be paid in full to underwriters within 60 days of inception of this policy (or, in respect of instalment premiums, when due).

If the premium due under this policy has not been so paid to Underwriters by the 60th day from the inception of this policy (and, in respect of instalment premiums, by the date they are due) Underwriters shall have the right to cancel this policy by notifying the (Re)Insured via the broker in writing. In the event of cancellation, premium is due to Underwriters on a pro rata basis for the period that Underwriters are on risk but the full policy premium shall be payable to Underwriters in the event of a loss or occurrence prior to the date of termination which gives rise to a valid claim under this policy.

It is agreed that Underwriters shall give not less than 30 days prior notice of cancellation to the (Re)Insured via the broker. If premium due is paid in full to Underwriters before the notice period expires, notice of cancellation shall automatically be revoked. If not, the policy shall automatically terminate at the end of the notice period.

Unless otherwise agreed, the Leading Underwriter (and Agreement Parties if appropriate) are authorised to exercise rights under this clause on their own behalf and on behalf of all Underwriters participating in this contract.

If any provision of this clause is found by any court or administrative body of competent jurisdiction to be invalid or unenforceable, such invalidity or unenforceability will not affect the other provisions of this clause which will remain in full force and effect.

Where the premium is to be paid through a London Market Bureau, payment to Underwriters will be deemed to occur on the day of delivery of a premium advice note to the Bureau.

11/01
LSW3000

WINDCAR 2003 – GE Arklow Bank Windpark

SECTION II--LIABILITY

INSURING AGREEMENT

1. COVERAGE

Underwriters agree, subject to the limitations, terms, conditions and exclusions herein, to indemnify the Assured(s) for Ultimate Net Loss which the Assured(s) shall be obligated to pay by reason of

i. liability imposed upon the Assured(s) by law, and/or

ii. Express Contractual Liability,

for Bodily Injury or Property Damage caused by an Occurrence, provided always that the Occurrence takes place during the Project Period and arises out of the activities described in the Scope of Insurance section herein.

2. DEDUCTIBLE

Regardless of the number of:

i. Assureds under the Policy,
ii. persons or organisations who sustain Bodily Injury or Property Damage, or
iii. claims made or suits brought on account of Bodily Injury or Property Damage,

Underwriters shall only be liable for Ultimate Net Loss exceeding the Deductible set forth in Item 5 of the Declarations in respect of each and every Occurrence including expenses, liability, debris removal, uncollected accrued charges and legal fees, and/or defence charges, or all combined.

3. LIMIT OF LIABILITY

The Section II Limit of Liability stated in Item 4 of the Declarations is the limit of Underwriters' liability under Section II for all Ultimate Net Loss by reason of any one Occurrence without regard to the number of Assureds, claims or claimants. The Limit of Liability shall be reduced and may be exhausted by Ultimate Net Loss payments. Underwriters shall not be obligated to make any Ultimate Net Loss payment once the Limit of Liability is met, or upon deposit of the available Limit of Liability in a court of competent jurisdiction.

1. DEFENCE AND SETTLEMENT

Underwriters shall not be called upon to assume charge of the settlement or defence of any claim or suit brought or proceeding instituted against the Assured(s), but Underwriters shall have the right and shall be given the opportunity to associate with the Assured(s) in the defence and control of any claim, suit or proceeding relative to an Occurrence where the

claim or suit involves, or appears reasonably likely to involve amounts payable by Underwriters, in which event the Assured(s) and Underwriters shall co-operate in all things in the defence of such claim, suit or proceeding.

TERMS AND CONDITIONS
(Section II only)

1. NOTICE TO UNDERWRITERS

In the event of an Occurrence, the Assured(s) shall provide written notice to Underwriters as soon as is practicable stating the following:

(1) the specific Occurrence; and
(2) the damages which may result or has resulted from the Occurrence; and
(3) the circumstance by which the Assured(s) first became aware of the Occurrence.

In respect of Claims to which Section II, Exclusion 15 applies, the Assured(s) shall provide such notice within the timing requirements set forth in that exclusion.

2. ADMISSION OF LIABILITY

The Assured(s) shall not in any way acknowledge or admit any liability on account of any Occurrence nor settle nor negotiate the settlement of any claim or suit resulting therefrom, nor without the consent of Underwriters, incur any expense other than such immediate medical or surgical aid as is imperative at the time of the accident.

3. OTHER INSURANCE

If other valid and collectible insurance with any other insurer is available to the Assured(s) covering a loss also covered by this Section II of the Policy, other than insurance that is specifically stated to be excess of the Policy, the insurance afforded by Section II shall be in excess of and shall not contribute with such other insurance. Nothing herein shall be construed to make the Policy subject to the terms, conditions and limitations of other insurance.

4. CROSS LIABILITIES

In the event of one Assured incurring liability to any other of the Assureds, this Section II of the Policy shall cover the Assured against whom the claim is or may be made in the same manner as if separate policies had been issued to each Assured. However, the inclusion of more than one Assured hereunder shall not operate to increase the Limit of Liability.

In no case shall this Section II of the Policy provide coverage for any physical loss of or physical damage to or defects discovered in the property insured under Section I.

Coverage in respect of Other Assureds does not apply to actual or alleged liability to other contractors and/or vendors and/or suppliers for consequential loss, loss of profit or business interruption.

DEFINITIONS
(Section II only)

1. **"BODILY INJURY"** means bodily injury, sickness or disease, including death resulting therefrom (and including damages allowed for loss of services) and mental anguish, provided such injuries are accidentally sustained by any person by reason of the Assured's operations as declared hereto.

2. **"CLAIMS EXPENSES"** shall mean reasonable legal costs and other expenses incurred by or on behalf of the Assured(s) in the defence of any covered claim including attorney's fees and disbursements, investigation, adjustment, appraisal, appeal costs and expenses and pre- and post- judgement interest, excluding salaries, wages and benefits of the Assured's employees and the Assured's administrative expenses.

3. **"DAMAGES"** shall mean compensatory damages, monetary judgements, awards, and/or compromise settlements entered with Underwriters' consent, but shall not include fines or penalties, punitive damages, exemplary damages, equitable relief, injunctive relief or any additional damages resulting from the multiplication of compensatory damages.

4. **"EXPRESS CONTRACTUAL LIABILITY"** means liability that the Assured has expressly assumed prior to any Occurrence covered by this Policy in:

   a. any written contract; or
   b. any oral contract reduced to writing within 7 days after the contract is orally agreed.

5. **"OCCURRENCE"** means an accident, including continuous or repeated exposure to conditions, which results in Bodily Injury or Property Damage neither expected nor intended from the standpoint of the Assured.

6. **"PROPERTY DAMAGE"** means physical loss of or direct damage to or destruction of tangible property, including the loss of use thereof, and including the loss of use of tangible property which has not been physically injured or destroyed provided such loss of use is caused by an Occurrence during the Policy Period, and such losses are accidentally sustained by reason of the Assured's operations as declared to Underwriters.

7. **"ULTIMATE NET LOSS"** shall mean the total sum the Assured is obligated to pay as Damages, and shall include Claims Expenses in respect of claims covered under this Policy.

EXCLUSIONS
(Section II only)

The insurance afforded by Section II does not apply to actual or alleged liability:

1. arising out of operations in intentional violation of any national, international, federal or state statute or law;

2. caused by any automobile, tractor, trailer, vehicle (other than hand propelled), team, locomotive, freight cars or aircraft whilst outside confines of the contract works site. This exclusion shall not apply to any crawler type tractor, ditch or trench digger, power crane, shovel, grader, scraper and similar equipment, not subject to motor vehicle registration;

3. for Bodily Injury or Property Damage directly or indirectly occasioned by, happening through or in consequence of:

   a. war (whether declared or not), invasion, acts of foreign enemies, hostilities, civil war, rebellion, revolution, insurrection, military or usurped power or confiscation or nationalisation or requisition or destruction of property by or under the order of any government or public or local authority; or

   b. the consequence of any act for political or terrorist purposes of any person or persons whether or not agents of a sovereign power and whether or not the loss, damage or expenses resulting therefrom is accidental or intentional;

4. for indemnification of persons for damage to or loss of their tools, materials or equipment while performing operations for any Assured;

5. arising out of the use or operation of watercraft, whether owned, time chartered, bareboat chartered or operated by any Assured, or for which any Assured may be responsible other than as declared hereto;

6. to an Assured's employees, whether the Assured is liable as an employer or in any other capacity, including without limiting the generality of the foregoing any liability under any workers' compensation law, unemployment compensation law, disability benefit law, United States Longshoremen's and Harbour Workers' Compensation Act, Jones Act, Death on the High Seas Act, General Maritime Law, Federal Employers' Liability Act, or any similar laws of liabilities, and/or whether by reason of the relationship of master and servant or employer and employee or not.

7. to the spouse, child, parent, brother, sister, relative, dependent or estate of any employee of an Assured arising out of the bodily and/or personal injury to or illness or death of said employee, whether the Assured may be liable as an employer or in any other capacity whatsoever;

8. arising out of Bodily Injury to any employee of the Assured, including without limiting the generality of the foregoing any such liability for (i) indemnity or contribution whether in tort, contract or otherwise and (ii) any liability of such other parties assumed under contract or agreement;

9. of any employee of any Assured with respect to Bodily Injury to another employee of the Assured sustained in the course of such employment;

10. which any director, officer, partner, principal, employee or stockholder of the Assured may have to any employee of any Assured;

15. for Bodily Injury or Property Damage directly or indirectly caused by or arising out of seepage, pollution or contamination however caused whenever or wherever happening;

This exclusion shall not apply when the Assured has established all of the following conditions:

a. the seepage, pollution or contamination was caused by an event;

b. the event first commenced on an identified specific date during the Policy Period set out in Item 3 of the Declarations;

c. the event was first discovered by the Assured within 14 days of such commencement;

d. Underwriters received written notification of the event from the Assured within 60 days of the Assured's first discovery of the event; and

e. the event did not result from the Assured's intentional violation of any statute, rule, ordinance or regulation.

Even if the above conditions a) to e) are satisfied, this policy does not apply to any actual or alleged liability:

i. to evaluate, monitor, control, remove, nullify or clean up seeping, polluting or contaminating substances to the extent such liability arises solely from any obligations imposed by any statute, rule, ordinance, regulation or imposed by contract;

ii. to abate or investigate any threat of seepage onto or pollution or contamination of the property of a third party;

iii. for seepage, pollution or contamination of property which is or was, at any time, owned, leased, rented or occupied by any Assured, or which is or was at any time in the care, custody or control of any Assured (including the soil, minerals, water or any other substance on, in or under such owned, leased, rented or occupied property or property in such care, custody or control);

iv. arising directly out of the transportation by the Assured of oil (other than fuel or other substances used in furtherance of the Assured's operations) or other similar substances by watercraft; or

v. arising directly or indirectly from seepage, pollution or contamination which is intended from the standpoint of the Assured or any other person or organisation acting for or on behalf of the Assured;

16. for or arising out of the handling, processing, treatment, storage, disposal, dumping, monitoring, controlling, removing or cleaning-up of any waste materials or substances, or arising out of such waste materials during transportation;

17. for loss of, damage to, or loss of use of property directly or indirectly resulting from subsidence caused by sub-surface operations of the Assured;

18. for loss of or damage to sub-surface oil, gas, water, or other substance or material, or for the cost or expense of reducing to physical possession above the surface of the earth any oil, gas, water, or other substance or material, or for the cost or expense incurred or rendered necessary to prevent or minimise such loss or damage;

19. for fines, penalties, punitive or exemplary damages, including treble damages or any other damages resulting from multiplication of compensatory damages;

20. arising out of goods or products manufactured, sold, handled or distributed by the Assured or by others trading under his name, including any container thereof;

21. for damage to or loss of or loss of use of:

    i. property owned or occupied by or rented or leased to the Assured;

    ii. property used by the Assured; or

    iii. property in the care, custody or control of the Assured or over which the Assured is for any purpose exercising physical control;

21. for the costs of removal, recovery, repair, alteration or replacement of any product (or any part thereof) which fails to perform the function for which it was manufactured, designed, sold, supplied, installed, repaired or altered by or on behalf of the Assured in the normal course of the Assured's operations;

22. arising from any negligence, error or omission, malpractice or mistake in providing or failing to provide professional services, which is committed or alleged to have been committed by or on behalf of any Assured in the conduct of any of the Assured's business activities. Professional services include but are not limited to the preparation or approval of maps, plans, opinions, reports, surveys, designs or specifications and supervisory, inspection, engineering, or data processing services;

23. for Bodily Injury or Property Damage directly or indirectly arising out of: asbestos; carpal tunnel; coal dust; polychlorinated biphenyl's; methyl tertiary butyl ether; silica; benzene; lead; talc; dioxin; electromagnetic fields; pharmaceutical or medical drugs/products/substances/devices; or any substance containing such material or any derivative thereof;

24. for Bodily Injury, Property Damage or expense directly or indirectly caused by or contributed to by or arising from:

    i. ionising radiations from or contamination by radioactivity from any nuclear fuel or from any nuclear waste or from the combustion of nuclear fuel;

ii. the radioactive, toxic, explosive or other hazardous or contaminating properties of any nuclear installation, reactor or other nuclear assembly or nuclear component thereof;

iii. any weapon of war employing atomic or nuclear fission and/or fusion or other like reaction or radioactive force or matter; or

iv. radioactive contamination however caused whenever or wherever happening;

25. assumed under a warranty for the fitness or quality of the Assured's products or a warranty that work performed by or on behalf of the Assured will be done in a workmanlike manner;

MARSH

CERTIFICATE OF INSURANCE

CERTIFICATE NUMBER
NYC-001730911-01

PRODUCER
Marsh USA, Inc.
1166 Avenue of Americas
New York, NY 10036

024880-GE-EL-

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER OTHER THAN THOSE PROVIDED IN THE POLICY. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES DESCRIBED HEREIN.

COMPANIES AFFORDING COVERAGE

COMPANY A: ACE AMERICAN INSURANCE COMPANY

INSURED
General Electric Company/
GE Wind Energy GmbH
Holsterfeld 16,
48499 Salzbergen Germany

COMPANY B:

COMPANY C:

COMPANY D:

COVERAGES

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CO LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS	
	GENERAL LIABILITY				GENERAL AGGREGATE	$
	COMMERCIAL GENERAL LIABILITY				PRODUCTS - COMP/OP AGG	$
	CLAIMS MADE / OCCUR				PERSONAL & ADV INJURY	$
	OWNER'S & CONTRACTOR'S PROT				EACH OCCURRENCE	$
					FIRE DAMAGE (Any one fire)	$
					MED EXP (Any one person)	$
	AUTOMOBILE LIABILITY				COMBINED SINGLE LIMIT	$
X	ANY AUTO					
	ALL OWNED AUTOS				BODILY INJURY (Per person)	$
	SCHEDULED AUTOS					
	HIRED AUTOS				BODILY INJURY (Per accident)	$
	NON-OWNED AUTOS					
					PROPERTY DAMAGE	$
	GARAGE LIABILITY				AUTO ONLY - EA ACCIDENT	$
	ANY AUTO				OTHER THAN AUTO ONLY:	
					EACH ACCIDENT	$
					AGGREGATE	$
	EXCESS LIABILITY				EACH OCCURRENCE	$
	UMBRELLA FORM				AGGREGATE	$
	OTHER THAN UMBRELLA FORM					$
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY				WC STATU-TORY LIMITS / OTH-ER	
	THE PROPRIETOR/ PARTNERS/EXECUTIVE OFFICERS ARE: INCL / EXCL				EL EACH ACCIDENT	$
					EL DISEASE-POLICY LIMIT	$
					EL DISEASE-EACH EMPLOYEE	$
A	OTHER EMPLOYERS LIABILITY	CSZ 0301247	12/01/02	12/01/03		5,000,000

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/SPECIAL ITEMS

CERTIFICATE HOLDER

The Minister for Communications
Coastal Zone Management Division
Department of Communications Marine and Natural Resources,
Leeson Lane, Dublin 2
Attn: Tom Burke

CANCELLATION

SHOULD ANY OF THE POLICIES DESCRIBED HEREIN BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE INSURER AFFORDING COVERAGE WILL ENDEAVOR TO MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED HEREIN, BUT FAILURE TO MAIL SUCH NOTICE SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE INSURER AFFORDING COVERAGE, ITS AGENTS OR REPRESENTATIVES, OR THE ISSUER OF THIS CERTIFICATE.

MARSH USA INC.
BY: Laura M. Tesoriero Laura M. Tesoriero

MM1(3/02)

VALID AS OF: 05/28/03

SPECIAL CERTIFICATE OF INSURANCE - SPC25747

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER OTHER THAN THOSE PROVIDED IN THE POLICY. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES LISTED BELOW

COMPANIES AFFORDING COVERAGES

NAME AND ADDRESS OF INSURANCE COMPANY:

ELECTRIC INSURANCE COMPANY
152 CONANT STREET, BEVERLY, MA 01915

FOR REVISIONS, RENEWAL OR QUESTIONS ON THIS CERTIFICATE CONTACT:
STEPHEN G. PALENSCAR
152 CONANT ST.
BEVERLY, MA 01915
Phone (978) 524-5210
Fax (978) 524-5278

COMPANY LETTER	
A	ELECTRIC INSURANCE COMPANY
B	
C	
D	

NAME AND ADDRESS OF INSURED:
GE Wind Energy GmbH
Holsterfeld 16 , 48499 Salzbergen, Germany

THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

COMPANY LETTER	TYPE OF INSURANCE	POLICY NUMBER	POLICY PERIOD	LIMITS OF LIABILITY	EACH OCCURRENCE	AGGREGATE
	GENERAL LIABILITY [X] COMMERCIAL FORM [X] PREMISES-OPERATIONS [X] XCU [X] PRODUCTS/COMPLETED OPERATIONS HAZARD [X] BLANKET CONTRACTUAL INSURANCE [X] BROAD FORM PROPERTY DAMAGE [X] INDEPENDENT CONTRACTORS [X] SEPARATION OF INSUREDS [X] PERSONAL INJURY [X] OCCURRENCE FORM	N/A	N/A	BODILY INJURY AND PROPERTY DAMAGE COMBINED	N/A	N/A
	AUTOMOBILE LIABILITY [X] COMPREHENSIVE FORM [X] OWNED [X] HIRED [X] NON-OWNED	N/A	N/A	BODILY INJURY AND PROPERTY DAMAGE COMBINED	N/A	N/A
A	**EXCESS LIABILITY** [X] FOLLOWING FORM	XS 02-1	12/1/02 TO 12/1/03	BODILY INJURY AND PROPERTY DAMAGE COMBINED	$15,000,000	$15,000,000
	WORKERS COMPENSATION AND EMPLOYERS LIABILITY Includes USLS&HW and Jones Act Coverage and 'All States' Endorsement	N/A	N/A	[X] STATUTORY LIMITS	N/A	N/A
				EACH ACCIDENT	N/A	N/A
				DISEASE - POLICY LIMIT	N/A	N/A
				DISEASE - EACH EMPLOYEE	N/A	N/A

LOCATION:
REMARKS: This policy provides worldwide coverage excess of Employers Liability as provided under various policies.

CANCELLATION: SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING INSURER WILL ENDEAVOR TO MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT BELOW, BUT FAILURE TO DO SO SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE INSURER AFFORDING COVERAGE, ITS AGENTS OR REPRESENTATIVES.

NAME AND ADDRESS OF CERTIFICATE HOLDER:
The Minister for Communications, Coastal Zone Management Division, Attn: Tom Burke
Department of Communications Marine and Natural Resources,

Leeson Lane, Dublin 2

CONTRACT NO.:

DATE ISSUED: 5/23/2003

Stephen G. Palenscar

Stephen G. Palenscar
Authorized Representative

MARSH

CERTIFICATE OF INSURANCE

CERTIFICATE NUMBER
NYC-001730913-01

PRODUCER
Marsh USA, Inc.
1166 Avenue of Americas
New York, NY 10036

024880-GE-EL-

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER OTHER THAN THOSE PROVIDED IN THE POLICY. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES DESCRIBED HEREIN.

COMPANIES AFFORDING COVERAGE

COMPANY A: ACE AMERICAN INSURANCE COMPANY

INSURED
General Electric Company
GE Energy Rentals (Ireland) Limited
Toughers Industrial Park, Unit 1c
Newhall, Naas, Co. Kildare

COMPANY B:

COMPANY C:

COMPANY D:

COVERAGES

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CO LTR	TYPE OF INSURANCE	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YY)	POLICY EXPIRATION DATE (MM/DD/YY)	LIMITS	
	GENERAL LIABILITY				GENERAL AGGREGATE	$
	☐ COMMERCIAL GENERAL LIABILITY				PRODUCTS - COMP/OP AGG	$
	☐ CLAIMS MADE ☐ OCCUR				PERSONAL & ADV INJURY	$
	☐ OWNER'S & CONTRACTOR'S PROT				EACH OCCURRENCE	$
					FIRE DAMAGE (Any one fire)	$
					MED EXP (Any one person)	$
	AUTOMOBILE LIABILITY				COMBINED SINGLE LIMIT	$
	☒ ANY AUTO				BODILY INJURY (Per person)	$
	☐ ALL OWNED AUTOS				BODILY INJURY (Per accident)	$
	☐ SCHEDULED AUTOS				PROPERTY DAMAGE	$
	☐ HIRED AUTOS					
	☐ NON-OWNED AUTOS					
	GARAGE LIABILITY				AUTO ONLY - EA ACCIDENT	$
	☐ ANY AUTO				OTHER THAN AUTO ONLY:	
					EACH ACCIDENT	$
					AGGREGATE	$
	EXCESS LIABILITY				EACH OCCURRENCE	$
	☐ UMBRELLA FORM				AGGREGATE	$
	☐ OTHER THAN UMBRELLA FORM					$
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY				☐ WC STATU-TORY LIMITS ☐ OTH-ER	
	THE PROPRIETOR/ PARTNERS/EXECUTIVE OFFICERS ARE: ☐ INCL ☐ EXCL				EL EACH ACCIDENT	$
					EL DISEASE-POLICY LIMIT	$
					EL DISEASE-EACH EMPLOYEE	$
A	OTHER EMPLOYERS LIABILITY	CSZ 0301247	12/01/02	12/01/03		5,000,000

DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/SPECIAL ITEMS

CERTIFICATE HOLDER

The Minister for Communications
Coastal Zone Management Division
Department of Communications Marine and Natural Resources,
Leeson Lane, Dublin 2
Attn: Tom Burke

CANCELLATION

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MARSH USA INC.
BY: Laura M. Tesoriero Laura M. Tesoriero
MM1(3/02)
VALID AS OF: 05/28/03

SPECIAL CERTIFICATE OF INSURANCE - RSPC25748

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER OTHER THAN THOSE PROVIDED IN THE POLICY. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES LISTED BELOW

NAME AND ADDRESS OF INSURANCE COMPANY:

ELECTRIC INSURANCE COMPANY
152 CONANT STREET, BEVERLY, MA 01915

FOR REVISIONS, RENEWAL OR QUESTIONS ON THIS CERTIFICATE CONTACT:
STEPHEN G. PALENSCAR
152 CONANT ST.
BEVERLY, MA 01915
Phone (978) 524-5210
Fax (978) 524-5278

NAME AND ADDRESS OF INSURED:
GE Energy Rentals (Ireland) Limited
Toughers Industrial Park, Unit C1 , Newall , Nass , County Kildare

COMPANIES AFFORDING COVERAGES

COMPANY LETTER	**A ELECTRIC INSURANCE COMPANY**
COMPANY LETTER	**B**
COMPANY LETTER	**C**
COMPANY LETTER	**D**

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COMPANY LETTER	TYPE OF INSURANCE	POLICY NUMBER	POLICY PERIOD	LIMITS OF LIABILITY	EACH OCCURRENCE	AGGREGATE
	GENERAL LIABILITY [X] COMMERCIAL FORM [X] PREMISES-OPERATIONS [X] XCU [X] PRODUCTS/COMPLETED OPERATIONS HAZARD [X] BLANKET CONTRACTUAL INSURANCE [X] BROAD FORM PROPERTY DAMAGE [X] INDEPENDENT CONTRACTORS [X] SEPARATION OF INSUREDS [X] PERSONAL INJURY [X] OCCURRENCE FORM	N/A	N/A	BODILY INJURY AND PROPERTY DAMAGE COMBINED	N/A	N/A
	AUTOMOBILE LIABILITY [X] COMPREHENSIVE FORM [X] OWNED [X] HIRED [X] NON-OWNED	N/A	N/A	BODILY INJURY AND PROPERTY DAMAGE COMBINED	N/A	N/A
A	**EXCESS LIABILITY** [X] FOLLOWING FORM	XS 02-1	12/1/02 TO 12/1/03	BODILY INJURY AND PROPERTY DAMAGE COMBINED	$15,000,000	$15,000,000
	WORKERS COMPENSATION AND EMPLOYERS LIABILITY Includes USLS&HW and Jones Act Coverage and 'All States' Endorsement	N/A	N/A	[X] STATUTORY LIMITS	N/A	N/A
				EACH ACCIDENT	N/A	N/A
				DISEASE - POLICY LIMIT	N/A	N/A
				DISEASE - EACH EMPLOYEE	N/A	N/A

LOCATION:
REMARKS: This policy provides worldwide coverage excess of Employers Liability as provided under various policies.

CANCELLATION: SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, THE ISSUING INSURER WILL ENDEAVOR TO MAIL 30 DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT BELOW, BUT FAILURE TO DO SO SHALL IMPOSE NO OBLIGATION OR LIABILITY OF ANY KIND UPON THE INSURER AFFORDING COVERAGE, ITS AGENTS OR REPRESENTATIVES.

NAME AND ADDRESS OF CERTIFICATE HOLDER:
The Minister for Communications, Coastal Zone Management Division, Attn: Tom Burke
Department of Communications Marine and Natural Resources,

Leeson Lane, Dublin 2

CONTRACT NO.:

DATE ISSUED: 5/23/2003

Stephen G. Palenscar

Stephen G. Palenscar
Authorized Representative

ARKLOW ENERGY LIMITED
Toughers Industrial Park, Unit 1C, Newhall, Naas, County Kildare
Company Number: 369950

Seamus Taaffe
GE Audit Engagement Partner
KPMG
1 Stokes Place
St Stephen's Green
Dublin 2

Appointment of Auditors

May, 2003

Dear Sir,

We, Herman Busschots and William Lacey, who are the two Directors of the Company, **HEREBY APPOINT**, KPMG to act as the Company's auditors, effective from the date herein. Please confirm that you agree to this appointment by signing this letter and returning a copy of the enclosed letter.

SIGNED by the following being the duly authorised directors of the Company:

WILLIAM LACEY

Dated: 15th day of May, 2003

HERMAN BUSSCHOTS

Dated: 15th day of MAY, 2003

ACKNOWLEDGED AND AGREED for and on behalf of KPMG:

By: KPMG

Dated: 16th day of MAY, 2003

M-439832-1

GE WIND ENERGY

ARKLOW OFFSHORE WINDPARK

METHOD STATEMENT DECOMMISSIONING

GE Wind Energy recognize that, for all offshore wind farm developments, it is a statutory requirement to commit to fully decommission all at the end of the project's useful life. We have carried out research as how best to address this issue using current offshore techniques and equipment. Summarised below are the main components of the decommissioning process, taking into account the nature of the site at Arklow Bank.

DECOMMISSIONING of GENERATING EQUIPMENT

The decommissioning process for generating equipment (turbine components including blades, nacelle, and containerized transformer/electrical control system) will largely be the reversal of the installation process, and will be subject to the same constraints. Dismantling of the turbines themselves will require a jack-up rig/barge to ensure adequate control and to cope with the relatively high lifts and high crane hook loads. This external lifting plant will work in conjunction with the internal crane on the turbine itself.

If there is an opportunity to re-use the generating equipment at a new location, the same level of care should be applied during the dismantling process which is applied during installation. Any attempt to cut corners on procedures or equipment size during dismantling is likely to compromise safety and to impact on the condition of the generating equipment. Therefore all work should be undertaken in an entirely controlled manner, with each component being disconnected electrically and mechanically and carefully lowered onto a barge for transport away from the site.

The general methodology for carrying this out is as follows:

a) De-energise and isolate from Grid (may be undertaken in phases)
b) Remove transformer container from turbine platforms
c) Remove individual blades or rotor as complete assembly using jack-up or shear-leg barge
d) Remove nacelle including gearbox and generator
e) Remove tower sections(s)
f) Load sections onto barges for removal and tow to suitable offloading/disposal point

SUPPORT STRUCTURE DECOMMISSIONING

The preferred method for decommissioning the support structure (towers, platform, transition piece and monopile foundations) is also to remove the components in the reverse order of installation, again using the same marine and lifting equipment as used during installation. The one exception to this process pertains to the removal of the monopile foundations. These steel structures will be embedded (driven) some 20 metres into the seabed. It would not be feasible to remove the portion of these foundations which lies more than one or two metres below the seabed surface. The solution is to cut the pile off at that depth. This operation may be performed by divers and specialist remote cutting equipment. It is estimated that two teams of four divers operating underwater jetting cutters would take about 24hrs to cut off each pile, which could then be lifted out with a jack-up or shear-leg crane barge, although it is anticipated the latter would be adequate and more cost effective.

The pile can be cut-off below the sea-bed level with specialist in-pile cutting equipment that uses an underwater jet cutting technique. The inside of the pile is first cleaned out of spoil using airlift techniques and then the cutting equipment is lowered into the pile and set up to cut the tube at a pre-selected depth below the mud-line.

The general methodology for carrying this out is as follows:

a) Cut off connection piece and upper part of monopile to just below sea-bed level using high

GE WIND ENERGY

ARKLOW OFFSHORE WINDPARK

METHOD STATEMENT DECOMMISSIONING

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The general methodology for carrying this out is as follows:

a) Cut off connection piece and upper part of monopile to just below sea-bed level using high

pressure water jets operating from small support vessel
b) Use shear-leg barge to lift pile-top/connection-piece onto barge or jack-up platform.
c) Transport to offloading/disposal point.
d) Sea bed reinstatement/sweeping.
e) Diver survey, sonar etc to check sea bed

DECOMMISSIONING of SUB-SEA CABLING

Buried cable removal techniques will be to some extent dependent on the burial method used, which may vary according to sub-sea conditions along the cable route. It is considered likely that if full removal of sub-sea cables is to be achieved then decommissioning costs will be of a similar order of magnitude to installation costs.

The general methodology for carrying this out is presumed as follows:

a) Excavate cable (38kV and comms in same trench)
b) Cut into sections or spool onto cable-laying vessel
c) Transport to offloading/disposal point
d) Backfill trench, sea bed reinstatement/sweeping.
e) Diver survey, sonar etc to check sea bed

CONCLUSION

The above presents a summary that conveys that we are comfortable with the required processes of removal given today's technology. As more offshore windfarms are constructed and the offshore industry grows, we anticipate that these processes and the way in which we address them will become even more conventional and efficient.

GE WIND ENERGY

ARKLOW OFFSHORE WINDPARK

METHOD STATEMENT EROSION PROTECTION

Index

1. General

GE Wind Energy will install seven wind turbines on the Arklow Bank, near the town of Arklow, County Wicklow, approximately 10 km from the shore at a water depth of four to ten meters.

This project takes into consideration an installation of turbines mounted on foundations of mono-pile structures.

Due to the foreseen changes to the existing current profile when installing these types of foundations, erosion protection around the piles will be necessary.

This proposed method describes our selected equipment and methods to fulfil this part of the job to satisfy both technical and environmental requirements.

The design of the proposed scour protection scheme is the result of extensive physical model testing at the hydraulic laboratory of HR Wallingford in Wallingford, Berkshire, UK.

2. Quantities foreseen by GE Wind

Assumptions:

- Water depth: 4-10 m
- max current: 0,9 m/s for excavation and installation
- max current at Arklow Bank may exceed 1.0 m/s approx 40% of the time during installation period

The foreseen erosion protection in the reference project can be summarized and interpreted as follows:

1/ Excavation of 1.0 m under slope 1 on 2 (30 degrees)

2/ Filter/armor layer with typical D_{50} = 200 mm
Thickness = 1.0 m
Diameter on top of layer = 25 m (radiating 10m outward from 5.0m diameter foundation wall)
Slope 1 on 2

This layer will be installed before piling of the monopile. The assumption is that this layer can be installed, and the monopile installed through it, without damage during the summer months.

3/ Access channel for pile n° 5:

Excavation of an area of 50 m by 60 m, 2.5 m deep under slope 1 over 2 (30 degrees)

The stone- dredging volumes taken into consideration in our calculations are as follows:

Excavation : Theoretical volume : 491 m³ per foundation and on foundation n° 5: 7.500 m³. Total excavation approx 11,000 m³.

- Filter/armor layer :
    - Theoretical volume: 491 m³ / foundation

3. Mobilisation / demobilisation of equipment and personnel

A small crane vessel is mobilized to the site to excavate the bottom at the wind turbine locations.

The dedicated side-dumping Stone-Dumping Vessel or Hydro Soil Services, Pompei (or equivalent), will be mobilized for part of the works (installation of the filter layer). There will be no special modifications to the vessel. It will be used in its normal configuration as Dynamic Positioned Self-Discharging Rock-Dumping Vessel equipped with 4 separate stone bunker areas with 4 sliding / pushing doors. This vessel, with normal sailing crew on board when mobilising, will sail on its own propulsion to the job site.

Normal small crane vessels (small hopper barges with fixed hydraulic or cable cranes) will also be mobilised to the site to assist on the rock placing works. These crane-vessels can also been used to install the armor layer.

The supporting survey-vessel will be mobilized approx. two weeks before arrival of the Stone-Dumping Vessel.

If any additional bathymetric survey is needed of the area around each pile location, it will be performed prior to excavation.

A storage area for the stone does not need to be prepared because an existing facility in the port of Arklow, near the quay wall, may be used, or the stone will be procured from the quarry at Arklow.

The installation works will be performed working 7 days per week, 24hrs per day with intermediate demob and mob periods depending of the progression of the foundation works.

It is anticipated that each foundation location will be available for monopile pile-driving immediately upon completion of the scour protection for that turbine.

4. Transport of stones, loading / unloading

The scour protection stone material, after quality and specification final approval by GE Wind Energy, will be transported to the site, with Self-Discharging Vessels (2000-3000 tons per load). The choice of actual transported stone quantity for each load will be made at the time of transportation, depending on the weather conditions and other local conditions (such as permits, location of the final selected quarry)..

If the stone material comes from a non-local source, it is possible that the material will be unloaded temporarily stored on the quay wall at Arklow.

The same unloading set, existing of a hydraulic excavator (type CAT 375 or equivalent) and a wheel loader (type CAT 966 F or equivalent) will be used to load the rock-dumping vessel (RDV).

5. Seabed excavation

Before the installation of the erosion protection can start it may be necessary to conduct further bathymetric survey and side-scanning sonar survey of the different working areas. This work will be coordinated with and monitored by our retained archeological engineer, Mr. Donal Boland.

After the completion of the survey, if necessary, an excavation will be made by the crane vessel to a depth of 1.0 m below existing seabed level. Side slopes of one over two (30 degrees) should be stable on site until the stone dumping vessel can install the filter layer of stones. If not, then the side slopes will be made more gradual until stability is achieved. The excavated material will be deposited to the sides of the excavated areas and will not be brought to the water surface.

From previous archeological surveys, there is no indication that obstacles (wrecks and others) exist at the immediate locations of the turbine positions. If such an obstacle is discovered, then the turbine will be moved (no more than 50 m) to avoid the obstacle.

6. Installation of scour protection layer

Once the RDV is loaded to its maximum allowable capacity, the RDV will sail to the job-location. The filter layer will be installed before any other work (piling, etc.), which means there will not be any obstruction on the location. Therefore, the installation will be done by using the Dynamic Positioning System and the DGPS mounted on board (standard outfit) will be used.

Considering the maximum operating current of 0,9 m/s, it is possible that stone-dumping operations may occasionally have to wait for slack tide. Otherwise, the dumping activity is planned for around the clock.

The scour protection layer each individual turbine-location will be installed in one vessel position, as the maximum width of the stone storage is 28 m.

GE WIND ENERGY

ARKLOW OFFSHORE WINDPARK

METHOD STATEMENT
FOUNDATION AND TURBINE INSTALLATION

METHOD STATEMENT FOR INSTALLATION

A. TRANSPORTATION

Nacelle, hub and electrical container

The equipment manufactured at GE Wind Energy's factory in Salzbergen, Germany, and will be transported by truck to the port facility at Brake, Germany, for final assembly and loading onto sea transport vessels. From there they will be shipped to the Port of Rosslare, Republic of Ireland, for final staging prior to installation. Components shipped in this manner include nacelle components, container with built-in transformer and electrical equipment, hubs with built-in blade regulations, special tools and other relevant equipment.

Blades

The blades for the 104m rotor are manufactured in Brazil by TECSIS. They will be transported by road to the port of Santos, near Sao Paolo, for sea shipment to the Port of Rosslare for further assembling with the hub.

Towers

The towers are manufactured at Bladt Industries A/s, Aalborg, Denmark. They also will be transported by ship to the Port of Rosslare for final staging.

Foundations

The foundations and transition pieces are manufactured at Sif/Smulders facilities in Rohrmond, Netherlands, and Hoboken, Belgium. The steel monopile foundations will be taken from the point of manufacture on a self-propelled jack-up barge directly to their installation location on Arklow Bank. The transition pieces, including work platform and ancilliaries, will be transported on another barge to the Port of Rosslare for staging and final preparation for installation.

Submarine cables

The submarine cables between the turbines will be delivered by sea transport to the Port of Rosslare staging area in separate coils for each run. The cables for the run between the centre wind turbine of the row of seven and the landside switch house connection will be taken directly to Arklow Bank on the cable laying ship, coiled in one length for installation directly into the seabed.

Onshore cables

The onshore cables will be supplied directly to the site by ESB and transported by road. Onshore cables will be trenched in and properly marked in accordance with Irish and ESB standards of safety and security.

Switch House

The electrical panels, switchgear, and measuring equipment are all to be supplied directly to the landside switch house for installation by a local subcontractor.

Civil works

The civil works at the switch house will be designed and installed using conventional methods at the time called for in the programme.

B. INSTALLATION

Scour Protection

Prior to beginning the installation of the foundations and turbines, a layer of stone will be placed in the area of each turbine to protect against seabed erosion caused by local hydraulic action around the foundations. This process is the topic of a separate Method Statement.

Foundation, Transition and Platform

The foundations consist of cylindrical steel monopiles, 5.3m diameter, approximately 50m in length and weighing approximately 270 tonnes. They will be driven into the seabed using a hydraulic pile-driving hammer.

The monopiles will be delivered directly to the Arklow Bank on a self-propelled jack-up barge. They will be up-ended by the barge-mounted crane and tipped into the water using a hinged guide mounted on the edge of the jack-up barge. Once set into position by the crane, the crane then will also be used to place the driving hammer adaptor, guides and the hammer itself into position. Employing a soft-start technique, the hammer will be used to drive the pile approximately 30m into the seabed. During the driving process, constant checks will be made to ensure the necessary degree of verticality is maintained.

After all seven monopile foundations are installed, the pile-driving hammer will be returned to the port for further transportation back to its owner. Then the jack-up barge will load two complete sets of remaining wind turbine components, consisting of transition pieces, towers (two sections), turbine nacelle with electrical container, and complete rotor star consisting of three turbine blades attached to the cast steel hub. These components will be installed in sequence for each turbine on the foundations under the procedure described in detail below.

The transition piece, which is the top section of the foundation consisting of a 15m-long cylinder similar to the monopile, combined with pre-assembled fabricated steel work platform, switchgear cabinet, access ladders and J-tubes, will be lifted by crane into position from the jack-up vessel. The annular space between the outer wall of the foundation and the inner wall of the transition piece will then filled with non-shrinking grout and allowed to cure for six to eighteen hours, depending on ambient temperature and humidity. Again, checks will be made to ensure a level, horizontal surface at the top of the transition piece prior to installing the tower and turbine nacelle.

Tower and Turbine

The wind turbine tower will be installed in two sections using the same crane and jack-up barge configuration as for the transition pieces. Then follows the fully

APPENDIX 3
3.CORRESPONDANCE WITH THE MARINE INSTITUTE AND ENVIRONMENTAL PROTECTION AGENCY

Marine Institute
Foras na Mara

Rinville
Oranmore
Co Galway
Tel: 091 387200

Kim Moore
Ramboll UK
Carlton House, Ringwood Road
Woodlands
GB-Southampton SO40 7HT
United Kingdom

19 February 2016

Re: Sampling and Analysis Plan – Arklow Bank Wind Farm

Dear Kim,

A proposed sampling and analysis plan is detailed below to cover plough dredging at the Arklow Bank Wind Farm.

You should give your contractor a copy of this plan. You will need to draw their attention especially to Section 3 and Section 4 to confirm that they are capable of meeting the quality assurance standards required.

If you need clarification on anything, please don't hesitate to contact me.

Best regards,

MCronin

_____

Margot Cronin
Marine Environment Chemist

1.0 Sample location and analyses required:

The following surface samples, (as listed in Table 1 below) should be taken[1]. Sample locations are shown on the chart in Figure 1 at the end of this document.

Table 1. Locations and details of proposed samples

Sample No.	Depth	Longitude (° W) *	Latitude (° N) *	Parameters for analysis
S1	Surface	-5.94341	52.79901	1, 2, 3, 4a, 4b, 4c
S2	Surface	-5.94638	52.78686	1, 2, 3, 4a, 4b, 4c, 4d, 4e, 4f, 4g
S3	Surface	-5.94973	52.77665	1, 2, 3, 4a, 4b, 4c

* Positions given in decimal degrees, WGS84S

2.0 Parameter Code:

1. Visual inspection, to include colour, texture, odour, presence of animals etc
2. Water content, density (taking into account sample collection and handling)
3. Granulometry including % gravel (> 2mm fraction), % sand (< 2mm fraction) and % mud (< 63µm fraction).
4. The following determinants in the sand-mud (< 2mm) fraction * :
   a) total organic carbon
   b) carbonate
   c) mercury, arsenic, cadmium, copper, lead, zinc, chromium, nickel, lithium, aluminium.
   d) organochlorines HCH and γ-HCH (Lindane), and PCBs (to be reported as the 7 individual CB congeners: 28, 52, 101, 118, 138, 153, 180).
   e) total extractable hydrocarbons.
   f) tributyltin (TBT) and dibutyltin (DBT)
   g) Polycyclic aromatic hydrocarbons (PAH) - Acenaphthene, Acenaphthylene, Anthracene, Benzo (a) anthracene, Benzo (a) pyrene, Benzo (b) fluoranthene, Benzo (ghi) perylene, Benzo (k) fluoranthene, Chrysene, Dibenz (a,h) anthracene, Flourene, Fluoranthene, Indeno 1,2,3 – cd pyrene, Naphthalene, Phenanthrene, Pyrene.
   h) Toxicity tests (Microtox or whole sediment bioassay) using appropriate representative aquatic species. (This requirement will depend on the results of the chemical analyses.)

[1] Further sampling and analysis, at depth if necessary, may be required in the event that problem areas of heavy contamination are identified as a result of the initial testing.

**where the gravel fraction (> 2mm) constitutes a significant part of the total sediment, this should be taken into account in the calculation of the concentrations.*

3.0 Important notes:

3.1 Details of the methodologies used must be furnished with the results. This should include sampling, sub sampling and analytical methods used for each determinant

3.2 Appropriate marine CRM are to be analysed during each batch of analyses and the results to be reported along with sample results.

3.3 The required detection limits for the various determinants are given in Table 2. below.

Table 2. Maximum limits of detection required

Contaminant	Concentration	Units (dry wt)
Mercury	0.05	mg kg^{-1}
Arsenic	1.0	mg kg^{-1}
Cadmium	0.1	mg kg^{-1}
Copper	5.0	mg kg^{-1}
Lead	5.0	mg kg^{-1}
Zinc	10	mg kg^{-1}
Chromium	5.0	mg kg^{-1}
Nickel	15	mg kg^{-1}
Total extractable hydrocarbons	10.0	mg kg^{-1}
TBT and DBT (not organotin)	0.01	mg kg^{-1}
PCB – individual congener	1.0	µg kg^{-1}
OCP – individual compound	1.0	µg kg^{-1}
PAH – individual compound	20	µg kg^{-1}

4.0 Reporting requirements

Reports should include the following information

4.1 Date of sampling

4.2 Location of samples eg ING or lat/long.

4.3 Treatment of samples and indication of sub sampling, compositing etc.

4.4 Tabulated geophysical and chemical test results

4.5 Completed excel spreadsheet for results

4.6 Summary method details

4.7 Method performance specifications: Limit of detection, Precision, Bias

4.8 Clear expression of units and indication of wet weight or dry weight basis

4.9 Blanks & in-house references to be run with each sample batch, and reported with sample results.

4.10 Appropriate Certified Reference Materials (CRM) to be run with each sample batch, and reported in full with sample results.

4.11 If determinant is not detected, report less than values, and indicate LoD/ LoQ used.

Other quality assurance information (e.g. accreditation status)

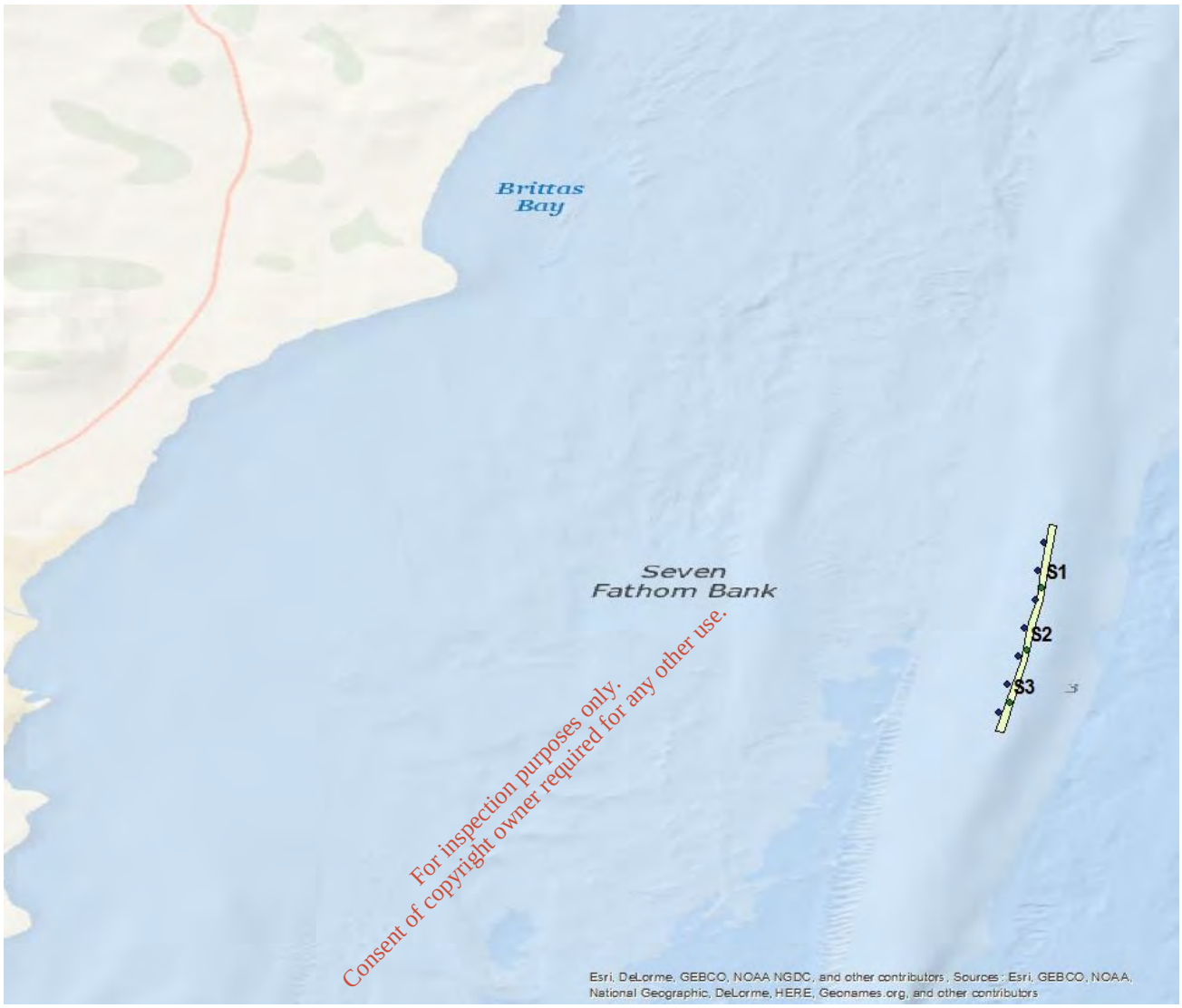


Figure 1: Sampling stations,.
Positions given in Table 1.

Kim Moore

From: Martina Nolan <M.Nolan2@epa.ie>
Sent: 19 February 2016 16:42
To: Kim Moore
Cc: Tara Higgins; Máirín O'Colmáin
Subject: Sediment Sampling Arklow - Dumping at Sea
Attachments: Arklow_Bank.pdf; dredge_area.zip

Follow Up Flag: Follow up
Flag Status: Flagged

Dear Kim,

My colleague Máirín in the Radiation Monitoring Section has advised that based on 10,000 m^3 of material as mentioned in your earlier email, 3 samples would be sufficient. This is taken from the table below.

Project size (1000m^3)		
Greater than	**Less than or equal to**	**Number of samples stations**
0	25	3
25	100	4-6
100	200	7-15
500	2000	16-30
2001	+	Extra 10 per million m^3

Table: number of sediment samples recommended for testing for dredging projects (or strata) of different sizes in OSPAR countries. These numbers assume a reasonably uniform sediment in the area to be dredged.

A sample size of about 1.2kg per sample will be required and a grab samples are fine.

The sample can be stored in any clean container and may be frozen if necessary (in the case there is a time lapse between sampling and delivery to the lab).

Cost per analysis is €302 plus vat, the ORP price list is available at http://www.epa.ie/pubs/reports/radiation/radiationmonitoringservicespricelist.html#.Vlc2pqSvm3F

If you require any further information, please do not hesitate to contact Máirín at +353 1 2680100 / 2697766 or m.ocolmain@epa.ie.

Kind Regards,
Martina

Martina Nolan,
Inspector,
Environmental Licensing Programme,
Office of Environmental Sustainability,
Environmental Protection Agency,
P.O. Box 3000,
Johnstown Castle Estate,
Co. Wexford
Y35 W821

APPENDIX 4
4.SEDIMENT CHEMISTRY RESULTS

Instructions

As part of an application for a Dumping at Sea (DAS) Permit, sediment chemistry results must be submitted using this form. When completing this form, please ensure that you:

* Complete all worksheets in full - i.e. sheets "2. Project Info", "3. Results" and "4. QA".
* Report all results in the units specified (e.g. mg kg^{-1} versus µg kg^{-1}).
* Do not alter the format of this spreadsheet by changing units, by moving columns or by inserting new columns amongst the existing used columns.
* Insert additional rows as necessary at the end of the existing rows in sheet. "3 Results"
* Insert other determinants as necessary in the empty columns to the right in sheet. "3 Results".
* Any additional information should be included as inserted comments or in the Notes column in sheet. "3 Results".
* Provide a brief description of methodology used in sheet "2. Project Info".
* Enter the measured value (as well as the certified value) for Certified Reference material in sheet "4.
* If in-house reference material is used, insert the measured value and the range normally achieved.
* Refer to the Dumping at Sea Application Form Guidance Note for further relevant information: http://www.epa.ie/downloads/forms/lic/das/name,30267,en.html

Key	
Location	Name of area e.g. Cork Harbour, Dublin Bay
CRMs	Certified reference materials used in analyses for metals, organics & TBT
Fraction analysed	Specify which fraction of sediment was analysed. < 2mm is requested, but some labs use < 63um
Analysing laboratory	Main laboratory where samples were sent to for analysis
Sub-contract lab	Sub-contracted laboratory where samples were sent by main laboratory
Sample ID code	Sample number assigned by sampler
Lab Report ID	Code assigned by analysing laboratory
Position (dd/mm.mmm)	Give lat/long coordinates in degrees & decimal minutes (dd mm.mmm) of the position where the sample was taken. List also the datum & projection.
Sampling depth (m)	The depth below the seabed surface at which the sample was collected.
<2mm	Grain size % < 2mm
<63um	Grain size % < 63mm
OC	Organic carbon (NOT organic matter)
TEH	Total extractable hydrocarbons
Cu	Copper
Zn	Zinc
Cd	Cadmium
Hg	Mercury
Pb	Lead
As	Arsenic
Cr	Chromium
Mn	Manganese
Ni	Nickel
Li	Lithium
Al	Aluminium
DBT	Dibutyl tin
TBT	Tributyl tin
Σ TBT + DBT	Sum of di-butyl tin & tri-butyl tin
Σ 7 PCB	Sum of the seven ICES polychlorinated biphenyls: PCB 028, PCB 052, PCB 101, PCB 138, BCB 153, PCB 180, PCB 118.
Σ 16 PAH	Sum of US EPA 16 polycyclic aromatic hydrocarbons: Naphthalene, Acenaphthylene, Acenaphthene, Fluorene,Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibenzo(ah)anthracene, Benzo(ghi)perylene, Indeno(123-cd)pyrene.
γ-HCH	1α,2α,3β,4α,5α,6β-hexachlorocyclohexane (Lindane)
HCB	Hexachlorobenzene

1. General Information	Applicant (company name)	Arklow Energy Limited
	Location (port/harbour)	Arklow Bank
	Dredge Quantity (tonnes)	99,999
	Permit Application Reg. No. (to be assigned by EPA)	
2. Survey Information	Survey Company	Aquatic Services Unit
	Sampling Date	25/06/2016
	Analysing Laboratory	NLS Leeds
	Sub Contract Lab	
	Analysis Date	31/05/2016
3. Methods Information	Fraction analysed	<2mm
	Water content of sample (reported as %)	yes
	Are results reported as wet weight or dry weight?	Dry Weight
	Granulometry method	Graduated Seiving Method
	TEH method	Fluorescence
	Organic carbon (OC) method	
	Metals (incl. mercury & arsenic) extraction type	Microwave aqua regia digest
	Methods of detection (metals, incl. mercury & arsenic)	ICPMS, ICPOES, and CV-AFS for Mercury
	Organics extraction types	Solvent extracted
	Methods of detection (PCBs / PAHs / TBT / DBT)	GCMS

EPA Dumping at Sea Permit Application - Material Analysis Reporting Form (Version 1.0)
Sheet 3. Results

Sample ID code	Company Name	Location	Sampling date (dd/mm/yyyy)	Sampling Location ID	Position Latitude (dd mm.mmm)	Position Longitude (dd mm.mmm)	Sampling depth m	Lab Report ID	Sample appearance (e.g. colour, texture, signs of life)	% Moisture
DP-01A	*<example> Dublin Port Co.*	*Dublin Port*	*23/08/2010*	*DP-01*	*53d 20.833m*	*06d 13.167m*	*0.2*	*20024124-1*	*Grey-black silty mud, no visible signs of life*	*56.95*
Site 1	Arklow Energy Limited	Arklow	26/05/2016	S1	52d 47.127m	06d 56.474m	20.4	20094276-1	clean sand, no visible sign of animal life	22.1
Site 2	Arklow Energy Limited	Arklow	26/05/2016	S2	52d 47.558m	06d 56.361m	20	20094276-1	clean sand, no visible sign of animal life	22.6
Site 3	Arklow Energy Limited	Arklow	26/05/2016	S3	52d 46.359m	06d 56.595m	19	20094276-1	clean sand, no visible sign of animal life	22.3

EPA Dumping at Sea Permit Application - Material Analysis Reporting Form (Version 1.0)
Sheet 3. Results

Sample ID code	Particle size >2mm %	Particle size <2mm >63um %	Particle size <63um %	OC %	TEH g kg^{-1}	Cu mg kg^{-1}	Zn mg kg^{-1}	Cd mg kg^{-1}	Hg mg kg^{-1}	Pb mg kg^{-1}	As mg kg^{-1}	Cr mg kg^{-1}	Mn mg kg^{-1}	Ni mg kg^{-1}	Li mg kg^{-1}	Al mg kg^{-1}
DP-01A	*24.8*	*12.7*	*62.5*	*1.23*	*0.0653*	*62.5*	*167*	*0.307*	*0.104*	*43*	*16.5*	*47.4*	*322*	*18.9*	*37.7*	*27000*
Site 1	0.8	95.4	3.7	15.0		0.797	9.42	0.031	0.0011	2.31	7.38	4.62		3.73	3.06	1910
Site 2	0.5	96.6	2.9	15.0	0.00204	1.06	9.86	0.025	0.0012	2.47	6.29	4.74		3.75	2.56	1750
Site 3	7	89.6	3.4	15.0		1.1	11.5	0.025	0.0011	2.95	9.47	5.75		4.92	4.3	2280

EPA Dumping at Sea Permit Application - Material Analysis Reporting Form (Version 1.0)
Sheet 3. Results

Sample ID code	DBT mg kg^{-1}	TBT mg kg^{-1}	Σ TBT + DBT mg kg^{-1}	PCB 028 ug kg^{-1}	PCB 052 ug kg^{-1}	PCB 101 ug kg^{-1}	PCB 138 ug kg^{-1}	PCB 153 ug kg^{-1}	PCB 180 ug kg^{-1}	PCB 118 ug kg^{-1}	PCB Σ7 PCB ug kg^{-1}	PAH Acenaphthene ug kg^{-1}	PAH Acenaphthylene ug kg^{-1}	PAH Anthracene ug kg^{-1}
DP-01A	*0.02*	*0.06*	*0.08*	*< 0.100*	*< 0.100*	*< 0.100*	*< 0.100*	*< 0.100*	*< 0.100*	*< 0.100*	*< 0.700*	*15.6*	*43.2*	*47.6*
Site 1														
Site 2	<0.004	<0.004	<0.008	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.7	<1	<1	<1
Site 3														

EPA Dumping at Sea Permit Application - Material Analysis Reporting Form (Version 1.0)
Sheet 3. Results

Sample ID code	PAH Benzo (a) anthracene ug kg^{-1}	PAH Benzo (a) pyrene ug kg^{-1}	PAH Benzo (b) fluoranthene ug kg^{-1}	PAH Benzo (ghi) perylene ug kg^{-1}	PAH Benzo (k) fluoranthene ug kg^{-1}	PAH Chrysene ug kg^{-1}	PAH Dibenz (a,h) anthracene ug kg^{-1}	PAH Flourene ug kg^{-1}	PAH Fluoranthene ug kg^{-1}	PAH Indeno (1,2,3–cd) pyrene ug kg^{-1}
DP-01A	*167*	*185*	*245*	*186*	*99.3*	*203*	*38.4*	*121*	*274*	*209*
Site 1										
Site 2	<1	<1	<1	<1	<1	<3	<1	<5	<1	<1
Site 3										

Sample ID code	PAH Naphthalene ug kg^{-1}	PAH Phenanthrene ug kg^{-1}	PAH Pyrene ug kg^{-1}	PAH Σ 16 ug kg^{-1}	γ–HCH (Lindane) ug kg^{-1}	HCB ug kg^{-1}	Density g ml^{-1}	<enter additional determinants as necessary>	<enter additional determinants as necessary>	Notes / comments:
DP-01A	*188*	*195*	*258*	*2475*	*0.1*	*0.6*				
Site 1							1.38			
Site 2	<5	<5	<1	<34	<0.1	<0.1	1.39			
Site 3							1.49			

Reference Type	Reference Material	OC %	TEH g kg^{-1}	Cu mg kg^{-1}	Zn mg kg^{-1}	Cd mg kg^{-1}	Hg mg kg^{-1}	Pb mg kg^{-1}	As mg kg^{-1}	Cr mg kg^{-1}	Mn mg kg^{-1}	Ni mg kg^{-1}	Li mg kg^{-1}	Al mg kg^{-1}	DBT mg kg^{-1}	TBT mg kg^{-1}
CRM (meas)				34.2	152	0.225	0.0886	19.4	21.6	87.8		45.8	68.3	60200	0.771	0.475
CRM (certified value)				33.9 +/- 1.6	159 +/-8	0.24+/- 0.01	0.091+/- 0.009	21.1 +/- 0.7	21.2 +/- 1.1	105 +/-4		46.9 +/- 2.2	73.6 +/- 5.2	85900 +/- 2300	0.770 +/- .09	0.480 +/- 0.08
Blank	Blank															
CRM (meas)																
CRM (certified value)																

Reference Type	Σ TBT + DBT mg kg^{-1}	PCB 028 ug kg^{-1}	PCB 052 ug kg^{-1}	PCB 101 ug kg^{-1}	PCB 138 ug kg^{-1}	PCB 153 ug kg^{-1}	PCB 180 ug kg^{-1}	PCB 118 ug kg^{-1}	PCB Σ7 PCB ug kg^{-1}	PAH Acenaphthene ug kg^{-1}	PAH Acenaphthylene ug kg^{-1}	PAH Anthracene ug kg^{-1}
CRM (meas)		4.28	5.55	5.18	3.62	5.06	3.2	4.18		29.9	39.4	186
CRM (certified value)		4.52 +/- 0.57	5.24 +/- 0.28	5.11 +/- 0.34	3.60 +/- 0.28	5.47 +/- 0.32	3.24 +/- 0.51	4.23 +/- 0.19		38.4 +/-5.2	53.3 +/-6.4	184 +/-18
Blank												
CRM (meas)												
CRM (certified value)												

Reference Type	PAH Benzo (a) anthracene ug kg^{-1}	PAH Benzo (a) pyrene ug kg^{-1}	PAH Benzo (b) fluoranthene ug kg^{-1}	PAH Benzo (ghi) perylene ug kg^{-1}	PAH Benzo (k) fluoranthene ug kg^{-1}	PAH Chrysene ug kg^{-1}	PAH Dibenz (a,h) anthracene ug kg^{-1}	PAH Flourene ug kg^{-1}	PAH Fluoranthene ug kg^{-1}
CRM (meas)	261	196	369	273	191	229	44.9	46.1	504
CRM (certified value)	335 +/-25	358 +/-17	453 +/-21	307 +/-45	225 +/-18	291 +/-31	48.9 +/-4.6	85 +/-15	651 +/-50
Blank									
CRM (meas)									
CRM (certified value)									

Reference Type	PAH Indeno (1,2,3–cd) pyrene ug kg^{-1}	PAH Naphthalene ug kg^{-1}	PAH Phenanthrene ug kg^{-1}	PAH Pyrene ug kg^{-1}	PAH Σ 16 ug kg^{-1}	γ–HCH (Lindane) ug kg^{-1}	HCB ug kg^{-1}	Notes / comments:
CRM (meas)	224	708	369	397		<0.1	9.51	
CRM (certified value)	341 +/-57	848 +/-95	406 +/-44	581+/-39			5.83 +/-0.38	
Blank								
CRM (meas)								
CRM (certified value)								

APPENDIX 5
5.SEDIMENT CHEMISTRY LABORATORY REPORT

Report on the chemical analyses of marine sediments from the Arklow Bank (September 2016)

Aquatic Services Unit Report on behalf of Ramboll UK (08/09/16)

Introduction & Brief

In May 2016 the Aquatic Services Unit (ASU) were commissioned by the Ramboll UK to carry out the sampling and analysis of marine sediment from 3 sites on the Arklow Banks. It is proposed to dredge a channel through the Bank to facilitate service vessels for the Wind Farm. This operation is the subject of a dumping at sea application and accordingly requires the material to be chemically analysed in advance. The analysis was undertaken on samples obtained from three sites within the proposed dredge area following the instructions and recommendations of the Marine Institute for such sampling and analysis. The sampling was undertaken by ASU personnel and the analyses were carried out at the UK Environment Agency Laboratory at Leeds and the Radiological Protection Agency of Ireland.

Methodology

Sampling and Analysis

Samples for chemical analysis were collected on May 26th, 2016 from three sites at the positions specified in the sampling and analysis plan using the Husky survey vessel. Sediment samples were collected using stainless steel Van Veen grabs (0.10 m^2 and 045m^2) which were deployed from the vessel. The grabs was washed, acid rinsed and cleaned and finally rinsed in distilled water prior to their initial use. The grabs were also thoroughly rinsed in seawater between each station on site.

Samples for metals analysis and general analysis were placed in new 500ml HDPE tubs with snap-on lids, while sediment for organics analysis were placed in laboratory supplied amber glass containers. Samples for granulometry and were placed in zip-lock plastic bags. Samples for radiological analyses were stored in clean 1litre plastic tubs.

Once the samples were collected they were stored in cooler boxes containing icepacks while in transit to the Aquatic Services Unit laboratory in Cork. Here they were stored at 4º C in a walk-in refrigerator before being subsequently being shipped in a cooler box with ice packs to the Environment Agency Laboratory in UK and to the Radiological Protection Agency in Dublin. Granulometry was measured in the ASU laboratory in UCC.

Table 1 Location and depths of sediment sampling sites on the Arklow Bank for chemical and radiological analyses. Positions are presented in Latitude/ Longitude (WGS84 Datum)

Site		Northing	Depth(m)
S1	52º 47.127’	-5 56.474’	20.4
S2	52º 47.558’	-5 56.361’	20.0
S3	52º 46.359’	-5 56.595’	19.0

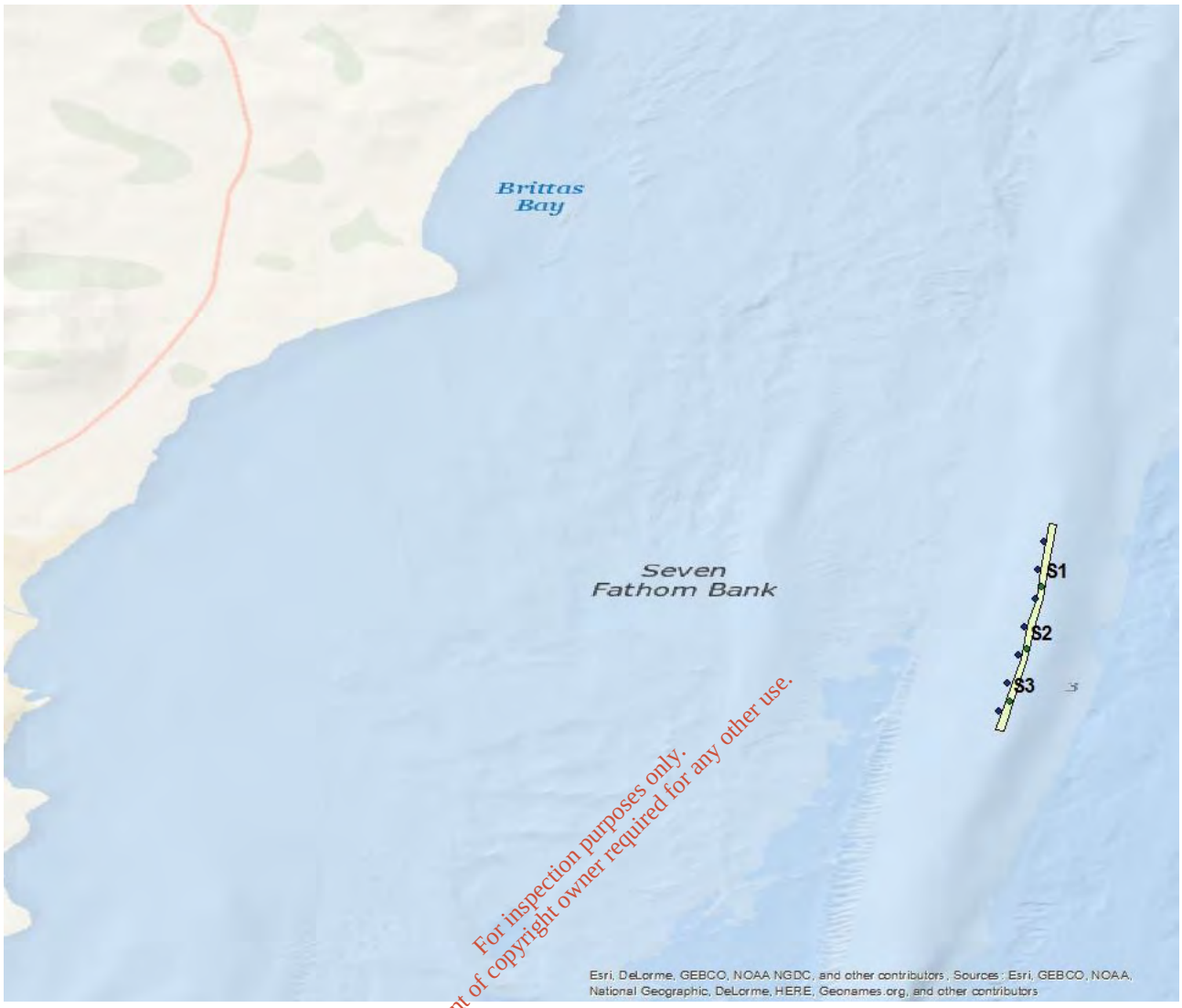


Figure 1 Scale drawing showing the Arklow bank and the 3 sampling sites labelled S1-3.

Parameters Tested

Table 2 List of Parameters measured on the >2mm fraction and detection limits requested by the Marine Institute.

Determinant	Detection Limit Required	Units	Testing Laboratory	Accreditation Status
Granulometry		% grain fractions	ASU	None
Bulk Density		g/ml	EA Leeds	None
Water Content	~	%	EA Leeds	None
TOC	~	%	EA Leeds	None
[1]Carbonate	~	%	EA Leeds	UKAS
Arsenic	1	mg/kg	EA Leeds	UKAS
Cadmium	0.1	mg/kg	EA Leeds	UKAS
Copper	5.0	mg/kg	EA Leeds	UKAS
Chromium	5.0	mg/kg	EA Leeds	UKAS
Iron	~	mg/kg	EA Leeds	UKAS
Lead	5.0	mg/kg	EA Leeds	UKAS
Mercury	0.05	mg/kg	EA Leeds	UKAS
Nickel	15	mg/kg	EA Leeds	UKAS
Tin	~	mg/kg	EA Leeds	UKAS
Zinc	10	mg/kg	EA Leeds	UKAS
TBT	0.01	mg/kg	EA Leeds	UKAS
DBT	0.01	mg/kg	EA Leeds	none
Total Extractable Hydrocarbon (tested as Mineral Oil - Ecofisk)	10	mg/kg	EA Leeds	UKAS
PCB's:				
CB 28	1	µg/kg	EA Leeds	UKAS
CB 52	1	µg/kg	EA Leeds	UKAS
CB 101	1	µg/kg	EA Leeds	UKAS
CB 118	1	µg/kg	EA Leeds	UKAS
CB 138 / 163	1	µg/kg	EA Leeds	UKAS
CB 153	1	µg/kg	EA Leeds	UKAS
CB 180	1	µg/kg	EA Leeds	UKAS
***Chlorinated pesticides:**				
DDE pp	1	µg/kg	EA Leeds	UKAS
DDT pp	1	µg/kg	EA Leeds	UKAS
DDD pp	1	µg/kg	EA Leeds	UKAS
Dieldrin	1	µg/kg	EA Leeds	UKAS
Lindane	1	µg/kg	EA Leeds	UKAS
Hexachlorobenzene	1	µg/kg	EA Leeds	UKAS

Table 2 contd:

Determinant	Detection Limit Required	Units	Testing Laboratory	Accreditation Status
PAH				
Naphthalene	20	µg/kg	EA Leeds	None
Acenaphthylene	20	µg/kg	EA Leeds	None
Acenaphthene	20	µg/kg	EA Leeds	None
Fluorene	20	µg/kg	EA Leeds	None
Phenanthrene	20	µg/kg	EA Leeds	None
Anthracene	20	µg/kg	EA Leeds	None
Fluoranthene	20	µg/kg	EA Leeds	None
Pyrene	20	µg/kg	EA Leeds	None
Benzo(a)anthracene	20	µg/kg	EA Leeds	None
Chrysene	20	µg/kg	EA Leeds	None
Benzo(b)fluoranthene	20	µg/kg	EA Leeds	None
Benzo(k)fluoranthene	20	µg/kg	EA Leeds	None
Benzo(a)pyrene	20	µg/kg	EA Leeds	None
Benzo (ghi) perylene	20	µg/kg	EA Leeds	None
Indeno (1,2,3-cd) pyrene	20	µg/kg	EA Leeds	None
Dibenzo(ah)anthracene	20	µg/kg	EA Leeds	None

Results

Sediment General Analysis and Granulometry

The results of general sediment analyses are presented in Tables 3 and granulometry results are presented in Table 4. Photographs of each sediment sample are presented in Plates 1-3.

Sediment Metal Results

Results of sediment metal analysis including those for TBT and DBT are presented in Table 5

Sediment PCB and Hexachlorobenzene results

Results of sediment analysis of PCB's and HCB are presented in Table 6

Sediment Polycyclic Aromatic Hydrocarbon (PAH) results

Results for 16 PAH's are presented in Table 7

Organochlorine Pesticides results

OCP's results are presented in Table 8.

Certified Reference Material

CRM analysis results are presented in Tables 9 (metals) & 10 respectively (organics)

Plate 1- Photograph of grab with sediment from Site 1

Plate 2- Photograph of grab with sediment from Site 2

Plate 3- Photograph of grab with sediment from Site 3

Table 3 General Sediment Chemistry – Arklow Bank (May 2016)

Sampling Sites	Water Content %	Bulk Density (Wet) g/ml	Acid Soluble Carbonate %	TOC %	HydroCarbon (mg/kg) dry wgt.
S1	22.1	1.38	15	<0.2	
S2	22.6	1.39	15	<0.2	2.04
S3	22.3	1.49	15	<0.2	

Table 4 Granulometry – Arklow Bank (May 2016)

Sampling Sites	Granulometry % Gravel >2mm	Granulometry % Sand 63µm-2mm	Granulometry % Silt/Clay <63µm
S1	0.8	95.4	3.7
S2	0.5	96.6	2.9
S3	7	89.6	3.4

Table 5 Sediment Metals & Organo-tins – Arklow Bank (May 2016)

Parameters	Units	S1	S2	S3
Aluminium	mg/kg	1910	1750	2280
Arsenic	mg/kg	7.38	6.29	9.47
Cadmium	mg/kg	0.031	0.025	0.025
Chromium	mg/kg	4.62	4.74	5.75
Copper	mg/kg	0.797	1.06	1.10
Mercury	mg/kg	0.0011	0.0012	0.0011
Lithium	mg/kg	3.06	2.56	4.30
Nickel	mg/kg	3.73	3.75	4.92
Lead	mg/kg	2.31	2.47	2.95
Zinc	mg/kg	9.42	9.86	11.5
TBT	µg/kg		<4	
DBT	µg/kg		<4	

Table 6 Sediment PCB & HCB Levels – Arklow Bank (May 2016)

PCB Congener Number	Units	S1	S2	S3
28	µg/kg	-	<0.1	-
52	µg/kg	-	<0.1	-
101	µg/kg	-	<0.1	-
118	µg/kg	-	<0.1	-
153	µg/kg	-	<0.1	-
138	µg/kg	-	<0.1	-
180	µg/kg	-	<0.1	-
180	µg/kg	-	<0.1	-
HCB	µg/kg	-	<0.1	-

Table 7 Sediment PAH levels – Arklow Bank (May 2016)

PAH	Unit	S1	S2	S3
Naphthalene	µg/kg		<5	-
Acenaphthylene	µg/kg		<1	-
Acenaphthene	µg/kg		<1	-
Fluorene	µg/kg		<5	-
Phenanthrene	µg/kg		<5	-
Anthracene	µg/kg		<1	-
Fluoranthene	µg/kg		<1	-
Pyrene	µg/kg		<1	-
Benzo(a)anthracene	µg/kg		<1	-
Chrysene	µg/kg		<3	-
Benzo(b)fluoranthene	µg/kg		<1	-
Benzo(k)fluoranthene	µg/kg		<1	-
Benzo(a)pyrene	µg/kg		<5	-
Indene(1,2,3-cd)pyrene	µg/kg		<1	-
Dibenzo(ah)anthracene	µg/kg		<1	-
Benzo(ghi)perylene	µg/kg		<1	-

Table 8 Sediment Organochlorine pesticide levels – Arklow Bank (May 2016))

OCP	Unit	S1	S2	S3
gamma-HCH(Lindane)	µg/kg		<0.1	
Hexachlorobenzene	µg/kg		<0.1	
p,p'-DDE	µg/kg		<0.1	
Dieldrin	µg/kg		<0.5	
p,p'-TDE	µg/kg		<0.1	
p,p'-DDT	µg/kg		<0.1	

Table 9 EA Laboratory Llanelli analysis results of Certified Reference Material for Metals (Marine Sediment, Mess-3) and organo-tin (BCR-646) from the Research Council of Canada and European Commission Joint Research Centre respectively.

Parameter	Test Result mg/kg	Certified value mg/kg
*Aluminium	6.02	8.59 ± 0.23
Arsenic	21.6	21.2 ± 1.1
Chromium	87.8	105 ± 4
Lead	19.4	21.1 ± 0.7
Lithium	68.3	73.6 ± 5.2
Copper	34.2	33.9 ± 1.6
Zinc	152	159 ± 8
Cadmium	0.225	0.24 ± 0.01
Mercury	0.0886	0.091 ± 0.009
Nickel	45.8	46.9 ± 2.2
TBT	475	480 ± 80

* = %

Table 10 Analysis results from the EA Lab at Llanelli of Certified Reference Material 1941(b) (International Atomic Energy Agency) for organic constituents in sediments

Parameter	Units	Certified Value	EA Laboratory Result
HCB	µg/kg	5.83 ±0.38	9.51
PCB Congener 028	µg/kg	4.52 ±0.57	4.28
PCB Congener 052	µg/kg	5.24 ±0.28	5.55
PCB Congener 101	µg/kg	5.11 ±0.34	5.18
PCB Congener 118	µg/kg	4.23 ±0.19	4.18
PCB Congener 138	µg/kg	3.60 ±0.28	3.62
PCB Congener 153	µg/kg	5.47 ±0.32	5.06
PCB Congener 180	µg/kg	3.24 ±0.51	3.20

Table 10 contd:

Analyte:	Units	Certified Value	EA Laboratory Result
Acenaphthene	ug/kg	38.4 ±5.2	29.9
Acenapthylene	ug/kg	53.3 ±6.4	39.4
Aldrin	ug/kg		<0.5
Anthracene	ug/kg	184±18	186
Benz-[A]-Anthracene	ug/kg	335 ±25	261
Benzo (B) Fluoranthene	ug/kg	453 ±21	369
Benzo (K) Fluoranthene	ug/kg	225 ±18	191
Benzo-[A]-Pyrene	ug/kg	358 ±17	196
Benzo-[GHI]-Perylene	ug/kg	307 ±45	273
Napthalene	ug/kg	848±95	708
Chrysene	ug/kg	291 ±31	229
DDE (pp')	ug/kg	3.22 ±0.28	3.09
DDT (pp')	ug/kg	1.12 ±0.42	0.348
Dibenzo(AH) anthracene	ug/kg	48.9 ±4.6	44.9
Dieldrin	ug/kg		<0.5
Fluoranthene	ug/kg	651 ±50	504
Fluorene	ug/kg	85 ±15	46.1
HCH Gamma	ug/kg		<0.1
Hexachlorobenzene	ug/kg	5.83 ±0.38	9.51
Indeno-[1,2,3-Cd]-Pyrene	ug/kg		224
Phenanthrene	ug/kg	406 ±44	369
Pyrene	ug/kg	581 ±39	397

APPENDIX 6
6.CORRESPONDANCE WITH THE OFFICE OF RADIOLOGICAL PROTECTION

Office of Radiological Protection

3 Clonskeagh Square
Clonskeagh Road
Dublin 14, D14 H424, Ireland

3 Cearnóg Cluain Sceach
Bóthar Cluain Sceach
Baile Átha Cliath 14, D14 H424, Éire

T: +353 1 268 0100
F: +353 1 268 0199
E: info@epa.ie
W: www.epa.ie

LoCall: 1890 33 55 99

Laboratory Test Report

Report Date: 12th August 2016

Samples Tested on Behalf of: Aquatic Services Unit,
Environmental Research Institute (UCC),
Lee Road,
Cork

Laboratory Analysis: High Resolution Gamma Spectrometry with appropriate density correction

Sample Type: Marine Sediment ex Arklow Bank

Date of Receipt: 31st May 2016

Date of Analysis June - July 2016

Results:

ORP Reference	Client Reference	Coordinates		Nuclide	Activity Concentration (Bq/kg, dry)[1]
		Easting	Northing		
ES1600219	ARK S1			K-40	127 ± 14
				I-131	nd
				Cs-134	nd
				Cs-137	0.14 ± 0.02
				Ra-226	4.6 ± 0.9
				Ra-228	4.6 ± 0.6

ES1600220	ARK S2	K-40	139 ± 16
		I-131	nd
		Cs-134	nd
		Cs-137	0.26 ± 0.03
		Ra-226	4.7 ± 0.9
		Ra-228	4.6 ± 0.6
ES1600221	ARK S3	K-40	135 ± 2
		I-131	nd
		Cs-134	nd
		Cs-137	0.18 ± 0.01
		Ra-226	4.9 ± 0.4
		Ra-228	4.7 ± 0.2

Note:
(1) Quoted uncertainties are ±1 SD counting statistics
(2) nd = not detected

The Office of Radiological Protection received three grab sediment samples from the Aquatic Services Unit at UCC. These samples were taken at the Arklow Bank in May 2016 in support of application for a Dumping at Sea Permit. The sample was prepared by placing an aliquot in a well-defined counting geometry and then measured on a high-resolution gamma spectrometer. Appropriate density corrections were applied to the resultant spectra to take account of the differences in sample density. Dry to wet weight ratio was determined for the samples. Results are quoted on a dry weight basis.

The results indicate that dumping of these materials at sea will not result in a radiological hazard.

Ms Lorraine Currivan
Laboratory Manager
Radiation Monitoring Section

Notes:
- **This report relates only to the samples tested.**
- **This report shall not be reproduced except in full, without the approval of the Office**
- **The following scientific officers may sign test reports on behalf of the laboratory manager: Dr Ciara McMahon, Dr Kevin Kelleher.**
- **Where applicable, the number following the symbol ± is the combined standard uncertainty and not a confidence interval.**

APPENDIX 7
7.2011 BENTHIC SURVEY REPORT

Arklow Bank Offshore Windfarm Environmental Monitoring
Benthic Ecology Survey Report

June 2011

A Report to GE Wind Energy

March 2012

Table of Contents

1. INTRODUCTION

Aquatic Services Unit, University College Cork, was requested by Island Shipping Ltd., on behalf of Arklow Energy Ltd., to undertake a benthic biological survey, as part of a post construction monitoring programme, for the Arklow Bank Offshore Windfarm. The following report outlines the work undertaken for this survey. Work for this report was undertaken on the 07th June, 2011.

The Arklow Bank Offshore Wind Farm lies 13 km east of Arklow town and consists of seven 3.6 MW turbines. Construction was begun in 2002 with the building of these seven turbines. However, it is a possibility that large numbers of additional turbines may be built in the general area in the future. A baseline survey of the Arklow Bank area and cable route was conducted in 2000–01 (pre-construction), consisting of three sampling periods: June 2000, September 2000 and April 2001. Various sampling techniques were used during the baseline survey; the first survey used otter trawls and anchor dredges, while the following two used Agassiz trawls and anchor dredges. Only qualitative data was produced from the anchor dredge samples and species were recorded as present/absent. Plankton was also sampled and temperature/salinity profiles were generated.

The initial surveys undertaken in June/July 2004 were taken using Day Grabs, and these encountered severe problems with the hard ground. Subsequent surveys were undertaken using semi-quantitative anchor dredges to assess the benthic infauna and associated sediments. In addition, semi-quantitative beam trawls were used to assess benthic epifauna and benthic fish communities.

The locations of the sampling positions of the current survey are consistent with previous monitoring surveys. These sampling locations were specified by the client and are presented in Figure 1.1 and as a table in Table 1.1. These positions are the same as those sampled in previous surveys. As reported in the previous survey, the positions of the current stations do not coincide with the positions of the baseline survey.

	Beam Trawl Co-ordinates			
	Trawl In		Trawl Out	
	Easting	Northing	Easting	Northing
Trawl 1	698365	5856812	698347	5855773
Trawl 2	703956	5856874	703293	5857380
Trawl 3	706944	5866885	706860	5866494
Trawl 4	708523	5858186	708645	5857734
Trawl 5	703147	5847963	703085	5848436
Trawl 6	703055	5836917	703072	5837505

	Anchor Dredge Co-ordinates			
	Dredge In		Dredge Out	
	Easting	Northing	Easting	Northing
D1	695364	5854444	695227	5854460
D2	699254	5854467	699534	5854301
D3	700669	5855488	700711	5855551
D4	702787	5860447	702834	5860681
D5	703196	5864494	703345	5864844
D6	704080	5863629	704090	5863493
D7	704761	5864365	704880	5864656
D8	707380	5866618	707457	5866821
D9	708143	5856666	708217	5856960
D10	708280	5851229	708379	5851342
D11	707005	5846527	707070	5846801
D12	704197	5844452	704144	5844552
D13	703831	5838715	703800	5838930
D14	702002	5844922	702005	5844625
D15	703280	5851169	703275	5851319
D16	706239	5853396	706174	5853390
D17	706230	5858155	706252	5858209
D18	700360	5857060	700500	5857363
D19	697163	5847650	696981	5847680
D20	703650	5857125	703748	5857206

Table 1.1. Positions of the sampling positions for the ongoing monitoring programme at the Arklow Bank Offshore Windfarm. All locations are presented in UTM CM 9°W. Zone UTM 29N.

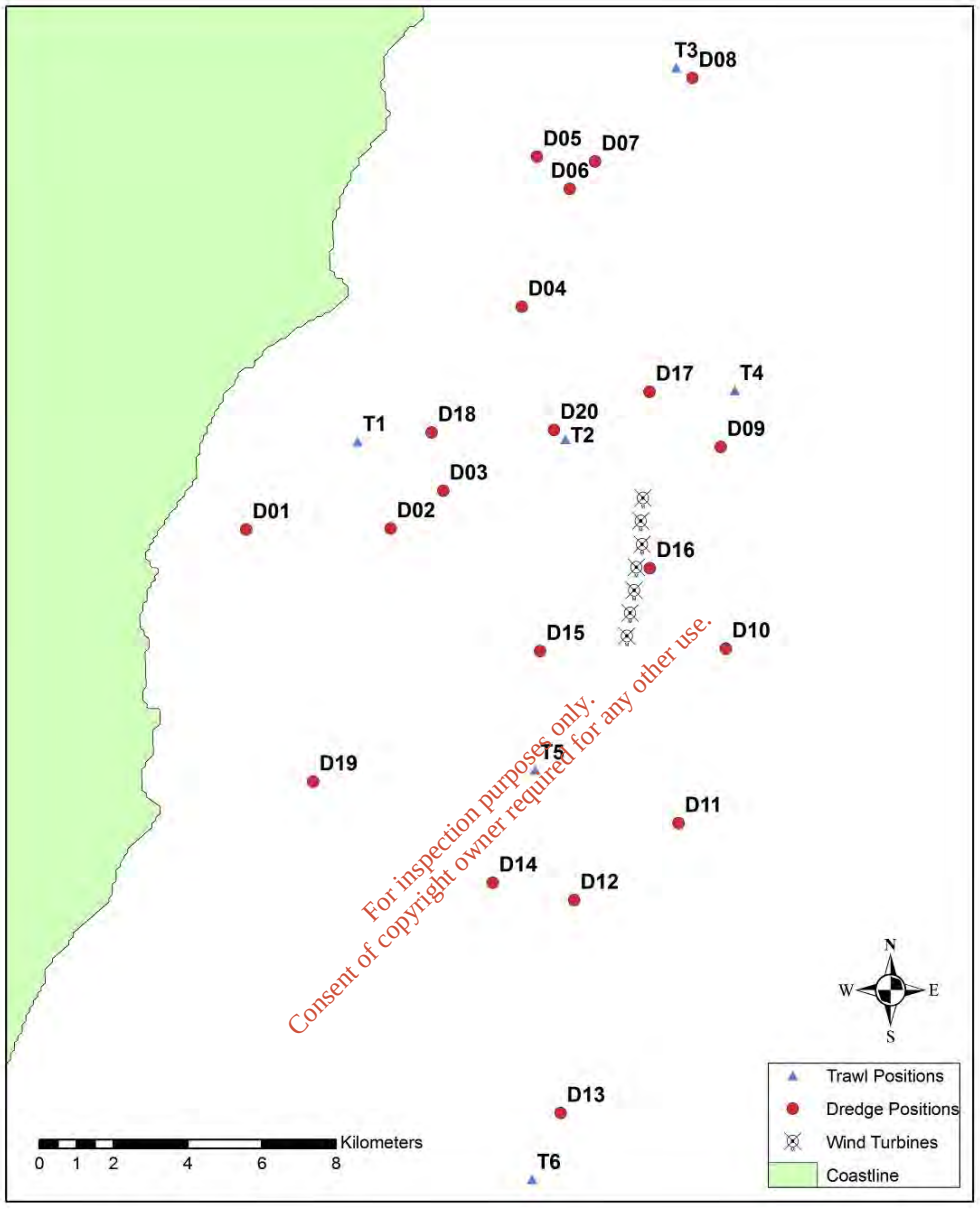


Figure 1.1 Anchor Dredge (● numbered D1 to D20) and Beam Trawl locations (▲ numbered T1 to T6) for the present monitoring survey (June 2011). These stations correspond to locations sampled in previous surveys.

2. METHODOLOGY

All sampling was undertaken from the MV Husky, based out of the port of Wicklow. The present survey was completed over the course of the 6th & 7th June 2011.

2.1 Beam trawls

All trawls were taken using a 2 m Beam Trawl, equipped with tickler chains and a 4 mm mesh cod-end, as per previous surveys. All tows were 10-15 mins duration over the ground at a speed of ~2 knots, with a warp of 2½ times water depth. This equated to a distance of approximately 300 m. Once on board, the contents were placed into a sorting table and photographed prior to processing.

Fish species (both commercial and non-commercial) were separated and counted. Fish were measured using a graduated fish board before being returned to the sea. Colonial organisms (such as hydroids, bryozoans etc.) were marked present or absent.

Organisms were identified in the field, where possible. Organisms which were difficult to identify were retained in formalin for later processing. There was no sub-sampling undertaken in the present survey. Where the volume of sample was deemed to be too large, larger specimens were identified, counted and returned. All other specimens were retained for later identification and enumeration.

2.2 Anchor Dredge Sampling

At each sample station, a single anchor dredge sample was obtained with no replication of samples. The anchor dredge was deployed 20 m in advance of the target and sufficient warp was paid out. The dredge was then dragged through the target to 20 m beyond the target point. Where this proved unsuccessful, the process was repeated and the anchor dredge was dragged for a further distance.

After successful deployment and retrieval of the anchor dredge, the sample was transferred to a large container. The sample was labelled and photographed. Field notes were taken to include information such as sample number, date and time of sampling, a visual description of the sample, an estimate of the volume of the sample and any other relevant information in relation to the sampling effort.

A small sub-sample (~ 400 g) was removed and transferred to a labelled container for Particle Size Analysis (PSA). This sample was placed in a cooler box whilst aboard the vessel and transferred immediately to a freezer on return to the laboratory until processing.

The remaining dredge sample was then sub-divided into three identical sampling units. Each unit was sieved through a 1.0 mm mesh using a gentle puddling motion. Sediment which passed through the sieve was discarded, and the material retained on the sieve was transferred to a labelled container and fixed with 40% buffered formalin to a final concentration of 4% minimum. A waterproof label was then added to the sample bucket and the sample number was written in triplicate using a waterproof marker on the outside of each sample container.

As per previous surveys, only one of the three sampling units per site was processed and analysed. Samples were manually sorted by eye, using a binocular microscope where necessary. Sorted samples were then stored in 70% alcohol until identification. Samples were sent to qualified taxonomists for enumeration and identification to species level, where possible. The remaining sub-samples are held in storage.

2.3 Particle Size Analysis (PSA)

On arrival at the laboratory, Particle Size Analysis (PSA) samples were immediately stored in a freezer until processing. Samples were dried to a constant weight at a temperature of 100°C. Prior to dry-sieving, samples were pre-treated using the methods employed by Buchanan and Kain (1984). Dried samples were then sieved through a series of nested sieves (Endecott BS410/1986) using an electronic sieve shaker. A list of sieves used is displayed in Table 2.3.1.

Sediment grainsize distribution and statistics were then calculated for each of the sediment samples using the GRADISTAT package (Blott & Pye, 2001). This package was used to determine the mean and median particle sizes and determination of sorting co-efficient. Each sample was ascribed to a sediment type (Figure 2.3.1) based on Folk (1954) with size division based on the Wentworth Scale (Table 2.3.2). Sorting co-efficient terms are defined in Table 2.3.3.

Sieve Series Sizes (mm)							
4.0	2.0	1.0	0.5	0.25	0.125	0.63	<0.63

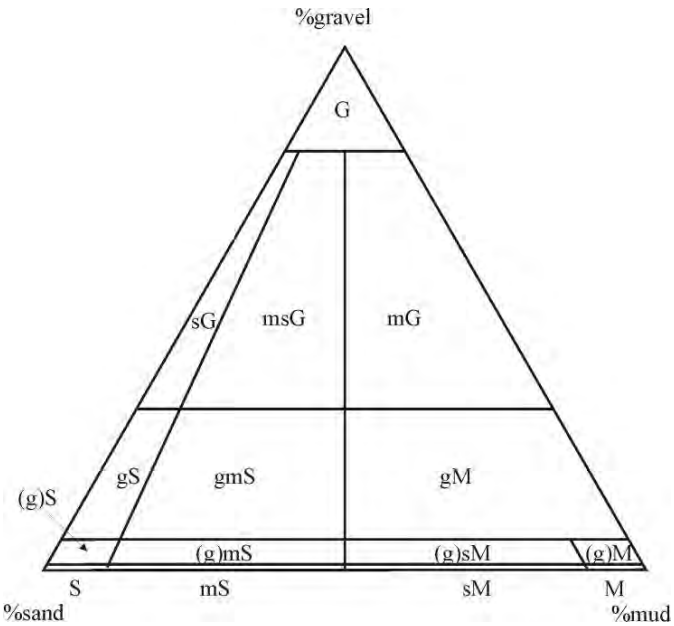
Table 2.3.1 Sieve series sizes (mm) used for particle size analysis (PSA).

Wentworth Scale (mm)	Phi units	Sediment types
>256 mm	<-8	Boulders
64 - 256 mm	-8 to -6	Cobble
4 - 64 mm	-6 to -2	Pebble
2 - 4 mm	-2 to -1	Granule
1 - 2 mm	-1 to 0	Very coarse sand
0.5 - 1 mm	0 - 1	Coarse sand
250 - 500 µm	1 - 2	Medium sand
125 - 250 µm	2 - 3	Fine sand
63 - 125 µm	3 - 4	Very fine sand
<63 µm	>4	Silt

Table 2.3.2 Classification used for defining sediment type (from Buchanan & Kain, 1984).

Standard Deviation of mean Phi	Classification
<0.35	Very well sorted
0.35 - 0.5	Well sorted
0.5 - 0.71	Moderately well sorted
0.71 - 1	Moderately sorted
1 - 2	Poorly sorted
2 - 4	Very poorly sorted
>4	Extremely poorly sorted

Table 2.3.3 Classification used defining degree of sediment sorting (from Buchanan & Kain, 1984).



G = gravel
msG = muddy sandy gravel
gS = gravelly sand
gM = muddy gravel
(g)mS = slightly gravelly muddy sand
(g)M = slightly gravelly mud
mS = muddy sand
M = mud

sG = sandy gravel
mG = muddy gravel
gmS = gravelly muddy sand
(g)S = slightly gravelly sand
(g)sM = slightly gravelly sandy mud
S = sand
sM = sandy mud

Figure 2.3.1 Sediment classification after Folk (1954) as also used by the BGS. "Gravel" is greater than 2 mm and "mud" is less than 63 µm.

2.4 Data Analysis

On completion of the sample processing and identification the data was analysed using a variety of univariate and multivariate analyses to determine community structure and assess change compared to previous surveys.

As stated in previous reports different types of sampling gear have been used in previous surveys, as well as different levels of species identification. Therefore the present report will compare the current dataset against the previous surveys which were sampled using the same methodology. Statistical analysis between the previous surveys and the baseline survey has been undertaken in previous surveys and will not be addressed in the current report. An assessment on the habitats identified in the present survey will be made.

Multivariate analysis was performed on the raw datasets using PRIMER *v* 5 (Clarke & Warwick, 1994). The data was subjected to a variety of multivariate analyses, including non-metric Multi Dimensional Scaling (MDS).

2.4.1 Beam Trawls

In the present survey, as in previous surveys, a total of 6 beam trawls were taken across the survey area. Although this number of trawls is quite small and results from multivariate analysis can only be described as descriptive, it was considered a useful exercise to compare against the results of the previous surveys.

Square-root transformations were performed on the abundance data with colonial organisms removed. In addition the beam trawl data was subjected to analysis on the presence/absence dataset including all identified taxa.

2.4.2 Anchor dredge samples

As in previous reports, a variety of univariate, multivariate and graphical techniques were used to provide the information concerning species diversity and community structure.

Multivariate analysis was based on square-root transformed abundances of species present, which allows for a sensible balance between the rare and common species. Multi-Dimension Scaling (MDS) ordination was based on the Bray-Curtis similarity coefficient. Stress values are provided for each MDS plot. It is important to note that these stress values represent the relationship between the various samples. In brief, a stress value of <0.05 indicates that there is an excellent representation of the relationship between the various samples, <0.1 indicates good ordination and <0.2 indicates a potentially useful 2-dimensional picture (Clarke and Warwick, 1994). In order to investigate the effect of the environmental data on the stations, sample clustering determined from the above analysis was repeated with mean sediment particle size superimposed.

The initial monitoring report (Hydroserv, 2004) compared pooled replicates between the sites taken with a 0.1 m^2 Day Grab. This information was compared to information obtained in the baseline survey of 2000. Analysis indicates that comparisons between these two surveys were incompatible due to inherent differences in the sampling equipment used. A resurvey was undertaken in October 2004 using the current sampling methodology (anchor dredge and beam-trawl sampling methods). This report indicated that the assemblages reported in October 2004 were broadly similar to those identified in the baseline survey (Ecoserve, 2001), although direct comparisons were difficult due to the different sampling methods used (Hydroserv, 2005).

3. RESULTS

3.1 Beam Trawls

Raw data from the beam trawls are presented in the appendices (Appendix 6.3), in addition to information on fish species and lengths (Appendix 6.4). A total of 187 taxa were identified in the present survey. Of these 187 taxa, 14 are fish species. Overall, the number of taxa identified is higher than all previous surveys; the total number of taxa is much higher than the June 2006 (98 taxa), June 2005 (47 taxa) and October 2004 (51 taxa) surveys, and marginally higher than those identified in 2007 (177 taxa), 2008 (170 taxa), 2009 (132 taxa) and 2010 (158 taxa).

The number of fish species and abundances found at each trawl location in the 2006 – 2010 surveys, as well as the present surevy, are presented in Figures 3.1.1 and 3.1.2. The total number of fish taxa identified in the present survey (14 taxa) is similar to those identified in previous surveys (12 – June 2010, 10 – June 2009, 12 – May 2008, 14 – June 2006, 13 – June 2005), but higher than the October 2004 (9 taxa) and May 2007 (7 taxa) surveys. In addition, the number of fish caught in the present survey 51 individuals) is similar to those caught in previous surveys (33 – 2010, 32 – 2009, 33 – 2008, 55 – 2006) but lower than those identified in 2005 (74) and 2004 (80). In the present survey, Trawls 1 and 2, had the highest number of species (6) and the highest number of individuals (13). Overall, fish abundances ranged from 1 individual in Trawls 6 to 13 individuals in two trawls (Trawls 1 & 2).

Important commercial fish were limited to 4 Plaice (*Pleuronectes platessa*), 1 Whiting (*Merlangius merlangus*), 3 Dogfish (*Scyliorhinus canicula*) and 1 John Dory (*Zeus faber*). Three elasmobranchs were caught in the present survey (3 x *Scyliorhinus canicula*) compared to 2 (2010), 1 (2009), 4 (May 2008), 3 (June 2006), 4 (June 2005), 3 (October 2004). No elasmobranchs were returned during the 2007 survey.

As mentioned in previous reports, the use of small (2 m) beam trawls is far from ideal as a survey method for fish sampling. However, it has been shown to be quite effective for most bottom dwelling fish species (ICES 2003). Results from the present survey concur with the findings of previous reports, that benthic fish populations are quite low in the surveyed area.

The beam trawl surveys yielded a total of 187 taxa, which is in keeping with more recent previous surveys (2007, 2008 & 2009). Total numbers of countable organisms (2,457) has increased from those identified in 2010 (1819) and 2009 (1779). Twenty taxa were found in numbers ≥ 20 over the whole survey area, compared with 20 taxa in 2010, 15 taxa in 2009, 9 taxa in 2008 and 19 taxa in 2007. A complete list of the most countable faunal species identified in the present survey is presented in Table 3.1.1.

The highest numbers of taxa encountered at the trawl sites were found in Trawl 1 (117). This station also had the highest number of countable taxa (96) and colonial taxa (21) as well as the highest abundances recorded in the present survey with 1,450 individuals. The most abundant species present in the survey area are the polychaete *Sabellaria alveolata* and the crustaceans *Pandalus montagui*, *Crangon almanni* and *Pagurus* bernhardus.

	Jun-11	Jun-10	Jun-09	May-08	May-07	Jun-06	Jun-05
Sabellaria alveolata	651	4	3	111	2083	668	0
Crangon allmanni	234	218	124	68	52	53	0
Pandalus montagui	170	287	406	16	13	187	65
Pagurus bernhardus	146	69	94	33	54	26	95
Macropodia rostrata	131	10	29	26	39	31	28
Asterias rubens	112	36	52	70	131	39	8
Psammechinus miliaris	104	22	40	13	53	130	162
Hippolyte varians	72	3	11	4	2	0	0
Pisidia longicornis	66	81	0	21	1033	238	4
Lepidopleurus asellus	62	10	30	10	10	5	0

Table 3.1.1 Numbers of the 10 most common countable faunal species found in June 2011 compared to abundances found in June 2010, June 2009, May 2008, May 2007, June 2006 and June 2005 beam trawl surveys

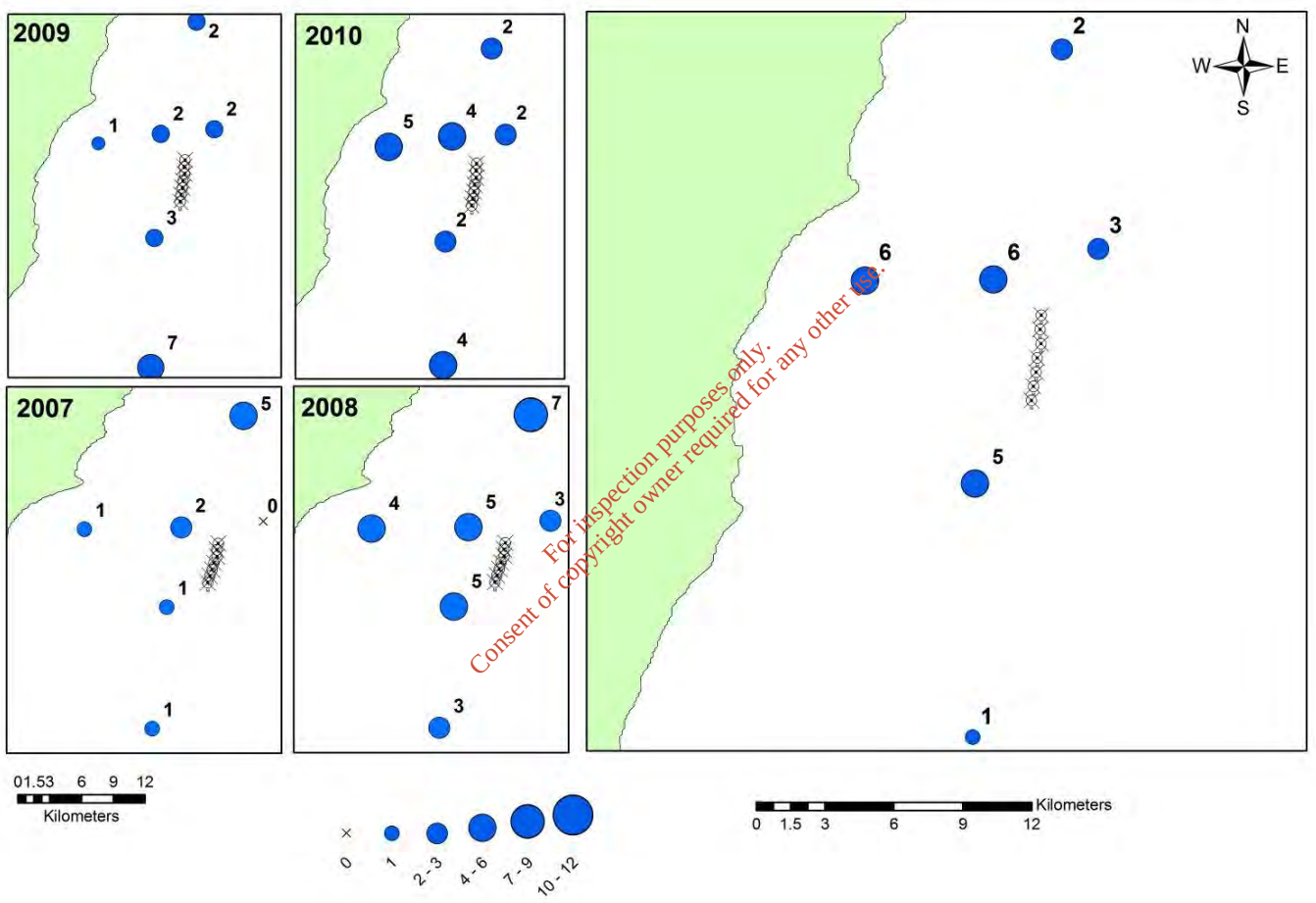


Figure 3.1.1 Total number of fish taxa per trawl site (May 2007, May 2008, June 2009, June 2010 & June 2011)

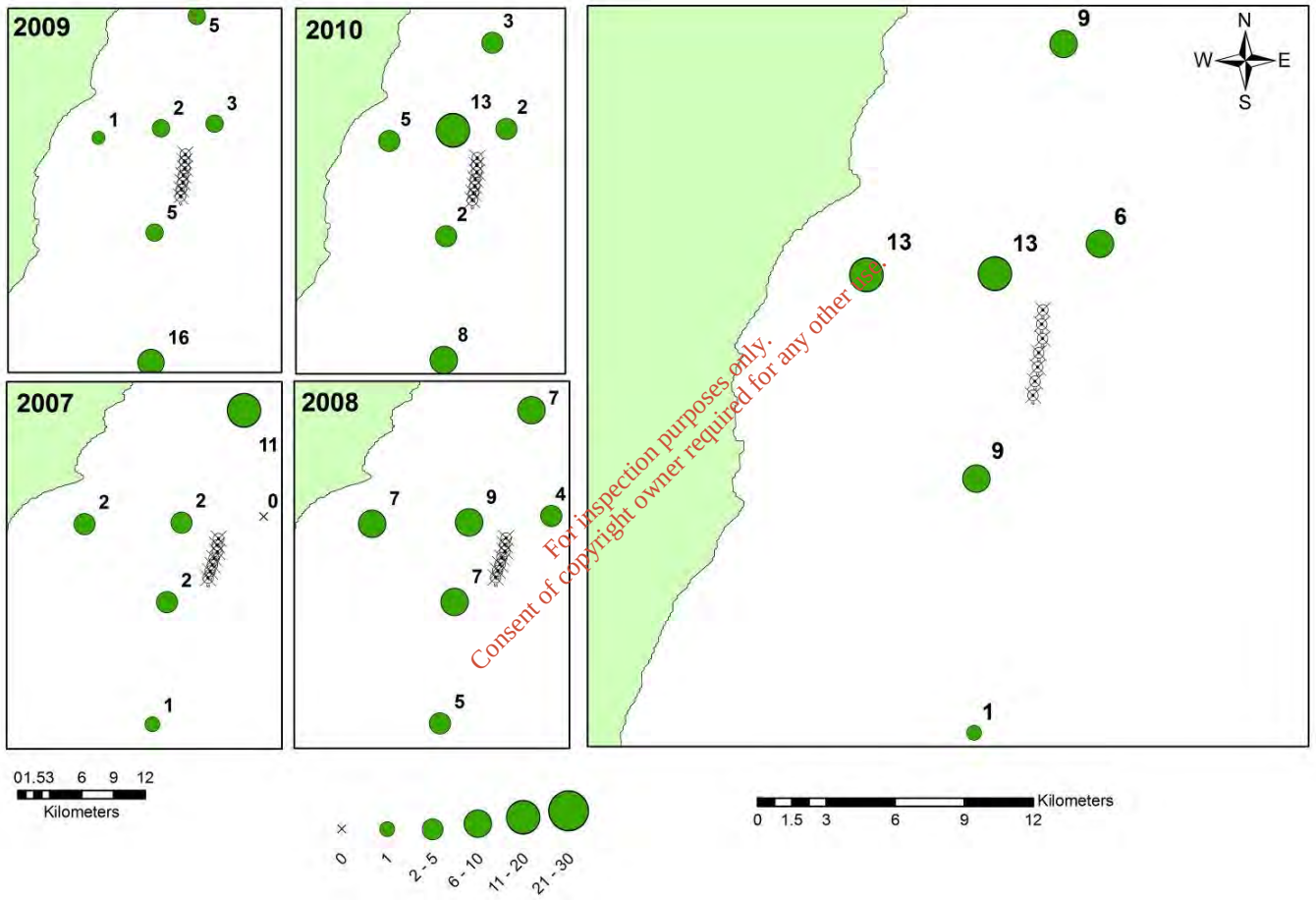


Figure 3.1.2 Total number of fish per trawl site (May 2007, May 2008, June 2009, June 2010 & June 2011)

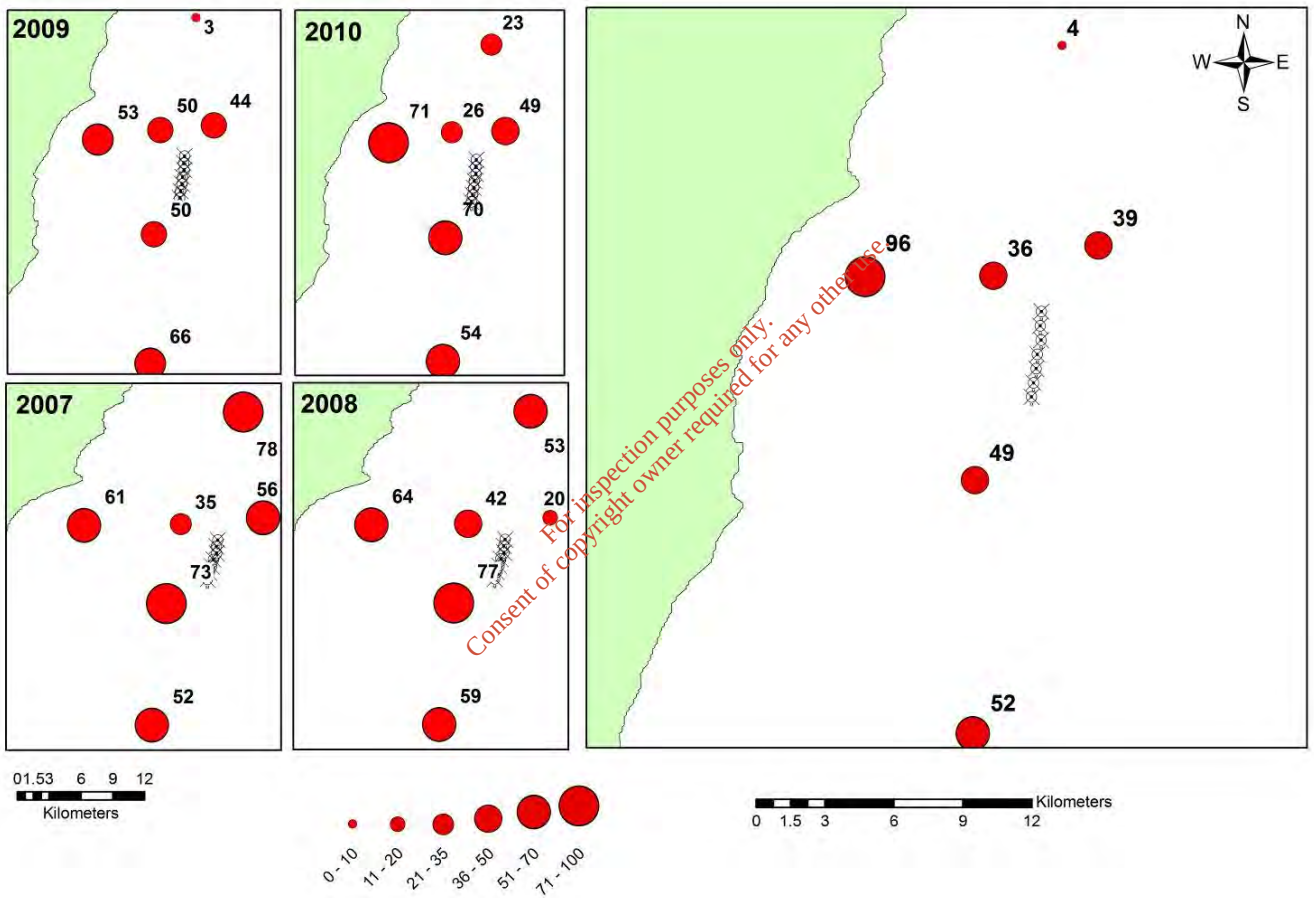


Figure 3.1.3 Total number of invertebrate taxa per trawl site (May 2007, May 2008, June 2009, June 2010 & June 2011)

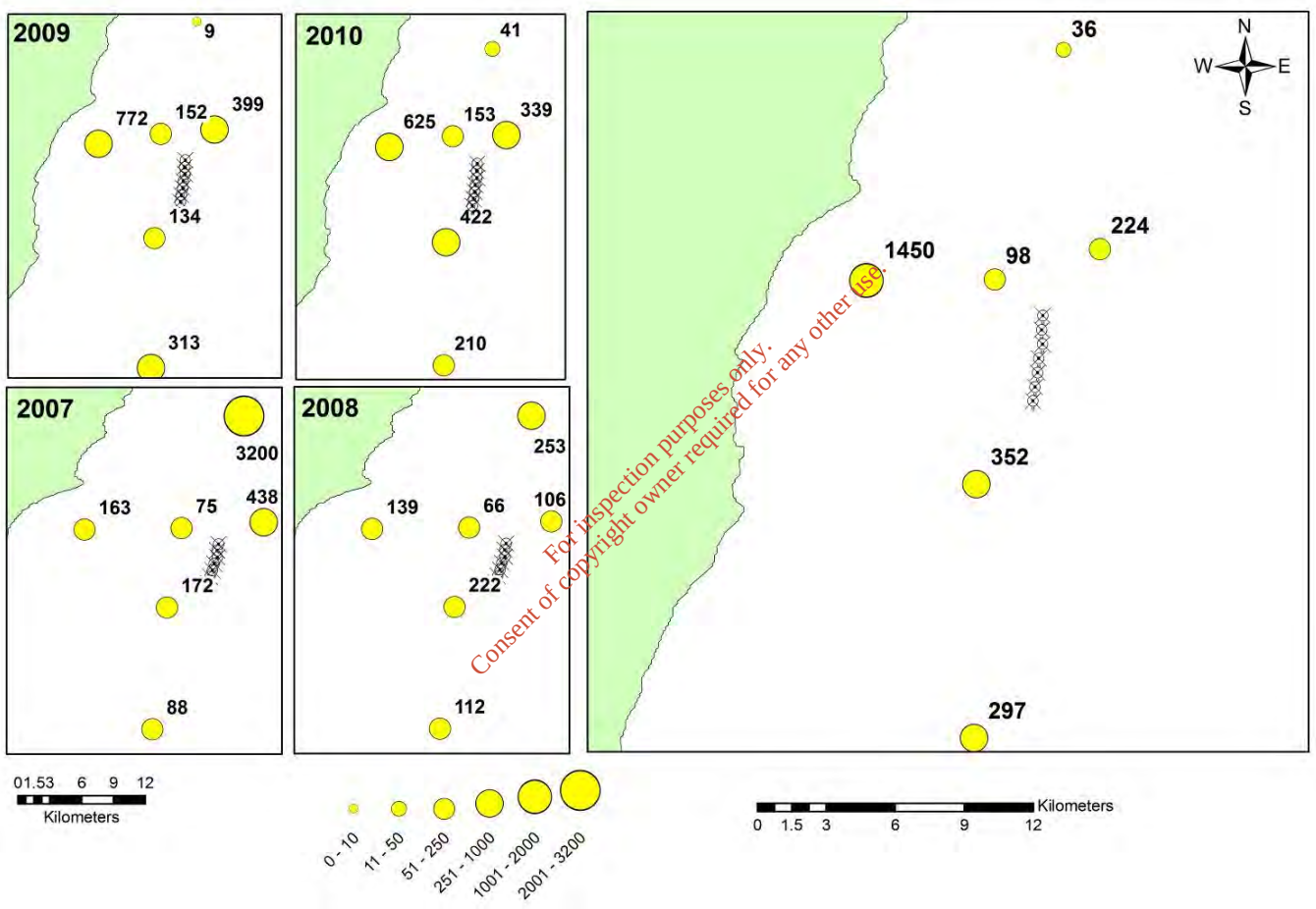


Figure 3.1.4 Total number of countable invertebrates per trawl site (May 2007, May 2008, June 2009, June 2010 & June 2011)

As with previous surveys multivariate analysis of the community structure reveals the presence of no distinct community structure, based on both the presence/absence dataset (Figure 3.2.5 a) and the dataset with colonial organisms removed (Figure 3.2.5 b).

Figure 3.1.5 **(a)** Multivariate analysis (nMDS plot) on the 2011 trawl data, colonial data included (Stress = 0.01).
(b) Multivariate analysis of the countable fauna, colonial data removed (Stress = 0.01).

3.2 Anchor Dredge Samples

3.2.1 Particle Size Analysis

Data for the full Particle Size Assessment is presented in Appendix 6.6. Table 3.2.1 presents a summary of the results and a visual assessment based on the on-board field notes. As with previous surveys there is an extensive range of sediment types present across the study area with sediments ranging from pure gravel at a single location to sand at two locations and a range of sediment types in between. As reported previously, the heterogeneous nature of the sediment in the survey area results in minor differences in the sediment composition across the study site when compared to previous surveys. A distribution map of the sediment encountered in the present survey is presented in Figure 3.2.2. The sediments across the Arkow Bank are dominated by sands (D12 & D16) and gravelly sands (D8, D9, D13, D14 & D15). The deeper areas of the survey area are dominated by sandy gravels (D7, D10, D17 and D20) and gravelly sands (D1, D2, D3, D4, D6 & D18). A single area is characterised as pure gravel (D5).

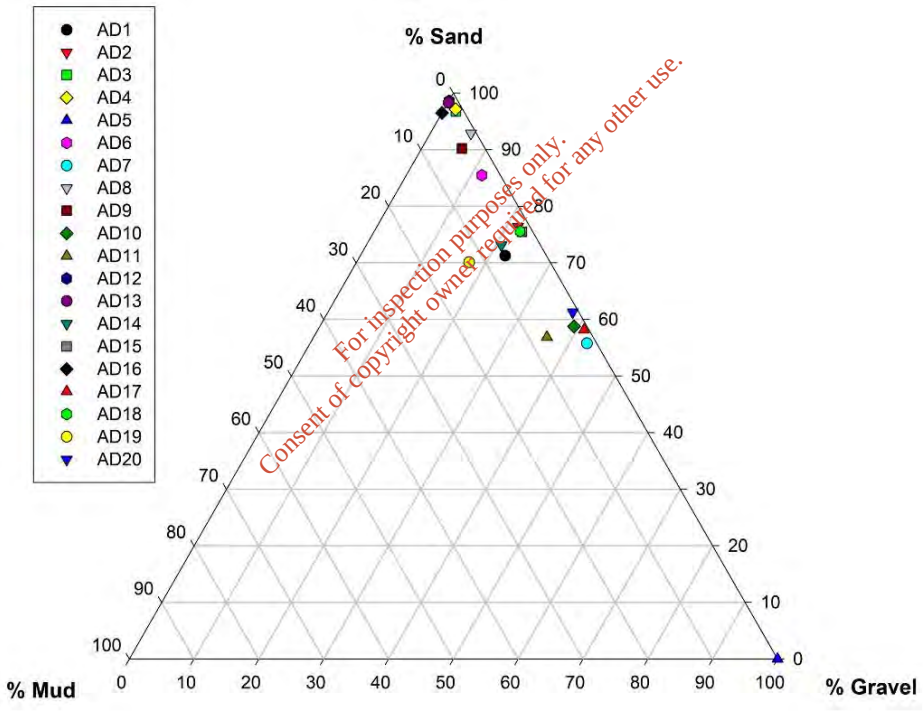


Figure 3.2.1 Ternary plot of PSA results from June 2011 survey.

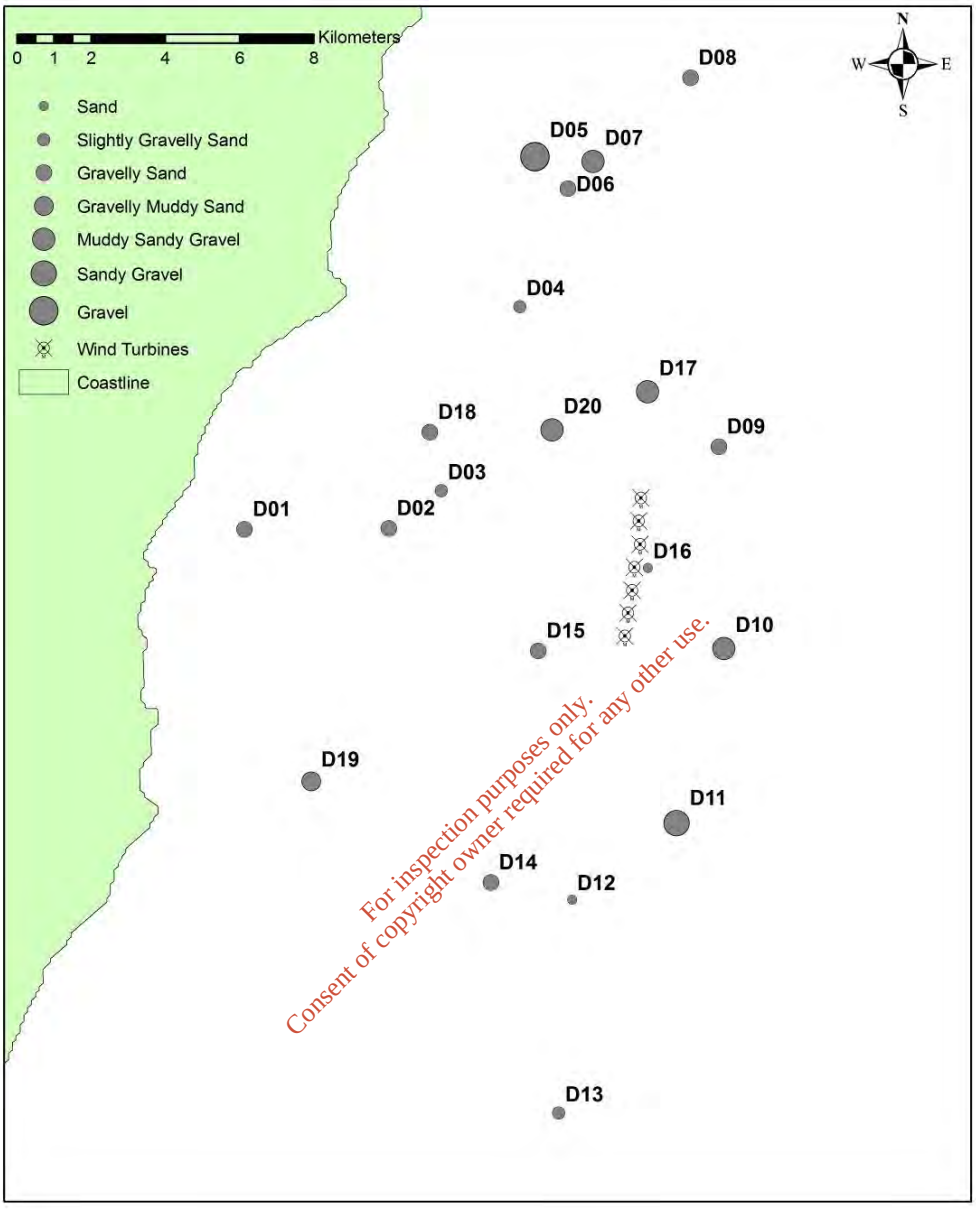


Figure 3.2.2 Distribution of sediment type as determine from the anchor dredge samples in June 2011. Site numbers are shown.

Site Code	Classification after Buchanan	Textural Group (June 2011)	Textural Group (June 2010)	Visual assessment
1	Fine Gravelly Fine Sand	Gravelly Sand [gS]	Gravelly Sand [gS]	Gravelly muddy sand
2	Very Fine Gravelly Fine Sand	Gravelly Sand [gS]	Gravelly Muddy Sand [gMS]	Gravelly Muddy Sand
3	Slightly Very Fine Gravelly Fine Sand	Slightly Gravelly Sand [(g)S]	Slightly Gravelly Sand [(g)S]	Sand
4	Slightly Very Fine Gravelly Medium Sand	Slightly Gravelly Sand [(g)S]	Slightly Gravelly Sand [(g)S]	Gravelly Sand
5	Gravel	Gravel [G]	Gravel [G]	Gravel
6	Very Fine Gravelly Medium Sand	Gravelly Sand [gS]	Gravelly Sand	*Sabellaria* reef
7	Sandy Fine Gravel	Sandy Gravel [sG]	Gravel [G]	Sandy Gravel
8	Very Fine Gravelly Medium Sand	Gravelly Sand [gS]	Slightly Gravelly Sand [(g)S]	Coarse Sand
9	Very Fine Gravelly Medium Sand	Gravelly Sand [gS]	Sandy Gravel [sG]	Gravelly Sand
10	Sandy Fine Gravel	Sandy Gravel [gS]	Gravelly Sand [gS]	Sandy Gravel
11	Coarse Silty Sandy Fine Gravel	Muddy Sandy Gravel [msG]	Gravelly Sand [gS]	Muddy gravelly sand
12	Moderately Well Sorted Fine Sand	Sand [S]	Sand [S]	Sand
13	Slightly Very Fine Gravelly Medium Sand	Slightly Gravelly Sand [(g)S]	Sand [S]	Sand
14	Fine Gravelly Fine Sand	Gravelly Sand [gS]	Gravelly Muddy Sand [gMS]	Gravelly muddy sand
15	Fine Gravelly Medium Sand	Gravelly Sand [gS]	Sandy Gravel [sG]	Sandy shell gravel
16	Moderately Well Sorted Fine Sand	Sand [S]	Slightly Gravelly Sand [(g)S]	Sand
17	Sandy Fine Gravel	Sandy Gravel [sG]	Gravelly Sand [gS]	Sandy Gravel
18	Very Fine Gravelly Fine Sand	Gravelly Sand [gS]	Sandy Gravel [sG]	Shell gravel and sand
19	Fine Gravelly Very Coarse Silty Fine Sand	Gravelly Muddy Sand [gMS]	Gravelly Sand [gS]	Muddy Sand
20	Sandy Fine Gravel	Sandy Gravel [sG]	Gravelly Sand [gS]	Gravelly Sand

Table 3.2.1 Classification of sediment types at June 2011 grab stations according to methods after- Buchanan & Kain and Folk & Ward, as used by BGS (see methods), together with visual assessment of sediments from notes taken at the time. Folk and Ward classification for the June 2010 survey is also given for comparison.

3.2.2 Biota

3.2.2.1 Abundance and diversity

A full taxonomic list of all species identified for the June 2011 survey is presented in Appendix 6.2 with a full data matrix, including abundance data, presented in Appendix 6.5. In total, 2,876 individuals from 144 countable taxa were recorded in the present survey. An additional 19 colonial taxa were recorded, resulting in 165 taxa in total identified in June 2011. Overall abundances are lower than those identified in all previous surveys and continue the trend in decreasing faunal abundances identified in previous surveys. It is difficult to say if this represents a true trend, or whether it is a result of local heterogeneity or some other external factor. For example, several species, which were present in large numbers in previous surveys are absent, or much reduced, in the present dataset.

The reduction in keelworm (*Pomatoceros* spp.) abundances identified in previous surveys continues in the present survey. Abundances identified in the present survey are mainly limited to only a single station with 1252 individuals from a total of 1318 identified coming from AD7.

The largest reduction in abundances in the present survey comes from the reef-forming polychaete *Sabellaria* spp. A total of 618 individuals were identified from the dredges in 2011. This shows a decrease from 2,866 in 2010 and 3,994 in 2009 and are similar to those identified in 2007 (491) and 2008 (51). *Sabellaria* spp. were identified in 7 stations, although they only occurred in large numbers in a single dredge (429 individuals in AD6). As mentioned previously, this variation in abundances may be explained by the heterogeneous nature of the seabed and the scattered distribution of these reefs across the surveys sites.

The most abundant species identified in the present survey are similar to those identified in previous surveys. However, the reduction in abundances is reflected in the presence of only 5 taxa with >70 individuals present across the survey area. This compares to 10 taxa in 2010 and 2009, 7 taxa in 2008, 11 taxa in 2007, 17 taxa in 2006, 34 taxa in 2005 and 19 taxa in 2004.

The highest recorded Margelef's species richness score in the present survey was found at Station 10 (10.4). Overall species richness scores increased in only 5 stations during the present survey when compared to 2010. In the present survey, abundances recorded in 2011 increased at only 4 stations when compared to 2010. The most significant changes between the results obtained in 2011 and 2010 were reductions at AD 10 (from 1,670 to 232), AD11 (from 1,320 to 141) and AD18 (1,320 to 34). The reasons for the decrease in the numbers in the present survey relate to a further decrease in both *Pomatoceros* spp. abundances (from 2,750 in 2010 to 1318 in 2011) and *Sabellaria* spp. abundances (from 2,866 in 2010 to 618 in 2011) across the survey area.

3.2.2.2 Multivariate analysis

All multivariate analysis was undertaken using the statistical package PRIMER *v* 5.

Non-metric multi-dimensional scaling (MDS) analysis was performed on the 2011 dataset. As recorded in previous surveys, the sandy sites across the survey area (sands, gravelly sands and muddy sands) tend to show no obvious relationship with each other although the samples tend to group away from the gravel dominated sites. This is related to the reduced abundances present at these sites and the strong hydrodynamic nature of the site.

	Number of Taxa (S)	Number of Individuals (N)	Simpson's Dominance Index (d)	Shannon-Wiener Diversity Index (H')	Margalef's Species Richness (Dmg)
D1	36	208	0.184	2.45	6.56
D2	16	27	0.111	2.5	4.55
D3	0	0	****	****	****
D4	4	29	0.696	0.642	0.891
D5	13	38	0.382	1.62	3.3
D6	45	642	0.451	1.64	6.81
D7	26	1350	0.862	0.426	3.47
D8	1	1	1	0	****
D9	37	114	0.0714	3.13	7.6
D10	56	232	0.199	2.68	10.1
D11	47	141	0.0416	3.47	9.3
D12	3	3	0.333	1.1	1.82
D13	2	2	0.5	0.693	1.44
D14	14	24	0.132	2.36	4.09
D15	6	7	0.184	1.75	2.57
D16	1	1	1	0	****
D17	1	1	1	0	****
D18	9	34	0.234	1.74	2.27
D19	6	17	0.516	1.08	1.76
D20	6	6	0.167	1.79	2.79

Table 3.2.2 Univariate descriptors of abundance and richness in the 20 dredge samples from June 2011.

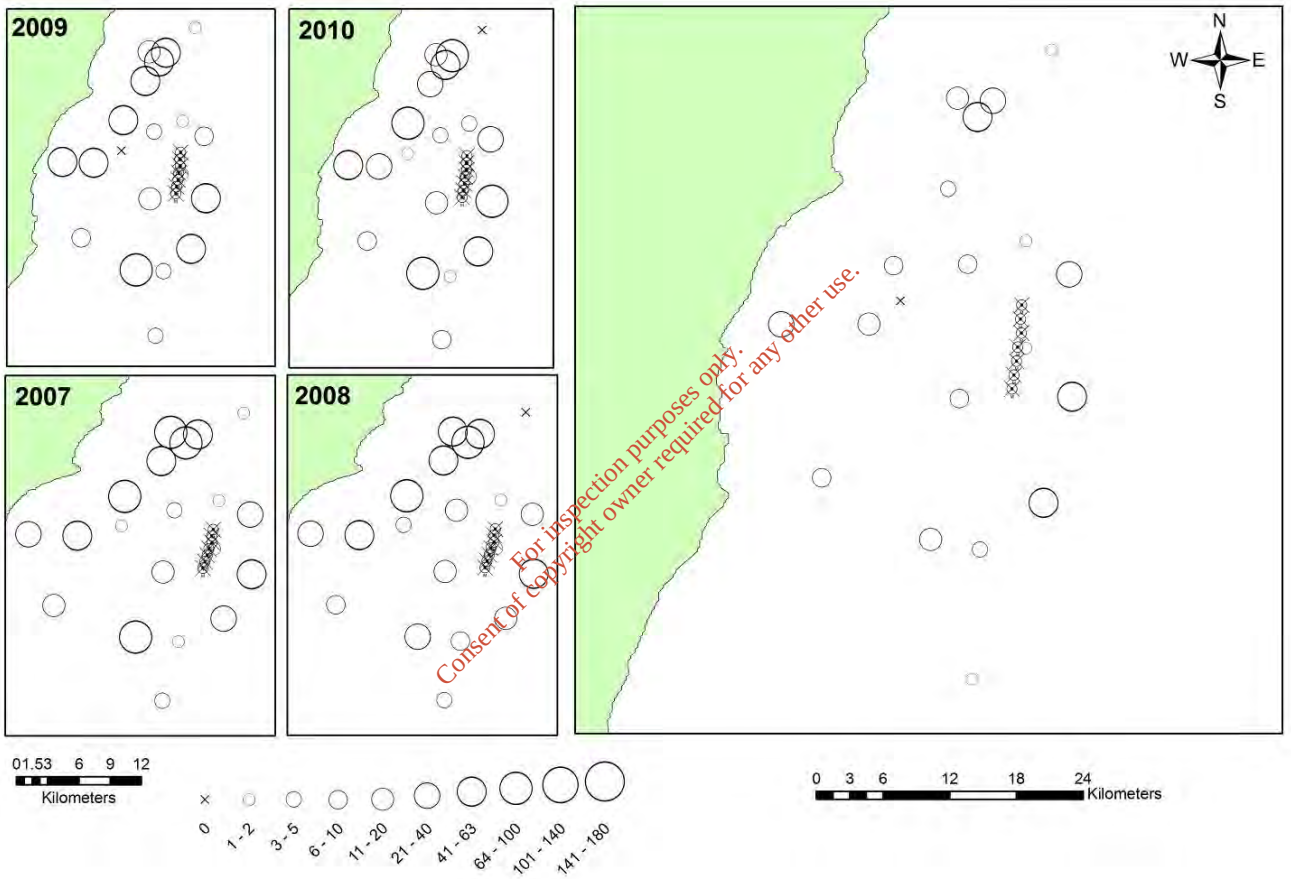


Figure 3.2.3 Total number of taxa per anchor dredge (May 2007, May 2008, June 2009, June 2010 & June 2011)

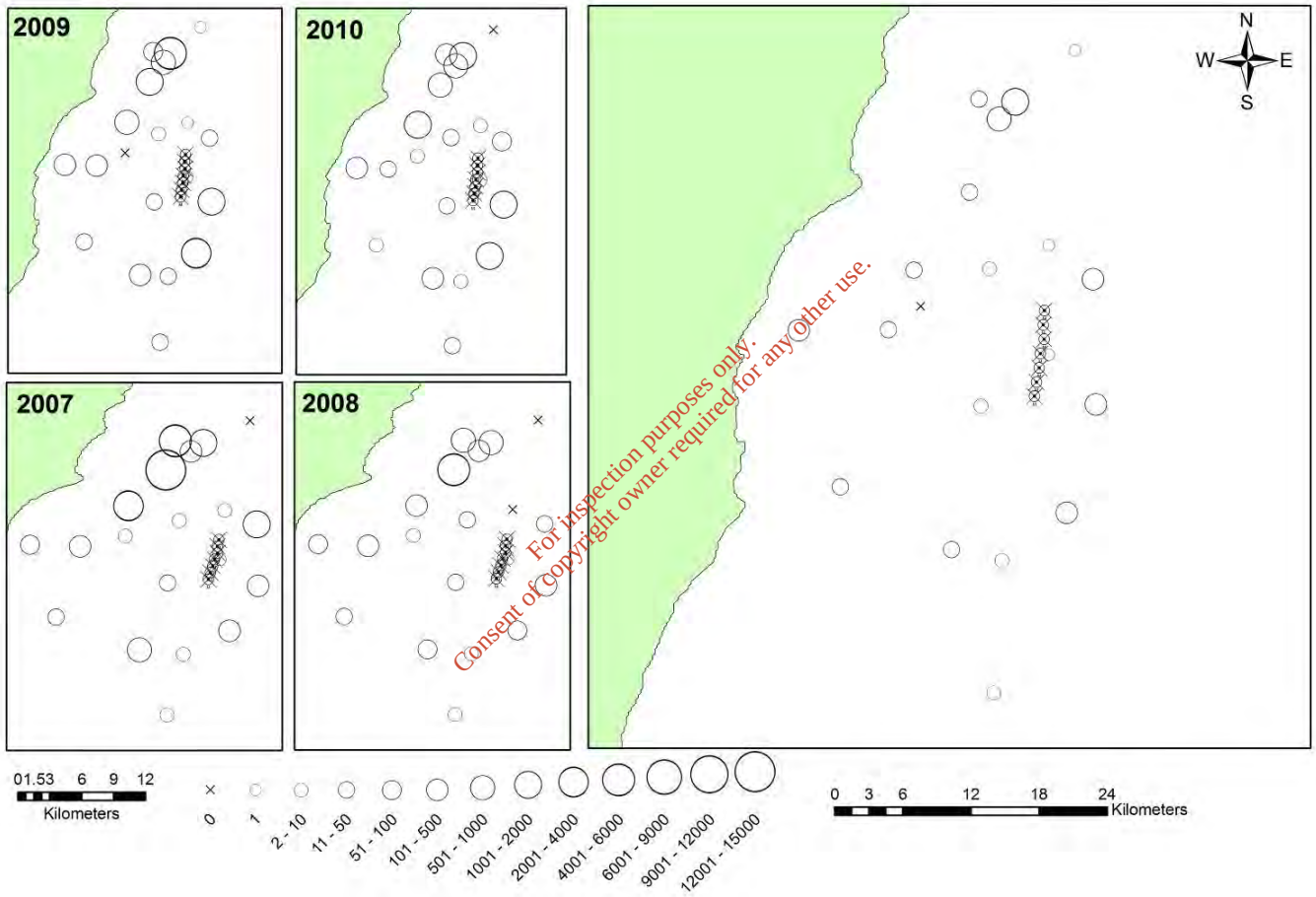


Figure 3.2.4 Total number of countable invertebrates per anchor dredge (May 2007, May 2008, June 2009, June 2010 & June 2011)

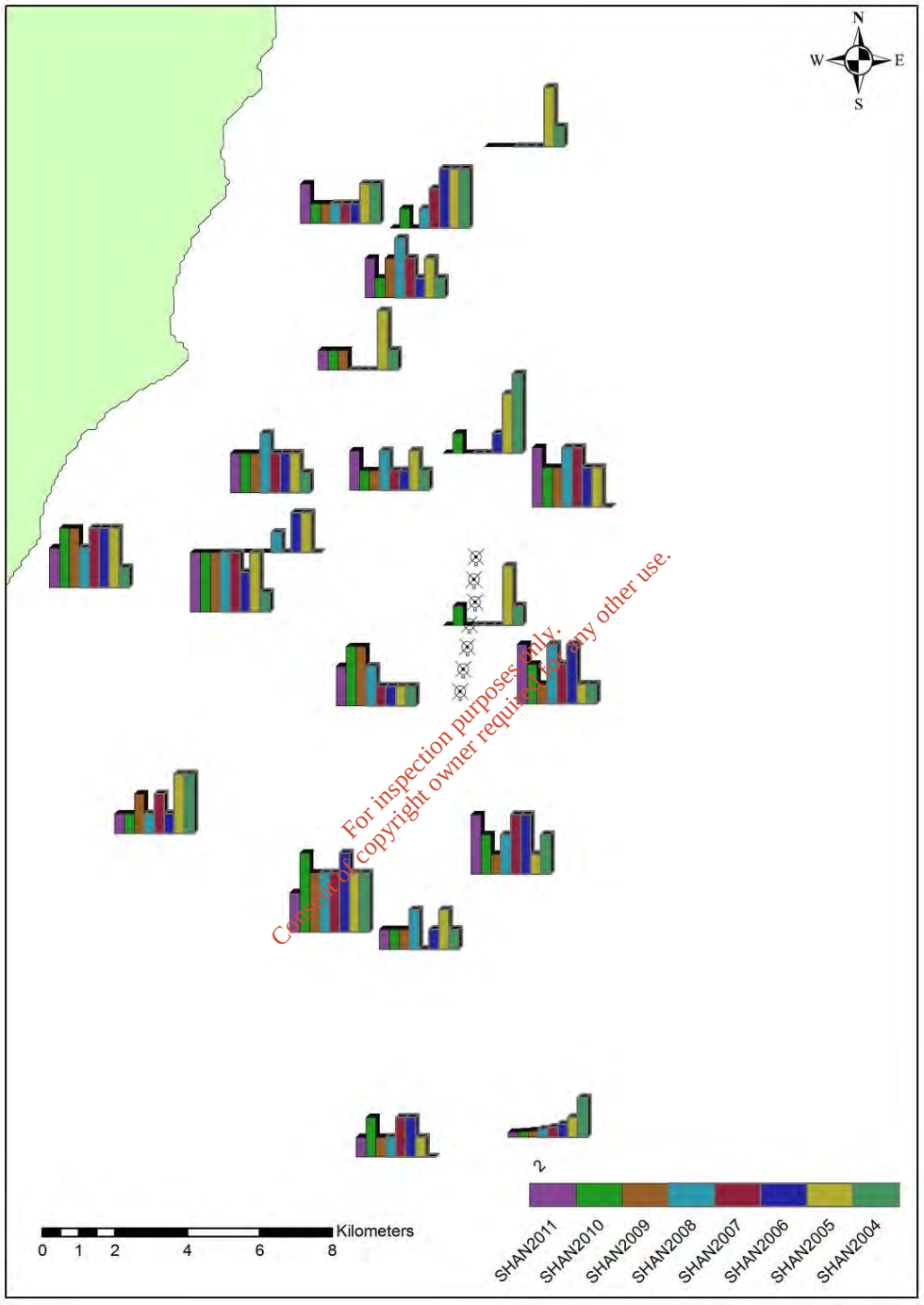


Figure 3.2.5 Shannon Wiener diversity indices per anchor dredge (October 2004, June 2005, June 2006, May 2007, May 2008, June 2009, June 2010 & June 2011)

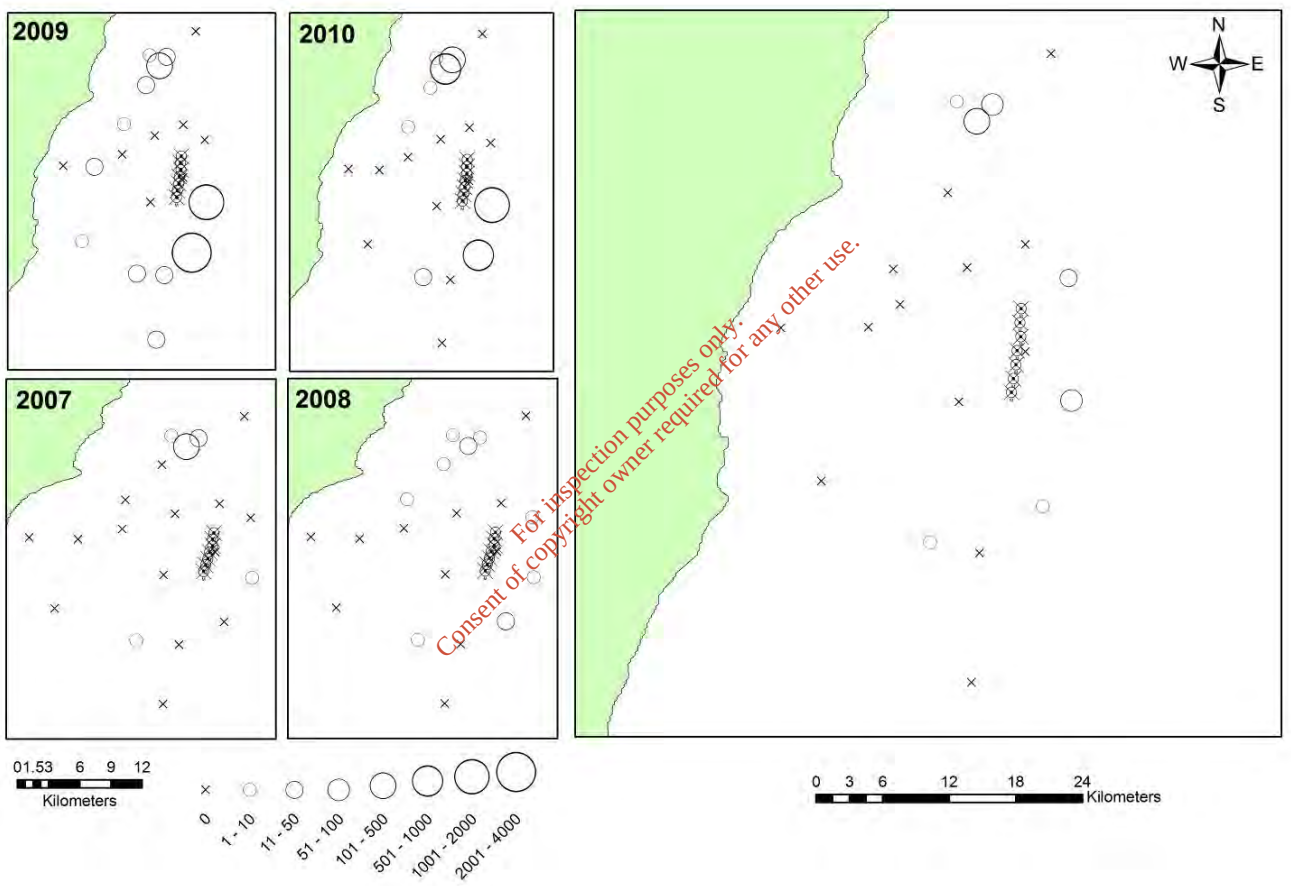


Figure 3.2.6 Total number of *Sabellaria* spp. found at each dredge (May 2007, May 2008, June 2009, June 2010 & June 2011)

Table3.2.3 List of the most abundant taxa (where >30 individuals were recorded across the survey area) in descending order of abundance from the anchor dredge survey of June 2011.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
Annelida	*Pomatoceros lamarcki*	0	0	0	24	23	3	1252	0	6	1	6	0	0	0	1	0	0	2	0	0	1318
Annelida	*Sabellaria alveolata*	0	0	0	0	0	426	35	0	3	0	0	0	0	0	0	0	0	0	0	0	464
Annelida	*Sabellaria spinulosa*	0	0	0	0	1	3	17	0	23	99	9	0	0	2	0	0	0	0	0	0	154
Annelida	*Scoloplos armiger*	80	2	0	0	0	0	0	0	10	7	7	0	0	0	0	0	0	0	0	0	106
Annelida	*Jasmineira elegans*	0	0	0	0	0	41	9	0	5	6	10	0	0	0	0	0	0	0	0	0	71
Annelida	*Clymenura johnstoni*	7	0	0	0	0	0	5	0	6	19	12	0	0	0	0	0	0	0	0	0	49
Decapoda	*Pisidia longicornis*	0	0	0	0	0	38	1	0	2	0	0	0	0	0	0	0	0	0	0	0	41
Annelida	*Lanice conchilega*	24	0	0	0	0	0	1	0	3	3	5	0	0	0	0	0	0	0	0	0	36
Annelida	*Lumbrineris gracilis*	2	5	0	0	0	0	0	0	3	6	9	0	0	7	0	0	0	0	0	0	32

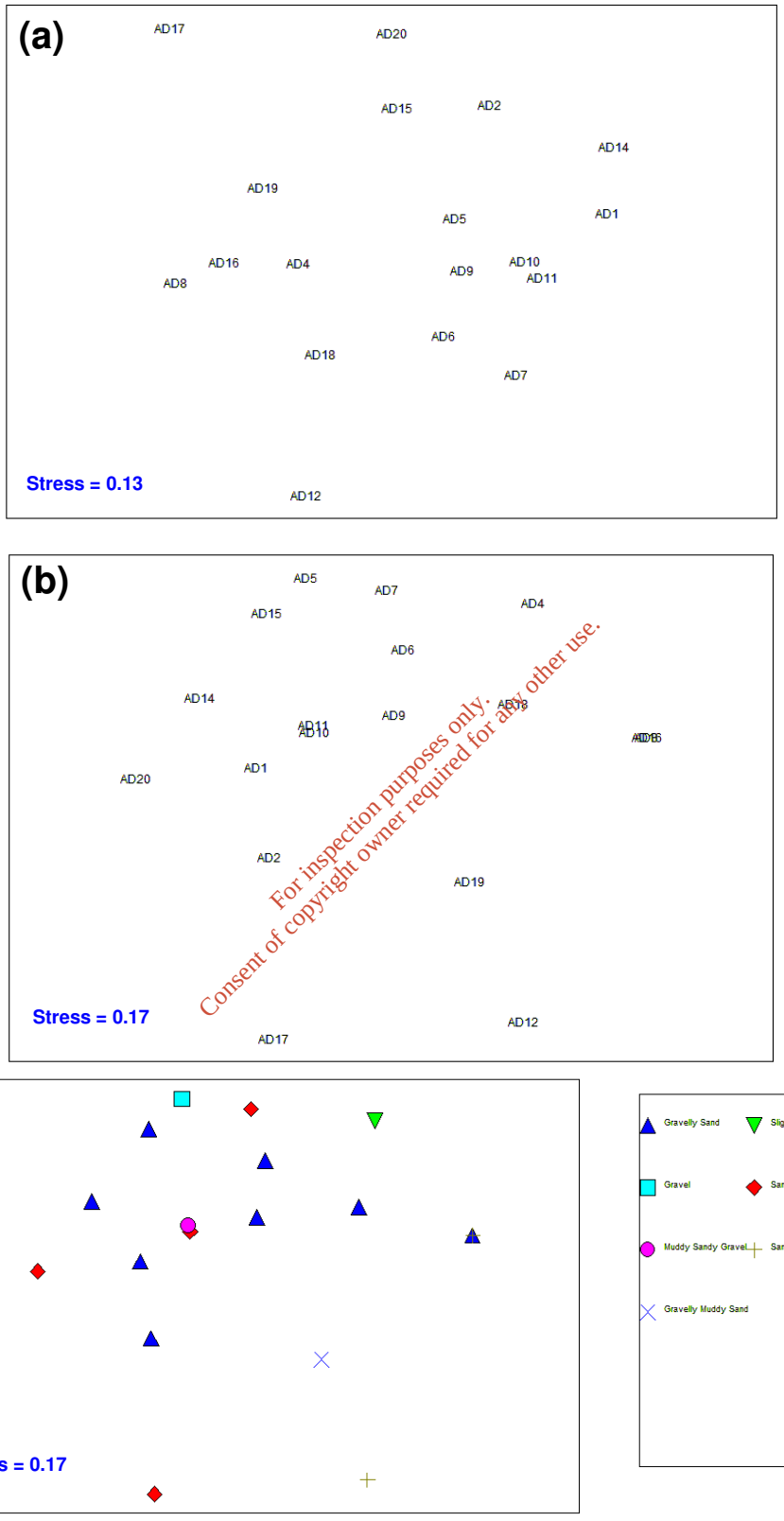


Figure 3.2.7 Multi-dimensional scaling plot of faunal data from the anchor dredge survey, June 2010. [(a) Presence/Absence data; (b) Abundance data, colonial organisms removed; (c) Abundance data, no colonial's; with sedimentary environment superimposed]

3.3 Biotope Classification

Because of the nature of the current monitoring survey and the inherent differences in sampling protocol undertaken in both study types, direct comparison of the datasets is difficult. As such, it is easier to assess the communities identified in each of the surveys to assess potential change in the benthos compared to the baseline survey. The baseline survey undertaken in 2000 identified six separate biotopes within the survey (Ecoserve 2001) area using the 1997 JNCC classification system (Connor *et al*, 1997). These are presented in Table 3.3.1.

Biotope Classification	Description of Biotope	Approximate location within the survey area
IGS.Mob	Sparse fauna in infralittoral mobile clean sand	Along the Arklow Bank and to the south-west of the survey area. Small presence closer inshore near Arklow.
IGS.Scup.Hyd	*Sertularia cupressina* and *Hydrallmania falcata* on tide swept sublittoral cobbles or pebbles in coarse sand	Immediately surrounding the Arklow Bank, and also dominating the north-east corner of the survey area
MCR.CSab	Circalittoral *Sabellaria* reefs	Present north-west of the survey area. Also small patches located to the west of the survey area towards Arklow.
MCR	Circalittoral rock or mixed substrata in moderately exposed environments.	Immediately to the east of the Arklow Bank.
MCR.Flu	*Flustra foliacea* and other hydroid/bryozoan turf species on slightly scoured circalittoral rock or mixed substrata	To the north-west of the survey area surrounding MCR.CSab
IMS	Infralittoral clean or muddy sand	Immediately within the vicinity of Arklow Town.

Table 3.3.1 Biotope classifications identified in baseline survey (Ecoserve, 2001)

The current data is presented in Table 3.3.2 with the sampling positions broadly classified using the JNCC classification scheme for marine biotopes. To facilitate comparison with the baseline data, the 1997 JNCC classification was used (Connor *et al.*, 1997).

	Biotope Classification		Biotope Classification
Station 1	IGS.FaS Shallow sand faunal communities [No Change]	***Station 11***	IGS.Scup.Hyd *Sertularia cupressina* and *Hydrallmania falcata* on tide swept sublittoral cobbles or pebbles in coarse sand [Previously MCR.CSab Circalittoral *Sabellaria* reefs.]
Station 2	IGS.FaS Shallow sand faunal communities [No Change]	***Station 12***	IGS.Mob Sparse fauna in infralittoral mobile clean sand [No Change]
Station 3	IGS.Mob Sparse fauna in infralittoral mobile clean sand [No Change]	***Station 13***	IGS.Mob Sparse fauna in infralittoral mobile clean sand [No Change]
Station 4	IGS.Mob Sparse fauna in infralittoral mobile clean sand [Previously MCR.Flu.SerHyd *Sertularia argentea*, *S. cupressina* and *Hydrallmania falcata* on tide swept circalittoral cobbles and pebbles]	***Station 14***	IGS.Mob Sparse fauna in infralittoral mobile clean sand [Previously MCR Circalittoral rock or mixed substrata in moderately exposed environments.]
Station 5	MCR Circalittoral rock or mixed substrata in moderately exposed environments [No Change]	***Station 15***	IGS.Mob Sparse fauna in infralittoral mobile clean sand [No Change]
Station 6	MCR.CSab Circalittoral *Sabellaria* reefs [No Change]	***Station 16***	IGS.Mob Sparse fauna in infralittoral mobile clean sand [No Change]
Station 7	MCR Circalittoral rock or mixed substrata in moderately exposed environments [Previously MCR.CSab Circalittoral *Sabellaria* reefs.]	***Station 17***	IGS.Mob Sparse fauna in infralittoral mobile clean sand [No Change]
Station 8	IGS.Mob Sparse fauna in infralittoral mobile clean sand [No Change]	***Station 18***	MCR Circalittoral rock or mixed substrata in moderately exposed environments [Previously MCR.Flu.Flu *Flustra foliacea* on slightly scoured silty circalittoral rock or mixed substrata]
Station 9	MCR.Flu.Flu (*Flustra foliacea* on slightly scoured silty circalittoral rock or mixed substrata [No Change]	***Station 19***	IGS.Mob Sparse fauna in infralittoral mobile clean sand [No Change]
Station 10	MCR Circalittoral rock or mixed substrata in moderately exposed environments [Previously MCR.CSab Circalittoral *Sabellaria* reefs.]	***Station 20***	IGS.Mob Sparse fauna in infralittoral mobile clean sand [No Change]

Table 3.3.2 Biotope classifications identified in the present survey (June 2011).

4. DISCUSSION AND CONCLUSIONS

As identified previously, the survey area is characterised by a range of sediments ranging from sands to gravels which is reflected in the fish and invertebrate species identified during the survey. Previous scientific reviews have shown that the fish species expected to be found in these habitats are quite characteristic. In sandy areas <50m depth species diversity is reported to be relatively high with many elasmobranchs, gadoids, wrasses and flatfish. This is similar to species found in gravel areas <50m depth (Nash, 1990). The fish species which were found in the present survey are consistent with those found in previous surveys. Overall fish species and abundances are similar to those observed in previous surveys, with marginal increase in taxa identified (14) and abundances (55) from surveys in 2010 and 2009. All species identified during the present and in previous trawl surveys are considered common throughout the survey area and within the Irish Sea (Ellis *et al*., 2000).

A total of 187 taxa were identified in the trawls during the present survey. Of these 187 taxa, 14 are fish species. Overall, the number of taxa identified is in keeping with previous surveys; the total number of taxa is higher than the June 2006 (98 taxa), June 2005 (47 taxa) and October 2004 (51 taxa) surveys and is similar to those identified in May 2007 (177 taxa), May 2008 (170 taxa), June 2009 (132 taxa) and 2010 (158 taxa).

Total numbers of countable organisms in the trawls (2,457) has increased from numbers identified in 2010 (1,819). Although numbers identified in the present survey are still much reduced from levels identified in 2007, this is directly related to the non-sampling of the *Sabellaria* reef identified in Trawl 3 that year.

The important *Sabellaria* reef communities identified in previous surveys were identified at only a single location in the present survey. These biogenic reefs are very important and are listed under Annex I of the EU Habitats Directive (Code 1170: Reefs). They play an important role in stabilising sediments, in addition to improving species diversity and community stability (Holt *et al*., 1998). It should be noted that the distribution of the *Sabellaria* reef communities throughout the survey area would be considered patchy, which is reflected in the sporadic identification of reef communities across various stations over the years.

A look at the biotopes present across the survey area in 2011 reveals a pattern which is largely similar to that idenftified in previous surveys. The Arklow Bank samples (Stations 8, 12, 16 & 17), in addition to the samples located to the south and west of the bank (Stations 3, 4, 12, 13, 14, 15, 16, 17, 19 & 20), are all classified as IGS.Mob (Sparse fauna in infralittoral mobile clean sand). A single station (S11) is classified as IGS.Scup.Hyd, which shows a change from MCR.CSab identified in 2010. Overall, the distribution of these habitats concur with the results of the baseline survey which showed similar distribution patterns for this community type (although it was interspersed with IGS.Scup.Hyd [*Sertularia cupressina* and *Hydrallmania falcata* on tide swept sublittoral cobbles or pebbles in coarse sand]). This is similar to results obtained in the survey of 2010. The main change identified in the present survey is a change from coarse sediment, and associated fauna, at Station 4 to finer, mobile sediments. This is the first time this has been classified as a fine sediment site.

As identified in 2010, Stations 1 & 2 remain classified as IGS.FaS (Shallow sand faunal communities). These stations have been previously classified as MCR (Station 2) and IGS.FaS.ScupHyd (Station 1). Further classification of these stations wasn't possible due to the absence of key identifying taxa.

As identified in 2009 and 2010, a single station along the eastern part of the Arklow Bank (Station 9) is classified as MCR.Flu.Flu (*Flustra* foliacea on slightly scoured silty circalittoral rock or mixed substrata). A further four stations (Stations 5, 7, 10 & 18) are all classified as MCR (Circalittoral rock or mixed substrata in moderately exposed environments). These results are similar to those identified in previous surveys.

Reef communities were identified at only a single location during the present survey (Station 6). As previously reported, the reefs around the Arklow Bank would be considered patchy,

and this is reflected in the variation of *Sabellaria* abundances and the sporadic identification of these reefs across the years. The largest number of reef sites identified within the survey area was in 2005, when a total of 5 reef sites were identified; three reef sites were identified in 2009 & 2004; two sites in 2006; one site in 2007; and no reef sites were identified in 2008.

The number of countable fauna identified in the present survey is much reduced compared to previous surveys, with a total of 2,876 countable fauna identified in the 2011 survey. This is a large decrease from abundances identified in all previous surveys. The main reason for this is the reduction in abundances of the keelworm *Pomatoceros* spp. which was present in small numbers in the present survey compared to previous surveys. In addition, only 1 station returned significant numbers of the reef forming polychaete *Sabellaria* spp during the course of the present survey.

There have been no records in the present survey of rare or unusual species. This is concurrent with findings in previous surveys with no rare or unusual species recorded in the survey area.

Overall results from the present survey indicate that, by and large, there is very little variation at the community level between the communities recorded in the present survey and the communities recorded in the baseline survey although some local changes at a number of sites have been identified.

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6. APPENDICES

Appendix 6.1 Species List for Beam Trawl Survey; June 2011

Annelida
Adyte pellucida
Amphitritides gracilis
Aphrodita aculeata
Autolytus indet.
Branchiomma bombyx
Eulalia aurea
Eulalia expusilla
Eulalia ornata
Eumida juv. indet.
Eumida ockelmanni
Eumida sanguinea
Euphrosine foliosa
Eupolymnia nebulosa
Eusyllis blomstrandi
Exogone naidina
Exogone verugera
Flabelligera affinis
Harmothoe indet.
Harmothoe spinifera
Hydroides norvegicus
Jasmineira elegans
Lanice conchilega
Lepidonotus squamatus
Maldanidae indet.
Malmgrenia indet.
Marphysa sanguinea
Micromaldane ornithochaeta
Nereiphylla rubiginosa
Nereis elitoralis
Nereis longissima
Nereis zonata
Nicolea venustula
Pholoe inornata
Pista cristata
Pista maculata
Polycirrus norvegicus
Polydora cf. socialis
Polydora indet.
Polynoe scolopendrina
Pomatoceros lamarcki
Procerastea sp.

Annelida
Sabella pavonina
Sabellaria alveolata
Sabellaria spinulosa
Sphaerosyllis erinaceus
Sphaerosyllis taylori
Spinther oniscoides
Spio armata
Sthenelais boa
Streblosoma intestinalis
Syllis indet.
Syllis sp. A
Syllis sp. H
Syllis variegata
Thelepus cincinnatus
Thelepus setosus
Arthropoda
Nymphon brevirostre
Phoxichilidium femoratum
Pycnogonum littorale
Crustacea
Aora gracilis
Aoridae sp. females
Atylus swammerdami
Balanus crenatus
Cancer pagurus
Cheirocratus sundevalli
Corophium
Crangon allmanni
Cressa dubia
Epimeria cornigera
Eualus cranchii
Hippolyte varians
Hyas coarctatus
Idotea emarginata
Iphimedia
Liocarcinus holsatus
Liocarcinus sp juv.
Liocarcinus vernalis
Macropodia rostrata
Metopa
Pagurus bernhardus
Pagurus prideaux

Crustacea
Pandalina brevirostris
Pandalus montagui
Paramysis arenosa
Pariambus typicus
Pasiphaea sivado
Photis
Phtisica marina
Pilumnus hirtellus
Pisidia longicornis
Stenothoe
Xantho pilipes
Bryozoa
Alcyonidium diaphanum
Alcyonidium parasiticum
Alcyonium digitatum
Amathia lendigera
Bicellariella biciliata
Bryozoa indet.
Bugula flabellata
Bugula stolonifera
Celleporella hyalina
Crisia eburnea
Electra pilosa
Eucratea loricata
Flustra foliacea
Membranipora membranacea
Cnidaria
Abietinaria abietina
Actinia equina
Actiniaria indet.
Adamsia carciniopodes
Campanularia sp. indet
Halecium halecinum
Hydractinia echinata
Hydrallmania falcata
Hydroidea indet
Metridium senile
Nemertesia antennina
Obelia cf longissima
Sertularia cupressina
Tubularia indivisa

Echinodermata

Amphipholis squamata
Asterias rubens
Crossaster papposus
Echinocyamus pusillus
Henricia sanguinolenta
Ophiothrix fragilis
Psammechinus miliaris

Mollusca

Abra alba
Acanthochitona cf fascicularis
Acanthodoris pilosa
Adalaria loveni
Aeolidia cf papillosa
Aequipecten opercularis
Astarte sulcata
Buccinum undatum
Calliostoma lyonsii
Calliostoma zizyphinum
Colus jeffreysianus
Cuthona sp
Dendronotus frondosus
Doto coronata
Doto fragilis
Doto hystrix
Euspira catena
Euspira pulchella
Heteranomia squamula
Hiatella arctica
Jujubinus montagui
Lepidopleurus asellus
Leptochiton asellus
Modiolarca subpicta
Modiolus modiolus
Musculus costulatus
Mytilus edulis
Necora puber
Nudibranchia indet.
Onchidoris muricata
Sepiola atlantica
Spisula elliptica
Tritonia hombergi
Tritonia sp

Nemertea

Nemertea indet.

Pisces

Agonus cataphractus
Ammodytes tobanius
Aspitrigla cuculus
Callionymus lyra
Echiichthys vipera
Gobiusculus flavescens
Hyperoplus lanceolatus
Liparis montagui
Merlangius merlangius
Pleuronectes platessa
Scyliorhinus caniculus
Syngnathus rostellatus
Taurulus bubalis
Zeus faber

Porifera

Porifera indet
Scypha compressa
Sycon sp. indet

Sipuncula

Golfingia vulgaris
Nephasoma minutum

Tunicata

Ascidiella aspera
Dendrodoa grossularia
Polyclinidae indet

Appendix 6.2 Species List for Anchor Dredge Survey; June 2011

Annelid
Ampharete lindstroemi
Amphitritides gracilis
Anobothrus gracilis
Aonides oxycephala
Aonides paucibranchiata
Aphelochaeta sp. A
Asclerocheilus sp. 1
Autolytus indet.
Caulleriella alata
Caulleriella zetlandica
Chaetozone sp.
Cirrophorus branchiatus
Clymenura johnstoni
Ehlersia ferrugina
Eteone foliosa
Eteone longa
Euchone rubrocincta
Euclymene oerstedii
Eulalia aurea
Eulalia ornata
Eulalia viridis
Eumida juv. indet.
Eumida ockelmanni
Eusyllis blomstrandi
Exogone verugera
Galthowenia oculata
Glycera lapidum
Glycera oxycephala
Glycera tridactyla
Goniada maculata
Harmothoe indet.
Hydroides norvegicus
Jasmineira elegans
Kefersteinia cirrata
Lagis koreni
Lanice conchilega
Laonice bahusiensis
Lepidonotus squamatus
Lumbrineris gracilis
Macrochaeta helgolandica
Maldanidae indet.
Malmgrenia indet.
Marphysa sanguinea
Mediomastus fragilis
Nematonereis unicornis
Nephtys caeca
Nephtys cirrosa
Nephtys kersivalensis
Nephtys hombergii

Annelid
Nephtys longosetosa
Nereis longissima
Nicomache personata
Notocirrus scoticus
Notomastus latericeus
Odontosyllis fulgurans
Ophelia borealis
Ophelina acuminata
Orbinia sertulata
Owenia fusiformis
Paraonidae indet.
Pholoe inornata
Pholoe synophthalmica
Phyllodoce groenlandica
Podarkeopsis capensis
Poecilochaetus serpens
Polycirrus medusa
Polycirrus norvegicus
Polydora indet.
Polynoe scolopendrina
Pomatoceros lamarcki
Praxillella affinis
Pseudonotomastus southerni
Pseudopolydora pulchra
Sabella pavonina
Sabellaria alveolata
Sabellaria spinulosa
Scalibregma celticum
Scoloplos armiger
Sphaerosyllis taylori
Spio armata
Spio decorata
Spio martinensis
Spiochaetopterus typicus
Spiophanes bombyx
Sthenelais boa
Syllis armillaris
Syllis sp. H
Syllis variegata
Terebellidae indet.
Tharyx killariensis
Thelepus cincinnatus
Thelepus setosus
Travisia forbesii
Bryozoa
Alcyonidium diaphanum
Bicellariella biciliata
Clymenura tricirrata
Conopeum reticulum

Bryozoa
Electra pilosa
Escharella variolosa
Eucratea loricata
Flustra foliacea
Vesicularia spinosa
Chelicerata
Nymphon brevirostre
Cnidaria
Abietinaria abietina
Actiniaria indet
Campanularia sp. indet
Cerianthus lloydii
Edwardsia claparedii
Hydrallmania falcata
Nemertesia antennina
Obelia cf longissima
Tubularia
Crustacea
Ampelisca tenuicornis
Atylus swammerdami
Bathyporeia guilliamsoniana
Corophium
Corophium bonelli
Crangon allmanni
Gnathia sp.
Maera sp
Pagurus bernhardus
Pisidia longicornis
Urothoe elegans
Urothoe marina
Xantho pilipes
Cancer pagurus
Cheirocratus sundevalli
Corystes cassivelaunus
Siphonocetes kroyeranus
Echinodermata
Amphiura filiformis
Asterias rubens
Leptosynapta indet.
Ophiothrix fragilis
Ophiura ophiura
Psamechinus miliaris
Hemichordata
Saccoglossus indet.
Mollusc
Abra nitida
Hiatella arctica
Lepidopleurus asellus
Modiolus modiolus

Mollusc
Nucula nucleus
Nudibranch indet
Timoclea ovata
Trivia arctica
Diodora graeca
Monia patelliformis
Nemertea
Cerebratulus sp. 1
Nemertea indet.
Tubulanus polymorphus
Cephalothricidae indet.
Phoronida
Phoronis indet.
Platyhelminthes
Platyhelminth sp
Porifera
Porifera indet
Sipuncula
Golfingia vulgaris
Golfingia elongata
Nephasoma minutum
Sipuncula juv. indet.
Phascolion strombi
Phascolion strombus
Tunicata
Ascidiella scabra
Ascidiella aspera
Dendrodoa grossularia
Triteata sp.

Appendix 6.3 Total results from the Beam Trawl June 2011

Trawl Description

	Trawl 1	Trawl 2	Trawl 3	Trawl 4	Trawl 5	Trawl 6
Description	Good Trawl Sample, contains Bryozoans & Starfish	Good Trawl Sample with Bryozoans	Good Trawl Sample with Bryozoans	Good Trawl Sample, contains Bryozoans & Starfish	Good Trawl Sample with Bryozoans & urchins	Good Trawl Sample with shell & shell gravel
Date of hauling	07/06/2011	07/06/2011	07/06/2011	07/06/2011	07/06/2011	07/06/2011
Time of hauling	1430	1610	1020	2227	1808	2010
Layback/warp (m)	70	100	75	120	100	125
Speed of Vessel (kts)	2	2.1	2	2.2	2	2.2
Vessel Bearing	180°	0°	180°	180°	0°	0°

Table of Contents for the Beam Trawls taken during the course of the June 2011 survey.

	Trawl 1	Trawl 2	Trawl 3	Trawl 4	Trawl 5	Trawl 6
Abietinaria abietina	0	0	P	P	0	0
Abra alba	2	0	0	1	0	0
Acanthochitona cf fascicularis	3	0	0	0	1	0
Acanthodoris pilosa	1	0	0	0	0	0
Actinia equina	0	0	0	0	0	P
Actiniaria indet.	1	0	0	0	0	1
Adalaria loveni	2	0	0	0	0	0
Adamsia carcinopodes	0	0	0	0	0	P
Adyte pellucida	1	0	0	3	1	0
Aeolidia cf papillosa	0	0	0	0	1	0
Aequipecten opercularis	0	0	0	0	4	0
Alcyonidium diaphanum	P	0	0	P	P	P
Alcyonidium parasiticum	P	P	0	0	0	P
Alcyonium digitatum	0	0	0	0	P	0
Amathia lendigera	P	P	0	0	0	0
Ammodytes tobanius	0	0	0	2	2	2
Amphipholis squamata	4	0	0	0	0	0
Amphitritides gracilis	1	0	0	1	0	0
Aora gracilis	1	0	0	0	0	0
Aoridae sp. females	0	1	0	0	0	0
Aphrodita aculeata	1	0	0	0	1	1
Apogon cataphractus	2	8	0	2	3	0
Ascidiella aspera	P	P	0	0	0	0
Aspitrigla cuculus	0	1	0	0	0	0
Astarte sulcata	0	1	0	0	0	0
Asterias rubens	74	3	0	13	11	11
Atylus swammerdami	0	1	0	0	0	1
Autolytus indet.	1	0	0	0	1	1
Balanus crenatus	0	0	P	0	0	0
Bicellariella biciliata	0	0	0	P	0	P
Branchiomma bombyx	1	1	0	0	1	0
Bryozoa	P	0	0	0	0	P
Buccinum undatum	25	0	0	2	0	0

	Trawl 1	Trawl 2	Trawl 3	Trawl 4	Trawl 5	Trawl 6
Bugula flabellata	P	P	0	0	0	P
Bugula stolonifera	P	0	0	0	0	0
Callionymus lyra	4	0	0	2	2	0
Calliostoma lyonsii	1	0	0	0	0	0
Calliostoma zizyphinum	0	0	0	0	1	0
Campanularia sp. indet	P	0	0	P	0	0
Cancer pagurus	1	0	0	0	0	0
Celleporella hyalina	0	0	0	0	P	P
Cheirocrates sundevalli	0	1	0	0	0	0
Colus jeffreysianus	1	0	0	0	0	0
Corophium	3	0	0	0	0	0
Crangon allmanni	34	14	0	28	65	97
Cressa dubia	1	0	0	0	0	0
Crisia eburnea	P	0	0	0	0	0
Crossaster papposus	13	0	0	2	0	1
Cuthona sp	0	0	0	0	0	3
Dendrodoa grossularia	P	0	0	0	0	0
Dendronotus frondosus	0	0	0	3	0	0
Doto coronata	0	0	0	0	0	1
Doto fragilis	33	0	0	0	0	0
Doto hystrix	1	2	0	0	1	0
Echiichthys vipera	0	0	5	0	0	0
Echinocyamus pusillus	0	0	0	0	1	0
Electra pilosa	P	0	P	0	0	0
Epimeria cornigera	0	0	0	0	0	3
Eualus cranchii	8	0	0	0	0	2
Eucratea loricata	P	P	0	P	0	0
Eulalia aurea	2	0	0	0	1	0
Eulalia expusilla	1	0	0	0	0	0
Eulalia ornata	12	0	0	0	0	0
Eumida juv. indet.	1	0	0	1	1	1
Eumida ockelmanni	4	0	0	0	0	0
Eumida sanguinea	2	0	0	0	0	0
Euphrosine foliosa	1	1	0	0	0	0
Eupolymnia nebulosa	0	0	0	0	1	0
Euspira catena	1	0	0	0	0	0
Euspira pulchella	0	0	0	1	0	0
Eusyllis blomstrandi	4	0	0	0	2	4
Exogone naidina	2	0	0	0	0	0
Exogone verugera	3	0	0	0	0	0
Flabelligera affinis	1	0	0	0	0	0
Flustra foliacea	P	P	P	P	P	P
Gobiusculus flavescens	1	0	0	0	0	0
Golfingia vulgaris	0	0	0	0	0	1
Halecium halecinum	0	0	0	P	0	0
Harmothoe indet.	4	0	0	3	6	2
Harmothoe spinifera	2	0	0	0	0	0
Henricia sanguinolenta	4	0	0	0	0	0
Heteranomia squamula	0	0	0	1	1	0
Hiatella arctica	4	0	0	1	1	2
Hippolyte varians	62	0	0	4	3	3
Hyas coarctatus	17	0	0	2	0	0
Hydractinia echinata	P	P	0	0	0	P

	Trawl 1	Trawl 2	Trawl 3	Trawl 4	Trawl 5	Trawl 6
Hydrallmania falcata	P	0	0	0	P	P
Hydroidea indet	0	0	0	0	0	P
Hydroides norvegicus	0	0	0	0	2	0
Hyperoplus lanceolatus	0	1	4	0	0	0
Idotea emarginata	0	5	0	0	1	0
Iphimedia	1	0	0	0	0	0
Jasmineira elegans	35	1	0	0	1	3
Jujubinus montagui	0	0	0	1	0	0
Lanice conchilega	12	3	0	0	0	6
Lepidonotus squamatus	11	0	0	3	13	2
Lepidopleurus asellus	0	0	0	7	53	2
Leptochiton asellus	0	0	0	0	1	0
Liocarcinus holsatus	0	0	0	0	1	5
Liocarcinus sp juv.	4	11	0	12	0	0
Liocarcinus vernalis	0	0	0	1	0	0
Liparus montagui	0	0	0	0	1	0
Macropodia rostrata	67	10	0	8	15	31
Maldanidae indet.	0	0	0	0	0	P
Malmgrenia indet.	0	0	0	P	0	0
Marphysa sanguinea	0	0	0	0	0	1
Membranipora membranacea	0	P	0	0	0	0
Merlangius merlangius	0	1	0	0	0	0
Metopa	1	0	0	0	0	0
Metridium senile	0	0	0	0	0	P
Micromaldane ornithochaeta	1	0	0	0	0	0
Modiolarca subpicta	1	0	0	0	0	0
Modiolus modiolus	6	1	0	9	0	1
Musculus costulatus	0	0	0	1	0	0
Mytilus edulis	1	0	0	3	0	1
Necora puber	1	0	0	0	0	0
Nemertea indet.	0	0	0	0	1	1
Nemertesia antennina	P	P	0	0	P	0
Nephasoma minutum	7	0	0	0	0	1
Nereiphylla rubiginosa	0	0	0	0	1	0
Nereis elitoralis	0	0	0	0	0	1
Nereis longissima	1	0	0	3	0	0
Nereis zonata	0	0	0	0	0	9
Nicolea venustula	0	1	0	0	0	0
Nudibranchia indet.	0	0	0	0	0	5
Nymphon brevirostre	0	0	0	0	0	1
Obelia cf longissima	P	0	0	0	0	0
Onchidoris muricata	0	1	0	0	0	0
Ophiothrix fragilis	3	1	0	0	1	1
Pagurus bernhardus	48	10	25	19	14	30
Pagurus prideaux	0	0	0	0	0	1
Pandalina brevirostris	1	0	0	0	0	0
Pandalus montagui	127	2	0	18	13	10
Paramysis arenosa	1	1	0	0	0	1
Pariambus typicus	1	0	0	0	0	0
Pasiphaea sivado	0	0	0	0	0	1
Pholoe inornata	1	0	0	0	0	0
Photis	2	0	0	0	0	0
Phoxichilidium femoratus	0	0	0	0	0	1

	Trawl 1	Trawl 2	Trawl 3	Trawl 4	Trawl 5	Trawl 6
Phtisica marina	1	0	0	0	0	0
Pilumnus hirtellus	1	0	0	0	0	0
Pisidia longicornis	6	3	0	42	0	15
Pista cristata	1	0	0	0	0	0
Pista maculata	0	0	0	0	0	1
Pleuronectes platessa	4	0	0	0	0	0
Polycirrus norvegicus	4	0	0	1	0	0
Polyclinidae indet	P	0	0	0	0	0
Polydora cf. socialis	0	0	0	0	1	0
Polydora indet.	1	0	0	0	0	0
Polynoe scolopendrina	6	0	0	0	2	1
Pomatoceros lamarcki	1	0	2	8	19	2
Porifera indet	P	0	0	P	0	P
Proceraea sp.	2	0	0	0	0	0
Psammechinus miliaris	33	0	0	1	66	4
Pycnogonum littorale	0	1	0	1	0	0
Sabella pavonina	0	0	0	0	0	1
Sabellaria alveolata	650	1	0	0	0	0
Sabellaria spinulosa	15	1	0	11	1	0
Scyliorhinus caniculus	1	1	0	0	1	0
Scypha compressa	0	0	0	0	0	P
Sepiola atlantica	1	1	0	0	0	0
Sertularia cupressina	P	0	0	0	P	0
Sphaerosyllis erinaceus	1	0	0	0	0	0
Sphaerosyllis taylori	2	0	0	0	0	0
Spinther oniscoides	3	0	0	0	0	0
Spio armata	1	0	0	0	0	0
Spisula elliptica	0	1	0	1	0	2
Stenothoe	1	0	0	0	0	0
Sthenelais boa	2	0	0	0	0	0
Streblosoma intestinalis	1	0	0	0	0	0
Sycon sp. indet	P	0	0	0	0	0
Syllis indet.	1	0	0	0	0	0
Syllis sp. A	0	0	0	0	4	0
Syllis sp. H	1	0	0	0	0	0
Syllis variegata	10	0	0	0	0	0
Syngnathus rostellatus	0	1	0	0	0	0
Taurulus bubalus	0	1	0	0	0	0
Thelepus cincinnatus	0	0	0	1	21	17
Thelepus setosus	14	3	0	1	5	1
Tritonia hombergi	0	0	0	0	1	1
Tritonia sp	4	1	0	0	0	0
Tubularia indivisa	0	0	0	0	0	P
Xantho pilipes	0	0	0	0	1	1
Zeus faber	1	0	0	0	0	0

Appendix 6.4 Total fish numbers and lengths

	Trawl 1	Trawl 2	Trawl 3	Trawl 4	Trawl 5	Trawl 6
Callionymus lyra	4 [7,8,9,9]			2 [16, x]	2 [18,8]	
Pleuronectes platessa	4 [16,17,12,12]					
Ammodytes tobanius				2 [3,3]	2 [4, x]	1 [x]
Echiichthys vipera			5 [10,7,7,5,6]			
Merlangius merlangius		1 [4]				
Hyperoplus lanceolatus		1 [15]	4 [15,12,10,10]			
Scyliorhinus caniculus	1 [59]	1 [51]			1 [57]	
Zeus faber	1 [15]					
Agonus cataphractus	2 [x]	8 [x]		2 [x]	3 [x]	
Aspitrigla cuculus		1 [22]				
Syngnathus rostellatus		1 [15]				
Gobiusculus flavescens	1 [x]					
Liparis montagui					1 [x]	
Taurulus bubalis		1 [x]				

Measurements in mm (where possible) of all fish species; June 2011 (x denotes no measurement taken).

Appendix 6.5 Anchor dredge raw data, June 2011

		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Annelid	*Ampharete lindstroemi*	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
Annelid	*Amphitritides gracilis*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Anobothrus gracilis*	-	-	-	-	-	-	-	-	-	-	7	-	-	-	-	-	-	-	-	-
Annelid	*Aonides oxycephala*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Aonides paucibranchiata*	-	1	-	-	-	-	1	-	1	1	-	-	-	1	-	-	-	-	-	-
Annelid	*Aphelochaeta sp. A*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Asclerocheilus sp. 1*	-	-	-	-	-	3	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Annelid	*Autolytus indet.*	-	-	-	-	1	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-
Annelid	*Caulleriella alata*	6	-	-	-	-	-	-	-	1	2	2	-	-	-	1	-	-	-	-	-
Annelid	*Caulleriella zetlandica*	3	-	-	-	-	-	-	-	2	1	1	-	-	-	-	-	-	-	-	-
Annelid	*Chaetozone sp.*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Cirrophorus branchiatus*	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Annelid	*Clymenura johnstoni*	7	-	-	-	-	-	5	-	6	19	12	-	-	-	-	-	-	-	-	-
Annelid	*Ehlersia ferrugina*	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Eteone foliosa*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Eteone longa*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Euchone rubrocincta*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Annelid	*Euclymene oerstedii*	10	-	-	-	-	-	-	-	-	-	6	-	-	2	-	-	-	-	-	-
Annelid	*Eulalia aurea*	-	-	-	2	-	4	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Eulalia ornata*	-	-	-	-	-	22	1	-	1	1	-	-	-	-	-	-	-	-	-	-
Annelid	*Eulalia viridis*	-	-	-	-	-	1	1	-	-	1	-	-	-	-	-	-	-	-	-	-
Annelid	*Eumida juv. indet.*	-	-	-	-	-	-	2	-	-	2	-	-	-	-	-	-	-	-	-	-
Annelid	*Eumida ockelmanni*	-	-	-	-	-	5	2	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Eusyllis blomstrandi*	-	-	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-
Annelid	*Exogone verugera*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Annelid	*Galthowenia oculata*	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Annelid	*Glycera lapidum*	-	-	-	-	-	-	-	-	2	1	-	-	-	-	2	-	-	-	-	-
Annelid	*Glycera oxycephala*	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-
Annelid	*Glycera tridactyla*	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Goniada maculata*	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Annelid	*Harmothoe indet.*	-	-	-	-	-	3	1	-	-	1	-	-	-	-	-	-	-	-	-	-
Annelid	*Hydroides norvegicus*	-	-	-	-	-	-	1	-	-	1	3	-	-	-	-	-	-	-	-	-
Annelid	*Jasmineira elegans*	-	-	-	-	-	41	9	-	5	6	10	-	-	-	-	-	-	-	-	-
Annelid	*Kefersteinia cirrata*	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Lagis koreni*	4	-	-	-	-	-	-	-	-	3	4	-	-	-	-	-	-	-	-	-
Annelid	*Lanice conchilega*	24	-	-	-	-	-	1	-	3	3	5	-	-	-	-	-	-	-	-	-
Annelid	*Laonice bahusiensis*	-	2	-	-	-	-	-	-	-	1	1	-	-	1	-	-	-	-	-	-
Annelid	*Lepidonotus squamatus*	-	-	-	-	-	2	1	-	1	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Lumbrineris gracilis*	2	5	-	-	-	-	-	-	3	6	9	-	-	7	-	-	-	-	-	-
Annelid	*Macrochaeta helgolandica*	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Maldanidae indet.*	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Annelid	*Malmgrenia indet.*	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Annelid	*Marphysa sanguinea*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Annelid	*Mediomastus fragilis*	3	-	-	-	-	1	2	-	1	1	-	-	-	-	-	-	-	-	-	-
Annelid	*Nematonereis unicornis*	-	1	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-
Annelid	*Nephtys caeca*	3	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Annelid	*Nephtys cirrosa*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
Annelid	*Nephtys hombergii*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Annelid	*Nephtys kersivalensis*	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Annelid	*Nephtys longosetosa*	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-
Annelid	*Nereis longissima*	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Nicomache personata*	-	-	-	-	-	-	-	-	-	2	1	1	-	-	-	-	-	-	-	-
Annelid	*Notocirrus scoticus*	1	-	-	-	-	-	-	-	-	1	3	-	-	1	-	-	-	-	-	-
Annelid	*Notomastus latericeus*	2	-	-	-	-	1	-	-	1	10	1	-	-	-	-	-	-	-	12	1
Annelid	*Odontosyllis fulgurans*	-	1	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-

		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Annelid	*Ophelia borealis*	-	-	-	2	-	1	-	1	4	-	-	-	-	-	-	1	-	10	1	-
Annelid	*Ophelina acuminata*	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-
Annelid	*Orbinia sertulata*	-	6	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
Annelid	*Owenia fusiformis*	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Annelid	*Paraonidae indet.*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Pholoe inornata*	1	-	-	-	-	1	-	-	1	2	1	-	-	-	-	-	-	-	-	-
Annelid	*Pholoe synophthalmica*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Phyllodoce groenlandica*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Annelid	*Podarkeopsis capensis*	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Annelid	*Poecilochaetus serpens*	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Annelid	*Polycirrus medusa*	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	3	-	-
Annelid	*Polycirrus norvegicus*	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-
Annelid	*Polydora indet.*	-	-	-	1	1	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Polynoe scolopendrina*	-	-	-	-	1	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-
Annelid	*Pomatoceros lamarcki*	-	-	-	24	23	3	1252	-	6	1	6	-	-	-	1	-	-	2	-	-
Annelid	*Praxillella affinis*	2	-	-	-	-	-	-	-	-	5	3	-	-	-	-	-	-	-	-	-
Annelid	*Pseudonotomastus southerni*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-
Annelid	*Pseudopolydora pulchra*	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Annelid	*Sabella pavonina*	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	-
Annelid	*Sabellaria alveolata*	-	-	-	-	-	426	35	-	3	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Sabellaria spinulosa*	-	-	-	-	1	3	17	-	23	99	9	-	-	2	-	-	-	-	-	-
Annelid	*Scalibregma celticum*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Annelid	*Scoloplos armiger*	80	2	-	-	-	-	-	-	10	7	7	-	-	-	-	-	-	-	-	-
Annelid	*Sphaerosyllis taylori*	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-
Annelid	*Spio armata*	-	-	-	-	-	8	4	-	8	3	3	-	-	-	-	-	-	-	-	-
Annelid	*Spio decorata*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Spio martinensis*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1
Annelid	*Spiochaetopterus typicus*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Annelid	*Spiophanes bombyx*	5	1	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-

		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Annelid	*Sthenelais boa*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Syllis armillaris*	-	-	-	-	-	1	-	-	3	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Syllis sp. H*	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Syllis variegata*	-	-	-	-	1	13	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Annelid	*Terebellidae indet.*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annelid	*Tharyx killariensis*	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
Annelid	*Thelepus cincinnatus*	-	-	-	-	-	-	-	-	2	1	1	-	-	-	-	-	-	-	-	-
Annelid	*Thelepus setosus*	-	-	-	-	2	1	-	-	-	2	2	-	-	-	-	-	-	-	-	-
Annelid	*Travisia forbesii*	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Bryozoa	*Alcyonidium diaphanum*	P	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-
Bryozoa	*Bicellariella biciliata*	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bryozoa	*Clymenura tricirrata*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Bryozoa	*Conopeum reticulum*	-	-	-	-	P	-	-	-	-	P	P	-	-	-	-	-	-	-	-	-
Bryozoa	*Electra pilosa*	-	-	-	-	P	-	P	-	P	P	P	-	-	-	-	-	-	-	-	-
Bryozoa	*Escharella variolosa*	-	-	-	-	-	-	-	-	P	-	-	-	-	P	-	-	-	-	-	-
Bryozoa	*Eucratea loricata*	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bryozoa	*Flustra foliacea*	-	P	-	-	P	P	-	-	P	-	-	-	-	-	-	P	-	-	-	-
Bryozoa	*Vesicularia spinosa*	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-
Chelicerata	*Nymphon brevirostre*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Cnidaria	*Abietinaria abietina*	-	-	-	-	-	P	-	-	P	P	-	-	-	-	-	P	-	-	-	-
Cnidaria	*Actiniaria indet*	-	-	-	-	-	-	-	-	-	-	P	-	-	P	-	-	-	-	-	-
Cnidaria	*Campanularia sp. indet*	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cnidaria	*Cerianthus lloydii*	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Cnidaria	*Edwardsia claparedii*	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-
Cnidaria	*Hydrallmania falcata*	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	P	-	-
Cnidaria	*Nemertesia antennina*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	P	-	-
Cnidaria	*Obelia cf longissima*	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cnidaria	*Tubularia*	-	-	-	-	-	-	P	-	-	-	P	-	-	-	-	-	-	-	-	-
Crustacea	*Ampelisca tenuicornis*	-	-	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-

		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Crustacea	*Atylus swammerdami*	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Crustacea	*Bathyporeia guilliamsoniana*	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crustacea	*Cancer pagurus*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crustacea	*Cheirocrates sundevalli*	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-
Crustacea	*Corophium*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crustacea	*Corophium bonelli*	-	-	-	-	-	6	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Crustacea	*Corystes cassivelaunus*	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Crustacea	*Crangon allmanni*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Crustacea	*Gnathia sp.*	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Crustacea	*Gnathia sp. (praniza)*	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crustacea	*Maera sp*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Crustacea	*Pagurus bernhardus*	-	-	-	-	-	1	-	-	4	2	-	-	-	-	-	-	-	-	-	-
Crustacea	*Pisidia longicornis*	-	-	-	-	-	38	1	-	2	-	-	-	-	-	-	-	-	-	-	-
Crustacea	*Siphonocoetes kroyeranus*	-	-	-	-	1	5	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Crustacea	*Urothoe elegans*	-	-	-	-	-	8	5	-	-	1	-	-	-	-	-	-	-	1	-	-
Crustacea	*Urothoe marina*	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-	-	-	-
Crustacea	*Xantho pilipes*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Echinodermata	*Amphiura filiformis*	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Echinodermata	*Asterias rubens*	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Echinodermata	*Leptosynapta indet.*	1	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Echinodermata	*Ophiothrix fragilis*	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-
Echinodermata	*Ophiura ophiura*	1	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-
Echinodermata	*Psammechinus miliaris*	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-
Hemichordata	*Saccoglossus indet.*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mollusc	*Abra nitida*	26	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Mollusc	*Diodora graeca*	-	-	-	-	1	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mollusc	*Hiatella arctica*	-	-	-	-	-	10	1	-	-	-	3	-	-	-	-	-	-	1	-	-
Mollusc	*Lepidopleurus asellus*	-	-	-	-	1	-	-	-	-	14	10	-	-	1	-	-	-	-	-	-
Mollusc	*Modiolus modiolus*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-

		S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Mollusc	*Monia patelliformis*	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mollusc	*Nucula nucleus*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	12	-	-
Mollusc	*Nudibranch indet*	-	-	-	-	-	2	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Mollusc	*Timoclea ovata*	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mollusc	*Trivia arctica*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Nemertea	*Cephalothricidae indet.*	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Nemertea	*Cerebratulus sp. 1*	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Nemertea	*Flatworm*	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nemertea	*Nemertea indet.*	2	1	-	-	3	6	-	-	-	1	3	-	-	1	1	-	-	-	-	1
Nemertea	*Tubulanus polymorphus*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Phoronida	*Phoronis indet.*	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Platyhelminthes	*Platyhelminth sp*	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Porifera	*Porifera indet*	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-	-	-	P	-	-
Sipuncula	*Golfingia elongata*	-	-	-	-	-	3	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Sipuncula	*Golfingia vulgaris*	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Sipuncula	*Nephasoma minutum*	-	-	-	-	-	2	1	-	-	1	1	-	-	-	-	-	-	-	-	-
Sipuncula	*Phascolion strombi*	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-
Sipuncula	*Phascolion strombus*	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-
Sipuncula	*Sipuncula juv. indet.*	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Tunicata	*Ascidiella aspera*	-	-	-	-	P	P	-	-	P	-	-	-	-	-	-	-	-	-	-	-
Tunicata	*Ascidiella scabra*	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tunicata	*Dendrodoa grossularia*	-	-	-	-	-	-	-	-	-	-	P	-	-	-	-	-	-	-	-	-
	Triteata sp.	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total number of Taxa (June 2011)	38	17	0	4	18	50	28	1	44	60	54	3	2	16	6	3	1	12	6	6
	Total number of Indiviuals (June 2011)	208	27	0	29	38	642	1349	1	114	232	141	3	2	24	7	1	1	34	17	6
	Total number of Taxa (June 2010)	42	20	1	30	10	48	49	0	19	67	38	2	9	69	16	3	3	69	5	5
	Total number of Indiviuals (June 2010)	161	46	2	743	172	801	1720	0	97	1670	1320	3	27	242	46	4	3	1320	8	11

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	S17	S18	S19	S20
Total number of Taxa (June 2009)	47	61	0	49	22	63	53	2	10	48	61	5	4	66	16	1	1	64	9	3
Total number of Indiviuals (June 2009)	380	254	0	1529	84	587	4355	3	34	1474	2613	31	16	243	24	1	2	912	17	5
Total number of Taxa (May 2008)	24	42	3	49	52	64	50	0	20	48	17	6	3	34	13	1	1	83	6	11
Total number of Individuals (May 2008)	94	144	2	4666	737	306	891	0	26	115	65	7	3	73	21	1	0	471	12	17
Total number of Taxa (May 2007)	40	45	2	44	83	73	51	1	31	55	38	2	5	74	13	1	1	67	13	4
Total number of Individuals (May 2007)	50	71	1	6158	9061	796	573	0	25	169	74	0	5	169	5	1	0	594	45	3
Total number of Taxa (June 2006)	39	56	11	94	131	17	102	0	94	83	64	2	8	128	5	1	2	116	4	4
Total number of Individuals (June 2006)	68	179	8	12896	4531	347	1433	0	1159	374	200	2	9	742	13	1	3	2793	17	4
Total number of Taxa (June 2005)	95	38	6	121	155	128	129	8	96	117	108	7	19	125	13	9	5	167	13	15
Total number of Individuals (June 2005)	816	67	1	7872	7806	9669	1887	2	590	897	2216	1	12	1584	39	5	1	16324	8	14
Total number of Taxa (Oct 2004)	74	40	9	102	113	106	76	1	70	116	99	4	4	115	3	5	3	125	7	5
Total number of Individuals (Oct 2004)	450	101	21	5154	2126	3919	3247	1	1818	1176	4071	6	7	998	3	10	3	8972	9	5

Appendix 6.6 Particle Size Analysis: June 2011.

Site Code	4mm	2mm	1mm	0.5mm	0.25mm	0.125mm	0.063mm	<0.063mm	Mean phi	skewness	kurtosis	Classification after Buchanan	Folk Triangles after BGS
D01	17.25	5.11	1.25	4.03	8.15	55.33	2.47	6.41	1.17	-0.62	1.36	Very Poorly Sorted Fine Gravelly Fine Sand	Gravelly Sand
D02	10.07	11.68	7.53	6.73	17.73	43.72	0.69	1.85	1.16	-0.56	0.71	Poorly Sorted Very Fine Gravelly Fine Sand	Gravelly Sand
D03	0.00	2.01	0.88	1.08	46.91	47.68	0.19	1.25	2.15	0.36	0.59	Moderately Well Sorted Slightly Very Fine Gravelly Fine Sand	Slightly Gravelly Sand
D04	0.69	1.07	1.75	5.54	73.07	16.70	0.07	1.11	1.95	0.25	2.66	Moderately Well Sorted Slightly Very Fine Gravelly Medium Sand	Slightly Gravelly Sand
D05	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-2.24	0.00	0.74	Gravel	Gravel
D06	5.74	5.88	6.10	7.37	55.02	15.89	1.11	2.90	1.40	-0.43	2.15	Poorly Sorted Very Fine Gravelly Medium Sand	Gravelly Sand
D07	36.06	6.62	4.33	12.83	26.12	11.39	1.10	1.55	0.10	-0.25	0.55	Poorly Sorted Sandy Fine Gravel	Sandy Gravel
D08	2.38	3.88	10.53	26.75	49.80	5.73	0.07	0.87	1.14	-0.54	1.33	Poorly Sorted Very Fine Gravelly Medium Sand	Gravelly Sand
D09	3.08	3.12	4.09	5.70	64.40	14.54	1.47	3.60	1.95	0.13	4.89	Moderately Sorted Very Fine Gravelly Medium Sand	Gravelly Sand
D10	28.67	10.55	5.18	6.68	19.12	25.93	1.86	2.01	0.49	-0.25	0.48	Very Poorly Sorted Sandy Fine Gravel	Sandy Gravel
D11	26.11	9.87	4.00	5.22	20.16	24.30	3.16	7.18	0.77	-0.28	0.66	Very Poorly Sorted Coarse Silty Sandy Fine Gravel	Muddy Sandy Gravel
D12	0.00	0.00	0.00	0.23	33.05	65.08	0.29	1.34	2.41	-0.50	0.61	Moderately Well Sorted Moderately Well Sorted Fine Sand	Sand
D13	0.00	0.12	0.80	10.72	76.21	10.38	0.16	1.61	1.75	0.01	2.65	Well Sorted Slightly Very Fine Gravelly Medium Sand	Slightly Gravelly Sand
D14	15.60	5.22	5.91	11.55	23.12	28.10	4.43	6.08	1.07	-0.32	1.00	Very Poorly Sorted Fine Gravelly Fine Sand	Gravelly Sand
D15	15.07	7.76	9.43	15.16	45.80	4.92	0.15	1.70	0.66	-0.66	0.94	Poorly Sorted Fine Gravelly Medium Sand	Gravelly Sand
D16	0.00	0.00	0.06	0.76	37.82	55.91	1.92	3.53	2.39	-0.24	0.84	Moderately Well Sorted Moderately Well Sorted Fine Sand	Sand
D17	23.08	17.98	13.79	10.47	24.38	9.43	0.09	0.78	-0.15	0.08	0.67	Poorly Sorted Sandy Fine Gravel	Sandy Gravel
D18	10.18	12.31	10.24	6.69	29.10	29.20	0.35	1.94	1.06	-0.49	0.72	Poorly Sorted Very Fine Gravelly Fine Sand	Gravelly Sand
D19	15.46	1.93	2.51	6.71	25.09	25.93	9.80	12.55	1.47	-0.13	1.73	Very Poorly Sorted Fine Gravelly Very Coarse Silty Fine Sand	Gravelly Muddy Sand
D20	22.23	15.52	9.19	5.00	33.89	13.01	0.19	0.97	0.21	-0.32	0.66	Poorly Sorted Sandy Fine Gravel	Sandy Gravel

APPENDIX 8
8.MARINE MAMMAL RISK ASSESSMENT

A8. MARINE MAMMAL RISK ASSESSMENT

Introduction

A8.1.1 This marine mammal risk assessment reviews the marine mammal activity in the vicinity of the proposed dump site to the east of the Arklow Bank Wind Park. This risk assessment has been completed by Ramboll Environ (Principal Environmental Consultant Kim Moore, who has more than nine years' experience in marine environmental assessment, and Ecologist Emily McVean, who has more than four years' experience is assessing marine projects). The proposed works involve the proposed removal of up to 99,999 wet tonnes of material over an eight year permit term.

A8.1.2 An initial seabed levelling campaign has been identified in the vicinity of Turbines 3 and 4, where approximately 10,500 wet tonnes of material will be moved and locally deposited by use of plough within the plough area. It is anticipated that works will primarily be undertaken during daylight hours due to the close proximity of the turbines and associated infrastructure. The timing of the proposed works is dependent on when the decision is received on the Dumping at Sea Permit application, however, timescales are expected to be of a period of weeks, although this is weather dependent.

A8.1.3 A marine mammal risk assessment is a requirement to support any Dumping at Sea Permit application. This assessment fulfils this requirement and is completed in accordance with the Guidance to Manage Risk to Marine Mammals from Manmade Sound Sources in Irish Waters[19].

A8.2 Legislative Background

A8.2.1 In Ireland, cetaceans (whales, dolphins and porpoises), pinnipeds (seals) and the Eurasian otter (*Lutra lutra*) are protected under a range of national and international legislation. All cetaceans, grey seal (*Halichoerus grypus*), harbour seal (*Phoca vitulina*) and Eurasian otter are protected under the Wildlife Act 1976 (as amended). Under this act, it is an offence to hunt, injure or wilfully interfere with, disturb or destroy the resting or breeding place of a protected species within Irish territorial waters (within 12 nautical mile limit, equal to 22.2 km).

A8.2.2 The EC Habitats Directive 92/43/EEC is transposed into national law by the European Communities (Birds and Natural Habitats) Regulations 2011. These consolidate earlier regulations and provide protection for all marine mammal species in Ireland. The grey and harbour seals as well as the harbour porpoise (*Phocoena phocoena*) and bottlenose dolphin (*Tursiops truncates*) are listed in Annex II of the Directive whose conservation requires the designations of Special Areas of Conservation (SACs). Furthermore, all cetacean species are listed under Annex IV of the Directive as species requiring strict protection.

A8.2.3 The EC Habitats Directive and associated Regulations also require various conservation measures to be undertaken to protect SACs, amongst them to avoid "the deterioration of natural habitats of species as well as disturbance of the species for which the areas have been designated". Plan or project related activities both within and beyond the extents of the SACs, either alone or in combination, must be assessed to ensure that they are unlikely to adversely affect the integrity of the site concerned. A screening assessment has been undertaken with consideration to mobile marine species that may be associated with SACs in the region, including marine mammals (see Appendix 9). The assessment concluded that likely significant effects to SACs and their qualifying features (species/habitats) can be ruled out.

A8.3 Relevant Guidance

A8.3.1 The National Parks and Wildlife Service of the Department of Arts, Heritage and the Gaeltacht have produced relevant guidance which aims to:

[19] National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht. 2014. Guidance to Manage Risk to Marine Mammals from Manmade Sound Sources in Irish Waters. Accessed 13/01/2016. http://www.npws.ie/sites/default/files/general/Underwater%20sound%20guidance_Jan%202014.pdf

i. Give an understanding of selected sound sources introduced into the environment by specific human activities, which may impact detrimentally on protected marine mammal populations or individuals of those species;
ii. Describe a structured, staged process for the informed assessment of risk and decision making with regard to such sources; and
iii. Outline the practical risk avoidance and/or risk reduction measures which in the Department's view must be considered in order to minimise the potential effects of sound sources on the natural ecology of marine mammal species whether in Ireland's extensive and diverse coastal/marine waters or in designated conservation sites therein.

A8.3.2 The evaluation of risk to protected marine mammal species from anthropogenic sound depends on three elements, namely the source, the receptor and the environment. The staged process for the evaluation of risk is outlined in Figure A8.1 and is followed in by this assessment.

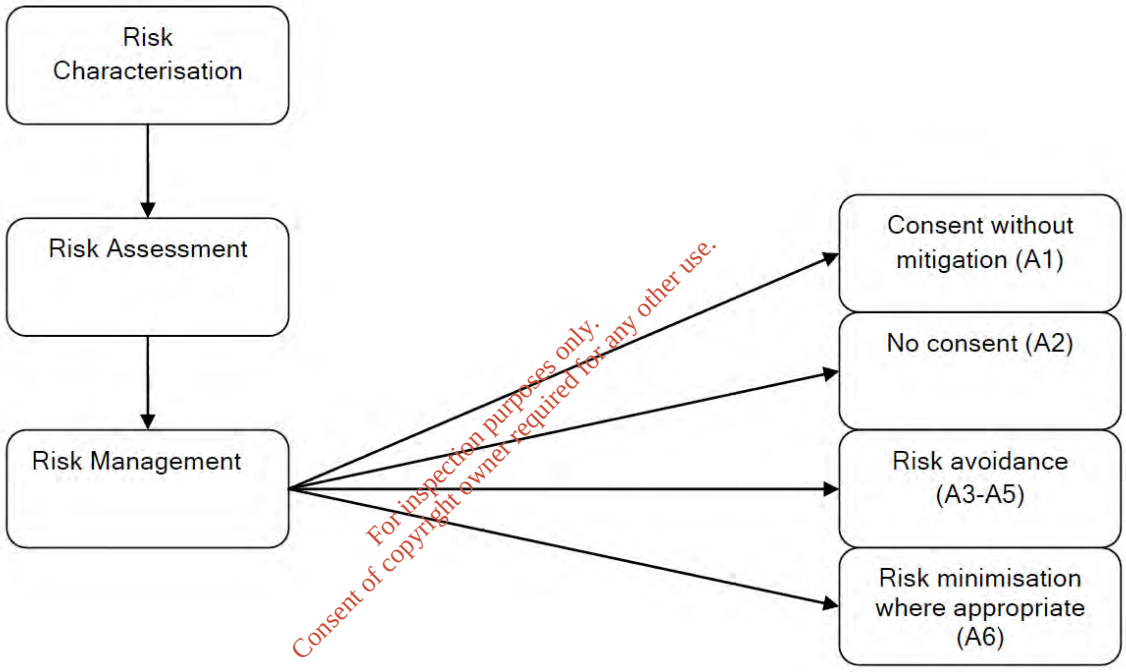


Figure A8.1 Flow diagram showing the staged process for the evaluation of risk.

A8.4 Proposed Activity

A8.4.1 Seabed levelling is proposed in an area to the east of the Arklow Bank Wind Park, located around 10 km east of Arklow, County Wicklow. Arklow Bank is considered a highly dynamic sandbank. Bathymetric monitoring surveys have been undertaken by the client between 2004 and 2015, which have monitored the change in seabed levels around the turbines on the central area of the Bank in the vicinity of the Wind Park.

A8.4.2 The accretion of sand (specifically around Turbines 3 and 4, and potentially others over time) has compromised the safe navigation of maintenance and service vessels directly accessing the turbines on the Bank during particular states of the tide. The maintenance and service vessels require a minimum of 2.4 m (Chart Datum Arklow) for safe access to the turbines during all states of the tide.

A8.4.3 The client is applying for a multi-year Dumping at Sea Permit for a maximum period of eight years and maximum tonnage of 99,999 wet tonnes. The exact area and wet tonnage to be levelled during each year cannot be determined at the present time, since this is dependent on the rate of sand accumulation on the seaward side of the turbines and the point at which this impedes safe access by maintenance vessels.

A8.4.4 However, an area to the east of Turbines 3 and 4 has been identified for the initial seabed levelling campaign. This area has had a significant accumulation of sediment over the previous years, which currently compromises the safe access to the turbines by maintenance vessels.

A8.4.5 GIS analysis has determined that approximately 10,500 wet tonnes (5,500 m^3) of material will be levelled during the initial seabed levelling campaign in the vicinity of Turbines 3 and 4 to relocate sediment that has accumulated above 2.5 m CD Arklow. It is estimated that the duration for this initial campaign will be complete in a timescales of weeks, although this is weather dependent.

A8.4.6 It is requested by the client that seabed levelling is permitted within the dumping site. This involves the use of a plough, approximately 11 m in width, which is towed behind a vessel. The plough is considered to be an effective method for the removal of high spots of seabed within a specific area, with layers of sediment being removed at each pass until the desired depth is achieved. The contents of the plough would be released once the water depth increases to a depth greater than the plough depth within the dumping site. It should be noted that material will also be suspended and transported by natural hydrodynamic processes while the plough is in operation.

A8.4.7 For plough control, the depth of seabed will be monitored at all times, utilising both the onboard echo sounder and dredge master system, with adjustments made accordingly to the ploughing operation. This will ensure that the desired depth is achieved as quickly and efficiently as possible.

A8.4.8 It is anticipated that seabed levelling works will be undertaken during daylight hours only, given that the works are being carried out within 15 m to 20 m of the turbines and associated infrastructure. It is also anticipated that works will be undertaken on all states of the tide. A full method statement will be provided to the EPA at least one week prior to a seabed levelling campaign being undertaken.

A8.5 Marine Mammal Activity

A8.5.1 Twenty-four cetacean species have been recorded in the wider Irish Sea, the majority from sightings or acoustic recordings as well as occasional strandings. A number of these species are known to breed in Irish waters, including the harbour porpoise, common dolphin, bottle-nosed dolphin, Risso's dolphin, Atlantic white sided dolphin, white beaked dolphin and pilot whale. The distribution of cetaceans in the Irish Sea is based on a number of factors, including the availability of prey, water temperature, water depth and seabed topography.

A8.5.2 The grey and harbour seals are also native to Irish waters and establish themselves in territorial colonies (haul outs) along the coastline, which they leave when foraging or moving between areas and to which they return to rest ashore, rear young etc. The haul outs for harbour seals tend to be on inshore bays and islands, coves and estuaries whereas grey seal haul outs tend to be located on exposed rocky shores, sandbars, sea caves or steeply shelving sand banks[20].

Site Specific Survey

A8.5.3 A site specific marine mammal survey was undertaken to support the Environmental Impact Assessment[21]. The surveys were run twice per month in the period of July to September 2000 and once per month between October 2000 and February 2001.

A8.5.4 Harbour porpoise was the only species recorded regularly during the survey with a total of 89 observations during 16 of the 18 survey days. This was translated by the EIA into an extrapolated peak of 173 animals in the 406 km^2 study area. A pod of eight or nine Risso's

[20] Xodus Group and Aquafact International Services Ltd (2011) Fourth Strategic Environmental Assessment for Oil and Gas Activity in Ireland's Offshore Waters: IOSEA4 Irish and Celtic Seas Environmental Report. Report produced for the Department of Communities, Energy and Natural Resources.

[21] Fehily Timoney and Co. (2001) Environmental Impact Assessment Arklow Bank Wind Park. Final Report. June 2001.

dolphins were also sighted in both July surveys. Two individuals were also recorded in June 2001 near the middle of the Bank and at least one of these dolphins were different from the pod recorded in 2000. Three grey seals were recorded over the survey period and a single leatherback turtle was recorded in August 2000.

National Biodiversity Data Centre's Database

A8.5.5 The National Biodiversity Data Centre's online database was accessed for cetacean and pinniped records in the vicinity of the proposed works at Arklow Bank. The results of the data search are shown in Figure A8.2 to Figure A8.8.

A8.5.6 The most common species recorded in the vicinity of Arklow Bank are the harbour porpoise (Figure A8.2). Sightings that were not recorded with accuracy are represented with larger grid squares on the figures below. The larger grid squares to not represent the total area over which the species has been seen to occur, but an estimate of where a sighting has been made. This species has been recorded from ferry sightings, casual sightings and the ESAS cetacean survey from 1996 to 2013. Strandings of harbour porpoise have also been recorded in both 2012 and 2014.

A8.5.7 Other species recorded less regularly in the vicinity of Arklow Bank include the bottle-nosed dolphin, Risso's dolphin, striped dolphin and minke whale (Figure A8.3 to Figure A8.6).

A8.5.8 Grey seals (Figure A8.7) were also recorded in the along the coastline to the west of Arklow Bank, with sightings recorded in both the Atlas of Mammals of Ireland and the NPWS Seal Database. Aerial surveys of the coastline in 2003 found that four grey seals were present at Kilmicheal Point, Wexford, in August 2003[22], which may indicate a small haul-out site (see location on Figure A8.7). Harbour seals (Figure A8.8) were also recorded in one location in the Atlas of Mammals in Ireland.

[22] Cronin, M., Duck, C., Ó Cadhla, O., Nairn, R., Strong, D. & O' Keeffe, C. (2004). *Harbour seal population assessment in the Republic of Ireland: August 2003.* Irish Wildlife Manuals, No. 11. National Parks & Wildlife Service, Department of Environment, Heritage and Local Governement, Dublin, Ireland.

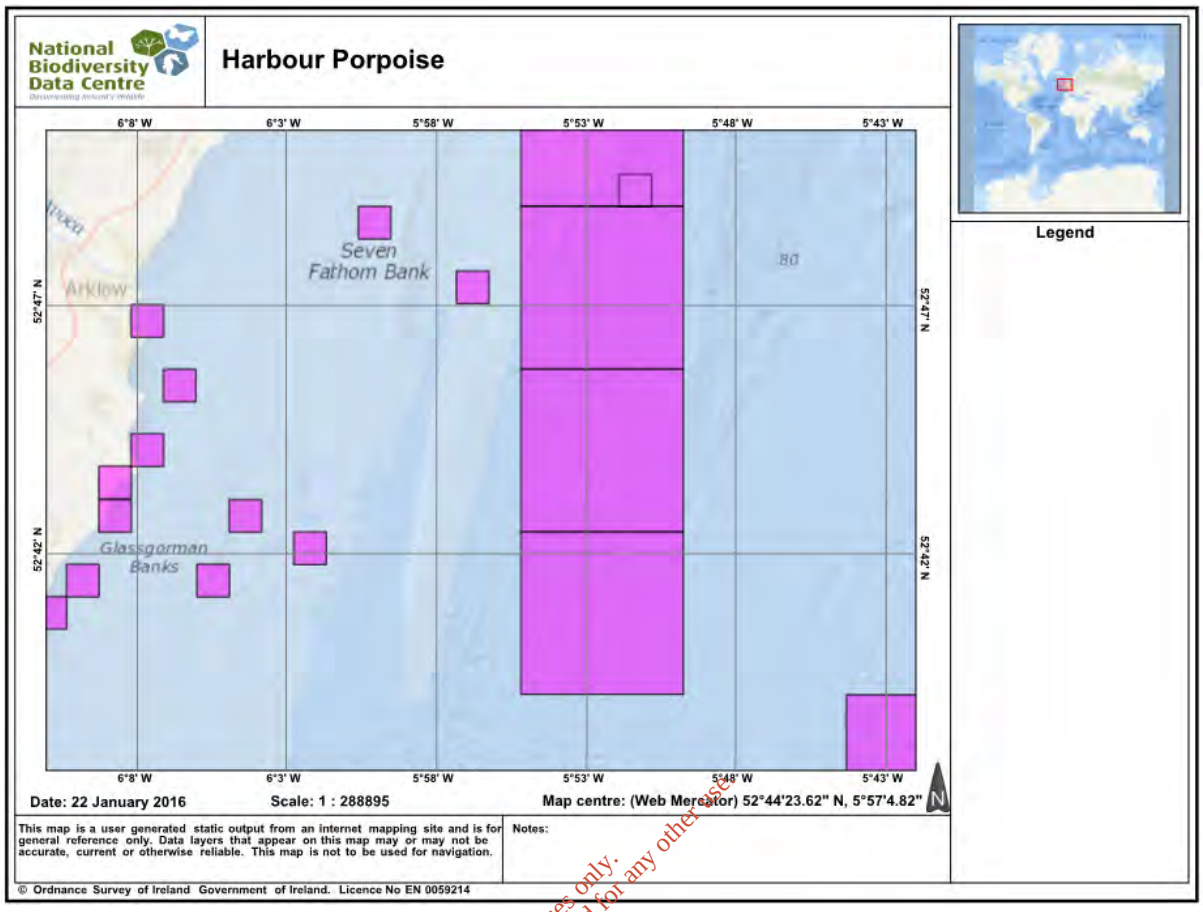


Figure A8.2 Harbour porpoise distribution data held by the National Biodiversity Data Centre

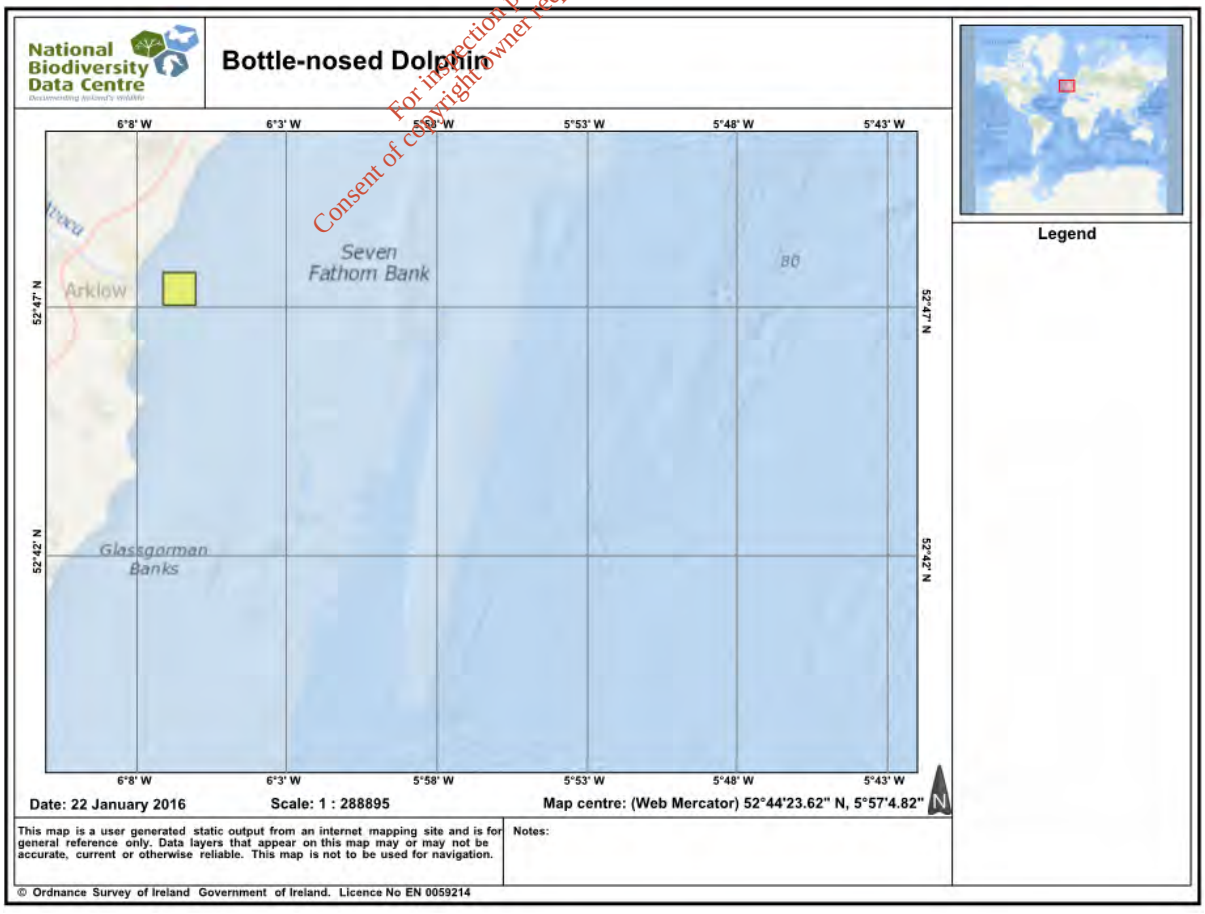


Figure A8.3 Bottle-nosed dolphin distribution data held by the National Biodiversity Data Centre

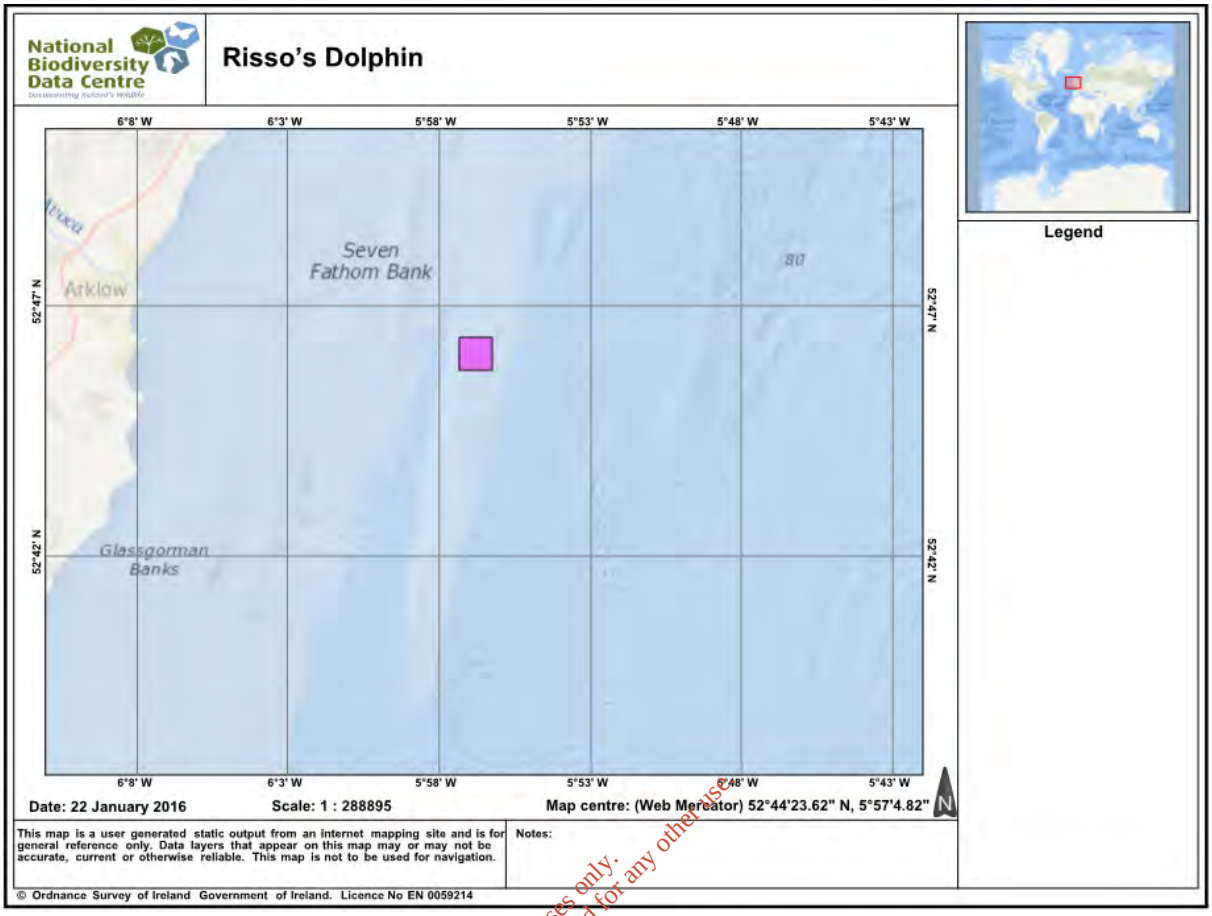


Figure A8.4 Risso's dolphin distribution data held by the National Biodiversity Data Centre

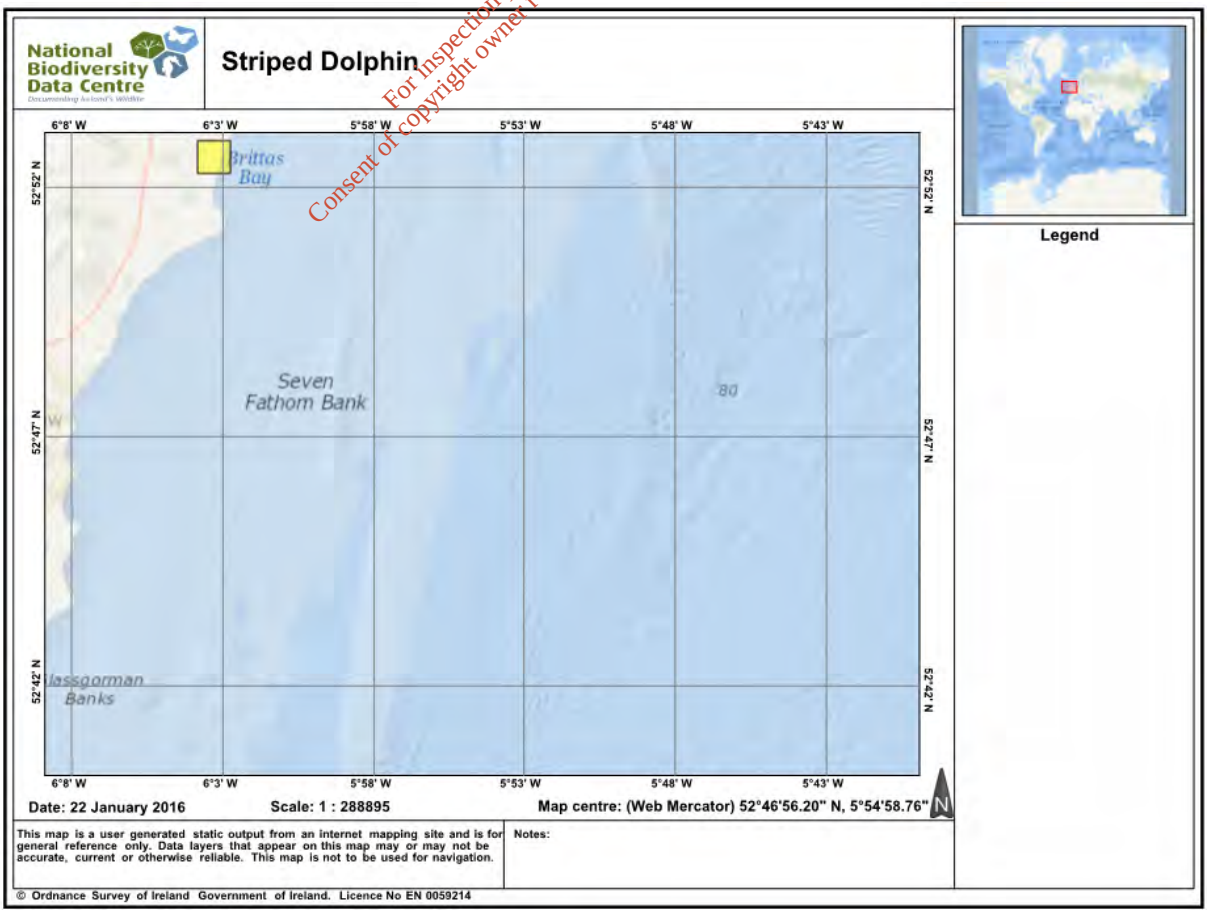


Figure A8.5 Striped dolphin distribution data held by the National Biodiversity Data Centre

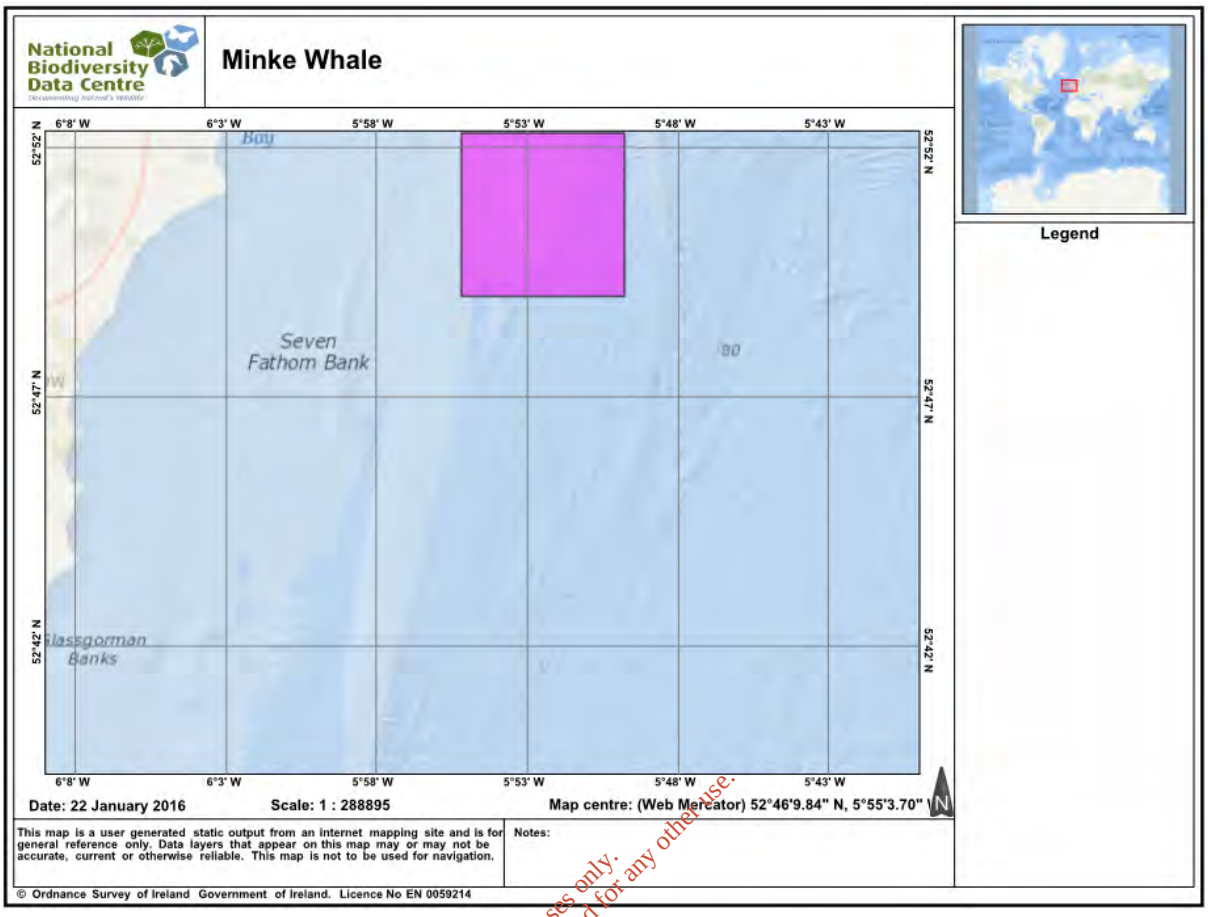


Figure A8.6 Minke whale distribution data held by the National Biodiversity Data Centre

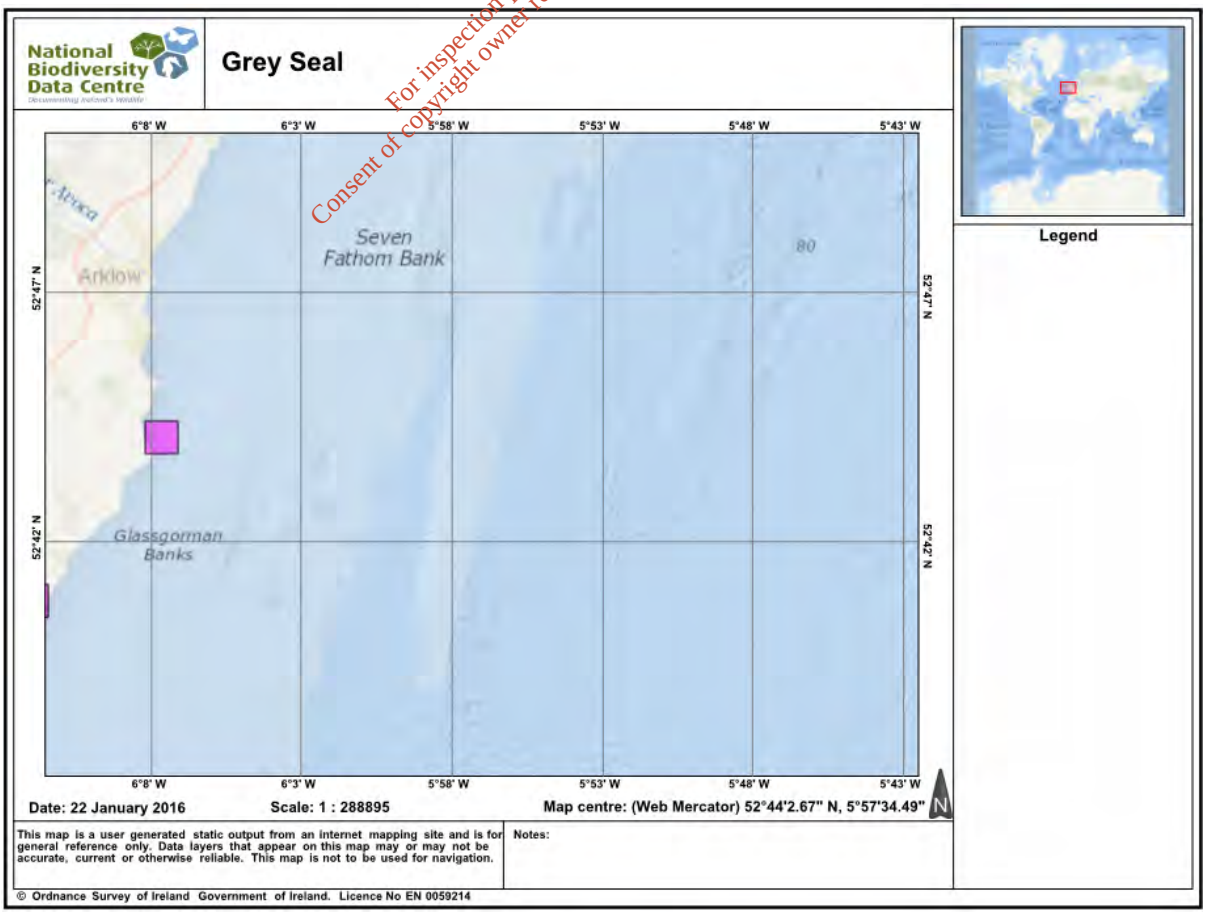


Figure A8.7 Grey seal distribution data held by the National Biodiversity Data Centre

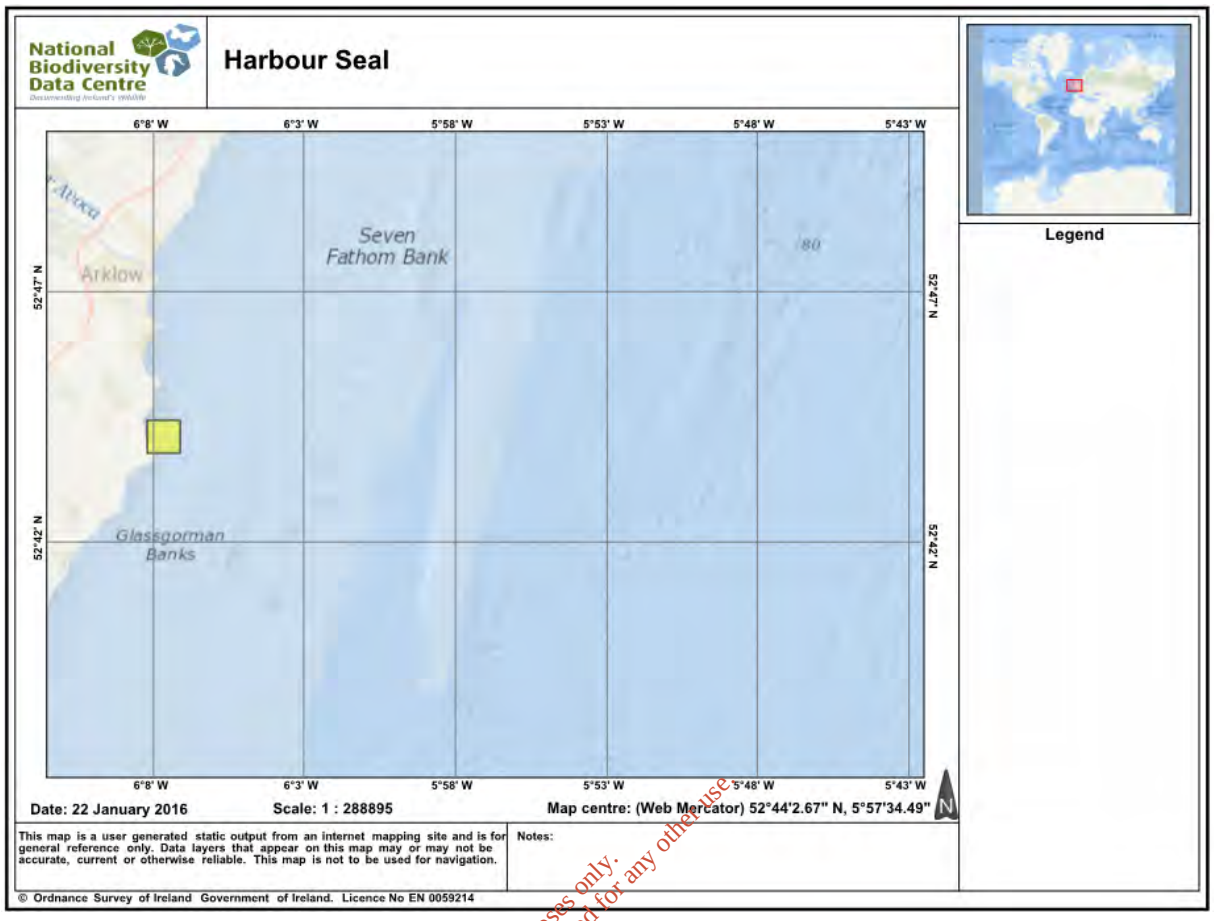


Figure A8.8 Harbour seal distribution data held by the National Biodiversity Data Centre

Irish Whale and Dolphin Group Data

A8.5.9 A review of data collected by the Irish Whale and Dolphin Group suggests that the majority of cetacean species are sighted along Ireland's southern and western coasts rather than in the Irish Sea itself. However, Risso's dolphin, bottle-nosed dolphin and harbour porpoise remain regularly sighted marine mammals off counties Wexford and Wicklow in the Irish Sea[23]. Grey seals are located with lesser numbers off the east coast of Ireland, whereas harbour seals are known to have a more widespread and coastal distribution.

NPWS Guidance Appendix 4

A8.5.10 Appendix 4 of the NPWS Guidance[19] provides generalised maps of marine mammal distribution and habitat in Irish waters. These maps indicate that there is habitat suitable for the following species in the vicinity of the proposed works, and are shown in Figure A8.9 and Figure A8.10.

A8.5.11 The maps in Figure A8.9 and Figure A8.10 show that a large amount of habitat is available along the east coast of Ireland and in the wider Irish waters. This is consistent with the other sources of data described in this section.

[23] Berrow, S. D., Wholley, P., O'Connell, M. and Wall, D. (2010) Irish Cetacean Review (2000-2009). Irish Whale and Dolphin Group, 60pp.

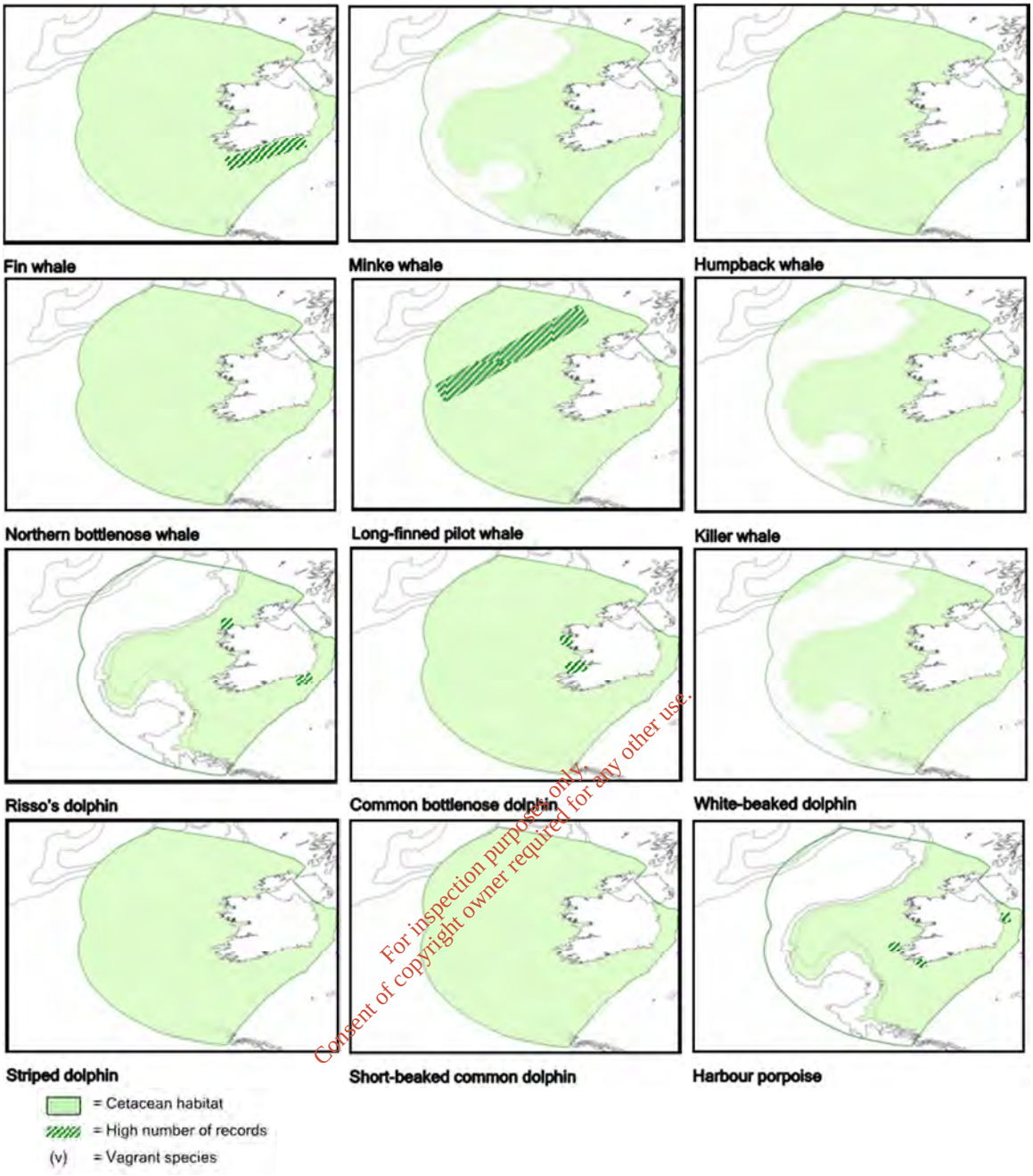
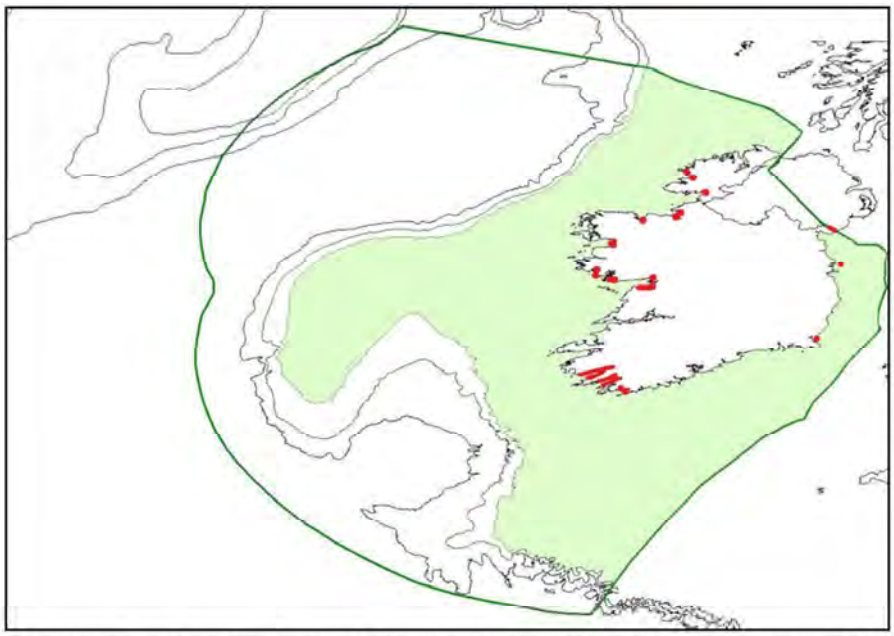
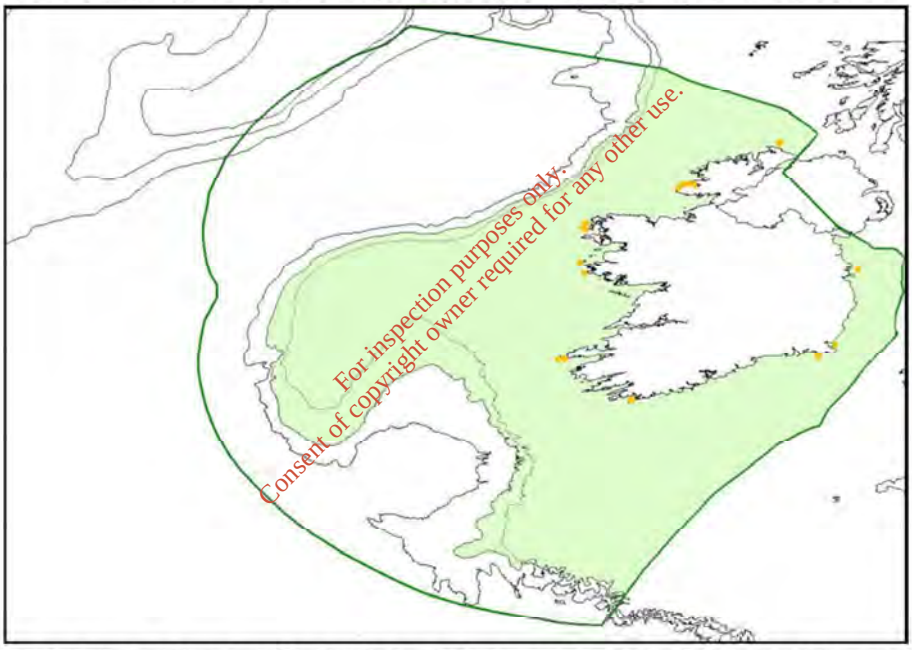


Figure A8.9 Generalised distribution and habitat of cetacean species in Irish waters.



Generalised distribution range (shaded green) postulated for Harbour seal *Phoca vitulina* in the Irish EEZ based on background movement information and knowledge of coastal habitats occupied by the species. Key breeding and non-breeding haul-out locations in Ireland are marked red.



Generalised distribution range (shaded green) postulated for Grey seal *Halichoerus grypus* in the Irish EEZ based on background movement information and knowledge of coastal habitats occupied by the species. Key breeding and non-breeding haul-out locations in Ireland are marked orange.

Figure A8.10 Generalised distribution and habitat of pinniped species in Irish waters.

Summary of Desktop Data Records

A8.5.12 In summary, from the data sources described above, the cetacean species most regularly occurring in the vicinity of Arklow Bank are harbour porpoise, with the remaining species being occasionally recorded. With respect to pinnipeds, grey and harbour seal have been recorded on the coastline to the west of Arklow Bank but not in significant numbers.

A8.5.13 It should be noted that no one species exclusively utilises the habitat provided by Arklow Bank, and that all of the cetacean and pinniped species recorded in the area have large areas of marine habitat available to them which provide suitable foraging habitat. Additionally, Arklow Bank has been shown to support little benthic fauna compared to other areas of available foraging habitat. .

A8.6 Impacts of the Proposed Activity

A8.6.1 The excavation of sand, gravel, loose rock and other material from the seabed during seabed levelling operations is common, particularly in coastal waters where harbour works and channel maintenance require such activity. There are many different types of seabed levelling devices but the proposed works include the use of a seabed plough towed behind a vessel to gradually reduce the height of the seabed within the proposed seabed levelling area.

A8.6.2 Sound from seabed levelling operations are reported to produce a low frequency omnidirectional sound of several tens of Hz to several thousand Hz at sound pressure levels of 135 – 186 dB re: 1 µPa (decibel at reference pressure of 1 microPascal root-mean-square[24]). While sound exposure levels from such operations are thought to be below that expected to cause injury to marine mammals, they have the potential to cause lower level disturbance, masking of acoustic cues (communication, signals) or behavioural impacts. However, noise generated by the plough passing over the seabed, from the physical presence of the vessel and possibly highly localised increases in water turbidity have the potential to cause low level disturbance to marine mammals.

A8.6.3 Seabed levelling activities tend to occur in a fixed area for a number of days; therefore they introduce continuous anthropogenic sound at levels that may impact marine mammals for the duration of the proposed activity.

A8.6.4 The location of the proposed works is adjacent to the Arklow Harbour shipping channel. The Navigational Risk Assessment produced to support the EIA identified shipping navigation routes to the east and west of Arklow Bank. The annual number of ship movements on these routes was 12,606 during the time of the Navigational Risk Assessment. It was also estimated that ten vessels were operating beam trawling equipment for 170 days of the year in the area. These vessels add to the vessel traffic and would be undertaking similar movements to the proposed seabed levelling activity.

A8.7 Assessment Criteria

A8.7.1 The following sections outline the responses to the Assessment Criteria outlined by the NPWS Guidance[19].

i. Do individuals or populations of marine mammals species occur within the proposed area?

From the data sources accessed, the most likely species to be encountered are harbour porpoise, although the presence of this species is considered sporadic between 1996 and 2013. Other species may also be present, but the sightings of these species are noted to occur less regularly.

ii. Is the plan or project likely to result in death, injury or disturbance of individuals?

There is potential for the impact of the seabed levelling operations to affect marine mammals. These impacts will be through increased noise from the plough passing over the seabed and from the presence of the vessel and plough which present disturbance or collision risks and increased turbidity which may inhibit foraging.

Seabed levelling within the Dumping Site will be undertaken on a campaign basis as required within the permitted time period. Each campaign is expected to last a period of days to weeks. This further reduces the potential for disturbance of marine mammals. Arklow Bank was found not to have particularly valuable benthic assemblages to support prey species, and is considered to have naturally high levels of suspended sediment at bed level due to the high bed shear stress (relative to the critical stress needed to bring

[24] The relative pressure (in decibels for a sound level) can take on different values depending on the method used to characterise the pressure of the signal. For underwater sounds the reference pressure preference is an root-mean-square pressure of 1 µPascal. This is why the units for decibels are given as "dB re1 µPa," indicating that the reference pressure is 1 µPa rms.

the sediment into suspension); therefore, it is not considered a valuable area for foraging and the temporary increase in turbidity is unlikely to affect foraging success in the area. Additionally, the proposed works are in the vicinity of existing shipping channels and hence the presence of an additional vessel that will be operating at a low and constant speed will not have a significant impact.

The risk of injury or death of a marine mammal over the course of the works is considered to be extremely low. The vessel undertaking the seabed levelling is relatively slow moving and thus ensuring that any marine mammals in the vicinity would have sufficient time to avoid any collisions and thus injury or death.

iii. *Is it possible to estimate the number of individuals of each species that are likely to be affected?*

The number of sightings available for Arklow Bank is low, so the number of cetaceans likely to be encountered on any given day could vary from zero to a small group of dolphins, as previously up to six have been recorded. Therefore it is not possible to accurately estimate the number of individuals that are likely to be affected.

iv. *Will individuals be disturbed at a sensitive location or sensitive time of their life cycle?*

No sensitive areas are evident within the vicinity of Arklow Bank based on the data accessed, so it is unlikely that the proposed seabed levelling will cause a disturbance at a sensitive location or time in their life cycle. Please refer to the information to support Habitats Regulations Screening in Appendix 9.

v. *Are the impacts likely to focus on a particular section of the species population, e.g., adults vs. juvenile, males vs. females?*

It is not possible to accurately assess this impact as the data available does not distinguish between adults and juveniles, males and females. Sightings of marine mammals in the vicinity of Arklow Bank are sporadic.

vi. *Will the plan or project cause displacement from key functional areas, e.g., for breeding, foraging, resting or migration?*

Based on the datasets available, it is unlikely that the proposed seabed levelling works will cause displacement from key functional areas. As described in under Assessment Criteria ii, Arklow Bank is not considered to be a key area for foraging due to the poor assemblage and high energy environment at seabed level; there is no pathway to known functional areas (such as SACs or more favourable foraging areas) due to the small extent of works proposed, which will not overlap or will undergo substantial abatement, dispersion or elimination over the distances considered.

vii. *How quickly is the affected population likely to recover once the plan or project has ceased?*

It is expected that any marine mammals displaced from the vicinity of the Dump Site would quickly return after the works have stopped. Displacement, if evident, is expected to be short lived based on the duration of the proposed works (period of days to weeks during daylight hours only).

A8.8 Mitigation

A8.8.1 The NWPS Guidance[19] recommends a number of mitigation measures are employed for specific activities such as dredging, drilling, pile driving, geophysical acoustic surveys and blasting. While there are no specific measures for seabed levelling, any recommendations for mitigation

must therefore be based on the anticipated risk to marine mammals arising from the proposed works.

A8.8.2 Harbour porpoise was recorded intermittently within the vicinity of Arklow Bank, with other species, less regularly sighted, including the bottle-nosed dolphin, Risso's dolphin, striped dolphin and minke whale. Grey and harbour seals were also recorded along the coastline. The number of marine mammals likely to be encountered is expected to vary between zero to a small group of dolphins (up to six animals).

A8.8.3 While there is potential for these species to be impacted as a result of the seabed levelling through increased noise from the plough passing over the seabed and the presence of the vessel, the risk to marine mammal species is considered extremely low. Any seabed levelling undertaken within the Dumping Site will be undertaken on a campaign basis during daylight hours only and any displacement is expected to be short lived in duration.

A8.8.4 On this basis, the overall risk to marine mammals as a result of the proposed seabed levelling is considered to be low and therefore no specific mitigation is recommended by this review.

APPENDIX 9
9.SCREENING FOR APPROPRIATE ASSESSMENT

A9. SCREENING FOR APPROPRIATE ASSESSMENT

A9.1 Brief

A9.1.1 A screening for Appropriate Assessment (AA) is required as part of the application to deposit/move sediments; the information provided within this section has been prepared to provide information regarding the screening of Likely Significant Effects (LSEs) to European Sites of nature conservation.

A9.2 Legislative context

A9.2.1 Special Protection Areas (SPAs) are designated under the European Commission (EC) Birds Directive[25] for rare, vulnerable and regularly occurring migratory bird species and Special Areas of Conservation (SACs) or Sites of Community Importance (SCIs)[26] are designated under the EC Habitats Directive[27] for their habitats and/or species of European importance; the Directives are implemented domestically by the European Communities (Birds and Natural Habitats) Regulations 2011.. SPAs and SACs are collectively known as Natura 2000 sites (or European Sites).

A9.2.2 Natura 2000 is a European network of protected sites, representing areas of the highest value for natural habitats and species of plants and animals which are rare, vulnerable or endangered in the European Community. Candidate SACs (cSACs) are also submitted to the EC to await formal adoption and must be considered as fully designated SACs, and will eventually be recognised fully by the EC and under domestic legislation as fully designated sites.

A9.2.3 As stated in the Habitats Directive, a competent authority, before deciding to undertake, or give any consent, permission or other authorisation for a plan or project which – (a) is likely to have a significant effect on a European site (either alone or in-combination with other plans or projects); and (b) is not directly connected with or necessary to the management of the sites, shall make an AA of the implications for the site in view of that site's conservation objectives. This section provides information to allow the competent authority to determine whether a significant effect is likely.

A9.3 Data Sources and Guidance

A9.3.1 The following data sources have been used to complete this assessment:

i. Assessments undertaken in the Preliminary Environmental Screening report (document reference: 1620000345-2)[28];
ii. 2001 Environmental Impact Assessment and associated appendices for the Arklow Bank Wind Park;
iii. Benthic monitoring reports (2004 to 2011);
iv. Bathymetric monitoring reports (2004 to 2015);
v. Underwater inspection reports (2013 and 2014);
vi. Fourth Strategic Environmental Assessment for Oil and Gas Activity in Ireland's Offshore Waters: IOSEA 4 Irish and Celtic Seas, Environmental Report (2011);
vii. Tidal and Current Energy Resources in Ireland (2005);
viii. Accessible Wave Energy Resource Atlas: Ireland (2005);
ix. Anglian Marine Aggregates Regional Environmental Assessment (2012);
x. Area 473 East Dredger and Plume Monitoring Study (2011); and
xi. Harnessing our ocean wealth, An Integrated Marine Plan for Ireland, Roadmap (2012).

[25] European Communities (1979) Council Directive 79/409/EEC on the conservation of wild birds
[26] SCIs refer to sites that have been adopted by the European Commission but not yet formally designated as a SAC by the government of each country.
[27] European Communities (1992) Council Directive 92/43/EEC on the conservation of natural habitats and of wild flora and fauna
[28] Ramboll Environ (2015) *Arklow Bank Seabed Levelling Preliminary Environmental Screening*. September 2015, Document Ref 1620000345-2.

A9.4 Methodology

A9.4.1 The approach to the screening exercise will comprise:

i. A description of the proposed works and other projects considered as part of the in-combination assessment (assessment of cumulating effects from other projects);
ii. Characterisation of potential sources of effects;
iii. Identification of European Sites to undergo screening; and
iv. Screening for likely significant effects to European Sites.

A9.4.2 Screening will identify European sites that have the potential to be affected (alone or in-combination with other projects) by the proposed works. This screening process has been provided in anticipation of the formal screening process to be undertaken by the competent authority, or to be may be adopted by the competent authority. Sites are screened in or out of further assessment based on connectivity between the predicted effects of the proposed works and the qualifying interest features of the designated site.

A9.4.3 Qualifying features of European Sites have the potential to be affected by the proposed development where:

i. There is spatial and temporal overlap between the predicted effects of the proposed works (alone or in-combination with other plans or projects) and in the case of Annex I habitats, with the qualifying feature itself; or
ii. In the case of Annex II species or other qualifying species, the predicted effects of the proposed development (alone or in-combination with other plans or projects) overlap spatially and temporally with vital habitats or food resources within their normal foraging range (i.e. for seabirds, the mean maximum foraging ranges estimated by Thaxter et al., 2012[29]).

A9.5 Site Description

A9.5.1 The Arklow Bank Wind Park is an existing 25 megawatt (MW) offshore wind farm generating electrical power for the Wicklow region in Ireland. The wind farm consists of seven 3.6 MW turbines; each supported by a steel monopile foundation and is located on the Arklow Bank.

A9.5.2 The Arklow Bank Wind Park was granted a Foreshore Licence in January 2002 by the Minister for Communications, the Marine and Natural Resources (now the Department for Environment, Community and Local Government). The term of the Foreshore Licence is for a period of 30 years.

A9.5.3 Arklow Bank is a shallow water sandbank in the Irish Sea, around 10 km to the east of Arklow, County Wicklow. Arklow Bank covers an area of approximately 27 km by 2.5 km. Water depths on the Bank generally vary between 2 m and 25 m, although there are areas on the Bank which have water depths of less than 1 m in depth. The Arklow Bank Wind Park is located towards the centre of the Bank, with water depths varying between 2 m and 5 m (LAT).

A9.5.4 Arklow Bank has a morainic ridge at its core, covered by a layer of mobile sediments (sand and gravel). The moranic ridge is thought to have been deposited by glacial activity during the last ice age (pre 12,000 years before present (BP)) with the mobile sediments forming following relative sea level rise post 10,000 BP. The site is likely to be undergoing reworking as a result of natural hydrodynamic processes, e.g. tidal currents and waves.

A9.6 Proposed Works

A9.6.1 The proposed activity includes the levelling of the seabed within the turbine area by use of an 11 m width plough towed by a vessel. The campaign will be undertaken during daylight hours

[29] Thaxter, C. B., Lascelles, B., Sugar, K., Cook, A. S. C. P., Roos, S., Bolton, M., Langston, R. H. W.,. (2012). Seabird foraging ranges as a preliminary tool for identifying candidate Marine Protected Areas. *Biological Conservation*, **156**: 53-61.

only, at all states of the tide, and will be complete in the order of weeks. The works are not directly related to nature conservation management of European Sites.

A9.7 Projects Considered for the Assessment of In-combination

A9.7.1 The Habitats Directive requires that plans or projects are assessed alone and in-combination with other plans or projects to determine whether a likely significant effect to European Sites could occur. This is to protect sites from cumulative effects from multiple projects, and ensure all possible effects are considered when effects from individual projects alone would not be significant. Only plans or projects that would increase the likelihood of significance of effects should be considered. The considerations of in-combination effects will be undertaken for each site considered within the screening.

A9.7.2 The following types of project and plan must be considered in the in-combination assessment:

i. Incomplete projects;
ii. Projects consented but not started;
iii. Projects subject to periodic review (such as annual licences);
iv. Applications lodged but not determined;
v. Refusals subject to appeal;
vi. Known projects not needing consent;
vii. Proposals in adopted plans; and
viii. Firm proposals in published draft plans.

A9.7.3 Plans or projects that are not in the stages listed above are considered to be part of the baseline environment, as they are already in place, or are not sufficiently well-founded to assume that they may occur. The following industries or activities will be considered as projects that may contribute to an in-combination effect as they may cause similar effects to those of seabed levelling:

i. Dredging and aggregate extraction projects;
ii. Offshore renewable energy projects and ancillaries;
iii. Cable and pipeline installations;
iv. Oil and gas installations;
v. Carbon capture and storage (CCS) / gas storage; and
vi. Coastal works (such as sea-defences, ports and harbours).

A9.7.4 Consultation with the Environmental Protection Agency (EPA)[30] indicates that there are no EPA-licensable activities of relevance in the vicinity of the proposed ploughing works. Therefore, is it understood that other projects are all a significant distance from the proposed seabed ploughing.

A9.7.5 Commercial fishing and general shipping activity has been occurring for centuries, and is considered to be part of the baseline environment as it cannot be considered to be a plan or project in terms of the Habitats Directive. Such activity is considered to be relevant to article 6(2) of the Directive, placing responsibility on member states to avoid deterioration of the habitats and significant disturbance, rather than article 6(3) of the Directive, which requires the competent authority to assess plans and projects likely to have a significant effect against conservation objectives. This report aims to provide information to aid the competent authority to undertake its obligations under article 6(3) of the Directive. Therefore, commercial fishing activity is not included within the consideration of in-combination effects.

A9.8 Potential Sources of Effects

Disturbance and alteration to seabed by plough

[30] Higgins, T. (2016) *In-combinations effects*, Email, 18/01/2016. Environental Protection Agency, Inspector.

A9.8.1 The plough will cause direct disturbance and re-working of seabed sediment. The seabed may support benthic invertebrates, and their abundance/diversity may be reduced. This may lead to the indirect of reduction of prey available to species of interest. Although the plough will not be removing sediment or fauna from the seabed, the mechanical action of the plough may cause direct damage to benthic fauna, leaving it exposed at the seabed surface and subject to predation, or buried/smothered[31].

A9.8.2 The plough will be towed within a defined area of 0.42 km^2 and will be undertaken on a campaign basis, with the initial seabed levelling campaign proposed to take approximately eight days to complete (weather dependent). It is expected that the habitat will be returned to its natural state following ploughing, as the seabed substrate will remain as fine sand in shallow and exposed water.

A9.8.3 The fisheries identified in the region of Arklow Bank mainly comprise demersal fish and molluscs[32], that indicate a sub-optimal foraging resource for seabirds, which favour small, pelagic fish. Benthic monitoring has been undertaken at in the region since 2004. The sediment is classed as moderately well sorted fine sane (after Buchanan). Analysis of biota indicated that the 2011 anchor dredge sample included one individual from a single taxa only. The sample was classed as the biotope IGS.Mob (Infralittoral mobile clean sand with sparse fauna), which is typical of sandbanks and was also apparent in samples collected from other parts of Arklow Bank to the north and south. This biotope has a very low sensitivity to physical disturbance (with moderate confidence)[33]

A9.8.4 Arklow Bank Wind Park monitoring samples from the wider region, particularly 10 km to the northwest and 5 km to the south, have continually shown greater benthic invertebrate abundance and diversity of than Arklow Bank[34]. This may be due to the high energy environment and mobility of sediment on the banks.

Increase in suspended sediment

A9.8.5 The water quality of marine European Sites is a key determinant in ensuring the integrity of the habitats and species of the site. Increases in suspended sediment, above natural variation, can result in reduced visibility in the water column and therefore reduced foraging success. Increased solids in the water column can also reduce the gill function in fish and reduce the capabilities of filter feeders by blocking their feeding apparatus.

A9.8.6 Increases in suspended sediment concentrations may be caused as sediment is mobilised from the seabed by the plough. Due to the nature of the levelling activity, the source of the sediment will be limited to the plough location (i.e. the sediments will not be dredged into a hopper with spillways or screening mechanisms). Therefore, sediment will be introduced low in the water column where there is a higher chance of sediment settling out (due to the small distance to settle through). It is inferred that seabed turbidity is naturally high, and visibility is naturally low, as the tidal bed shear stress varies to forces greater than those required to bring the sediment into suspension (mean bed stress is 15-20 N/m^2 at Arklow bank, and the critical shear stress of fine sand is 0.145 – 0.194 N/m^2)[35,36].

A9.8.7 It is likely that the potential sediment plume will last less than an hour after the cessation of seabed ploughing, and the peak suspended sediment plumes above the natural background variation is likely to occur over less than ten minutes, in which time it will decay rapidly. The plume may extend northwards as a result of the mean currents and net tidal excursion, but as

[31] Boyd, S. E., Limpenny, D. S., Rees, H. L., and Cooper, K. M. (2005) The effects of marine sand and gravel extraction on the macrobenthos at a commercial dredging site (results 6 years post-dredging). *ICES Journal of Marine Science*, **62**: 145-162.
[32] Ramboll Environ (2015) Arklow Bank Seabed Levelling Preliminary Environmental Screening. September 2015.
[33] Tyler-Walters, H., Lear, D. & Allen J.H., (2004) *Identifying offshore biotope complexes and their sensitivities*. Report to Centre for Environmental, Fisheries, and Aquaculture Sciences from the Marine Life Information Network (MarLIN). Plymouth: Marine Biological Association of the UK.
[34] Aquatic Services Unit (2012) *Arklow Bank Offshore Windfarm Environmental Monitoring Benthic Ecology Survey Report June 2011.* A Report to GE Wind Energy March 2012.
[35] HowarthH, M J. 2005. *Hydrography of the Irish Sea*. Proudman OceanographicLaboratory Internal Document, 174.
[36] Berenbrock, Charles, and Tranmer, A.W., (2008) *Simulation of flow, sediment transport, and sediment mobility of the Lower Coeur d'Alene River*, Idaho: U.S. Geological Survey Scientific Investigations Report 2008–5093, 164 p.

demonstrated, the extent is likely to be very limited to approximately 350 m (see Section 11.2) and unlikely to be discernable from the natural variation caused by the high energy environment.

Sediment deposition

A9.8.8 Contrary to the potential effect of altering the seabed habitat through direct disturbance by the plough, the potential effect of sediment deposition may extend beyond the immediate area of the plough. This will occur as mobilised sediment settles out back to the seabed. However, due to the source of the sediment input being low in the water column, there is little opportunity for far-field dispersal. The habitats in the area likely to be affected by sediment disposition are characterised by infralittoral mobile clean sand with sparse fauna, which have an inherently low sensitivity as the biotope is typically made up of tolerant or mobile species than are capable of burrowing in sand and are characterised for being present in high energy environments.

Noise and visual disturbance

A9.8.9 Noise and visual disturbance will be created as a result of the vessel presence. This may cause species such as birds and marine mammals to cease feeding or move away from the area, which may affect the energy requirements of the birds, which may influence individual fitness. Whilst some groups such as gulls have been shown to be attracted to areas with increased shipping activity, many others, including seaduck, divers, shearwaters, grebes and terns, have been shown to actively avoid shipping lanes[37].

A9.8.10 The location of the proposed works is adjacent to the Arklow Harbour shipping channel. A navigation risk assessment (NRA) was undertaken for the Arklow Bank Wind Park as part of the EIA. This identified shipping navigation routes to the east and to the west of Arklow Bank. The annual number of ship movements on these routes was 12,606 during the time of the study[38]. It was also estimated that ten vessels were operating beam trawling equipment for 170 days of the year in the area, these vessels add to the vessel traffic and would be undertaking similar movement to the proposed seabed levelling activity.

A9.8.11 The seabed ploughing will be completed by one vessel only, over a course of eight days (for the initial campaign). Therefore, the addition of the single vessel is considered to be negligible in the context of the baseline activity.

A9.9 Potential for Likely Significant Effects

European Sites with potential to be affected by the development- preliminary exclusion of sites

A9.9.1 This section provides details of the exercise that has been undertaken to exclude non-relevant sites from the assessment – this was undertaken before more detailed screening on the remaining potentially relevant sites. . This preliminary exercise uses a broad-brush approach to exclude European sites where it can be demonstrated that these will not experience likely significant effects. As part of this, all sites outside a 20 km radius search area from the proposed works have been excluded. Although this distance has been arbitrarily chosen as a threshold (i.e. is not based on ecological grounds), it is considered beyond reasonable doubt that the proposed activity will not result in likely significant effect to the features of sites beyond this range based on the following rationale:

i. There is a lack of connectivity between the ploughing works and designated features at the European sites due to mechanisms of dispersion or attenuation limiting the extent of the effect. As a result, the proposed works will not cause detectible changes to the

[37] Cook, A.S.C.P. & Burton, N.H.K. (2010) *A review of the potential impacts of marine aggregate extraction on seabirds*. Marine Environment Protection Fund (MEPF) Project 09/P130.

[38] RAMBØLL BREDEVEJ (2001) Arklow Bank Wind Park, Ship Collision Frequencies and Potential Oil Spillage Trawl and Anchor damage frequencies for Cables. Ref: 145104A, June 2001.

environment more than 20 km from the works site. The scale of the effects are characterised in Section A9.8.

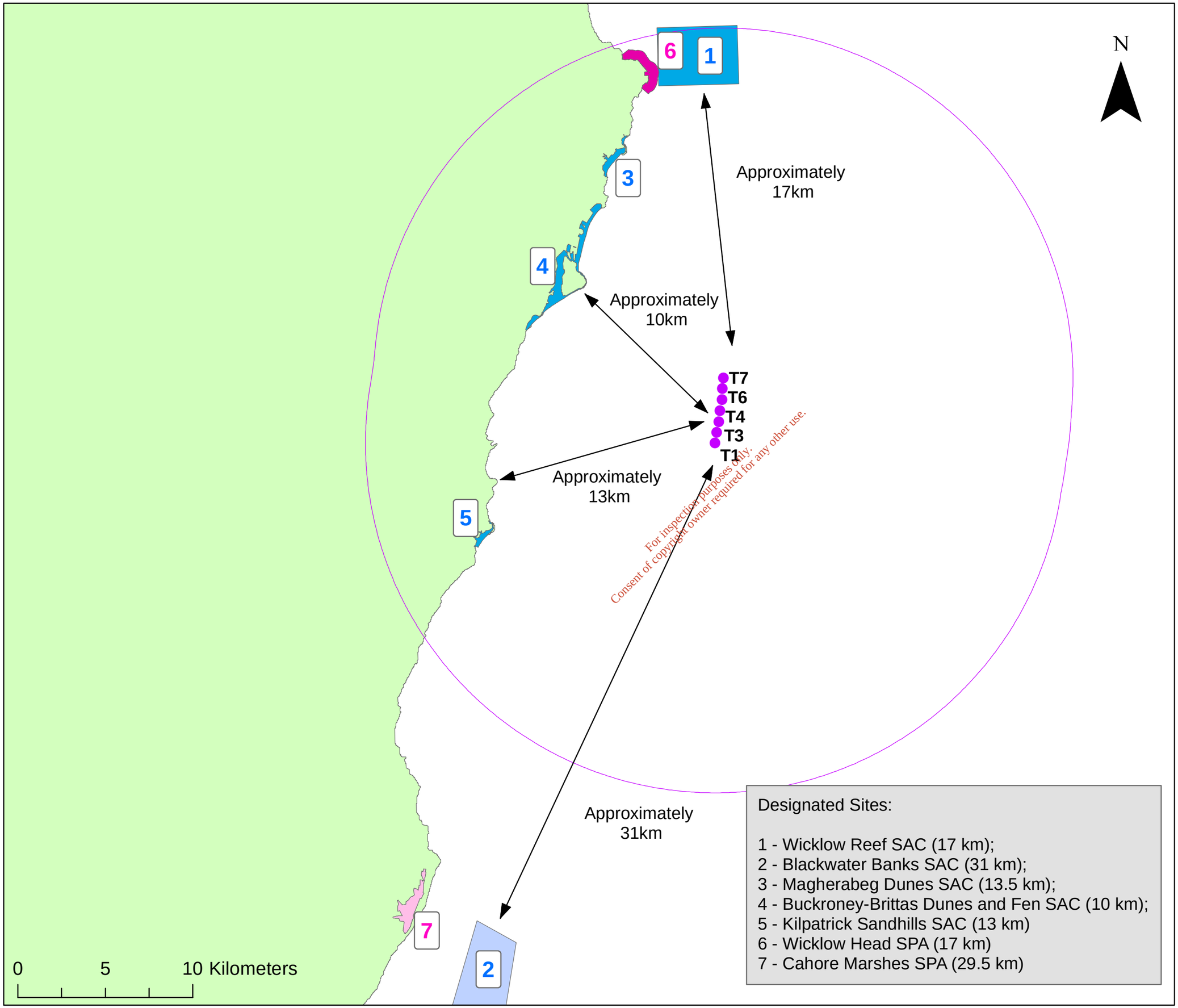
ii. For European sites that are further than 20 km from the works (see Figure A9.1)and designated for species that are mobile, and therefore have a possibility of passing through the area of works, there will be a lack of significant effect to that species/population and therefore the integrity of those sites.
    a. For example, marine element of the Wexford Harbour and Slobs SPA is approximately 52 km from the works site and includes wintering lesser black-backed gull (*Larus fuscus*) as a feature. The average maximum foraging range of lesser black-backed gull is 141.0 ± 50.8 km during breeding (taken as 141 km due to a 'moderate' confidence in the mean). Therefore, it would be considered possible for this feature to be temporarily present in the area affected by the works and experience disturbance/disruption due to noise or plume presence. This species would have access to a foraging area of over 67,000 km^2 based on its average maximum foraging range (while breeding), of which 40,900 km^2 is marine habitat[39]. The application area is 0.42 km^2, and therefore occupies 0.0010% of the marine habitat available (of which only a proportion would be affected at any one time due to the single vessel operating). Additionally, this area of marine habitat has been shown to support little benthic fauna compared to other areas of available foraging habitat and has naturally high suspended solids. Sightings of lesser black-backed gull and other seabirds indicate that they are present throughout the Irish Sea and St George's Channel[40,41]. Seabirds are therefore considered to be capable utilising other parts of the marine habitat and tolerant of the changes due to the effects' negligible severity, extent, duration and frequency. This justification may also be applied to other mobile Annex II species, such as marine mammals, originating from European sites that are a substantial distance from the application area.

iii. The European sites beyond 20 km are not considered to experience likely significant effects in-combination with other projects due to the following reasons depending on the distance:
    a. The proposed works do not present any direct or indirect significant effects to the integrity of a European Site beyond 20 km from the site; therefore do not contribute to any in-combination effects;
    b. The project cannot contribute to an in-combination effect to breeding populations of seabirds associated with European Sites due to the distance from potential breeding-bird foraging grounds being greater than the species foraging range whilst breeding. During the non-breeding season (when foraging ranges are not applicable), effects from other projects will not accrue in a cumulative manner as the area is not considered to be an important feeding area and the distance to other projects means that individuals are highly likely to recover before encountering other project's effects; and
    c. The effects caused by similar activities are unlikely to accrue in a cumulative manner based on the distances to other project locations. Individuals will tolerate or recover from the negligible-scale changes caused by seabed levelling before potential interaction with other projects.

[39] This calculation considered the marine element of the SPA only due to the irrelevance of the wider riverine extent. A 141 km buffer was applied to the marine element of the SPA, then the area above the high tide mark was removed to indicate the marine foraging area to lesser black-backed gulls originating from any point within the marine part of the SPA

[40] Stone, C.J. et al, (1995), An atlas of seabird distribution in north-west European waters, 326 pages, A4 softback, ISBN 1 873701 94 2

[41] Marine Institute and Department of Environment, Community and Local Government (2016) Ireland's Matine Atlas [online]. Avavilable at: http://atlas.marine.ie/ [accessed 14/01/2016].



Designated Sites:

1 - Wicklow Reef SAC (17 km);
2 - Blackwater Banks SAC (31 km);
3 - Magherabeg Dunes SAC (13.5 km);
4 - Buckroney-Brittas Dunes and Fen SAC (10 km);
5 - Kilpatrick Sandhills SAC (13 km)
6 - Wicklow Head SPA (17 km)
7 - Cahore Marshes SPA (29.5 km)

Turbines

20km Ssearch Area

Ireland

Special Protection Areas (SPA)

SPA within search area

SPA outside search area

Special Areas of Conservation (SAC)

SAC within search area

SAC outside search area

Client

Arklow Energy Limited

Project Title

Arklow Bank Wind Park Seabed Levelling

Project Number

1620000345

Figure Title

European Sites of Nature Conservation

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Figure No.	Revision
Figure A9.1	-

European Sites with potential to be affected by the development considered for full screening

A9.9.2 Those that are within the 20 km buffer area, and are therefore nominally considered for full screening are:

i. Wicklow Reef SAC;
ii. Wicklow Head SPA;
iii. Magherabeg Dunes SAC;
iv. Buckroney-Brittas Dunes And Fen SAC; and
v. Kilpatrick Sandhills SAC.

A9.10 **Full Screening of Interest Features**

A9.10.1 This process refines the list of associated European Sites by assessing if likely significant effects to individual features can be ruled out. For example, if the feature of the site is not sensitive or likely to occur within the extent of an effect, the feature is ruled out of further assessment.

A9.10.2 The potential for any of the effects to influence each of the features of the European Sites is indicated by a cross or tick in Table A9.1 (a cross indicates that a likely significant effect has been screened out (i.e. no likely significant effect), tick indicates that likely significant effect screened in (likely significant effect)), accompanied with a description of the rationale. This information is then used to indicate if the feature should be ruled out of further assessment, or whether there is potential for a likely significant effect.

A9.10.3 Only habitats and species listed as part of the conservation objectives of the sites have been considered because the AA must be carried out in light of these objectives[42]. As there is no potential for a 'significant effect' in HRA terms to other habitat/species associated with sites (as 'significant effect' refers to a compromise in the conservation objectives), they are ruled out of further assessment.

A9.10.4 Simple geospatial assessments have been undertaken to estimate the approximate proportion of foraging habitat available to certain species of seabirds during the breeding season. This has been done by creating a buffer area around a known SPA/SCI/colony to indicate the mean maximum foraging range of a specific species – the buffer is measured from the SPA/SCI boundary. Following this, the areas above mean high water springs (land areas), are removed from the buffer, and where the buffer overlaps to unrealistic areas, such as extending over to the North Atlantic Sea by the west coast of Ireland, these areas are also removed because it is not realistic to assume that seabirds would regularly cross large landmasses.

A9.10.5 The resulting, clipped buffer indicates the marine area available for foraging. This has been used in justifications for screening decisions. The justifications also take into account that density of bird foraging areas will always be greater closer to the colony, and decline further away. This can be inferred because at any one point away from the colony, the density of the colony's seabirds will be inversely proportional to the square of the distance from the source because the area of the circle around the colony increases with the square of the radius, and from the reporting of curved lines for cumulative bird abundance against distance from the colony[43]. Reasonable discretion has been used to take this concept into account.

A9.10.6 Following the screening exercise shown in Table A9.1, no European Sites have been selected as requiring further consideration to determine if the conservation objectives of the site could be undermined as a result of the proposed seabed levelling works.

[42] Environment, heritage and Local Governement (2010) Appropriate Assessment of Plans and Projects in Ireland Guidance for Planning
Authorities. 11 February 2010:

[43] Natural England (2012) *Galloper Wind Farm Order Application*. Written Summary of Oral Case put by Natural England at the Issue Specific Hearing relating to Biodiversity, Biological Environment and Ecology EN010003. 40pp.

A9.11 Conclusions

A9.11.1 This report has been prepared to support the Dumping at Sea Permit application and provide information regarding likely significant effect to European Sites in light of their conservation objectives. It is intended that the information presented is used by the licensing authority to determine whether significant impacts on the SPAs and SACs are likely.

A9.11.2 The key findings of the report are:

i. The effects of seabed ploughing were assessed as not causing an effect to the integrity of the European Sites; and
ii. Effects to species and habitat features of European Sites were screened out. Each feature was individually assessed, but the most common reasons for screening out features from further investigation were:
    a. There was no effect pathway to the feature (direct or indirect); and
    b. Where a potential pathway was present, the scale of the effect would not undermine the site's conservation objectives – effects from similar projects are not considered accrue in a cumulative manner due to the vast opportunity for recovery between projects' effects.

Table A9.1 Screening of sites for Likely Significant Effects

European Site	Distance to site	Interest features	Seabed disturbance/alternation effect	Increase in suspended sediment	Sediment deposition effect	Noise and visual disturbance effect	In-combination effects	Likely significant effect
Kilpatrick Sandhills SAC (IE0001742)	9.4 km	• Annual vegetation of drift lines • Embryonic shifting dunes • Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) • Fixed coastal dunes with herbaceous vegetation (grey dunes)* • Atlantic decalcified fixed dunes (Calluno-Ulicetea)*	✖ The interest features are terrestrial or supralittoral habitats and therefore cannot be disturbed or altered by the proposed seabed levelling works.	✖ The interest features are terrestrial or supralittoral habitats and therefore not influenced by marine suspended sediment concentrations.	✖ The interest features are terrestrial or supralittoral habitats and therefore cannot be affected by sediment deposition under water.	✖ The interest features are terrestrial or supralittoral habitats and therefore not sensitive to noise or visual changes.	✖ The works cannot contribute to an in-combination effect as there is no pathway to the seabed levelling and the features and no in-combination projects are in the area.	✖
Buckroney-Brittas Dunes And Fen SAC (IE0000729)	13.2 km	• Annual vegetation of drift lines • Perennial vegetation of stony banks • Mediterranean salt meadows (*Juncetalia*	✖ The interest features are terrestrial or supralittoral habitats and therefore cannot be disturbed or altered by the proposed seabed levelling works.	✖ The interest features are terrestrial or supralittoral habitats and therefore not influenced by marine suspended	✖ The interest features are terrestrial or supralittoral habitats and therefore cannot be affected by sediment	✖ The interest features are terrestrial or supralittoral habitats and therefore not sensitive to noise or visual changes.	✖ The works cannot contribute to an in-combination effect as there is no pathway to the seabed levelling and the	✖

European Site	Distance to site	Interest features	Seabed disturbance/alternation effect	Increase in suspended sediment	Sediment deposition effect	Noise and visual disturbance effect	In-combination effects	Likely significant effect
		maritimi) • Embryonic shifting dunes • Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) • Fixed coastal dunes with herbaceous vegetation (grey dunes)* • Atlantic decalcified fixed dunes (Calluno-Ulicetea)* • Dunes with Salix repens ssp. argentea (Salicion arenariae) • Humid dune slacks • Alkaline fens		sediment concentrations.	deposition under water.		features and no in-combination projects are in the area.	
Magherabeg Dunes SAC (IE0001766)	13.4 km	• Annual vegetation of drift lines • Embryonic shifting dunes	✖ The interest features are terrestrial or supralittoral habitats and therefore cannot be disturbed or altered by the	✖ The interest features are terrestrial or supralittoral	✖ The interest features are terrestrial or supralittoral	✖ The interest features are terrestrial or supralittoral	✖ The works cannot contribute to an in-combination	✖

European Site	Distance to site	Interest features	Seabed disturbance/alternation effect	Increase in suspended sediment	Sediment deposition effect	Noise and visual disturbance effect	In-combination effects	Likely significant effect
		• Shifting dunes along the shoreline with *Ammophila arenaria* (white dunes) • Fixed coastal dunes with herbaceous vegetation (grey dunes)* • Atlantic decalcified fixed dunes (Calluno-Ulicetea)* • Petrifying springs with tufa formation (Cratoneurion) *	proposed seabed levelling works.	habitats and therefore not influenced by marine suspended sediment concentrations.	habitats and therefore cannot be affected by sediment deposition under water.	habitats and therefore not sensitive to noise or visual changes.	effect.	
Wicklow Head SPA (IE0004127)	16.5 km	• Kittiwake *Rissa tridactyla*[44]	✖ Kittiwake have a very low vulnerability to changes to fish and benthic communities[37]. This species has a mean maximum foraging range of 60.0 km, therefore may be capable of foraging over the proposed levelling area.	✖ Kittiwake have a very low vulnerability to turbidity[37]. This species has a mean maximum foraging range of 60.0 km, therefore may be	✖ Kittiwake have a low vulnerability to sediment depostion[37]. This species has a mean maximum foraging range of 60.0 km,	✖ Kittiwake have a very low vulnerability to disturbance caused by vessel presence (noise and visual)[37]. This species has a	✖ The effects caused by similar activities are unlikely to accrue in a cumulative manner based on the distances	✖

[44] This feature is the only habitat or species listed within the conservation objectives for Wicklow Head SPA.

European Site	Distance to site	Interest features	Seabed disturbance/alternation effect	Increase in suspended sediment	Sediment deposition effect	Noise and visual disturbance effect	In-combination effects	Likely significant effect
			However, the Bank does not support fisheries of importance to kittiwake, and birds would have access to approximately 6,930 km^2 of marine areas from this colony. The proposed levelling area makes up approximately 0.006% of this area. During the non-breeding season, this species is capable of travelling further distances from the colony, and the proportion of available sea area would increase. Due to the mobility of the species and the lack of prey fauna associated with the dump site, the localised effects of seabed disturbance are not considered to present a Likely Significant Effect to the foraging success of kittiwakes or the integrity of the SPA.	capable of foraging over the proposed plough area. However, the Bank does not support fisheries of importance to kittiwake, and birds would have access to 6,930 km^2 of marine areas from this colony. The proposed ploughing area makes up approximately 0.006% of this area. During the non-breeding season, this species is capable of travelling further distances from the colony, and the proportion of available sea area would increase. Due to the mobility of the species, the abundance of similar feeding habitat and the	therefore may be capable of foraging over the proposed plough area. However, the Bank does not support fisheries of importance to kittiwake, and birds would have access to approximately 6,930 km^2 of marine areas from this colony. The proposed ploughing area makes up approximately 0.006% of this area. During the non-breeding season, this species is capable of travelling further distances from the colony, and the proportion of available sea area would increase. Due to the	mean maximum foraging range of 60.0 km, therefore may be capable of foraging over the proposed plough area. However, the bank does not support fisheries of importance to kittiwake, and birds would have access to approximately 6,930 km^2 of marine areas from this colony. The proposed ploughing area makes up approximately 0.006% of this area. During the non-breeding season, this species is capable of travelling further distances from the colony, and the proportion of	to other project locations. Individuals will recover from the negligible-scale effects caused by ploughing before potential interaction with other projects.	

European Site	Distance to site	Interest features	Seabed disturbance/alternation effect	Increase in suspended sediment	Sediment deposition effect	Noise and visual disturbance effect	In-combination effects	Likely significant effect
				natural variability in turbidity, the localised effects of potential increases in turbidity are not considered to present a Likely Significant Effect to the foraging success of kittiwakes or the integrity of the SPA.	mobility of the species, the abundance of similar feeding habitat, the localised effects of deposition are not considered to present a Likely Significant Effect to the foraging success of kittiwakes or the integrity of the SPA.	available sea area would increase. Due to the mobility of the species, the abundance of similar feeding habitat and the existing background disturbance, the negligible increases in noise/vessel presence are not considered to present a Likely Significant Effect to the fitness of kittiwakes or the integrity of the SPA.		
Wicklow Reef SAC (IE002274)	16.6 km	• Reefs[45]	✖. This feature is beyond the extent of the effect.	✖. This feature is beyond the extent of the effect.	✖ This feature is beyond the extent of the effect.	✖ This feature is beyond the extent of the effect.	✖ No contribution to an in-combination effect.	✖

* denotes a priority habitat

[45] This feature is the only habitat or species listed within the conservation objectives for Wicklow Reef SAC.