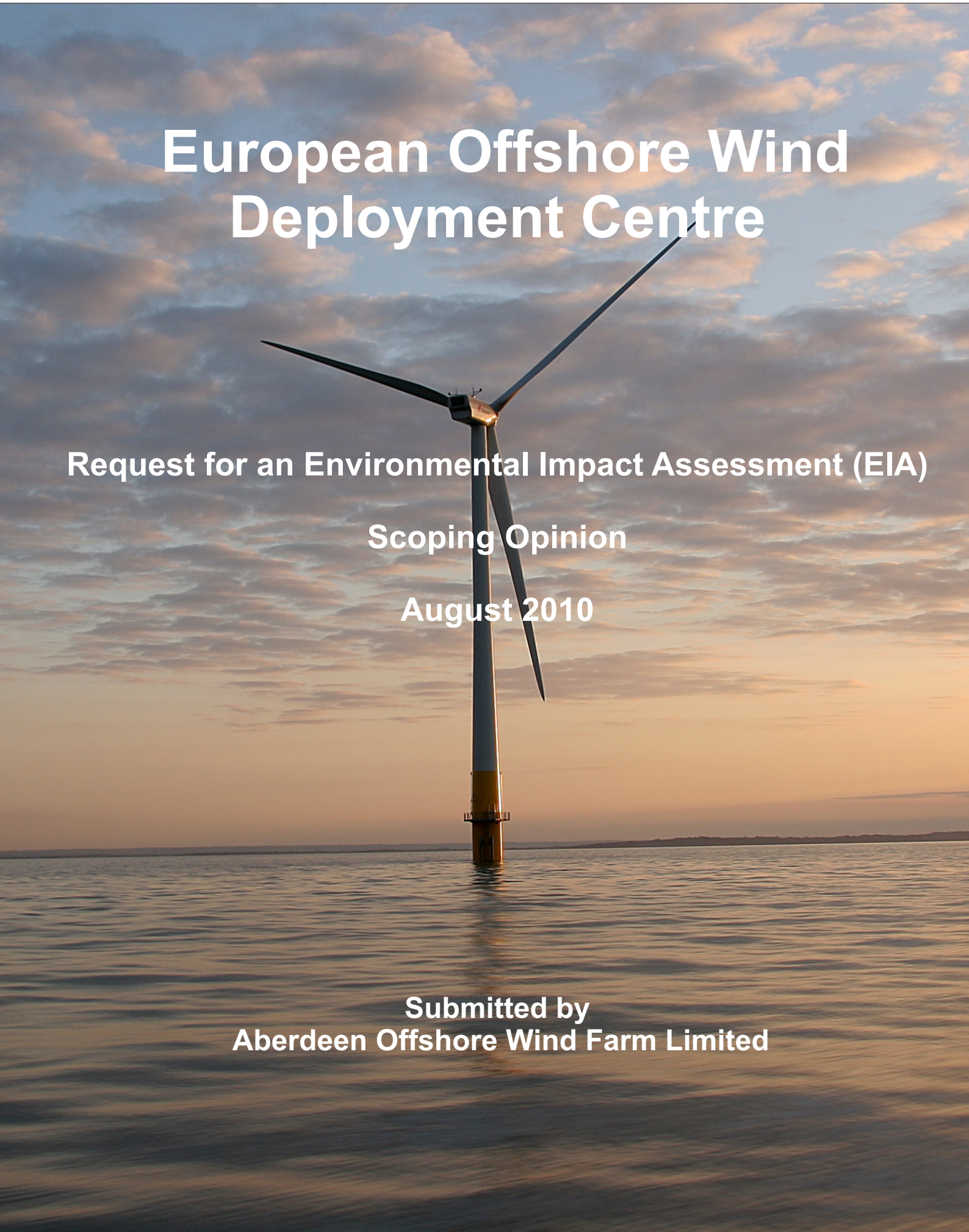
European Offshore Wind Deployment Centre
Environmental Statement

Appendix 4.1: Request for Scoping Opinion 2010

A project part-funded by the European Union under the European Economic Plan for Recovery in the field of Energy



European Offshore Wind Deployment Centre

Request for an Environmental Impact Assessment (EIA)

Scoping Opinion

August 2010

Submitted by
Aberdeen Offshore Wind Farm Limited

PREFACE

Aberdeen Offshore Wind Farm Limited (AOWFL) is proposing to develop an offshore wind farm and deployment centre off the coast of Aberdeen, known as the European Offshore Wind Deployment Centre (EOWDC).

The proposed project would combine a small commercially operated wind farm with a test and research centre, allowing manufacturers to test "first of run" wind turbines and innovative foundation solutions along with related operation and maintenance access logistics.

The project would also include an Ocean Laboratory which would allow environmental monitoring before, during and after deployments. Environmental data may also be collected through a series of planned surveys.

The site is considered ideal for this purpose as it is close to the city of Aberdeen, a recognised centre of excellence for offshore activities and easily accessible, being approximately 2 to 4.5 km from the shore, and in close proximity to Aberdeen Harbour.

The maximum output, as governed by The Crown Estate lease conditions, is 100 MW which would meet the demand of over 55,300 households, approximately 50 % of the domestic need of the Aberdeen City population.

An application for an agreement for lease from The Crown Estate was submitted as part of the 'Demonstration Sites' round in December 2009. In August 2010 AOWFL was awarded an exclusivity agreement for the Aberdeen site.

A Section 36 consent in relation to the European Offshore Wind Deployment Centre, will be applied for within the first quarter of 2011. This timeline is driven by securing and committing 40 million Euros from Europe under the European Energy Programme for Recovery (EEPR).

The project is also likely to require consent under Section 34 of the Coast Protection Act 1949, and a Marine Construction Licence under Section 5 of the Food and Environment Protection Act 1985.

A previous Scoping Report was submitted in 2005. Following detailed consultation the site layout for the project has altered significantly. This document aims to inform stakeholders about the current proposal, the consents required and the planned approach to the Environmental Impact Assessment.

AOWFL welcome your comments on this Scoping Report. Comments should be sent to:

David Rodger
Vattenfall Wind Power Ltd
The Tun Building
4 Jacksons Entry
Holyrood Road
Edinburgh
EH8 8AE

Alternatively please e-mail david.rodger@vattenfall.com.

1 INTRODUCTION

1.1 Background Information

1 In 2005 there was an intention to develop a project comprising 33 commercially operating wind turbines off the coast of Aberdeen. However, due to constraints on the layout which became apparent at an early stage, recent rapid developments in technology and the need for further research in key areas, in 2008 the project was developed into its current form and is now known as the European Offshore Wind Deployment Centre (EOWDC) – a small (11 wind turbine) commercially operated wind farm with a test and research facility, including an Ocean Laboratory.

1.2 Project Overview

2 The vision of the project is:

"To deploy new equipment, systems, processes and initiate R&D to improve the competitiveness of Offshore Wind Energy production, whilst generating environmentally sound marketable electricity and to increase the supply chain capabilities in Scotland, the wider UK and Europe."

3 This project is targeted at both enabling and encouraging increased competition into the European wind turbine supply chain by providing sites for manufacturers both to prove new and innovative solutions and also to allow the acquisition of offshore "hands-on" design, build and operational and maintenance experience, in advance of Round 3.

4 This project will allow "first of run" production wind turbine systems to be operated in the marine environment so that developers, owners and financiers can gain confidence in wind turbine manufacturer's new machine designs, allowing the development of the supply chain in this area.

5 The project will promote and enable the deployment of pre-production innovative foundations.

6 There will be an Ocean Laboratory that could hold meteorological masts, environmental monitoring equipment and be used for access training. The inclusion of an Ocean Laboratory would allow environmental monitoring before, during and after deployments. Environmental data may also be collected through a series of planned surveys. The environmental effects of the deployment centre could be closely monitored and data collected prior to Round 3 developments being installed.

7 Environmental monitoring would provide stakeholders with information on associated environmental impacts.

8 There is the possibility of novel electrical design through testing grid connection technologies.

1.3 The Developer

9 The project will be developed by Aberdeen Offshore Wind Farm Ltd ("AOWFL"). AOWFL will build, own and operate the project's permanent wind

farm assets. AOWFL is an established legal entity owned by Vattenfall Wind Power Ltd (75 %) and Aberdeen Renewable Energy Group (AREG) (25 %).

1.3.1 Vattenfall Wind Power Ltd (VWPL)

10 Vattenfall Wind Power Ltd's ultimate holding company is Vattenfall AB (publ.), a state owned Swedish energy utility company. It currently operates nearly 570 MW of offshore wind capacity around Europe and has a pipeline of 4,800 MW of offshore wind capacity at various stages of development. Vattenfall are currently constructing Thanet Offshore Wind Farm, located 12 km off the Kent coast. The project consists of 100 wind turbines of 3 MW installed capacity each. Vattenfall are also jointly developing with ScottishPower Renewables, the Round 3 East Anglia zone off the east coast of England which has the potential to provide a capacity of up to 7,200 MW.

1.3.2 Aberdeen Renewable Energy Group (AREG)

11 AREG is an incorporated company representing the interests of over 150 member organisations. Established in 2001, AREG aims to ensure that Aberdeen City and Shire and its businesses play a major role in the energy revolution. AREG has been supported by the Energising Aberdeen Fund of Aberdeen City Council. The Fund represents a £22.25 million investment in the future of Aberdeen over five years by the Scottish Government.

1.4 Aims of this Document

12 AOWFL requests a Scoping Opinion from the Scottish Ministers under Regulation 7 of the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2000 specifying the information to be provided in the Environmental Statement (ES) which will accompany the application for a consent under Section 36 of the Electricity Act 1989.

13 A request for a Scoping Opinion was originally made for the scheme in 2005. However there have been considerable changes in both layout and information available on the site since that date so it was suggested and thought highly appropriate that a new Scoping Opinion be requested.

14 AOWFL also requests the Scottish Ministers to procure Scoping Opinions on the basis of the same information under Regulation 4 of the Harbour Works (Environmental Impact Assessment) Regulations 1999 in relation to the intended application for a consent under Section 34 of the Coast Protection Act 1949 and under the provisions of the Food and Environment Protection Act 1985 in relation to the intended application for one or more licences pursuant to Section 5 of that Act.

15 In addition, AOWFL formally notifies the Scottish Ministers under Regulation 8 of the 2000 Regulations described above, that it is intended to submit an application for consent under Section 36 of the 1989 Act for the Aberdeen Offshore Wind Farm and that it is intended to submit an Environmental Statement to accompany this application.

16 In accordance with the above Regulations, this scoping document includes:

- a plan to identify the proposed development site
- a brief description of the nature and purpose of the proposed development and of its possible effects on the environment
- further information as required

17 This document has been prepared with reference to the above Regulations and the Guidance Notes on the Offshore Wind Farm Consents Process issued by Scottish Executive Consents and Emergency Planning Unit.

18 Under Directive 2000/42/EU (the Strategic Environmental Assessment Directive) an environmental assessment is required for plans and programmes in specific sectors, including energy, that sets the framework for development consents for projects listed in the EIA Directive and for those requiring an appropriate assessment under the Habitats or Birds Directives. At present an SEA is being prepared by the Scottish Government in respect of Scottish Territorial Waters, which may impact upon this proposal. We welcome advice from the Scottish Executive on this subject. However we note that the Draft Plan for Offshore Wind Energy in Scottish Territorial Waters confirms “smaller areas that are suitable for test and demonstration sites, including existing sites have been scoped out of the Draft Plan and it’s environmental assessment” (Marine Scotland, 2010 paragraph 2.5.3).

1.5 The Need for Offshore Wind Energy

19 Climate change represents one of the greatest environmental threats faced by the world today with far reaching implications for the global environment and economy. Renewable electricity generation is vital for decarbonising the global energy system and hence global climate change mitigation. Wind energy is one of the most competitive technologies in renewable energy. However, large scale implementation offshore, whilst offering potential for significant opportunity to develop vast wind resource capacity, also poses huge challenges, requiring technological innovation, industrial & market development and, in parallel, significant cost reduction to become cost competitive with other forms of energy sources.

20 The UK, and specifically Scotland, has some of the best wind resource in Europe.

21 The Scottish Government aims to achieve a target of 50 % of Scottish demand for electricity from renewable sources by 2020 with a milestone of 31 % by 2011. The Scottish Parliament passed the Scottish Climate Change Act in 2009. It demanded a 42 % cut in greenhouse gas emissions by 2020 and 80 % cuts by 2050, based on a 1990 baseline. The development of Scotland's offshore wind potential will be crucial to the delivery of Scotland's legal obligations on climate change.

22 The rapid development of offshore wind capacity is central to the delivery of the UK’s share of the EU target of 20 per cent renewable energy by 2020. The Crown Estate, as the seabed owner, has recently announced proposals to deliver up to 25 GW of new offshore wind farm sites by 2020 through the Round 3 licensing. This is intended to provide a stimulus throughout the EU and to provide an important contribution to both reducing CO_2 emissions and improve security of energy supply to the wider EU. This builds on the 8 GW of offshore wind farm projects currently under development and to be

delivered by Rounds 1 and 2. If successful, the addition of the capacity from Round 3 and the Scottish Territorial Waters Round together with any additional smaller sites, could lead to a potential total of 39.5 GW of offshore wind energy.

23 The scale of the challenge in delivering such a large programme is such that the equipment and services supply chains need to be dramatically enhanced very quickly and efficiently. The central requirement is for live operational experience with validated data, together with an area to deploy novel technologies to gain actual operational hours offshore in a controlled, yet real, environment.

24 The EOWDC focus on proving new technology, processes and operations and improving existing technology, processes and operations. Key objectives will be increasing reliability, efficiency and reducing costs. As such, it will directly contribute to the delivery of not only the UK Round 3 and Scottish Territorial Water Rounds, but also the wider European programme of offshore development.

25 The maximum output, as governed by The Crown Estate lease conditions, is 100 MW, and with a 30 % capacity factor would provide enough capacity to meet the demand of over 55,300 homes, equating to a supply large enough to meet over 50 % of the domestic need of the Aberdeen City population[1]. The 2013 household estimate for Aberdeen is 108,150 (See Appendix 9.1).

1.5.1 Creation of Employment from Wind Energy

26 Estimates vary as to the global job creation potential for wind power (on and offshore). However a middle case scenario suggests 462,000 by 2010 and 1.3 million by 2020 with a potential maximum recognised as 572,000 by 2010 and 2.2 million by 2020 (GWEA, 2008). As Europe is a particularly intensive area for wind development, it is to be expected that the proportion of global employment secured could be significantly higher than implied by the population or land mass and sea area. The European Wind Energy Association estimates that European employment in wind power will increase to almost 330,000 in 2020 and to 375,000 by 2030, 57 % of the latter figure being accounted for by offshore wind (EWEA, 2008).

1.6 Approach to Environmental Impact Assessment

27 The EIA for this project will comprise the following sections:

- Non-Technical Summary
- Introduction
- Legislative Framework
- Project Description
- Physical Environment Baseline Description and Impact Assessment
  - Meteorological Conditions
  - Geology, Bathymetry and Topography

[1] This assumes number of households in Aberdeen was 102,900 in 2008. This is based on the “Household Projections for Scotland 2008-based” from the General Register Office for Scotland (2010).

  - Oceanographic Conditions
  - Sediment and Water Quality
  - Coastal Processes
- Biological Environment Baseline Description and Impact Assessment
  - Marine Ecology
  - Intertidal Ecology
  - Ornithology
  - Bats
  - Marine Mammals
  - Underwater Noise and Vibration
  - Electromagnetic Fields
  - Conservation - to include information to support an Appropriate Assessment if one is required
- Human Environment Baseline Description and Impact Assessment
  - Shipping and Navigation
  - Aviation
  - Ministry of Defence
  - Archaeology
  - Seascape, Landscape and Visual and Cultural Heritage
  - Commercial Fisheries
  - Socio-economics
  - Recreation and Tourism
  - In-Air Noise
  - Energy and Emissions
  - Electromagnetic Interference
  - Other Marine Users
- Summary of Environmental Impact Assessment and Mitigation Measures
- Glossary of Terms
- References
- Supporting Technical Appendices

28 Each Environmental section is likely to comprise the following information:

- Introduction
- Methodology and Guidance
- Baseline Methodology
- Impact Assessment Methodology
- Description of the Baseline Environment
- Impact Assessment – Construction, Operation and Decommissioning
  - Potential Impact
  - Mitigation
  - Residual Impact
  - Monitoring
- Cumulative Impact Assessment
- In-combination Impact Assessment

1.6.1 Impact Assessment Methodology

29 In the case of each impact, the assessment aims to describe the magnitude of effect (ie the change created by an activity in terms of spatial extent, duration and scale) and the sensitivity of each receptor. The combination of the effect and the sensitivity of the receptor are then used to derive the

significance of the impact. The criteria that will be used in general is given below:

1.6.1.1 Spatial Extent of Effect

- a national/international effect
- a regional effect
- a local effect (within 5 km of the site)
- a site-specific effect

1.6.1.2 Duration of Effect

- a long-term/permanent effect (more than 10 years)
- a medium-term effect (existing for 5 to 10 years)
- a short-term effect (existing for 1 to 5 years)
- a temporary effect (existing for less than a year)

1.6.1.3 Scale of Effect

- above accepted standards/guidelines
- within accepted standards/guidelines
- where there are no standards/guidelines available, the impact relative to background conditions

1.6.1.4 Recoverability of the Receptor

- high
- medium
- low or none

1.6.1.5 Importance of the Receptor

- high
- medium
- low

30 The impact significance is then given as *major*, *moderate*, *minor* or *negligible*, see Table 1.1.

TABLE 1.1
Matrix for significance of impact

	Sensitivity of Receptor				
Magnitude of Effect based on spatial, duration and scale of effect		**Very High**	**High**	**Medium**	**Low**
	Very High	Major	Major	Major	Moderate
	High	Major	Major	Moderate	Minor
	Medium	Major	Moderate	Moderate	Minor
	Low	Moderate	Minor	Minor	Negligible
	Negligible	Minor	Negligible	Negligible	Negligible

1.6.2 Cumulative and In-combination Impact

31 An important part of the EIA process will be to consider cumulative and in-combination impacts.

1.6.2.1 Cumulative Impact

32 Schedule 3 of the Electricity Works EIA (Scotland) Regulations 2000 requires that the potential for *cumulative impact* should be considered and where appropriate, assessed.

33 Cumulative impacts will include, but may not be limited to, impacts that arise from the following existing and reasonably foreseeable development activities:

- other wind farms
- aggregate extraction and dredging
- navigation and shipping
- established fishing activities
- existing and planned construction subsea cables and pipelines
- potential port / harbour development
- oil and gas installations

34 The cumulative assessment will address where predicted impacts of the wind farm construction and operation could interact with impacts from other industry sectors within the same region and impact sensitive receptors. This may be through direct effects or spatially/temporally separated impacts on the same population of a receptor.

1.6.2.2 In-combination Impacts

35 The Conservation (Natural Habitats, & c.) Regulations 1994 (as amended) require that an Appropriate Assessment (AA) must be conducted by a competent authority of the implications for the European site in view of the European sites conservation objectives in respect of any plan or project which is not directly connected with or necessary to the management of the European site for conservation purposes and which is likely to have a significant effect on the European site either alone or *in-combination* with other plans or projects.

36 Therefore the term ‘in-combination’ will be used when considering the impacts of the proposals with other plans or projects on European sites.

2 PROJECT DESCRIPTION

2.1 Site Location

37 The EOWDC site is located approximately 2 km from the Aberdeenshire coast (see Figure 1). The proposed site comprises an area following the coastline between northern Aberdeen and Balmedie. The lease boundary for development would cover up to 20 km^2.

2.2 Site Selection

38 The EOWDC site location has been determined through a long process of examining the constraints, undertaking consultations, and conducting surveys, studies and assessments.

39 The concept of an offshore wind farm in Aberdeen originated in 2002 following approach by AREG to AMEC Wind Energy. The concept of a Renewable Energy Centre in Aberdeen was discussed and included an onshore wind turbine and a number of offshore wind turbines. AMEC Wind Energy began to look at a layout stretching up the coastline and initial visualisations were carried out by the Macaulay Institute.

40 The joint venture was formed in 2005 in the proportions AMEC 75 % and AREG 25 %. With the sale of AMEC Wind Energy to Vattenfall, the joint venture now comprises Vattenfall Wind Power Ltd 75 % and AREG 25 %. The company has a board of directors drawn from the two constituent organisations.

41 The wind farm layout has undergone a number of iterations from 2004 to 2010 which are described in Table 2.1 and shown on Figures 3, 4 and 5. These layout changes have primarily been a result of consultation with Aberdeen Harbour Board, the aviation industry, the Ministry of Defence and key environmental stakeholders.

42 In 2005, a Scoping Opinion was sought on a wind farm development layout which was located approximately 1 km from the Aberdeenshire coast (See LABER007 Figure 3). This site comprised an area following the coastline between Girdle Ness and Newburgh, with the study area for development covering approximately 26 km^2. It was proposed that the wind turbines would be aligned in two rows either side of the 10 m water depth contour. The wind farm at that time comprised approximately 33, three-bladed wind turbines, with an individual wind turbine capacity of up to 5 MW.

43 The project described in this Scoping Report now comprises 11 wind turbines and an Ocean Laboratory located approximately between 2 and 4.5 km offshore, see Figure 2.

Table 2.1
Site Layout Iterations

Internal Layout Reference	Number of Wind Turbines	Date	Wind Turbine Layout Description
LABER002	18	October 2004	Initial layout (based on 10 m water depth constraint) extended north to Newburgh Bar and increased indicative rotor diameter to 120 m and separation between wind turbines to suit.
LABER007	33	February 2005	Layout followed the coastline between Girdle Ness and Newburgh. Two rows of wind turbines were designed to be aligned either side of the 10 m water depth contour. This is the layout included in the previous Scoping Report 2005.
LABER008	24	September 2005	Similar to LABER007, this layout follows the coastline between Girdle Ness and Newburgh. There are two distinct groups, a northern one and a southern one, with a gap in the middle to accommodate a 4 nm helicopter corridor (Shrub – Balis). Both groups have three columns of wind turbines. Outer wind turbines now in water depths up to 20 m. Not a valid layout, created for discussion only.
LABER011	23	January 2006	Updated aviation constraints (including Bridge of Don alternative route) were used to create this layout along with a water depth limit of 25 m. Layout wind turbines have a 120 m rotor diameter. Not a valid layout, created for discussion only.
LABER012	10	September 2008	Site reduced to 10 wind turbines for MOD re-assessment. From the previous layout, the columns closest and furthest from the shore were both removed (for bird and shipping interests) along with the two northern most wind turbines of the remaining 12 (for Black Dog Rifle Range impact), leaving 10 wind turbines.
LABER015	10	March 2009	Wind turbine locations similar to subset of LABER011. Wind turbine locations differ slightly due to increased separation to accommodate a 126 m rotor diameter. Created with the intention of a 10 wind turbine layout not extending as far south as LABER012, in order to avoid Bridge of Don alternative helicopter corridor constraint.
LABER021	15	September 2009	Layout created based on LABER015. Five wind turbines added in total. Two coastal wind turbines removed, extra row added to south (but outside helicopter constraint) and three wind turbines added as eastern column. One wind turbine added into the Black Dog Rifle Range giving a total of two in this area.
LABER027	12	October 2009	Layout based on new internal agreed list of constraints: - outside existing northern and alternative southern helicopter constraints - within geophysical survey area

Table 2.1 Site Layout Iterations			
Internal Layout Reference	**Number of Wind Turbines**	**Date**	**Wind Turbine Layout Description**
			- outside of MoD Black Dog Rifle Range - no closer to coast than layout LABER021. Layout designed to consider multiple rotor diameters of 90 m, 126 m and 150 m so that outer row accommodates largest rotor diameter. The layout was limited by the necessary spacing between wind turbines. Layouts LABER022 to 026 informed this layout through several variations for discussion.
LABER028	11	November 2009	Following a response from the MoD the wind turbine which was located within the MoD Black Dog Firing Range was removed.
LABER032	16	April 2010	Following further consultation with NATS, it became apparent that there is a possibility of moving the northern helicopter route further north allowing room for two more wind turbines at the north of the site. Also three wind turbines were added to the east of the site as the geophysical survey boundary constraint was relaxed due to this expansion to the north. The decision to have wind turbines beyond the geophysical survey boundary was driven by desire to increase distance from Aberdeen Harbour.
LABER033	11	April 2010	The six southernmost wind turbines were removed to increase distance from the harbour and shipping. The entire site was slightly shifted down to accommodate an extra wind turbine to the north of the site such that it doesn't lie within the helicopter constraint.
LABER034	11	April 2010	Entire layout was rotated using northernmost wind turbine as a turning point to align the rows of wind turbines to the proposed realigned helicopter constraint. Layout created for discussion.
LABER037	12	April 2010	New layout based on latest constraints of revised northern helicopter route, MoD Black Dog Rifle Range and maintaining a distance from the harbour similar to LABER036. Layout is a regular grid of 3 rows and 4 columns of wind turbines.
LABER039	11	April 2010	Removed the easternmost wind turbine of LABER037 to increase distance from shipping routes.

2.3 The Project Concept

44 The intent is to install a mix of "first run of production" wind turbines on a mix of conventional and novel foundations with monitoring and instrumentation, both for technical and environmental purposes.

45 By providing this infrastructure relatively close to shore, the EOWDC has a possibility for novel training, logistics and an accreditation centre to enable the efficient and timely deployment for European offshore wind turbines

46 Timely construction of the EOWDC will be conditional on successfully raising of all the funding requirements which include a €40m grant from the EU under the European Energy Programme for Recovery (EEPR).

47 At the heart of the project is the interaction between a research, test and training centre with a small, highly innovative, commercially operated and highly instrumented and monitored offshore wind farm. The technologies deployed on the wind farm will provide supporting income to the EOWDC and will offer potential opportunities for:

- the provision of renewable electricity
- technology "proving" through commercial development and deployment
- logistics and supply chain development and proving
- accreditation and training as commercial offerings, especially Health, Safety and Environmental protection (HS&E)
- commercial R&D, testing and dissemination including:
  - long-term environmental monitoring and improvement
  - University level research
  - community, regional, national and international education

2.4 Proposed Development

48 This section summarises the key aspects of the project design. It should be noted that, in defining the project that will be assessed during the EIA, the "Rochdale Envelope" approach (see section 3.4.1) will be adopted. By adopting this approach, it will be possible to conclude that the environmental impact of the proposed development will be no greater than set out in the Environmental Statement.

49 The key offshore components of the proposed EOWDC are:

- 11 offshore wind turbines and their associated foundations
- subsea cables between the wind turbines
- an export cable for connection to the electricity transmission network
- scour protection around foundations and on inter-array and export subsea cables as required and
- an Ocean Laboratory

50 The key onshore components of the wind farm are likely to be:

- onshore deployment facilities
- the landfall site with associated jointing between the offshore export cable and onshore cable to the onshore substation
- the onshore substation

51 This scoping report deals with the offshore components of the project only. The onshore cables and onshore components will be applied for under the Town and Country Planning Act and will be dealt with under a separate Scoping Report. The level of environmental information required to support

the planning application for the onshore works will be discussed with the relevant authorities.

2.4.1 Wind Turbines

52 The wind turbines will be between 4 and 10 MW. The 4 MW wind turbines will have a maximum hub height of 100 m above LAT and the 10 MW wind turbines will have a maximum hub height of 120 m above LAT. Maximum rotor diameter will be 120 m and 150 m respectively. It should be noted that the exact specifications for the project are yet to be determined as it is a test centre and it is not known yet exactly which wind turbines will be deployed on the site.

TABLE 2.2
Wind Turbine Dimensions for the Minimum and Maximum Size Machines

Wind Turbine Size	Maximum Hub Height above LAT (m)	Maximum Rotor Diameter (m)	Maximum Tip Height above LAT (m)
4 MW	100	120	160
10 MW	120	150	195

53 The Environmental Impact Assessment will be based on a hypothetical machine with a maximum height to tip of 195 m above LAT. The lifetime of the project is dependent upon seabed lease agreements and the current proposal for the length of the lease is 22 years.

2.4.2 Foundations

54 Potential foundation types which will be considered within the EIA are:

- steel monopile
- concrete monopile
- jacket on piles
- tripod on piles
- gravity base structure and
- suction caisson

55 A detailed description of the installation, and decommissioning methods for each foundation type considered will be included within the Environmental Statement.

56 Apart from the different foundation types stated in Table 2.3, the EOWDC may also be used to test new concepts.

57 It is expected that any new foundation concepts which may be proposed for the wind farm site would lie within the project envelope used for the purposes of the EIA.

58 More than one foundation type could be used within this project. For all the foundation options, the foundation structure will extend by approximately 15 to 20 m above mean sea level (MSL) such that the base of the wind turbine tower is clear of the most extreme design wave height.

59 Indicative dimensions, construction materials and a brief description of the expected installation methods for each of the foundation options are outlined in Table 2.3. The indicative dimensions are based on a 5 MW wind turbine size and mid-range water depth but will vary for larger wind turbine sizes.

2.4.3 Ocean Laboratory

60 It is the intention to install an Ocean Laboratory on the wind farm site. This is likely to comprise of meteorological monitoring and other environmental measuring equipment. The Ocean Laboratory structure could also be used for access training. Options for future research and monitoring of the site can be found within the relevant sections of this document. The Ocean Laboratory would be subject to a separate consent application which would be discussed with the relevant consenting authorities. Once the Ocean Laboratory is operational it could be used by research organisations to allow long-term environmental monitoring. Potential locations for the Ocean Laboratory can be seen on Figure 2 as an indicative monitoring location.

2.4.4 Export Cable

61 The potential location of the export cable route is dependent on the location of the onshore substation. An indicative onshore substation location and indicative cable route can also be seen on Figure 2.

Table 2.3
Basic Foundation Types and Information

Type	Indicative Dimensions[1]	Construction Material	Indicative Installation Method
Steel monopile[2]	Up to 7.5 m diameter Pile embedment 30 m plus	Steel pile and transition piece	Pile and transition piece transported to site by installation vessel or barge Pile up-ended by crane and lowered to seabed Pile driven by hammer (sometimes drilled) Transition piece installed by crane and connection grouted Rock dumping scour protection (if required)
Concrete monopile[2]	Up to 8.5 m diameter Pile embedment 30 m plus	Pre-cast reinforced concrete ring elements with steel post-tensioning	Pile and ice cone platform transported to site by installation vessel or barge Pile up-ended by crane and lowered to seabed Pile drilled from inside toe of pile Ice cone platform installed Rock dumping scour protection (if required)
Jacket on piles	Numerous variants are being considered. Typically, lattice structure comprising tubular sections of diameter 0.5 to 1.2 m Approx. 25 m x 25 m footprint at base Pile diameter approx. 1.8 to 2.5 m Pile embedment approx. 30 m – 35 m	Steel jacket and piles	Jacket and piles transported to site by barge Installation template set down on sea bed Piles stabbed and driven Survey of pile levels and adjustment of jacket leg positions Jacket lifted and set down on piles Jacket levelled and pile connections grouted

Table 2.3
Basic Foundation Types and Information

Type	Indicative Dimensions[1]	Construction Material	Indicative Installation Method
Tripod on piles	Typically main column approx. 5.5 m diameter, with 3 No. diagonal braces approx. 4 m diameter Approx. 25 m diameter footprint at base Pile diameter approx. 1.8 to 2.5 m Pile embedment approx. 30 m – 35 m	Steel tripod and piles Concrete tripod variants also being considered	Tripod and piles transported to site by barge Tripod lifted and set-down on mudmats on the seabed by crane Piles stabbed and driven Tripod levelled and pile connections grouted
Gravity base structure	Typically conical tower, approx. 6.5 m diameter at top Approx. 30-40 m diameter footprint at base	Reinforced concrete shell with pumped sand ballast fill	Seabed preparation as necessary GBS transported to site by barge or heavy lift vessel (or floated) GBS lifted by crane (or up-ended) and lowered to seabed Levelling and underbase grouting Ballasting (sand or similar) and further levelling as necessary Rock dumping scour protection (if required)
Suction caisson/bucket	Tower section 5.5 to 6.5 m diameter Approx. 18 m diameter footprint for bottom skirt Skirt embedment approx. 10 m depending of the soil conditions	Primary material is steel	Caisson transported to site by floating Up-ended by crane and lowered to seabed Air deflated in bucket skirt to sink caisson Scour protection (if required)

Notes
1 Initial estimate based on mid-range wind turbine size (5 MW) and mid-range water depth
2 These foundation types are limited to lower end of range of wind turbine sizes and water depths

2.5 Project Construction

2.5.1 Construction Timescales

62 The construction of the proposed project is planned in a phased approach and will be further described in the Environmental Statement but it is likely to be:

- four wind turbines installed in Year 1 (2012)
- seven wind turbines to be installed in Year 3 (2014)

63 Construction in the marine environment is potentially hazardous, and in the interests of safe working the project should be permitted to take advantage of as much construction time in favourable conditions as is possible. Construction activity is expected to continue, subject to site weather conditions, for 24 hours per day until construction is complete.

2.5.2 Construction Infrastructure

64 Key to defining the construction methodologies (and therefore the likely construction activities) will be choices on the following:

- wind turbine selection
- foundation types
- inter-array cables
- port(s) used as the base for the construction phase
- vessels to be used for the offshore construction works

65 Potential options would be addressed during the detailed design and EIA phase. However, as the project is being used to test first of run wind turbine and innovative foundation types, new concepts may become apparent throughout the project development. It is anticipated that these would lie within the project envelope used for the purposes of the EIA.

66 A number of ports exist on the east coast of Scotland and mainland Europe coast that may be suitable for much of the construction and operation activities required for the wind farm project. Part of the detailed project design and logistics planning for the project involves assessing a number of potentially suitable port facilities.

67 In addition to using ports for the construction of the wind farm, consideration will be given to the components of the wind farm being brought directly to the project site from their point of manufacture.

68 Construction compounds and storage facilities will be required at the ports used as the construction base(s).

69 It can be assumed that the key stages associated with the installation of the wind farm are likely to be as follows:

- detailed pre-construction site investigation (eg cone penetration tests, boreholes and high resolution geophysics), subject to a separate consent application process

- foundation installation and associated site preparation
- installation of tower, nacelle, hub and blades of the wind turbine generators
- installation of inter-array transmission cables
- installation of transmission cables to shore and
- construction of the required onshore electrical infrastructure (onshore substation) to link the development to the National Grid transmission system

2.5.2.1 Foundations

70 Foundation installation will be one of the first offshore construction activities to take place. Methods of installation for foundations vary significantly depending upon the foundation type selected. Techniques typically employed for foundation installation include:

- pile driving
- pile drilling
- seabed levelling (for gravity base structures)
- ballasting (for gravity base structures) and
- grouted connections (eg for connecting piles to jacket)

2.5.2.2 Wind Turbines

71 Following foundation installation, offshore wind turbines will be erected. Commonly, towers and nacelles are pre-erected or erected individually at the site using a crane barge. Blades are subsequently fitted to the tower/nacelle structure as individual components or in a part assembled state.

72 Aviation warning lighting to be fitted to some or all of the wind turbines, as required by the UK Air Navigation Order 2009 which will be designed in consultation with key stakeholders, such as the Civil Aviation Authority (CAA). Additionally, international aviation regulatory documentation requires that the rotor blades, nacelle and upper two thirds of the supporting mast that are deemed to be an aviation obstruction should be painted white, unless otherwise indicated by an aeronautical study.

2.5.2.3 Inter-Array Cables

73 The extent to which the various burial techniques are used will be dependent on the result of a detailed seabed survey of the final cable route and associated burial risk assessment process. It is likely that some form of ploughing or jetting, or combination of both, will be used.

74 Rock dumping, frond mats/ grout bags or concrete mattresses may be used to protect the cable ends where they enter wind turbine foundations and may be utilised when ground conditions result in the cable being laid near to or on the surface. It is conceivable that the laying of cable protection may also be necessary after burial, where sections of cables are too shallow or have otherwise become exposed as informed by the post installation inspection or periodic maintenance surveys.

2.5.2.4 Cable and Pipeline Crossings

75 There are two telecommunications cables west of and close to EOWDC and it is therefore possible that crossings may be required. The design of any crossing will be agreed with the cable/pipeline owner/operator to ensure that integrity of all the assets is maintained.

2.5.2.5 Scour Protection

76 Scour can occur around the base of a foundation when seabed sediment is worn away as a result of the flow of water around the structure. A number of options for scour protection could be considered for installation, depending on the final project design process, ground conditions and scour assessments. These could include:

- rock and gravel dumping
- protective aprons
- mattresses and
- flow energy dissipation (frond) devices

77 The installation of scour protection material would be carried out using a ship or barge, for example using an on-board fall pipe system. Alternatively, custom-built vessels equipped with side-dump facilities, grabs or fall pipe with a remotely operated vehicle can also be used.

2.6 Project Operation and Maintenance

78 The operation and control of the wind farm will be managed by a Supervisory Control and Data Acquisition (SCADA) system, connecting each wind turbine to a control room.

79 The current technology of wind turbines will require a major service every 12 months. Periodic visits will also be required in the event the wind turbines experience a fault which cannot be remotely reset. Gearbox oil changes are required every five years. Periodically, large components such as gearboxes and blades may need to be replaced.

80 It is not considered a requirement to have formal safety zones around the wind turbines during operation, but an area may be established around each wind turbine to regulate other users of the sea for safety reasons. The applicants understand that provisions within the Electricity Act 1989 could be revised to allow this. Any safety areas will be proposed only after full consultation with the Maritime and Coastguard Agency (MCA) and Aberdeen Harbour Board.

2.7 Project Decommissioning

81 The design life of the wind turbines and other components of the wind farm are likely to be in the order of 20 to 30 years. If the decision to refurbish or replace the wind turbines is made, then any relevant consents or licences required would be applied for at that time.

82 At the end of the operational life of the wind farm it is anticipated that all structures above the seabed will be completely removed by reverse lay, that is, the reverse construction sequence.

83 The decommissioning plan submitted prior to the construction of the EOWDC will be reviewed and revised as necessary throughout the lifecycle of the project to reflect changing circumstances and regulatory requirements, and to incorporate improvements in knowledge and understanding of the marine environment and advances in technology and working practices.

84 Part 2 of the Energy Act 2004 sets out powers requiring the decommissioning of offshore renewable energy installations and their related equipment. Guidance supporting the Act requires a decommissioning plan to be in place prior to the completion of the construction of an offshore wind farm. As part of the decommissioning plan an assessment on the potential environmental impacts may also be required.

85 The International Maritime Organisation Guidelines (IMO) and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone (IMO 1989), set out the minimum global standards to be applied to the removal of offshore installations and structures. The Guidelines and Standards were designed essentially to ensure the safety of navigation and are not intended to preclude a coastal state from imposing more stringent removal requirements.

86 In large part, the UK's approach to decommissioning is governed under the 1992 Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR Convention). Agreement on the regime to be applied to the decommissioning of offshore installations in the Convention area was reached at a meeting of the OSPAR Commission in July 1998 (OSPAR 98/3). The UK's acceptance of OSPAR Decision 98/3 means that the UK will apply the provisions of that instrument when considering the decommissioning of offshore installations rather than the standards and guidelines laid down by the IMO. However, certain aspects of the IMO Guidelines and Standards are still relevant. These are:

- any disused installation or structure, or part thereof, which projects above the surface of the sea should be adequately maintained
- an unobstructed water column of at least 55 m must be provided above the remains of any partially removed installation to ensure safety of navigation
- the position, surveyed depth and dimensions of any installation not entirely removed should be indicated on nautical charts and any remains, where necessary, properly marked with aids to navigation
- the person responsible for maintaining any aids to navigation and for monitoring the condition of any remaining material should be identified
- the liability for meeting any claims for damages which may arise in the future should be clear
- on or after 1 January 1998, no installation or structure should be placed on any continental shelf or in any exclusive economic zone unless the design and construction of the installation or structure is such that entire removal upon abandonment or permanent disuse would be feasible

87 Under the terms of Decision 98/3, which entered into force on 9 February 1999, there is a prohibition on the dumping and leaving wholly or partly in

place offshore installations. The topsides of all installations must be returned to shore. All installations with a jacket weight less than 10,000 tonnes must be completely removed for re-use, recycling or final disposal on land.

3 LEGISLATIVE FRAMEWORK

3.1 The Crown Estate Lease

88 A developer must obtain a site lease from The Crown Estate (TCE) prior to installing a renewable energy device in the marine environment. The Crown Estate owns much of the foreshore and seabed from Low Water out to 12 nautical miles (nm).

89 A Strategic Environmental Assessment (SEA) is currently being prepared by Marine Scotland on behalf of the Scottish Government to assess offshore wind energy within Scottish Territorial Waters to ensure that environmental considerations are incorporated within the decision-making process and that ultimately offshore wind energy development is sustainable. Until the results of the SEA have been finalised by Marine Scotland, developers will be offered an exclusivity agreement with TCE. In the event that the results of the SEA do not rule out prospective development of the proposed site, TCE will proceed to the negotiation of an Agreement for Lease with the developer. AOWFL was awarded an exclusivity agreement with TCE for the Aberdeen site in August 2010. As noted earlier, the Draft Plan for Offshore Wind Energy in Scottish Territorial Waters confirms, “smaller areas that are suitable for test and demonstration sites, including existing sites, have been scoped out of the Draft Plan and its environmental assessment (Marine Scotland, 2010 paragraph 2.5.3). The implications of this for the EOWDC will be discussed with TCE.

90 The Agreement for Lease will contain an option (subject to the fulfilment of all conditions including statutory consents) for the developer to call for the grant of an agreed form lease. The lease will provide the right for the construction, siting and occupation of an area for the purpose of placing structures on, or passing cables over Crown Estate land.

3.2 Marine Licensing

91 On 1 April 2010, Marine Scotland - Licensing Operations Team (MS-LOT) became responsible for a range of statutory controls in waters adjacent to Scotland. Until the new marine licensing regime comes into effect (which is discussed further below), Marine Scotland is responsible for dealing with consent applications.

3.2.1 Current Statutory Regime

92 Under the current statutory regime, the following consents, licences and permits are likely to be required for the project:

3.2.1.1 Marine Permissions

- Section 36 Electricity Act 1989 consent from the Scottish Ministers for the offshore electricity generating station
- Section 36A Electricity Act 1989 declaration will be required to extinguish public rights of navigation

- A licence under the Food and Environment Protection Act 1985 will be required for placing materials in the sea
- A consent under the Coast Protection Act 1949 will be required for placing cables within the water

93 As stated there are presently no offshore works (ie the wind farm and indicative export cable route) within the limits Of the Harbour Board and therefore a works licence will not be required from the Ports and Harbour Authority.

94 In addition, depending upon the characteristics of the site when further investigatory work has been undertaken, the following consent/licences may also be required: wildlife consents, a CAR licence, a licence regarding wrecks, scheduled monument consent, safety zones etc. These will be applied for if necessary.

3.2.1.2 Terrestrial Permissions

95 As noted earlier, this Scoping Report only deals with the offshore element, however for completeness, the following terrestrial permissions would be required:

- an application for the onshore section of the cable route would be made under Section 37 Electricity Act 1989 with a declaration that planning permission be deemed to be granted (if it is for overhead cables)
- a separate planning application under the Town and Country Planning (Scotland) Act 1997 would be required for the onshore substation and any underground cables

3.2.1.3 Other Consents/Licences

- European Protected Species licence under the Habitats Regulations 1994 (as amended) (EPS) (if required)
- Decommissioning Plan Approved by the Department for Energy and Climate Change (DECC)

3.3 Future Statutory Regime

96 The marine consenting regime in Scotland is undergoing change. On 10 March 2010, the Marine (Scotland) Act 2010 received Royal Assent. The Act introduces a framework for the sustainable management of seas around Scotland. This requires marine plans to be produced and be compatible with terrestrial plans to deliver integrated coastal zone management. It is estimated that the marine plans will take approximately two years to produce. In terms of the consenting process, applications for consent under Section 36 of the Electricity Act 1989 and a new marine licence together with any wildlife consents that may be required will all be considered together. Part of the Marine (Scotland) Act came into effect on 1 July 2010 and there will be a phased implementation thereafter. The timing of the coming into effect of the Act will affect whether the applications for consent for the proposal will be made under the statutory regime outlined above or under the Marine

(Scotland) Act. For the terrestrial consents, the process will remain as outlined above under the current statutory regime.

3.4 Environmental Impact Assessment

97 The Environmental Impact Assessment Directive (97/11/EC) requires an EIA to be carried out in support of an application for development consent for categories of project listed in the Directive at Annexes I and II.

98 Offshore wind farm developments are listed in Annex II as 'installations for the harnessing of wind power for energy production (wind farms)'. The EIA Directive has been transposed into UK legislation through various 'EIA Regulations', generally in the form of secondary legislation associated with existing consent provisions.

99 The Electricity Works (Environmental Impact Assessment)(Scotland) Regulations 2000 ("the EIA Regulations") apply Council Directive 85/337/EEC as amended by Council Directive 97/11/EC to the Electricity Act 1989. The EIA Regulations relate to the assessment of the environmental impact of applications for consent to construct, extend or operate a power station or install or keep installed overhead electricity lines under Sections 36 and 37 of the Act.

100 Under the EIA Regulations, all Section 36 developments, which are considered likely to have significant effects on the environment must be the subject of an EIA, and an Environmental Statement (ES) must therefore be submitted with the Section 36 application.

101 The EIA Directive has not been directly applied under FEPA regulations but there are existing provisions within the Act requiring developers to provide information equivalent to a formal Environmental Statement.

3.4.1 Scope of Environmental Impact Assessment (EIA)

102 Large projects such as an offshore wind farm need to obtain a certain degree of flexibility when applying for consents. AOWFL will submit an application including EIA, which is based on the best design and layout information available to the project when making the applications, involving an assessment allowing for different types of wind turbines and foundations.

103 As not all the details of the proposed development will be known to AOWFL at the time that the application is submitted, when assessing the wind farm, a worst case approach will be taken, according to the principles described as the "Rochdale envelope". What is considered to be the worst case could be different depending on the receiving environment affected (eg birds, shipping & navigation etc) and the activity undertaken (construction/decommissioning or operation). Where possible, the Environmental Statement will contain a detailed project description. However, when this is not possible, the Environmental Statement will provide a clear rationale for all parameters of the Rochdale Envelope.

3.5 Appropriate Assessment

104 Where the possibility of a likely significant effect on a European offshore marine site and/or a European site cannot be excluded and the plan or project is not directly connected with or necessary to the management of the European site for conservation purposes, a competent authority must undertake an Appropriate Assessment (AA) before deciding to undertake or give any consent, permission or other authorisation for a plan in accordance with the Habitats Directive.

105 For information on Statutory Designations see Section 5.9 Statutory Designations and Conservation.

4 PHYSICAL ENVIRONMENT

4.1 Meteorological Conditions

4.1.1 Introduction

106 Information on the meteorological conditions is required to inform the design of wind farm projects. This section outlines the baseline data collected to date.

4.1.1.1 Project Reports

- Prevailing (2009) Aberdeen Offshore Wind Farm: Analysis of LIDAR Data (00028-001-R: 7 October 2009).

4.1.2 Baseline Information

107 The North Sea climate is characterised by large variations in wind direction and speed, a high level of cloud cover and relatively high precipitation (OSPAR, 2000; DTI, 2004). The local climate along the north-east coast is dependent to a large extent on the shelter from winds from the north and west. Predominant winds are from the south and west. Wind strengths along this stretch of coast are variable and generally affected by local topography.

108 Mean annual rainfall in the central North Sea is 400 – 600 mm (OSPAR 2000; DTI, 2004). Coastal fog ("haar") is common during spring and summer along the east coast of Scotland, with up to 14 days per month recorded in exceptional years (North Sea Pilot, 1997; DTI, 2004).

109 Wind data have been recorded at an onshore location nearby the EOWDC site using Natural Power's ZephIR remote sensing LIDAR (Light Detection And Ranging) device.

110 Wind data were recorded by the LIDAR for a period of approximately two and half months from 31 October 2008 to 22 January 2009. A summary of the LIDAR measurements is presented in Table 4.1.

TABLE 4.1
Summary of LIDAR Measurements

Measurement device	Natural Power ZephIR
Location	OS Grid Reference 395024 810254
Monitoring period	31 October 2008 to 22 January 2009
Wind speed measurement heights*	27 m, 70 m, 90 m, 125 m, 153 m
Data recorded	Horizontal and vertical wind speed, wind direction, turbulence, temperature, pressure, humidity.
Configuration	Cloud correction turned on

* Note: 1 m added to the LIDAR measurement heights to account for height of device

111 In addition to the LIDAR data, the following data from the Dyce Meteorological Station are also available:

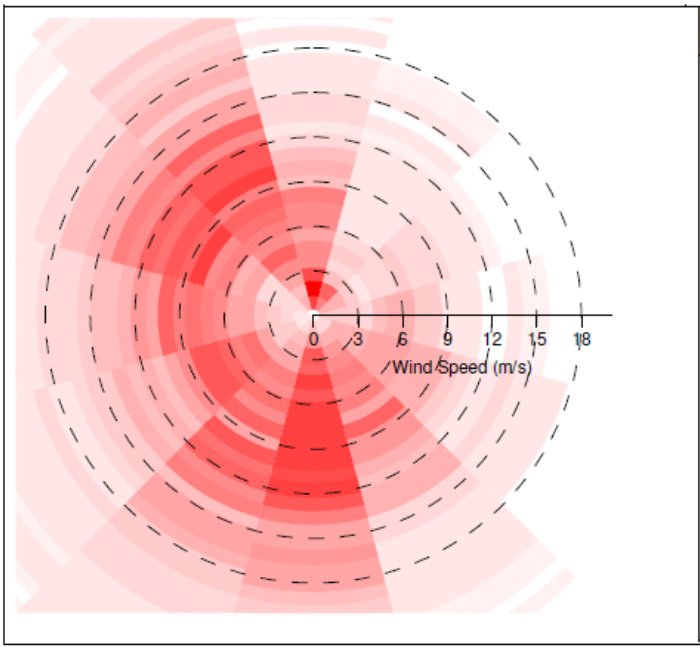
- hourly data from 1 November 2008 to 31 January 2009

- wind speed and direction data collected from January 2001 to January 2009

112 Correlations of the concurrent wind speed at Dyce and the LIDAR using hourly, daily and weekly averaging periods were conducted and the daily correlation used to derive the long-term mean wind speed of 8.74 m/s at a height of 90 m (Prevailing, 2009).

113 Data from the Dyce site has been used to derive the long-term site wind rose using a Measure-Correlate-Predict methodology. The Dyce wind rose was scaled to the predicted long-term mean wind speed of 8.74 m/s at 90 m at the LIDAR location. The resultant wind rose is shown in Diagram 4.1.

Diagram 4.1 Estimated long-term wind rose at the LIDAR location at 90 m



Sector	Probability
0	9.1%
30	2.8%
60	2.0%
90	2.4%
120	4.4%
150	8.4%
180	17.9%
210	12.2%
240	8.8%
270	7.9%
300	10.6%
330	13.4%

114 The meteorological conditions for the EOWDC area are summarised in Table 4.2.

TABLE 4.2
Meteorological conditions at EOWDC area

Meteorological Conditions	EOWDC area
Long-term wind speed*	8.7 m/s
Predominate wind speed – summer**	4.6 m/s
Predominate wind speed – winter**	5.2 m/s
Prevailing wind direction – summer**	South
Prevailing wind direction – winter*	South
Air temperature – annual average+	4.6 – 11.2 ^{o}C
Days of air frost – annual average+	53.6
Hours of sunshine – annual average+	1409
Rainfall – annual average+	816.3 mm
Days of rainfall ≥1mm – annual average+	134.2

*Long-term wind speed predicted at 90 m above ground level for LIDAR location (Prevailing report). Further offshore data collection would clarify this figure
**Dyce Station; summer (June, July & August), winter (December, January & February) measured at 10 m above ground level
+Craibstone 1971-2000 averages
Sources: *DTI (2004); +MetOffice Website (2010)

115 More detailed analysis of wind and meteorological data for the area will be conducted as part of the EIA for the EOWDC site.

4.1.3 EOWDC Future Research and Monitoring

116 Options for future wind are currently being discussed within the project.

117 It will be essential to monitor meteorological conditions throughout the life-span of the project to enable comparison between the wind dataset and the operational performance data.

4.2 Oceanographic Conditions

4.2.1 Introduction

118 This section outlines the baseline data collected to date with respect to oceanographic conditions. The information will be used in the coastal process modelling of the wind farm to assess the environmental impact.

4.2.1.1 Project Reports

- EMU Ltd. (2008a) Aberdeen Wind Farm Oceanographic Survey. Report No. 08/J/1/01/1138/0749. February 2008.

4.2.2 Baseline Information

119 EMU Ltd conducted an oceanographic survey in Aberdeen Bay in 2007/2008. Wave, tide, current and suspended solids were monitored within the previously proposed site area for 45 days, subsequently extended to 90 days, at the location shown on Figure 9.

120 A seabed mounted acoustic profiler (Nortek Acoustic Wave and Current, AWAC) was deployed, which is capable of recording current profiles, tidal heights, directional wave data and acoustic backscatter (ABS) profiles (see Plate 4.1). In addition, the frame was equipped with an environmental sonde comprising optical backscatter (OBS), salinity and temperature sensors. The ABS and OBS data were used to ascertain the suspended sediment load in combination with water samples analysed for total suspended solids (EMU Ltd, 2008a).

Plate 4.1 AWAC Seabed Frame

121 The AWAC was onsite from 12 September 2007 to 13 February 2008. During the course of this survey, the following main results were obtained:

- the tidal regime is characteristic of a standing oscillation. A standing oscillation tide is characterised by the occurrence of slack water at mid-tide. It appears as a phase difference between tidal and tidal current principal harmonic of approximately 6-7 hours, which indicates that high water and low water coincide with the periods of strongest currents
- the currents are tidally dominated with a semi-diurnal pattern, showing an expected spring-neap cycle
- the current peaks at the surface, reducing towards the seabed
- the current appears to be flowing parallel to the coast in a north-east/ south-west direction
- the dominant wave direction is south-east whereas the larger events are from due east during the survey period
- the largest recorded wave peaked at 5.5 m significant wave height. This coincided with a large storm event (1 to 5 January 2008) with a wave direction from the east. Other storm events were recorded throughout the deployment period, but none as energetic or sustained
- in general, wave periods appear to fluctuate between 4 s and 12 s, indicating that then energy recorded is both locally generated sea waves and remotely generated swell from the east
- the water samples collected returned suspended sediment values in the range of 6 mg/l to 29 mg/l. Variations in suspended solid concentration (SSC) values over time appear to show a correlation to physical forcing (waves and currents). A high SCC value throughout the water column coincided with the large storm event at the beginning of January 2008

122 Table 4.3 summarises the main statistical parameters for each data type collected during the survey period.

TABLE 4.3
Oceanography Survey (AWAC) Summary Statistics

Data Type		Maximum	Minimum	Mean	Standard deviation
Tidal Data	Height to LAT	4.675	-0.101	2.37594	0.98152
	Residual height	0.777	-0.791	0.00000	0.17809
Suspended Solid	OBS (mg/l)	1768.39 *	0.00	28.53	104.92
	ABS 2 (mg/l)	43.12	0.12720	20.67	7.97
	ABS 20 (mg/l)	39.48	0.13	11.97	6.72
Environmental data	Temperature (°C)	13.14	6.18	9.73	2.17
	Salinity (ppt)	34.86	31.05	34.14	0.41
Current data	Velocity 2 (m/s),	1.098	0.000	0.221	0.109
	Direction 2 (°T)	Major Axis 12.9-192.9			
	Easting Vector 2 (m/s)	0.489	-0.739	-0.008	0.083
	Northing Vector 2 (m/s)	0.664	-1.061	0.028	0.231
	Vertical Vector 2 (m/s),	0.204	-0.496	-0.001	0.015
	Velocity 20 (m/s),	0.889	0.002	0.287	0.162
	Direction 20 (°T)	Major Axis 15.9-195.9			
	Easting Vector 20 (m/s)	0.382	-0.390	0.00091	0.103
	Northing Vector 20 (m/s)	0.858	-0.807	0.043	0.310
	Vertical Vector 20 (m/s)	0.056	-0.484	0.001	0.015
	Velocity 40 (m/s),	1.1168	0.004	0.332	0.187
	Direction 40 (°T)	Major Axis 18.5-198.5			
	Easting Vector 40 (m/s)	0.901	-0.764	0.031	0.162
	Northing Vector 40 (m/s)	1.112	-0.988	0.026	0.342
	Vertical Vector 40 (m/s)	0.082	-0.515	-0.048	0.059
Wave data	Significant wave height (m)	5.53	0.19	1.078	0.79
	Maximum wave height (m)	6.82	0.29	1.45	0.99
	Peak period (s)	19.6	1.9	7.8	2.7
	Zero up crossing period (s)	7.2	3.1	4.5	0.6
	Mean period (s)	10.9	4.0	6.2	1.0
	Significant wave period (s)	20.0	1.9	7.9	2.8
	Peak coming direction (°T)	Northeast-Southeast			
	Peak spreading angle (°T)	40.5	0.8	24.1	10.0

4.2.3 EOWDC Future Research and Monitoring

123 Potential effects of both individual structures and a collection of structures on the physical oceanographic characteristics of the area and the potential resulting impact on coastal processes are discussed in Section 4.3 Coastal Processes.

4.3 Coastal Processes

4.3.1 Introduction

124 This section will outline the key coastal process issues which influence the form and function of the local coastal environment. At this stage a brief overview is offered in relation to the relationships between the wave, tidal and sediment regimes which will be described in further detail through the EIA phase.

4.3.2 Baseline Information

125 Aberdeen Bay is on the east coast of Scotland. It is characterised by dune backed sandy beaches which are fully exposed to the wave climate of the North Sea. The coastline adopts a crenulated bay formation whereby a sandy embayment has formed between Girdle Ness and the River Don in the south, and Collieston in the north. Offshore, the seabed bathymetry is relatively featureless forming a sloping ramp of sandy sediment. The exception to this is a narrow ridge of unknown origin situated in the region between the offshore and littoral zones; it is possible that this ridge affords some protection to the coast from wave action.

126 In the context of the overall hydrodynamic regime, tidal currents in the littoral zone are relatively weak and existing modelling studies (ABPmer, 2006) have noted that tidal currents alone are insufficient to mobilise beach sediment. Because of this it is likely that sediment transport in the nearshore area is predominantly due to wave action. Waves recorded within the vicinity of the development show that the most common wave direction is from the south-east although waves are also common from the sector between south-east and the north-east (Emu, 2008a). The south-east wave direction results in a net northerly direction of littoral transport as evidenced by the numerous small streams along the embayment that have been deflected to the north due to sediment deposition at their mouths. However, the southerly orientation of a spit across the mouth of the River Ythan at the northerly extent of the bay shows the potential for a locally net southerly littoral transport in this part of the bay. Three main rivers intersect with the coast within Aberdeen Bay namely (south to north) the Dee, the Don and the Ythan. Transport processes will be locally more complex at the mouths of the rivers Don and Ythan due to the interaction of waves, tides and freshwater flows (Halcrow Crouch, 1999).

127 Further offshore tidal processes become more important and sediment transport in the offshore zone is likely to be tidally dominant (Kenyon and Cooper, 2004). Based on regional scale BGS mapping the seabed sediment within the proposed wind farm site is generalised as predominantly sand with some gravel present further offshore, just outside the site. Net regional sediment transport direction has previously been shown to be in a northerly direction towards a bedload convergence zone which lies offshore from Rattray Head (DTI, 2004). Rates of transport are however reported to be low (HR Wallingford, 1997). Isolated areas of sand waves have also been reported in the area.

128 For the site itself, the following sections identify the currently available data and proposed additional data collection.

129 **Bathymetric data:** The principal source of bathymetry data for the EOWDC site is a swath bathymetry survey undertaken by Emu Ltd in September 2007 (Emu Ltd, 2008b). Additional surveys are also planned to cover those parts of the new site outwith the previously surveyed area.

130 In addition to the project specific bathymetric data, data is possibly available from the southern part of Aberdeen Bay collected for the Aberdeen Beach Study. We would need to seek the permission to use these data.

131 Data are also available from the United Kingdom Hydrographic Office (UKHO). The most recent data set is from December 2004, but this only

covers half the proposed model area; the remaining area is covered by data from 1965. SeaZone 'GIS ready' bathymetry data is also available as well as bathymetric survey.

132 Additional datasets, which are planned to be acquired, are the UKHO hydrospatial, digital survey bathymetry, charted raster and charted vector data.

133 Enquiries have also been made to Aberdeen University about the availability of bathymetric survey data, which was collected for the southern part of Aberdeen Bay for the Aberdeen Beach study.

134 **Beach elevation data:** Several datasets have been researched including Light Detection and Ranging (LIDAR), Ordnance Survey Landform Profile (OSLP) and NextMap Digital Surface Model (DSM). The NextMap Digital Surface Model (DSM) was identified as potentially providing a valuable data source for input into the littoral transport modelling. However, due to the potential limitations associated with the above data source and the importance of obtaining an adequate beach profile dataset, the options for undertaking a specific site survey are being considered.

135 Aberdeen University collect beach profile data along the Aberdeen Beach front between the Aberdeen North breakwater and the River Don. This information could be available from the University at a number of selected locations along this part of frontage, which is to the south of the site. There is also the possibility for ABPmer to undertake a survey to collect beach profile data and sediment samples along the foreshore adjacent to the site to inform the littoral drift modelling.

136 **Sediment size data:** This, combined with beach profile data, is a primary input into sediment modelling. Grain size information is available from 14 sediment samples collected by Fisheries Research Services (FRS) in 2006. These are located within the old site boundary and were processed using particle size analysis. Twelve samples were collected by ABPmer in 2003 along the nearshore opposite the Aberdeen Beach defences (near Beach Boulevard) as part of the Aberdeen Beach works. Permission would need to be sought to use this information for the site. The collection of project specific sediment data is planned to fill the data gap that exists within close proximity to the site as part of the offshore and intertidal grab sampling programmes, as discussed under 'Marine Ecology' and 'Intertidal Habitats and Ecology' (Sections 5.1 and 5.2). There is also the possibility for ABPmer to undertake a survey to collect beach profile data and sediment samples along the foreshore adjacent to the site to inform the littoral drift modelling.

137 Additional information identifying the offshore surface sediments is also available from the British Geological Survey (BGS).

138 **Geology:** The surface morphology and subsurface geology within the previously proposed EOWDC area has been characterised through a geophysical survey using sidescan sonar, seismics, magnetometer, AGDS and a video survey (Emu Ltd, 2008b). In addition to the geophysical survey, a desk review of available geotechnical information has also been carried out (Setech, 2009). During this study a review was carried out of BGS boreholes and maps along with the geophysical report to determine the likely subsurface geology. No new boreholes were collected for this survey. Additional

geophysical surveys are planned for the proposed site outwith the previous survey area and the geotechnical desk study updated to cover this area.

139 Additional information identifying the sub-surface geology is also available from the BGS.

140 **Tidal (hydrodynamic) data:** Tidal data for the site were collected by Emu Ltd using an AWAC device (see section 4.2) deployed in the north eastern part of the previous site (this corresponds to the south western part of the new layout area) (Emu Ltd, 2008a). This device collected tidal data between 12/09/2007 and 13/02/2008 and current data between 01/11/2007 and 13/02/2008.

141 The British Oceanographic Data Centre's (BODC) National Tidal and Sea Level Facility (NTSLF) holds data for water levels at a tide gauge maintained at Aberdeen. Water levels at the site are available from 1980 to 2010. The BODC also holds a record of in-situ current meter data at two locations in Aberdeen Bay.

142 **Wave data:** Wave data were collected by Emu Ltd between 01/11/2007 and 13/02/2008 using an AWAC (see section 4.2) deployed in the north eastern part of the previously proposed site (this corresponds to the south western part of the new layout area) (Emu Ltd, 2008a). This dataset details significant wave height, maximum wave height, peak period, zero up crossing period, mean period, significant wave period, total energy, mean coming direction, peak coming direction, mean spreading angle and peak spreading angle.

143 Limited offshore wave data are held within the CEFAS Wavenet system for two locations close to the EOWDC area. The available data was collected over the winter period of 1992 to 1993. Further information may also be available from a Datawell Waverider buoy deployed in Aberdeen Bay from 1 November 2007 to 9 August 2008 and from 24 September 2008 to 1 December 2008. The data recorded during deployment were significant wave height, average (zero crossing) wave period, dominant (peak) wave period and dominant (peak) wave direction. These data should be available through Aberdeen University or Aberdeen City Council.

144 Additional wave data are also available from the Met Office's 'European Wave Model'.

145 **Wind data:** Wind data are available from the two and half month LIDAR deployment and from Aberdeen Airport at Dyce (see section 4.1). Further data collection is planned (see section 4.1).

146 Aberdeen Harbour Board also record wind (and tidal) data at four hourly intervals, but these data will not be available for this project.

147 **Freshwater data:** The Scottish Environmental Protection Agency (SEPA) maintains river gauging stations in the River Dee, the River Don and the River Ythan. There are a number of gauging stations along each of these rivers which record daily mean flows.

148 A selection of the available datasets is shown in Figure 11.

4.3.3 Proposed Scope of Assessment

149 The proposed scope of assessment will make consideration of spatial and temporal scales using the presently available guidance (Defra, CEFAS and DfT, 2004), (OfDPM, 2001), (Defra, 2005), (SNH, 2003) which requires a specific assessment to be made of the following:

4.3.3.1 Baseline Assessment

- coastal processes which maintain the existing system, explanations for past changes and the sensitivity of the system to changes in these processes
- relative importance of high-energy, low-frequency (episodic) events versus low-energy, high-frequency events
- coastal processes controlling morphological change
- identification of sediment sources, pathways and sinks
- identification of the geological, geophysical and geotechnical sediment properties and the depth of any sediment strata within the wind farm site

4.3.3.2 Impact Assessment

- scour around the wind turbine structures and consideration of scour protection
- stability of buried cables under the influence of coastal processes
- scour around any cabling overlying the sediment surface
- effect on the spatial distribution of wave patterns, tidal flows and sedimentation (all near-field) and wave direction and energy (far-field) and any subsequent impacts on littoral transport
- non-linear interaction of waves and currents and the extent of sea bed sediment mobilisation
- sediment mobility and the natural variability of sediment depth across the near-field and the effect on wind turbine foundations and cable burial depth
- effect of cable laying on local levels of suspended sediment
- assessment of the scales and magnitudes of processes controlling sediment transport rates and pathways; and
- assessment of climate change impact on the coastal process regime

150 The baseline, or pre-construction, conditions include a description of the existing coastal process regimes prior to any works on the wind farm site. A consideration of natural changes (ie sea level rise) which may result in changes to the regime over the wind farm's operating period will be included, thus providing context for comparing natural changes against any introduced by the development.

151 Based on the understanding of the sediment and coastal processes occurring within the study area and the relative proximity of the development to the coastline the main concern will be addressing the potential impacts of the wind farm array on coastal processes. This will involve the assessment of any changes to the wave regime and any subsequent changes to rates and / or direction of littoral transport and any resultant changes to the crenulated bay form of the coastline.

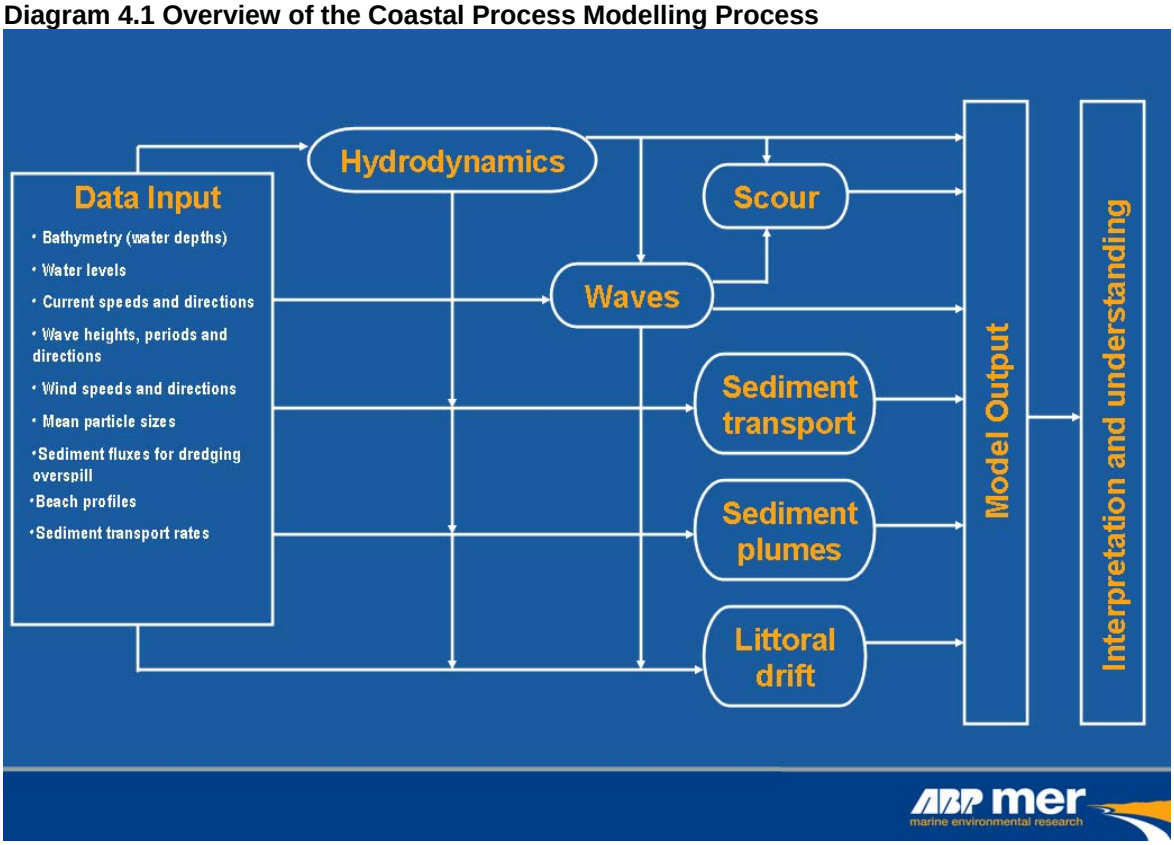
152 The oceanographic and coastal processes investigations will be conducted at different scales including:

- spatial scales:
  - near-field (ie the area within the immediate vicinity of different wind turbines/foundation types, within the wind turbine grid and along the cable route – an indicative near-field area is should on Figure 11); and
  - far-field (ie the wider environment over which effects could potentially occur an indicative far-field area is should on Figure 11)
- temporal scales:
  - baseline (pre-construction phase)
  - construction phase
  - post-construction phase
  - sediment recovery phase (period during which a new equilibrium position is attained with the wind turbines in place)
  - lifetime of the EOWDC array
  - decommissioning phase
  - post-decommissioning phase

153 Coastal process numerical modelling will be undertaken using a range of state of the art computer models which simulate tidal flow and coastal hydraulics, wind and wave, and resultant sediment transport processes. The application of the coastal process models will provide a series of quantified descriptions of changes to the wave, tidal and sediment transport regimes brought about from the proposed site development at a number of scales and representative of a number of stages during the lifecycle of the development. Outputs from the numerical modelling will be used to assess any direct and indirect impacts and provide considerations for potential mitigation and appropriate monitoring requirements (ABPmer, 2008). Diagram 4.1 outlines the modelling process.

154 Diagram 4.1 gives an overview of the modelling process; the effectiveness of modelling is highly dependent on the availability of data sources (as described in the previous section.

Diagram 4.1 Overview of the Coastal Process Modelling Process



4.3.4 Potential Impacts

155 Issues raised during the initial scoping in 2005 and ongoing consultations include the importance of understanding effects of the wind farm on patterns of erosion, deposition and on issues such as longshore drift and coastal morphology, specifically the impacts on foreshore aesthetics and harbour siltation rates. Concerns were raised that there should be no impact on the current erosion tendency of the coastline. Golf clubs have expressed concern regarding the impact on sand dunes and increasing the potential for erosion of some of the fairways and greens. FRS raised the need to consider seasonal changes in oceanic currents and wind forcing in the model. The need to consider other activities which may impact coastal processes, including offshore munitions dumping, the recent coastal defence works and dredging/aggregates removal, was also highlighted. In addition it is recognised that the Aberdeen Beach represents an important recreational resource in terms of surfing and the impacts of the development on this resource should be considered within the context of the coastal processes report (SAS, 2009).

156 Conclusions will be given that highlight the significance of any impact particularly relating to sediment movement, coastal erosion, coastal processes, depth and movement and coastal defences, with reference where appropriate to existing, consented and proposed wind farm development impacts elsewhere in the UK.

4.3.5 Cumulative Assessment

157 Coastal process studies must consider the effects of each wind farm acting cumulatively with other seabed activities. Guidance which exists from Scottish Natural Heritage (SNH) re-enforces that published by Cefas and Defra. Here it was defined that:

- all developments, both known, under consideration and in existence must be considered; and
- all developments within one tidal excursion must be considered.

158 With respect to coastal processes, other developments which are typically considered are dredging and aggregate activities. An initial consideration of other seabed users within the study area, includes:

- offshore munitions dumping. Conventional munitions are dumped within the study area (QinetiQ, 2007; OSPAR, 2005)
- coastal defence works. Coastal defence works are located to the south of the proposed wind farm site towards Aberdeen. Recent works have been carried out to enforce these defences through the installation of rock revetments. Immediately onshore of the wind farm, there are no hard defences installed with the natural dune system providing some protection to the hinterland
- dredging/aggregates. There are currently only two licensed dredge areas in Scotland (Scottish Executive, 2006) and neither is located within the study area. However, there is ongoing maintenance dredging in Aberdeen harbour.

4.3.6 Mitigation

159 Best practice procedures during construction and operation would be followed to minimise effects on coastal processes, seabed and water movements. Measures relating to coastal processes may include the installation of appropriate scour protection.

4.3.7 EOWDC Future Research and Monitoring

160 Potential effects of both individual structures and a collection of structures on the physical oceanographic characteristics of the area and the potential resulting impact on coastal process can be studied in a number of ways.

161 Possible options include an environmental station and additional array of buoys within the EOWDC research area and beyond which could be used to determine the oceanographic and coastal processes which maintain the existing system in the area before construction and any potential effects during and after construction, including:

- physical factors – temperature and salinity to ensure that any changes are the result of changes to physical processes e.g. location of tidal front due to fluid movement, rather than an external force, such as heavy run-off
- physical processes, such as effects on tidal movements/fluid dynamics leading to potential scouring/deposition, turbidity, etc.

- Effect on sediment transport of the area and comparison with sediment transport models
- scour around the different wind turbine structures / foundation types and cable routes. Effectiveness of different scour protection methods, including the potential impacts of scour and scour protection methods on benthic ecology (see reef effects Section 5.1)
- effect on the spatial distribution of wave patterns, tidal flows, sedimentation, wave direction and energy
- interaction of waves and currents and the extent of seabed sediment mobilisation
- sediment mobility and the natural variability of sediment depth at different distances from the wind turbine(s) and the effect of different wind turbine foundations and cable burial depth

4.4 Geology and Seabed Characteristics

4.4.1 Introduction

162 A review of the offshore sediments and geology in Aberdeen Bay indicates that the seabed sediments are defined as non-solid sediments laid down on the seabed by the actions of the sea during the early Holocene. The sediments in this region reflect its glacial history and hydrodynamic regime. There is little input of sediment from land most being derived from peat deposits. The sediments off Aberdeen consist predominantly of sand and slightly gravelly sand (DTI, 2004).

163 Below the seabed, Pleistocene deposits off the Aberdeenshire coast varies from soft red-brown, grey-brown and pink-grey muds to compact grey clays with scattered pebbles that probably indicate glacial tills. The soft muds probably date from late Devensian to Early Flandrian and were most likely deposited during the retreat of the last ice sheet. Seabed sediments mostly conceal bedrock in the area. The underlying bedrock along the coast between Aberdeen and Stonehaven comprises sandstones, conglomerates, mudstones and cherts.

164 Forvie is designated as a geological conservation statutory review site, this is a non statutory designation which reflects the areas earth science interest in relation to coastal geomorphology.

165 Surveys to obtain bathymetric, seabed and sub-bottom data are critical to the project, providing a basis for the foundation design work, and informing the coastal process modelling and marine ecological and archaeological impact assessments.

4.4.1.1 Project Reports

- EMU Ltd (2008b) Geophysical and Seabed Habitat Assessment of the Proposed Aberdeen Offshore Wind Farm. Report No. 07/J/1/02/1136/0716. February 2008.
- Setech Ltd (2009) Geotechnical Desktop Study. Report No. 8733-0-0. January 2009.

4.4.2 Baseline Information

166 EMU Ltd. was commissioned to undertake geophysical and seabed habitat survey of the previously proposed site (Figure 9). The aim of the survey was to determine and report on the seabed and sub-bottom conditions. The survey involved swath bathymetry, sidescan sonar imaging, shallow seismic profiling, magnetometer survey and use of an Acoustic Ground Discrimination System (AGDS) with video ground-truthing (EMU Ltd, 2008b). The survey was completed using the vessel FPV Morven between 12th and 18th September 2007.

4.4.2.1 Geophysical and Seabed Habitat Assessment Survey Results

167 Paper charts that were produced included the seismic trackplot, contoured and colour shaded bathymetry, sidescan sonar mosaic, seabed features with magnetometer and sidescan targets along with video ground truth information. Sediment isopach charts and geological cross sections are also available. Summary information is shown in Figure 9.

168 **Bathymetry:** At the previously proposed site, the bathymetry from shore, as shown in Figure 9, has an even gradient, deepening with distance offshore. Depths throughout the survey area range from 0.7 m to 29.1 m below Chart Datum and the water depth across the previous site ranges from 8.7 m nearshore to 29.1 m offshore, with a gradual gradient of 1 in 10 to 1 in 20 sloping to the east (EMU Ltd, 2008b).

169 **Seabed sediments:** The seabed sediments at the previously proposed site (as illustrated in Figure 9) are dominated by silty sand, with small patches of glacial till towards shore (and therefore in the area for the cable route). The surface sediments range from 0 m thickness at the shore to 6 m thickness at the offshore limit (EMU Ltd, 2008b).

170 The sidescan sonar data revealed five main seabed types in the survey area:

- silty sand
- exposed consolidated glacial material
- patches of glacial material exposed within seabed depression
- silty sand with patches of finer sediment
- linear ribbons of finer sediment within silty sand

171 The sidescan sonar data do not show any significant man-made debris or wrecks. Several trawl scars were noted and there were small amounts of debris including what appears to be a chain. Smaller debris may exist which cannot be resolved from the side scan or magnetometer data (EMU Ltd, 2008b).

172 **Geology and geomorphology:** Beneath the seabed sediments, there is glacial till comprising fine to coarse sand with possible areas of gravel and cobbles. The bedrock is Devonian Old Red Sandstone and increases in depth below seabed from 5 m at the shore to 30 m at the offshore boundary, being between 18 m and 25 m for most of the site. The depths and geology are therefore suitable for a range of foundations, including monopiles (EMU Ltd, 2008b).

173 **Magnetometer data:** The total magnetic field intensity chart for the survey area is dominated by large positive anomalies to the north of the survey area. These anomalies are thought to be the result of submerged geological features, possibly re-worked local material, with the high magnetic signature indicating the presence of remnant igneous material in the fabric of the till deposit. In total, 59 magnetic targets have been identified and plotted on a seabed features chart (EMU Ltd, 2008b).

174 **Video survey:** The objective of the video survey was to provide ground truth habitat identification for each of the seabed types identified from the sidescan sonar and AGDS surveys. Most of the area surveyed was silty to fine-medium sand with occasional patches of shelly fragments (EMU Ltd, 2008b).

4.4.2.2 Geotechnical Study Results

175 Setech (Geotechnical Engineers) Ltd. conducted a geotechnical desk study to determine anticipated soil conditions, in order to facilitate the options for foundation design, at the previously proposed site. The study used data available from the British Geological Survey (BGS) including borehole data and geological surveys, information held by Vattenfall and the Setech database.

176 The study indicated that it is likely that the site is covered by a veneer of silty Holocene Sand underlain by soft to very stiff clays with occasional sand and gravel lens of the Wee Bankie Formation. The base of Wee Bankie Formation ranges in depth from approximately 5 m BSL inshore to 22 m BSL (below seabed level), to the western extent of the previous wind farm lease boundary. Wee Bankie is likely to be underlain by Devonian Old Red Sandstone.

4.4.3 Proposed Scope of Assessment

177 Geophysical and geotechnical information currently available will be collated and assessed. An additional geophysical survey will be undertaken to assess the ground conditions in the area of the proposed site that is being taken forward in the Environmental Statement, which has seven out of the 11 wind turbines that lie outwith the previous geophysical survey area.

178 Following the recommendations by Setech (2009), a full site investigation will be undertaken to obtain site specific data on soil conditions. This would confirm the potential strength parameters of the Wee Bankie Formation, and would also verify the bedrock composition, competency and strength as an addition to the geophysical survey and this desktop study. This survey will be conducted as part of the pre-construction survey.

179 The information from geophysical and geotechnical surveys and studies will be used to assess the potential impact of the wind farm on the seabed and substrata, determine the options for foundation design and other engineering aspects of the site, and provide information for other studies, including coastal processes modelling and marine ecology. The potential impacts of the proposal on the hydrogeology (ground water / aquifers) will be investigated if considered appropriate.

4.4.4 Possible Constraints

180 From a foundation perspective, the Setech (2009) study anticipates that the soils do not pose any unusual impacts on likely foundation options.

181 Water depth has a direct effect on the required support structure height, weight of steel and fabrication cost, as well as associated costs for transport to site, and installation. However, the depth ranges at the proposed site are unlikely to pose any constraints to the proposed development.

182 There is no evidence at this stage to suggest that shallow gas will be present at the proposed site.

183 The UK is an area of low seismicity and the risk to offshore structures is considered to be correspondingly low.

184 The seabed across the proposed EOWDC area appears to be free from significant natural seabed features and from the data sources available no environmentally sensitive habitats have been reported (EMU Ltd, 2008b).

185 The Dee Valley Fault strikes diagonally across Aberdeen Harbour, however it is unlikely to affect ground conditions below the wind farm area (Setech, 2009).

4.4.5 Potential Impacts

186 The Setech (2009) study anticipates that the main issues, regarding soil conditions and foundation options, are likely to be scour in the sand, and the possibility / probability that a drill out will be required if a monopile foundation option is used due to the presence of shallow rockhead.

187 Offshore wind farm construction would not alter the geology of the site other than in localised areas directly impacted by the installation of wind turbine foundations. This is dependent upon the method of foundation chosen, effect will vary between piled foundation and gravity based structures. It is anticipated that during decommissioning, foundations would be removed to below the seabed surface.

188 Offshore wind farm construction is judged not to have a significant effect on the geomorphological features of the seabed.

4.5 Sediment and Water Quality

4.5.1 Introduction

189 The main factors affecting water quality, and in turn marine organisms, are contaminant levels (organic pollutants and metals) and levels of suspended sediments. In this area, nutrient inputs, predominantly from run-off from agricultural land, are also altering the biology of local enclosed waters such as the Ythan Estuary to the north of the proposed site.

190 Any changes to water quality as a result of the development of the wind farm, eg disturbance of polluted sediments and/or the re-suspension of sediment

during construction, have the potential to affect plankton, benthos, fish, birds and marine mammals.

191 Recreational use will also be considered here. The coast along Aberdeen and Aberdeenshire has a number of bathing waters identified under EC Bathing Water Directive (76/160/EEC) shown on Figure 12.

4.5.1.1 Project Reports

- Titan Environmental Survey (TES) Ltd (2008a) Marine Ecology - Review of Baseline Information. Report CS0208/R2/V2. May 2008.

192 Data are also available from the Fisheries Research Services (FRS) which collected sediment samples and analysed the levels of contaminants in Aberdeen Bay in 2006 (FRS, 2006).

4.5.2 Baseline Information

193 Data were collected by FRS in April 2006 to assess the level of contaminants in the sediments in Aberdeen Bay. Figure 9 indicates the location of the FRS samples.

194 **Hydrocarbons:** Levels of PAHs (polyaromatic hydrocarbons) in the FRS sediment samples from Aberdeen Bay were near or below background concentrations. The exception to this was levels of Phenanthrene, Anthracene and Pyrene at one site which were 5, 8 and 6 times higher than OSPAR's Background Assessment Criteria[2] respectively.

195 **Metals:** The results of the FRS survey indicate that metal concentrations were similar within all samples analysed. The average concentrations across all sites are presented in Table 4.4.

TABLE 4.4
Average metal concentrations in Aberdeen Bay

Metal	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Concentration in mg/kg dry weight	4.717	BDL	15.693	3.081	0.079	7.385	7.146	21.716

BDL=Below Detection limits
Source: FRS (2006), TES (2008a)

196 These average concentrations are all below OSPAR Background Concentrations (BC), i.e. those expected in the North East Atlantic if certain industrial developments had not happened, with the exception of mercury concentrations (0.08 mg/kg dry weight) which are slightly above the BC of 0.05 mg/kg. Mercury is on OSPARs list of Chemicals for Priority Action.

197 **Sewage and faecal coliforms:** Overall water quality in the vicinity of Aberdeen is good given the presence of sewage outfalls for trade and domestic effluent. Table 4.5 provides details of the sewage outfalls in the vicinity of Aberdeen.

[2] Background Assessment Criteria (BACs) are statistical tools defined in relation to Background Concentrations to enable testing of whether mean observed concentrations can be considered to be near background concentrations.

TABLE 4.5 Sewage outfalls in the vicinity of Aberdeen	
Activity	**Description**
Sewage (Public) Emergency Overflow (EO)	Technology Park SWS, EO to coastal waters, Bridge of Don
Sewage (Public) Combined Sewer Overflow (CSO)	Donmouth Rd PS, SSO to River Don, Bridge of Don, Aberdeen
Sewage (Public) Emergency Overflow (EO)	Bridge Terrace PS, EO to River Don, Bridge of Don, Aberdeen
Sewage (Public) Emergency Overflow (EO)	Lord Hays PS, EO to River Don, Seaton Park
Surface Water (SW) Commercial, Ind & Other	Kings Links SWS, FE to Rive Don estuary, Aberdeen
Sewage (Private) Primary	245 & 247 Don Street, STE to soakaway, Old Aberdeen, Aberdeen

Source: TES (2008a)

198 **Bathing waters:** Various bathing waters have been designated on the east coast of Scotland. The EC Bathing Waters Directive (76/160/EEC) requires monitoring of microbial indicators of faecal contamination (faecal coliform, total coliform and faecal streptococci) during the bathing season. Two main bathing waters have been identified near the proposed EOWDC development area: Aberdeen – Ballroom and Balmedie Country Park. The water quality of these bathing waters has been generally good for the past few years (2005-2007). In 2008 and 2010, Balmedie was designated as MCS Recommended (reaching the highest UK standard for bathing water quality). Aberdeen reached the guideline standard in 2010 and was given a basic pass in 2008. Water quality was poor at both beaches in 2009, Balmedie achieving a basic pass and Aberdeen failing to reach European minimum standards (MCS, 2010).

199 The Ythan estuary and the lower River Don are designated as Sensitive Areas on account of eutrophication (possibly due to run-off from agricultural land). Nutrient inputs to the Ythan estuary are at such a level that the then Scottish Office (now the Scottish Government) proposed its designation as Scotland's first Nitrate Vulnerable Zone under the EC Nitrates Directive (91/676/EEC) in 1994. Increasing weed cover (*Enteromorpha intestinalis*) in the estuary has led to a change in benthic community, with increases in the opportunistic polychaete species *Capitella capitata* noted in the 1980s (TES, 2008a).

200 **Naturally Occurring Radioactive Material (NORM):** Since 1982 offshore oil and gas equipment contaminated with low specific activity (LSA) scale or Naturally Occurring Radioactive Material (NORM) has been cleaned at an industrial site in Aberdeen Harbour. The main discharges from the offshore equipment are radium-226 and radium-228 and lead-210 and polodium-210. The contaminated wastes are discharged into Aberdeen Bay via an outfall pipe. Consequently, there is the potential that the seabed could be contaminated in Aberdeen Bay and that this could be disturbed during the construction of the proposed EOWDC.

201 Surveys undertaken near the outfall in Aberdeen Bay have not found any elevated levels of contamination in the sediments further than 50 m from the point of discharge (CEFAS, 2009). The results from NORM monitoring previously undertaken in Aberdeen Bay will be used in the Environmental Statement, but it is not thought to be of significant concern.

4.5.3 Proposed Scope of Assessment

202 Further literature reviews and detailed consultation will be undertaken in order to collate and assess existing data.

203 Sediment contaminant levels will be assessed during the benthic survey (see Section 5.1 Marine Ecology).

4.5.4 Potential Impacts

204 Potential impacts due to the development of the proposed EOWDC that may require further investigation include:

- discharges of contaminants from the construction vessels affecting water quality
- disturbance of contaminated sediment (if revealed to be present) leading to deterioration in water quality and mortality of plankton and benthos
- release of fines during construction leading to increased turbidity potentially altering planktonic growth and smothering benthic fauna

4.5.5 Cumulative Assessment

205 Data on sediment contaminants within Aberdeen Bay suggests that impacts associated with disturbance and dispersion of contaminated sediments are unlikely. The potential for cumulative impacts associated with an increase in fines during construction will be reviewed within the coastal processes assessment.

4.5.6 Mitigation

206 Implementing the following measures can mitigate potential impacts:

- adherence to MARPOL regulations which set out requirements to establish Pollution Action Plans to control pollution incidents
- good working practices to be adopted throughout the construction to prevent pollution incidents; and
- adherence to the required legislation for the use of paints and biocides

5 BIOLOGICAL ENVIRONMENT

5.1 Marine Ecology

5.1.1 Introduction

207 The North Sea is a complex and productive ecosystem, which supports important populations of fish, seabirds and marine mammals.

208 Plankton and primary productivity play a fundamental role in the food chain, providing food for the benthos and fish. Benthic communities, comprising species which live either within the seabed sediment (infauna) or on its surface (epifauna), feed off the plankton, and detritus (decomposing biogenic material), in turn providing food for larger invertebrate predators, fish and birds.

5.1.1.1 Project Reports

- Titan Environmental Survey (TES) Ltd (2008a) Marine Ecology - Review of Baseline Information. Report CS0208/R2/V2. May 2008.
- EMU Ltd (2008b) Geophysical and Seabed Habitat Assessment of the Proposed Aberdeen Offshore Wind Farm. Report No. 07/J/1/02/1136/0716. February 2008.
- Titan Environmental Survey (TES) Ltd (2008b) Marine Benthic Sampling Proposal. Report CS0208/D1/V1. May 2008.
- GoBe (2010) Review of Proposed Benthic Ecology Sampling

209 In addition, data are available from the Fisheries Research Services (FRS) from their plankton sampling off Stonehaven (FRS, 2010) and video surveys and epifaunal trawls within Aberdeen Bay (FRS, 2006).

5.1.2 Baseline Information

5.1.2.1 Plankton and Primary Productivity

210 Weekly sampling for hydrographic parameters, concentrations of inorganic chemical nutrients and the abundance of phytoplankton and zooplankton species has been carried out 5 km offshore from Stonehaven since January 1997. The objective of the sampling programme is to establish a monitoring base for assessing the status of the Scottish coastal waters ecosystem and responses to climate change (ICES, 2006; FRS, 2010).

211 The biological data show significant differences across seasons and years. The water column at the Stonehaven sampling site remains well mixed throughout much of the year, except in late summer and autumn when surface heating and settled weather often cause temporary thermoclines to appear. The seasonal minimum temperature generally occurs in the last week of February/first week of March.

212 Water movement in the area is generally southerly with quite strong tidal currents. In late summer and through autumn of most years, water with a high Atlantic Ocean content passes down the Scottish east coast. These

influxes often bring oceanic species, for example, the chaetognath *Sagitta serratodentata* and the siphonophore *Muggiea atlantica* are indicators of this oceanic influence.

213 The seasonal pattern of plankton production is clearly evident in the data collected so far, as is the variability among years in its extent. Nutrient data also show strong seasonal cycles but interannual variability.

214 Data are regularly processed in the FRS MLA database, and some of these data are displayed on the MLA website (FRS, 2010) and published in periodic reports.

5.1.2.2 Benthic Habitats

215 Geophysical data from the surveys of the previously proposed Aberdeen Offshore Wind Farm site boundary show that the area is relatively uniform, comprising predominantly silty sand with patches of finer sediment (Figure 10). Further offshore in the south-east corner of the area surveyed there is an area of linear ribbons of finer sand within the silty sand (TES, 2008a).

216 Two main biotope types were found in the surveys: SS.SSa.CMuSa and SS.SSa.CCS (Figure 10).

- SS.SCS.CCS: Circalittoral coarse sediment: Tide-swept circalittoral coarse sands, gravel and shingle generally in depths of over 15-20 m. This habitat may be found in tidal channels of marine inlets, along exposed coasts and offshore. This habitat, as with shallower coarse sediments, may be characterised by robust infaunal polychaetes, mobile crustacea and bivalves.
- SS.SSa.CMuSa: Circalittoral muddy sand: Circalittoral non-cohesive muddy sands with the silt content of the substratum typically ranging from 5 % to 20 %. This habitat is generally found in water depths of over 15-20 m and supports animal-dominated communities characterised by a wide variety of polychaetes, bivalves and echinoderms.

217 Data from Stephen (1922) from a group of inshore samples from around Aberdeen (20 – 40 m depth) and a transect of eight stations extending offshore in a north-westerly direction to the 100 m contour, show a community characterised by the presence of *Ophiura affinis* and *Echinocyamus pusillus*. Stephen (1922) concluded that there was large-scale geographic similarity in the offshore fauna and that it was less abundant than the inshore fauna.

218 McIntyre (1958) described the benthos of the east coast fishing grounds with reference to surveys of Aberdeen Bay. He found the benthic fauna to be dominated by lamellibranchs and polychaetes with *Abra alba*, *Tellina fabula*, *Nucula turgida* and *Ensis* sp. The polychaetes *Lanice conchilega*, *Sigalion mathildae*, *Notomastus latericeus* and *Nephtys* spp were also dominant.

219 The geophysical data show that the nature of the sediments offshore is relatively homogenous and it is expected that the planned surveys will give very similar results to those of McIntyre (1958) despite the lapse of 50 years.

220 Data from FRS summarising the epifauna trawls undertaken on the 7th of April 2006 in Aberdeen Bay (FRS, 2006) are presented in Table 5.1.

TABLE 5.1 Species collected in epifauna trawls of Aberdeen Bay			
	Haul 1	**Haul 2**	**Haul 3**
Haul duration	**20 min**	**20 min**	**23 min**
Start and end coordinates	57º12.690N 2º00.320W57º11.800N 2º00.740W	57º11.970N 2º01.430W57º11.070N 2º00.980W	57º11.170N 2º02.660W57º12.230N 2º02.380W
Depth	25m	19m	12m
Species:			
Common dab	13	13	2
Long rough dab	1	3	/
Plaice	26	29	10
Flounder	1	/	1
Pandalus	1	/	1
Asterias	17	8	/
Echinoderm	2	3	1
Brittle stars	180	50	20
Dead men's fingers	/	1	/
Pipe fish	/	1	4

221 Analysis of video footage collected by FRS during the same survey shows that the surveyed area is a seemingly barren fine grained sand bank containing no weed and no apparent life except for *Ophiura* sp and *Asterias*. Brittle stars were more abundant in the deeper part of the surveyed area (Run 1 – 25 m) whereas *Asterias* are more abundant in Run 1. There was evidence of an *Echinocardium* community due to the presence of empty tests in Runs 2 and 3 (FRS, 2006). Locations of the video runs are indicated in Figure 10.

222 None of the surveys to date have identified species which are of concern from a conservation perspective eg *Sabellaria* reefs and *Modiolus* beds within the general application area. Known seagrass beds on the east coast of Scotland are to the south of Aberdeen. Broken *Sabellaria* tubes were noted by Stephen (between 1922 and 1925) off the north east coast of Aberdeenshire, however these probably originated from masses growing near Rattray Head (Stephen, 1933, 1934).

5.1.3 Proposed Scope of Assessment

223 Further literature reviews and detailed consultation will be undertaken in order to collate and assess existing data.

224 The proposed wind farm lies close to a known front. Modelling will be undertaken, as part of the Coastal Processes modelling (Section 4.3.3) to assess the impacts of the proposed EOWDC on this front.

225 Site specific benthic grab and trawl surveys will be conducted to provide more detailed and current baseline information in order to undertake an impact assessment for the proposed EOWDC development. From a review of available data, the benthic communities in the area are likely to comprise typical and common infaunal invertebrate species of no particular conservation significance.

226 The survey will aim to provide information on habitat type and community structure in the area within which the wind turbines will be placed and the wider area which may be affected by the development. The survey will also form the baseline for future post-construction surveys and, as such, comparable control sites have been included in the survey design.

227 From the detailed geophysical data, it is evident that the habitat in and around the proposed development site is relatively homogenous. Therefore, a relatively low intensity of sampling is proposed to ground truth the habitat types present.

228 All survey data, desk studies and additional information for benthic habitats will be collated and assessed as apart of the EIA process.

229 Benthic surveys will be undertaken in accordance with recommended guidance and in consultation with Marine Scotland.

230 The proposed sampling approach is as follows:

- benthic samples at approximately 19 sites, with single grab samples (no replicates) collected at each site:
  - two sites shall be located within a single cable corridor
  - eight sites shall be within the wind turbine area
  - five sites shall be in the tidal ellipse (outside of the wind farm area) but extending from the edge of the wind turbine array and along the tidal axis
  - four sites shall be inshore of the array (between the 5 to 10 m contour)
  - replicates to be agreed with Marine Scotland
- a total of six single beam trawls of which:
  - three within the wind turbine area
  - two within the secondary impact area (one north and one south)
  - one within the cable route area

231 The beam trawls will be undertaken using a scientific beam trawl with beam width of 2 m, comprised of 20 mm mesh (knot to knot), and a 5 mm liner into the cod-end.

5.1.4 Potential Impacts

232 The planktonic community in the vicinity of the proposed EOWDC development is typical of the area and has the capacity to recover quickly due to the continual exchange of individuals with surrounding waters. Any impacts associated with the proposed EOWDC development are likely to be small in comparison with natural variations and it is proposed that impacts on plankton populations are scoped out of the EIA for this site.

233 Potential impacts on benthic habitats, which will be considered in detail in the Environmental Impact Assessment (EIA), include:

- loss of seabed habitat due to the addition of wind turbine foundations and scour protection
- loss of and disturbance to benthic habitats due to long term changes in sediment transport rates altering seabed sediment types

- release of contaminants from the seabed and contaminant discharge from construction vessels
- disturbance due to increased sediment suspension and deposition. Fine sediments could be brought into suspension during the installation works which could result in the smothering of sessile organisms. Given the relatively coarse nature of the sediments likely to be encountered across the site, it is not expected that increases in suspended sediment concentrations would be significant relative to background levels
- underwater noise and vibration which may affect the behaviour of benthic species
- electromagnetic effects from inter array and export cables which may affect the physiology or behaviours of benthic species
- provision of new habitat due to the presence of wind turbine foundations and scour protection (if required). Small and localised increases in biodiversity could be expected as species that are not regularly found in sandy / muddy environments may be able to establish themselves on the foundation structures

5.1.5 Cumulative Assessment

234 Potential impacts on plankton and marine benthos are likely to be short term and to be site specific. As a result, interactions with other activities are not anticipated and it is proposed that cumulative impacts on plankton and marine benthos are scoped out of the EIA for this site.

5.1.6 Mitigation

235 Implementing the following measures can mitigate potential impacts:

- MARPOL regulations set out requirements to establish Pollution Action Plans to control pollution incidents
- good working practices will be adopted throughout the construction to prevent pollution incidents / spillage of excavated material (if required)
- construction techniques will be used that minimise the amount of fines released into the marine environment
- the required legislation will be adhered to for the use of paints and biocides
- if the site surveys reveal any biologically sensitive areas, micrositing of foundations / cabling may be employed (on the basis of available information, this is considered unlikely)
- scour would be mitigated (as required) through the implementation of appropriate scour protection as agreed with the consenting authorities. The foundations and associated scour would introduce new surfaces for benthic colonisation

5.1.7 EOWDC Future Research and Monitoring

236 Monitoring of seabed communities would be undertaken before and after construction in order to identify any potential long term effects.

5.1.7.1 Further Research Opportunity: Reef Effect

237 The development of arrays of wind turbines at offshore locations may lead to medium-term changes in the "marine ecology" of the whole area of a site. Currents may be subtly altered, sedimentation changed, new surfaces for marine organisms introduced and, crucially, the patterns and amount of commercial fishing activity may change. The presence of hard structures will locally promote marine growth , fish and other marine organisms will in turn be attracted to these structures. The marine organisms that are associated with the turbines are likely to be composed of different species and abundances in comparison to the seabed community that existed previously and, with time, could become typical of a reef like community with encrusting epifauna. If fishing activities, particularly bottom trawling, are reduced or ceases within the wind farm footprint, then this provides an opportunity to study on a small scale potential reef effects. It has been hypothesised that, offshore wind farm sites have the potential to become large "reef complexes", with each of the turbine support structures acting as a reef module. Depending on the spacing between turbines, and, crucially, the fisheries management regime that is agreed for the site, not only would the area immediately around each wind turbine, in time, become a small reef, but the spaces between turbines might also benefit from reduced fishing pressure.

238 Artificial reefs have long been used as part of fisheries management programmes. On a local scale, they can enhance fishing success, or increase fish populations, or support fish breeding and recruitment. Marine organisms within these areas can still be actively "harvested" by sustainable techniques, or they can be left alone to act as sanctuaries and breeding grounds for fish and shellfish that could eventually disperse into the wider population.

239 The beneficial "side-effect" of wind turbine arrays as artificial reefs is poorly understood and the proposed EOWDC could provide an ideal site for a multi-disciplinary study, for the following reasons:

- Aberdeen, and its Universities and Research Institutes and government agencies, has a long and distinguished history of research into commercial fishing and aquaculture. It is well-placed to develop, implement, manage and report on a study of the effects of wind turbine arrays as reefs, and on the implications of the creation of large arrays on existing and future commercial fishing operations and the management of fish stocks
- the site has an established baseline of information, and this could be appropriately enhanced, and control sites established, before construction of the wind farm
- the site is already a multi-user environment, and changes to the status of the area and the management of the site will have to be made. The recognition that the wind farm is also an artificial reef, of benefit to other users of the sea, would be an additional catalyst for imaginative planning and management of the area, perhaps under the umbrella of a broad spectrum of stakeholder groups including fishermen

240 Specific reef study work that could be done at the site, in addition to some of the associated or complimentary studies noted elsewhere in this submission, and the studies on commercial fisheries noted below, could include the following;

- monitoring the change in condition, "health", biodiversity and contaminant burden of the seabed and benthos (epifaunal and infauna)
- monitoring the change in numbers and species richness of fish and shellfish in and around the site
- monitoring changes in the health/quality of individuals, and the population profile and reproductive potential of populations, of commercial fish and shellfish in and around the area
- conducting trials of "sustainable" fishing methods, such as creeling and long-lining, in and around the area.

5.2 Intertidal Habitats and Ecology

5.2.1 Introduction

241 The intertidal substrate close to the proposed site is mostly sand, however, the sandy foreshore from Aberdeen to the Ythan Estuary is interrupted by a few rock platforms around Blackdog Rock. There are also rock platforms and boulders/loose rock to the south of Aberdeen (south of the Dee river) and to the North of the Ythan Estuary.

5.2.1.1 Project Reports

- Titan Environmental Survey (TES) Ltd (2008a) Marine Ecology - Review of Baseline Information. Report CS0208/R2/V2. May 2008.
- Titan Environmental Survey (TES) Ltd (2008b) Marine Benthic Sampling Proposal. Report CS0208/D1/V1. May 2008.
- GoBe (2010) Review of Proposed Benthic Ecology Sampling.

5.2.2 Baseline Information

242 **Rocky littoral and sublittoral on the east coast:** The macro alga of the rocky outcrops of north eastern Scotland were surveyed by Wilkinson (1975) who found 80 species not previously recorded from the area, including the first British record of the brown algae *Sorapion Kjelmanii* (Bennett and McLeod, 1998). Early records by Jack (1890) provided information on the marine algae of the rocky shores in the vicinity of Arbroath.

243 A large number of common and widespread species in the east coast of Scotland such as chitons, gastropods and bivalves have been recorded from many habitats along the coast. On rocky shores chitons (*Lepidochitona* sp. and *Acanthochitona sp.*), gastropods such as *Nucella lapillus*, *Patella aspera*, *P. vulgata*, *Margarites helicinus*, and several species of *Littorina* and *nudibranchs* (*Onchidoris* spp., *Archidoris*, *Facelina*, *Aeolidia*) were present. There was a large gastropod fauna including *Helcion pellucidum*, several species of Lacuna and some pyramidellids that were associated with Fucus fronds and *laminarian stipes* (Eleftheriou *et al.*, 2004).

244 **Sedimentary shores on the east coast:** The fauna of the Aberdeenshire and Angus beaches is characteristically dominated by haustorid amphipods (*Haustorius arenarius* and *Bathyporeia pelagica*) and in some cases the spionid polychaete *Nerine* (*Scolelepis*) *cirratulus* (Hart, 1971). In a rare study on the vertical and horizontal distribution of the meiofauna of the sandy

sediments at Collieston Beach, north of Aberdeen, a restricted fauna with a patchy distribution due to the local differences in the variation of the grades of sediment has been found (Seaton, 1975).

245 **Ythan Estuary:** The Ythan estuary is a small meso-tidal bar-built estuary (Davidson *et al.*, 1991) lying approximately half way between Peterhead and Aberdeen on the east coast of Scotland.

246 The faunal community of the estuary has been well studied, the amphipod *Corophium volutator*, with the gastropod mollusc *Hydrobia ulvae*, the polychaete *Nereis* (now Hediste) diversicolor and the bivalve *Macoma balthica* being widely distributed. Species such as the cockle *Cerastoderma edule*, the gastropod *Littorina littorea*, the shore crab *Carcinus maenas* and the mussel, *Mytilus edulis* exhibit more localised distributions (Bennett and McLeod, 1998). Increasing weed cover (*Enteromorpha intestinalis*) has led to increases in the opportunistic polychaete species *Capitella capitata* in the 1980s.

5.2.3 Proposed Scope of Assessment

247 Once the location of the cable landfall is known, further literature reviews and detailed consultation will be undertaken in order to collate and assess existing data and ascertain the need for further site specific surveys.

248 If surveys are required, samples would be collected from sites along the beach at high, mid and low water. In order to collect a sufficient number of animals in what is likely to be a sparsely populated area, each sample would cover an area of 0.1 m^2 to a depth of 15 cm.

5.2.4 Potential Impacts

249 Potential impacts on intertidal habitats, which will be considered in detail in the Environmental Impact Assessment (EIA), include:

- substrate loss, physical disturbance and abrasion from cable laying
- smothering of benthos from increases in sediment suspension and deposition
- heating effects

5.2.5 Cumulative Assessment

250 Other shore based activities will be reviewed and assessed at the time of the Environmental Statement compilation. However, from the information available to date, cumulative impacts are not expected.

5.2.6 Mitigation

251 Mitigation could include:

- careful siting of the cables to avoid sensitive areas
- use of appropriate cable laying tools to minimise disturbance
- burial of export cables to reduce potential heating and EMF effects

5.3 Fish, Shellfish and Elasmobranchs

5.3.1 Introduction

252 The fish ecology of any site is an important consideration during offshore wind farm development, the fish communities forming a fundamental part of the part marine ecosystem and providing stock for commercial and recreational fisheries.

253 The northern North Sea is important for its fish stocks and the commercial fisheries it supports; fishing is important to local communities and to the economy of coastal regions (see Section 6.6).

5.3.1.1 Project Reports

- Titan Environmental Survey (TES) Ltd (2008a) Marine Ecology - Review of Baseline Information. Report CS0208/R2/V2. May 2008.
- Brown & May Marine Ltd (2008) Aberdeen Offshore Wind Farm – salmon and sea trout preliminary baseline assessment. August 2008.
- Brown & May Marine Ltd (2008) Aberdeen Offshore Wind Farm – commercial fishing aspect. August 2008.

5.3.2 Baseline Information

254 The SEA 5 area supports a range of fish and shellfish species, including spawning grounds. A number of fish species found in the SEA 5 area have been included on the OSPAR Initial List of Threatened and/or Declining Species, including cod (*Gadus morhua*), common skate (*Raja batis*), spotted ray (*Raja montagui*), basking shark (*Cetorhinus maximus*), common sturgeon (*Acipenser sturio*), allis shad (*Alosa alosa*), sea lamprey (*Petromyzon marinus*) and salmon (*Salmo salar*). A number of rivers within the SEA 5 area support internationally important numbers of salmon and sea lamprey (Chapman, 2004).

255 The offshore area around Aberdeen supports a range of fish and shellfish species. Offshore fish communities are dominated by haddock (*Melanogrammus aeglefinus*), whiting (*Merlangius merlangus*) and cod, with saithe (*Pollachius virens*) and Norway pout (*Trisopterus* sp.) being associated with deeper waters. Migratory species such as herring (*Clupea harengus*) and mackerel (*Scomber scombrus*) are found throughout the area, although their distribution is seasonal. Sandeels (*Ammodytes marinus*) are also abundant and their distribution is closely associated with well-oxygenated, medium to coarse sand.

5.3.2.1 Spawning and Nursery Grounds

256 Data from Coull *et al.* (1998) show that the offshore area off north-east Scotland contains spawning grounds for cod, herring, lemon sole (*Microstomus kitt*), Norway lobster (*Nephrops norvegicus*), Norway pout, saithe, sandeel, sprat (*Sprattus sprattus*) and whiting (Diagram 5.1), as well as nursery grounds for whiting, saithe, lemon sole, sprat, plaice (*Pleuronectes platessa*) and sandeel, *Nephrops* and haddock (Diagram 5.2).

257 The proposed EOWDC site coincides with potential spawning grounds used by herring (May to August, with peak spawning period in May and June), lemon sole (February to June, with peak spawning period between April and May), sandeels (November to February) and scallops (*Pecten maximus*) (August/September and April/May) and nursery areas for lemon sole, sprat, saithe, plaice and sandeel.

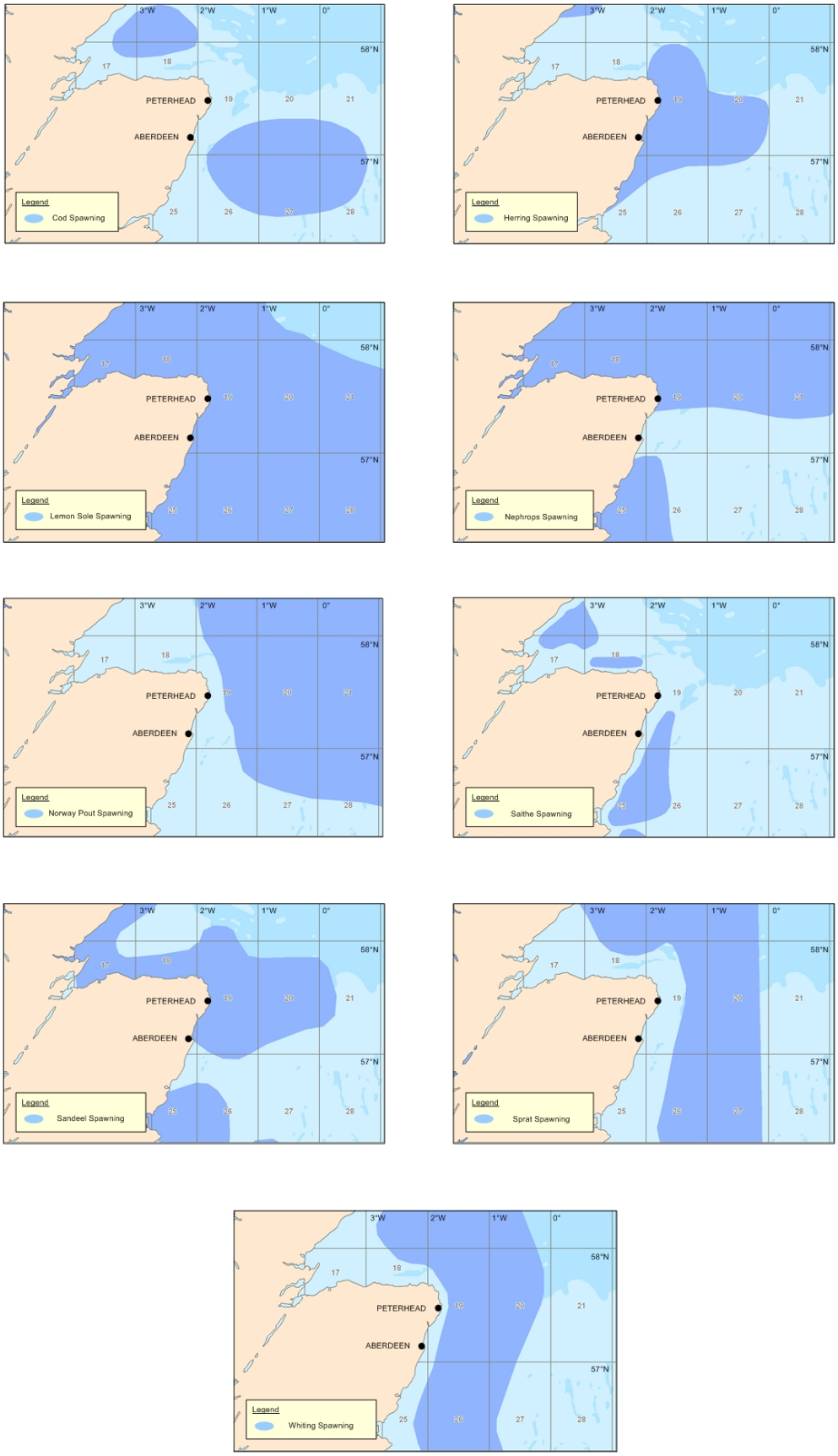
258 Spawning grounds are dynamic features of fish life history and are rarely fixed in one location from year to year. Although some fish species exhibit the same broad patterns of distribution from one year or season to the next, others show a large degree of variability. For sediment spawners, not all suitable sediment areas might be used in every year and areas used will depend on the size of the spawning stock. Therefore, the information provided in Diagram 5.1 represents the widest known distribution given current knowledge and should not be seen as a rigid, unchanging description of presence or absence. Spawning times represent the generally accepted maximum duration of spawning. In addition, fish may spawn earlier or later in the season in response to environmental change (Coull *et al.*, 1998).

259 In the North Sea, sub-populations of herring (*Clupea harengus*) spawn at different times and localised groups of herring can be found spawning in almost any month. At present there are three major populations of herring in the North Sea. These 'races' are mixed for the majority of the year, but separate during the breeding season when each race migrates to its own spawning grounds (Daan *et al.*, 1990). In the area off the north-east coast of Scotland, herring spawn during August to September. Spawning normally takes place in relatively shallow water, at depths of approximately 15-40 m.

260 Lemon sole are distributed throughout the central and northern North Sea and are pelagic spawners. Little is known about its spawning habits, and it is thought that Lemon sole spawns throughout its range (CEFAS, 2001).

261 There are five species of sandeel in the North Sea, though the majority of commercial landings are of *Ammodytes marinus* (CEFAS, 2001). Sandeel eggs are demersal, and are laid in sticky clumps on sandy substrates. On hatching, the larvae become planktonic, resulting in a potentially wide distribution (CEFAS, 2001).

262 The locations of nursery areas can change from year to year depending on factors such as water temperature or the availability of food. It is therefore difficult to define the limits of nurseries precisely and, as with the spawning locations the maps in Diagram 5.2 give an indication of the likely positions of juvenile concentrations and represent the widest known distribution, rather than a definitive description of the limits of all nursery grounds (Coull *et al.*, 1998).



Source: Coull *et al.* (1998)

Diagram 5.1 Fish spawning grounds off north-east Scotland

Diagram 5.2 Fish Nursery Areas off north-east Scotland
Source: Coull *et al.* (1998)

5.3.2.2 Shellfish

263 Shellfish species known to occur off Aberdeen include European lobster (*Homarus gammarus*), edible crab (*Cancer pagurus*), velvet swimming crab (*Necora puber*), shore crab (*Carcinus maenus*), giant scallops, cockle (*Cerastoderma edule*), mussels (*Mytilus edulis*), whelks (*Buccinum undatum*) and periwinkles (Littorina sp.).

264 The Norway lobster (*Nephrops norvegicus*) is by far the most important shellfish species exploited in Scottish waters. Norway lobsters are located in areas of soft mud or muddy sand in which they excavate and inhabit burrows. There are known spawning grounds to the north and south of Aberdeen Bay.

5.3.2.3 Cephalopods

265 Cephalopods (including cuttlefish, squid and octopus) are a prey item for a number of marine top predators such as fish, birds and marine mammals (Stowasser *et al.*, 2004). Evidence exists that fishing pressure has changed ecological conditions and shifts in community structures have occurred with cephalopod stocks slowly replacing predatory fish stocks (Caddy and Rodhouse, 1998).

266 Oceanic inflows from the Atlantic, coupled with the numerous shallow inshore habitats, make the northern North Sea a region of greater cephalopod diversity and abundance than the southern North Sea. Among the most frequently recorded species are: the long-finned squids, *Alloteuthis subulata* and *Loligo forbesii*; the short finned squid, *Todaropsis sagittatus*, *G. fabricii* and *Onychoteuthis banksii*; *the bobtail squids*, *Rossia macrosoma*, *Sepietta atlantica* and *Sepietta oweniana* and the octopus, *Eledone cirrhosa* (Hastie, Pierce and Wang 2008).

5.3.2.4 Non-commercial Species

267 The number of exploited and non-exploited fish species from coastal areas of SEA 5 was estimated by Potts and Swaby 1993 (cited by Swaby and Potts 1996, 1997a, b, c). Information on the distribution and abundance of non-commercial species comes from records made during routine groundfish surveys, landings data, historical records as well as scientific studies. The most abundant species found in near surface surveys in areas from Aberdeen to off Shetland were rocklings (*Gadidae*), members of the herring family (*Clupeidae*) and three-spined sticklebacks (*Gasterosteus aculeatus*) (Hislop 1979, cited by Swaby and Potts 1996). In summer and autumn, there is a large population of the sand goby (*Pomatoschistus minutus*) in the Ythan Estuary (NESBiodiversity, 2007).

5.3.2.5 Diadromous and freshwater species

268 There are several species that migrate between fresh and salt waters (diadromous species). These include the Atlantic salmon (*Salmo salar*), sea trout (*Salmo trutta*), sea lamprey (*Petromyzon marinus*), river lamprey (*Lampetra fluviatilis*), eel (*Anguilla anguilla*), twaite shad (*Alosa fallax*) and allis shad (*Alosa alosa*) (Barne *et al.*, 1996; DTI, 2004). Atlantic salmon, river

and sea lamprey, twaite shad and allis shad are listed as protected species in Annex II of the EU Habitats Directive.

269 In addition to salmon and sea trout, the North East Scotland region has records of all seven British marine and estuarine species protected under national, European and international legislation. However, these records tend to be individual records of the lamprey and sea lamprey, allis and twaite shads, and sturgeon. These species are considered threatened in the UK and European waters.

270 There are no designated SAC sites in the vicinity of the proposed EOWDC for sea lamprey, river lamprey, allis shad and twaite shad (JNCC, 2010).

Salmonids

271 Salmonids (salmon and sea trout) spawn in freshwater and migrate to the sea to mature. On the North Sea coast, salmon rivers are concentrated in the north and northeast Scotland. Trout tend to have a more westerly distribution. Around the North East of Scotland region, the Deveron, Ugie, Ythan, Don, Dee and Bervie are the main rivers that are known to contain populations of salmon and sea trout. Smaller rivers and tributaries may also contain populations (Barne *et al.*, 1996).

272 The river Dee has been designated as an SAC for its populations of Atlantic salmon. The River Dee supports a high-quality Atlantic salmon population and contributes to a significant proportion of the Scottish salmon resource. In recent years it has contributed about 4 or 5 % of all salmon caught in Scotland (JNCC, 2010).

273 As a result of various environmental pressures, the numbers of both species, salmon and sea trout, have declined in recent years leading to increased concerns over fish stocks. International and national legislation, as well as a number of management initiatives have been introduced in an effort to halt declines and improve stocks.

274 Salmon and sea trout are of particular importance in this area with the Rivers Dee and Don having salmon and trout fisheries. In Scotland, the management of the salmon fishery is entrusted to District Salmon Fishery Boards (DSFBs) whose responsibilities include the protection and improvement of the salmon fisheries within their districts. The two Salmon Fishery Districts in the immediate vicinity of the proposed development are the Dee and Don Boards.

275 All Scottish salmon fisheries are closed for a minimum of 168 days a year for spawning. The actual dates may vary but are usually from late August to mid February. Salmon spawning periods vary between rivers and are thought to be influenced by water temperature and day length. Hatching generally occurs in spring. The length of time young salmon stay in a river varies considerably and is dependent upon water temperature and food availability. With transition into smolts (the stage between a parr and a grilse when a salmon first migrates from fresh water to the sea), fish normally leave rivers between February and June to commence their northward migration. Young fish however spend some time at the river mouth, acclimatising to the transition from fresh to salt water; observations on the River Dee have noted that this takes around three weeks, during which time the smolts are vulnerable to predation. Salmon return to their native rivers throughout the year, with districts recording different peak periods. Generally, returning

grilse (young salmon returning to freshwater after the sea) peak in June and continue until October. As with smolts, returning salmon and grilse are known to congregate around the river entrances.

276 Sea trout spawning generally occurs between mid October and January. Parr (young salmon and trout in the first two years of life) destined to become smolts leave the river slightly later than salmon, but migration is again over by mid-June. Adult sea trout return to their native rivers in May and this may continue in some areas until October. Sea trout are also known to congregate at river mouths.

Freshwater Pearl Mussel

277 The freshwater pearl mussel (*Margaritifera margaritifera*) is a rare and threatened species which is listed in Annex II of the EU Habitats Directive. The life cycle of the freshwater pearl mussel is closely linked to that of salmonids fish, therefore any potential impacts on salmonids may have implications for freshwater pearl mussels.

278 Freshwater pearl mussels inhabit cool, well-oxygenated soft water free of pollution or turbidity in fast-flowing rivers and streams with healthy salmon populations. The mussels spend their larval stage attached to the gills of salmonid fishes, attaching themselves during mid to late summer and then dropping off the following spring to settle in the riverbed gravel where they grow to adulthood (JNCC, 2009).

279 The freshwater pearl mussel is a primary reason for the selection of the River Dee SAC, along with Atlantic salmon and otter (JNCC, 2010). The River Dee supports a functional population of freshwater pearl mussel and mussels have been recorded from a location approximately 30 km from the river source to approximately 6-7 km upstream of its mouth. Juveniles make up approximately 30 % of the recorded population, among the highest proportions recorded in Scotland. This indicates that the population is recruiting strongly and is one of the most important in the UK (JNCC, 2010).

5.3.2.6 *Elasmobranchs*

Basking Shark

280 The basking shark (*Cetorhinus maximus*) is listed as ‘vulnerable’ on the IUCN Red List of Threatened Species and in Appendix II of CITES. The species is also listed on the Wildlife and Countryside Act (1981), Schedule 5. The distribution of basking sharks in British waters is predominantly along the west coast of the British Isles, with peak sightings occurring in May to August (MCS, 2005). Studies conducted by the Marine Conservation Society indicate an increase in the numbers of basking sharks sighted in British waters, with a 65 % increase in Scottish waters between 2001 and 2004. The majority of sightings are from the west coast of Scotland; however, there has been an increase in basking shark sightings on the Scottish east coast since 1999.

281 The basking shark is the world's second largest fish species, with a circum-global distribution in warm-temperate to boreal seas. Little is known about many aspects of the life history and biology of basking sharks, including how their distribution may be related to broader scale changes of the marine environment.

282 Reference to data from the Wildlife Trusts' basking shark study shows that there have been no basking shark sightings close to Aberdeen as their usual distribution follows the west coast of Britain. However, a basking shark was observed during a boat survey of the wind farm site on the 16th November 2007 (IECS, pers. comm.).

Other Shark and Ray Species

283 Porbeagle sharks (*Lamna nasus*) are found throughout the North Atlantic, with the largest population in UK waters found to the north of Scotland. Recorded sightings of porbeagle sharks within the North Sea have generally occurred offshore in the central North Sea, between May and September (JNCC, 2010).

5.3.2.7 *Threatened and Protected Species*

284 A number of fish species present in the area have been included in the OSPAR Initial List of Threatened and/or Declining Species and Habitats. These include cod (*Gadus morhua*), common skate (*Dipoturus batus*), basking shark (*Cetorhinus maximus*), allis shad (*Alosa alosa*), sea lamprey (*Petromyzon marinus*) and salmon (*Salmo salar*). A number of fish species, including the Atlantic salmon (*Salmo salar*), river and sea lamprey (*Lampetra fluviatilis* and *Petromyzon marinus*), twaite shad (*Alosa fallax*), allis shad (*Alosa alosa*) and freshwater pearl mussel (*Margaritifera margaritifera*) are listed on Annex II of the Habitats Directive (92/43/EEC). Several fish species are also protected in UK waters under Schedule 5 of The Wildlife and Countryside Act, 1981 including the sturgeon (*Acipenser sturio*), allis shad (*Alosa alosa*), twaite shad (*Alosa fallax*) and basking shark (*Cetorhinus maximus*). The basking shark has also been given protection by the Convention on International Trade in Endangered Species (CITES).

5.3.3 Proposed Scope of Assessment

285 In order to investigate the potential effects on fish including salmon and sea trout, shellfish and elasmobranches in the area, extensive consultation and a desk study will be undertaken. This will include liaison with:

- The District Salmon Fishery Boards (DSFBs)
- Aberdeen University
- Scottish Sea Fisheries Committees (SFCs)
- The Scottish Fishermen's Federation (SFF)
- Local fishermens organisations
- Marine Scotland
- SNH
- JNCC

5.3.4 Potential Impacts

286 Potential impacts to be considered within the Environmental Impact Assessment (EIA) will include:

- loss of spawning and nursery grounds due to the installation of foundations and cables

- disturbance to benthic and pelagic habitats due to an increase in sediment suspension and deposition
- remobilisation of contaminants from seabed disturbance / release of contaminants from vessels leading to a reduction in water quality
- noise and vibration which could affect fish and shellfish behaviour
- electro-magnetic fields which could affect fish and shellfish physiology and behaviour
- introduction of new habitat which could have positive impacts on fish and shellfish species
- disruption of shoaling and migration patterns

5.3.5 Cumulative Assessment

287 Relevant activities to be considered within the cumulative assessment include shipping, fishing and oil and gas exploration.

5.3.6 Mitigation

288 Possible mitigation measures to reduce and minimise potential impacts on fish and other species include:

- choice of foundation type and installation method
- timing of construction to avoid key spawning and/or migration periods
- use of a soft start to piling operations
- careful siting of wind turbines and cable routes
- contaminant management

5.3.7 EOWDC Future Research and Monitoring

5.3.7.1 Migratory Fish

289 The effects of buried electricity cables on migrating fish remain unclear and further work on this would be valuable. The impacts of construction (eg underwater noise) are also unclear. The site lies in the vicinity of the Rivers Dee and Don, two of Scotland's great salmon rivers. The city's universities and research institutes have a long history of researching the population dynamics, migration, life history and behaviours of salmonid fish. The EOWDC would therefore be a good location for further studies on this important topic. Subjects that could be studied could include:

- potential effects from noise and turbidity on life cycles and movements of migratory fish
- assessment of noise reduction mitigation measures and techniques
- EMF effects on migrating populations – establish migrating routes (salmon highway)
- benefits of various mitigation methods to eliminate or reduce impacts on salmon

5.4 Birds

5.4.1 Introduction

290 The assessment of EOWDC on the ornithological resource of the area entails identifying the species that use the area, and the extent to which the value of the overall ornithological resource of the area could be altered both directly, for example through increased mortality as a consequence of wind turbine collision, or indirectly, for example through changes to prey.

291 Aberdeen Bay is recognised as supporting a wide variety of avian species that are present throughout the year or only during winter or summer months. Although the bay itself is not a designated site it has been considered, as a possible Special Protected Area (SPA) for the concentrations of sea ducks and divers in the inshore area.

292 Many seabird colonies along the Scottish east coast have been afforded protection status under the EU "Birds" Directive as SPAs for the species breeding there and the numbers they support (JNCC, 2010). Seven Special Protection Areas (SPAs), located within the daily flight distance of their qualifying species, were identified as relevant to the development (Table 5.2 & Figure 6). The requirement for evidence based assessments of the potential impacts on the SPA interests has been identified as the most important requirement in the EIA and AA process.

293 This section outlines the bird surveys undertaken to date, which have included radar, boat-based surveys and vantage point counts, and discusses the boat-survey programme that is planned for 2010-2011. The interim results for the surveys carried out so far are presented along with the analysis planned for the impact assessment stage.

5.4.1.1 Project Reports

Radar

- Simms, I.C., Dale, S., Plonczkier, P., Budgey, R., Eassom, A. & Jowett A. (2008). Radar Study Report (Spring 2007). Bird Management Unit, Central Science Laboratory (CSL).
- Plonczkier, P., Simms, I. Radar Study Report (Spring, April 2010). Food and Environmental Research Agency (FERA).
- Walls, R.J., Brown, M.D., Plonczkier, P. & Parnell, M. (2006) A Preliminary study using bird detection radar for the remote monitoring of bird movements at the proposed Aberdeen Offshore Wind Farm - Autumn 05. Bird Management Unit, Central Science Laboratory (CSL).

Boat Based Surveys

- Boat-based survey results Year 1 Feb 07 – Jan 08, IECS, April 2008
- Monthly survey boat based survey results February-April 08 IECS, April 2008

Vantage Point Counts

- Species Accounts of Seabird Movements (April 06 - September 06), Envirocentre, August 2007
- Species Accounts of Seabird Movements (October 06 - March 07), Envirocentre, August 2007

- Species Accounts of Seabird Movements (April 07 - September 07) Parts 1 to 4, Alba Ecology Ltd, Feb 2008
- Species Accounts of Seabird Movements (October 07 - March 08), Alba Ecology Limited, July 2008

Additional Data Sources for Aberdeen Area to inform the Environmental Statement

- Dean, B.J., Webb, A., McSorley, C.A., Schofield, R.A. & Reid, J.B., 2004. Surveillance of wintering seaducks, divers and grebes in UK inshore areas: Aerial surveys and shore-based counts 2003/04. JNCC Report No. 357.
- Lewis M., Wilson L.J., Söhle I., Dean B.J., Webb A. and Reid J.R. (2008). Surveillance of winter and spring aggregations of seaducks, divers and grebes in UK inshore areas: Aerial surveys and shore-based counts 2006/07. JNCC Report No. 414.
- Mitchell, P.I., Newton, S.F., Ratcliffe, N. & Dunn, T.E., 2004. Seabird populations of Britain and Ireland. T. & A.D. Poyser, London, 511pp http://www.jncc.gov.uk/page-1548
- North East Scotland Bird Club reports.
- Skov, H., Durinck, J., Leopold, M.F. & Tasker, M.L., 1995. Important bird areas for seabirds in the North Sea, including the Channel and Kattegat. BirdLife International, Cambridge.
- Söhle, I., Wilson, L.J., Dean, B.J., O'Brien, S.H., Webb, A. & Reid, J.B., 2006. Surveillance of wintering seaducks, divers and grebes in UK inshore areas: Aerial surveys and shore-based counts 2005/06. JNCC Report No. 392.
- Wilson, L. J., Dean, B. J., Webb, A., McSorley, C. A. and Reid, J. B. (2006) Wintering seaducks, divers and grebes in UK inshore areas: Aerial surveys and shore-based counts 2004/05. JNCC Report No. 371.

5.4.2 Baseline Information

294 The north-east coast of Scotland supports a wide variety of avian species and offers a variety of habitats from sea cliffs to sand dunes. A number of designated sites are located in the region, although all are outwith the proposed development area. The Ythan Estuary and Sands of Forvie is the protected site in closest proximity and is particularly important for a range of species, including pink-footed goose, common eider, cormorant, common scoter and terns (common, Sandwich and little). The Buchan Ness and Collieston coast SPA along with the Fowsheugh SPA are important sites for seabird assemblages containing more than 20,000 birds with Fowsheugh also being an SPA interest feature for breeding guillemots and kittiwakes.

295 Full species accounts of seabirds and waterbirds that are present in the Aberdeen Bay area will be provided in the Environmental Statement. The following information provides summary information of the main species present in the area.

296 Large numbers of shorebirds and waterfowl also use North Sea coastal waters and shores, particularly in winter (DTI, 2001). Divers, grebes and seaduck are primarily inshore species typically wintering in sandy bays or estuaries, although some prefer rocky shorelines. Some species are resident while others are winter visitors to Britain. Scotland is particularly important for these species, with Shetland, Orkney, the Moray Firth and the Aberdeenshire

coast rated of prime importance for divers, grebes and seaduck for all months of the year (Barton & Pollack, 2004a).

297 Tern colonies occur on the Ythan, Loch of Strathbeg and Spey Bay. Common terns also breed along the rivers of Dee and Don. The Sandwich tern colony on the Ythan is the largest in Scotland and holds more than half the Scottish breeding population. There are also smaller colonies of common, Arctic and little terns, and also a black-headed gull colony. Terns are present in the area during spring, summer and autumn with particular concentrations along the north east coast during the breeding season. All four species are listed on Annex 1 of the EU Birds Directive. Breeding populations of Sandwich tern, common tern and little tern are an interest feature of the Ythan Estuary, Sands of Forvie and Meikle Loch SPA.

298 Daily feeding movements of cormorants and shags have been recorded passing Peterhead throughout the year (Innes, 1991) and occur throughout the Aberdeen Bay area. The shag forms part of the Buchan Ness to Collieston Coast SPA seabird assemblage interest feature.

299 Gannets are present throughout the year. At Peterhead, gannets are scarcest in the winter, but numbers present increase significantly in the spring from April onwards, peaking in May (Innes, 1991). They are observed to feed and fly along the north east coast with movements to and from their breeding colony at Troupe Head SPA and possibly the Bass Rock which is part of the Forth Islands SPA.

300 Gulls occur throughout the year. At Peterhead, black-headed, common, herring and great black-backed gulls pass along the north-east coast throughout the year (Innes 1994). Lesser black-backed gulls are regularly recorded between of March and September (Innes, 1994). Little gulls are relatively scarce but have been recorded in every month, with most sightings between June and November (Innes, 1994). Detailed counts of common gulls on the Ythan Estuary during the 1980s showed that numbers peaked in October and November, thereafter declining until return passage in the spring (Wernham *et al.* 2002). Kittiwakes pass along the north-east coast throughout the year and observations at Peterhead indicate that they are less frequent during the winter compared to the summer months (Innes, 1994). Kittiwake and herring gull form part of the Buchan Ness to Collieston Coast SPA seabird assemblage interest feature.

301 Fulmar breeding numbers in North-East Scotland have steadily increased in recent decades with increases along Banff and Buchan of 136 %; Gordon 26 %; City of Aberdeen 241 %; and Kincardine and Deeside 167 % all between 1969 and 2000 (Mitchell *et al.*, 2004). At Peterhead, fulmars pass along the north-east coast throughout the year, but are scarcest in winter (Innes, 1992). Fulmar form part of the Buchan Ness to Collieston Coast SPA seabird assemblage interest feature.

302 Auks (guillemots, razorbills, puffin) are present throughout the year with peaks in spring and autumn and numbers tend to be lower during the winter months. Auks leave colonies in the early morning to forage offshore and return in the evening.

303 Three species of diver are known to be present along the north east coast of Scotland: red-throated diver, black-throated diver and great northern diver. Of these, red-throated divers are by far the most abundant. The

Aberdeenshire coast regularly holds nationally-important numbers of red-throated diver (Barton & Pollack, 2004a). Numbers are highest during late autumn, winter and early spring with peak passages during April-May and October. All three species are listed on Annex 1 of the EU Birds Directive.

304 Seaduck (including eider, common scoter, velvet scoter and long-tailed duck) are likely to be present throughout the year. Eider forms part of the Ythan Estuary, Sands of Forvie and Meikle Loch SPA seabird assemblage interest feature. Eider are found in nationally important numbers from Donmouth to the Ythan Estuary. The Aberdeenshire coast also regularly holds nationally-important numbers of common scoter; numbers of eider and common scoter tend to peak in late summer (Barton & Pollack, 2004a).

305 There are major concentrations of waders associated with the Ythan Estuary. In winter many species of wader are present in the estuary, including turnstone, purple sandpiper, knot, redshank, lapwing and golden plover. There is some movement of waders, both north and south, close to shore throughout the year. Redshank and lapwing form part of the Ythan Estuary, Sands of Forvie and Meikle Loch SPA seabird assemblage interest feature.

306 Manx shearwaters are present in North East Scotland from late spring, throughout the summer and autumn. During a ten-year study of seabird movements at Peterhead, Manx shearwater passage began in April, peaked in June-July and continued through to early November (Innes, 1992). Sooty shearwaters are a scarce autumn passage migrant in North East Scotland usually seen from mid-July to mid-November. Most birds recorded are heading north with peak numbers in August and September (Innes, 1992). Manx and sooty shearwaters are thought to come closer to shore when visibility is poor. Storm and Leach's Petrels are rarely recorded in North East Scotland except from between July and September when they are frequently caught and ringed along coast. They are rarely seen during the day except during very poor stormy weather when small numbers are occasionally recorded offshore.

307 Skuas are present offshore during summer months. Great skuas occur from April with numbers increasing throughout the summer until August before dropping off towards late October/early November (Innes, 1993). Great skuas are regularly sighted at Fowlsheugh SPA. The passage of Arctic skua is generally from the April to November, with peak numbers in late summer (Innes, 1993). Pomarine skuas and to a lesser extent, long-tailed skuas are regular, but uncommon late summer-autumn passage migrants in the north-east of Scotland (Innes, 1993).

308 Apart from the resident mute swan, Swans and Geese are primarily winter visitors to north-east Scotland, arriving in autumn and spending the winter feeding on agricultural land or saltmarshes. North-east Scotland is a particularly important wintering and passage area for these species. Five species of swans and geese (whooper swan, mute swan, pink-footed goose, greylag goose and barnacle goose) occur in internationally-important numbers at coastal sites along the east coast of Scotland, (Barton & Pollack, 2004b).

309 Whooper swans have been observed over the sea during October to December. Whooper swan is listed on Annex 1 of the EU Birds Directive. Greylag, barnacle, pink-footed, white-fronted and Brent geese are present

from September through the winter until they return to breeding grounds in March and April. Greenland white-fronted goose and barnacle goose are listed on Annex 1 of the EU Birds Directive. The wintering population of pink-footed goose is an interest feature of the Ythan Estuary, Sands of Forvie and Meikle Loch SPA. The Loch of Strathbeg is internationally important for whooper swans, pink-footed geese and barnacle geese from the Svalbard breeding population in autumn and winter. Several inland sites also hold significant numbers of Swans and Geese during the winter.

TABLE 5.2 SPA and their qualifying interest features in the vicinity of Aberdeen Bay		
Site	**SPA interest feature breeding**	**SPA interest feature non-breeding**
Ythan Estuary, Sands of Forvie and Meikle Loch SPA (also Ramsar site)	Common Tern Little Tern Sandwich Tern	Pink-footed Goose Waterfowl assemblage, including Eider, Redshank and Lapwing.
Loch of Skene SPA (also Ramsar site)	-	Whooper Swan Greylag Goose
Fowlsheugh SPA	Kittiwake Guillemot Seabird assemblage including Fulmar, Herring Gull and Razorbill	-
Buchan Ness to Collieston Coast SPA	Seabird assemblage, including Fulmar, Shag, Kittiwake, Herring Gull and Guillemot	
Loch of Strathbeg SPA (also Ramsar site)	Sandwich Tern	Barnacle Goose Greylag Goose Pink-footed Goose Whooper Swan Waterfowl assemblage including Teal
Troup, Pennan and Lion's Heads SPA	Guillemot Seabird assemblage including Fulmar, Herring Gull, Kittiwake and Razorbill	-
Forth Islands SPA (includes Bass Rock)	Gannet Shag Lesser Black-backed Gull Roseate Tern Arctic Tern Common Tern Sandwich Tern Puffin Seabird assemblage including Cormorant, Herring Gull Kittiwake, Razorbill and Guillemot	
Aberdeen Bay potential coastal or marine SPA	[not stated by SNH]	[not stated by SNH]

5.4.3 Proposed Scope of Assessment

310 A comprehensive programme of surveys and studies have been undertaken and are underway for the EOWDC site in order to provide baseline data for use in the environmental impact assessment and to help inform any appropriate assessments should they be required. To date, surveys have included land based vantage point surveys, boat based surveys, and radar surveys.

311 The survey programme aims to provide data and supplement the existing information for the EOWDC site, and determine:

- the general importance of the area for birds, including the distribution and abundance of birds and densities of the birds in the area for use in population estimates
- the behaviour of birds and their use of the site for example, for feeding, resting or passage
- the flight height of birds for use in assessments of collision risk with wind turbines
- bird behavioural responses to ship-based survey vessel to gauge the extent to which counts can be influenced by avoidance responses of flushed birds
- the evidence for the site being located on any spring or autumn migratory flight route and occurrence of significant numbers of migrants

5.4.3.1 Vantage Point Bird Surveys

312 Shore-based vantage point bird surveys were conducted for two hours weekly at Blackdog and Donmouth and fortnightly at Drums and Balmedie covering a distance of up to 2 km from shore. These surveys were conducted between April 2006 and March 2008 (two years completed). The surveys gave good coverage of the inshore areas of the bay which were not accessible by boat due to shallow water depth. However, due to the distance offshore of the proposed wind turbines it was not possible to accurately survey out to the revised proposed location. The detection arc possible from each vantage point surveyed, in relation to the wind farm survey area is presented in Figure 7.

TABLE 5.3
Totals and mean numbers per hour of principal species recorded in Aberdeen Bay for the four six-month periods summer 2006, winter 2006-2007, summer 2007 and winter 2007-2008.

Species	Summer 2006	Winter 2006-2007	Summer 2007	Winter 2007-2008
Red-throated Diver	567 (5.7)	226 (3.0)	435 (4.3)	272 (2.5)
Fulmar	852 (8.6)	25 (0.3)	898 (8.8)	24 (0.2)
Gannet	4492 (45.4)	165 (2.2)	4352 (42.7)	713 (6.4)
Manx Shearwater	186 (1.9)	1 (0.01)	49 (0.5)	7 (0.1)
Sooty Shearwater	12 (0.1)	0 (0.0)	10 (0.1)	5 (0.05)
Cormorant	418 (4.2)	248 (3.3)	446 (4.4)	424 (3.8)
Shag	46 (0.5)	66 (0.9)	43 (0.4)	35 (0.3)
Eider	885 (8.9)	355 (4.7)	780 (7.7)	877 (7.9)
Common Scoter	2798 (28.3)	297 (4.0)	4665 (45.7)	1159 (10.4)
Velvet Scoter	41 (0.4)	7 (0.1)	16 (0.2)	16 (0.1)
Red-breasted Merganser	44 (0.4)	53 (0.7)	45 (0.4)	97 (0.9)
Curlew	50 (0.5)	199 (2.7)	181 (1.8)	92 (0.8)
Oystercatcher	34 (0.3)	147 (2.0)	190 (1.9)	62 (0.6)
Guillemot	5635 (56.9)	1495 (19.9)	3151 (30.9)	628 (5.7)
Razorbill	91 (0.9)	113 (1.5)	198 (1.9)	56 (0.5)
Puffin	22 (0.2)	1 (0.01)	54 (0.5)	4 (0.04)
undiff. auks	1145 (11.6)	1324 (17.7)	3354 (32.9)	838 (7.6)
Great Skua	109 (1.1)	3 (0.04)	110 (1.1)	2 (0.02)
Arctic Skua	69 (0.7)	0 (0.0)	164 (1.6)	6 (0.05)
Black-headed Gull	143 (1.4)	638 (8.5)	684 (6.7)	912 (8.2)
Common Gull	1256 (12.7)	3419 (45.6)	1215 (11.9)	3024 (27.2)
Herring Gull	6158 (62.2)	4112 (54.8)	8099 (79.4)	6737 (60.7)
Lesser Black-backed Gull	19 (0.2)	3 (0.04)	50 (0.5)	19 (0.2)
Great Black-backed Gull	360 (3.6)	178 (2.4)	232 (2.3)	367 (3.3)
Kittiwake	6429 (64.9)	67 (0.9)	4127 (40.5)	124 (1.1)
undiff. gulls	4001 (40.4)	924 (12.3)	3845 (37.7)	786 (7.1)
Sandwich Tern	2536 (25.6)	1 (0.01)	4561 (44.7)	1 (0.01)
Common Tern	1720 (17.4)	0 (0.0)	105 (1.0)	0 (0.0)
Arctic Tern	359 (3.6)	0 (0.0)	2678 (26.3)	14 (0.1)
'commic' terns	*2079 (21.0)*	*0 (0.0)*	*2783 (27.3)*	*14 (0.1)*
Little Tern	6 (0.1)	0 (0.0)	11 (0.1)	0 (0.0)
undiff. terns	70 (0.7)	0 (0.0)	1186 (11.6)	0 (0.0)

313 The vantage point surveys primarily collected data on flying birds (ie species, numbers, direction of flight, distance from shore and height), although some information on birds on the surface was noted, along with marine mammals. Weather conditions, including wind direction and sea state was also recorded for each of the surveys.

314 Vantage point surveys are very useful in establishing the bird species frequenting and passing through Aberdeen Bay and can detect the large variations in numbers for some species that have been recorded between consecutive seasons (Table 5.3). The results of the vantage point surveys are useful in providing evidence for the main passage of birds along the shorefront and the flight height of these birds. This information has been used to modify the original wind turbine layout and position it further offshore away from the main areas used by birds.

315 No further vantage point surveys are planned as they are not suitable for accurately detecting birds at the revised wind farm location.

5.4.3.2 Boat Based Surveys

316 Boat based surveys following the methodology of Camphuysen *et al.* (2004), were carried out monthly between February 2007 and April 2008. There has been a gap in survey coverage since April 2008. To date, boat based surveys have covered a period of 15 months, which is recognised to be below the recommended two years of survey coverage advised by SNH. For the months May to January there has only been one months worth of boat based survey data (Table 5.4). Following the recommendations of a gap analysis on the existing survey data, and advice from statutory consultees, an additional boat based survey programme has been designed. Further surveys started in August 2010 and will continue for at least 12 months, or more prior to construction.

TABLE 5.4
Summary of monthly boat based survey coverage

Month of Coverage	2007	2008
January	-	✓
February	✓	✓
March	✓	✓
April	✓	✓
May	✓	-
June	✓	-
July	✓	-
August	✓	-
September	✓	-
October	✓	-
November	✓	-
December	✓	-

✓Survey took place

317 The original boat based survey transect design, followed the statutory advice provided by JNCC and SNH and consisted of a survey area including the wind farm plus a buffer zone and control site to the north of wind farm site. The total survey area was 101.6 km^2. The boat survey track, wind farm and study site and control areas are shown on Figure 8.

318 Data obtained from all the surveys will be used to assess the importance of the site for all species, especially those likely to be from SPAs. The data will also be used to help determine the risk and significance of potential impacts and identify possible mitigation measures. A summary of the initial boat based survey results for the main species of interest is shown in Table 5.5 and brief conclusions are provided. The impact assessment section expands upon the further analysis that is planned for the complete survey dataset.

TABLE 5.5
Summary accounts of key bird species detected in the surveys in Aberdeen Bay. The three main risks to birds which are collision, displacement and barrier effects are shown with each species being assigned a low, medium or high score. Species that are highlighted in red are qualifying species of SPAs.

	Species	Comments	Risks		
			Collision	Barrier	Displacement
Auks	Guillemot	Population was estimated at over 1,000 individuals within the wind farm survey area in summer with a peak of 1,161 (95 % confidence limits 796 - 1,692) individuals in July and lower than the control area 2,419 (1812-3231). The numbers of common guillemot declines during the winter with birds dispersing further offshore. Population estimates produced were larger in the control survey area during the breeding and post breeding season, but smaller in the winter in comparison to the wind farm survey area. Birds were evenly distributed with marginally more observations in waters <20 m. One out of 243 recorded flights was above 25 m.	Low	Low	Moderate
	Razorbill	Increase in abundance occurred during the summer months. Post-breeding surveys in July, August and September featured the largest numbers of birds Peak count in wind farm area of 273 in August 2007. Up to 378 in control area (August 2007). Sightings were evenly distributed between shallow and deeper areas. Only a few individuals were detected in the survey areas during winter. All flights recorded below 25 m.	Low	Low	Moderate
	Unidentified Guillemot / Razorbill	Some common guillemot and razorbill were not identified to a species level, and as such, sightings were grouped into an unidentified common guillemot/razorbill category. The peak count from boat surveys was made in July within the control survey area, and reached 1,431 birds.	Low	Low	Moderate
	Atlantic Puffin	Increase in numbers during summer months. Peak population estimate of 285 (95 % confidence limits 172-471) birds in September (control area). Majority of birds were found in deeper waters >20 m. No sightings in winter months (Dec-Apr). Sightings were relatively scarce within the wind turbine footprint and wind farm survey area. No birds were detected flying above 15 m.	Low	Low	Moderate
	Little Auk	The little auk is an overwinter visitor to the North East coast, a total of 6 little auks were detected during the boat based surveys during the winter months.	Low	Low	Low
Terns	Common Tern	Common terns were present in the survey areas between May and	Low	Low	Moderate

		September. Populations were much lower in the wind farm survey area than in the control survey area. Numbers peaked in July with a maximum population 55 birds in the wind farm survey area and 264 birds in the control survey area. 93 % of the common terns recorded in transect were actively foraging (shallow plunging). No birds were recorded in the wind turbine footprint. Foraging concentrations were found in the south-west corner of the wind farm survey area and off the Ythan Estuary. No birds recorded flying above 25 m.			
	Arctic Tern	The Sands of Forvie support a breeding population of 76 pairs (Mitchell *et al.,* 2004). Only three Arctic terns were recorded in the control survey area during the July survey.	Low	Low	Low
	Common/Arctic Tern	A total of 29 birds classed as 'commic' tern were observed from May to September. 20 % of the individuals were recorded foraging 'in transect'.	Low	Low	Low
	Sandwich Tern	Very few birds were recorded in the ship-based survey areas. Based on extrapolation of overall density, the maximum counts were of only five birds in the wind farm survey and 21 birds in the control survey area. Majority of sightings were in close proximity to the shore in shallow waters <20 m. No birds were recorded in the wind turbine footprint. No birds recorded flying above 25 m.	Low	Low	Low
Gulls	Common Gull	The largest counts of were recorded during the winter period, producing a population estimate of 239 individuals in March in the wind farm survey area and 235 individuals in the control survey area. Estimated population sizes within the wind farm site were larger from September to February. The majority of common gulls were present in the southern part of the wind farm survey area during winter. There was a net reduction in April following the departure of birds to their main breeding ground, however, although, a small population breed in Aberdeen city, numbers were almost absent from the area during summer. The majority of birds (66 %) were observed flying below 25 m.	Moderate	Low	Low
	Herring Gull	Within the wind farm survey area, the population size was estimated to be of 417 birds in June and 456 in July. Outside the late breeding and post breeding period, monthly population estimates were very low, and the species was absent from this area in April and May. A similar pattern was observed within the control survey area, although estimated populations were very low during the breeding season. Low numbers of counts were	Moderate	Low	Low

		observed between November to May. In contrast, during the post breeding season, large concentrations occurred in the south-west corner of the wind farm site close to Aberdeen Harbour, but also around the cliffs of Collieston within the control survey area. The majority of birds (52.8 %) were observed flying above 25 m.			
	Great Blacked Gull	Great black-backed gulls were present in Aberdeen Bay all year round. Within the wind farm survey area, numbers of birds recorded in transect peaked in June, resulting in a population estimate of 123 individuals. Monthly population estimates in the control survey area were lower. Bird sightings are dispersed across the site, but small concentrations were found between the Ythan Estuary and the cliffs of Collieston, as well as the southern transects of the wind farm survey area. The majority of birds (56%) were observed flying above 25 m.	Moderate	Low	Low
	Black Legged Kittiwake	Population estimates were at their highest during the late breeding season and their lowest during the winter. Within the wind farm survey area, a population of 1,092 black-legged kittiwakes was estimated in July. Distance sampling produced similar population estimates in the control survey area with a total of 810 individuals in July (95% confidence limits on distance estimate: 405 - 1,620). Outside the breeding season the species is essentially oceanic, and low numbers were recorded from November to March. Distribution of black-legged kittiwake to be patchy during the late breeding season, but with large flocks present (single flock of up 130 individuals). This is possibly linked to the distribution of the kittiwake's main prey items across the survey area, i.e. small pelagic shoaling fish, such as sandeels, sprats and young herring. By contrast, sightings in winter consisted of one or two individuals scattered across the ship-based survey area. Majority (61.6 %) of birds were flying below 25 m, with birds observed flying upto 100 m.	Moderate	Low	Low
	Black Headed Gull	In the North Sea, black-headed gulls occur at sea only during migration periods. In the winter, black-headed gulls can be found in inshore tidal waters with a preference for bays and estuaries with sandy and muddy beaches . Eight of the nine sightings recorded during the survey programme were made in November - all in the inshore short legs between the main transects.	Low	Low	Low
	Lesser Black	Lesser black-backed gulls breed in colonies along the coast and at some	Low	Low	Low

	backed Gull	inland sites in Britain and Ireland. Only two sightings of lesser black-backed gull were made during the survey programme. Both were in June within the wind farm survey area.			
Skuas	Great Skua	Great skuas were recorded from July to September, with peak numbers in August (74 % of the sightings occurred in August). Great skuas were recorded in lower numbers than Arctic skuas. Sightings indicate a concentration of birds in the north-east part of the control survey area. 25 % of birds were observed flying within wind turbine height.	Low	Low	Low
	Arctic Skua	Arctic skuas were present in the survey areas from June to November. Peak passage occurred in November with a total of 23 birds. Several kleptoparasitic attempts were recorded during the surveys on terns, black-legged kittiwakes and common gull. Arctic skuas were more abundant and widely distributed in the control survey area than in the wind farm survey area. The majority of observations (83 %) were observed flying below 25 m.	Low	Low	Low
	Long-tailed Skua	One long-tailed skua was seen in June. The species is a passage migrant to the UK, breeding in the high Arctic.	Low	Low	Low
Cormorants	European Shag	Present in low numbers from between February 2007 and January 2008 with fewer sightings during the winter. Sightings were scattered across the ship-based seabird survey area. No birds were detected in the wind turbine footprint and majority of sightings occurred in shallow < 20 m waters. All birds were detected flying below 10 m.	Low	Low	Low
	Great Cormorant	Present all year around in Aberdeen Bay, but with lowest numbers in May and greatest numbers in September and October. Estimated population sizes indicates the control area to support the largest population, with up to 20 individuals in September. The distribution of sightings from February 2007 to January 2008 indicates the species to prefer shallow waters with the species rarely occurring in water exceeding the 20 m depth contour line. Concentrations were found in shallow waters from the Ythan estuary to the cliffs of Collieston. All birds were detected flying below 25 m.	Low	Low	Low
Gannets, Shearwaters, Fulmars	Northern Gannet	Population estimates were the highest during the breeding season in the wind farm and control survey areas with 45 birds and 62 birds, respectively in August. Outwith the breeding season, estimated populations using the site were low and the species was almost absent during the winter period. Population estimates are mainly derived from birds seen in flight ('in	Moderate	Low	Low

		transect' at the time of snapshot), which suggest that the species passes through the site rather than stopping to forage. The distribution maps indicate the sightings to be scattered across the boat survey areas during the breeding season, but occurring mainly in the deepest water of the survey areas during the post breeding season. The majority of birds (82 %) were observed flying below 25 m.			
	Manx Shearwater	During the first year of surveys, the sightings of Manx shearwater began in May, peaked in September and continued through to early November. Of a total of 22 individuals recorded during the May to November period, 90 % were recorded in flight, mainly in a northerly direction. This suggests that Manx shearwater spent most of the time passing through the area without stopping and foraging. No birds were observed flying above 10 m.	Low	Low	Low
	Sooty Shearwater	Only one individual was recorded flying north in October. Although breeding only in the Southern Ocean, sooty shearwaters disperse widely outwith the breeding season and regularly reach the North Atlantic. Sooty shearwaters are a scarce autumn passage migrant in north-east Scotland usually seen from July to mid November.	Low	Low	Low
	Northern Fulmar	With the exception of February (16 individuals), northern fulmar population estimates using the wind farm survey area were very low in comparison to the control survey area. Sightings were dispersed in water deeper than 20 m with small concentrations observed around the cliffs of Collieston, where the species nests. No birds were observed flying above 10 m.	Low	Low	Low
Seaducks	Common Scoter	Only a few sightings were recorded 'in transect' as the majority of birds were recorded between the 'short legs' and the coast in the shallowest water, and therefore outside the 300m band transect. As a result, population estimates are very low in the wind farm and the control survey areas, despite large flocks being present between Donmouth and Balmedie, in particular around Blackdog. Counts outside transect included a single flock of up to 1,200 common scoters in July 2007. During winter, low numbers of common scoters remained between Donmouth and Balmedie. Only 3 % of birds were observed flying within wind turbine height (25-100 m).	Low	Moderate	Moderate
	Common Eider	Common eiders were present in both the control and wind farm sites throughout most of the year, but in very low numbers, with only a total of 53 individuals recorded 'in transect' between February 2007 and January	Low	Moderate	Low

		2008. As the result the population size estimated by extrapolation of overall density was very low in the ship-based survey areas. Common eiders were mainly distributed in inshore shallow waters, between the short legs and the coast, and thus not shown in as these were outside transects. Only a few individuals were seen in water exceeding 10 m depth. It is noteworthy that maximum counts outside the survey area were made in August (450 birds) and September (450 birds), both around Blackdog. No birds were observed flying above 25 m.			
	Velvet Scoter	Three sightings of velvet scoter were made during the survey programme totalling 14 birds. The two sightings in February (two individuals) and July (five individuals) were associated with a flock of common scoter. The seven individuals sighted in early November at dawn were presumably birds on migration as the birds were noted to fly in a south-westerly direction. Velvet scoters passed along the north-east coast through the year, with a notable increase during the spring before numbers dropped off in the summer and peaked again in late autumn. No birds were observed flying above 15 m.	Low	Low	Low
	Long-tailed Duck	The surveys did not identify the presence of a flock within the wind farm survey area, although occasional sightings close to the beach were an indication of the preference of this species for the shallowest areas. A total of 14 birds were recorded in ship-based survey areas in April, October and November. All sightings related to birds flying parallel to the coast (flock of up to four individuals), in a northerly or southerly direction. No birds were observed flying above 15 m.	Low	Low	Low
Wildfowl	Red-breasted Merganser	Only one red-breasted merganser was recorded in March at the mouth of the river Don. Red-breasted mergansers are recorded in small numbers throughout the year in Aberdeen Bay.	Low	Low	Low
Divers	Red-throated Diver	Red-throated divers were present throughout the year in Aberdeen Bay. The greatest usage was noted to occur in spring and winter within the wind farm survey area. The peak in May probably reflected movement of divers heading to northern Scottish breeding sites or to Scandinavia, whilst the increase in winter months indicated the presence of wintering a population in Aberdeen Bay. A total of 88 birds were estimated to be using the wind farm survey area during the passage period in May whilst an estimated 55 birds were present in January. Population estimates were much lower in	Low	Low	Moderate

		the control survey area, particularly during the winter months. Distribution maps indicate that red-throated divers exhibit a preference for water shallower than 20m, but with concentrations observed on the 'short legs' around the 5 to 10m depth contour line. No birds were observed flying above 25 m.			
	Unidentified divers	A total of six unidentified black-throated/red-throated diver were seen in both survey areas, mainly birds in flight or taking off from the sea surface at great distances.	Low	Low	Moderate

319 Seaducks (including common scoter and common eider) exhibited a very near-shore distribution, with concentrations observed in water depths of less than 5 m, and thus in low abundance in the wind farm site itself where water depths are greater. Red-throated divers were recorded within both the proposed development area and control survey areas. The species had a less concentrated near-shore distribution than that of the seaducks, but were found around the 5 to 10 m depth contour line, and thus found in shallower area than the proposed development.

320 Terns were more abundant in the control survey area than in the wind farm survey area. Sandwich, common and Arctic terns exhibited a preference for shallow waters adjacent to the Sands of Forvie colonies.

321 Gulls were numerous during the survey programme, with black-legged kittiwake and herring gull primarily recorded during the summer months (June and July) and mew (common) gull present during the winter period. Black-legged kittiwake exhibited no particular concentration of usage within, or adjacent to, the proposed project, although the control survey area was potentially one of the preferred areas for this species.

322 Common guillemots were widespread within the wind farm survey area, but with the largest foraging aggregations found in the control survey area during the post-breeding period. A general north-south flight line was observed through the wind farm survey area, although flight movements across the survey area were undertaken below 15 m.

5.4.3.3 Boat Based Surveys 2010 – 2011

323 AOWFL has contracted SMRU Ltd to provide further boat surveys which will be combined to cover marine mammals and birds. The new survey design is a gradient type approach and is different to the BACI type design that was surveyed in 2007 and 2008.

324 The 2010 surveys commenced in August and will be conducted monthly over two days. The surveys will extend the survey coverage and will follow a different type of transect pattern to that used in the original survey to allow the continual collection of data during line turns (Figure 8). SNH and JNCC were consulted upon the new survey transect design and surveying schedule.

325 The survey area has been extended to cover three survey strata

- i) extending northwards, covering both the wind farm, buffer and control areas surveyed in the previous surveys
- ii) extending eastwards further offshore
- iii) a southwards stratum

326 The total survey area is 339 km^2. This gradient approach allows potential displacement of birds to be assessed once the wind farm is operational. One 2-day survey will be conducted per month, initially for a 12 month period, with at least three months of data available for inclusion in the EIA and Environmental Statement, in addition to the previous data collect for the site. The boat surveys will continue after the submission of the Environmental Statement until 12 months of data have been collected, giving two years of data for the site. The intention is to then continue the surveys before, during and after construction, using the same transect design.

327 Standardised survey methods (as described in Camphuysen *et al.* 2004) will be used to allow comparison with previous boat-based surveys. Seabird observers will be experienced and ESAS trained and survey effort will be restricted to sea states of 4 or less. The data collected will allow density estimates to be created for the survey area and the data will provide a repeatable baseline from which to monitor throughout the wind farm installation. Data collected from previous surveys once fully analysed will contribute to the new dataset and be analysed in conjunction with it.

5.4.3.4 Radar Surveys

328 Radar studies provide data on flight height and bird movements for bird species in the area. Radar also provides a way of assessing bird movement during the hours of darkness and in adverse weather conditions, such as haar. The areas of Aberdeen Bay surveyed using radar are illustrated on Figure 7. The following radar surveys have been conducted:

- Autumn 2005: two 5-day surveys were conducted at Drums (24 – 29 October 2005) and Easter Hatton (29 October – 3 November 2005).
- Spring 2007: 10-day survey conducted at Blackdog (11-27 April 2007).
- Spring 2010: 6-day survey conducted at Blackdog (24-29th April 2010).

329 The results of the Autumn 2005 study indicated that the majority (>95 %) of flight movements were outside the proposed wind farm footprint but flight transits were detected up to 5000 m offshore, with the majority of movements being within 3000 m. Flight altitude was predominantly low (<50 m) at both the Drums site and the Easter Hatton site. The study indicated a high degree of interchange between birds along the whole coastline from Ythan Estuary south to Drums, Balmedie and Blackdog.

330 The results of the Spring 2007 study conducted at Blackdog supported the results of the previous radar study in that the majority of flight activity (90.9 %) was within 1.4 km of the shore. The majority of flight altitudes were below 40 m and from the visual observations by ornithologists the flight heights for most species of seaduck and diver observed was <30 m. Due to the spring migration a considerable northern bias to flight movements was detected.

331 Night activity was of a similar magnitude to daytime bird movement activity levels. Activity levels during Haar conditions did not alter for species within the fast speed classes, (seaduck, divers, auks,) but was much reduced for slow speed class species, notably gulls.

332 During periods identified from the radar tracks as having low migrational activity there were still numbers of tracks recorded within the wind farm footprint. This would indicate that the wind farm area is used by local birds either for foraging or transit, a pattern also repeated in the visual observation results

333 The spring 2010 radar study was designed to target the spring migration of geese. Very few geese were recorded during the survey undertaken in April and it may have missed the main migration period or, it is possible that the offshore area is not frequently used by migrating geese. Studies undertaken at constructed offshore and onshore wind farms have reported a very high avoidance rates by geese with collisions with wind turbines being extremely

unusual. AOWFL are not planning to commission any further radar studies that will specifically target geese.

5.4.3.5 *Aerial Surveys*

334 After careful consideration, aerial surveys were not considered appropriate for this development due to the size of the site and its proximity to land and helicopter flight paths. No aerial surveys are planned as part of the EIA process.

5.4.4 Predicted Impacts

335 A preliminary analysis of all ornithological data was undertaken in order to assess the potential impacts of the original proposal for a 23 wind turbine wind farm on the sensitive species identified above. Impacts assessed were: collision risk, disturbance / displacement, barrier effects, and habitat loss. From the initial analysis of the data it was recognised that bird movement was primarily within the inshore section close to the coast, this was confirmed from the results of the vantage point counts and radar monitoring. This resulted in a redesign of the wind farm layout with wind turbines placed further offshore avoiding the area which appeared to have the highest movement of birds.

336 The impact assessment for the new wind farm area will take into account and assess collision risk, displacement / disturbance, barrier effects, habitat loss and cumulative impacts. In order to analyse the data and to calculate the total population size within the areas survey it is proposed to use distance computer modelling. Modelling the data using distance methods may not produce accurate results where the numbers of observations are very small, which will be the case for many species in Aberdeen Bay. Where this is the case, use of an alternative method is necessary to estimate population size. Where distance sampling was not possible (< 50 different observations), simple extrapolation of the overall sample density will be used to estimate the total numbers of birds in the seabird survey areas. This approach has so far been used to analyse one year's worth of boat based data and will be extended to include all available monthly survey data at the compilation stage of the Environmental Statement. Initial population estimates of birds in the wind farm survey areas will be generated using distance sampling techniques where possible, and distribution maps of seabird and seaduck sightings will be produced on a seasonal basis.

337 The use of the gradient approach for the 2nd phase of boat based survey work (rather than Treatment – Control) allows distance from the development footprint to be included as a covariate within analyses. This is particularly useful where the level of an impact may be expected to decline with distance or the spatial extent of an impact footprint is unknown. At the Aberdeen site, it may be expected that any negative impact results in displacement of birds away from the development site, with movement along the depth gradient up/ down the coast potentially more likely than offshore displacement (particularly with species like scoter, divers and eider). By extending the survey areas to the north and south of the development site, the potential to detect any such coastal displacement of divers and sea duck is maximised.

338 **Collision risk:** Collision risk to birds transiting through the wind farm area will be assessed using the Band model (Band, 2000) and will incorporate flight

height data collected during the offshore surveys and available literature on flight heights. The collision risk calculations will include all species, with particular attention paid to key species in the wind farm area, red throated diver, common eider and common scoter and terns.

339 **Displacement:** Displacement will be assessed for sensitive receptors with a particular emphasis on the key species red throated diver, common scoter, eider, guillemot and razorbill would be likely to be most sensitive to displacement due to their presence in large aggregations or high numbers on the surface waters of the bay. For species where insufficient information exists to predict likely displacement impacts, a worst case scenario will be applied which uses the assumption that 100 per cent of birds would be displaced from the wind farm and buffer zone and that habituation would not occur. Displacement effects will be considered on a number of scales, temporary displacement during construction and longer term after the installation of the wind farms.

340 **Barrier effects:** The assessment will take into consideration the potential for disruption to flight lines, including migratory flight paths and also daily movement of birds. From the initial analysis of the data it is considered unlikely that a significant barrier effect would arise owing to the orientation of the wind turbines in a north-south direction which is parallel to the predominant flight direction identified by radar and also parallel to the shore line. If appropriate, an energetic model will be applied to bird flight tracts to determine the effect that any deviation to flight lines will have.

341 **Habitat loss:** This will be assessed in its simplest form by calculating the amount of benthic habitat lost by the installation of the wind turbine bases, inter-array cables and export cables. Consideration will also be given to potential change in habitat and indirect effects on prey due to the installation and operation of the wind farm.

5.4.5 Cumulative Assessment

342 The cumulative assessment will follow the latest recommended guidance on CIA published by COWRIE (King *et al.*, 2009). For the assessment purposes, the only consented offshore renewable development for which there are bird data available to use in a cumulative impact assessment is the Beatrice wind farm located in the Moray Firth. The cumulative assessment will therefore be restricted to species that are found off Aberdeen Bay and the Moray Firth. The cumulative assessment will make reference to other renewable developments that are planned for Scottish territorial waters and Round 3 offshore areas, however detailed cumulative assessment is not possible for projects that are at an early stage of data collection and for which no data are available.

5.4.6 EOWDC Future Research and Monitoring

343 AOWFL proposes to monitor the movement of birds around, through and over the wind turbines to determine more accurately the actual influence of the wind turbines on the birds, and the birds' interaction with the wind turbines. Other parameters that could be investigated include studies into mortality of birds through collisions with wind turbine blades. This information would help inform the theoretical mortality estimates produced for collision risk, eg the

SNH bird-collision model. Further discussion on how to best collect this type of post construction data will be held with SNH and other appropriate organisations at a later date. EOWDC could be the focus of pre-construction, construction and post-construction ornithological surveys to determine the actual effects of the wind farm on the bird species of Aberdeen Bay and also validate the predictions made within the Environmental Statement.

344 The studies will include observations by ornithologists during bird boat-based surveys. The proposed Ocean Laboratory on the site could also be used to conduct specific bird investigations from, although the design and the type of equipment on the platform have yet to be ascertained so at this early stage it is not possible to commit to particular types of equipment. Stakeholders are being contacted to discuss potential collaborations and research opportunities that the platform will bring.

5.5 Bats

5.5.1 Introduction

345 It is recognised that bats may be impacted by wind farms; evidence from a number of onshore wind farms has indicated that bats have a higher mortality rate due to wind farms than birds. Although direct collisions with the wind turbines does occur, a higher mortality rate arises from due to barotraumas caused by sudden changes in air pressure causing lethal lung damage.

346 Bats have been recorded foraging around offshore wind farms. Studies undertaken in Sweden to explore potential impacts on migrating bats discovered that non migratory bats also occurred foraging around the wind turbines as far as 10 km from shore (Ahlén *et al.,* 2007).

347 All bats in the UK are fully protected under the Wildlife and Countryside Act and the European Habitats Directive.

5.5.2 Baseline Information

348 Bats in north-east Scotland have been extensively studied with significant research over the years undertaken by the University of Aberdeen.

349 Seven species of bat are known to occur in north-east Scotland of which only two are very common, the other species are either uncommon, rare or very rare (Table 5.6). There is little or no evidence of any regular migration of European bats to or from Scotland.

350 **Common pipistrelle and Soprano pipistrelle** - Due to the similarity of the two species *Soprano pipistrelle* was not discovered until the 1990s but has since been found to be common and widespread throughout the UK, including north-east Scotland. They occur in most habitats but particularly riparian woodland and parkland. They will forage up to 5 km from their roosts and are the most frequently recorded species along the Aberdeenshire coast.

351 **Nathusiu's pipistrelle** - A previous migrant species, it has only been classified as a resident in the UK since 1996. Only one record in north-east

Scotland. Two records from oil platforms suggest that this species may be a very scarce migrant.

352 **Brown long-eared bat** - This species is widespread but less common than the pipistrelles particularly along the coast. Brown long-eared bats roost in old houses and forage within 1.5 km from their roost which are invariably near to thick woodland. Consequently they are scarce along the coast.

353 **Daubenton's bat** - Although widespread in north-east Scotland, Daubenton's bats are closely associated with fresh water and avoid urban habitats. Roosts are in mature deciduous trees and rarely in houses. The species occurs along the Ythan as well as Deeside and Donside. However, it is rare or scarce near the coast.

354 **Natterer'sbat** - Natterer's bats are found throughout most of the British Isles. Recent records have extended its range in Scotland north to the Great Glen fault. This is a very rare bat in north-east Scotland with few records reported. It does forage widely and over a wide variety of habitats including grassland, but it prefers semi-open woodland often coniferous.

355 **Whiskered bat** – Very rare with just one record in north-east Scotland. It is found throughout England and Wales and even in southern Scotland and throughout Ireland.

TABLE 5.6	
Species	**Status**
Common pipistrelle	Very Common
Soprano pipistrelle	Very Common
Nathusiu's pipistrelle	Very Rare
Brown long-eared bat	Uncommon
Daubenton's bat	Uncommon
Natterer's bat	Rare
Whiskered bat	Very Rare

5.5.3 Proposed Scope of Assessment

356 A literature review will provide the major source of information for the Environmental Statement. From the information above there are only two species potentially occurring at the proposed offshore wind farm site should foraging occur at the wind farm. The assessment will also explore the potential for migrating bats to occur within the wind farm location.

5.6 Marine Mammals

5.6.1 Introduction

357 The north east of Scotland is widely recognised as being important for marine mammals and there has been considerable research effort directed towards studying populations and marine mammals in the wider area. The EIA will review and take into account all relevant available information along with the data collected at the site to establish potential impacts associated with the proposed development and determine adequate mitigation measures to implement.

358 Marine mammals are protected under several sections of conservation legislation. All cetacean species are listed in Annex IV of the EC Habitats Directive, which protects them from any deliberate disturbance, particularly during the periods of breeding and migration. In addition, bottlenose dolphins, harbour porpoises, harbour seals, grey seals and otters are also listed in Annex II of the Habitats Directive.

359 This section outlines the marine mammal surveys undertaken to date which have included acoustic monitoring, boat-based surveys and vantage point counts, and the future monitoring that is planned for the site. The interim results for the surveys carried out thus far are presented along with the analysis planned for the impact assessment stage.

5.6.1.1 Project Reports

- Review of Bird and Marine Mammal Data, RPS. January 2008
- Gordon, J. (2008). Preliminary analysis of acoustic detections of porpoise from AMEC surveys off Aberdeen. Ecologic UK Ltd Report. 11pp.
- Marine Mammal Data Review, SMRU Limited, January 2010
- Travers, S., Thomson, S. and Mander, L. (2008). Aberdeen Offshore Wind Farm – ship-based Marine Mammal Survey Results (February 07-January 08). Final Report ZBB706 –F- 2008.
- Travers, S., Thomson, S. and Mander, L. (2008). Institute of Estuarine & Coastal Studies, University of Hull. 68pp.Monthly boat based marine mammal survey reports February-April 2008. The Institute of Estuarine & Coastal Studies (IECS).
- Weir, C. (2008). Photo-identification catalogue for bottlenose dolphins (Tursiops truncatus) and other cetacean species off the coast of Aberdeenshire, NE Scotland. Version 1.1 ACC.

5.6.2 Baseline Information

360 The coastal stretch between the Moray Firth and St Andrews contains a population of bottlenose dolphins. In Aberdeen Bay the bottlenose dolphins are semi-resident and are frequently observed at the mouth of the harbour entrance. Other frequently sighted marine mammals include the harbour porpoises (*Phocoena phocoena*), harbour seals (*Phoca vitulina*) and grey seals (*Halchoerus grypus*). In the summer months white-beaked dolphins (*Lagenorhynchus albirostris*) and minke whales (*Balaenoptera acutorostrata*) have been observed further offshore. Records of marine mammal sightings including from stranding records indicate 12 odontocete species, three mysticete species and three pinniped species (Table 5.8).

361 For species such as white-sided dolphins, killer whales, common dolphins, striped dolphins, long-finned pilot whales, sperm whales, humpback whales, fin whales, northern bottlenose whales, Sowerby's beaked whales and other pinniped species, the area off north-east Scotland is either on the edge of their range or the habitat is unsuitable for them consequently, they are likely to occur only occasionally and then only be a few individuals (Hammond *et al.*, 2004).

362 The proposed wind farm site does not contain any designated sites for marine mammals, but there are a number of SACs, on the east coast of Scotland for

which marine mammals are an interest feature. These sites are the Inner Moray Firth SAC for bottlenose dolphins (*Tursiops truncatus*); Dornoch Firth and Morrich More SAC and the Firth of Tay and Eden Estuary SAC for harbour seals; Faray and Holm of Faray SAC, the Isle of May SAC and Berwickshire and Northumberland Coast SAC for grey seals (*Halichoerus grypus*). For seals there is no evidence linking the SACs further north of Aberdeen Bay with any seals present in Aberdeen. Due to the requirements of the EU Birds and Habitats Directive, assessing potential impacts on SAC interest features is an important component of the EIA process and due consideration will be given to this assessment.

363 Harbour seals are widely distributed along the east coast of Scotland. They are present in the Aberdeen area throughout the year. Their occurrence at the estuaries of the Rivers Dee and Don is seasonal with an increase in numbers during the winter and early spring. Harbour seals use haul-out sites at the Donmouth, at the mouth of the Ythan River and at Catterline. Harbour seals have been observed feeding on salmonids and flatfish at the estuaries of the Rivers Dee and Don, as well as other marine prey species. The pupping period for harbour seals occurs from June to July and moulting occurs from June to September. During these times they spend a higher proportion of their time ashore and in coastal waters. The closest SAC for harbour seals to the wind farm site is in the Firth of Tay.

364 Grey seals are also found along the east coast of Scotland. They are present in the Aberdeen area throughout the year. Grey seals use haul-out sites at the Donmouth, at the mouth of the Ythan River, outside Peterhead harbour, Cruden Bay, Boddom and at Catterline. The most well established colony in the area is at Catterline where up to five pups may be born each year. The pupping period for grey seals occurs from October to November and moulting occurs from February to April. During these times they spend a higher proportion of their time ashore and in coastal waters. Grey seals have been observed feeding on salmonids and flatfish at the estuaries of the Rivers Dee and Don, as well as on other marine prey species. The closest SAC for grey seals to the wind farm site is the Isle of May in the Firth of Forth.

365 The otter (*Lutra lutra*) is a semi-aquatic mammal which occurs in a wide range of ecological conditions including inland freshwater and coastal areas. Otters are one of the primary reasons for the site selection of the River Dee SAC. The Dee is a major east coast Scottish river which flows uninterrupted for approximately 130 km from its upland reached in the high Cairngorms to the North Sea. Surveys have indicated that the otter is found throughout the Dee catchment, from its mouth at Aberdeen to the high-altitude lochs (JNCC, 2008a). Otters are generally limited to coastal waters so any impacts on it would be near the shore. Surveys of the cable landfall and on-shore cable route would be conducted to determine the presence and potential impacts on otters.

366 There is a substantial amount of baseline information that can be used in the EIA. The most applicable reference sources and organisations that hold data are discussed below.

367 A cetacean photo-id catalogue was sponsored by AOWFL based on photographs and surveys previously conducted in the area between May 1999 and June 2007 - the ACC (2008) Aberdeenshire Cetacean Catalogue (ACC). A total of 49 dedicated boat surveys where cetacean photo-

identification images were collected were carried out between Aberdeen and Inverbervie, however dedicated photo-identification data has not been collected evenly over the 1999–2007 period. A total of 1,823 images from 88 cetacean encounters were analysed from the 1 May 1999 to 9 June 2007 period. The identified animals predominantly comprised bottlenose dolphins with some Risso's dolphins, white-beaked dolphins and minke whale. A total of 63 bottlenose dolphins has been identified during this study (ACC, 2008). This reference will be useful in identifying specific animals that are observed in future monitoring effort that can be attributed with other sightings records to help develop our understanding of how animals move within specific areas of the North Sea.

368 An overview of the distribution of cetaceans in north-west European waters is provided by Reid *et al.* (2003) based on data collected by the Seabirds at Sea Team (SAST) of the JNCC, opportunistic sightings from the SeaWatch Foundation and a (Small Cetacean Abundance in the North Sea) SCANS survey conducted in July 1994. Additional information on recorded sightings of marine mammals is also available on UKDMAP (1998).

369 Hammond *et al.* (2004) reviewed and examined the distribution and abundance of marine mammals occurring to the north and east of Scotland as part of the Strategic Environmental Assessment 5 (SEA5).

370 SCANS surveys provide information on the distribution and abundance estimates of cetaceans. The first SCANS survey was conducted in the summer of 1994 and SCANS II in the summer of 2005 (Hammond *et al.*, 2002; SCANS II, 2006).

371 The Joint Nature Conservation Committee (JNCC) conducted aerial surveys of wintering aggregations of seaducks, divers and grebes within Aberdeen Bay between 2003 and 2007. During these surveys observations of bottlenose dolphins and harbour porpoises were recorded incidentally (Söhle *et al.*, 2006; Wilson *et al.*, 2006).

372 Cetacean surveys have been conducted from the bridge of the MV Hascosay ferry between Aberdeen, Orkney and Shetland during daylight hours in summer months (April to September) from 2002 to 2006 (MacLeod *et al.*, 2007).

373 The Scottish Agricultural College (SAC) Veterinary Services at Inverness carry out necropsies on stranded and by-caught cetaceans in Scotland for the DEFRA funded Marine Mammal Stranding Program.

374 Land- and vessel based surveys for marine mammals have been conducted between 1999 and 2005, along the Aberdeenshire coast (between St Cyrus and Collieston, primarily between Stonehaven and Aberdeen) as part of SeaWatch surveys and University of Aberdeen research projects (Canning, 2007; SeaWatch, 2008; Sini *et al.*, 2005; Stockin *et al.*, 2006; Weir & Stockin, 2001, 2002; Weir *et al.*, 2007).

375 Since 1990, research on marine mammals in the Moray Firth has been conducted from the University of Aberdeen's Lighthouse Field Station in Cromarty. There have been numerous reports and peer-reviewed publications produced by the marine mammal research group the Cromarty Lighthouse Field Station and many researchers are involved in current

research projects upon marine mammals, such as the Department of Energy and Climate Change seismic study in the Moray Firth.

376 The Sea Mammal Research Unit (SMRU) conducts surveys for harbour and grey seals to monitor seal populations around the UK. SMRU provides scientific information to the Special Committee on Seals (SCOS) (SCOS, 2008).

377 An initial marine mammal desk study has been conducted to review the available information on marine mammals off north-east Scotland with particular reference to the Aberdeen Bay area, providing information their occurrence, distribution, abundance, movements, diet and seasonal sensitivities, such as calving periods. In addition, the potential impacts associated with offshore wind farm construction and operation, the possible effects on marine mammals and mitigation measures have been reviewed. Summary results of the review that illustrate the predicted seasonal occurrence of marine mammals in Aberdeen Bay are shown in Table 5.8.

5.6.2.1 Boat Based Surveys

378 Boat based surveys have been conducted monthly between February 2007 and April 2008. The surveys covered an area that includes the entire wind farm site plus a buffer zone (south to the limit of the shipping lane, 3 km north, 3 km east and up to the 5 m contour line to the west) and a control site immediately to the north (Figure 8).

379 The surveys were conducted over two days (one day for wind farm site and one day for control site) every month. The boat-based survey programme employed standard marine mammal survey techniques used in similar studies. Visual observations of marine mammals were conducted by two marine mammal observers (MMOs) during the surveys. Data collected included species, number, location and activity of marine mammals in the survey area. In addition, marine mammal observations were also made 'off-transect' when the boat was steaming to and from the survey areas.

380 The following species were observed during the boat based surveys: harbour porpoise; bottlenose dolphin; minke whale; grey seal and harbour seal. The white-beaked dolphin has only been recorded off-transect. Table 5.7 summarises the observations of marine mammals during monthly boat surveys of wind farm & control survey areas between February 2007 and January 2008 (including observations off transect). In general, the species sightings corroborate well with the existing baseline information for the area.

381 The harbour porpoise was the most commonly sighted marine mammal species. There were at least twice as many harbour porpoise sightings in the control survey area (119 sightings) compared to the wind farm survey area (47 sightings) over the course of the 12 month survey period. Within the wind farm survey area, the peak sighting index for harbour porpoises was during October-November surveys (0.1149 sightings km-1). In the control survey area, the peak sighting index was during October-November and December-January survey groups (0.2365 and 0.2500 sightings km-1 respectively) (Travers *et al.*, 2008).

382 Bottlenose dolphin were the second most commonly sighted species, however the number of sightings was relatively low . An absence of

bottlenose dolphin sightings was noted during February-March, August-September, October-November and December-January month groups (Travers *et al.*, 2008). .

383 A single minke whale was sighted during the 12 months of surveys in July 2007 (Travers *et al.*, 2008).

384 Five sightings of unidentified cetaceans were recorded during the 12 month survey period: three sightings in the wind farm survey area and two in the control survey area (Travers *et al.*, 2008).

385 Seal sightings were recorded in all month groups during the 12 month survey period apart from the April-May and August-September groups. Overall there were more than twice as many seal sightings in the control survey area (25 sightings) compared to the wind farm survey area (10 sightings), with all seal sightings recorded being of individuals (Travers *et al.*, 2008).

386 Harbour porpoise, bottlenose dolphin, seal species and white-beaked dolphin were sighted off-transect during the 12 month survey programme. Bottlenose dolphins occurred at least once off-transect in more than half of the surveys (13 out of 24 surveys). The majority of off-transect bottlenose dolphin sightings have been recorded in the vicinity of the Aberdeen Harbour mouth. Harbour porpoise were observed to a lesser extent than the bottlenose dolphin; being detected in seven out of 24 surveys off-transect. Seals were observed off-transect in one out of 24 surveys. The white-beaked dolphin was recorded during the August 2007 survey trip (Travers *et al.*, 2008).

387 The results of the first year of marine mammal survey will be pooled together with future boat based survey information. To establish the numbers of marine mammal using specific survey areas density and abundance estimates will generated for species detected where sufficient sightings allow this. Based on current sightings rates, this approach is only likely to be possible for the harbour porpoise. The harbour porpoise data could be pooled over all months and the possibility of fitting a detection function explored within the software DISTANCE. If the model fit is adequate, this could be used to generate density and abundance estimates. These estimates would be biased low because the single platform visual method cannot account for sightings missed on the transect line. Distance estimates are preferable to basic encounter rates because they take into account the effects of distance (and other covariates if there are sufficient data) on the sightings process.

5.6.2.2 Towed Acoustic Monitoring (PAM)

388 In conjunction with the boat based surveying PAM data were collected between October 20007 and February 2008. PAM enables the detection of dolphins and porpoises that might not otherwise be observed by the MMOs, for example due to poor visibility. These surveys were designed to optimise the collection of acoustic information on the occurrence of harbour porpoises. From the initial 5 months of acoustic survey effort harbour porpoises were detected every hour for every survey, in both the control and wind farm site. The acoustic data suggests a regular presence of these marine mammals during the months surveyed. Although, no acoustic survey effort occurred in Spring and Summer, from evidence supplied by the visual surveys, it is likely that the harbour porpoises will still be present throughout spring and summer months.

389 Towed acoustic monitoring is taking place for EOWDC as part of the ongoing boat based surveys which started in August 2010.

Table 5.7 Observations of marine mammals during monthly boat surveys of wind farm & control survey areas between February 2007 and January 2008 (including observations off transect) Travers *et al.* (2008)

	Survey Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bottlenose dolphin	Wind farm												
	Control												
Harbour porpoise	Wind farm												
	Control												
White-beaked dolphin	Wind farm												
	Control												
Minke whale	Wind farm												
	Control												
Unidentified cetacean	Wind farm												
	Control												
Seals	Wind farm												
	Control												

Key

- Observed during boat surveys
- Observed off transect only
- Not observed

Table 5.8 Summary of the occurrence of marine mammals in the Aberdeen area (based on desk study and all Aberdeen offshore wind farm surveys)

Species	Occurrence	Seasonal Occurrence											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bottlenose dolphin	**Regular**												
Harbour porpoise	**Regular**												
White-beaked dolphin	**seasonal/regular**												
Minke whale	**seasonal/regular**												
Risso's dolphin	Occasional												
White-sided dolphin	rare/occasional												
Killer whale	rare/occasional												
Common dolphin	rare/occasional												
Striped dolphin	Rare												
Long-finned pilot whale	rare/occasional												
Sperm whale	Rare												
Humpback whale	Rare												
Fin whale	Rare												
Northern bottlenose whale	Rare												
Sowerby's beaked whale	Rare												
Harbour seal	**Regular**												
Grey seal	**Regular**												
Hooded seal	Rare												

Key

- Recorded during AOWF surveys (VP and boat surveys of wind farm and control survey areas, including on & off transect)
- Present in area (sighting and/or stranding based on desk study)
- Potential to be present in area (based on desk study)
- Not recorded

(Sources: Canning, 2007; Hammond *et al.*, 2001, 2002, 2004; Northridge *et al.*, 1995; Reid *et al.*, 2003; SAC, unpublished stranding data; Sabin *et al.*, 2006; Stockin *et al.*,. 2006; Stone, 2003; Travers, *et al.*, 2008; VP survey data; Weir & Stockin, 2001; Weir *et al.*, 2007; Wilson *et al.*, 2004).

5.6.2.3 Future Boat Based Surveys 2010 – 2011

390 Further boat surveys commenced in August 2010. These will be conducted monthly over two days. The surveys involve a new survey area and methodology from the previous boat surveys. The new survey methodology is based on a monitoring approach.

391 Three survey strata will be surveyed each month: i) extending northwards, covering both the wind farm, buffer and control areas surveyed in the previous surveys; ii) extending eastwards further offshore; and iii) a southwards stratum. The total survey area is 339 km^2, comprising three strata: 150.8 km^2 (north), 82.8 km^2 (south) and 105.2 km^2 (offshore).

392 The aim is to conduct one 2-day survey per month, initially for 12 months, with at least four months of these data being included in the EIA and Environmental Statement, in addition to the previous data collected for the site. The boat surveys will continue during the Environmental Statement process for 12 months, giving two years of data for the site. If there are any significant changes to the data presented in the Environmental Statement, these will be submitted as an addendum. The intention is to then to continue the surveys before, during and after construction, using the same transect design but perhaps focusing effort on key periods, for example during the pile installation period where any acoustic disturbance effects to marine mammals may occur.

5.6.2.4 Vantage Point Counts

393 Shore-based vantage point (VP) bird surveys have been conducted at the Donmouth, Blackdog, Balmedie and Drums between April 2006 and March 2008. VP surveys were undertaken at Blackdog and Donmouth (wind farm site) four times per month and fortnightly at Drums and Balmedie (control sites). Although the surveys were designed primarily for birds, the ornithologists also recorded marine mammal sightings up to 3 km from shore. During the two years of VP surveys, bottlenose dolphins were the most frequently observed marine mammal, seen in nine out of 12 months, with absences in June, September and October. Sightings for this species reached a peak in April with 15 sightings over the two survey years. Harbour porpoises were the next most frequently sighted species, seen in all seasons. The grey seal was also seen in all seasons. Only one sighting was made over the two years for the harbour seal and Risso's dolphin (Travers *et al.*, 2008). These data support the general pattern of key marine species frequenting Aberdeen Bay found during the boat-based surveys.

5.6.3 Potential Impacts

394 There are a number of potential impacts to marine mammals associated with the construction, operation and decommissioning of an offshore wind farm, these include (but are not limited to):

- underwater noise disturbance:
  - pile driving
  - other construction operations, eg drilling, rock dumping, dredging

  - vessels during surveys, construction, installation and maintenance, including vessel noise, sonar systems and navigational depth sounders
  - seismic surveys
  - Trenching operations to bury sub-sea cables
  - vibration of wind turbines during operation
  - decommissioning operations
  - cumulative noise effects
- construction activities, in addition to noise:
  - increased turbidity
  - increased vessel activity
  - pollution incidents, eg fuel spill if accidental vessel-vessel or vessel-wind turbine collision
- physical presence and operation of wind turbines, in addition to noise
  - creation of artificial reefs
  - loss of seabed area
  - electromagnetic fields from cables
- decommissioning activities

395 The potential effects on marine mammals include:

- risk of physical injury, or temporary auditory hearing effects
- disturbance and displacement
- changes to foraging areas and prey availability
- barrier effects to movements
- increased collision risk with vessels

396 Information collected and evaluated from field and desk studies will be used to identify and predict impacts associated with the proposed development. The potential impacts and effects will be considered individually, and cumulatively, for all species (individuals and populations) using the proposed development site and surrounding areas.

397 The potential impacts from underwater noise, especially during any pile driving operations, have the greatest risk of having a significant effect on marine mammals. In order to assess any possible impacts, detailed modelling of underwater noise levels from different activities will be conducted. The results will help inform ranges from the development at which potential physical injury, such as permanent threshold shifts (PTS) in hearing, could occur and also distances at which the sound levels from construction will be audible to marine mammals. The assessment will cover cumulative noise dose and make recommendations of suitable stand-off distances, see also Section 5.7 Underwater Noise.

398 Consideration will be given to the requirement for a European Protected Species licence, following advice from SNH, to cover the potential risk to any injury or disturbance that may result from the construction of the wind farm.

5.6.4 Cumulative Assessment

399 There is relatively little information on the potential cumulative effects of underwater noise from construction of offshore wind farms and other coastal developments on marine mammals. The approach to the assessment of

cumulative impacts of the development will focus mainly on the noise aspects of the development, but will also cover potential loss of habitat to marine mammals. All other sources of noise that contribute either to the ambient noise level in Aberdeen Bay, or are short term events such as seismic surveys, will be reviewed and considered in relation to potential cumulative effects.

5.6.5 Mitigation

400 There are a number of potential mitigation measures that are available to minimise the risk of causing injury to marine mammals from construction noise, particularly pile driving. AOWFL will apply the results of the noise modelling studies, specifically the ranges at which marine mammals are likely to be at risk from any auditory hearing effects, and incorporate these findings into the mitigation measures.

401 For the piling activity itself, it is envisaged that monitoring both acoustical and visual will be conducted from a platform around the wind turbine and the JNCC piling protocol will be followed, specific aspects of this include:

- establishment of a pre-agreed 'monitored zone' (MZ)
- delay of commencement of piling should marine mammals be detected
- use of soft start procedure for piling operations
- use of Acoustic Mitigation Devices (AMDs) prior to piling start up will be assessed taking into account licensing requirements and current best practice advice issued by SNH

402 Other possible mitigation measures which will be assessed include:

- Timing of operations. The preliminary assessment has not identified any periods as being particularly sensitive, for example no evidence of breeding / calving areas in Aberdeen Bay.
- Use of lower-impact piling techniques, pile sleeves, pile head softening, vibropiling and/or other techniques available at the time of construction.

5.6.6 EOWDC Future Research and Monitoring

5.6.6.1 C-PODs

403 AOWFL have purchased 12 C-PODs. These are acoustic monitoring devices used to detect the vocalisations of marine mammals. Continuous acoustic recorders provide valuable information over a long time period. This cannot be achieved by other survey methods and would enable information to be collected during hours of darkness and poor visibility. C-PODs can be used for before, during and after construction monitoring.

404 It is planned to deploy these devices within the wind farm and surrounding area following a gradient approach design where acoustic recorders are also placed in the southerly and northerly extremities of Aberdeen Bay and in deeper waters offshore. SNH have been consulted and provided feedback on the provisional C-POD design layout put forward for the project and will be again consulted before the deployment phase. The impact range and planned distance of C-POD deployment (out to a distance of 35 km) has been

estimated with reference to the current literature (Bailey *et al.*, 2010; Carstensen *et al.*, 2006). The design layout makes an assumption that animals may be dispersed both along the coastline and offshore, and maximises the potential for detecting behavioural responses regardless of response direction (ie offshore or alongshore movements).

405 The use of acoustic devices enables detailed information to be collected about how marine mammals use Aberdeen Bay. This information is useful in terms of collecting further baseline information about general usage of the area, and will also allow an indication of relative abundance of acoustically active cetaceans. However, it is not possible to detect seals or to discriminate between dolphin species (for example bottlenose dolphin and common dolphin).

406 It would be reasonably foreseeable that during the piling phase of construction marine mammals would leave the immediate locality and only return once the piling has ceased. Using the information from C-PODS and other marine mammal studies, further information could be collected to ascertain the responses to underwater noise (for example animals temporarily leaving Aberdeen Bay) and help populate the evidence base for the duration and magnitude of impacts (for example, when marine mammals were shown to return).

407 The long-term effects of the presence of wind turbines on marine mammals are not well understood. It would be valuable to obtain data to determine if marine mammals change their behaviour or utilisation of the area or their feeding patterns or movements as a result of the presence of the wind turbines. A long-term dataset (pre-construction) would ideally be needed to provide a robust evidence base and C-POD deployment pre-construction would contribute to the existing baseline.

5.6.6.2 Ambient Noise Measurements and Validation of Construction Noise Levels

408 Further underwater noise studies are planned including measurements of ambient noise levels and construction noise. These would be useful to validate the predictions made within the impact assessment and also in the analysis of the observations of marine mammals detected visually and acoustically during post construction monitoring.

5.7 Underwater Noise

5.7.1 Introduction

409 The construction of an offshore wind farm is an activity which can generate noise. Impact piling in particular can generate high levels of predominantly low frequency underwater noise that can travel large distances. Other activities that generate underwater noise include vessel movement to and from the construction site.

410 Once operational, the wind farm is expected to generate low levels of underwater noise via the transfer of energy from the moving wind turbine blades into the seabed sediments and water column.

411 AOWFL proposes to conduct a number of noise studies that will be carried out during specific stages of the wind farm. Initial studies, commissioned to support the Environmental Statement, will aim to model and estimate the underwater noise levels generated from construction, specifically piling.

412 The noise predictions in the model will inform other parts of the EIA process notably:

- marine mammals
- fisheries
- commercial fisheries

5.7.2 Baseline Information Overview

413 In order to model sound, it is important to have information on the wind turbine design and piling details (if used) as well as oceanographic information including water depth and seabed conditions. Ambient underwater noise levels are also required. AOWFL are not aware of any underwater noise studies that have been carried out in the Aberdeen area and are proposing to collect ambient noise data within Aberdeen Bay from published reports.

414 Noise modelling will be undertaken to predict the propagation of sound from the piling location along a number of water depth transects. The sound levels that are predicted from the noise modelling can then be assessed against potential impact criteria for marine animals to inform the EIA.

415 The ranges at which hearing injury and temporary threshold shifts in hearing are expected will be estimated using recognised marine mammal impact criteria, such as Southall (2007) and other types of proposed impact thresholds, such as conservative temporary threshold hearing levels proposed by Lucke (2008).

416 Current practice to mitigate impacts to marine mammals from piling is to apply the JNCC piling guidelines which specify that a mitigation zone of 500 m, or higher is used. The mitigation zone is the area within which if a marine mammal is observed prior to starting operations then any commencement must be delayed for at least 30 minutes during which time there must be no observations of marine mammals within the zone. The use of trained MMOs and PAM will reduce the risk of a marine mammal not being detected. Modelling will be able to predict the range at which injury, defined as a Permanent Threshold Shift (PTS) in hearing is expected and this will be used as the basis for setting the mitigation zone. In the likely event that the modelling predicts PTS to be restricted to the immediate vicinity of the pile, a minimum of 500 m will be used as the mitigation zone.

417 The following data sources will be reviewed as part of the EIA process:

- ambient noise recording measurements for the North Sea, for example the DECC funded Moray Firth seismic survey ambient noise measurement programme

5.7.3 Potential Impacts

418 Impacts to marine mammals from noise are covered in Section 5.6 Marine Mammals. Impacts to fish are covered in Section 5.1 Marine Ecology.

5.7.4 Mitigation

419 The mitigation measures for underwater noise will follow the piling protocol as specified in the marine mammal chapter.

5.7.5 EOWDC Future Research and Monitoring

420 Additional noise studies are planned for the construction phase. It is expected that future noise studies will obtain noise measurements at piling locations at a range of distances and use these to provide a breakdown of the spectral levels of sound received to determine sound pressure level and sound exposure level during construction activities. The estimates of sound levels will be particularly useful in validating the noise modelling performed and the assessment of likely impacts on marine fauna made in the Environmental Statement.

421 The scope of work for the future noise studies has yet to be finalised but it is envisaged that underwater noise recording instrumentation will be deployed within the study area to characterise the frequency spectra and levels of sound received.

422 Any future noise studies will be designed to help complement and support the other research activities that are ongoing at the time, such as the acoustic monitoring studies and boat-based survey work.

5.8 Electromagnetic Fields

5.8.1 Introduction

423 The electromagnetic fields (EMF) generated by alternating current (ac), sub-sea power cables have been recognised as an environmental concern since the Round 1 sites were developed. The significance of any likely impact is difficult to quantify due to a lack of information on the type of fields generated by offshore wind farm cables and the effects these have upon marine fauna. Recent research attempted to establish the risk that EMFs pose to the marine environment (Gill, 2008). Although submarine power cables are fully electrically insulated, the fluctuating magnetic field induces a very small electric field in the environment which have the potential to affect fish behaviour. As power cables will be installed as part of the project development for EOWDC, the potential impacts of electromagnetic fields will be assessed in the EIA.

5.8.2 Baseline Information

424 Many fish and a number of other species found in UK waters are potentially capable of responding to anthropogenic sources of electric and magnetic fields. Certain fish species, including common ones such as plaice, are

understood to be both magnetically and electrically sensitive and a range of other species, notably cetaceans and many crustacea, to be magnetically sensitive. Most attention, however, has focused on elasmobranchs (sharks, skates and rays) which have specialist electro-receptive organs and are capable of detecting very small electric fields of around 0.5µV/m (Gill 2005).

425 Potential impacts could result from: *repulsion* effects leading to exclusion of animals from an area of seabed (eg for elasmobranchs in the presence of relatively high electric fields); *attraction* effects, for example, causing elasmobranchs to waste time and energy resources foraging around electric fields mistaken for bioelectric fields of prey organisms; and *disruption* to migrations for magnetically sensitive species such as eels and salmonids that may use the earth's geomagnetic field for navigational cues. The information available on magneto-sensitive species is limited, but it does suggest that potential interactions between EM emissions, of the order likely to be associated with wind farm cables, and a number of UK coastal organisms could occur from the cellular through to the behavioural level.

426 Elasmobranchs have been exposed to similar EMF signals to those generated by power cables (Gill, et al 2008). The results were inconclusive and there was no evidence to suggest any positive or negative effect on elasmobranchs exposed to typical EMF stimuli encountered at an offshore wind farm (Gill, et al 2009). However, it should be noted that the behavioural responses observed in the study are not predictable and appear to be species specific and perhaps individual specific (Gill *et al.*, 2009). It has been recognised that there are inherent difficulties in testing the significance of the EMF and further targeted research is required in order to better develop our understanding of the responses of animals to EMF stimuli.

5.8.3 Proposed Scope of Assessment

427 A literature review will provide a summary of the major sources of information for the EIA. The conclusion of most project-specific environmental impact assessments is that whilst there could be an interaction between marine species and EMF generated by sub-sea cables, it is unlikely to be of any significance at a population level. The assessment for EOWDC is likely to reach the same conclusions as previous offshore wind farms, and will support this by identifying the main species likely to be sensitive to EMF and predicting potential magnitudes of impact. The Cowrie research into EMF will be the primary data source used to support the EIA.

5.9 Statutory Designations and Conservation

428 Although the proposed site does not lie within a designated area, the north-east coast of Scotland does support many sites of national and international importance for wildlife. Table 5.9 presents the designated sites that may be affected by the proposed demonstrator project. These sites are identified on Figure 6.

TABLE 5.9 Designated sites potentially impacted by the proposed EOWDC		
Designation	**Approximate distance from proposed wind farm (km)**	**Citation Information**
Special Areas of Conservation (SACs)	*Convention of Natural Habitats and of Wild Fauna and Flora Directive (92/43/EEC), transposed in the UK through the Conservation (Natural Habitats) Regulations 1994.*	
River Dee SAC	7.5	Presence of Annex II species, Freshwater Pearl Mussel, Atlantic Salmon, Otter
Sands of Forvie SAC	7.2	Annex I habitats, Embryonic shifting dunes, shifting dunes along the shoreline with *Ammophila arenaria*, decalcified fixed dunes with *Empetrum nigrum*, humid dune slacks
Buchan Ness to Collieston SAC	12.2	Annex 1 habitats, vegetated sea cliffs
Moray Firth SAC	150	Annex II Species: Bottlenose dolphin, Annex I Habitats: Sandbanks which at all times are covered by seawater
Special Protection Areas (SPAs) and Ramsar Sites	*Council Directive 79/409/EEC on the Conservation of Wild Birds*	
Ythan Estuary, Sands of Forvie and Meikle Loch Special Protection Area (SPA)	7.2	Qualifying species, pink-footed goose, Sandwich tern, common tern, little tern and waterfowl assemblage including eider, redshank and lapwing
Ythan Estuary and Meikle Loch Ramsar	7.2	Wintering Pink footed geese, breeding sandwich terns Non-breeding waterfowl assemblages
Buchan Ness to Collieston SPA	9.5	Article 4.2: holding in excess of 20,000 seabirds: fulmar, shag, kittiwake, herring gull and guillemot.
Loch of Skene SPA	21	Qualifying species: whooper swan, greylag goose. Article 4.2 waterfowl assemblages: wintering goldeneye, goosander, common gull. Breeding tufted duck
Fowlsheugh SPA	31.1	Qualifying species: kittiwake, guillemot,. Article 4.2 seabird assemblages: fulmar, herring gull and razorbill
Loch of Strathbeg SPA	47.6	Qualifying species: Sandwich tern. Article 4.2 waterfowl assemblages: pink-footed goose, greylag goose, teal and goldeneye.
Troup, Pennan and Lion's Heads SPA	74.3	Article 4.2 seabird assemblages: fulmar, kittiwake, guillemot, herring gull and razorbill.
Forth Islands SPA	124.4	Qualifying species: gannet, shag, lesser black-backed gull, roseate tern, Arctic tern, common tern, Sandwich tern, puffin. Article 4.2 Seabird assemblages: cormorant, herring gull, kittiwake, razorbill and guillemot
National Nature Reserves (NNRs)	*National Parks and Access to the Countryside Act (1949)*	
Forvie NNR	7.2	Sand dune, foreshore, estuarine, spit, dune heath, slacks, rough pasture and cliffs habitat
Sites of Special Scientific Interest (SSSIs)	*Wildlife and Countryside Act (1981/1985)*	
Corby, Lily and Bishops Lochs SSSI	6.7	Wetland sites, aquatic vegetation, wildfowl roost
Foveran Links SSSI	4.8	Mobile foreshore and dunes, interesting

TABLE 5.9 Designated sites potentially impacted by the proposed EOWDC		
Designation	**Approximate distance from proposed wind farm (km)**	**Citation Information**
		vegetation assemblages, migrating birds, moulting and passage sea ducks and divers, and coastal geomorphology
Sands of Forvie and Ythan Estuary SSSI	7.2	Sandwich tern, common tern and little tern
Other Designations	*Ministerial Conference on the Environment (1973); Countryside Act 1968; National Parks and Access to the Countryside Act (1949)*	
Donmouth Local Nature Reserve	5.0	Birds that feed and roost, Grey seals
Balmedie Country Park	2.7	Recreation and leisure interests
Forvie Biogenetic Reserve	7.2	Heathland Interest.

429 There are no other national or local landscape designations such as national scenic areas within the vicinity of the proposal that have the potential to be affected by the proposed project. In pre-scoping consultation, SNH have highlighted, in conjunction with the JNCC, that they are currently in the process of identifying possible marine SPAs. AOWFL will ensure that any relevant changes are addressed within the Environmental Statement.

5.9.1 Conservation Designations

430 A number of protected sites and species in the vicinity of the proposed EOWDC site are designated both internationally and nationally (Table 5.9). The following section provides details of these designations and sites identified of relevance to the proposed project.

5.9.2 Requirement for an Appropriate Assessment

431 Under the Conservation (Natural Habitats, & c.) Regulations (as amended), the relevant Competent Authority (in this case the Scottish Government) must consider the effect of a development on the integrity of a European site. If the development is considered likely to have a significant effect on that site, the competent authority would undertake an Appropriate Assessment using information supplied as part of the EIA process to accurately determine risk to site integrity. Special Areas of Conservation (SACs) or Special Protection Areas (SPAs) constitute a European site.

432 Initial consultation with statutory bodies has indicated that the interaction between the proposed EOWDC and European sites in the wider area would need to be considered as part of the EIA process and that an Appropriate Assessment may be required.

5.9.2.1 International Sites

Ramsar Sites

433 These sites are internationally important wetland sites protecting wildfowl habitat. Ramsar sites are designated under the Convention of Wetlands of

International Importance. The Convention was adopted in Ramsar, Iran, in 1971 and ratified by the UK Government in 1976.

Natura 2000 Sites

434 The two most influential pieces of European legislation relating to nature conservation are the "Habitats" Directive and the "Birds" Directive. The 'Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora', commonly known as the Habitats Directive, adopted in 1992, complements and amends the 1979 'Council Directive 79/409/EEC on the conservation of wild birds', commonly known as the Birds Directive. . A further Directive *On The Conservation of Wild Birds* (Directive 2009/147/EC) amends the 1979 Directive.

435 The Birds Directive protects all wild birds, their nests, eggs and habitats within the European Community. It gives EU member states the power and responsibility to classify Special Protection Areas (SPAs) to protect birds which are rare or vulnerable in Europe as well as all migratory birds which are regular visitors.

436 The Habitats Directive builds on the Birds Directive by protecting natural habitats and other species of wild plants and animals. Together with the Birds Directive, it underpins a European network of protected areas known as Natura 2000. This network includes SPAs classified under the Birds Directive and Special Areas of Conservation (SAC) under the Habitats Directive.

437 Annexes I and II of the Habitats Directive identify a set of habitats (Annex I) and species (Annex II), which require special conservation measures to be taken by Member States. These lists of habitats and species have been used to define the 'features' of a site which form the basis for designating the site as a SAC. Marine SACs may be put forward for habitats of conservation importance (listed in Annex I to the Habitats Directive) or for species of conservation importance (listed in Annex II) (Table 5.10).

TABLE 5.10
Marine habitats on Annex I and species on Annex II of the Habitats Directive found in UK waters

Annex I Habitats Considered for SAC Selection in UK Offshore Waters	Species Listed in Annex II Know to Occur in UK Offshore Waters
Sandbanks which are slightly covered by seawater all the time Reefs (bedrock, biogenic and stony) – Bedrock reefs – made from continuous outcroppings of bedrock which may be of various topographical shape (eg pinnacles, offshore banks) – Stony reefs – these consist of aggregations of boulders and cobbles which may have some finer sediments in interstitial spaces (eg cobble and boulder reefs, iceberg ploughmarks) – Biogenic reefs – formed by cold water corals (eg *Lophelia pertusa*) and the polychaete worm *Sabellaria spinulosa* Submarine structure made by leaking gases Submerged or partially submerged sea caves	Grey seal (*Halichoerus grypus*) Harbour or common seal (*Phoca vitulina*) Bottlenose dolphin (*Tursiops truncatus*) Harbour porpoise (*Phocoena phocoena*)

Source: JNCC (2002, 2010)

Special Protection Areas (SPAs)

Buchan Ness to Collieston SPA

438 Buchan Ness to Collieston Coast SPA is located on the coast of Aberdeenshire in north-east Scotland, approximately 9.5 km from the EOWDC site. It is a 15 km stretch of south-east facing cliff formed of granite, quartzite and other rocks running to the south of Peterhead, interrupted only by the sandy beach of Cruden Bay. The low, broken cliffs (generally less than 50 m high) show many erosion features such as stacks, arches, caves and blowholes. The varied coastal vegetation on the ledges and cliff tops includes maritime heath, grassland and brackish flushes.

439 The site is of importance as a nesting area for a number of seabird species (Gulls and Auks). These birds feed outside the SPA in the nearby waters as well as more distantly. It is the sea bird assemblage of international importance that qualifies Buchan Ness to Collieston as a SPA. The area qualifies under Article 4.2 of the Habitats Directive (79/409/EEC) by regularly supporting at least 20,000 seabirds.

440 During the breeding season, the area regularly supports 95,000 individual seabirds (Count, as at mid-1980s) including: Guillemot (*Uria aalge*), Kittiwake (*Rissa tridactyla*), Herring Gull (*Larus argentatus*), Shag (*Phalacrocorax aristotelis*), Fulmar (*Fulmarus glacialis*).

Ythan Estuary, Sands of Forvie and Meickle Loch SPA

441 The Ythan Estuary, Sands of Forvie and Meikle Loch make up an area of 1016.24 ha. The site comprises the long, narrow estuary of the River Ythan and eutrophic Meikle Loch. At its mouth, the river splits an extensive area of sand dunes with the Forveran Links on the west bank and the Sands of Forvie dune system on the east bank. Extensive mud-flats in the upper reaches of the estuary are replaced by coarser gravels with mussel (*Mytilus edulis*) beds closer to the sea (JNCC, 2010).

442 These varying habitats give rise to a varied substrate including clay, sands and gravel, extensive areas of bare mud, small areas of salt marsh with representative northern salt marsh flora. Small areas of club-rush swamp are associated with the salt marsh. In the upper parts of the estuary there is a reed bed and near the mouth of the estuary there are shifting sand dunes and areas of bare shingle. To the west of the estuary there is a large area of improved grassland.

443 The margins of the estuary are varied with areas of salt marsh, reed bed and poor fen, heath and scrub, coniferous woodland and grassland. Meikle Loch is an important roost site for geese which feed away from the SPA on surrounding farmland in winter. It is a eutrophic loch supporting limited aquatic vegetation. In summer, the coastal habitats of the dunes and estuary provide an important breeding site for three species of tern, whilst in winter the estuary holds large numbers of waders, ducks and geese.

444 The site qualifies under a number of articles of the European Directive. Firstly, the site qualifies under Article 4.1 of the Habitats Directive (79/409/EEC) by supporting populations of European importance of the following species listed on Annex I of the Directive. During the breeding

season it supports common tern (*Sterna hirundo),* 265 pairs representing up to 2.2 % of the breeding population in Great Britain, little tern (*Sterna albifrons*), 41 pairs representing up to 1.7 % of the breeding population in Great Britain and Sandwich tern (*Sterna sandvicensis*), 600 pairs representing up to 4.3 % of the breeding population in Great Britain (Seabird Census Register).

445 This site also qualifies under Article 4.2 of the Directive (79/409/EEC) by supporting populations of European importance of migratory species. Over-winter pink-footed goose (*Anser brachyrhynchus*), 17,213 individuals representing up to 7.7 % of the wintering Eastern Greenland/Iceland/UK population (winter peak means).

446 The site also qualifies under Article 4.2 of the Directive by regularly supporting at least 20,000 waterfowl. Over winter, the area regularly supports 51,265 individual waterfowl including: redshank *Tringa totanus*, lapwing *Vanellus vanellus*, eider *Somateria mollissima*, and pink-footed goose *Anser brachyrhynchus*.

447 The Ythan Estuary and Meikle Loch sites are also designated as a Ramsar wetland site. The justification for this designation are the assemblages of internationally important waterfowl and the species/populations occurring at levels of international importance.

Loch of Strathbeg SPA

448 The Loch of Strathbeg is located in north-eastern lowland coats of Scotland, in Aberdeenshire, inland from Rattray Head and covers an area of 615.93 ha.

449 The SPA provides wintering habitat for a number of important wetland bird species, particularly wildfowl (swans, geese and ducks), and is also an important staging area for migratory wildfowl from Scandinavia and Iceland/Greenland. In summer, coastal parts of the site are an important breeding area for Sandwich tern (*Sterna sandvicensis*), which feed outside the SPA in adjacent marine areas.

450 The site qualifies under Article 4.1 of the Habitats Directive (79/409/EEC) by supporting populations of European importance of species listed on Annex I of the Directive. During the breeding season it supports Sandwich tern (*Sterna sandvicensis*), 530 pairs representing up to 3.8 % of the breeding population in Great Britain. Over winter it supports barnacle goose (*Branta leucopsis*), 226 individuals representing up to 1.9 % of the wintering population in Great Britain and whooper swan (*Cygnus cygnus*), 183 individuals representing up to 3.3 % of the wintering population in Great Britain.

451 This site also qualifies under Article 4.2 of the Directive (79/409/EEC) by supporting populations of European importance of migratory species. Over winter it supports greylag goose (*Anser anser*), 3,325 individuals representing up to 3.3 % of the wintering Iceland/UK/Ireland population, pink-footed goose, (*Anser brachyrhynchus*), 39,924 individuals representing up to 17.7 % of the wintering Eastern Greenland/Iceland/UK population.

452 In addition area qualifies under Article 4.2 of the Directive (79/409/EEC) by regularly supporting at least 20,000 waterfowl and being a wetland of international importance. Over winter, the area regularly supports 49,452

individual waterfowl including: teal (*Anas crecca*), greylag goose, (*Anser anser*), pink-footed goose, (*Anser brachyrhynchus*), barnacle goose, (*Branta leucopsis*), and whooper swan, (*Cygnus Cygnus*).

453 The majority of the site is managed by the Royal Society for the Protection of Birds (RSPB) for conservation and primarily for the SPA interest. Scottish Natural Heritage (SNH) has piloted a Strathbeg Goose Management Scheme to alleviate the conflict between the geese which roost on the loch and the surrounding farms where they feed.

454 The Loch of Strathbeg site is also a designated Ramsar site as the loch constitutes the largest dune slack pool in the UK and the largest water body in the north-east Scottish lowlands, one of the very few naturally eutrophic lochs of the size in the region. The site also qualifies under criterion 5 and 6 with assemblages of international importance, especially peaks in winter, and species/populations occurring at levels of international importance.

Loch of Skene SPA

455 Loch of Skene lies approximately 21 km from the proposed wind farm location.

456 The qualifying species is greylag goose which roost on the loch during the winter. The population of wintering greylag geese on the Loch has declined in recent years as increasing numbers of greylag geese now winter in Orkney.

457 In addition to greylag geese the loch also holds nationally important numbers of goldeneye (*Bucephala clangula*) and goosander (*Mergus merganser*) during the winter and a large roost of common gulls occurs during the winter. During the summer the loch holds 50 to 100 pairs of tufted duck.

Fowlsheugh SPA

458 Fowlsheugh is a 10.15 ha stretch of cliffs to approximately 31.1 km south of the proposed wind farm location. It is an important site for breeding seabirds with up to 145,000 birds present including guillemot, razorbill, kittiwake, fulmar and herring gull. The site is also part of an RSPB reserve.

Troup, Pennan and Lion's Heads SPA

459 The sea cliffs along Troup, Pennan and Lion's Head SPA hold internationally and nationally important numbers of seabirds, notably kittiwake, guillemot, fulmar, herring gull and razorbill. There is a seaward extension out to 2 km from the cliffs which are approximately 74.3 km from the project location.

Forth Islands SPA

460 The Forth Islands SPA comprises a series of islands situated in the Firth Forth and include the Bass Rock and the Isle of May. It is a site holding internationally and nationally important seabirds including gannet, fulmar, shag, cormorant, common tern, Sandwich tern, Arctic tern and roseate tern. Three species of auk: puffin, razorbill and guillemot, and three species of gull: herring, lesser black-backed and kittiwake are found there.

Special Ares of Conervation (SACs)

Buchan Ness to Collieston Coast SAC

461 Buchan Ness to Collieston Coast, an area of 207.52 ha, is a designated special area of conservation (SAC). The site includes shingle sea cliffs and islets, bogs marshes, water fringed vegetation and fens as well as heath, scrub, maquis, garrigue, phygrana, humid grassland, and mesophile grassland. Such habitat qualifies the site as an Annex I Habitat, 1230 Vegetated Sea Cliff of the Atlantic and Baltic Coasts.

462 The vegetated cliff slopes support a wide range of coastal vegetation types with an abundance of such local species as Scots lovage (*Ligusticum scoticum*) and roseroot (*Sedum rosea*). In several places the cliff edge retains semi-natural plant communities such as maritime heath, acid peatland and brackish flushes. All these are now rare on the coast of north-east Scotland and this section of coastline contains some of the best remaining examples. Possibly due to the local microclimate and the presence of lime-rich soils, these communities contain several plants which are associated with dry, calcareous grassland, including carline thistle (*Carlina vulgaris*) and cowslip (*Primula veris*). Sea wormwood (*Seriphidium maritimum*) also occurs. The cliffs and offshore stacks support a scattered but considerable colony of cliff-nesting seabirds with bird-influenced vegetation.

Sands of Forvie SAC

463 The Sands of Forvie SAC includes an area of coastal sand dunes, beaches, machair, inland water bodies, sea cliffs, bogs, marshes, water fringed vegetation, fens, heath, scrub, marquis and garrigue, phygrana, humid grassland and mesophile grassland covering an area of approximately 734.05 ha. There are three primary reasons for selecting Sands of Forvie as an SAC. These include the embryonic shifting dunes, shifting dunes along the shoreline with *Ammophila arenaria* (white dunes), decalcified fixed dunes with *Empetrum nigrum* and humid dune slacks.

464 Sands of Forvie is one of only three sites on the east coat of Scotland which represent the northern part of the UK range of embryonic shifting dunes. Sands of Forvie is one of the most geomorphically active dune systems in the UK and as a result the site contains significant representation of dune types associated with shifting sands. Present throughout the site are identifiable zones of lyme-grass (*Leymus arenarius*) and sand couch (*Elytrigia juncea*).

465 In recent years, Terns have bred in much lower numbers owing to predation and the periodic overtopping of the favoured shingle beds by sand. There is growing concern about the effects of eutrophication on the estuary and its flora and fauna. The continuing build up of algal mats has apparently led to a reduction in the populations of invertebrates which are the prey of waterfowl such as redshank and shelduck.

466 The site forms the Forvie National Nature Reserve which is managed for its nature conservation interest under an agreed management plan. The site is also 100 % covered by SSSI designation.

Moray Firth Marine SAC

467 The Moray Firth was designated by Scottish Ministers as a Special Area of Conservation (SAC) on 17 March 2005. The Moray Firth marine SAC has been designated for the species bottlenose dolphin (*Tursiops truncatu*) which is listed on Annex II of the Habitats Directive, as well as for the Annex I habitat 'Sandbanks which are slightly covered by sea water all the time'.

468 The conservation objectives for the Moray Firth marine SAC with regards to bottlenose dolphins are:

- to avoid deterioration of the habitats of the qualifying species (bottlenose dolphin *Tursiops truncatus*) or significant disturbance to the qualifying species, thus ensuring that the integrity of the site is maintained and the site makes an appropriate contribution to achieving favourable conservation status for the qualifying interest
- to ensure for the qualifying species that the following are established then maintained in the long-term:
  - population of the species as a viable component of the site
  - distribution of the species within the site
  - distribution and extent of habitats supporting the species
  - structure, function and supporting processes of habitats supporting the species
- no significant disturbance of the species.

469 The conservation objectives ensure that the obligations of the Habitats Directive are met; that is, there should not be deterioration or significant disturbance of the qualifying interest. This will also ensure that the integrity of the site is maintained and that it makes a full contribution to achieving favourable conservation status for its qualifying interests (SNH, 2006).

River Dee SAC

470 The River Dee SAC lies inland from the proposed project and enters the sea at Aberdeen. The river contains three qualifying species otter (*Lutra lutra*), freshwater pearl mussel (*Margaritifera margaritifera*) and Atlantic salmon (*Salmo salar*). The salmon enter the river throughout the year and the freshwater pearly mussel relies upon the salmon for part of its life cycle when it uses the salmon as a host species. Otters are infrequent on the coast and the majority of the otter population found along the Dee is upstream from the river mouth.

5.9.2.2 *National Sites*

Sites of Special Scientific Interest (SSSI)

Corby, Lilly and Bishops Lochs SSSI

471 Corby, Lilly and Bishops Lochs are designated as Sights of Special Scientific Interest under the Wildlife & Countryside Act (1981). The Lochs lie approximately 6.7 km inland from the proposed wind farm location. The lochs contain locally important vegetation and invertebrate populations. The Lochs also use to hold roosting greylag geese but the numbers roosting on the Lochs has reduced in recent years.

Foveran Links SSSI

472 Extensive sand dune systems lie to the north of the proposed development. Up to the Ythan Estuary. The 205 ha Foveran Links SSSI contains plant communities not found elsewhere along the coast and a variety of habitats including, fixed dunes, dune pastures, marshes and heaths.

Sands of Forvie and Ythan Estuary SSSI

473 The Sands of Forvie lie approximately 7.2 km to the north of the proposed wind farm location. The site is also covered by the SAC.

474 It is an extensive area of sand dunes containing a wide range of typical dune habitats and very diverse range of flora. The site holds the UKs largest breeding colony of eider ducks and nationally and internationally important populations of pink-footed geese and other wildfowl and waders.

5.9.2.3 *Local Sites*

Biodiversity

475 Following the 1992 Rio Earth Summit, the UK Biodiversity Action Plan was published in 1994. At the local level, this is implemented through the North East Scotland Local Biodiversity Action Plan (LBAP). LBAP is a partnership of local authorities, environmental, forestry, farming, land and education agencies, businesses and many individuals involved in biodiversity across North East Scotland (Aberdeen, Aberdeenshire and Moray)

476 Most of the North East action for biodiversity is addressed through Habitat Action Plans (HAPs) which incorporate action for associated priority species. These HAPs are grouped under the broader habitat headings of Coastal & Marine; Farmland & Grassland; Woodland; Montane, Heath & Bog; Wetland & Freshwater; and Urban (NESBiodiversity, 2007).

477 The Coastal and Marine Habitat Action Plans (HAPs) are the most relevant for the proposed development. The protection of these coastal and marine habitats is a top priority for North East LBAP and several specific action plans have been developed, including:

- Coastal Sand Dunes and Shingle
- Coastal Cliffs and Heaths [action plan development in progress]
- Marine Habitats [action plan development in progress]
- Estuarine and Intertidal Habitats

478 A number of species has been identified with dedicated North East Action Plans (NESBiodiversity, 2007).

5.9.3 Marine (Scotland) Act 2010

479 The Marine (Scotland) Act (which applies to Scottish territorial waters) introduces new powers relating to functions and activities in the Scottish marine area, including provisions concerning marine plans, licensing of marine activities, the protection of the area and its wildlife including seals, and regulation of sea fisheries. The Act comprises six key elements: the formation of Marine Scotland, a strategic marine planning system, a

streamlined marine licensing system, improved marine nature conservation measures, improved measures for the protection of seals and improved enforcement measures (JNCC, 2010).

480 Marine Scotland will deliver integrated marine management functions relating to marine science and data, planning, policy development and delivery, compliance, monitoring and enforcement, whether fully or executively devolved to Scottish Ministers out to 200 nautical miles; and will work closely with the UK Marine Management Organisation (MMO) established under the UK Marine and Coastal Access Act 2009 (JNCC, 2010).

481 Scottish Marine Protection Areas (MPAs) are a new national designation under the **Marine (Scotland) Act** for inshore waters and the **Marine and Coastal Access Act 2009** for offshore waters. Scottish Ministers have executive devolution of authority for the designation of MPAs for the conservation of important marine biodiversity and geodiversity out to 200 nm.

482 Within the Marine Nature Conservation element, powers in the **Marine (Scotland) Act** enable Scottish Ministers to designate three types of Marine Protected Area (MPA) across Scottish territorial waters: Nature Conservation MPAs; Historic MPAs; and Research/Demonstration MPAs (JNCC, 2010).

483 The Scottish MPA project has been established by Marine Scotland (Scottish Government), Scottish Natural Heritage and the Joint Nature Conservation Committee (JNCC) to identify and recommend MPAs for the conservation of nationally important features of marine biodiversity and geodiversity to Government. Scottish MPAs will be identified using science-based selection criteria, but socio-economic information may be taken into account when selecting between sites of equal scientific merit and to identify likely management issues (Natural England, 2010).

484 The new MPA powers allow Scotland to contribute to the UK's European and International marine conservation commitments, such as those laid out under the Marine Strategy Framework Directive, the OSPAR Convention and the Convention on Biological Diversity (JNCC, 2010) and the government is required by European law to introduce a network of MPAs by the end of 2012 (Natural England, 2010).

6 HUMAN ENVIRONMENT

6.1 Shipping and Navigation

6.1.1 Introduction

485 Aberdeen Harbour is important to the people and the local economy of Aberdeenshire and is one of the main commercial ports in the North of Scotland. Coastal traffic also exists along the Aberdeenshire and East of Scotland coastline. Any wind farm development has the potential to impact navigational practices and as a result careful consideration of the site and wind turbine layout is required to ensure the safety of the marine stakeholders in preserved.

6.1.2 Baseline Information

486 The proposed wind farm is 4 nm to the north of the entrance to Aberdeen Harbour in Aberdeen Bay Area to the north of a newly designated anchorage. Detailed information on annual shipping has been based on the Annual Review for Aberdeen Harbour (2009). Key points are as follows:

- import and exports: 4.54 million tonnes
- vessel arrivals: 7,933
- tonnage of shipping: 24.01 million gross tonnes
- number of passengers: 142,468

487 Three, two-week AIS and radar surveys were carried out to develop an understanding of shipping and navigational practices in proximity to the proposed development site.

488 The surveys were carried out from a site adjacent to Girdle Ness Lighthouse, south of Aberdeen harbour, at co-ordinates 57° 08'.364 North, 002° 02'.916 West, providing good coverage to the North, including Aberdeen Bay and the harbour entrance.

489 4The results from the study indicate that the majority of the shipping passing in closest proximity to the site is destined for Aberdeen Harbour. The majority of vessels are associated with offshore oil and gas industry and the Northlink passenger ferries: Hrossey, Hamnavoe and Hjaltland. Some cargo vessels were also identified using this route. The results from the study also indicated limited fishing and recreational shipping in and around the proposed wind farm site.

490 Figure 13 provides an overview of the proposed wind turbine layout relative to shipping.

6.1.3 Proposed Scope of Assessment

491 The scope of assessment has been based on the following:

- Department for Energy and Climate Change (DECC) Methodology for Assessing the Marine Navigational Safety Risks of Offshore Windfarms (2005)
- Maritime and Coastguard Agency (MCA) Marine Guidance Notice 371 (MGN 371) Offshore Renewable Energy Installations (OREIs) – Guidance on UK Navigational Practice, Safety and Emergency Response Issues

492 Other key guidance and reference materials that will be used in the assessment are listed below:

- Trinity House Lighthouse Service (2008). Guidance based on IALA Recommendation O-139 On The Marking of Man-Made Offshore Structures, 1st Edition
- DECC Guidance Notes on Applying for Safety Zones around Offshore Renewable Energy Installations
- IMO Guidelines for Formal Safety Assessment (FSA)
- Results of the EM Investigations and assessments of marine radar, communications and positioning systems undertaken at the North Hoyle Wind farm by QinetiQ and the MCA
- BWEA, DTI, MCA & PLA (2007). Investigation of Technical and Operational Effects on Marine Radar Close to Kentish Flats Offshore Wind farm
- MCA Marine Guidance Notice 372 (2008). Guidance to Mariners Operating in the Vicinity of UK OREIs

493 The DECC methodology provides a template for preparing a navigation risk assessment. The methodology is centred on risk controls and the feedback from risk controls into risk assessment. It requires a submission that shows that sufficient risk controls are, or will be, in place for the assessed risk to be judged as broadly acceptable or tolerable with further controls or actions. The DECC assessment methodology includes:

- defining a scope and depth of the submission proportionate to the scale of the development and the magnitude of the risk
- estimating the ‘base case’ level of risk
- estimating the ‘future case’ level of risk
- creating a hazard log
- defining risk control and creating a risk control log
- predicting ‘base case with wind farm’ level of risk
- predicting ‘future case with wind farm’ level of risk

494 The key features of the Marine Safety Navigational Risk Assessment Methodology are risk assessment (supported by appropriate techniques and tools), creating a hazard log, defining the risk controls (in a Risk Control Log) required to achieve a level of risk that is broadly acceptable (or tolerable with controls or actions), and preparing a submission that includes a Claim, based on a reasoned argument, for a positive consent decision.

495 One of the primary tasks of the scope of assessment was key stakeholder consultation. This has been carried out throughout the entire project and is integral to the navigational review. The following organisations have been involved in this process:

- Aberdeen Harbour Board
- Marine Safety Forum
- Aberdeen users
- Northern Lighthouse Board
- Chamber of Shipping
- Fisheries Associations
- RYA and Cruising Association

496 In addition to the three, two week radar surveys which have been carried out, Anatec has access to a year of current AIS survey data for the area which will be used in the assessment.

6.1.4 Potential Impacts

6.1.4.1 Merchant Shipping

497 The proposed 11 wind turbine wind farm layout has been determined through ongoing consultation with the Aberdeen Harbour Board and other marine stakeholders associated with this area. It has been designed to minimise the impacts on shipping and to ensure safe vessel operations.

498 The layout is positioned over 4 nm to the north of the north breakwater and inshore of the main route taken by vessels heading between the port and the north, and is well clear from other routes taken by vessels to and from Aberdeen Harbour.

499 Consultation with the Harbour Board, Marine Safety Forum and Ferry Operator has indicated that wind turbines located at the proposed site will not impact their operations significantly. As a result the proposed development is unlikely to have significant navigational impacts providing reasonable mitigation measures are put in place. A hazard workshop is to be carried out with the stakeholders to ensure their views are considered and the mitigations put in place are adequate.

6.1.4.2 Fishing Vessels

500 Fishing vessels are also exposed to collision risks (and radar interference) in the same way as merchant ships. In addition, if fishing within the site, there would be a risk of collision and subsea cable interaction. Also if fishing activity is displaced to outside the site during construction and/or operation, this could influence the rate of vessel-to-vessel encounters and hence the collision risk.

501 A review of the survey data and information gathered over the course of this project indicated that fishing vessel activities in this area is very limited and therefore the potential impacts are considered to be very low. Further discussions will be held with the fishing stakeholders to ensure their views are considered and that the mitigation measures put in place are adequate. Figure 14 provides an overview of the proposed wind turbine layout relative to fishing vessels.

6.1.4.3 Recreational Vessels

502 Recreational vessels can pass close to and in some cases between wind turbines, which exposes them to potentially increased collision risk as well as changes in traffic movements in the vicinity. There is also a risk of blade/mast interaction which depends upon the clearance of the rotor blades in different tidal and sea conditions, and the air draught of yachts using the area. The risk can be minimised through adequate clearance height and implementation of an emergency shutdown system of the rotor blades.

503 A review of the survey data and information gathered over the course of this project has shown that recreational vessel activities in this area are very limited and therefore the potential impacts are considered to be negligible. Further discussions will be held with the recreational stakeholders to ensure their views are considered and the mitigation measures put in place are adequate.

6.1.5 Cumulative Assessment

504 The potential impact of the wind farm on vessels associated with all stakeholders eg the oil and gas industry and those associated with dredging activities will be assessed as part of the Navigational Risk Assessment.

505 No other wind farms are proposed for this area so there are no cumulative impacts to be assessed.

6.1.6 Mitigation

506 There are a range of measures that can be applied to mitigate the impacts of a wind farm development (including through site design). MGN 371 lists the following measures to be applied to a particular development as appropriate to the level and type of risk determined during the EIA:

- promulgation of information and warnings through notices to mariners and other appropriate media
- continuous watch by multi-channel VHF, including Digital Selective Calling (DSC)
- safety zones of appropriate configuration, extent and application to specified vessels
- designation of the site as an area to be avoided (ATBA)
- implementation of routeing measures within or near to the development
- monitoring by radar, AIS and / closed circuit television (CCTV) or other agreed means
- appropriate means to notify and provide evidence of the infringement of safety zones or ATBAs
- any other measures and procedures considered appropriate in consultation with stakeholders (including the MCA)
- creation of an Emergency Response Co-operation plan with the relevant Maritime Rescue Co-ordination Centre from construction phase onwards

507 Other mandatory control measures and/or standard industry practice include:

- marking and lighting the site in accordance with General Lighthouse Authority requirements (which will include a system of routine inspection and maintenance of lights and marks)
- MCA standards and procedures for wind turbine generator shut-down in the event of a search and rescue, counter pollution or salvage incident in or around a wind farm
- wind turbine rotor blade tip clearance at a minimum 22 m above Mean High Water Springs
- vessel nominated as guard vessel during construction /decommissioning activities

6.1.7 EOWDC Future Research and Monitoring

508 Navigational Risk Assessment work and projections are based on a sound understanding of shipping patterns and experience of the likely changes to shipping, ie they represent the best estimate. During construction, operation there is excellent opportunity to assess the impacts of the development in more detail and to review the mitigation measures to ensure they are appropriate and adequate. There is a requirement for this review work to be carried out over the lifetime of the development. This will be carried out by the project and is likely to rely on continued AIS monitoring of the development and continued liaison with the port and other marine stakeholders.

6.2 Aviation

6.2.1 Introduction

509 The handling of aviation issues raised by this project has been an area of high priority for the project team. Aberdeen airport serves more than 3 million travellers a year and is the world's busiest commercial heliport, transporting more than 500,000 passengers in support of the North Sea oil and gas industry.

510 An Aviation Working Group was established as early as 2005, and has met since that time (although there have been periods of lesser activity). The group has met four times in 2010 already.

511 The Civil Aviation Authority (CAA) was an early attendee at these meetings, but in recent years they have been content to allow aviation issues – largely operational in nature – to be discussed by National Air Traffic Services (NATS) (Aberdeen) and BAA (Aberdeen).

512 These meetings have also been attended by the three helicopter companies operating out of Aberdeen airport – Bond, Bristows and CHC Scotia. Also in attendance has been Oil and Gas UK, the main client for their helicopter operations.

6.2.2 Baseline Information

513 No new data has been required in relation to flight movements. Existing data are available to assess the impacts of the wind farm on aviation activities.

514 The presence of helicopter traffic is the most significant aviation issue, the previously proposed wind farm location site assumed that helicopters could fly over the wind turbines. However, following early consultation with the relevant authorities it was identified that in certain weather conditions the helicopters may descend to 1000 feet (or lower), while the tip height of the wind turbines could be in the region of 520 feet. This would breach the minimum clearance limit required for helicopter safety and consequently the wind farm layout has been amended to account for the helicopter corridors. This was a major revision to the wind farm layout, and has dominated all subsequent layout considerations.

6.2.3 Proposed Scope of Assessment

515 The assessment will address all aspects of the potential impact of the wind farm on aviation activities at Aberdeen airport. This may include the following issues:

- as part of the agreement on the final layout of the wind farm, it has been agreed that the northern helicopter route into Aberdeen could be moved to the north, thereby allowing greater clearance between the wind farm and Aberdeen Harbour entrance. The route change is shown in Figure 15. The change will be brought about by applying for an Air Space Change
- the proposed layout is within 10 km of the secondary radar facility at Aberdeen airport and as such it has been necessary to assess the potential impacts of the wind farm on this function. AOWFL has commissioned a study from QinetiQ and the report has been passed to NATS. The report shows that although there may be potentially significant effects there are a number of technical solutions available to solve them. Ongoing consultation with NATS will determine the most efficient and effective technical solution to this issue
- the presence of the wind farm will require some minor changes to helicopter procedures in the event of encountering problems during take-off and landing phases at Aberdeen which may be exacerbated in icy conditions.
- in favourable weather, Aberdeen airport enjoys a relaxation on the carrying of alternate aerodrome helicopter fuel as a result of this “coastal status”. It will be necessary for the project to confirm with the CAA that the wind farm would not prejudice such status. Informal indications are that based on the revised plans the coastal status should be maintained

6.2.4 Potential Impacts

516 The potential impacts of the project on the aviation sector around Aberdeen should be minimal. The effects of the issues listed above are expected to be:

- one minor change to air route maps (and related documents), with associated amendments to procedures, and training requirements
- the construction of a technical solution to the secondary radar issue – possibly a supplementary secondary radar, although a multilateration system using an array of approximately 4 static antenna may prove as effective and less expensive. This system would also need to be “patched in” to the new Perwinnes radar equipment serving Aberdeen airport

- some amendments to the emergency procedures of helicopter companies
- it is likely there will be no change to Aberdeen's "coastal status"

6.2.5 Cumulative Impact

517 Discussions are ongoing with NATS as to whether any of the above issues have any relevance to other wind farms under development in the Aberdeenshire area.

6.2.6 Mitigation

518 In view of the small nature of these impacts, it is believed that the measures described above will be sufficient to mitigate their effects on aviation safety and security.

519 The implementation of these measures will be the subject of ongoing monitoring by the Aviation Working Group, thereby ensuring that the objectives of minimal impact are sustained.

6.2.7 EOWDC Future Research and Monitoring

520 Consultation with CAA, NATS, BAA and the helicopter operators will be ongoing on the research issues that could be addressed by the deployment centre.

6.3 Ministry of Defence

6.3.1 Introduction

521 Consultation with the MoD has been ongoing since 2005. Two principal issues have been dealt with:

- any effect of the wind farm on the operability of the defence radar installation at Peterhead
- any effect of the wind farm on the Black Dog firing range – a small-arms firing range on the coast nearby, but with an associated exclusion zone at sea during firing

522 Liaison with MoD has been constructive, with several meetings being held at Defence Estates, and one at an RAF base in the north of England to discuss the radar interference issue.

6.3.2 Baseline Information

523 In matters of national security, the MoD is the sole holder of the relevant detail to make the assessment of the acceptability of our project on their activities.

6.3.3 Proposed Scope of Assessment

524 An assessment on the potential for interference to radar has been undertaken by the MoD including a number of radar interference trials. During consultation with the MoD, initial objections on the grounds of radar interference have subsequently changed.

525 On the Black Dog Firing range, the MoD has consistently stated that no wind turbines should be placed within the safety exclusion zone at sea.

6.3.4 Potential Impacts

526 The potential impacts of the project on MoD interests should therefore be minimal. The effects of the issues listed above are expected to be:

- confirmation from MoD that a layout of 10 wind turbines close to the current layout is acceptable in terms of radar interference has been received. AOWFL has applied to MoD for confirmation that the current layout of 11 wind turbines is acceptable
- while there will be no wind turbines within the firing range exclusion zone, there will be a need for project vessels to enter the area for the purposes of surveying, construction, operations and maintenance. It will therefore be necessary to agree access provisions with the MoD

6.3.5 Cumulative Impact

527 Cumulative impact between our project and other projects in respects of MoD issues are not anticipated.

6.3.6 Mitigation

528 It is expected that the effect of the project on the military activities described above will be minimal.

529 Operational procedures will be agreed with MoD to allow vessel access to the firing range exclusion zone for project activities during the lifetime of the project.

530 The implementation of these measures will be the subject of ongoing monitoring and communication with MoD Defence Estates in Birmingham, thereby ensuring that the objectives of minimal impact are sustained.

6.3.7 EOWDC Future Research and Monitoring

531 Consultation with the MoD on the research issues that could be addressed by deployment centre will be ongoing.

6.4 Archaeology

6.4.1 Introduction

532 An archaeological desk-based assessment of the proposed EOWDC has been carried out.

533 The aim of the archaeological assessment was to inform the overall environmental assessment of the impacts of the scheme and its associated onshore and offshore infrastructure on the historic environment and archaeology of the area.

6.4.2 Baseline Information

534 The desk-based assessment has focused upon two areas of potential archaeological interest. Firstly, the potential for the survival of submerged prehistoric archaeology, which could manifest itself in the form of either sites or landscapes dating from the Palaeolithic to the Mesolithic periods and is closely related to sea level changes. Secondly, the assessment has focussed on the potential for the presence of maritime archaeology, ie the potential for the presence of ship and boat remains and debris linked to human use of the sea from the Mesolithic to the 20th century.

535 The report concluded that potential for the presence of formerly terrestrial prehistoric archaeology exists within the survey area, but that there is currently insufficient detailed information available concerning the shallow geology and sediments to enable the presence of such archaeology to be proved. Therefore, it is currently not possible to determine potentially significant impacts nor identify suitable mitigation. The report therefore recommends that there should be an archaeological assessment of seismic and geotechnical data produced for the scheme and that there should be archaeological input in geophysical and geotechnical survey planning.

536 The report identified a total of 16 United Kingdom Hydrographic Office (UKHO) charted wreck or obstruction records in the survey area. Known wrecks are predominantly 20th century losses and include a number of steam trawlers and locally built vessels. In addition, coarse analysis of maritime records for the Aberdeen area contained within the National Monuments Record of Scotland (NMRS) database indicates that there are over 200 known vessel losses that could have occurred within the study area or in its vicinity. These known losses date from the medieval period to the 20th century but are predominantly of the Industrial period (AD 1700-1900). This loss record is likely to be unrepresentative of losses from earlier periods due to a lack of wreck reporting prior to the mid-18th century. Several of these known losses appear to be located within the study area, although their precise position is unknown.

537 The relatively dense concentration of loss records in or in the vicinity of the survey area reflects the importance of the port of Aberdeen since at least the medieval period. Loss descriptions contained in the NMRS database and other secondary sources, together with reports submitted to UKHO suggest that losses occurring within the survey area are either clustered around Aberdeen Harbour entrance or along and very close to the shore to the north.

Available wreck descriptions suggest that those charted wrecks located along the shore to the north are largely broken up.

6.4.3 Proposed Scope of Assessment

538 The desk-based assessment of the proposed project has demonstrated that the potential exists for the presence of submerged prehistoric archaeological deposits in the study area. However insufficient data are available about the shallow geology of the study area to determine the level of this potential and how extensive any archaeological deposits are likely to be.

539 The data derived from the geophysical survey will be subject to archaeological assessment and the potential for submerged prehistoric archaeology within the reassessed study area.

540 In addition, the archaeological assessment and analysis of any geotechnical data collected during the development of the wind farm also has the potential to provide information about the presence of submerged prehistoric archaeological deposits in the study area.

541 Analysis of both the charted wrecks and recorded losses for the vicinity of Aberdeen indicates that there is a high potential for the presence of maritime sites within the survey area. Several sites charted by the United Kingdom Hydrographic Office in the study area and buffer zone are of some archaeological importance, but not all are identified and their current extent and condition are unknown.

542 Analysis of available evidence about loss location and likely causal factors suggests that a significant proportion of the losses recorded may have occurred in the vicinity of the study area. Coupled with the relatively few charted wrecks, this suggests that there is high potential for known, but uncharted wrecks to be present in the wind farm development area.

543 Data obtained during the forthcoming geophysical survey for the scheme will be subject to archaeological assessment to determine the condition, character and extent of known sites within the study area and whether there is any evidence for the presence of other, currently uncharted wrecks in the area.

544 Geophysical data will be assessed for features and deposits of archaeological significance. Side scan sonar data will be reviewed to confirm the location and character of known wrecks and to identify previously unrecorded features of anthropogenic origin on the seabed. A review of the magnetometer data will identify further anomalies of anthropogenic origin and assist in confirming identification as anthropogenic of anomalies seen on the side scan sonar.

545 A proportion of the sub bottom profiler data will be reviewed to identify paleo-geographic features, for example paleo-channels and peat horizons and these will be traced through the data with a view to establishing the paleo-landscape during periods of possible hominid occupation.

546 The multi-beam/swathe bathymetry data review will provide vertical datum for the sub bottom interpretation, will aid in the identification of paleo-geographic features and help establish a baseline against which sea level change can be

assessed and will provide additional information on wreck sites identified from the side scan sonar and desk based assessment.

547 The geophysical data will be reviewed and interpreted in order to characterise key units, features and sites, to create an integrated gazetteer.

548 The EIA will include an impact assessment that, if appropriate identifies potential exclusion zones, highlight awareness of risk factors to facilitate project planning, and identify areas, which may require avoidance or mitigation.

6.4.4 Potential Impacts

549 There is potential for damage to occur during pre-construction seabed preparation, wind farm construction, cable laying and intrusive geotechnical survey to:

- submerged prehistoric archaeological sites and finds on the seabed
- wrecks that could potentially date from the later Mesolithic through to the present day
- submerged prehistoric sites and finds and submerged topographic features and deposits that contain palaeo-environmental evidence

550 Potential damage may also occur where local changes in sediment movement caused by the new structures results in scour which may result in heritage assets (wrecks, submerged prehistoric archaeological sites, and archaeological finds) being exposed or undermined. As heritage assets underwater have usually survived as a result of achieving a broadly stable equilibrium with their immediate environment, changes in this environment may trigger renewed degradation as a result of alterations in the physical, chemical and biological processes that the asset is subject to.

551 Archaeological sites identified may require protection from:

- cable burial
- foundation installation
- scour protection
- anchoring
- construction vessel movement
- decommissioning activities

6.4.5 Cumulative Assessment

552 Activities that will potentially have to be considered in relation to cumulative and in-combination impact assessment are:

- aggregate extraction and dredging
- subsea cables and pipelines
- oil and gas infrastructure and operations

553 The main impacts envisaged are movements of sediment and changes in sediment regime deriving from the construction of the wind farm or the construction or operation of the above activities in the proximity of the wind farm and potentially affecting the archaeological study area.

554 Wrecks are site specific so operations in other areas are not likely to affect wreck sites in the project area. If wreck sites are known they will be avoided so that no cumulative effects arise.

6.5 Seascape, Landscape and Visual Effects

6.5.1 Introduction

555 Consideration of landscape, seascape and visual impacts arising from the EOWDC will form an integral part of the EIA process. Initial consultation on the methodology for the Seascape, Landscape and Visual Impact Assessment (SLVIA) with Scottish Natural Heritage (SNH), Aberdeenshire Council (AC) and Aberdeen City Council (ACC) has already taken place and decisions agreed on the approach, which is discussed below.

6.5.2 Baseline Information

556 Defining the baseline character and visual amenity of the study area has been recently discussed with SNH, ACC & AC. The proposed wind farm deployment centre consists of 11 wind turbines anticipated to be of different types/heights, and lies approximately 2.2 km at its closest point from the coastline. Aberdeen City centre lies approximately 8 km south-west of the wind turbines, with its northern suburbs approximately 4.5 km from the nearest wind turbine. Balmedie is the closest settlement to the wind farm, at approximately 3 km from the nearest wind turbine, although there are individual properties which lie closer. A 35 km radius study area and a 50 km cumulative study area were requested by SNH, ACC & AC with the intention that they can be refined down depending on distance/specific areas and the likelihood of significant effects. Due to the close proximity of the offshore wind turbines to the coast the study area will include Aberdeen City, most of Aberdeenshire and limited areas within Moray.

6.5.2.1 Landscape and Seascape Character

557 The landscape character of Aberdeen and Aberdeenshire has been comprehensively documented in the SNH landscape character assessments which were completed in 1996 and 1998 respectively. Given the time elapsed since these were published there will have been changes in the landscape and therefore desk and field work for the SLVIA will take this into consideration when assessing the baseline character of the study area. One of the main changes to the landscape over the last 15 years has been the introduction of wind turbines which are now part of the landscape character of a number of areas in Aberdeenshire.

558 The coastline and sea within the study area has been defined as one national seascape unit (Area 4 – North East Coast) by the SNH commissioned report 'An assessment of the sensitivity and capacity of the Scottish Seascape in relation to wind farms' (Scott *et al.*, 2005). Regional seascape units will be established during the assessment through desk and field work. Documents such as SNH's 'Beaches of Scotland' report series will also provide additional baseline information.

559 National landscape designations within 15 km of the site include two Historic Gardens and Designed Landscapes; Duthie Park and Pitmedden Gardens. Local landscape designations include the coastal 'Areas of Landscape Significance' which extend from Balmedie to Peterhead, and beyond, along the north coast of Aberdeenshire.

6.5.2.2 Visual Amenity

560 There are a variety of visual receptors within the study area but the key receptors are:

- residents of Balmedie, Aberdeen and its suburbs, and residents of smaller villages and isolated dwellings along the coast and inland (within approximately 5 km of the site)
- recreational users of the foreshore and in particular Balmedie Country Park, Forvie NNR, Foveran Links SSSI and Aberdeen Beach
- the development is also likely to be visible from a number of key transport routes including, ferries to and from Aberdeen, certain air-routes into Aberdeen Airport, and roads such as the A90

561 The representative viewpoints to be used to establish the effects on key visual receptors were discussed and agreed with the consultees. Although this was done on a previous layout and not the layout taken forward here in this Scoping Report it is thought that these viewpoints still represent good coverage of the site layout. Whilst the exact locations may yet be refined during the assessment, it was agreed that the viewpoints listed in Table 6.1 covered all the key receptors across the study area. The Aberdeen City viewpoints are to be confirmed following more detailed desk and field work.

TABLE 6.1
Representative Viewpoint Locations

	Location	Grid Reference
1	Public local road near Murcar Golf Course	NJ 956 123
2	Aberdeen Beach	NJ 954 069
3	Footdee	NJ 957 057
4	Torry Battery	NJ 966 056
5	Middleton Park	NJ 929 112
6	Anderson Drive, Kittybrewster Area,	NJ 913 077
7	Kincorth Hill	NJ 939 028
8	Balmedie Beach	NJ 977 178
9	Forvie Nature Reserve	NK 020 264
10	Brimmond Hill	NJ 856 091
11	Nr Newmachar – Formartine and Buchan Way	NJ 889 205
12	A96 Chapel of Stoneywood	NJ 866 113
13	A90 South of Tipperty	NJ 970 240
14	Near Upper Muirskie	NO 830 960
15	Bennachie, Mither Tap	NJ 682 224
16	Dunnottar Castle	NO 880, 840
17-20	Aberdeen city centre viewpoints - to be confirmed	

6.5.3 Proposed Scope of Assessment

562 A full Seascape and Landscape Visual Impact Assessment (SLVIA) will be undertaken for the Aberdeen Offshore Wind Deployment Centre in close

consultation with statutory stakeholders (eg SNH, AC & ACC). Consultation has already taken place which has confirmed study areas, methodology and initial viewpoints.

563 Relevant good practice guidance on landscape, seascape and cumulative assessment will be used. Examples of such guidance are provided below;

- Maritime Ireland/Wales Interreg 1994 – 1999 Guidance 'Guide to Best Practice in Seascape Assessment', (GSA), published in March 2001
- Guidelines for Landscape and Visual Impact Assessment, Institute of Environmental Management and Assessment (IEMA) and the Landscape Institute's (2nd edition 2002);
- Visual representation of Wind Farms Best Practice Guidance, Scottish Natural Heritage (2007);
- The Guidance on the Assessment of the Impact of Offshore Wind Farms – DTI (2005)
- Cumulative Effects of Wind Farms, SNH (2005)

564 The SLVIA process will be undertaken as follows:

565 The baseline study establishes the relevant landscape planning policy context, the scope of the assessment and the key landscape receptors. It includes the following key activities, some of which have already been undertaken with the statutory consultees:

- a desk study of relevant current national, regional and local planning policy for the study area
- agreement of the main study area radius with the local planning authority and SNH
- a desk study of nationally and locally designated landscapes for the study area
- a desk study of existing landscape character assessments for the study area, at national, regional and local level
- draft Zone of Theoretical Visibility (ZTV) studies to assist in identifying potential viewpoints and indicate the potential visibility of the proposed wind farm, and therefore scope of receptors likely to be affected (An example ZTV can be found as Figure 16, this is based on a maximum tip height of 195 m (above LAT) for all 11 wind turbines)
- the identification of and agreement upon, through consultation, the number and location of representative viewpoints within the study area.
- identification of the range of other visual receptors (public rights of way, settlements and residential properties) within the study area.
- site visits to become familiar with the study area and to identify viewpoints and receptors

566 During this stage, the scheme design may not yet have been finalised and there will be a degree of iteration between this stage (particularly in respect of preparing ZTV studies and consequent changes to likely effects on receptors) whilst the design is finalised.

567 The assessment of effects includes further desk and site based work, covering the following key activities:

- the preparation of ZTVs based on the identified and agreed worst case wind turbine layout for the offshore development

- the preparation of computer generated wireframes showing the proposed development from the agreed representative viewpoints
- an assessment of the magnitude and significance of effects upon the seascape character, landscape designations and the existing visual environment within the study area arising from the proposed development during construction, operational and decommissioning stages
- the production of photomontages from a selection of the agreed viewpoints showing the anticipated view following construction of the proposed wind deployment centre

568 A cumulative assessment of the EOWDC in relation to onshore wind farms, as well as any other relevant developments within the study area will be part of the assessment.

6.5.4 Potential Impacts

6.5.4.1 During Construction

569 Potential landscape and visual effects during construction may include the following:

- the visual impact of active, brightly coloured marine construction plant equipment such as the cranes that will be used to construct and erect the wind turbines, and already constructed wind turbines on site over the construction programme
- the visual effects associated with increased vessel movements in the area as plant, materials and personnel are moved to and from site
- the visual effects of lighting during the construction period. Lighting will be required at sea (wind turbine construction and cable installation) if there is a 24 hour construction programme. The extent of the impact will depend upon elements of the weather and types of lighting used

6.5.4.2 During Operation

570 The potential operational impacts of the extension of the EOWDC may include the following;

- the seascape, landscape and visual effects of the operating wind farm upon sensitive receptors
- the visual effects of increased vessel movements as a result of operation and maintenance activities.
- a change in the landscape or seascape character as a result of the wind turbine structures

571 Due to the proximity of the proposed wind deployment centre to the coast and a large city, the assessment of potential effects on the landscape, seascape and visual amenity of the area is an integral part of the EIA.

572 Particular consideration will need to be given to any character and visual amenity effects that might arise as a result of the anticipated different wind turbine types/heights (Example wireframes can be found as Figures 17 and 18 and these show two different viewpoints with layouts comprising two

different wind turbine heights. Wind turbines 1 to 6 with a tip height of 160 m (above LAT) and wind turbines 7 to 11 with a tip height of 195 m (above LAT).

6.5.4.3 *During Decommissioning*

573 Impacts arising during the decommissioning are expected to be similar to those experienced during the construction phase. There would be a temporary impact from the activities on site to remove structures, but this would be of relatively short duration.

6.5.5 Cumulative Assessment

574 Consideration will be given to cumulative character and visual effects with other wind farm developments or other relevant structures within 50 km of this proposal that are either operational, consented or formally lodged in the planning/consent process. At the time of writing there are no other offshore wind farms in the area but over 15 operational/consented onshore wind farms within the wider study area and at least a further 10 wind farms in the planning process. Further consultation with SNH will take place to agree an approach to assessing the cumulative effects of the offshore wind farm with the large number of onshore wind farms. This is also anticipated to include a review of which other wind farm developments should be included within the assessment, the scope of the cumulative assessment and the final extent of the study area.

575 Potential cumulative effects may include the following:

- cumulative effects upon seascape/landscape character arising from combined, successive or sequential views from sensitive receptors. This could result where a receptor may experience the presence of other existing and planned wind farm developments in conjunction with the Aberdeen Offshore Wind Deployment Centre
- cumulative effects upon seascape/landscape character arising from the Aberdeen Offshore Wind Deployment Centre when viewed in combination with other structures on land and in the North Sea.

6.5.6 Mitigation

576 Embedded mitigation measures will include the distance that the wind deployment centre is located from sensitive receptors. Also, the choice of colour for the wind turbines will mitigate any landscape and visual impacts.

577 The wind turbines will be temporary in nature (due to maximum lease duration of 22 years) with no anticipated lasting visual effects following completion of decommissioning.

6.5.7 Cultural Heritage Assessment

578 A cultural heritage assessment will be carried out in consultation with Historic Scotland and Scottish Natural Heritage to assess the potential impact on the setting of sites of national or greater significance (eg Scheduled Monuments, Listed Buildings). The locations of Scheduled Monuments and Listed Buildings in the area can be seen on Figure 12.

579 Where significant impacts are predicted, wireframes and photomontages would be produced and assessed.

580 A report on the results of the desk-based survey will be incorporated into the Environmental Statement.

6.6 Commercial Fisheries

6.6.1 Introduction

581 Until the mid 1950s, Aberdeen was Scotland's main fishing port, however, due to the rapid expansion of oil interests in the North Sea, which allowed fishermen to diversify into oil-based work, and the general downturn in the fishing industry, there is now only one fish quay. Although the market now handles significantly reduced quantities of fish, some vessels registered to other ports still land into Aberdeen. A number of fish processing plants remain in Aberdeen with fish brought by road from other ports.

6.6.2 Baseline Information

582 Aberdeen offshore wind farm is located across the boundaries of 2 ICES rectangles, 43E7 and 43E8.

583 ICES rectangle 43E7 has significantly lower landings values than other ICES rectangles in the region, although this is largely due to its small sea area. Within this rectangle, demersal trawling for *Nephrops* and whitefish is the principal method undertaken, followed by scallop dredging by mechanical dredge. Creel fishing is also deployed in inshore areas.

584 Within ICES Rectangle 43E8, there is demersal trawling and mechanical dredging, the majority of which is by the over 10 m fleet. Vessels employing these methods will target whitefish and *Nephrops*, and scallops respectively. There are low levels of pelagic activity by foreign vessels in this rectangle. Creel fishing also takes place, undertaken almost exclusively by the under 10 m fleet.

6.6.2.1 Whitefish

585 The offshore area around Aberdeen supports a range of commercially important fish species. Offshore fish communities are dominated by haddock (*Melanogrammus aeglefinus*), whiting (*Merlangius merlangus*) and cod (*Gadus morhua*), with saithe (*Pollachius virens*) and Norway pout (*Trisopterus* sp.) being associated with deeper waters. Migratory species such as herring (*Clupea harengus*) and mackerel (*Scomber scombrus*) are found throughout the area, although their distribution is seasonal.

6.6.2.2 Shellfish

586 Shellfish species that are commercially important within the Aberdeen fishing areas include the following:

- European lobster, *Homarus gammarus*

- Edible crab, *Cancer pagurus*
- Velvet swimming crab, *Necora puber*
- Shore crab, *Carcinus maenus*
- Giant scallop, *Pecten maximus*
- Cockle, *Cerastoderma edule*
- Mussel, *Mytilus edulus*
- Whelk, *Buccinum undatum*
- Periwinkle, *Littorina littorea*

587 The Norway lobster (*Nephrops* sp.) is by far the most important shellfish species exploited in Scottish waters. Norway lobsters are located in areas of soft mud or muddy sand in which they excavate and inhabit burrows; however known spawning grounds are to the north and south of Aberdeen Bay.

588 In coastal waters, a baited creel fishery exploits four species, the European lobster, edible crab, velvet swimming crab and to a lesser extent, the shore crab (Chapman, 2004). The edible crab is fished all round the coast of Scotland, mostly on inshore grounds over-lapping with the European lobster but occasionally in deeper water away from the coast. The main landing ports in the North Sea are Aberdeen, Fraserburgh, Wick and in the Orkney and Shetland Islands (Chapman, 2004).

589 Four species of bivalve mollusc are exploited in the SEA5 zone, of which the giant scallop is by far the most important. The main fisheries are located around Orkney and Shetland, in the Moray Firth and off the east coast of Scotland, with most of the landings taken within these zones.

590 Gastropod molluscs are represented by two species, the common whelk and the periwinkle. Some fishing for whelks takes place around the whole Scottish coast, though mostly in the North Sea and the Northern Isles. Winkles are inter-tidal in distribution and are harvested by hand at low tide.

6.6.2.3 Cephalopods

591 The commercial importance of cephalopods is of relatively recent, but growing, importance (Boyle and Pierce, 1994). Evidence exists that fishing pressure has changed ecological conditions and shifts in community structures have occurred with cephalopod stocks slowly replacing predatory fish stocks (Caddy and Rodhouse, 1998).

592 Several species of cephalopod have been recorded off north-east Scotland. The main commercial species in Scottish waters is the long-finned squid *Loligo forbesi* (Boyle and Pierce, 1994; Pierce *et al.*, 1994a,b, 1998; Stowasser *et al.*, 2004). Since 1995, annual UK landings of loliginid squid have ranged between 1600 and 3200 tonnes, making the UK the second most important fishery nation for loliginid squid within the ICES region after France.

593 Other cephalopod species of commercial interest, present in North Sea area, are the squid species (*Todarodes sagittatus*), (*Todaropsis eblanae*), (*Alloteuthis subulata*) and the octopus (*Eledone cirrhosa*) though in much smaller numbers (Stowasser *et al.*, 2004).

6.6.2.4 Diadromous and Freshwater Species

Salmonids

594 Salmon and sea trout are of particular importance in this area with the Rivers Dee and Don having salmon and trout fisheries. In Scotland, the management of the salmon fishery is entrusted to District Salmon Fishery Boards (DSFBs) whose responsibilities include the protection and improvement of the salmon fisheries within their districts. The two salmon Fishery Districts in the immediate vicinity of the proposed development are the Dee and Don Boards.

595 All Scottish salmon fisheries are closed for a minimum of 168 days a year for spawning. The actual dates may vary but are usually from late August to mid February. Salmon spawning periods vary between rivers and are thought to be influenced by water temperature and day length. Sea trout spawning generally occurs between mid October and January.

6.6.3 Proposed Scope of Assessment

596 The principal data sources to be used for the baseline assessment will be:

- Marine Scotland (an executive agency of the Scottish Government)
- The Scottish Executive Environment and Rural Affairs Department (SEERAD)
- International Council for the Exploration of the Sea (ICES)
- Fisheries Research Services (FRS)
- Scottish Fisheries Protection Agency (SFPA)
- The Scottish Fishermen's Federation (SFF)

597 Consultation with local fishermen began in 2007, and was principally undertaken by the Scottish Fishermen's Federation (SFF). The SFF represents approximately 90 % of Scottish fishermen. Those consulted include:

- Scottish Fishermen's Federation (SFF)
- Scottish Inshore Whitefish Producers

598 Consultation with commercial fishermen will continue throughout the development of the project. Liaison with fisheries organisations will primarily be via the contractor of the assessment.

599 A baseline report was completed for commercial fisheries in 2008. For the purposes of the EIA, this report will be reviewed and updated to include more recent information and to cover the revised site layout and cable corridor.

600 The information within the baseline assessment is expected to include:

- review of the types of commercial and traditional fisheries (including shell fisheries) in the area (eg methods/gear used, season, duration, etc.)
- review of the types of salmon and sea trout fishing in the area (eg methods/gear used, season, duration, etc.)
- review of the location of fishing grounds for commercial fisheries and salmon and sea trout (type and season)

- the location and season of spawning and nursery areas of commercial species
- update of fishing activity in and adjacent to the wind farm site (eg fishing effort, number of vessels)
- update of identification of local and foreign vessels using the area (eg size, type, operating ranges, port, nationality)
- update of fish catch and landings data for commercial fisheries and salmon and sea trout (value and amount)
- update on any known fish farms planned for the future in the area
- any hereditary rights to particular fishing grounds in the area and the legal implications of such rights
- review of fishing and angling in the surrounding rivers, the importance of these rivers, eg economic value and potential impacts associated with the wind farm development

601 Full use will be made of information from the Fisheries Statistics Unit including fisheries surveillance information, landings and fishing effort data and registered vessel lists. These data will be supplemented through discussions with local fishermen.

6.6.4 Potential Impacts

602 The following aspects are identified by CEFAS in the Defra (2004) guidelines as requiring addressing in the impact assessment.

- Presence of seabed obstacles
- Impacts on commercially exploited species
- Increased steaming times to fishing grounds
- Safety issues for fishing vessels
- Complete loss of, or restricted access to traditional fishing grounds
- Interference with fisheries activities
- Any other concerns raised by local fishermen and fishermen's organisations

603 Table 6.2 presents the impacts as identified within the impact assessment for the previous site layout. Impacts of the site now proposed are not expected to differ significantly. All aspects are assessed for construction/decommissioning and construction respectively.

TABLE 6.2
Impact Assessment for previous layout

Environmental effect	Description of feature(s)/people affected (receptors)	Spatial extent	Duration	Magnitude	Probability of effect occurring	Significance level	Mitigation measures and rationale	Significance level after mitigation
Construction and Decommissioning								
Damage to fishing gears by presence of seabed debris	Potting vessels Demersal trawlers	Local	Temporary	Low to High	Uncertain	Negligible to Major if damage occurred	Contractors obligations and standard offshore practices would prevent, or in the case of accidental incidents, remove dropped objects	Negligible
Adverse Impacts on Commercially Exploited Species	Fish and shellfish	Local	Temporary	Low	Uncertain	Minor	Use of appropriate engineering techniques, eg soft start piling Low sensitivity of principal target species	Minor
Safety issues for fishing vessels (collision with construction vessels)	All vessels	Local	Temporary	High	Unlikely	Negligible to Major if collision occurred	Implementation and adherence to standard offshore safety procedures Involvement of the SFF for liaison and information distribution	Negligible

Increased steaming times to fishing grounds	All vessels	Local Local	Temporary Temporary	Low Low	Likely Unlikely	Minor Negligible	Transitory, short term exclusion areas around construction activities within the site Limited numbers of potentially impacted vessels Low probability of a significant number of steaming routes likely to be affected	Negligible, possibly minor for locally based potters
Complete loss or restricted access to traditional fishing grounds	All vessels	Site-specific	Temporary	Low	Certain	Minor Negligible	Transitory, short term exclusion areas around relatively small areas of sea Limited numbers of potentially impacted vessels Use of local vessels for wind farm related work	Negligible to minor
Interference to fishing activities (from construction vessels)	All vessels	Site-specific	Temporary	Low	Unlikely	Negligible	Construction vessels using existing shipping routes Fishermen's representatives	Negligible
Restriction of access during laying of export cables	All vessels	Site-specific	Temporary	Low	Certain	Negligible, possible minor for some vessels	Short duration and small transitory area of exclusion Limited numbers of potentially affected vessels	Negligible, possibly minor for some vessels

Operational Phase								
Damage to fishing gear by presence of seabed debris	All vessels	Local	Temporary	Low to High	Uncertain	Minor to Major if damage occurred	Contractors obligations and standard offshore practices should have removed objects Any scour protection rock placement would be adjacent to wind turbine bases	Negligible
Adverse impacts on Commercially Exploited Species	All vessels	Local	Permanent	Low	Unlikely	Negligible	Scour protection will likely offer additional habitat for species by providing shelter and nursery grounds	Negligible to beneficial
Safety issues for fishing vessels (collision with wind turbines)	All vessels	Site-specific	Permanent	High	Unlikely	Minor to Major if collision occurred	Implementation and adherence to standard offshore safety procedures	Negligible
Increased steaming times to fishing grounds	All vessels	Local/ Regional	Permanent	Low	Unlikely	Negligible	Potential for fishing vessels to steam through the site in favourable conditions Limited numbers of potentially impacted vessels Low probability of a significant number of steaming routes likely to be affected	Negligible

Complete loss or restricted access to traditional fishing grounds	All vessels	Local	Permanent	Low	Unlikely	Negligible	Potential for potting gear to be deployed within the operational site Low numbers of other vessels likely to be potentially affected	Negligible to beneficial
Interference to fishing (avoidance of/collision with maintenance vessels)	All vessels	Local	Temporary	Low	Unlikely	Negligible	Maintenance vessels using existing shipping routes Fishermen's representatives	Negligible
Damage to fishing gear/vessels from exposed cables	All vessels	Local	Temporary	High	Unlikely	Minor to Major	Cable burial to a certain depth depth. Implementation and adherence to standard offshore safety procedures Cable route surveys Temporary exclusion zones until issues are rectified	Negligible to Minor

6.6.5 Cumulative Assessment

604 At present there are no offshore wind farms applying for consent off the coast of north-east Scotland. However, there are two proposed wind farms in the Moray Firth which could potentially have a cumulative impact on fisheries.

605 Other elements that could realistically contribute to cumulative impacts are:

- commercial shipping movements
- aggregate dredging
- offshore oil and gas installations
- introduction of protected marine areas

6.6.6 Mitigation

606 Mitigation measures are presented in Table 6.2 and will be further investigated.

6.7 Socioeconomics

6.7.1 Introduction

607 Offshore wind farms offer the potential for significant positive socioeconomic benefits, through job creation locally and nationally, during both the construction and operational phases of the project. In addition to job creation, the proposed development can have positive socioeconomic impacts on a national scale. The generation of renewable energy is essential in assisting the Scottish Government's goal of generating 50 % of Scotland's energy from renewable sources by 2020 (Scottish Government, 2010) and the UK Government's target of 15 % of energy from renewable sources by 2020 (DECC, 2010). Furthermore, wind farms can contribute to achieving long-term sustainable development of the Scottish Economy.

6.7.2 Baseline Information

608 Baseline information should identify key population, employment and economic data. Aberdeen has a total population of 210,400 as reported in 2009. It has an extensive existing offshore skills base generated by the oil and gas industry and between 2007 and 2008 the city had the highest GDP growth rate in Scotland (Aberdeen City Council, 2010).

609 Baseline information at both the regional and national level should be recognized, identifying specific socioeconomic impacts caused by offshore wind farms within particular regions as well as the impacts to Scotland (and the UK) as a whole. The following study areas are suggested:

- inner study area: Aberdeen and Aberdeenshire, the development will pose direct socioeconomic impacts to this area (discussed in section 6.7.4)

- wider study area: Other parts of Scotland. Possible impacts on other areas where potential suppliers and contractors exist should also be identified
- potential national impacts, such as offshore wind farms' potential to assist in national climate change commitments, could be considered at the high level

610 Local communication links including harbours, ports and links to manufacturing and assembly sites should be identified as the development of local infrastructure can result in economic benefits. Furthermore, the identification of local construction and suppliers is also of relevance as the use of local companies will lead to further positive socioeconomic impacts.

6.7.3 Proposed Scope of Assessment

611 The position and performance of Aberdeen's economy and its prospects for the future will be reviewed. This will include information on area, population, economic activity, employment and education and skills. Data on the socioeconomic impacts of existing offshore wind farms will be collated in consultation with relevant organisations, eg Aberdeen City Council and Aberdeenshire Council, the local fishing community via the Fisheries Liaison Officer (FLO), local communities and local groups such as Community Planning in Aberdeen, and via public exhibitions. The potential for job creation and local training opportunities will be assessed. Local communication links, including port facilities, will be assessed for their suitability for construction and operation activities.

612 The following data sources will be reviewed as part of the EIA process:

- The Crown Estate (2008) Socio-Economic Indicators of Marine-Related Activities in the UK Economy
- Scottish Government General Register Office for Scotland (2006) Scottish Economic Statistics

6.7.4 Potential Impacts

613 The economic impact of the project would be most significant during the construction phase, however potential benefits over the lifespan of the wind farm would also be assessed.

614 Potential impacts on socioeconomics, both positive and negative, which will be investigated are:

- construction (may also occur during decommissioning)
  - increased employment in construction and supporting industries Construction jobs relate to both construction of the wind farm itself and onshore facilities, including substation civil and electrical works.
  - increased expenditure through supply of goods and services required to develop the wind farm
  - change in population structure and consequent impacts on infrastructure requirements. The potential use of specialist contractors from out with the area could result in increased use of local accommodation and service industries.

    - academic research opportunities
- operation
    - increased employment, both local and further a field, due to maintenance and operation
    - change in population structure and consequent impacts on infrastructure requirements
    - academic research opportunities
- power generation
    - the development will result in a localised power generation consequently, less power will be wasted in transmission over long distances
    - the supply of site generated power will reduce the requirement to buy power from commercial utility companies, thus reducing fuel bills
- indirect benefits
    - improved marketing of Aberdeen as a 'green' city, leading to potential inward investments in new technologies
    - re-circulation of increased income

615 In 2009 approximately 5000 people were unemployed in the Aberdeen and Aberdeenshire area (Aberdeen City Council, 2010), in. The resultant positive socioeconomic effects of the development could alleviate unemployment.

616 Construction, operation and maintenance of the EOWDC will require both on and offshore local, national and international contractors. Thus, although the focus here has been on local socioeconomic impacts, the development will result in socioeconomic impacts in a wider sense.

617 Offshore wind farms also generate potential socioeconomic impacts on tourism, both beneficial and adverse. Impacts on tourism and commercial fisheries are dealt with in sections 6.6 and 6.8.

618 The visual impacts and mitigation methods are discussed in section 6.5 of this report.

6.7.5 Cumulative Assessment

619 The assessment of impacts would be undertaken on a site specific and cumulative basis to include the proposed project in addition to proposed other developments.

620 The development's impacts on other offshore operations, including oil and gas installations, shall also be addressed.

6.7.6 Mitigation

621 The majority of socioeconomic impacts on the area will be beneficial, thus ways to enhance such impacts must be explored. This may include:

- use of local port facilities where possible
- use of local vessels for survey and guard work where possible
- use of local employment base for both construction, operation and maintenance

- consideration of employment and training for operations and maintenance work
- use of locally manufactured supplies

622 The emphasis here is on focusing on local socioeconomic opportunities, thus consultation with local stakeholders is essential.

6.7.7 EOWDC Future Research and Monitoring

623 Monitoring will be proposed to ensure the implementation and effectiveness of the mitigation.

6.8 Recreation and Tourism

6.8.1 Introduction

624 Tourism is important to the local economy of Aberdeen, in 2008 tourism expenditure in the city was over £300 million (Aberdeen City and Shire Economic Future, 2010). The physical appearance of near shore wind farms means that visual impacts can be important and is of particular relevance to the tourism and recreation industry. Consequently, a detailed assessment of potential impacts would be required. Consultation with relevant organisations will continue throughout the project.

625 In 2005 and 2006 there were two road show events taking an exhibition to libraries, town halls and village halls along the stretch of coast. The events were open to all and were publicised in advance. The road shows proved a very successful means of engaging the public over the wind farm project and reaction was on the whole supportive. Meetings have also been held at earlier stages with both Royal Aberdeen and Murcar golf courses to inform about the project.

6.8.2 Baseline Information

626 Baseline information will identify key tourism data, including Aberdeen's most popular and profitable tourism features and if such features will be impacted by the offshore wind farm.

627 Visit Scotland statistics show that during 2008 UK residents made 1.30 million tourism trips to Aberdeen spending £242 million. Visitors from overseas took 0.25 million trips and spent £90 million in the area. Tourism related employment accounts for 8 per cent of jobs in the area (Visit Scotland, 2008).

628 In addition to summertime recreational boating, the beach adjacent to the area is used by local people for bird watching/nature walks etc.

629 SNH commissioned a review of marine and coastal recreation in Scotland (Land Use Consultants, 2006) which indicates that the most popular specialist activities on the Scottish coastline are walking, sea fishing, sailing, kayaking, canoeing, and wildlife and bird watching.

630 According to Visit Scotland (2008) the top visitor attractions in the Aberdeen and Grampian area are as follows:

- David Welch Winter Gardens, Aberdeen
- Aden Country Park, Mintlaw
- Aberdeen Art Gallery, Aberdeen
- Aberdeen Maritime Museum, Aberdeen
- WDCS Wildlife Centre, Spey Bay
- Provost Skene's House, Aberdeen
- Crathes Castle, Banchory
- Logie Steading Visitor Centre, Forres
- Loch Muick & Lochnagar Wildlife Reserve, by Ballater
- Aberdeen Arts Centre, Aberdeen

631 Coastal golf courses are also popular sites for recreation. There are currently two close-by golf courses situated along the shoreline of northern Aberdeen and further courses are planned.

632 Visual impacts are of particular relevance with regard to tourism and recreation. The geographical extent of the visual impacts of the wind farm will be identified using a ZTV map (discussed in section 6.5) which will be undertaken as part of the SLVIA. Sites that are of particular importance with regards to tourism and the extent to which such sites will be visually impacted will be identified.

633 Aberdeen's tourism resources' dependence on visual features will be identified. The extent to which each resource (eg restaurant views, foot paths, view points etc.) is dependent on the surrounding land/seascape will be identified and the visual impacts the wind farms determined.

6.8.3 Proposed Scope of Assessment

634 The EIA will include an assessment of the tourism sector in Aberdeen focussing on coastal tourism.

635 The following data sources will be referred to during the EIA process:

- Glasgow Caledonian University (2007) Economic Impact of Wind Farms on Scottish Tourism
- Scottish Renewables and the British Wind Energy Association (2002) Tourist Attitudes Towards Wind Farms
- Ladenburg *et al.*, (2006) Socioeconomic Effects: Positive Attitudes in Local Communities
- Land Use Consultants (2006) Review of Marine and Coastal Recreation F05AA608

636 Consultation with Aberdeen City Council and Aberdeenshire Council, Visit Scotland, local recreational groups.

6.8.4 Potential Impacts

637 The development is located 2 km from the coast and will follow the coastline from northern Aberdeen to Balmedie, visually impacting the seascape of the area. According to Glasgow Caledonian University's (2007) study the economic impact of wind farms onScottish tourism is relatively small. This

study was based on the impacts of onshore wind farms, however, the same basic principles can be applied to offshore wind farms.

638 Glasgow Caledonian University's study focused on four case study areas in Scotland, concluding that three quarters of tourists surveyed felt that wind farms had a positive or neutral impact on the landscape. Of the 380 tourists surveyed 39 % were positive about wind farms, 36 % had no opinion and 25 % were negative. Within the minority that were negative about wind farms, only a very small group changed their opinions about revisiting Scotland. The likelihood of those surveyed intentions to return showed that wind farms have very little impact. Three visual situations were required to determine the likelihood of return:

- those having actually seen a wind farm
- respondents were shown photos of an area before and after construction of a wind farm
- respondents were shown a photo montage of an area with an existing wind farm with illustrations of how the landscape would look if the wind farm was extended

639 In all cases the vast majority, 93-99 %, suggested that the experience of seeing a wind farm would have no effect. In addition the presence of wind farms increased the likelihood of some tourists to return to the case study areas and Scotland as a whole.

640 A number of the top visitor attractions, outlined in section 6.8.2, will be completely unaffected by the wind farm. Therefore the wind farm's economic impacts on tourism should be negligible.

641 The potential impacts on Tourism and Recreation which will be investigated are:

- construction (may also occur during decommissioning)
  - visual impacts
  - temporary disruption of offshore tourism and recreation
- operation
  - visual impacts
  - site access for offshore tourism and recreation
  - marine navigational safety
  - offshore wind farms can also present tourism potentials. Many boat operators offer tours of offshore wind farms.

642 Locally, the development may also impact bird watching, during both construction and operation.

6.8.5 Cumulative Assessment

643 The need to assess tourism and recreational impacts cumulatively will be discussed with relevant consultees.

6.8.6 Mitigation

644 A desk study and consultation will be undertaken to gain the views of the local tourist industry, and potentially consider ways of benefiting it.

645 The majority of impacts on tourism will be visual. As such, the mitigation methods outlined in section 6.5 should be considered. In addition, the wind farm may attract tourists. Of the 380 tourists surveyed by Glasgow Caledonian University 48 % agreed with the statement 'I like to see wind farms.' Thus potential ways to use wind farms as a tourist attraction, such as locally run boat trips, will be explored.

6.9 In-Air Noise

6.9.1 Introduction

646 Construction activities, such as wind turbine installation and the associated vessel movements, have the potential to generate airborne noise. The acoustic impacts during construction and operation will be assessed following the former Department of Trade and Industry's (DTI) best practice guidelines. Preliminary noise predictions have been carried out for close-by dwellings, golf course club houses, close coastal points, Balmedie Ranger Station and more. According to these calculations background noise levels will generally be below 35 dB(A).

6.9.2 Baseline Information

647 Aberdeen has a total population of 210,400 as reported in 2009. The proposed wind farm is located 2-4 km from shore north of Aberdeen City. Sensitive receptors to in-air acoustic impacts will include local residents, businesses and tourists. There are beaches and two golf courses along the coastline.

648 Local levels of background ambient noise will be used in the modelling for airborne noise levels during construction and operation.

6.9.3 Proposed Scope of Assessment

649 A detailed baseline noise survey will be conducted at representative locations onshore following consultation with Aberdeen City Council and Aberdeenshire Council with the following proposed outputs:

- identification and agreement on the location of the nearest sensitive receptors
- agreement of noise limits for each receptor with Aberdeen City Council and Aberdeenshire Council
- prediction of noise levels received at each receptor using a recognised computer model that implements the calculation method specified in ISO 9613: Acoustics – Attenuation of sound during propagation outdoors (ISO, 1996)
- comparison of predicted levels with agreed noise limits

650 Advice will be sought on whether measurements of background noise levels will be necessary.

6.9.4 Potential Impacts

651 Potential impacts on in-air noise which will be investigated are:

- construction (may also apply during decommissioning)
  - impacts on recreational users of the area
  - noise disturbance to residential populations
- operation
  - operational noise from wind turbines

6.9.5 Cumulative Assessment

652 If required, a cumulative assessment would be completed.

6.9.6 Mitigation

653 Noise during construction could be managed by the implementation of a site construction policy and, as far as is possible, minimising vessel traffic levels at the construction site.

6.10 Energy and Emissions

6.10.1 Introduction

654 In their Annual Statement (DECC 2010), DECC reports that it is likely that demand for electricity will double over the coming forty years, as a result of the need to electrify large parts of the heat and transport sectors. Further, for the UK to meet its obligations on reducing emissions of greenhouse gases, the electricity being consumed will need to be almost exclusively from low carbon sources. In the first quarter of 2010 nearly 80 % of the UK's electricity was generated by burning gas and coal. This needs to change and, as the Statement sets out, offshore wind will be crucial to delivering the UK's renewable and low carbon targets.

655 This project will be a small, but important, part of delivering a reduction in greenhouse gas emissions due to the displacement of fossil fuel use. Quantification of this will however depend on assumptions regarding the nature of the generating capacity it replaces and will be addressed in the EIA.

6.10.2 Baseline Information

656 The construction and operation of EOWDC would not significantly increase the overall CO_2, SO_x, NO_x and other pollutants within the project site area.

6.10.3 Proposed Scope of Assessment

657 The EIA will consider the current electricity generation mix and assess what greenhouse gas savings could be made. No further assessment is proposed.

6.10.4 Potential Impacts

658 Potential impacts during construction and decommissioning would be addressed through standard mitigation techniques, which are to be agreed as part of an Environmental Management Plan (EMP) for the construction phase. Potential impacts from vessels used during maintenance of the wind turbines may arise during the operation of the wind farm.

6.10.5 Cumulative Impacts

659 Cumulative impact between our project and other projects in respects of energy and emissions issues are not anticipated.

6.11 Electromagnetic Interference

6.11.1 Introduction

660 Provided careful attention is paid to siting, wind turbines should not cause any significant problems due to electromagnetic interference. Wind farms have the potential to cause adverse effects on communication systems which use electromagnetic waves as the transmission medium (for example, television, radio or microwave links).

6.11.2 Baseline Information

6.11.2.1 Television Reception

661 An on-line tool to estimate potential television interference provided by the BBC indicates that no households would be affected.

6.11.2.2 Microwave and Other Telecommunications

662 Contact was made with Ofcom regarding the proposal and information on the site centre and the radius of the development was submitted.

663 Ofcom responded that there are currently no fixed link ends within or fixed paths that cross the site in respect of microwaves.

664 For scanning telemetry the information was passed to both the Joint Radio Company (JRC) and Atkins Ltd both of whom responded with no objection to the proposal.

6.11.3 Proposed Scope of Assessment

665 Relevant organisations will be contacted again prior to consent if necessary.

6.11.4 Potential Impacts

666 Wind turbines can cause electromagnetic interference (EMI) by two means:

- physical interference
- electrical interference

6.11.5 Mitigation

667 If there are any impacts to television signals there are several solutions available that which have been used successfully at other wind farms, for example realigning aerials, fitting better aerials or the use of a digital service.

6.12 Other Marine Users

668 This section of the Environmental Statement will consider other marine users in the area that could be potentially affected by the development. Other marine users are shown on Figure 12.

669 It is likely to consider the following activities:

- existing subsea cables and pipelines
- oil and gas installations
- marine dredging areas and disposal sites
- salmon fisheries
- unexploded ordnance

6.12.1.1 Existing Cables and Pipelines

670 There are two telecommunications cables west of and close to EOWDC and it is therefore possible that crossings may be required. The design of any crossing will be agreed with the cable/pipeline owner/operator to ensure that integrity of all the assets is maintained.

6.12.1.2 Oil and Gas Installations

671 There are currently no oil and gas fields in the area of the proposed development nor is there any related infrastructure. The closest pipelines are gas pipelines entering into St Fergus Gas Terminal, north of Peterhead. Consequently, there will no impact on oil and gas installations from the proposed project.

6.12.1.3 Dredging and Disposal site

672 There are currently only two licensed dredge areas in Scotland (Scottish Executive, 2006) neither are located within the study area. Ongoing dredging activities occur in Aberdeen harbour. The quantity of dredged material and the disposal sites are to be confirmed and will be addressed within the ES.

673 There is a disused explosive dumping ground approximately 6.4 km from the project site.

6.12.1.4 Salmon Fisheries

674 There are a number of salmon fisheries along the coast between the river Don and the Ythan Estuary (Figure 12). No wind turbines are proposed within these areas, however, consultation will take place with the associated Fishery boards.

6.12.1.5 Unexploded Ordnance

675 There is a potential for unexploded ordnance to be the found on the wind farm site and in the surrounding area. There was a study commissioned by the project in 2007 (Bactec, 2007) to look at the risk of unexploded ordnance. A further study will be commissioned due to the change in site location.

6.12.2 Proposed Assessment

676 The effect of the wind farm on the above will be considered in the individual impact assessments previously discussed in this document.

7 CONSULTATIONS

677 The information provided in this document is designed to help consultees and stakeholders comment on the assessment approach outlined, raise other issues of perceived concern, provide further information and, where necessary, advise on alternative methods of assessment.

678 Below is a list of consultees to whom this scoping report has been sent. Suggestions from other bodies of any groups, organisations or individuals not on the list would also be welcome.

List of Statutory Consultees to Marine Scotland
Scottish Natural Heritage (SNH)
Scottish Environment Protection Agency (SEPA)
Aberdeen City Council
Aberdeenshire Council
Fisheries Committee
Association of Salmon Fishery Boards
British Telecom (Radio Network Protection Team)
Civil Aviation Authority (CAA)
Chamber of Shipping
The Crown Estate
Defence Estates
Health and Safety Executive (HSE)
Joint Radio Company (JRC)
Maritime and Coastguard Agency
Marine Safety Forum
Marine Scotland
NATS
Northern Lighthouse Board (NLB)
Royal Yachting Association
RSPB
Scottish Canoe Association
Scottish Fisherman's Federation
Scottish Fisherman's Organisation

List of other Consultees who will be informed of this report
Aberdeen Harbour Board
Aberdeen International Airport
Associated British Ports (ABP)
Atkins Ltd
Scottish Sub Aqua Club
Aberdeen Chamber of Commerce
COWRIE
DEFRA Marine Consents Unit
East Grampian Coastal Partnership
Scottish Federation of Sea Anglers
Friends of the Earth Scotland
Greenpeace
Joint Nature Conservation Committee (JNCC)
Local Fisherman's Organisations
Local Sailing Clubs
The Moray Firth Partnership
National Grid – Gas Distribution
National Trust For Scotland
Ofcom
Oil and Pipelines Agency
Receiver Of Wreck
Royal National Lifeboat Institution
Scottish Wildlife Trust (SWT)
Scottish and Southern Energy Plc
Scottish Water
Shell
Trinity House
University of Aberdeen
Visit Scotland

8 REFERENCES

Aberdeen City Council (2010). Behind the Granite, Aberdeen Key Facts. http://www.aberdeencity.gov.uk/nmsruntime/saveasdialog.asp?lID=30354&sID=332 [Date accessed August 2010]

Aberdeen City & Shire Economic Future (2010) Key Statistics. http://www.acsef.co.uk/uploads/reports/6/ACSEF%20Tourism%20-%20Expenditure%20-%20Aberdeen%20City%20and%20Shire%202008%20(Mar%2010).pdf. [Date accessed August 2010]

Aberdeen Harbour (2009) Aberdeen Harbour Board 2009 Annual Review

Aberdeen Harbour (2010). http://www.aberdeen-harbour.co.uk/index.html. [Date accessed August 2010]

Aberdeen Airport (2010). http://www.aberdeen-airport-guide.co.uk/history.html [Date accessed August 2010]

ABPmer (2006). Aberdeen Beach Protection Study. ABP Marine Environmental Research Ltd, report No. R.1237.

ABPmer (2008). Aberdeen Offshore Wind Farm Coastal Process Investigation. Report No. R/3745/2/R1407. February 2008.

ACC (2008). Aberdeenshire Cetacean Catalogue (ACC): Photo-identification catalogue for bottlenose dolphins (Tursiops truncatus) and other cetacean species off the coast of Aberdeenshire, NE Scotland.

Ahlén, I., Bach, L., Baagøe, H.J. & Pettersson, J (2007). Bats and offshore wind turbines studied in southern Scandinavia. Swedish Environmental Protection Agency.

BACTEC (2007). Explosive Ordnance Threat Assessment for the proposed Aberdeen Offshore Wind Farm. Report prepared for Aberdeen Offshore Wind farm Ltd. Report Ref: 9253TA.

Bailey, H., Senior, B., Simmons, D., Rusin, J., Picken, G. and Thompson, P.M. (2010). Assessing underwater noise levels during pile-driving at an offshore wind farm and its potential effects on marine mammals. Marine Pollution Bulletin.

Band (2000). Wind farm and birds. Calculating a theoretical collision risk assuming no avoidance action. Scottish Natural Heritage.

Barne J.H., Robson C.F., Kaznowska S.S., Doody J.P. and Davidson N.C. (1996) Coasts and seas of the United Kingdom. Region 3. North-East of Scotland: Cape Wrath to St. Cyrus. Peterborough, JNCC (Coastal Directory Series).

Barton, C. and Pollock, C. (2004a) Review of divers, grebes and seaduck distribution and abundance in the SEA 5 area. Report to the DTI as part of SEA 5.

Barton, C. and Pollock, C. (2004b) Review of the potential impacts of offshore wind farms on migrating and overwinteringswans and geese in the SEA 5 area. Report to the DTI as part of SEA 5.

Bennett T.L. and McLeod C.R. (1998). East Scotland (Duncansby Head to Dunbar) (MNCR Sector 4). In: K Hiscock Ed. Marine nature conservation review. Benthic marine ecosystems of Great Britain and the north-east Atlantic. Joint Nature Conservation Committee. (Coasts and seas of the United Kingdom MNCR series), Peterborough, 123 – 154.

Boyle P.R. and Pierce G.J. (1994). Fishery biology of Northeast Atlantic squid: An overview. Fisheries Research (Amsterdam), 21(1-2), pp. 1-15.

Caddy J.F. and Rodhouse P.G., (1998). Cephalopod and groundfish landings: Evidence for ecological change in global fisheries? Reviews in Fish Biology and Fisheries, 8(4), pp. 431-444.

Camphuysen, C.J., Fox, T.J., Leopold, M.F. & Petersen, I.K. (2004). Towards standardised seabirds at sea census techniques in connection with environmental impact assessments for offshore wind farms in the U.K. Report commissioned by the Collaborative Offshore Wind Research into the Environment (COWRIE). The Netherlands: Royal Netherlands Institute for Sea Research.

Canning, S.J. (2007). Cetacean distribution and habitat use along the east coast of Scotland. PhD thesis, University of Aberdeen, UK
CEFAS (Centre for Environment, Fisheries and Aquaculture) (2001) North Sea Fish and Fisheries. Technical report TR_003 produced for Strategic Environmental Assessment – SEA2.

Carstensen, J., Henriksen, O.D and Teilmann, J., 2006. Impacts of offshore wind farm construction on harbour porpoises: acoustic monitoring of echolocation activity using porpoise detectors (T-PODs). Marine Ecology Progress Series 321, 295–308.

CEFAS (2009) Radioactivity in Food and the Environment, 1998. RIFE 4 SEPA

CEFAS (2001) North sea fish and fisheries – Technical report TR_003. www.cefas.co.uk/media/20461/tr_003.pdf. [Date accessed August 2010]

Chapman, C.J. (2004) Northern North Sea Shellfish and Fisheries. Strategic Environmental Assessment - SEA5. Technical Report for Department of Trade & Industry
Clark, R. B. (1996) Oil Pollution. In: Marine Pollution. 3rd edition. pp 28-51.

Coull K.A., Johnstone R. and Rogers S.I. (1998) Fisheries Sensitivity Maps in British Waters. UKOOA Ltd.

Daan, N., P. J. Bromley, J. R. G. Hislop and N. A. Nielsen (1990). Ecology of North Sea Fish. Netherlands Journal of Sea Research. 26(2-4). 343-386

Davidson N.C., d'A Laffoley D., Doody J.P., Way L.S., Gordon J., Key R., Pienkowski M. W., Mitchell, R. and Duff K. L. (1991). Nature conservation and estuaries in Great Britain. Peterborough: Nature Conservancy Council.

DECC (2010). The Renewable Energy Strategy. http://www.decc.gov.uk/en/content/cms/what_we_do/uk_supply/energy_mix/renewable/res/res.aspx. [Date accessed August 2010]

DECC 2010
http://www.decc.gov.uk/assets/decc/What%20we%20do/UK%20energy%20supply/237-annual-energy-statement-2010.pdf

Defra, CEFA and DfT (2004) Offshore wind farms: guidance note for Environmental Impact Assessment in respect of FEPA and CPA requirements: Version 2

Defra (2005) Nature Conservation Guidance on Offshore Wind Farm Development

DTI (2001). Strategic Environmental Assessment of the Mature Areas of the Offshore North Sea – SEA 2. Consultation Document. Report to the Department of Trade and Industry, September 2001.

DTI (2004). SEA 5: Strategic Environmental Assessment of Parts of the Northern and Central North Sea to the East of the Scottish Mainland, Orkney and Shetland. Department of Trade and Industry.

Eleftheriou A., Basford D. and Moore D.C. (2004). Synthesis of information on the Benthos of Area SEA 5. Strategic Environmental Assessment – SEA5 – benthos. A review on behalf of the Dept. of Trade and Industry.

EWEA (2008).. Wind at Work.
http://www.ewea.org/fileadmin/ewea_documents/documents/publications/Wind_at_work_FINAL.pdf [Accessed July 2010]

FRS (2006). Video survey, Assessment of the Level of Contaminants and Epifauna trawls in Aberdeen Bay.

FRS (2010). Website: http://www.marlab.ac.uk/ [Date accessed: May 2010].

General Register Office for Scotland (2010). Household Projections for Scotland 2008-based. http://www.gro-scotland.gov.uk/statistics/publications-and-data/household-projections-statistics/hproj-08-based/index.html [Accessed July 2010]

Gill AB, Gloyne-Phillips IT, Neal KJ & Kimber JA (2005). The potential effects of electromagnetic fields generated by sub-sea power cables associated with offshore wind farm developments on electrically and magnetically sensitive marine organisms – a review. Report to COWRIE, London,90pp. SAME REPORT??

Gill AB, Huang Y, Gloyne-Phillips I, Metcalfe J, Spencer J & Wearmouth V (2008). COWRIE 2.0 Electromagnetic Fields (EMF) Phase 2. Contract No COWRIE-EMF-1-06. Draft Final Report.

Gill, A.B., Huang, Y., Gloyne-Philips, I., Metcalfe, J., Quayle, V., Spencer, J. & Wearmouth, V. (2009). COWRIE 2.0 Electromagnetic Fields (EMF) Phase 2: EMF-sensitive fish response to EM emissions from sub-sea electricity cables of the type used by the offshore renewable energy industry. Commissioned by COWRIE Ltd (project reference COWRIE-EMF-1-06).

GWEA (2008). Global Wind Energy Outlook 2008.
http://www.gwec.net/fileadmin/documents/GWEO08-graphs/GWEO_A4_2008_42b.jpg [Accessed July 2010]

Halcrow Crouch, 1999. Aberdeen Bay Coastal Protection Study. Final Report. Unpublished report to Aberdeen City Council, Scottish Natural Heritage and Grampian Enterprise. September 1999. Aberdeen City Council, Aberdeen.

Hammond, P. S., Gordon, J. C. D., Grellier, K., Hall, A. J., Northridge, S. P., Thompson, D. & Harwood, J. (2001). Background Information on Marine Mammals relevant to SEA2. Technical report produced for Strategic Environmental Assessment - SEA2. DTI Technical Report TR_006.

Hammond, P.S., Berggren, P., Benke, H., Borchers, D.L., Collet, A., Heide-Jorgensen, M.P., Heimlich, S., Hiby, A.R., Leopold, M.F. & Oien, N. (2002). Abundance of harbour porpoises and other cetaceans in the North Sea and adjacent waters. Journal of Applied Ecology 39: 361-376.

Hammond, P.S., Northridge, S.P., Thompson, D., Gordon, J.C.D., Hall, A.J., Sharples, R.J., Grellier, K. & Matthiopoulos, J. (2004). Background Information on Marine Mammals relevant to SEA5. Technical report produced for Strategic Environmental Assessment – SEA5 to the DTI. Sea Mammal Research Unit.

Hart J.R. (1971). The distribution of intertidal macrofauna on Aberdeen Beach with particular reference to Nerine cirratulus (Delle Chiaje) and Haustorius arenarius (Slabber). BSc dissertation, University of Aberdeen, Department of Zoology.

HR Wallingford (1997). Shoreline Management Plans.

ICES (International Council for the Exploration of the Sea) (2006). ICES Cooperative Research Report No 281: Zooplankton monitoring results in the ICES area, Summary Status Report 2004/2005, Sept. 2006, pp.19-21.

IMO (1989). The International Maritime Organisation Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone.
http://www.imo.org/environment/mainframe.asp?topic_id=1026 [Accessed August 2010]

Innes, M.(1991) The movement of Gannets, Cormorants and Shags off Peterhead, Grampian. North-East Scotland Bird Report 1990. North-East Scotland Bird Club

Innes, M. (1992) The movement of Procellariiformes off Peterhead, Grampian. North-East Scotland Bird Report 1991. North-East Scotland Bird Club

Innes, M.(1993) The movement of skuas off Peterhead, Grampian. North-East Scotland Bird Report 1992. North-East Scotland Bird Club

Innes, M. (1994) The movement of gulls and terns off Peterhead, Grampian. North-East Scotland Bird Report 1993. North-East Scotland Bird Club

Jack J. (1890). Marine algae of the Arbroath district. Journal of Botany, 28 10-15.
Jensen. H., Per Sand K. PS and Hoffmann. E. (2004) Sandeels in the wind farm area at Horns Reef Compiled by Danish Institute for Fisheries Research Depart of Marine Fisheries. Report to ELSAM August 2004. Final report.

JNCC (Joint Nature Conservation Committee) (2010) http://www.jncc.gov.uk [Date accessed – May/June 2010]

JNCC (Joint Nature Conservation Committee) (2009) Species pages for 2007 UK BAP priority species. http://www.jncc.gov.uk/_speciespages/437.pdf [Date accessed August 2010]

Lucke, K, P.A Lepper, M Blanchet, and U. Siebert. "Testing the acoustic tolerance of harbour porpoise hearing for impulsive sounds." Bioacoustics, 2008: 329-331.

MacLeod, C.D., Hay, I. & Hepworth, K. (2007). Northern North Sea Cetacean Ferry Surveys (NORCET): An Analysis of Cetacean Information Collected in the First Five Years (2002-2006). (University of Aberdeen; East Grampian Coastal Partnership; South Grampian Seawatch Group). Unpublished Report.

Marine Scotland (2010) Draft Plan for Offshore Wind Energy in Scottish Territorial Waters www.scotland.gov.uk/Resource/Doc/312147/0098586.pdf

McIntyre A. D. (1958). The ecology of Scottish inshore fishing grounds. 1. The bottom fauna of east coast grounds. Marine Research. Vol 1. 1 – 24.

MCS (Marine Conservation Society) (2005) http://www.mcsuk.org/basking_sharks/recent_sightings.php

MCS (Marine Conservation Society) (2010) http://www.goodbeachguide.co.uk [Date accessed May 2008 and May 2010].

MetOffice Website (2010) http://www.metoffice.gov.uk/climate/uk/averages/19712000/sites/craibstone.html [Date Accessed: May, 2010].

Natural England (2010) http://www.naturalengland.org.uk/about_us/news/2010/230210.aspx [Date accessed - June 2010]

NESBiodiversity (2007) www.nesbiodiversity.org.uk North East Scotland Local Biodiversity Action Plan (LBAP) website.

North Sea Pilot (1997) – wind monitoring

Northridge, S.P., Tasker, M.L., Webb, A. & Williams, J.M. (1995). Distribution and relative abundance of harbour porpoises (Phocoena phocoena L.), white-beaked dolphins (Lagenorhynchus albirostris Gray), and minke whales (Balaenoptera acutorostrata Lacepède) around the British Isles. ICES Journal of Marine Science 52: 55-66.

OfDPM 2001 Guidance on Environmental Impact Assessment in Relation to Dredging Applications

OSPAR, 2005. Overview of past dumping at sea of chemical weapons and munitions in the OSPAR Maritime Area. ISBN 1-904426-59-X. Publication Number 2005/222.

OSPAR Commission (2000). Quality Status Report 2000, Region II - Greater North Sea. OSPAR Commission, London, 136 +xiii pp.

Pierce G.J., Bailey N., Stratoudakis Y. and Newton A. (1998). Distribution and abundance of the fished population of Loligo forbesi in Scottish waters: analysis of research cruise data. ICES Journal of Marine Science 55, 14-33.

Pierce G.J., Boyle P.R., Hastie L.C. and Key L.N. (1994a). The life history of Loligo forbesi (Cephalopoda: Loliginidae) in Scottish waters. Fisheries Research 21, 17- 41.

Pierce G.J., Hastie L.C., Guerra A., Thorpe R.S., Howard F.G. and Boyle P.R (1994b). Morphometric variation in Loligo forbesi and Loligo vulgaris: regional, seasonal, sex, maturity and worker differences. Fisheries Research 21, 127-148.

QinetiQ, 2007. Munitions contamination of marine renewable energy sites in Scottish Waters: A study for the Scottish Executive.

Reid, J.B., Evans, P.G.H. and Northridge, S.P. (Ed.) (2003). Atlas of cetacean distribution in north-west European waters. Peterborough, Joint Nature Conservation Committee, 75pp.

SAC (2006). Unpublished data for cetaceans stranded around Scotland (January 1992- August 2006). Scottish Agricultural College, Inverness.

SAS. 2009. Guidance on environmental impact assessment of offshore renewable energy development on surfing resources and recreation. Published by Surfers Against Sewage, June 2009.

Scottish Natural Heritage 2003 Marine Renewable Energy and the Natural Heritage: An Overview and Policy Statement - Note this is based upon the findings from: Scott Wilson and Downie, A.J. (2003). A review of possible marine renewable energy development projects and their natural heritage impacts from a Scottish perspective. Scottish Natural Heritage Commissioned Report FO2AA414.

Seaton P.J.G. (1975). A preliminary study of the meiofauna of Collieston Beach. BSc dissertation, University of Aberdeen, Department of Zoology.

SCANSII (2006). SCANS II: Small Cetaceans in the European Atlantic and North Sea, Quarterly Newsletter Issue 7: June 2006. Accessed online on August 2008: http://biology.st-andrews.ac.uk/scans2/inner-background.html

Scott KE, Anderson C, Dunsford H, Benson JF and McFarlane R (2005). An assessment of the sensitivity and capacity of the Scottish seascape in relation to offshore wind farms. Scottish Natural Heritage Commissioned Report No. 103 (ROAME No. FO3AA06).

Scottish Executive (2006). Extraction of minerals by marine dredging. Consultation Paper. ISBN. 0-7559-6186-2.

Scottish Government (2010). Renewables Action Plan, Renewable Energy Division, June 2009. http://www.scotland.gov.uk/Resource/Doc/278424/0083663.pdf. [Date accessed August 2010]

SNH (2006) Moray Firth Special Area of Conservation, Advice under Regulation 33(2) of The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended). http://www.snh.org.uk/pdfs/about/directives/Moray_Firth.pdf. [Date accessed August 2010]

SCOS (2008). http://www.smru.st-andrews.ac.uk/pageset.aspx?psr=411 [Date accessed: September 2008].

SeaWatch (2008). http://www.seawatchfoundation.org.uk/ [Date accessed: September 2008].

Sini, M.I., Canning, S.J., Stockin, K.A. & Pierce, G.J. (2005). Bottlenose dolphins around Aberdeen Harbour, north-east Scotland: a short study of habitat utilization and the potential effects of boat traffic. Journal of the Marine Biological Association of the United Kingdon, 85: 1547-1554.

Southall, B.L, et al. "Marine mammal noise exposure criteria: Initial scientific recommendations." Aquatic Mammals 33(4), 2007: 411-521.

Stephen A.C. (1922).

Stephen A.C. (1933). Studies on the Scottish marine fauna: the natural faunistic divisions of the North Sea as shown by the quantitative distribution of the molluscs. Transactions of the Royal Society of Edinburgh, Vol 57. 601 – 616.

Stephen A.C. (1934). Studies on the Scottish marine fauna: quantitative distributions of the echinoderms and natural faunistic divisions of the North Sea. Transactions of the Royal Society of Edinburgh, Vol 57. 777 – 787.

Stephen A.C. (1944). The cephalopoda of Scottish and adjacent waters. Transactions of the Royal Society of Edinburgh 61, 247-270

Stockin, K.A., Weir, C.R. and Pierce, G.J. (2006). Examining the importance of Aberdeenshire coastal waters for North Sea bottlenose dolphins (Tursiops truncatus). Journal of the Marine Biological Association of the UK, 86: 201-207.

Stone, C.J. (2003). The effects of seismic activity on marine mammals in UK waters, 1998-2000. JNCC Report No. 323.

Stowasser G., Pierce G.J., Wang J. and Begona Santos M. (2004) An overview of cephalopods relevant to the SEA5 Area. Strategic Environmental Assessment – SEA5 – cephalopods. A review on behalf of the Dept. of Trade and Industry

Swaby S.E. and Potts G.W. (1996). Fish: other species. In: JH Barne, CF Robson, SS Kaznowska, JP Doody and NC Davidson Eds. Coasts and seas of the United Kingdom. Region 3 North-east Scotland: Cape Wrath to St. Cyrus. Joint Nature Conservation Committee, Peterborough, pp. 109-111.

Swaby S.E. and Potts G.W. (1997a). Fish: other species. In: JH Barne, CF Robson, SS Kaznowska, JP Doody, NC Davidson and AL Buck Eds. Coasts and seas of the United Kingdom. Region 1 Shetland. Joint Nature Conservation Committee, Peterborough, pp. 105-107.

Swaby S.E. and Potts G.W. (1997b). Fish: other species. In: JH Barne, CF Robson, SS Kaznowska, JP Doody, NC Davidson and AL Buck Eds. Coasts and seas of the United Kingdom. Region 2 Orkney. Joint Nature Conservation Committee, Peterborough, pp.99-100.

Swaby S.E. and Potts G.W. (1997c). Fish: other species. In: JH Barne, CF Robson, SS Kaznowska, JP Doody, NC Davidson and AL Buck Eds. Coasts and seas of the

United Kingdom. Region 4 South-east Scotland: Montrose to Eyemouth. Joint Nature Conservation Committee, Peterborough, pp.107-108.

UKDMAP (1998). United Kingdom Digital Marine Atlas – An atlas of the seas around the British Isles. Third Edition, British Oceanographic Data Centre: Birkenhead.

Visit Scotland (2008). Visit Scotland Regional Facts and Figures. http://www.visitscotland.org/research_and_statistics/tourism_statistics/regional_facts___figures.aspx. [Date accessed August 2010]

Weir, C.R., and Stockin, K.A. (2001). The occurrence and distribution of the bottlenose dolphin (Tursiops truncatus) and other cetacean species in the coastal waters of Aberdeenshire. Sea Watch Foundation Report to Shell UK Exploration and Production.

Weir, C.R. and Stockin, K.A. (2002). Seasonal occurrence of the white-beaked dolphin (Lagenorhynchus albirostris) in coastal Aberdeenshire waters, North-east Scotland. Proceedings of the 16th Annual Conference of the European Cetacean Society, Liege, Belgium, 7-11 April 2002.

Weir, C.R., Stockin, K.A. and Pierce, G.J. (2007). Spatial and temporal trends in the distribution of harbour porpoises, white-beaked dolphins and minke whales off Aberdeenshire (UK), north-western North Sea. Journal of the Marine Biological Association of the UK, 87: 327-338.

Wernham, C.V., Toms, M.P., Marchant, J.H., Clark, J.A, Siriwardena, G.M. and Baillie, S.R. (eds). (2002) The Migration Atlas: movement of the birds of Britain and Ireland. T & AD Poyser.

Wilson, B., Reid, R.J., Grellier, K., Thompson, P.M. & Hammond, P.S. (2004). Considering the temporal when managing the spatial: a population range expansion impacts protected areas based management for bottlenose dolphins. Animal Conservation 7: 331–338.

9 APPENDIX

9.1 Calculations

Based on RenewableUK's calculation for wind energy statistics 100 MW installed capacity is estimated to produce about 260 GWh electricity per year (100 MW * 0.3 capacity factor * 8760 h/yr = 262,800 MWh ie 263 GWh).

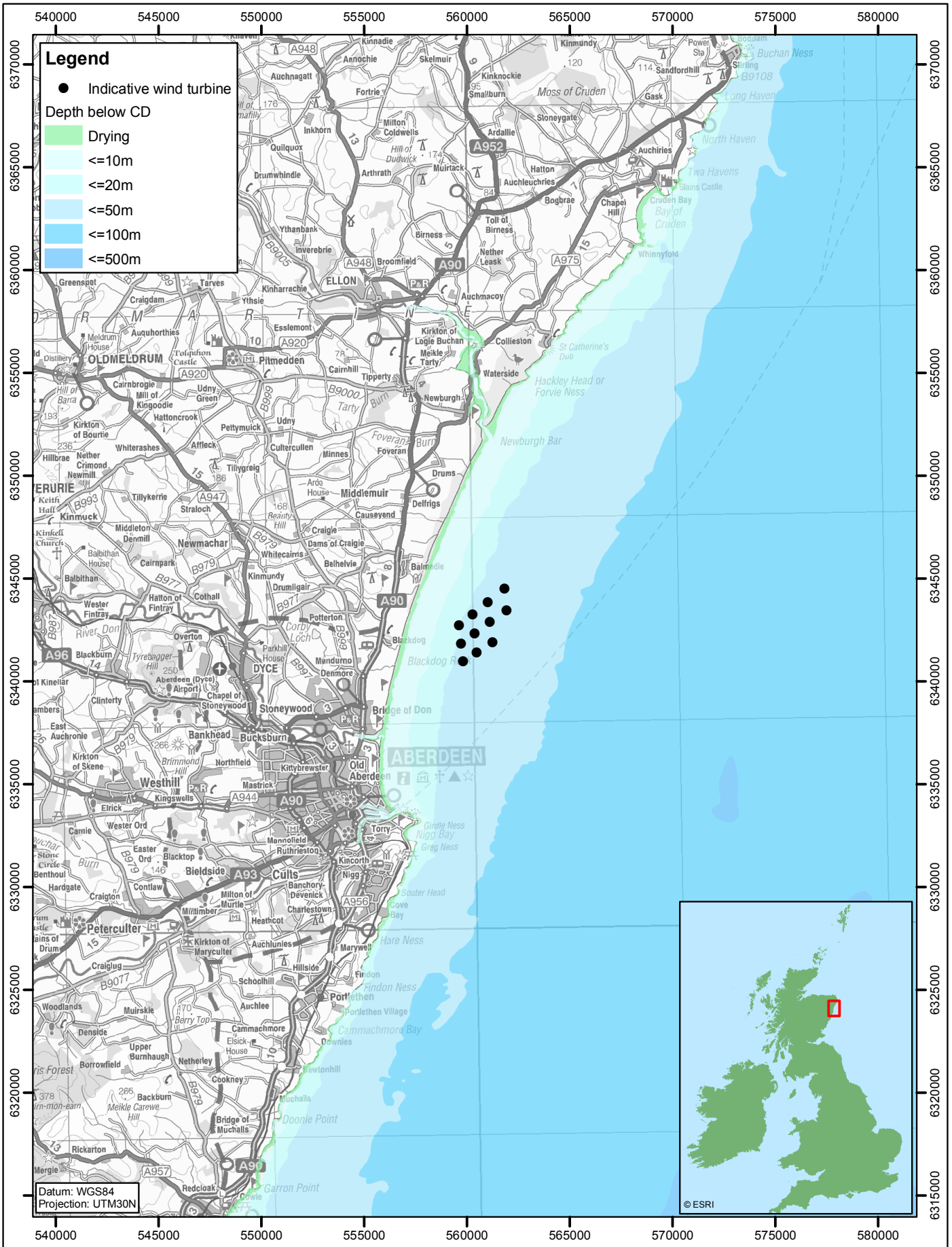
Please note that this assumes a capacity factor of 30 %, however in the offshore environment it is likely to be higher which would give a greater production of electricity. The following is stated by RenewableUK: "This is only an average estimation given that in many places, particularly Scotland and offshore, the wind speeds are higher leading to a greater electricity production per turbine, as power output is a cube of the wind speed." (http://www.bwea.com/edu/calcs.html)

According to RenewableUK an average UK household makes use of 4,700 kWh per year for household electricity. This means that 55,300 households can get their household electricity from EOWDC (260 GWh / 4,700 kWh = 55,319 ie 55,300 households).

Share of households that would have been provided with electricity from the EWODC in 2008: 55,300/102,900[3]= 53 %

Estimated share of households provided with electricity from the EOWDC in 2013: 55,300/108,150 = 51 %

[3] This assumes number of households in Aberdeen was 102,900 in 2008. This is based on the "Household Projections for Scotland 2008-based" from the General Register Office for Scotland (2010).



0 0.5 1 nm 0 1 2 km

Original A4 Plot Scale 1:250,000

VATTENFALL

areg Aberdeen Renewable Energy Group

Vattenfall Wind Power Ltd.
Bridge End, Hexham, NE46 4NU, United Kingdom,
Tel +44 (0) 1434 611300, Fax +44 (0) 1434 611301

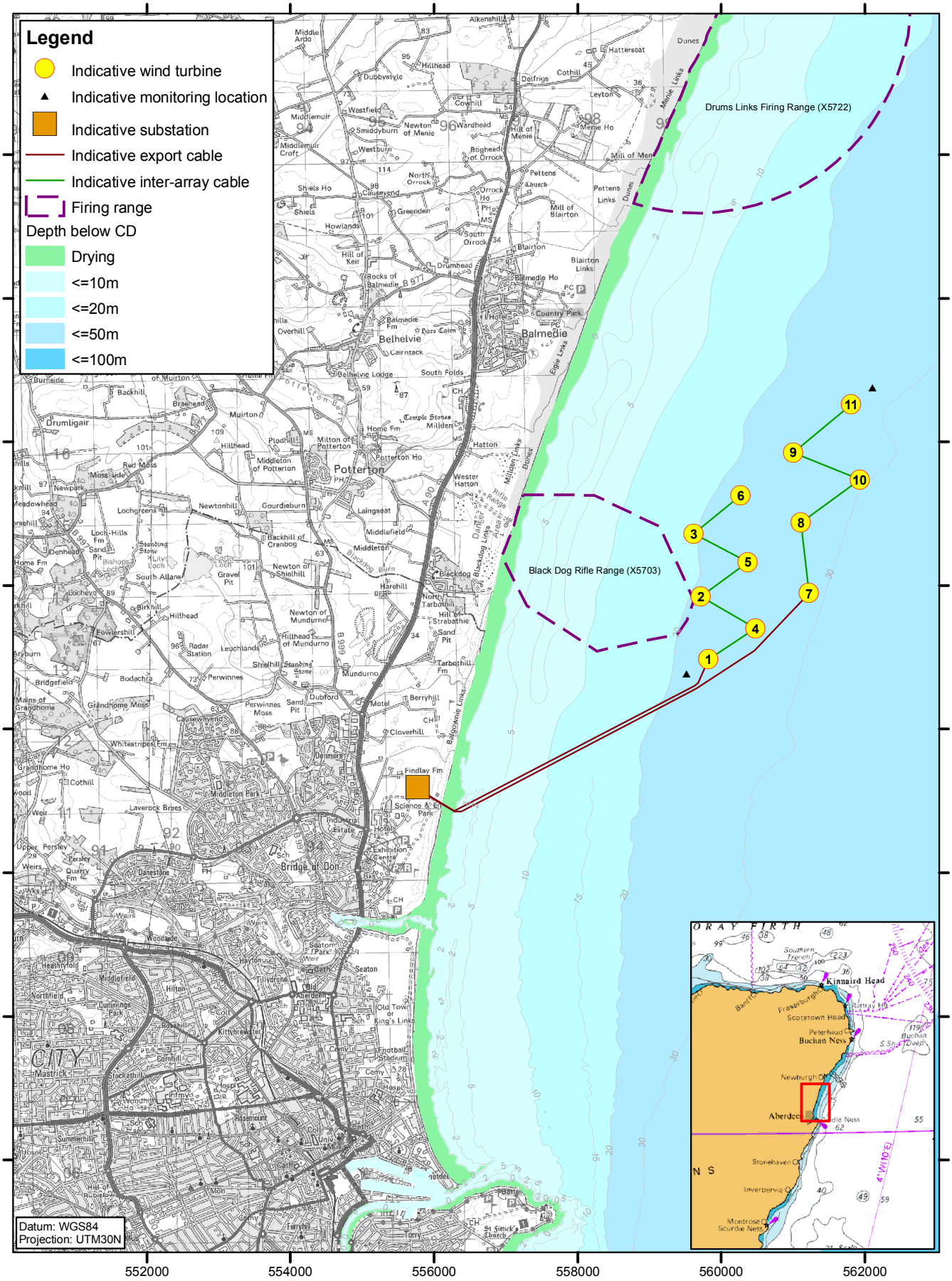
Rev	Date	By	Comment
A	16/08/10	LH	First Issue

European Offshore Wind Deployment Centre

Site Location

Layout	Date	Rev	Dwg No.
LABER039	16/08/2010	A	6129-521-PA-001

Figure 1



0 0.25 0.5 nm 0 0.5 km

Original A4 Plot Scale 1:75,000

VATTENFALL

areg Aberdeen Renewable Energy Group

Vattenfall Wind Power Ltd, Bridge End, Hexham, NE46 4NU, United Kingdom. Tel +44 (0) 1434 611300. Fax +44 (0) 1434 611301

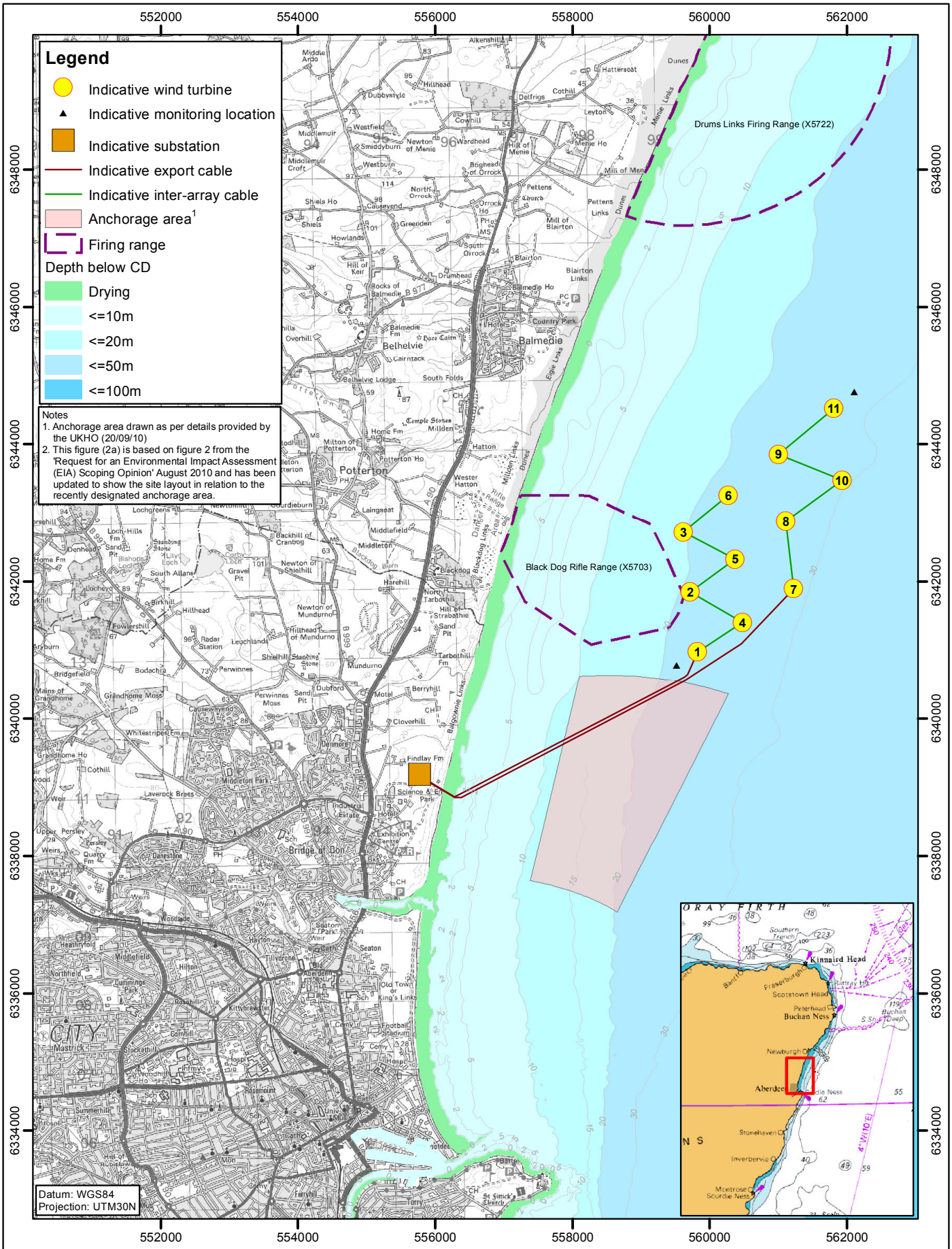
Rev	Date	By	Comment
A	16/08/10	LH	First Issue

European Offshore Wind Deployment Centre

Site Layout

Layout	Date	Rev	Dwg No.
LABER039	16/08/10	A	6129-521-PA-002

Figure 2



0 0.25 0.5 nm 0 0.5 km Original A4 Plot Scale 1:75,000

VATTENFALL

areg Aberdeen Renewable Energy Group

Vattenfall Wind Power Ltd, Bridge End, Hexham, NE46 4NU, United Kingdom. Tel +44 (0) 1434 611300. Fax +44 (0) 1434 611301

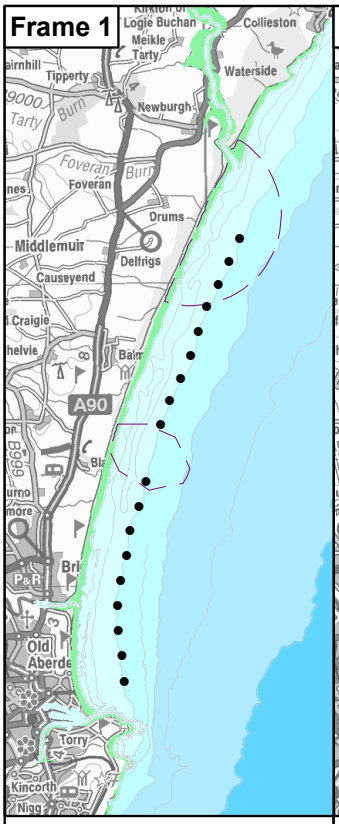
Rev	Date	By	Comment
A	07/10/10	LH	First Issue

European Offshore Wind Deployment Centre

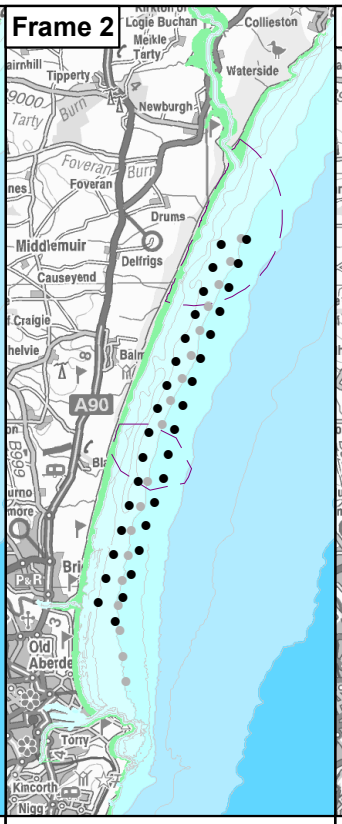
Site Layout

Layout	Date	Rev	Dwg No.
LABER039	07/10/10	A	6129-521-PA-023

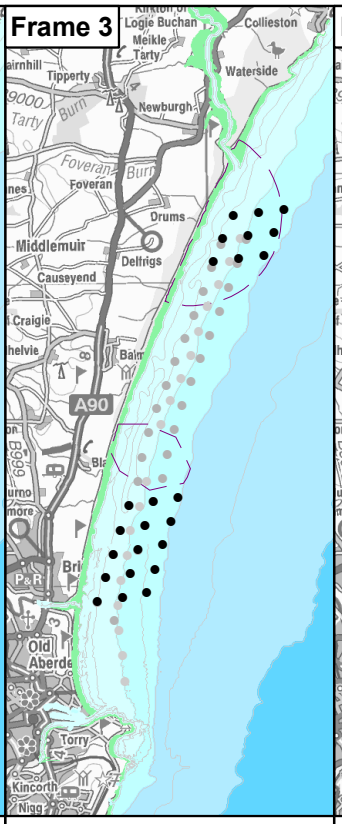
Figure 2a



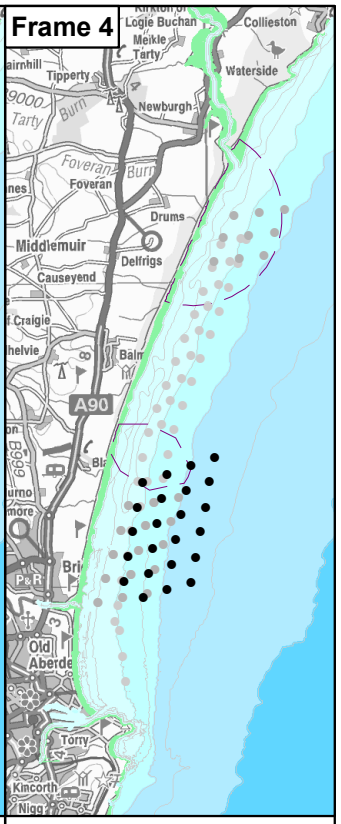
Layout ref.: LABER002
Date: October 2004



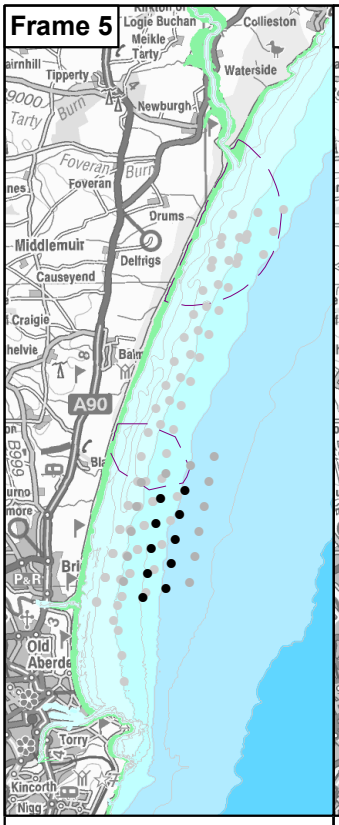
Layout ref.: LABER007
Date: February 2005



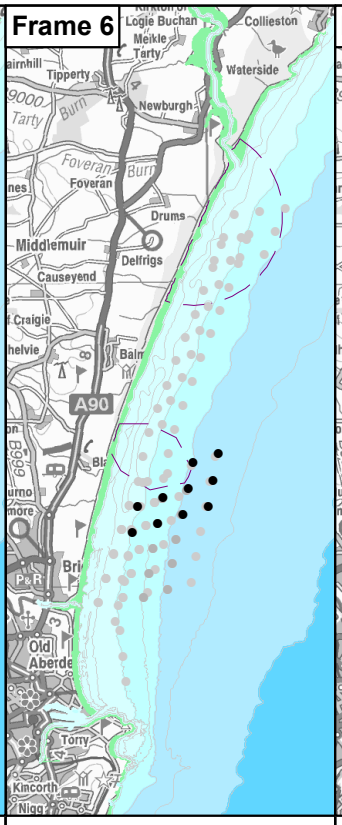
Layout ref.: LABER008
Date: September 2005



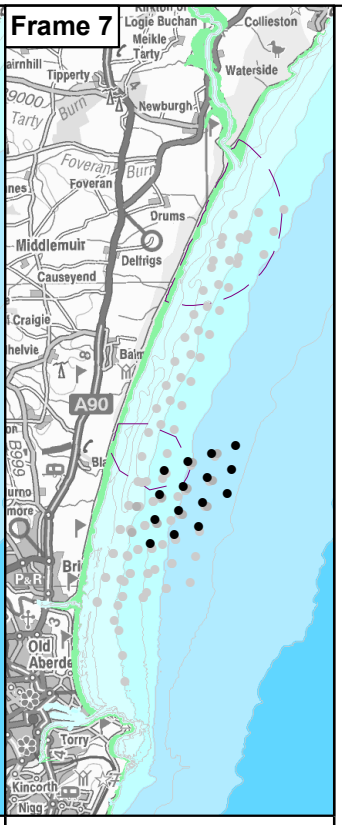
Layout ref.: LABER011
Date: January 2006



Layout ref.: LABER012
Date: September 2008



Layout ref.: LABER015
Date: March 2009



Layout ref.: LABER021
Date: September 2009

Legend

- Wind turbine
- Wind turbine from previous frame
- Wind turbine from prior frames (composite)
- Firing range

Depth below CD

- Drying
- <=10m
- <=20m
- <=50m
- <=100m

Datum: WGS84
Projection: UTM30N

See Figure 4 for further layout iterations.

See Figure 5 for composite display of layout iterations.

0 0.5 1 1.5 nm 0 1 2 km Original A4 Plot Scale 1:250,000

VATTENFALL

areg Aberdeen Renewable Energy Group

Vattenfall Wind Power Ltd,
Bridge End, Hexham, NE46 4NU, United Kingdom.
Tel +44 (0) 1434 611300, Fax +44 (0) 1434 611301

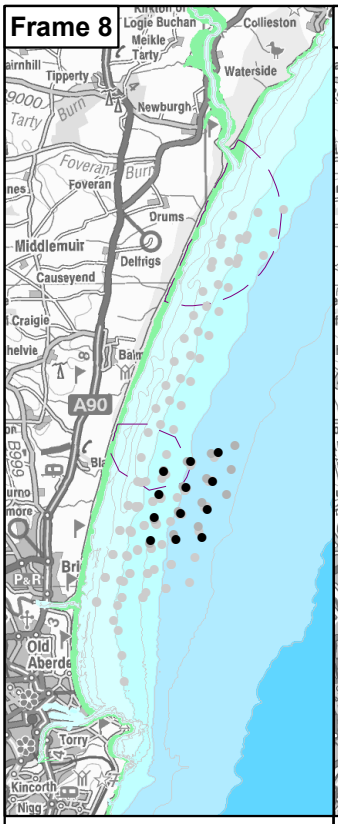
Rev	Date	By	Comment
A	16/08/10	LH	First Issue.

European Offshore Wind Deployment Centre

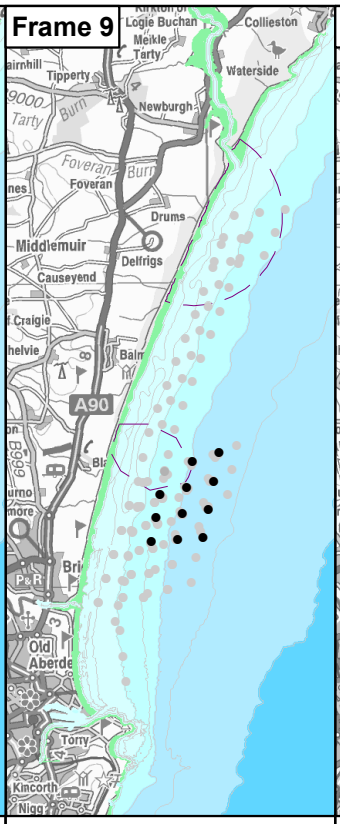
Site Iterations: 2002 to 2009

Layout	Date	Rev	Dwg No.
Multiple	16/08/2010	A	6129-521-PA-015

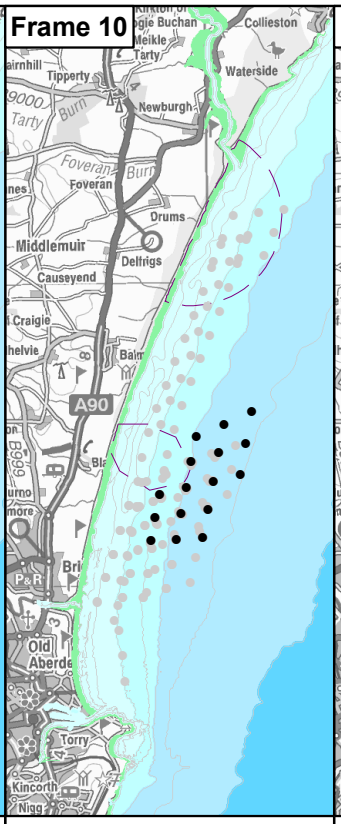
Figure 3



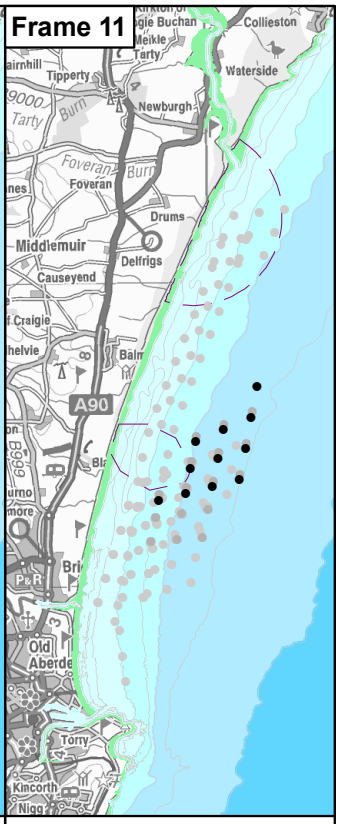
Layout ref.: LABER027
Date: October 2009



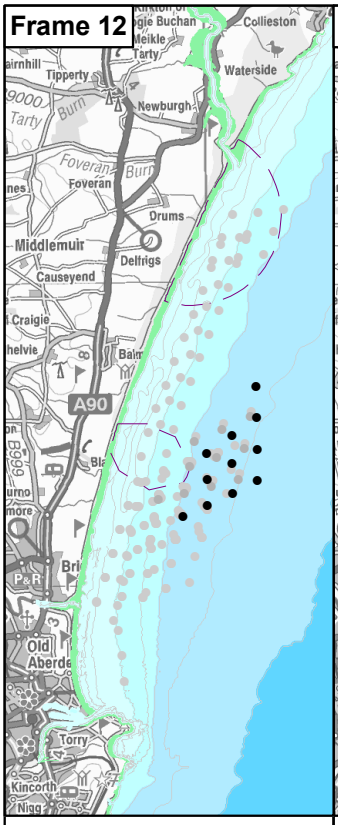
Layout ref.: LABER028
Date: November 2009



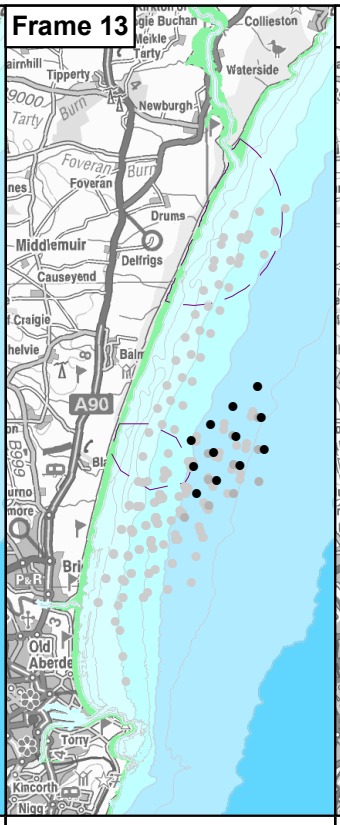
Layout ref.: LABER032
Date: April 2010



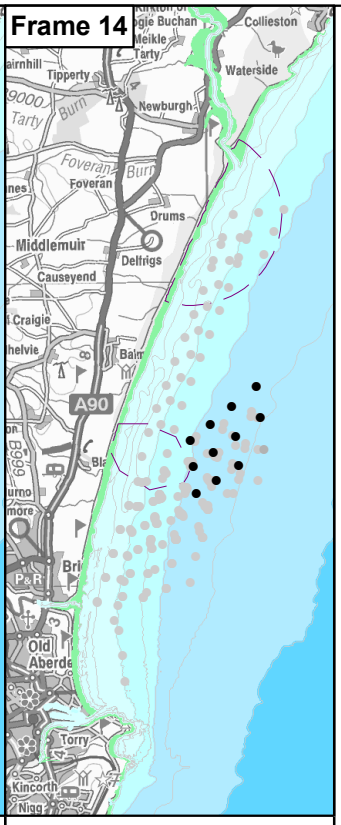
Layout ref.: LABER033
Date: April 2010



Layout ref.: LABER034
Date: April 2010



Layout ref.: LABER037
Date: April 2010



Layout ref.: LABER039
Date: April 2010

Legend

- Wind turbine
- Wind turbine from previous frame
- Wind turbine from prior frames (composite)
- Firing range

Depth below CD

- Drying
- <=10m
- <=20m
- <=50m
- <=100m

Datum: WGS84
Projection: UTM30N

See Figure 3 for prior layout iterations.

See Figure 5 for composite display of layout iterations.

0 0.5 1 1.5 nm 0 1 2 km Original A4 Plot Scale 1:250,000

VATTENFALL

areg Aberdeen Renewable Energy Group

Vattenfall Wind Power Ltd,
Bridge End, Hexham, NE46 4NU, United Kingdom.
Tel +44 (0) 1434 611300, Fax +44 (0) 1434 611301

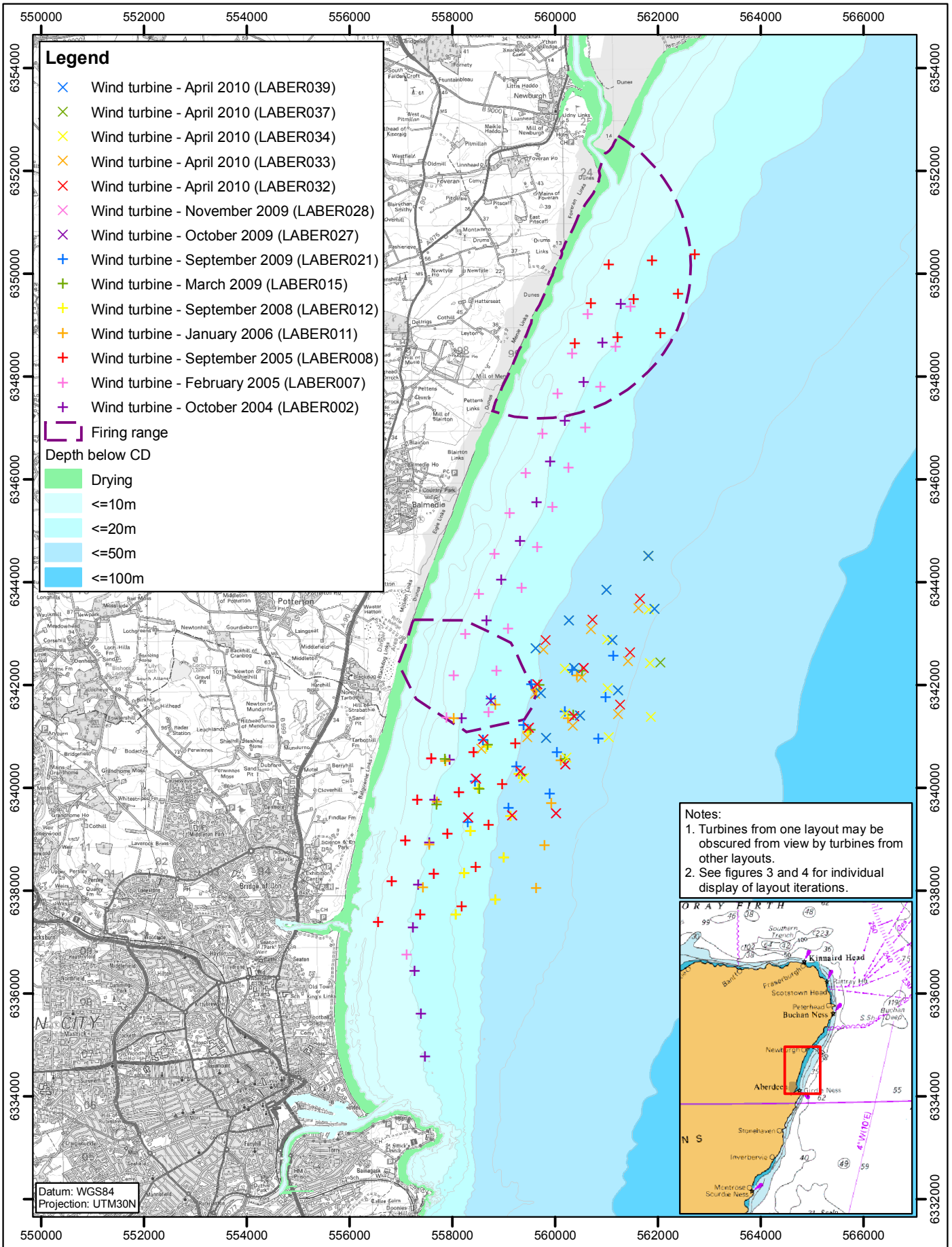
Rev	Date	By	Comment
A	16/08/10	LH	First Issue.

European Offshore Wind Deployment Centre

Site Iterations: 2009 - 2010

Layout	Date	Rev	Dwg No.
Multiple	16/08/2010	A	6129-521-PA-016

Figure 4



0 0.25 0.5 nm 0 0.5 1 km
Original A4 Plot Scale 1:100,000

VATTENFALL

areg
Aberdeen Renewable Energy Group

Vattenfall Wind Power Ltd,
Bridge End, Hexham, NE46 4NU, United Kingdom.
Tel +44 (0) 1434 611300, Fax +44 (0) 1434 611301

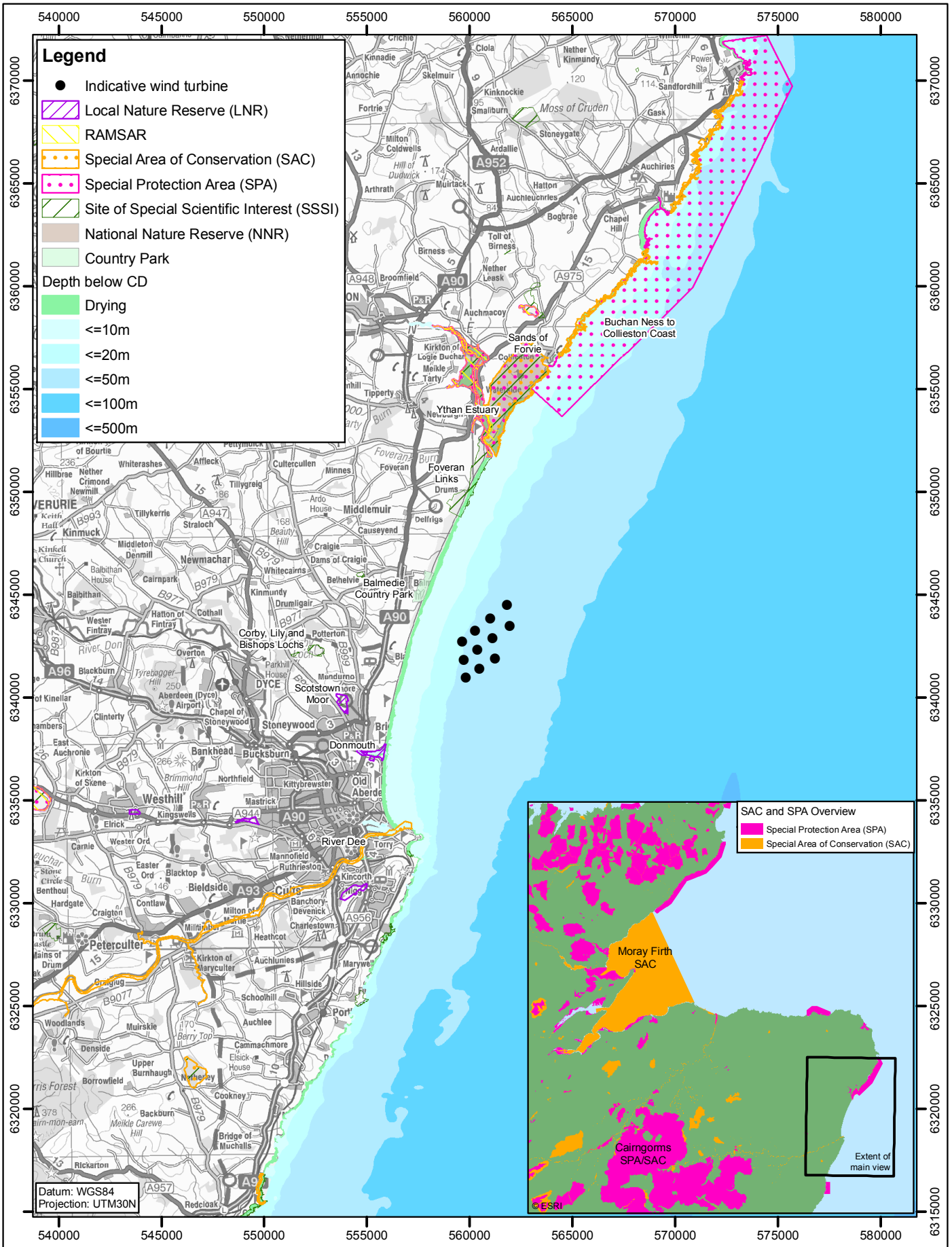
Rev	Date	By	Comment
A	16/08/10	LH	First Issue.

European Offshore Wind Deployment Centre

Site Iterations - Composite

Layout	Date	Rev	Dwg No.
Multiple	16/08/2010	A	6129-521-PA-007

Figure 5



0 0.5 1 nm 0 1 2 3 km
Original A4 Plot Scale 1:250,000

VATTENFALL

areg Aberdeen Renewable Energy Group

Vattenfall Wind Power Ltd, Bridge End, Hexham, NE46 4NU, United Kingdom. Tel +44 (0) 1434 611300. Fax +44 (0) 1434 611301

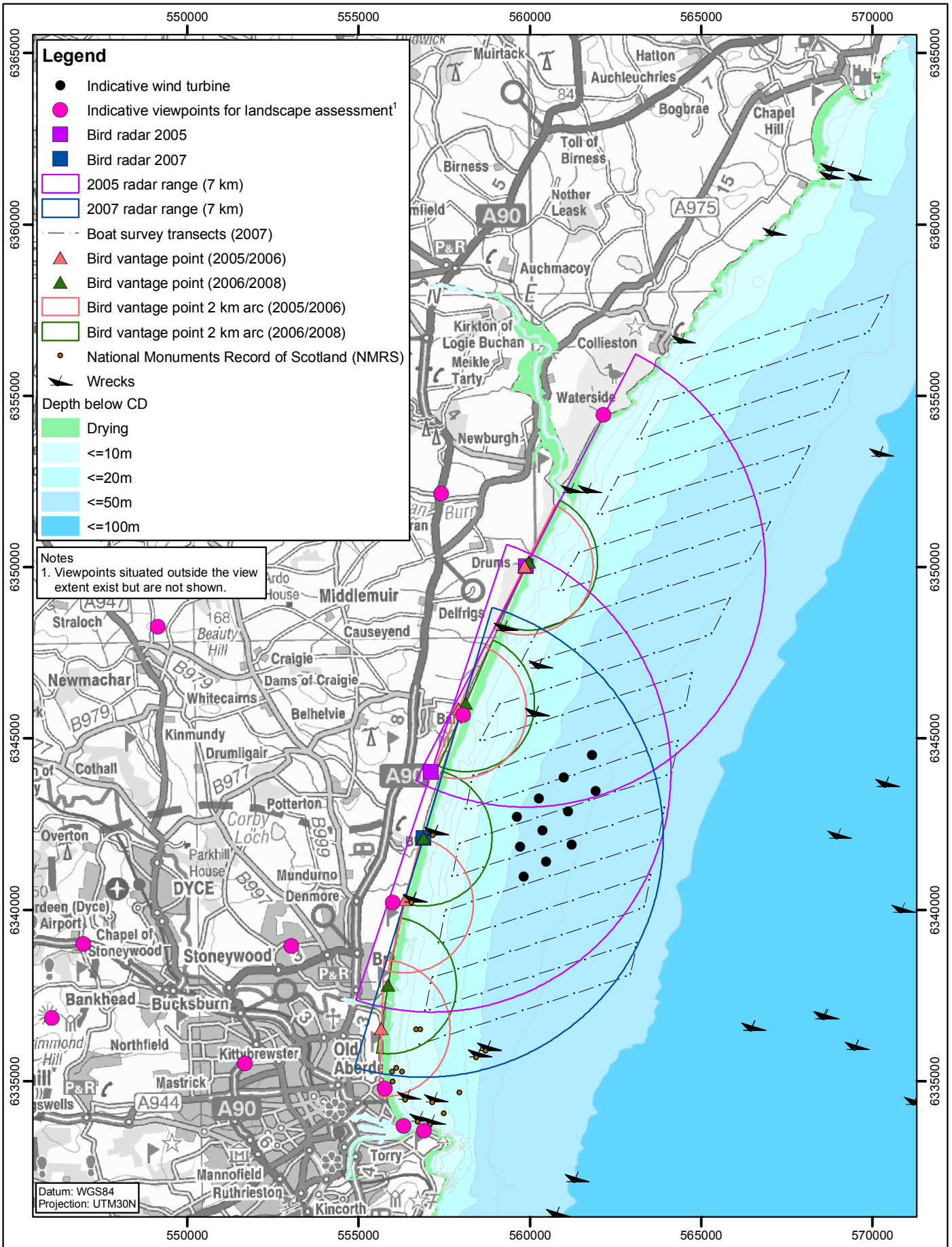
Rev	Date	By	Comment
A	16/08/10	LH	First Issue.

European Offshore Wind Deployment Centre

Designations

Layout	Date	Rev	Dwg No.
LABER039	16/08/2010	A	6129-521-PA-008

Figure 6



0 0.5 1 nm 0 1 2 km Original A4 Plot Scale 1:150,000

VATTENFALL

areg Aberdeen Renewable Energy Group

Vattenfall Wind Power Ltd, Bridge End, Hexham, NE46 4NU, United Kingdom. Tel +44 (0) 1434 611300, Fax +44 (0) 1434 611301

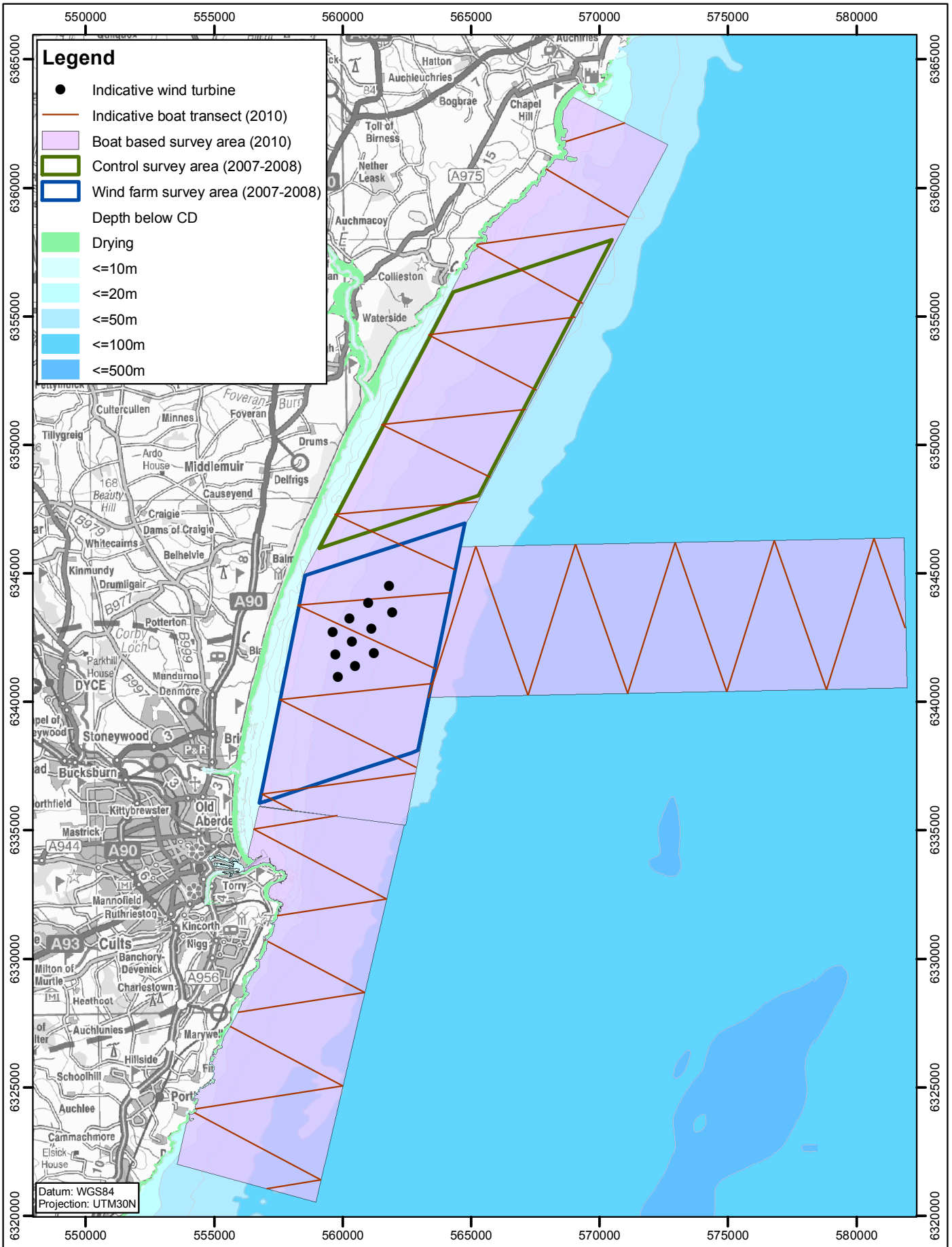
Rev	Date	By	Comment
A	16/08/10	LH	First Issue

European Offshore Wind Deployment Centre

Environmental Studies

Layout	Date	Rev	Dwg No.
LABER039	16/08/2010	A	6129-521-PA-011

Figure 7



0 0.5 1 nm

0 1 2 km

Original A4 Plot Scale 1:200,000

VATTENFALL

areg Aberdeen Renewable Energy Group

Vattenfall Wind Power Ltd, Bridge End, Hexham, NE46 4NU, United Kingdom. Tel +44 (0) 1434 611300, Fax +44 (0) 1434 611301

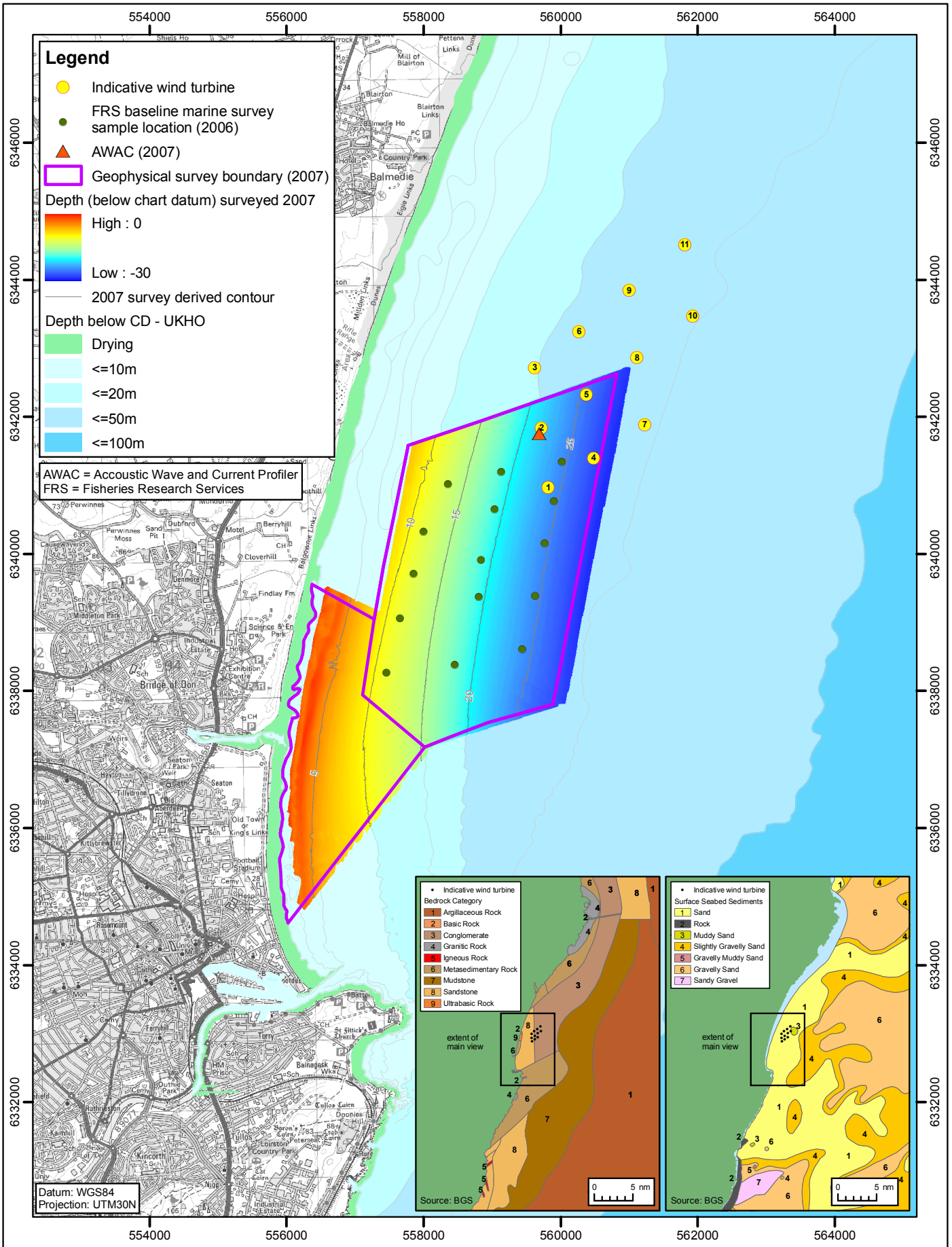
Rev	Date	By	Comment
A	16/08/10	LH	First Issue.

European Offshore Wind Deployment Centre

Boat Based Survey Areas

Layout	Date	Rev	Dwg No.
LABER039	16/08/2010	A	6129-521-PA-019

Figure 8



0 0.25 0.5 nm 0 0.5 km Original A4 Plot Scale 1:75,000

VATTENFALL

areg Aberdeen Renewable Energy Group

Vattenfall Wind Power Ltd, Bridge End, Hexham, NE46 4NU, United Kingdom. Tel +44 (0) 1434 611300, Fax +44 (0) 1434 611301

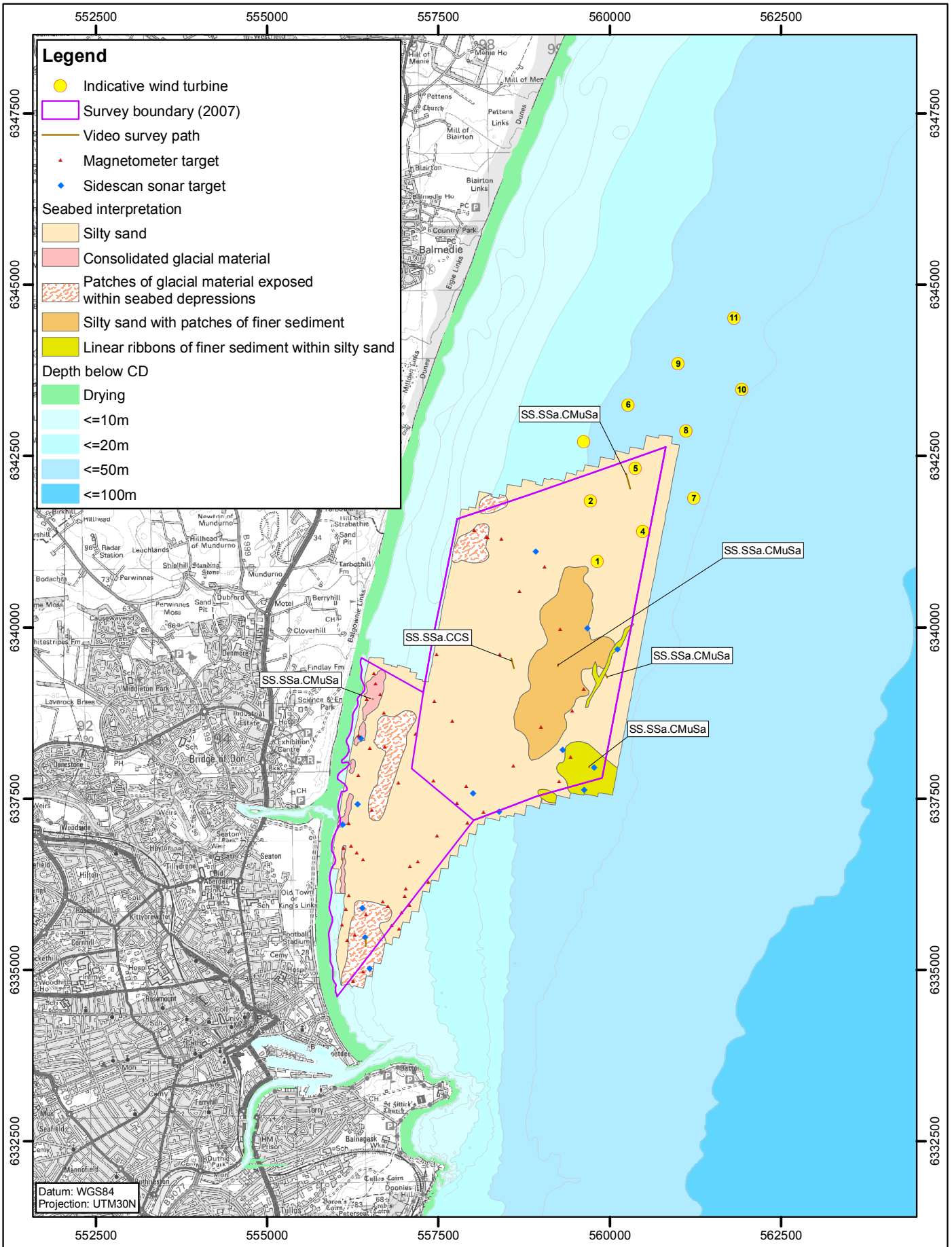
Rev	Date	By	Comment
A	16/08/10	LH	First Issue.

European Offshore Wind Deployment Centre

Seabed Characteristics

Layout	Date	Rev	Dwg No.
LABER039	16/08/2010	A	6129-521-PA-010

Figure 9



0 0.5 nm 0 0.5 1 km Original A4 Plot Scale 1:75,000

VATTENFALL

areg Aberdeen Renewable Energy Group

Vattenfall Wind Power Ltd, Bridge End, Hexham, NE46 4NU, United Kingdom. Tel +44 (0) 1434 611300. Fax +44 (0) 1434 611301

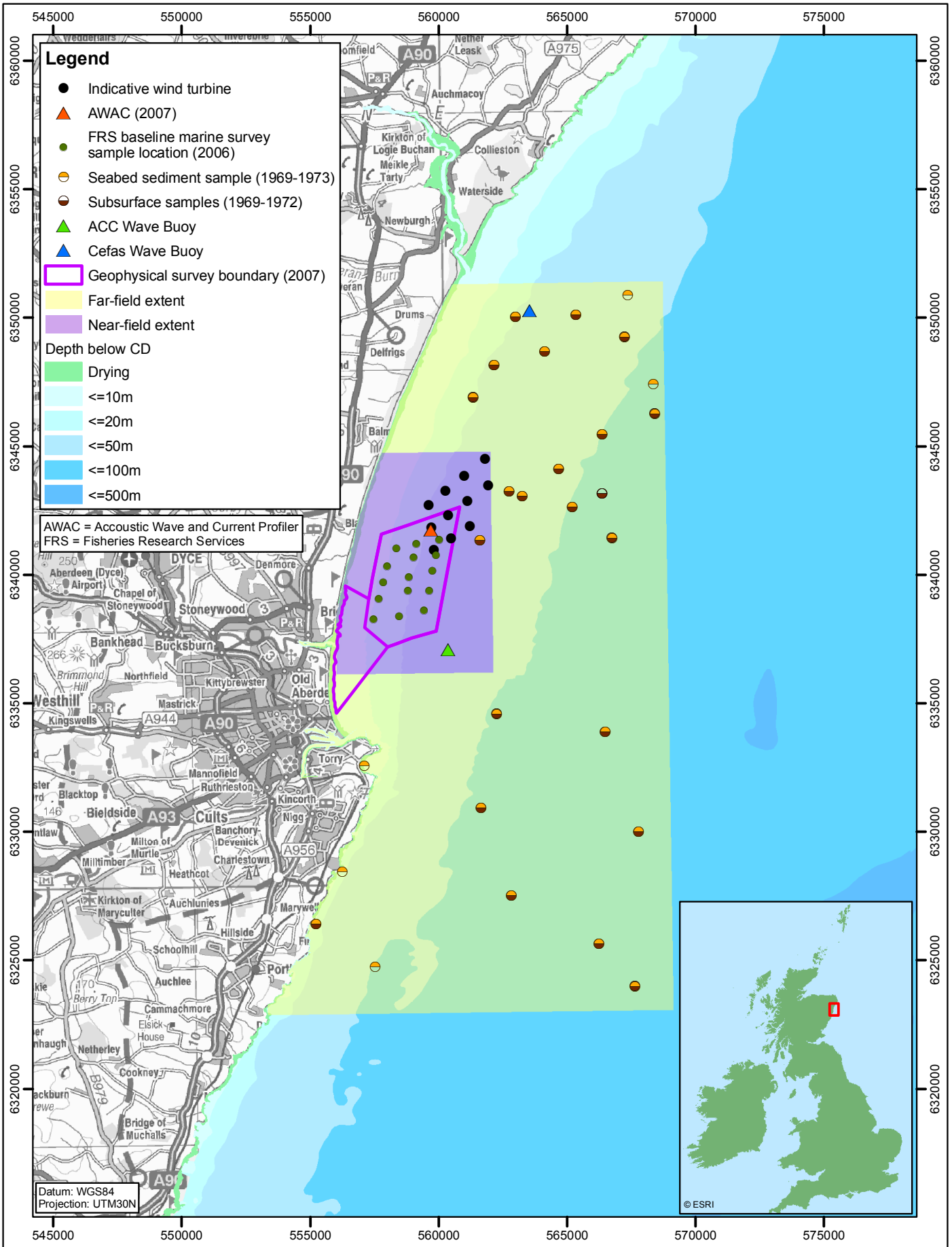
Rev	Date	By	Comment
A	16/08/10	LH	First Issue.

European Offshore Wind Deployment Centre

Benthic Habitats of 2007 Survey Area

Layout	Date	Rev	Dwg No.
LABER039	16/08/2010	A	6129-521-PA-014

Figure 10



0 0.5 1 nm 0 1 2 km

Original A4 Plot Scale 1:200,000

VATTENFALL

areg Aberdeen Renewable Energy Group

Vattenfall Wind Power Ltd, Bridge End, Hexham, NE46 4NU, United Kingdom, Tel +44 (0) 1434 611300, Fax +44 (0) 1434 611301

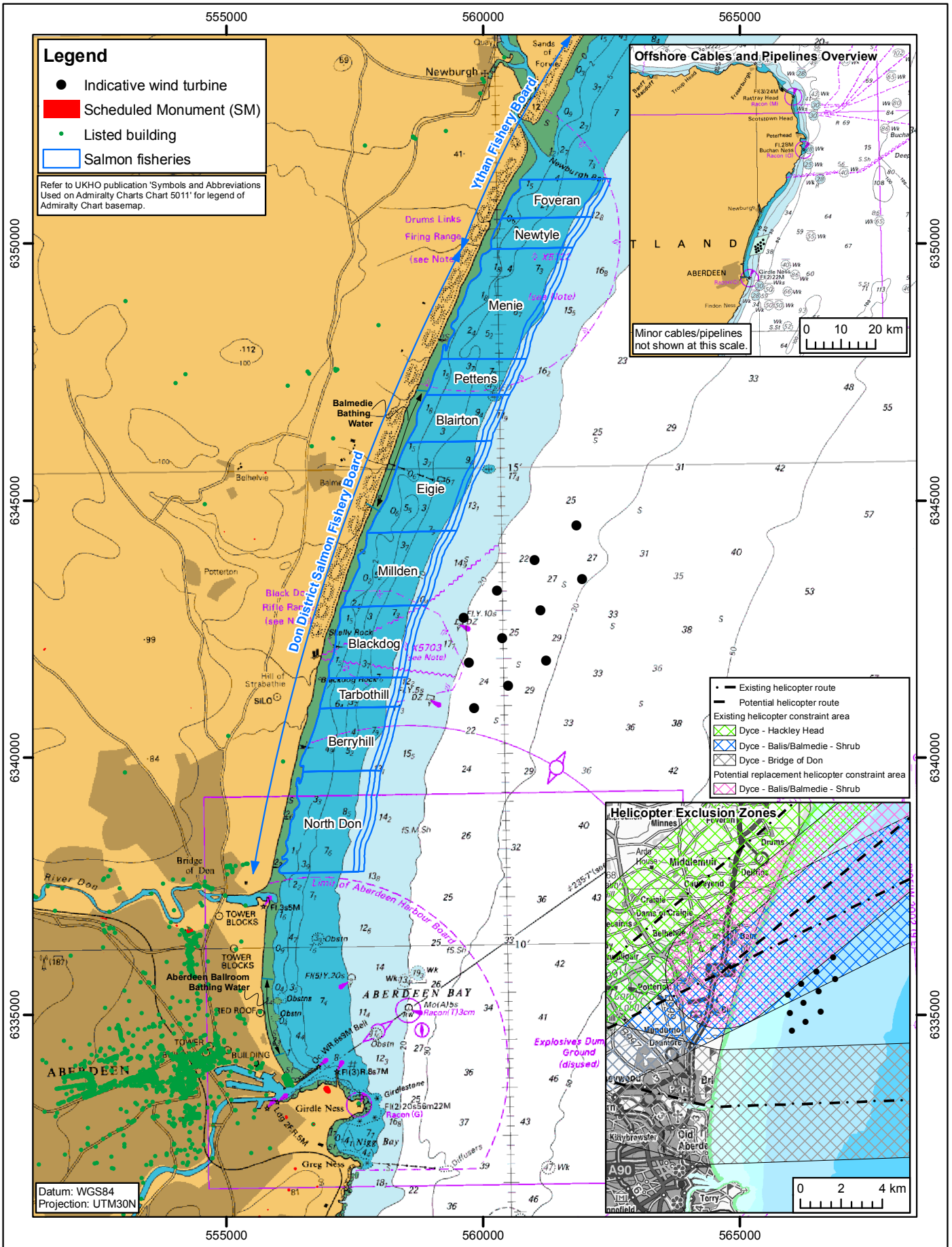
Rev	Date	By	Comment
A	16/08/10	LH	First Issue.

European Offshore Wind Deployment Centre

Coastal Process Modelling Data

Layout	Date	Rev	Dwg No.
LABER039	16/08/2010	A	6129-521-PA-017

Figure 11



0 0.25 0.5 nm 0 0.5 1 km
Original A4 Plot Scale 1:100,000

VATTENFALL

areg Aberdeen Renewable Energy Group

Vattenfall Wind Power Ltd, Bridge End, Hexham, NE46 4NU, United Kingdom. Tel +44 (0) 1434 611300. Fax +44 (0) 1434 611301

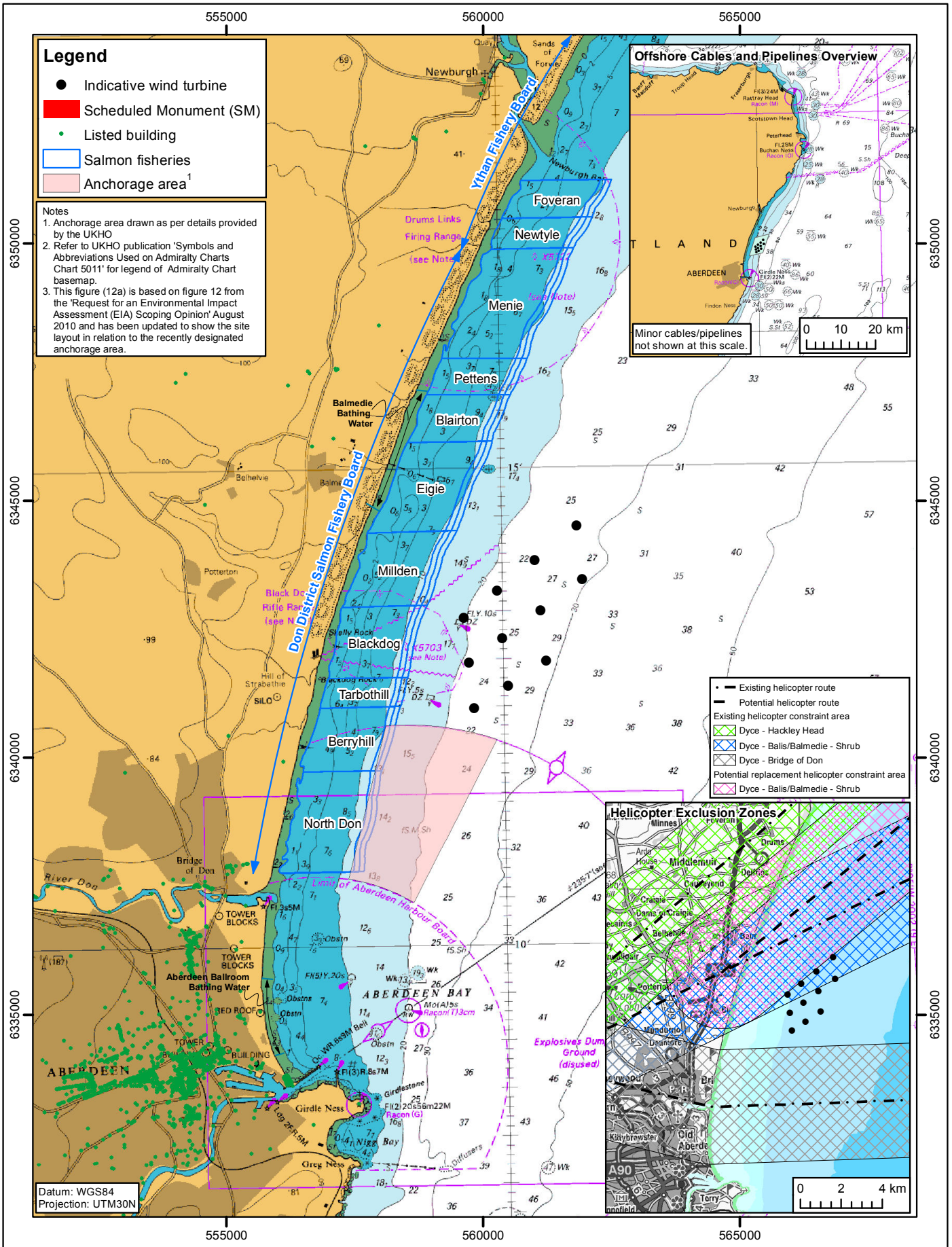
Rev	Date	By	Comment
A	16/08/10	LH	First Issue.

European Offshore Wind Deployment Centre

Other Marine Users

Layout	Date	Rev	Dwg No.
LABER039	16/08/2010	A	6129-521-PA-009

Figure 12



0 0.25 0.5 nm 0 0.5 1 km
Original A4 Plot Scale 1:100,000

VATTENFALL

areg Aberdeen Renewable Energy Group

Vattenfall Wind Power Ltd, Bridge End, Hexham, NE46 4NU, United Kingdom. Tel +44 (0) 1434 611300. Fax +44 (0) 1434 611301

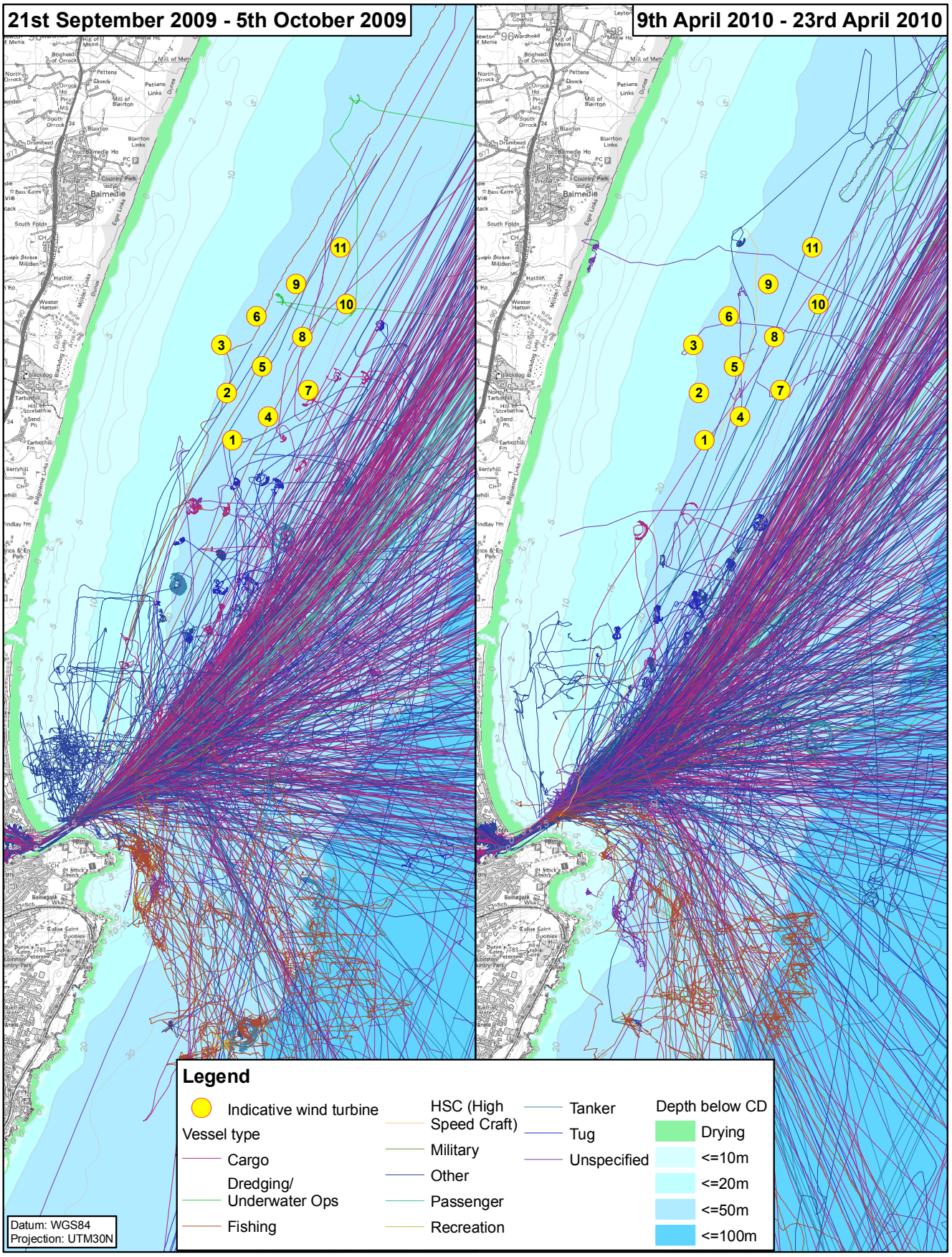
Rev	Date	By	Comment
A	07/10/10	LH	First Issue.

European Offshore Wind Deployment Centre

Other Marine Users

Layout	Date	Rev	Dwg No.
LABER039	07/10/2010	A	6129-521-PA-024

Figure 12a



0 0.25 0.5 nm 0 0.5 km

Original A4 Plot Scale 1:100,000

VATTENFALL

areg Aberdeen Renewable Energy Group

Vattenfall Wind Power Ltd, Bridge End, Hexham, NE46 4NU, United Kingdom. Tel +44 (0) 1434 611300, Fax +44 (0) 1434 611301

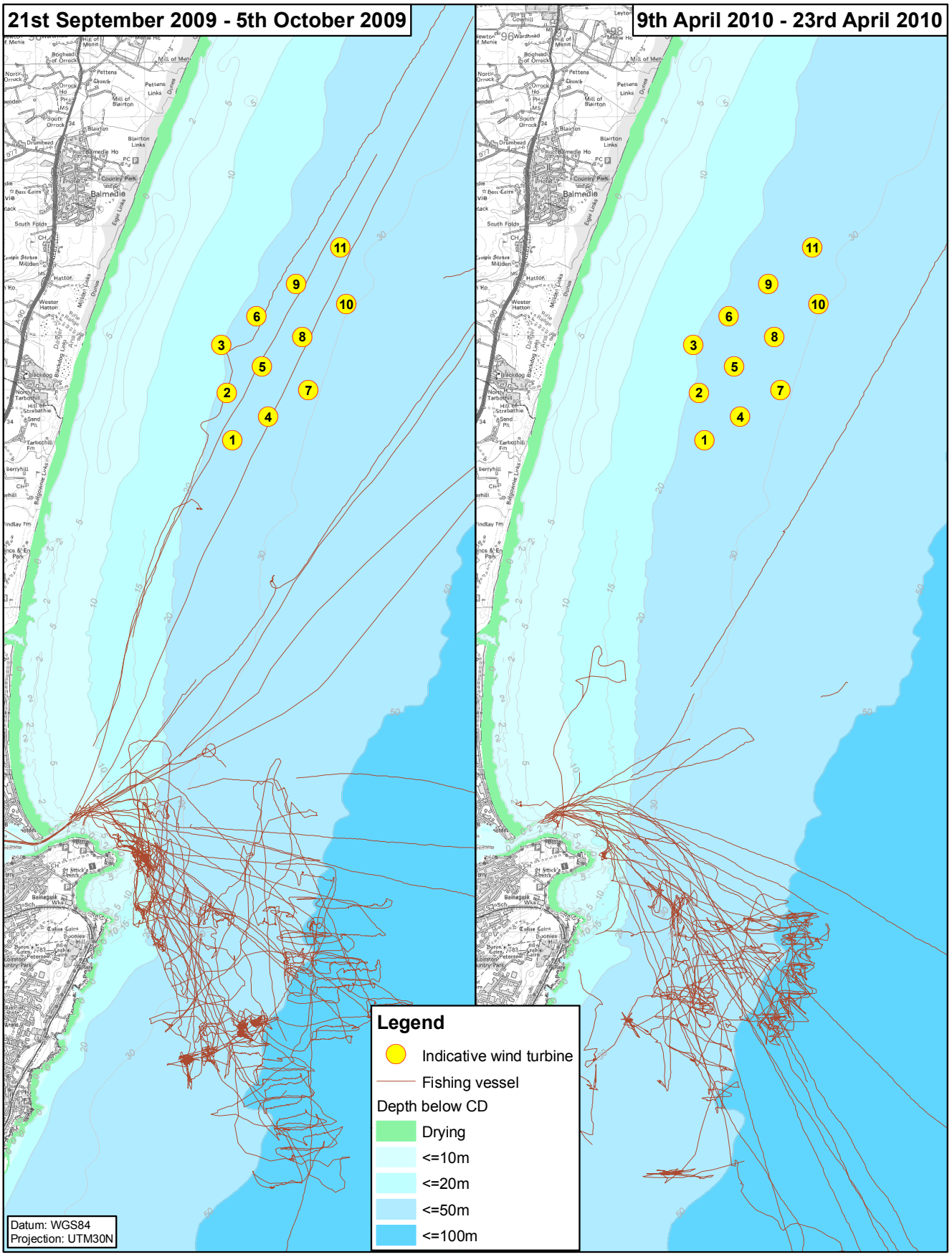
Rev	Date	By	Comment
A	16/08/10	LH	First Issue.

European Offshore Wind Deployment Centre

Shipping Activity Surveys (All Vessels)

Layout	Date	Rev	Dwg No.
LABER039	16/08/2010	A	6129-521-PA-012

Figure 13



0 0.25 0.5 nm 0 0.5 km

Original A4 Plot Scale 1:100,000

VATTENFALL

areg Aberdeen Renewable Energy Group

Vattenfall Wind Power Ltd, Bridge End, Hexham, NE46 4NU, United Kingdom. Tel +44 (0) 1434 611300, Fax +44 (0) 1434 611301

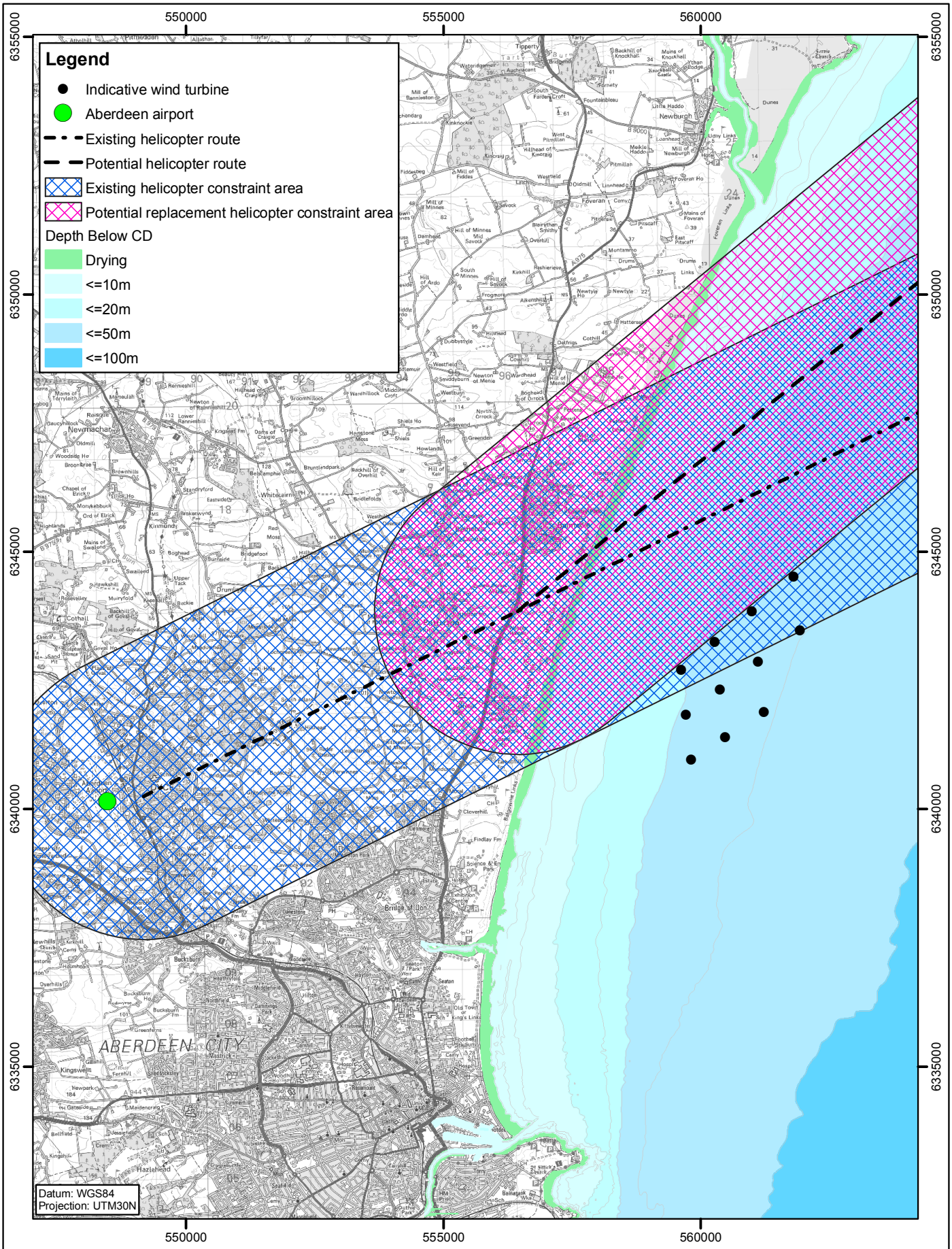
Rev	Date	By	Comment
A	16/08/10	LH	First Issue.

European Offshore Wind Deployment Centre

Shipping Activity Surveys (Fishing Vessels)

Layout	Date	Rev	Dwg No.
LABER039	16/08/2010	A	6129-521-PA-013

Figure 14



0 0.25 nm
0 0.5 1 km
Original A4 Plot Scale 1:100,000

VATTENFALL

areg
Aberdeen Renewable Energy Group

Vattenfall Wind Power Ltd,
Bridge End, Hexham, NE46 4NU, United Kingdom,
Tel +44 (0) 1434 611300, Fax +44 (0) 1434 611301

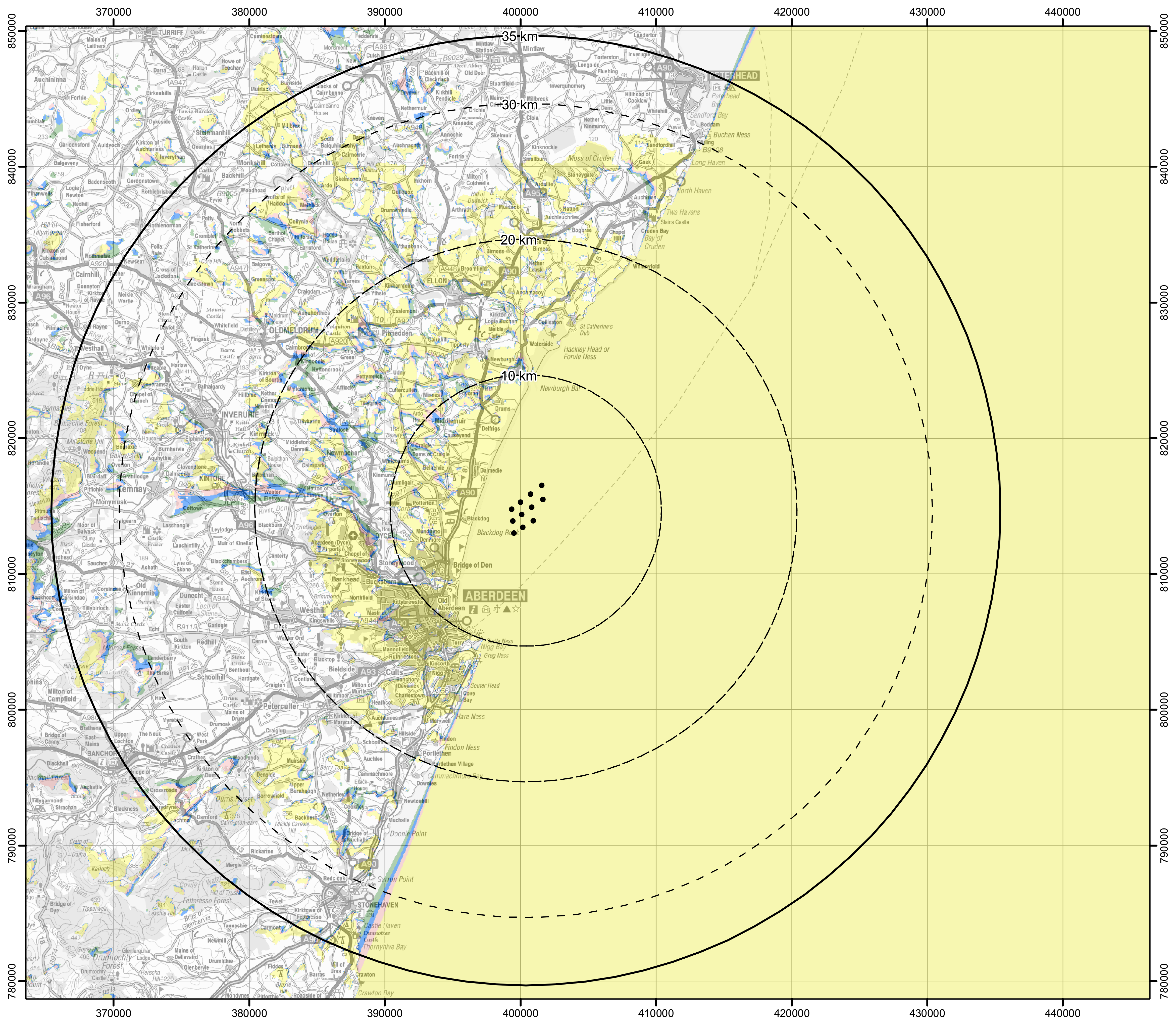
Rev	Date	By	Comment
A	16/08/10	LH	First Issue

European Offshore Wind Deployment Centre

Dyce - Balis/Balmedie - Shrub Helicopter Route

Layout	Date	Rev	Dwg No.
LABER039	16/08/2010	A	6129-521-PA-018

Figure 15



areg
Aberdeen Renewable Energy Group

VATTENFALL

European Offshore Wind Deployment Centre

Zone of Theoretical Visibility to Tip Height (195 m above L.A.T.)

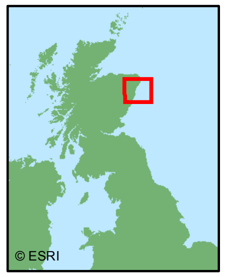
Legend

● Indicative wind turbine

Theoretical Visibility to Turbine Tip Height (195 m above L.A.T.)

🟩 1 - 3 wind turbines may be visible
🟦 4 - 6 wind turbines may be visible
🟥 7 - 9 wind turbines may be visible
🟨 10 - 11 wind turbines may be visible

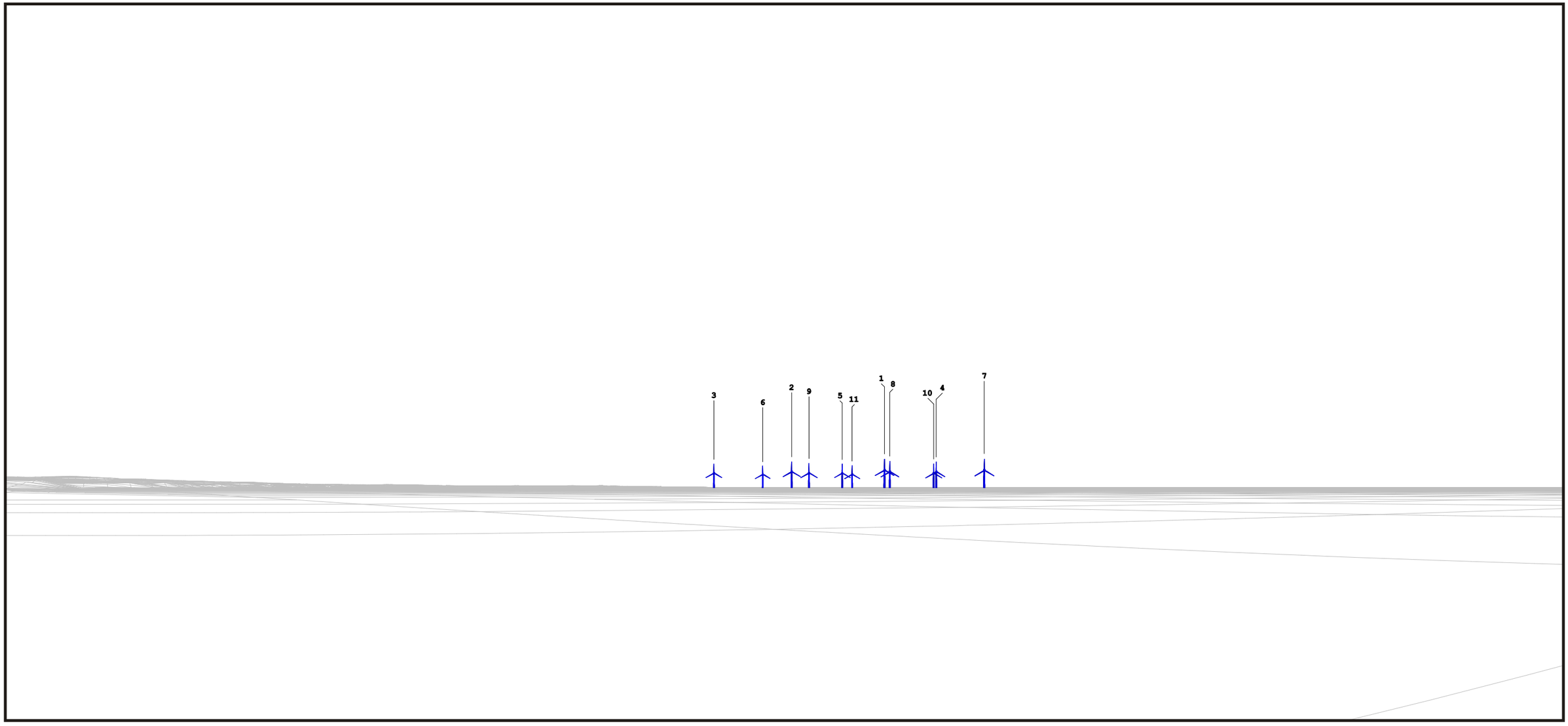
Notes
1. Calculated using Earth's curvature (radius 6367 km) and atmospheric refraction coefficient of 0.075.
2. Terrain data is derived from Ordnance Survey 50 m gridded height data.
3. ZTV calculation does not take into account any surface features such as trees and buildings.
4. Tip height - 192.85 m
5. ZTV view height - 2 m
6. ZTV calculation resolution - 50 m
7. Heights are above Ordnance Datum unless otherwise stated
8. Layout - LABER039.WFL
9. ZTV Run File - ZABER005.WFZ



0 1 2 3 km
0 1 2 nm

Drg No	6129 - 521 - PA - 020		
Rev	A	Date	12/08/10
By	LH	Layout	LABER039

Figure 16



European Offshore Wind Deployment Centre

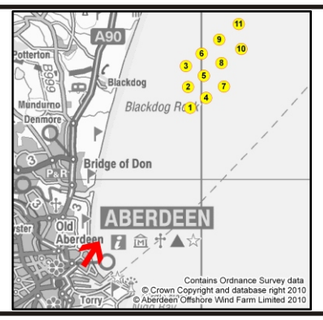
areg
Aberdeen Renewable Energy Group

VATTENFALL

Grid Reference: NJ9536806893
Terrain Height (ODN): 0 m
View Direction: 30º
Angle Of View: 67º
Observer Height: 2 m
Viewing Distance: 330 mm
Nearest Turbine: 7.4 km
Turbine Numbers 1 - 6:
Hub Height: 100 m / Rotor Diameter: 120 m
Turbine Numbers 7 - 11:
Hub Height: 120 m / Rotor Diameter: 150 m

Drg No: 6129-521-PA-021-A
Date: 13th August 2010
Layout ref: LABER039_SCOPING2
Viewpoints ref: VABER008
Earth's curvature: 6367 km
Atmospheric refraction coeff: 0.075

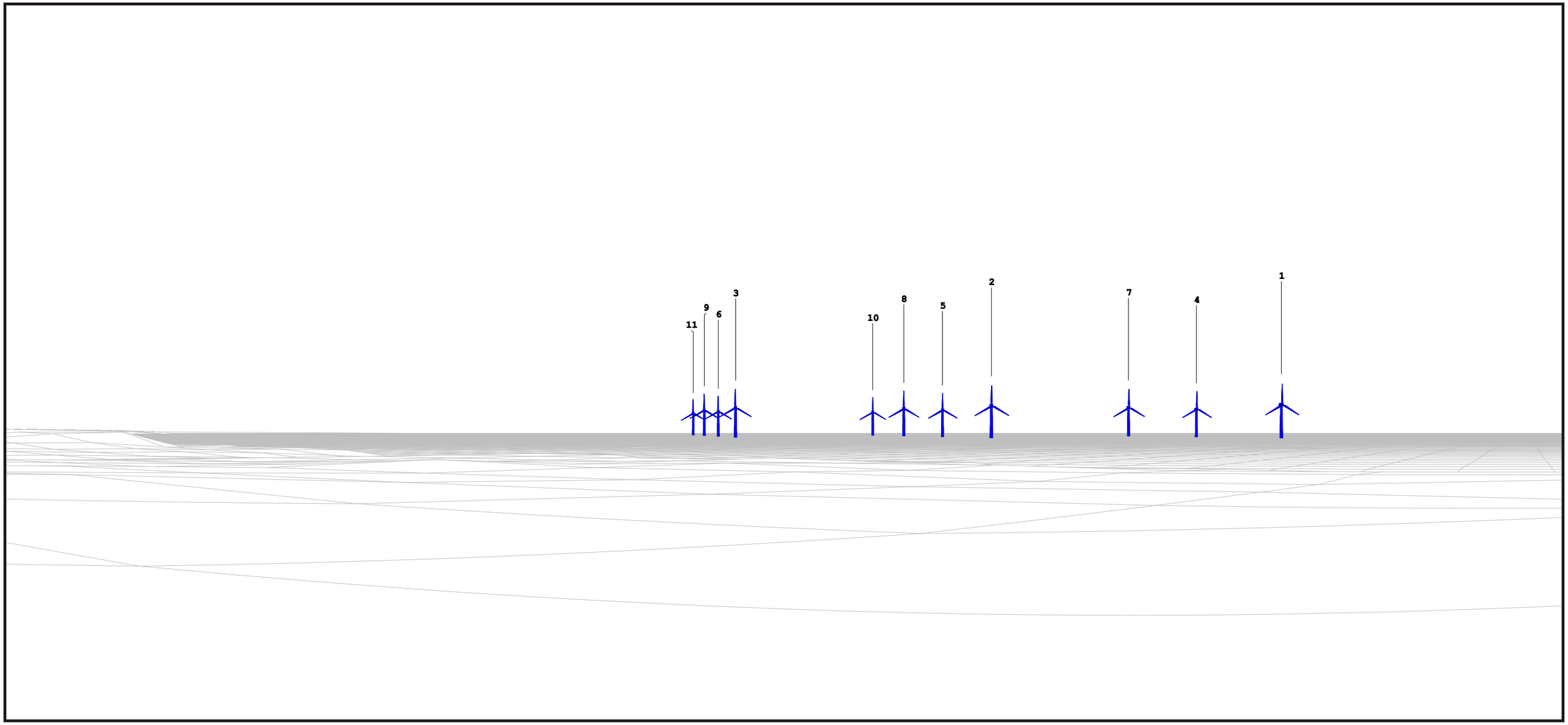
Hub heights are above L.A.T.



Viewpoint 1

View from Aberdeen Beach

Figure 17



European Offshore Wind Deployment Centre

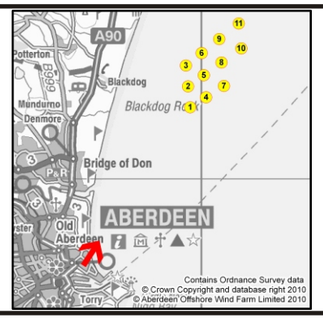
areg
Aberdeen Renewable Energy Group

VATTENFALL

Grid Reference: NJ9568012316
Terrain Height (ODN): 19 m
View Direction: 58º
Angle Of View: 67º
Observer Height: 2 m
Viewing Distance: 330 mm
Nearest Turbine: 3.9 km
Turbine Numbers 1 - 6:
Hub Height: 100 m / Rotor Diameter: 120 m
Turbine Numbers 7 - 11:
Hub Height: 120 m / Rotor Diameter: 150 m

Drg No: 6129-521-PA-022-A
Date: 13th August 2010
Layout ref: LABER039_SCOPING2
Viewpoints ref: VABER008
Earth's curvature: 6367 km
Atmospheric refraction coeff: 0.075

Hub heights are above L.A.T.



Viewpoint 2

View from Public Road Near Murcar Golf Course

Figure 18